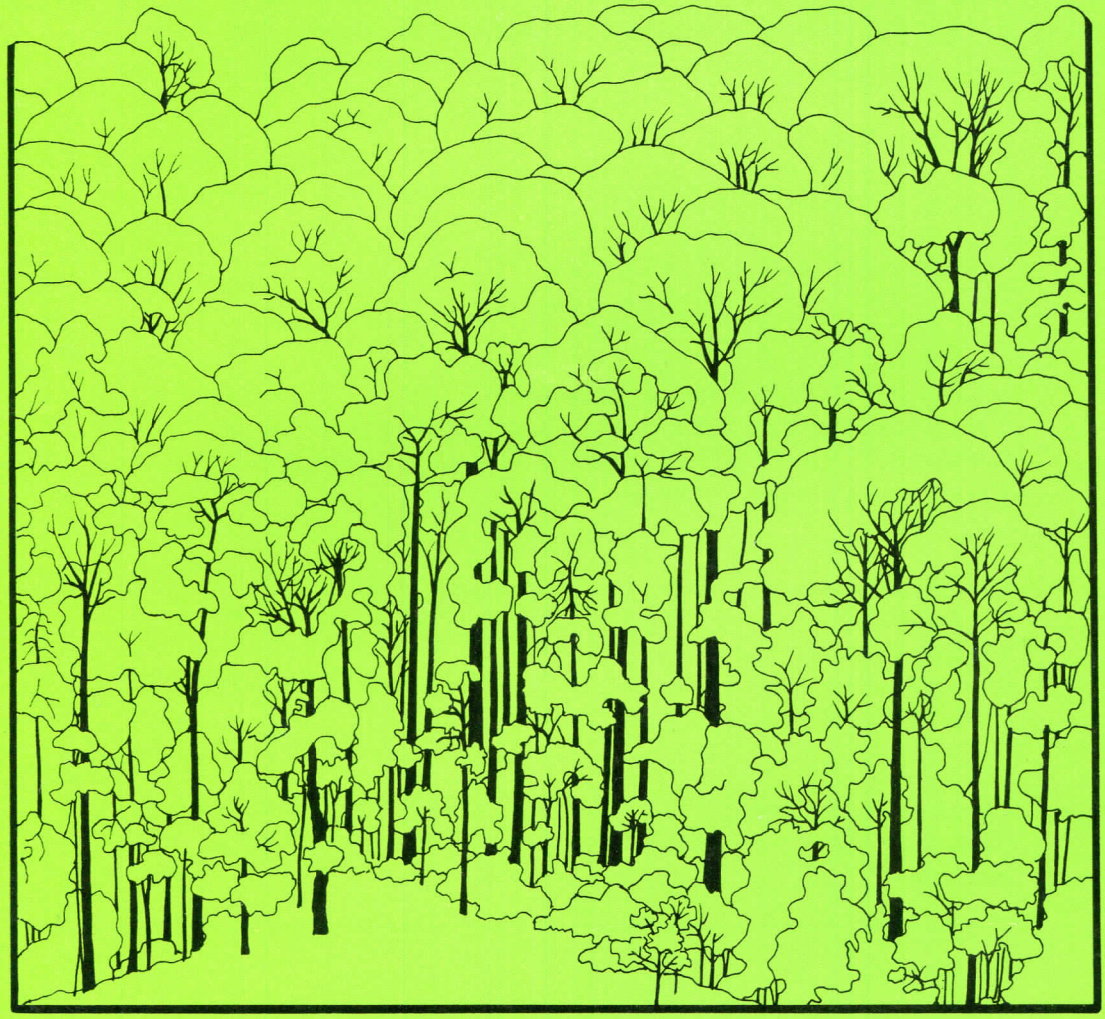
SANDAKANIA

No. 2 February, 1993



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SANDAKANIA 2(1993):1-7

A new species of *Dipterocarpus (Dipterocarpaceae)* with vestigial fruit-calyx lobes

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Summary. *Dipterocarpus megacarpus* is described as a new species, presently found as localised populations in central Sabah's lowland dipterocarp forests. Its differences from two other species, *D. elongatus* and *D. tempehes*, which like it are characterised by fruits with vestigial fruit-calyx lobes, are discussed.

Although the Dipterocarpaceae has been revised (Ashton 1982) continuing fieldwork brings in further information and novelties. In Borneo, Ashton (1982) enumerated 267 species of Dipterocarpaceae, including 41 species of *Dipterocarpus*. In Sabah, until now, 179 species of Dipterocarpaceae including 28 species of *Dipterocarpus* have been recorded. During recent fieldwork in the Pinangah Forest Reserve near Sungai Imbak, in the Tongod District, Sabah, Malaysia, a new species of *Dipterocarpus* with vestigial calyx lobes in the fruit was collected. This paper describes the new species and explains its differences from the two other species of *Dipterocarpus* known also to have vestigial calyx lobes in fruit.

The new species

Dipterocarpus megacarpus *Madani*, sp. nov. species *D. elongati Korth. affinis sed fructibus subglobosis versus apicem tuberculis conspicuis destitutis, lobis calycum extus sparse pubescentibus vel glabris; stipulis pilis in caespitibus dispersis ferentibus, petiolis glabris differt. Typus: Wong WKM 2342, Sabah, Pinangah Forest Reserve, near Sungai Imbak (holotypus SAN; isotypi A, K, KEP, L, SAR).*

Tree, to 45 m tall, 80 cm diameter, with small buttresses. Bark smooth, lenticellate, pale brown, becoming scaly lenticellate; inner bark pale brown; wood pale yellow. Ultimate branches densely covered with long (4-6 mm) appressed hairs. Stipules encircling the twig, large, to 3-5 cm across and 5-8 cm long with only scattered tufts of coarse hair on

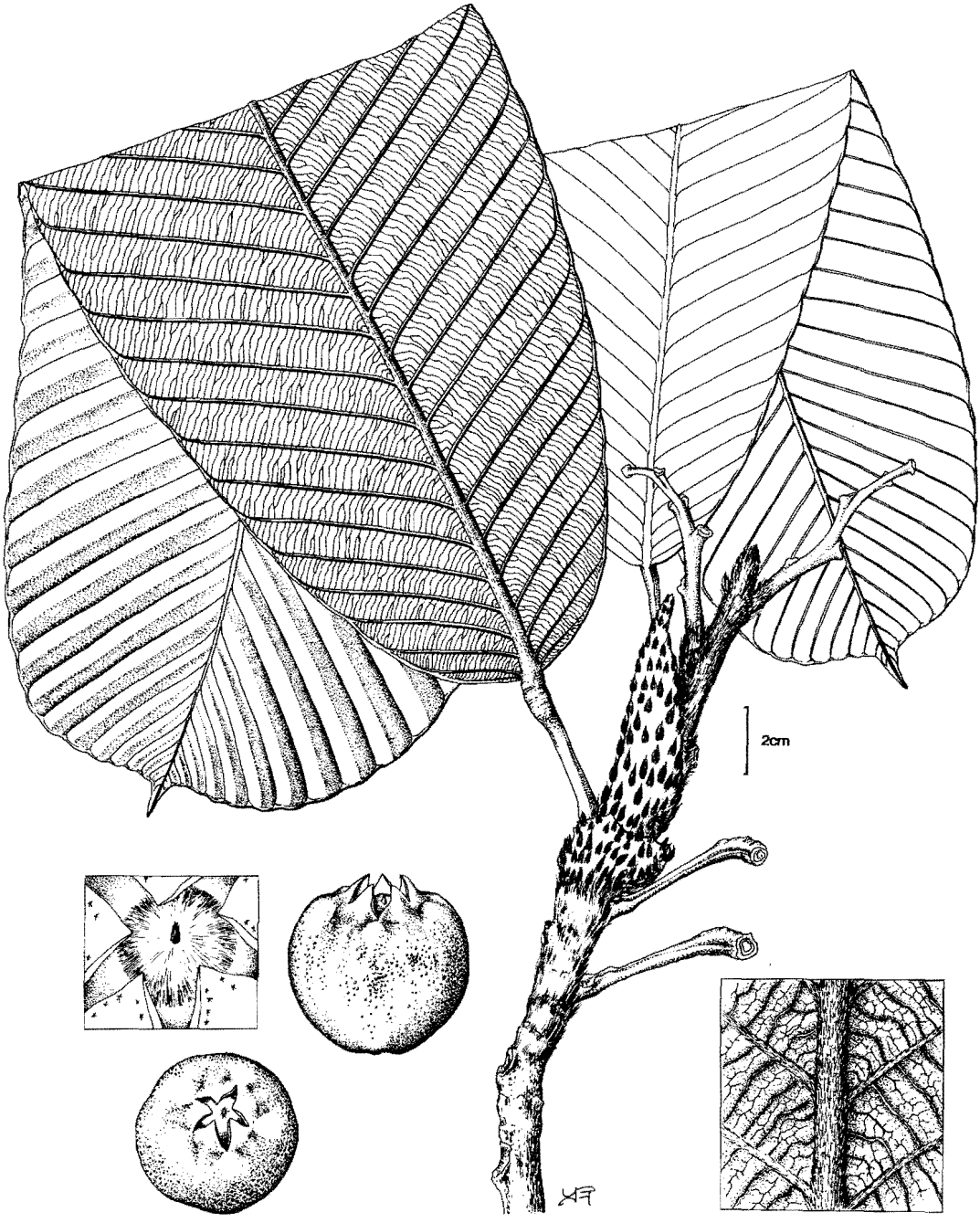

Fig. 1. *Dipterocarpus megacarpus*: leafy branch (right) and fruits (left; inset showing hairy fruit apex). From WKM 2342.

the surface, even when young. Leaves elliptic-obovate, apex abruptly caudate, base obtuse, margin wavy, stiffly coriaceous, to 55 cm long and 20 cm wide; midrib raised below, densely covered with pale long appressed hairs; secondary veins 25-40 pairs; tertiary veins ladderlike (scalariform) between secondary veins; leaf stalk to 3-5 cm long, 6-8 mm across, at first (in newly emerged leaves) with scattered tufts of hair but rapidly becoming glabrous in mature leaves. Flowers not seen but remains of corolla on some fruit observed to have obovate lobes about 3 cm long, 1 cm wide, and pale velvety hairy on the outside. Infructescence terminal, each bearing 4 to 10 fruits. Fruits subglobose, 3-6 cm across when mature, densely coarsely lenticellate all over, glabrous, apex with 5 faintly or weakly developed shoulders, even in young fruits; calyx lobes ovate-triangular, subequal (none expanded), 8-10 mm wide and 8-15 mm long; scantily-stellate hairy to glabrous on the outside.

The species is illustrated in Figs. 1, 2 and 3.

Fig. 2. Fruiting branch of *Dipterocarpus megacarpus*. Specimen WKM 2342 (photo: Robert C. Ong).

Fig. 3. Fruits of *Dipterocarpus megacarpus*. Note the remains of corolla still attached to the fruit near the centre (Photo: Robert C. Ong).

SPECIMENS EXAMINED - BORNEO. SABAH: Tongod District, Pinangah Forest Reserve, near Sungai Imbak, *Wong, Madani & Tokilip* WKM 2342 (holotype SAN, isotypes A, K, KEP, L, SAR); *L. Madani* SAN 133997 (SAN, A, K, KEP).

Discussion

In Malesia, only two other species of *Dipterocarpus* are known to have fruits with vestigial calyx lobes, *viz.*, *D. elongatus* Korth. and *D. tempehes* Sloot. (Ashton 1982). *D. elongatus* (Fig. 4) differs from *D. megacarpus* (Table 1) in having fruits with five strong tubercles below the calyx lobes at the apex of the fruit, calyx lobes which are densely stellate-hairy outside, and stipules and mature leaves with stalks which are completely covered by tufts of coarse hair. *D. tempehes* differs from *D. megacarpus* (Table 1) in having smooth fruits entirely without any shoulders or tubercles; calyx lobes which are glabrous on the outside, stipules which are completely covered by tufts of long hairs, and leaf stalks which are

densely covered by appressed long hairs. In contrast, *D. megacarpus* has fruits with five weakly developed shoulders below the calyx lobes near the apex of the fruit, calyx lobes that are scantily stellate-hairy to glabrous outside, stipules which bear only scattered tufts of hair, and glabrous leaf stalks in the mature leaf. The leaves of *D. tempehes* are also smaller, to 12 X 8 cm, whereas those of *D. elongatus* and *D. megacarpus* reach 50 X 20 cm.

Table 1. Characters distinguishing *Dipterocarpus elongatus*, *D. tempehes* and *D. megacarpus*.

	D. elongatus	*D. tempehes*	*D. megacarpus*
Leaf size	Large, to 50 X 20 cm	Small, to 12 X 8 cm	Large, to 55 X 20 cm
Number of nerves	25-38 pairs	9-12 pairs	25-40 pairs
Stalk of mature leaf	Completely covered by hair	Completely covered by hair	Glabrous
Stipules	Completely covered by hairs	Completely covered by hairs	With only scattered tufts of hairs
Fruit shape	Subglobose, with 5 strong tubercles at apex	Obovoid-subglobose, smooth	Subglobose, with 5 weakly developed shoulders at apex
Fruit size	To 5.5 cm across	2-4 cm across	3-6 cm across
Fruit-calyx	Densely stellate-hairy on outside	Glabrous outside	Scantily stellate-hairy to glabrous outside

Dr Peter Ashton (*in litt.*, 20 October 1992) has cautioned against uncritically accepting character-states of the mature fruit, leaf stalk and stipules as valid in distinguishing the taxon here named *D. megacarpus* and *D. elongatus*. He pointed out that the fruit-apex tubercles in tuberculate *Dipterocarpus* species may become stretched out, and hence less prominent, as the fruit matures. We are confident that this is not the case in *D.*

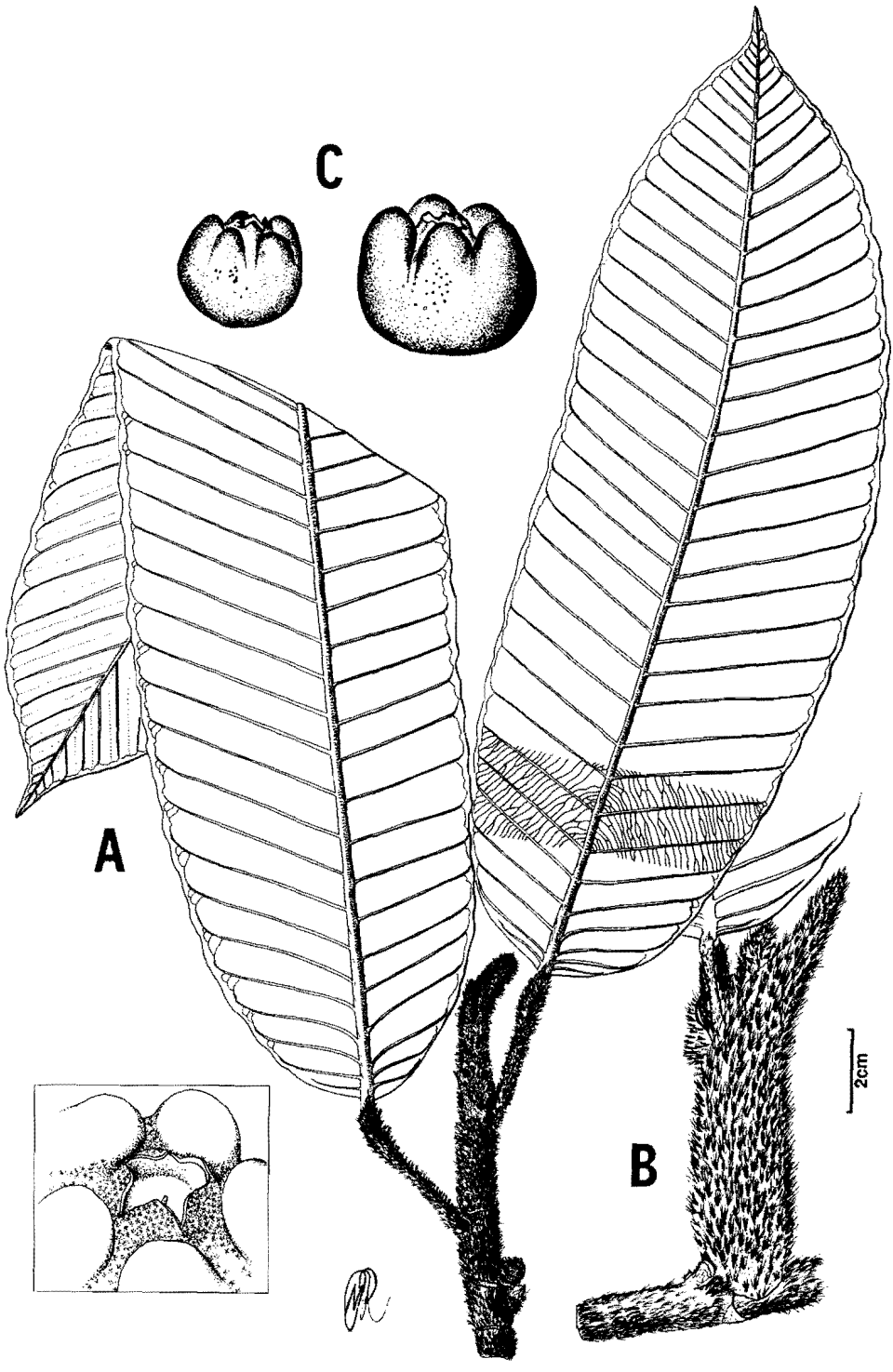

Fig. 4. *Dipterocarpus elongatus*. **A**, Leafy branch. **B**, Stipules. **C**, Young and mature fruit. Inset showing densely hairy fruit calyx. (A & C, *Ilias* S. 15131; B, *Sinclair* SFN 40296).

megacarpus after examining very many fruits, both young and mature, from different trees in the field as well as after drying. The fruit-apex tubercles in *D. megacarpus* are always weakly developed in young or old fruits; moreover young fruits do not shrink during drying such that the tubercles appear to be more prominent. Ashton also cautioned that apparent differences in tomentum on the leaf stalk and stipules can be deceptive, as during development and expansion of these organs individual hair tufts can be increasingly separated or even fall away. We are fortunate to have observed young plants raised at the Forest Research Centre, Sepilok, as well as in the field, and can offer comments on these characters. Newly emerged leaves of *D. megacarpus* bear scattered hair tufts on their stalks but these rapidly fall away, leaving glabrous stalks in all mature leaves. This is not the case in *D. elongatus* where mature leaf stalks retain their densely hairy nature, and very old stalks at least still show a hair cover. Thus Symington (1943) also figures a densely hairy leaf stalk in illustrating a typical mature leaf of *D. elongatus* (therein as *D. apterus*, a synonym). We have also compared young stipules of *D. megacarpus* and *D. elongatus*; those in *D. megacarpus* have comparatively sparse coarse hair tufts whereas those in *D. elongatus* are completely covered with fine hair tufts.

D. elongatus has been recorded from Malaya, eastern Sumatra, the Lingga Archipelago, Anambas Islands (S. China Sea), and Borneo (Sarawak and South East Kalimantan). *D. tempehes* is known only from Borneo (Sarawak and eastern Sabah south to Kutei in Kalimantan). As presently known, *D. megacarpus* is not at all common.

The population of *D. megacarpus* seen at the Pinangah Forest Reserve was apparently small. Only seven adult fruiting trees and about 8-10 saplings were seen although it is possible that more intensive searching in the area may yield further localised populations. Nevertheless *D. megacarpus* is a rare species.

Mature fallen fruit of *D. megacarpus* has been collected for the Arboretum of the Forest Department's Forest Research Centre at Sepilok, Sandakan, Sabah where a conservation collection of Sabah's woody plants is being assembled. It is planned to raise enough seedlings for eventual distribution to other gardens and institutions.

ACKNOWLEDGEMENTS

I thank Prof. G.T. Prance of the Royal Botanic Gardens, Kew, U.K. for helping with the Latin diagnosis, and Dr K.M. Wong for guidance and advice. I am grateful to Dr P.S. Ashton for his comments on an earlier draft of this paper. I wish also to thank members of the Botany Section, Forest Research Centre, Sepilok, especially tree climber Mr Donggop Tokilip. Madam Yap Pak Hau and Mr Martin Molubin kindly prepared the drawings.

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SANDAKANIA 2(1993):9-11

A note on aerial branch-shoots in the rattan *Plectocomia mulleri*

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Summary. Rooted aerial branch-shoots naturally occurring in *Plectocomia mulleri* are described for the first time, in Sabah.

Plectocomia mulleri is a common species of rattan which is found in abundance on poor soils where the forest has been disturbed, and is very characteristic of some facies of kerangas (heath) forest (Dransfield 1984). It is one of two species of the genus known in Sabah.

During recent field work in the kerangas forest at the Ruku-Ruku Forest Reserve near Telupid, at about 150m a.s.l., six individuals of *Plectocomia mulleri* were observed bearing aerial branch-shoots. These rooted branch-shoots of about 30 cm in height were produced at the nodes of mature canes and resembled seedlings (Fig.1) This has not been documented before, although Dransfield (1984) has described such branches (which he termed " aerial suckers") for *Plectocomia elongata*, a montane species.

These individuals were solitary, high-climbing rattans with stems of about 30 m in length. The stem diameter without sheath was 1-2 cm and the internodes were 24-30 cm long. Two herbarium vouchers (deposited with the Sandakan herbarium, SAN) have been collected *viz.*, *Dewol* SAN 134913 (flowering male specimen) and *Dewol* SAN 134914 (fruiting specimen). These individuals were found in a patch of forest of about 100sq.m. These aerial branch-shoots developed vigorously whether or not the basal part and the main shoot of the cane were damaged. It appears that flowering also did not influence this behaviour as aerial branch-shoots occurred in both vegetative and reproductive individuals.

Such aerial branch-shoots have initially one leafy shoot each but later develop into clusters of shoots. Branch-shoots which are formed at the lower parts of the cane appeared more

Fig. 1. Aerial branch-shoots along a stem of *Plectocomia mulleri*.

vigorous compared with those formed at the higher middle part. This may be because roots of these aerial branch-shoots at the lower part of the cane can easily reach the soil (as was observed) and can directly absorb nutrients whereas suckers at the middle part cannot and depend entirely on the mother cane to provide nutrients.

Aerial branching of rattan stems is quite characteristic of *Korthalsia* species, where the stem actually branches high in the canopy (Dransfield 1979). In *Korthalsia*, such branches do not root. Elsewhere, Dransfield (1979) has also noted aerial branching in *Calamus simplex* in Peninsular Malaysia; in this species, however, the branches do not or at least seldom root even though at first they resemble small sucker shoots (K.M. Wong, pers. comm.).

The rooted aerial branch-shoots in *Plectocomia mulleri* would seem to be effective vegetative propagules, as each could potentially grow into a separate individual of the same clone. The relative commonness of this form of vegetative reproduction in nature has yet to be assessed though generally among rattans this is uncommon. It is possible that the production of widely spaced, rooted aerial branch-shoots is more effective in vegetative reproduction than basal suckers as fragmentation of the parent body disperses the new clonal individuals further apart, reducing competition among them and producing more physically separate indivuals.

ACKNOWLEDGEMENTS

The authors would like to thank Patrick Lassan and Good Antok for help in the field, K.M. Wong and Y.F. Lee for comments and advice.

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SANDAKANIA 2 (1993) : 13–34

A synopsis of the genera of Rubiaceae in Borneo

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Summary. Over 90 genera of Rubiaceae indigenous to Borneo are recorded. An additional 7 genera cultivated in Borneo are also included (this number may be higher as herbarium records of cultivated ornamentals of extra-Bornean origin are likely to be incomplete). It is pointed out that our state of knowledge of a considerable number of genera (often obscure monotypic endemics) is poor; the number of genera recorded may, therefore, not be fully reliable.

There is no current survey of Bornean Rubiaceae. The most recent treatments dealing with the entire family are those of Merrill (1921) and Masamune (1942). The aim of the current publication is to give an up-to-date information on the genera of Rubiaceae occurring in Borneo. This is a first step towards a comprehensive treatment of the family for the island, and also for the treatment of the family for the "Tree Flora of Sabah and Sarawak".

The arrangement of the data is as follows:

- Genera are listed alphabetically. Those not indigenous to the island (i.e., cultivated taxa such as *Coffea* spp., or ornamentals such as *Rondeletia*) are marked by an asterisk.
- The generic name is followed by the current tribal position of the genus. This information is largely based on Robbrecht (1988), but certain newer findings, either already published (e.g. the recircumscription of the Cinchoneae: Andersson & Persson 1991) or to be published in Robbrecht (1993), are incorporated.
- The (approximate) total number of species and the overall distribution of a genus are also given. If detailed treatments and data are unavailable, approximate species numbers are taken from Mabberley (1987). Abridged information on the growth form concludes the general characterisation of a genus.

This block is followed by information specific to Borneo:

- The number of species recorded for Borneo is listed. Usually, the species names are given if their number is limited (i.e., if there are only three or less species). As far as known, it is noted if they are endemic to the island.

- The distribution in Borneo; it is abbreviated as follows (in alphabetical sequence): BRUN - Brunei; KALIM - Kalimantan; SAB - Sabah, SAR - Sarawak.
- For many taxa, various comments (on correct names, taxonomic problems, etc.) are necessary. These are included in the "Notes" section.
- Finally, recent revisions, useful treatments, etc. are cited.

For many alliances within the family, *generic concepts* have changed quite drastically since Masamune's (1942) publication. In order to enable the reader to compare and cross-check currently used names with those in the cited work, "old" names are given in square brackets, together with a reference to or a short comment on the current names [e.g. "*Zeuxanthe* Ridley in Masamune (1942: 719) and Anderson (1980: 307) — see *Prismatomeris*"]. References to Merrill (1921) are largely omitted, as Masamune (l.c.) in many instances already has updated his data. — On numerous occasions, reference is made to names used in Anderson's (1980) "Checklist of the Trees of Sarawak" that need updating.

If *species names* of Bornean taxa are given, there is a cross reference to Masamune (1942) and/or Anderson (1980), provided there is a discrepancy. E.g. "*Catunaregam spinosa* (Thunb.) Tirv.: as *Randia spinosa* (Thunb.) Poir. in Masamune (1942: 709)", or "*Aidia wallichiana* (Wall.) Tirv.: as *Randia densiflora* Benth. in Anderson (1980: 303)". In the latter example, it automatically means that the name given in Anderson is a synonym of the currently used one.

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Merrill, E.D. (1921) A bibliographic enumeration of Bornean plants. J. Straits Branch Royal Asiatic Soc. Special Nr.: 1-637 [Fraser & Neave, Singapore].

Robbrecht, E. (1988) Tropical woody Rubiaceae. Opera Bot. Belg. 1: 1-271.

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Acranthera Arn.
Uncertain tribal position (perhaps Isertieae?). — 35 spp. — Indomalesia; Borneo centred. — Herbs, subshrubs or shrubs.
Borneo: numerous spp.; BRUN, KALIM, SAB, SAR.
Note: a revision is badly needed.
Most recent treatment: Bremekamp, C.E.B. (1947): A monograph of the genus *Acranthera* Arn. ex Meisn. J. Arnold Arb. 28: 261-308.

[Asemanthia Ridley in Masamune (1942: 675) — see *Mussaenda*.
The genus is no longer upheld and now considered to be congeneric with *Mussaenda*]

[Adina Salisb. in Anderson (1980: 295) — see *Pertusadina*.
A. minutiflora Val. in Anderson (l.c.) is *P. eurhyncha* (Merrill) Ridsdale]

Aidia Lour.
Gardenieae subtribe Gardeniineae. — 25 spp. — Paleotropics; reaching Australia and the Pacific Isls. — Trees or shrubs.
Borneo: 2 sp. [*A. racemosa* (Cav.) Tirv. *, *A. wallichiana* (Wall.) Tirv. **]; BRUN, KALIM, SAB, SAR.
Note: * as *Randia racemosa* (Cav.) F.-Vill. in Masamune (1942: 708); ** as *Randia densiflora* Benth. in Anderson (1980: 303).
Also see *Anomanthodia*.
Useful reference: Tirvengadum, D.D., Sastre, C. (1986): Etude taxonomique et systèmes de ramification chez *Aidia* et genres asiatiques affins, et chez *Brachytome* (Rubiaceae). Bull. Mus. natn. Hist. nat. Paris, sér. 4, 8, sect. B, Adansonia 3: 257-296.

Amaracarpus Blume
Psychotrieae subtribe Psychotriinae. — 60 spp. — From the Malay Peninsula eastwards through Malesia to the Pacific Isls. — Shrubs.
Borneo: 1 (?) sp. (*Amaracarpus pubescens* Blume); SAR; ? elsewhere.
Note: the resemblance of species of the genus to both *Lasianthus* and *Saprosma* has often been commented on, and (extra-Bornean) species have, in fact, been transferred to these genera. It is to be seen whether *Amaracarpus* can be upheld. A careful reinvestigation of the genus complex and a revision is badly needed.

Anomanthodia Hook. f.
Gardenieae subtribe Gardeniineae. — 6 spp. — Indomalesia, Philippines, Borneo. — Scandent or subscandent shrubs.
Borneo: 3 spp. [*A. corymbosa* (Blume) Tirv. *, *A. dilleniacea* (Baillon) Tirv. **, *A. lancifolia* (Wong) Tirv.]; BRUN, SAR, SAB; ? KALIM.
Note: * as *Randia auriculata* (Wall.) K. Schum. and ** *R. d.* in Masamune (1942: 707-708).

The generic concepts of Wong (1984) and Tirvengadum & Sastre (1986) differ. Two species placed in *Aidia* by Wong [*Aidia corymbosa* (Blume) Wong and *Aidia lancifolia* Wong] are now placed in *Anomanthodia*.

Useful references: Wong, K.M. (1984): The genera of Peninsular Malaysian Rubiaceae formerly confused with *Randia*. Malayan Nat. J. 38: 1-57.
Tirvengadum, D.D., Sastre, C. (1986): Etude taxonomique et systèmes de ramification chez *Aidia* et genres asiatiques affins, et chez *Brachytome* (Rubiaceae). Bull. Mus. natn. Hist. nat. Paris, sér. 4, 8, sect. B, Adansonia 3: 257-296.

[Anthocephalus A. Rich. emend. Havil. in Masamune (1942: 675) and in Anderson (1980: 295) — see *Neolamarckia*]

Antirhea A.L. de Jussieu (syn. *Guettardella* Benth.)

Guettardeae. — 20 spp. — From tropical East Asia to Australia, Solomon Isls. and Fiji. — Shrubs or small trees.

Borneo: 2 spp. (one still named *Guettardella obscura* M.E. Jansen, another undescribed), endemic; KALIM, SAB.

Useful references: Jansen, M.E. (1984): A synopsis of *Guettardella* Benth. and the Old World species of *Anthirea* A.L. De Jussieu (Rubiaceae: Guettardeae). Blumea 29: 565-588.
Wong, K.M. (1988): The Antirheoideae (Rubiaceae) of the Malay Peninsula. Kew Bull. 43: 491-518.

Argostemma Wall.

Argostemmateae. — c. 150 ? spp.* — Paleotropics; centred in Asia. — Herbs.

Borneo: 28 spp., the majority endemic; BRUN, KALIM, SAB, SAR.

Note: * 100 spp. (Mabberley 1987), "c. 220 described species" (Bremer 1989).

Revision: Bremer, B. (1989): The genus *Argostemma* (Rubiaceae-Argostemmateae) in Borneo. Ann. Missouri Bot. Gard. 76: 7-49.

[Borreria G.F.W. Mey. in Masamune (1942: 678) — see *Spermacoce*]

Caelospermum Blume ("*Coelospermum*")

Morindeae. — 7 spp. — Southeast Asia, Philippines, Moluccas, Caroline Isl., New Guinea, Solomon Isl., East Australia and New Caledonia. — Climbing shrubs.

Borneo: 1 sp. [*C. truncatum* (Wall.) Baillon ex K. Schum. *]; BRUN, KALIM, SAB, SAR.

Note: * as *C. scandens* Blume in Masamune (1942: 680).

Revision: Johansson, J.T. (1988): Revision of the genus *Caelospermum* Blume (Rubiaceae, Rubioideae, Morindeae). Blumea 33: 265-297.

[Campanocalyx Val. in Masamune (1942: 678) — see *Myrioneuron*]

Canthium Lamk.

Vanguerieae. — 100 spp. — Paleotropics. — Trees or shrubs.

Borneo: numerous spp.; BRUN, KALIM, SAB, SAR.

Notes: *Canthium* sensu Masamune (1942: 678-679) and Anderson (1980: 295) — also see *Psydrax*.
Numerous (African and Madagascan) taxa previously placed in *Canthium* have recently been removed to various other genera. Relevant for Borneo is that *Canthium* in the old sense includes taxa that should be transferred to *Psydrax* (see there for further comments. Some spiny scramblers are confusable with *Meyna* Link.
A regional revision is badly needed.

Catunaregam Wolf
Gardenieae subtribe Gardeniineae. — 6 spp. — Paleotropics. — Small trees or shrubs.
Borneo: 1 sp. [*C. spinosa* (Thunb.) Tirv.*]; SAB; ? elsewhere.
Note: * as *Randia spinosa* (Thunb.) Poir. in Masamune (1942: 709).

Cephaelis Sw.
Psychotrieae subtribe Psychotriinae. — 200 spp. — New World; ? Asia *. — Shrubs.
Borneo: several spp.; BRUN, KALIM, SAB, SAR.
Note: * *Cephaelis* in the strict sense is a neotropical genus. Asiatic taxa currently placed in that genus do show some resemblance to certain American species, but this may merely be a convergence; they may have to be transferred to *Psychotria*.
A revision of this genus complex is badly needed.

Ceriscoides (Hook. f.) Tirv.
Gardenieae subtribe Gardeniineae. — 7 spp. — India, Indochina and West Malesia. — Small trees or shrubs.
Borneo: 1 sp.; undescribed, endemic; SAB.
Note: According to Tirvengadum (1978), the genus is confined to continental Asia; we now have collections from Sabah.
Useful references: Tirvengadum, D.D. (1978): A synopsis of the Rubiaceae-Gardenieae of Ceylon (Sri Lanka). Bull. Mus. Natn. Hist. Nat., 3e Sér., 521, Bot., 35: 3-33.
Wong, K.M. (1984): The genera of Peninsular Malaysian Rubiaceae formerly confused with *Randia*. Malayan Nat. J. 38: 1-57.

Chassalia Commers.
Psychotrieae subtribe Psychotriinae. — 60 spp. — Paleotropics, including Madagascar, the Comoros and the Mascarenes. — Shrubs or small trees.
Borneo: a few spp.; BRUN, KALIM, SAB, SAR.
Note: a revision is badly needed.

* **Cinchona** L.
Cinchoneae. — 40 spp. — From central to northwestern South America. — Trees.
Borneo: several (?) spp. or cultivars, respectively ("*C. succirubra*-group", "*C. ledgeriana-calisaya-officinalis*-group") *.
Note: * species identifications are difficult because there is an enormous number of "varieties" or cultivars; moreover, many of the cultivated plants are hybrids.

Previously probably quite widely cultivated for the quinine-containing bark, but now no longer of great economic importance.

*** Coffea** L.

Coffeeae. — 90 spp. — Tropical Africa, Madagascar, Mascarenes. — Shrubs or trees.

Borneo: at least 3 spp. [*C. arabica* L. *; *C. canephora* Froehner (syn. *C. robusta* De Wildem.) **; *C. liberica* Hiern].

Note: * "Arabica" and ** "Robusta Coffee".

Coprosma J.R. & G. Forst.

Anthospermeae subtribe Coprosminae. — 90 spp. — Centred in New Zealand; eastwards to Hawaii, northwestwards to Borneo and Java [± amphi-transpacific but not reaching South America]. — Shrubs.

Borneo: 1 sp. [*C. crassicaulis* Stapf, syn. *C. hookeri* Stapf)], endemic; SAB (Mt. Kinabalu).

Most recent treatment: Oliver, W.R.B. (1935): The genus *Coprosma*. Bernice P. Bishop Museum Bull. 132: 1-207.

Coptophyllum Korth. (syn. *Pomazota* Ridley)

Hedyotideae. — 3 spp. — West Malesia. — Low herbs.

Borneo: 1 sp. (*C. bracteatum* Korth. *); KALIM, SAR.

Note: * as *Pomazota rivularis* Hend. in Bremekamp (1947: 201); his view that *Pomazota* should be used as a nom. nov. for *Coptophyllum* was found to be incorrect.
Very near *Hedyotis* L. and perhaps not generically distinct. A detailed reinvestigation is needed to determine whether the genus should be upheld.

Most recent treatment: Bremekamp, C.E.B. (1947): A monograph of the genus *Pomazota* Ridley. J. Arnold Arb. 28: 186-203.

Coptosapelta Korth.

Coptosapelteae. — 13 spp. — Southeast China to Malesia. — Lianas.

Borneo: a few spp.; BRUN, KALIM, SAB, SAR.

Note: a revision is badly needed.

Most recent treatments: Valeton, T. (1922): Die Gattung *Coptosapelta* Korth. Rec. Trav. Bot. Néerl. 19: 281-292.
Valeton, T. (1923): Het Rubiaceëngeslacht *Coptosapelta* Korth. Kon. Akad. Wet. Amsterdam, Versl. Wissen Natuurk., Afd. 32: 423-440.

Cowiea Wernh.

Hypobathreae. 2 spp. — Borneo and Philippines (Mindanao), one species each. — Shrubs.

Borneo: 1 sp. (*C. borneensis* Wernh.), endemic; SAB.

Note: it is very likely that *Cowiea* is congeneric with *Hypobathrum*. Already Merrill (1929: 284) commented that "...it may be gravely doubted if *Cowiea* is generically distinct from *Petunga* [= *Hypobathrum*]...". To our knowledge, no one has ever formally validitated this. — The genus was upheld by Masamune (1942: 680).

Reference: Merrill, E.D. (1929): Plantae Elmerianae Borneenses. Univ. Calif. Publ. Bot. 15: 1-316.

Crobylanthe Bremek.

Urophylleae. — Monotypic [*C. pellacalyx* (Ridley) Bremek. *]. — Endemic to Borneo. — Treelets.

SAR; ? elsewhere.

Note: * as *U. pellacalyx* Ridley and *U. shelfordii* Ridley [the latter being a synonym of *C. p.*] in Masamune (1942: 717, 718); as *U. pellacalyx* Ridley in Anderson (1980: 307).

Most recent treatment: Bremekamp, C.E.B. (1940): On *Urophyllum* Wall. (Rubiaceae) and its nearest allies. Rec. Trav. Bot. Néerl. 37: 171-197.

Dentella J.R. & G. Forst.

Hedyotideae. — 10 spp. — Centred in Australia, extending to Indomalesia. — Creeping herbs.

Borneo: 1 sp. [*D. repens* (L.) J.R. & G. Forst.]; KALIM; ? elsewhere.

Dichilanthe Thw.

Guettardeae. — 2 spp. — Sri Lanka and Borneo, one species each. — Trees.

Borneo: 1 sp. (*D. borneensis* Baillon), endemic; KALIM, SAR.

Diplospora DC. [syn. *Hypobathrum* sect. *Diplospora* (DC.) Baillon, syn. *Tricalysia* sect. *Diplospora* (DC.) K. Schum.]

Gardenieae subtribe Diplosporinae. — 12 spp. — Tropical Asia . — Trees or shrubs.

Borneo: several spp.; BRUN, KALIM, SAB, SAR.

Notes: of the three *Diplospora* spp. in Masamune (1942: 681), only *D. cuspidata* Val. actually belongs to this genus; the others are *Discospermum*; likewise, both *Diplospora* spp. in Anderson (1980: 296) are *Discospermum* — see below.

Tricalysia tinagoense Elmer in Masamune (1942: 713) and in Anderson (1980: 306) is *Diplospora tinagoense* (Elmer) Ali & Robbr.

Tricalysia malaccensis (Hook. f.) Merrill in Masamune (1942: 713) is *Diplospora malaccensis* Hook. f.

A regional revision is needed.

Useful treatment: Ali, S.J., Robbrecht, E. (1991): Remarks on the tropical Asian and Australian taxa included in *Diplospora* or *Tricalysia* (Rubiaceae-Ixoroideae-Gardenieae). Blumea 35: 279-305.

Discospermum Dalz. [syn. *Diplospora* sect. *Discospermum* Dalz. (Hooker)]

Gardenieae subtribe Diplosporinae. — 7 spp. — Tropical Asia. — Trees or shrubs.

Borneo: 3 (?) spp. [*D. abnorme* (Korth.) Ali & Robbrecht *, *D. beccarianum* (King & Gamble) Ali & Robbrecht **, *D. javanicum* (Miq.) Kuntze]; BRUN, KALIM, SAB, SAR.

Note: * as *Diplospora abnormis* (Korth.) Val., *Randia abnormis* (Korth.) Boerl. and *Tricalysia abnormis* (Korth.) Merrill in Masamune (1942: 681, 707, 713) and as *Diplospora singularis* Korth. in Anderson (1980: 296); ** as *Diplospora beccariana* King & Gamble in Masamune (1942: 681) and in Anderson (1980: 296).

Useful treatment: Ali, S.J., Robbrecht, E. (1991): Remarks on the tropical Asian and Australian taxa included in *Diplospora* or *Tricalysia* (Rubiaceae-Ixoroideae-Gardenieae). Blumea 35: 279-305.

Gaertnera Lamk.

Psychotrieae subtribe Psychotriinae. — 45 spp. — Paleotropics, including Madagascar and the Mascarenes. — Shrubs or trees.

Borneo: 6 spp. (2 endemic); BRUN, KALIM, SAB, SAR.

Revision: Van Beusekom, C.F. (1969): A revision of the Malesian and Ceylonese species of the genus *Gaertnera* Lamk. (Rubiaceae). Blumea 15: 359-391.

Galium L.

Rubieae. — 400 spp. — Worldwide, centred in temperate regions of the northern hemisphere.

Borneo: 1 sp. (*G. rotundifolium* L. s.l.); SAB (Mt. Kinabalu).

Gardenia Ellis

Gardenieae subtribe Gardeniineae. — 250 spp. — Paleotropics, reaching New Caledonia. — Shrubs or trees.

Borneo: several spp.; BRUN, KALIM, SAB, SAR.

Note: Masamune seems to have overlooked that he listed *G. grandis* Korth. also as *Randia grandis* (Korth.) Val. (1942: 682, 708); Merrill (1921: 562) had listed the species under *Randia*. The correct generic position of the species is unknown and needs to be checked.

Gardenia tentaculata Hook. f. in Masamune (1942: 682) and in Anderson (1980: 296-297) — see *Kailarsenia*.

A revision is badly needed.

Gardeniopsis Miq.

Aulacocalyceae. — Monotypic (*G. longifolia* Miq.). — Malay Peninsula, Sumatra and Borneo. — Shrubs or treelets.

Borneo: BRUN, SAB, SAR.

Geophila D. Don

Psychotrieae subtribe Psychotriinae. — 15 spp. — Pantropical. — Creeping forest floor herbs.

Borneo: a few spp.; KALIM, SAB, SAR; ? BRUN.

Note: a regional revision is needed.

Greenea Wight & Arn.

Rondeletieae. — 10 spp. — Burma, Thailand, Indochina, Malay Peninsula, Sumatra, Borneo and Philippines. — Shrubs or trees.

Borneo: 1 sp. (*G. xanthophytoides* Vahl), endemic; SAR.

Note: a revision is badly needed.

Guettarda L.

Guettardeae. — 80 spp. — Centred in the Neotropics; the species occurring in Borneo widespread in coastal areas in the Old World tropics; some spp. in New Caledonia and the New Hebrides. — Trees or shrubs.

Borneo: 1 sp. (*G. speciosa* L.); BRUN, SAB, SAR; ? not in KALIM.

[Guettardella Benth. — see *Antirhea*]

Gynochtodes Blume ("*Gynochthodes*"; syn. *Tetralopha* Hook. f.)

Morindeae. — 14 spp. — Southeast Asia; through Malesia to the Pacific Isls. — Lianas.

Borneo: a few spp.*; BRUN, KALIM, and likely also SAB, SAR.

Note: * including *Tetralopha motleyi* Hook. f. (as such in Masamune 1942: 711). Although it is now generally accepted that *Tetralopha* is to be included in *Gynochtodes*, *T. l.* has apparently never been formally transferred.

A revision is badly needed.

Gynopachis Blume

Gardenieae subtribe Gardeniineae. — 9 spp. — Malesia; East to New Guinea. — Climbing shrubs.

Borneo: 4 spp. [*G. acuminata* Blume *, *G. beccariana* (Baillon) Tirv. *, *G. binata* (King & Gamble) Tirv. *, *G. jambosoides* (Val.) Tirv. *]; KALIM, SAB, SAR.

Note: * all under *Randia* in Masamune (1942: 707-708); *G. acuminata* as *Randia boerlagei* Val. and *G. binata* as *R. impressinervis* King & Gamble.

G. impressinervis (King & Gamble) Tirv. is considered to be a synonym of *G. binata*.

Useful reference: Tirvengadum, D.D., Sastre, C. (1986): Etude taxonomique et systèmes de ramification chez *Aidia* et genres asiatiques affins, et chez *Brachytome* (Rubiaceae). Bull. Mus. natn. Hist. nat. Paris, sér. 4, 8, sect. B, Adansonia 3: 257-296.

* **Hamelia** Jacq.

Hamelieae. — 16 spp. — Subtropical and tropical America. — Shrubs.

Borneo: 1 sp. (*Hamelia patens* Jacq.); cultivated as an ornamental.

Hedyotis L.

Hedyotideae. — 150 spp. * — Almost worldwide in warm regions (when broadly delimited; see Note, below). — Herbs or shrubs.

Borneo: numerous spp.; BRUN, KALIM, SAB, SAR.

Note: * the problem of the circumscription and delimitation of the genus is not settled; if *Hedyotis* is taken in the wide [broad] sense (i.e. incl. *Oldenlandia* L., *Houstonia* L., etc.) it comprises c. 400 spp.

A revision is badly needed.

Hydnophytum Jack

Psychotrieae subtribe Hydnophytinae. — 45 spp. — From the Malay Peninsula through Malesia to Pacific Isls. — Epiphytes.

Borneo: 2 (?) spp.; BRUN, KALIM, SAB, SAR.

Hypobathrum Blume (syn. *Petunga* DC.*)
Hypobathreae. — 20 spp. — From India to Indochina and Malesia. — Shrubs or small trees.
Borneo: several sp.; BRUN, KALIM, SAB, SAR.
Note: * as such in Masamune (1942: 701-702).
Cowiea borneensis Wernh. (Masamune 1942: 680) is likely to be a *Hypobathrum* species. — see also comments under *Cowiea*.
A revision is badly needed.

Ixora L.
Pavetteae. — 400 spp. — Pantropical (incl. Australia); centred in tropical Asia. — Shrubs or small trees.
Borneo: numerous spp.; BRUN, KALIM, SAB, SAR.
Note: a revision is badly needed.

[Jackia Wall. in Masamune (1942: 689) and Anderson (1980: 299) — see *Jackiopsis*]

Jackiopsis Ridsdale (syn. *Jackia* Wall.)
Jackieae. — Monotypic [*J. ornata* (Wall.) Ridsdale]. — Sumatra, Malay Peninsula and Borneo. — Trees.
Borneo: BRUN, KALIM, SAB; SAR.
Useful reference and revision: Ridsdale, C.E. (1979): *Jackiopsis*, a new name for *Jackia* Wall. (Rubiaceae-Jackieae). Blumea 25: 295-296.

Kailarsenia Tirv.
Gardenieae subtribe Gardeniineae. — 11 spp. — From tropical Asia to tropical Australia. — Trees or shrubs.
Borneo: 2 (?) spp. [*K. tentaculata* (Hook. f.) Tirv. *; *K. stenosepala* (Merrill) Tirv.]; KALIM, SAR.
Note: * as *Gardenia tentaculata* Hook. f. in Masamune (1942: 682) and in Anderson (1980: 297).
A regional revision is needed.
Useful reference: Puttock, C.F. (1989): *Kailarsenia* Tirvengadum emend. Puttock (Rubiaceae: Gardenieae) in Australia. Austrobaileya 3: 51-62.

Knoxia L.
Knoxieae. — 9 spp. — Paleotropics, to tropical Australia; centred in tropical Asia. — Herbs.
Borneo: 1 sp. [*K. sumatrensis* (Retz.) DC. *]; KALIM, SAB; ? elsewhere.
Note: * as *K. corymbosa* Willd. and *K. lineata* (Blume) DC. in Masamune (1942: 689).
Useful references: Bhattacharjee, R., Deb, D.B. (1985): A revision of *Knoxia* (Rubiaceae). J. Econ. Tax. Bot. 6: 73-95.
Puff, C., Robbrecht, E. (1989): A survey of the Knoxieae (Rubiaceae-Antirheoideae). Bot. Jahrb. Syst. 110: 511-558.

Lasianthus Jack

Morindeae. 150 spp. — Centred in tropical Asia. — Shrubs or small trees.

Borneo: numerous spp.; BRUN, KALIM, SAB, SAR.

Note: A revision is badly needed. Too many species may be described and some species may have to be removed to *Litosanthes* — see there for further comments.

Lecananthus Jack

Isertieae. — 2 spp. — West Malesia. — Climbing shrubs, often epiphytic.

Borneo: 2 (?) spp. (*L. erubescens* Jack; *L. fuscescens* Val. *); BRUN, KALIM, SAR and likely SAB.

Note: * it seems doubtful if this is really specifically distinct from *L. erubescens*; a re-investigation is needed.

Lecariocalyx Bremek.

Psychotrieae subtribe Psychotriinae. — Monotypic (*L. borneensis* Bremek.). — Endemic to Borneo. — Shrubs? *.

SAR.

Note: * the growth form is unknown. The monotypic genus, possibly only known from the type, needs rechecking; there is some doubt whether it really is distinct from *Psychotria*.

Most recent and only available treatment: Bremekamp, C.E.B. (1940): Two new Bornean Rubiaceae [Additions to the flora of Borneo and other Malay islands: XVII]. Kew Bull. 1940: 192-194.

Litosanthes Blume

Morindeae. — 20 spp. — From India and Sri Lanka to New Guinea; also in Taiwan. — Undershrubs, shrubs or small trees.

Borneo: 1 (?) sp. (*L. biflora* Blume); SAB (Mt. Kinabalu), SAR.

Note: If the wide generic concept of Deb & Gangopadhyay (1989) is accepted, it is likely that Bornean species of *Lasianthus* Jack (those grouped in *Lasianthus* in sect. *Pedunculatae* Hook. f.) need to be transferred to *Litosanthes*.

Useful reference: Deb, D.B., Gangopadhyay, M. (1989): Review of the genus *Litosanthes* Bl. (Rubiaceae). Candollea 44: 209-223.

[Lucinaea DC. in Masamune (1942: 692-693) — see *Schradera*]

Ludekia Ridsdale

Naucleeae subtribe Adinnae. — 2 spp. — Philippines and Borneo, one species each — Trees.

Borneo: 1 sp. (*L. borneensis* Ridsdale), endemic; BRUN, KALIM, SAB, SAR.

Revision: Ridsdale, C.E. (1978): A revision of the tribe Naucleeae s.s. Blumea 24: 307-366.

Maschalocorymbus Bremek.

Urophylleae. — 4 spp. — Malay Peninsula, Sumatra, Java and Borneo. — Small trees or shrubs.

Borneo: 1 sp. [*M. corymbosus* (Blume) Bremek. *]; KALIM, SAB; ? elsewhere.
Note: * as *Urophyllum sericeum* Ridley in Masamune (1942: 718).

Most recent treatment: Bremekamp, C.E.B. (1940): On *Urophyllum* Wall. (Rubiaceae) and its nearest allies. Rec. Trav. Bot. Néerl. 37: 171-197.

Metadina Backh. f.
Naucleeae subtribe Adininae. — Monotypic [*M. trichotoma* (Zoll. & Mor.) Bakh. f.]. — From India to Malesia. — Trees.
Borneo: BRUN, KALIM, SAB, SAR.

Revision: Ridsdale, C.E. (1978): A revision of the tribe Naucleeae s.s. Blumea 24: 307-366.

Mitragyna Korth.
Coptosapelteae. — 10 spp. — Paleotropics (continental Africa and tropical Asia). — Trees.
Borneo: 1 sp. [*M. speciosa* (Korth.) Havil.]; KALIM; ? elsewhere.

Revision: Ridsdale, C.E. (1978): A revision of *Mitragyna* and *Uncaria* (Rubiaceae). Blumea 24: 43-100.

Morinda L.
Morindeae. — 80 spp. — Pantropical, centred in the paleotropics. — Trees, shrubs or woody climbers.
Borneo: several spp.; BRUN, KALIM, SAB, SAR.
Note: a revision is badly needed.

Motleya J.T. Johanss. (as "*Motleyia*")
Prismatomerideae. — Monotypic (*M. borneensis* J.T. Johanss.). — Endemic to Borneo. — Small to medium-sized trees.
SAB, SAR.

Revision: Johansson, J.T. (1987): *Motleyia*, a new genus of the Rubiaceae from Borneo. Blumea 32: 149-155.

Mussaenda L. (syn. *Asemanthia* Ridley)
Isertieae. — 190 spp. — Paleotropics. — Climbing or erect shrubs.
Borneo: several spp.; BRUN, KALIM, SAB, SAR.
Note: a regional revision is badly needed.

Mussaendopsis Baillon
Coptosapelteae. — 2 spp. — Malay Peninsula, Sumatra, Borneo (1 sp.); Sulawesi (Celebes) (1 sp.). — Trees.
Borneo: 1 sp. (*Mussaendopsis beccariana* Baillon); BRUN, KALIM, SAB, SAR.

Most recent treatment: Bremekamp, C.E.B. (1939): The genus *Mussaendopsis* Baill. (Rubiaceae). Rec. Trav. Bot. Néerl. 36: 367-371.

Mycetia Reinw.
Isertieae. — 25 spp. — Northeast India to South China and West Malesia. — Shrubs.

Borneo: 3 sp. [*M. cauliflora* Reinw. *, *M. fasciculata* (Blume) Korth.), *M. javanica* (Blume) Korth.)]; KALIM, SAB, SAR; ? BRUN.

Note: * as *M. lateriflora* (Blume) Korth. in Masamune (1942: 695).

Useful reference: Gideon, O.G., Tjitrosoedirdjo, S.S., Veldkamp, J.F. (1988): Notes on *Mycetia* (Rubiaceae). Floribunda 1: 17-19.

Myrioneuron R.Br. ex Kurz

Isertieae. — 15 spp. — Eastern Himalaya to West Malesia. — Shrubs, subshrubs or herbs.

Borneo: a few spp.; BRUN, KALIM, SAB; ? SAR.

Note: The Bornean monotypic genus *Campanocalyx* Val. (*C. winkleri* Val.; KALIM) is most likely congeneric with *Myrioneuron*; a critical evaluation of its status is suggested. To our knowledge, a formal reduction of the genus has never appeared in literature.

Myrmecodia Jack

Psychotrieae subtribe Hydnophytinae. — 26 spp. — From Malay Peninsula through Malesia to the Pacific Isls. — Epiphytes.

Borneo: a few (or only 1 ?) spp.; BRUN, KALIM, SAB, SAR.

Note: a revision is needed.

Myrmeconauclea Merrill

Naucleeae subtribe Adininae. — 3 spp. — Philippines, Borneo, Anambas Isls. — Small trees or shrubs.

Borneo: 2 spp. [*M. strigosa* (Korth.) Merrill *, *M. stipulacea* Ridsdale]; BRUN, KALIM, SAB, SAR.

Note: * as *Neonauclea strigosa* Korth. in Anderson (1980: 301).

Revision: Ridsdale, C.E. (1978): A revision of the tribe Naucleeae s.s. Blumea 24: 307-366.

Nauclea L.

Naucleeae subtribe Naucleinae. — 10 spp. — Paleotropics. — Trees.

Borneo: 3 or 4 spp.; BRUN, KALIM, SAB, SAR.

Note: *Nauclea maingayi* Hook. f. in Masamune (1942: 696) and Anderson (1980: 300) — see *Ochreinauclea.*

Revision: Ridsdale, C.E. (1978): A revision of the tribe Naucleeae s.s. Blumea 24: 307-366.

Neolamarckia Bosser

Naucleeae subtribe Neolamarckiinae. — 2 spp. — from India eastwards to New Guinea. — Trees.

Borneo: 1 sp. [*N. cadamba* (Roxb.) Bosser]; BRUN, KALIM, SAB, SAR.

Note: The Bornean species was previously known as *Anthocephalus chinensis.* Bosser (1984) found that this name originally referred to a Mauritian plant correctly called *Breonia chinensis* (Lamk.) Capuron. As *Anthocephalus* is typified by *A. chinensis*, it becomes a synonym of *Breonia* A. Rich ex DC. The Bornean species

was thus referred to a new generic name, using its earliest applicable specific epithet, thus *N. cadamba* (Roxb.) Bosser.

Masamune (1942: 675) lists a second *Anthocephalus* sp. (*A. macrophyllus* Havil.) as occurring in Borneo; according to Ridsdale (l.c.), this species, however, is restricted to Celebes and the Moluccas. The true identity of *A. macrophyllus* sensu Masamune is not known.

References: Bosser, J. (1984): Sur le type du *Cephalanthus chinensis* Lam. *Neolamarckia*, nouveau nom pour *Anthocephalus* auct. non A. Rich. (Rubiaceae). Bull. Mus. Natn. Hist. Nat., 4e sér., B, Adansonia 6: 243-248.

Ridsdale, C.E. (1978): A revision of the tribe Naucleeae s.s. Blumea 24: 307-366.

Neonauclea Merrill

Naucleeae subtribe Adininae. — 65 spp. — From Southwest and Southeast Asia through Malesia to the Pacific Isls. — Trees or erect shrubs.

Borneo: 14 spp.; BRUN, KALIM, SAB, SAR.

Note: *Neonauclea strigosa* in Anderson (1980: 300-301) — see *Myrmeconauclea*.

Revision: Ridsdale, C.E. (1989): A revision of *Neonauclea*. Blumea 34: 177-275.

Nertera Banks & Soland. ex Gaertn.

Anthospermeae subtribe Coprosminae. — 6 spp. — South China to Java; Australia, New Zealand, Society Isls. and Hawaii; South America. — Creeping herbs.

Borneo: 1 sp. [*N. granadensis* (Mutis ex L. f.) Druce, syn. *N. depressa* Banks & Soland. ex Gaertn.]; SAB (Mt. Kinabalu).

[Neurocalyx Hook. in Masamune (1942: 698) — see *Steenisia*]

Ochreinauclea Ridsdale & Backh. f.

Naucleeae subtribe Naucleinae. — 2 spp. — One species in India, the other in the Malay Peninsula, Sumatra and Borneo. — Trees.

Borneo: 1 sp. [*O. maingayi* (Hook. f.) Ridsdale *]; KALIM, SAR; ? elsewhere.

Note: * as *Nauclea maingayi* Hook. f. in Masamune (1942: 696) and in Anderson (1980: 300).

Revision: Ridsdale, C.E. (1978): A revision of the tribe Naucleeae s.s. Blumea 24: 307-366.

Oldenlandia L.

Hedyotideae. — 100 spp. — Pantropical, centred in the Old World. — Herbs.

Borneo: several spp., including some pantropical weeds; BRUN, KALIM, SAB, SAR.

Note: revision needed.

Ophiorrhiza L.

Ophiorrhizeae. — 150 spp. — From India and Sri Lanka eastwards to Micronesia and the Society Isls. — Herbs or subshrubs.

Borneo: numerous spp.; BRUN, KALIM, SAB, SAR.

Useful reference: Darwin, S.P. (1976): The Pacific species of *Ophiorrhiza* L. (Rubiaceae). Lyonia 1: 47-102.

Oxyceros Lour.

Gardenieae subtribe Gardeniineae. — 10 spp. — Indomalesia. — Climbing shrubs.

Borneo: several spp. [including the common coastal *O. longiflora* (Lam.) Yamazaki *]; BRUN, KALIM, SAB, SAR.

Note: * as *Randia longiflora* Lam. in Masamune (1942: 708) and in Anderson (1980: 304).

Useful reference: Wong, K.M. (1984): The genera of Peninsular Malaysian Rubiaceae formerly confused with *Randia*. Malayan Nat. J. 38: 1-57.

Paederia L.

Paederieae. — 29 spp. — Pantropical; centred in (sub)tropical Asia. — Lianas.

Borneo: 2 spp. (*P. foetida* L., *P. verticillata* Blume); BRUN, KALIM, SAB, SAR.

Revision: Puff, C. (1991): Revision of the genus *Paederia* L. (Rubiaceae-Paederieae) in Asia. In: Puff, C. (ed.), The genus *Paederia* L. (Rubiaceae-Paederieae): a multidisciplinary study. Opera Bot. Belg. 3: 207-289.

Pavetta L.

Pavetteae. — 400 spp. — Paleotropics (incl. Australia). — Shrubs or small trees.

Borneo: numerous spp.; BRUN, KALIM, SAB, SAR.

Most recent treatment: Bremekamp, C.E.B. (1934): A monograph of the genus *Pavetta* L. Rep. spec. nov. regni veg. (Fedde Rep.) 37: 1-208.

* **Pentas** Benth.

Hedyotideae. — 40 spp. — Tropical Africa and Arabia, Madagascar and the Comoro Isl. — Herbs or subshrubs

Borneo: 1 (?) sp. [*P. lanceolata* (Forssk.) Defl. s.l.] *; cultivated as an ornamental.

Note: * and also other species?

Pertusadina Ridsdale

Naucleeae subtribe Adininae. — 4 spp. — China to Malesia. — Trees.

Borneo: 1 sp. [*P. eurhyncha* (Merrill) Ridsdale *]; BRUN, SAB, SAR; ? also KALIM.

Note: * as *Adina minutiflora* Val. in Anderson (1980: 295).

Revision: Ridsdale, C.E. (1978): A revision of the tribe Naucleeae s.s. Blumea 24: 307-366.

[Petunga DC. in Masamune (1942: 701-702) and in Anderson (1980: 301) — see *Hypobathrum*]

Phyllocrater Wernh.

Hedyotideae. — Monotypic (*P. gibbsiae* Wernh.). — Endemic to Borneo. — Herbs or subshrubs.

SAB (Mt. Kinabalu).

Note: apparently very close to *Hedyotis* and perhaps not generically distinct; a reinvestigation is needed.

Reference: Wernham, H.F. (1914): Rubiaceae. In: Gibbs, L.S. (ed.), A contribution to the flora and plant formations of Mount Kinabalu and the highlands of British North Borneo. J. Linn. Soc. (Bot.) 42: 87-97.

Pleiocarpidia K. Schum.

Urophylleae. — 27 spp. — West Malesia, centred in Borneo. — Shrubs or small trees.

Borneo: 21 spp.; BRUN, KALIM, SAB, SAR.

Note: *Urophyllum enneandrum* (Wight) Ridley sensu Masamune (1942: 716) is *P. sandahanica* Bremek. [according to Bremekamp (l.c.), *P. enneandra* (Wight) K. Schum. (syn. *U. enneandrum*) is restricted to the Malay Peninsula].

P. borneensis (Miq.) Bremek.*, *P. bracteolata* (Ridley) Bremek., *P. capituligera* (Ridley) Bremek., *P. cephalotes* (Ridley) Bremek., *P. longipetala* (Ridley) Bremek., *P. paniculata* (Ridley) Bremek., *P. pilosa* (Ridley) Bremek. and *P. polyneura* (Miq.) Bremek. are found under *Urophyllum* in Masamune (1942: 715-717); * also under *Urophyllum* in Anderson (1980: 306).

It is likely that too many species are described; a revision is badly needed.

Most recent treatment: Bremekamp, C.E.B. (1940): A monograph of the genus *Pleiocarpidia* K. Sch. Rec. Trav. Bot. Néerl. 37: 198-236.

Porterandia Ridley

Gardenieae subtribe Gardeniineae. — 10 spp. — From the Malay Peninsula eastwards to Borneo, Fiji and Tonga. — Trees.

Borneo: 7 spp; BRUN, KALIM, SAB, SAR.

Note: *P. anisophylla* (Jack) Ridley: as *Randia scortechinii* King & Gamble in Masamune (1942: 709).

A revision is badly needed.

Useful references: Ridley, H.N. (1939): Notes on some Malayan Rubiaceae. Kew Bull. 1939: 593-613.

Wong, K.M. (1984): The genera of Peninsular Malaysian Rubiaceae formerly confused with *Randia*. Malayan Nat. J. 38: 1-57.

Praravinia Korth. (syn. *Williamsia* Merrill)

Urophylleae. — 50 spp. — Philippines, Borneo and Sulawesi. — Shrubs or small trees.

Borneo: 23 spp.; BRUN, KALIM, SAB, SAR.

Notes: *P. creaghii* (Ridley) Bremek., *P. havilandii* (Ridley) Bremek. and *P. suberosa* (Merrill) Bremek. are found under *Urophyllum* in Masamune (1942: 716); *Williamsia borneensis* Merrill in Masamune (1942: 718) is *P. borneensis* (Merrill) Bremek. — see also note under *Prismatomeris* (*"Prismatomeris urophylloides"*).

It is likely that too many species are described; a revision is badly needed.

Most recent treatment: Bremekamp, C.E.B. (1940): The genus *Praravinia* Korth. (Rubiaceae) in Borneo and Celebes. Rec. Trav. Bot. Néerl. 37: 237-278.

Pravinaria Bremek.

Urophylleae. — 2 spp. [*P. leucocarpa* Bremek., *P. endertii* Bremek.] — Endemic to Borneo. — Shrubs.

BRUN, SAB, SAR; ?KALIM.

Most recent treatment: Bremekamp, C.E.B. (1940): On *Urophyllum* Wall. (Rubiaceae) and its nearest allies. Rec. Trav. Bot. Néerl. 37: 171-197.

Prismatomeris Thw. (syn. *Zeuxanthe* Ridley)

Prismatomerideae. — 15 spp. — Southeast Asia centred; also Sri Lanka, Northeast India and Andaman Isls. — Shrubs or small trees.

Borneo: 3 spp.[*P. beccariana* (Baill.) J.T. Johanss. *, *P. glabra* (Korth.) Val., *P. robusta* J.T. Johanss.]; BRUN, KALIM, SAB, SAR.

Note: * as *Tribrachya beccariana* (Baillon) Boerl., *Zeuxanthe beccariana* (Baillon) Ridley, *Z. moultonii* Ridley and *Z. prismatomeriformis* (Merrill) Ridley in Masamune (1942: 713, 719).

"*Prismatomeris urophylloides* Val. ex Winkl." is an error introduced by Merrill (1921: 581) and overlooked by Masamune (1942: 704); this is actually *Praravinia urophylloides* Val.

Revision: Johansson, J.T. (1987): Revision of the genus *Prismatomeris* Thw. (Rubiaceae, Morindeae). Opera Bot. 94: 1-62.

Psychotria L.

Psychotrieae subtribe Psychotriinae. — More than 1000 (?) spp. — Pantropical (including Australia). — Trees, shrubs or climbers; rarely subshrubs.

Borneo: numerous spp.; BRUN, KALIM, SAB, SAR.

Note: taxa listed under *Cephaelis* in Masamune (1942: 679) may have to be transferred to *Psychotria*.

A regional revision is badly needed.

Psydrax Gaertn.

Vanguerieae. — 60 spp. — Paleotropics (including Madagascar). — Trees or shrubs.

Borneo: several spp.; BRUN, KALIM, SAB, SAR.

Note: some species listed under *Canthium* in Masamune (1942: 678-679) and Anderson (1980: 295) actually belong to *Psydrax*.

Since the Asiatic taxa of *Psydrax* have not been dealt with by Bridson (1985), correct names can, at present, not be given; a regional revision is badly needed.

Useful reference: Bridson, D.M. (1985): The reinstatement of *Psydrax* (Rubiaceae subfam. Cinchonoideae, tribe Vanguerieae) and a revision of the African species. Kew Bull. 40: 687-725.

"**Randia** Houst."

Gardenieae subtribe Gardeniineae. — See *Aidia*, *Anomanthodia*, *Catunaregam*, *Discospermum*, *Gardenia*, *Gynopachis*, *Oxyceros*, *Porterandia* and *Rothmannia*.

Notes: *Randia* is a strictly neotropical genus; all paleotropical taxa previously placed in that genus need to be removed.

There are 16 "*Randia*" spp. listed in Masamune (1942: 707-709) assignable to the genera *Aidia*, *Anomanthodia*, *Catunaregam*, *Discospermum*, *Gardenia*, *Gynopachis*, *Oxyceros*, *Porterandia* and *Rothmannia* (see there); the generic position of *R. keithii* Fischer and *R. korthalsii* Merrill requires investigation.
Of the 5 "*Randia*" spp. listed in Anderson (1980: 303-304), one each belongs to *Aidia, Gardenia, Oxyceros, Porterandia* and *Rothmannia*.

Useful references: Wong, K.M. (1984): The genera of Peninsular Malaysian Rubiaceae formerly confused with *Randia*. Malayan Nat. J. 38: 1-57.
Robbrecht, E., Puff, C. (1986): A survey of the Gardenieae and related tribes (Rubiaceae). Bot. Jahrb. Syst. 108: 63-137.

Rennellia Korth.

Prismatomerideae. — 4 spp. — From Borneo, Sumatra and the Malay Peninsula to South Burma. — Trees or shrubs.
Borneo: 1 sp. (*R. elliptica* Korth. *); BRUN, KALIM, SAB, SAR.
Note: * all three *Rennellia* spp. listed in Masamune (1942: 709) are this species.

Revision: Johansson, J.T. (1989): Revision of the genus *Rennellia* Korth. (Rubiaceae-Rubioideae). Blumea 34: 3-19.

Rhaphidura Bremek.

Urophylleae. — Monotypic [*R. lowii* (Ridley) Bremek. *]. — Endemic to Borneo. — Treelets or shrubs.
SAR.
Note: * as *Urophyllum lowii* Ridley in Masamune (1942: 717) and Anderson (1980: 306).

Most recent treatment: Bremekamp, C.E.B. (1940): On *Urophyllum* Wall. (Rubiaceae) and its nearest allies. Rec. Trav. Bot. Néerl. 37: 171-197.

*** Richardia** L.

Spermacoceae. — 15 spp. — Neotropical; some spp. naturalised elsewhere in the tropics. — Decumbent herbs.
Borneo: 1 (or 2?) sp. (*R. brasiliensis* Gomes *); exotic weed; SAB; ? also elsewhere.
Note: * it is likely that a second weedy species, *R. scabra* L., also occurs in Borneo.

Useful reference: Lewis, W.H., Oliver, R.L. (1974): Revision of *Richardia* (Rubiaceae). Brittonia 26: 271-301.

*** Rondeletia** L.

Rondeletieae. — 150 spp. — Tropical America. — Shrubs.
Borneo: 1 (?) sp. (*R. odorata* Jacq.) *; cultivated as an ornamental.
Note: * and also other species?

Rothmannia Thunb.

Gardenieae subtribe Gardeniineae. — 40 spp. — Paleotropics. — Trees or shrubs.
Borneo: several spp.; BRUN, KALIM, SAB, SAR.
Note: *Randia kuchingensis* W.W. Sm. in Masamune (142: 708) and Anderson (1980: 301) is *R. kuchingensis* (W.W. Sm.) Wong.

Useful reference: Wong, K.M. (1984): The genera of Peninsular Malaysian Rubiaceae formerly confused with *Randia*. Malayan Nat. J. 38: 1-57.
Wong, K.M. (1987): Some new and interesting plant species from Ulu Endau, Johore, Malaysia. Malayan Nat. J. 41: 267-273.

Rubia L.

Rubieae. — 60 spp. — Europe; mediterranean and tropical Africa; temperate to tropical Asia to Macaronesia. — Erect or climbing herbs.
Borneo: 1 sp. (*R. cordifolia* L. s.l.); SAB (Mt. Kinabalu) only?

Saprosma Blume

Psychotrieae subtribe Psychotriinae. — 30 spp. — Indomalesia. — Shrubs or trees.
Borneo: a few spp.; KALIM, SAB, SAR; ?BRUN.
Note: a badly needed revision is currently underway (C.P.).
Recent investigations show that the genus will have to be transferred from the Psychotrieae to the tribe Paederieae (C.P.).

Schradera Vahl (syn. *Lucinaea* DC.)

Schradereae. — 50 (?) spp. — Malesia, East to New Caledonia; tropical America. — Epiphytic shrubs.
Borneo: several spp.; BRUN, KALIM, SAB, SAR.
Note: Detailed investigations by Puff et al. (1992) have shown that the paleotropical *Lucinaea* and the neotropical *Schradera* are to be united.
A revision of the paleotropical taxa is currently underway (C.P.).
Useful reference: Puff, C., Andersson, L., Rohrhofer, U., Igersheim, A. (1992): The tribe Schradereae (Rubiaceae) reexamined. Bot. Jahrb. Syst. (in press).

Scyphiphora Gaertn. f.

Gardenieae subtribe Diplosporinae. — Monotypic (*S. hydrophyllacea* Gaertn. f.). — From India and Sri Lanka through Malesia to North Australia and New Caledonia. — Trees restricted to mangrove formations.
Borneo: BRUN, SAB, SAR; ? not in KALIM.
Useful reference: Puff, C., Rohrhofer, U. (1993): The character states and taxonomic position of the monotypic mangrove genus *Scyphiphora* Gaertn. f. (Rubiaceae). In: Robbrecht, E. (ed.), Advances in Rubiaceae Macrosystematics. Opera Bot. Belg. (in press).

Siderobombyx Bremek.

Hedyotideae. — Monotypic (*S. kinabaluensis* Bremek.) — Endemic to Borneo. — Herbs.
SAB (Mt. Kinabalu).
Note: Bremekamp's (1947) original description of the genus was based on a single collection. Its validity needs checking; it is suspected that it is very near *Hedyotis* L.
Most recent and only available treatment: Bremekamp, C.E.B. (1947): *Siderobombyx* Bremek. nov. gen. Rubiacearum Hedyotidearum. J. Arnold Arb. 28: 204-206.

Spermacoce L. (syn. *Borreria* G.F.W. Mey.)
Spermacoceae. — 200 spp. — Throughout the warmer parts of the world (incl. Australia). — Herbs.
Borneo: a few weedy spp.; BRUN; ? elsewhere.

Steenisia Bakh. f. (syn. *Neurocalyx* ser. *Thyrsoideae* Airy Shaw)
Rondeletieae. — 5 spp. — Endemic to Borneo (only one sp. also in the Natuna Isls.). — Herbs or subshrubs.
BRUN, KALIM, SAR.
Note: apparently absent from SAB.
Revision: Bremer, B. (1984): The genus *Steenisia* (Rubiaceae) and its taxonomic position. Nordic J. Bot. 4: 333-345.

Stichianthus Val.
Urophylleae. — 2 (?) spp. (*S. minutiflorus* Val., *S. kinabaluensis* Bremek. *). — Endemic to Borneo. — Small trees or shrubs.
BRUN, KALIM, SAB, SAR.
Note: * a reinvestigation of *S. kinabaluensis* is needed; it may be conspecific with *S. minutiflorus*.
Most recent treatment: Bremekamp, C.E.B. (1940): On *Urophyllum* Wall. (Rubiaceae) and its nearest allies. Rec. Trav. Bot. Néerl. 37: 171-197.

Streblosa Korth.
Psychotrieae subtribe Psychotriinae. — 25 spp. — Malay Peninsula, Sumatra, Java, Borneo and the Philippines. — Herbs or (sub)shrubs.
Borneo: 14 spp.; BRUN, KALIM, SAB, SAR.
Note: a revision is badly needed.
Most recent treatment: Bremekamp, C.E.B. (1947): A monograph of the genus *Streblosa* Korthals (Rubiaceae). J. Arnold Arb. 28: 145-185.

Streblosiopsis Val.
Isertieae (?). — Monotypic (*S. cupulata* Val.). — Endemic to Borneo. — Perennial herbs.
KALIM; ? elsewhere.
Note: the genus is incompletely known; a reinvestigation is needed.

Tarenna Gaertn.
Pavetteae. — 370 spp. — Paleotropics. — Trees or shrubs.
Borneo: numerous spp.; BRUN, KALIM, SAB, SAR.
Note: a regional revision is badly needed.
See also *Tarennoidea*, below!
Useful reference: Bridson, D.M. (1979): Studies in *Tarenna* sensu lato (Rubiaceae subfam. Cinchonoideae) for part 2 of 'Flora of Tropical East Africa: Rubiaceae'. Kew Bull. 34: 377-402.

Tarennoidea Tirv. & Sastre

Gardenieae subtribe Gardeniineae. — 2 spp. — From India to China; Malesia. — Trees or shrubs.

Borneo: 2 spp. [*T. axillaris* (Ridley) Tirv. & Sastre *, *T. wallichii* (Hook. f.) Tirv. & Sastre **]; SAB, SAR; ? elsewhere.

Note: * basio. *Tarenna axillaris* Ridley, ** basio. *Randia wallichii* Hook. f.; both not in Masamune (1942).

Useful reference: Tirvengadum, D.D., Sastre, C. (1979): La signification taxonomique des modes des ramification de *Randia* et genres affines. Mauritius Inst. Bull. 8: 77-98.

[Tetralopha motleyi Hook. f. in Masamune (1942: 711) — see *Gynochtodes*]

Timonius DC.

Guettardeae. — 180 spp. — Mascarenes, Seychelles; Sri Lanka; throughout Malesia to the Pacific Isls. and Australia. — Trees or shrubs.

Borneo: numerous spp.; BRUN, KALIM, SAB, SAR.

Note: a revision is badly needed.

[Tribrachya beccariana (Baillon) Boerl. in Merrill (1921: 581) and Masamune (1942: 713) — see *Prismatomeris*]

[Tricalysia spp. in Masamune (1942: 713) and in Anderson (1980: 306) — see *Diplospora* and *Discospermum*]

Uncaria Schreber

Coptosapelteae. — 34 spp. — Pantropical; centred in tropical Asia. — Climbers.

Borneo: 13 spp.; BRUN, KALIM, SAB, SAR.

Revision: Ridsdale, C.E. (1978): A revision of *Mitragyna* and *Uncaria* (Rubiaceae). Blumea 24: 43-100.

Urophyllum Wall.

Urophylleae. — 150 spp. — Tropical Asia, reaching Japan and New Guinea. — Shrubs or small trees.

Borneo: numerous spp.; BRUN, KALIM, SAB, SAR.

Notes: *Urophyllum* sensu Masamune (1942: 715-718) and sensu Anderson (1980: 306-307) also includes species now placed in *Crobylanthe*, *Maschalocorymbus*, *Pleiocarpidia*, *Praravinia* and *Rhaphidura* — see there.

It is likely that holdings of "*Urophyllum*" in many herbaria still include some of the genera listed above (closely allied and sometimes difficult to distinguish). Moreover, it seems that too many species are described in *Urophyllum* s.str. — A revision is badly needed.

Useful reference: Bremekamp, C.E.B. (1940): On *Urophyllum* Wall. (Rubiaceae) and its nearest allies. Rec. Trav. Bot. Néerl. 37: 171-197.

* **Warszewiczia** Klotzsch

Rondeletieae. — 4 spp. — Central to tropical South America. — Shrubs.

Borneo: 1 sp. [*W. coccinea* (Vahl) Klotzsch]; cultivated as an ornamental.

Wendlandia Bart.

Rondeletieae. — 70 spp. — Paleotropics; through tropical Asia to New Guinea and Australia (Queensland); also Southwest Asia, tropical Arabia and Northeast Africa. — Small trees.

Borneo: probably several spp. ; BRUN SAB, SAR; ?KALIM.

Note: a revision is badly needed.

Most recent overall treatment: Cowan, J.M. (1932): The genus *Wendlandia.* Notes Roy. Bot. Gard. Edinburgh 16: 233-318.

[Williamsia Merrill in Masamune (1942: 718) — see *Praravinia*]

Xanthophytum Blume

Hedyotideae. — 30 spp. — From Southeast Asia and Malesia eastwards to Fiji. — Shrubs or subshrubs.

Borneo: 18 spp.; BRUN, KALIM, SAB, SAR.

Revision: Axelius, B. (1990): The genus *Xanthophytum* (Rubiaceae). Taxonomy, phylogeny and biogeography. Blumea 34: 425-497.

[Zeuxanthe Ridley in Masamune (1942: 719) and Anderson (1980: 307) — see *Prismatomeris*]

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The genus *Pandanus* in Borneo

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Summary. The genus *Pandanus* is well represented in Borneo, with some 53 species (51 wild, 2 only in cultivation) currently known from the island. This total is roughly the same as that for the Malayan Peninsula. For the most part, the Bornean species belong to the same subgenera and sections of the genus as the Malayan species; showing that the overwhelming affinity of the Bornean pandan flora is with the western Malesian (or Sundaland) floristic zone. Five subgenera (out of eight in the genus) are found in Borneo: *Rykia, Lophostigma, Kurzia, Pandanus*, and *Acrostigma*; none of them endemic. *Rykia* is represented by four of its sections; *Lophostigma* by three (of which one is endemic); *Kurzia* by two; *Pandanus* by two; and *Acrostigma* by three (of which one is endemic). Species endemism is rather marked, with some 35 species restricted to Borneo. In this annotated checklist, information on these species is presented with brief notes on occurrence, distribution, relationship, nomenclature, bibliography, and miscellanea. A provisional key is included. The need to continue collecting, especially to locate staminate flowering specimens and to document distribution and ecology in greater detail, is pointed out.

The last published list of Bornean *Pandanus* was that in Merrill's "Bibliographic Enumeration of Bornean Plants" (Merrill 1921), which included 22 species. Later, Merrill (1922) described three new Bornean species of *Pandanus*, and Martelli (1930) added another, describing for it also a new section. In 1938, Kanehira published a further Bornean species. More recently, Bornean species have been described by St. John (1961, 1965) and Stone (1967, 1978, 1982, 1983) and a new record noted (Stone 1980). In precursory parts of a general monograph two subgenera were reviewed (*Acrostigma* and *Rykia* in 1978 and 1983, respectively), including the Bornean species of these subgenera.

During the past twenty-five years, thorough study of the *Pandanus* collections in nearly all the relevant herbaria has been carried out, including the historically important collections in A, B, BISH, BM, BO, CAL, E, FI, FU, G, GH, K, KLU, L, P, PH, SAN, SAR, SING, UC, US.

Cordial thanks are expressed to the curators of these collections for their cooperation and assistance.

In this annotated checklist, the species are arranged alphabetically within the next higher infrageneric taxon (either subsection or section). For a fuller account of the infrageneric classification of *Pandanus*, the treatment by Stone (1974b) should be referred to; some modifications of this arrangement have been made since then, but the essential features are still valid. The species listed by Merrill (1921) represented only about six sections; today about 13 sections and several subsections are known in Borneo.

This checklist presents a concise and up-to-date (through 1990) overview of the genus *Pandanus* in Borneo, showing the considerable augmentation and improvement in our knowledge of this distinctive group of plants; but it also shows where the gaps in our knowledge are, and mention is made of these, with an indication of unsolved problems intended (hopefully) to stimulate further study by local botanists in Malaysia, Indonesia, and Brunei.

Format: after each binomial will be found the reference to the original publication; selected subsequent bibliographic information; synonymy (with full notes on synonyms); specification of the type specimen(s); distribution, citation of specimens seen; and further notes where relevant.

Subgenera, Sections and Subsections in Borneo

A summary listing of the subgenera, sections and subsections of *Pandanus* Parkinson ex Z. occurring in Borneo is as follows.

I. Subgenus RYKIA Stone, 1974

(1) Section *Rykia* (De Vr.) Kurz, 1867
(2) Section *Asterodontia* Stone, 1969
(3) Section *Solmsia* Stone, 1969
(4) Section *Hombronia* (Gaudich.) Warb., 1900

II. Subgenus LOPHOSTIGMA (Brongn.) St. John, emend. Stone, 1974

(1) Section *Asterostigma* Martelli, 1914
(2) Section *Hastatistigma* Stone, 1987
(3) Section *Kanehiraea* Stone, 1970

III. Subgenus KURZIA Stone, 1974

(1) Section *Jeanneretia* (Gaudich.) Stone, 1967
(2) Section *Pulvinistigma* Martelli, 1930, emend. Kanehira, 1938

IV. Subgenus PANDANUS

(1) Section *Pandanus*
(2) Section *Fagerlindia* Stone, 1974

V. Subgenus ACROSTIGMA (Kurz) Stone, 1974

(1) Section *Acrostigma* Kurz, 1867
  a. Subsection Acrostigma
  b. Subsection Scabridi Stone, 1969
  c. Subsection Ornati Stone, 1974
  d. Subsection Herbacei Stone, 1974
  e. Subsection Parvi Stone, 1974
  f. Subsection Rostellati Stone, 1974
  g. Subsection Caespitosae Stone, 1978
  h. Subsection Papilionati Stone, 1967
  i. Subsection Alticolae Stone, 1974
  j. Subsection Pumili Stone, 1974

(2) Section *Pseudacrostigma* Stone, 1970
(3) Section *Epiphytica* Martelli 1904, 1913
(4) Section uncertain (*sp. incertae sedis*)

Key to the Subgenera of Pandanus in Borneo

Stigma abaxial, linear and grooved or ovate acute; carpels solitary, ripening as simple drupes, never connate in phalanges. Staminate flowers sessile, usually of only 3 (or 2-1) stamens, in dry specimens these appearing solitary; filaments usually very short (except in Sect. *Epiphytica*) and the anthers much longer. Leaf apex adaxially spinulose along two main pleats (prickles few or absent in some leaves, especially in Sect. *Epiphytica*). .... Subgenus ACROSTIGMA

Stigma adaxial, rarely linear (Sect. *Solmsia*), usually ovate, rotund, reniform, or irregular; carpels either solitary and ripening as simple drupes or connate into few- or many-celled phalanges with an integrated endocarp showing as many cells as there are stigmas; carpels in such phalanges united either concentrically (radially) or rarely transversely. Staminate flowers very diverse, but in Bornean species usually with the stamens borne on a distinct column or stemobophore (except in Sect. *Asterostigma*); filaments more or less developed, usually about as long as (or longer than) the anthers. Leaf apex adaxial pleats either entirely unarmed (smooth) or spinulose-prickly.

Style with stigma a short spine or flattened tooth, often forked. Carpels simple, free, ripening as drupes (or if, rarely, connate, then usually transversely). Stamens (sub)umbellate at apex of the column, on distinct filaments or, in Sect. *Solmsia*, on the peltate-discoid apex of the column. Leaf apex adaxially with smooth pleats

(prickles never present thereon); leaf base often suffused with purplish-bronze. ..... Subgenus RYKIA

Style with stigma neither spiniform nor forked, but sometimes the margin minutely toothed. Carpels either simple or connate in phalanges. Staminate flowers various, usually in distinct phalanges, except in Sect. *Asterostigma*. Leaf apex with either smooth or spinulose adaxial pleats.

Carpels simple, ripening as simple drupes, or sometimes two or three connate to form small paucilocular phalanges, but then with carpel tips not individually distinct. Leaf apex with clearly spinulose adaxial pleats.

Stigma rounded to ovate or reniform, entire, usually horizontal. Stamens few in short phalanges, the anthers often short, oblong, and the apex blunt or even emarginate. Leaf base green to brownish, never dark purple-bronze. ..... Subgenus KURZIA

Stigma suberect, the margin toothed. Stamens (where known) seemingly solitary, on long filaments. Leaf base green, or in some cases, purplish to bronzy ..... Subgenus LOPHOSTIGMA

Carpels radially connate (and often concentrically radial) in phalanges with integral, multilocular endocarps. Staminate flowers with distinct filaments and column, the anthers usually racemose, oblong, and apiculate. Leaf apex with the adaxial pleats either completely smooth and unarmed (Sect. *Pandanus*) or prickly (Sect. *Fagerlindia*). ..... Subgenus PANDANUS

SYSTEMATIC ANNOTATED CHECKLIST

I. Subgenus RYKIA Stone, 1974

Key to Sections of Subgenus *Rykia*

1a. Style and stigma predominantly forked (2-toothed), sometimes unequally so, or sometimes sharply 1-toothed, but then at least some basal drupes with forked styles; cephalia often solitary, sometimes 2-3 together; leaf base usally purple-brown; venation (especially when dry) often rather conspicuously tessellate; younger leaves often showing dark and light green marbling ..... Sect. *Rykia*

1b. Style not forked, sometimes spiniform, or several-toothed.

2a. Cephalia small, subglobose, spicate; styles usually 3-several-toothed ..... Sect. *Asterodontia*

2b. Cephalia small to large, usually solitary (rarely 2 or 3 together); styles broad to spiniform, but not several-toothed.

3a. Styles broad, angled ovate; drupes 1-5-celled, very large; coastal plants ..... Sect. *Hombronia*

3b. Styles spiniform; drupes simple, very slender; riverine or lacustrine plants ..... Sect. *Solmsia*

(1) Section Rykia (De Vriese) Kurz, 1867

Key to Bornean species of *Pandanus* Section *Rykia*
(omitting *P. aristatus* for which information is insufficient)

1a. Medium to rather small shrubs with short erect or somewhat decumbent trunks, to about 2 m tall; leaves mostly 80-330 cm long, 3.5-9 cm wide. Fruit head solitary, oblong or subglobose, to about 12 X 5 cm.

2a. Leaf apex abruptly caudate, the blade broad (loriform) rarely over 100 cm long but usually 6-9 cm wide, rather conspicuously tessellate-reticulate when dry.

3a. Fruit head ellipsoid to short oblong, seldom subglobose; drupes mostly 21-30 mm long, 5-10 mm wide. Leaf undersurface, especially nearer the base, glaucous white ..... *P. leuconotus*

3b. Fruit head ellipsoid to globose; drupes mostly 16-21 mm long, 5-10 mm wide. Leaf undersurface green, but near base somewhat purplish-brown ..... *P. dictyotus*

2b. Leaf apex gradually acuminate; blade narrow (linear-ensiform), to 5-6 cm wide. Fruit head oblong-ellipsoid, about 8-15 cm long ..... *P. kinabaluensis*

1a. Tree or large shrub, massive plants with short trunks to 1m high, very long leaves (to 500 cm, and 6-9 cm wide). Fruit head solitary, oblong-ellipsoid, on a long peduncle (45 cm); immature head already 13.5 X 5.5 cm. ..... *P. "paulii"*

Pandanus labyrinthicus Kurz has been attributed to Borneo (Merrill, Enum. 36. 1921) but I have seen no specimens to substantiate this; the species is known only from Java and Sumatra.

1. Pandanus aristatus Martelli, Webbia 4 (1): 6. 1913; 4 (2): 434, t. 33, f. 11. 1914. Merrill, Enum. 35. 1921. Masamune, Enum. 6. 1942. Stone, Fedn Mus. J. n. s. 28: 6. 1983.

Type: *Hallier* 2250 (BO), from Kalimantan (Djemala, Gunung Kelam).

Distribution: presumably endemic.

The type collection is staminate; no fruits are known. Probably it is related to *P. crinifolius* Martelli, of the Malay Peninsula. A search for this species to provide new collections, and if possible the fruits, is needed.

2. Pandanus dictyotus St. John, J. Arn. Arb. 64: 319. 1983; Stone, Fedn Mus. J. n. s. 28: 21. 1983.

Type: *Rashid b. Taggoi* S13017 (SAR), from Sarawak (Bako National Park).

Distribution: presumably endemic.

Known only from the type collection (in fruit). A low shrub.

3. Pandanus kinabaluensis St. John ex Stone, Malays. J. Sci. 3A: 73, f. 2. 1975; Fedn. Mus. J. n. s. 26: 36, Pl. 6A, 6B, 1983.

Type: *J. & M. S. Clemens* 30176 (G-Del), from Sabah (Mt. Kinabalu).

Distribution: endemic (known only in Sabah).

Additional collections: SABAH: Mt. Kinabalu; 1932, *Clemens* 29811 (G-Del). May 1973, *Stone* 11325, 11326, 11327, 11429, 11442 (KLU). May 1974 *Aban Gibot* SAN 79598 (SAN). Apr 1964, *Chew & Corner* RSNB 8464, 8465 (K). Apr 1977, *Stone* 12923 (KLU).

Notes: this species is locally abundant on Mt Kinabalu at middle altitudes (c. 1500 m). The trunk may reach over 2 m in length but is often decumbent. Floral bracts are straw-yellow. The staminate inflorescence has about 5 dull white spikes, each about 15 X 2 cm, composed of phalanges of 9-13 stamens. Fruit heads are relatively small.

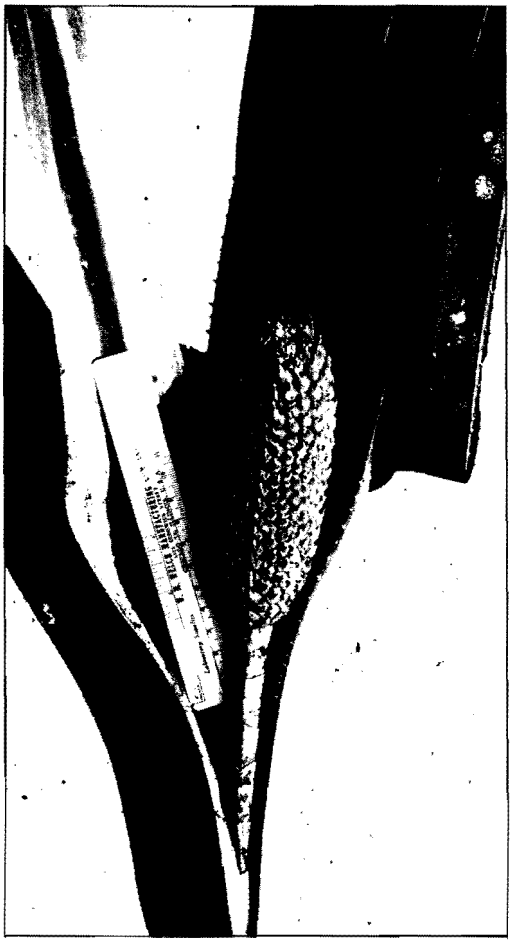
4. Pandanus leuconotus Stone, J. Arn. Arb. 64: 319, f. 8. 1983; Fedn Mus. J. n. s. 26: 36, Pl. 8A, 8B. 1983.

Type: *Stone* 12906 (KLU), from Sabah (Ranau, Poring, 330 m).

Distribution: endemic.

Additional collections: SABAH: Ranau, Poring, Apr 1975, *Stone* 12905 (staminate). Mt Kinabalu, Nov. 1931, *Clemens* 26857; Dec 1931, *Clemens* 27751. Sandakan-Telupid road, mile 83, Bukit Tangkunan, Mar 1977, *Stone* 12897 (KLU). Kota Merudu, W. of Bukit Madalon, Nov 1981, *Aban Gibot* SAN 94293 (SAN).

Notes: evidently a close relative of *P. albifrons* Stone, of Peninsular Malaysia. The white leaf undersurfaces are distinctive.



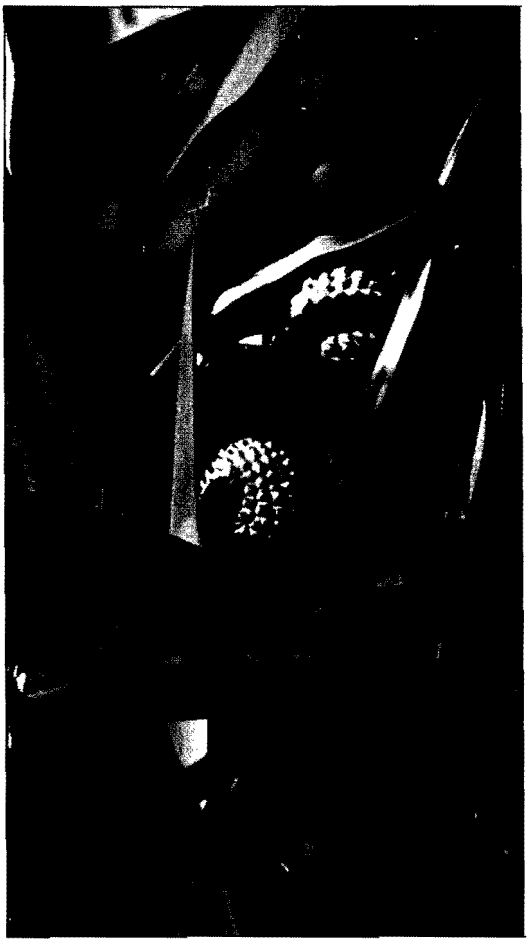


Fig. 1 (left). *Pandanus "paulii"* (Sect. *Rykia*). Immature fruit. *Stone* 6779.
Fig. 2 (right). *Pandanus dubius* (Sect. *Hombronia*). Fruits. From a wild population in Guam.

5. Pandanus "**paulii**" (*ined.*) (Fig. 1)
Syn. *Pandanus* cf. *kamiae* Stone, in Fedn Mus. J. n. s. 26: 33, f. 9-10. 1983; not *P. kamiae* ("*-ii*") Stone, Fedn. Mus. J. n. s. for 1970, 15: 201, f. 1. 1972.

Type: to be designated.

Distribution: presumably endemic.

Collections: SARAWAK: Kuching, Stampin Forest, Apr 1967, *Stone* 6779. SABAH: Sandakan, Ulu Dusun, Oct 1979, *Dransfield* 5764.

Notes: While identifying these Bornean collections as *P. kamiae* it was hoped that further collection would clarify the characters of both Peninsular and Bornean populations. The

assignment of the Bornean plants was optimistic; now it seems preferable to acknowledge the subtle differences between the Peninsular (Malayan) plants, strict *P. kamiae*, and the Bornean material. Another possibility is that this is *P. calamianensis* Merr. (of the Philippines). Assuming tentatively that it is not, the suggested name is intended as a tribute to Dr. Paul Chai, formerly of the Forest Herbarium in Sarawak, who accompanied me on the collection trip in 1967.

Plants perhaps representing this species were seen in some other localities (Bako National Park, and Mulu National Park), but were sterile or had imperfect fertile parts. The combination of very large leaves and a relatively short but erect trunk is distinctive. Staminate collections are unknown.

(2) Section Asterodontia Stone, 1969

Key to Bornean species of Section *Asterodontia*

1a. Slender stiltrooted trees to 6 m tall. Cephalia 3-5 together ..... *P. borneensis*

1b. Shrubs to about 2 m tall. Cephalia 1-3 together ..... *P. tetrodon*

6. Pandanus borneensis Warb., Pflanzenr. 3 (IV. 9): 78. 1900. Martelli, Webbia 4 (1): 8. 1913; 4 (2): t. 13, f. 11. 1914. Merrill, Enum. 22. 1921. Masamune, Enum. 6. 1942. Stone, Fedn Mus. J. n. s. 26: 79, f. 25, Pl. 16A. 1983.

Type: *Korthals s. n.* (L), Kalimantan.

Syn. *P. sandakanensis* Merr., J. Str. Br. Roy. Asiat. Soc. 85: 152. 1942. Masamune, Enum. 8. 1942. - Type: *Ramos* 1790 (K), Sabah (Sandakan). - *P. sulcatus* St. John, Pacif. Sci. 22: 529, f. 278. 1968. - Type: *Motley* 38 (K. Mus.), Borneo (locality unknown).

Distribution: endemic.

Additional collections: KALIMANTAN: W. Kutei, Sg. Belajan, Mt Additional Palimasan, Sept 1956, *Kostermans* 12726 (L). SABAH: Sandakan, Kebun China, Sept 1963, *Meijer* SAN 39390 (SAN). Same locale, Mar 1967, *Stone* 6702 (KLU). Leila Forest Reserve, Jan 1968, *Chow* SAN 62124 (SAN). Lahad Datu, Lok Magulong, Pulau Sakar, May 1964, *Pereira* SAN 43668 (SAN). Tawao, Bahanga Forest Reserve, Mar 1968, *Binson & Bongsu* SAN 62828 (SAN). SARAWAK: Bawan, Balingian, Ulu Begrith. Oct 1963, *Chai* S19455 (SAR). Upper Rejang River, Gat, Oct 1929, *Clemens* 21901 (FI). Lundu, May-June 1908, *Foxworthy* 15 (FI). Bako National Park, Apr 1967, *Stone* 6821 (KLU).

One plant of this species can be seen in cultivation at the Botany Department, University of Malaya, in Kuala Lumpur (Peninsular Malaysia); fruiting specimens have been made (*Stone* 13494, 14136).

7. Pandanus tetrodon Ridley, J. Str. Br. Roy. Asiat. Soc. 68: 13. 1915. St. John, Pacif. Sci. 17: 353, f. 187. 1963. Stone, Fedn Mus. J. n. s. for 1967, 12: 114, f. 2. 1969; *ibid.* 26: 83. 1983.

Type: *Ridley* 15465 (SING), from Singapore (Botanic Gardens).

Syn. *P. singaporensis* Kanehira, J. Jap. Bot. 14: 173-177, f. 6-8, 10. 1938, *nom. superfl.*

Distribution: Borneo and Singapore.

Additional collections: KALIMANTAN: *Winkler* 2601 (B, staminate). This was cited as *P. stelliger* by Martelli, in Winkler, Engl., Bot. Jahrb. 48: 88. 1912, and Merrill, Enum. 36. 1921. SARAWAK: Lundu, Mt Gadin, Oct 1929, *Clemens* 22218 (SAR).

(3) Section Hombronia (Gaudich.) Warb., 1900

One species in Borneo.

8. Pandanus dubius Sprengel, Syst. Veg. 3: 897. 1826. Kurz, J. Bot. 5: 127. Martelli, Webbia 4 (1): 12. 1913. Merrill, Enum. 35. 1921. Masamune, Enum. 6. 1942. St. John, Pacif. Sci. 29: 378. 1975. Stone, Fedn. Mus. J. n. s. 26: 88, f. 31, Pl. 17. 1983. (Fig. 2)

Type: *Folium Baggea maritimum* Rumphius, Herb. Amb. 4: 151, t. 80. 1743.

Distribution: West Malesia (Sumatra, Java, as P. bidur; Malaya, costal Johore and Pulau Tioman; Borneo) eastward to Melanesia, and north to Philippines and Micronesia. St. John (*loc. cit.*) gives a full account of the distribution. The plants are typically coastal and often favour rocky sea-swept coasts, less often sandy beaches, and rarely penetrate to interior areas. The variety (sometimes regarded as an independent species) var. *compressus* (Martelli) Stone, ranges about as far west and even farther east (into the New Hebrides and Shepherd Islands).

Bornean collections: SABAH: Pulau Gaya (off Jesselton), Mar 1910, *Gibbs* 4334 (BM). Pulau Gaya (probably), *Burbidge s. n.* (K). Labuan, observed in 1967 (Stone). Pulau Balambangan, Apr 1977, *Stone* SAN 86750 (SAN). SARAWAK: Bako National Park, Apr 1967, *Stone* 6818 (KLU).

(4) Section Solmsia Stone, 1969

Key to Bornean species of Section *Solmsia*

1a. Lacustrine or riverine trees (often partly or largely submerged) with stems to 24 cm diameter; leaves to 150 cm long and 4 cm wide, the midrib beneath usually prickly;

undersurface rather strongly glaucous; leaf base and prickles purple-brown; fruit head to about 22 X 10 cm; ripe drupes 30-45 mm long; spiniform style about 5-6 mm long ..... *P. helicopus*

1b. Shrubs of streams and swamps with relatively slender stems; leaves smaller, less than 4 cm wide, the midrib beneath often unarmed, the undersurface glaucous or green; prickles purplish or greenish; fruit head smaller, sometimes subglobose, usually not over 12 cm long; drupes usualy less than 30 mm long; spiniform styles about 3-6 mm long.

2a. Erect shrubs, the stems purplish-black, prickly: leaves narrowly linear-ensiform, firm, the base and prickles purplish-brown; fruit heads ellipsoid to subcylindric.

3a. Leaf margin prickles reduced or obsolete, at most 1 mm long; pollen grains smooth ..... *P. sigmoideus*

3b. Leaf margin prickles developed, 1-2 mm long; pollen grains (where known) minutely spinulose ..... *P. motleyanus*

2b. Low shrubs, the stems short, brownish, not (?) prickly; leaves somewhat noticeably narrowed to the base, widest near or above the middle, flexible; fruit heads ellipsoid or subglobose ..... *P. brevifolius*

9. Pandanus brevifolius Martelli, Bull. Soc. Bot. Ital., 302. 1914; Webbia 4 (1): 8. 1913; 4 (2): t. 32, f. 21-26. 1914. Merrill, Enum. 35. 1921. Masamune, Enum. 6. 1942. Stone, Fedn Mus. J. n. s. for 1972, 17: 141, f. 7, Pl. 24, 25. 1974.

Type: *Beccari* PB 273 (FI), from Sarawak (Siul near Kuching).

Distribution: endemic. A species of the peat swamps.

Additional collections: KALIMANTAN: Pontianak, Sept 1948, *Md. Enoth* 311 (BO, L). SARAWAK: Kuching, Telok Sabang, Oct 1960, *Anderson* S10199 (SAR). Sg. Kelapu, Pulau Bruit, May 1957, *Anderson* S8055 (SAR). Triso Protected Forest, Simanggang, Oct 1959, *Anderson* S12209 (SAR).

10. Pandanus helicopus Kurz, in Miq. Ann. Mus. Lugd.-Bat. 2: 54, t. 2. 1866; J. Bot. 5: 101. 1867. Solms-Laubach, Linnaea 42: 53. 1878. Martelli, Webbia 4 (1): 16. 1913; 4 (2): t. 31, f. 16-18. 1914. Stone, Fedn Mus. J. n. s. for 1972, 17: 116, f. 1, 10, Pl. 13-16. 1974.

Type: *Kurz s. n.* (CAL) from Bangka.

Syn. *P. johorensis* Martelli, Bull. Soc. Bot. Ital. 302. 1904. - *P. muarensis* Ridley, Mat. Fl. Mal. Pen. 2: 226. 1907; Fl. Mal. Pen. 5: 77. 1925.

Distribution: Borneo, Sumatra, Peninsular Malaysia.

Additional collections: KALIMANTAN: Sendabai, Sept 1949, *Dain* 1901 (BO). W. Kutei, May 1925, *Endert* 1563 (L). Sg. Sambas, *Hallier* 1179 (BO). Sampit, Sg. Sapiri near Kuala Kuajan, Aug 1953, *Kostermans* 8114 (BO); same location, *Berger* 12 = bb.9437 (BO). SABAH: Papar, Gadong, Oct 1964, *Meijer* SAN 19584 (SAN). SARAWAK: Nanga Bawan, Balingian, Oct 1963, *Ashton* S19584 (SAR).

11. Pandanus motleyanus Solms, Linnaea 42: 21. 1878. Martelli, Webbia 4 (1): 24. 1913; 4 (2): t. 32, f. 12-14 (stam.), 15-17 (pist.), 1914. Merrill, Enum. 35. 1921. Masamune, Enum. 6. 1942. Stone, Fedn Mus. J. n. s. for 1972, 17: 130, f. 14, Pl. 21. 1974.

Type: *Motley* 1057 (K. Mus.), Borneo.

Syn. *P. fruticosus* St. John, Pacif. Sci. 15: 579, f. 35-36. 1961.

Distribution: Borneo, Bangka, and (rare) Johore.

Additional collections: BRUNEI: Bukit Biang, Apr 1957, *Ashton* A95 (K). KALIMANTAN: Banjermassin, Oct 1939, *Polak* 439 (BO). Pontianak, Sg. Raja, Mar 1931, *Abondi* 9 (BO); same locale, Dec 1931, *Schuitemaker* 139 (BO); Mempawah, Sept 1928, *Enoh* 399 (BO). Samenggaris, Dec 1912, *Amdjah* 1077 (BO). Sg. Kelassar, *Hallier* 1549 (BO). W. Kutei near Tabang, Belajan River, Mt Palimasan, Sept 1956, *Kostermans* 12823 (BO). Sampit, Aug 1940, *Buwalda* 7647 (BO). Sampit, Nov 1953, *Meijer* 2303 (BO). Samarinda, Aug 1952, *Meijer* 1100 (BO). Tarakan, 1953, *Meijer* 2479 (BO). Nurukan, 1953, *Meijer* 2308 (BO). Balikpapan, *H.J. Lam* 3876 (L). SABAH: Sandakan, Elopura, Jan 1948, *Keith* A1505 (SAN). Sandakan, *Elmer* 20308 (L). Kobon China, Mar 1967, *Stone & Meijer* 6708 (KLU). Leila, Mar 1967, *Stone & Meijer* 6686 (KLU). Papar, Oct 1964, *Meijer* SAN 47487 (SAN). Tawao, *Elmer* 20843 (UC). Keningau, NE of Tambunan, Aug 1954, *Wood & Wyatt-Smith* A4430 (SAN). Keningau swamp, Dec 1972, *Heya & al.* SAN 72490 (SAN). Weston, Mt. Sunggau, Feb 1973, *Jumatin* SAN 77409 (SAN). Sipitang, Merintaman, June 1973, *Dewol & Karim* SAN 77681 (SAN). Beaufort, May 1963, *Meijer* SAN 33523 (SAN). Beluran, Bongaya, July 1975, *Aban Gibot & Kodoh* SAN 81918 (SAN). Kamansi, Kalagan, May 1965, *Meijer & Kodoh* SAN 49816 (SAN). Lamag, Sg. Lokan, July 1983, *Amin & Trang* SAN 97477 (SAN); Tavai plateau, Aug 1970, *Fox* SAN 70401 (SAN). Kalabakan, G. Rara, June 1983, *Fedilis & Sumbing* SAN 96146 (SAN). - SARAWAK: Simanggang, Linga, Jan 1958, *Anderson* S9817 (SAR). Binatang, Loba Kaban, Sept 1957, *Anderson* S9069 (SAR). Limbang, Sept 1959, *Brunig* S17491 (SAR). Kuching, Sept 1905, *Hewitt s. n.* (SAR). Sibu, Lassa, July 1961, *Anderson* R-7 (SAR). Bako National Park, Mar 1961, *Rashid b. Taggoi* S13018 (SAR). Stepok Forest, Jan 1959, *Corner & Brunig* S10367 (SAR). Selalang, Apr 1967, *Anderson* S25569 (SAR). Kuching, Aug 1960, *Sinclair & Kadim* 10195 (SAR).

Several unpublished names apear on duplicates of some of these cited collections (e.g. *infracarnosus, brunneus, lanceoloideus,* and *semiglobosus*) but there is no basis for recognizing more than one (normally variable) species.

12. Pandanus sigmoideus St. John ex Stone, Fedn Mus. J. n. s. for 1972, 17: 124. f. 5, 15. 1974.

Type: *Brunig* S12384 (L), Sarawak (Baram, Lobok Pasir).

Distribution: Endemic.

Collections: SARAWAK: Marudi, Baram, Labok Pasir, Apr 1961, *Brunig* S12384 (K, L, SAR). Same area, Oct 1956, *Anderson* S4119 (SAR); Sept 1907, *Hewitt s. n.* (SAR); Sept 1961, *Yakup* S11238 (SAR). Near Marudi, Lobok Pasir, Aug 1963, *Fuchs* 21249 (SAR).

This very local endemic species is evidently a very near relative of *P. motleyanus*, differing mainly in having slightly smaller leaf prickles, leaf base with an auriculiform basal lobe on each side, a slightly more slender cephalium, noticeably shorter styles of the drupes, smaller staminal phalanges, and smooth pollen grain exine.

II. Subgenus LOPHOSTIGMA (Brongn.) St. John, emend. Stone, 1974

Key to Sections of Subgenus *Lophostigma*

1a. Style and stigma toothed (sometimes multitoothed). Interior plants of peat swamps and along humic acid streambanks.

2a. Bushy streamside plants with narrow, linear leaves rarely over 15 mm wide; cephalia ovoid or subglobose ..... Sect. *Asterostigma*

2b. Cespitose larger plants of peat swamps; leaves to 3-5 cm wide; cephalia oblong ..... Sect. *Hastatistigma*

1b. Style and stigma entire or merely angled. Coastal or estuarine plants ..... Sect. *Kanehiraea*

(1) Section Asterostigma Martelli, 1914

Syn. Sect. *Multidens* St. John, 1963

Key to Bornean species of *Pandanus* Section *Asterostigma*

1a. Style and stigma deflected, several-toothed; drupes about 20 mm long ..... *P. dorystigma*

1b. Style and stigma horizontal, peltate, irregularly multitoothed; drupes 10-16 mm long.

2a. Drupes about 10 mm long ..... *P. discostigma*

2b. Drupes about 16 mm long ..... *P. matthewsii*

13. Pandanus discostigma Martelli, Webbia 4 (1): 12. 1913, *nomen*; 4 (2): 427, t. 39, f. 12-15. 1914. Merrill, Enum. 35. 1921. Masamune, Enum. 6. 1942. Stone, Fedn Mus. J. n. s. for 1966, 11: 117. 1967.

Type: *Jaheri* 662 (BO), Kalimantan.

Distribution: endemic.

Collections: KALIMANTAN: Nieuwenhuis Expedition of 1896-97, *Jaheri* 662 (BO, holotype).

Notes: Martelli describes the type material as with immature fruit heads, giving the drupe length as 8 mm. This difference, in comparison with material of *P. matthewsii*, is probably unimportant; in other respects these two taxa are essentially similar. (See notes under no. 14).

14. Pandanus dorystigma Martelli, Bull. Soc. Bot. Ital. 301. 1904; Webbia 4 (1): 12; 4 (2): t. 29, f. 17-24. 1914. Merrill, Enum. 35. 1921. Masamune, Enum. 6. 1942. Stone, Fedn Mus. J. n. s. for 1966, 11: 117. 1967. (Fig. 3)

Fig. 3. *Pandanus dorystigma* (Sect. *Asterostigma*). Habit. *Stone* 13392.

Type: *Beccari* PB 2084 (FI), Sarawak , near Kuching.

Distribution: endemic.

Collections: SARAWAK: Bako National Park, June 1963, *Ashton* S17949 (SAR). Bako National Park, Sept 1977, *Stone* 13392 (KLU). Selalang Road, Apr 1967, *Anderson* S25568 (SAR). Bau-Lundu Oct 1979, *Yii Puan Ching* S41130 (SAR). Simanggang, Entalau, Oct 1982, *Ilias Paie* S45139 (SAR). Limbang, Ulu Sg. Ensungei, Sept 1980, *Rena & al.* S42909 (SAR).

15. Pandanus matthewsii Merrill, J. Str. Br. Roy. Asiat. Soc. 85: 153. 1922. Masamune, Enum. 7. 1942. Stone, Fedn Mus. J. n. s. for 1966, 11: 117. 1967.

Type: *Ramos* 1321 (K, isotype), Sabah (Sandakan).

Distribution: endemic.

Collections: KALIMANTAN: W. Kutei, Nov 1925, *Endert* 4904 (BO). SABAH: Sandakan, Sepilok, Mar 1967, *Stone & Meijer* 6744 (KLU). Leila Forest Reserve, Mar 1967, *Stone & Meijer* 6683, 6690 (KLU). Telupid, Sg. Rukuruku, Aug 1981, *Aban Gibot* SAN 94020 (SAN). Beluran, Paliu River, June 1961, *Meijer* SAN 25411 (SAN). Lamag, Tavai, Karamuak, June 1975, *Leopold Madani* SAN 81705 (SAN).

Notes: as mentioned above (under no. 12) this species is probably synonymous with *P. discostigma.* The ripe fruits in these collections show longer drupes, but the formation of the stigma and the other characters (leaves, habit, habitat) appear to be the same. Until new collections from south Kalimantan are made, this taxon may be recognized, but it is highly probable that Martelli's earlier published name should apply to the specimens cited here including the type of *P. matthewsii.* The unusual staminate floral structure has been discussed in Stone (*l. c.* 1967).

(2) Section Hastatistigma Stone, 1987
Monotypic.

16. Pandanus vinaceus Stone, Fedn Mus. J. n. s. for 1966, 11: 116-119, f. 3. 1967; Bot. Jahrb. Syst. 94: 500. 1974; Blumea 32 (2): 434. 1987. Huynh, Bot. Jahrb. Syst. 97: 96, 113. 1976. (Fig. 4)

Type: *Stone & Anderson* 6774 (KLU), Sarawak (Stepok, Kuching).

Distribution: endemic.

Collections: Known only from the type.

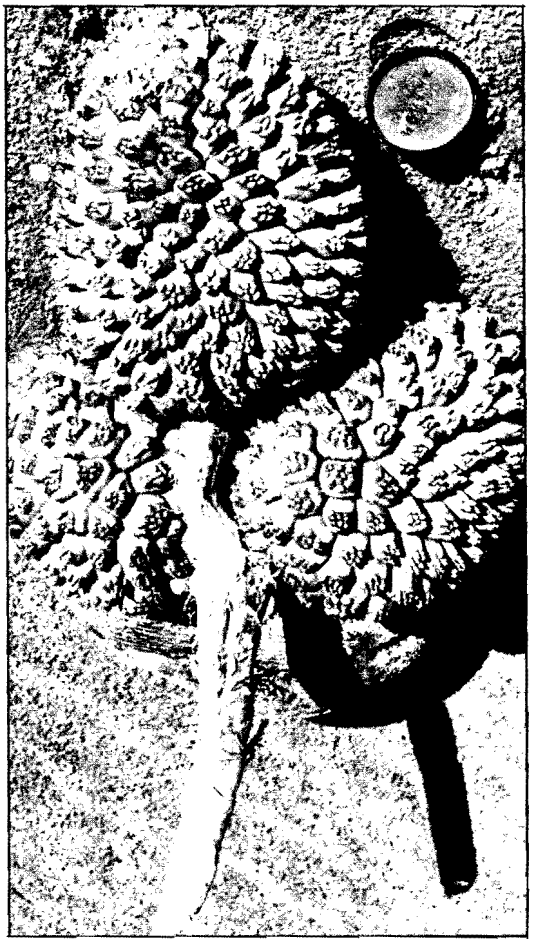


Fig. 4 (left). *Pandanus vinaceus* (Sect. *Hastatistigma*). Fruit. *Stone & Anderson* 6774.
Fig. 5 (right). *Pandanus basilocularis* (Sect. *Fagerlindia*). Raceme of fruit-heads. *Stone* 6817.

Further collections, especially discovery of staminate flowering material, is greatly needed to fully understand the systematic placement of this species.

(3) Section Kanehirae Stone, 1970
Monotypic.

17. Pandanus rostratus Martelli, Bull. Soc. Bot. Ital. n. s. 11: 300. 1904; Webbia 4 (1): 30. 1913; 4 (2): t. 19, f. 7-12. 1914. Merrill, Enum. 36. 1921. Masamune, Enum. 8. 1942. Stone, Bot. Jahrb. 94: 505. 1974.

Type: *Beccari* PB 3989 (FI, lectotype), 1896 (FI, syntype), Sarawak (near Kuching).

Syn. *P. corneri* Kanehira, J. Jap. Bot. 14: 433, f. 6-8. 1938. Stone, Fedn Mus. J. n. s for 1968, 13: 139. 1970.

Distribution: Borneo, southern Malaya (and Singapore).

Additional collections: SABAH: Sandakan, Mar 1967, *Stone* 6681 (KLU). Jesselton (Kota Kinabalu) between Kawang and Kinarut, Mar 1967, *Stone* 6768 (KLU). Sandakan, Batu Sapi road, Apr 1966, *Meijer* SAN 48595 (SAN). SARAWAK: Plaoh, mouth of Bangau River (3rd Div.), July 1971, *Chai* S30669 (SAR).

Notes: One of the most readily recognized species of the genus, with its abruptly acute leaf tips shaped like the bow of a boat, short or decumbent stems, solitary oblong fruits (ripening red) and simple drupes with rounded to reniform subapical stigmas. The floral bracts are white. The plants are restricted to the muddy banks of rivers and mangrove sites.

III. Subgenus KURZIA Stone, 1974

The well known garden cultivar "pandan wangi" (*Pandanus amaryllifolius* Roxb.) almost certainly belongs, on the basis of the staminate flowers and vegetative characters, to this subgenus; however, fruits of this plant are unknown, and staminate flowers are extremely rare (only one specimen has ever been collected). Because of the lack of fruits, the placing of the species in a particular section is not possible.

Key to Sections of Subgenus *Kurzia*

1a. Leaves strongly fragrant (musky scented), sparsely prickly to unarmed; cultivated, not naturalized, flowers and fruit rarely if ever produced ..... Section unknown

1b. Leaves not musky scented, more or less distinctly prickly; wild plants, not in cultivation; flowering and fruiting normally.

2a. Cephalia spicate; stigma ovate, round or reniform, not conspicuously pilose; carpels free or sometimes united in 2-3-celled phalanges. Usually erect shrubs with distinct stems and proproots ..... Sect. *Jeanneretia*

2b. Cephalia solitary; stigma round to reniform, conspicuously pilose; carpels simple. Usually cespitose plants with few or no distinct proproots .... Sect. *Pulvinistigma*

(1) Section Jeanneretia (Gaudich.) Stone, 1967
Represented by a single species in Borneo.

18. Pandanus bracteosus St. John, Pacif. Sci. 22: 525, f. 277, 277A. 1968. Stone, Bot. Jahrb. Syst. 94: 504. 1974.

Type: *Motley* in 1857-58 (CGE, K. Mus.), Borneo (Bangarmassing).

Distribution: Endemic.

Collections: Only known from the type.

Notes: This species is highly similar to *P. brachyspathus* Martelli of Sulawesi.

The staminate specimen collected by Motley included by St. John in his description of this species, does not really belong here; it is apparently the staminate material of *Motley* 1247, which is *Pandanus apicalis* St. John, a very different species (of Subgenus *Acrostigma*).

(2) Section Pulvinistigma Martelli, 1930 (as "*Pulvistigma*")
In Merrill, Univ. Calif. Publ. Bot. 12 (12): 369. 1930; *emend.* Kanehira, J. Jap. Bot. 14: 435. 1938.

Represented by one species in Borneo.

19. Pandanus fusinus Martelli, in Merrill, Univ. Calif. Publ. Bot. 15: 17. 1929. Masamune, Enum. 7. 1942. Stone, Bot. Jahrb. Syst. 94: 505. 1974.

Type: *Elmer* 21534 (UC), Sabah (Tawao).

Syn. *P. Durio* Martelli, Univ. Calif. Publ. Bot. 12: 369, pl. 48. 1930. - *P. dasystigma* Kanehira, J. Jap. Bot. 14: 435, f. 9-10. 1938. - *P. echinodermops* Holttum & St. John, Pacif. Sci. 16: 228, f. 103. 1962.

Distribution: Borneo, endemic.

Additional collections: KALIMANTAN: Banjarmassin, Martapura, Danna Salak, June 1936, *Obu* in *Kanehira* 3744 (KYU). Sangkulirang, Sept 1957, *Kostermans* 13684 (L). - SABAH: Sandakan, Labuk road, Apr 1962, *Meijer* SAN 28444 (SAN); same locale, *Salleh* SAN 36608 (SAN); same locale, Oct 1975, *Tarmiji* SAN 82125 (SAN); same locale, July 1965, *Meijer* SAN 53517 (SAN). Lamag, Kinabatangan, Ulu Sg. Lokan, Nov 1980, *Dewol* SAN 92374 (SAN); Tongod: Karamuak, opposite G. Tavai, June 1975, *Leopold Madani* SAN 81704 (SAN). Bukit Pantagaluang, June 1983, *Dewol* SAN 96985 (SAN). Lungmanis, July 1961, *Fox* SAN 26536 (SAN). Mamahat, Nov 1962, *Ampuria* SAN 32623 (SAN). Segaliud Forest Reserve, Apr 1975, *Leopold Madani & Kadoh* SAN 81581 (SAN); same locale, July

1964 *Meijer* SAN 44009 (SAN). Bettotan River, *Kloss* SF 19050 (SING). Telupid, Ulu Sg. Tariu, Kpg. Wonod, Mar 1974, *Saikeh & Aban Gibot* SAN 79386 (SAN). Beaufort, Sept 1970, *Aban Gibot* SAN 66949 (SAN). Kalabakan, Jan 1984, *Pikko* SAN 101486 (SAN); June 1982, *Krispinus* SAN 95814 (SAN). - SARAWAK: S. of Bukit Krian, Sept 1964, *Anderson & al.* S20277 (SAR). Bidi Cave, 1929, *Clemens* 20605 (BO), staminate. Lawas, May 1955, *Brooke* 9954 (L), staminate.

Notes: some collections bear unpublished names ("*oblanceolatus*" and "*bidiensis*"). The material however is quite uniform. It is patently a species widely distributed in Borneo. A closely related species is found to the north in Palawan (*P. reclinatus* Martelli).

(Section unknown)

20. Pandanus amaryllifolius Roxb. Hort. Beng. 71. 1814 (*nomen*); ex Voigt, Syll. Pl. Soc. Bot. Ratisb. 2: 52. 1828 (as "*amaryllidifolius*"); Fl. Ind. 3: 743. 1832. Stone, Econ. Bot. 32: 285-293. 1979 ("1978"). Teng, Shen & Goh, Econ. Bot. 33: 72-74. 1979.

Type: (probably) B (ex Herb. Hauniense).

Syn. *P. latifolius* vel *odoratus* Rumph., Herb. Amb. 4: 146. 1844. - *P. latifolius* Hassk., Flora 2, Beibl. 13. 1842; & var. *minor* Hassk., Cat. Hort. Bog. 61. 1844. - *P. Hasskarlii* Merr., Interpret. Rumph. Herb. Amboin. 80. 1917. - *P. odorus* Ridley, Fl. Mal. Pen. 5: 81. 1925.

This culinary species has been observed in Kuching and is doubtless elsewhere in Borneo in cultivation, the leaves being commonly used in the cooking of rice, preparation of jellies, etc. It is not found naturalized. Originally from Amboina (and perhaps adjacent Moluccan islands), it is evidently an old cultivar; as usually seen, the plants are low, small, and the leaves are tender and rarely over 50cm long; but when allowed to grow unhindered, a trunk may eventually develop which can reach a height of 1-2 m, and which bears leaves up to 100-125 cm long and proportionally wider, but still fragrant. Flowering can only be expected to occur on these old, trunked plants (which at one time were thought to be a different species). The pistillate plants, and hence fruits, are quite unknown; collection of these, should they be found, would be a major contribution to our understanding of these plants.

IV. Subgenus PANDANUS

Key to the Sections of Subgenus *Pandanus* in Borneo

1a. Leaf apex with prickly adaxial pleats ..... Sect. *Fagerlindia*

1b. Leaf apex with pleats smooth and unarmed ..... Sect. *Pandanus*

(1) Section Fagerlindia Stone, 1974

Key to Bornean species of Section *Fagerlindia*

1a. Cephalia usually spicate, exposed and conspicuous on the leafy branches; trunks erect; leaf apices rather abruptly caudate-acuminate ..... *P. basilocularis*

1b. Cephalia solitary, hidden (often near the ground); trunks short, rarely erect; leaf apices gradually acuminate ..... *P. occultus*

21. Pandanus basilocularis Martelli, Bull. Soc. Bot. Ital. n. s. 11: 299. 1904; Webbia 4 (1): 7, t. 5, f. 1-4. 1913. Merrill, Enum. 35. 1921. Masamune, Enum. 6. 1942. Stone, Bot. Jahrb. Syst. 94: 518. 1974. (Fig. 5)

Type: *Beccari* PB 1739 (FI), Sarawak (Sibu).

Distribution: Borneo and Palawan.

Additional collections: SABAH: Beluran, Sg. Mangkaryaok, May 1965, *Meijer* SAN 51614 (SAN). Pulau Banggi (Banguey), 1923, *Castro & Melegrito* 1484 (K). Sandakan, Sg. Lidong, May 1965, *Meijer & Kodoh* SAN 49813 (SAN). - SARAWAK: Lubok Tulang, Batang Balingian, *Ashton* S195839 (SAR). Bako National Park, Apr 1967, *Stone* 6817 (KLU). same locale, Sept 1977, *Stone* 13483 (KLU).

Notes: this is a species of estuaries, riverbanks and coasts; vernacular names are "pala" (Iban) and "bangkoang" (Kalagam). Plants from Palawan (Philippines) described by Martelli as *P. decipiens* also belong to this species. An unpublished epithet suggested by St. John, based on the vernacular name "bangkuang" is found on some sheets of *Meijer* SAN 51614.

22. Pandanus occultus Merrill, Philipp. J. Sci. Bot. 13C: 265. 1918. Stone, J. Malays. Br. Roy. Asiat. Soc. 53 (1): 73, Pl. 13-14. 1980.

Type: *Merrill* 9361 (US), Palawan.

Distribution: Palawan and Sabah (Pulau Balambangan).

Collections: SABAH: Pulau Balambangan, Apr 1977, *Stone* SAN 85511, 86770 (SAN).

(2) Section Pandanus

One indigenous species, with some varieties; and one introduced species (*P. tectorius*) with several cultivated forms, not apparently becoming naturalized.

Key to Bornean species of Section *Pandanus*

1a. Leaves usually more or less strongly glaucous beneath, often somewhat twisted; marginal spines white or whitish, often 4-6 (-10) mm long. Phalanges when fully ripe usually with fleshy shoulders. Coastal plants, on rocky or sandy shores, and near mangrove ..... *P. odoratissimus*

1b. Leaves green to slightly glaucous beneath, usually not twisted; marginal spines greenish, usually not over 4 mm long. Phalanges when fully ripe usually without fleshy shoulders. Cultivated plants, as various cultivars, some with variegated (striped) leaves, some with spineless leaves ..... *P. tectorius*

23. Pandanus odoratissimus L. f., Suppl. 424. 1781. Stone, Gard. Bull. Sing. 22: 231-257. 1967.

Type: *Thunberg* (S), Ceylon.

Syn. *P. tectorius sensu* Warb. *et auctt.*: Merrill, Enum. 36. 1921: Masamune Enum. 6. 1942.

Distribution: Western Malesia west to India, S. China, Taiwan, Ryukyu Isl.

Varieties: because of the considerable variation in this species (chiefly in the form of the fruits), it has been traditional to recognize varieties. Some of these, at least, are probably no more than clones of a particular pistillate genotype, since it is known that apomixis occurs in this species as well as in *P. tectorius*. The status of the following named taxa, therefore, is hardly well established but it may be a useful starting point for a study of variation in this species based on a combination of experimental and geographical information.

23a. var. borneensis (Martelli) Stone, *comb. nov.*

Syn. *P. tectorius* var. *borneensis* Martelli, Webbia 4 (2): 410, t. 19, f. 6. 1914. Merrill, Enum. 36. 1921; Philipp. J. Sci. 26: 348. 1926. - Type: *Beccari s. n.* (FI), Sarawak.

Collections: SABAH: Pulau Banggi (Banguey), 1923, *Castro & Melegrito* 1695 (A). Sandakan, 1921, *Agama* 1122 (A). Sipitang, Sibubu River, Menggalong Forest Reserve, July 1954, *Wood & Wyatt Smith* A4567 (SING). Sipitang, Merintaman Forest Reserve, Sept 1972, *Saikeh* SAN 72311 (SAN). Pulau Bakungan, Oct. 1975, *Cockburn* SAN 82488 (SAN). Kudat Harbour, *Meijer & Jawanting Ampuria* SAN 41172 (SAN). Pulau Selingan, P. Gaya, Sept 1969, *Kanis* SAN 56121 (SAN), Pulau Balambangan, Mar 1970, *Fox* SAN 69624 (SAN); Apr 1977, *Stone* SAN 86771, 86749 (SAN). Jesselton (Kota Kinabalu), Mar 1967, *Stone* 6751 (KLU). Pulau Labuan, Mar 1967, *Stone* 6674 (KLU). Pulau Langkayan, July 1969, *Chow* SAN 64567 (SAN) seedlings only. - SARAWAK: Datu Protected Forest, May 1980, *Lee* S41860 (SAR).

Notes: the leaf margin spines in *Castro & Melegrito* 1695 are especially long (to 10 mm, and 5 mm broad at the base).

23b. var. sarawakensis (Martelli) Stone, *comb. nov.*

Syn. *P. tectorius* var. *sarawakensis* Martelli, Webbia 4 (1): 34, *nomen*, t. 17, f. 1-2. 1913; 4 (2): 433. 1914. Merrill, Enum. 37. 1921. - Type: *Beccari* PB 6 (FI), Sarawak.

Collections: SARAWAK: Kapit, Upper Rejang River, 1929, *Clemens* 21085 (FI, staminate; SAR). Telok Asam, Bako National Park, May 1956, *Purseglove* 5054 (SAR). Bako National Park, Apr 1967, *Stone* 6824 (KLU).

23c. var. triceps Stone, *var. nov.*

Cephalia 3 spicata, cetera ut videtur var. typica simillima. Typus: *Ilias Paie* S17911, Sarawak, Bako National Park, Telok Asam, rocks along seashore, June 1963 (holotypus SAR).

24. Pandanus tectorius Park. ex. Z., Der Naturforscher 4: 250. 1774. Cultivar CV "*veitchii*" = *P. veitchii* Hort. ex Linden & Andre, Illustr. Hortic. 19: 55 (mispr.39) 1872; ex Dalliere, Pl. Ornam.; Gard. Chron. 2: 349. 1868.

This cultivar, with variegated leaves, has been observed in Kuching in cultivation only. The species is not wild in Borneo.

It is likely that other cultivars of this species will be confirmed as cultivated plants in other places in Borneo, particularly "*baptistii*," "*sanderi*," and "*laevis*".

V. Subgenus ACROSTIGMA Kurz (Stone), 1974

Key to Sections of Subgenus *Acrostigma*

1a. Style spiniform, sharp; stigma a linear minutely papillose groove ..... Sect. *Acrostigma*

1b. Style beaklike to acute, acuminoid-truncate, with a blunt elliptic-ovate stigma.

2a. Acaulescent cespitose soboliferous plants with very long, rigid, dark leaves; style beaklike; pileus not calyptrate ..... Sect. *Fusiforma*

2b. Not as above,

3a. Large epiphytes (or on boulders); leaves large, firm, with large basal auricles; apical ventral pleats unarmed; cephalia cylindric, spicately disposed; drupes very small, stigma small ovate ..... Sect. *Epiphytica*

3b. Terrestrial shrubs, leaves relatively slender, without large basal auricles; apical ventral pleats prickly; cephalia subglobose, solitary; drupes small but fleshy, stigma subovate. ..... Sect. *Pseudacrostigma*

(1) Sect. Acrostigma Kurz, 1867

Key to Subsections of Section *Acrostigma*

1a. Epiphytes (sometimes on limestone rocks) without rigid proproots; stems usually decumbent, attached to substrate by adventitious rootlets; leaf base usually with more or less prominent basal auricles.

2a. Leaf base auricles little or not developed.

3a. Small plants; cephalia medium (5+ cm diam.), solitary or spicate ..... Subsect. *Alticolae*

3b. Dwarf plants; cephalia very small (1 cm diam.), spicate, crowded at end of very long, slender peduncle ..... Subsect. *Pumili*

2b. Leaf base auricles well developed, lobelike ..... Subsect. *Papilionati*

1b. Terrestrial plants, often with rigid proproots; stems erect or sometimes decumbent, or short; adventitious (axillary) roots little or not developed; leaf without auricles.

4a. Carpel apex finely scabrid (with minute, appressed, overlapping, palpable firm scales) ..... Subsect. *Scabridi*

4b. Carpel apex smooth (or if microscopically papillate, not palpably scabrid).

5a. Cephalia cylindric ..... Subsect. *Ornati*

5b. Cephalia globose, ovoid, ellipsoid, or shortly oblong.

6a. Leaves small but proportionally broad, narrowed toward base, at apex more or less abruptly caudate-acuminate; apical ventral prickles often lacking ..... Subsect. *Parvi*

6b. Leaves otherwise; apical ventral prickles usually present (sometimes few or lacking on some leaves).

7a. Large cespitose acaulescent shrubs; inflorescences hidden among the leaves near the groud ..... Subsect. *Caespitosae*

7b. Small to large erect trunked shrubs or trees, or sometimes short-stemmed subdecumbent shrublets; inflorescences more exposed.

8a. Drupe pileus short, cupular to conic; style slender.

9a. Tall (usually 2-4 m) erect shrubs; leaves usually over 60 cm long, over 6 mm wide; fruit heads various .... Subsect. *Acrostigma*

9b. Small erect shrubs; leaves ca. 60 X 0.6 cm; fruit head solitary, subglobose, about 17-28 mm long .... Subsect. *Herbacei*

8b. Drupe pileus elongate; style narrowly conic, almost rostrate ..... Subsect. *Rostellati*

(1a) Subsect. Acrostigma

Key to Bornean species of Subsection *Acrostigma*

1a. Style spiniform, slender, 5-10 mm long. Spike of usually about 3-5(-7) heads.

2a. Drupes usually 20-23 mm long ..... *P. affinis*

2b. Drupes 30-35 mm long ..... *P. sarawakensis*

1b. Style ovate acute, short, 1.5-2 mm long. Spike of 7-9 heads. Drupes 15-19 mm long ..... *P. microglottis*

25. Pandanus affinis Kurz, J. Bot. ed. Seem. 5: 101. 1867 (excl. syn.). Merrill, Enum. 35. 1921. Masamune, Enum. 6. 1942. Stone, Malay. Nat. J. 21: 135, pl. 25 (*sub P. aurantiacus*) 1968; Fedn Mus. J. n. s. 23: 13, pl. 1C. 1978. (Fig. 6)

Type: *Kurz* (BO), from Bangka.

Syn. *P. aurantiacus* Ridley, J. Str. Br. Roy. Asiat. Soc. 41: 49. 1903. Merrill, Enum. 35. 1921. - *P. korthalsii sensu* Martelli, in Merrill, Univ. Calif. Publ. Bot. 15: 17. 1929, not of Solms 1878.

Distribution: Vietnam; Malay Peninsula; Singapore; Sumatra; Bangka; Borneo.

Fig. 6. *Pandanus affinis* (Sect. *Acrostigma*, Subsect. *Acrostigma*). Ripe fruits. *Stone & Lamb* 12856.

Collections: BRUNEI: Ulu Brunei, Jan 1960, *Ashton* A 191 (K). - KALIMANTAN: *Korthals s. n.* (BO). Pontianak, Kg. Bangsir, Mar 1931, *Mondi* 3 (BO). Kapuas, Dec 1930, *Polak* 244 (BO). - SABAH: Sandakan, *Ramos* 1357 (K). Sepilok, Aug 1969, *Zain* SAN 62889 (SAN); Feb 1948, *Castro* A 725 (K); Dec 1948, *Kadir* A 985 (K); *Wood* SAN 3481 (K). Jalan Pangkalan, Aug 1969, *Patrick Ping Sam* SAN 64740 (SAN); Aug 1972, *Ampon & Sumbing* SAN 74281 (SAN); Kabili-Sepilok, June 1937, *Agama* 7265 (KEP); *Cockburn* SAN 64982 (SAN); *Meijer* SAN 19294 (SAN). Sg. Sepilok Besar, Mar 1967, *Stone* 6738 (KLU). Near Sandakan, Mar 1967, *Stone* 6682 (KLU). Sepilok, Jalan Pangkalan, Mar 1974, *Leopold Madani* SAN 78681 (SAN). Same locale, Hujung Tanjong, May 1982, *Amin Gambating* SAN 90298 (SAN). Kawang-Kinarut, Mar 1967, *Stone* 6770 (KLU). Labuan, Mar 1967, *Stone* 6675 (SAN). Beluran, Bongaya, July 1975, *Aban Gibot & Kodoh* SAN 82040 (SAN). Kota Belud, Feb 1966, *Kanis & Kuripin* SAN 56102 (SAN). Ulu Dusun, Mar 1977, *Stone & Lamb* 12856 (KLU). - SARAWAK: Kuching, Jan 1915, *Ridley s. n.* (K). Bako National Park, Sept 1977, *Stone* 13484 (KLU). Rajang Forest Reserve, May 1971, *Chai* S26791 (SAR).

This common species of freshwater (or very slightly brackish) swamps and riverbanks is readily recognized by the 3-9 vermilion ovoid fruit heads borne crowded on a suberect spike.

26. Pandanus sarawakensis Martelli, Bull. Soc. Bot. Ital. n. s. 11: 303. 1904; Webbia 4 (1): 30. 1913; 4 (2): t. 32, f. 4-6. 1914. Merrill, Enum. 35. 1921. Masamune, Enum. 6. 1942. Stone, Fedn Mus. J. n. s. for 1969, 14: 127. 1971.

Type: *Beccari* PB. 550 (FI, syntype); PB 1895 (FI, syntype), from Kuching, Sarawak.

Distribution: Sarawak, endemic.

Collections: SARAWAK: Kapit District, between Sg. Balang and Sg. Balleh (extreme headwaters of Sg. Balleh), 1700 ft. alt., sandstone ridge, June 1969, *Anderson & Ilias Paie* S28350 (SAR).

See Stone (1971) for a discussion of this poorly known species. It closely resembles *P. affinis*, but has somewhat larger fruits and evidently a very different habitat.

27. Pandanus microglottis Stone, in Jermy & Kavanagh, Bot. J. Linn. Soc. 85 (1): 34-36, f. 7. 1982. (Fig. 7)

Type: *Stone* 13654 (KLU), Sarawak (Mulu National Park, Sg. Melanau). Isotypes in K, SAR, PH.

Distribution: Endemic.

Collections: SARAWAK: Mulu National Park, Sg. Melanau, rocky riverbank, 150 m alt., Apr 1978, *Stone* 13654 (KLU).

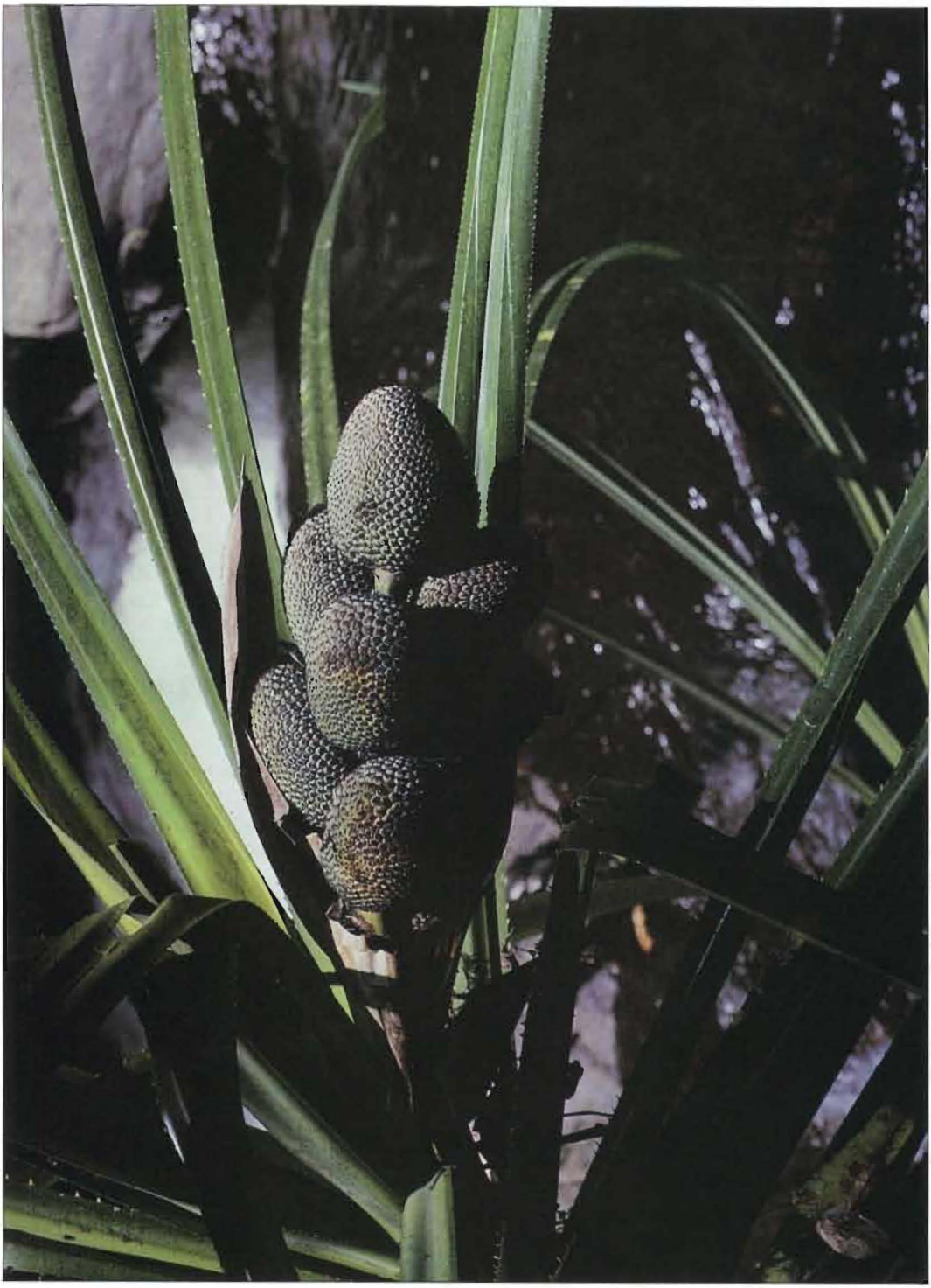


Fig. 7. *Pandanus microglottis* (Sect. *Acrostigma*, Subsect. *Acrostigma*). Fruits. *Stone* 13654.

Notes: The unusually short style and stigma provide a striking feature of the species and hint at a possibly more remote affinity to the above two species than may be indicated by their sequential position in the text. Staminate collections of this species are highly desirable for further taxonomic assessment.

(1b) Subsect. Scabridi Stone, 1969

Key to Bornean species of Subsection *Scabridi*

1a. Cespitose, subacaulescent plants of open swamps; fruit heads 1-3 per spike ..... *P. andersonii*

1b. Small tree with erect trunks; fruit heads 1-5 per spike.

2a. Fruit heads usually 2-5 per spike; drupes to 41 mm long, the pileus 6-9 mm long ..... *P. gibbsianus*

2b. Fruit head usually solitary; drupes to 45 mm long, the pileus 10-15 mm long ..... *P. sylvaticus*

28. Pandanus andersonii St. John, Pacif. Sci. 15: 576, f. 33-34. 1961. Stone, Bot. Jahrb. 94: 524. 1974; Fedn Mus. J. n. s. 23: 28. 1978.

Type: *Anderson s. n.* in Nov 1960 (SAR) from Sarawak (Lawas).

Distribution: Endemic in Sarawak and southwestern Sabah.

Collections: SABAH: Bongawan-Mandahan, Mar 1967, *Stone* 6752 (KLU). - SARAWAK: Kuching, Dec 1906, *Ridley* (?) in Dec 1906 (SAR). Baram, Sg. Dua, Oct 1956, *Anderson* S4150 (SAR). Simanggang, Lingga, Jan 1958, *Anderson* S9818 (SAR). Ulu Sg. Karap to Batang Tinjau, Sept 1971, *Anderson* S30710 (SAR). Batang Saribas, Tanjong Keranji, June 1971, *Banyeng & Jugah* S30046 (KLU). Jemoreng Protected Forest, May 1972, *Lee Hua Seng* S31647 (SAR). Above Telok Pandan, Apr 1967, *Stone* 6874 (KLU), sterile.

Notes: A distinctive species of freshwater swamp forest. The cephalia are sometimes solitary, but often 2 or 3 together at the apex of the peduncle, and ripen to a characteristic dull red of the pilei, with the lower exocarp yellow.

An Iban vernacular name "geronggang kerupok" is given on S30710, with the note that the leaves are used for roofing material.

29. Pandanus gibbsianus Martelli, J. Linn. Soc. Bot. 42: 170. 1914; Webbia 4 (1): 15, *nomen*. 1913; 4 (2): t. 41, f. 7-9. Merrill, Enum. 35. 1921. Masamune, Enum. 6. 1942. Stone, Fedn Mus. J. n. s. 23: 28. 1978.

Type: *Gibbs* 3030 (BM), from Sabah (Tambunan & Korihut).

Syn. *P. obovoideus* Merrill, J. Str. Br. Roy. Asiat. Soc. 85: 154. 1922.

Distribution: Endemic, known so far only from Sabah.

Collections: SABAH: Kudat, Nov 1920, *Castro* 976 (K, US, isotypes of *P. obovoideus*). Bukit Tanjong near Sandakan, May 1965, *Meijer & Kodoh* SAN 51611 (SAN). Labuk above Kiabau, Meliau River, May 1965, *Meijer & Kodoh* SAN 51554 (SAN). Kebun China near Sandakan, Mar 1967, *Stone & Meijer* 6703 (KLU). Leila Forest Reserve, Mar 1967, *Stone & Meijer* 6687 (KLU). Tamparuli to Tengilan (North of Jesselton), Mar 1967, *Stone* 6763 (KLU). Beaufort hill, *Saikeh* SAN 72202 (SAN). Tenom, Kg. Kapulu, SAN 73544 (SAN). Ranau, N. of Kg. Peranchangan, May 1973, *Shea & Aban Gibot* SAN 76376 (SAN). Tenom, Katubu-Kapulu, Apr 1972, *Cockburn & Saikeh* SAN 70025 (SAN). Papar, Kimanis, Aug 1959, *Meijer* SAN 19806 (SAN). Tawao, 1922-23, *Elmer* 21776 (A,K).

Notes: A lowland species on ridges and hillsides or in level country. The drupes when more or less ripe are dark brown; the cephalia are usually 3-5 together, but occasionally only one or two.

30. Pandanus sylvaticus Stone, Fedn Mus. J. n. s. 23: 31. 1978.

Type: *Stone* 13475 (KLU), Sarawak (Semengoh).

Distribution: Known only from Sarawak.

Collections: SARAWAK: Semengoh Arboretum, Aug 1977, *Stone* 13475 (pistillate; type), 13476 (staminate, paratype) (KLU).

Notes: Very similar to *P. gibbsianus* but with usually solitary cephalia and somewhat longer drupes.

(1c) Subsect. Ornati Stone, 1974

Key to Bornean speceis of Subsection *Ornati*

1a. Leaves mostly less than 12 mm wide, and sometimes less than 80 cm long, at most to 170 cm long. Cephalia solitary or spicate, ovoid or short oblong but never long-cylindric. Trunks slender.

2a. Fruit heads usually spicate, to about 4 X 2.6 cm.

3a. Leaves slender, 150-170 cm long and 10-11 mm wide, somewhat stiffly thin coriaceous, very dark above; fruit head about 3 X 2 cm .... *P. ashtonii*

3b. Leaves proportionally somewhat broader, about 90 cm long and 8-17 mm wide, chartaceous to thin coriaceous; fruit heads somewhat oblong, 40 X 26 mm ..... *P. korthalsii*

2b. Fruit head usually solitary, about 6 X 3 cm; leaves about 130 cm long, 11 mm wide ..... *P. brunigii*

1b. Leaves mostly more than 10 mm wide (commonly 9-35 mm) and usually over 80 cm long. Trunks robust (often 3-5 cm diam.).

4a. Leaf margin prickles near base 1-2 mm long; near apex about 0.3-0.5 mm long ..... *P. monotheca*

4b. Leaf margin prickles near base about 1 mm long; near apex about 0.25-0.3 mm long.

5a. Young proproots ferruginous tuberculate. Lower leaf surface glaucous grayish ..... *P. rusticus*

5b. Young proproots smooth gray. Lower leaf surface not conspicuously glaucous ..... *P. beccatus*

31. Pandanus ashtonii Stone, Fedn Mus. J. n. s. 23: 32. 1978.

Type: *Ashton* 283 (K), Brunei (G. Pagon Priok).

Distribution: Sabah and Brunei.

Collections: BRUNEI: Sg. Temburung, Gunung Pagon Priok, 4700 ft. alt., Apr 1958, *Ashton* 283 (K, holotype). SABAH: Tenom, W of Kg. Melayu, *Saikeh* SAN 72071 (SAN). Sandakan, Boutu, mile 82, July 1967, *Meijer* SAN 59312 (SAN).

Notes: Staminate materials have not yet been collected.

32. Pandanus brunigii St. John ex Stone, Fedn Mus. J. n. s. 23: 32. 1978.

Type: *Brunig* S17492 (SAR), Sarawak (Miri).

Distribution: Known only from the type collection.

Collections: SARAWAK: Miri, Sg. Dalam F. R., kerangas forest, 75 m alt., May 1979, *Brunig* S17492 (SAR).

33. Pandanus korthalsii Solms, Linnaea 42: 12. 1878. Warburg, Pflanzenr. 3 (IV.9): 81. 1900. Martelli, Webbia 4 (1): 19. 1913. Stone, Bot. Jahrb. Syst. 94: 525. 1974; Fedn Mus. J. n. s. 23: 33. 1978.

Type: *Kothals s. n.* (L), S. Kalimantan.

Distribution: Borneo and Sumatra.

Collections: KALIMANTAN: Samenggaris, Dec 1972, *Amdjah* 1027 (BO). - SARAWAK: G. Matang, June 1893, *Haviland s. n.* (SAR); 1929, *Clemens* 20966 (BO); Aug 1976, *Chai* S36488 (SAR). Near Kuching, May 1893, *Sarawak Museum coll.* 3132, 3133 (SAR). Lundu, G. Poi (Pueh), *Clemens* 20220 (SAR); Sept 1955, *Purseglove* 4782 (SING). Berumpit W of Lundu, May 1954, *Brooke* 8585 (L).

Notes: occurring in rain forests up to 1800 m alt. as small understorey shrubs. In some herbaria specimens may bear unpublished names (e.g. "*congestus*" and "*membranaceus*") in annotations by Prof. St. John; the species is however not very heterogeneous.

34. Pandanus monotheca Martelli, Bull. Soc. Bot. Ital. n. s. 11: 303. 1904; Webbia 4 (1): 24. 1913; 4 (2): t. 41, f. 18-20. 1914. Stone, Fedn Mus. J. n. s. 23: 33. 1978.

Type: *Ridley* 10821 (CAL? not found), Malaya (Malacca).

Syn. *Fisquetia ornata* Gaudich., Bot. Voy. Bonite Atl. t. 5, f. 1, 8-9. 1843, *nom. illegit.* - *P. ornatus* [Gaudich.] Kurz, J. Asiat. Soc. Bengal 38: 147. 1869, *nom. illegit.* - NOT *P. ornatus* Hort. ex Bull, J. Roy. Hort. Soc. n. s. 1, misc. ser. 1. 1866; *P. ornatus* Lem. Ill. Hort. 19: 143, t. 19, 97. 1872. - *P. recurvatus* St. John, Pacif. Sci. 19: 227, f. 220-221. 1965.

Distribution: Malay Peninsula and southern Thailand, Sumatra, Borneo.

Collections: SARAWAK: Bawan, Balingian, Ulu Begrik, Oct 1963, *Chai* S19464 (SAR).

Notes: This specimen is cited here with much doubt; it has the narrow, linear abaxially glaucous leaves, cylindric glaucous cephalia (ripening to a cream color) and the long, pendulous peduncle of this species, but the material may pertain to the following species. There is an unpublished name on *Chai* S19464 ("*cylindratus*"). Further detailed exploration and comparison with the Malayan specimens (i.e. of true *P. monotheca*) may result in the exclusion of this species from Borneo, but whether this collection belongs to *P. rusticus* or not is also not clear.

35. Pandanus rusticus Stone, Fedn Mus. J. n. s. for 1969, 14: 131, f. 2. 1972; Malays. J. Sci. 3A: 73. 1975; Fedn Mus J. n. s. 23: 36. 1978.

Type: *Nooteboom & Chai* 2108 (L), Sarawak (Kelabit Highlands).

Distribution: Endemic.

Collections: SABAH: Mt Kinabalu, May 1974, *Aban Gibot* SAN 79596 (SAN). Bukit Burong, Liwagu Cave trail junction, Jan 1976, *Stevens* 592 (A). Tenom, Kg. Kapulu, May 1972, *Saikeh* SAN 72071 (SAN); Aug 1972, *Saikeh* SAN 73514 (SAN). Katubu-Kapulu trail, *Cockburn & Saikeh* SAN 70023 (SAN). Sandakan, Karamuak, G. Tavai, Sept 1963, *Meijer* SAN 39338 (SAN). Boutu, mile 82, July 1967, *Meijer* SAN 59312 (SAN). - SARAWAK: Bintulu, Merurong plateau, *Brunig* S17490 (SAR). Siul, Oct 1907, *Ming s. n.* (SAR). Kapit, headwaters of Balleh R., Bukit Tibang, 5000 ft alt., July 1969, *Anderson & Ilias Paie* S28669 (SAR). Tubau, Dataran Tinggi Merurong, Bukit Sekelap, 1250 m, Oct 1984, *Othman, Yii & al.* S48931 (SAR).

Notes: see notes above under no. 34. On Bukit Tangkunan, 9 miles E of Telupid, Sabah, staminate plants probably of this species were observed in March 1977 (by Stone, Anderson, and Albert). In the Stevens collection, the infructescence surprisingly bears 5 cephalia.

36. Pandanus beccatus Stone, *sp. nov.* (Fig. 8)

Frutex erectus stipite usque ad 4.5 m alto, gracile, ad 3.3 cm diametro; foliis linear-attenuatis, 75-110 cm longis, 2.6-3 cm latis, arcuatis, congestibus. Inflorescentia terminalis, pedunculo usque ad 30 cm longo, cephalio solitario oblongo 9.5 cm longo, 5.5 cm lato, ferenti. Drupe anguste subfusiformi-oblanceoloidea, 17-20 mm longa, 3-4 mm lata, pileo laeve, acuto, angulato, stylo breve 1-2 mm longo, stigmate 1-2 mm longo; endocarpio 10 mm longo. Typus: *Ansow, Kulip & Tan* SNP 1054, Sabah, Mt Kinabalu, Marai Parai ridge (holotypus SNP).

An erect shrub to 4.5 m tall, with slender trunks 1.5-3.3 cm in diameter. Leaves arching, linear and gradually attenuate, subflagellate at apex, glossy on the sheathing base, the lamina finely striate-veined, proximally somewhat obscurely tessellate on both surfaces, distally finely veined, about 75-110 cm long, 2.6-3 cm wide, with about 60-64 longitudinal veins per leaf, these 0.4-0.45 mm apart, with cross-veins about 0.7-1.5 mm apart. Leaf margin from about 6 cm above the base prickly with small spreading prickles to 1 mm long and 2-7 mm apart; near the middle, the prickles antrorse, 0.5-0.7 mm long, 4-15 mm apart; near the apex, the prickles about 0.3 mm long and 1 mm apart. Midrib beneath unarmed at extreme base, but from the middle of the leaf and beyond set with prickles similar in size and shape to those of the adjacent margins. Upper secondary pleats distally (along terminal 20 cm) with antrorse prickles like those on the adjacent margins but more irregularly spaced and sometimes with a few accessory prickles on nearby veins. Inflorescence terminal, pedunculate, the peduncle about 30 cm long, bearing a solitary oblong cephalium about 9.5 X 5.5 cm, its receptacle about 6.5 X 2.7 cm, bearing numerous drupes, these slenderly subfusiform-oblanceoloid, 17-20 mm long, 3-4 mm wide, the pileus smooth, acute, almost parallel-sided, angular, narrowed abruptly to a short, inclined stylar beak 1-2 mm long, with slender grooved stigma 1-2 mm long. Endocarp about 10 mm long, oblanceoloid, with thin pale walls 0.2 mm thick; upper chamber 2 mm long; seed about 8 mm long. Upper mesocarp sparsely fibrous; lower mesocarp short, sparsely fibrous.

Distribution: Endemic.

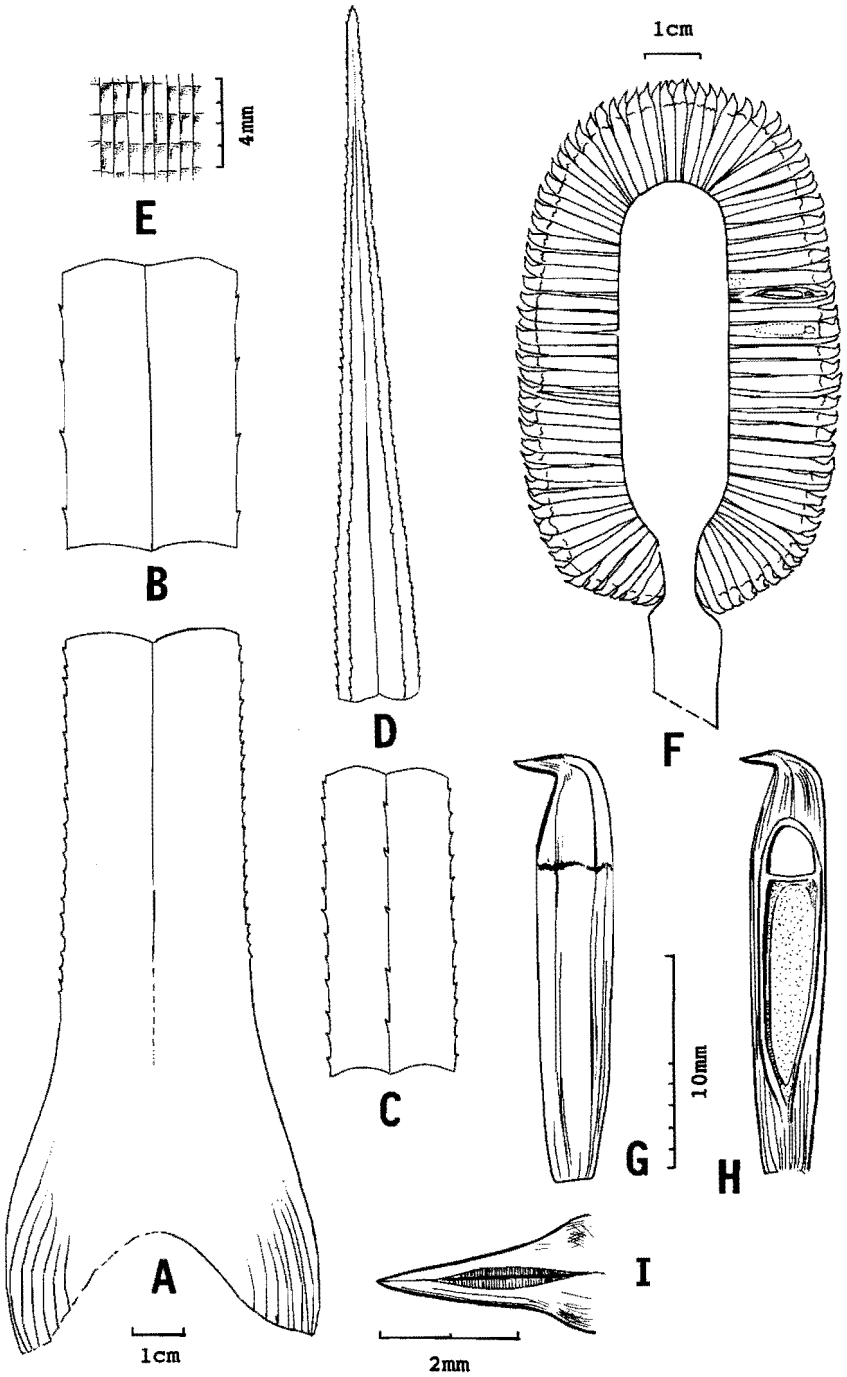


Fig. 8. *Pandanus beccatus* (Sect. *Acrostigma*, Subsect. *Ornati*). **A**, Leaf base. **B**, Middle portion of leaf. **C**, Distal portion of leaf showing prickly midrib on abaxial side. **D**, Terminal portion of leaf showing antrorse prickles on upper secondary pleats. **E**, Vein tessellation near distal part of leaf. **F**, Longitudinal section through cephalium. **G**, Drupe. **H**, Longitudinal section through drupe. **I**, Grooved stigma of drupe. All from SNP 1054.

Collections: SABAH: Mt Kinabalu, Marai Parai ridge, 17 Jan 1983, *Ansow, Kulip & Tan* SNP 1054 (Sabah National Park Herbarium). Same locality 24 Mar 1933, *Clemens* 32348 (G). Mt Kinabalu, Dallas, 8000 ft. alt., 26 Sept 1932, *Clemens* 26609 (BO, G - excl. leaf). Trail to Liwagu (Liwoga) Cave, 6 May 1974, *Aban Gibot* SAN 79596 (SAN).

Notes: This plant had previously been tentatively discriminated (under the name "*missorum*") by Prof. St. John, but the Clemens' collections were confusing; as it turns out, *Clemens* 26609 at least as regards some of the duplicates, is a mixture, with fruit of this species and leaves of another. Material of two, possibly three species, appears to have been mingled and misassociated during either the collection process or in distributing the duplicates. (Problems in the recognition of *P. tunicatus* and *P. kinabaluensis* resulted). The recent collection by the Sabah National Parks staff members has permitted the association of fruit and leaf material; fruits of SNP 1054 clearly represent the same species as the fruit collected by the Clemenses as their no 26609. (The clear presence of apical ventral pleat prickles in leaves of this species will separate leaves of *P. kinabaluensis* which lack such prickles, but leaves of *P. tunicatus* can only be distinguished by their slightly greater dimensions and their longer filiform tips; but drupes of the latter have slightly longer styles. The difference is not very pronounced and further comparative study in the field is necessary.) Another collection from Kinabalu, *Chew & Corner* RSNB 1569, which bears an unpublished name ("*arboricola*") and which at one time I believed to be the same as "*missorum*" is not the same, and may be an unusual form of *P. pectinatus*.

(1d) Subsect. Herbacei Stone, 1974
One species in Borneo.

37. Pandanus brevistylis St. John ex Stone, Fedn Mus. J. n. s. 23: 39. 1978.

Type: *J. Singh* SAN 24235 (SAN), Sabah (Beaufort, Lumat).

Distribution: Endemic.

Collections: KALIMANTAN: W. Kutei, Belajan River, Mt Palimasan, Sept 1956, *Kostermans* 13042, 13134 (L). - SABAH: Beaufort, Lumat, July 1971, *Saikeh* SAN 73217 (SAN); same locale, July 1965, *Lajangah* SAN 44450 (SAN). Klias, July 1976, *Talib Bidin* SAN 80716 (SAN).

Notes: Small shrubs, with somewhat coriaceous leaves, glaucous cephalia, and tiny drupes.

(1e) Subsect. Parvi Stone, 1974
One species in Borneo.

38. Pandanus parvus Ridley, J. Str. Br. Roy. Asiat. Soc. 33: 71. 1900. Stone, Fedn Mus. J. n. s. 23: 39-42. 1978.

Type: *Ridley* 8928 (SING), Singapore (Pulau Ubin, Kranji).

Syn. *P. flagellifer* Warb., Pflanzenr. 3(IV.9):80. 1900. - *P. mollifoliaceus* St. John. Pacif. Sci. 17: 8, f. 153. 1963.

Distribution: Malay Peninsula; Singapore; and Borneo.

Collections: SABAH: Tambunan, Crocker Range, 5000 ft alt., Oct 1969, *Chow & Aban Gibot* SAN 65044 (SAN).

Notes: This collection differs from the Malayan and Singapore material in its more opulent foliage, slightly greater dimensions, particularly of the cephalium; but seems not to be separable taxonomically, though further collections are to be desired in interpreting its status. The broad, though rather small leaves, with abruptly caudate-acuminate tips, the blades narrowed toward the base, and somewhat glaucous beneath, and the lack of apical ventral pleat prickles, are distinctive features of this species.

(1f) Subsect. Rostellati Stone, 1974
One species in Borneo (the remainder, in this subsection, in Papua New Guinea).

39. Pandanus tunicatus Stone, Malays. J. Sci. 3A: 70, f. 1. 1975. Bot. Jahrb. Syst. 94: 524. 1974, *nomen*; Fedn Mus. J. n. s. 23: 47. 1978.

Type: *Stone & al.* 11437 (KLU), Sabah (Kinabalu).

Distribution: Endemic.

Collections: SABAH: Mt Kinabalu, 5121 ft alt., May 1973, *Stone & al.* 11437 (KLU, holotype; isotypes BISH, K, L, SAN). Marai Parai, 5000 ft., Oct 1985, *Phillipps & Argent* SNP 2718 (SNP).

Notes: The SNP collection is noteworthy in having an infructescence of three heads; but in other characters it seems to match the type material. The local Dusun name is "baranggi".

The position of this species in Subsect. *Rostellati* is suspect and anomalous, given that all other members (including the type of the subsection) are species of New Guinea; a new position for this species is to be sought.

(1g) Subsect. Caespitosae Stone, 1974
One species in Borneo.

40. Pandanus pachyphyllus Merrill, J. Str. Br. Roy. Asiat. Soc. 85: 154. 1922. Stone, Reinwardtia 7: 412. 1968; Malay. Nat. J. 21: 11. 1968; Bot. Jahrb. Syst. 94: 526. 1974; Fedn Mus. J. n. s. 23: 50, Pl. 3C. 1978. (Fig. 9)

Type: *Ramos* 1541 (US), Sabah (Sandakan).

Syn. *P. apicalis* St. John, Pacif. Sci. 22: 523, f. 276. 1968. Stone, Fedn Mus. J. n. s. 23: 51. 1978.

Distribution: Borneo, endemic.

Collections: KALIMANTAN: Bangarmassing, 1857-58, *Motley* 1247 (K. Mus., fruit head; holotype of *P. apicalis*). SABAH: Sandakan, Kebun China, Mar 1967, *Stone, Meijer & Gaudet* 6699 (KLU). Sepilok, Mar 1967, *Stone & Meijer* 6709 (KLU). - SARAWAK: Sabal F. R., Siminjam, July 1959, *Brunig* S9975 (SAR).

Notes: as previously discussed this species was at first assigned to Sect. *Fusiforma*, which includes some vegetatively similar species. The relationship of this species to *P. celebicus* seems evident enough. The synonym (*P. apicalis*) was previously accepted (in 1978) but it seems to me now inadequately distinguished. The confusion in the protolog of this species as regards the staminate material cited by St. John has been discussed and clarified in the "Revisio Pandanacearum" paper (1978).

(1h) Subsect. Papilionati Stone, 1968
A single, variable species.

41. Pandanus pectinatus Martelli, Bull. Soc. Bot. Ital. n. s. 11: 304. 1904; Webbia 4 (1): 27. 1913; 4 (2): t. 31, f. 8-10. 1914. Merrill, Enum. 36. 1921. Masamune, Enum. 6. 1942. Stone, Fedn Mus. J. n. s. 23: 56, Pl. 4C. 1978.

Type: *Beccari s. n.* (FI), Sarawak.

Syn. *P. papilio* Stone, Malay. Sci. 3: 24, f. 1. 1967; Bot. Jahrb. Syst. 94: 525. 1974.

Distribution: Borneo, Sumatra.

Collections: KALIMANTAN: W. Kutei, Belajan River, Mt Palimasan near Tabang, Sept 1956, *Kostermans* 12966, 13081 (L). - SABAH: Mt Kinabalu, Aug 1931, *Clemens* 26210 (K); Tenompok, Mar 1932, 28832 (L); Mar 1932, 28801 (BO); Penibukan, Jan 1933, 30716 (UC); Panataran River, 32549, 31259 (UC); 40600 (G-Del); Gurulau Spur, Nov 1933, 50406 (K). Kinabalu, Dahobong River, Mar 1933, *Carr* SF 26384 (= A 5061) (SAN, SING). Kinabalu,

Fig. 9. *Pandanus pachyphyllus* (Sect. *Acrostigma*). **A** (left), entire fruiting plant, taken from understorey in forest but showing the "stemless" appearance. **B** (right), immature fruit and leaf tips. All from *Stone* 6732 (Sabah, Sepilok).

Mesilau River, Feb 1964, *Chew & Corner* RSNB 4206, 4403 (K); Pinosuk Plateau, 1961, *Chew, Corner & Stainton* RSNB 1780 (K). Kundasang, Aug 1964, *Pereira* SAN 47214 (SAN). Cascade trail, Aug 1980, *Peter William* SNP 0706 (SNP). Kinabalu N. P., Apr 1974, *Cockburn* SAN 71900 (SAN). Same locale, May 1973, *Stone, Waagen & Littke* 11408 (KLU), *Stone & Littke* 11444 (KLU). Ranau, Bukit Kulong, Aug 1960, *Meijer* SAN 23451 (SAN). Poring, July 1961, *Meijer* SAN 34646 (SAN). Lamag, G. Lotong, May 1876, *Saikeh* SAN 93209 (SAN).

Notes: many of the specimens cited above bear unpublished manuscript names in annotations by Prof. St. John; none of these are likely to be published, and I do not think there is any sound reason to discriminate taxa among these collections, the differences being attributed to normal variation, artefacts of processing, differences in state of development of fruits, etc. The names encountered were *auriculatus, crenatus,*

deltoideus, dentatus, galbus, septentrionalis, but there may be others on other duplicates.

This species is one of the few epiphytes in the genus, along with *P. epiphyticus, P. pumilus* and the species belonging to the next subsection including *P. alticola* and *P. inquilinus*. It is probably facultatively able to grow on boulders (or exposed limestone) when other conditions (shade, humidity, temperature) are suitable. In the middle altitude forests on Mt Kinabalu, it is actually fairly common, but may be perched on the branches of trees far above the ground and thus easily overlooked. Several collections have been made from fallen trees or branches.

(1i) Subsect. Alticolae Stone, 1974

Key to Bornean species of Subsection *Alticolae*

1a. Cephalia (fruit heads) solitary, ellipsoid; drupes 6-8 mm long; style 1-4 mm long.

2a. Cephalia ellipsoid or short-oblong.

3a. Cephalium ellipsoid, about 4 X 3 cm; drupes 7-8 mm long; style about 1 mm long. Leaves about 140 cm long, 1.3-1.6 mm wide ..... *P. alticola*

3b. Cephalium short-oblong, to 7 X 3 cm; drupes about 12 mm long; style 3.5-4 mm long. Leaves about 100-200 cm long, 1.3-1.7 cm wide ..... *P. inquilinus*

2b. Cephalium subglobose, less than 2 cm long; drupes 6-7 mm long; style 3-4 mm long. Leaves 32 cm long, 0.8-1.1 cm wide ..... *P. lepatophilus*

1b. Cephalia (fruit heads) spicately disposed, usually 5-9 (rarely 3-4) together; drupes 5-13 mm long; styles 1-7 mm long.

4a. Cephalia usually 3 together, ovoid-oblong; drupes 9-10 mm long; styles elongate, 5-7 mm long; leaves relatively large, up to 300 cm long and 2.4 cm wide ..... *P. thomissophyllus*

4b. Cephalia usually 5-9 together, ovoid to cylindric; drupes 5-13 mm long; styles shorter, usually 1-3 mm long.

5a. Cephalia usually 4-6 together; leaves less than 3 cm wide.

6a. Cephalia cylindric; leaves to 2.9 cm wide ..... *P. scandens*

6b. Cephalia ovoid or ovoid-oblong; leaves 1-2 cm long.

7a. Drupes about 5-6 mm long; style 1.5-2 mm long ..... *P. calcinactus*

7b. Drupes 13 mm long; styles 2-3 mm long .... *P. oresbios*

5b. Cephalia 7-9 together, oblong; leaves 3-4.4 cm wide. Drupes 7-8 mm long; style 2 mm long ..... *P. rupestris*

42. Pandanus alticola Holttum & St. John, Pacif. Sci. 16: 218, f. 98-99. 1962. Stone, Malay. Nat. J. 21: 136. 1968; Bot. Jahrb. Syst. 94: 525. 1974; Fedn Mus. J. n. s. 23: 57, Pl. 4B. 1978.

Type: *Corner s. n.* in Feb 1935 (SING), Malay Peninsula (Johore).

Distribution: Malaya and Borneo.

Collections: SARAWAK: Bau on limestone hill, *Brunig* S10425 (SAR). N. Pengiran, Mujong, Baleh, epiphyte, Mar 1964, *Ashton* S12104 (SAR).

Notes: as the collections show, this species is facultatively epiphytic, occurring either on trees or on limestone. The same alternative substrates probably exist for the other species of this subsection.

43. Pandanus calcinactus St. John ex Stone, Fedn Mus. J. n. s. 23: 57. 1978.

Type: *Anderson* 4720 (SAR), Sarawak (Baram, G. Api).

Distribution: Endemic.

Collections: SARAWAK: Baram, Gunung Api 3000-4000 ft alt., on limestone, July 1961, *Anderson* 4720 (SAR).

Notes: probably closer to *P. oresbios* than to any other species.

44. Pandanus inquilinus Stone, Fedn Mus. J. n. s. 23: 60. Pl. 6. 1978.

Type: *Stone, Anderson & Lamb* 12890 (KLU), Sabah (Ulu Dusun).

Distribution: Endemic.

Collections: SABAH: Sandakan, Ulu Dusun, low alt., epiphytic, Mar 1977, *Stone, Anderson & Lamb* 12890 (KLU).

45. Pandanus lepatophilus Stone, in Jermy & Kavanagh, Bot. J. Linn. Soc. 85 (1): 31-34, f. 6. 1982.

Type: *Argent & Jermy* 973 (E), Sarawak (G. Api).

Distribution: Endemic.

Collections: SARAWAK: Mulu National Park, Gunung Api, limestone ridge, 1500 m, Apr 1978, *Argent & Jermy* 973 (E).

Notes: a very distinctive small sprawling and branching shrub.

46. Pandanus oresbios Stone, Fedn Mus. J. n. s. 23: 58. 1978.

Type: *Endert* 3896 (L), Kalimantan (near Mt Kemul).

Distribution: Endemic.

Collections: KALIMANTAN: West Kutei, near Mt Kemul, Oct 1925, *Endert* 3896 (L).

Notes: Endert's label data does not specifically indicate the substrate, but the placement of the species in this subsection is certain, and by implication the epiphytic or lithophytic habitat is very probable.

47. Pandanus rupestris Stone, Fedn Mus. J. n. s. for 1969, 14: 129, f. 1. 1972; *ibid.* 23: 58. 1978.

Type: *Ilias Paie* S25278 (SAR), Sarawak.

Distribution: Endemic.

Collections: SARAWAK: Kapit, Bukit Pantu, 2400 ft., epiphytic, Aug 1967, *Ilias Paie* S25278 (SAR). Baram, Kelabit Highlands 3500 ft. Nov 1974, *Chai* S35317 (SAR).

Notes: this species resembles *P. scandens* but has slightly wider, thicker, firmer leaves with green, not glaucous, leaf undersurfaces.

48. Pandanus scandens St. John ex Stone, Fedn. Mus. J. n. s. 23: 59. 1978.

Type: *Brunig* S8797 (SAR), Sarawak (Bintulu).

Distribution: Endemic.

Collections: SARAWAK: Bintulu, Merurong plateau, 3950 ft., May 1960, *Brunig* S8797

(SAR). Baram, Kelabit Highlands, Bario-Pau Ukat, 1000 m, Mar 1970, *Nooteboom & Chai* 1788 (L).

Notes: the label data states "climbing" but the plant is not a true liana.

49. Pandanus thomissophyllus Stone, Fedn Mus. J. n. s. for 1969, 14: 133, f. 3. 1972; *ibid.* 23: 59. 1978.

Type: *Anderson & Chai* S29924 (KLU), Sarawak.

Distribution: Endemic.

Collections: SARAWAK: Bau, Bukit Jebong, limestone ridge, 1100 ft., July 1970, *Anderson & Chai* S29924 (SAR). Bau, near Tai Tong, limestone, May 1973, *Ilias Paie* S32994 (SAR). Padawan, Bukit Manok, 1100 ft., on limestone, Mar 1969, *Erwin & Paul* S27412 (SAR). Bidi Cave, Oct 1929, *Clemens* 20631 (FI).

Notes: this species is very closely related to *P. alticola.*

(1j) Subsect. Pumili Stone, 1974
One species.

50. Pandanus pumilus St. John, Pacif. Sci. 19: 96, f. 206. 1965. Stone, Bot. Jahrb. 94: 525. 1974; Fedn Mus. J. n. s. 23: 60. 1978.

Type: *Purseglove* 4799 (SAR), Sarawak (Gunung Pueh).

Distribution: Sabah and Sarawak, endemic.

Collections: SABAH: Lahad Datu, Danum Valley, Sg. Segama below K. Beatrice, 900 ft., Aug 1976, *Cockburn* SAN 84911 (SAN). Ulu Segama, July 1970, *Talip* SAN 70985 (SAN). Sandakan-Telupid road mile 81, Sept 1969, *Talip & Termiji* SAN 62429 (SAN). Beluran, Sg. Meliau, June 1976, *Cockburn* SAN 82495 (SAN). - SARAWAK: Baram, Gunung Api, limestone hill, July 1961, *Anderson* 4736 (SAR). Nanga Pelagos, July 1938, *Daud & Tachun* SF 35645 (SAR). No locality, n. d., *Native coll.* 1785 (FI).

(2) Sect. Pseudacrostigma Stone, 1970
One species in Borneo (a second in West Irian).

51. Pandanus platystigma Martelli, Bull. Soc. Ital. n. s. 11: 304. 300; Webbia 4 (1): 27. 1913; 4 (2): t. 24, f. 12-15. 1914. Merrill, Enum. 36. 1921. Masamune, Enum. 8. 1942.

Stone, Fedn Mus. J. n. s. for 1968, 13: 146, f. 3, Pl. 7. 1970; Bot. Jahrb. Syst. 94: 526. 1974; Fedn Mus. J. n. s. 23: 65, Pl. 5A. 1978.

Type: *Beccari* PB 44 (FI), Sarawak (Kuching).

Distribution: Endemic.

Collections: SARAWAK: Near Kuching, *Beccari* PB 2050 (FI, syntype, on same sheet as the lectotype, PB 44). Kuching, Semenggoh Forest, Aug 1967, *Anderson* S27667 (SAR). Same locality, Apr 1967, *Othman Ismawi & Banyeng* S29456 (SAR). Same locality, Apr 1967, *Stone & Anderson* 6780 (KLU). Sabah Forest Reserve, June 1963, *Brunig* S1793 (SAR).

Notes: an unpublished name ("*exflexus*") of St. John is found on some of the above specimens (see synonymy in Stone 1974).

(3) Sect. Epiphytica Martelli, 1913 (as "*Epiphytici*"); 1904 (as "*Plantae Epiphyticae*").
A single species.

52. Pandanus epiphyticus Martelli, Bull. Soc. Bot. Ital. n. s. 11: 304. 1904; Webbia 4 (1): 13. 1913; 4 (2): t. 28, f. 11-19. 1914. Stone, Fedn Mus. J. n. s. for 1968, 13: 143, f. 2. 1970; 23: 65, Pl. 5B-D. 1978. (Fig. 10)

Type: *Beccari* in June 1866 (FI), Sarawak (Mt. Mattang).

Syn. *P. trigonus* St. John, Pacif. Sci. 19: 98, f. 207. 1965.

Distribution: Borneo, southern Malay Peninsula. In Brunei, seen along the major rivers Temburong, Tutong and Belait (K.M. Wong, pers. comm.)

Collections: KALIMANTAN: Nunukan, Dec 1953, *Kostermans* 9115 (BO). - SABAH: Sandakan, Sepilok, Mar 1967, *Stone* 6711 (KLU). Tawao, 1922, *Elmer* 21022 (UC, etc.). Lamag, Batu Puteh, Sg. Pin, Feb 1978, *Tiong* SAN 87953 (SAN). - SARAWAK: Mt Mattang near Kuching, June 1866, *Beccari* PB (FI, holotype); PB 1901, 2708, 3991 (FI). Pulau Salak, Jan 1959, *Corner & Brunig* S10442 (SAR). Bako National Park, Mar 1967, *Stone* 6816 (KLU). Bau, limestone, *Ridley s. n.* (SING, holotype of *P. trigonus*).

Notes: this species has been observed in the Danum Valley, Sabah (Stone). It used to be fairly frequent in Johore (Malay Peninsula) before the severe deforestation. In Bako (Sarawak) it is common on the sandstone boulders, so it is facultatively epiphytic. In K. K. Tiong's specimen (SAN 87953) the label data indicates "on limestone cliff". The massive spikes of long cylindric heads, the very tiny drupes, and the very small but roundish stigmas are striking features of the species.

Fig. 10. *Pandanus epiphyticus* (Sect. *Epiphytica*). Fruiting plant on coastal rocks at Bako, Sarawak.

(4) Section uncertain (*sp. incertae sedis*).

The following species is known only from vegetative material, the fruit having been lost in the herbarium; the collector's notes, therefore, are the only data on the fruit. However the leaf material leaves little doubt that the species belongs to subg. *Acrostigma*, although it cannot confidently be assigned to a section. However, it certainly does not pertain to Sect. *Epiphytica* nor to any of these subsections of Sect. *Acrostigma*: *Scabridi, Ornati, Parvi, Papilionati, Alticolae, Pumili.* It is unlikely to belong to Sect. *Pseudacrostigma*. Therefore it probably will be found to be a member of one of the following subsections: *Acrostigma, Herbacei, Caespitosae*, or possibly to an unrecognized subsection.

53. **Pandanus pugnax** Stone, Fedn Mus. J. n. s. 23: 61. 1978.

Type: *Meijer* SAN 23289 (SAN), Sabah (Bukit Tingka).

Distribution: Endemic.

Collections: SABAH: Sandakan, Kinabatangan, Bukit Tingka, 2000 ft alt., ultrabasic soil, 24 Nov 1960, *Meijer* SAN 23289 (SAN, holotype). Bukit Gambaran, near Telupid, 2000 ft alt., ultrabasic soil, 8 May 1965, *Meijer* SAN 51521 (SAN).

Notes: A small rosette shrub with a short stem to 30 cm long, to 17 mm thick, with a few slender aerial roots to 8 mm thick; leaves "bluish green" slender, linear-attenuate, about 115 cm long, 10-12 mm wide, at apex acute and somewhat prolonged; margins, near base, with antrorse prickles 2-2.5 mm long, 3-10 mm apart; near middle, the prickles more appressed, 1-1.5 mm long, 5-12 mm apart; near apex, the prickles scarcely 0.5 mm long, 1-2.5 mm apart. Midrib at base with reflexed prickles 2.5-5 mm long, 4-18 mm apart; from the middle and beyond, the prickles lacking; toward apex, the prickles antrorse, 0.5-1 mm long, 2-25 mm apart. Apical ventral pleats prickly with antrorse prickles scarcely 0.5 mm long, 5-15 mm apart but irregularly spaced. Sheathing leaf base with narrow thinner margins 8-10 cm long, 2 mm wide, gradually tapered toward apex, pale brown. Inflorescence terminal, among the leaves, the peduncle exceedingly long, slender, smooth, to 57 cm long, 3.2 mm thick; fruit head "solitary, red." (Other data lacking).

This species needs to be recollected as the only fruit material has been lost.

Species dubia

Pandanus micracanthus Warburg, Pflanzenr. 3 (IV.9): 83, f. 21 U-V. 1900. Martelli, Webbia 4 (1): 23. 1913.

Type: not stated (from Borneo).

Syn. "*P. micranthus*" Merrill (misprint for *micracanthus*), Enum. 26. 1921.

No collections seen.

Notes: Warburg does not give the collector's name, and does not indicate a definite locality. Moreover the description is extremely brief. Although assigned to *Acrostigma* (in the text), the illustration is placed among others all representing species of sect. *Rykia*, and perhaps Warburg was actually in doubt about the correct placement. The illustration (of immature drupes) suggests either a species of *Acrostigma* or, possibly, of *Solmsia*. The pilei of the drupes are shown as having short spinules; this may be consistent with the scabridity (of scales) found in the species of *Acrostigma* subsect. *Scabridi*. Under the circumstances, the identity of this species is probably not resolvable, and the name is consigned to the limbo of "species dubia".

Discussion:
A Provisional Field Key to Bornean Pandanus

Because flowering and fruiting specimens of *Pandanus* are in some cases scarce, a field key based as far as possible on vegetative and some ecological characters is desirable. At present, in the absence of staminate specimens of many of the Bornean species, such a key would also be necessary for the at least tentative identification of staminate plants. Such a field key is attempted here, but it cannot be used successfully to identify all species

10a. Tall shrubs (2-4 m) ..... *P. affinis, P. sarawakensis*

10b. Low shrubs with short or decumbent stems.

11a. Habitat exclusively on streambanks of humic-acid (tea-colored) waters ..... *P. discostigma, P. dorystigma, P. matthewsii*

11b. Habitat otherwise; usually along stream banks, rivermouth ..... *P. fusinus*

9b. Low or erect shrubs usually of rainforest understorey.

12a. Taller erect shrubs (2-6 m).

13a. Proproots rusty brown tuberculate ..... *P. rusticus*

13b. Proproots not so.

14a. Large, almost treelike shrubs, usually over 3 m tall, with rather stout trunks often more than 7-8 cm thick .... *P. gibbsianus, P. sylvaticus*

14b. Medium or small shrubs mostly less than 2.5 m tall and more slender trunks.

15a. Leaves small but relatively broad, abruptly caudate, narrowed to the base; apical ventral pleats usually unarmed ..... *P. parvus*

15b. Leaves otherwise, mostly linear-attenuate .... *P. ashtonii, P. beccatus, P. brevistylis, P. brunigii, P. korthalsii, P. monotheca, P. tunicatus, P. bracteosus*

12b. Short-stemmed, almost cespitose shrub (on ultrabasic soil) ..... *P. pugnax*

3b. Fruit heads composed of phalanges with several seeds.

16a. Fruit heads usually several on a spike; trunks erect, stout .... *P. basilocularis*

16b. Fruit head solitary; cespitose plants ..... *P. occultus*

2b. Leaf apex with unarmed ventral pleats.

17a. Leaf apex abruptly acute, boat-shaped; low shrubs; riverbanks, estuaries, mangrove ..... *P. rostratus*

17b. Leaf apex otherwise.

18a. Massive epiphytes (or on sandstone boulders); leaf base with stiff auricles .. .. *P. epiphyticus*

18b. Terrestrial or aquatic plants; leaf base without auricles.

19a. Leaves very large, elongate, often over 3 m long and 8-10 cm wide, dark green with green to greenish brown or slightly purplish prickles.

20a. Short trunked plants with short, sometimes rather inconspicuous proproots; leaves firm to rigid; leaf apex rather gradually acuminate; usually plants of shady moist forest ..... *P. "paulii"*

20b. Erect trunked plants, trunk tall, stout, usually supported on long stout proproots; leaves slightly spongy-leathery; leaf apex rather abruptly acuminate-caudate; plants of rocky coastlines or sandy beaches, usually exposed ..... *P. dubius*

19b. Leaves smaller or much smaller.

21a. Leaf margin prickles white or almost so, undersurface (and sometimes upper surface also) more or less glaucous; proproots large, abundant; plants of coastal areas ..... *P. odoratissimus*

21b. Leaf margin prickles not white; leaf surfaces glaucous or not; proproots usually slender, sometimes little developed or weak and inconspicuous; habitat usually in forest.

22a. Leaf undersurface especially near base very white-glaucous .... *P. leuconotus*

22b. Leaf undersurface green or glaucous-greenish-gray.

23a. Leaf apex abruptly acuminate-caudate ..... *P. dictyotus*

23b. Leaf apex acuminate or attenuate.

24a. Leaf base distinctly purplish; venation sometimes rather evidently tessellate.

25a. Virtually aquatic shrubs or trees, or in forested swamps or along streambanks; stems and proproots often prickly.

26a. Tall shrubs, often almost submerged, in lakes, deep swamps, and on river banks where more or less completely exposed ..... *P. helicopus*

26b. Slender erect shrubs, usually inswamps or along streambanks, often in forest, sometimes exposed .... *P. motleyanus* and *P. sigmoideus*

25b. Terrestrial shrubs, in inland, forest habitats (including midmontane forest) ..... *P. aristatus, P. kinabaluensis*

24b. Leaf base green or greenish to brownish; venation not so manifestly tessellate.

27a. Erect shrubs with well-developed proproots.

28a. Leaves variegated (striped); in cultivation only .... *P. tectorius*

28b. Leaves all green ..... *P. borneensis* and *P. tetrodon*

27b. Low slender shrubs or shrublets with slender proproots ..... *P. brevifolius*

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SANDAKANIA 2 (1993) : 85-89

A new species in *Cymbidium* sect. *Cyperorchis* (*Orchidaceae* : *Epidendroideae* : *Cymbidieae*), newly recorded for Borneo

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Summary. *Cymbidium kinabaluense* is described as a new species, so far known to occur only on Mount Kinabalu in Sabah, Malaysia, in northern Borneo. It belongs to Subgenus *Cyperorchis*, hitherto not recorded for Borneo, and corresponds to section *Cyperorchis*, one of five sections recognized in that subgenus. The differences between *C. kinabaluense* and *C. sigmoideum* J.J. Smith, the most closely related species which occurs in Sumatra and Java, are elucidated.

The monograph on *Cymbidium* by Du Puy & Cribb (1988) recognized three subgenera: Subgen. *Cymbidium* (with four of its six sections represented in Borneo), Subgen. *Jensoa* (with two of its four sections represented in Borneo), and Subgen. *Cyperorchis* (with five sections and not hitherto known to occur in Borneo). The chief character used to distinguish Subgen. *Cyperorchis* from the other two subgenera is the fusion of the base of the lip to the base of the column in the flower. In Subgen. *Cymbidium* and *Jensoa* the lip, though attached to the column base, is not further fused to it for any noticeable length.

The new species described here has this special character of Subgen. *Cyperorchis*; in addition, like the other species of this subgenus, it has narrow, incurved hyaline leaf margins, relatively large flowers, and a pair of pollinia which are cleft behind. Within the subgenus, the new species here corresponds to section *Cyperorchis*, characterised by linear-elliptic leaves with their bases covering a compressed-ovoid pseudobulb; an inflorescence that arises from near the base of the pseudobulb; flowers less than 4 cm across; a lip with two callus ridges that are not apically fused; a glabrous or slightly hairy

column; an anther-cap with a backwards-pointing beak; and clavate to quadrangular pollinia.

Description of the new species

Cymbidium kinabaluense *K.M. Wong & C.L. Chan* **sp. nov.** *C. sigmoideo J.J. Smith affinis sed inflorescentia 78-83 cm longa, 21-23 flores ferenti, pedicelo ovarioque olivaceo, sepalis petalisque luteo-viridibus et brunneo-marroninis maculatis et tinctis, columna breviore, 1.8-2 cm longa, labello basin 1/4 longitudinem columnae connata differt. Typus: C.L. Chan & Jamili Nais, s.n. 20 January 1993, Sabah, Mount Kinabalu, montane forest at 1700 m alt., epiphytic near ground in moss cushion, in shade (holotypus SAN; isotypus SNP).*

A perennial, epiphytic herb. Pseudobulbs to 5 cm long, 2.5 cm across, not inflated, hidden within the leaf bases, with about 12 leaves and 3 cataphylls that persist as fibrous sheaths. Leaves linear or strap-shaped, to 102 cm long, 1.3-1.8 cm broad, acute, articulated 9-10 cm from the pseudobulb.

Inflorescence from the base of the pseudobulb, 78-83 cm long; pendulous, peduncle bearing 9-10 overlapping, acute sheaths to 17 cm long; rhachis 31-38 cm long, with 21-23

Fig. 1. Flower of *Cymbidium kinabaluense*.

flowers; bracts 3-4 mm long, ovate, acute. Flower about 3.5 cm across, pendulous to horizontal; pedicel and ovary dark olive green, with a slight tinge of maroon-brown near the top, slightly glossy; sepals and petals pale yellowish green, matt, adaxially spotted and blotched rather uniformly throughout with maroon-brown; dorsal sepal abaxially with maroon-brown spots and streaks especially in the lower 2/3, glossy at the base; lateral sepals abaxially with maroon-brown spots and streaks almost restricted to the longitudinal half nearer the dorsal sepal; petals abaxially with pale maroon-brown spots; lip darker yellowish green with maroon-brown bars, the mid-lobe with pale maroon-brown stripes, the callus ridges yellowish green; column yellowish green flushed with maroon-brown at the apex, the sides and lower surface of the base with a few maroon-brown spots; anther-cap cream, base rather whitish; pollinia dark yellow; stipes translucent cream.

Pedicel and ovary 2.5-3.2 cm long. Dorsal sepal 3.1-3.3 cm long, 1 cm broad, narrowly lanceolate-obovate, acute, concave, porrect, closely covering the column; lateral sepals similar, falcate, spreading. Petals about 2.9-3 cm long, 0.4-0.5 cm broad, ligulate, acute, curved. Lip short, 3-lobed, basally fused to the base of the column for 4-5 mm, forming a short sac; side-lobes about 6 mm broad, broadly triangular-falcate, erect and closely flanking the column, glabrous, front margin S-shaped and minutely and irregularly dentate; mid-lobe small, 7.5-9 mm long, 2-2.5 mm broad, ligulate, acute, glabrous, strongly recurved; callus ridges 2, subparallel, not apically fused, glabrous. Column 1.8-2 cm long, S-shaped in profile, glabrous, the basal 1/4 fused with the base of the lip; anther-cap and viscidium with a short, backwards-pointing rostellum; pollinia clavate, 1-1.5 mm long, cleft, on a narrow rectangular viscidium without hair-like processes from the lower corners.

The species is illustrated in Figs. 1 and 2.

Comparisons with other species

C. kinabaluense appears to be most related to *C. sigmoideum* J.J. Smith within the section *Cyperorchis*, in having glabrous flowers and a narrowly ligulate mid-lobe to the lip which is strongly recurved. The other three species in this section have hairs at least at the centre of the mid-lobe, at the apices of the callus ridges and at the lower part of the column; and the mid-lobe is either cordate-elliptic (*C. cochleare* Lindl. and *C. whiteae* King & Pantling) or basally broadly ligulate and apically expanded into two broad lobes (*C. elegans* Lindl.).

The significant characters that distinguish *C. kinabaluense* include an inflorescence which is 78-83 cm long (much longer than that in *C. sigmoideum* which is only about 25 cm long); more flowers (21-23, compared to 4-14 in *C. sigmoideum*); larger flowers with the dorsal sepal 3.1-3.3 cm long and petals 2.9-3 cm long (in *C. sigmoideum* the dorsal sepal being 2.7-2.9 cm long and petals 2.4-2.5 cm long); a longer (2.5-3.2 cm) pedicel and ovary (that in *C. sigmoideum* 1.9-2.3 cm long); and a very short column which is 1.8-2 cm long (the shortest for any species in the section, that in *C. sigmoideum* 2.8-2.9 cm long and that in the other species mostly exceeding 3 cm long).

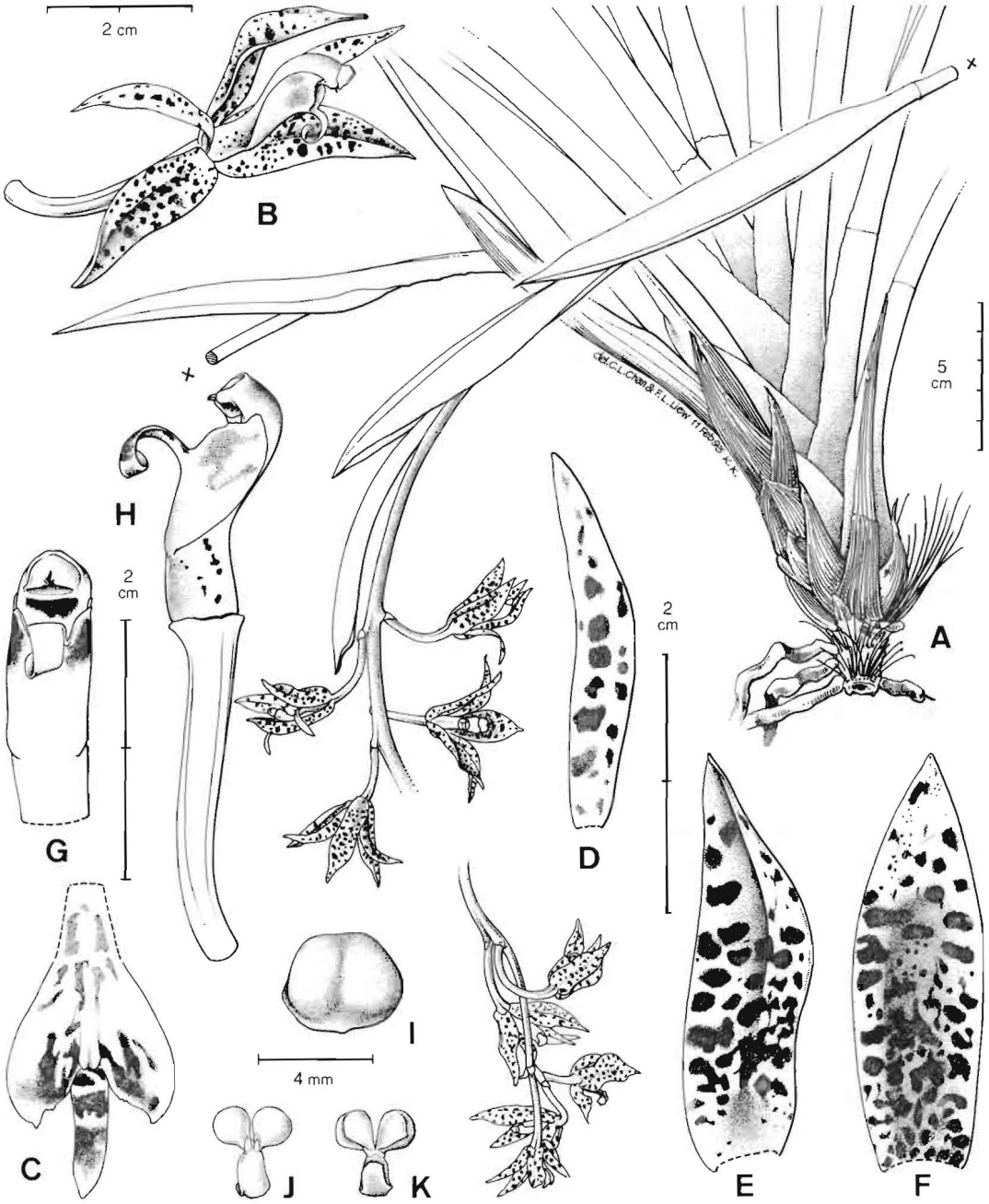

Fig. 2. *Cymbidium kinabaluense*. **A**, Plant. **B**, Flower. **C**, Lip, spread out. **D**, Petal. **E**, Lateral sepal. **F**, Medium sepal. **G**, Column, abaxial view. **H**, Column with lip, ovary and pedicel, profile. **I**, Anther cap. **J**, Pollinia, front view. **K**, Pollinia, back view. All from the holotype, *Chan & Jamili s.n.* 20 Jan. 1993, Mount Kinabalu.

A key to the species thus far known in *Cymbidium* section *Cyperorchis* is as follows:

1a. Flower parts glabrous. Lip mid-lobe narrowly ligulate, only 2-2.5 mm broad.

2a. Inflorescence 78-83 cm long. Dorsal sepal 3.1-3.3 cm long, petals 2.9-3 cm long. Column short, 1.8-2 cm long. Pedicel and ovary 2.5-3.2 cm long .... *C. kinabaluense*

2b. Inflorescence around 25 cm long only. Dorsal sepal shorter, 2.7-2.9 cm long; petals shorter, 2.4-2.5 cm long. Column longer, 2.8-2.9 cm long. Pedicel and ovary shorter, 1.9-2.3 cm long ..... *C. sigmoideum*

1b. Flowers hairy at least at the centre of the mid-lobe, apices of the callus ridges, and near the base of the column. Lip mid-lobe shaped differently and broader.

3a. Mid-lobe with a ligulate base and apically expanded into two broad lobes ..... *C. elegans*

3b. Mid-lobe cordate-elliptic, without a narrowed base.

4a. Base of lip fused to column for about 2 mm. Lip hairy only at the centre of the mid-lobe ..... *C. cochleare*

4b. Base of lip fused to column for about 5 mm. Lip ventrally hairy all over side-lobes and mid-lobe ..... *C. whiteae*

Thus far, *C. elegans* and *C. cochleare* are known over the Nepal - south China region, and *C. whiteae* only in Sikkim (Du Puy & Cribb 1988). *C. sigmoideum* is known only in Sumatra and Java (Du Puy & Cribb 1988; Comber 1990), and *C. kinabaluense* appears restricted to northern Borneo.

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SANDAKANIA 2 (1993) : 91-94

Lindsaea repens (Bory) Thwaites var. *truncata*, a new variety of fern from Sabah, Malaysia

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Summary. *Lindsaea repens* var. *truncata* is a new variety of fern collected near Sapulut in the Interior Residency of Sabah. It is the largest of the varieties known, with fronds to over 100 cm long.

Lindsaea repens var. **truncata** *P.S. Shim* **var. nov.** var. *pectinatae (Bl.) Mett. ex Kuhn affinis sed amplitudine maiore, stipite terete, pinnulis oblongis duplo-numerosis differt. Typus: P.S. Shim SAN 136418, Sabah, Sapulut, road from Nabawan (holotypus SAN; isotypi K, KEP).*

Epiphytic fern. Rhizome long creeping, 2 mm diameter, covered with scales; scales 4 X 0.5 mm, narrowly triangular with uniseriate apex. Fronds 1-2 cm apart; stipe 1-2.5 cm long, terete, with scattered short scales; rachis to 100 cm long, quadrangular in section, angles pale, glabrous; lamina simply pinnate, linear, 7 cm wide, gradually narrowed at the base and to an acuminate apex. Pinnules to 100 pairs, the middle ones largest, 4 cm long and 1.4 cm wide, glabrous, chartaceous, sessile, oblong to parallelogram-shaped, lower edge ascending and straight, outer edge truncate, crenate, the incisions 0.5-1 mm deep, apices of lobes rounded, upper edge either straight or decurved halfway to 2/3 way towards the apex, crenate, inner edge truncate, overlapping the rachis; apical pinnules gradually reduced, triangular to elongate-triangular, lower edge straight to convex, outer edge absent or rounded to meet the upper edge, crenate, upper edge crenate, converging towards lower edge, inner edge touching and parallel to the rachis; basal pinnules gradually reduced, elongate-triangular, deflexed. Veins immersed, branched 1-3 times, with 1 or 2 running to each lobe and ending 0.5 mm from the edge. Sori mainly bi-, some uni-nerval, one per lobe. Indusium pale, semicircular, subentire to reniform or oblong, 0.2-0.3 mm wide, up to 0.8 mm long, base concave to convex and removed from the margin by 2 to 3 times its width, reflexed and concealed at maturity; sporangia sometimes merging with adjacent ones. (Fig. 1)

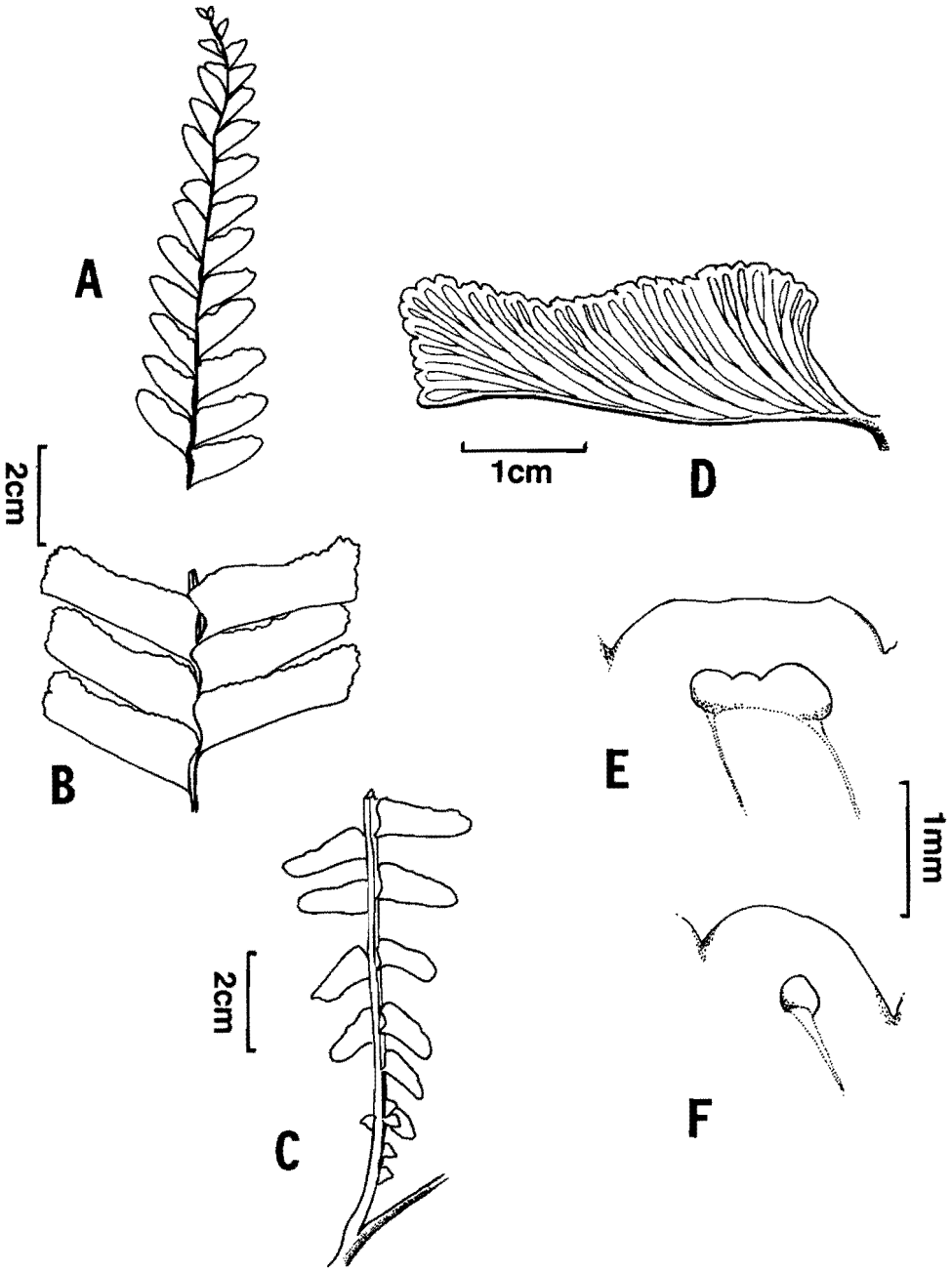

Fig. 1. *Lindsaea repens* var. *truncata*. **A**, Apex of frond. **B**, Middle pinnules. **C**, Basal pinnules. **D**, Middle pinnule showing venation. **E**, Bi-nerval sorus showing indusium. **F**, Uninerval sorus showing indusium. All from SAN 136418.

SPECIMENS EXAMINED - BORNEO. SABAH: Sapulut, road from Nabawan, 19 Nov. 1992, *P.S. Shim* SAN 136418 (holotype SAN; isotypes K, KEP).

This variety was found on a hill slope at 500 m elevation in primary forest. It is larger than any of the five previously known varieties, and is distinctive by its apically truncate pinnules with up to 30 incisions. Besides this new variety, the varieties occurring in Borneo, all found on Mt Kinabalu, are var. *sessilis* (Copeland) Kramer, var. *pseudohemiptera* v.A.v.R., and var. *pectinata* (Bl.) Mett. ex Kuhn.

A key to the varieties known is as follows.

1a. Rhizomes of mature plants less than 1 mm in diameter ..... var. *delicatula*

1b. Rhizomes of mature plants (1.5-)2-3 mm in diameter.

2a. Indusium with strongly concave base, subhippocrepiform; most sori uninerval and round; margin regularly incised, the incisions reaching down almost twice the distance from receptacle to margin; most lobes rounded; sporangia at maturity strongly laterally spreading; petiole very short ..... var. *sessilis*

2b. Indusium with weakly concave, straight or somewhat convex base, or, if concave, then the sori almost marginal; sori uni- to pluri-nerval.

3a. Fully fertile pinnules with at least the broaderbasal lobes truncate; sori straight and plurinerval or round and uninerval, most incisions not reaching the level of the receptacle.

4a. Sori very close to margin, the sporangia at full maturity often adaxially visible; pinnules 3-4 times as long as wide .... var. *submarginalis*

4b. Sori more distinctly intramarginal, the sporangia never adaxially visible; pinnules 2-3 times as long as wide.

5a. Apex of large pinnules truncate, incisions to 30 ... . var. *truncata*

5b. Apex of large pinnules rounded to subtruncate; incisions to 12 ..... var. *pectinata*

3b. Fertile pinnules with lobes narrowed, rounded, or irregular; sori nearly marginal and round, incisions mostly reaching 3 or more times the distance from margin to receptacle ..... var. *pseudohemiptera*

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