The Araceae of Indomalaya I: *Piptospatha* N.E.Br.

Peter C. Boyce
Pusat Pengajian Sains Kajihayat [School of Biological Sciences]
Universiti Sains Malaysia 11800 USM
Pulau Pinang, Malaysia
phymatarum@gmail.com

Wong Sin Yeng
Department of Plant Science & Environmental Ecology
Faculty of Resource Science & Technology
Universiti Malaysia Sarawak
94300 Kota Samarahan
Sarawak, Malaysia
sywong@frst.unimas.my

ABSTRACT

A review of the genus *Piptospatha* N.E.Br. is presented with new generic boundaries implemented since the last full revision. 10 species are recognized, two of them (*P. marginata* (Engl.) N.E.Br. & *P. repens* H.Okada & Tsukaya) recognized only recently as distinct species. Two species (*P. angustifolia* Engl. ex Alderw. and *P. remiformis* Ridl.) are treated as inadequately known. A key to accepted species is given, and all species are illustrated, the majority from living plants.

KEY WORDS

Araceae, *Piptospatha*, Schismatoglottideae, Indomalaya, Sunda, Borneo.

Introduction

Piptospatha is a genus of 10 accepted described species of obligate rheophytes occurring along streams and on waterfalls in lowland to lower montane perhumid to everwet tropical broadleaf forest. Two of these (*P. perakensis* (Engl.) Ridl. & *P. ridleyi* N.E.Br.) occur in West Malaysia, with one of these (*P. perakensis*) extending into southern Peninsular Thailand. The remainder are endemic on Borneo, with one species (*P. viridistigma* P.C.Boyce, S.Y.Wong & Bogner) recorded from the Aru Islands (Bogner, pers. comm.), but this requiring confirmation. Study of the significant herbarium collections in Leiden (L) and Herbarium Bogoriense (BO) has revealed at least another 5 species awaiting formal description. Unfortunately none of the material is of insufficient quality to permit description of these novelties.

Most species are restricted to specific geologies, for example: sandstone (e.g., *P. impolita* P.C.Boyce, S.Y.Wong & Bogner), shales (e.g., *P. marginata* (Engl.) N.E.Br.), granite (e.g., *P. elongata* (Engl.) N.E.Br.), karst limestone (e.g., *P.viridistigma*), and travertine (*P. manduensis* Bogner & A.Hay).

The most recent complete taxonomic revision of *Piptospatha* is Bogner & Hay (2000). However, generic boundaries proposed there are now considerably altered following combined molecular and morphological analyses. Key changes are:

1. Removal (and resurrection to generic status) of *Hottarum truncatum* (M.Hotta) Bogner & Nicolson (Low *et al.*, unpubl. data)
2. Recognition of two new genera based on species previously included in *Piptospatha*:

   Bakoa P.C.Boyce & S.Y.Wong (Boyce & Wong, 2008; Wong, 2011)
   Ooia S.Y.Wong & P.C.Boyce (Wong & Boyce, 2010)

3. Additional novel species: *P. impolita* and *P. viridistigma* (Wong *et al.*,

2009), and *P. repens* H.Okada & Tsukaya (Okada & Tsukaya, 2010)
4. Resurrection of *P. marginata* (Wong *et al*., 2011)

Problems remain, however. Critically, the type species (*P. insignis* N.E.Br.) has never been recollected, and is yet to be sampled for molecular analysis; attempts to isolate DNA from the type material have failed. *Piptospatha insignis* has staminate flowers of unique morphology, and this together with the free pistils set it apart from all other species.

Preliminary molecular analysis of *P. perakensis* has shown it to fall outside the clade to which all *Piptospatha* species belong (Ooi, unpubl. data). Combined with a suite of unique morphologies this lends much support to the removal of *P. perakensis* from *Piptospatha*, and into a new genus; a decision awaits further supporting molecular evidence from the ITS (internal transcribed spacer) marker.

Piptospatha is now defined by the combination of ligular petiolar sheaths, nodding inflorescences, shedding spathe limb, thecae lacking a horn- or needle-like structure, parietal placentation, an erect splash cup carried on an erect peduncle, fruits either fused into a syncarpium (most) or free but cohering (*P. insignis*), and the presence of micropylar appendage on the seed.

Piptospatha N.E.Br., *Gard. Chron., n.s.* 11: 138, fig.20 (1879); Engler in A.L.P.de Candolle & A.C.P.de Candolle, *Monogr. Phan.* 2: 644–645 (1879); Brown in G.Bentham & J.D.Hooker, *Genera Plantarum* 3(2): 985 (1883); Engler in H.A.G.Engler & K.A.E.Prantl, *Nat. Pflanzenfam.* 2(3): 132. (1889); Ridley, *Mat. Fl. Malay. Penins.*: 34–35. 1907; Engler in H.G.A.Engler, *Pflanzenr.* 55(IV.23Da) 124–128, Fig.75 (1912); Ridley, *Fl. Mal. Pen.* 5: 114 (1925); Mayo *et al*., *Genera of Araceae* 184–187, Map 50, Pl.50 & 117D (1997); Bogner & Hay, *Telopea* 9(1): 201–218 (2000);Wong *et al*., *Gard. Bull. Sing.* 61(1): 221–238. (2009); Wong & Boyce, *Bot. Stud. (Taipei)* 51: 543–552 (2010); Wong *et al*., *Webbia* 66(1): 29–32 (2011). **Type:** *Piptospatha insignis* N.E.Br.

Rhynchopyle Engl., *Bot. Jahrb. Syst.* 1: 183 (1880 '1881'). Lectotype: *Rhynchopyle elongata* (Engl.) Engl. [= *Piptospatha elongata* (Engl.) N.E.Br.] (selected by Nicolson, 1967: 518).

Gamogyne N.E.Br., J. Bot. 20: 195 (1882); Engler in H.G.A.Engler, *Pflanzenr.* 55(IV.23Da): 123 (1912). — *Piptospatha* sect. *Gamogyne* (N.E.Br.) M.Hotta, *Mem. Coll. Sci. Univ. Kyoto, Ser. B*, 32: 26 (1965). Type: *Gamogyne burbidgei* N.E.Br. [= *Piptospatha burbidgei* (N.E.Br.) M.Hotta].

Small to medium-sized evergreen obligate rheophytes; *Stem* erect or decumbent, usually more or less condensed. *Leaves* several; petiole semi-terete to canaliculate on upper side; *petiolar sheath* short with long, marcescent ligule; *leaf blade* elongate-lanceolate to elliptic or oblanceolate, coriaceous, basally cuneate, apex with tubular mucro; *primary lateral veins* pinnate, running into distinct marginal vein, *secondary laterals* and *higher order venation* either parallel-pinnate or tessellate. *Inflorescence* solitary per module, emerging orthotropic, maturing (prior to the onset of anthesis) anatropic; *peduncle* subequal to or longer than petiole; *spathe* stoutly ellipsoid, not constricted, usually pink, rarely white, lower part persistent and cup-like, upper part inflating and then gaping at anthesis, soon-caducous, cuspidate to acuminate, often with a pronounced terminal rostrum becoming reflexed at anthesis, interior frequently with one to several pronounced crests, especially in the distal part; *spadix* sessile with oblique insertion, often with *staminodes* basally; *pistillate flower zone* cylindric; *pistils* connate into a syncarpium, or free but cohering to neighboring ones; *ovary* 1-locular; *ovules* many, placenta 2–4, parietal; *stigma* ± sessile, usually as broad as ovary and more or less contiguous with adjacent ones; *staminate flower zone* contiguous with pistillate, cylindric to ellipsoid, equal in thickness to pistillate, obtuse; *stamens*

arranged in pairs or irregular, free, compressed, anthers truncate, connective ± flat or expanded apically or with conspicuous conical beak overtopping thecae; *thecae* oblong-ellipsoid, dehiscing by apical pore; *appendix* absent. *Infructescence* a cluster of berries subtended by a narrow to wide-flaring obconic spathe base carried on an erect peduncle, spadix above fruiting portion degrading and shed entirely soon after fertilization; *berry* obovoid to subcylindric, small, green, either fused into a syncarpium (most species), or free but cohering to adjacent berries. *Seed* numerous, elongate-ellipsoid to cylindric, with long, curved micropylar appendage, testa slightly costate, embryo elongate, endosperm copious.

KEY TO *PIPTOSPATHA*

1a. Sterile interstice between pistillate and staminate flower zones well-defined
  2a. Stem short, erect; spadix thick (width of pistillate zone: entire length = 5/18); pistillate zone green, staminate zone pale yellow; N Borneo (Sarawak: Limbang, Brunei, W Sabah) . . . . . ***P. burbidgei***
  2b. Stem long, repent, spadix slender (width of pistillate zone: whole length = 3/30), pink; N Kalimantan Tengah. . . . . ***P. repens***
1b. Sterile interstice absent or very ill-defined 3
  3a. Anther connective extended into a pronounced elongate beak; "North Borneo". . . . . ***P. insignis***
  3b. Anther connective not so, or if elevated then shortly so and obtuse. 4
    4a. Anthers pubescent 5
      5a. Connective of stamen swollen, dome-like; S Peninsular Malaysia . . . ***P. ridleyi***
      5b. Connective not swollen, flat 6
        6a. Spathe white; anthers in closely appressed regularly arranged pairs; leaf blade with conspicuously tessellate tertiary venation on both surfaces; Malay Peninsula and S peninsular Thailand . . . . . ***P. perakensis***
        6b. Spathe pink; anthers irregularly arranged; leaf blade without tessellate venation, or if present then only very faint and only abaxially; Borneo . . . 7
          7a. Robust plants to 25 cm tall with short, erect stems; leaves forming a rosette; leaf blade very narrowly oblong-elliptic, 12–20 cm long, all veins parallel pinnate; spadix ca. 2 cm long; pistillate flower zone fertile to the base; fruiting spathe 2.5 cm long and wide; plants of exposed shales; Sarawak: Rejang valley . . . . . ***P. marginata***
          7b. Diminutive plants up to 14 cm tall with decumbent-creeping stems; leaves loosely clustered, or distributed along the stem; leaf blade elliptic, 4–6 cm long, tertiary venation abaxially forming a very faint tessellate reticulum; spadix 0.8–1.2 cm long, pistillate flower zone with 3–5 oblique whorls of staminodes at the base; fruiting spathe up 1 cm long and wide; plants of travertine; Kalimantan Timur: Sangkulirang . . . . . ***P. manduensis***
    4b. Anthers glabrous 8
      8a. Spadix bullet-shaped, the staminate portion tapering towards the apex; lower part of staminate zone comprised of larger flowers, that may be sterile, intermixed adjacent to the pistils with white staminodes; thecae broadly excavated, the excavations of adjacent anthers forming a butterfly-shaped depression; stigmas bright green; spathe at anthesis shading proximally to distally from deep olive-green through very pale pink to medium pink, the interior of the spathe tip rostrum with 5–7 conspicuous keels; persistent fruiting spathe wide-flared; plants frequently limestone associated; SW Sarawak (? NW Kalimantan) . . . . . ***P. viridistigma***

8b. Spadix cylindrical; staminate flowers uniform throughout zone; thecae longitudinally sulcate with the pores ventral and dorsal to the sulcae; stigmas pink or dirty whitish. Spathe at anthesis shading proximally to distally from deep plum purple through medium pink to deep pink, the interior of the spathe tip rostrum with 2–3 conspicuous keels or keels ± absent. Persistent fruiting spathe narrowly obconic; plants of sandstone or granite 9

9a. Stigmas mid-deep pink; anthers with connective flat; spathe tip rostrum almost straight or only weakly reflexed (ca. 45°) relative to spathe axis at anthesis, inside with 2–3 conspicuous longitudinal keels; plants exclusively of granite; NW Borneo . . . . . ***P. elongata***

9b. Stigmas dirty whitish; anthers with a short acute-triangular connective on each side, spathe tip rostrum strongly reflexed (ca. 130°) relative to spathe axis at anthesis, inside lacking keels, or keels only very vaguely defined; plants exclusively of sandstone; NW Sarawak . . . . ***P. impolita***

Piptospatha burbidgei (N.E. Br.) M.Hotta, *Mem. Coll. Sci. Univ. Kyoto, Ser. B*, 32: 27, fig.4, A–F (1965); Mayo *et al.*, *Genera of Araceae* 186, Pl.50C–F & 357, Pl.117D (1997); Bogner & Hay, *Telopea* 9(1): 204–205 (2000).—*Gamogyne burbidgei* N.E.Br., *J. Bot.* 20: 196 (1882). **Type:** Malaysian Borneo, Limbang Division, Sarawak/Brunei borders, Bukit Sagan, Jan. 1878, *F.W.Burbidge s.n.* (holo K!). Figure 1.

Distribution

Endemic to N & NE Borneo from NE Sarawak (notably Mulu N.P.) throughout Brunei to NE Sabah; frequently locally abundant (as, e.g., at Kuala Belalong, Temburong, Brunei).

Ecology

Rheophytic on and among shale boulders in stream beds, or on stream banks; altitude: up to ca. 200 m asl.

Notes

Piptospatha burbidgei is readily distinguished by its leaf blades adaxially glossy olive green, the extremely fine primary venation (visible abaxially), and the petiole much shorter than the blade; floral morphologies include the usually very shortly stipitate spadix with the stipe (if present) more or less free, the coarsely papillate (at anthesis) laterally contiguous stigmas, the conspicuous sterile interstice separating the pistillate and staminate flower zones, and the almost flat-topped glabrous stamens.

Eponymy

Named for Frederick William Thomas Burbidge (1847–1905), who between 1877 and 1878 was employed by Messrs Veitch & Sons, the London and Exeter-based nursery, as an explorer for ornamental plants. Burbidge's travels and adventures, and details of his more notable plant introductions for Veitch, which included *Nepenthes rajah*, are entertainingly chronicled in '*The Gardens of the Sun*' (Burbidge, 1880).

Piptospatha elongata (Engl.) N.E.Br., *Curtis's Bot. Mag.* 51, *in descr. ad tab.* 7410 (1895); Engler in H.G.A.Engler, *Pflanzenr.* 55 (IV.23Da): 124, fig.75 (1912); Ridl., *J. Bot.* 51: 202 (1913); Bogner & Hay, *Telopea* 9(1): 205–206 (2000).—*Schismatoglottis elongata* Engl., *Bull. R. Soc. Tosc. Ortic.* 4: 298 (1879).—*Rhynchopyle elongata* (Engl.) Engl., *Bot. Jahrb. Syst.* 1: 184 (1881) & in O.Beccari, *Malesia* 1: 289, pl. 23, figs, 3–15 (1882). **Type:** Malaysian Borneo, Sarawak, Kuching Division, Lundu, Gunung Gading, June 1867, *O. Beccari P.B. 2308* (holo FI-B!). Figure 2.

Gamogyne pulchra N.E. Br., *Kew Bull.* (1910): 197 (1910) & *Curtis's Bot.*

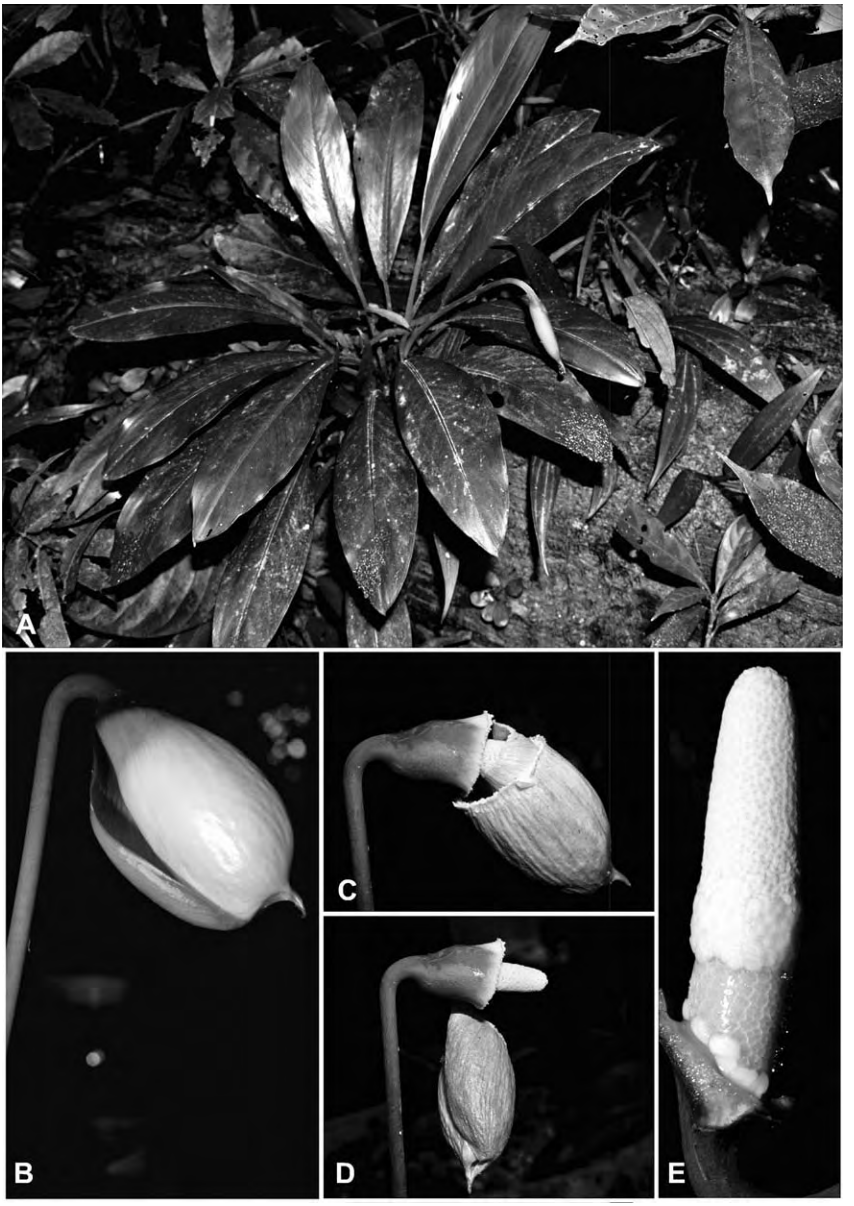

Fig. 1. ***Piptospatha burbidgei*** **(N.E.Br.) M.Hotta. A.** Flowering plant in habitat, on shales, Mulu N.P., N.Sarawak. **B.** Inflorescence at pistillate anthesis. **C.** Inflorescence at onset of staminate anthesis. Note that the spathe limb has begun to senesce and has partly separated from the lower, persistent spathe. **D.** Inflorescence towards end of staminate anthesis. **E.** Spadix (spathe artificially removed) at pistillate anthesis. All from *P.C.Boyce et al. AR-1973*.

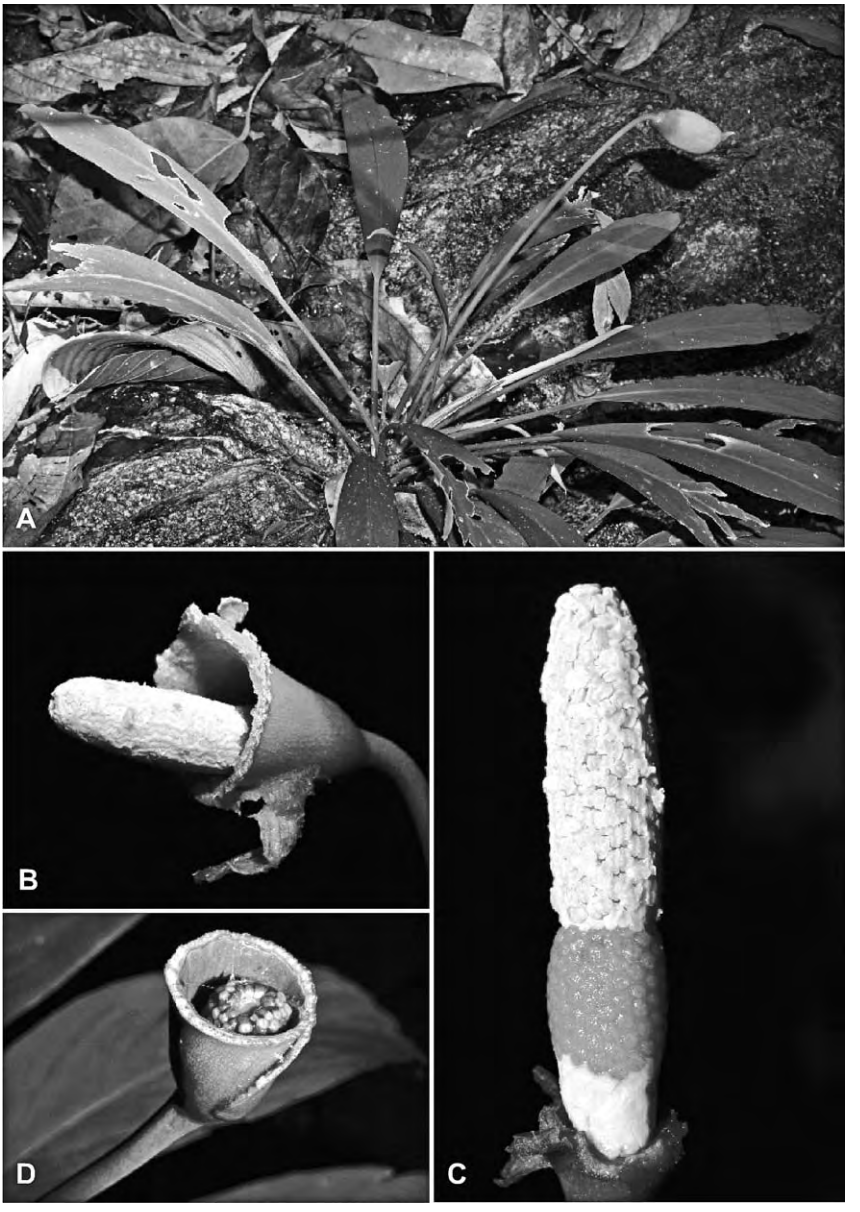

Fig. 2. ***Piptospatha elongata* (Engl.) N.E.Br. A.** Flowering plant in habitat on granite, Gunung Gading N.P., NW Sarawak. **B.** Inflorescence at onset of staminate anthesis. Note that the spathe limb has been shed to leave a cup-shaped persistent lower spathe. **C.** Inflorescence at male anthesis with spathe artificially removed to reveal spadix. **D.** Infructescence showing the persistent lower spathe and the fruits. A, B & D: from *P.C.Boyce et al. AR-2052*; C: from *P.C.Boyce et al. AR-2338*.

Mag. 135 t.8330 (1910). Type: Cult Kew, March. 1909 (original collection: Malaysian Borneo, Sarawak, Kuching Division, Lundu, Gunung Gading, *H.N.Ridley* s.n.) (holo K!)

Piptospatha rigidifolia Engl.in H.G.A.Engler, *Pflanzenr*. (IV.23Da): 127 (1912). Type: Malaysian Borneo, Sarawak, Kuching Division, Lundu, Gunung Gading, Sept. 1905, *H.N. Ridley s.n.* (lecto, SING!, selected by Bogner & Hay, 2000: 205).

Distribution

NW Borneo: Malaysian Borneo: Sarawak, Kuching Division, Lundu area (centered on Gunung Gading), and Indonesian Borneo: Kalimantan Barat.

Ecology

Rheophytic on granite rocks in moist lowland to lower hill forest in light to medium shade; altitude: 10–400 m asl.

Notes

Piptospatha elongata is readily separated from the other *Piptospatha* species occurring in West Sarawak (*P. viridistigma* and *P. impolita*). From *P. impolita*, *P. elongata* is readily distinguished by the mid- to dark pink stigmas (vs. dirty white), the spathe tip rostrum conspicuously 2–3 keeled internally and remaining straight or reflexing by only ca. 45° during anthesis, and the flat anther connectives.

Piptospatha elongata differs from *P. viridistigma* by the mid- dark pink (vs. bright green) pistils, cylindrical creamy white (vs. bullet-shaped, brilliant yellow) staminate flower portion, longitudinally sulcate unexcavated thecae, 2–3 (vs. 5–7 keels) on the interior of the spathe tip rostrum, and a narrowly obconic (vs. wide flared) persistent lower spathe. The pollen of *P. elongata* and *P. impolita* is released in masses whereas that of *P. viridistigma* is extruded in strings.

Piptospatha elongata is restricted to granite, whereas *P. viridistigma* is mainly, although not exclusively, found on limestones, and *P. impolita* is not found away from hard sandstone.

Etymology

From Latin, *elongatus* (prolonged). Engler (1879) does not specifically explain the origin of the species epithet. However, in the Protologue (1879: 239) he states "*pedunculis valde elongatus*", morphology remarkable for *Schismatoglottis*, the genus to which Engler first attributed *P. elongata*.

Piptospatha impolita S.Y.Wong, P.C. Boyce & Bogner, *Gard. Bull. Sing.* 61(1): 224, Pl.3 (2009). **Type:** Malaysian Borneo, Sarawak, Kuching Division, Lundu, Sempadi, Sungai Limau, Bukit Kankar, 25 Aug. 2007, *P.C. Boyce, Wong Sin Yeng & Jipom ak Tisai AR-2141* (holo + spirit SAR!). Figure 3.

Distribution

Borneo, Sarawak, Kuching Division, endemic to the Lundu area along the coast.

Ecology

Rheophytic on very hard sandstones in seasonally dry (but perhumid), lowland and lower hill forest; altitude: 50–150 m asl.

Notes

Piptospatha impolita is most similar to *P. elongata*, but readily distinguished by the anthers with a short acute-triangular connectives (one on each side of the stamen and held parallel to the longitudinal sulcae), the spathe tip rostrum without internal keels, or the keels only very weakly defined, and the rostrum becoming strongly reflexed (ca. 130° vs. 45°) relative to spathe axis at anthesis, and the dirty whitish pistils and stigmas.

Etymology

From Latin *impolitus* (unpolished) in reference to leaf blade adaxially conspicuously matte.

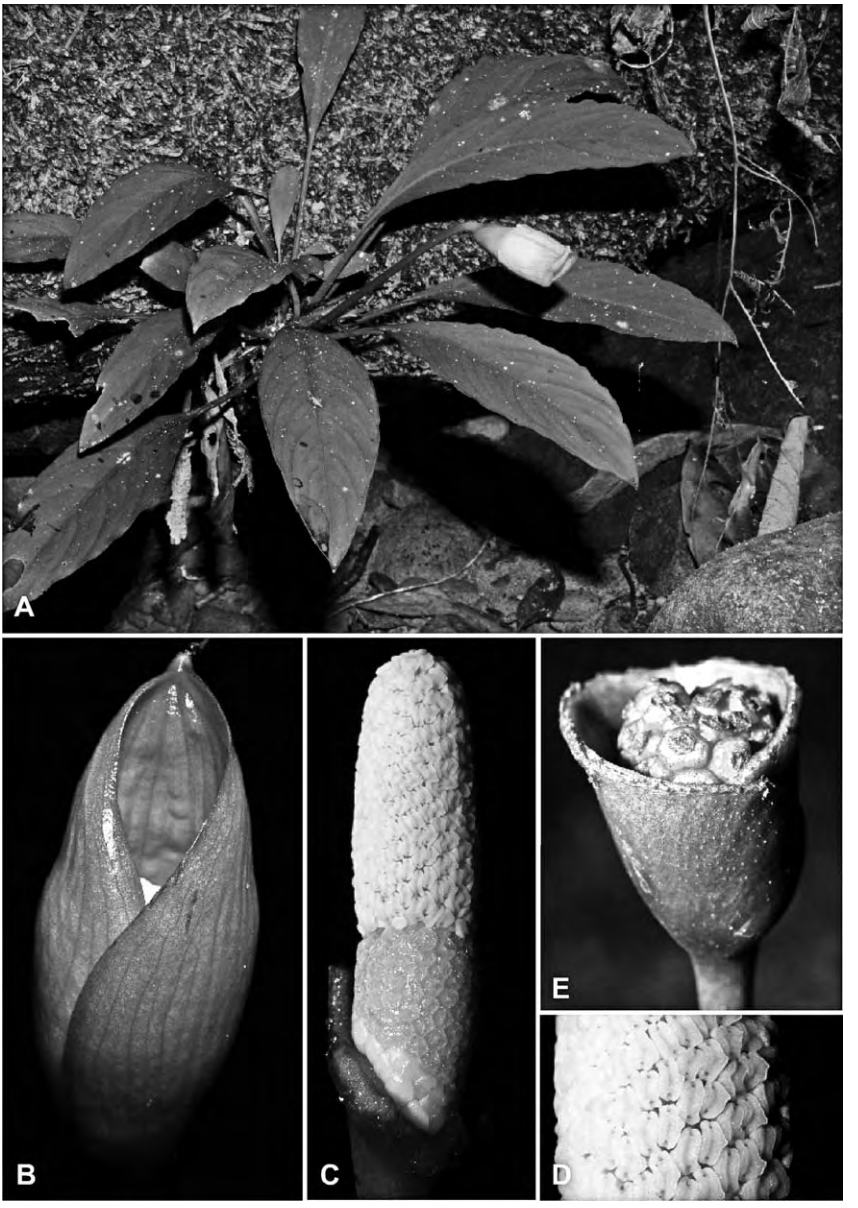

Fig. 3. ***Piptospatha impolita*** **S.Y.Wong, P.C. Boyce & Bogner. A.** Flowering plant at late staminate anthesis, in habitat, on hard sandstones. **B.** Spathe at late pistillate anthesis. Note that the orifice of the spathe limb lacks keels (c.f. with *P. elongata* and *P. viridistigma*). **C.** Spadix at pistillate anthesis, spathe artificially removed. **D.** Detail of staminate flower zone just prior to staminate anthesis, showing the sulcate stamens and lateral, beaked connective. **E.** Infructescence at mid-maturity, Note that the persistent lower spathe is narrowly obconic. All from *P.C.Boyce et al. AR-2141*.

Piptospatha insignis N.E.Br., *Gard. Chron. n.s.*, 11: 138, fig.20 (1879); Engler in A.L.P.de Candolle & A.C.P.de Candolle, *Monogr. Phan.* 2: 644–645 (1879); Hooker, *Curtis's Bot. Mag.* 107, t. 6598 (1881); Engler in H.G.A.Engler, *Pflanzenr.* 55(IV.23Da): 127 (1912); Bogner & Hay, *Telopea* 9(1): 206–207 (2000). **Type:** Cult. RBG Kew ex 'North Borneo', *F.W.Burbidge 95* sub *N.E.Brown s.n.* (holo K!; iso BM!, FI-B!). Figure 4.

Distribution

Bogner & Hay (2000) suggest Sabah, based on the "North Borneo" locality given by Burbidge on the herbarium material. However, this does not accord well with Burbidge's known itinerary, or with the arrival dates of the plants at Veitch's from where Kew received the plants used by Brown to publish the name *P. insignis*. On balance, it seems most likely that *P. insignis* was collected during the same trip that Burbidge gathered *P. burbidgei* - Bukit Sagan, Limbang, on the borders of modern Sarawak and Brunei (Boyce & Wong, 2011).

Ecology

Rheophytic on sandstones. Burbidge (1880: 342) states "Of the new genera discovered two have very pretty spathes, and if they can be successfully cultivated will prove very interesting and ornamental stove plants. *Piptospatha insignis* N.E.Br., a pretty little "rock arad, (*sic*)" found on sandstone boulders in the beds of mountain streams, has a tuft of lance-shaped leaves and dainty white spathes tipped with pink."; altitude: unknown.

Notes

The staminate flower structure of *P. insignis* is quite unlike that of any other known species and raises interesting questions about the likelihood that despite recent revisions, *Piptospatha* is still not yet fully resolved.

Etymology

From Latin, *insignis* (remarkable, notable, distinguished). Although not explicitly stated, Brown (1879) repeatedly alludes to the plant's remarkable and attractive appearance.

Piptospatha manduensis A.Hay & Bogner, *Telopea* 9(1): 207, Fig.4 (2000). **Type:** Indonesian Borneo, Kalimantan Timur, Sangkulirang District, Sungai Mandu region, north of Sangkulirang, 14 Aug 1957, *A.J.G.H. Kostermans 13493a* (holo L!; iso BO!; K!, SING!). Figure 5.

Distribution

Indonesian Borneo, Kalimantan Timur; known only from the type locality.

Ecology

"On travertine in river"; altitude: 50 m asl.

Notes

A singular species, that until the discovery of *P. repens* was the only *Piptospatha* with a creeping rhizome (recalling that of *Phymatarum* M.Hotta). Bogner & Hay noted the general similarity of *P. manduensis* to *Piptospatha* (now *Ooia*) *kinabalunesis*, but given the now established relationship between *Ooia* and *Piptospatha* the similarity in appearance is not significant.

Etymology

The species epithet is contrived from the Sungai Mandu, the Type locality, with the termination *–ensis* (originating from).

Piptospatha marginata (Engl.) N.E.Br., *Curtis's Bot. Mag.* 51, *in descr. ad tab. 7410* (1895); Engler in H.G.A.Engler, *Pflanzenr.* 55(IV.23Da): 125 (1912); Aldewerelt, *Bull. Jard. Bot. Buitenzorg* 3(4): 194 (1922); Wong *et al.*, *Webbia* 66(1): 29–32 (2011).—*Schismatoglottis marginata* Engl., *Bull. R. Soc. Tosc. Ortic.* 4: 298 (1879).—*Rhynchopyle marginata* (Engl.) Engl., *Bot. Jahrb.*

Fig. 4. ***Piptospatha insignis* N.E.Br.** Reproduced from *Curtis's Botanical Magazine* 107 [ser.3, v.37], t.6598 (1881). Note the elongated connectives.

Fig. 5. ***Piptospatha manduensis* A.Hay & Bogner.** *A.J.G.H.Kostermans 13493a*. (K) isotype. Image © Trustees, Royal Botanic Gardens, Kew.

Syst. 1: 184 (1880 '1881') & in .Beccari, *Malesia* 1: 288, pl. 23, Figs. 1 and 2 (1882). **Type**: Malaysian Borneo, Sarawak, Kapit Division, Rejang, Balleh, 1867, *O.Beccari P.B. 3838* (holo -B!; iso B†). Figure 6.

Distribution

Malaysian Borneo: Sarawak, Kapit Division, seemingly restricted to the Rejang above Kapit town eastwards to the Sungai Gaat at Batang Balleh.

Ecology

Rocky streams in lowland perhumid moist closed canopy forest on exposed shales; altitude: 160–220 m asl.

Notes

Bogner & Hay (2000) treated *Piptospatha marginata* as a synonym of a broadly-circumscribed *P. elongata*. However, fieldwork in Sarawak has clearly established that *P. elongata sensu* Bogner & Hay comprises a number of morphologically discrete and furthermore locally endemic species (Wong *et al*., 2009). Examination of the holotype of *P. marginata* revealed the staminate flowers to be pubescent, otherwise occurring in only one other, morphologically highly distinct species of Bornean *Piptospatha* (*P. manduensis*). The pubescent nature of the staminate flowers was not reported by Engler (1879, 1880, 1882, 1912). A review of herbarium specimens in Munich (M) and Kew (K) revealed a more recent, well-preserved specimen of *P. marginata* (*B.L.Burtt B.12976*) collected only 35 km west of the type locality of *P. marginata*. Both areas are ecologically very similar, comprising lowland perhumid moist forest on exposed shales.

Etymology

Latin, *marginatus*, enclosed with a border. Although not specifically explained, Engler, in the Protologue emphasizes "*nervo collectivo marginali crassiore valde prominente*", implying that the collective vein 'encloses' the rest of the leaf blade.

Piptospatha perakensis (Engl.) Engl. in H.G.A.Engler, *Pflanzenr*. 71(IV.23E): 2* [i.e. supplementary pages] (1920); Ridley, *Fl. Mal. Pen*. 5: 114 (1925); Henderson, *Malayan Wildfl., Monocots* 232, fig. 138, A (excl. fig. 138, B— i.e., *P. elongata*); Bogner & Hay, *Telopea* 9(1): 208–210, Fig.5. (2000).—*Piptospatha elongata* var. *perakensis* Engl. in H.G.A.Engler, *Pflanzenr*. 55(IV.23Da): 125 (1912).—*Rhynchopyle perakensis* (Engl.) Ridl., *J. Bot*. 51: 202 (1913). **Type:** Malaysia, Melaka, Tampin Hill, Waterfall, May 1894, *J.S. Goodenough 1850* (lecto SING!; isolecto CAL!, selected by Bogner & Hay, 2000: 208). Figure 7.

[*Schismatoglottis elongata* auct. non Engl.: Hooker, *Fl. Brit. Ind*. 6: 539 (1893)] [*Piptospatha elongata* auct. non (Engl.) N.E.Br.: Ridl., *Mat. Fl. Mal. Pen*. 3: 35 (1907)]

Distribution

S Peninsular Thailand and Malay Peninsula.

Ecology

Rheophytic on granite boulders in streams and by waterfalls and stream banks; altitude: 100– ca. 1,400 m asl.

Notes

Piptospatha perakensis is unique in the genus by the combination of powerfully fragrant (jasmine) inflorescences, the white spathe limb, leaf blades with conspicuously tessellate tertiary venation, and the very finely branched roots. Dry material is immediately recognizable by drying pale orange to straw-colored. Molecular data (Ooi, unpubl. data) indicates that *P. perakensis* does not cluster with the other species, but forms a well-supported separate clade.

Etymology

Perak + *ensis*, Latin for 'originating from'.

Piptospatha repens H.Okada & Tsukaya, *Acta Phytotax. Geobot*. 61(2):

Fig. 6. ***Piptospatha marginata* (Engl.) N.E.Br.** *B.L.Burtt 12976* collection from Munich (M).

Fig. 7. ***Piptospatha perakensis* (Engl.) Engl. A.** Plant in habitat on granite. **B.** Inflorescence at pistillate anthesis. **C.** Spadix, spathe artificially partially removed. **D.** Semi-mature infructescence. **E.** Detail of leaf blade (abaxial surface) showing tessellate tertiary venation. All from *P.C.Boyce et al. AR-2603*.

87, figs. 1–2. (2010). **Type:** Indonesia, West Kalimantan, Betung-Kerihun National Park: along a clear stream (Sg. Rongun), a branch on the right bank of Mendalam River, NE of Putussibau, Kab. Kapuas Hulu (01°01′52″–02′04″N, 113°16′12″–14″E), 2 Jan. 2010, *H.Okada*, *H.Tsukaya* & *H.Nagamasu O-58* (holo BO!; iso KYO!). Figure 8.

Distribution

Confirmed only from the type locality, where it is reported to be rare.

Ecology

"…rocky riverside along a rapid stream with very clean water under a primary rain forest"; altitude (calculated by projecting given coordinates onto Google Earth): 174–234 m asl.

Notes

Superficially very similar in appearance to *Schismatoglottis roseospatha* Bogner (1988), but differing by features of the spadix, notably the much smaller subpistillar staminodes, and differently shaped staminate flowers.

Etymology

Latin, *repens* – creeping – in allusion to the stem morphology.

Piptospatha ridleyi N.E.Br. ex Hook.*f*., *Curtis's Bot. Mag.* 51, t. 7410 (1895); Ridley, *Mat. Fl. Mal. Pen.* 3: 35 (1907); Engler in H.G.A.Engler, *Pflanzenr.* 55(IV.23Da): 127 (1912); Ridley, *Fl. Mal. Pen.* 5: 114 (1925); Bogner & Hay, *Telopea* 9(1): 210–212 (2000). **Type:** Cult. RBG Kew ex Malaysia, Johor, (orig. coll. *H.N. Ridley*), ?1893, *N.E. Brown s.n.* (holo K!). Figure 9.

Piptospatha ridleyi var. *lanceolata* Ridl., *Fl. Mal. Pen.* 5: 114 (1925).—Type: Malaysia, Johor, Ulu Kahang, 1 Jun 1923, *R.E. Holttum 10865* (holo SING!).

Distribution

Malay Peninsula, primarily in Johor with one collection each from Pahang and Selangor.

Ecology

Rheophytic on rocks in and along streams in perhumid to moist forest; altitude: 100–900 m asl.

Notes

Piptospatha ridleyi is distinguished from *P. perakensis* by the pink spathes, the basal staminodes more or less obpyramidal, and the stamens not arranged in such distinct pairs. Vegetatively, the leaf blades with fewer, weaker primary lateral veins, and lacking the conspicuous tessellate tertiary venation are distinctive. Herbarium material of *P. ridleyi* dries dull green (not straw-colored). The leaf blades of *P. ridleyi* are frequently variegated, although the degree and colouration varies considerably even in a single population. The plate accompanying the type description (Hooker, 1895: t.7410) depicts a particularly heavily variegated leaf blade.

Eponymy

Named for Henry Nicholas Ridley (1855–1956), prodigiously productive botanist, also geologist, entomologist, and pioneering agriculturalist with the introduction and commercialization of rubber to then Malaya. Director of Gardens and Forests for the Straits Settlements, 1888–1911.

Piptospatha viridistigma S.Y.Wong, P.C. Boyce & Bogner, *Gard. Bull. Sing.* 61(1): 227, Pl.4. (2009). **Type:** Malaysian Borneo, Sarawak, Kuching Division, Siburan, Kampung Giam, Air Terjun Giam, 01°19′11.2″ N; 110°16′11.4″ E, 7 Feb. 2006, *P.C. Boyce, Jeland ak Kisai & Wong Sin Yeng AR-1687* (holo + spirit SAR!). Figure 10.

Distribution

Malaysian Borneo, Sarawak, Kuching & Samarahan Divisions, restricted to the Serian & Padawan areas, and the southernmost Bau limestones. As with *P. elongata* it is very likely that *P. viridistigma* extends into adjacent Kalimantan; recently located populations at Kg Mayang (Sarawak: Serian) occur within 2 km of the international border.

Ecology

Rheophytic, usually on limestone, occasionally on sandstone (*pers. obs.*) or basalt

Fig. 8. ***Piptospatha repens*** **H.Okada & Tsukaya. A.** Whole plant from type locality. **B.** Pre-anthesis inflorescences, Note color of fresh spathe and spadix. Spathe partly artificially removed to show spadix. Images © H.Okada. Used with permission.

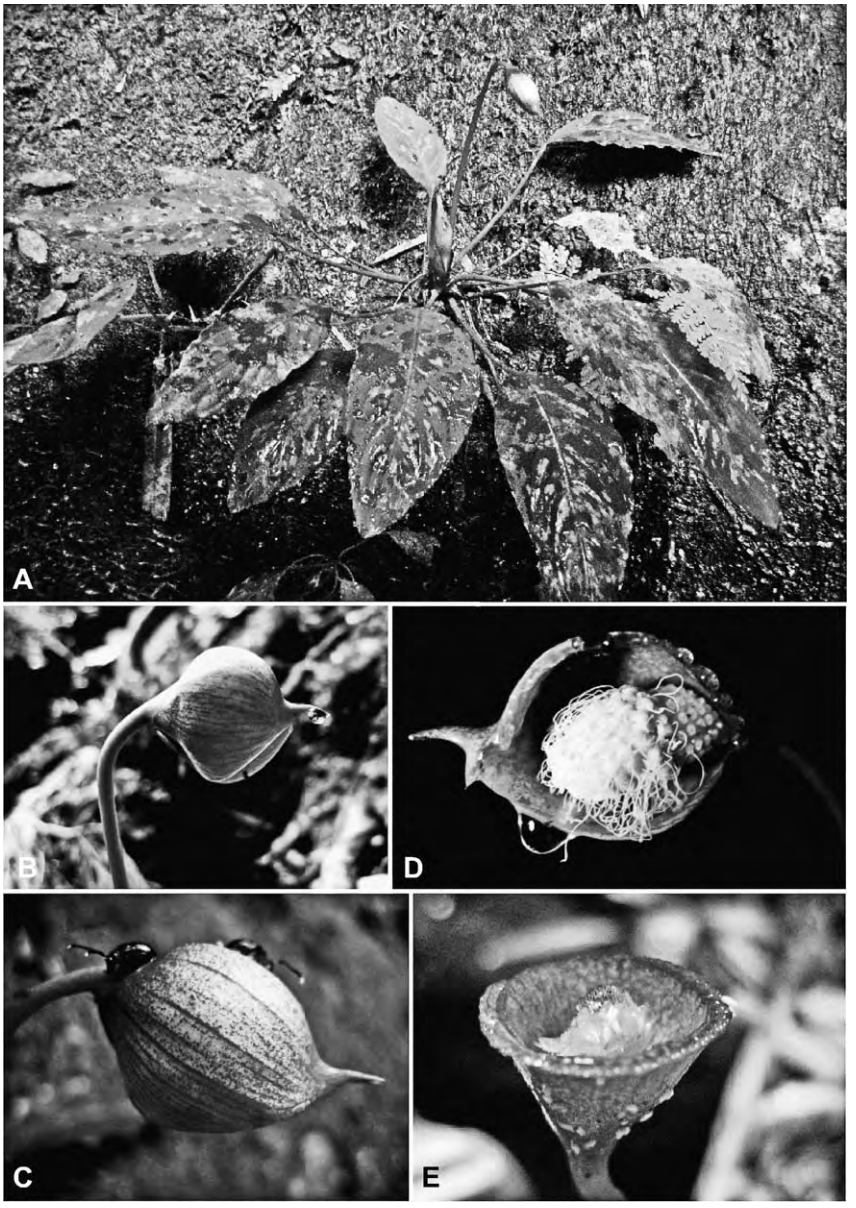

Fig. 9. ***Piptospatha ridleyi*** **N.E.Br. ex Hook.*f.* A.** Plant flowering in habitat, Endau Rompin N.P. Note the lightly spattered leaf blades. **B.** Inflorescence at staminate anthesis. **C.** Inflorescence at pistillate anthesis. Note the different spathe shape. The beetles are Chrysomelidae, possibly *Chaloenus*. **D.** Inflorescence at staminate anthesis, nearside part of spathe artificially removed to reveal spadix. Note the exceptionally long pollen strings. **E.** Infructescence towards end of fruit/seed dispersal. Note the seeds adhering to the exterior of the persistent, cup-shaped lower spathe. Images © Ooi Im Hin. Used with permission.

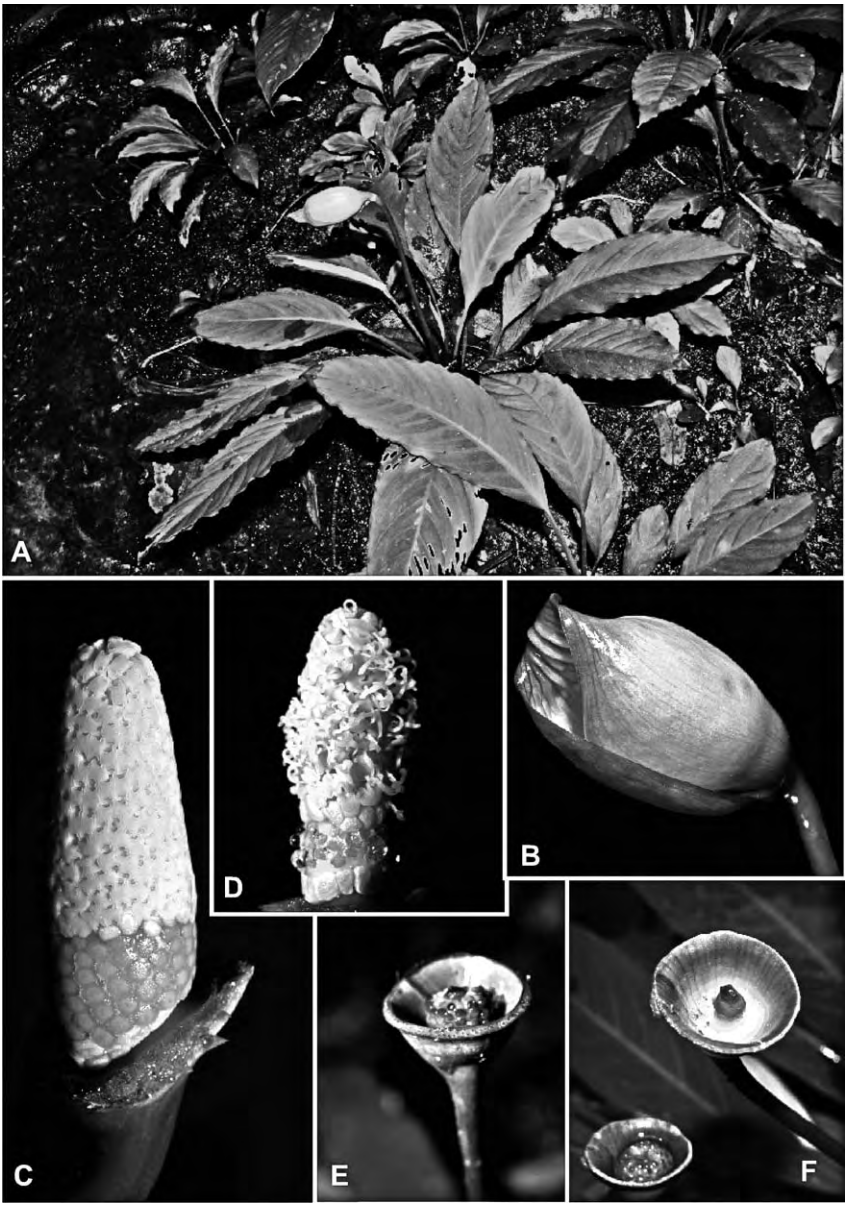

Fig. 10. ***Piptospatha viridistigma*** **S.Y.Wong, P.C. Boyce & Bogner. A.** Flowering plant in habitat. **B.** Inflorescence at late pistillate anthesis. Note the conspicuous keels in the orifice of the spathe. **C.** Spadix at pistillate anthesis, spathe artificially removed. **D.** Spadix at staminate anthesis, spathe artificially removed. Note the pollen strands; **E.** Infructescence at mid-maturity. Note that the persistent lower spathe is broadly funnelform. **F.** Infructescence post fruit/seed dispersal (RH); and nearly mature (LH).A & F from *P.C.Boyce & S.Y.Wong AR-3669*; B from *P.C.Boyce et al. AR-733*; C & E from *P.C.Boyce et al. AR-250*; D from *P.C.Boyce & S.Y.Wong AR-2432*.

(fide *P.S.Ashton S 21298*), along small forest streams and waterfalls, 100–350 (950) m asl.

Notes

Piptospatha viridistigma is readily differentiated from *P. elongata* and *P. impolita* by the bullet-shaped spadix, with the staminate portion deep yellow (vs. pale cream) tapering towards the apex, the anthers with the thecae broadly excavated with the excavations of adjacent anthers together forming a butterfly-shaped depression, and the diagnostic bright green pistils (from whence the trivial epithet is derived) and stigmas. Other characters include the minutely puberulent petioles and peduncle, pollen extruded in strings (vs. masses) and the spathe at anthesis shading proximally to distally from deep olive-green through very pale pink to medium pink. In fruit the persistent fruiting spathe is wide-flared rather than narrowly conical. Sterile plants of *P. viridistigma* are very similar to *P. elongata*, although the uniformly minutely asperous petioles (D-shaped in cross-section) and longer persistent petiolar sheath are stable morphologies to differentiate *P. viridistigma* from *P. elongata*. To date *P. elongata* has never been collected away from granite.

Etymology

From Latin *viride* (green), and *stigma*, in allusion to the strikingly green colored stigmas.

INADEQUATELY KNOWN SPECIES

Piptospatha angustifolia Engl. ex Alderw., *Bull. Jard. Bot. Buitenzorg* III, 4: 193 (1920); Bogner, *Pl. Syst. Evol.* 142: 52 (1983); Bogner & Hay, *Telopea* 9(1): 205 (2000); Wong *et al.*, *Webbia* 66(1): 30 (2011)—Type: Indonesia, Kalimantan, *H. Hallier 614* (BO, holo).

Piptospatha angustifolia appears never to have been recollected. Bogner & Hay (2000) provisionally assigned it to the synonymy of *P. elongata* but given that the type (BO) sheets are functionally sterile (all flowers degraded), and further provide no field information aside from 'Borneo', *P. angustifolia* is better for the time being treated as a taxon of dubious status.

Piptospatha remiformis Ridl., *J. Straits Br. Roy. Asiat. Soc.* 49: 51 (1907); Bogner & Hay, *Telopea* 9(1): 218–219. **Type**: Malaysian Borneo, Sarawak, Sri Aman Division, Mt Lingga (modern Bukit Balau), *J.Hewitt s.n.* (holo, SING!).

Bogner & Hay (2000) failed to locate the Type of *P. remiformis*. However, a thorough search located the material, depauperate in the extreme and not assignable to a known species. Bogner & Hay (2000: 219) noted that Hewitt collected an *Aridarum* on Mt Lingga (attributed to *A. nicolsonii* Bogner, but in fact *A. crassum* S.Y.Wong & P.C.Boyce) and speculated that the collection of *P. remiformis* might be attributable as a duplicate of this. This is not so. Several recent excursions to Bukit Balau have failed to locate any species of *Piptospatha*, although *Aridarum crassum* is abundant.

INDEX TO TAXA

Gamogyne N.E.Br. = **Piptospatha** N.E.Br.

Gamogyne burbidgei N.E.Br. = **Piptospatha burbidgei** (N.E.Br.) M.Hotta

Gamogyne pulchra N.E.Br. = **Piptospatha elongata** (Engl.) N.E.Br.

Piptospatha acutifolia Engl. = ***Schismatoglottis schottii*** Bogner & Nicolson

Piptospatha brevipedunculata = ***Bakoa brevipedunculata*** **(H.Okada & Y.Mori) S.Y.Wong**

Piptospatha burbidgei (N.E.Br.) M.Hotta

Piptospatha elongata (Engl.) N.E.Br.

Piptospatha elongata var. *perakensis* Engl. = **Piptospatha perakensis** (Engl.) Ridl.

Piptospatha grabowskii (Engl.) Engl. = ***Ooia grabowskii*** **(Engl.) S.Y.Wong & P.C.Boyce**

Piptospatha havilandii (Engl.) Engl. = ***Ooia grabowskii*** **(Engl.) S.Y.Wong & P.C.Boyce**

Piptospatha impolita P.C.Boyce, S.Y.Wong & Bogner

Piptospatha insignis N.E.Br.

Piptospatha kinabaluensis (Bogner) Bogner & A.Hay = ***Ooia kinabaluensis* (Bogner) S.Y.Wong & P.C.Boyce**

Piptospatha lucens (Bogner) Bogner & A.Hay = ***Bakoa lucens* (Bogner) P.C.Boyce & S.Y.Wong**

Piptospatha manduensis Bogner & A.Hay

Piptospatha marginata (Engl.) N.E.Br.

Piptospatha perakensis (Engl.) Ridl.

Piptospatha repens H.Okada & Tsukaya

Piptospatha ridleyi N.E.Br. ex Hook.f.

Piptospatha rigidifolia Engl. = **Piptospatha elongata** (Engl.) N.E.Br.

Piptospatha truncata (M.Hotta) Bogner & A.Hay = ***Hottarum truncatum* M.Hotta**

Piptospatha viridistigma P.C.Boyce, S.Y.Wong & Bogner

Rhynchopyle Engl. = **Piptospatha** N.E.Br.

Rhynchopyle elongata (Engl.) Engl. = **Piptospatha elongata** (Engl.) N.E.Br.

Rhynchopyle grabowskii Engl. = ***Ooia grabowskii* (Engl.) S.Y.Wong & P.C.Boyce**

Rhynchopyle havilandii Engl. = ***Ooia grabowskii* (Engl.) S.Y.Wong & P.C.Boyce**

Rhynchopyle marginata (Engl.) Engl. = **Piptospatha marginata** (Engl.) N.E.Br.

Rhynchopyle perakensis (Engl.) Ridl. = **Piptospatha perakensis** (Engl.) Ridl.

Schismatoglottis havilandii (Engl.) M. Hotta = ***Ooia grabowskii* (Engl.) S.Y.Wong & P.C.Boyce**

REFERENCES

Bogner, J. 1988. *Schismatoglottis roseospatha* Bogner, spec. nov. (Araceae), eine neue Art aus Sarawak. *Aqua Planta* 3: 96–99.

——— & A. Hay. 2000. Schismatoglottideae (Araceae) in Malesia 2: *Aridarum*, *Bucephalandra*, *Phymatarum* and *Piptospatha*. *Telopea* 9(1): 179–222.

Boyce, P. C. & S. Y. Wong. 2008. Studies on Schismatoglottideae (Araceae) of Borneo VII: *Schottarum* and *Bakoa*, two new genera from Sarawak, Malaysian Borneo. *Bot. Stud. (Taipei)* 49: 393–404.

——— & ———. 2012. Lost Aroids: On the taxonomic importance of relocating poorly collected species. *Aroideana* 35.

Brown, N. E. 1879. New Garden Plants. *Piptospatha insignis* N.E.Br. *Gard. Chron.*, n.s., 11: 138–139, Fig.20.

Burbidge, F. W. 1880. *The Gardens of the Sun*. John Murray, London.

Engler, A. 1879. Araceae specialmente Borneensi e Papuane raccolte da O. Beccari. *Bull. R. Soc. Tosc. Ortic.* 4: 265–271 & 295–302.

———. 1880 ('1881'). Beiträge zur Kenntnis der Araceae I. *Bot. Jahrb. Syst.* 1: 179–190.

———. 1882. In O.Beccari, *Malesia* 1: pp. 259–304, Pl.16–28.

———. 1912. *Araceae-Philodendroideae-Philodendreae-Homalomeninae und Schismatoglottidinae In* A. Engler (ed.), *Das Pflanzenreich* 55(IV. 23Da): 1–134. W. Engelmann, Leipzig.

Hooker, J. D. 1895. *Piptospatha ridleyi* N.E.Br. ex Hook. *f. Curtis's Bot. Mag.* 121 [ser.3, v.51], t.7410.

Nicolson, D. H. 1967. Selection of Lectotype Species for Genera of the Family Araceae. *Taxon* 16(6): 514–519.

Okada, H. & H. Tsukaya. 2010. A New Species of *Piptospatha* (Araceae: Schismatoglottideae) from West Kalimantan, Indonesian Borneo. *Acta Phytotax. Geobot.* 61(2): 87–92.

Wong, S. Y. 2011. Studies on Schismatoglottideae (Araceae) of Borneo XV: A Second Species of *Bakoa* from Indonesian Borneo. *Acta Phytotax. Geobot.* 61(3): 127–129.

———, J. Bogner & P. C. Boyce. 2011. Studies on Schismatoglottideae (Araceae) of Borneo XIV: *Piptospatha marginata* resurrected and observations on *Piptospatha*, notably for the Rejang drainages. *Webbia* 66(1): 29–32.

——— & P. C. Boyce. 2010. Studies on Schismatoglottideae (Araceae) of Borneo XI: *Ooia*, a new genus, and a new generic delimitation for *Piptospatha*. *Bot. Stud. (Taipei)* 51: 543–552.

———, ——— & J. Bogner. 2009. Studies on Schismatoglottideae (Araceae) of Borneo VIII: A review of the *Piptospatha elongata* Group in West Sarawak. *Gard. Bull. Sing.* 61(1): 221–238.