

NOTES ON THE GENUS AMORPHOPHALLUS (ARACEAE) – 11 NEW AND OBSOLETE SPECIES FROM EAST MALAYSIA AND CONTINENTAL SOUTHEAST ASIA

W.L.A. HETTERSCHIED¹ & R.W.J.M. VAN DER HAM²

SUMMARY

Sixteen new *Amorphophallus* (Araceae) species from East Malaysia, Thailand and Vietnam are described and figured. Moreover, six species, four of which were originally published by the first author, are synonymized.

Key words: *Amorphophallus*, Araceae, Asia, Malesia, taxonomy.

INTRODUCTION

All species described in the present paper were collected in the late eighties and early nineties of the last century, and subsequently cultivated in botanical gardens. The type specimens were prepared from cultivated plants. All material cited has been examined by the first author. He also made the photos of the plants, unless stated otherwise. The second author provided the pollen data and micrographs. Plant persons who contributed to the knowledge of both authors of several species were invited to act as second or third author of the names of the relevant species. Without their help, many data would not have been available to the authors of this paper.

DESCRIPTIONS

1. *Amorphophallus amygdaloïdes* Hett. & M. Sizemore, *spec. nov.* — Fig. 1a, b, 9a

Amorphophallo putii persimilis, staminodis inter partes masculinas femineas gaudenti, stigmatibus duplo maioribus rotundatioribus differt. — Typus: *Hetterscheid H.A.M. 969-T* (holo L, spirit coll.), Thailand, Kanchanaburi prov., route 323, 7 km south of Three Pagodas Pass (coll. from a plant cultivated in the Leiden Botanical Garden, 27 June 1999; orig. coll. *M. Sizemore*).

Tuber depressed globose, brown, 10 cm diam., 6 cm high, seasonally producing a few short rhizomatous offsets, these easily detaching from the main tuber. *Petiole* to 70 cm long, to 1.5 cm diam., smooth, pale green with many circular or elliptic indistinct whitish spots; *lamina* 120 cm diam., rachises winged distal from the basal branchings; *leaflets* elliptic-lanceolate, acuminate, to 18 cm long, to 6 cm diam., upper surface

1) Chrysantenstraat 28, 1214 BM Hilversum, The Netherlands.

2) Nationaal Herbarium Nederland, Universiteit Leiden branch, P.O. Box 9514, 2300 RA Leiden, The Netherlands.

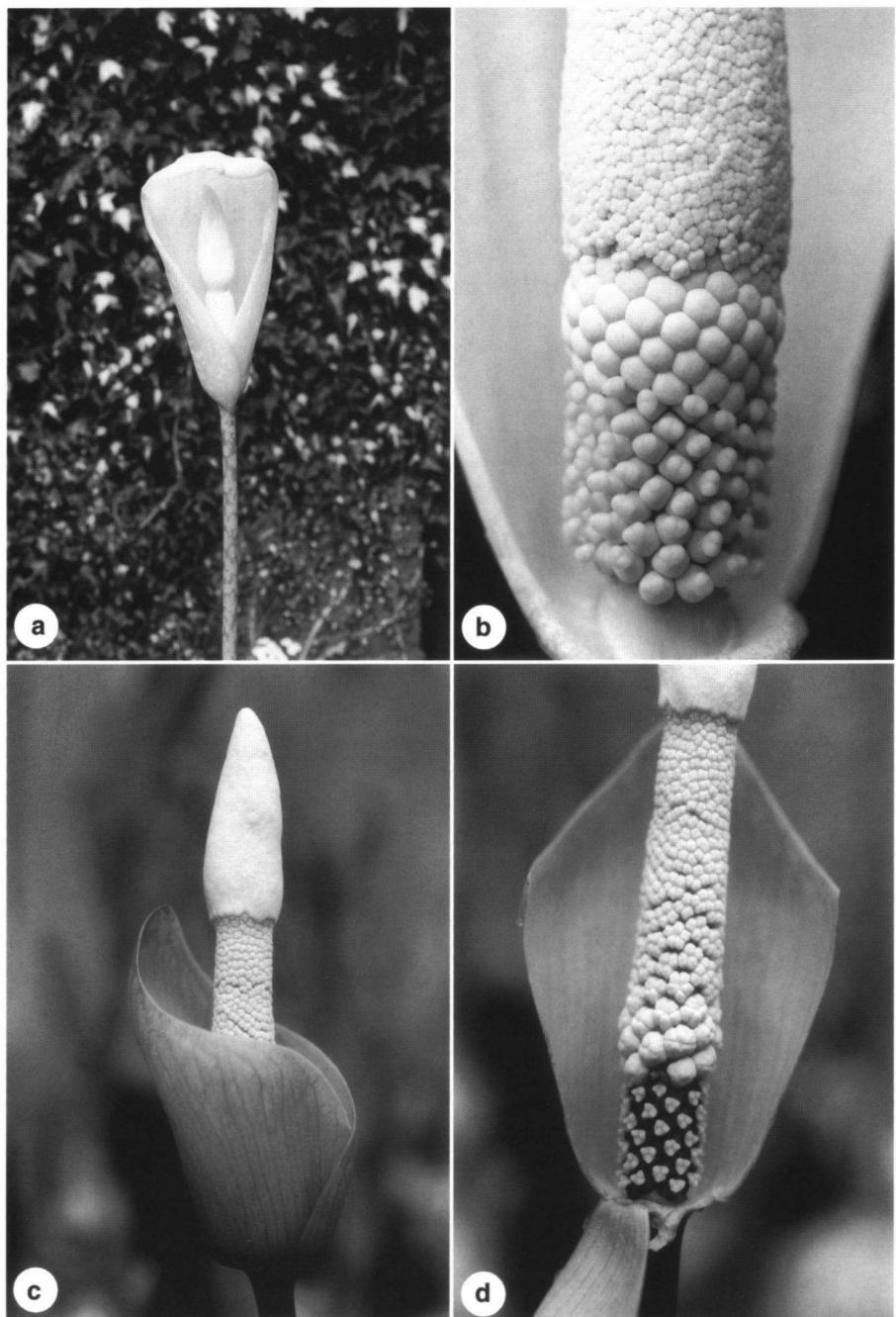


Fig. 1.—a & b. *Amorphophallus amygdalooides* Hett. & M. Sizemore. a. Inflorescence, front view; b. spadix (base) [Hettterscheid H.A.M.969, type plant].—c & d. *A. atrorubens* Hett. & M. Sizemore. c. Inflorescence, front view; d. spadix (lower part) [Hettterscheid H.A.M.737, type plant].

mid-green. *Inflorescence* solitary, long peduncled; *peduncle* to 47 cm long, to 1.2 cm diam., as petiole; *spathe* elliptic, to 24 cm long, to 20 cm diam., strongly concave, fornicate, acute, base coriaceous, shortly convolute, outside pale green with whitish green spots, inside uniformly whitish green but for a very small pinkish zone at the base, base within smooth. *Spadix* shorter than spathe, stipitate (stipe 0.5–1 cm long), 15 cm long; *female zone* cylindric, 2 cm long, 2 cm diam., flowers congested; *male zone* cylindric, top slightly truncated, 4 cm long, 2 cm diam., flowers congested; *sterile zone* between male and female zone short, slightly fusiform, 1 cm long, 2.2 cm diam., entirely covered with congested staminodes; *appendix* fusiform-conical, 8 cm long, 2.7 cm diam., base constricted, top subacute, surface smooth, creamy white, developing a strong almond-like scent at female anthesis. *Ovaries* depressed, mostly quadrangular in outline, 2 mm high, 2.5 mm diam., top truncated, whitish green, bilocular; *style* 1 mm long, 1.3 mm diam., whitish green; *stigma* hemispherical, elliptic in outline, 1 mm high, 2–3 mm diam., shallowly bilobed, lobes obtuse, surface verruculate, pale yellow. *Male flowers* consisting of 4 or 5 stamens; *stamens* 3 mm long; *filaments* 1 mm long, partly or entirely connate, creamy white; *anthers* elongate, 2 mm long, 1 mm diam., truncate, creamy white; pores apical, elongate, connecting with the margin through a groove; *pollen* striate, ellipsoidal (length/breadth 1.36), 61 µm long. *Staminodes* depressed, 2.5–3 mm long, 3–4 mm diam., angulate, top slightly hemispheric, smooth, creamy white.

Etymology—The species epithet refers to the almond-like scent of the spadix produced at female anthesis.

Distribution—Thailand, known only from the type locality.

Note—A member of the *A. yunnanensis*-alliance but the only known member with staminodes. *Amorphophallus amygdalooides* is in all other aspects very similar to *A. putii* Gagnep. (Thailand).

2. *Amorphophallus atrorubens* Hett. & M. Sizemore, spec. nov. — Fig. 1c, d, 9b

Amorphophallo pygmaeo similis, laminis supra modice viridibus infra pallide viridibus, spathe pallide ad atro-castanea, floribus masculis infimis valde pyramidaliter inflatis, stigmatibus valde triangularibus differt. — Typus: *Hetterscheid H.AM.737-T* (holo L, spirit coll.), Thailand, Loei prov., along route 201, near Pha Nok Khan (coll. from a cultivated plant in the Leiden Botanical Garden; orig. coll. *M. Sizemore*).

Tuber short, irregularly elongate, 7 cm long, 4 cm diam., base with few short branches, older parts dark brown, young parts white. *Petiole* short, to 18 cm long, to 0.8 cm diam., smooth, turgid, dark greyish brown; *lamina* to 68 cm diam., rachises unwinged; *leaflets* elliptic, to 22 cm long, to 8 cm diam., acuminate, upper surface slightly glossy green. *Inflorescence* solitary, long peduncled; *peduncle* 13–23 cm long, 4–7 mm diam., dirty greenish brown to dark reddish brown, smooth, glossy; *spathe* erect, broadly ovate, 7–8 cm long, 8–10 cm diam., opening slightly around the spadix at female anthesis, base truncated, not separated from the limb, outside pale bronze green with brown veins, top purplish brown, inside pale greyish green, margin slightly concave, top broadly acute, base within smooth. *Spadix* sessile, longer than spathe, 8–10.5 cm long, slightly bending forward; *female zone* cylindric, 0.5–1.3 cm long, 1 cm diam., flowers slightly distant; *male zone* elongate conical, 3–4 cm long, 1–1.3 cm diam., lower flowers slightly distant, upper ones congested, or all congested; *sterile zone*

between male and female zone 0.7 cm long, 1.1–1.4 cm diam., staminodial; *appendix* short conical, 3.7–4 cm long, 1.2–1.5 cm diam. at the base, laterally compressed or terete, top obtuse, surface smooth, off-white with a faint greenish flush, emitting a powerful gaseous smell in the first half of the day. *Ovaries* depressed, 3 mm diam., 1.5 mm high, pale green, upper part purplish or entirely purplish, unilocular; *style* c. 1 mm long, 1 mm diam., ridged, purplish; *stigma* large, depressed, 2.5 mm diam., 1 mm high, moderately or strongly and deeply trilobed, lobes conical, surface papillate-flaky, white. *Male flowers* consisting of 4 or 5 stamens; *stamens* 1.2–2 mm long; *filaments* 0.2–1 mm long, connate, off-white, those in the lowermost flowers strongly enlarged; *anthers* 1 mm long, 1–2 mm diam., truncated, off-white; pores apical, connective broad, pale green, usually extending down to the lateral sides; *pollen* striate, ellipsoidal (length/breadth 1.74), 77 µm long. *Staminodes* broadly conical, rhombic in outline, base slightly constricted, top with a distinct depression or with a 3- to 5-rayed groove representing the borderlines of sterile stamens, c. 5 mm diam., c. 3 mm high, off-white.

Etymology — The species epithet refers to the colour of the spathe.

Habitat & Ecology — In heavy shade at the base of a limestone outcrop.

Distribution — Thailand, known only from the type locality.

Note — The inflorescence of *A. atrorubens* is quite similar to that of *A. pygmaeus* Hett. (Thailand) but differs in having strongly triangular stigmas and staminodes between the male and female zones. The leaf of *A. atrorubens* lacks the deep reddish purple lower surface typical of *A. pygmaeus*. The pyramidal near-synanthorous lower male flowers are shared with *A. saururus* Hett. (Thailand, this publication) and *A. synandrifer* Hett. & V.D. Nguyen (Vietnam, this publication).

3. *Amorphophallus boyceanus* Hett., spec. nov. — Fig. 2a, b, 9c

Amorphophallo variabilis similis, spatha non constrictus. — Typus: *Heiterscheid H.A.M.*

515-T (holo L, spirit coll.), Thailand (peninsular), Satun prov., Tale Ban (coll. from a plant cultivated in the Leiden Botanical Garden; orig. coll. M. Sizemore).

Tuber subglobose, 6 cm diam., 4.5 cm high, white, developing many offsets, these short, thick rhizomatous or with a swollen top, to 2.5 cm long, 1.5 cm diam., often with additional small offsets themselves. *Leaves* 2 or 3 simultaneous or in succession; *petiole* smooth, to 50 cm long, 1 cm diam., background dark brown, with many scattered or confluent, elongate elliptic spots, these brown with a whitish margin or entirely dirty whitish, or brownish with a white margin and a white spotted central region; *lamina* to 70 cm diam., rachises winged in the distal half; *leaflets* elliptic-lanceolate, to 17 cm long, to 6 cm diam., acuminate, base not or hardly decurrent. *Inflorescence* solitary, long peduncled; *peduncle* 25–30 cm long, 1 cm diam., as petiole; *spathe* elongate triangular, 11–12 cm long, 5–6 cm diam., acute, a very shallow constriction on the dorsal side, base convolute, outside background pale green or dirty greyish green, with scattered or nearly entirely covered by dark to mid-brown spots, often confluent, large and tiny, in between with or without a few scattered irregular pale green spots, inside whitish with a green flush, near the top with tiny purplish dots and a few veins purplish, base pale yellow or dark orangish yellow, with numerous shallow verrucae, especially on the dorsal side. *Spadix* sessile, longer than spathe, 20–28 cm

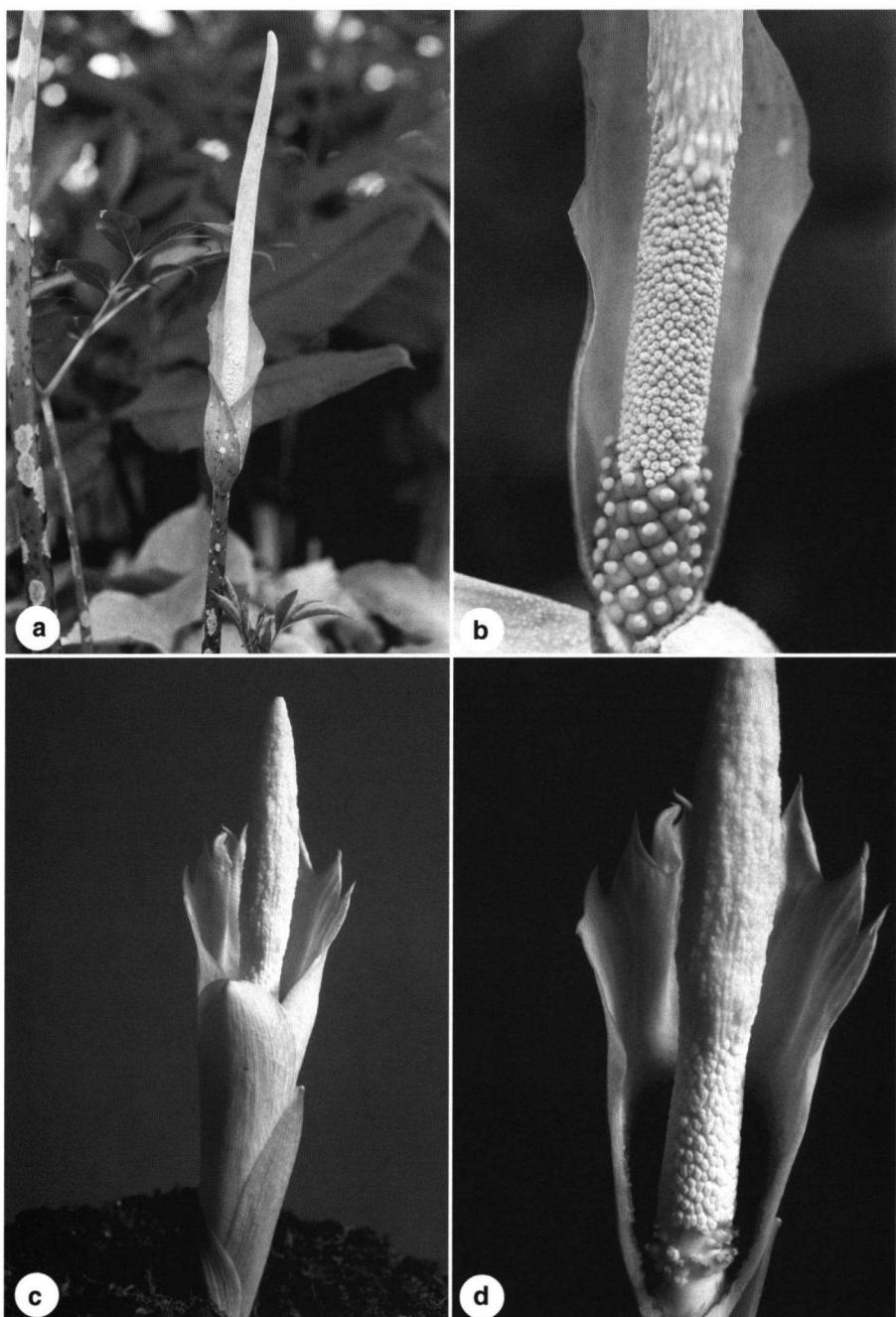


Fig. 2.—a & b. *Amorphophallus boyceanus* Hett. a. Inflorescence, front view; b. spadix (lower part) [Hetterscheid H.AM.530].—c & d. *A. brachyphyllus* Hett. c. Inflorescence, front view (photo: A. Vogel); d. spadix (lower part) (photo: A. Vogel) [Hetterscheid H.AM.032C, type plant; the lacrate spathe margin is an aberration].

long; *female zone* cylindric, 1.5–2.5 cm long, 1.2–1.3 cm diam., flowers congested; *male zone* cylindric, 3.5–5 cm long, 0.9–1.2 cm diam., terete or slightly laterally compressed, flowers congested; *appendix* 14–20 cm long, to 1.3 cm diam., elongate conic, narrow, terete or laterally compressed, base or lower half with short, shallow ridges, sometimes accompanied by shallow conical staminodes, upper half smooth, apex subacute, surface dirty pale yellowish brown or dirty creamish. *Ovaries* depressed, prismatic, 4 mm diam., 2 mm high, bright green, bilocular; *style* short or very short, curved upwards or nearly straight, 0.3–1 mm long, 0.8 mm diam., bright green; *stigma* slightly depressed, 2 mm diam., 1.5 mm high, shallowly bi- or trilobed, lobes slightly hemispheric, obtuse, surface yellowish, verruculate. *Male flowers* consisting of 3 or 4 stamens; *stamens* c. 2 mm long; *filaments* c. 0.8 mm long, fused only at the base, off-white; *anthers* c. 1.2 mm long, c. 1 by 2 mm diam., rectangular, off-white; pores apical, elongate, connective flat or sunken, dirty greyish green turning creamish; *pollen* striate (muri rather coarse and irregular), ellipsoidal (length/breadth 1.36), 50 µm long. *Fruiting part* of infructescence 7 cm long, 2 cm diam., cylindric; *berries* subglobose, 0.8 cm long, 0.8–1 cm diam., bright red, 1- or 2-seeded; *seeds* subhemispheric, to 0.8 mm diam., and 0.6 mm thick, greyish black, with whitish dots, raphe short, irregular.

Etymology — This species is named in honour of the first authors' good friend and colleague Peter Boyce (RBG Kew), who collected valuable information on *Amorphophallus* during his many expeditions in SE Asia.

Distribution — Thailand, known only from the type locality.

Note — *Amorphophallus boyceanus* resembles most closely *A. elegans* Ridl. (West Malaysia, Peninsular Thailand), but the latter has a much shorter and straight style and the spathe is broadly triangular, the petiole and peduncle are verruculate. The Javan *A. variabilis* Blume is also very similar but has a distinctly narrowed base of the spathe limb and many more and smaller annual offsets and the appendix usually being three times or more the length of the fertile part of the spadix.

Additional material: *Heiterscheid H.AM.530* (cult. in Leiden Bot. Gard.), type locality.

4. *Amorphophallus brachyphyllus* Hett., spec. nov. — Fig. 2c, d, 9d, e

Amorphophallo eburneo persimilis, petioli longitudine dimidio vel minore, foliolis centra-libus petiolatis, cataphyllis semper eburneis, stigmatis longitudine dimidio differt. —

Typus: *Heiterscheid H.AM.032C-T* (holo L, spirit coll.), Malaysia, Sarawak, 1st Div., Bau distr., exact loc. unknown (coll. from a plant cultivated in the Leiden Botanical Garden; orig. coll. P. Keßler EVK 246).

Tuber depressed globose, with irregular raised areas, to 32 cm diam., to 15 cm high, surface with a grey, corky layer. *Petiole* short, to 50 cm long, to 5 cm diam., uniformly green, very turgid; *lamina* to 188 cm diam., highly dissected, rachises naked; *leaflets* elliptic-lanceolate, to 35 cm long, to 11 cm wide, those on the most proximal parts of the rachises petiolulate, upper surface mid-green, slightly glossy or dull, texture slightly coriaceous. *Inflorescence* solitary, short peduncled; *cataphylls* off-white; *peduncle* 8–13 cm long, 1–2.2 cm diam., entirely subterranean, white with a faint greenish flush, smooth, very tightly enveloped by the cataphylls; *spathe* erect, suborbicular, often broader than long, 10–13.5 cm long, 11.5–16 cm diam., limb obliquely spreading at female anthesis, erect at male anthesis, base tubular, strongly convolute, largely hidden in cataphylls, outside spathe entirely off-white, inside similar but base reddish

purple, base within with scattered small warts or coarsely grooved, grooves distinctly verruculate. *Spadix* longer than spathe, stipitate, 13.5–21 cm long; *stipe* massive, oblique, off-white, 0.6–1 cm long, 1.6 cm diam. (base); *female zone* 1.5–2.5 cm long, 1.5–2.3 cm diam., slightly conic, flowers in vertically separate, horizontal, sinuous chains; *male zone* conic, 3–4.5 cm long, 1.1–2.2 cm diam., flowers arranged as female flowers but chains closer together, or partly or entirely fused vertically, sometimes forming vertical chains; *appendix* fusiform, 8–14 cm long, 1.2–2.8 cm diam., slightly laterally compressed, subacute, yellowish white, surface rugulose and with narrow, shallow grooves, producing a strong smell of fried fish and oozing out droplets at female anthesis. *Ovaries* ovate or slightly depressed, 2–3 mm diam., 2.5–3 mm high, base off-white, top dirty reddish brown, unilocular, one basal ovule; *style* excentrically placed, consisting of three acute branches, two acrosopic small ones and one basiscopic longer one, pale dirty reddish brown, c. 1.5 mm diam., 0.3–0.8 mm long; *stigma* thin, c. 1.5 mm diam., c. 0.5 mm high, irregularly, shallowly lobed-sinusoid, surface very pale dirty brownish, verruculate. *Male flowers* consisting of c. 3 stamens but pattern often obscured by lateral and vertical fusion of flowers; *stamens* c. 1 mm high, c. 1–2 mm diam., often fused with adjacent stamens; *filaments* c. 0.5 mm long, entirely connate; *anthers* c. 0.5 mm long, truncate, often entirely connate, ivory-white; pores apical, rounded, oval or variously elongate, often confluent with adjacent pores in various ways; *pollen* striate, ellipsoidal (length/breadth 1.15), 47 µm long, or fossulate to coarsely striate, spheroidal (length/breadth 1.09), 39 µm long.

Etymology — The species epithet refers to the very short petiole relative to the diameter of the lamina.

Habitat & Ecology — On rocky limestone slopes, in humus layer or clay.

Distribution — E Malaysia, Sarawak (endemic).

Note — *Amorphophallus brachyphyllus* is a close relative of *A. eburneus* Bogner (Malaysia, Sarawak) and the inflorescence is deceptively similar. However, there is a marked difference in leaf morphology. In *A. eburneus* the leaf has a long petiole (to 120 cm) relative to the lamina diameter (the reverse in *A. brachyphyllus*); the lamina in *A. eburneus* is much less strongly divided, the leaflets are distinctly larger (to 60 cm) and never petiolulate. The cataphylls of *A. eburneus* are greyish brown, those in *A. brachyphyllus* off-white. These vegetative differences have been observed several times in cultivation and in the habitat and remain constant, even though both species occur in the same areas and habitats. Notable differences in the inflorescence are: the stigma of *A. eburneus* is twice as large as that in *A. brachyphyllus* and the pistils are much more regularly placed and more congested. Bogner's (1989) observation of bilocular ovaries in *A. eburneus* could not be confirmed after investigating several inflorescences, in which all ovaries were unilocular.

Additional material: *Hetterscheid H.AM.031A* (L), Sarawak; *Vogel 940011* (L, cult. in Bot. Garden, *Hetterscheid H.AM.402*), Sarawak, 1st Div., Padawan; *Vogel 940012* (L, cult. in Bot. Garden, *Hetterscheid H.AM.394*), Sarawak, 1st Div., Padawan; *Vogel 970518* (L, cult. in Bot. Garden, *Hetterscheid H.AM.1045*), Sarawak, exact loc. unknown; *Vogel 970519* (L, cult. in Bot. Garden, *Hetterscheid H.AM.1044*), Sarawak, exact loc. unknown; *Vogel 970520* (L, cult. in Bot. Garden, *Hetterscheid H.AM.1042*), Sarawak, exact loc. unknown; *Vogel 970606* (L, cult. in Bot. Garden, *Hetterscheid H.AM.1043*), Sarawak, exact loc. unknown; *Vogel 970607* (L, cult. in Bot. Garden, *Hetterscheid H.AM.1037 & 906*), Sarawak, 4th Div., Mulu; *Vogel 970616* (L, cult. in Bot. Garden, *Hetterscheid H.AM.895*), Sarawak, 4th Div., Niah.

5. *Amorphophallus dzui* Hett., spec. nov. — Fig. 3a, b, 9f

Amorphophallo subpedato similis, appendice parte mascula non latiore, staminodiis inter partes masculas et feminineas gaudenti differt. — Typus: *Hetterscheid H.A.M.523-T* (holo L, spirit coll.), N Vietnam, Ninh Binh prov., Cuc Phuong National Park (coll. from a plant cultivated in the Leiden Bot. Garden, orig. coll. V.D. Nguyen s.n.).

Tuber shortly elongate, broad, 10 cm diam. at the top, c. 20 cm long, branched in the lower half. *Petiole* 19–24 cm long, 1–1.5 cm diam., smooth, pale green to whitish green; *lamina* 60–90 cm diam., rachises largely unwinged; *leaflets* elongate oblong, acute-acuminate, to 24 cm long, 6–8 cm diam., leathery, margin more or less strongly undulate, upper surface glossy green, lower surface moderately glossy pale green. *Inflorescence* solitary, long (and short?) peduncled; *peduncle* (3–)9 cm long, 5–10 mm diam., smooth, greyish green; *spathe* broadly triangular, broader than long, 3–9 cm long, 4–11.5 cm diam., convolute, limb strongly reduced, strongly clasped around the male zone during anthesis, top obtuse, separated from the base by a very shallow constriction or not, base outside greyish green or pale grey with or without dark grey small spots and blackish veins, the margin pale grey, inside blackish maroon, the base a little paler, limb outside dark greyish or dark brownish purple, inside paler and spotted dark maroon, base within smooth or grooved. *Spadix* much longer than spathe, sessile, 14.5–26 cm long; male zone extending well beyond the spathe; *female zone* cylindric, 0.5–2.5 cm long, 0.7–1.7 cm diam., flowers congested; *male zone* cylindric, 4–8.5 cm long, 0.7–1.8 cm diam., flowers congested, or slightly distant; *sterile zone* between male and female zone 0.5–1.5 cm long, 0.7–2.2 cm diam., staminodes congested; *appendix* narrowly conical, slightly or distinctly constricted at the base, 9.5–13 cm long, 1–2.2 cm diam. near the base, acute, smooth or shallowly rugulose, off-white. *Ovaries* depressed, irregularly angulate-lobate in cross section, 2 mm diam., 1 mm high, narrowed to the base in a short pedicel, pale green, top flushed maroon, unilocular; *style* short, thick, conical, c. 0.5 mm long, c. 1 mm diam., pale green or flushed maroon; *stigma* depressed, 1.2–2 mm diam., c. 0.6 mm high, trilobed, lobes conical, resulting in obtuse undulations of the margin. *Male flowers* consisting of 4–6 stamens; *stamens* 1–1.5 mm diam., 1.2–2 mm long; *filaments* 0.2–0.8 mm long; *anthers* truncated, c. 1 mm long, off-white, the connective much broadened, almost rhombic, distinctly raised, orangish, remaining prominent after male anthesis; pores aligning the margin of the connective, laterally connected to form one halfmoon-shaped pore per anther, laterally displaced after anthesis; *pollen* striate, ellipsoidal (length/breadth 1.64), 67 µm long. *Staminodes* depressed, irregular in cross section, 1.5–4 mm diam., c. 1.4 mm long, the lowest ones small, the upper ones large and with distinct grooves, representing the outline of the once anthers, off-white, smooth or shallowly rugulate.

Etymology — The species epithet refers to Mr. Nguyen Van Dzu (IEBR, Hanoi), whose studies of the Araceae of Vietnam and fieldtrips have yielded invaluable information on Vietnamese *Amorphophallus*.

Distribution — N Vietnam, known only from the type locality.

Note — *Amorphophallus dzui* resembles closely *A. subpedatus* Hett. & V.D. Nguyen (N Vietnam; to be publ. in Novon). The latter has a very distinct subpedate leaf form, upper leaflet surface not glossy, no staminodes between male and female zone, stigmas half the size and an appendix much broader than the diameter of the male zone.

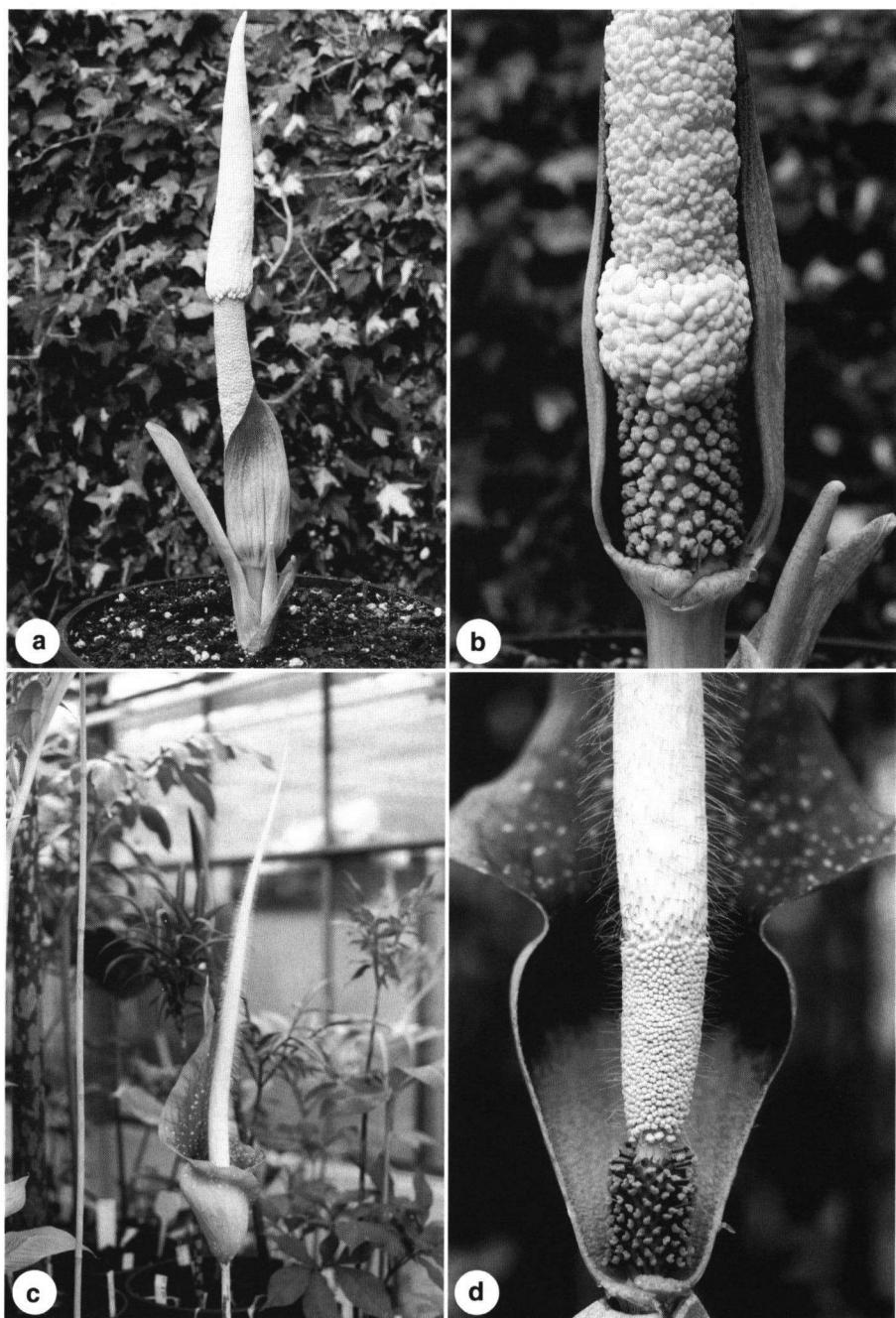


Fig. 3.—a & b. *Amorphophallus dzui* Hett. a. Inflorescence, side view; b. spadix (lower part) [Hetterscheid H.AM. 523, type plant].—c & d. *A. longicomus* Hett. & Serebryanyi. c. Inflorescence, side view; d. spadix (lower part) [Hetterscheid H.AM. 177, type plant].

6. *Amorphophallus longicomus* Hett. & Serebryany, spec. nov. — Fig. 3c, d, 9h

Amorphophallo piloso similis, tubere depresso globoso, folioli marginibus purpureo-rubris, petiolo glabro, sine staminodiis inter partes masculas et feminas differt. — Typus: *Hetterscheid H.A.M.177-T* (holo L, spirit coll.), Vietnam, Gia Lai prov., Mang Yang distr., 20 km NW of Can Ha Na, forestry Station nr. 2. (coll. from a plant cultivated in the Leiden Botanical Garden; orig. coll.: *Cherevchenko & Bogatyr s.n.*, 1 March 1991, living tuber).

Tuber globose, no offset development, 7 cm diam., 7 cm high. *Petiole* 95 cm long, 1.3 cm diam., background dark olive green with numerous scattered, small, slightly raised, blackish dots and scattered, large, whitish greenish spots, these partly confluent and with slightly raised, white, verrucate margins; *lamina* to 100 cm diam., rachises narrowly or broadly winged distal from the basal main branchings; *leaflets* elliptic to elliptic-lanceolate, acuminate, 8–15 cm long, 3–4.5 cm diam., upper surface rich deep velvety green with a narrow, lilac purple undulate margin. *Inflorescence* solitary, long peduncled; *peduncle* solitary, 120 cm long, 1.8 cm diam., as petiole; *spathe* erect, 36 cm long, 28 cm diam., elongate triangular, base and limb separated by a strong constriction, top acute, base outside greyish green with scattered, indistinct whitish orbicular spots and scattered dark green dots, these slightly raised, veins brownish, inside lower 1/3 to 2/3 parts bright greenish yellow, rest maroon with scattered whitish orbicular spots, limb lower part somewhat auriculate, upper part pressed against the appendix, margin slightly undulate, top slightly twisted, outside with a strongly raised midrib, greyish green with scattered whitish orbicular spots, the upper margins flushed pale purple, inside pale maroon with numerous whitish orbicular spots, margins greenish, base within densely covered by short, flaky warts, often forming short transverse ridges. *Spadix* sessile, much longer than spathe, 66 cm long; *female zone* cylindric, 3.5 cm long, 2.5 cm diam. (incl. styles), flowers slightly distant; *male zone* elongate obconical, 5.5 cm long, 2 cm diam. at the top, flowers congested and with scattered hairlike staminodes in between; *sterile zone* between male and female zone 0.5 cm long, carrying a few scattered hairlike staminodes; *appendix* elongate conical, c. 57 cm long, 2.5 cm diam. just above the base, base slightly constricted, top acute, wall very thin, rest hollow, surface bright yellow, upper part with a faint purplish flush, entirely densely covered with long, hairlike staminodes. *Ovaries* depressed, 2.5 mm diam., 1.5 mm high, purple, bilocular; *style* slender, 5 mm long, 1 mm diam., purple; *stigma* elliptic in outline, deeply bilobed, 2.5 mm diam. (long axis), 1.5 mm high, lobes conical, subacute or obtuse, surface densely scabrate, dirty yellow. *Male flowers* consisting of 4–6 stamens; *stamens* 2 mm long; *filaments* 0.8 mm long, connate at the base, yellowish; *anthers* 1.2 mm long, 1 mm diam., orange-yellow; pores apical, elongate, connective broad; *pollen* orange, psilate, spheroidal (length/breadth 1.02), 83 µm long. *Staminodes* in the male zone hairlike with a swollen base, representing the defunct stamen, 8–10 mm long, hairlike part purplish; *staminodes* on the sterile zone as previous; *staminodes* on the appendix with a slightly ridge-like base, otherwise as previous.

Etymology — The species epithet refers to the long, hairlike staminodes on various parts of the spadix.

Distribution — S Vietnam, known only from the type locality.

Note.—*Amorphophallus longicomus* is a member of the *A. hirtus*-alliance (Engler's section *Dysamorphophallus*). The long, densely hairy appendix ally this species morphologically to *A. hirtus* N.E. Br. from Taiwan, but it differs primarily from that species in having much longer styles, free filaments and a tuber not producing offsets. Inflorescences similar to that of *A. longicomus* are found in *A. pilosus* Hett. (N Vietnam) and *A. laoticus* Hett. (Laos). Both, however, have elongate tubers. Additionally, *A. pilosus* has a short style (1 mm) and an entirely velvety petiole. *Amorphophallus laoticus* has sessile anthers.

7. *Amorphophallus obscurus* Hett. & M. Sizemore, spec. nov. — Fig. 4a—c

Amorphophallo pusillo persimilis, spathe parte dimidio inferiore angustata, stigmate fere sessili structura symmetrica. — Typus: *Hetterscheid H.A.M. 1148-T* (holo L, spirit coll.) Thailand, Ubon Ratchathani prov., Pha Taem (coll. from a cultivated plant in Leiden Bot. Garden; orig. coll. M. Sizemore).

Tuber elongate, to 3 cm long, 1 cm diam. *Petiole* 6 cm long, 2 mm diam., pale green; *lamina* 8 cm diam., consisting of only 5 leaflets; *leaflets* elliptic-obovate, to 5 cm long, to 3 cm diam., acuminate, upper surface green with few or numerous small, rounded, white spots. *Inflorescence* solitary, short peduncled, partly subterranean; *peduncle* 1 cm long, 2 mm diam., smooth, white, entirely subterranean; *spathe* tubular, swollen in the middle, 1.7–2 cm long, 3.5–3.8 cm diam., lower part of the base convolute with margins shortly overlapping and fused along a line close to the margins, upper part of the base convolute, outside pale purplish, inside smooth, densely purple punctate, limb slightly dilated then shallowly constricted towards the narrow collar-like upper part, outside dilated part whitish, inside white, outside upper part densely brownish purple punctate or uniformly dark brown, inside similar, margin slightly undulating. *Spadix* sessile, longer than spathe, 7.5 cm long; *female zone* consisting of one whorl of flowers or only 2 or 3 isolated ones, 2 mm long, 4 mm diam., flowers distant; *sterile zone* 3 mm long, naked or with one or a few staminodes; *male zone* cylindric, 1 cm long, 2.5 mm diam., flowers distant; *appendix* erect, elongate, narrowly conical or nearly terete, near filiform, 6 cm long, 2 mm diam., smooth, dirty brownish, the base with or without an indistinct purplish flush. *Ovaries* depressed, 1 mm diam., c. 0.7 mm high, the acroscopic side slightly higher ('stylar region'), basal half white, upper half dirty purplish, white punctated, unilocular; *style* ('stylar region') 0.2 mm long, 0.4 mm diam.; *stigma* depressed, c. 0.8 mm diam., c. 0.5 mm high, shallowly bilobed, surface densely papillate, dirty brownish purple. *Male flowers* consisting of 1–3 stamens; *stamens* 1–1.3 mm long; *filaments* 0.3 mm long, fused, white or purplish with white punctations; *anthers* truncated, 0.7–1 mm long, 1–1.5 mm diam., off-white, sometimes flushed dirty purple; pores apical, slit-like; *pollen* unknown. *Staminodes* cushion-shaped or conical, depressed, c. 1 mm diam., 0.7–1 mm high, colour as ovaries.

Etymology—The species epithet refers to the diminutive size and sand-like coloration of the spathe, making it easy to overlook.

Distribution—Thailand, known only from the type locality.

Note—*Amorphophallus obscurus* is obviously closely allied to *A. pusillus* Hett. & Serebryanyi (Vietnam) and *A. polyanthus* Hett. & M. Sizemore (Thailand, this publication) sharing the diminutive proportions, colour patterns and leaf shape. *Amor-*

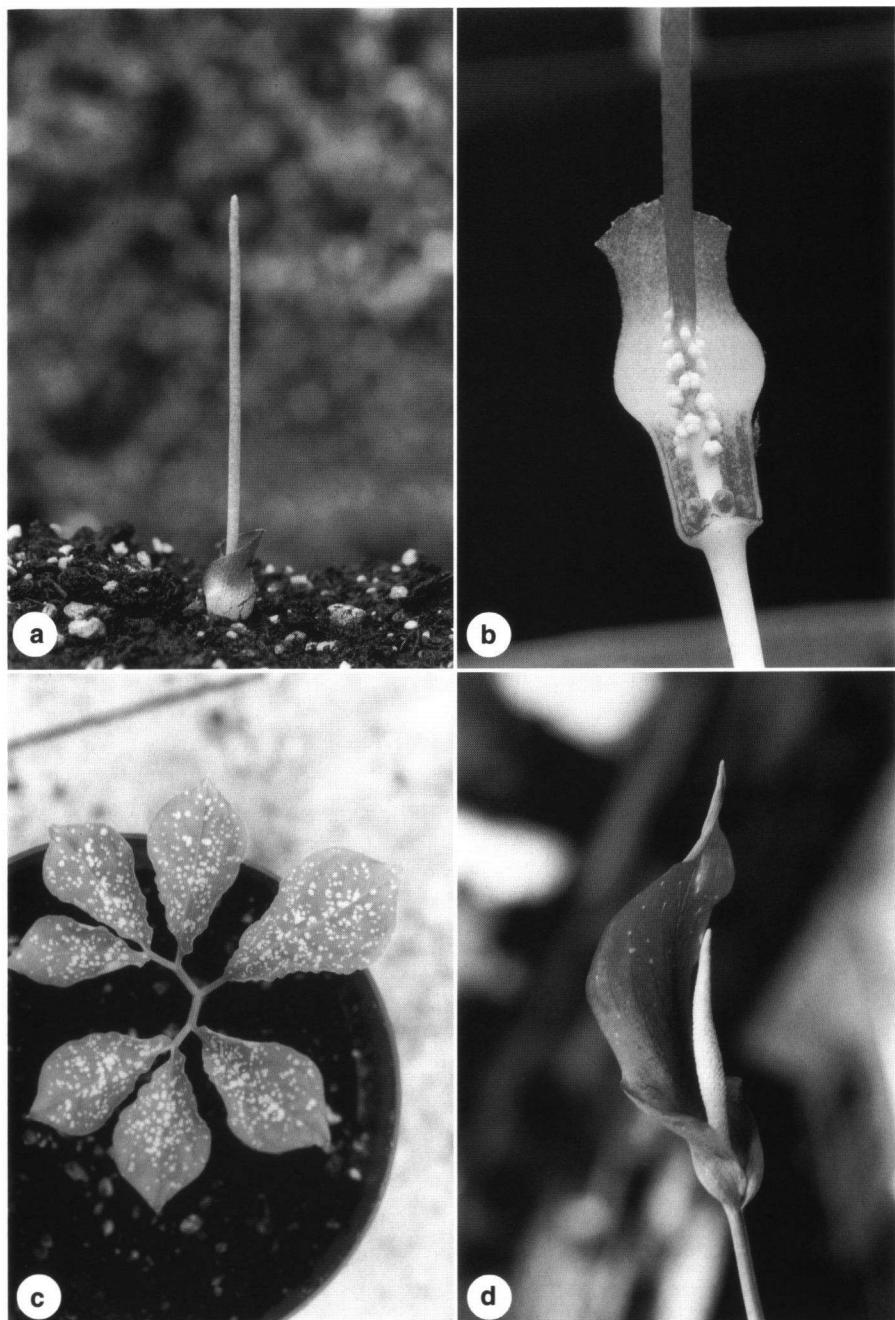


Fig. 4. — a–c. *Amorphophallus obscurus* Hett. & M. Sizemore. a. Inflorescence (base subterraneus); b. spadix (lower part); c. leaf, seen from above [a & b: *Hetterscheid H.AM. 1147*; c: *Hetterscheid H.AM. 1148*, type plant]. — d. *A. venustus* Hett., A. Hay & J. Mood. Inflorescence, side view (photo: A. Hay) [Hay et al. 12042, type plant].

phophallus obscurus mostly resembles *A. pusillus*, from which it differs in having almost no style, a regular, depressed stigma, a thinner and longer appendix and a more tubular spathe.

Additional material: *Hetterscheid H.A.M.1147* (L, spirit coll.; cult. in Leiden Bot. Garden; orig coll. *M. Sizemore*), type locality.

8. *Amorphophallus ochroleucus* Hett. & V.D. Nguyen, spec. nov. — Fig. 5a, b, 9g

Amorphophallo albo similis, inflorescentia juxta folium evoluta, foliis bulbillis intercalaribus gaudentibus differt. — Typus: *Hetterscheid H.A.M.927-T* (holo L, spirit coll., flowering 22 February 1998), Vietnam, Gia Lai prov., K'bang distr. (coll. from a plant cultivated in the Leiden Bot. Garden; orig. coll. *Averyanov* 4747).

Tuber depressed globose, to 15 cm diam., to 10 cm high, no offset development. *Petiole* 40–60 cm long, 2–3 cm diam., turgid, smooth, bright green with numerous, blackish or very dark reddish purple, small, irregular or elliptic or rounded spots; *lamina* to c. 120 cm diam., rachises unwinged; *leaflets* distant, the most proximal ones short petiolulate, elliptic to elongate elliptic, acuminate, leathery, to 26 cm long, to 7 cm diam., acuminate. *Inflorescence* simultaneous with leaf but appearing several months later, long peduncled; *peduncle* 18–21 cm long, 0.8–1 cm diam., yellowish green, otherwise spotted as petiole; *spathe* erect, elongate ovate, 11–17 cm long, 9–10 cm diam., acute, base and limb hardly differentiated, outside pale dirty yellowish or pinkish, with very indistinct greenish flushes and scattered dark reddish brown or blackish dots, often concentrated around the midrib and near the base and there confluent to form narrow bands lengthwise or patches, the margin very faintly flushed with pinkish purple, inside as outside but unspotted, or only a few blackish spots near the top, base within densely but very shallowly rugulose. *Spadix* sessile, slightly longer than the spathe, 12–23 cm long; *female zone* cylindric or slightly obconic, 2 cm long, 1.5–2.5 cm diam., terete or slightly dorsoventrally compressed; *male zone* cylindric or slightly conic, dorsoventrally compressed, 4–8 cm long, 1.2–3 cm diam., flowers congested; *sterile zone* between female and male zone thickened, slightly conical, base truncate, 0.6–1.2 cm long, 1.4–3 cm diam., staminodes congested; *appendix* fusiform-conical, dorsoventrally compressed, 5–11 cm long, 1.4–3 cm diam. slightly above the base, obtuse, surface smooth with scattered, very shallow depressions, white, producing a strong gaseous smell during female anthesis. *Ovaries* angulate, 3 mm diam., 1.8 mm high, bilocular, pale green; *style* conical, 1 mm long, 1.2 mm diam. at the base, 0.8 mm diam. at the top, yellowish white; *stigma* subglobose or depressed, 2 mm diam., 1–1.5 mm high, sinuously bilobed or very shallowly bilobed, surface densely verruculate, off-white or pale yellow, lobes/sinuses obtuse, shallow. *Male flowers* consisting of 4 or 5 stamens; *stamens* 2 mm long; *filaments* 1 mm long, basally connate, off-white; *anthers* 1–2 mm diam., 1 mm long, truncated, off-white; pores apical, near the margin, slit-like when closed, oval when open, connective broad; *pollen* reticulate, ellipsoidal (length/breadth 1.50), 60 µm long. *Staminodes* rhombic, flat, to c. 5 mm diam., off-white.

Etymology — The species epithet refers to the whitish yellowish colour of the spathe of the type plant.

Distribution — Vietnam, Gia Lai prov.

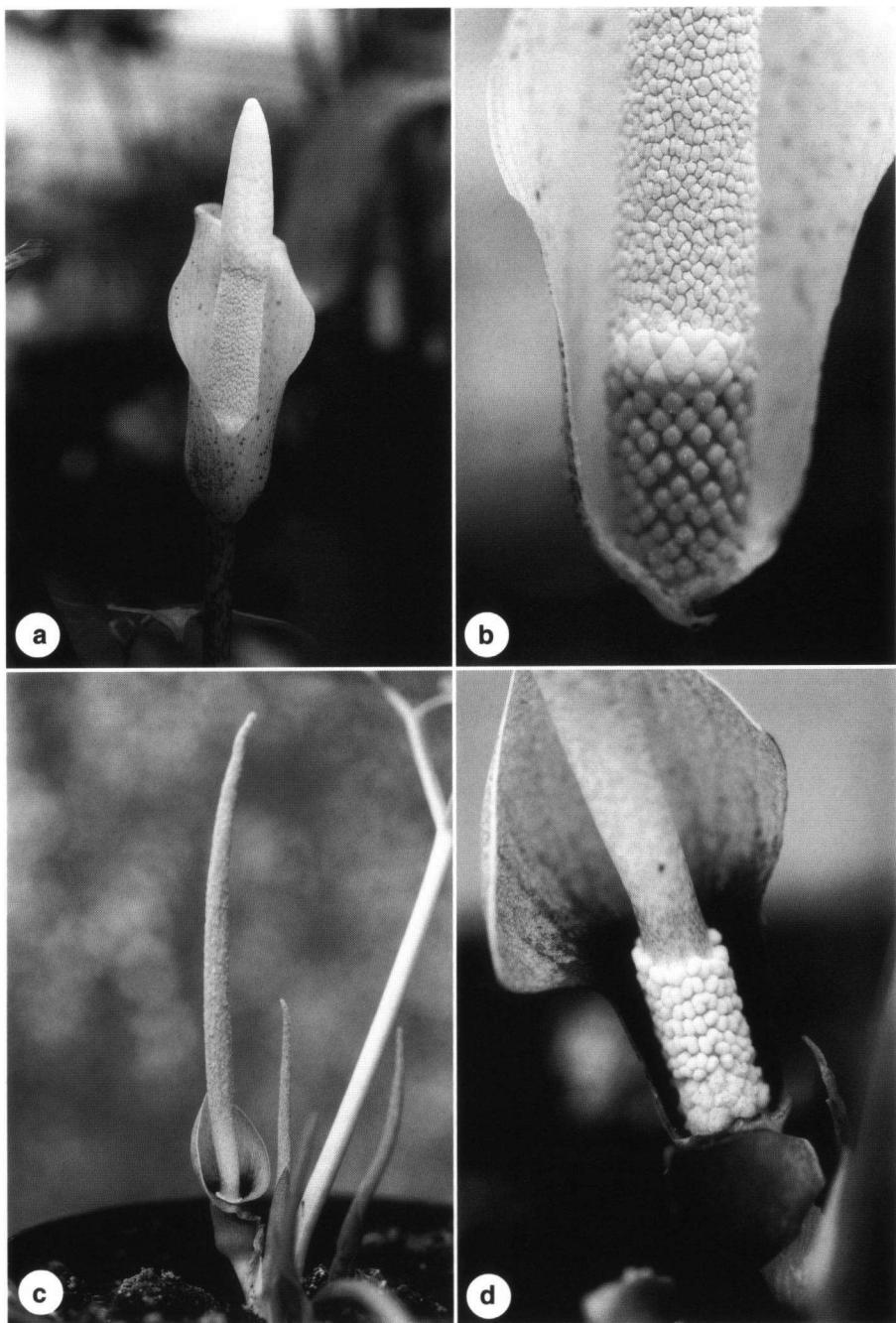


Fig. 5.—a & b. *Amorphophallus ochroleucus* Hett. & V.D. Nguyen. a. Inflorescence, front view; b. spadix (lower part) [Heterscheid H.A.M.927, type plant]. — c & d. *A. polyanthus* Hett. & M. Sizemore. c. Inflorescence, front view; d. spadix (lower part) [Heterscheid H.A.M.873, type plant].

Note.—*Amorphophallus ochroleucus* is morphologically similar to members of a group of predominantly Asian mainland species with e.g. *A. krausei* Engl. [Burma, Thailand, China (Yunnan)], *A. albus* P.Y. Liu & J.F. Chen [China (Yunnan)] and *A. salmoneus* Hett. [Philippines (Palawan)]. They all share the general spathe and spadix morphology. *Amorphophallus ochroleucus* is unique in this group in flowering simultaneous with the leaf. From all species of *Amorphophallus* it differs in having distinctly reticulate pollen. From *A. krausei* and *A. albus* it differs in having much larger stigmas, and from *A. salmoneus* it differs e.g. in having almost smooth staminodes and a smooth appendix; from *A. krausei* it differs in having bilocular ovaries; from *A. albus* it differs in having a much shorter style, an apical stigma and functionally bilocular ovaries.

Additional material: *Hetterscheid H.A.M. 926* (L, spirit coll.), N Vietnam, Gia Lai prov., Cha Lo (cult. in Leiden Bot. Garden; orig. coll. *V.D. Nguyen* s.n.).

9. *Amorphophallus polyanthus* Hett. & M. Sizemore, spec. nov. — Fig. 5c, d, 10a

Ab *Amorphophalli* speciebus omnibus differt in inflorescentiis 1–15 per anni tempo evolutis saepe aliquot simultaneis. *Amorphophallo pusillo* similis, spathae basi convoluta, stigmate sessili differt. — Typus: *Hetterscheid H.A.M. 873-T* (holo L, spirit coll.), Thailand, Loei prov., near Pha Nok Khan (coll. from a cultivated plant in the Leiden Bot. Garden; orig. coll. *M. Sizemore*).

Tuber elongate, branched, to c. 10 cm long, 2.5 cm diam., white. *Petiole* to 15 cm long, to 6 mm diam., smooth, pale green; *lamina* to 26 cm diam., subpedate, rachises unwinged, anterior segment undivided; *leaflets* rhombic, 3–10 cm long, 2–5.5 cm diam., upper surface green. *Inflorescences* rarely solitary, often appearing several months after the leaves, one terminal from a petiolar sheath, the next ones directly from the rim of the upper part of the tuber, often developing simultaneous, short peduncled; *peduncle* entirely or largely subterranean, 1–3 cm long, 2–5 mm diam., smooth, white; *spathe* broadly triangular, 2–4 cm long, 2.5–5 cm diam., base and limb separated by a shallow constriction, base strongly convolute, partly subterranean or entirely exposed, outside greyish, inside smooth, dark purple, limb erect, strongly concave, acute, margin with elongate glandular epidermal cells, resulting in a micro-fimbriate appearance, outside dirty whitish with many minute greyish flesh-coloured dots, inside dirty whitish with minute, greyish purple dots. *Spadix* sessile, much longer than spathe, 6.5–13 cm long; *female zone* cylindric, 1–3 mm long, 5–6 mm diam., flowers in 1–3 rows, congested; *male zone* cylindric, 4–7 mm long, 4–6 mm diam., flowers congested, or partly vertically separated and arranged in oblique near-verticils; *appendix* elongate, 6–12 cm long, 4–7 mm diam., thin, straight or slightly sigmoid, acute, terete or slightly dorsoventrally compressed, slightly narrowing to the base, dirty pale greyish brownish, surface densely verruculate. *Ovaries* irregularly 2- or 3-lobed, 1–1.5 mm diam., c. 1 mm high, 2- or 3-locular, white with a few minute, pinkish dots; *style* very short, 0.05–0.2 mm long, c. 0.3 mm diam. at the top, conical, white; *stigma* depressed, irregularly elongate or triradiate, 0.2–0.3 mm diam., c. 0.1 mm high, dirty brown or white, papillate. *Male flowers* consisting of 1–3 stamens; *stamens* 0.5–0.8 mm diam., c. 0.5 mm long; *filaments* c. 0.2 mm long, connate; *anthers* c. 0.3 mm long, truncate, orange; pores apical, elliptic after anthesis; *pollen* striate, ellipsoidal (length/breadth 1.37), 34 µm long.

Etymology — The species epithet refers to the unique development of many inflorescences per tuber per season.

Distribution — Thailand, known only from the type locality.

Habitat — In deep shade, near base of rocky outcrop.

Note — *Amorphophallus polyanthus* is obviously a close relative of *A. pusillus* Hett. & Serebryanyi (Vietnam) and *A. obscurus* Hett. & M. Sizemore (Thailand, this publication), but differs markedly from both by its simultaneously developing inflorescences and a convolute spathe base (not connate) and the generally larger dimensions. Additionally, it differs from *A. pusillus* in lacking a style on the ovary.

10. *Amorphophallus saururus* Hett., *spec. nov.* — Fig. 6a, b, 10b

Amorphophallo pygmaeo similis, folio infra nunquam purpureo, appendice triplo vel plus longiore sigmoideo differt. — Typus: *Heiterscheid H.A.M.026-T* (holo L, spirit coll.), Thailand, Loei prov., “along the Mekong river” (coll. from a cultivated plant in the Leiden Botanical garden; orig. coll. C.M. Fitch).

Tuber shortly elongate, often irregularly branched when mature, dark brown, to c. 10 cm long, to c. 2.5 cm diam. *Petiole* smooth, 13–50 cm long, 0.5–1.5 cm diam., uniformly green, yellowish, or reddish brown; *lamina* moderately or highly dissected, 16–90 cm diam.; *leaflets* obovate to broadly elliptic, acute-acuminate, base decurrent, 2–15 cm long, 1–6 cm diam., upper surface very dark green to blackish green, margin bright pink, main vein pale yellowish, lower surface greyish green with dark green venation. *Inflorescence* solitary, long peduncled; *peduncle* as petiole, 3–40 cm long, 0.4–1.2 cm diam.; *spathe* erect, rather concave, 4–10.5 cm long, 2–7 cm diam., base convolute, limb constricted at the base, margins involute, top fornicate, acute, outside base pale green with thin brown veins, limb off-white veins paler towards the top, margin with a faint pinkish hue, inside similar, base within sparingly or densely clothed with fleshy, inconspicuous or shortly elongate, warts with thickened and irregularly scabrate apical parts. *Spadix* sessile longer to much longer than spathe, 8–20 cm long; *female zone* cylindric, short, 0.3–1 cm long, 0.6–1.1 cm diam., flowers congested or distant; *male zone* elongate conic, 2–7 cm long, 0.4–1.4 cm diam., flowers congested; *appendix* myosuroid, 4–12 cm long, 0.3–1 cm diam., erect, sigmoid, acute, slightly narrowed to the base, with irregular, shallow depressions, developing a powerful gaseous stench at female anthesis. *Ovaries* depressed, rhombic or rounded in cross section, 3 mm diam., 2 mm high, pale greyish brown, 2-locular; *style* pale greyish brown with a few pinkish longitudinal stripes, 3–4 mm long, c. 0.8 mm diam., slightly obconic, mostly parallel to the spadix-axis but the top curved outward towards the spathe; *stigma* depressed, 0.7–1.5 mm diam., 0.5 mm high, with a shallow, radiating central depression, shallowly 5- or 6-lobed, occasionally nearly entire, dirty yellowish white, surface minutely scabrate. *Male flowers* consisting of 2–4 stamens, the lowermost flowers often pyramidal; *stamens* 0.8–1 mm long, the lowermost ones sometimes to 2 mm long; *filaments* nearly absent or to 1 mm long, connate, in the lower flowers very obliquely elongate, the inside-facing half much longer than the outer facing; *anthers* flattened, irregular in cross section, in the lowermost flowers the inside-facing wall enlarged, 1.5–2 mm diam., 0.8–1 mm long, sometimes with a groove containing the pores, white or yellowish, pale brownish around the pores and in the groove; pores

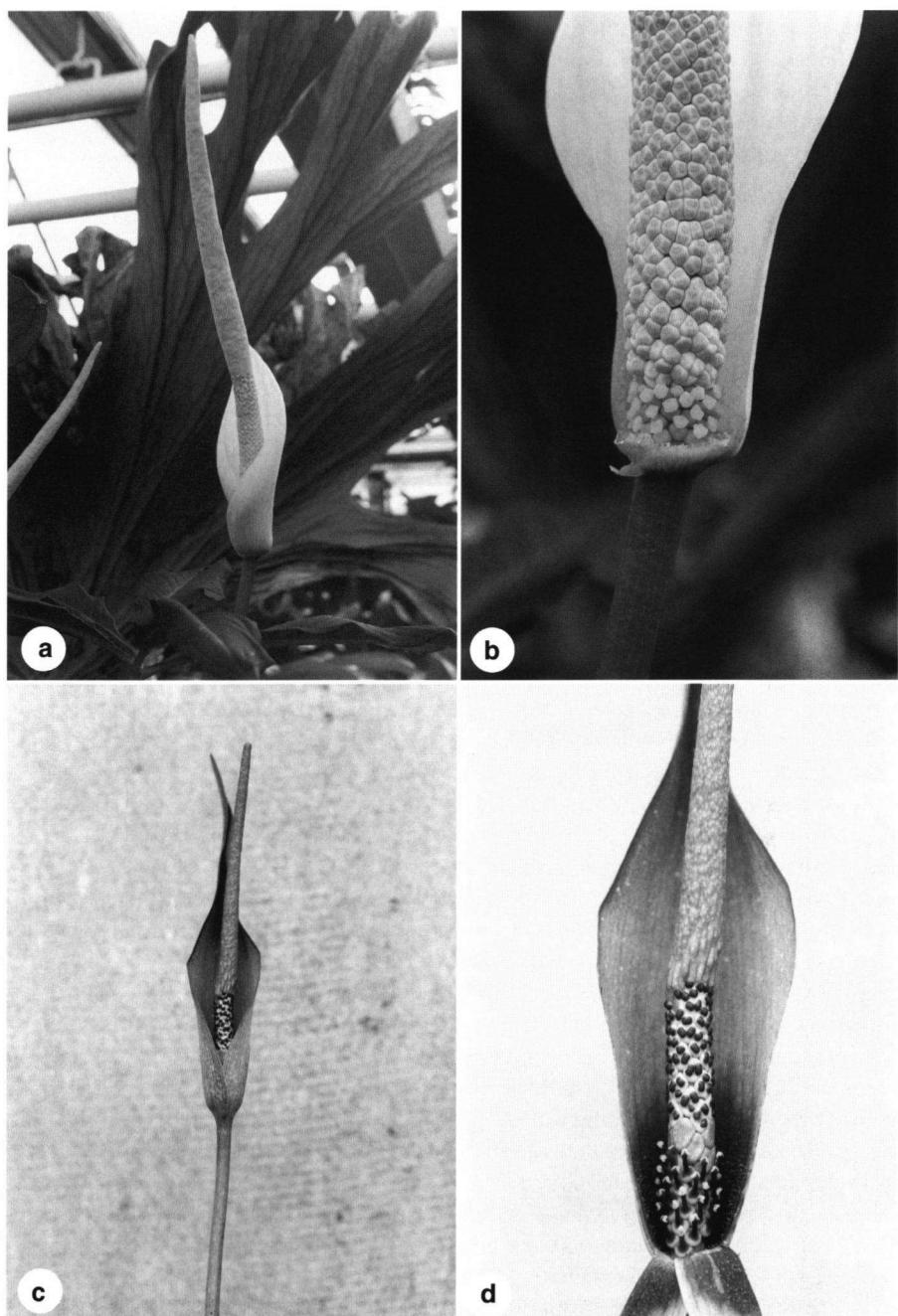


Fig. 6.—a & b. *Amorphophallus saururus* Hett. a. Inflorescence, front view; b. spadix (lower part) [Hetterscheid H.AM.026, type plant].—c & d. *A. scutatus* Hett. & T.C. Chapm. c. Inflorescence, front view; d. spadix (lower part) [Hetterscheid H.AM.589, type plant].

elongate; *pollen* striate, ellipsoidal (length/breadth 1.48), 56 µm long. *Berries* lageniform, white.

Etymology — The species epithet refers to the lizardtail-like shape of the appendix.

Distribution — Thailand, Loei prov.

Note — *Amorphophallus saururus* is in many respects similar to *A. pygmaeus*, but lacks the reddish purple lower leaf surface and has a style twice as long. The species was introduced into cultivation a long time ago but erroneously identified as *A. parvulus* Gagnep. (Hettterscheid & Ittenbach, 1996).

11. *Amorphophallus scutatus* Hett. & T.C. Chapm., *spec. nov.* — Fig. 6c, d, 10c

Amorphophallo saraburiensi similis, stylis duplo ad triplo longioribus spadics axe valde parallelis differt. — Typus: *Hettterscheid H.AM.589-T* (holo L, spirit coll.), Thailand, Petchabun prov., exact loc. unknown (coll. from a plant cultivated in the Leiden Botanical garden; orig. coll. *T.C. Chapman s.n.*).

Tuber elongate, white, to 25 cm long, 6 cm diam., not branching. *Petiole* 40–50 cm long, 0.9–1 cm diam., smooth, turgid, background pale green with elongate elliptic, grey-green spots, very pale flesh coloured or whitish greyish with silvery shimmer and very tiny blackish dots, or creamy white with small olive brown-green dots and largely covered by elongate elliptic, confluent olive green-brown spots; *lamina* to 100 cm diam., rachises narrowly winged all over; *leaflets* linear, lanceolate, elliptic or elliptic-lanceolate, 5–10 cm long, 0.7–4 cm diam., acuminate. *Inflorescence* solitary, long peduncled; *peduncle* slender, 20–55 cm long, 6–8 mm diam., smooth, pattern as petiole or dark spots confluent to almost entirely covering the background; *spathe* triangular to lanceolate, 8.5–20 cm long, 5–8 cm diam., limb and base not strongly differentiated, base convolute, limb slightly folded lengthwise, sometimes forming a tube during anthesis, or slightly reflexing, outside pale grey or grey-green with darker veins and few or many tiny greenish grey spots and scattered, small or larger, rounded, indistinct grey or whitish greyish spots or without the latter, margin brownish or dull dark greyish, inside base purple, rest grey, green or grey-green, upwards flushed with dark greyish brown or grey, base within verrucate, warts fleshy, the lower ones elongate, papillate, the upper ones conical or flaky, whitish or pale purple. *Spadix* shorter or distinctly longer than spathe, substipitate, 14–26 cm long; *female zone* cylindric, 1.5–2.5 cm long, 0.8–1 cm diam., flowers congested or slightly distant; *sterile zone* between male and female zone 0.5–1 cm long, 0.7–0.8 cm diam.; staminodes congested; *male zone* cylindric, 2–3.5 cm long, 0.7–0.9 cm diam., flowers congested; *appendix* thin elongate conical, 9.5–20 cm long, 0.8–1 cm diam. at the base, top obtuse, base shallowly ridged, rest rugulose, pale olive green, pale whitish grey or pale brown, giving off a heavy gaseous or pungent cheesy stench. *Ovaries* depressed, subcircular or circular in cross section, 3 mm diam., 1 mm high, bright green, purple near style base, 1-locular; *style* 3–4 mm long, 1 mm diam., at the base, purple, strongly parallel to the spadix-axis; *stigma* depressed but strongly folded, laterally displaced or apical, c. 1.5 mm diam., c. 0.6 mm high, notched at the raised acroscopic side or at the sides where the elongate style-branches appear, off-white, surface papillate-echinulate. *Staminodes* flat, rhombic, oval or egg-shaped, 3–5 mm long, 3 mm diam., margins slightly raised or not, surface very shallowly rugulose, pale green, pale whitish grey or pale brown.

Male flowers consisting of 2 or 3 stamens; *stamens* shallowly hemispheric, broad, spindle-shaped or irregular, c. 2 by 1 mm in cross section, c. 1.5 mm high; *filaments* entirely fused and broadened beyond the base of the anthers, c. 0.5 mm high, pale green, off-white, with or without a very faint green flush; *anthers* c. 1 mm high, sub-truncate, dark or pale purple, connective flat or slightly raised; pores slit-like before anthesis, often laterally fused to form one long, curved slit; *pollen* areolate (areolae 1–7 µm), spheroidal (length/breadth 1.07), 51 µm long.

Etymology — The species epithet refers to the shield-like shape of the staminodes.

Distribution — Thailand: Petchabun & Saraburi prov.

Note — *Amorphophallus scutatus* is closely similar to *A. saraburiensis* Gagnep. (Thailand) but has styles twice as long. The leaflets of *A. scutatus* are remarkably variable. One cultivated clone (*Hetterscheid H.AM.589*) has elliptic leaflets, whereas another (*Hetterscheid H.AM.590*) has linear leaflets. Such differences are rarely found in one and the same species of *Amorphophallus*.

Additional material: *Hetterscheid H.AM.590* (L, spirit coll.), type locality (cult. in Leiden Bot. Gard., orig. coll. T.C. Chapman s.n.); *Hetterscheid H.AM.1003* (L, spirit coll.), Saraburi prov., route 21, N of Saraburi, marker 80 (cult. in Leiden Bot. Gard., orig. coll. M. Sizemore).

12. *Amorphophallus sizemoreae* Hett., spec. nov. — Fig. 7a, b, 10d

Amorphophallo pygmaeo similis, inflorescentia duplo majore in partibus omnibus, parte mascula parte feminea manifeste latiore, appendice duplo latiore differt. — Typus: *Hetterscheid H.AM.985-T* (holo L, spirit coll.), Thailand, Nakhon Sawan prov., Bo Ya Cave (coll. from a cultivated plant in the Leiden Botanical Garden; orig. coll. M. Sizemore).

Tuber irregularly elongate, branching, branches spreading or vertical, 3.5 cm diam., 4–8 cm long, glossy dark brown. *Petiole* to 60 cm long, c. 1 cm diam., smooth, uniformly pale to olive green or pale to darker rich reddish brown; *lamina* to 60 cm diam., with relatively few leaflets, rachises winged nearly to the base; *leaflets* elongate elliptic, acuminate, to 20 cm long, to 7 cm diam., upper surface deep rich green with a narrow bright lilac reddish margin. *Inflorescence* solitary, long peduncled; *peduncle* 22–30 cm long, 0.7–0.8 cm diam., smooth, pale reddish brown at the base, upwards grading to pale green; *spathe* erect, base and limb separated by a shallow constriction, 7.5–9 cm long, 7–10 cm diam., limb concave, top acute, margins involute, outside base pale green, inside base whitish green, outside and inside limb creamish, base within densely verrucate, verrucae irregular conical, often secondarily verrucate at the top. *Spadix* sessile, longer than spathe, 17.5–21 cm long; *female zone* cylindric, 13–14 mm long, 9–10 mm diam., flowers slightly distant; *male zone* fusiform-cylindric, base and top constricted, 4 cm long, 1.3 cm diam., flowers congested; *appendix* elongate conical, 12–15 cm long, 17–18 mm diam., thin-walled, hollow, base constricted, top sharply acute, surface shallowly rugulose, creamish, producing a strong gaseous smell during female anthesis. *Ovaries* depressed, orbicular, 2.5 mm diam., 1.5 mm high, pale green, unilocular; *style* thick, 0.8 mm long, 1.3 mm diam., dilating towards the top, creamish; *stigma* disciform, 2 mm diam., 0.4 mm high, entire but with a central depression, surface whitish, densely verruculate. *Male flowers* consisting of 3–5 stamens; *stamens* 1 mm long; *filaments* c. 0.2 mm, fused; *anthers* c. 0.8 mm long,

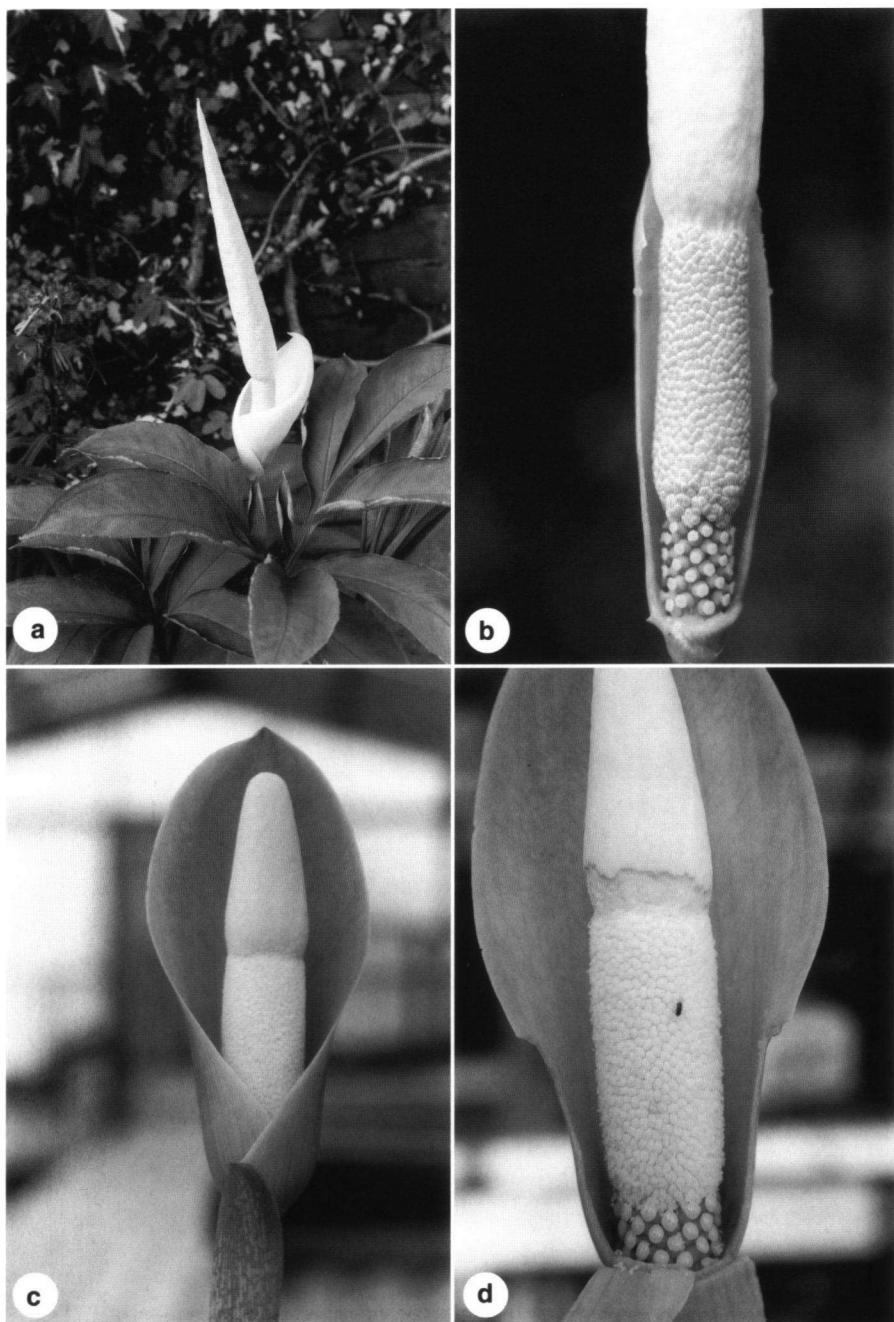


Fig. 7. — a & b. *Amorphophallus sizemoreae* Hett. a. Inflorescence, side view; b. spadix (lower part) [Hettterscheid H.A.M. 985, type plant]. — c & d. *A. symonianus* Hett. & M. Sizemore. c. Inflorescence, front view (photo: M. Sizemore); d. spadix (appendix base damaged) (photo: M. Sizemore) [Hettterscheid H.A.M. 942, type plant].

2–2.5 mm diam., rectangular, truncate, creamish; pores apical, elongate, connective indistinct, very pale green; *pollen* striate, ellipsoidal (length/breadth 1.68), 60 µm long.

Etymology — This horticulturally attractive species is named after Mrs Mary Sizemore, whose numerous visits to Asia have yielded a collection of data on *Amorphophallus* of the utmost importance for the revision of the genus.

Habitat & Ecology — Altitude c. 60 m.

Distribution — Thailand, known only from the type locality.

Note — *Amorphophallus sizemoreae* is a close ally of *A. saururus* Hett. (Thailand, this publication) and *A. pygmaeus* Gagnep. (Thailand). All three species share the short, elongate, branching tuber, the peculiar deep rich, lilac margined leaflets, the slightly constricted, concave spathe and the slightly pyramidal lower male flowers (synandria). *Amorphophallus sizemoreae* however has a much broader appendix, a broader male part and less strongly lobed stigmas. From *A. saururus*, *A. sizemoreae* additionally differs in having much less strongly divided stigmas. This entire species group may be closely related to *A. synandrifer* Hett. & V.D. Nguyen (Vietnam, this publication) in which the typical pyramidal synandrous male flowers occupy the entire male zone.

Additional material: *Hetterscheid H.A.M.983* (L), *Hetterscheid H.A.M.984* (L, spirit coll., from cultivated stock).

13. *Amorphophallus symonianus* Hett. & M. Sizemore, spec. nov. — Fig. 7c, d, 10e

Amorphophallo yuloensi similis, folii bulbillis totis intercalaribus, tubere tuberibus lateribus gaudenti, stigmata duplo latiore differt. — Typus: *Sizemore 96-168* (L, spirit coll.), Thailand, Loei prov., east of Wang Saphung (coll. from a plant cultivated in Florida).

Tuber depressed globose, to 10 cm diam., brown, c. 6 cm high, producing several annual offsets, these globose, not severing from the main tuber the first season. *Petiole* to 105 cm long, 2.5 cm diam., smooth, pale green with numerous short, narrowly linear, white stripes, the joint with the *lamina* swelling and transforming into a globose or elongate intercalary bulbil, often incorporating the swollen bases of the three main rachises; *lamina* to c. 100 cm diam., rachises narrowly winged distal from the basal branchings, the nodes swelling and transforming entirely into globose or elliptic intercalary bulbils; *leaflets* elliptic to elongate elliptic, acuminate, 7–24 cm long, 4–9 cm diam., upper surface green, corrugate, venation strongly impressed, lower surface green, venation strongly raised. *Inflorescence* solitary, long peduncled; *peduncle* largely or entirely hidden by the cataphylls, 10–20 cm long, 0.5–1 cm diam., smooth, as petiole; *spathe* elongate oval or orbicular, sometimes broader than long, slightly concave, top overarching the spadix, 10–13 cm long, 7–14 cm diam., base and limb not strongly differentiated, top obtuse, margins of limb slightly recurved, outside pale green or flushed with pale reddish brown and with some scattered, more or less distinct whitish dots, inside as outside, slightly less green, base within smooth. *Spadix* shorter than spathe, sessile, 8.5–12 cm long; *female zone* slightly obconical, 1.2–2 cm long, 0.8–1.5 cm diam. at the base, 1.2–2 cm diam. at the top, flowers congested; *male zone* elongate, slightly fusiform, terete or dorsoventrally compressed, 3.7–4.7 cm long, 1.7–3 cm diam., flowers congested; *appendix* short conical, slightly dorsoventrally

compressed, 3.5–5.5 cm long, 1.6–3.5 cm diam., obtuse, smooth, ivory white. *Ovaries* depressed-globose, slightly angulate or orbicular, 3 mm diam., 2.5–3 mm high, pale green, bilocular; *style* conical or terete, c. 1 mm long, c. 0.8 mm diam. at the base, pale green; *stigma* discoid, large, c. 2.5 mm diam., c. 0.5 mm high, entire, with a shallow, slightly elongate central depression, surface glossy white, smooth. *Male flowers* consisting of 3–5 stamens; *stamens* 1.5 mm long; *filaments* 0.5 mm long, free; *anthers* 1 mm long, c. 1.5 mm diam., truncated, off-white; pores apical, shortly elongate; *pollen* psilate, ellipsoidal (length/breadth 1.54), 71 µm long.

Etymology — The species epithet commemorates the late Dr James R. Symon of San Francisco, whose strong interest in *Amorphophallus* and many visits to the Asian tropics have yielded a wealth of data of great value to the first author's taxonomic revision of this genus.

Distribution — NE Thailand.

Note — *Amorphophallus symonianus* is similar in appearance to the southern Chinese *A. yuloeensis* H. Li, with which it shares the general shape of spathe and spadix. *Amorphophallus symonianus* differs in having entirely intercalary bulbils (vs. half-epiphyllar in *A. yuloeensis*), recurved spathe margins (vs. slightly incurved in *A. yuloeensis*), and the stigma surface being smooth (vs. densely verrucate in *A. yuloeensis*). *Amorphophallus yuloeensis* also never produces offset tubers.

Additional material: *Hettterscheid H.A.M.724* (cult in Leiden Bot. Gard., from E of Loei); *Hettterscheid H.A.M.936* (cult. in Leiden Bot. Gard., from N of Petchabun); *Hettterscheid H.A.M.942* (type plant, cult. in Leiden Bot. Garden).

14. *Amorphophallus synandrifer* Hett. & V.D. Nguyen, *spec. nov.*

— Fig. 8a, b, 10g, h

In genere *Amorphophallo* unicus ob flores masculos synanthericis. Cetero *Amorphophallo* *pygmaeo* affinis, plantis triplo vel plus, stigmate duplo maiore rhombeo. — Typus: *Boyce* & *V.D. Nguyen 1334* (holo L, spirit coll.), Vietnam, Tuy Phong prov., Can Na distr., Vinh Hao community, adjacent to Highway 1, 11° 20' N, 108° 52' E, alt. 5 m., in deep white quartz sand over granite, in the shelter of seasonal deciduous thorn scrub, 20 May 1998.

Tuber narrowly elongate, unbranched, 10–30 cm long, to 2.5 cm diam. *Petiole* smooth but with distinct, conical epidermal cells, background dark grey speckled brown, with large, irregular, confluent, pale grey spots, the latter with minute blackish dots, or background dark brown with blackish dotting and scattered irregular or linear pale grey to whitish spots; *lamina* to c. 40 cm diam., rachises narrowly winged throughout; *leaflets* small, elliptic, to 5.5 by 2 cm, acuminate. *Inflorescence* solitary, long peduncled; *peduncle* as petiole, to c. 80 cm long, to c. 8 mm diam.; *spathe* elongate triangular, acute, erect, cymbiform, slightly fornicate, base and limb not separated, shortly and weakly convolute and opening nearly to the base at anthesis, 15–23 cm long, 5–7 cm diam., lower margins slightly revolute, outside pale grey-green or pale grey, with darker pattern of scattered small blackish dots, inside uniformly pale grey or yellowish grey-green, base dark purple and with numerous, tiny, irregularly elongate warts. *Spadix* equalling the spathe, or slightly longer, sessile (or substipitate), 12–23 cm long; *female zone* cylindrical to slightly obconic, 0.8–2 cm long, c. 1.5 cm diam.,

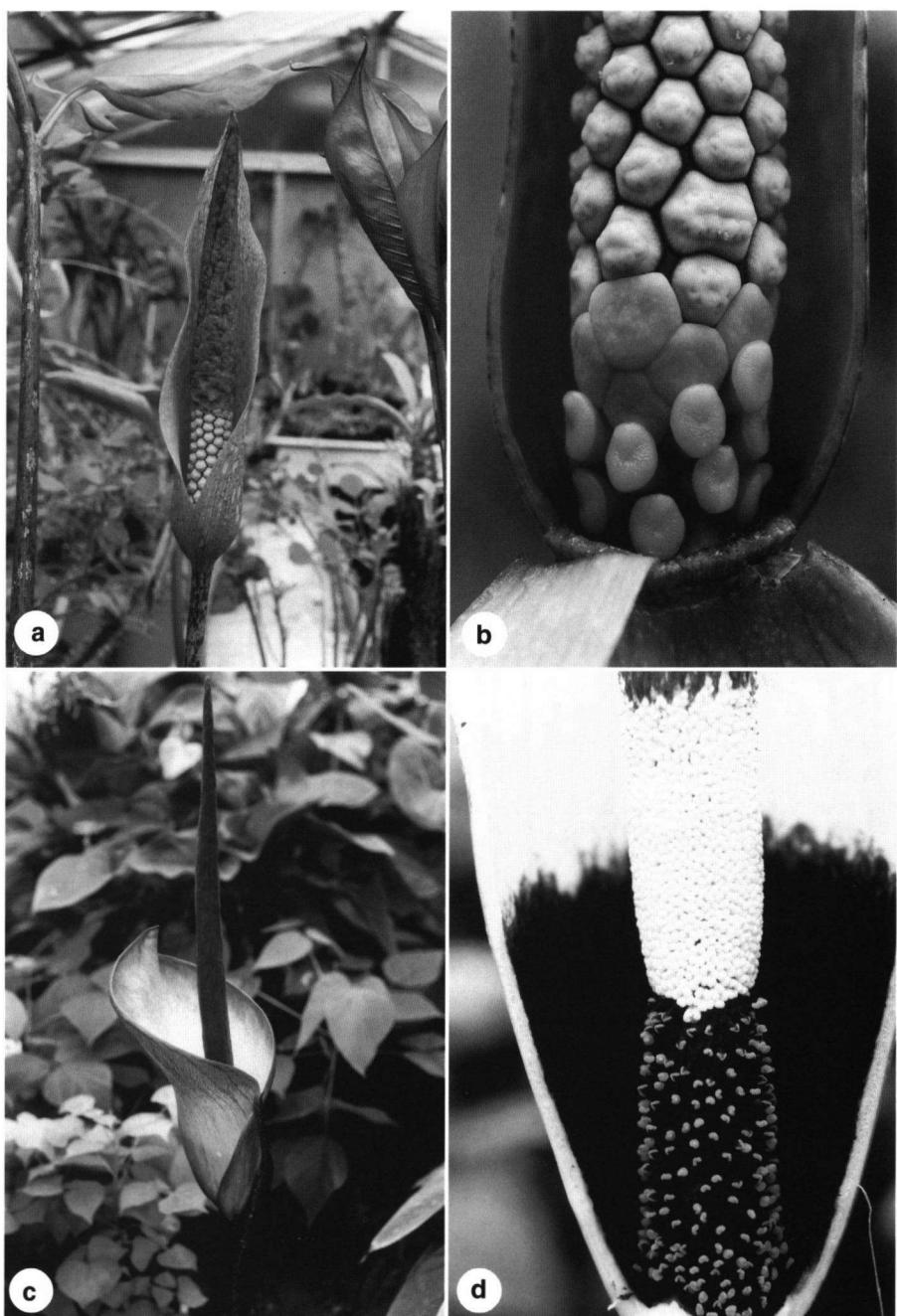


Fig. 8.—a & b. *Amorphophallus synandriser* Hett. & V.D. Nguyen. a. Inflorescence, front view; b. spadix (lower part) [Hetterscheid H.A.M. 1087].—c & d. *A. tinekeae* Hett. & A. Vogel. c. Inflorescence, side view; d. spadix (lower part) [Hetterscheid H.A.M. 830, type plant].

flowers congested; *sterile zone* between male and female zone c. 0.5 cm long; *male zone* elongate, subcylindric or conic, 2.5–5.5 cm long, 1.7–2 cm diam. at the base; *appendix* elongate conical, obtuse, 7–12 cm long, 1.5–2 cm diam., dull grey, dull yellowish grey-green or slightly pinkish, surface conspicuously rugulose, especially the upper half. *Ovaries* depressed, oblique, oval or conspicuously diamond-shaped in cross section, c. 2 mm high, 3 mm diam., bright green, unilocular, locule situated in the acroscopic part of the ovary; *style* hardly separated from ovary, thick, oblique, 1 mm long, 2–3 mm diam., bright green; *stigma* very depressed, diamond-shaped or ellipsoid or slightly irregular in cross section, broader than the style, margins slightly curved downward, entire or with a shortly elongate, transverse depression, 0.5 mm high, 2–4 mm diam., surface near smooth, pale to deep yellow. *Male flowers* consisting of 4 or 5 stamens, these entirely fused to a synandrium, diamond-shaped or polygonal in cross section, to 5 by 6 mm diam., 1–3 mm long, depressed pyramidal to pyramidal, top truncated, filamentous region c. 2 mm long, off-white, anther region c. 1 mm long, off-white, individual anthers sometimes partly separated by shallow ridges; *pollen* indistinctly reticulate, ellipsoidal (length/breadth 1.56), 73 µm long. *Staminodes* very depressed, rhombic or polygonal in cross section, 5–6 mm diam., 1–2 mm high, off-white.

Etymology — The species epithet refers to the synandrous nature of the male flowers.

Distribution — Vietnam, known from the type locality only.

Note — The phylogenetic position of *A. synandrifer* is not too clear. The peculiar male flowers are also found in the lower part of the male zone of *A. saururus* Hett. (Thailand, this publication) and *A. sizemoreae* Hett. (Thailand, this publication). However, the latter species have fairly thick, shortly elongate tubers and spadices that are much longer than the spathe. The peculiar thin tuber of *A. synandrifer* is shared with *A. napiger* Gagnep. (Thailand, Vietnam), *A. laoticus* Hett. (Laos), and *A. parvulus* Gagnep. (Thailand). From all these, *A. synandrifer* differs, among other things, in having very large stigmas and large flattened staminodes.

Additional material: *Heterscheid H.A.M. 1087* (L, spirit coll.; cult. in Leiden Bot. Garden; orig coll. Boyce & V.D. Nguyen 1334).

15. *Amorphophallus tinekeae* Hett. & A. Vogel, spec. nov. — Fig. 8c, d, 10f

Amorphophallo borneensi persimilis, pedunculo spathae longitudine semper breviore ad aquilongo, stigmatibus valde zygomorphis stylis apice sublateralibus differt. — Typus: *Heterscheid H.A.M. 830-T* (holo L, spirit coll.), E Malaysia, Sabah, Gomantong Caves (coll. from a plant cultivated in the Leiden Bot. Garden; orig. coll. M. van Balgooy).

Tuber subglobose, c. 20 cm diam., c. 13 cm high, off-white, surface with several raised areas, no offset development. *Petiole* to 160 cm long, 5 cm diam., near the base slightly rugulose, otherwise smooth, background off-white, nearly entirely covered by small transverse, very dark blackish green, crack-like spots and scattered, larger, elongate-elliptic, dirty whitish spots with or without a dirty olive-brown centre; *lamina* to 160 cm diam., rachises winged almost to the base; *leaflets* elliptic to elongate-elliptic, acuminate, 7–26 cm long, 3–9 cm diam., slightly leathery, upper surface glossy mid-green. *Inflorescence* solitary, short peduncled; *peduncle* 13–36 cm long, 1–2 cm

diam., smooth, as petiole; *spathe* transversely oval, 18–35 cm long, 16–32 cm diam., leathery, limb oblique, after anthesis actively curving forward and closing the spathe, outside base lower half bright green with thin maroonish veins and a very few scattered small white spots, upwards flushed with greyish to blackish maroon, veins prominently maroon to blackish purple, inside base deep maroon, central part whitish greenish, upper part flushed with greyish maroon, base within densely verruculate and with several grooves lengthwise, outside limb largely green with brownish purple venation, upwards generally flushed with dirty purplish brown, inside limb pale green, the margin flushed with dirty purplish brown, margin incurved. *Spadix* sessile, longer than spathe, 21–58 cm long; *female zone* slightly conic, 2.5–7 by 1.8–3 cm, flowers congested or slightly distant; *male zone* slightly obconic, 3–6.5 by 1.3–2.3 cm, flowers congested; *appendix* elongate narrowly conic, 15.5–45 cm long, 1.3–3 cm diam. at 1/3 from the base, gradually tapering to the acute top, surface dark maroon, slightly rugulose, base with a few narrow grooves. *Ovaries* depressed globose, 3 mm diam., 2 mm high, bilocular, dark maroon; *style* 4 mm long, 1 mm diam., maroon; *stigma* laterally placed, highly asymmetrical, ovate in upper view, long axis c. 3 mm, short axis 2 mm, c. 1 mm thick, 1-lobed, lobe apical on the style, conic, below the lobe a shallow slightly curved depression, surface echinulate, dirty yellowish brown. *Male flowers* consisting of 4 or 5 stamens; *stamens* c. 2 mm long, 1.5–2 mm diam.; *filaments* 1.2 mm long, half connate; *anthers* 0.8 mm long, truncated, off-white, connective off-white or brownish; *pollen* psilate, ellipsoidal (length/breadth 1.13), 62 µm long.

Etymology — The species epithet refers to Mrs Tineke Roelfsema from the Netherlands, whose financial back up and interest in botany have provided ample opportunities to Mr A. Vogel (co-author of the species name) to collect Asian *Amorphophallus* species.

Distribution — E Malaysia (Sabah), known from the type locality only.

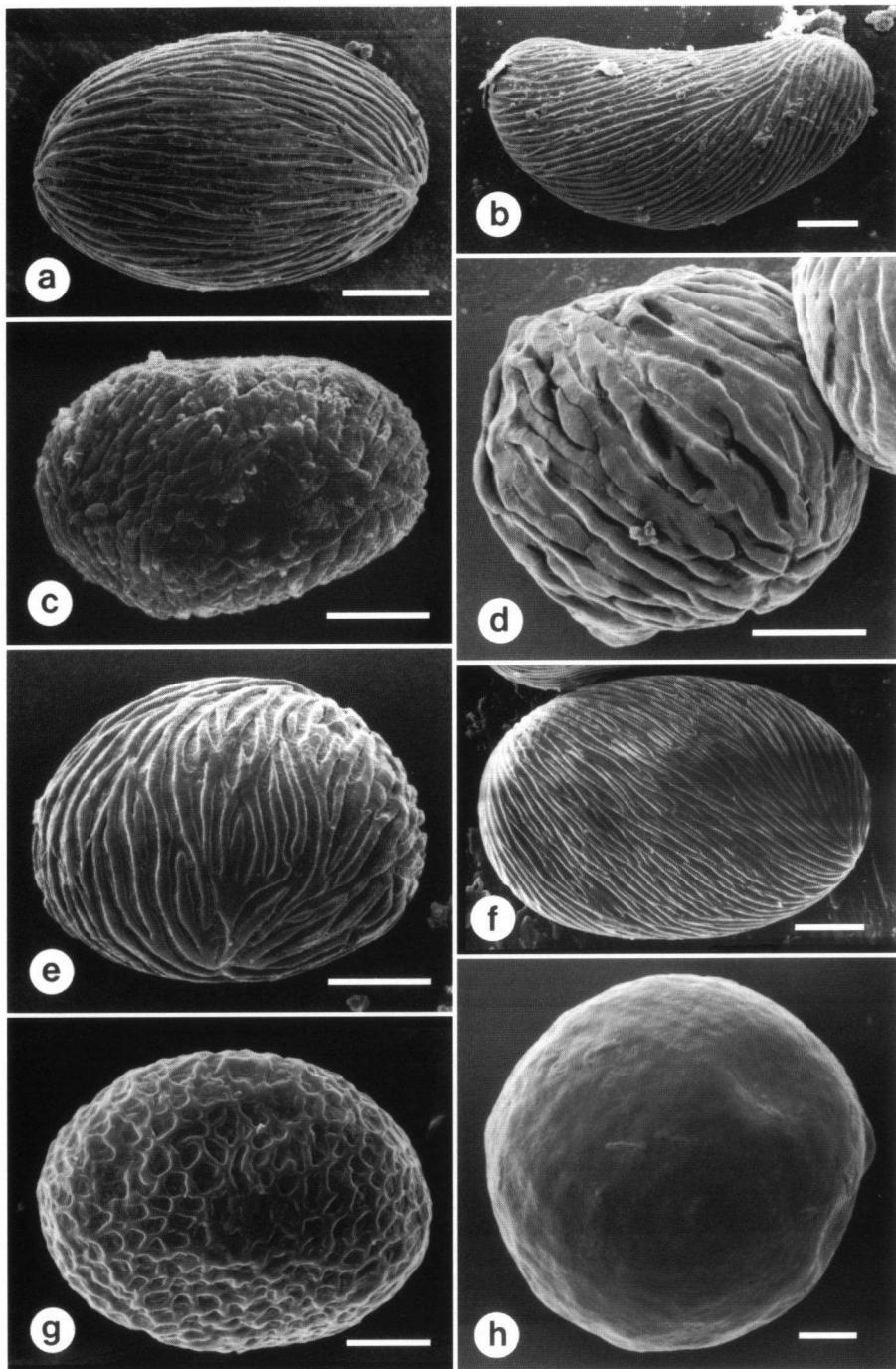
Note — *Amorphophallus tinekeae* is a member of a group of exclusively Bornean species and most closely resembles *A. borneensis*, from which it differs in having a consistently short peduncle, strongly zygomorphic stigmas and a rather narrow appendix.

Additional material: *Hetterscheid H.A.M. 477* (L, spirit coll.; cult. in Leiden Bot. Garden; orig. coll. A. Vogel 950012, flowering 5 April 1997).

16. *Amorphophallus venustus* Hett., A. Hay & J. Mood, spec. nov. — Fig. 4d

Amorphophallo manta et A. bufo persimilis, foliolis supra costa argentea, appendice multo angustiore verrucis rhombis tecta differt. — Typus: *Herscovitch s. n.* (holo NSW, spirit coll.), Malaysia, Sabah, Maliau basin, Gunung Rara Forest Reserve, 2.5 km above main Maliau Falls, in mixed dipterocarp forest over sandstone, c. 530 m alt. (coll. from a plant cultivated in the RBG Sydney, acc. nr. 960475; orig. coll. Hay et al. 12042).

Tuber subglobose, c. 4 cm diam., no offsets. *Leaf* (known only partially from photographs) solitary; petiole to c. 100 cm long; *leaflets* lanceolate, upper surface deep velvet green, feathered bright silvery along both sides of the main vein. *Inflorescence* (known only from the holotype) solitary, long peduncled; *peduncle* (incompletely known) longer than spathe, to c. 130 cm long, to c. 2 cm diam.; *spathe* linguiform, 15 cm long, 5.5 cm diam., base funnel-shaped, above the base constricted and margins strongly dorsally reflexed, limb erect, slightly hooded, top acute, base outside dirty



pale greyish green with a few scattered, small, whitish spots, margins flushed purple, inside upper part purple, lower part dirty creamish, surface entirely smooth, limb inside dark purple with scattered, small, rounded, whitish spots. *Spadix* sessile, shorter than spathe, 9 cm long; *female zone* cylindric, 0.9 cm long, 0.8 cm diam., flowers just touching or slightly distant; *male zone* cylindric, slightly dilating at the top, 2.5 cm long, 0.7–0.8 cm diam., flowers congested; *appendix* elongate conical, 5.5 cm long, 1 cm diam., top subacute, surface verrucate (staminodes) but towards the top changing to distantly echinate, creamish. *Ovaries* globose to slightly elongate, slightly laterally compressed, 1.5–2 mm long, 1.5 mm diam., bilocular; *style* short, thick, c. 0.3 mm long, c. 1.2 mm diam.; *stigma* conical, thin, shallowly bilobed, c. 1.3 mm diam., c. 0.4 mm high, surface verruculate. *Male flowers* consisting of 3 or 4 stamens; *stamens* 1 mm long; *filaments* 0.3 mm long, free; *anthers* 1–1.5 mm diam., 0.7 mm long, truncate; pores apical, elongate; *pollen* unknown. *Staminodes* on appendix hemispherical, obtuse, slightly laterally compressed, 1–2 mm diam., 1–1.5 mm high, creamish.

Etymology — The species epithet ('beautiful') refers to the highly ornamental upper surface of the leaflets.

Habitat & Ecology — In secondary forest on sandstone, in deep shade, c. 450 m altitude.

Distribution — E Malaysia (Sabah, endemic).

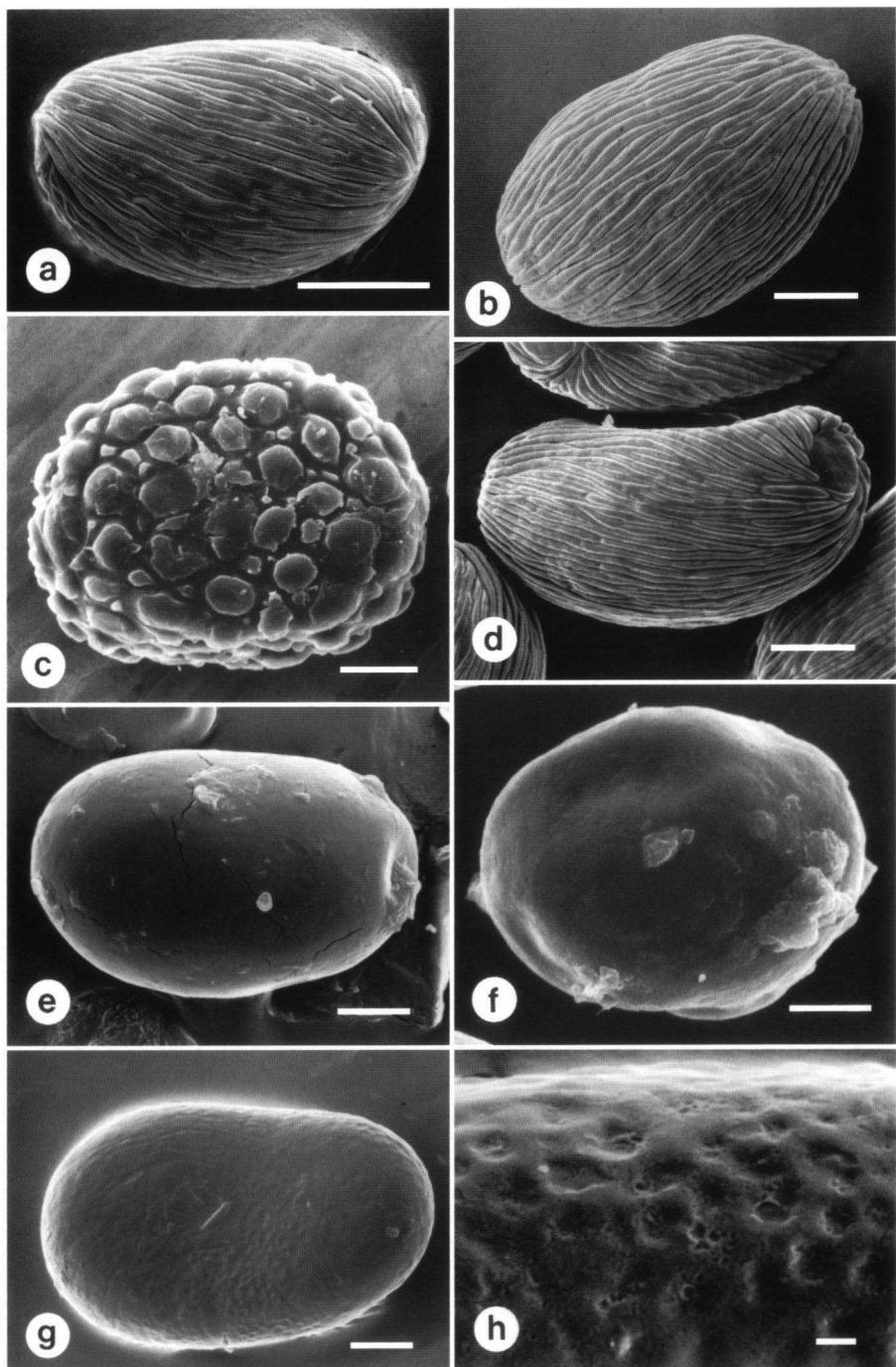
Note — *Amorphophallus venustus* is doubtless a close ally of *A. manta* Hett. & Ittenbach (Sumatra), *A. bufo* Ridl. (W Malaysia) and *A. sparsiflorus* Hook.f. (W Malaysia), with which it shares the unique linguiform spathe with its peculiar strongly dorsally curved margin above the base. *Amorphophallus venustus* differs mostly from all of these species by the silver variegation along the main veins of the leaflets, the presence of verrucae on the appendix, and the appendix itself being quite thin and creamish (vs. dark glossy purple and inflated in the other species). The peculiar colour and variegation of the leaflets of *A. venustus* is only shared with *A. pendulus* Bogner & Mayo (Sarawak), a species also closely allied to the species group mentioned above.

Additional specimen: Mood 1126 (cult. in Hawaii, no vouchers), E Malaysia, Sabah, near Kg. Sepulut.

REDUCED SPECIES

1. *Amorphophallus arnautovii* Hett., Blumea 39 (1994) 245 (N Vietnam, southern China).
2. *Amorphophallus pingbianensis* H. Li & C.L. Long, Aroideana 11 (1989) 4 (China, Yunnan).

Fig. 9. Pollen, scanning electron micrographs. — a. *Amorphophallus amygdaloïdes* Hett. & M. Sizemore. Striate grain [Hetterscheid H.AM.969]. — b. *A. atrorubens* Hett. & M. Sizemore. Striate grain [Hetterscheid H.AM.737]. — c. *A. boyceanus* Hett. Striate grain with coarse muri [Hetterscheid H.AM.515]. — d & e. *A. brachyphyllus* Hett. d. Fossulate/coarsely striate grain; e. striate grain [d: Hetterscheid H.AM.031A; e: Hetterscheid H.AM.032C]. — f. *A. dzui* Hett. Striate grain [Hetterscheid H.AM.523]. — g. *A. ochroleucus* Hett. & V.D. Nguyen. Reticulate grain [Hetterscheid H.AM.927]. — h. *A. longicomus* Hett. & Serebryanyi. Psilate grain [Hetterscheid H.AM.177]. — Scale bar = 10 µm.



Amorphophallus arnautovii was compared by Hetterscheid (op. cit) to *A. pingbianensis* Li & Long (China, Yunnan). However, because of insufficient data, a comparison with *A. coetaneus* S.Y. Liu & S.J. Wei [Guighaiia 6, 3 (1986) 183; from China, Guangxi] was omitted. Recently the first author was given data and material pertaining to the holotype of *A. coetaneus* by Prof. Dr. Li Heng (KUN), which convinced him that *A. arnautovii* and *A. coetaneus* represent the same species. Additionally, living material of *A. pingbianensis* was given to the first author by Prof. Dr. Li Heng, which showed far less convincing differences with *A. arnautovii* and *A. coetaneus* as was originally believed. Notably this material showed intercalary bulbils and a bilocular ovary as well. It is therefore proposed here that *A. arnautovii* and *A. pingbianensis* are made new synonyms of *A. coetaneus*.

3. *Amorphophallus erubescens* Hett., Blumea 39 (1994) 253 (Thailand).

Amorphophallus erubescens was compared by Hetterscheid (op. cit.) with *A. muelleri* Blume and found to differ in having a short peduncle and an almost all-pink spathe. New field observations by Dr J.F. Maxwell (CMU) and Dr P.C. van Welzen (L) in Kanchanaburi prov., Thailand revealed intermediate plants in mixed populations. Although the extreme case as represented by the holotype plant of *A. erubescens* was not seen again, the intermediate plants undermine the separation of both species. The name *A. erubescens* Hett. is thus proposed as a new synonym to *A. muelleri*.

4. *Amorphophallus odoratus* Hett. & H. Li, Blumea 39 (1994) 265 [China (Hong Kong)].

5. *Amorphophallus mellii* Engl., Notizbl. Bot. Gart. Mus. Berlin-Dahlem 8 (1922) 13 (south-eastern China).

The recognition of *A. odoratus* was based mainly on the opinion of Prof. Dr. Li Heng, expert on Chinese aroids, that it represented a new species for the Chinese flora. However, closer examination by the first author of the, only later to him available, type material of *A. dunnii* Tutcher [J. Bot. 49 (1911) 273; China, Hong Kong] and *A. mellii* Engl. showed that all three names represent the same species. It is therefore proposed here that the names *A. mellii* and *A. odoratus* are placed as new synonyms to *A. dunnii*.

6. *Amorphophallus pachystylis* Hett., Blumea 39 (1994) 268 (Thailand, Kanchanaburi prov.).

New observations by Dr P.C. van Welzen (L) in the Kanchanaburi prov. in western Thailand revealed that the differences mentioned by the first author to separate *A. pachystylis* from *A. krausei* Engl. [Pflanzenr. IV, 23C (1911) 94; Burma, Laos, Thai-

Fig. 10. Pollen, scanning electron micrographs. — a. *Amorphophallus polyanthus* Hett. & M. Sizemore. Striate grain [Hetterscheid H.AM.873]. — b. *A. saururus* Hett. Striate grain [Hetterscheid H.AM.026]. — c. *A. scutatus* Hett. & T.C. Chapm. Areolate grain [Hetterscheid H.AM.589]. — d. *A. sizemoreae* Hett. Striate grain [Hetterscheid H.AM.984]. — e. *A. symonianus* Hett. & M. Sizemore. Psilate grain [Hetterscheid H.AM.942]. — f. *A. tinekeae* Hett. & A. Vogel. Psilate grain [Hetterscheid H.AM.830]. — g & h. *A. synandrifer* Hett. & V.D. Nguyen. g. Indistinctly reticulate grain; h. detail of g [Hetterscheid H.AM.1087]. — Scale bar: a-g = 10 µm; h = 1 µm.

land, China] are not sufficient for species recognition. More plants are now known to bridge the gaps described as separating both species. It is here proposed to reduce the name *A. pachystylis* to the synonymy of *A. krausei*.

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