

NOTES ON THE GENUS *AMORPHOPHALLUS* (ARACEAE) – 2<sup>1</sup>  
NEW SPECIES FROM TROPICAL ASIA

W.L.A. HETTERSCHIED

Chrysantenstraat 28, 1214 BM Hilversum, The Netherlands

SUMMARY

Of the genus *Amorphophallus*, thirty-three new species are described, from SE China, Vietnam, Myanmar (Burma), Thailand, Malaysia, Indonesia (Sumatra, Java, Kalimantan), and the Philippines.

INTRODUCTION

During preparation of a revision of the genus *Amorphophallus* by the author, many new species were discovered. Of these, 33 are described here. Several are cultivated by the author and in the Leiden Botanic Garden, others are described from dried material only. Some of the new species are co-authored. Pollen is only briefly described, awaiting an extensive paper on this subject (Van der Ham, Hetterscheid & Van Heuven, in prep.). All specimens cited have been seen by the author.

DESCRIPTIONS

1. *Amorphophallus aberrans* Hett., *spec. nov.* — Fig. 1a, b

A speciebus omnibus velo circum spadice basin, staminodiis capillaceis aggregatis inter zonas masculas femineasque et inter pistilla, pillis longis stigmati insidentibus differt. — Typus: *Murata, Fu-kuoka & Phengkhlai T-16977* (KYO holo), Thailand, N Tak, between Tak and Ban Dan Lan Hoi, in dry savannah forest, c. 5 km east of Tak, c. 150 m alt., 24-vii-1973.

*Tuber* unknown. *Leaf* unknown. *Inflorescence* long peduncled; *peduncle* 42–71 cm long, c. 0.8 cm in diam. (base); *spathe* erect, lanceolate, acute, base shortly convolute, 8 × 2 cm, persistent in fruit, base within smooth. *Spadix* subsessile, longer than spathe, 13.5 cm long, base very oblique, surrounded by a basally attached, 1 cm long, collar-like, free velum, open at the ventral side; *female zone* slightly obconic, 1 cm long, 0.7 cm in diam., flowers loosely arranged; *male zone* elongate, slightly obconic, 2.5 cm long, 0.5 cm in diam., flowers in lower half slightly distant, in upper half more congested; *appendix* myosuroid, acute, 10 cm long, 0.2 cm in diam., arcuate (?). *Pistils* at the base surrounded by 4–6 staminodes; *ovaries* ovate or slightly

<sup>1</sup>) The first paper in this series, by J. Bogner & W.L.A. Hetterscheid, was published in *Blumea* 36 (1991) 467–475.

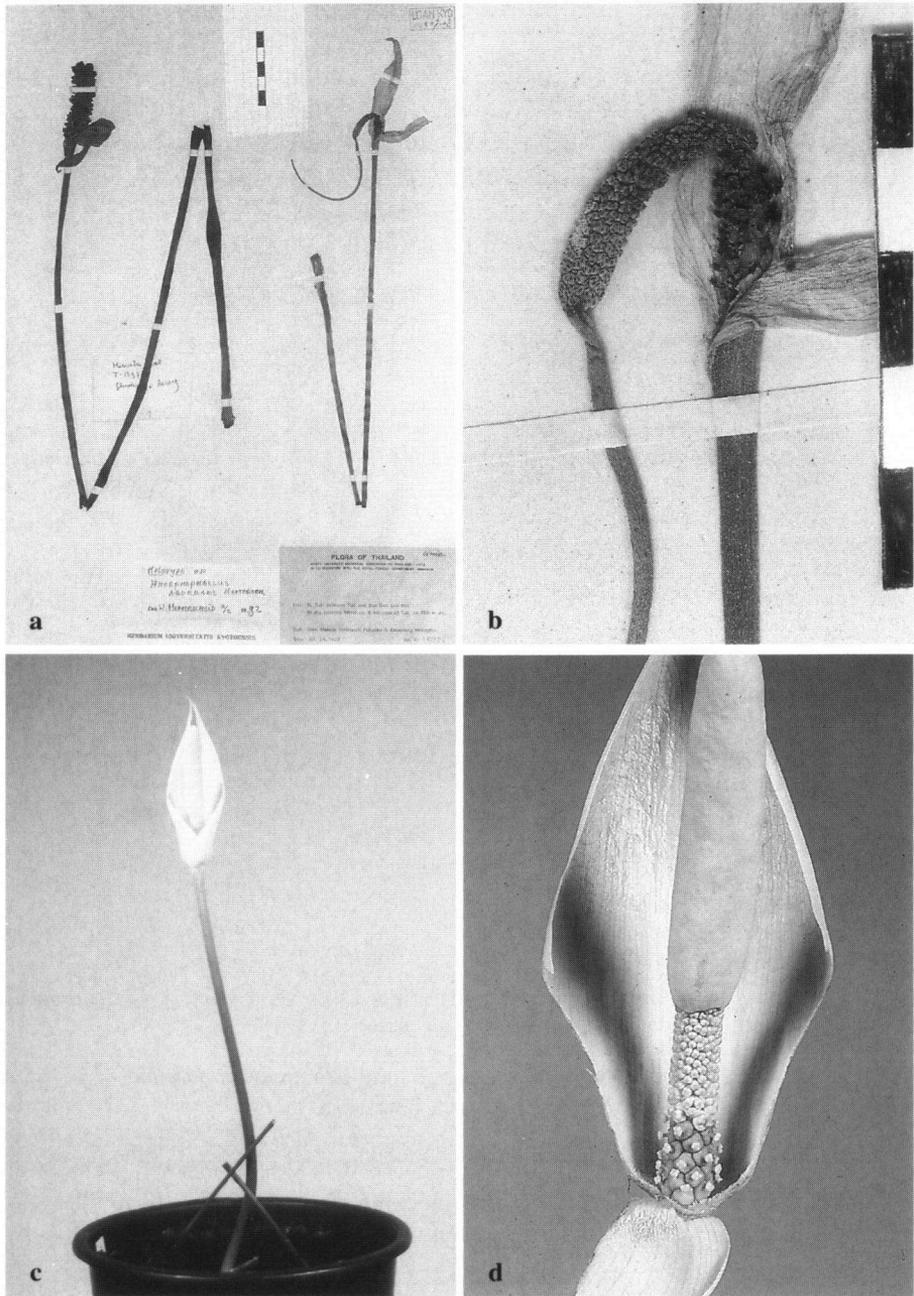


Fig. 1. — a, b: *Amorphophallus aberrans* Hett. (Murata et al T-16977, type); b: detail of the spadix. Scale bar = 5 cm. — c, d: *A. albispatus* Hett. (Hetterscheid H.AM.019, type-plant); c: c.  $\times 0.16$ ; d: spathe cut open., c.  $\times 0.64$ .

depressed, 1–1.5 mm in diam., 1 mm high, 2- or 3-locular; *style* shortly conic, 0.5 mm long, 0.8 mm (base) to 0.2 mm (top) in diam.; *stigma* large, longer than broad, shallowly or deeply bilobed, 1 mm high, 0.5–0.8 mm in diam., surface verruculate, often with a few irregularly distributed long flexuous hairs, lobes conic; staminodes elongate, base c. 0.8 mm long, 0.2 mm (base) and 0.6 mm (top) in diam., top thickened and showing reduced thecae and pores, between the pores a long, thin, flexuous hair. *Male flowers* consisting of 1–3 *stamens*; *anthers* sessile, disciform, 0.5 mm long, 1–1.5 mm in diam., pores apical. *Pollen* areolate.

**Etymology** – The species epithet refers to the quite unusual morphology of the inflorescence.

**Distribution** – Thailand (known only from the type collection).

**Habitat & Ecology** – In dry savannah forest; 150 m altitude; fl., fr. July.

**Note** – The general appearance of the inflorescence of *A. aberrans* is reminiscent of *A. parvulus* Gagnep. and *A. linearis* Gagnep. but the details of the female zone and the presence of a basal velum inside the spathe are unique in the genus. The latter character may turn out to be an aberrant and underdeveloped second spathe, which is not an uncommon phenomenon in Araceae in general.

## 2. *Amorphophallus albispathus* Hett., *spec. nov.* — Fig. 1c, d

Ab *A. longituberoso* (Engl.) Engl. & Gehrm. in tubere multiramoso et foliolis multo longioribus differt. — Typus: *Hetterscheid H.AM. 019-T* (L. holo; spirit coll.), 23-iv-1991, cult. Hort. Bot. Leiden ex Thailand, 40 km south of Chumphon, growing in a rocky slope (orig. coll. *Bogner 429*, 1971).

*Tuber* elongate, up to c. 17 cm long, c. 7 cm in diam., pale brown. *Leaf* one or two; petiole 10–55 cm long, 0.8–1.8 cm in diam. (base), turgid, smooth, greyish green, to the base often with a pinkish or reddish brown hue, or nearly entirely pale reddish brown, immaculate or with a few, scattered dark greyish spots; *lamina* moderately dissected, 15–90 cm in diam., *leaflets* elliptic, long acuminate (acumen c. 3.5 cm long), base long decurrent, 20–35 cm long, 6–10 cm in diam., subcoriaceous, upper surface moderately glossy, greyish green, lower surface paler. *Inflorescence* solitary, long-peduncled; *peduncle* as petiole but slightly shorter, up to c. 40 cm long; *spathe* erect or concave, cymbiform, triangular-ovate, basal fifth convolute, top acuminate, 6–14 cm long, 3–10 cm in diam., outside dirty white with some scattered pale or dark grey-green punctiform spots and sometimes a very faint, pale purplish hue, inside as outside, base inside papillate, the most basal papillae hairlike and often laterally fused and/or with some irregular branches. *Spadix* shorter than spathe, up to 13 cm long, slightly curvate, sessile, emitting a strong, anise-like scent at female anthesis; *female zone* slightly conic, 1–2.3 cm long, 0.7–1.3 cm in diam., flowers congested; *male zone* slightly conic, 1.5–3(–6.5?) cm long, 0.5–1.2 cm in diam., flowers congested; *appendix* cylindrical-fusiform, smooth with some shallow depressions, ivory white with a greenish hue, apex and base obtuse, 2–8 cm long, 0.8–2 in diam. *Ovaries* ± diamond-shaped or somewhat irregular in cross section, depressed, bright green, 3–4 mm in diam., c. 2 mm high, 3- or 4-locular; *style* slender, bright green, c. 1 mm long, 0.7–0.8 mm in diam.; *stigma* flattened, 3- or 4-lobed, 1.5–2

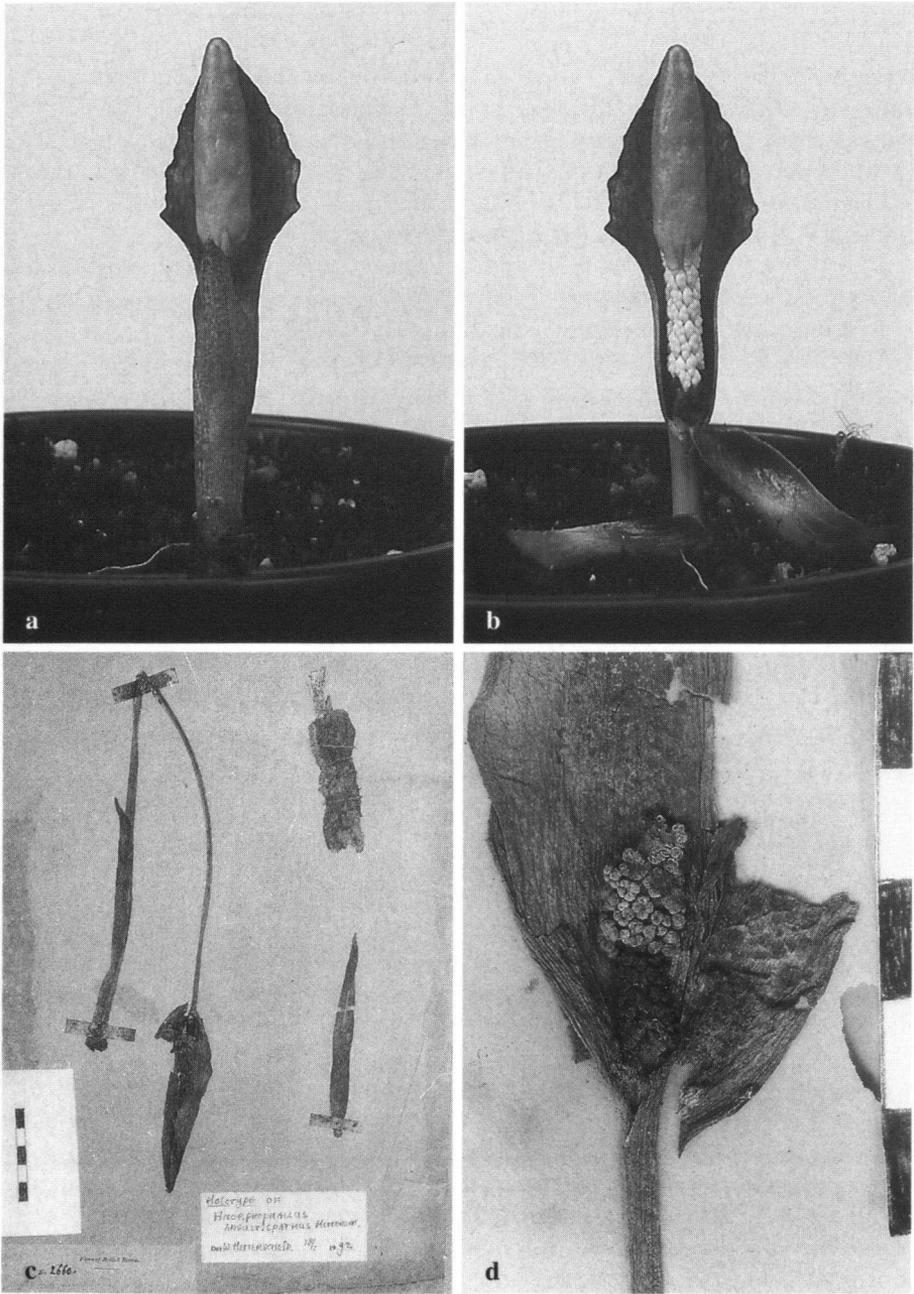


Fig. 2. — a, b: *Amorphophallus angulatus* Hett. & A. Vogel (*Hetterscheid H.A.M.* 329, type-plant); b. spathe cut open; both c.  $\times 0.78$ . — c, d: *A. angustispatus* Hett. (*Kurz* 2660, type); d. spadix base with anthers grouped on long fused filaments. Scale bar = 5 cm.

mm in diam., dirty white, surface shallowly scabrate-verruculate, lobes subhemispheric. *Male flowers* consisting of 2–4 (or 5) stamens; *stamens* with fused *filaments*, the latter strongly enlarged in the lower flowers; *anthers* short (c. 1 mm), hemispheric, pale orange-yellow, connective green; pores elongate, lateral or rarely subapical. *Pollen* striate.

Etymology – The specific epithet refers to the white spathe.

Distribution – Central Thailand.

Note – *Amorphophallus albispatus* is most similar to *A. longituberosus* (Engl.) Engl. & Gehrm. They share the overall inflorescence morphology, the short, hair-like papillae in the spathe-base, the anise-like scent and elongate tuber. However, the leaf blade of *A. albispatus* is much less strongly divided, the petiole is much sturdier, the tuber is much shorter and branched and the spathe is white (greyish or greenish in *A. longituberosus*).

### 3. *Amorphophallus angulatus* Hett. & A. Vogel, *spec. nov.* — Fig. 2a, b

Ab *A. eburneo* Bogner in dimensionibus multo inferioribus, colore purpureo in inflorescentiae aliquot partibus, foliis bulbiliferis differt. — Typus: *Hetterscheid H.AM. 329-T* (L. holo; spirit coll.), 15-ii-1994, cult. in Leiden Bot. Gard. ex Malaysia, Sarawak, Mt Selantik, at the base of sandstone cliffs in primary forest, c. 550 m alt., 1993 (orig. coll. *A. Vogel 933256B*).

*Tuber* globose, dark brown, c. 3 cm in diam. *Leaf* solitary; petiole c. 30 cm long, c. 0.5 cm in diam., subterete in cross section, angulate in seedling and juvenile leaves, dirty greenish or with a reddish purple flush; *lamina* c. 40 cm in diam., rachises once or twice branched, short; leaflets elliptic-lanceolate, elliptic in juvenile leaves, acuminate, 17–19 cm long, 4–5 cm in diam., mid green, in seedling and juvenile leaves entirely or partly reddish purple. *Inflorescence* short peduncled, partly hidden in cataphylls; cataphylls 1–4.5 cm long, pale greyish with faint purple flushes; *peduncle* entirely hidden by the cataphylls, terete, 2.5 cm long, 0.5 cm in diam., pale olive-green; *spathe* erect, elongate elliptic, 6 cm long, 2.5 cm in diam., top acute, base tightly convolute into a narrow tube, limb with a slightly undulate margin, outside brownish purple with paler, brownish veins, inside slightly paler and moderately glossy, base outside purplish, upwards grading into dirty pale yellowish brown, inside strongly glossy dark maroon, upwards grading into reddish purple and finally dirty pale yellowish brown, smooth but the veins in the lower part raised. *Spadix* equalling the spathe, 6 cm long, subsessile; *female zone* ± cylindric, c. 0.8 cm long, c. 0.7 cm in diam., flowers lax and irregularly placed, leaving large parts of the axis visible; *male zone* cylindric, c. 1.7 cm long, 0.5 cm in diam., flowers congested; *appendix* fusiform-conic, 3.8 cm long, 0.8 cm in diam., obtuse, with scattered irregular shallow depressions, base slightly constricted, surface smooth, moderately glossy, pale brown with a yellowish flush, producing a foul smell. *Ovaries* slightly or clearly depressed, 1.5–2 mm in diam., c. 1 mm high, subcircular in cross section, blackish purple, 2- or 3-locular; *style* 0.1–0.2 mm long, c. 1 mm in diam., blackish purple; *stigma* large, slightly depressed, subcircular in cross section, 1–1.5 mm in diam., c. 0.8 mm high, dark purple, mostly with 2 or 3 elongate conic projections near the centre, these perpendicular to the stigma or variously pressed against it, surface

otherwise verruculate. *Male flowers* consisting of 2 or 3 stamens, elongate diamond-shaped, free or irregularly fused to form short longitudinal rows; *stamens* nearly entirely connate in one flower, c. 1 mm long, yellowish white; *filaments* 0.1–0.2 mm long, connate; *anthers* c. 0.8 mm long, the top slightly raised around the pores, these rounded or slightly elongate, apical. *Pollen* finely striate.

**Etymology** – The species epithet refers to the shape of the cross section of the petiole in juvenile plants.

**Distribution** – Malaysia: Sarawak.

**Additional specimen** – *Vogel 933298* (p.p.), Sarawak, 1st Div., Mt Ampungan, SE of Serian (cult. by author, *H.A.M.* 328).

**Note** – *Amorphophallus angulatus* resembles *A. eburneus* Bogner (Sarawak) in general shape but differs markedly by the much smaller dimensions, the purple colours of the spathe and spadix and a much smaller leaf.

#### 4. *Amorphophallus angustispathus* Hett., *spec. nov.* — Fig. 2c, d

*A speciebus omnibus in filamentis longis tenuis connatis differt.* — *Typus: Kurz 2660* (CAL holo), Myanmar (Burma), Pegu Yomah, eastern and western slopes, 'Swa'.

*Tuber* elongate, napiform, at least 11 cm long, top part thickened, 2–3 cm in diam. *Leaf* unknown. *Inflorescence* solitary, long peduncled; cataphylls up to 14 cm long; *peduncle* smooth, 36–43 cm long, c. 1 cm in diam. (base); *spathe* ovate-lanceolate to narrowly lanceolate, base shortly convolute, top acute, 10–14 cm long, 1.5–3 cm in diam., base inside smooth. *Spadix* slightly longer than the spathe, sessile, 13.5–17 cm long; *female zone* cylindrical, c. 1 cm long, c. 0.5 cm in diam., flowers congested; *male zone* conic, 3–3.5 cm long, 0.6–0.8 cm in diam., flowers distant; *appendix* narrowly elongate-fusiform, smooth, acute, 10–13 cm long, c. 1 cm in diam. *Ovaries* (depressed?-)globose, diamond-shaped in cross section, c. 2 mm in diam., 2 mm high, 2-locular; *stigma* sessile, flattened, circular, c. 1 mm in diam. *Male flowers* consisting of (2) 3 or 4 (5) stamens; *stamens* 2.5–3 mm long; *filaments* entirely fused into a slender column, only the uppermost part free and spreading; column 1.5–2 mm long but in the uppermost flowers shorter to nearly absent, 0.6–1 mm in diam., base broadened; *anthers* at the top of the column, spreading, subglobose, 1 mm long, 1–1.5 mm in diam.; pores apical to subapical, elongate. *Pollen* striate.

**Distribution** – Myanmar (Burma), Pegu Yomah, and Tharawaddy district.

**Additional specimen** – *Rogers 11* (CAL), Myanmar (Burma), Tharawaddy district, Konbibi Reserve, Zen Nyaungbuizen, rest-home, c. 60 m alt., 23-iv-1914.

**Notes** – 1. Engler (1911: 86) cited *Kurz 2660* under *A. purpurascens* Kurz ex Hook. f., apparently overlooking the elongate tuber and the long stalked anthers. Other differences with *A. purpurascens* are the smooth inner side of the spathe base and the spadix clearly exceeding the spathe.

2. *Amorphophallus angustispathus* is similar to *A. longituberosus* (Engl.) Engl. & Gehrm. but differs in the shape of the male flowers, the longer spadix and the sessile stigmas. The slender column resulting from the fusion of filaments is unique in *Amorphophallus* and has always been regarded as a valuable character to distinguish the genus *Pseudodracontium* N.E. Brown from *Amorphophallus*.

### 5. *Amorphophallus annulifer* Hett., *spec. nov.* — Fig. 3a, b

*Amorphophallus muelleri* auct. non Blume ('mulleri').

Ab omnibus aliis in inflorescentiis bene evolutis appendicis basis concretescentia annuliformi differt. Inflorescentiae parvae quae hunc characterem carentes *A. discophoro* similes sed illae extensione disciformi in zona mascula egent et spadix spatha superans. — Typus: *Hetterscheid H. AM. 119-T* (L holo; spirit coll.), 3-i-1991, cult. Hort. Bot. Leiden ex Indonesia, Java, Lengkong, c. 750 m alt., in lowland rain forest on clayish soil (orig. coll. *van Balgooy s.n.*, v-1990).

*Tuber* subglobose, up to c. 10 cm in diam., weighing up to c. 600 gr., dark brown, no offset development. *Leaf* (only known from small specimen) solitary; *petiole* 90 cm long, 2 cm in diam., background a complex marbling of shades of blackish green, mid green and paler green, upwards grading into dark brown and mid green shades, in upper half with larger, scattered, oval to elongate-elliptic white spots with brown marbling in the centre, basal part with many small, rigid verrucae; *lamina* 100 cm in diam., rachises only narrowly winged in the distal parts; *leaflets* elliptic or elliptic-lanceolate, 8–15 cm long, 4–5 cm in diam., long acuminate, upper surface moderately glossy green. *Inflorescence* long peduncled; *peduncle* as petiole, 66–156 cm long; *spathe* oval to triangular ovate, 13–29 cm long, 14–25 cm in diam., base strongly convolute, limb erect, broadly acute, outside base with pale greenish background and larger and smaller brown spots and numerous small white spots, towards the limb suffused with a brownish purple hue, the latter especially strong near the margin, inside base pale greenish white, above that a small zone of reddish purple, then entirely dark maroon, with some small white dots at the base-limb transition, base within smooth or with furrows and in between scattered, small, muricate warts. *Spadix* sessile, longer than spathe, 22–56 cm long; *female zone* near cylindric, slightly tapering to the top, 3–8 cm long, 1.7–2.7 cm in diam., base oblique, flowers congested; *male zone* cylindric with a strongly expanded top or obconic, 3–3.5 cm in diam., flowers congested; *appendix* elongate fusiform-conic, inflated, hollow, thin-walled, 16–44 cm long, slightly or more prominently laterally compressed, with or without (feeble specimens) a strong, ring-like expansion near the base, thickest at about 1/3 from the base, diameter at the base 2.7–3.5 cm, that of the ring c. 5.5 cm, diameter at widest point 3.5–8 cm, top subacute, surface granulate, off-white, at the base with flattened staminodial structures separated by shallow grooves, a strong stench of dirty socks or fish develops at female anthesis. *Ovaries* depressed, angulate, 3–5 mm in diam., 2.5–3.5 mm high, bilocular, lower part whitish green, upper part dark maroon; *style* 2 mm long, 0.5 mm in diam., dark maroon; *stigma* c. 1 mm in diam., c. 1 mm high, shallowly bilobed, lobes conic, leaving the style clearly visible on the outer side, surface densely echinulate, reddish brown. *Male flower* consisting of 3 or 4 stamens; *stamens* c. 3 mm long; *filaments* c. 1.5 mm long; *anthers* c. 1.5 mm long, c. 2 mm in diam., truncate, pale yellow, connective very pale greyish green, pores elongate, apical. *Pollen* fossulate.

Etymology – The species epithet refers to the annulate widening of the appendix-base.

Additional specimens – *Van Balgooy 4536* (L), Indonesia, Java, Lengkong; *Widjaja s.n.* (L), Indonesia, Java, Jampang Kulon Forest.

Distribution – Indonesia, Java.

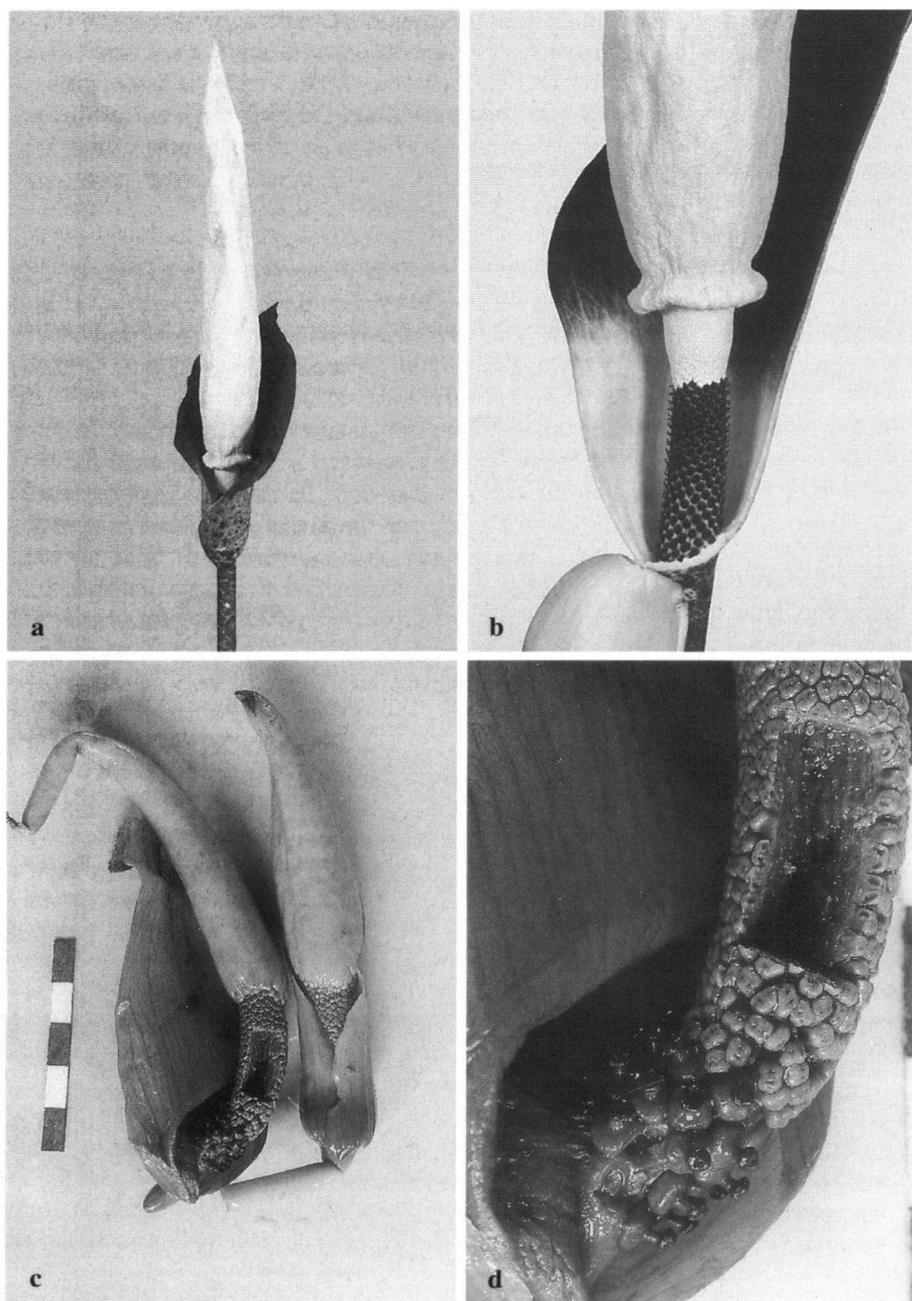


Fig. 3. — a, b: *Amorphophallus annulifer* Hett. (Hetterscheid H.AM. 119, type-plant); a: spathe and spadix, c.  $\times 0.13$ ; b: spathe cut open, c.  $\times 0.32$ . — c, d: *A. arnautovii* Hett. (Arnautov 87-149, type = left specimen and 3d); c: inflorescences with peduncles missing; d: detail of spadix base of type specimen. Scale bar = 5 cm.

Notes – 1. Larger specimens of *A. annulifer* are recognisable by the ring-like extension of the spadix-base. Smaller specimens, lacking this character, resemble *A. discophorus* Backer & Alderw. but differ from the latter in lacking the typical disc-like extension in the male zone.

2. The name *Amorphophallus muelleri* Blume has consistently been misapplied to this species dating from Beumée (1919). True *A. muelleri* Blume is the species better known as *A. oncophyllus* Prain (a later name, so now a synonym). In Backer & Bakh. f. (1968: 113) Blume's name *A. punctulatus* was synonymised with the wrongly applied name *A. muelleri*, suggesting this to be a candidate for the correct name of *A. annulifer*. However, the description of *A. punctulatus* (Blume, 1837: 148) is indecisive and its proper application remains in doubt. No name being available, it had to be decided to publish *A. annulifer*.

### 6. *Amorphophallus arnautovii* Hett., *spec. nov.* — Fig. 3c, d

Ab *A. pingbianensi* H. Li & Long in ovarii bilocularibus, stigmatibus maioribus, appendice robustiore differt. — Typus: *Arnautov 87-149*, p. p. (LE holo; spirit coll.), cult. Hort. Bot. St. Petersburg ex Central Vietnam, Gialai-Kontum Prov., northern part of Tay Nguyen Plateau.

*Tuber* unknown. *Inflorescence* long peduncled; *peduncle* incompletely known. *Spathe* triangular, 7.5–9 cm long, 4.5–5.5 cm in diam., base shortly convolute, top acute, outside with raised veins, base within nearly smooth with a few scattered, small, punctiform warts. *Spadix* sessile, longer than spathe, 11–16 cm long; *female zone* cylindric, 1–1.5 cm long, 1.1 cm in diam., flowers congested; *male zone* cylindric, top slightly widened, 2.3–3.5 cm long, 1–1.4 cm in diam., sometimes slightly bilaterally compressed, flowers congested; *appendix* elongate fusiform, 7.5–11.5 cm long, base slightly compressed, diameter (short axis) 1.1–1.7 cm, long axis 1.5–2.2 cm, top acute, base constricted, surface smooth, base with some flattened staminodes, separated by grooves. *Ovaries* strongly depressed, 3–3.5 mm in diam., 1.5–1.8 mm high, angulate or irregularly circular in cross section, bilocular; *style* straight or slightly upcurved, 1–1.5 mm long, 0.8 mm in diam.; *stigma* depressed, nearly disciform, 1.5 mm in diam., 0.7 mm high, irregularly circular in cross section, entire with a shallow, elongate, central depression or shallowly bilobed, surface densely verruculate. *Male flowers* consisting of 4 or 5 stamens; *stamens* c. 2 mm long, 1–1.9 mm in diam.; *filaments* c. 0.7 mm long, connate; *anthers* c. 1.3 mm long, truncate, pores apical, elongate and connected to the margin of the anther by a groove. *Pollen* psilate.

*Etymology* – The species is named after Dr. N. Arnautov of the Komarov Institute of Botany in St. Petersburg, Russia, who collected the type plant.

*Distribution* – East Central Vietnam (only known from the type collection).

*Note* – *Amorphophallus arnautovii* is morphologically near to *A. pingbianensis* Li & Long (Yunnan), from which it differs in having a bilocular ovary, a larger stigma and a longer and more robust spadix.

### 7. *Amorphophallus atroviridis* Hett., *spec. nov.* — Fig. 4a, b

A speciebus omnibus in tubere elongato, staminodiorum complanatorum zona inter zonis masculas femineasque differt. — Typus: *Hetterscheid H.AM. 107-T* (L holo; spirit coll.), 22-iii-1991, cult. Hort. Bot. Leiden ex Thailand (no locality; type plant obtained from S. Hyndman).

*Tuber* napiform, up to 11 cm long. *Leaf* solitary; petiole 10–45 cm long, up to c. 1.5 cm in diam. (base), dark reddish brown with some rounded, dirty white, brown centred spots and numerous tiny, dirty white dots, densely velvety hairy; *lamina* with few leaflets (5 or 6), 18–55 cm in diam., rachises winged; leaflets large, obovate, shortly acuminate, slightly succulent, 9–25 cm long, 4.5–12 cm in diam., upper surface with minute, erect, white hairs, dark emerald-green with a conspicuous, pinkish violet margin and often a bluish sheen, margin undulate, lower surface greyish green, with numerous tiny white hairs, main and secondary veins pale pink, the surface in between less hairy, margin pinkish violet. *Inflorescence* solitary; *peduncle* like petiole, c. 30 cm long, c. 1 cm in diam. (base); *spathe* erect, c. 10 cm long, lower third convolute, separated from the limb by a shallow constriction, limb triangular, acute, margins slightly reflexed, base outside dirty whitish, upwards grading into pale brown with many scattered, small, irregular, dirty white spots, the margin pinkish violet, main veins in the lower half dark brown, inside pale whitish green, suffused with purplish near the upper margin, entire margin pinkish violet, surface densely clothed with irregularly shaped, more or less flattened warts. *Spadix* sessile, about twice as long as spathe, up to 25 cm; female part cylindrical, c. 1 cm long, c. 1.2 cm in diam., flowers slightly distant; male part elongate-conic, c. 7 cm long, c. 1.5 cm in diam. (near base), flowers congested; sterile zone between male and female parts short, carrying a few staminodes; *appendix* elongate conic, slender, acute, irregularly, shallowly sulcate with some small, punctiform warts, brown, c. 18 cm long, c. 1.3 cm in diam. (near the base), developing a strong, cheesy smell at female anthesis. *Ovaries* depressed, c. 2.5 mm in diam., c. 1.5 mm high, pale green, near the style-insertion dirty violet, unilocular; *style* c. 1 mm long, 0.8 mm in diam., straight or slightly upcurved, dirty violet; *stigma* depressed, irregularly disciform, rounded or slightly angulate in cross section, c. 2 mm in diam., c. 0.6 mm high, surface with several very small knob-like warts and one usually eccentric large conic rounded wart/lobe, dirty orange-yellow. *Male flowers* consisting of 3–5 *stamens*, creamy white; *filaments* short, fleshy, c. 1.5 mm long, c. 2 mm in diameter, in the lowermost flowers entirely connate and strongly enlarged and then c. 5 mm long; *anthers* c. 1 mm long, c. 2 mm in diameter (in some of the basalmost flowers strongly reduced and often sterile), the top rounded, pores apical, elongate; *staminodes* semiflattened, oval in cross section, c. 5 mm in diameter, ivory-white. *Pollen* striate.

**Etymology** – The species epithet refers to the colour of the upper surface of the leaflets.

**Distribution** – Thailand.

**Additional specimen** – *Smitinand & Phengkhlai 8835* (BKF), Thailand, Khao Phaeng, among limestone boulders, 3-vii-1965.

**Notes** – 1. *Amorphophallus atroviridis* is in many respects morphologically similar to *A. brevispathus* Gagnep. and *A. macrorhizus* Craib, both from Thailand. The velvety hairiness and the elongate tubers are found in both species and the dark emerald-green, pinkish violet margined leaves are also found in *A. macrorhizus*. Compared with *A. macrorhizus*, *A. atroviridis* is much smaller, has a prominent style, no hairs on the appendix; compared to *A. brevispathus* the species has larger male flowers, a longer style, a flattened stigma and larger leaves.

2. The present species has been obtained from cultivated stock through Mr. Scott Hyndman of Florida (USA). It has long been in cultivation in the USA as *Thomsonia larsenii* Hu (a synonym of *A. brevispathus*).

### 8. *Amorphophallus cicatricifer* Hett., *spec. nov.* — Fig. 4c

Ab *A. bulbifero* (Roxb.) Blume in pistillis minoribus, zona mascula obconica, coloris ordinatione in spatha diversa differt. — Typus: *den Hoed, Kwae Noi River Basin Exp. nr. 663* (L holo; iso K), Thailand, near Neeckey, near Wangka, in dense moist forest, alt. 150 m, 21-v-1946.

*Tuber* depressed-globose, 4–6 cm in diam., c. 3 cm high. *Leaf* unknown. *Inflorescence* solitary, long peduncled; cataphylls up to 30 cm long, 'brownish purple'; *peduncle* 22–43 cm long, 0.8 cm in diam. (base), smooth, 'purple, paling up to the lower part'; *spathe* elliptic, acute, base convolute, c. 20 cm long, c. 8 cm in diam., 'pale flesh coloured with purple veins', base within slightly rugulose and probably darker coloured than other parts of the spathe, no distinct warts. *Spadix* shorter than spathe, sessile, 14–16 cm long; *female zone* slightly obconic, 1–1.5 cm long, 0.7–0.9(–1.7?) cm in diam., 'yellow and purple', flowers slightly distant, a few of the uppermost absent, leaving only a small scar; *male zone* obconic, distinctly narrowed to the base, 3–3.5 cm long, diameter 0.5–0.7 mm at base, 1.2–1.5 mm at the top, flowers congested, to the base less so, basal flowers reduced to one stamen or entirely absent, leaving a scar; sterile zone between male and female zone very short, consisting of several scars of absent male and/or female flowers, 2–3 mm long; *appendix* massive, fusiform-conic, smooth, subacute, base with some flattened staminodes, 8–10 cm long, 1.5–2.5 cm in diam., 'cream coloured'. *Ovaries* depressed, 2–3 mm in diam., c. 1.5 mm high, stipitate, unilocular, stipe 1 mm long, 0.5 mm in diam., sunken into the spadix-axis; *style* 1 mm long, 0.5 mm in diam.; *stigma* disciform, circular in cross section, entire or with a shallow central depression, sometimes surrounded by three small lobes, margins slightly irregularly deflexed, surface verruculate, 1.5–2 mm in diam., 0.3–0.4 mm high. *Male flowers* consisting of 1–4 stamens; *stamens* c. 1 mm long; *filaments* 0.1–0.2 mm long; *anthers* truncate, 1–1.4 mm in diam., 0.8–1 mm long, 'light yellow', pores apical, oval at anthesis, connective slightly enlarged, with a transverse groove connecting the pores. *Pollen* irregularly striate.

*Etymology* – The specific epithet refers to the scars of absent flowers between male and female zone.

*Distribution* – Thailand (only known from type collection).

*Note* – *Amorphophallus cicatricifer* is morphologically near to *A. bulbifer* (Roxb.) Blume, from which it differs in the smaller pistils, the obconic male zone, a sterile zone between male and female zones, a different colour pattern of the spathe and striate pollen (vs. psilate).

### 9. *Amorphophallus costatus* Hett., *spec. nov.* — Fig. 4d

Ab *A. pendulo* Bogner & Mayo in pedunculo brevi, appendice multo brevior et foliis ellipticis inornate viridis differt. — Typus: *Hetterscheid H.AM. 225-T* (L holo; spirit coll.), 23-iv-1992, cult. Hort. Bot. Leiden ex Indonesia, S Kalimantan, Datar Alei, W of Mt Batu Besar, alt. 400 m, along stream (orig. coll. *J. Murata s.n.*, 24-vi-1991).

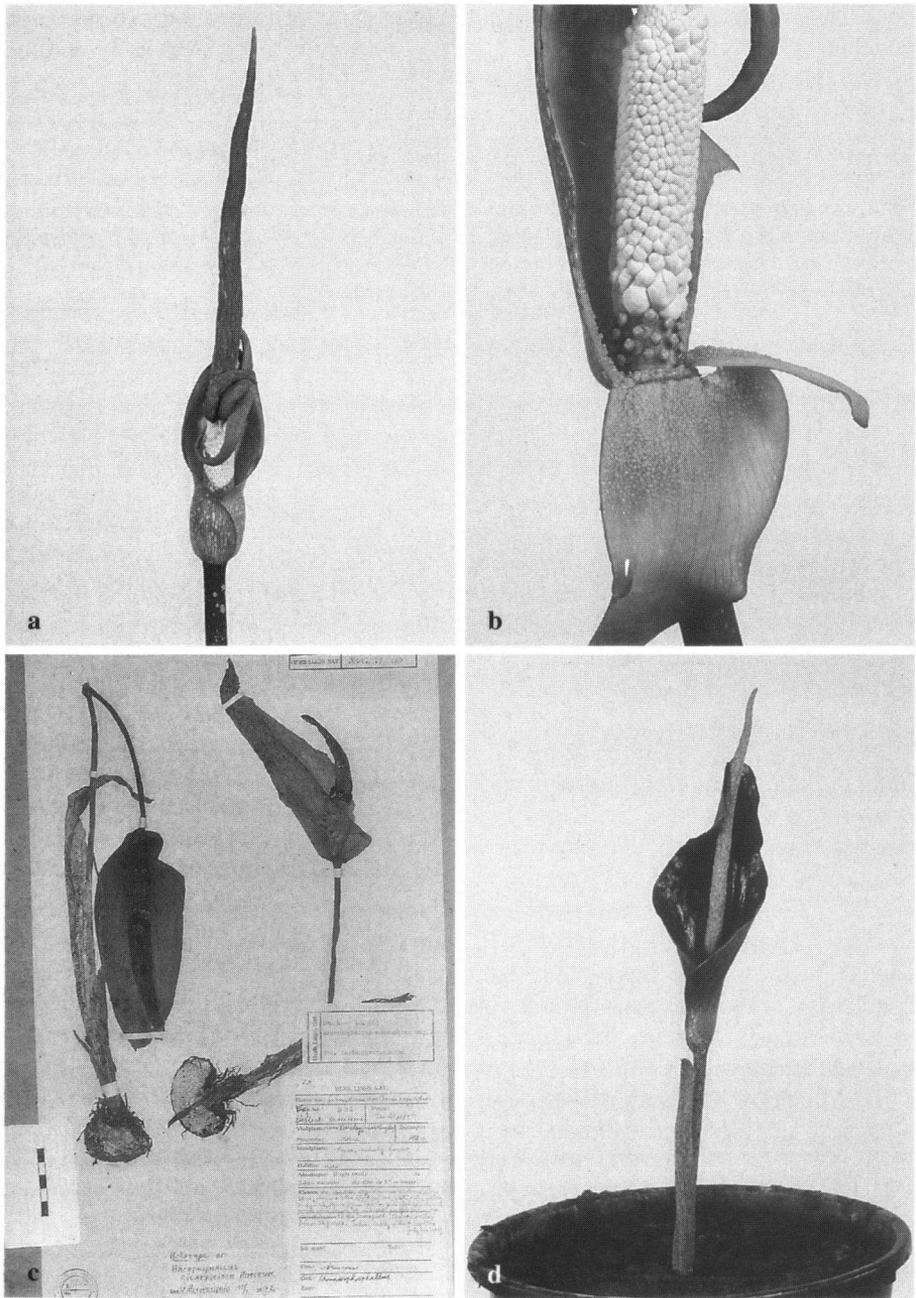


Fig. 4. — a, b: *Amorphophallus atroviridis* Hett. (*Hetterscheid H.A.M. 107*, type-plant with abnormal extra appendices); a: c.  $\times 0.29$ ; b: spathe cut open, showing the base of the spadix, c.  $\times 0.8$ . — c: *A. cicatricifer* Hett. (*den Hoed, Kwae Noi River Basin Exp. 663*, type); scale bar = 5 cm. — d: *A. costatus* Hett. (*Hetterscheid H.A.M. 225*, type-plant), c.  $\times 0.25$ .

*Tuber* globose. *Leaf* solitary; petiole c. 60 cm long, c. 1.5 cm in diam., smooth, background whitish, largely obscured by irregular confluent dark emerald green spots with obscurely dark violet-brown upper margins and flushes; *lamina* with distant leaflets, c. 100 cm in diam., rhachises narrowly winged only in the distalmost branches; leaflets oblanceolate, acuminate, base cuneate, 8–21 cm long, 2.5–5 cm in diam., upper surface moderately glossy dark green, margin irregularly undulate. *Inflorescence* solitary, short peduncled; *peduncle* 14–16.5 cm long, c. 1 cm in diam. (base), lilac-pink with several blackish green  $\pm$  elliptic or irregular small blackish green spots; *spathe* erect, elongate triangular, 16–24 cm long, 8–10 cm in diam., base strongly convolute, forming a narrow tube, limb shortly acuminate, lower margin outwardly reflexed, subauriculate, base outside pinkish with brownish veins and a few punctiform blackish spots, inside lowermost zone dark maroon, otherwise dirty white to yellowish white, limb outside dirty greyish green with strongly raised dirty brownish violet main veins, inside entirely glossy maroon and with a few rounded dirty white spots, base within with several shallow warts, these shortly ridge-like. *Spadix* longer than spathe, sessile, 19.5–26.5 cm long; *female zone* obliquely cylindrical, 0.7–1.3 cm long, 0.8–1.1 cm in diam., flowers congested or some more distant; *male zone* cylindrical, 2.5–3 cm long, 0.8–1.1 cm in diam., flowers slightly distant, irregularly arranged or in longitudinal or oblique interrupted rows; *appendix* narrowly elongate, acute, base slightly constricted, 16–22 cm long, 0.8–1.1 cm in diam., surface densely rugulose, ground colour dirty pale yellow, strongly suffused with brownish, giving off a strong cheesy smell at female anthesis. *Ovaries*  $\pm$  pyriform, c. 1.5 mm high, 1.2–1.4 mm in diam., base white, rest blackish maroon, unilocular; *style* inconspicuous, conic, bi- or trifurcate, slightly rugulose, c. 0.5 mm long, c. 0.8 mm high, blackish maroon; *stigma* often subapical, 2- or 3-lobed, thin, verruculate and with some longer scabrae, pale brown, 0.8–1 mm high, 1 mm in diam., lobes conic. *Male flowers* consisting of 2–4 stamens but their limits often obscured through fusion into irregular longitudinal ridges; *stamens* c. 2 mm long; *filaments* c. 1.5 mm long, free to the base or connate up to 2/3 of their length; *anthers* subtruncate, rounded or elliptic in cross section, c. 0.5 mm long, carrying 1 or 2 thecae, these consisting of 1 or 2 locules; pores apical, rounded or elliptic. *Pollen* irregularly striate to irregularly areolate.

Etymology – The species epithet refers to the strongly raised main veins on the outside of the spathe.

Distribution – Indonesia, South Kalimantan (known only from the the type locality).

Note – *Amorphophallus costatus* resembles *A. pendulus* Bogner & Mayo (Sarawak) in the overall shape of the inflorescence but the latter species has a much longer, whip-like, pendulous appendix and a longer peduncle. Floral details of *A. costatus* resemble those of *A. eburneus* Bogner (Sarawak) in the alignment of the male flowers and the shape of the female flowers, also the shape of the spathe is similar. However, *A. eburneus* has a much larger leaf with much larger leaflets (up to c. 50 cm long), an ivory-white spathe and appendix, the latter being much thicker than that in *A. costatus*.



**10. *Amorphophallus curvistylis* Hett., *spec. nov.* — Fig. 5a, b**

Ab *A. napalense* (Wall.) Bogner & Mayo in stylis valde curvatis, stigmatibus bilabiatis ad spadicis axem vergentibus, appendice laevi differt. — Typus: *Hetterscheid H.AM.002-T* (L holo; spirit coll.), 9-xi-1989, cult. Hort. Bot. Leiden ex Thailand, Kanchanaburi Prov., Sai Yok, between Kvae Noi and Kvae Yai, N of Kanchanaburi, along Burmese border, on limestone hills (orig. coll. *K. Larsen FOT 10754*, 1964).

*Tuber* subglobose or slightly depressed, up to 12 cm in diam., dark brown, smooth, developing long rhizomatous offsets. *Leaf* solitary; petiole very turgid, smooth, 50–120 cm long, c. 3 cm in diam. at the base, entirely green or spotted white-tan and brown; blade highly dissected, up to 130 cm in diam.; basal parts of the rhachises naked, distal parts narrowly winged; leaflets elongate elliptic, acuminate, base decurrent on the rhachis, upper surface mid-green, 22–30 cm long, 7.5–8.5 cm in diam., venation strongly impressed on the upper surface. *Inflorescence* moderately long peduncled; *peduncle* 20–40 cm long, c. 1.5 cm in diam., colour as petiole; *spathe* erect, cymbiform, elongate triangular, slightly constricted at the middle, acute, 10–30 cm long, 8–17 cm in diam., subcoriaceous, base convolute, outside dull green with a few paler spots and with a faint brownish hue or spotted white-tan and brown, inside side pale green, limb outside and inside as base, base within with numerous small shallow longitudinally elongate warts. *Spadix* shortly stipitate, subequalling the spathe, 9–28 cm long; *female zone* cylindrical, 1–5 cm long, 0.8–2.5 cm in diam., flowers congested; *male zone* cylindrical or slightly conic, 4–12.5 cm long, 0.9–2.1 cm in diam., flowers congested, the lower ones distant, upwards irregularly connate or in ascending spirals; *appendix* elongate, fusiform-conic, 4–10.5 cm long, 1.5–2.5 cm in diam., top rounded, base with a few grooves or with a few rounded staminodes, ivory-white, surface at first smooth but rugulose at male anthesis, developing considerable heat at female anthesis and a heavy gaseous stench. *Ovaries* depressed, angulate, green or greenish white, 4–5 mm in diam., 2 mm high, unilocular; *style* placed eccentrically on the acroscopic part of the ovary, laterally compressed, strongly curved upwards and to the spadix-axis, suddenly enlarged near the top, 3–4 mm long, white or green with a pale brownish hue, turning entirely brown at male anthesis; *stigma* large, pointing towards the spadix-axis, more or less strongly transversely folded, bilabiate, auricled, with two central depressions, the acroscopic margin emarginate, surface verruculate, dirty yellow or orange, turning entirely brown at male anthesis, 3 × 2 mm in diam. *Male flowers* consisting of (2–)3–7 stamens; *stamens* ivory-white, 1.5–3 mm long, c. 2 mm in diam, in the lowermost flowers c. 3 mm in diam., these sometimes sterile through reduction of the anther; *filaments* 1–2.5 mm long, basal half connate, length varying considerably within one flower; *anthers* c. 0.5 mm long, truncate or subglobose, pores apical, elongate, narrow. *Pollen* striate.

*Etymology* – The species epithet refers to the shape of the style.

*Additional specimen* – *Maxwell 73-146* (BK), Thailand, Kanchanaburi Prov., Tawng Pa Poom District, Cow Ngoo River area, 800 m altitude, on shaded limestone slopes and outcrops in bamboo/hardwood forest, 5-vii-1973.

*Distribution* – Thailand (eastern), Kanchanaburi Prov.

Note — *Amorphophallus curvistilus* mostly resembles *A. napalensis* (Wall.) Bogner & Mayo in several characters but differs among other characters in the smaller and smooth appendix and the shorter peduncle. It also resembles *A. krausei* Engl. but lacks the staminodial zone between male and female parts of the spadix and it has a different stigma and a shorter peduncle.

**11. *Amorphophallus dactylifer* Hett., *spec. nov.* — Fig. 5c, d**

Ab *A. konjac* K. Koch in stylis multo longioribus, ovariis unilocularibus, verrucis in basi spathae multo ramosis digitiformibus differt. — Typus: *H. G. Gutierrez PNH 78180* (field nr. 61-218) (L. holo), Philippines, Luzon, San Mariano, Isabela, Sierra Madre Mts, Bo. Disulap, undergrowth in Nabulay Forest, alt. c. 500 ft, 18-v-1961.

*Tuber* depressed globose, at least 7 cm in diam. and c. 3 cm high. *Leaf* solitary; *petiole* incompletely known; *leaflets* elliptic or elliptic-lanceolate, up to c. 16 cm long and c. 5 cm in diam., long acuminate (acumen up to 3 cm long). *Inflorescence* solitary, long peduncled; *peduncle* up to 65 cm long, 1–2 cm in diam., 'violet'; *spathe* campanulate, 30–38 cm long, 12–20 cm in diam., elongate triangular, acute, base strongly convolute, limb probably arching over, outside 'brown with white spots', base inside dark purple with pale upper part, densely clothed with long, simple or branched, fleshy warts, especially near the base of the spadix. *Spadix* sessile, longer than spathe, 42–60 cm long; *female zone* cylindrical, 4–8.5 cm long, c. 2 cm in diam., flowers slightly distant; *male zone* elongate obconic, 4.5–6 cm long, 1.5–2.5 cm in diam. at the top, flowers congested; *appendix* elongate conic, acute, 31–46 cm long, 2–3 cm in diam. at the base, smooth, probably dark brownish purple. *Ovaries* subglobose, 2–3 mm in diam., c. 2 mm high, unilocular; *style* 2–5 mm long, c. 0.8 mm in diam.; *stigma* large, 2 mm in diam., 1–1.5 mm high, oval in cross section, shallowly or deeply 2- or 3-lobed, lobes rounded or conic, surface with numerous large conic fleshy projections. *Male flowers* consisting of 3–5 stamens; *stamens* 1–1.5 mm long; *filaments* 0.1–0.5 mm long, connate; *anthers* c. 1 mm long, 1.5–2.5 mm in diam., truncate, pores apical, elongate. *Pollen* psilate.

Etymology — The species epithet refers to the finger-like warts in the spathe base.

Additional specimens — *Aguilar 01124* (KYO), Laguna, Los Baños, Mt Makiling; *H. G. Gutierrez et al. PNH 117246* (field nr. 264) (L), Samar; *Mendoza & Convocar PNH 10477* (A), Mindanao, Surigao Prov., Mt Kabatuan; *Solheim II PNH 11414* (field nr. 4) (A), Luzon, San Narciso.

Distribution — Philippines.

Note — In general appearance *A. dactylifer* resembles *A. konjac* K. Koch but differs by the unilocular ovary, the much longer styles and the long and branched warts in the spathe base.

**12. *Amorphophallus declinatus* Hett., *spec. nov.* — Fig. 6a, b**

Ab *A. konjac* K. Koch in stylis brevissimis, appendice gracillima, spatha valde declinata differt. — Typus: *Merrill 9419* (L. holo; iso BO, SING), Philippines, Palawan, Taytay Bay.

*Tuber* unknown. *Leaf* (only known from young specimen) solitary; *leaflets* elliptic-lanceolate, acuminate, up to c. 8 cm long and c. 3 cm in diam. *Inflorescence* solitary,

long peduncled; *peduncle* 69–113 cm long, 1.5–2 cm in diam., smooth; *spathe* elongate triangular, 17–30 cm long, 9–20 cm in diam., base strongly convolute, separated from the limb by a shallow constriction, limb acute, fornicate during anthesis, inside base with numerous, slightly ridge-like, fleshy warts. *Spadix* exceeding the spathe, sessile, 25–50 cm long; *female zone* elongate, slightly conic, 2–4 cm long, 0.8–1.2 cm in diam., flowers congested; *male zone* slightly obconic, 2–5.5 cm long, 1–1.5 cm in diam., flowers congested; *appendix* elongate, 21–40 cm long, c. 1.5 cm in diam. at the base, gradually tapering to the acute tip, surface smooth. *Ovaries* slightly depressed, circular in cross section, 1 mm high, 1.5 mm in diam., unilocular; *style* short, c. 0.3 mm long, c. 0.7 mm in diam.; *stigma* hemispheric or slightly depressed, circular in cross section, 0.7–1 mm high, 1 mm in diam., entire, surface verruculose. *Male flowers* consisting of 1–4 stamens; *stamens* c. 1 mm long; *anthers* sessile, elliptic in cross section, truncate, 1–1.5 mm in diam., pores apical. *Pollen* psilate.

Etymology – The species epithet refers to the fornicate spathe limb during anthesis.

Distribution – Philippines, Palawan (only known from the type collection).

Note – In general appearance *Amorphophallus declinatus* resembles *A. konjac* K. Koch, but differs in the much shorter style, the narrow appendix and the fornicate spathe-limb.

### 13. *Amorphophallus erubescens* Hett., *spec. nov.* — Fig. 6c

Ab *A. muelleri* Blume in spadice spatha brevior ad aequanti, coloris ordinatione in spatha diversa, et ab *A. bulbifero* (Roxb.) Blume in stigmatibus diametro eo ovarii minore differt. — Typus: *Wichian, Kwa Noi Basin Exp. nr. 200 A* (L. holo; iso A, K, L), Thailand, near Neeckey, near Wangka, on sandy soil, 30-iv-1946.

*Tuber* depressed-globose, 7–18 cm in diam. *Leaf* solitary; *petiole* smooth, 30–120 cm long, 0.5–2 cm in diam. (base), pale green to bluish green with elongate, paler spots or brownish black with pale brown spots; *lamina* moderately dissected, rachises winged nearly down to the base, 30–120 cm in diam.; *leaflets* lanceolate, strongly decurrent, top shortly acuminate, 9–25 cm long, 3–5 cm in diam. *Inflorescence* solitary, long peduncled; *peduncle* as petiole, 9–85 cm long, 0.5–1.5 cm in diam. (base), only in the smallest specimens equalling the spathe, otherwise much longer; *spathe* coriaceous, erect, elliptic-lanceolate, 10–32 cm long, 3–20 cm in diam., subacute, base convolute, separated from the limb by a very shallow constriction, limb slightly spreading, margins moderately reflexed, base outside whitish, upwards grading into pale pink, inside dark reddish pink, limb outside pale pink with some whitish spots, top sometimes greenish, inside pink with reddish pink veins, margin paler, base within with numerous small, shortly ridge-like warts, often confluent forming a reticulate pattern of narrow ridges. *Spadix* sessile, shorter or slightly longer than spathe, 9–34 cm long; *female zone* cylindrical, 1.5–9.5 cm long, 0.5–2.5 cm in diam., flowers congested; *male zone* cylindrical or obconic, 2.5–6.5 cm long, 0.6–2.5 cm in diam., flowers congested; *appendix* massive, elongate fusiform-conic, subacute, smooth, 4.5–20 cm long, 1.5–4 cm in diam. (above base), ivory white, base with some irregular staminodes, these flattened. *Ovaries* depressed, circular in cross section, shortly stipitate, c. 3 mm in diam., c. 2 mm high, bilocular,

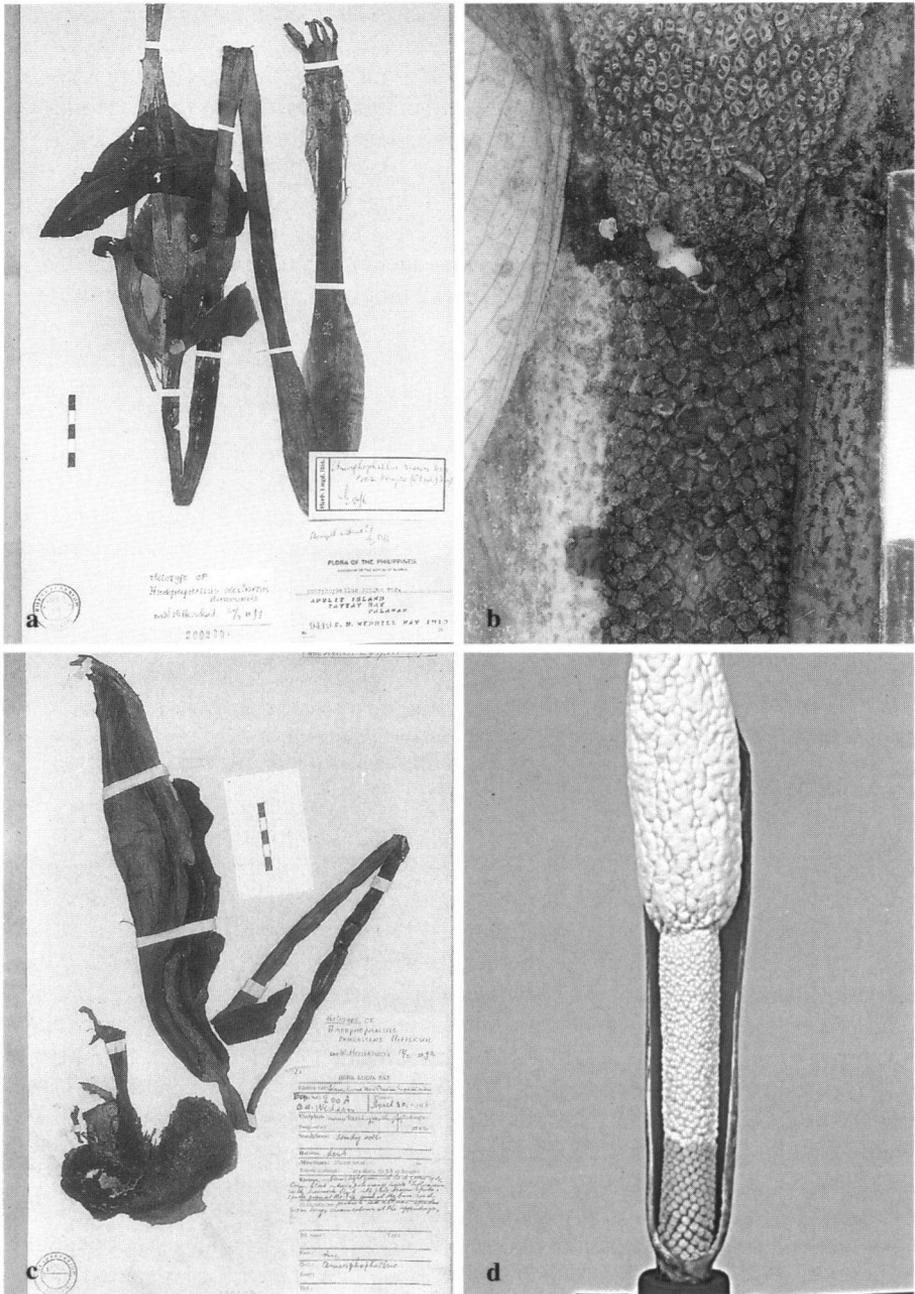


Fig. 6. — a, b: *Amorphophallus declinatus* Hett. (Merrill 9419, type); b: detail of spadix base. Scale bar a = 5 cm, b = 3 cm. — c: *A. erubescens* Hett. (Wichian, Kwa Noi River Basin Exp. 200, type); scale bar = 5 cm. — d: *A. excentricus* Hett. (Hetterscheid H.AM.154, type-plant); slightly immature spathe cut open; c.  $\times 0.56$ .

stipe 0.5 mm long; *style* thick, 1 mm long, 0.8–1.2 mm in diam., cylindrical or slightly conic; *stigma* large, subhemispheric or hemispheric, 1.5–2 mm in diam., 0.5–1 mm high, oval or irregular in cross section, entire or with a central depression, the latter often surrounded by several (4–6) rounded irregular lobes, surface rugulose. *Male flowers* consisting of 2–4 *stamens*; *anthers* sessile, elongate, truncate, irregularly angulate in cross section, yellow or brown, 1–1.5 × 0.7–1 in diam., 1–2 mm long, pores very small, elongate, round at anthesis, connective rather broad. *Pollen* psilate.

Etymology – The species epithet refers to the reddish spathe colour.

Distribution – Thailand, Kanchanaburi Prov.

Additional specimens – *Bloembergen & Kostermans*, *Kwae Noi River Basin Exp. nr. 725* (A, K, L, P), near Wangka; *Wichian*, *Kwae Noi River Basin Exp. nr. 200* (A, K, L, P), near Neeckey, near Wangka; *Yamazaki 4514* (TI, incl. colour photograph), Kanchanaburi Prov., Kwai village, Sai Yok.

Note – *Amorphophallus erubescens* resembles *A. muelleri* Blume (India to Timor) in general appearance but the appendix is shorter or only slightly longer than the spathe (in *A. muelleri* usually much longer, rarely slightly longer), leaflets narrower, the spathe always longer than broad and with a very different colour pattern. From *A. bulbifer* (Roxb.) Blume it differs in the stigma having a smaller diameter than the ovary. The resemblance to *A. bulbifer* in colour pattern of spathe and peduncle is remarkable but the latter species differs in being marbled with white and grey on the outside of the spathe. When living material of this species becomes available, it may turn out to be part of the variation in *A. muelleri*.

#### 14. *Amorphophallus excentricus* Hett., *spec. nov.* — Fig. 6d

Ab *A. asterostigmate* Bogner & Hett. in appendice multo solida, stigmatibus tenuissimis non stellatolobato differt. — Typus: *Hetterscheid H.AM. 154-T* (L. holo; spirit coll.), 19-viii-1992, cult. Hort. Bot. Leiden ex Thailand, Phuket Island, National Park, near Ton Sai Falls, c. 250 m alt. (orig. coll. *M. Koenen*, 1986).

*Tuber* subglobose, yellowish brown, up to 10 cm in diam., developing globose offsets, attached to the main tuber by a short rhizomatous part. *Leaf* solitary; *petiole* up to c. 130 cm long, c. 2.5 cm in diam. (base), smooth, ground colour a very pale, dirty greenish grey or creamish, to the base pale reddish violet, covered with more or less elliptic, blackish green or dirty brownish green spots, these with a sharply defined acroscopic margin and a diffuse basisopic margin, in between several scattered, tiny white dots; *lamina* up to c. 160 cm in diam., distal part of the rachises winged, wings narrowly wedge-shaped; *leaflets* elliptic-lanceolate, acuminate, 12–24 cm long, 4–7 cm in diam., upper surface dull green, lower surface paler green. *Inflorescence* solitary, long peduncled; *peduncle* 45–62 cm long, 1.2–1.3 cm in diam. (base), as petiole or in all parts with an extra brownish hue; *spathe* erect, cymbiform, ovate-triangular, acute, mucronate, 18–24 cm long, 10–11.5 cm in diam., basal part convolute, margin slightly recurved, base outside whitish green to green, near the base with a few diffuse, dark green spots and numerous small, white dots, inside pale whitish green, limb outside green, inside whitish, to the margin and near the top suffused with pale pink, base within with numerous, small, rounded or lon-

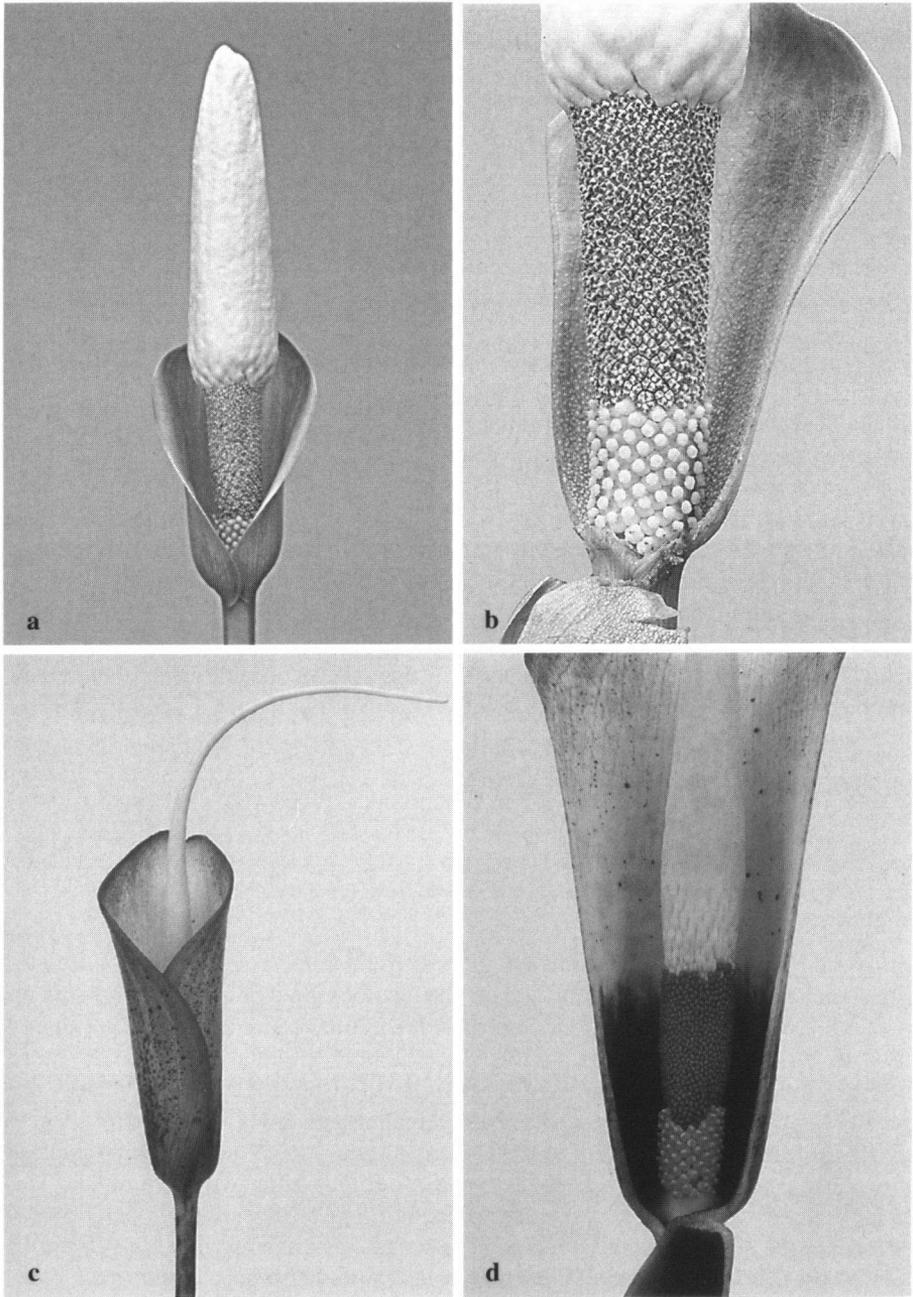


Fig. 7. — a, b: *Amorphophallus glossophyllus* Hett. (Hetterscheid H.AM.242, type-plant); a: spathe and spadix, c.  $\times 0.4$ ; b: lower half of spadix, c.  $\times 0.8$ . — c, d: *A. hayi* Hett. (Hetterscheid H.AM.278, type-plant); c: spathe and spadix, c.  $\times 0.26$ ; b: lower part of spadix, c.  $\times 0.72$ .

gitudinally elongate warts. *Spadix* sessile, slightly longer or shorter than spathe, 18–24 cm long; female part cylindrical or slightly fusiform, 2–3 cm long, 1–1.4 mm in diam., flowers all congested or less so near the base; male part cylindrical or slightly obconic, 5–8 cm long, 1.2–1.3 cm in diam., flowers congested; *appendix* elongate fusiform, dorsoventrally flattened, top acute or slightly rounded, base constricted, 9–12 cm long, 2.2–2.6 cm in diam., surface irregularly, shallowly grooved and minutely rugulose, white. *Ovaries* depressed, base acute, slightly angulate in cross section, 2–3 mm in diam., 1–1.5 mm high, pale green, unilocular; *style* short and thick, 0.5–1 mm long, 1–2 mm in diam., pale green, very excentrically inserted near the acroscopic margin of the ovary; *stigma* thin, 1.5–2.5 mm in diam, 0.5–1 mm high, irregularly angulate in cross section, surface irregularly sulcate with a central, shallow, star-shaped depression or more or less 3- or 4- lobed, verruculate, yellowish to brownish, margin undulate. *Male flowers* consisting of 3–5 stamens; *stamens* 2 mm long, 1.5–2 mm in diam.; *anthers* truncate, with two apical to subapical, elongate pores, off-white. *Pollen* striate.

**Etymology** – The species epithet refers to the place of insertion of the style relative to the ovary.

**Distribution** – Peninsular Thailand.

**Additional specimens** – *Kerr 13374* (K, spirit coll. nr. 22064), Thailand, Ban Kawp Kep, Surat, c. 50 m., in evergreen forest, 3-viii-1927; *Kerr 13376* (K), same locality, 12-viii-1927; *Anonymous s.n.* (probably Kerr) (K, spirit coll. nr. 16864), Thailand, Kaw Titi, Krabi ('Karbi'), 18-vii-1939; *Kerr s.n.* (K, coloured drawing of specimen cultivated in Kew, received from Kerr in August 1931; drawn by S. Ross-Craig on 17-viii-1946), Thailand, Kaw Titi, Krabi ('Karbi').

**Note** – *Amorphophallus excentricus* is morphologically similar to *A. asterostigmatus* Bogner & Hett. but differs among others by its much heavier appendix, the lack of basal staminodes on the appendix and a much flatter stigma.

## 15. *Amorphophallus glossophyllus* Hett., *spec. nov.* — Fig. 7a, b

Ab *A. brevispatho* Gagnep. in foliolis nitidissimis dilute viridibus, staminibus longioribus, appendice obtuso differt. — **Typus:** *Hettterscheid H.AM. 242-T* (L holo; spirit coll.), 9-i-1994, cult. Hort. Bot. Leiden ex Central Vietnam, Gialai-Kontum Prov., northern part of Tay Nguyen Plateau (orig. coll. *N. Arnautov 87-77*).

**Tuber** irregularly napiform, c. 13 cm long, c. 7 cm in diameter at the top, weighing c. 600 gr., whitish with a pale brownish flush, basal part much branched, with the branches gradually developing into new tubers. **Leaf** solitary; **petiole** c. 45 cm long, c. 1.5 cm in diam., smooth, uniformly glossy pale green; **lamina** much branched, c. 70 cm in diam., rachises broadly or narrowly winged, except for the basalmost parts; **leaflets** elliptic-lanceolate or lanceolate, 9–22 cm long, 4.5–6 cm in diam., moderately coriaceous, acuminate, base shortly or very long decurrent, upper surface strongly glossy midgreen. **Inflorescence** solitary, long peduncled; **peduncle** as petiole, 60 cm long, 1.3 cm in diam.; **spathe** oval, 11 cm long, 10 cm in diam., erect, obtuse, base and limb hardly differentiated, only basal 1.5 cm convolute, outside uniformly pale green with slightly darker veins, inside as outside, margin whitish,

base within with numerous, small whitish green warts; spadix sessile, much longer than spathe, 21 cm long; *female zone* cylindrical, 2.5 cm long, 2 cm in diam., flowers congested; *male zone* elongate, slightly obconic, slightly dorso-ventrally compressed, 5 cm long, 1.8 cm in diam. at the base, 2.6 cm in diam. at the top, flowers congested; *appendix* elongate conic, slightly compressed, 13.5 cm long, 3.5 × 3 cm in diam. at the base, top obtuse, base constricted, surface creamish, with numerous very shallow, irregular depressions, developing a powerful, gaseous stench at female anthesis. *Ovaries* depressed, angulate in cross section, 4 mm in diam., 2 mm high, whitish, unilocular, 1 basal ovule; *style* short, 1 mm long, 1 mm in diam., whitish; *stigma* large, depressed, circular in cross section, 2 mm in diam., 1 mm high, inconspicuously 3–5-lobed, whitish, verruculate. *Male flowers* consisting of 4 or 5 stamens; *stamens* 2 mm long; *filaments* 1 mm long, basal half connate, ivory-white; *anthers* 1 mm long, c. 1.5 mm in diam., truncate, ivory-white, around the pores first pale green, later greyish, pores apical. *Pollen* released in strings, coarsely striate.

Etymology – The species epithet refers to the glossy upper surface of the leaflets.

Distribution – Vietnam (only known from the type plant).

Note – *Amorphophallus glossophyllus* resembles *A. brevispathus* Gagnep. (Thailand) but differs in the glossy and much paler green leaflets, a thicker, obtuse appendix and longer stamens.

#### 16. *Amorphophallus hayi* Hett., *spec. nov.* — Fig. 7c, d

A speciebus omnibus in rhizomate crasso longo horizontali c. 5 cm diam., spadice stipitato, appendice myosuroide horizontaliter curvata differt. — Typus: *Hetterscheid H.AM.278-T* (L. holo; spirit coll.), cult. Hort. Bot. Leiden ex North Vietnam, Lao Cai Prov., Ban Khoang village, across the Sa Pa to Phong Tho road, on a small, seasonally inundated island in a creek bed, on granitic bedrock, in schistose alluvial soil, in very deep shade, alt. 1500 m (orig. coll. *Goodwin 92/124*).

*Rhizome* horizontal, branching infrequently, up to c. 25 cm long and 5 cm in diam., brown and green, internodes 1–1.3 cm long, leaf scars transversely oval, offset tubers long lasting, depressed, broadly attached, roots mainly developed from the ventral side. *Leaf* solitary or paired; *petiole* 40–60 cm long, 1–1.5 cm in diam., turgid, smooth, moderately glossy, background colour dirty greyish green but nearly totally hidden by large, oval, confluent, reddish brown spots; *lamina* 50–70 cm in diam., anterior segment less strongly developed than posterior ones, rachises short, unwinged but for the distalmost parts; *leaflets* lanceolate, 8–32 cm long, 2.5–7 cm in diam., acuminate, margin crispate-undulate, upper surface moderately glossy green, venation quite strongly impressed, lower surface paler green. *Inflorescence* solitary, long peduncled; *peduncle* 50 cm long, 1.5 cm in diam. at the base, 0.8 cm in diam. at the top, smooth, reddish brown to yellowish brown, densely covered with dark reddish brown, elongate-oval, often confluent spots; *spathe* ovate, erect, funnel-shaped, upper third part slightly spreading, lower part loosely convolute, base and limb not differentiated, 20 cm long, 15 cm in diam., top narrowly acute, outside base very pale purplish brown on a creamish background, with numerous, small and slightly larger, punctiform, rounded, partly confluent, dark purplish brown spots, upper part outside dirty cream with less numerous rounded spots but numerous tiny ones, to the margin flushed with grey, inside base dark maroon, upper part

creamish with few tiny dark purple spots, to the margin flushed with dirty dark brownish green, base within with very shallow, interconnected ridges. *Spadix* shortly stipitate, longer than spathe, 28 cm long; *female zone* slightly obconic, 1.8–2.2 cm long, 1.3 cm in diam., upper margin irregular, flowers congested; *male zone* fusiform-obconic, 2.4–3 cm long, 1.5 cm in diam., lower margin irregular, flowers congested; stipe c. 2 mm long; *appendix* c. 23 cm long, basal part c. 1.7 cm in diam., upper part 4 mm in diam., elongate fusiform, upper half myosuroid and horizontally flexed, top obtuse, all creamish with a faint bright greenish hue, base with flattened staminodes separated by shallow grooves, upwards diminishing, remainder smooth, emitting a strong cheesy smell or of rotten meat. *Ovaries* very broadly ovate, 2–2.3 mm long, 2 mm in diam., bright pale green with tiny reddish purple dots near the stigma, rounded in cross section, unilocular; *style* absent; *stigma* very thin, acropically palced on the ovary, more or less kidney-shaped, c. 1 × 0.8 mm in diam., scabrous, pale dirty yellowish. *Male flowers* consisting of c. 4 stamens; *stamens* 1.5–1.8 mm long; *filaments* c. 0.3 mm long, basally connate, whitish; *anthers* 1.2–1.5 mm long, c. 1 mm in diam., dark pink to purplish, truncate, pores elongate, apical. *Pollen* in irregular tetrads, psilate, not shed (in cultivation).

**Etymology** – The species is named for Dr. Alistair Hay (Royal Botanic Gardens, Sydney), who brought this plant to my attention and provided me with living material.

**Distribution** – North Vietnam (only known from the type collection).

**Note** – The stout rhizome of *A. hayi* and the ovate ovaries lacking a style and having very thin stigmas make this species unique in the genus. The only other rhizomatous species known is *A. rhizomatosus* Hett. (see this publication). From this species, *A. hayi* differs among other characters in the much stouter rhizome and a different leaf type.

### 17. *Amorphophallus infundibuliformis* Hett., Dearden & A. Vogel, *spec. nov.*

Fig. 8a

Ab omnibus speciebus in spatha obconica infundibuliformi, staminodiis longis aristatis ad uncinatis appendici insidentibus differt. — Typus: *Dearden s. n.* (L. holo; spirit coll.), cult. Cairns ex Malaysia, Sarawak, 1st Division (no locality), 1990.

**Leaf** solitary; *petiole* (partly known) dirty whitish with numerous, confluent, irregular, green spots and scattered white punctiform dots, these more or less raised; terminal segments lanceolate, long acuminate, margin with numerous small undulations, main veins impressed, upper surface green, moderately glossy. **Inflorescence** short peduncled; cataphylls whitish with numerous small, pinkish dots and many larger, blackish green, irregular spots; *peduncle* 4 cm long, c. 0.8 cm in diam. (base), lengthening in fruit; *spathe* strongly convolute, funnel-shaped, obconic in side-view, transversely orbicular-elliptic, 6 cm long, c. 8 cm in diam., very widely acute, limb and base poorly differentiated, outside dirty whitish with pale brownish venation and scattered, small, angulate, blackish green spots, inside whitish, the lower half dark maroon, base within strongly, longitudinally ridged. *Spadix* sessile, very obliquely inserted, slightly longer than spathe; *female zone* oblique, annuliform, 1 mm (dorsal side)–5 mm (ventral side) long, c. 1 cm in diam., flowers congested; *male zone*

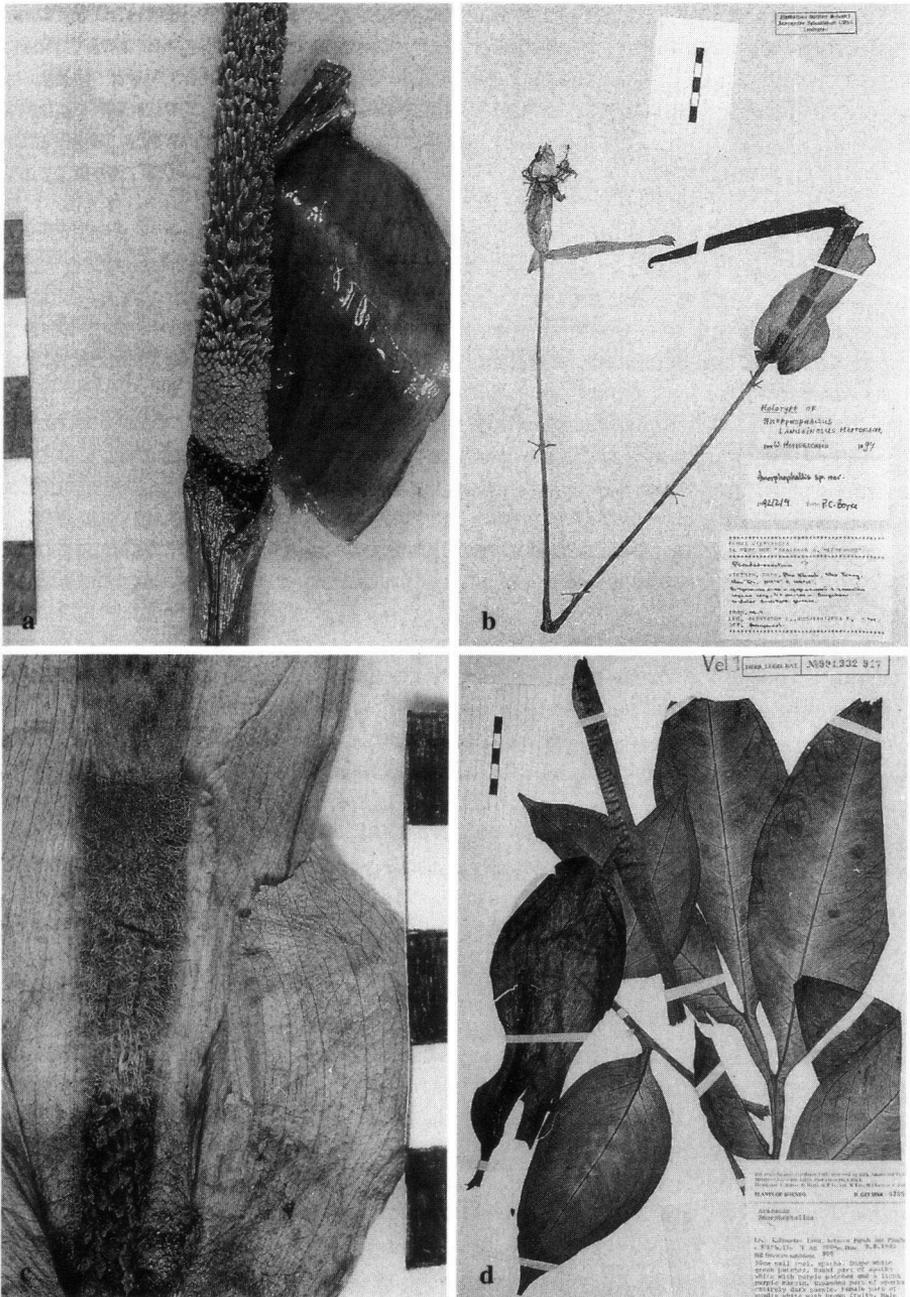


Fig. 8. — a: *Amorphophallus infundibuliformis* Hett., Dearden & A. Vogel (*Dearden s.n.*, type), spathe cut open; scale bar = 5 cm. — b, c: *A. lanuginosus* Hett. (*Averyanov & Kudryaviseva 105*, type); c: spathe cut open, showing the lower part of the spadix. Scale bar = 5 cm. — d: *A. lingui-formis* Hett. (*Geesink 9285*, L., type); scale bar = 5 cm.

cylindric, base oblique, 0.8–1.3 cm in length, c. 1 cm in diam., flowers congested; *appendix* cylindric, obtuse, whitish, 6.5 cm long, 1 cm in diam., entirely, densely covered with staminodes, these in the lower third shortly conical to aristate, sometimes uncinatate, up to 2 mm long. *Ovaries* depressed, irregular or cubic, angulate in cross section, 0.9–1.5 mm in diam., 1.2–1.5 mm high, reddish brown, near the style insertion maroonish, unilocular; *style* absent or only basiscopically developed; *stigma* sessile or partly sessile, acroscopically orientated, reniform, a shallow depression in the middle, one conic lobe on the outward facing margin, 0.8–1 mm in diam., 0.3–0.5 mm high, dark greyish brown, surface densely verruculate. *Male flowers* upwards fused into longitudinal chains, otherwise consisting of 3–5 stamens; *stamens* 1–1.3 mm in diam., c. 0.7 mm long, rounded, oval or irregular in cross section, white; *filaments* absent or nearly so, entirely connate; *anthers* truncate; pores apical, rounded or elongate (confluent). *Pollen* weakly striate.

Etymology – The species epithet refers to the shape of the spathe.

Distribution – Malaysia, Sarawak (only known from the type collection).

Note – *Amorphophallus infundibuliformis* cannot be mistaken for any other species in the genus by the combination of the obconic spathe and the long, aristate-uncinate staminodes on the appendix.

### 18. *Amorphophallus lanuginosus* Hett., *spec. nov.* — Fig. 8b, c

Ab omnibus speciebus in tubere elongato, stigmatibus valde lobatis, staminodiis capillaceis aggregatis inter flores masculos et in zona sterili inter zonas masculas femineasque differt. — Typus: *Averyanov & Kudryavtseva 105* (LE holo; iso LE), Vietnam, Phu Khanh Prov., Nha Trang, Hon Tre, 12° 11' N, 109° 16' E, 6-xi-1989.

*Tuber* elongate, length unknown, diam. top part c. 3 cm. *Leaf* unknown. *Inflorescence* solitary, long peduncled; *peduncle* 54–55 cm long, c. 0.7 cm in diam., mottled; *spathe* erect, elongate triangular-ovate, acute, 13 cm long, 4.5–5 cm in diam., base within with numerous, very irregular verrucae, especially on the dorsal side. *Spadix* sessile, much longer than the spathe, 25–35 cm long; *female zone* cylindric, 1.8–2.8 cm long, c. 0.7 cm in diam., flowers congested; *male zone* obconic, 2.5–3 cm long, c. 0.5 cm in diam. at the base, c. 0.9 cm in diam. at the top, flowers distant, in between surrounded by masses of staminodes with long, flexuous, hairs, nearly entirely covering the male zone and hiding the flowers from sight; sterile zone between female and male zone 0.5–0.8 cm long, with sterile male flowers sunken in deep, longitudinally elongate pockets, hairlike appendages of flowers extruding from the pockets; *appendix* elongate fusiform, acute, base constricted, smooth, 20–27 cm long, c. 1.5 cm in diam. (at one-third from the base). *Ovaries* diamond-shaped in cross section, depressed, sunken in spadix axis, c. 3 mm in diam., c. 1.5 mm high, bilocular; *style* very short, c. 0.5 mm long, c. 0.5 mm in diam.; *stigma* very flattened, more or less diamond-shaped or star-shaped in cross section, sides concave, c. 2 mm in diam., c. 0.5 mm high, with a deep central depression and mostly four-lobed, surface rugulose. *Male flowers* basically consisting of c. 5 or 6 stamens; *stamens* c. 1 mm long, diam. long axis c. 2 mm, short axis c. 1 mm; *filaments* c. 0.5 mm, connate; *anthers* c. 0.5 mm, truncate, pores apical, elongate to oval; staminodes in male zone mostly between male flowers but also within male flowers, consisting of a

conic basal part, representing a reduced stamen, strongly laterally flattened, long axis c. 0.5 mm, on the top a long, flexuous, translucent hair of 2.5–3 mm long; staminodes of the sterile zone distinctly grouped in numbers of c. 6, representing reduced entire male flowers. *Pollen* psilate.

Etymology – The species epithet refers to the woolly appearance of the male zone.

Distribution – Vietnam (only known from type collection).

Note – Due to the peculiar morphology of the male zone, *A. lanuginosus* cannot easily be mistaken for any other species. Its morphological affinity is to *A. macrorhizus* Craib (N Thailand) and *A. cruddasianus* Prain ex Engl. (N Burma). It differs from both in the aforementioned character but also in the differently shaped stigma and the irregular warts in the spathe-base.

### 19. *Amorphophallus linguiformis* Hett., *spec. nov.* — Fig. 8d

Ab *A. costato* Hett. in appendice multo brevior differt. — Typus: *Geesink 9285* (L. holo), Indonesia, Kalimantan Timur, between Papadi and Pamilau, c. 3° 52' N, 116° 00' E, alt. 700–800 m, hill forest on sandstone.

*Tuber* unknown. *Leaf* solitary; *petiole* c. 1 m long, c. 2 cm in diam., smooth, background colour whitish, largely covered by confluent, dark green, elliptic spots; *lamina* c. 160 cm in diam., rhachises narrowly winged; *leaflets* elliptic or elliptic-lanceolate, 10–30 cm long, 5–10 cm broad, shortly acuminate. *Inflorescence* solitary, short peduncled, peduncle and part of spathe hidden by cataphylls; *peduncle* c. 4 cm long, c. 1 cm in diam.; *spathe* linguiform, narrowed between base and limb, 20 cm long, 9 cm in diam., base narrowly tubular, outside whitish with small, purple spots, limb erect, slightly fornicate, elliptic-oval, acute, colour of outside unknown, inside glossy dark maroon. *Spadix* shorter than spathe, sessile, c. 13 cm long; *female zone* cylindrical, c. 2 cm long, c. 1 cm in diam., flowers irregularly disposed, partly in horizontal rows; *male zone* cylindrical c. 4 cm long, c. 1 cm in diam., flowers partly isolated and partly aligned in vertical rows; *appendix* cylindrical, narrowed to the base, c. 7 cm long, c. 1.5 cm in diam., obtuse, dark maroon. *Ovaries* depressed, c. 2 mm high, c. 1 mm in diam., purple, unilocular; *style* very indistinct, c. 0.2 mm long, c. 1 mm in diam.; *stigma* circular in outline, c. 1 mm in diam., c. 0.5 mm high, trilobate with a deep central depression, lobed shallowly conic. *Male flowers* consisting of c. 3 stamens; *stamens* c. 0.8 mm high, pale yellow; *filaments* absent; *anthers* 1.5–2 mm in diam., often irregularly fused between adjacent flowers, pores elongate, apical.

Etymology – The species epithet refers to the shape of the spathe when pressed flat.

Distribution – Indonesia, Kalimantan (only known from the type collection).

Note – *Amorphophallus linguiformis* resembles *A. pendulus* Bogner & Mayo especially in general shape of the spathe but differs markedly by the much shorter peduncle and appendix. From *A. costatus* Hett. (see this publication) it differs among others in the shorter, obtuse, dark maroon appendix and the much larger leaf and leaflets.

**20. *Amorphophallus manta* Hett. & Ittenbach, *spec. nov.* — Fig. 9a**

Ab *A. bufo* Ridley in spadice spatha equilonga et stylis subnullis differt. — Typus: *Ittenbach s.n.* (BONN holo; spirit coll.), 23-ii-1994, cult. in Bonn Bot. Gard. ex Indonesia, W Sumatra, Harau gorge (orig. coll. *Kielmann s.n.*, vii-1992).

*Tuber* and *leaf* as yet unknown. *Inflorescence* solitary, long peduncled; *peduncle* c. 27 cm long, c. 1.2 cm in diam., dark reddish brown with numerous, small, blackish green, elongate, short spots and scattered larger, elliptic, dirty whitish spots; *spathe* ovate, c. 14 cm long, c. 11 cm in diam., broadly acute, base strongly convolute, limb basally spreading, then suddenly bent forward and then curved back again, base outside dirty brownish green with numerous, small, punctiform, blackish green spots and a few, slightly larger, dirty white spots, inside dark purple, upwards with a creamy zone, limb outside at the centre as base but margins and top brownish purple with rounded, white spots, inside dark maroon with rounded, white spots, base within verrucate, warts conical. *Spadix* slightly longer than spathe, 16 cm long, sessile; *female zone* cylindrical, c. 2.8 cm long, 1.5 cm in diam., flowers distant; *male zone* obconic, 3.5 cm long, diam. in upper part c. 2 cm, top constricted, flowers slightly distant, some of the upper flowers sterile; *appendix* shortly stipitate, conic, subacute, upper part slightly dorso-ventrally compressed, c. 10 cm long, c. 3 cm in diameter at the base, glossy dark purple, rugulose and with many, irregular, shallow depressions, stipe 4 mm long, yellowish white. *Ovaries* globose or depressed globose, 2 mm in diam., c. 1.7 mm high, (1-)2-3-locular, lower half dirty white, upper half purple; *style* very short to near absent, 0.1-0.3 mm long, c. 1 mm in diam.; *stigma* sessile, hemispheric, 1-1.4 mm in diam., c. 1 mm high, with 2 or 3 very shallow lobes, brownish grey. *Male flowers* consisting of 3-5 stamens; *stamens* c. 2 mm long; *filaments* c. 1 mm long, connate, forming a cushion; *anthers* 1-1.7 mm in diam., c. 1 mm long, hemispheric, yellow, dark purple around the pores, pores apical, elongate. *Pollen* coarsely striate.

*Etymology* — The species epithet refers to the shape of the spathe resembling a swimming Manta ray.

*Distribution* — Indonesia, W Sumatra (only known from the type locality).

*Note* — *Amorphophallus manta* resembles *A. bufo* Ridley (West Malaysia) but differs from the latter by the spadix equalling the spathe, a very indistinct style and distant male flowers with much longer filaments. Both species share the broad spathe with large undulations.

**21. *Amorphophallus maxwellii* Hett., *spec. nov.* — Fig. 9b, c**

A speciebus omnibus in stylis longissimis 8-9 mm longis, spatha magna campanulata, appendice longissima tenui differt. — Typus: *T. Yamazaki 4515* (TI holo), Thailand, Kanchanaburi Prov., foot of mountain in eastern part of Thing Pha Phum, alt. 700 m, in mixed deciduous forest under bluff of limestone, 10-v-1983.

*Tuber* subglobose to depressed globose, 10-23 cm in diam. and 12-14 cm high. *Leaf* unknown. *Inflorescence* long peduncled; *peduncle* smooth, 18-100 cm, dark olive green with creamish spots; *spathe* campanulate, broadly ovate to elongate-elliptic, 27-69 cm long, 13-30 (or more?) cm in diam., base convolute, top acute, mar-

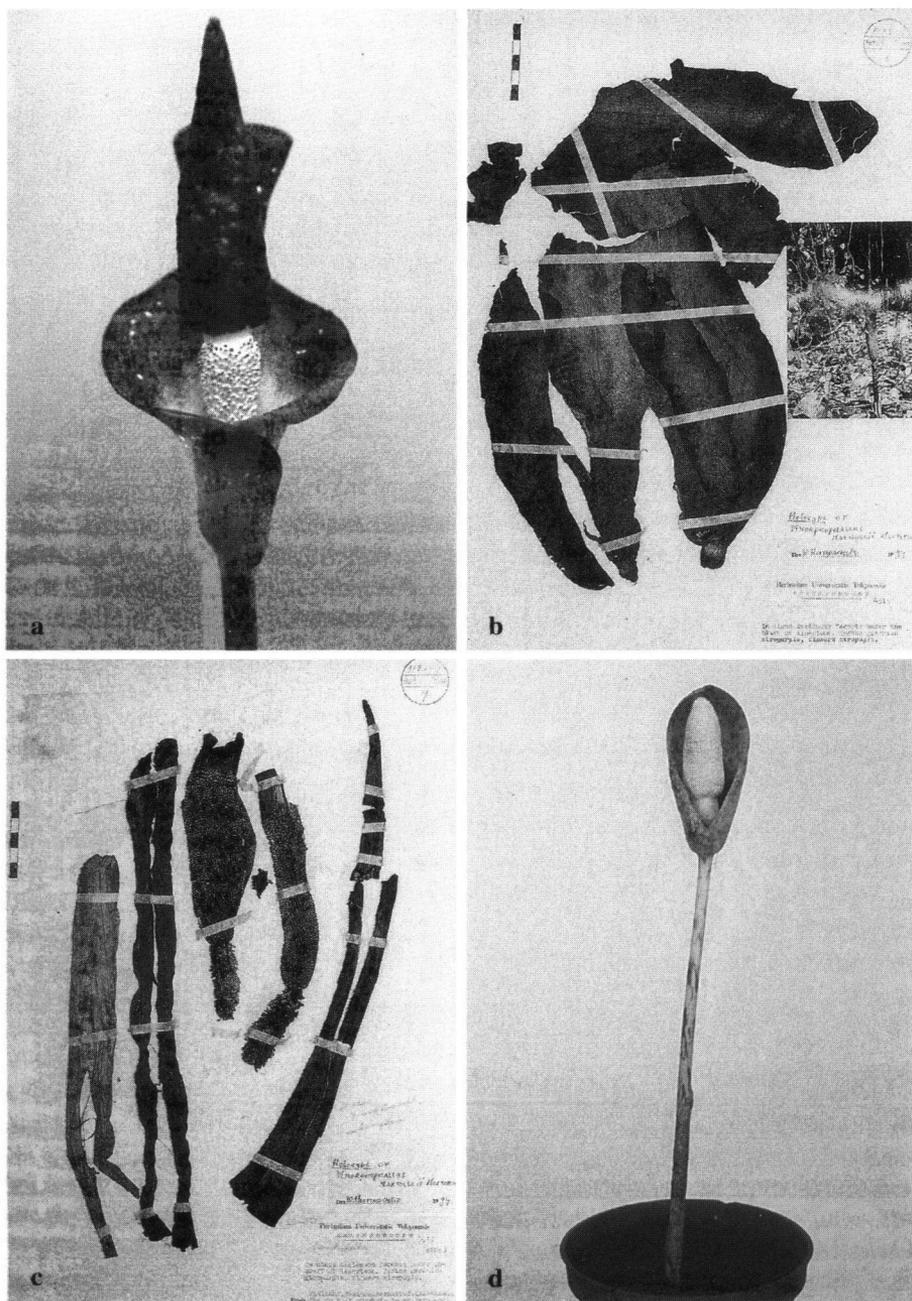


Fig. 9. — a: *Amorphophallus manta* Hett. & Itenbach (Hetterscheid H. AM. 347, type-plant), spathe and spadix; c.  $\times 0.5$ . — b, c: *A. maxwellii* Hett. (Yamazaki 4515, type); c: spadix fragmented. Scale bar = 5 cm. — d: *A. odoratus* Hett. & H. Li (Hetterscheid H. AM. 001, type-plant), c.  $\times 0.13$ .

gins strongly undulate, limb outside lower half pale cream with dull violet stains, upper half very dark maroon, inside lower half cream, upper half very glossy dark maroon, base inside dark violet, densely clothed with fleshy, elongate, often hair-like warts. *Spadix* sessile, slightly or distinctly longer than spathe, 30–82 cm long; *female zone* cylindrical, 4–6.5 cm long, 2–3 cm in diam. (incl. styles), flowers slightly distant or the lower ones congested; *male zone* elongate obconic or cylindrical, 6–12 cm long, 1–2.3 cm in diam., flowers congested; naked zone between male and female zone c. 0.5 cm long or absent; *appendix* subulate, 18–52 cm long, 1–3.5 cm in diam. (base), smooth, acute, dull brownish violet, in small inflorescences myosuroid. *Ovaries* depressed, oval-elliptic in cross section, c. 3 × 2 mm in diam., 1.5–2 mm high, unilocular, dark maroon; *style* very long and slender, thickening near the top, 8–9 mm long, 1 mm in diam. at the base and c. 2 mm in diam. at the top, dark maroon; *stigma* ± broadly conic-depressed in longitudinal section, 2.5–3 mm in diam., 1.5–2 mm high, pale yellow, shallowly 3- (or 4-)lobed, lobes broadly conic, obtuse, surface echinulate. *Male flowers* consisting of (3–)4–6(–7) stamens; *stamens* 3 mm long; *filaments* 1 mm long, entirely connate, in the lowermost flowers with an expanded base, creamish; *anthers* conical, 2 mm long, 1–1.5 mm in diam., truncate, creamish with a violet connective, pores apical, elongate. *Pollen* fossulate (probably underdeveloped).

**Etymology** – The species is named for Dr. J.F. Maxwell (Chiang Mai University, Thailand) for his invaluable help in gathering important taxonomic, geographical and ecological data on *Amorphophallus* species in Thailand.

**Distribution** – Thailand, Kanchanaburi Prov.

**Additional specimens** – *G. den Hoed 599* (K, L), Kwae Noi River Basin, near Neeckey, near Wangka; *Maxwell 93-646* (L), Kanchanaburi Prov., Toong Yai Naresuan Wildlife Reserve (cultivated by the author, *H.A.M. 287*).

**Note** – *Amorphophallus maxwellii* resembles *A. tenuistylis* Hett. (see this publication) but the latter has an elongate tuber, shorter styles (c. 3 mm) and a 3-locular ovary.

## 22. *Amorphophallus odoratus* Hett. & H. Li, *spec. nov.* — Figs. 9d, 10a

Ab *A. tonkinensi* Engl. & Gehrm. in spadice stipitate, basi spathae parte interiore porcato-verrucata at ab *A. yunnanensi* Engl. in stigmatibus maioribus, tuberis propagulis fusiformibus differt. — Typus: *Hetterscheid H.A.M. 001-T* (L. holo; spirit coll.), 18-ii-1994, cult. Hort. Bot. Leiden ex China, Hong Kong, New Territories, Tai Mo Shan, in gully, deep shaded forest, 300 m (orig. coll. *Simmons 550*).

*Tuber* subglobose or depressed globose, up to 12 cm in diam., developing numerous offsets annually, these shortly elongate-fusiform. *Leaf* solitary; *petiole* 30–60 cm long, smooth, green or greyish green with numerous, elongate, confluent, pale green or brownish green spots; *lamina* up to c. 100 cm in diam., rhachises winged; *leaflets* lanceolate or elliptic-lanceolate, 3–20 cm long, 2–6 cm broad, upper surface dark green. *Inflorescence* solitary, long peduncled, producing a scent of fresh carrots; *peduncle* as petiole, 20–60 cm long, 0.7–1.8 cm in diam. (base); *spathe* 8.5–24 cm long, 8.5–23 cm in diam., broadly ovate, strongly concave, top acute, overarching the spadix, base shortly convolute, outside bright pale green, basally with rounded

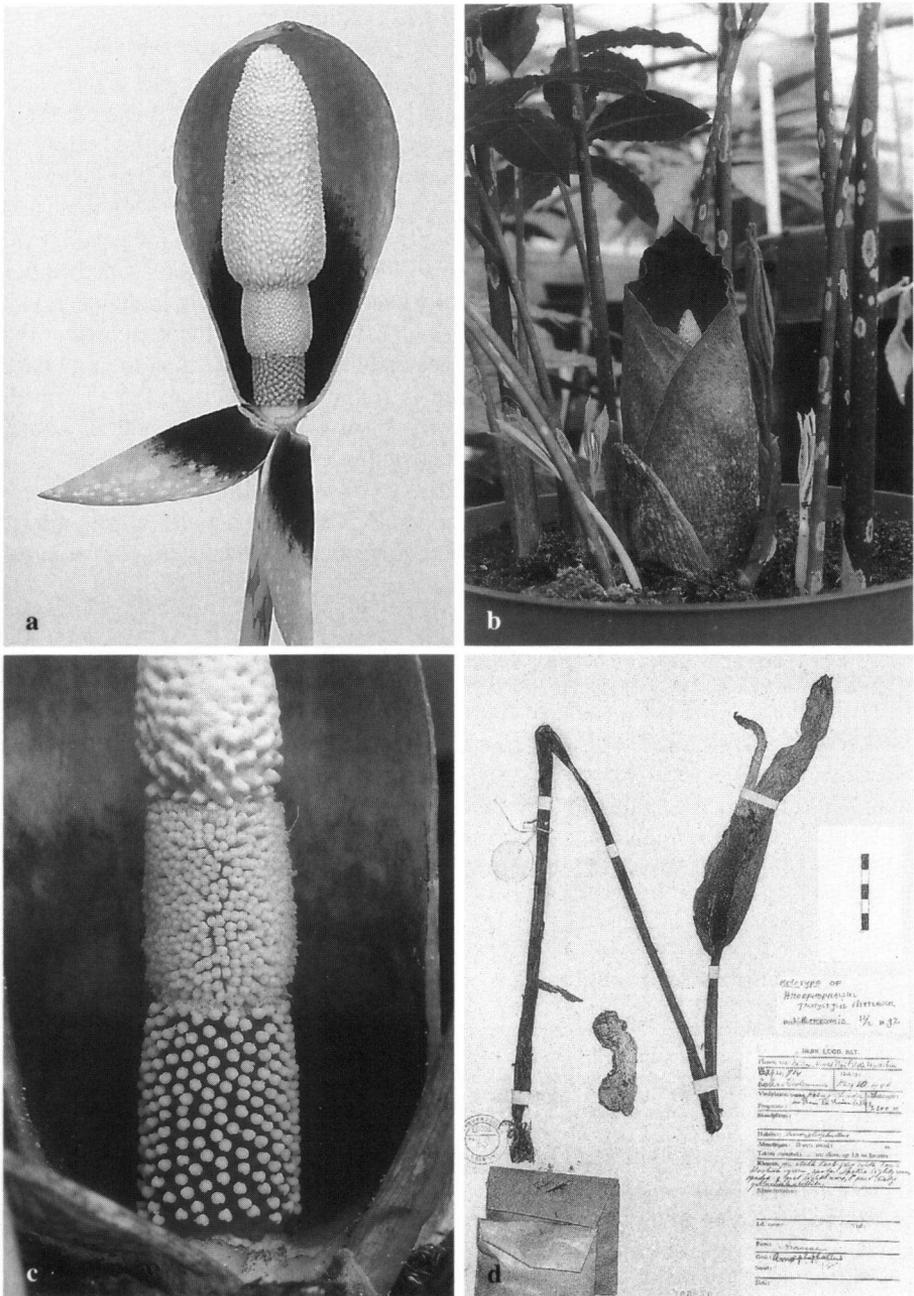


Fig. 10. — a: *Amorphophallus odoratus* Hett. & H. Li (Hetterscheid H.AM.001, type-plant), spathe cut open, c.  $\times$  0.25. — b, c: *A. opertus* Hett. (Hetterscheid H.AM.141, type-plant); b: c.  $\times$  0.3; c: spathe cut open, c.  $\times$  1.2. — d: *A. pachystylis* Hett. (Kostermans, Kwae Noi River Basin Exp. 764, type); scale bar = 5 cm.

white spots, these upwards grading to whitish green, inside base or a larger patch reddish purple, remainder and limb as outside but paler, base within ridged-verruculate. *Spadix* slightly shorter than spathe, stipitate or, rarely, near sessile, 8–20 cm long; *stipe* 0.5–1.5 cm long, coloured as peduncle but much paler; *female zone* cylindrical, upper part occasionally broadened, 0.5–2.5 cm long, 1–2.2 cm in diam., flowers congested; *male zone* broadly fusiform, 1.8–3 cm long, 1.3–3.5 cm in diam., flowers congested; *appendix* narrowly to broadly conic, usually slightly dorso-ventrally compressed, occasionally substipitate, variable, hollow, 3–14 cm long, 1.3–4.5 cm in diam. (near base), ivory-white, base constricted, top subacute or obtuse, surface smooth or entirely echinate or verruculate, or only the upper third part so, base sometimes grooved. *Ovaries* depressed, angulate in cross section, 2–3 mm in diam., 1–1.5 mm high, pale green, 2- or 3-locular; *style* 0.5–1 mm long, 0.8–1 mm in diam., pale green; *stigma* flattened, 2 mm in diam., 1 mm high, 2- or 3- (or 4-)lobed, oval or triangular in cross section, yellowish, scabrate-verrucate, lobes obtuse. *Male flowers* consisting of 4 or 5 stamens; *stamens* 3 mm long; *filaments* 1.5 mm long, basal third connate; *anthers* butterfly-shaped in cross section, 1.5 mm long, 1.5–1.8 mm in diam.; pores elongate, apical but near the margin, sometimes connected by an excentric groove. *Pollen* striate.

**Etymology** – The species epithet refers to the strong and pleasant scent of fresh carrots produced during female anthesis.

**Distribution** – Southeast China (only known from the type collection).

**Note** – *Amorphophallus odoratus* mostly resembles *A. tonkinensis* but differs from the latter by the differently patterned petiole and peduncle, the stipitate spadix, the differently sculptured inside of the spathe-base and the much broader and thin-walled appendix. From *A. yunnanensis* Engl. it differs in the much larger stigmas and the often echinate appendix and fusiform offsets.

### 23. *Amorphophallus opertus* Hett., *spec. nov.* — Fig. 10b, c

Ab *A. koratensi* Gagnep. in *stigmatibus non lobatis ovariis unilocularibus* differt. — **Typus:** *Hetterscheid H.AM. 141-T* (L. holo; spirit coll.), 9-v-1994, cult. Hort. Bot. Leiden ex Vietnam, Dac Lac Prov., s. loc. (orig. coll. A. Kuznetsov, 1992).

**Tuber** depressed, up to c. 10 cm in diam., c. 6 cm high, weighing up to c. 500 gr., young parts organe-brown, otherwise dark brown, annually developing numerous, rhizomatous offsets, these up to 7 cm long and c. 1.5 cm in diam. **Leaf** solitary; **petiole** up to c. 100 cm long, c. 2 cm in diam., surface scabrous, background colour blackish green to nearly black, often mixed with a dense pattern of olive green, or small white spots and with larger, scattered, elliptic-oval, pale whitish green spots, the largest ones with a dark centre, surface with an oily sheen; **lamina** up to c. 110 cm in diam., rhachises naked or very narrowly winged; **leaflets** elliptic, elliptic-lanceolate, or lanceolate, 8–27 cm long, 4–8.5 cm in diam., subacute, upper surface green. **Inflorescence** solitary, short peduncled; **peduncle** 3 cm long, 1.2 cm in diam., entirely subterranean, moderately verrucate, dirty white with small, confluent, greyish or greyish greenish spots; **spathe** opening only at the top, very turgid, broadly cylindrical, transversely oval, 17 cm long, 21 cm in diam., lower 10 cm strongly convolute, base broadly truncated, top acute, base and limb hardly differentiated by only

a shallow depression, clearest at the backside at c. 5 cm from the base, margin around the opening sinuous, outside base near peduncle off-white with a few greyish spots, then with a greyish brown background colour with numerous small, very dark green spots and scattered, slightly larger dirty whitish spots, basal and central part of the backside glossy, inside lower half deep purple, upwards with irregular, diffuse whitish spots, upper half with a basal dirty pale yellowish greenish zone, the remainder dirty brown, upper margin bright emerald-green, base within shallowly verrucate. *Spadix* sessile, shorter than spathe, 10 cm long, nearly entirely hidden by spathe but for the upper part of the appendix; *female zone* slightly conic, 3 cm long, 2 cm in diam. at the base, 1.7 cm in diam. at the top, flowers congested; *male zone* cylindrical, base slightly constricted, 2.7 cm long, 1.8 cm in diam., flowers congested; *appendix* conic, 4.3 cm long, 1.8 cm in diam. at the base, off-white, top subacute, base consisting of separated, rod-shaped staminodes, upwards fusing to form the appendix-wall, leaving deep, narrow depressions in between, upper half transversely rugulose, developing a powerful gas-stench at female anthesis. *Ovaries* depressed, angulate, 3 mm in diam., 2 mm high, unilocular, reddish base whitish, rest reddish purple; *style* sturdy, slightly conic, 2 mm long, 1 mm in diam. at the base, 0.8 mm in diam. at the top, reddish purple; *stigma* conic, circular in cross section, 1.5 mm in diam., 1 mm high, entire but with a one-sided, transversely elongate, shallow depression, mostly directed to the top of the spadix, surface densely echinulate, off-white. *Male flowers* consisting of 2–4 stamens; *stamens* off-white, 3 mm long, 1–1.5 mm in diam.; *filaments* 0.5 mm long, connate; *anthers* 2.5 mm long, truncated, pores apical, marginal, elongate, elliptic at anthesis, connective slightly raised. *Pollen* psilate, orange.

**Etymology** – The species epithet refers to nearly entirely hidden spadix.

**Distribution** – Vietnam.

**Habitat** – In open forest.

**Additional specimens** – *Kuznetsov s.n.* (L, cult. by author *H.AM.140*), Vietnam, Lam Dong Prov., Nam Ca Tien Reserve; *Kuznetsov s.n.* (L, cult. by author *H.AM.143*), locality as previous.

**Note** – *Amorphophallus opertus* is very similar to *A. koratensis* Gagnep. and *A. scaber* Serebryanyi & Hett.. From the first it differs primarily in having an entire stigma, a unilocular ovary and elliptic-lanceolate leaflets. From *A. scaber* it differs additionally in being much smaller.

#### 24. *Amorphophallus pachystylis* Hett., *spec. nov.* — Fig. 10d

Ab *A. krausei* Engl. in *stylis crassioribus*, *filamentis longioribus*, *zona mascula femineaque contigua* differt. — **Typus:** *Kostermans, Kwae Noi River Exp. nr. 764* (L. holo), Thailand, near Kaeng Chada in Ban Ti River valley, c. 200 m alt., 20-v-1946.

**Tuber** incompletely known, c. 7 cm in diam., probably depressed-globose. **Leaf** unknown. **Inflorescence** solitary; **peduncle** smooth, 61 cm long, 1.5 cm in diam. at the base, 'dark grey with dark blackish green spots'; **spathe** erect, elongate-triangular, acute, base convolute, 21 cm long, 8 cm in diam., 'light green'. **Spadix** subequalling spathe, sessile, c. 18 cm long; **female zone** cylindrical, 2.5 cm long, 1 cm in diam., 'light brown', flowers congested; **male zone** elongate-obconic, 6 cm long, 1 cm in

diam. at the base to 1.5 cm in diam. at the top, 'dirty yellowish white', flowers congested but in the basal part more distant; spadix erect, smooth, elongate, ?conic (top of the only specimen slightly damaged), 9.5 cm long, 1.5 cm in diam. at the base. *Ovaries* subpyriform or slightly depressed, stipitate, gradually narrowed to the style, circular or oval in cross section, 1.5 mm in diam, 1 mm high, unilocular; *style* short, very thick, obconic, 0.5 mm long, 0.8 mm in diam. at the base, 1 mm in diam. at the top; *stigma* thin, flat, circular in cross section, 1.2 mm in diam., 0.2 mm high, with 3 or 4 irregularly shortly elongate or rounded depressions, in the centre sometimes three small, shallow lobes alternating with the depressions, surface smooth. *Male flowers* consisting of 1-3 stamens, lowermost flowers very reduced, unistaminate; *stamens* 1 mm long; *filaments* 0.1 mm long, connate; *anthers* 0.8-1 mm long, subtruncate, rectangular in cross section, connective enlarged and with a deep longitudinal groove, pores apical, oval at anthesis. *Pollen* striate.

Etymology - The species epithet refers to the thick style.

Distribution - Western Thailand (only known from the type collection).

Note - *Amorphophallus pachystylis* resembles *A. krausei* Engl. [Burma, N Thailand, China (Yunnan)] in general inflorescence morphology but the latter species possesses a zone of flattened staminodes between male and female zone, has slender styles and longer filaments and smaller connectives.

## 25. *Amorphophallus pilosus* Hett., *spec. nov.* — Fig. 11a, b

Ab *A. hirto* N.E. Brown staminodiis numerosis longis capilliformibus inter pistillos differt. — Typus: *C.B. Robinson 1428* (P holo), Vietnam, Phu Khanh Prov., Nha-trang, Binh-than, in light forest, 21-iii-1911.

*Tuber* unknown. *Leaf* unknown. *Inflorescence* long peduncled; *peduncle* 90 cm long, 2 cm in diam. at the base, 'blotched light and dark green and black', smooth; *spathe* erect, elongate-triangular, acute, 28 cm long, 15 cm in diam., basal margin of the limb slightly spreading, outside 'blotched mostly white below, green in middle, purplish green above', inside 'above purplish blotched with green, below dark lilac then white', base within with fleshy, conical warts. *Spadix* sessile, much longer than the spathe, 44 cm long; *female zone* slightly conic, 2.5 cm long, 1.5 cm in diam., flowers slightly distant, in between with numerous staminodes; *male zone* obconic, 3 cm long, 1 cm in diam. at the base, 1.8 cm in diam. at the top, flowers distant, accompanied by scattered staminodes; sterile zone between male and female zone 0.5 cm long, with scattered groups of staminodes; *appendix* elongate fusiform, acute; 38 cm long, c. 3 cm in diam., 'dark green', with scattered flexuous hairs, these c. 1 cm long. *Ovaries* depressed globose, 2 mm in diam., c. 1.5 mm high, bilocular, one basal ovule per locule, surrounded by 3 or 4 staminodes; *style* c. 1 mm long, c. 0.6 mm in diam. (?slightly obconic); *stigma* oval in cross section, subcordate in longitudinal section, c. 1.2 mm in diam., c. 0.8 mm high, bilobed, lobes conic, surface minutely rugulose. *Male flowers* basically consisting of 5 or 6 stamens, sometimes accompanied by one or a few staminodes but in the larger part of the male zone dissolved in isolated stamens; *stamens* 0.6-1.5 mm long; *filaments* 0.1-1 mm long, basally connate; *anthers* c. 0.5 mm long, 0.5-0.7 mm in diam., subangulate in cross section, pores apical, oval at anthesis. *Staminodes* in female zone implanted

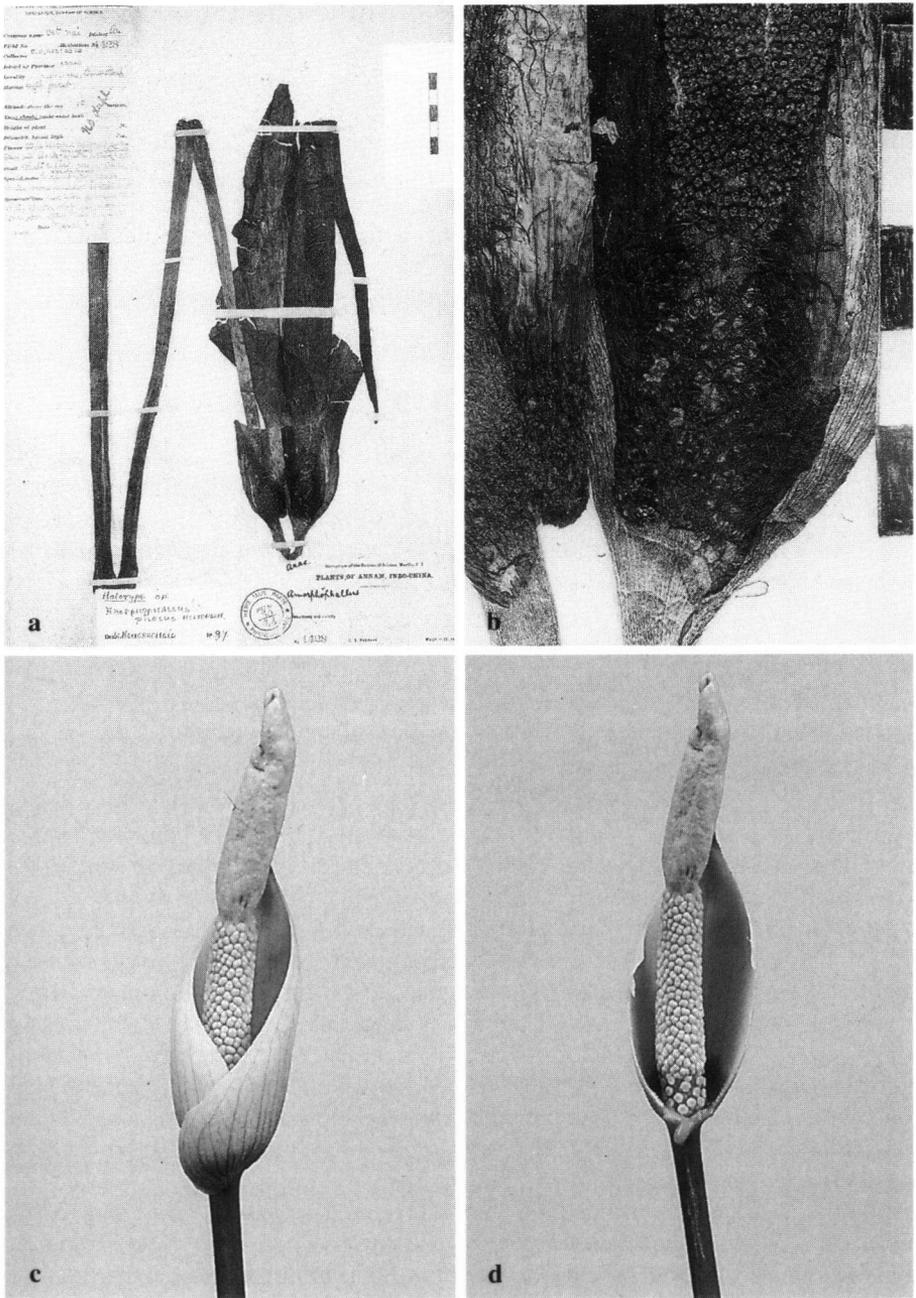


Fig. 11. — a, b: *Amorphophallus pilosus* Hett. (Robinson 1428, type); scale bare = 5 cm. — c, d: *A. pygmaeus* Hett. (Hetterscheid H.AM. 104, type-plant); c: c.  $\times 0.9$ ; d: spathe cut open, c.  $\times 0.8$ .

very near the base of the pistils, consisting of an elliptic or obconic, c. 1 mm long base and a c. 1.5 cm long, hair-like extension; those in the male zone either being part of the male flowers or between the isolated stamens, similar to those in the female zone but their bases less long (c. 0.5 mm) and of firmer structure, showing reduced thecae; staminodes in the sterile zone as those in the male flowers but aggregated in groups of c. 5 or 6. *Pollen* areolate.

Distribution – Vietnam (only known from the type specimen).

Note – *Amorphophallus pilosus* is characterised by the large number of long hair-like staminodes in the female zone. In general morphology, including the hairs on the appendix, though much fewer in number, it resembles *A. hirtus* N.E. Brown from Taiwan.

## 26. *Amorphophallus pygmaeus* Hett., *spec. nov.* — Fig. 11c, d

Ab *A. parvulo* Gagnep. in appendice brevior, stigmatibus hemisphaericis et ab *A. brevispatho* Gagnep. dimensionibus generatim minoribus, spadice spatha tantum parum longiore differt. — Typus: *Hetterscheid H.AM.104-T* (L. holo; spirit coll.), 16-x-1993, cult. Hort. Bot. Leiden ex Thailand, Prachuap, Kirikun (orig. coll. *J.R. Shelton*, 1971).

*Tuber* shortly elongate, or globose. *Leaf* solitary; *petiole* smooth, 10–40 cm long, 0.5–1 cm in diam. (base), uniformly reddish brown or pale olive brown; *lamina* moderately dissected, 10–25 cm in diam., rhachises narrowly winged only in the distal branches; *leaflets* elliptic-lanceolate, obovate or oblong, base long or short decurrent or constricted, 3–10 cm long, 1–6 cm in diam., upper surface very dark velvety green, lower surface flushed with purple-red. *Inflorescence* solitary, long peduncled; *peduncle* as petiole but longer, 18–36 cm long, 0.5–0.8 cm in diam. (base); *spathe* triangular, base shortly convolute and with rather strong concave sides, top acute, 1.5–6 cm long, 1.5–4 cm in diam., outside and inside creamy white or pinkish white, base within dirty brownish red and with scattered or numerous fleshy, shortly elongate, irregularly branched or laterally flattened warts. *Spadix* sessile, longer than spathe, 5–8 cm long; *female zone* shortly cylindrical, 0.5–0.8 cm long, 0.4–0.5 cm in diam., flowers congested or slightly distant; *male zone* fusiform, fusiform-obconic or slightly conic, 2–3 cm long, 0.4–0.9 cm in diam., flowers congested; *appendix* elongate-fusiform, smooth, very pale green or creamy white, top obtuse, 2.5–4 cm long, 0.4–0.9 cm in diam., producing a heavy gaseous smell at female anthesis. *Ovaries* depressed, diamond-shaped, angulate or circular in cross section, 2.5 mm in diam., 1–1.4 mm high, pale green, unilocular; *style* short, 0.3–0.7 mm long, c. 1 mm in diam., pale green; *stigma* hemispheric or flattened, slightly angulate in cross section, 1–1.8 mm in diam., 0.5 mm high, very shallowly multi-lobed and with a shallow central depression, surface verruculate, dirty creamy white. *Male flowers* consisting of 3–8 stamens; *stamens* c. 1 mm long; *filaments* c. 0.6 mm long, entirely connate; *anthers* angulate in cross section, truncate, c. 0.4 mm long, 0.5–2 mm in diam., white with a pale greenish hue, pores apical, oval at anthesis. *Pollen* striate.

Etymology – The species epithet refers to the diminutive proportions.

Distribution – Thailand.

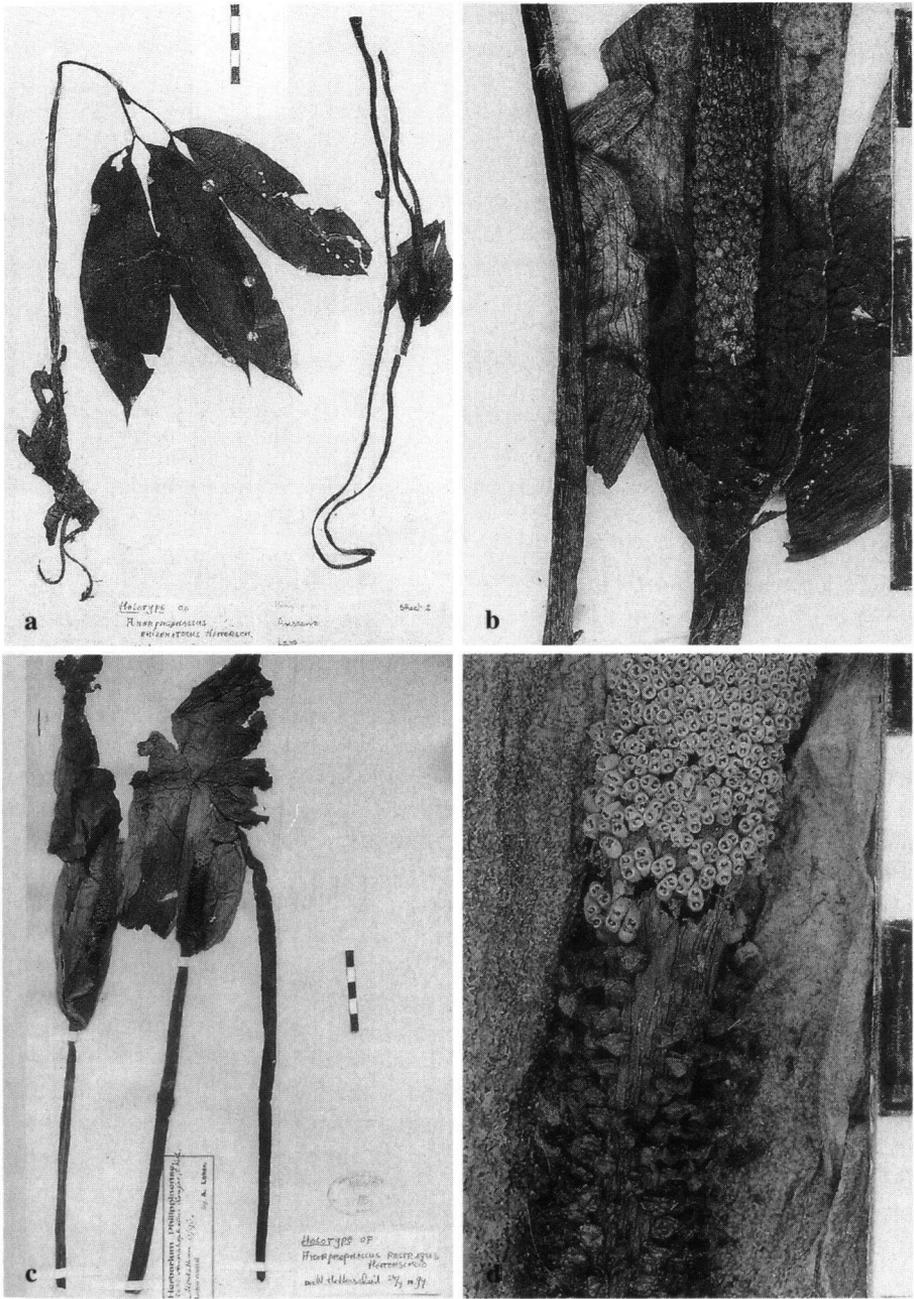


Fig. 12. — a, b: *Amorphophallus rhizomatosus* Hett. (Kerr 21104, type); b: detail of spadix base. Scale bar = 5 cm. — c, d: *A. rostratus* Hett. (Loher 2433, type); d: detail of spadix base. Scale bar = 5 cm.

Additional specimens – *Kerr 10958* (K, P), Thailand, Sam Roi Yawt, Prachuap, crevices of limestone rock, 200–500 m, 12-vii-1936; *Kerr 19473* (K), same locality, cult. in Bangkok, 4-vii-1930.

Note – *Amorphophallus pygmaeus* resembles *A. parvulus* Gagnep. but the appendix is shorter and thicker, the stigmas often hemispheric. Compared with *A. brevispatus* Gagnep. it has much smaller leaves, a smaller spadix and the connective does not rupture at anthesis.

## 27. *Amorphophallus rhizomatosus* Hett., *spec. nov.* — Fig. 12a, b

A speciebus omnibus in rhizomate tenui c. 1 cm crasso horizontali, appendice longissima myosuroidae, spadice sessili differt. — Typus: *Kerr 21104* (K holo, iso K), Laos, Muang Cha, Chiang Kwang, c. 1100 m, in evergreen forest on limestone, 17-iv-1932.

*Rhizome* at least 20 cm long, c. 1.5 cm thick. *Leaf* solitary or paired; *petiole* slender, 29–57 cm long, c. 1 cm in diam. at the base, smooth; *lamina* 42–48 cm in diam., divided in only 5 or 6 large leaflets, rhachises unwinged; *leaflets* elliptic or elliptic-lanceolate, 14–20 cm long, 4–8 cm in diam., acuminate, base not decurrent, mid green above, pale green below. *Inflorescence* occurring simultaneous with leaf, long peduncled; *peduncle* slender, 40–53 cm long, c. 0.8 cm in diam., smooth, pale green; *spathe* oval, apex obtuse, 6–7 cm long, c. 5 cm in diam., outside base pale green shading upwards to whitish, base within smooth and purple. *Spadix* sessile, much longer than spathe, 16–17 cm long; *female zone* cylindrical, 1–1.5 cm long, c. 0.6 cm in diam., flowers slightly or more distant; *male zone* elongate, slightly conic, 2–3 cm long, 0.6–0.8 cm in diam., upper limit sharp or diffuse, flowers congested or slightly distant; *appendix* myosuroid, acute, smooth, 12–13 cm long, 0.6–0.8 cm in diam. *Ovaries* ± globose, c. 1.5 mm in diam., c. 1.5 mm high, green, unilocular; *style* poorly differentiated, c. 0.5 mm long, c. 1 mm in diam.; *stigma* flat, thin, entire or with a very shallow central depression, only slightly broader than the style, c. 1.2 mm in diam., c. 0.3 mm high, surface minutely verrucate, greenish yellow. *Male flowers* consisting of (2 or) 3 stamens; *stamens* 1 mm long, those in the lowermost flowers occasionally entirely connate within one flower (synandrium); *filaments* absent; *anthers* 1–2 mm in diam., truncate, pale yellow, connective brownish purple, pores apical, oval. *Pollen* irregularly striate.

Etymology – The species epithet describes the rhizomatous morphology of the underground parts.

Distribution – Laos and Vietnam.

Additional specimen – *Newman 185* (E), Vietnam, Thua Thien-Hue Province.

Note – The rhizomatous underground part of *Amorphophallus rhizomatosus* is shared only with *A. hayi* Hett. (this publication). For differences with *A. hayi*, see under that species.

## 28. *Amorphophallus rostratus* Hett., *spec. nov.* — Fig. 12c, d

A *A. variabilis* Blume in stigmatate rostrato, basi spathae cristis longitudinalibus prominente verrucatis differt. — Typus: *Loher 2433* (K holo), Philippines, Central Luzon, Montalban, v-1896.

*Tuber* unknown. *Leaf* solitary; *petiole* c. 30 cm long (or more?), c. 1 cm in diam., smooth, with scattered elliptic pale spots and many short, dark, lines; *lamina* c. 50 cm in diam. (or more?), rachises narrowly winged all over; *leaflets* numerous, small, lanceolate, 3–7 cm long, 0.5–2 cm in diam., long acuminate. *Spathe* elongate triangular, base strongly convolute, 20–25 cm long, 9–12 cm in diam., acute, base within darker than limb and with numerous, large, irregular warts, aligned into vertical ridges. *Spadix* sessile, longer than spathe, 35–40 cm long; *female zone* cylindrical or slightly conic, 4–5 cm long, c. 1.5 cm in diam., flowers more or less distant; *male zone* cylindrical, 4–5 cm long, 1–1.5 cm in diam., flowers congested; *appendix* elongate conic, 27–30 cm long, c. 1.5 cm in diam., base with some scattered, shallowly conic staminodes. *Ovaries* ovate, circular in cross section, c. 2 mm high, c. 1.5 mm in diam., unilocular; *style* conic, 0.8 mm long, c. 0.5 mm in diam. at base and c. 0.3 mm in diam. at the top; *stigma* large, 1–2 mm high, 0.7–1 mm in diam. at the base, lobate, lobes one to many, one lobe extremely long, conical (up to 1.5 mm long), the others shallow, surface rugulose. *Male flowers* consisting of 1–3 stamens; *stamens* c. 1.5 mm long; *anthers* sessile, 1–2 mm in diam., truncate, pores apical, elongate. *Pollen* psilate.

Distribution – Philippines, Luzon.

Additional specimen – *Loher 7039* (K), Central Luzon, Montalban.

Note – *Amorphophallus rostratus* resembles *A. variabilis* Blume (Indonesia, Java) and this may explain the repeated sightings of the latter species in the Philippines. However, *A. rostratus* differs among other characters in having a rostrate stigma and a strongly ridged spathe-base.

## 29. *Amorphophallus rugosus* Hett. & A.L. Lamb, *spec. nov.*

Ab *A. pendulo* Bogner & Mayo in dimensionibus multo maioribus, petiolo ruguloso, appendice erecta rugulosa spatha subequanti differt. — Typus: *Lamb & Surat ALFS 625* (L. holo), Malaysia, Sabah, Interior Zone, Tambruan/Keningan District-boundary, Ulu Apin Apin, in colluvial soil, on slope of sandstone ridge, cool shaded habitat, alt. c. 700 m, i-1993.

*Tuber* depressed globose, c. 20 cm in diam. *Leaf* unknown. *Inflorescence* long peduncled; *peduncle* c. 45 cm long, c. 2.5 cm in diam. (base), slightly rugulose at the base, otherwise smooth, background colour whitish, at the base densely and irregularly marbled with dark greyish green, upwards mixed with purple; *spathe* elongate triangular, base convolute, limb erect but upper part arching, c. 36 cm long, c. 14 cm in diam., base outside pale pinkish with small dark purple and purple-green or whitish spots, inside purple, upwards turning pinkish cream, limb outside purple, inside basally pinkish cream, margin and upper part purple with scattered small, creamish spots. *Spadix* slightly longer than spathe, sessile; *female zone* c. 2 cm long, c. 1.5 cm in diam., strongly oblique, flowers congested; *male zone* cylindrical, top subtruncate, 6 cm long, c. 2 cm in diam., flowers congested and for the greater part vertically aligned and fused, separated by furrows; *appendix* elongate fusiform-conic, c. 36 cm long, c. 2 cm in diam., base constricted, apex acutish, surface strongly rugulose, dark purple with a narrow whitish zone at the base. *Ovaries* elongate, c. 3 mm long, c. 2 mm in diam., dark purple, unilocular; *style* short and thick, 0.2 mm long, 0.5 mm in diam., dark purple; *stigma* conic or flattened in longitudinal section, shallowly

or prominently 2- or 3-lobed, 1–1.3 mm in diam., 0.8–1 mm high, surface rugulose, lobes shallowly or prominently conic, subacute. *Male flowers* consisting of 4 or 5 stamens; *stamens* c. 1 mm long; *filaments* c. 0.2 mm long, entirely connate, creamish; *anthers* quadrangular or irregular in cross section, c. 1 mm in diam., c. 0.8 mm long, truncate, dirty brownish; pores elongate, apical. *Pollen* striate.

Etymology – The species epithet refers to the appendix surface structure.

Distribution – Malaysia, Sabah (only known from the type collection).

Note – *Amorphophallus rugosus* resembles *A. costatus* Hett. (this publication) but differs markedly by the much longer peduncle and larger proportions in general.

### 30. *Amorphophallus salmoneus* Hett., *spec. nov.* — Fig. 13a, b

A speciebus omnibus in staminodiorum applanatorum rugulosorum zona inter zonas masculas feminasque, appendice valde verrucosa differt. — Typus: *Hetterscheid H. AM. 036-T* (L holo; spirit coll.), cult. Hort. Bot. Leiden ex Philippines, Palawan (orig. coll. *Podzorski, Palawan Botanical Expedition nr. 156*).

*Tuber* depressed-globose, 4–15 cm in diam. *Leaf* solitary; *petiole* smooth, entirely green or with a few scattered, small, white dots, rather turgid, 5–70 cm long, up to c. 2.5 cm in diam. (base); *lamina* highly dissected, up to 110 cm in diam., lower part of the rhachises unwinged; *leaflets* elliptic-lanceolate, long acuminate (acumen 3–4 cm long), base shortly decurrent, upper surface mid-green, venation impressed, 18–29 cm long, 6–8 cm in diam. *Inflorescence* solitary, long peduncled; *peduncle* as petiole but slightly laterally compressed, 18–45 cm long, 0.5–1.5 cm in diam. at the base; *spathe* ovate-triangular, acute, 9–20 cm long, 6–10 cm in diam., lower 3.5–6 cm convolute, tubular with a slight apical constriction, base outside pale whitish green or pale magenta, inside pale green, to the base dirty reddish brown and minutely verrucose; limb triangular, upper half curved forward at anthesis, basal margins slightly recurved, outside medially pale whitish green, towards the margin suffused with pale reddish brown or entirely pale magenta, inside nearly entirely pale reddish brown or pale magenta or only so in upper third part. *Spadix* sessile, 9.5–20 cm long, equalling the spathe; female part cylindrical, 0.8–2 cm long, 0.9–1.5 cm in diam., flowers congested; sterile zone between female and male parts, cylindrical, 0.5–1.5 cm long, 0.8–1.4 cm in diam., covered with staminodes; male part cylindrical or slightly conic, 3–7 cm long, 0.8–1.3 cm in diam. (base), flowers congested; *appendix* elongate-conic, 4–11 cm long, 0.8–1.7 cm in diam. (base), pale yellowish white, nearly entirely to entirely verrucate, producing a heavy, gaseous stench at female anthesis. *Ovaries* depressed, subangulate in cross section, 2–3 mm in diam., 1.5 mm high, base ivory-white, upper part pale green, unilocular; *style* slender, very excentric, strongly curved upwards, green, 2–3 mm long, 0.8–1.2 mm in diam.; *stigma* transversely elongate, thin, more or less bilabiate, upper margin tricuspidate, lobes and cusps separated by grooves, surface minutely scabrate, very pale whitish green, orientated towards the spadix-axis, 2 × 1 mm in diam. *Male flowers* consisting of 1 or 2 stamens; *stamens* rectangular, 2.3–3 × 1–1.5 mm in diam., 1.5–2 mm high; *filaments* absent; *anthers* oval, top rounded or subtruncate, salmon-pink, connective slightly elevated, creamy-white and with a deep, longitudinal groove, pores apical, elongate. *Pollen* fossulate. *Staminodes* of neuter zone large, congested, ovate

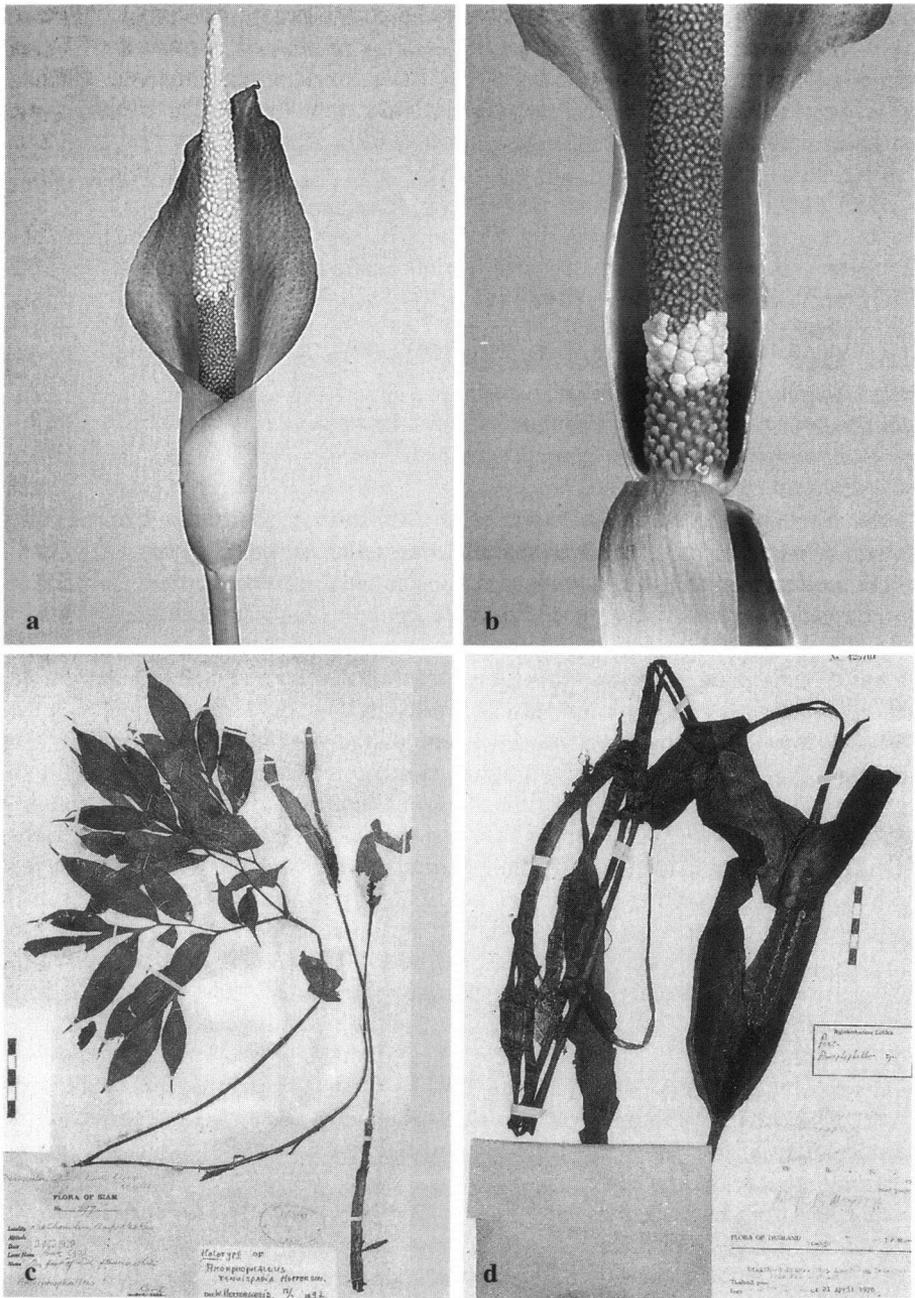


Fig. 13. — a, b: *Amorphophallus salmoneus* Hett. (Hetterscheid H. AM. 036, type-plant); a: spathe and spadix, c.  $\times 0.35$ ; b: spathe cut open, showing the base of the spadix, c.  $\times 0.6$ . — c: *A. tenuispadix* Hett. (Rabil 297, type); scale bar = 5 cm. — d: *A. tenuistylis* Hett. (Maxwell 76-250, type); scale bar = 5 cm..

or elliptic or irregularly angulate, depressed, slightly convex, yellowish white, surface rugulose, 2–6 mm in diam.

Etymology – The species epithet refers to the colour of the male flowers.

Distribution – Philippines, Palawan and Langen Island.

Additional specimen – *Podzorski SMHI 835* (L), Philippines, Langen (Malapan) Island, west-central karst outcrop, alt. 260 m, in open pole forest with rattans and climbing bamboo; soil pocket on steep slope.

Note – *Amorphophallus salmoneus* resembles *A. krausei* Engl. (*A. sutepensis* Gagnep., *A. ximengensis* H. Li) from Thailand, Burma and China (Yunnan) but differs from it among other characters by appendix structure (longer and verrucate), shape of the spathe (tubular base), shape of stigma (bilabiate) and leaf structure (leaflets shorter and broader).

### 31. *Amorphophallus tenuispadix* Hett., *spec. nov.* — Fig. 13c

Ab *A. longituberoso* (Engl.) Engl. & Gehrm. in tubere globose, antheris poribus apicalibus, ovario uniloculari differt. — Typus: *Rabil 297* (K holo; iso BK, K), Thailand, Kao Chom Lem, Ampo Kao Kao, on foot of hill, 2-viii-1929.

Small species. *Tuber* globose, 2–3 cm in diam., 1.8–2.5 cm deep. *Leaf* solitary; *petiole* smooth, slender, 22–32 cm long, 0.7 cm in diam. (base); *lamina* highly dissected, 36–45 cm in diam., rhachises only narrowly winged in the most distal branches; main segments subdichotomous, in smaller leaves the central one unbranched; *leaflets* lanceolate, base decurrent or nearly so, acute, top long acuminate, 5–12 cm long, 1.5–3 cm in diam. *Inflorescence* solitary, long peduncled; cataphylls up to 15 cm long; *peduncle* as petiole, 11–29 cm long, 0.5 cm in diam. (base); *spathe* elliptic to lanceolate, base shortly convolute, top acute, shortly apiculate, base inside with many, loosely arranged, hemispheric or slightly elongate warts, 5–13 cm long, 2–3.5 cm in diam., white. *Spadix* sessile, equalling spathe or slightly longer, rarely shorter, 5.5–12 cm long; *female zone* cylindrical, 1–2.5 cm long, 0.4–0.5 cm in diam., flowers ± distant; *male zone* cylindrical, 2.5–5 cm long, 0.4–0.6 cm in diam., flowers congested; *appendix* fusiform, apex obtuse, smooth, 1.5–4 cm long, 0.5–0.9 cm in diam. *Ovaries* shortly stipitate, depressed, circular in cross section, 1.5–2 mm in diam., c. 1 mm high, unilocular, stipe 0.5 mm long; *style* ± conic, 1.2 mm long, 0.8 mm in diam.; *stigma* large, disciform with a shallow central depression, circular in cross section, 1.3–1.5 mm in diam., 0.3 mm high. *Male flowers* consisting of 2–4 stamens; *stamens* 1.5 mm long; *filaments* 0.5 mm long, the basal half connate; *anthers* truncate, 1.4 × 0.8 mm in diam., 1 mm long, pores apical, elongate. *Pollen* irregularly striate.

Etymology – The species epithet refers to the slender spadix.

Distribution – Thailand.

Additional specimen – *Rabil s.n.* (K), Thailand, Kao Chem, Tung Song, on rock, 21-vii-1929.

Notes – 1. *Amorphophallus tenuispadix* closely resembles *A. albispadix* Hett. (this publication) but differs in having a globose tuber, pores apical on the thecae and a unilocular ovary. From *A. longituberosus* (Engl.) Engl. & Gehrm. it differs in the same characters.

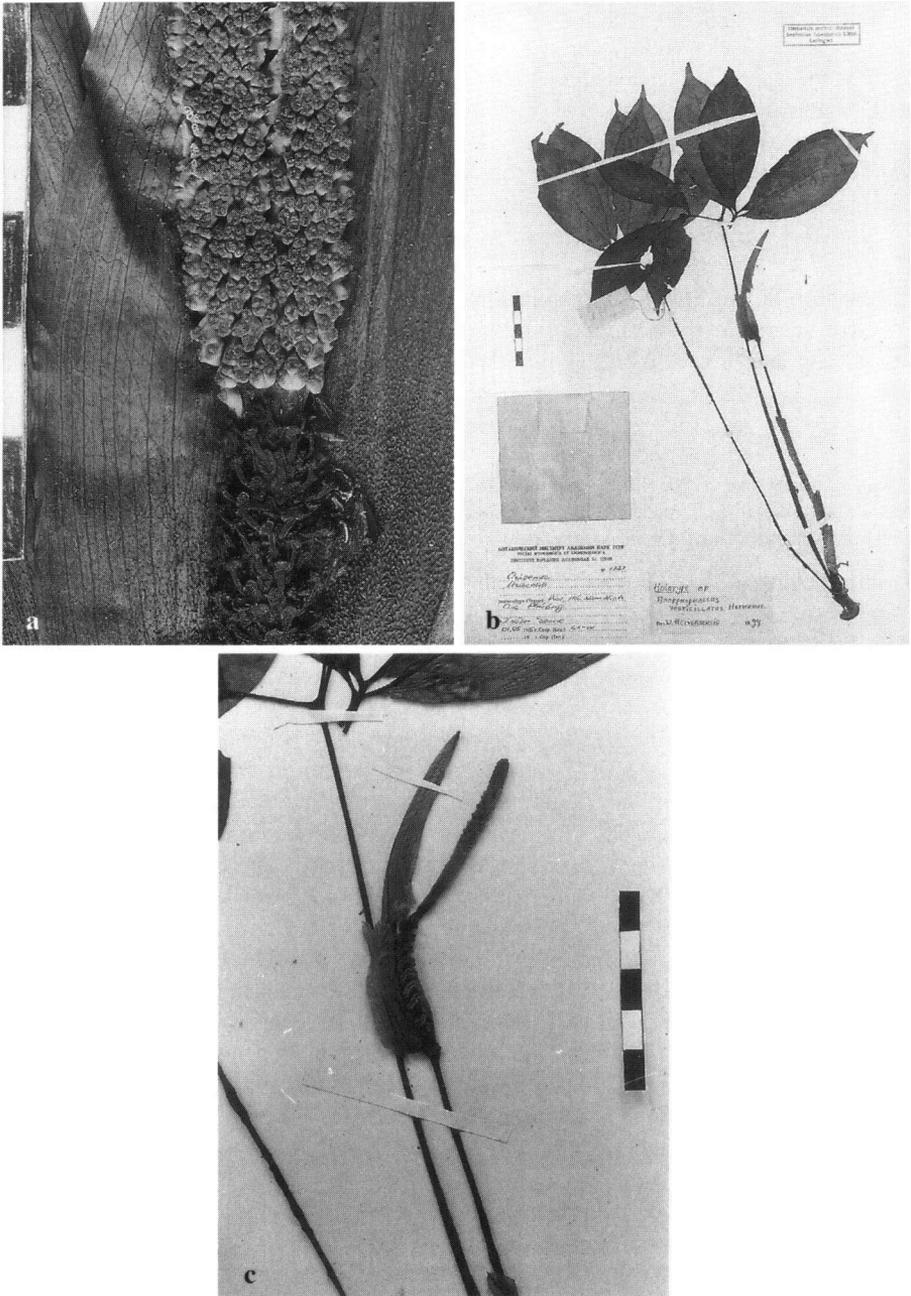


Fig. 14. — a: *Amorphophallus tenuistylis* Hett. (Maxwell 76-250, type); detail of lower part of spadix; scale bar = 5 cm. — b, c: *A. verticillatus* Hett. (Anon. [LX-VN] 1727, type); c: spathe and (restored) spadix; scale bar = 5 cm.

2. *Rabil* 297 was cited by Gagnepain (1942: 1154) with *Pseudodracontium kerrii* Gagnep. (nom. illeg., no Latin diagn.), apparently overlooking the smooth appendix.

### 32. *Amorphophallus tenuistylis* Hett., *spec. nov.* — Figs. 13d, 14a

Ab omnibus speciebus in tubere elongato, stylis longissimis 3–4 mm longis differt. — Typus: *Maxwell* 76-250 (L holo; iso AAU, BK), Thailand, Utathani Prov., Bahn Rai District, Huay Kha Kaeng Reserve, near Kow Hin Dang (15° 30' N, 99° 15' N), in open bamboo/deciduous forest, alt. 200 m, 21-iv-1976.

*Tuber* elongate, napiform, 11–16 cm long (probably longer), top-part 2–3 cm in diam. (in sicco!). *Leaf* unknown. *Inflorescence* solitary. Peduncle 64–88 cm long, 1–2 cm in diam. at base, mottled greyish and olive-green; *spathe* erect, lanceolate to elliptic-lanceolate, base convolute, top acute, 19–40 cm long, 7–20 cm in diam., outside mottled greyish and olive-green, inside as outside but base maroonish and densely clothed with short and long, more or less fleshy, often hair-like warts, sometimes with a few irregular branches. *Spadix* slightly to distinctly longer than spathe, sessile, 24–48 cm long; female part cylindric, flowers slightly distant, 2–6.5 cm long, 1–2 cm in diam. (incl. styles), with or without a very short naked interstice at the top; male part cylindric, the base truncated, flowers congested, 6–11 cm long, 1–1.5 cm in diam.; *appendix* elongate, acute, in smaller inflorescences myosuroid, otherwise sturdier, lower part verrucate otherwise smooth, brownish grey, 16–30 cm long, 0.4–0.8 cm in diam. (base). *Ovaries* depressed, oval in outline, 2–3 mm in diam., 1.5–2 mm high, 3-locular, one basal ovule per locule; *style* slender, 3–4 mm long, 0.6–0.8 mm in diam.; *stigma* hemispheric or slightly depressed, 1.5–2 mm in diam., c. 1 mm high, entire or shallowly 2- (or 3-)lobed, lobes hemispheric, surface verruculate. *Male flowers* consisting of (2-)4–6 stamens, in the lowermost part of the male zone enlarged, c. 5 × 2 mm in transverse section; *stamens* 2–3 mm long; *filaments* c. 1 mm long, in the lowermost flowers 2 mm long, for the greater part connate within one flower; *anthers* 1–1.3 mm long, 1–1.5 mm in diam., truncate, pores apical, elongate. *Pollen* coarsely areolate.

Etymology – The species epithet refers to the slender, long styles.

Distribution – Central and West Central Thailand.

Additional specimen – *Van Beusekom & Phengkhlai* 492 (L), Kanchanaburi Prov., Erawan National Park.

Note – A species very distinct by the unique combination of the elongate tuber and the long styles. The warts in the spathe-base are reminiscent of those in *A. longituberosus* (Engl.) Engl. & Gehrm. and *A. albispatus* Hett. (this publication), though they are not as long nor branched in these species. Both are, however, the nearest morphological allies of *A. tenuistylis*, also taking into account the 3-locular ovary and the enlarged lower male flowers, common to this species group.

### 33. *Amorphophallus verticillatus* Hett., *spec. nov.* — Fig. 14b, c

Ab omnibus speciebus in foliis coactaneis, spadice spatha equanti, floribus masculis in verticillis disjunctis differt. — Typus: *Anonymous (LX-VN)* 1727 (LE holo), Vietnam, Prov. Ha Nam Ninh, Cuc Phuong, 1-v-1985.

*Tuber* shortly rhizomatous (?), 3–4 cm long, 1–2 cm in diam. *Leaves* two on a tuber; *petiole* slender, 13–28 cm long, 3–4 mm in diam.; *lamina* moderately dissected, c. 30 cm in diam., rhachises unwinged; main segments carrying 2 or 3 leaflets; *leaflets* elliptic-oblong or oblanceolate, 7–14 cm long, 2.5–5.5 cm in diam., broadly acuminate, acumen apiculate, base unequally cuneate. *Inflorescence* long peduncled, appearing with the leaves; *peduncle* slender, 18–19 cm long, 3–4 mm in diam.; *spathe* erect, narrowly elongate triangular, cymbiform, acute, 8–9.5 cm long, c. 2.5 cm in diam., base within smooth or very shallowly verrucate. *Spadix* sessile, slightly shorter than the spathe, 7–8 cm long; *female zone* cylindrical or conic, 0.5–1 cm long, 0.4–0.8 cm in diam. (base), flowers distant or congested; *male zone* cylindrical, 2.5–3.5 cm long, 0.5 cm in diam., lowermost flowers free or irregularly linked, remaining flowers in oblique verticils, these c. 5 mm in diam., separated by naked interstices of c. 1.5 mm long; *appendix* more or less cylindrical, obtusish, 4–4.5 cm long, c. 0.5 cm in diam., lower fourth part smooth, then distinctly verrucate, verrucae broadly conic, obtuse, irregularly laterally connected or separated by grooves, more or less following the disposition of the male flowers. *Ovaries* depressed, circular or angulate in cross section, 2–3 mm in diam., c. 1 mm high, unilocular; *style* short, c. 0.4 mm long, c. 0.3 mm long, conic; *stigma* circular or oval in cross section, c. 0.8 mm in diam., c. 0.4 mm high, shallowly 2- or 3-lobed. *Male flowers* consisting of c. 4 stamens but the exact number mostly obscured by extensive lateral fusion; *stamens* 1.5 mm long; *filaments* 1 mm long, connate only with opposite sides of adjacent stamens in whorl; *anthers* truncate, 0.5 mm long, c. 1 mm in diam., pores apical, rounded or oval at anthesis. *Pollen* striate.

**Etymology** – The species epithet refers to the verticillate arrangement of the male flowers.

**Distribution** – Vietnam.

**Additional specimen** – *Pételot 7576* (P, Saigon), Vietnam, Muong thon, Hoa Binh Prov.

**Note** – The general morphology of *A. verticillatus* resembles closely to species of *Pseudodracontium*. However, it differs in having a much thinner and less elaborately structured appendix and male flowers arranged in verticils. The lateral linking of the male flowers is also found in *A. interruptus* Engl. & Gehrm. but in this species the chains are not regularly verticillate but often interrupted or partly helically arranged. *Amorphophallus interruptus* has much larger dimensions, a larger leaf and the spadix much longer than the spathe.

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