Everything you Always Wanted to Know about *Amorphophallus*, but Were Afraid To Stick Your Nose Into!!!!!

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INTRODUCTION

Amorphophallus is best known to the general public because of the publicity that has been amassed in the literature about the gigantic *A. titanum* (Becc.) Becc. ex Arcang, discovered in the last century by the Italian botanist Odoardo Beccari (Fig. 1). Flowering specimens of this species in botanical gardens have aroused unprecedented attention and many textbooks on botany feature this plant as one of the true marvels of nature. In the shadow of all this attention, however, dwells a genus of no less than ca. 170 species, which, to the eye of the beholder, hold a special attraction largely evoked by the unusual characters of many species. To the aroid systematist *Amorphophallus* is a true treasure of variation. The morphological variation in this genus is unmatched by any of the other genera of the family, and this excess of variation is found in the spathe (dimension, color, and shape), the appendix (dimension, shape, and sculpturing), odors, tuber (shape), petiole (dimension, colors, and pattern) and finally the individual female flower. The mysterious shapes of the inflorescences and their often evil odors, have aroused interest in collectors and connoisseurs alike. The sheer size of some of the species has added to the layman's comparison to dinosaurs. But whereas the dinosaurs found their graves many millions of years ago, the vegetable dinosaurs of *Amorphophallus* are very much alive and among us. Quite a number of the readers of this journal already experience the pleasure of the challenge to bring an *Amorphophallus* into flower and be surprised by its form and smell. There is always the chance that a particular species actually smells GOOD! An equally mysterious character of most flowering *Amorphophallus* species is the stunning heating of the appendix on the first day of flowering. Temperatures of the appendix may rise as much as 13° Celsius above the temperture of the surrounding air [*A. paeonifolius* (Dennst.) Nicolson]. Because so little is known about most of the less "public" species, this volume of *Aroideana* will be a pictorial overview featuring no less than 90 different species. They are selected on the availability of photographic material of living specimens, and most of them are also present as living specimens in the research collections of the botanical gardens of Leiden (Netherlands) and Bonn (Germany). Of each species one or two plates are provided, a short description of the most distinct characters, a comparison with the nearest relative, distribution, ecology, additional notes, and a few words on cultivation will be included in addition to what will be said about cultivation in general in a following chapter. Introductory chapters will cover the genus' diagnosis,

Fig. 1. Odoardo Beccari (photo: Bot. Museum Florence).

taxonomic history, taxonomic position, biogeography, ecology and conservation, and selected literature.

The taxonomy of the species presented here is taken from manuscripts by both authors. The African species are revised by the second author, and the remainder of the genus by the first author. Both revisions are part of Ph.D. projects. Photos by the first author (W. Hetterscheid), unless otherwise stated.

GENERIC DIAGNOSIS AND SPECIES LIST OF AMORPHOPHALLUS

Small to massive terrestrial plants, herbaceous; stem subterraneous, tuberous (Fig. 2), rarely a chain of tubers (Fig. 3) or rhizomatous (Fig. 4); tuber globose (Fig. 2), subglobose, depressed-globose, saucer-shaped (Fig. 5), or vertically elongate and then unbranched or branched (Fig. 6), representing one module and being renewed each season; chains consisting of tubers not being renewed every season; rhizomes long, terete, creeping, horizontal, consisting of several modules; offset

Fig. 2. *A. hirtus*: tuber.

development absent, seasonal or gradual; offsets globose, spindle-shaped (Fig. 7), shortly elongate (Fig. 2) or rhizomatous (Fig. 8); leaf usually solitary, rarely paired, emerging from the top of the tuber or rhizome, lasting one growing season or rarely long-lasting; petiole terete, rarely angulate, smooth, shallowly grooved or partly rugulose, rarely entirely verrucate or hairy, unicolorous or variously blotched (Fig. 9); lamina decompound and divided in three main branches; main branches equally long (Fig. 10) or the anterior main branch shorter than the posterior main branches (subpedate, Fig. 11); rachises unbranched,

Fig. 3. *A. arnautovii*: chain of tubers.

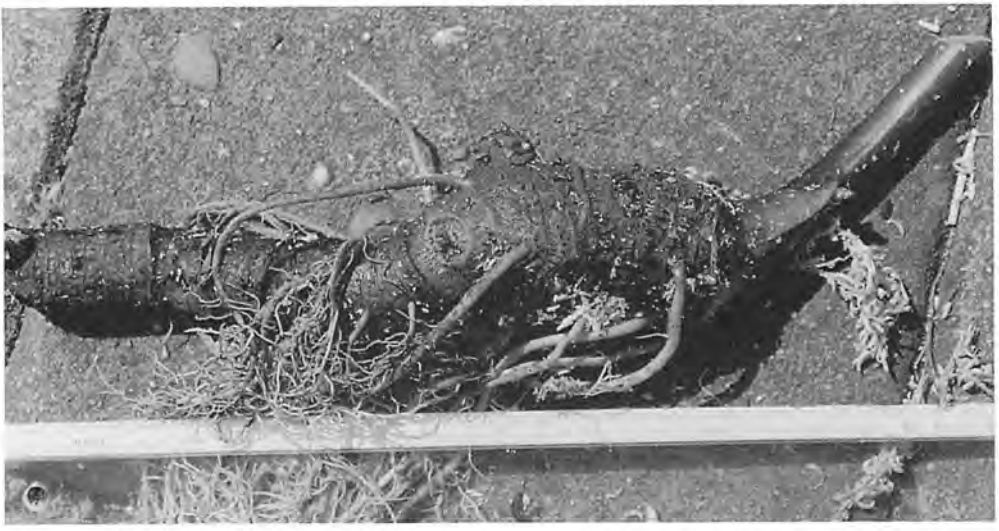

Fig. 4. *A. hayi*: rhizome.

overtopped or once or more pseudodichotomously branched; secondary rachises simple or variously branched; rachises naked, narrowly or broadly winged and often carrying supernumerary leaflets on the proximal parts; sometimes bulbils develop on the leaves, either epiphyllar, intercalary (Fig. 12) or half-epiphyllar; distal leaflets obovate, elliptic, elongate-elliptic, elongate, oblong, lanceolate or linear, sessile or rarely petiolulate, base often asymmetric and decurrent on one side, apex acute, acuminate or rarely caudate, margin entire rarely erose, often undulate, upper side green or dark green, rarely with reddish margin or variegation; inflorescence epigeal, rarely partly buried, solitary or simultaneous with or directly preceding leaf development, rarely emerging after leaf development; peduncle short or long, often sculptured and patterned as petiole, when short often elongating in fruit (Fig. 13, 14); spathe elongate-triangular, triangular or ovate to broadly ovate, variously

Fig. 5. *A. ankarana*: tuber.

Fig. 6. *A. glossophyllus*: tuber.

Fig. 7. *A. cicatricifer*: tuber.

shaped, often cymbiform or campanulate, more rarely funnel-shaped, outside variously colored but often shades of brownish-purple or whitish-green, inside mostly paler than outside but base within often dark maroon; base convolute, rarely open or connate, not or clearly separated from the limb by a constriction, oval, rounded, urceolate or funnel-shaped in longitudinal section, inside smooth or clothed with ridges or warts, the latter small or large, short or hairlike, sometimes forming ridges; limb rimshaped or broadly or elongate triangular, erect, spreading, oblique, or fornicate, margin entire or rarely lobed, flat, undulate or rarely plicate, apex acute, rarely acuminate or rarely caudate; spadix sessile or shortly stipitate, shorter than, equalling or longer than spathe; female zone cylindric, fusiform, conic or obconic, contiguous with male zone or separated by a sterile zone, flowers congested or rarely distant, sometimes surrounded by staminodes; sterile zone consisting of staminodes, rarely mixed with pistillodes, rarely partly or entirely naked; male zone cylindric, fusiform, conic or obconic, flowers congested, rarely distant, often vari-

Fig. 8. *A. abyssinicus*: tuber.

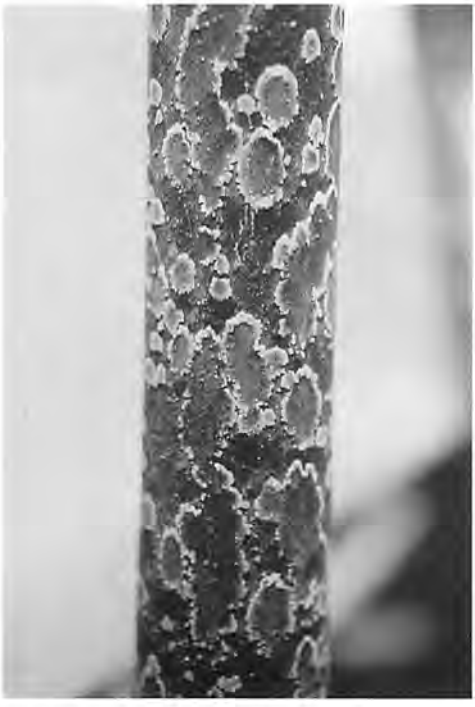

Fig. 9. *A. borneensis*: petiole (detail).

ously fused in the upper part of the zone, sometimes fused into vertical rows or helically or verticillate, sometimes mixed with staminodes; appendix rarely absent, contiguous with male zone or separated by a constriction or a short stipe, erect, rarely horizontal, arching, nodding or pendulous, outline conic, fusiform, triangular, myosuroid, ovate, subglobose or globose, sometimes with large longitudinal folds or deep cracks, surface smooth, rugulose, or with distinct, variously shaped staminodes, often only at the base, often warming up during female anthesis and spreading strong scents, sometimes emitting droplets of a clear fluid, apex acute or obtuse, wall thin or massive, inside a narrow canal or a large cavity; female flowers consisting of one pistil; ovary sessile or shortly stipitate, globose, subglobose, depressed or ovate, rounded or angulate in cross-section, 1-, 2-, 3-, or 4-locular, one ovule per locule, basifixed, or rarely axillary ca. halfway up the ovary; style present or absent, cylindric or rarely slightly conic or obconic, clearly

Fig. 10. *A. cicatricifer*: leaf.

separated from the ovary or less so, equalling or shorter or longer than ovary, sometimes with apical projections extending beyond the stigma; stigma indistinct or large, terminal or rarely subterminal, globose, hemispheric, concave or flattened, entire or variously lobed, surface spongy, papillate, scabrate or echinate, during anthesis covered with a sticky fluid; male flowers consisting of (1-) 3 to 6 (-8) stamens; stamens depressed or elongate; filaments present or nearly absent, massive or rarely thin, separate or partly or entirely fused within one flower; anthers short or elongate, rarely subglobose or globose, truncate, rarely rounded, connective indistinct or massive, sometimes with one or

Fig. 11. *A. manta*: leaf (photo: M. Sizemore).

Fig. 12. *A. angulatus*: old leaf with intercalary bulbil.

Fig. 13. *A. lewallei*: peduncle stretching just after pollination.

Fig. 14. *A. lewallei*: infructescence ripening.

Fig. 15. *A. eburneus*: fruiting (photo: A. Vogel).

Fig. 16. *A. eichleri*: fruiting (photo: B. v.d. Zwaan).

more projections, pores apical, rarely lateral or subterminal, rounded, reniform or elongate; staminodes of sterile zone shield-like, globose or hairlike, those on the appendix shield-like, hairlike, rounded or conic warts, echinae, sulci or papillae. Pollen globose or elliptic, exine rarely absent, psilate, striate, foveolate, etc. Infructescence usually long-peduncled, rarely short-peduncled; fruiting part globose (Fig. 15) or elongate (Fig. 16–18); berries globose (Fig. 17) or elongate (Fig. 15), red, orange-red, white, white-and-yellow, blue; seeds globose, subglobose, ovate, elliptic, usually with a distinct raphe.

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Species list of Amorphophallus (those with an asterisk are treated in this paper; a checklist of the Malesian and Austromalesian species, incl. types and references to protologues can be found in Hay et al., 1995):

A. aberrans Hett. (central Thailand)
A. abyssinicus (Rich.) N.E. Br.* (western to eastern and southeastern Africa)
A. albispathus Hett.* (Thailand)
A. albus Liu & Wei* (China)
A. angolensis (Welw. ex Schott) N.E. Br.* (Gabon, Angola, Zaire)
A. angulatus Hett. & A. Vogel* (Sarawak)
A. angustispathus Hett. (Myanmar)
A. ankarana Hett., Bogner & Ittenb.* (ined.; Madagascar)
A. annulifer Hett.* (Java)
A. antsingyensis Bogner, Hett. & Ittenb.* (ined.; Madagascar)
A. aphyllus (Hook.) Hutch.* (Senegal,

Fig. 17. *A. kiusianus*: infructescence.

Fig. 18. *A. titanum*: fruiting.

Guinea Bissau, Sierra Leone, ? Gambia)
A. arnautovii Hett.* (North Vietnam, China: Yunnan)
A. asper Engl. (Sumatra)
A. asterostigmatus Bogner & Hett.* (central Thailand)
A. atroviridis Hett.* (central Thailand)
A. barthlottii Ittenb. & Lobin* (ined.; Ivory Coast, Liberia)
A. baumannii (Engl.) N. E. Br. (Ghana, Sierra Leone, Nigeria, Togo)
A. beccarii Engl.* (Indonesia: Sumatra)
A. becqaertii De Wild. (Zaire)
A. bonaccordensis Sivad., N. Mohanan & Rajkumar (southwest India)
A. borneensis (Engl.) Engl. & Gehrm.* (southern Kalimantan)
A. brachyphyllus Hett.* (ined.; Sarawak)
A. brevispathus Gagnep. (central Thailand)
A. bufo Ridl.* (Malacca)
A. bulbifer (Roxb.) Bl.* (India)
A. calabaricus N. E. Br. (Nigeria, Cameroon)
A. canaliculatus Ittenb., Hett. & Lobin* (ined.; Gabon)
A. carneus Ridl.* (West Malaysia)
A. chlorospathus Kurz ex Hook. f. (Myanmar)
A. cicatricifer Hett.* (western Thailand)
A. cirrifer Stapf* (central Thailand)
A. coaetaneus Liu & Wei (southern China)
A. commutatus (Schott) Engl.* (southern India)
A. corrugatus N.E. Br.* (northern Thailand, Myanmar)
A. costatus Hett.* (southern Kalimantan)
A. coudercii (Bogner) Bogner* (central Vietnam, Cambodia)
A. cruddasianus Prain ex Engl. (Myanmar)
A. curvistylis Hett.* (western Thailand)
A. dactylifer Hett. (Philippines)
A. declinatus Hett.* (Palawan)
A. decus-silvae Backer & Alderw.* (Java)
A. discophorus Backer & Alderw. (Java)
A. doryphorus Ridl. (Gambia, Senegal)
A. dracontioides (Engl.) N.E. Br.* (Benin,

Ivory Coast, Ghana, Niger, Nigeria, Togo, Central African Rep.)
A. dunnii Tutcher (southeastern China)
A. eburneus Bogner* (Sarawak)
A. echinatus Bogner & Mayo (eastern Thailand)
A. eichleri (Engl.) Hook. f.* (Zaire, ?Angola)
A. elatus Ridl.* (West Malaysia, peninsular Thailand)
A. elegans Ridl.* (West Malaysia, peninsular Thailand)
A. elliottii Hook. f. (Sierra Leone)
A. erubescens Hett.* (western Thailand)
A. excentricus Hett.* (peninsular Thailand)
A. forbesii Engl. (Sumatra)
A. galbra F.M. Bail.* (northern Australia: Queensland)
A. gallaensis (Engl.) N. E. Br.* (Ethiopia, Somalia, Kenya)
A. gigas Teijsm. & Binn.* (Sumatra)
A. gliruroides Engl. (Myanmar)
A. glossophyllus Hett.* (central and North Vietnam)
A. goetzei (Engl.) N.E. Br.* (Tanzania, Mozambique)
A. gomboczianus Pic. Serm.* (Ethiopia)
A. gracilior Hutch. (Nigeria)
A. gracilis Engl. (Sumatra)
A. haematospadix Hook. f.* (West Malaysia, peninsular Thailand)
A. harmandii Engl. & Gehrm. (Cambodia)
A. hayi Hett.* (North Vietnam, China: Yunnan)
A. henryi N.E. Br.* (Taiwan)
A. hetterscheidii Ittenb. & Lobin* (ined.; Gabon, Zaire, Central African Rep.)
A. hewittii Alderw.* (Sarawak)
A. hildebrandtii (Engl.) Engl. & Gehrm.* (Madagascar)
A. hirsutus Teijsm. & Binn.* (Sumatra)
A. hirtus N.E. Br.* (Taiwan)
A. hohenackeri (Schott) Engl. & Gehrm.* (southwestern India)
A. hottae Bogner & Hett. (Sabah)
A. impressus Ittenb.* (ined.; Tanzania, Malawi)
A. incurvatus Alderw. (Sumatra)
A. infundibuliformis Hett., Dearden & A. Vogel* (Sarawak)
A. interruptus Engl. & Gehrm. (North Vietnam)
A. johnsonii N.E. Br.* (Ivory Coast, Burkina Fasso, Ghana, Guinea, Liberia, Mali)
A. kachinensis Engl. & Gehrm.* (northern Thailand, Laos, China: Yunnan)
A. kiusianus (Makino) Makino* (southern Japan, eastern China, Taiwan)
A. konjac K. Koch* (southern China, Vietnam, ?Sabah)
A. konkanensis Hett., Yadav & Patil* (southwestern India)
A. koratensis Gagnep.* (central and eastern Thailand)
A. krausei Engl.* (Myanmar, northern Thailand, China: Yunnan)
A. lambii Mayo & Widjaja* (Sabah, ?Kalimantan)
A. lanuginosus Hett. (central Vietnam)
A. laoticus Hett. (Laos)
A. lewallei Malaisse & Bamps* (Burundi)
A. linearis Gagnep. (central & western Thailand)
A. linguiformis Hett. (northeastern Kalimantan)
A. longiconnectivus Bogner (central India)
A. longispathaceus Engl. & Gehrm. (Philippines)
A. longistylus Kurz ex Hook. f. (India: Andamans)
A. longituberosus (Engl.) Engl. & Gehrm.* (West Malaysia, Thailand)
A. luzoniensis Merr. (Philippines)
A. macrorhizus Craib* (northern Thailand)
A. manta Hett. & Ittenb.* (Sumatra)
A. margaritifer (Roxb.) Kunth* (northeastern India, Nepal)
A. margretii Ittenb. (ined.; Zaire)
A. maximus (Engl.) N.E. Br.* (Tanzania, Kenya, Zambia, Zimbabwe, Somalia)
A. maxwellii Hett.* (western Thailand)
A. mayoi Ittenb. (ined.; Kenya, Uganda, Zaire)
A. mekongensis Engl. & Gehrm. (Vietnam)
A. mellii Engl. (southeastern China)
A. merrillii K. Krause (Philippines)
A. mildbraedii K. Krause (Cameroon)
A. minor Ridl. (West Malaysia)

A. muelleri Bl.* (western Thailand, Andamans, Sumatra, Java, Timor, south Sulawesi)
A. mullendersii Malaisse & Bamps (Zaire, Angola)
A. mysorensis Barnes & Fischer (southwestern India)
A. nanus H. Li & C. L. Long (China: Yunnan)
A. napalensis (Wall.) Bogner & Mayo* (northern India, Nepal, Bhutan)
A. napiger Gagnep. (central Thailand)
A. nicolsonianus Sivad. (southwestern India)
A. obovoideus Alderw. (Sumatra)
A. odoratus Hett. & H. Li* (China: Hong Kong)
A. opertus Hett.* (southern Vietnam)
A. pachystylis Hett. (western Thailand)
A. paeoniifolius (Dennst.) Nicolson* (Madagascar to Polynesia)
A. palawanensis Bogner & Hett.* (Palawan)
A. parvulus Gagnep.* (western, central & eastern Thailand)
A. pendulus Bogner & Mayo* (Sarawak, northwestern Kalimantan)
A. perakensis Engl. (West Malaysia)
A. pilosus Hett. (central Vietnam)
A. pingbianensis H. Li & C. L. Long (China: Yunnan)
A. plicatus Bok & Lam (northern Sulawesi)
A. prainii Hook. f.* (Thailand, West Malaysia, Sumatra, ? eastern Kalimantan)
A. preussii (Engl.) N.E. Br.* (Cameroon)
A. purpurascens Kurz ex Hook. f. (Myanmar)
A. pusillus Hett. & Serebr.* (South Vietnam)
A. putii Gagnep. (central Thailand)
A. pygmaeus Hett.* (central Thailand)
A. rhizomatosus Hett. (North Vietnam, Laos)
A. richardsii Ittenb. (Zambia)
A. rostratus Hett. (Philippines)
A. rugosus Hett. & A. Lamb (Sabah)
A. sagittarius Steenis* (Java)
A. salmoneus Hett.* (Palawan)
A. saraburiensis Gagnep. (central Thailand)
A. scaber Serebr. & Hett.* (South Vietnam)
A. smithsonianus Sivad.* (southwestern India)
A. sparsiflorus Hook. f.* (West Malaysia)
A. spectabilis (Miq.) Engl. (nom. cons. prop.; Java)
A. staudtii (Engl.) N. E. Br. (Cameroon)
A. staurostigma Ittenb., Hett. & Bogner (Madagascar)
A. stipitatus Engl. (southeastern China)
A. stuhlmannii (Engl.) Engl. & Gehrm.* (Tanzania, Kenya)
A. subcymbiformis Alderw. (Sumatra)
A. sumawongii (Bogner) Bogner (southeastern Thailand)
A. swynnertonii Rendl. (Mozambique, Tanzania, Zimbabawe, Zambia)
A. sylvaticus (Roxb.) Kunth (southern India, Sri Lanka)
A. tenuispadix Hett. (central Thailand)
A. tenuistylis Hett. (central Thailand)
A. teuszii (Engl.) N. E. Br. (Zaire, Angola)
A. titanum (Becc.) Becc. ex Arcang.* (Sumatra)
A. tonkinensis Engl. & Gehrm.* (North Vietnam)
A. urceolatus Hett. (ined.; Philippines)
A. variabilis Engl.* (Java)
A. verticillatus Hett. (North Vietnam)
A. yuloensis H. Li* (China: Yunnan)
A. yunnanensis Engl.* (northern Thailand, Laos, N. Vietnam, China: Yunnan)
A. zenkeri (Engl.) N.E. Br.* (Cameroon, Nigeria, Equatorial Guinea)

TAXONOMIC HISTORY & FUTURE PERSPECTIVES

The oldest systematic record of an *Amorphophallus* dates back to 1692, when the Dutchman van Rheede tot Drakenstein published Vol. 11 of his magnum opus, entitled Hortus Malabaricus. He described and illustrated two plants named in the Indian Malayam language as Mulenschena and Schena. In 1747 Rumphius described similar plants from the Indonesian island of Ambon under the generic name *Tacca*. Not surprising since *Amorphophallus* species have a leaf similar to that of the most

widespread *Tacca* species, *T. leontopetaloides*. In literature of the previous century, *Amorphophallus* species were often classified as *Arum* or *Dracontium*. It was the Dutch botanist Blume, who finally, in 1834, published for the first time the name *Amorphophallus,* thereby acknowledging the generic status these plants were entitled to in his opinion. He simultaneously gave a name to "Mulenschena", *A. campanulatus* (a name fraught with nomenclatural problems, and finally "changed" into *A. paeonitifolius*). Blume also presented the first systematic treatment of the genus in 1837, including 9 species, divided over 3 sections. In the meantime (1830), Wallich had published the genus *Thomsonia* for a plant we now know as *A. napalensis*. Blume didn't pick up this name for his species, because *Thomsonia* had a verrucate appendix, and his own plants all had a smooth appendix, which therefore became one of the most important generic characters.

Heinrich Wilhelm Schott, of famous aroid lore, did not contribute too much to a better understanding of *Amorphophallus,* because he split Blumes creation up into several new genera (e.g. *Brachyspatha, Conophallus, Corynophallus, Hansalia, Hydrosme, Plesmonium, Rhaphiophallus, Synantherias*), of which not one remains today.

Adolph Engler, on the other hand, did concern himself extensively with the systematics of *Amorphophallus,* and in the period between 1876 and 1908 he reduced all but two of Schott's genera to sections of *Amorphophallus*. He did maintain *Hydrosme* as a genus but was criticized for this by N. E. Brown, who reduced *Hydrosme* to *Amorphophallus*. Finally, in 1911, Engler gave up *Hydrosme* as well in his famous treatment in Das Pflanzenreich. Next to Wallich's genus *Thomsonia,* only Schott's *Plesmonium* remained, but both were later reduced to *Amorphophallus* by Bogner et al. (1985).

Since Engler, no monographs on *Amorphophallus* have been published. Only additions of species as part of or precursors to flora treatments (e.g. Ridley, 1925; Gagnepain, 1942; Hetterscheid, 1994b) have been published, as well as purely floristic treatments (e.g. Mayo, 1985), and a few systematic accounts/discussions of parts of the genus (e.g. Bogner et al., 1985, Sivadasan, 1989; Hetterscheid et al., 1994). The near future will witness the publication of two partial revisions by both present authors (African species by Ittenbach and the Asian ones by Hetterscheid), after which an entire monograph will be undertaken by Hetterscheid.

SYSTEMATIC POSITION

The most vexing problem of *Amorphophallus* is its systematic position in the framework of the family Araceae. Recent phylogenetic studies undertaken as part of the *Genera of Araceae* project (Mayo, Bogner & Boyce, in press) did not solve this problem. Engler (1876) placed *Amorphophallus* in the subfamily Lasioideae and maintained his position in the 1911 monograph. In addition to *Amorphophallus,* this subfamily contained the genera *Anchomanes, Anaphyllum, Cercestis, Cyrtosperma, Dracontioides, Dracontium, Echidnium* (now *Dracontium*), *Lasia, Montrichardia, Nephthytis, Plesmonium* (now *Amorphophallus*), *Podolasia, Pseudodracontium, Pseudohydrosme, Rhektophyllum, Thomsonia* (now *Amorphophallus*), and *Urospatha*. Engler's main arguments for the classification of *Amorphophallus* with genera like *Anchomanes* and *Dracontium* were the shape of the leaf and the lack of endosperm in the seeds.

Grayum (1984; 1990; 1992) was the first to challenge Engler's opinion and he reclassified *Amorphophallus, Thomsonia, Plesmonium* and *Pseudodracontium* (together forming the tribe Thomsonieae) in the subfamily Aroideae, which a.o. (amongst others) includes genera like *Arisaema, Arum, Biarum, Dracunculus, Helicodiceros, Sauromatum, Typhonium* etc. Grayum was followed by Bogner & Nicolson (1991) and Hay (1992). The phylogenetic studies of the *Genera of Araceae* project have confirmed the separation of *Amorphophallus* from the Lasioideae and its re-

Fig. 19. *Pseudodracontium lacourii*: "typical" leaf.

Fig. 20. *Pseudodracontium harmandii*: *Amorphophallus*-type leaf.

classification in subf. Aroideae but at the same time this subfamily has been greatly enlarged, and the relative position of *Amorphophallus* to any of the other genera, except to *Pseudodracontium*, remains unclear (pers. comm. P. Boyce).

The genus *Pseudodracontium* (Fig. 19–22) was established in 1882 by N.E. Brown, accommodating two species, one of which was already known as *Amorphophallus lacourii* Lind. & André. Recently *Pseudodracontium* has been revised by Serebryanyi (1995), and now includes 7 species. There is no doubt that *Pseudodracontium* and *Amorphophallus* are closely related but there is no unanimity about the question whether *Pseudodracontium* should stand as a genus (Serebryanyi, 1995), or not (Hetterscheid, 1994a). This issue will be solved when all species of *Amorphophallus* and *Pseudodracontium* are subjected to a phylogenetic analysis (Hetterscheid, in prep.).

Thus remains the question of the relation of *Amorphophallus* + *Pseudodracontium* (= tribe Thomsonieae) to any of the other genera of the Aroideae. A possible link to the tribe Areae may be the repeated occurrence of hair-like staminodes in *Amorphophallus* which is a feature well-known in the genera of the tribe Areae. A preliminary phylogenetic analysis of *Amorphophallus* + *Pseudodracontium* and the genera of the Areae suggests a close relation to *Arisaema* (Hetterscheid, in prep.).

GEOGRAPHY, ECOLOGY, AND CONSERVATION

The present geographical distribution of *Amorphophallus* largely comprises the paleotropics. Western Africa is the westernmost limit whereas the easternmost limit lies in Polynesia. However, this eastern boundary is formed by the occurrence of *A. paeoniifolius*, a species that has a long history of cultivation in Asia, and there is considerable doubt whether its present distribution mirrors its natural distribution. Disregarding *A. paeoniifolius*, the eastern limit of *Amorphophallus* is the line Japan-Philippines-Taiwan-New Guinea-N.E. Australia, formed respectively by *A. kiusianus* (Makino) Makino (Japan, Taiwan), several species of the Philippines and *A. galbra* F.M. Bailey (New Guinea, Australia). Within the west and east boundary *Amorphophallus* is found throughout the tropical and some subtropical zones.

Within this generic distribution *Amorphophallus* species show a very high de-

Fig. 21. *Pseudodracontium kuznetsovii*: inflorescence (photo: B. v.d. Zwaan).

Fig. 22. *Pseudodracontium kuznetsovii*: detail of spadix, showing the female zone (bottom) and the male zone with the typical long-stalked (filament) anthers (photo: B. v.d. Zwaan).

gree of endemism. Only three species show a fair geographical range. *A. paeoniifolius* is found from Madagascar eastward into Polynesia (but see above), *A. muelleri* is found from Central Thailand, southward via Sumatra, Java to the Lesser Sunda Islands and *A. abyssinicus* has a fairly large distribution in Africa. All other species show much more local distributions. Part of this may be the effect of sampling bias but recent active collecting largely confirms the restricted geographical range of the vast majority of species. Some of the species distributional patterns form a dense mosaic and suggest that the genus is at least in some areas activity speciating. This is supported by the fact that closely related species are very often found in neighboring areas. This pattern seems to result in seven large areas of endemism in the genus's distribution. These are:

1. Africa
2. Madagascar
3. Southern and central India
4. Northern India–Myanmar (Burma)–northern Thailand–southern and southeastern China–Laos–North Vietnam
5. Central Thailand–Cambodia-South and central Vietnam–eastern China (mainland)–Taiwan-Japan
6. Malaysia-Sumatra–Java-Borneo–Lesser Sunda Islands–New Guinea-northern Australia
7. Borneo-Sulawesi–Philippines.

Borneo is an area of overlap in this scheme.

The majority of *Amorphophallus* species seem to be pioneers in disturbed vegetations. Many are found at forest margins, in

Fig. 23. *A. ankarana*: plant in shallow humus pocket in limestone karst area (Madagascar, Ankarana Massif; photo: C. Jongkind).

open savannah forests, on (steep) slopes, in disturbed parts of primary forest, and sometimes in very exposed parts in limestone karst areas (Fig. 23). Relatively few species are known to live in dense forest. Roughly there is a division possible in the genus between species found in strongly seasonal climates (e.g. most of Africa, India, Thailand, Indochina, Java), and those found in more wet climates (e.g. Sumatra, Borneo). Species may be found in soils on granitic bedrock, but more often in limestone areas. The altitudinal range varies from sea level to ca. 3000 m (the latter especially in the northernmost limits of the genus). Flowering starts mostly just prior to the onset of the rains. In Asia flowering specimens that are effectively pollinated will not develop leaves anymore that season (except for three "evergreen" species), but the African species will always develop leaves in each growing season, whether flowering or not.

Pollination observations are scarce for *Amorphophallus* species. Earlier this century, v.d. Pijl (1937) gathered some observations on the pollination of *A. muelleri* (syn. *A. oncophyllus*), *A. titanum*, and *A. variabilis*, from which it seems that carrion beetles and small staphylinid beetles are the pollinators. Sivadasan & Sabu [*Aroideana* 12(1–4), 1989 (1991)] describe the nitidulid pollinators of *A. hohenackeri* in detail and their behavior. Recent observations (Hetterscheid, 1995) of a flowering *A. titanum* in the wild, suggest action by sweat bees (*Trigona*-alliance) but doubt has been cast on the usefulness of that observation, as it now seems that sweat bees are not particularly discriminating in their visiting behavior (pers. comm. G. Hambali, Indonesia). The first author however also caught quite an array of carrion and dung beetles in a flowering *A. gigas* on Sumatra. A publication on the pollinators of *Amorphophallus* is forthcoming (Huijbrechts & Hetterscheid, in prep.).

Equally little is known about the distributors of *Amorphophallus* seed, although no one doubts that birds are the main group. This follows from the quite strongly and brightly colored berries. The gigantic berries of *A. titanum* are almost certainly eaten and dispersed by Hornbill birds (Hetterscheid, 1995), whereas those of *A. gigas* are dispersed by Bulbuls (Hetterscheid, 1995). Bulbuls are also known to disperse *Amorphophallus* seeds in India [Singh & Gadgil, 1995(1996)] and Sabah (pers. comm. A. Lamb). Quite remarkable is the occurrence of blue berried species exclusively in the northermost range of *Amorphophallus*, suggesting dispersal by a particular group of birds restricted to that particular geography.

Amorphophallus titanum is locally abundant on Sumatra and may be found in populations of several tens of individuals. On a larger scale, several hundreds of plants may be found in areas of several square kilometers. But the distribution is patchy and over large areas not one single specimen may be found. Only a few areas

lining the Barisan range have been investigated for the presence of *A. titanum*. The populations always contain many more seedlings and immature specimens than mature ones. Reports are known of large amounts ("truck loads") of tubers of *A. titanum* being transported to Japan and Korea, collected by underpaid locals. Needless to say, the search is for the largest specimens, yielding the most material for the least effort. This means that mature specimens will soon be overcollected in populations, and when immature specimens are collected next, no plants will reach flowering size. So the population will soon diminish and disappear, all the more so since *A. titanum* does not multiply vegetatively, despite incorrect reports in literature to the contrary.

Another threat may be the destruction of relatively "undisturbed" secondary forest. *Amorphophallus titanum* is mostly found in secondary forest with occasional old forest giants and young trees forming a loose canopy, as may be found in old colonial plantations. The enormous attention focused on the conservation of virginal primary forest may lead to an underestimation of the importance of secondary forest for biodiversity in general.

A third threat would be the disappearance of the species' pollinator and distributor. Sweat bees are probably not easy to expel from the forests but the giant Hornbills may be much more vulnerable in the face of trophy hunting and habitat destruction.

In the face of this, *A. titanum* certainly qualifies for adding to the CITES convention lists (Hetterscheid & v. Vliet, 1996).

The question may arise whether botanical gardens can contribute to the conservation of such a species as *A. titanum*. A positive role of botanical gardens in the conservation of plant species in general can only be reached when their infrastructure allows for the establishment of an artificial population of a species, covering as large a portion as possible of it's genomic diversity. If not, the value of such a collection is limited in terms of conservation. In the case of *A. titanum*, genomic diversity seems quite limited. Throughout its range the species is astoundingly homogeneous in morphology, both in vegetative and generative parts. This may mirror a rather strongly constrained genome and could therefore lead to a successful conservation by establishing populations in botanical gardens. Artificial fertilization is easy and this may continue the diversity in such circumstances.

A second role for botanical gardens would be to show to the public the astounding aspects of the biology of this vegetable dinosaur and so create a positive general attitude towards the costly conservation of this species and of plants in general.

CULTIVATION

The following information is based on experience by the first author, built up during ca. 10 years of cultivating *Amorphophallus* species, at first only a few specimens in a windowsill, but today a research collection of more than 400 individuals, representing some 130 species. Much of today's cultivation is carried out by skillfull greenhouse personnel of the Leiden Botanical Garden, but a fair number of difficult plants are still under the personal care of the first author. A number of African species are grown in the Bonn Botanic Garden (Germany). It has never been the goal to find out exactly what the perfect treatment of every individual species is. It would result in too many different guidelines and there just isn't enough opportunity to spend much time on all individual species in such a large collection. The early years were times of trial-and-error, since nothing relevant was known about cultivating *Amorphophallus*. Most botanical gardens did possess one or two out of three well-known species, viz. *A. bulbifer, A. konjac* (usually under the name *A. rivieri* Durieu ex Carr.), or *A. paeoniifolius*. That is not much of a surprise because these three are rather easily cultivated and readily available through tropical markets and even sold by specialized bulb growers. The luckier botanical gardens got hold

of specimens of *A. titanum,* but they were always imported as mature plants and usually died after flowering. That is why Kew Gardens may be mentioned as having made an astounding achievement at the end of the last century in bringing an *A. titanum* into flower starting from seed in a period of ten years.

The trial-and-error method worked quite well for *Amorphophallus* because a majority of the species are not very difficult to grow, provided a minimum of conditions are met. These are roughly a rich soil, the use of additional fertilizer, shading against direct sunlight, a minimum temperature of 22°C. during the daytime and 19°C. during the night, a well-defined resting period, and a severe regimen against pests, preferably aimed at prevention. With these requirements, roughly 80% of all *Amorphophallus* species can be grown succesfully. Below are some more precise ideas and observations, but it must be kept in mind that every grower may work out better circumstances for one or more species. On a smaller scale of cultivation such ideas can be tested better.

Temperature: what has been said above about temperatures holds true for some 98% of the species. A notable exception is *A. kiusianus* from southern Japan. This species does not appreciate particularly high temperatures in cultivation, and the leaf dies back quickly when the temperature rises well above 25°C. Similarly, *A. konjac* seems to thrive best between 20° and 25°C., although it is more resistant than *A. kiusianus*. *A. bulbifer* seems to tolerate a rather large range of temperatures and thrives well between 15° and 30°C.

Soil: roughly there are two types of soil needed. Both should be rich in organic matter and trace elements, but one must be well-drained and must not contain loam, while the other may be heavier and enriched with loam. This division corresponds roughly with the two major climate preferences of *Amorphophallus* species. Those of strongly seasonal climates can be grown in the heavier soil. This includes all species with elongate tubers, and those from Africa, China, Japan, India, Thailand, Indochina, the Philippines, Java (but not all!), eastern Indonesia, New Guinea, and Australia. Also, all three Asian species with a large geographical distribution are used to such soils (*A. muelleri, A. paeoniifolius,* and *A. prainii*). For easy reference this large group of species will hereafter be referred to as "Group I". Group II comprises nearly all species from Sumatra, Borneo (= Kalimantan, Sarawak, Sabah, and Brunei), and West Malaysia with the exception of the earlier mentioned widespread ones. Group II species must be kept in a well-drained soil because their roots only survive in a well aerated soil. When the soil becomes too dense (through excess water or too much loam) the roots will rot. The trouble is that the leaf does not die down but keeps on living, supported by energy from the tuber, which will finally be depleted, becomes weak and suddenly starts rotting. When the leaf then suddenly tips over, all (or most) is lost. Both groups require a rich soil, especially in trace elements, which may be added with a fertilizer (see below), and organic matter. Thus far, adding limestone has not proven to be mandatory for any of the species, not even those from limestone regions. However, since lime (e.g. dolomite) has a high content of trace elements, adding it to the soil is an improvement.

Fertilizing: Group I species, when grown in a rich and heavy soil, do not need fertilizer very frequently, i.e. once in a month may be more than enough. Group II species however must be fed extra when the soil is indeed loose and contains only organic matter. However, do not give a concentration any higher than what is recommended for the fertilizer. Excess fertilizer may well kill off all roots. The most ideal fertilizer is one with a high phosphate content (e.g. 15–30–15), which stimulates tuber growth. In the end the health of an *Amorphophallus* is measured by the increase of the size of the tuber every season, especially in young to

submature plants. The tuber may increase its weight up to three times per season.

Planting: the top of an *Amorphophallus* tuber must always be well below the soil surface, since the roots emerge from the top and must secure the tuber to carry the long leaf or inflorescence. For this purpose the first roots grow very fast and horizontal. After they have reached full length, they start contracting and so secure and stabilize the tuber and the developing leaf. This is necessary because the developing leaf depletes most or all of the old tuber, so its base tends to "hang loose" in an empty hole where the tuber first was. This entire structure is very unstable and has a great need for the contractile roots. Those species producing elongate tubers need very deep pots to accommodate the strong vertical growth. When the pot is not deep enough, the base of the tuber will get cramped against the bottom and becomes deformed. This however does not usually impede the health of the tuber. The only problem may be that excess water that is often found in the bottom of the pot may cause local rotting of parts of the tuber base. The diameter of the pot must be at least twice that of the tuber that is planted in it, for obvious reasons.

Watering: species of Group I are quite resistant to excess water with the exception of those with elongate tubers. The latter species usually show slight superficial rot, even when they have not been overwatered. These small spots usually dry well when the tuber is taken out during dormancy. When the spots are large, they may be scraped off superficially and inspected for deeper rot. Group I species are also quite resistant to dry conditions and they will stand neglect fairly well for a longer period (to ca. 3 weeks). Group II species are sensitive to excess water which is why they need to be grown in very well-drained soils. Since most roots of *Amorphophallus* plants amass in the bottom of the pot, the soil there must be especially well prepared to transport water. Do not use a thick layer of coarse grit, because then the roots will be unable to extract water and nutrients and will subsequently die. Adding bark to the bottom layer of the soil is a useful alternative.

Dormancy: except for a few evergreen species (e.g. *A. arnautovii, A. pingbianensis*), all *Amorphophallus* have a dormancy period in nature. All species of Group I show the strongest tendency to dormancy in cultivation, while those of Group II may on occasion skip dormancy altogether but not as a rule. Dormancy may take place in two parts of a species' growing cycle. When a leaf dies down after a regular growing season the tuber will invariably take a resting period. This period may take 3 to 7 months, depending on the species, after which a leaf may emerge. When the plant is mature enough to flower the resting period is usually considerably shorter and may take no longer than a month or even less at times. During this "after leaf" dormancy tubers of Group I species can be stored dry but not seedling tubers or thin rhizomatous offsets. Group II tubers must be left in the soil because they are usually prone to desiccation. A second type of dormancy may set in after flowering. This only holds true for Asian, non-evergreen species that in nature invariably refuse to develop a leaf after flowering and effective pollination. Therefore, of these species, fruiting plants are never found with leaves. In cultivation a similar behavior is observed with most species. But sometimes, when the inflorescence is taken off, a plant may develop a leaf after all. Since this behavior cannot be predicted, the tuber is best left in the soil after the withered inflorescence has been removed. Watering must be lessened and the pot must be well observed for renewed growth. If this happens, the plant must be watered as usual, if not, it must be left to dry out until the next season. African species all develop a leaf in the same season as flowering, with or without pollination and fruit set. Most develop a leaf shoot directly alongside the peduncle, others take a short resting period. This leads to an important warning: when the old inflorescence of an African species is cut away, be sure NOT to cut the

new leaf shoot which may be very close to the peduncle! Remove the cataphylls first to locate the new shoot before cutting the peduncle. The African savannah species pose a special problem (e.g. *A. aphyllus, A. dracontioides*) because it seems that they need a special treatment during dormancy. So far none of these species have been brought to flower, even though plants have reached full size. Probably they need extra heat during resting, imitating the harsh conditions on the savannah during the dry period.

Vegetative propagation: most Group I species readily produce offsets every year of vegetative growth. These offsets may still be attached to the main tuber and should be severed when the mother tuber is replanted for a new season. In other species the offsets are already loose when the plant is dug up after a season's growth. Usually less than 100% of the offsets grow into new plants. There is always a percentage of inert offsets that may linger on for years without sprouting and finally die. Every once in a while however, such a latent offset may start growing again, so never throw offsets away until they are definitely dead. Keep slim, rhizomatous offsets in soil during resting (e.g. *A. hohenackeri, A. krausei*). Offsets that are left on the main tuber will usually not develop into new plants but are often (though not always) devoured when the tuber dissolves to nourish the developing leaf.

Some species produce bulbils on the leaves. These are of two main types. One type is produced entirely on the surface of branching points of the leaf (epiphyllar bulbil, e.g. in *A. bulbifer* and *A. muelleri*). The other type is formed when the entire branching point of a leaf transforms into a bulbil and is dislodged when the leaf rots away (intercalary bulbil, e.g. in *A. angulatus, A. manta,* and *A. sparsiflorus*). A third type has been found only in *A. yuloensis,* which is half epiphyllar and half intercalary.

Some species produce seed vegetatively, without pollination (apomictic seed). These are *A. bulbifer, A. muelleri* and *A. kiusianus*. The first two species exhibit a genome with 39 chromosomes and can thus not form normal haploid gametes for sexual reproduction.

Vegetative propagation through tissue culture has succeeded in several occasions as witnessed by the literature. Cell suspensions have been prepared from tuber parts as well as from leaf parts (e.g. in *A. titanum*). The authors have no first-hand experience with this process.

Sexual propagation: pollinating plants of different clones in cultivation is usually successful. The pollen must be put on the stigmas on the first day of flowering, as early as possible. The stigmas are very sticky and no pollen will fall off. On the day that pollen is released the stigmas are no longer receptive to pollen. Pollination within one and the same clone has been successful in a limited number of cases (e.g. with *A. atroviridis,* pers. comm. J. Banta) but usually leads to only very partial seed-set (two selfings in *A. curvistylis* yielded only three viable seeds). Hybrids between different species have been raised in Leiden but not released to the public because of fear of spreading unnatural variation into existing collections, which may lead to taxonomic misnomers. The successful crosses were: *A. longituberosus* × *A. albispathus,* and *A. odoratus* × *A. yunnanensis.*

Growing from seed: fresh seed of *Amorphophallus* usually germinates quickly (between one and three weeks). Notable exceptions so far observed are *A. henryi* and *A. kiusianus*. The seeds may be taken from the flesh of the berries but must then not be stored dry. The seed coat of *Amorphophallus* is rather thin and there is no endosperm layer to protect the embryo from desiccation. The first leaf is already three- or five-parted (in *A. prainii* often to 7-parted) and soon new leaves will emerge. This may go on for more than a year before the first real resting period starts. The young tubers are best left in the soil until they are bigger and more resistant to drought (only Group I tubers may be stored dry!). Sow the seeds in a typical sowing-soil (poor in nutrients and slightly acidic). Difficult seeds may be forced to

germinate in sphagnum. Once dry, *Amorphophallus* seeds cannot be rehydrated successfully.

Pests: the two major primary pests of *Amorphophallus* in cultivation are nematodes and root mealybugs. Root mealybugs are similar in appearance to mealybugs and they are very resistant to most superficial chemical pesticides. No biological control mechanism yet exists. Therefore the best method is using a systemic pesticide with a broad activity spectrum. Unfortunately such pesticides are usually rather unhealthy for humans. The most effective has proven to be *Temik, and of the half-systemic pesticides *Vydate is effective but must be given in small doses because leaf damage may occur. Both pesticides can also be used preventively. Nematodes can only be effectively fought off with strong methods like using Temik. The infections are easily recognized in their early stages as small to medium-sized, hemispheric warts/bumps on the tuber surface, not associated with root scars or accessory buds. When cut, they show a dirty pale greyish center, consisting of cells that are greatly enlarged and contain a large quantity of water. In the middle of this bump resides the female nematode filled with young specimens. The female nematode is dissolved and releases the young ones, who feed on the watery tissue of the bump. After this, the bump implodes and becomes a crater, which is attacked by other secondary pests (acarids, fungi, bacteria). The released nematodes reinfect the newly developing tuber and destroy it, or damage it beyond rescue. All bumps on an infected tuber must be cut away and the tuber then put in a Temik solution. After that it must be left to dry and must be regularly inspected for desiccation or new infections. When planted, the soil must be mixed with Temik before planting. This treatment must be repeated for two or three seasons, after which the infection is usually conquered. Do not make an effort to save an individual of a species of which you have enough duplicates. Better to throw the infected tuber away. Heavily infected tubers show large craters and rotting parts. When the top of the tuber is still intact, it may be saved. When the top is gone and there are no accessory buds, the tuber is beyond rescue. A heavily infected tuber must be cleaned and the largest scars sealed with a fungicide (e.g. Topsin) in order to prevent infection and desiccation.

Tubers that have been in wet soil too long may start rotting at the base of the roots. This type of rot spreads through the tuber with a tremendous speed and is usually detected too late. Cut away all rotting parts, seal off with Topsin, and pray! The same holds for occasional bacterial infections. These are recognized by the flesh of the tuber turning into a slimy substance. Cut away the bad parts and treat the scars with a bactericide. When the scar becomes dry, seal off with Topsin.

Prevention is THE rule in controlling pests in *Amorphophallus*. It is therefore recommended that tubers are always inspected for pests after the growing season. Be sure to put tubers of Group II species back in the soil after examination.

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* Temik and Vydate are both restricted pesticides (and highly toxic) with specific applications and are available only to those individuals that hold the required permits.—Ed.

KEY TO THE SPECIES PRESENTED IN THIS PAPER

The characters used in the following key are partly to be found in the descriptions, but additional characters are used, mainly detailed characters from the individual male and female flowers, or details of the appendix. The key is prepared to identify living plants and therefore contains characters that would be impossible or nearly impossible to use with herbarium specimens. This key therefore must not be used to identify herbarium specimens.

1a: peduncle shorter than or equaling the spathe 2
b: peduncle exceeding the spathe 35
2a: spathe base inside covered with hairs 3
b: spathe inside smooth, ridged or warty 6
3a: appendix base irregularly grooved ..... *A. canaliculatus*
b: appendix base not grooved 4
4a: spathe limb outside and inside white or pale pinkish; spathe not exceeding 10 cm ..... *A. barthlottii*
b: spathe limb inside maroon 5
5a: spathe base depressed, broadly urn-shaped; inside of the spathe limb with a distinct white zone at the base ..... *A. zenkeri*
b: spathe base elongate, inside of the spathe limb uniformly maroonish ..... *A. johnsonii*
6a: appendix strongly warty, green ..... *A. lewallei*
b: appendix surface not as above 7
7a: appendix surface with hairs 8
b: appendix surface not as above 9
8a: appendix strongly curved horizontally ..... *A. cirrifer*
b: appendix erect ..... *A. henryi*
9a: spathe creamy white on both sides, largely hidden in the cataphylls 10
b: spathe variously colored, not as above 12
10a: spathe bell-shaped; style prominent ..... *A. prainii*
b: spathe largely erect; style absent 11
11a: ovaries densely congested, dark purple ..... *A. eburneus*
b: ovaries distant, pale purple to pink ..... *A. brachyphyllus*
12a: spathe opening only for the upper third part or less 13
b: spathe opening wide, or the top strongly arching over the lateral opening 15
13a: ovary unilocular; stigma entire ..... *A. opertus*
b: ovary bilocular; stigma lobed 14
14a: appendix with large shallow depressions ..... *A. scaber*
b: appendix entire or with cracks at the base ..... *A. koratensis*
15a: style much longer than ovary 16
b: style absent or as long as ovary 25
16a: appendix with elongate, often hooked staminodes; style absent ..... *A. infundibuliformis*
b: appendix without elongate staminodes; style present 17
17a: spathe margin incised ..... *A. titanum*
b: spathe margin entire 18
18a: appendix with a constriction and a truncate top with short, stiff hairs ..... *A. hirsutus*
b: appendix without constriction, no hairs on the top 19
19a: spathe base and limb separated by a constriction 20
b: no constriction in the spathe 22
20a: appendix narrowly elongate 21
b: appendix variously shaped, mostly conical, never narrowly elongate ..... *A. paeoniifolius*
21a: spathe constriction strong, base depressed ..... *A. henryi*
b: spathe constriction shallow, base elongate ..... *A. maxwellii*
22a: spathe base closed, subterraneous ..... *A. pusillus*
b: spathe base convolute, above ground 23
23a: style strongly curved; stigma bilabiate, directed towards the spadix axis ..... *A. curvistylis*
b: style straight; stigma (shallowly) lobed, not bilabiate, not directed towards the spadix-axis 24
24a: peduncle largely subterraneous; appendix gradually tapering to the top ..... *A. lambii*
b: peduncle well-exposed; upper 1/3rd of appendix abruptly narrowed ..... *A. hewittii*
25a: spathe limb inside brownish purple with white spots; female flowers distant ..... *A. sparsiflorus*

b: spathe limb inside variously colored, not as above 26
26a: stigma depressed, unlobed, with a shallow central depression 27
b: stigma lobed 28
27a: spathe limb inside uniformly pink; stigma very large, larger than ovary . . . . . *A. bulbifer*
b: spathe limb inside creamy white (base pink); stigma distinctly smaller than ovary . . . . . *A. yuloensis*
28a: appendix globose 29
b: appendix elongate or conical 30
29a: appendix protruding from the spathe . . . . . *A. aphyllus*
b: appendix hidden by arching spathe . . . . . *A. dracontioides*
30a: spathe and limb not separated by a constriction 31
b: spathe and limb separated by a constriction 33
31a: spadix longer than spathe . . . . . *A. costatus*
b: spadix shorter than or equal to the spathe 32
32a: female flowers distant; spathe limb pale brown on both sides . . . . . *A. angulatus*
b: female flowers congested; spathe outside spotted, inside flushed two shades of purple . . . . . *A. sagittarius*
33a: spathe base inside with large, flattened warts; appendix often conical, laterally flattened; spathe margin rim-shaped . . . . . *A. eichleri*
b: spathe base inside with warts and papillae, or with small tongue-shaped papillae 35
34a: male zone stretching beyond the constriction of the spathe; spathe base inside with small warts and papillae . . . . . *A. goetzei*
b: male zone not reaching beyond the constriction of the spathe; spathe base very depressed, inside with tongue-shaped papillae . . . . . *A. impressus*
35a: spadix distinctly longer than spathe 36
b: spadix shorter than, equal or subequal to the spathe 75
36a: appendix with hairs 37
b: appendix without hairs 38
37a: hairs on appendix numerous, long; hairs also between male and female zone . . *A. hirtus*
b: hairs on appendix few, short; no hairs between male and female zone . . . *A. macrorhizus*
38a: appendix base with a ring-like extension . . . . . *A. annulifer*
b: appendix base without any extension 39
39a: inflorescence appearing after the leaf, in the same season; leaves long-lived, or seasonal 40
b: inflorescence appearing before the leaf, or in a different season; leaves seasonal 41
40a: stem a series of connected tubers; appendix elongate conical, erect; leaves long-lived . . . . . *A. arnautovii*
b: stem a rhizome; appendix long, thin, curving; leaf seasonal, dying down after flowering . . . . . *A. hayi*
41a: leaf and inflorescence in the same season, inflorescence always preceding the leaf (African/Madagascan species) 42
b: leaf and inflorescence usually appearing in separate seasons, when appearing in the same season, the leaf always precedes the inflorescence (Asian species) 53
42a: spadix longer than spathe 43
b: spadix shorter than or equal to the spathe 51
43a: spathe base inside with hairs 44
b: spathe base inside (smooth, warty, ridged), lacking hairs 46
44a: stigma with 2-3 long, conical acute lobes . . . . . *A. stuhlmannii*
b: stigma with rounded lobes or unlobed 45
45a: spadix base shallowly sigmoid, the bends between the male and female zone and between male zone and appendix . . . . . *A. angolensis*
b: spadix base straight . . . . . *A. hetterscheidii*
46a: appendix base swollen and echinate; spathe base inside smooth . . . . . *A. gomboczianus*
b: appendix base not swollen, smooth; spathe base inside ridged or warty 47
47a: stigma with thin, conical, acute lobes . . . . . *A. staurostigma*
b: stigma unlobed or with rounded lobes 48
48a: ovaries bilocular . . . . . *A. maximus*
b: ovaries unilocular 49
49a: style absent; spathe limb inside white . . . . . *A. ankarana*
b: style present; spathe limb inside spotted or maroon 50
50a: stigma laterally placed . . . . . *A. gallaensis*
b: stigma terminal . . . . . *A. hildebrandtii*
51a: spathe base inside with short, scattered hairlike papillae; spathe greenish and whitish . . .

. . . . . *A. preussii*
b: spathe base inside smooth or warty, but not with hair-like papillae; spathe variously colored, not as above 52
52a: spathe base inside smooth; spathe all green . . . . . *A. antsingyensis*
b: spathe base inside heavily ridged; spathe largely maroon . . . . . *A. abyssinicus*
53a: sterile structures (staminodes) between male and female zones 54
b: male and female zone adjacent 56
54a: peduncle velvety hairy . . . . . *A. atroviridis*
b: peduncle smooth 55
55a: staminodes globose, appendix very long and thin (resembling a mouse tail) . . . . . *A. smithsonianus*
b: staminodes hemispheric, appendix elongate-conic . . . . . *A. konkanensis*
56a: appendix pendulous . . . . . *A. pendulus*
b: appendix erect 57
57a: tuber elongate 58
b: tuber globose or subglobose 62
58a: peduncle velvety hairy . . . . . *A. macrorhizus*
b: peduncle smooth 59
59a: appendix thin, very long, mouse tail like 60
b: appendix fusiform-conic 61
60a: spathe whitish on both sides; style distinct . . . . . *A. parvulus*
b: spathe spotted or all green; style absent . . . . . *A. elatus*
61a: spathe white on both sides; appendix shorter than 4 cm . . . . . *A. pygmaeus*
b: spathe green on both sides; appendix longer than 6 cm . . . . . *A. glossophyllus*
62a: spathe white on both sides, small . . . . . *A. pygmaeus*
b: spathe differently colored 63
63a: appendix distinctly stipitate; stipe white 64
b: appendix not stipitate 65
64a: style nearly absent (to 0.3 mm long) . . . . . *A. manta*
b: style ca. 1 mm long . . . . . *A. bufo*
65a: appendix white, creamy or very pale pink 66
b: appendix purple (dark, pale, or greyish) 71
66a: appendix fusiform-conic with a very thick wall 67
b: appendix elongate-conical, broad or narrow, with a thin wall 68
67a: spathe inside greenish or pink with white spots . . . . . *A. muelleri*
b: spathe inside uniformly pink . . . . . *A. erubescens*
68a: appendix broadly fusiform-conic 69
b: appendix narrowly fusiform 70
69a: style 4–4.5 mm; inflorescence more than 2 m. high . . . . . *A. decus-silvae*
b: style to 2 mm; inflorescence ca. 1 m. high . . . . . *A. annulifer*
70a: spathe suddenly narrowed above the base; stigma lobed . . . . . *A. variabilis*
b: spathe not narrowed; stigma sinuous . . . . . *A. elegans*
71a: style nearly absent or short (to 1 mm) 72
b: style distinct 73
72a: spathe outside and inside with white spots, style 0.3 mm long, spathe limb strongly arching forward at flowering . . . . . *A. declinatus*
b: spathe inside uniformly purple, style 0.8–1 mm long, spathe limb erect . . *A. commutatus*
73a: spathe base outside bright green with occasional whitish spots . . . . . *A. borneensis*
b: spathe base outside spotted in several colors 74
74a: stigma globose, shallowly bilobed; tuber lacking offset development . . . . . *A. gigas*
b: stigma flattened, strongly lobed, sinuous; tuber seasonally producing long, rhizomatous offsets . . . . . *A. konjac*
75a: appendix with a few scattered hairs 76
b: appendix hairless 77
76a: appendix base narrower than male zone; spathe green . . . . . *A. macrorhizus*
b: appendix base distinctly broader than male zone; spathe maroon and spotted . . . . . *A. kiusianus*
77a: appendix with distinct warts 78
b: appendix smooth or otherwise sculptured 79
78a: spadix with sterile structures (staminodes) between male and female zones *A. salmoneus*
b: spadix with male and female zone adjacent . . . . . *A. napalensis*
79a: naked zone between male and female zone, with small, shallow depressions (scars) . . . . . *A. cicatricifer*

b: male and female zone adjacent or separated by a staminodial zone 80
80a: spathe limb inside brownish purple with white circular spots 81
b: spathe limb inside without white circular spots 83
81a: female flowers densely crowded ..... *A. kiusianus*
b: female flowers distant 82
82a: style nearly absent (to 0.3 mm long) ..... *A. manta*
b: style ca. 1 mm long ..... *A. bufo*
83a: spadix with sterile structures (staminodes) between male and female zone 84
b: spadix with male and female zones adjacent 86
84a: appendix absent; staminodes elongate ..... *A. margaritifer*
b: appendix present; staminodes semi-flattened 85
85a: spathe base truncated, the lower 0.5–1 cm fused ..... *A. hohenackeri*
b: spathe base acute or rounded, convolute 101
86a: spathe creamy white, appendix reddish ..... *A. haematospadix*
b: spathe variously colored but not as above 87
87a: tuber elongate 88
b: tuber globose or subglobose 90
88a: appendix absent ..... *A. coudercii*
b: appendix present 89
89a: peduncle irregularly bending; spadix slightly curving forward; spathe all white, with or without a few greyish spots on the backside ..... *A. albispathus*
b: peduncle straight; spadix straight; spathe variously spotted and/or striped, or without any pattern ..... *A. longituberosus*
90a: spathe suddenly tightened above the appendix, the tightened part often partly convolute ..... *A. galbra*
b: spathe broadly opened to the top 91
91a: spathe purple on both sides, slightly constricted between base and limb *A. palawanensis*
b: spathe differently colored, not constricted 92
92a: appendix elongate-conical (3 × longer than broad) 93
b: appendix broadly and shortly conical (at most 2.5 × longer than broad) 96
93a: stigma star-shaped, margin strongly sinuous ..... *A. asterostigmatus*
b: stigma disciform, shallowly lobed 94
94a: spathe inside all pink, the base dark pink; stigma very large, nearly entirely covering the ovary; ovary reddish to pink ..... *A. bulbifer*
b: spathe inside whitish or greenish white 95
95a: appendix base smooth or shallowly grooved ..... *A. carneus*
b: appendix base with deep, interconnecting grooves ..... *A. excentricus*
96a: appendix surface deeply corrugate, brainlike ..... *A. corrugatus*
b: appendix surface smooth or with deep cracks 97
97a: appendix with a few or several deep, longitudinal fissures or grooves/cracks ..... *A. kachinensis*
b: appendix smooth 98
98a: style absent ..... *A. beccarii*
b: style present 99
99a: appendix with two or three large, shallow, longitudinal depressions, often very strongly laterally depressed ..... *A. yunnanensis*
b: appendix without depressions 100
100a: spadix stipitate ..... *A. odoratus*
b: spadix sessile ..... *A. tonkinensis*
101a: surface of staminodes smooth ..... *A. krausei*
b: surface of staminodes with numerous shallow depressions, appearing shallowly rugulose ..... *A. albus*

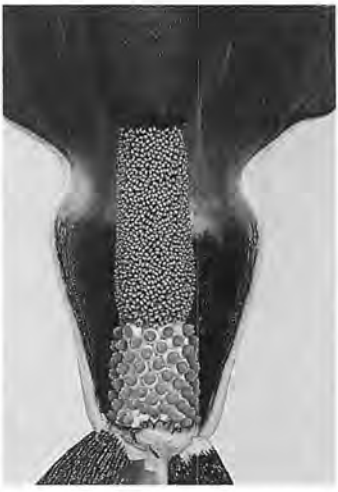

Fig. 24. *A. abyssinicus*: habit of long-peduncled form. Fig. 25. *A. abyssinicus*: habit of short-peduncled form. Fig. 26. *A. abyssinicus*: spadix (detail).

Amorphophallus abyssinicus (Rich.) N.E. Br. [syn.: *A. schweinfurthii* (Engl.) N.E. Br., *A. barteri* N.E. Br., *A. warneckei* (Engl.) Engl. & Gehrm., *A. chevalieri* (Engl.) Engl. & Gehrm., *A. foetidus* Chev., *A. fontanesii* (Schott) Kunth, *Hydrosme sereti* De Wild.]

Tuber subglobose to disciform, to 20 cm in diam., producing long, rhizomatous offsets. Leaf solitary; petiole to 100 cm long, green or maroon to brownish green with darker purplish green spots; lamina to ca. 80 cm in diam.; leaflets oblanceolate to linear, to ca. 15 cm. long. Inflorescence appearing just prior to the leaf, long-peduncled; peduncle to 70 cm long, as petiole; spathe to ca. 40 cm long, base and limb separated by a distinct constriction, base outside green or greenish purple with purple lines and spots or glaucous purple, inside dark purple and strongly ridged, limb outside as base, inside deep glossy maroon, the base with a glaucous blue-grey band. Spadix shorter than spathe, producing the odor of cow-dung.

Distribution—Cameroon, Ivory Coast eastwards to Ethiopia, then southwards to Tanzania, Zambia, Zimbabwe, and to the center in Zaire.

Notes—*Amorphophallus abyssinicus* mostly resembles *A. suynnertonii* Rendl but differs in a much sturdier spadix with a basal constriction and the ridges in the spathe base not being reticulate.

Cultivation—Easy of cultivation when grown in a rich soil. It will reproduce vegetatively fast from the long offsets. The tuber can be stored dry during dormancy.

Fig. 27. *A. albispathus*: spathe & spadix (photo: T. Croat)

Fig. 28. *A. albispathus*: spadix (detail).

Amorphophallus albispathus Hett.

Tuber elongate, unbranched (young plants) or with several, parallel, vertical branches, forming a clump of ca. 17 cm long, top part to ca. 7 cm in diam. Leaf solitary or two on one tuber; 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, emaculate or with a few, scattered dark greyish spots; lamina moderately dissected, 15–90 cm in diam., leaflets elliptic, long-acuminate (acumen ca. 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, to ca. 40 cm long; spathe erect or concave, cymbiform, triangular-ovate, basal fifth convolute, apex acuminate, 6–14 cm long, 3.0–10.0 cm in diam., outside dirty white with some scattered pale or dark grey-green punctiform spots and sometimes a very faint, pale purplish hue. Spadix shorter than spathe, to 13 cm long, slightly curvate, sessile, emitting a strong, anise-like scent at female anthesis. Berries elongate to ovoid, 1.5–2 cm long, 1–1.5 cm in diam., ripening from green, via orange to bright red, very glossy, 1- to 4-seeded.

Distribution—Only known from south central Thailand.

Note—*Amorphophallus albispathus* is a small and inconspicuous species, notable for its pleasant, aniseed smell upon flowering. This character is shared only with *A. longituberosus* and *A. coudercii*. Of its ecology nothing is yet known.

Cultivation—*Amorphophallus albispathus* is easily cultivated, tolerating quite heavy soil

with loam. It takes a very dry resting period for ca. 3–4 months or shorter when ready to flower.

Amorphophallus albus Liu & Wei. (Photos on front and back covers)

Tuber subglobose, 7–10 cm in diam., ca. 5–6 cm high, brown, seasonally producing long rhizomatous offsets, these up to 23 cm long and 1.5 cm in diam. Leaf solitary; petiole 40–70 cm long, ca. 1.5–2 cm in diam., smooth, pale green with greyish green, irregular, elongate, or rounded spots, and whitish dots; lamina ca. 80 cm in diam. leaflets elliptic-lanceolate, 2–12 cm long, 1–3 cm in diam., acuminate. Inflorescence long-peduncled; peduncle 16–30 cm long, ca. 1–2 cm in diam.; spathe cymbiform, elongate ovate, acute, 12–22 cm long, ca. 6–10 cm in diam, lower margin of limb recurved, outside base green to pale green, inside creamy white, outside limb pale green spotted dark green and near the margin with numerous indistinct white punctiform dots, inside creamy white with a faint pale green flush, base within densely verruculate. Spadix sessile, shorter than spathe, slightly curvate, 13.5 cm long; a distinct sterile, staminodial zone is present between the male and female zones.

Distribution—China (Yunnan Prov.).

Notes—*Amorphophallus albus* is morphologically very similar to *A. krausei* (see description) but differs from the latter in having thicker offsets, and very irregular and large staminodes. Like *A. krausei* it gives off a very upsetting, gaseous smell.

Cultivation—Grow in a rich soil. The species produces offsets freely and is easy in cultivation. The tuber may be stored dry when resting. This species is now also cultivated in China on a larger scale for economic purposes.

Amorphophallus angolensis (Welw. ex Schott) N. E. Br. [syn.: *A. leopoldianus* (Masters) N. E. Br.].

Tuber depressed globose, to 10 cm in diam. and 5 cm high, producing numerous annual offsets, these shortly elongate. Leaf solitary; petiole to ca. 1 m long, background color bright green, with few to many, partly confluent, elliptic, greyish black spots, sometimes with a metallic green shimmer; lamina to ca. 50 cm in diam.; leaflets elongate-oval to obovate, to 17 cm long. Inflorescence developing alongside the young leaf; peduncle to ca. 150 cm long; spathe to ca. 40 cm long, base and limb separated by a clear oblique constriction, outside base as peduncle, inside with purple base, densely covered with purplish hairs, outside and inside limb basally greenish purple, towards the margin dark reddish purple. Spadix much longer than spathe, to ca. 100 cm long, emitting the odor of decaying meat.

Distribution—Angola, Gabon, Zaire.

Note—The description above is based on the subspecies *maculatus* (N. E. Br.) Ittenb. (formerly a species), the only subspecies known in cultivation. It is a very elegant and robust subspecies. *Amorphophallus angolensis* ssp. *maculatus* is separated from *A. angolensis* subsp. *angolensis* in lacking a style (or rarely having one of less than 0.4 mm) and an entire stigma (rarely with 2 shallow lobes.) *Amorphophallus angolensis* resembles *A. hetterscheidii* (see descr.) but the latter differs a.o. in having a straight spadix base (versus abruptly bent between male and female zones, and again between male zone and appendix base in *A. angolensis*) and has a clearly constricted appendix base.

Fig. 29. *A. angolensis* subsp. *maculatus*: habit (photo: J. Bogner).

Fig. 30. *A. angolensis* subsp. *maculatus*: spathe opened (photo: J. Bogner).

Cultivation—*Amorphophallus angolensis* ssp. *maculatus* is easily grown in a well-drained soil. The offsets are best left on the main tuber, until the latter shows signs of regrowth. The offsets have been found not to be 100% viable after planting, so it may take some years to get a good stock. The main tuber is best left in the soil when dormant.

Amorphophallus angulatus Hett. & A. Vogel.

Tuber globose, dark brown, ca. 3 cm in diam. Leaf solitary; petiole ca. 30 cm long, ca. 0.5 cm in diam., subterete in cross-section, angulate in seedling and juvenile leaves, dirty greenish or with a reddish purple flush; lamina ca. 40 cm in diam., the center may develop into a bulbil with age; leaflets elliptic-lanceolate, acuminate, subcoriaceous, ca. 17–19 cm long, ca. 4–5 cm in diam., mid-green, in seedling and juvenile leaves entirely or partly reddish purple. Inflorescence short peduncled, partly hidden in cataphylls; peduncle entirely hidden by the cataphylls, 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.

Distribution—Malaysia, Sarawak, 1st Division.

Fig. 31. *A. angulatus*: inflorescence.

Fig. 32. *A. angulatus*: spathe base cut open.

Notes—*Amorphophallus angulatus* is the second smallest species in the genus and particularly attractive because of the dark reddish juvenile leaves, a feature shared with the West Malaysian *A. sparsiflorus* and *A. pendulus*, also from Sarawak. It is often said that this feature may be an adaptation to living in deep shade close to the forest floor. *Amorphophallus angulatus* belongs to a small group of Bornean species, characterized by erect spathes with quite long, strongly convolute, narrowly tubular bases, near absence of styles and male flowers often aligned into vertical rows. Several of these also produce foliar bulbils as *A. angulatus* does.

Cultivation—Grow in a loose, peaty soil with very good drainage. The tuber is to be left in the soil at all times but should not be watered during dormancy.

Fig. 33. *A. ankarana*: spathe and spadix.

Fig. 34. *A. ankarana*: spadix (detail).

Amorphophallus ankarana Hett., Bogner & Ittenb. (not yet published).

Tuber saucer-shaped, to ca. 15 cm in diam. and ca. 7 cm high, pale tan, developing several globose offsets per season, these directly attached to the main tuber. Petiole to ca. 80 cm long and ca. 2.5 cm in diam., smooth, succulent, dirty pale greenish or pale brownish with scattered small, oval, reddish brown to brown spots, near the base a reddish brown hue all over; lamina to ca. 100 cm in diam.; leaflets succulent, ovate-lanceolate to lanceolate, 4–21 cm long, 1.5–5 cm in diam., acuminate to long-acuminate, upper surface dull dark green. Peduncle 60–75 cm long. Spathe erect, elongate triangular, 30–35 cm long, ca. 10–14 cm in diam., limb slightly twisted and margins strongly undulate, base tubular, outside glossy dark or pale olive-green to olive-brown, with scattered, rounded, reddish brown spots, inside brownish purple at the base, above white with a faint purplish flush, inside white, sometimes with a faint purplish flush at the center. Spadix sessile, longer than spathe, 35–40 cm long, producing a suffocating, cacao-like scent.

Distribution—Madagascar, Ankarana Massif (in humus pockets on limestone).

Notes—This species has been distributed by the first author to many aroid enthusiasts as *A. hildebrandtii*, coll. nr. H.AM.048. The species of Madagascar are currently revised and formerly were all identified as *A. hildebrandtii*. It now seems they actually represent three or four species (see also *A. antsingyensis* & *A. hildebrandtii*).

Cultivation—A very easy species to grow, multiplying readily by offsets but not easy to flower before the tuber is really big. Grow in a fairly heavy soil and do not keep too dark. The tuber may be lifted during resting and will not desiccate.

Fig. 35. *A. annulifer*: spathe and spadix.

Fig. 36. *A. annulifer*: spadix (detail).

Amorphophallus annulifer Hett.

Tuber subglobose to ca. 10 cm in diam., no offset development. 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 center, basal part with many small, rigid small warts; lamina 100 cm in diam.; leaflets elliptic or elliptic-lanceolate, ca. 8–15 cm long, ca. 4–5 cm in diam., long-acuminate. 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, upwards to the limb suffused with a brownish purple hue, 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. Spadix sessile, longer than spathe, 22–56 cm long, in large specimens with a distinct ringlike expanded appendix base.

Distribution—Indonesia, Java (western), Mt. Karang and the Lengkong area.

Notes—This species has consistently been wrongly labeled in the literature as *A. muelleri* Bl. (see descr.) since 1919, when it was featured in a publication with a drawing, but mislabeled. With the clarification of the real identity of *A. muelleri*, it became clear that this species never received a proper name. The most remarkable, and near-unique, feature of *A. annulifer* is the ringlike expansion of the appendix base (hence the name!).

Cultivation—Grow in an average, not too heavy potting soil. The tuber may be kept out of the soil during resting.

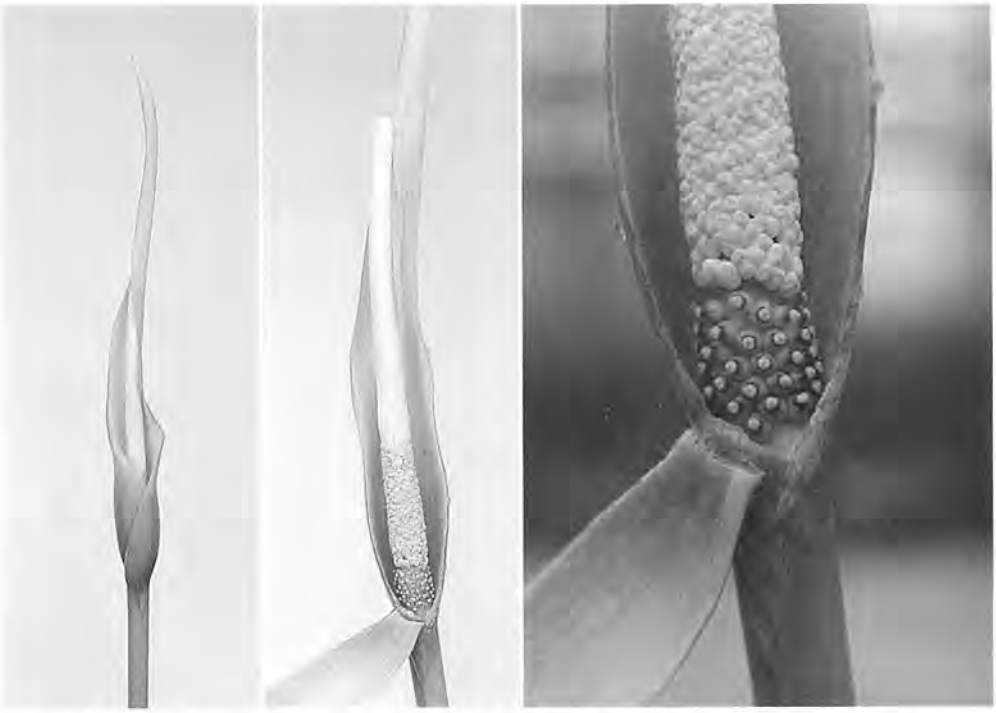

Fig. 37. *A. antsingyensis*: spathe and spadix. Fig. 38. *A. antsingyensis*: spathe base cut open. Fig. 39. *A. antsingyensis*: spadix (detail).

Amorphophallus antsingyensis Bogner, Hett. & Ittenb. (not yet published).

Tuber disciform, to ca. 12 cm in diam., producing long, rhizomatous offsets. Leaf solitary; petiole ca. 80 cm long, all pale greyish green; lamina ca. 70 cm in diam.; leaflets lanceolate to elliptic-lanceolate, to 20 cm long, slightly succulent, acuminate, upper surface greyish green. Inflorescence appearing before the leaf, long-peduncled; peduncle ca. 80 cm long, smooth, uniformly pale green; spathe erect, lanceolate, ca. 25 cm long, acute, base and limb poorly differentiated, limb narrow, upper part slightly twisted, outside pale green, inside whitish green, base outside green, inside pale green, basal part green and shallowly ridged. Spadix substipitate, shorter than spathe, ca. 14 cm long.

Distribution—Madagascar (so far only known from the Antsalova Gorge).

Notes—*Amorphophallus antsingyensis* can readily be differentiated from all other African species by the combination of the long, narrow spathe and the spadix much shorter than the spathe. Its alliance is with the Madagascan *A. ankarana* with which it shares e.g. the sessile, small stigma. *Amorphophallus ankarana* however has a spadix decidedly longer than the spathe and produces only sessile offsets.

Cultivation—Grow in a well-drained rich soil. The offsets start developing in a very early stage of growth and usually appear above the soil. The tuber may be stored dry when dormant.

Fig. 40. *A. aphyllus*: entire plant dug out (photo: G. Eggers).

Fig. 41. *A. aphyllus*: spadix (detail) (photo: W. Barthlott).

Amorphophallus aphyllus (Hook.) Hutch. (syn.: *Corynophallus afzelii* Schott, *A. leonensis* Lem.).

Tuber flattened, disciform, to ca. 30 cm in diam. and 6 cm high, developing globose offsets, these may not separate from the tuber the first year. Leaf solitary; petiole to 70 cm long, base purple, upper part bright green; lamina to 60 cm in diam.; leaflets linear or linear-lanceolate, to 20 cm long and 2 cm in diam, slightly succulent. Inflorescence developing before the leaf, short peduncled; peduncle to ca. 10 cm long; spathe to 25 cm long, base broadly kettle-shaped, separated from the limb by a shallow constriction, outside creamish or pale greenish, inside striped whitish and dark purple, smooth, limb reduced, collar-shaped, outside dark reddish brown or purplish, with a few whitish spots, inside as base but the white stripes broadening towards the margin; spadix longer than spathe; appendix hugely swollen, oval to nearly spherical.

Distribution—Senegal, Guinee Bissau, Sierra Leone, ?Gambia.

Note—A most remarkable and ornamental species in all its parts. The striking contrast in colors of the spathe and spadix is unmatched in the genus. *Amorphophallus aphyllus* cannot be mistaken for any other species. Its nearest relative, *A. dracontioides*, has a similar spadix but the spathe is longer than the spadix and cowl-shaped.

Cultivation—Although easy to grow in even a quite heavy soil, so far no specimen has been brought to flower in cultivation. It is a savannah species and maybe needs a very hot and dry resting period, during which it can be stored dry.

Fig. 42. *A. arnautovii*: spathe and spadix.

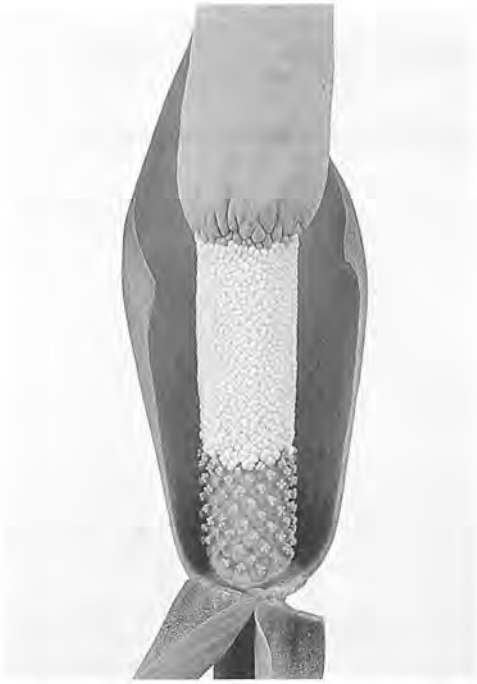

Fig. 43. *A. arnautovii*: spadix (detail).

Amorphophallus arnautovii Hett.

Tuber depressed-globose, persistent, to 6 cm in diam., to 3 cm high, chained with others to form a pseudo-rhizome, dark brown. Leaf solitary or paired, persistent to 3 years; petiole to 60 cm long, smooth, turgid, uniformly dark green; lamina ca. 50 cm in diam., common base of the three main branches may develop into an intercalary bulbil. Inflorescence long-peduncled; peduncle 33–49 cm long, 1.2–1.3 cm in diam., as petiole; spathe triangular or triangular-ovate, 7.5–11.5 cm long, 4.5–7 cm in diam., base shortly convolute, top acute, outside dirty green flushed with dirty brownish purple or the upper half entirely brownish purple, inside background color dirty green, at the base and along the midrib flushed dirty dark purplish, near the top less so, or the base pale green and the rest flushed with brownish purple, base within smooth or nearly smooth with a few scattered, small, punctiform warts. Spadix sessile, longer than spathe, 11–19.5 cm long. Berries 1 cm long, 0.8 cm in diam., 2–3-seeded, blue.

Distribution—East central Vietnam and southern China (Yunnan).

Notes—*Amorphophallus arnautovii* is remarkable for two characters. First there are the long lasting leaves that may become as old as three years. Equally remarkable are the tubers that do not disappear when a new leaf is formed, but stay in place, while the new tuber develops on top of the old one and is displaced a little to the side. Through the years a chain or clump of tubers is formed this way. Both these characters are shared with the Chinese *A. pingbianensis* [see *Aroideana* 11(1): 4]. Another similarity with that species are the blue berries.

Cultivation—*Amorphophallus arnautovii* is easily grown in an average, not too heavy potting mix. It tolerates dryish conditions quite well and doesn't have a resting period.

The leaf is more sensitive to excess sunlight than other species, but after damage the plant will regenerate quite easily.

Amorphophallus asterostigmatus Bogner & Hett.

Tuber depressed-globose, 5–9 cm diam. and 3–5 cm high, dark brown, with few or several short, rhizomatous or subglobose offsets, these loosening from the main tuber in the second year after development. Petiole 60–70 cm long, smooth, greyish reddish to greenish with some dark reddish brown spots. Leaf blade ca. 50 cm in diam.; leaflets more or less elliptic, 6–19 cm long, 2–4.7 cm wide, apex acuminate, upper side dark green, lower side lighter green. Inflorescence long-peduncled; peduncle 35–70 cm long. Spathe erect, as long as or longer than spadix, length 15–21 cm, width 7–13 cm., outside margin greenish, to the middle with a faint pale purplish or reddish brown tinge, inside cream, towards the base greenish and with some irregular, pale purplish flushes. Spadix subsessile, 11–17.5 cm long.

Distribution—Thailand, Lop Bori.

Note—*Amorphophallus asterostigmatus* has a spathe shape that is common to most Thai species and shows hardly any specific differentiation. This species has found its way to many amateur growers through Thai markets, where the tubers are often found. No natural localities were known until recently, when Tim Chapman (USA) located and pho-

Fig. 44. *A. asterostigmatus*: inflorescence.

Fig. 45. *A. asterostigmatus*: spadix (detail).

tographed specimens near Lop Bori. The seeds of *A. asterostigmatus* are said to be ground and made into one of Thailand's best curries.

Cultivation—Easily grown in a rich soil. The tuber may be stored dry when resting.

Amorphophallus atroviridis Hett.

Tuber napiform, to ca. 15 cm long, top ca. 5 cm in diam., brown, branching sparingly. Leaf solitary; petiole 10–50 cm long, dark reddish brown with some rounded, dirty white, brown-centered spots and numerous, tiny, dirty white dots, densely velvety hairy; lamina with few leaflets (5–9), 18–60 cm in diam.; leaflets large, obovate shortly acuminate, slightly succulent, 9–30 cm long, 4.5–14 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 sinuous, lower surface greyish green, main and secondary veins pale pink, with many white hairs, the surface in between less hairy, margin pinkish violet. Inflorescence solitary, long-peduncled; peduncle like petiole, ca. 30 cm long, ca. 1.0 cm in diam. (base); spathe erect, ca. 10 cm–13 cm long, ca. 8–9 cm in diam., lower third convolute, separated from the limb by a shallow constriction, limb triangular, acute, margins slightly reflexed, outside base dirty whitish, upwards grading into pale brown with many, small, irregular, scattered, dirty white spots, the margin pinkish violet, main veins in the lower half dark brown, inside pale whitish green, suffused with purplish near the

Fig. 46. *A. atroviridis*: inflorescence (photo: B. v.d. Zwaan).

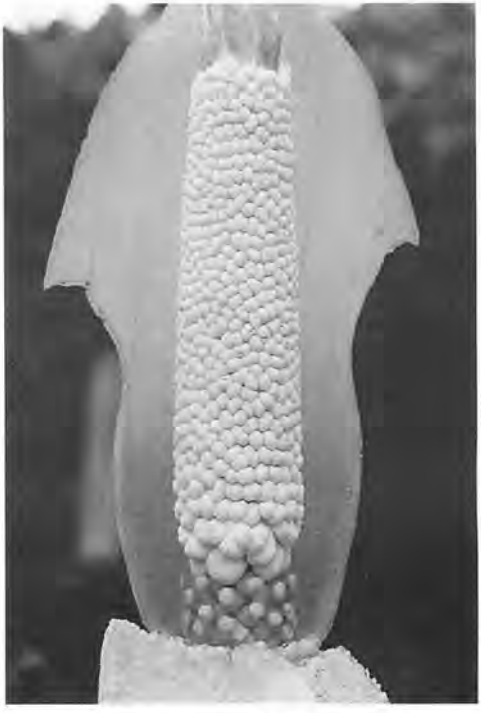

Fig. 47. *A. atroviridis*: spadix (detail) (photo: B. v.d. Zwaan).

upper margin, entire margin pinkish violet. Spadix sessile, about twice as long as spathe, 25–31 cm long. Berries elongate, ca. 1.5 cm long, white with a yellow apex.

Distribution—Thailand, Khao Phaeng (along limestone boulders).

Notes—*Amorphophallus atroviridis* plants were obtained by Scott Hyndman of Florida (USA) in the early 1980's from Mr. Robert Delaney (Florida), who received seeds from an anonymous sender with only "Thailand" as geographic information. The plants have long been known as "*Amorphophallus larsenii*", but this combination has never been validly published and refers back to *Thomsonia larsenii* Hu, which I consider to be a synonym of *Amorphophallus brevispathus* Gagnep. *Amorphophallus atroviridis* definitely ranks amongst the most ornamental species with the beautiful dark emerald green leaves with their bright pinkish violet margins. This character is shared with two small Thai species, *A. parvulus* (see descr.) and *A. pygmaeus* (see descr.).

Cultivation—As many other Thai species, *A. atroviridis* is easily grown in quite heavy soils with loam. It must be kept totally dry when dormant. Give it a deep pot, in order for the tuber to be able to develop its full length. This species can successfully be pollinated and yields numerous viable seeds. Scott Hyndman once obtained "albino seedlings" (petiole pink, veins pink, lamina white) but these soon perished.

Fig. 48. *A. barthlottii*: inflorescence (photo: W. Barthlott).

Fig. 49. *A. barthlottii*: spathe cut open (photo: W. Barthlott).

Amorphophallus barthlottii Ittenb. & Lobin (not yet published).

Tuber globose or subglobose, to ca. 4 cm in diam., probably not developing offsets. Leaf unknown. Inflorescence short-peduncled; peduncle to ca. 10 cm long; spathe ca. 10 cm long, base and limb separated by a shallow constriction, base outside whitish or a dirty pinkish or greenish, inside purple and covered with very short hairs, limb short, outside and inside whitish or dirty pinkish, towards the margin flushed with purple, margin sinuous. Spadix slightly longer than spathe.

Distribution—Ivory Coast, Liberia.

Notes—One of the smallest species in the genus and certainly the smallest of the African species. It was erroneously identified as *A. staudtii* (Engl.) N. E. Br. in *Aroideana* 4(4): 109.

Cultivation—Not known in cultivation.

Amorphophallus beccarii Engl.

Tuber depressed, with raised areas, up to ca. 10 cm in diam., ca. 7 cm high, reddish, no offset development. Leaf solitary; petiole up to ca. 90 cm long, ca. 2 cm in diam., smooth, turgid, glossy dark brown, at the base marbled with whitish spots, these upwards larger, elongate elliptic and with a brown center, the top together with the bases of the three

Fig. 50. *A. beccarii*: spathe and spadix.

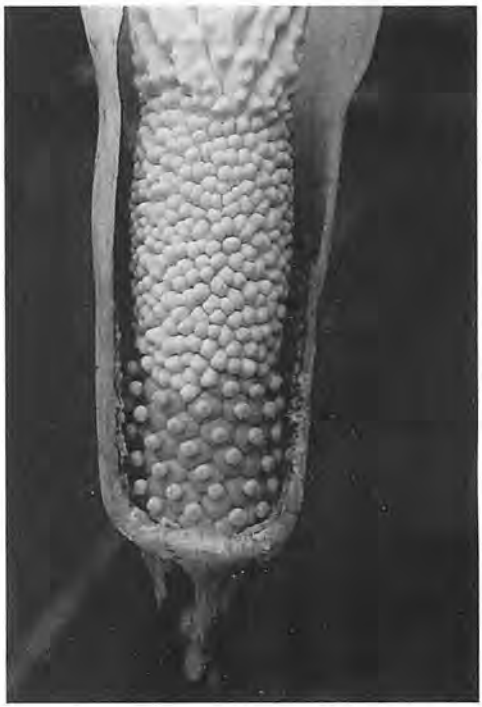

Fig. 51. *A. beccarii*: spadix (detail) (photo: B. v.d. Zwaan).

main branches may be developed into an intercalary bulbil; lamina ca. 90 cm in diam.; leaflets elongate-elliptic, 16–28 cm long, 6–7 cm in diam., acuminate, somewhat leathery, upper surface slightly glossy, green or dark green, apex reddish brown, lower surface green with brownish veins and margin. Inflorescence solitary, long-peduncled; peduncle as petiole or paler in all parts, 25–62 cm long, 0.6–1.5 cm in diam.; spathe erect in small specimens but in large specimens hanging over the appendix, ± cymbiform, 7–17 cm long, 4–8 cm in diam., elongate-triangular, top acutish, outside pale green with some faint purplish flushes, to the margin whitish green to whitish, inside dirty pale whitish green, the central lower part of the limb purple with rounded, whitish spots, the base dark maroon, the upper part of the base with paler purple warts, to the base confluent, forming a dense ridged-corrugate pattern, ridges mostly longitudinally arranged and their upper parts dirty white. Spadix sessile, slightly (small specimens) or distinctly shorter than spathe, 5.5–11 cm long.

Distribution—Indonesia, northern and western Sumatra (in forest in deep shade, alt. 200–1500 m).

Notes—*Amorphophallus beccarii* is member of a small, exclusively Sumatran group of species with a very confusing taxonomy, due to the loss or poor preservation of most of the type specimens. In the above description, *A. cobra* Alderw. is included but recent data have cast some doubt on the correctness of that decision. *A. beccarii* stands out due to its overhanging spathe and large, egg-shaped appendix.

Cultivation—Grow in a well-drained, not heavy soil. Keep in shade, no direct sunlight. The tuber must never dry out and must stay in the soil when the plant is dormant, which may not happen at all.

Amorphophallus borneensis (Engl.) Engl. & Gehrm.

Tuber subglobose, ca. 20 cm in diam., dark brown, no offset development. Leaf solitary; petiole to ca. 2 m high, largely smooth, slightly rugulose at the base, purplish or blackish green, with large, oval or rounded, whitish, blackish green-centered, confluent spots and numerous small, whitish and brownish purplish dots, the margins of the larger spots at the base of the peduncle slightly raised, lichen-like. Inflorescence solitary, long-peduncled; peduncle ca. 70–110 cm long (or more?), ca. 4 cm in diam. (base); spathe ovate, 40–43 cm long, ca. 25–35 cm in diam., subacute, limb with one large longitudinal fold, margin with a few large sinuses, margin rolled inwards, base outside dull green with a greyish hue and with scattered small and larger pale green rounded spots with or without a darker green center, and small, punctiform, blackish green spots, inside maroon, upwards pale green or whitish with a pale brownish violet hue, limb outside dull dirty reddish brown or dark brown, with small pale or blackish spots and paler main veins, these raised, inside glossy dirty dark brown or dark reddish brown. Spadix sessile, 50–67 cm long, longer than spathe.

Distribution—Indonesia, South Kalimantan.

Notes—*Amorphophallus borneensis* certainly ranks among the larger species. The mottling of the petiole and peduncle is of great beauty and resembles the complex patterns of lichen on a stem.

Cultivation—Grow in a medium to heavy soil. The tuber should not be left out of the soil during resting.

Fig. 52. *A. borneensis*: inflorescence.

Fig. 53. *A. borneensis*: spadix (detail).

Amorphophallus brachyphyllus Hett. (not yet published).

Tuber subglobose to depressed-globose, irregular, with raised areas, surface with a greyish corky skin, producing new plants through the development of subsidiary shoots. Leaf solitary; petiole to 50 cm long, all green, very turgid; lamina to ca. 190 cm in diam., highly dissected; leaflets elliptic-lanceolate, to 35 cm long, those closest to the center on small stalks. Inflorescence solitary, short-peduncled; peduncle 10–13 cm long, entirely subterranean, white with a faint greenish flush; spathe to 10 cm long, erect, largely hidden in the long cataphylls, outside entirely off-white, inside similar but base reddish purple, base within coarsely grooved, grooves distinctly warty. Spadix longer than spathe, to 21 cm long, producing a distinct scent of fried fish.

Distribution—West Malaysia (Sarawak).

Notes—A truly remarkable species because of its very short petiole supporting a tremendously large lamina. This in itself is unique in the genus. Another remarkable feature is the great resemblance of its inflorescence to that of *A. eburneus*, a species found in the same area. No doubt these two are intimately related but nevertheless they show a number of significant differences. The leaf of *A. eburneus* is very large and high and its lamina is much less strongly divided, it has no stalked leaflets and its leaflets are generally larger. The pistils in *A. brachyphyllus* are irregularly distributed over the female zone (vs. regular and congested in *A. eburneus*). The stigmas of *A. eburneus* are consistantly twice as large as those in *A. brachyphyllus*. The tuber of *A. eburneus* is regularly subglobose in shape.

Cultivation—Not difficult to grow in a well-drained soil. The tuber must not be left out of the soil and is quite sensitive to nematodes.

Fig. 54. *A. brachyphyllus*: inflorescence.

Fig. 55. *A. brachyphyllus*: spadix (detail).

Amorphophallus bufo Ridl.

Tuber globose or depressed-globose, to ca. 10 cm in diam., not producing offsets. Leaf solitary (sometimes accompanied by an inflorescence); petiole ca. 30–100 cm long, shallowly sulcate lengthwise, mottled grey and green, or dark reddish brown in several shades, mottles irregularly angulate, mostly broader than long and with additional blackish punctation; lamina ca. 45–80 cm in diam., the anterior main segment considerably less strongly developed and shorter than the posterior ones, often consisting of only one leaflet, base of the lamina may develop into an intercalary bulbil; leaflets elliptic-ovate to oblanceolate, acuminate, 9–18 cm long, 3–5 cm in diam., upper surface moderately glossy dark green with or without a few, small, rounded white spots, lower surface when young flushed with reddish brown, later with scattered, punctiform, reddish brown spots, margin reddish purple. Inflorescence long-peduncled; peduncle ca. 20–90 cm long, ca. 1 cm in diam.; spathe lyrate when spread, 15–26 cm long, 6–11 cm in diam., the limb hooded or erect and strongly narrowed towards the base, apex acute, basal margins strongly reflexed, auriculate, upper margin moderately reflexed, sinuous, outside pale olive green or brownish with paler green or whitish spots, inside brownish purple with scattered, cicular, greenish or whitish spots, base within irregularly shallowly rugose, warty or nearly smooth. Spadix sessile, much shorter than spathe, ca. 9–15 cm long.

Distribution—West Malaysia, Pahang, Johore, and Selangor states (in mountain forests, alt. ca. 1200 m).

Notes—*Amorphophallus bufo* is a very similar to *A. manta* (see descr.), both having a

Fig. 56. *A. bufo*: spathe and spadix (photo: A. Hay).

Fig. 57. *A. bufo*: spathe base cut open (photo: A. Hay).

very unique, wide, sinuous spathe. The leaf of both species is quite ornamental through a complex mottling of the petiole, and red and white spots on the leaf lamina.

Cultivation—Grow in a well-drained, not too heavy soil. The tuber must remain in the soil during resting. Plants may not go dormant at all, and when the leaf gets older an inflorescence may suddenly appear, after which a new leaf may develop immediately. *Amorphophallus manta* exhibits a similar behavior.

Fig. 58. *A. bulbifer*: inflorescence.

Fig. 59. *A. bulbifer*: spadix (detail).

Amorphophallus bulbifer (Roxb.) Bl.

Tuber subglobose, to 15 cm in diam., brown, no offset development. Leaf solitary or paired; petiole to 1 m high, smooth, fleshy, dark green or greyish green, with larger and smaller, elongate, whitish spots (rarely streaks), sometimes flushed with pink; lamina to 1.5 m in diam., developing one to numerous bulbils on the upper surface; leaflets elongate elliptic, to ca. 25 × 13 cm, upper side dark green, margins sometimes pinkish. Inflorescence short- or long-peduncled; peduncle 10–70 cm long, 1–3 cm in diam.; spathe erect, ovate, to 30 cm long and 20 cm in diam., outside background greyish green with tiny blackish green dots but largely obscured by large, transverse, confluent whitish spots with a pink flush, inside base dark pink, upwards paler, top dirty whitish. Spadix as long as, or shorter than spathe, sessile or stipitate, 8–25 cm long, producing a heavy gaseous stench upon female flowering.

Distribution—northern and eastern India, Bangladesh, Bhutan, Nepal.

Notes—*Amorphophallus bulbifer* is common in cultivation because of its strength and its ability to multiply rapidly with bulbils. Seed set is achieved without pollination (apomixis). It is very closely related to *A. muelleri* (see descr.) with which it shares the bulbil development and the apomictic seed set. Both species are very hard to distinguish in some areas of geographic proximity (e.g. Assam).

Cultivation—Grow in any fertile soil. The tuber may be kept out of the soil during resting. This species tolerates lower temperatures on average than most others (ca. 15°–20°C.).

Fig. 60. *A. canaliculatus*: inflorescence.

Fig. 61. *A. canaliculatus*: spathe base cut open.

Amorphophallus canaliculatus Ittenb., Hett, & Lobin (not yet published).

Tuber subglobose, brown, no offset development. Leaf solitary; petiole to 70 cm long, dark purplish brown with blackish purplish spots; lamina to 60 cm in diam.; leaflets elongate oval, to 12 cm long. Inflorescence developing before the leaf, short-peduncled; peduncle to 10 cm long; spathe urceolate, to 30 cm long, base and limb separated by a constriction, base outside greyish green with a purple flush and scattered dark brown to dark green spots, inside lower part purple, upwards changing to creamish or whitish green, covered with dark purple hairs, outside limb brownish green and purple, inside glossy dark purple. Spadix longer than spathe, to 70 cm long; appendix base with irregular warts and grooves

Distribution—Gabon.

Notes—*Amorphophallus canaliculatus* differs from all other African species with short peduncles in the strongly grooved appendix base.

Cultivation—Although initially growing easily, the type clone (and only one known) became more difficult to keep growing after it had flowered for the second time. It is kept in a loose soil and the tuber is left in the soil while resting.

Fig. 62. *A. carneus*: inflorescence (photo: A. Hay).

Fig. 63. *A. carneus*: spathe and spadix (photo: A. Hay).

Amorphophallus carneus Ridl.

Tuber depressed-globose, ca. 4–5 cm in diam., ca. 3 cm high, pale to mid brown, smooth, producing annual, shortly elongate offsets. Leaf solitary; petiole to ca. 40 cm long, ca. 1 cm in diam., smooth, dirty white or greyish green or pinkish white, with reddish brown or very dark brown spots; lamina to ca. 50 cm in diam.; leaflets elliptic-lanceolate, long-acuminate, 6–14 cm long, 2–5 cm in diam., upper surface glossy green, main veins impressed. Inflorescence long-peduncled; peduncle as petiole, ca. 10–30 cm long, ca. 0.5–1.0 cm in diam.; spathe triangular-ovate, 9–13 cm long, 8–10 cm in diam., obtuse or acute, outside pale brownish whitish to the base with a pinkish flush and with blackish brown spots, inside off-white with pale brownish veins, base within with small, punctiform or slightly longitudinally elongate warts. Spadix shortly stipitate (0.5 cm) or sessile, shorter than, equalling or slightly longer than spathe, 8–15.5 cm long.

Distribution—Northern states of West Malaysia, Peninsular Thailand (on limestone rocks).

Notes—*Amorphophallus carneus* resembles *A. excentricus* (see descr.) the latter differing mainly in having a larger, especially broader appendix with more prominent grooves. The upper side of the leaflets of *A. excentricus* are dull green as opposed to glossy green in *A. carneus*. The distribution and extreme morphological similarity between these two species suggests that they may represent one and the same taxon but more material is necessary to decide upon this.

Cultivation—A strong and readily multiplying species. Grow in any fertile soil. The tuber may be kept out of the soil when dormant.

Fig. 64. *A. cicatricifer*: inflorescence.

Fig. 65. *A. cicatricifer*: spadix (detail).

Amorphophallus cicatricifer Hett.

Tuber depressed-globose, 4–6 cm in diam., ca. 3 cm high., developing short elongate offsets. Leaf solitary; petiole ca. 30 cm long, smooth, rich dark reddish brown with a thin greyish waxy layer; lamina ca. 40 cm in diam., rachises winged; leaflets elliptic or elliptic-oblanceolate, 4.5–11 cm long, 2.5–5 cm in diam., acuminate, upper surface deep emerald-green with an oily bluish sheen, margin bright reddish purple, lower surface paler with a dark purplish flush towards the margin. Inflorescence solitary, long-peduncled; peduncle 22–43 cm long, 0.8–1.2 cm in diam. (base), smooth, as petiole or paler; spathe elliptic or elliptic-ovate, acute, base convolute, 20–22 cm long, ca. 10–14 cm in diam., pale flesh colored on both sides, base outside with thin purple veins, base within dark dirty purple, shallowly ridged-verrucate. Spadix shorter than spathe, sessile, 14–18 cm long; between male and female zones a short zone with impressed, punctiform scars.

Distribution—Thailand (western), Kanchanaburi Province (in dense, moist forest).

Notes—*Amorphophallus cicatricifer* is a highly ornamental species because of its beautifully colored leaf, with its reddish petiole and bluish upper surface of the leaflets. Its unique feature is the zone of scars between the male and female part of the spadix.

Cultivation—This easy-to-grow species can be potted in a fairly heavy, loamy soil. The tuber may be left out of the soil when resting. The species will readily multiply by yearly offsets.

Fig. 66. *A. cirrifer*: inflorescence.

Fig. 67. *A. cirrifer*: spadix (detail).

Amorphophallus cirrifer Stapf.

Tuber elongate, thick, 6–13 cm long. Leaf not known with certainty. Inflorescence solitary, short or moderately long peduncled, emitting a "somewhat offensive smell" or "smelling strongly of rotten eggs"; peduncle 3–14 cm long, 0.5–0.8 cm in diam., lengthening in fruit; spathe campanulate, base convolute, depressed-ovoid, separated by a constriction from the limb, apex acute or obtuse, margin irregularly undulate, limb horizontal or suberect, 6.0–15 cm long, 3–7 cm in diam., base within with many fleshy, conic or elongate, thick warts, these pointing downwards and sometimes partly confluent forming ridges, outside limb maroonish and spotted dark green, inside uniformly maroon, outside base slightly or distinctly glossy pale pink with brown veins, inside irregularly marbled with whitish and spotted with dark purple, veins reddish. Spadix sessile, longer than spathe, 14–45 cm long, at first horizontal and then curving upwards again, in most parts set with long, dark brown, flexible hairs.

Distribution—Central Thailand (in deciduous forest, open dry mixed forests, poor deciduous forest, and bamboo jungle, 50–400 m; once found in a *Platycerium* basket).

Notes—*Amorphophallus cirrifer* ranks among the most bizarre species of the genus. In flower it resembles a dead mouse, with its long, hairy tail prominently featured. The presence of hair-like staminodes is shared with *A. hirtus* (Taiwan), *A. henryi* (Taiwan), *A. pilosus* (Vietnam), *A. kiusianus* (Japan, China, Taiwan), *A. lanuginosus* (Vietnam) and *A. laoticus* (Laos), but in none of these species are hairs found on all parts of the spadix as in *A. cirrifer*. Until recently this species was never in cultivation, but due to a lucky find of the late Dr. James Symon it now is. From Symon's plants it seems that the leaf originally described for *A. cirrifer* is in error.

Cultivation—Grow in a loamy soil, in a deep pot. The tuber may be taken out of the soil during resting.

Fig. 68. *A. commutatus*: spathe and spadix (photo: B. v.d. Zwaan).

Fig. 69. *A. commutatus*: spadix (detail) (photo: B. v.d. Zwaan).

Amorphophallus commutatus (Schott) Engl.

Tuber depressed globose, to 16 cm in diam., to ca. 12 cm high, pale brown, producing short cylindric offsets. Leaf solitary; petiole to ca. 100 cm long, ca. 2 cm in diam., background color pale green, to the base pale brownish with numerous elongate, brown to dark brown spots, surface densely echinate, echinae minute; lamina to ca. 100 cm in diam., rachises of each main branch winged distal of the main subdichotmy; leaflets elliptic, elongate-elliptic or more or less oblong, 8–20 cm long, 4–7 cm in diam., acuminate. Inflorescence solitary, long-peduncled; peduncle as petiole, 25–ca. 120 cm long, 0.5–ca. 3 cm in diam.; spathe erect, narrowly elongate-triangular or triangular-ovate, 11–47 cm long, 5–25 cm in diam., acute, base and limb separated by a shallow constriction, stronger on the dorsal side, base tubular, outside glossy dark brown, inside dirty pale brown with numerous, slightly distant, tiny, yellowish warts, limb keeled, margins reflexed, outside dull maroonish, inside very deep maroon, slightly glossy. Spadix sessile or stipitate (stipe 0.3–1 cm long), usually longer than spathe, 13–ca. 55 cm cm long.

Distribution—Southwestern India (in evergreen and semi-evergreen forest, under the shade of trees, rarely in the open, forming small colonies, alt. 60 m).

Notes—*Amorphophallus commutatus* shows strong similarities to *A. ankarana* (see descr.) of Madagascar, which is an interesting fact, because in this way *A. commutatus* may bridge the gap between the African and Asian species, both in morphology and geographically. The petiole is eaten after preparation, mixed with acidic fruits.

Cultivation—Grow in an average fertile mix. The tuber must be left in the soil when dormant.

Fig. 70. *A. corrugatus*: inflorescence.

Fig. 71. *A. corrugatus*: spadix.

Amorphophallus corrugatus N.E.Br. (syn.: *Thomsonia sutepensis* S.Y.Hu).

Tuber globose, dark brown, up to 8 cm in diam., ca. 7 cm high, developing seasonal, slender, rhizomatous offsets. Leaf solitary; petiole slender, 10–95 cm long, up to 2 cm in diam. (base), longitudinally, shallowly ridged, ground color dirty white or pale green with a very faint, pale brownish hue overlain with numerous, tiny and fewer large, partly confluent, irregular, dark chocolate-brown or greyish spots; lamina 10–150 cm in diam.; leaflets oblong or lanceolate, acuminate, base long-decurrent in the most distal ones, others narrowly sessile, 10–28 cm long, 4–9 cm in diam., upper side green. Inflorescence long-peduncled; peduncle 30–70 cm long, 0.8–2.0 cm in diam. (base), colored as petiole; spathe ovate or elliptic-ovate, concave, acute or obtuse, base shortly convolute, 7–26 cm long, 4–16 cm in diam., outside pale greenish, greyish purple or white, sometimes to the base with whitish spots, or with grey-green or pale olive-brown spots, either only the margin purplish red or also large parts reddish brownish, inside pale greenish whitish with several irregular, purplish red spots and a purplish red margin, base inside often purplish red, or the utmost base whitish, surface smooth. Spadix much shorter than spathe, stipitate, 4–11 cm long; appendix globose or ovate, surface strongly brainlike folded.

Distribution—Northern Thailand and northern Burma (alt. 1000–1700 m, in primary evergreen forest in shaded places, on granite bedrock; found growing together with *A. yunnanensis*).

Notes—*Amorphophallus corrugatus* is morphologically very close to *A. kachinensis* (see descr.) and differs mainly in the irregular corrugate, brainlike appendix, whereas the appendix of *A. kachinensis* only has longitudinal furrows/fissures. *Amorphophallus cor-*

rugatus belongs to a group of species sharing the widely opened, concave spathe, a short spadix, and often blue berries. Other species of this group are *A. yunnanensis* (see descr.), *A. putii*, and *A. tonkinensis* (see descr.).

Cultivation—Grow in any fertile but well drained soil. The tuber may be taken out of the soil when resting. Multiply by taking off the rhizomatous offsets.

Amorphophallus costatus Hett.

Tuber subglobose, to ca. 10 cm in diam., brown, no offset development. Leaf solitary; petiole 60–90 cm long, 1.5–2 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 100–122 cm in diam.; leaflets oblanceolate, acuminate, base cuneate, 8–23 cm long, 2.5–5 cm in diam., upper side moderately glossy dark green, margin irregularly undulate. Inflorescence solitary, short peduncled; peduncle 14–16.5 cm long, ca. 1 cm in diam. (base), lilac-pink with several blackish green, ± 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

Fig. 72. *A. costatus*: inflorescence (photo: J. Murata).

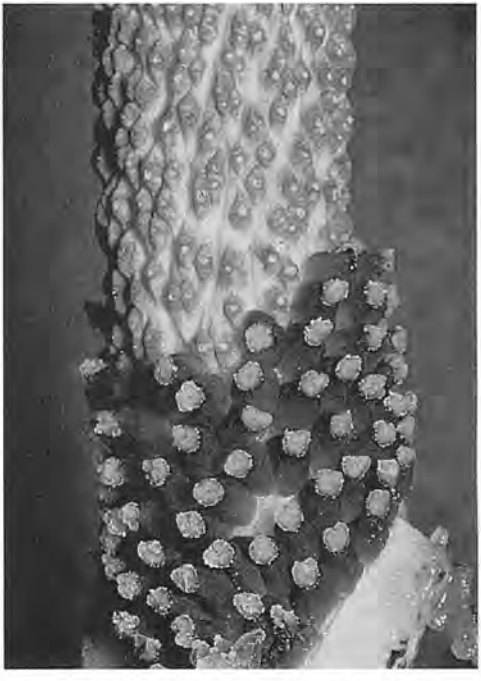

Fig. 73. *A. costatus*: spadix (detail) (photo: J. Murata).

white spots, base within with several shallow warts, these shortly ridge-like. Spadix longer than spathe, sessile, 19.5–26.5 cm long.

Distribution—Indonesia, South Kalimantan.

Notes—*Amorphophallus costatus* resembles *A. pendulus* (Sarawak; see descr.) in the general shape of the inflorescence but the latter species has a much longer, whiplike, decumbent appendix and a longer peduncle. A remarkable feature of the male flowers is the very unstable number of thecae per anther (one or two) and the equally unstable number of locules per theca, also either one or two, features that are very rare in the genus, especially in combination.

Cultivation—Grow in a loose, fertile soil. The tuber must be left in place when dormant.

Amorphophallus coudercii (Bogner) Bogner.

Tuber elongate, few-branched, 11 cm long, dirty whitish. Petiole 20–34 cm long, ground color pale creamy-brown, extensively spotted with black or blackish green, to the base with numerous blackish dots. Lamina ca. 40 cm in diam., highly dissected; leaflets small, elliptic, acuminate, dark green, 3.5–10 × 2–3, veins impressed. Inflorescence long-peduncled; peduncle 93 cm long, 1.8 cm in diam. (base). Spathe broadly ovate, erect, acute, 15.5 cm long, 15.5 cm broad, outside pale green, inside whitish green, base within with numerous, small, very shallow warts, appearing smooth. Spadix substipitate ('stipe' ca. 2–5 mm), shorter than spathe, 10.5 cm long; sterile appendix lacking.

Fig. 74. *A. coudercii*: spathe and spadix.

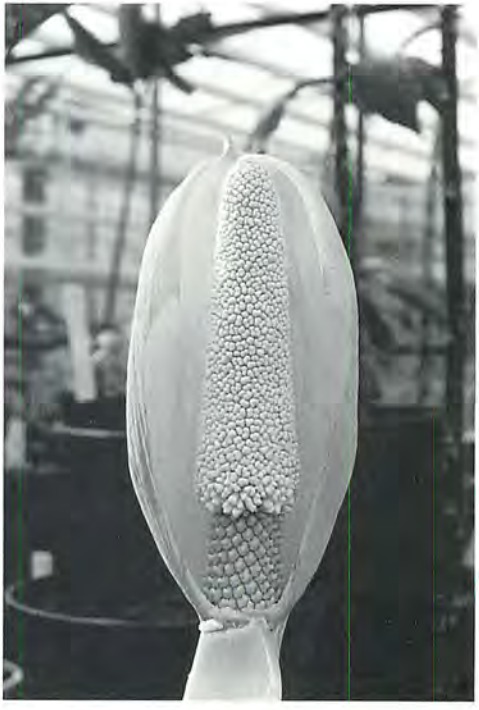

Fig. 75. *A. coudercii*: spathe cut open.

Distribution—Laos and central Vietnam.

Notes—*Amorphophallus coudercii* is a very close relative of *A. longituberosus,* with which it shares the tuber-shape, leaf-shape, scent (of anise), shape of the male flowers (a.o. the lateral pores) and the high number of locules. In view of this, it is highly likely that the apparent absence of an appendix is not due to its suppression but merely that it is entirely fertile. Better stated, an appendix is not differentiated from the male zone. This is in marked contrast with the situation in *A. margaritifer* (see paper by Hetterscheid & de Sarker, this volume) in which the appendix seems to be really suppressed.

Cultivation—*Amorphophallus coudercii* grows in rather heavy soils with loam. The pot must be deep for the extension of the tuber. The tuber may be stored dry during dormancy.

Amorphophallus curvistylis Hett.

Tuber subglobose, or slightly depressed, to 12 cm in diam. and 9 cm high, dark brown, smooth, developing offsets, these rhizomatous, 7–30 cm long. Leaf solitary; petiole very turgid, smooth, 50–120 cm long, ca. 3 cm in diam. at the base, entirely green or spotted white-tan and brown; lamina, to 130 cm in diam.; leaflets elliptic, acuminate, upper side mid-green, 22–30 cm long, 7.5–8.5 cm in diam., venation strongly impressed on the upper side. Inflorescence solitary: peduncle 20–40 cm long, ca. 1.5 cm in diam., color as petiole;

Fig. 76. *A. curvistylis*: inflorescence (photo: B. v.d. Zwaan).

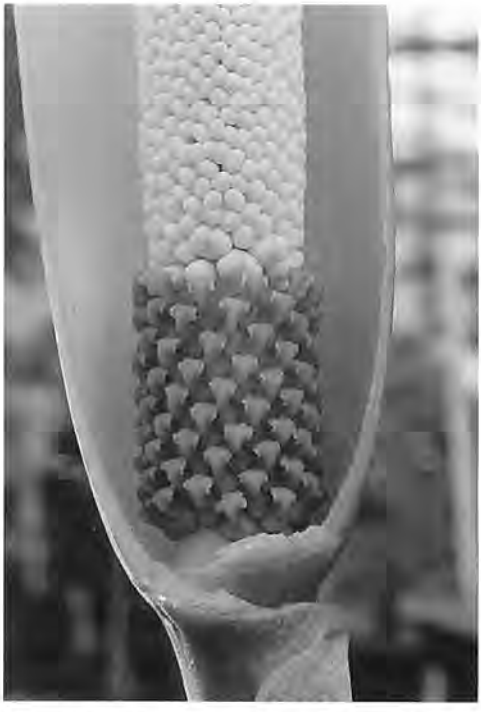

Fig. 77. *A. curvistylis*: spadix (detail) (photo: B. v.d. Zwaan).

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, emitting a strong, upsetting, gaseous stench; styles remarkably strongly curved, stigmas strongly bilabiate.

Distribution—Thailand (western), Kanchanaburi Prov.

Notes—*Amorphophallus curvistylis* resembles *A. napalensis* (see descr.) in several characters but differs a.o. in the smaller and smooth appendix and the shorter peduncle. It also resembles *A. krausei* (see descr.) but lacks the staminodial zone between male and female parts of the spadix, has a different stigma (lobed, not bilabiate) and a shorter peduncle. *Amorphophallus curvistylis* has a very ornamental inflorescence because of the striking contrast between the bright green spathe interior and the radiating white spadix.

Cultivation—This is a very strong species, that will tolerate quite heavy soils with loam. It multiplies readily with long offsets. A warning about the odor is in order! It is quite unmatched.

Fig. 78. *A. declinatus*: inflorescence (photo: O. Riegler).

Amorphophallus declinatus Hett.

Tuber unknown. Leaf (only known from young specimen) solitary; leaflets elliptic-lanceolate, acuminate, to ca. 8 cm long and ca. 3 cm in diam. Inflorescence solitary, long-peduncled; peduncle 69–113 cm long, ca. 1.5–2 cm in diam., smooth; spathe elongate-triangular, ca. 17–30 cm long, ca. 9–20 cm in diam., base strongly convolute, separated from the limb by a shallow constriction, limb acute, arching forward during anthesis, inside base with numerous, slightly ridge-like, fleshy warts. Spadix exceeding the spathe, sessile, ca. 25–50 cm long.

Distribution—Philippines, Palawan island.

Notes—A beautiful species for its bright pale spots on the inside of the otherwise maroon spathe. In general morphology, *A. declinatus* resembles *A. konjac* K. Koch but differs in the much shorter style, the narrow appendix and the forward-bent spathe limb.

Cultivation—This species is not known in cultivation.

Amorphophallus decus-silvae Backer & Alderw.

Tuber to ca. 40 cm in diam., weighing 20 kg. or more. Leaf solitary; petiole 200–350 cm long, 13–20 cm in diam., greyish to greyish green with numerous, more or less confluent, small, dark brown spots, diminishing upwards and becoming scattered, and larger, elon-

Fig. 79. *A. decus-silvae*: inflorescence (photo: B. v.d. Zwaan).

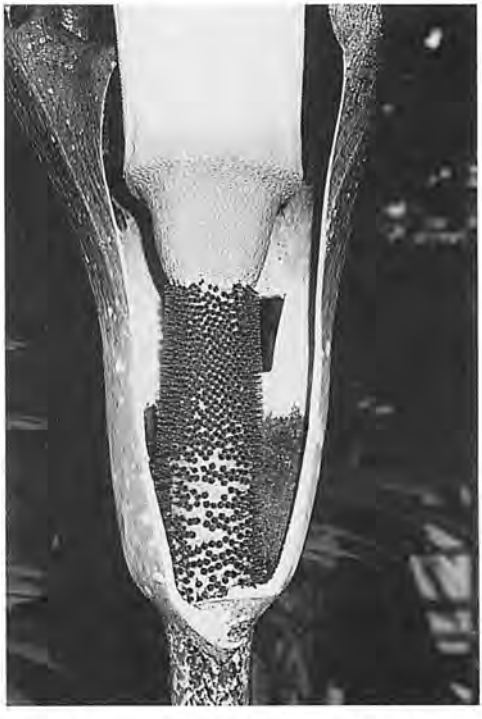

Fig. 80. *A. decus-silvae*: spadix (detail) (photo: A. Vogel).

gate, whitish spots, mostly greenish brown centered or spotted, surface smooth but to the base rugose; lamina 300–400 cm in diam.; leaflets elliptic or lanceolate, acuminate or long-acuminate, 20–32 cm long, 6–10 cm in diam., upper side green. Inflorescence long-peduncled; peduncle 105–200 (or more?) cm long; spathe campanulate, erect, broadly ovate, (50–)70–75 cm long, 45–50 cm in diam., outside olive-green or greyish purple with larger and smaller, pale green or dark spots, inside base purple, in the middle pale green, the rest purple, base within with numerous small, more or less ridge-like, often confluent warts. Spadix (50–)105–120 cm long, sessile, (subequalling or) exceeding the spathe.

Distribution—Indonesia, Java (western).

Notes—This is one of the truly giant species. Its present day geographical distribution is alarmingly restricted and with the vast devastations of forest in western Java, its days may be counted. It is the nearest relative of the Sumatran *A. gigas* (see descr.) but has a number of subtle differences in detailed characters of the inflorescence. In the literature, the Sumatran species is often wrongly called *A. decus-silvae* because of this great similarity.

Cultivation—Grow in a very fertile but well drained soil. The tuber is best left in place during dormancy.

Amorphophallus dracontioides (Engl.) N.E. Br.

Tuber disciform, to 25 cm in diam. and 15 cm high, producing annual offsets, these globose. Leaf solitary; petiole to 100 cm long, base white and purple-spotted, upwards grading to uniformly purple, or entire petiole green; lamina to ca. 110 cm in diam.; leaflets linear to lanceolate, to 30 cm long and 3 cm in diam., slightly succulent. Inflorescence

Fig. 81. *A. dracontioides*: inflorescence (photo: J. v.d. Maesen).

Fig. 82. *A. dracontioides*: spathe cut open (photo: J. v.d. Maesen).

developing before the leaf, short-peduncled; peduncle to 30 cm long; spathe cowl-shaped, entirely hiding the spadix from sight, opening only on the ventral side, to ca. 45 cm long, constriction lacking, outside greenish white or creamish, with greenish irregular spots, towards the margin purple-flushed, inside base, smooth, dark purple with thin white stripes, these diminishing upwards. Spadix shorter than spathe, to 17 cm long; appendix hugely swollen, oval or nearly spherical.

Distribution—Benin, Ivory Coast, Ghana, Niger, Nigeria, Togo, Central African Republic.

Notes—A most remarkable species because of its cowl-shaped, dark purple coriaceous spathe. This character is unique in African species but a few Asian species have similar spathes (e.g. *A. opertus, A. scaber*) but they are never as broad and less arching. The leaf is quite elegant with its narrow leaflets.

Cultivation—Easily grown in a fertile soil. This species has not yet flowered in cultivation. The tuber can be stored dry.

Amorphophallus eburneus Bogner.

Tuber depressed-globose, to 25 cm in diam., to ca. 16 cm high, weighing to ca. 5 kg, pale greyish brown, skin corky, consisting of numerous angulate fields, separated by narrow grooves, no offset development. Leaf solitary; petiole very turgid, to ca. 120 cm long and ca. 7 cm in diam., smooth, uniformly pale green or occasionally with a few

Fig. 83. *A. eburneus*: inflorescence (photo: A. Vogel).

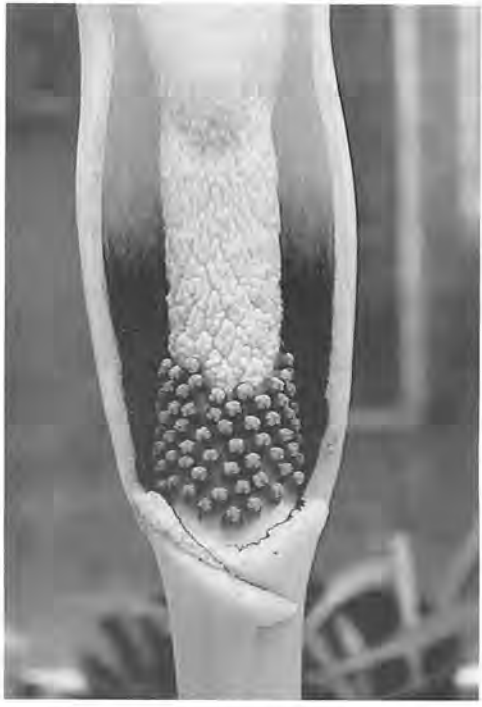

Fig. 84. *A. eburneus*: spadix (detail) (photo: B. v.d. Zwaan).

scattered whitish greenish spots; lamina to ca. 230 cm in diam.; leaflets elliptic or elliptic-lanceolate, 12–48 cm long, 5.5–18.5 cm in diam., mid or pale green, coriaceous, long acuminate. Inflorescence short-peduncled, largely hidden in cataphylls; peduncle 15–20 cm long, ca. 2.5 cm in diam., pale green, entirely hidden by cataphylls; spathe erect, infundibuliform, ovate, base strongly convolute and hidden by cataphylls, separated from limb by a shallow constriction, limb slightly spreading, acute, margins revolute, 20–23 cm long, 19–21 cm in diam., outside creamy white, the upper margins sometimes flushed with purple, inside base dark purple and then creamish, limb creamish with or without a pale purple flush, base within with numerous irregular, shallow warts and some shallow grooves. Spadix slightly longer than spathe, shortly stipitate, 21–26 cm long, producing a strong fishy smell; male flowers aligned in vertical rows.

Distribution—East Malaysia, Sarawak (on limestone).

Notes—*Amorphophallus eburneus* is remarkable for the enormous dimensions of the leaf compared to the rather small inflorescence. Another remarkable feature is the existence of a form of this species with a much shorter leaf and an extremely highly dissected, very broad lamina and a much more irregular tuber. The difference between these leaf forms is so conspicuous that a taxonomic separation seems to be in order (see *A. brachyphyllus*). Equally remarkable is the all whitish color of the spathe, a feature quite rare in *Amorphophallus* and shared only with *A. prainii* (see descr.).

Cultivation—Grow in a fertile, well drained soil. The tuber will dry out when left out of the soil!

Amorphophallus eichleri (Engl.) Hook. f.

Tuber depressed-globose, to 15 cm in diam., annually producing long, thin rhizomatous offsets. Leaf solitary or paired; petiole to 60 cm long, uniformly green or brown, or the

Fig. 85. *A. eichleri*: inflorescence.

Fig. 86. *A. eichleri*: spadix (detail).

base brown and the upper part green; lamina to 40 cm in diam.; leaflets broadly obovate, to 13 cm long, acuminate. Inflorescence developing just prior to the leaf, short-peduncled; peduncle to 5 cm long; spathe much broader than long, to ca. 15 × 30 cm, urceolate, limb and base separated by a clear constriction, the limb reduced to a narrow, sinuous collar, base outside bright pale brown to greenish with purple veins, inside largely dark purple and covered with rows of thick warts and folds, upwards grading to dirty pale purple or greenish, limb outside and inside variable, green, dark green, or dark purple. Spadix longer than spathe, to 20 cm long; appendix elongate-conic to laterally compressed and triangular, smelling of rotting meat, later often changing into a shrimp-like scent.

Distribution—Zaire, ?Angola.

Notes—This small and elegant species mostly resembles small forms of *A. zenkeri* from which it differs primarily by the possession of warts in the spathe base (vs. hairs in *A. zenkeri*). It also resembles *A. barthlottii* but the latter has hairs in the spathe base and a narrower spathe base and more prominent limb.

Cultivation—Easily cultivated in a well-drained, organic rich soil. It produces offsets freely. Pollination in cultivation has succeeded several times. The tuber may be stored dry during dormancy, but the offsets must remain covered or they will desiccate.

Amorphophallus elatus Hook. f.

Tuber elongate, unbranched, to ca. 25 cm long, ca. 4 cm in diam., dirty whitish, producing no offsets. Leaf solitary; petiole slender, to 50 cm long, ca. 1.5 cm in diam., smooth, uniformly pale green or dark yellowish brown or pinkish brown, with blackish green spots, to the base entirely confluent, and less numerous, elongate, larger, dirty creamy white spots; lamina to 80 cm in diam.; leaflets elongate-elliptic to lanceolate, 8–31 cm long, 3.5–7.5 cm in diam., acuminate or apiculate, upper side moderately glossy, dark green with a very thin, reddish margin. Inflorescence long-peduncled; peduncle as petiole, 16–75 cm long, 0.5–1.0 cm in diam.; spathe ovate-triangular, tubular, acute, base and limb poorly differentiated, 5–20 cm long, 4–15 cm in diam., outside pale green with or without a pinkish hue, or the central part dirty brownish green, to the margin dark brown, small, rounded, white spots scattered all over, inside as outside but spots slightly larger, base within pale green or violet, with scattered, very shallow, rounded, broad-based warts, these green or violet. Spadix longer than spathe, sessile, 14–37 cm long, emitting a strong scent of old cheese.

Distribution—Peninsular Thailand and northern Malaysia (in dry, evergreen forest or mixed deciduous forest; on granite or on limestone; on slopes, 75–100 m alt.).

Notes—*Amorphophallus elatus* may be looked upon as a small version of *A. macrorhizus* (see descr.) from northern Thailand. It differs from the latter a.o. by its smaller dimensions, lacking hairs on the appendix, the strongly 2-lobed stigma, and lacking hairs on the petiole and peduncle. Remarkable is the existence of totally green petioles and very heavily colored ones. This phenomenon is paralleled in the Javan *A. variabilis* (see descr.). The British botanist Ridley confused *A. elatus* with *A. variabilis,* presuming that the elongate tuber was a consequence of it being cramped between rocks in the ground as opposed to the normally depressed-globose form of *A. variabilis* when freely growing. This explains the recurrent misclaims in the literature that *A. variabilis* is a member of the Malaysian flora.

Fig. 87. *A. elatus*: inflorescence.

Fig. 88. *A. elatus*: spadix (detail).

Cultivation—Easily grown in an average potting mix. The tuber may be stored dry when dormant. Use a deep pot to provide room for the long tuber.

Amorphophallus elegans Ridl.

Tuber globose or subglobose, brown, to ca. 10 cm in diam., ca. 7 cm high, no offset development. Leaf solitary; petiole largely smooth but slightly rugulose at the base, (30–) 60–90 cm long, ca. 2 cm in diam. at the base, very turgid, background color dull mid green with many shades of dark green, the base with additional irregular and partly confluent grey spots and small, raised, whitish greyish punctiform dots, the upper part with large and small white spots; lamina to ca. 100 cm wide; leaflets elongate-elliptic or elliptic, long acuminate, the basal ones petiolulate, 8–22 cm long, 3–6 cm in diam., upper surface dull green or moderately glossy, main veins impressed, lower surface pale green, petiolules 0.5–1.0 cm long. Inflorescence solitary, long-peduncled; peduncle ca. 50–90 cm long, ca. 1.5 cm in diam. at the base, mottled grey, green and pink and with scattered pale green spots; spathe erect, elongate-triangular, acute, base and limb separated by only a very shallow constriction, ca. 8–20 cm long, ca. 5–12 cm in diam., outside base pale green or greyish green with small dark green or blackish green and whitish spots and pinkish flushes, inside base off-white, with very few, scattered minute warts, sometimes additionally shallowly furrowed, limb outside and inside as base but near the margin flushed with dirty green. Spadix longer than spathe, sessile, ca. 12–27 cm long.

Distribution—Peninsular Thailand and West Malaysia, in evergreen forests on limestone mountains or at lower altitudes, alt. ca. 100–300 m (probably also higher).

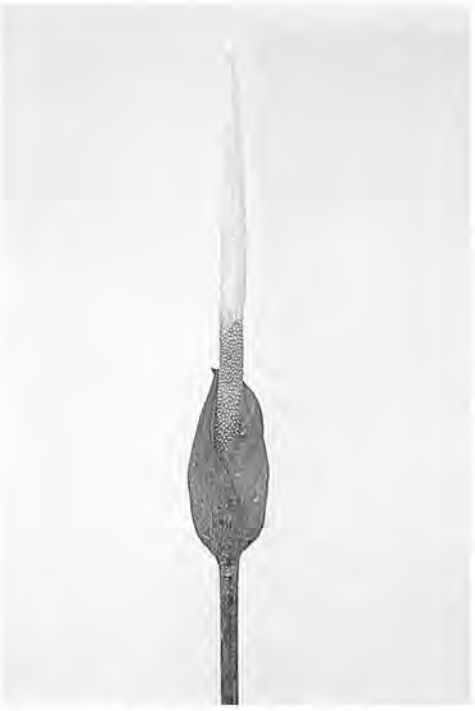

Fig. 89. *A. elegans*: spathe and spadix.

Fig. 90. *A. elegans*: spadix (detail).

Notes—*Amorphophallus elegans* resembles *A. variabilis* of Java but differs from the latter in having the spathe limb not suddenly narrowed, the spathe base inside not verrucate but smooth or furrowed, a non-lobate stigma and leaves with unwinged rachises and some of the leaflets petiolulate. The complex patterning of the petiole makes this a highly ornamental species.

Cultivation—Grow in a fertile, well-drained soil. The tuber must not be stored dry when dormant.

Amorphophallus erubescens Hett.

Tuber depressed-globose, 7–18 cm in diam., 2.5–8.0 cm high, outside blackish, inside pale orange. Leaf solitary; petiole smooth, 30–120 cm long, 0.5–2.0 cm in diam. (base), pale green to bluish green with elongate, paler spots or brownish black with pale brown spots; lamina moderately dissected, 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, upper part sometimes greenish, inside pink with reddish pink veins, margin paler, base within with numerous

Fig. 91. *A. erubescens*: inflorescence (photo: T. Yamazaki).

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.

Distribution—Thailand (western), Kanchanaburi Prov. (in mixed deciduous forest, on leaf mold with moderate humidity or on sandy soil, 150–500 m.).

Notes—*Amorphophallus erubescens* resembles *A. muelleri* (see descr.) in general morphology but the appendix is shorter or only slightly longer than spathe (in *A. muelleri* usually much longer, rarely slightly longer), leaflets narrower, the spathe always longer than broad and nearly uniformly dark pink. These differences may upon examination of more material turn out to be insufficient to separate both species. The peduncles are edible after roasting and crushing out the juice.

Cultivation—Grow in a heavy loam-rich soil. The tuber may be stored dry when resting.

Fig. 92. *A. excentricus*: inflorescence.

Fig. 93. *A. excentricus*: spadix (detail).

Amorphophallus excentricus Hett.

Tuber subglobose, yellowish brown, to 10 cm in diam., ca. 7 cm high, seasonally developing offsets, these globose, ca. 1–1.5 cm in diam., attached to the main tuber by a short rhizomatous part. Leaf solitary; petiole to ca. 130 cm long, ca. 2.5 cm in diam. (base), smooth, ground color 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 upper margin and a diffuse lower margin, in between several scattered, tiny white dots; lamina to ca. 160 cm in diam.; leaflets elliptic-lanceolate, acuminate, 12–24 cm long, 4–7 cm in diam., upper side dull green, lower side 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 apex suffused with pale pink, base within with numerous, small, rounded or longitudinally elongate warts. Spadix sessile, slightly longer or shorter than spathe, 18–24 cm long.

Distribution—Peninsular Thailand.

Notes—*Amorphophallus excentricus* is morphologically very similar to *A. carneus* (see descr.). This is a rather "generalized" Thai species that does not have particularly eye-catching features.

Cultivation—Grow in any fertile soil. The tuber may be stored dry during resting.

Fig. 94. *A. galbra*: spathe and spadix.

Fig. 95. *A. galbra*: spathe cut open.

Amorphophallus galbra F.M. Bailey (syn.: *A. angustilobus* F.M. Bailey).

Tuber depressed-globose, to ca. 30 cm in diam., ca. 10 cm high. Leaf solitary; petiole ca. 30–100 cm long, smooth or slightly rugulose, uniformly pale green or an olive-green background color with irregular, medium green, white, brown and black spots; lamina to ca. 150 cm in diam.; leaflets lanceolate or elliptic-lanceolate, 11–20 cm long, 3.5–5.0 cm in diam., long-acuminate. Inflorescence solitary, long-peduncled; peduncle as petiole, 12–ca. 100 cm long, 0.5–2 cm in diam.; spathe lanceolate, erect, 6–36 cm long, 2.5–ca. 10 cm in diam., opening very narrow, margins of the limb often strongly sinuous, outside plain green, off-white or pale brownish, or variously spotted with black, dark green, pale green and white, inside off-white, base within yellow, sometimes with a dirty brownish flush, verruculose. Spadix sessile, shorter than spathe, ca. 5–27 cm long.

Distribution—Northern Australia and Papua New Guinea (in rain forests and monsoon forests in undergrowth, woodland, scrub and fully open sites).

Notes—The description is partly based on Hay (1988). *Aroideana* 11(1): 14. *A. galbra* is morphologically similar to the Javan *A. sagittarius* (see descr.) and differs primarily by a slightly different spathe shape and a different pollen type. Hay (*op. cit.*) mentions several specimens from Irian Jaya, but they are all sterile and therefore not necessarily belonging to this species. The most remarkable feature of this species is undoubtedly its rather fruity scent.

Cultivation—Grow in a loose, well drained fertile soil. The tuber is best left in the soil when dormant.

Fig. 96. *A. gallaensis*: inflorescence (photo: Royal Bot. Gard. Kew).

Amorphophallus gallaensis (Engl.) N.E. Br. [syn. *A. gallaensis* var. *major* Chiovenda, *A. laxiflorus* N.E. Br., *A. sparsiflorus* (Engl.) Engl. & Gehrm. *non* Hook. f., *nom. illeg.*].

Tuber disciform, to 15 cm in diam., reddish brown to greyish white. Leaf solitary; petiole ca. 80 cm long, reddish green with green and white spots; lamina to 100 cm in diam.; leaflets elliptic-obovate, to 12 cm long. Inflorescence appearing before the leaf, long-peduncled; peduncle to 50 cm long; spathe to 40 cm long, base and limb separated by a shallow constriction, base outside greenish, purplish brown, or olive-green with white spots, inside brownish purple, upwards changing to greenish, surface with shallow, branching ridges, limb often helically twisted, margins strongly undulate, outside as base, inside brownish purple. Spadix much longer than spathe, to 70 cm long.

Distribution—Ethiopia, Somalia, Kenya.

Notes—The combination of the ridged spathe base and long styles identify this species from all other African ones. Its strongly twisted spathe with highly undulate margins give it a rather peculiar appearance, which is only matched by large specimens of *A. ankarana*.

Cultivation—Not known in cultivation.

Fig. 97. *A. gigas*: inflorescence (photo: J. R. Symon).

Fig. 98. *A. gigas*: leaf with Jim Symon.

Amorphophallus gigas Teijsm. & Binn. (syn.: *A. brooksii* Alderw.).

Tuber depressed-globose, reported to weigh to 70 kg, no annual offsets. Leaf solitary; petiole ca. 3–4 m long, ca. 11–20 cm in diam., smooth or rugose near the base, dark green with numerous large and small, rounded or elongate-oval, pale green spots; lamina to 4 m in diam.; leaflets lanceolate, long acuminate, 13–25 cm long, 5–9 cm in diam. Inflorescence long-peduncled, reported to reach to 4.36 m high; peduncle ca. 2–3.5 m long, patterned as petiole; spathe campanulate, erect, broadly ovate, ca. 55–60 cm long, outside dark green changing to pale green, the margin dark red-brown, the base dark olive-green with some obscure ringlike, paler spots, inside pale green with reddish brown spots and reddish veins, margin plicate-sinuous, veins in all parts strongly raised. Spadix longer than spathe, sessile, ca. 150 cm long, emitting a foul stench of decaying meat upon flowering.

Distribution—Indonesia, Sumatera.

Notes—*Amorphophallus gigas* ranks as the second bulkiest species in the genus, and certainly the tallest one in flower! It is in most respects very similar to the Javan *A. decus-silvae* (see descr.). Excellent historical photos are seen in *Aroideana* 4(2): 43, 44, albeit under its synonym *A. brooksii*.

Cultivation—Grow in a loose, well-drained but fertile soil. The tuber must not be exposed when dormant. Many growers in the USA did receive seeds of this species from an expedition by the first author together with the late Dr. James Symon. Although many seem to have germinated, an equal number of plants seem to have perished in many places in their second or third year. This may have been caused by using too heavy a soil.

Fig. 99. *A. glossophyllus*: spathe and spadix.

Fig. 100. *A. glossophyllus*: spadix (detail).

Amorphophallus glossophyllus Hett.

Tuber irregularly elongate, ca. 13 cm long, ca. 7 cm in diam. at the top, whitish with a pale brownish flush, basal part much branched, the branches gradually developing into new tubers. Leaf solitary; petiole ca. 45 cm long, ca. 1.5 cm in diam., smooth, uniformly glossy pale green; lamina much branched, ca. 70 cm in diam.; 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 mid-green. Inflorescence solitary, long-peduncled; peduncle as petiole, 40–60 cm long, 0.8–1.7 cm in diam.; spathe circular, oval or transversely oval, 6.5–11 cm long, 6.5–13 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, 13–21 cm long.

Distribution—Central and northern Vietnam.

Notes—*Amorphophallus glossophyllus* resembles *A. brevispathus* (Thailand) but differs in the glossy and much paler green leaflets, a thicker, obtuse appendix and longer stamens. Both species share the unique character of fused pores. *Amorphophallus glossophyllus* is remarkable for the highly glossy leaf that has a highly ornamental effect.

Cultivation—Of easy cultivation in a fertile soil, that may contain loam. The tuber can be stored dry during resting.

Fig. 101. *A. goetzei*: inflorescence (photo: K. Vollesen).

Fig. 102. *A. goetzei*: spathe cut open (photo: K. Vollesen).

Amorphophallus goetzei (Engl.) N.E. Br. (syn.: *A. anguineus* Peter).

Tuber disciform, to 13 cm in diam (but probably much larger), offsetting behavior insufficiently known. Leaf solitary; petiole to 60 cm long, color unknown; lamina ca. 100 cm in diam.; leaflets elliptic-oval, acuminate, to 15 cm long. Inflorescence appearing just prior to the leaf, short-peduncled; peduncle to 20 cm long; spathe urceolate, to ca. 40 cm long, base and limb separated by a strong constriction, base outside whitish green, densely covered with dark green, irregular spots, inside dark purple, covered with short warts and papillae, the latter in the base often merged to form irregular ridges, limb outside dark green to bright purple, inside bright purple. Spadix longer than spathe, to 80 cm long.

Distribution—Tanzania, Mozambique.

Notes—*Amorphophallus goetzei* was treated by Mayo (1985: 31) but he included material that is now recognized as a separate species (*A. impressus* Ittenb. ined., see descr.). Mayo's figure 8, actually also represents *A. impressus*. *Amorphophallus goetzei* differs from *A. impressus* in having a less depressed spathe base and the male part extends well beyond the constriction of the spathe. Smaller specimens resemble *A. eichleri*, but the latter lacks the papillae in the spathe base.

Cultivation—Not known in cultivation.

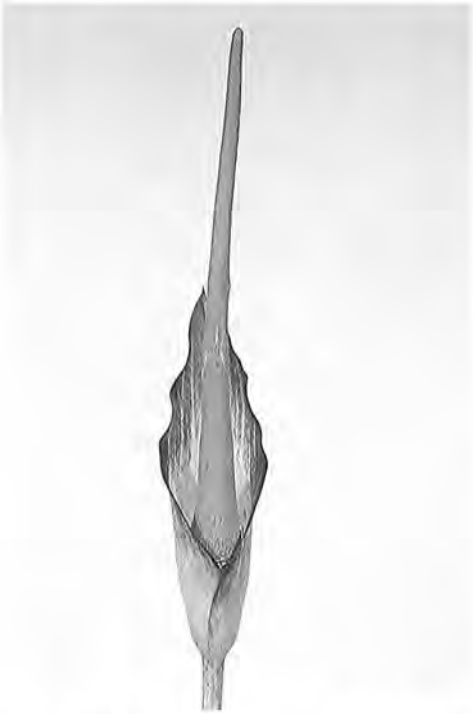

Fig. 103. *A. gomboczianus*: spathe and spadix.

Fig. 104. *A. gomboczianus*: spadix (detail).

Amorphophallus gomboczianus Pic. Serm. [syn.: *A. abyssinicus* Gombocz, non (Rich.) N.E. Br., *nom. illeg.*].

Tuber disciform, to 25 cm in diam., no offset development. Leaf solitary; petiole to 100 cm long, pale brown with numerous creamy spots and fewer blackish green dots, or blackish purple with dark green spots; lamina to 100 cm in diam.; leaflets oval or obovate, to 12 cm long, acuminate. Inflorescence developing before the leaf, long-peduncled; peduncle to 100 cm long, as petiole; spathe to 35 cm long, erect, no constriction between base and limb, outside marbled bright green and dark green or olive-green, or creamy with blackish green dots, upwards shading to green, margin flushed with purple, inside basal half whitish with dark purple striations or dark purple marbling, upwards entirely creamy or greenish with a dark purple margin, base within smooth. Spadix longer than spathe, to ca. 40 cm long; appendix elongate conic, base swollen and echinate.

Distribution—Ethiopia.

Notes—*Amorphophallus gomboczianus* resembles *A. betterscheidii* but lacks the hairs in the spathe base and has an echinate appendix base. It differs from the related *A. gallaensis*. The latter is shallowly ridged inside the spathe base and has unilocular ovaries (vs. 2-3-locular in *A. gomboczianus*).

Cultivation—Not easy to grow. Although the first author flowered his plant three times, it tends to get smaller and smaller. It is grown in a well drained, loamless soil. The tuber remains in the soil during dormancy but must be kept quite dry.

Fig. 105a. *A. haematospadix*: Inflorescence.

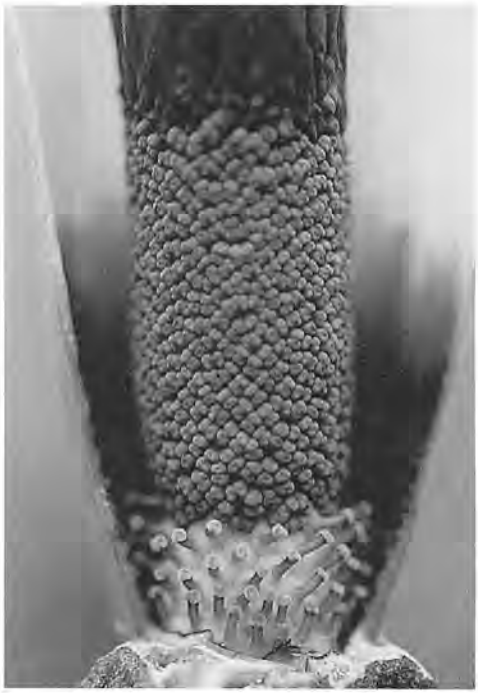

Fig. 105b. *A. haematospadix*: spathe cut open.

Amorphophallus haematospadix Hook. f. (syn.: *A. siamensis* Gagnep.).

Tuber depressed-globose or subglobose, up to ca. 12 cm in diam., up to ca. 9 cm high, pale brown, producing few annual offsets, these globose, fusiform or obovate, up to ca. 5 cm long and ca. 2 cm in diam. Leaf solitary; petiole uniformly green or olive-green, smooth, 50–85 cm long, 1–3 cm in diam. (base); lamina 60–80 cm in diam.; leaflets lanceolate, 7–25 cm long, 2–6 cm in diam., acuminate, leathery, upper surface dark green, moderately glossy, venation very dense, secondary veins very closely spaced. Inflorescence long-peduncled; peduncle as petiole, 17–40 cm long, ca. 0.8 cm in diam.; spathe elongate-triangular, apiculate, 8–21 cm long, 4–7 cm in diam., margins of limb strongly reflexed, limb on both sides creamy white, base outside creamy white, to the base suffused with pale purplish green, inside dark purple, base within with thickened, transverse veins, in between with or without small, punctiform warts. Spadix sessile, longer than spathe, occasionally shorter, 9–19 cm long.

Distribution—Northern parts of West Malaysia, southern Thailand and possibly Sumatra (on limestone).

Notes—*Amorphophallus haematospadix* cannot easily be mistaken for any other species. The presence of the red, clavate appendix and the transverse ridges on the inside of the base are unique in the genus. The leaf is very elegant because of the long, narrow leaflets with their dense, reticulate venation and leathery structure.

Cultivation—This species poses no problems in cultivation and grows well in a heavy soil. Although strong, it isn't a fast grower, and it may take many years before flowering size is reached. In the meantime it will multiply readily.

Fig. 106. *A. hayi*: inflorescences.

Fig. 107. *A. hayi*: spadix (detail).

Amorphophallus hayi Hett.

Rhizome horizontal, branching infrequently, to ca. 25 cm long and 5 cm in diam., brown and green, internodes 1–1.3 cm long, leafscars transversely oval, offset tubers long lasting, depressed, broadly attached, roots mainly developed from the ventral side. Leaf solitary or paired or simultaneous with inflorescence, the latter emerging from the petiole sheath; petiole ca. 40–60 cm long, ca. 1–1.5 cm in diam., turgid, smooth, moderately glossy, background color 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; leaflets lanceolate, 8–32 cm long, 2.5–7 cm in diam., acuminate, margin crispate-undulate, upper side moderately glossy green, venation quite strongly impressed, lower side paler green. Inflorescence solitary or with leaf, long-peduncled.; peduncle ca. 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, margin involute, upper third part horizontally spreading, lower part loosely convolute, base and limb not differentiated, 16–20 cm long, 12–15 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, 20–28 cm long.

Distribution—North Vietnam, China (Yunnan).

Notes—The stout rhizome of *A. hayi* and the styleless, ovate ovaries with their very thin stigmas render this species unique in the genus. The only other known truly rhizomatous species hitherto known is *A. rhizomatosus* Hett. From this, *A. hayi* differs a.o. in the much stouter rhizome and a different leaf type.

Cultivation—Grow in a well-drained soil and don't put the rhizome too deep (ca. 3 cm below the top of the soil). The plant has a tendency to surface and start growing on top of the soil and then climbs out of the pot. Whether this species has a true resting period is not yet clear.

Amorphophallus henryi N.E.Br. (syn.: *A. niimurai* Yamamoto).

Tuber depressed-globose, 3–11 cm in diam., 2–6 cm high, dark brown, seasonally producing several globose offset-tubers, these ca. 0.5–1.0 cm in diam. Leaf solitary; petiole smooth, 30–60 cm long, near the base ca. 1.0–2.0 cm in diam., mid- or dark green with several, more or less oval or irregular, whitish spots, with or without numerous small, white dots in between, surface dull or moderately glossy; lamina moderately or highly dissected, 30–100 cm in diam.; leaflets elliptic-ovate, elliptic or lanceolate, 4–26 cm long, 1.5–5.5 cm in diam., acuminate or long acuminate, upper side mid- or dark green, dull or glossy, margin at first reddish pink, later usually turning green or whitish, major veins strongly impressed, lower side pale green. Inflorescence solitary, short-peduncled; peduncle as petiole, 4–20 cm long, 0.8–1.5 cm in diam., lengthening in fruit; spathe cam-

Fig. 108. *A. henryi*: inflorescence.

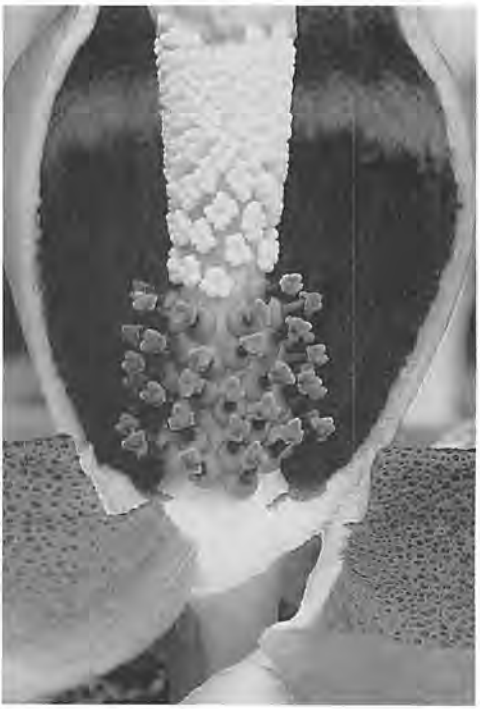

Fig. 109. *A. henryi*: spadix (detail) (photo: B. v.d. Zwaan).

panulate, constricted between base and limb, broadly triangular-ovate, 9–23 cm long, 8–22 cm in diam., acute or obtuse, base strongly convolute, thick-walled, outside glossy pale green, with or without a purplish flush, with or without a few small, paler spots, inside dark maroon, near the constriction dirty whitish or greenish purple, limb horizontal, irregularly wavy, outside pale green, with a variable, pinkish purplish hue, maroon near the margin, inside dark maroon, dull or glossy, near the margin greenish or pale purplish, venation strongly impressed, base within densely covered with large, irregular verrucae. Spadix sessile, longer than spathe, 20–46 cm long, male and female zone contiguous or separated by a short (ca. 0.5 cm), (partly) sterile zone.

Distribution—Taiwan (in rocky places, 120–250 m alt.).

Notes—Compared to its closest relative, *A. kiusianus*, *A. henryi* has much longer and more slender styles, a larger stigma, a longer spadix relative to the spathe, a much broader and more strongly constricted spathe, and a much shorter peduncle. The entire inflorescence of *A. kiusianus* is much more robust than in *A. henryi*. Both species share the presence of hairs on the appendix, the red-margined leaflets and the blue berries.

Cultivation—Grow in a fertile mixture that may contain some loam. The tuber can be stored dry during resting.

Fig. 110. *A. betterscheidii*: spathe and spadix.

Fig. 111. *A. betterscheidii*: spadix (detail) (photo: B. v.d. Zwaan).

Amorphophallus hetterscheidii Ittenb. & Lobin (not yet published).

Tuber depressed-globose, to ca. 10 cm in diam., producing short, rhizomatous offsets. Leaf solitary; petiole to 60 cm long, pale green with numerous confluent, blackish brown spots, often with a dark metallic green shimmer; lamina to ca. 60 cm in diam.; leaflets elliptic to elongate elliptic, acuminate, to 20 cm long. Inflorescence developing alongside the young leaf, long-peduncled; peduncle to 50 cm long, as petiole; spathe erect, to ca. 30 cm long, base and limb separated by a constriction, base outside bright green or creamish, basal part with large, confluent dark green spots, base inside bright green with numerous small, dark violet to blackish punctations, covered with whitish to pale pinkish hairs, limb outside bright green, to the margins grading into purple, inside dark purple. Spadix longer than spathe, to 40 cm long, and emerging excentrically from the opening of the spathe.

Distribution—Gabon, Zaire, Central African Republic.

Notes—A species quite similar to *A. angolensis* and differing from the latter by the oval spathe base, a less distinctly lobed stigma, appendix base not constricted and the base of the spadix being straight (vs. shallowly sigmoid in *A. angolensis*).

Cultivation—Easily grown in a rich soil. The tuber must be left in the soil during dormancy. The offsets are best taken off when the main tuber is replanted.

Fig. 112. *A. hewittii*: inflorescence (photo: A. Liew).

Fig. 113. *A. hewittii*: leaf (photo: A. Liew).

Amorphophallus hewittii Alderw.

Tuber depressed-globose, to ca. 30 cm in diam., to ca. 12 cm high. Leaf solitary; petiole to ca. 3 m long, ca. 20 cm in diam. (base), base rugulose, rest smooth, mottled pink, green, blackish green and dark grey at the base with occasional large, pale green or whitish, oval or elliptic spots, leaflets elliptic or elliptic-lanceolate, long-acuminate, ca. 10–22 cm long, ca. 4.5–8.0 cm in diam., acumen to 3 cm long, very slender. Inflorescence medium- to long-peduncled; peduncle ca. 20–60 cm long, ca. 3–ca. 15 cm in diam. (base); spathe erect, slightly campanulate, ovate or broadly ovate, ca. 20–90 cm long, ca. 16–150 cm in diam., apex obtuse, margins strongly sinuous, inwardly reflexed, base within ridged and with scattered, minute warts, outside bright green with occasional white spots and a purplish flushed margin, inside purplish at the top, the middle part creamish pink or as top part, base dark maroon. Spadix sessile, ca. 28–140 cm long.

Distribution—Malaysia, Sarawak (on limestone).

Notes—*Amorphophallus hewittii* resembles *A. lambii* in spathe and spadix morphology but the latter is very short-peduncled and has a densely verrucose spathe base within. The maximum dimensions of the inflorescence and leaf are taken from notes by Mrs. Alice Liew (Sarawak, see photos) from a giant specimen growing in a cacao plantation at Kampong Boring, near Kuching. The plant flowers every third year, in May. The enormous size of this species and its resemblance to *A. titanum* may account for the alleged sightings of the latter species in Sarawak. As in *A. lambii,* the petiole patterning of this species is truly magnificent with all its complex marbling and shading.

Cultivation—Grow in a very well-drained soil. The tuber must be kept in the soil during resting.

Amorphophallus hildebrandtii (Engl.) Engl. & Gerhm.

Tuber depressed-globose to disciform, to ca. 20 cm in diam., pale brown, developing long, rhizomatous offsets, these with a swollen apex. Leaf solitary; petiole to ca. 110 cm long, background color pale grey, with numerous, distinct or indistinct, partly confluent, circular, pale brown spots with dark brown margins; lamina to ca. 180 cm in diam., highly dissected; leaflets oval, elliptic-lanceolate or lanceolate, long-acuminate, 4–26 cm long, upper surface green with a distinct pinkish margin at the base. Inflorescence long-peduncled; peduncle as petiole, to ca. 100 cm long; spathe triangular ovate, ca. 40 cm long, outside base background pale greyish brown with minute white dots but largely covered by numerous, confluent, rounded spots, these bright pale green, usually with a dark green margin, upwards entirely dark green, outside limb maroonish or pale purplish with a dense pattern of punctiform, dirty whitish greenish dots, near the margin flushed dirty green, in the center with dirty pale greyish greenish rounded spots, base and limb poorly differentiated, limb strongly longitudinally folded and helically twisted, inside limb maroon or dirty purplish brown with faint, dark green spots and dark green veins, to the margin dark brown, inside base with broad, strong, branching and interconnecting ridges, greenish or dirty purplish brown, upper half dirty whitish and pale brownish with rounded, partly confluent pale green spots with darker green margins filled with whitish green dots, upwards turning to entirely dark green. Spadix longer than spathe, 57–65 cm long.

Distribution—Madagascar (endemic).

Notes—The description presented here is based on living plants in the Leiden collection.

Fig. 114. *A.* c.f. *hildebrandtii*: spathe and spadix.

Fig. 115. *A.* c.f. *hildebrandtii*: spadix (detail).

To date both authors are not quite sure if these plants indeed represent *A. hildebrandtii* as originally understood by Engler. Engler's description mentions a spadix shorter than the spathe, and flat, disciform stigmas (vs. deeply lobed stigmas in the Leiden plants). The Leiden plants may therefore represent a new species (*A. staurostigma*), but no decision has yet been made. The Leiden plants (originally collected by Josef Bogner) have magnificently colored petioles and very elegant laminas.

Cultivation—Easily grown in a rich soil. The tubers may be stored dry when dormant. Offsets may be found still attached to the main tuber but they may also have been released by the rotting of their middle part. It may take quite some years to produce flowering-size plants.

Amorphophallus hirsutus Teijsm. & Binn.

Tuber depressed-globose, to ca. 13 cm in diam., brown, no offset development. Leaf solitary or rarely paired; petiole to ca. 100 cm long, ca. 4 cm in diam., largely smooth but the base sometimes very slightly rugulose, background color bright pale green, to the base nearly entirely covered by or with less numerous, tiny blackish green dots and scattered, larger, whitish dots or blotches; lamina ca. 1 m in diam.; leaflets elliptic-lanceolate, 7–20 cm long, 2.5–5 cm in diam., acuminate. Inflorescence solitary, short-peduncled; peduncle ca. 4–10 cm long, ca. 1 cm in diam., green; spathe campanulate, broadly triangular-oval, ca. 14–25 cm long, ca. 16–29 cm in diam., acute, slightly constricted between base and limb, margin undulate, base outside plain green or with small blackish spots, limb outside dark purplish brown, inside as outside but glossy and paler towards the base, base within dark maroon and paler maroon, ridged-verrucate, verrucae ridge-like. Spadix sessile, shorter than spathe, ca. 8–22 cm long; appendix globose with a suddenly narrowed, truncate top, covered with tiny, stiff hairs.

Fig. 116. *A. hirsutus*: inflorescence (photo: T. Croat).

Fig. 117. *A. hirsutus*: spadix (detail) (photo: M. Sizemore).

Distribution—Western Sumatra (in disturbed areas, on limestone).

Notes—*Amorphophallus hirsutus* belongs to the group of *A. paeoniifolius* and allies, though its short anthers are unique in this group. The shape and sculpturing of the appendix render this species unique in the entire genus. Its morphology in general is nearly entirely intermediate between *A. paeoniifolius* and *A. prainii*. Spathe shape, spathe colors, spadix colors and female flowers are strongly reminiscent of *A. paeoniifolius*, whereas the leaf is hard to distinguish from *A. prainii*. Another unique feature of this species is its bright pink colored seedlings. Slightly older leaves display a pinkish reddish margin. *Amorphophallus hirsutus* has been obscured from study ever since its discovery by Teijsmann last century. Several years ago, the late James Trice (Tennessee) ran into a colony in western Sumatra, and one of his plants flowered in the Missouri Botanical Garden, of which an excellent picture is seen on the front cover of *Aroideana* Vol. 14 (reproduced here). Recent expeditions by Mary Sizemore (Deland, Fl.) and the late Dr. James Symon have secured this species for further study.

Cultivation—Grow in a well drained soil. The tuber should be left in the soil during dormancy.

Fig. 118. *A. hirtus*: inflorescence (photo: S.-C. Hsiao). Fig. 119. *A. hirtus*: spathe and spadix (photo: A. Vogel). Fig. 120. *A. hirtus*: spadix (detail) (photo: B. v.d. Zwaan).

Amorphophallus hirtus N.E.Br.

Tuber globose or depressed-globose, 3–15 cm in diam., 2–9 cm high, weighing to ca. 1500 gr., whitish, turning greyish brown at exposure, seasonally producing numerous, thin, rhizomatous offset tubers, these to 3 cm long and ca. 1 cm in diam. Leaf solitary; petiole 20–100 cm long, 1.0–2.5 cm in diam. at the base, turgid, smooth, dark green with numerous, tiny, blackish green spots or with larger, ± diamond-shaped, pale greyish green spots, these filled with numerous, dark green, elongate dots; lamina 30–120 cm in diam., highly dissected; leaflets ± obovate or elliptic-oval, 5.5–11 cm long, 2.5–4.5 cm in diam., long acuminate, ± succulent, upper side dark emerald green with a pinkish violet margin, venation on the upper side impressed. Inflorescence solitary, long-peduncled; peduncle as petiole, 38–125 cm long, 1–4 cm in diam. at the base; spathe campanulate, constricted between base and limb, broadly triangular, 13–53 cm long, 12–45 cm in diam., acute, base strongly convolute, obliquely urceolate, thick-walled, outside pale green faintly flushed with purple or dark greyish green with numerous pale whitish green spots, the lower ones confluent, veins dark green, inside blackish maroon, covered with numerous shortly ridge-like, laterally compressed, fleshy warts, limb horizontally spreading or obliquely upturned, margin undulate, outside pale green flushed with purple-brown or dark greyish green with angulate, whitish green spots and margins dirty purple, without spots, inside maroonish flushed with green or with numerous small, rounded, sometimes confluent, whitish greenish spots, veins maroon. Spadix much longer than spathe, ± stipitate, 31–88.5 cm long, stipe 0.2–1.0 cm, male and female zone separated by a narrow, sterile zone; appendix huge and covered with long, flexuous hairs.

Distribution—Taiwan (in dense grasslands, 50–80 m alt.).

Notes—Although a relative of *A. kiusianus*, *A. hirtus* cannot be mistaken for any other species because of its oversized, hairy appendix. The leaf is highly ornamental because of its numerous small leaflets with red margins. It produces blue berries after fertilization, as do all of its relatives.

Cultivation—Grow in a rich soil. The tuber may be stored dry when resting.

Fig. 121. *A. hohenackeri*: spathe and spadix.

Fig. 122. *A. hohenackeri*: spadix (detail).

Amorphophallus hohenackeri (Schott) Engl. & Gehrm.

Tuber depressed-globose, to ca. 10 cm in diam., ca. 6 cm high, seasonally producing numerous offsets, these thin, long rhizomatous, to 35 cm long and ca. 0.8 cm in diam. Leaf solitary; petiole to ca. 70 cm long, ca. 2 cm in diam., smooth, covered with a greyish waxy layer, background color pale grey, to the base mottled with blackish green spots, usually covered with greyish white dots, in leaves of subadult plants the blackish green spots are more distinctly oval; lamina to ca. 90 cm in diam.; leaflets elliptic to elliptic-lanceolate, 3–23 cm long, 2–8 cm in diam., acuminate. Inflorescence solitary, long-peduncled; peduncle 25–56 cm long, 0.8–1.3 cm in diam., as petiole; spathe erect, elongate-triangular, funnel-shaped, 8.5–21 cm long, 3–12 cm in diam., basal 0.5–1 cm connate, truncate, base and limb not differentiated, basal part convolute or open, top acute, outside dirty white with faint, pale greenish flushes, scattered dense groups of small, blackish green dots, the base and margin (near the top) with a faint purplish flush, margins green, veins green to dark green, inside pale green, the upper two-thirds suffused with reddish brown and some blackish green small spots, base within smooth. Spadix stipitate (stipe 0.5–1 cm), slightly shorter to longer than spathe, 8–23 cm long; between male and female zones, a short zone with large, flattened, egglike sterile male flowers (staminodes).

Distribution—Southern India (among bushes in open and shady places, c. 50 m alt.).

Notes—*Amorphophallus hohenackeri* is close to *A. bonaccordensis*, the latter differing by the spadix being distinctly shorter than the spathe and a barren zone below the staminodes. In a recent paper by Sivadasan & Sabu (*Aroideana* 12(1–4):32–37) the function of the staminodes as food bodies for the pollinators has been effectively shown. All

related species in this exclusively Indian group (section *Rhaphiophallus*) show this adaptation culminating in the "giant" food bodies of *A. margaritifer* (see Hett. & de Sarker, this volume).

Cultivation—Easily grown in any average but rich soil. The tuber may be stored dry but the rhizomatous offsets better be kept in soil because they are prone to desiccation.

Amorphophallus impressus Ittenb. (not yet published).

Tuber unknown. Leaf solitary; petiole 100 cm long, green with purple spots; lamina ca. 100 cm in diam.; leaflets elongate-oval, to 10 cm long. Inflorescence appearing before the leaf, short-peduncled; peduncle to 10 cm long; spathe to 25 cm long, base and limb separated by a strong constriction, base very depressed, urceolate, outside creamish to flesh-colored, the lower part greyish brownish green with dark green veins and small green to brown spots, inside pinkish purple to reddish brown, with small, tongue-shaped papillae, these colorless or purplish or reddish brown, limb rim-shaped, strongly undulate outside dark green to brownish purple, inside basal part reddish, margin maroon. Spadix longer than spathe, to 40 cm.

Distribution—Tanzania, Malawi.

Fig. 123. *A. impressus*: inflorescence (lateral view) (photo: Royal Bot. Gard. Kew).

Fig. 124. *A. impressus*: inflorescence (back view) (photo: Royal Bot. Gard. Kew).

Notes—Mayo's (1985) plate of *A. goetzei* is in fact this species. For comparison see under *A. goetzei*.

Cultivation—Not known in cultivation.

Amorphophallus infundibuliformis Hett., Dearden & A. Vogel.

Tuber subglobose, reddish. Leaf solitary; petiole dirty whitish with numerous, confluent, irregular, green spots and scattered white punctiform dots, these more or less raised resulting in a crusty appearance; leaflets lanceolate, long acuminate, margin with numerous small undulations. Inflorescence short-peduncled; peduncle 4 cm long, ca. 0.8 cm in diam.; spathe strongly convolute, funnel-shaped, obconic in side-view, 6 cm long, ca. 8 cm in diam., 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 very obliquely inserted, slightly longer than spathe; appendix cylindric, obtuse, whitish, entirely covered with staminodes, these in the lower third shortly conical to aristate, sometimes hooked, upwards shorter or reduced to only the base.

Distribution—East Malaysia (Sarawak) and probably also northwestern Kalimantan.

Notes—*Amorphophallus infundibuliformis* cannot be mistaken for any other species in the genus because of its unique, vase-funnel-shaped spathe, largely hidden in the cataphylls during flowering. It shows similarities with three other species found in Sarawak, viz. *A. costatus* (female and male flowers), *A. eburneus* (male flowers), and *A. pendulus* (surface of appendix base).

Cultivation—The first author has been unsuccessful in cultivating this species. It probably needs a very loose, well-drained soil and the tuber must not be kept exposed during dormancy.

Fig. 125. *A. infundibuliformis*: inflorescence (photo: A. Dearden).

Fig. 126. *A. infundibuliformis*: spathe cut open (photo: A. Dearden).

Fig. 127. *A. johnsonii*: inflorescence (photo: S. Ittenbach).

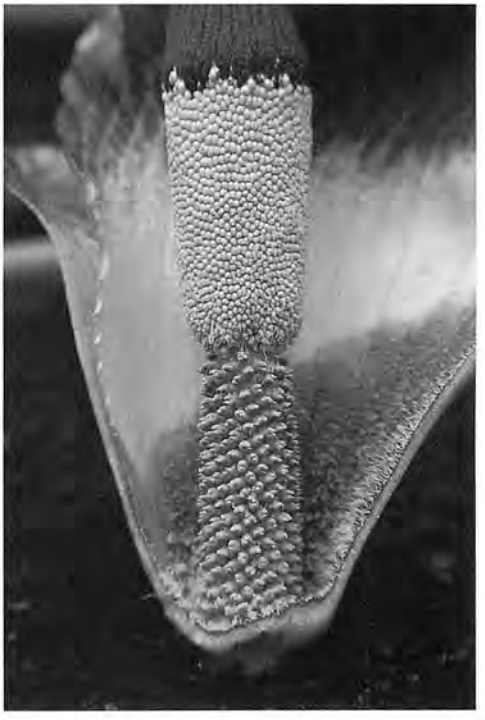

Fig. 128. *A. johnsonii*: spadix (detail) (photo: S. Ittenbach).

Amorphophallus johnsonii N.E. Br. [syn.: *A. accrensis* N.E. Br., *A. purpureus* (Engl.) Engl. & Gehrm.].

Tuber globose when young, later depressed globose, rarely producing short, cylindric offsets. Leaf solitary; petiole to 100 cm long, bright green with dark green spots; lamina to 100 cm in diam.; leaflets broadly oval, to 12 cm long, acuminate. Inflorescence developing just before the leaf, short- or long-peduncled; peduncle 10–95 cm long, as petiole; spathe erect, to 21 cm long, base and limb separated by a distinct constriction, base elongate, outside greenish, inside yellowish green or dark green, covered with fleshy, purple hairs, limb outside green or reddish brown, towards the margin purple, inside purplish. Spadix longer than spathe, to ca. 50 cm long.

Distribution—Ivory Coast, Burkina Fasso, Ghana, Guinea, Liberia, Mali.

Notes—A remarkable species because the inflorescences may be long- or short-peduncled, a rare polymorphism in *Amorphophallus*. The long-peduncled forms are found in Savannah conditions, those with short peduncles deeper in the forests. The variation in peduncle length is matched in Asia only by *A. bulbifer*. *Amorphophallus johnsonii* differs from *A. angolensis* in having sessile stigmas and more fleshy hairs.

Cultivation—Grow in a well-drained soil.

Fig. 129. *A. kachinensis*: inflorescences (photo: H. Li).

Amorphophallus kachinensis Engl. & Gehrm. (syn.: *A. bannaensis* H. Li).

Tuber depressed-globose, brown, 5–30 cm in diam., 3–5 (or more) cm high, developing offsets; offsets incompletely known but probably rhizomatous. Leaf solitary; petiole 20 cm long (or more?), smooth, dirty white with dark green to reddish brown spots; lamina to 100 cm in diam.; leaflets elliptic, 6–9 cm long, 2–3 cm in diam., acute-acuminate. Inflorescence solitary, long-peduncled; peduncle 24–80 cm long, 0.7–1.0 cm in diam. (base), ivory-white, greyish or greenish with brown or purple blotches and greenish patches; spathe concave, base shortly convolute, 8–29 cm long, 7–14 cm in diam., outside green or greenish brown with green spots or purplish red stripes and spots, top purple, base inside with scattered, shallow, punctiform warts. Spadix much shorter than spathe, 6.5–18 cm long, emitting an unpleasant, rancid odor; stipe 0.2–1.0 cm long, 0.4–1.0 cm in diam.; appendix globose or subglobose, with several deep fissures.

Distribution—Northern Burma (Kachin state), northern Thailand, Laos, China (Yunnan) (in dense climax forest, on limestone rocks, 1000–1500 m.).

Notes—*Amorphophallus kachinensis* is morphologically very close to *A. corrugatus* N.E.Br. but differs in the much less complexly fissured appendix and the pores of the anthers, which position varies from subapical to sublateral, depending on the dimensions of the connective. From *A. yunnanensis* it differs in the longer style, smaller stigma, unilocular ovule, the position of the pores and the color pattern in several parts of its morphology.

Cultivation—Not in cultivation by the authors.

Fig. 130. *A. kiusianus*: spathe and spadix (photo: J. Murata).

Fig. 131. *A. kiusianus*: spathe cut open (photo: B. v.d. Zwaan).

Amorphophallus kiusianus (Makino) Makino (syn.: *A. sinensis* Belval).

Tuber depressed-globose, to ca. 20 cm in diam., to ca. 12 cm high, no offset development. Leaf solitary; petiole smooth, to ca. 65 cm long, ca. 4 cm in diam., glossy, dirty olive-green or greyish green, with narrowly elongate, oval or irregular whitish or very pale greenish spots and numerous tiny dark green dots; lamina ca. 60–90 cm in diam.; leaflets elongate-elliptic to lanceolate, 6–20 cm long, 3–4.5 cm in diam., moderately to long-acuminate, margin undulate, upper side bright green with a narrow pale violet margin. Inflorescence solitary, long-peduncled; peduncle as petiole, 40–100 cm long (in fruit to ca. 120 cm long), 1.5–4 cm in diam.; spathe triangular, base rounded, 9–25 cm long, ca. 4–13 cm in diam., shallowly or clearly constricted between base and limb, limb first oblique, then reflexing and bending downwards, margin reflexed or undulate, outside greenish pinkish or glossy dark purplish brown, with small, whitish spots, midrib and top occasionally green, margin greenish and with a narrow, reddish violet marginal line, inside pale pinkish with a purplish base or entirely dark brown, or with a greenish margin, the latter sometimes flushed pinkish, sometimes medially pale green, with rounded, whitish spots, base outside dark green or dark greenish brown, with small, rounded whitish spots and blackish green veins, base within dark purple and with numerous, ± distant conical warts, occasionally with small, whitish spots. Spadix sessile or subsessile, shorter than, equal to, or longer than spathe, 9–22 cm long; between male and female zone and on appendix short or long, flexuous hairs.

Distribution—Southeast China, Taiwan, southern Japan (in shaded, semi-shaded, or sun-exposed places, in plantations. Elevation ca. 300–850 m).

Notes—A close relative of *A. hirtus* (see descr.). The elegant leaf, with its red-margined,

elongate leaflets, makes this a highly ornamental species. Also the spathe is remarkably colorful and is outstanding because of the white spotted inner surface. When the inflorescence is left to develop after flowering, a striking infructescence develops without pollination. The berries are at first green, then turn bright lilac-pink and finally shiny deep blue.

Cultivation—Grow in a fertile soil. The tuber is better left in the soil when dormant because reviving it after drought may be difficult. The species thrives best at moderate temperatures (ca. 18°–22°C). At continuing high tempertures, the leaf will die down too soon.

Amorphophallus konjac K. Koch (syn.: *A. rivieri* Durieu ex Carrierre, *A. mairei* Leveille).

Tuber depressed globose, to ca. 30 cm in diam., to ca. 20 cm high, weighing to ca. 10 kg., brown, slightly glossy, seasonally producing numerous, long rhizomatous offsets with enlarged top part, these to ca. 50 cm long and ca. 3 cm in diam. Leaf solitary; petiole to ca. 100 cm long and ca. 8 cm in diam., smooth or with scattered punctiform warts at the base, background color dirty whitish pinkish, often nearly entirely covered by large, elongate, dark green confluent spots and smaller white dots; lamina highly dissected, diam. to ca. 200 cm.; leaflets elliptic, acuminate, 3–10 cm long, ca. 2–6 cm in diam., upper side dull green. Inflorescence solitary, long-peduncled; peduncle as petiole, to ca. 110 cm long, ca. 5 cm in diam.; spathe elliptic-lanceolate to broadly ovate-triangular, acute,

Fig. 132. *A. konjac*: inflorescence (photo: B. v.d. Zwaan).

Fig. 133. *A. konjac*: spadix (detail).

ca. 10–60 cm long, ca. 10–55 cm in diam., base and limb more or less separated by a shallow constriction, outside base dirty pale brownish with blackish green spots, near the margin flushed with purple, inside base, basal part blackish purple and densely verrucate, verrucae tiny, punctiform, upper part whitish purplish, limb erect, undulate and/or longitudinally folded, margin spreading, outside dark purplish brown with scattered blackish green spots, inside uniformly dark brown, glossy. Spadix sessile, ca. 15–110 cm long.

Distribution—Southern and southeastern China, Vietnam (open situations or forest margins and thickets, to ca. 3000 m elev.). A specimen was found near Kota Kinabalu (Sabah, East Malaysia) by W. Mrazek and may have been a weedy specimen.

Notes—*Amorphophallus konjac* is widely known in cultivation, both as an ornamental and as an economic crop (Jansen et. al., 1996). The latter especially in China and Japan. In Japan the tubers are used to produce Konnyaku, a type of flour used as the basis for many dietary products. Von Siebold brought the first specimens of this species to Western Europe from Japan ("*Arisaema konjac*"). As a result of extensive cultivation and selection, it has become obscure which part of the above described morphology is "natural" and what is added through breeding/selection. The stench development in *A. konjac* commences during three days and is already noticeable before the actual flowering starts. During female anthesis the appendix oozes out considerable amounts of a clear, slightly viscous fluid. This finally runs into the spathe base and leaks out through the basal opening. *Amorphophallus konjac* resembles *A. maxwellii* (see descr.) but the latter has much longer styles, larger leaflets, a wider spathe, and a thinner appendix.

Cultivation—This easiest of species in cultivation can be grown in any fertile soil. It may even be cultivated in moderate temperatures (15°–20°C) and small tubers may even survive mild frosts in the open. The tuber can be stored dry during dormancy.

Amorphophallus konkanensis Hett., Yadav & Patil.

Tuber globose or depressed-globose, 3–8 cm in diam., 3–4.5 cm high, producing short, rhizomatous offsets. Leaf solitary; petiole smooth, 29–88 cm long, 0.6–1.5 cm in diam., brown or greenish brown, mottled pinkish and with whitish stripes; lamina 40–96 cm in diam.; leaflets lanceolate, acuminate, ca. 4–19 cm long, ca. 1–4 cm in diam. Inflorescence long-peduncled; peduncle as petiole, 25–55 cm long, 0.3–1 cm in diam.; spathe erect, ovate, acute, not constricted, limb poorly differentiated from base, 3.3–8.5 cm long, 2.3–7 cm in diam., outside dirty pinkish with a brownish hue and faint, brownish spots, veins dark purplish brown, inside maroon, base within dark maroon, longitudinally ridged. Spadix stipitate, to twice as long as spathe, 9.5–16 cm long, between male and female zone, a zone with egg-shaped, sterile male flowers (staminodes).

Distribution—India, southwestern Maharashtra State (common throughout the Konkan forest on laterite soils, near bushes).

Notes—*Amorphophallus konkanensis* is clearly a member of *A.* sect. *Rhaphiophallus* (Schott) Engl. (emend. Sivadasan, 1989), possessing the characteristic spathe shape and staminodes. Its general morphology and color-pattern make it very similar to *A. mysorensis* of the state of Mysore (India), from which it differs markedly in the semi-flattened staminodes (vs. globose in *A. mysorensis*) and the basal placentation (vs. axillary halfway up the length of the locule in *A. mysorensis*). Only three other species of sect. *Rhaphio-*

Fig. 134. *A. konkanensis*: inflorescences (photo: S. R. Yadav).

Fig. 135. *A. konkanensis*: spadix (detail) (photo: S. R. Yadav).

phallus possess similarly flattened staminodes as in *A. konkanensis*, viz. *A. hohenackeri* (see descr.), *A. bonaccordensis*, and *A. sylvaticus*, all from southern India.

Cultivation—Grow in a fertile mixture with added loam. The tuber may be stored dry during dormancy.

Amorphophallus koratensis Gagnep.

Tuber depressed-globose, 10–14 cm in diam., ca. 7 cm high, dark brown, surface irregular and with large, annulate root scars, developing few offsets; offsets rhizomatous, to ca. 10 cm long, ca. 1.5 cm in diam. Leaf solitary or two on one tuber; petiole entirely pale green, or the basal part largely blackish, surface echinate-scabrate, 60–200 cm long, 1–3 cm in diam. (base); lamina 35–150 cm in diam.; leaflets broadly elliptic or obovate, shortly acuminate, 10–20 cm long, 4–10 cm in diam., margin slightly wavy, main veins on the upper side impressed. Inflorescence solitary, shortly to moderately long-peduncled; peduncle 1.0–16 cm long, ca. 7 mm in diam., color etc. as in petiole; spathe erect, acute, slightly campanulate, ovate, 10–15 cm long, 9–10 cm in diam., for the greater part convolute, only the upper fourth part open, leaving only the larger part of the appendix visible, base very leathery, with a shallow apical constriction, margins slightly wavy, outside entirely green, or base pale yellowish with greenish spots, limb maroonish to the margin, inside entirely green, or base pale and dark maroon, middle part yellowish, limb mostly maroon, base inside densely verrucate, verrucae large, flattened or subhemis-

Fig. 136. *A. koratensis*: inflorescence (photo: D. Fisk).

Fig. 137. *A. koratensis*: spathe cut open (photo: D. Fisk).

phaeric, separated by grooves. Spadix shorter than spathe, 10–12 cm, very shortly stipitate.

Distribution—Central Thailand (in rocky bamboo/deciduous forest).

Note—*Amorphophallus koratensis* is most similar to *A. scaber* (South Vietnam, see descr.) in many respects. Both species possess a tubular spathe that hardly opens, similar tubers, offsets, floral morphology and leaf structure (echinate-scabrate petiole surface). *Amorphophallus scaber* however has much larger dimensions and the spathe is cymbiform and opens even less than *A. koratensis*. Equally similar is *A. opertus* (see descr.) but the latter has an undivided stigma and unilocular ovaries (vs. bilocular in *A. koratensis*). This species is quite often sold in Thai markets, and the tuber cannot be distinguished from those for sale of *A. paeoniifolius* unless parts of the petiole base are still on it.

Cultivation—Grow in a very rich mixture with added loam. The tuber is best left in the soil during resting.

Amorphophallus krausei Engl. (syn.: *A. sutepensis* Gagnep., *A. ximengensis* H. Li).

Tuber globose, sometimes slightly subcylindric, with a deep central depression, 5–25 cm in diam, 4–8 (or more) cm high, dirty pale yellowish, brownish or orangish, seasonally developing several offsets; offsets rhizomatous, long, thin, apex slightly thickened or not so, 2–27 cm long, 0.4–1.0 cm in diam. Leaf solitary; petiole smooth, 20–125 cm long, 1.0–3.0 cm in diam. (base), ground color pale green, at the base often pale pink or with a reddish-brown or reddish hue, with many, smaller and larger, elliptic, partly or nearly entirely confluent, elliptic to narrowly elliptic, blackish green or paler green or rarely reddish brown spots and several, small, white dots, the intensity of colors and the extension of the pattern variable; lamina 100–160 cm in diam.; leaflets lanceolate, rarely elliptic, acuminate, base decurrent, 11–48 cm long, 2–11 cm in diam., upper side green or greyish green, lower side paler green. Inflorescence long-peduncled; peduncle as petiole but smaller, 25–100 cm long, 0.8–2.0 cm in diam. (base); spathe erect, cymbiform, ovate to ovate-lanceolate, base convolute, convolute part 4–6 cm long, top acute-acuminate, 11–33 cm long, 6–16 cm in diam., outside pale green, to the base slightly darker, inside pale

Fig. 138. *A. krausei*: spathe and spadix (photo: A. Vogel).

Fig. 139. *A. krausei*: spathe cut open (photo: B. v.d. Zwaan).

yellowish-green, base sometimes maroonish, base inside with many, small, slightly elongate or irregularly ridge-shaped warts. Spadix nearly as long as spathe, rarely distinctly shorter or slightly longer, 8–22.5 cm., between male and female zone, a zone of small, slightly raised sterile male flowers (staminodes).

Distribution—Northern Thailand, northern Myanmar (Burma), southern China (in shaded to open, often fire-prone, places in mixed primary evergreen/deciduous forest and deciduous dipterocarp forest, often mixed with bamboo, on granite bedrock, sometimes near streams, lowland to ca. 1500 m).

Notes—*Amorphophallus krausei* is most similar to the Chinese *A. albus*, but the latter has rugulose staminodes. The odor of *A. krausei* is very upsetting and is reminiscent of a gas leak.

Cultivation—An easy species to grow in a rich soil with some added loam. The tuber can be stored dry during dormancy, but the offsets are better left in the soil to protect against desiccation.

Fig. 140. *A. lambii*: inflorescence (photo: A. Lamb).

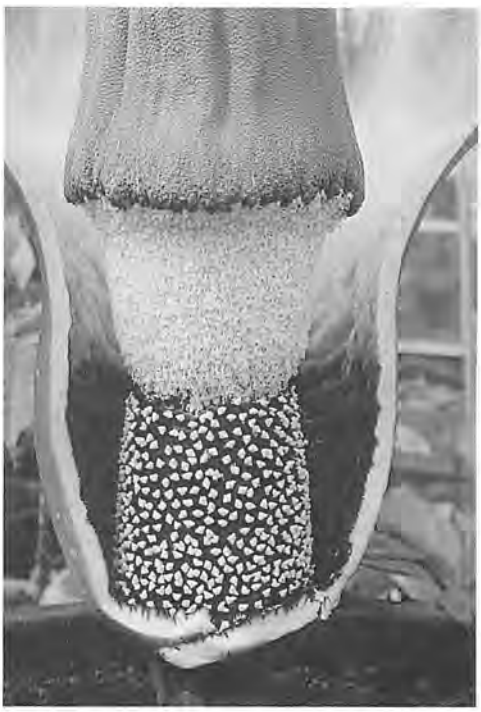

Fig. 141. *A. lambii*: spadix (detail) (photo: B. v.d. Zwaan).

Amorphophallus lambii Mayo & Widjaja.

Tuber depressed-globose, ca. 22 cm in diam., ca. 11 cm high, dirty white, no offset development. Leaf solitary; petiole to 200 cm long, ca. 8 cm in diam. (base), ground color whitish at the base, with a dense marbling of irregular green, confluent spots, their upper boundary darker and slightly raised, upwards a more continuous green color with scattered, large whitish or very pale greenish, oval spots with or without a darker green center; lamina to ca. 200 cm in diam.; leaflets elongate-elliptic, acuminate, 18–31 cm long, 7–10 cm in diam., upper side at first very glossy, later moderately glossy. Inflorescence short-peduncled; peduncle as petiole, 8–10 cm long, 2.5–3.5 cm in diam., strongly lengthening in fruit to at least 60 cm; spathe campanulate, 28–45 cm long, ca. 34–52 cm in diam., limb spreading, margin inrolled, often with a few sharp edged, inward sinuses, base outside glossy, bright apple green with occasional, pale green, ring-like spots, inside dark maroon with an upper, dirty yellowish to pale greenish zone, continuing on the limb, limb outside green suffused with a blackish brown hue between the major veins, inside pale green with a few scattered, small, rounded, dark brown spots, to the margin pale to darker brown, base within verrucate and grooved. Spadix longer than spathe, sessile, 55–90 (–150) cm long.

Distribution—East Malaysia, Sabah; Indonesia, Central Kalimantan (in shaded conditions in rubber plantations, cleared land, along river banks and in relict fragments of lowland rainforest surrounding hills, on rich alluvial soils, ca. 200 m alt.

Notes—Near *Amorphophallus hewittii* (see descr.) but the latter has a long peduncle. *Amorphophallus lambii* has a rather long flowering period in cultivation, which may last

over a week. It produces a distinct urine scent. The berries are eaten by Bulbuls (*Pycnonotus zeylanicus*) as soon as they become ripe and turn red. Infructescences are therefore always found to contain only orange, slightly unripe berries and a naked upper infructescence axis (pers. comm. A. Lamb). It is a highly ornamental species both in leaf (very beautiful petiole) as in flower (highly contrasting colors between spathe exterior and interior).

Cultivation—This species is not easy in cultivation and has a tendency to diminish year after year and finally die. Grow in a very loose but fertile soil. The tuber must never be stored dry!

Amorphophallus lewallei Malaisse & Bamps.

Tuber depressed, saucer-shaped, 3.5–20 cm in diam., developing several offsets, these rhizomatous, 5–25 cm long. Leaf developing simultaneously with inflorescence; petiole smooth, glossy, pale green with whitish green punctuation, diminishing upwards or moss-green with a few white, short stripes and many small, dark moss-green, elliptic spots, diminishing upwards, the lower third sometimes with a faint purplish hue, 30–140 cm long, 1.5–6 cm in diam. at the base; lamina to 160 cm in diam.; leaflets elliptic, acuminate, base decurrent on the rachis, upper side green or greyish green, often slightly glaucous, lower side green, 14–29 cm long, 5.5–8.0 cm in diam. Inflorescence nearly sessile; peduncle 4–8 cm long, after fertilization lengthening to 150 cm, colored as petiole; spathe

Fig. 142. *A. lewallei*: inflorescence (photo: B. v.d. Zwaan).

Fig. 143. *A. lewallei*: spadix (detail) (photo: B. v.d. Zwaan).

with a strong constriction above or at the middle of the male zone, 15–29 cm long; base convolute, obliquely compressed to various degrees, the ventral part always less compressed than the dorsal part, 3.5–10 cm long, 7.5–16 cm in diam.; outside glossy pale green with a few small, white spots; inside base (lower half) a dirty brownish purple, upper half very pale green up to the constriction or extending slightly beyond, or the entire base brownish purple, the purple part with deep, radial grooves, ridges densely verrucose; warts separated by deep lengthwise grooves, surface of warts with short, rounded or subulate lobes and/or variously folded; limb broadly triangular, at first horizontal, often at female anthesis actively curving forward and pressed against the appendix, 10–20 cm long, 10–29 cm broad, apex acute, margin irregularly sinuous, main veins on dorsal side very strong, outside basally glossy dark green and with a dark purple-brown hue or only dark green, the margin reddish brown, the main veins very pale green, inside at constriction off-white, at the top of the constriction a pale purple-brown hue, the middle part mixed with dark emerald-green, the entire margin velvety, dark emerald-green. Spadix sessile or with a very short, ventral, naked part, excentrically inserted, close to the ventral part of the spathe base, 16–33 cm long.

Distribution—Burundi (in open grassland).

Notes—*Amorphophallus lewallei* is in many morphological respects similar to *A. goetzei* (see descr.) but differs principally in the sculpturing and color of the appendix. Small specimens of *A. lewallei* also resemble *A. eichleri* (see descr.) but differ again in appendix characters and the much longer spathe limb. Bogner et al., *Aroideana* 8(1) (1985): 16, Fig. 9, misidentified a dried specimen of *A. lewallei* as *A. eichleri*. *Amorphophallus lewallei* has a highly ornamental inflorescence with numerous shades of green and purple.

Cultivation—Grow in a rich mixture with added loam. The tuber may be stored dry upon resting.

Amorphophallus longituberosus (Engl.) Engl. & Gehrm. (syn.: *A. viridis* Ridl.).

Tuber elongate, usually unbranched at maturity, off-white, turning grey or blackish brown at exposure, to 25 cm long, top-part to 7.5 cm in diam. Leaf solitary; petiole 10–60 cm, 0.5–2 cm in diam. (base), smooth, with a whitish waxy cover, ground color dirty pale grey, pale pinkish or pale green to various extents covered with dark grey or dark blackish green oval spots and/or ditto stripes, the latter often running the entire length of the petiole; lamina highly dissected, diameter to 120 cm; leaflets elliptic or lanceolate, 6–17 cm long, 2–5 cm in diam., shortly or long-acuminate, base decurrent, slightly succulent, main veins impressed, upper side green, lower side pale green. Inflorescence long-peduncled; peduncle as petiole, 10–76 cm long, to 1.5 cm in diam. (base); spathe erect, elliptic to elongate triangular, acute, top fornicate or nearly so, base convolute, widening at male anthesis, 4.0–18.5 cm long, 2.0–11.5 cm in diam., base inside nearly smooth, with few, scattered, shallow warts or densely covered with tiny, punctiform warts or moderately to densely covered with fleshy, elongate, variously branched warts, outside pale grey with several rounded or broad, elongate, dark grey spots/stripes and small white dots or uniformly green or greenish white with a few small white spots and/or some maroon streaks and a reddish or violet margin, inside entirely dirty greyish white or pale green, sometimes the upper part flushed with violet, with a darker green or pale to dark maroon base, margin sometimes flushed with greyish purple. Spadix sessile, slightly or distinctly shorter than spathe, 3.0–15.5 cm long, giving off a pleasant, anise-like scent.

Fig. 144. *A. longituberosus*: spathe and spadix.

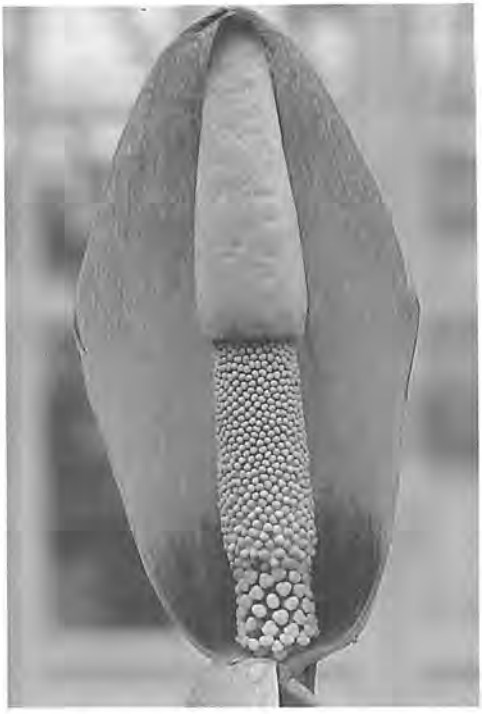

Fig. 145. *A. longituberosus*: spathe cut open (photo: B. v.d. Zwaan).

Distribution—Thailand, northern West Malaysia (in shaded or open places in evergreen or deciduous forests, in dry dipterocarp or dipterocarp-oak forests, in scree, on sandy or rocky poor ground, on limestone or shaley, granite bedrock, 0–600 m).

Notes—*Amorphophallus longituberosus* mostly resembles *A. coudercii* (see descr.) but differs markedly in having a sterile appendix.

Cultivation—Easily grown in a loam-rich mixture. The tuber may be stored dry during resting. The tuber becomes susceptible to rot in the final stages of the growing season and watering must then be minimized.

Amorphophallus macrorhizus Craib (syn.: *A. xiengraiensis* Gagnep., *A. longituberosus* var. *robustus* S.Y. Hu).

Tuber huge, elongate, unbranched or with few branches in lower part, 10–35 cm long, 1.5–6 cm in diam. (top), dirty brown, lacking seasonal offsets. Leaf solitary; petiole 40–110 cm long, 1–2 cm in diam. (base), turgid, densely, velvety hairy; color pattern very variable, from nearly entirely pale green with a few elongate, whitish spots, to reddish brown with many blackish green, large confluent spots, sometimes almost entirely covering the petiole, many intermediate patterns exist often suffused with reddish shades; lamina to 110 cm in diam., leaflets elliptic to obovate, shortly acuminate to apiculate, 10–36 cm long, 5–16 cm in diam., upper side dark, velvety green with a narrow reddish

Fig. 146. *A. macrorhizus*: spathe and spadix (photo: B. v.d. Zwaan).

Fig. 147. *A. macrorhizus*: spadix (detail) (photo: B. v.d. Zwaan).

purplish margin, smooth, lower side greyish green, hairy. Inflorescence solitary, long-peduncled; peduncle like petiole, to 125 cm long; spathe erect, cymbiform, deep, lower part transversely oval, limb triangular, 9–25 cm. long, 3–20 cm in diam., base convolute or nearly entirely open, grading into the limb or slightly constricted at the top, lower margins of the limb strongly recurved, outside pale green with some small, darker green spots at the base, the margin suffused with a purplish hue, top dark green, inside pale green with a purplish margin, base green or dirty maroon chequered with pale green or entirely pale maroon, the latter color sometimes extending over nearly the entire spathe, veins at the base impressed, groove-like, in between with very tiny, punctiform warts. Spadix sessile or very shortly stipitate, slightly to distinctly longer than spathe, 11–30 cm long, appendix with or without a few, scattered, blackish, thin hairs.

Distribution—Northern Thailand, not uncommon in the Doi Sutep-Pui National Park and eastward to Chiang Rai (in dry, deciduous dipterocarp-oak forests, 300 to 1500 m, on shaley, granitic bedrock in very hard soil, on shaded places).

Notes—Closely related to *A. cruddasianus* (Myanmar) and differing in the posession of the velvety hair-cover on the leaf and the occasional hairs on the appendix, the latter also being much narrower. *Amorphophallus macrorhizus* is remarkable for the irregular occurrence of hairs on the appendix, a feature unique to the group of species it belongs to (unless it is wrongly classified).

Cultivation—Easily grown in a rich mixture with added loam. Grow in a very deep pot to give room to the enormous elongate tuber. Watering must be withheld at the first signs of dormancy, when the leaf starts to turn yellow. The tuber is sensitive to excess water, especially in the base of the pot.

Fig. 148. *A. manta*: spathe and spadix.

Fig. 149. *A. manta*: spadix (detail).

Amorphophallus manta Hett. & Ittenb.

Tuber depressed-globose, 7 cm in diam. 4 cm high, brownish, no offsets. Leaf solitary; petiole ca. 60 cm long, surface papery, in many shades of green, pink, brown and black; lamina ca. 50 cm in diam., subpedate, anterior segment much less strongly developed than the posterior ones; near the end of the growing season an intercalary bulbil develops at the base of the lamina; leaflets leathery, elongate-elliptic, ca. 20 cm long, ca. 7 cm in diam., margins sinuous, upper surface dull green with occasional white spots, lower surface grey-green with pinkish shades and pinkish red spots, often numerous. Inflorescence solitary, long-peduncled; peduncle ca. 27–30 cm long, ca. 1.2–1.7 cm in diam., dark reddish brown with numerous, small, blackish green, elongate, short spots and scattered larger, elliptic, dirty whitish spots; spathe ovate, ca. 14–19 cm long, ca. 11–15 cm in diam., broadly acute or obtuse, base strongly convolute, upper margins spreading, limb basally spreading, then suddenly bent forward and then curved back again, base outside dirty brownish green or reddish brown 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 center as base or more greyish but margins and top brownish purple with rounded, white spots, inside dark maroon with rounded, white spots, base within verrucate, warts conical. Spadix slightly or distinctly longer than spathe, 16–23 cm long, sessile, producing a strong cacao-like scent.

Distribution—Western Sumatra (Harau Valley).

Notes—*Amorphophallus manta* strongly resembles *A. bufo* (see descr.) but the latter differs in having the spathe much longer than the spadix and more distinct styles and a more complexly divided leaf lamina. Maybe both species are mere aspects of one species.

Cultivation—Grow in a well-drained, rich soil. The tuber must be left in the soil during

dormancy (if this happens). The species has a tendency of developing an inflorescence immediately after the leaf dies down.

Amorphophallus maximus (Engl.) N.E. Br. [syn.: *A. fischeri* (Engl.) N.E. Br., *A. schliebenii* Mildbr.].

Tuber depressed-globose or disciform, to 25 cm in diam., producing globose offsets. Leaf solitary; petiole to 100 cm long, greyish green with reddish purple flushes, or mottled, with a distinct waxy layer; lamina to 120 cm in diam.; leaflets lanceolate to obovate, to 19 cm long. Inflorescence developing just prior to the leaf, long-peduncled; peduncle to 70 cm long, as petiole; spathe to 30 cm long, base and limb separated by a distinct constriction, outside base greyish purple to greyish brown, inside purple and warty, outside limb dirty purplish and greyish, inside glossy purple, margins strongly sinuous and twisted. Spadix longer than spathe, to ca. 70 cm long, emitting the smell of decaying meat; the appendix produces numerous droplets on the first day of flowering.

Distribution—Kenya, Tanzania, Zimbabwe, Zambia, Somalia.

Notes—A rather elegant species, also in leaf. The lamina has a pretty lacy appearance. It mostly resembles *A. mullendersii* Malaisse & Bamps, but the latter has a deeply lobed spathe limb and the spathe base is ridged inside.

Cultivation—Easily grown in a rich soil. The tuber may be stored dry when dormant.

Fig. 150. *A. maximus*: inflorescence (photo: B. v.d. Zwaan).

Fig. 151. *A. maximus*: spadix (detail) (photo: B. v.d. Zwaan).

Fig. 152. *A. maxwellii*: inflorescence.

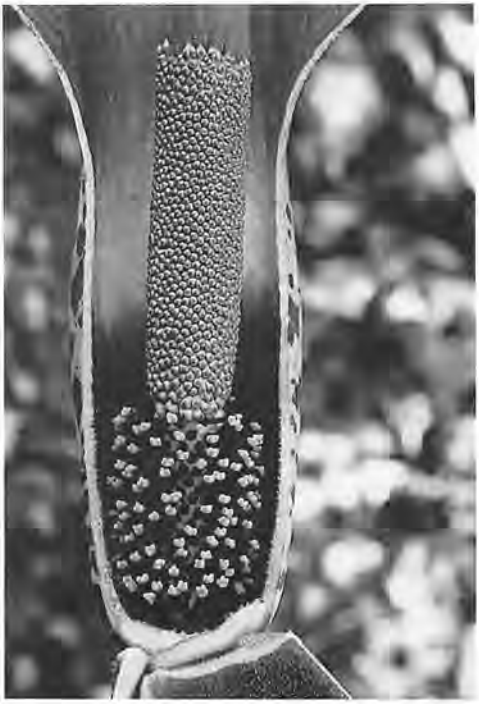

Fig. 153. *A. maxwellii*: spadix (detail).

Amorphophallus maxwellii Hett.

Tuber subglobose to depressed-globose, ca. 10–23 cm in diam. and 12–14 cm high, outside dark brown, distinctly glossy, producing annual, long rhizomatous offsets. Leaf solitary; petiole to 80 cm long, ca. 3 cm in diam., silvery white with irregular dark emerald-green spots; lamina ca. 100 cm in diam.; leaflets elongate-elliptic, to ca. 20 cm long, ca. 13 cm in diam. Inflorescence long-peduncled; peduncle smooth, 18–100 cm, ca. 1–2 cm in diam., as petiole; spathe subcampanulate, broadly ovate to elongate-elliptic, 27–69 cm long, 13–30 (or more?) cm in diam., base and limb separated by a very shallow constriction, base convolute and slightly laterally compressed, limb at first oblique then the top strongly arching forward, top acute, margins strongly sinuous, limb outside lower half pale cream with dull violet stains, upper half very dark maroon, inside lower half cream or purple, upper half very glossy dark maroon, base inside dark maroon, upper part dirty creamish, basal part densely clothed with fleshy, elongate, often hair-like warts. Spadix sessile, slightly or distinctly longer than spathe, 30–82 cm long.

Distribution—Thailand, Kanchanaburi Province (on limestone, in mixed deciduous forest, partly shaded areas).

Notes—*Amorphophallus maxwellii* resembles *A. konjac* but the latter has shorter styles, 2-3-locular ovaries, the appendix diameter at the base distinctly larger than the diameter of the male zone and the spathe does not bend over. This active moving of the spathe limb after female anthesis is also found in the Philippine *A. declinatus* (see descr.) which also resembles *A. maxwellii* quite strongly but has e.g. sessile stigmas. *Amorphophallus maxwellii* is a very ornamental species because of its strikingly colored petiole and peduncle as well as the large, dark maroon spathe.

Cultivation—Grow in a rich mixture, with added loam. The tuber may be stored dry when resting.

Amorphophallus muelleri Bl. [syn.: *A. planus* Teijsm. & Binn., *A. blumei* (Schott) Engl., *A. oncophyllus* Prain, *A. burmanicus* Hook. f., *A. carnosus* Engl., *A. timorensis* Alderw.].

Tuber globose or depressed-globose, dark brown, yellow inside, to 28 cm in diam., no annual offsets, rootscars annuliform, swollen. Leaf solitary, occasionally two on one tuber; petiole-smooth, 40–180 cm long, 1–8 cm in diam. (base), green, olive green, brownish green or almost black, with numerous large elongate-elliptic, diamond shaped or stripe-like, pale green spots, and sometimes with an additional high number of small, pale green, rounded dots; lamina highly dissected, 75–200 cm in diam., in the center, carrying epiphyllar bulbils on the major branchings and on the most distal branches; leaflets lanceolate or elliptic lanceolate, acuminate, base strongly and broadly decurrent, 10–40 cm long, 4–15 cm in diam., upper surface green or dark green with a narrow, whitish or pinkish red margin, especially when young, leaflets of seedlings dark emerald green with a reddish flush and strongly red margins; bulbils depressed, rounded or elongate, greyish brown, 0.5–6 cm in diam., 1–40 per leaf. Inflorescence solitary, long-peduncled; peduncle as petiole, 30–60 cm long, 0.5–3 cm in diam. (base); spathe broader than long, rarely slightly the reverse, very broadly triangular or transversely elliptic, coriaceous, marcescent, 7.5–27 cm long, 6.0–27 cm in diam., base strongly convolute and slightly or clearly constricted at the top, limb semi-erect or spreading, often partly horizontal, margin reflexed, ± suddenly narrowed to the top, the latter very obtuse, base within nearly smooth

Fig. 154. *A. muelleri*: inflorescence (photo: R. de Kok).

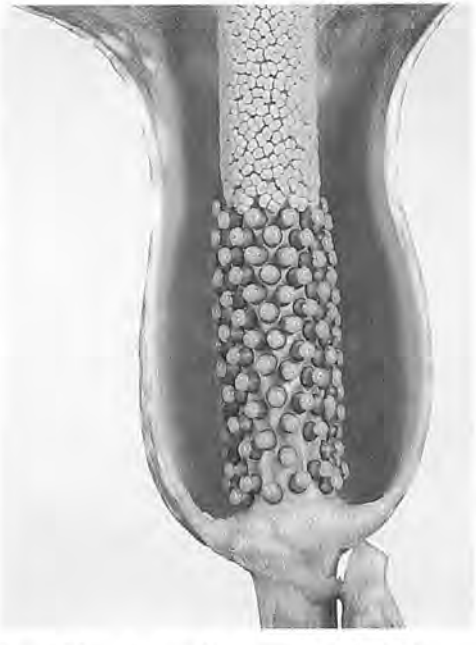

Fig. 155. *A. muelleri*: spadix (detail).

or with numerous small, elongate warts, these often confluent, outside base pale green or pale dirty pinkish with, usually transversely elongate, whitish spots and few small, blackish green dots, upwards grading to brownish purple or dark greyish green, with large, ± isodiametrical white spots, inside base dark pink or pale yellowish pink, upwards grading to purplish or brownish with dirty pale greenish and dirty pale brown, transversely oval spots. Spadix sessile or stipitate or intermediate, longer than spathe, 8–30 cm long, drying in fruit and remaining, stipe 0.1–1.5 cm long.

Distribution—From the Andamans eastward through Myanmar (Burma) into northern Thailand and southeastward on Sumatra, Java, Flores, and Timor (in disturbed areas, to 900 m alt.).

Notes—*Amorphophallus muelleri* is very similar in habit to *A. bulbifer* and *A. erubescens*. *Amorphophallus bulbifer* has a spadix equalling or shorter than the spathe, the inside of the limb is always some shade of pink, never brown, the ovaries are one-locular (always?) and the stigma diameter is (nearly?) always larger than the ovary diameter. *Amorphophallus bulbifer* may also be short peduncled. The tuber of *A. bulbifer* does not have the pronounced root-scars. The seedlings of *A. muelleri* are exceptionally beautiful. The lamina is a deep bronze-green and the margin bright pink, or white. Seeds are freely produced, without pollination, but the berries are slow to mature. *Amorphophallus muelleri* is one of the very few species with a more extensive geographical distribution, which accounts also for the high number of synonyms. In literature on the Javan flora, the name *A. muelleri* has long been misused for what is now *A. annulifer* (see descr.).

Amorphophallus napalensis (Wall.) Bogner & Mayo (syn.: *Thomsonia napalensis* Wall.).

Tuber subglobose or depressed-globose, to ca. 15 cm in diam., ca. 12 cm high, pale to dark dirty brownish, producing seasonal offsets, these rhizomatous, gradually thickening to the top, to 10 cm long and 1.5 cm in diam. Leaf solitary; petiole to ca. 1 m long, ca. 3 cm in diam. at the base, smooth, background color pale green, with more or less large, irregular or elongate-oval dark green or blackish spots, sometimes accompanied by numerous smaller dark green spots; lamina highly dissected, to ca. 1.5 m in diam.; leaflets elliptic-oblong or elliptic-lanceolate or obovate, 8–20 cm long, 4–8 cm in diam., margin undulate, top long-acuminate, upper surface mid-green. Inflorescence long-peduncled; peduncle as petiole, ca. 30–80 cm long; spathe elongate-triangular, 14–40 cm long, 6–14 cm in diam., spathe and limb not differentiated, top acute, outside and inside pale green, becoming yellowish green at male anthesis and then opening wider, base within sometimes with a pale purplish hue, with numerous, slightly distant, small, irregular or conic warts. Spadix sessile, shorter than spathe, 10–26 cm long, appendix with numerous, small, conical warts.

Distribution—Bhutan, Nepal, and Sikkim.

Notes—*Amorphophallus napalensis* is similar to *A. curvistylis* (see descr.) but the latter has a smooth appendix and bilabiate stigmas. This species is often found in cultivation and is usually imported from India in shipments of *A. bulbifer*.

Cultivation—Grow in a rich soil. The tuber may be stored dry when resting.

Fig. 156. *A. napalensis*: inflorescence (photo: B. v.d. Zwaan).

Fig. 157. *A. napalensis*: spadix (detail) (photo: B. v.d. Zwaan).

Amorphophallus odoratus Hett. & H. Li.

Tuber subglobose or depressed-globose, to 12 cm in diam., to 10 cm high, dark brown, developing numerous offsets annually, these shortly elongate-fusiform, 1–3 cm long, ca. 1 cm in diam. Leaf solitary; petiole 30–60 cm long, smooth, green or greyish green with numerous, elongate, confluent, pale green or brownish green spots; lamina to ca. 100 cm in diam.; leaflets elliptic-lanceolate, to ca. 15 cm long and 8 cm in diam. Inflorescence solitary, long-peduncled; 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 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, producing a scent of fresh carrots.

Distribution—China (Hong Kong, New Territories).

Notes—*Amorphophallus odoratus* belongs to a group of species, encompassing a.o. *A. yunnanensis, A. corrugatus, A. kachinensis, A. dunnii, A. putii,* and *A. tonkinensis.* The species are characterized by the following combination of characters: a stipitate spadix (except in *A. tonkinensis*), a variable, conical, hollow appendix, the spadix always shorter than the spathe, a strongly concave, broadly ovate spathe. At least two species in this group develop blue berries. *Amorphophallus odoratus* mostly resembles *A. tonkinensis*

Fig. 158. *A. odoratus*: inflorescence (photo: B. v.d. Zwaan).

Fig. 159. *A. odoratus*: spadix (detail) (photo: B. v.d. Zwaan).

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* it differs in the much larger stigmas and the often echinate appendix and the fusiform offsets. The species group mentioned has a rather well-defined geographical range, comprising northeastern India, northern Myanmar (Burma), northern Thailand, southern China, Laos, and northern Vietnam.

Amorphophallus opertus Hett.

Tuber depressed, to ca. 10 cm in diam., ca. 6 cm high, young parts orange-brown, otherwise dark brown, annually developing numerous, rhizomatous offsets, these to 7 cm long and ca. 1.5 cm in diam. Leaf solitary; petiole to ca. 100 cm long, ca. 2 cm in diam., surface scabrous, background color 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 center, surface with an oily sheen; lamina to ca. 110 cm in diam.; 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, thick-walled, broadly cylindric, transversely oval when spread, 17 cm long, 21–24 cm in diam., lower 10 cm strongly convolute, base broadly

Fig. 160. *A. opertus*: inflorescence (photo: B. v.d. Zwaan).

Fig. 161. *A. opertus*: spathe cut open.

truncated, top acute, base and limb hardly or distinctly differentiated by a shallow or more prominent constriction, strongest at the dorsal side at ca. 5 cm from the base, margin around the opening undulate, outside base near peduncle off-white with a few greyish spots, then with a greyish brown background color 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 part bright emerald-green or purple, base within shallowly verrucate and oozing out a slightly viscous fluid. Spadix sessile, shorter than spathe, 10–12 cm long, nearly entirely hidden by spathe but for the upper part of the appendix.

Distribution—South Vietnam (in open forest).

Notes—*Amorphophallus opertus* is highly similar to *A. koratensis* (see descr.) and *A. scaber* (see descr.) From the first it differs primarily in having an entire stigma, a unilocular ovary, and elliptic-lanceolate leaflets. From *A. scaber* it differs in the same characters as from *A. koratensis* but is also much smaller.

Cultivation—Easily cultivated, this species can be grown in a rich soil, with added loam. The tuber is best left in the soil when dormant, unless it is mature.

Fig. 162. *A. paeoniifolius*: inflorescence (photo: A. Lamb).

Fig. 163. *A. paeoniifolius*: spadix (detail).

Amorphophallus paeoniifolius (Dennst.) Nicolson [syn.: *A. campanulatus* Decne (non Roxb.), *A. dubius* Bl., *A. sativus* Bl., *A. decurrens* (Blanco) Kunth, *A. chatty* André, *A. virosus* N.E.Br., *A. rex* Prain, *A. malaccensis* Ridl., *A. gigantiflorus* Hayata, *A. microappendiculatus* Engl., *A. bangkokensis* Gagnep., *A. dixenii* Lars. & Lars.].

Tuber depressed-globose, to ca. 30 cm in diam., ca. 20 cm high, dark brown, rootscars prominent, annulate, offsets produced every season, these thick rhizomatous, to ca. 10 cm long, ca. 4 cm in diam. Leaf solitary or two; petiole to ca. 2 m long and ca. 20 cm in diam., background color pale to dark green or blackish green, usually with large and small pale blotches and numerous tiny dark dots, the large blotches often confluent, especially near the base, surface shallowly corrugate to strongly echinate-verrucate; lamina highly dissected, to ca. 3 m in diam.; leaflets rounded, oval, ovate, obovate, elliptic, elliptic-oblong, elliptic-lanceolate or lanceolate, acuminate, 3–35 cm long, 2–12 cm in diam., upper surface mid-green, lower surface mid-green or pale green. Inflorescence short-peduncled; peduncle 3–20 cm long, ca. 1–8 cm in diam., usually paler and smoother than petiole; spathe campanulate, broader than long, 10–ca. 40 cm long, 15–ca. 60 cm in diam., base and limb often separated by a shallow constriction, limb spreading, strongly undulate, base outside very variable, background color ranging from pale green to dark brown, usually with large and small, circular paler spots, base inside lower part deep maroon, upper zone dirty whitish or very pale pinkish, limb outside as base but with more prominent maroon flushes, especially near the margin, limb inside usually glossy dark maroon, base within densely verrucate, verrucae variable, mostly conical, fleshy. Spadix sessile, shorter or longer than spathe, 7–ca. 70 cm long.

Distribution—Madgascar, eastwards via India to Malesia, southern China, Indochina, Pol-

ynesia, northern Australia (in almost all imaginable secondary conditions, either secondary forest or highly disturbed areas, in dappled shade or fully exposed areas, alt. 0–700 m).

Notes—The large number of synonyms presented here originates from many an author's attempt to define a set of the variable characters of *A. paeoniifolius* as supporting the separation of new species from the main body of the species. The main body being specimens with large, pyramidal appendices, very long styles, bilobed stigmas and fairly rough petioles. Mostly the spadix is longer than the spathe but in inflorescences developing from small tubers this is reversed, and occasionally the appendix takes a more isodiametric shape, but this may also be found in large specimens. The relative length of the female zone compared to the male zone varies at random. The shape of the male zone depends strongly on the width of the appendix base. When the latter is large, the male zone is often roofed against the underside of the appendix resulting in a strong obconic shape. Alternatively, when the appendix base is narrow, the male zone is cylindric or only slightly obconic. The degree of roughness of the petiole may vary within one clone or specimen but is usually constant. In certain areas roughness is ubiquitous (e.g. in Papua New Guinea) but may vary from rough to near smooth (e.g. Java, India). So far no correlation between any of these characters has been found on a large scale. *Amorphophallus paeoniifolius* has a century old cultivation history in the Asian and Indopacific region and its natural distribution has been totally obscured because many specimens found in the wild are (probably) weedy escapees from cultivation. The closest relative of *A. paeoniifolius* is *A. hirsutus* (see descr.).

Cultivation—Grow in any fertile soil. The tuber may be stored dry when resting.

Amorphophallus palawanensis Bogner & Hett.

Tuber globose, depressed-globose or irregular, 4–11 cm in diam. and to 6 cm high, whitish or pale brown, no offset development. Petiole 30–55 cm long, diam. 0.7–1.8 cm (base), pale green, smooth. Leaf blade divided in three main parts, 35–110 cm diam., leaflets ± elliptic-lanceolate or lanceolate, decurrent, 5–22 cm long, 1–3.9 cm wide, acute to long-acuminate (apex ca. 2 cm long), upper side green. Inflorescence long-peduncled, with three, membranaceous, cataphylls, whithering soon and turning brown, 1.5–7 cm, rounded at the top and apiculate; peduncle 10–38 cm long, 0.3–0.8 cm in diam. (base), pale green with or without a pale brownish hue; spathe broadly triangular, 5.5–14 cm long, to 7.5 cm in diam., slightly constricted at the base of the limb, slightly hooded, purple on both sides but the outside with a greyish hue, the veins and inside base slightly darker, margins more or less reflexed, base of limb ± auriculate, base within smooth or with scattered, shallow, greyish warts, limb acute. Spadix sessile, shorter than spathe, 4.5–9 cm long.

Distribution—Philippines, Palawan Island.

Notes—The species is easily recognized by the following character combination: very small dimensions, spathe brownish purple on both sides, very few female flowers, and laxly disposed male flowers. It does not resemble any other species closely.

Cultivation—Grow in a rich soil, with some added loam. The tuber is best left in the soil when resting. The tuber will divide itself after a few years into a small daughter colony.

Fig. 164. *A. palawanensis*: spathe and spadix (photo: B. v.d. Zwaan).

Fig. 165. *A. palawanensis*: spadix (detail) (photo: B. v.d. Zwaan).

Amorphophallus parvulus Gagnep.

Tuber shortly elongate, often irregularly branched when mature, dark brown, length to ca. 6 cm, diam. at the top to ca. 2.5 cm, multiplying through the loosening of the branches. Leaf solitary; petiole smooth, 13–35 cm long, 0.5–0.8 cm in diam. (base), entirely green, yellowish to reddish brown or streaked purple and greyish; lamina moderately or highly dissected, 16–35 cm in diam.; leaflets obovate to broadly elliptic, acute-acuminate, base decurrent, 2–12 cm long, 1–6 cm in diam., upper surface very dark green to blackish green, margin bright pink, main vein pale yellowish, lower surface greyish green with dark green venation. Inflorescence solitary, long-peduncled; peduncle as petiole, 3–35 cm long, 0.4–0.7 cm in diam. (base); spathe erect, base convolute, limb constricted at the base, margins involute, top fornicate, acute, 4–10 cm long, 2–6.5 cm in diam., outside base pale green with thin brown veins, limb off-white veins paler towards the top, margin with a faint pinkish hue, inside similar, base within sparingly or densely clothed with fleshy, inconspicuous or shortly elongate, warts with thickened and irregularly scabrate top-parts. Spadix sessile longer to much longer than spathe, 8–19 cm long.

Distribution—Central Thailand (in deciduous forest, under bamboo, and in dry deciduous dipterocarp forest, 50–200 m alt.).

Notes—A highly ornamental species because of its dark green leaflets with bright pink margins. It is close to *A. linearis* Gagnep., but the latter has a very long, whip-like appendix, a large, undivided stigma and linear leaflets.

Fig. 166. *A. parvulus*: inflorescence.

Fig. 167. *A. parvulus*: spadix (detail).

Cultivation—Grow in a rich, well-drained soil. The tuber may be stored dry when dormant.

Amorphophallus pendulus Bogner & Mayo.

Tuber subglobose, to ca. 18 cm in diam., no offset development. Leaf solitary; petiole to 90 cm long (but probably longer), ca. 1 cm in diam., smooth, background color reddish or blackish green, with numerous pale green and/or dark green spots; lamina to ca. 80 cm in diam.; leaflets lanceolate, ca. 7–20 cm long, ca. 2–5 cm in diam., acuminate, upper side deep velvety green with silver variegation along the midrib, more rarely entirely green or flushed with reddish-purple, seedling leaves entirely reddish purple. Inflorescence solitary, or developing late in the season alongside the existing leaf (pers. comm. M. Sizemore), long-peduncled; peduncle 20–80 cm long, ca. 0.5–2 cm in diam., colored as petiole; spathe elliptic-lanceolate, 15–32 cm long, 6–13 cm in diam., acute, base convolute, tubular, limb obliquely erect, somewhat hooded over the spadix, outside dark to blackish purple with ± circular, pale green, sometimes confluent spots, more densely arranged near the base, limb inside dark dull violet-purple, with or without small, pale green spots near the margin, basalmost part inside with scattered small warts, blackish, above that a broad, deep wine-red zone and then a narrow pale purplish zone. Spadix much longer than spathe, 27–67 cm long; appendix myosuroid, pendulous, 20–60 cm long.

Distribution—East Malaysia (Sarawak and Sabah), northeastern Kalimantan (primary forest in damp, shady places, on sandstone, elev. ca. 400–800 m.).

Notes—In several respects, one of the most remarkable species. The leaf is highly ornamental, with its complex ornamented petiole and the deep velvety green leaflets with their bright silvery midrib. The pendulous shape of the appendix is another unique feature. Seedlings of *A. pendulus* are entirely reddish brown. *Amorphophallus pendulus* is

Fig. 168. *A. pendulus*: inflorescence (photo: P. Sargent).

Fig. 169. *A. pendulus*: leaf (photo: M. Sizemore).

not quite similar to any other species, although the shape of the spathe is matched by *A. costatus* (see descr.) and *A. linguiformis*.

Cultivation—*Amorphophallus pendulus* has proven to be difficult in cultivation. Grow in a very loose, well-drained, slightly acidic soil. The tuber must never be stored dry. The plant may skip dormancy altogether.

Amorphophallus prainii Hook. f. (syn.: *A. loerzingii* Alderw., *A. panomensis* Gagnep.)

Tuber depressed-globose, 4–25 cm in diam., 2.5–15 cm high, dark brown outside, orangish inside, root scars annuliform thickened, tuber multiplying by gradual off-setting. Leaf solitary, occasionally paired; petiole smooth, rarely slightly rugulose at the base, 10–210 cm long, 0.5–10 cm in diam. at base, soft or rather turgid, background color variable, whitish, greenish or reddish brown, mottled with numerous small, blackish green spots and large, circular or oval, creamy white spots, often confluent and internally with small blackish green spots or with a reddish brown center, sometimes nearly entirely covering the surface, the base often with a bluish purple hue; lamina highly dissected, 10–ca. 250 cm in diam.; leaflets elliptic-lanceolate, long-acuminate, base long-decurrent, 5–28 cm long, 1.5–10 cm in diam. Inflorescence solitary, short-peduncled; peduncle as for petiole but much shorter and sometimes paler, 3–20(–35) cm long, 0.8–6 cm in diam. (base), lengthening strongly in fruit; spathe campanulate, broadly ovate or circular when spread, slightly longer than broad to slightly broader than long, 10–25(–40) cm long, 10–25(–40) cm in diam., base strongly convolute, shallowly constricted at the top, limb obliquely erect during female

Fig. 170. *A. prainii*: inflorescence (photo: B. v.d. Zwaan).

Fig. 171. *A. prainii*: spadix (detail, taken during pollen shed) (photo: B. v.d. Zwaan).

anthesis, strongly reflexing just prior to male anthesis, or more rarely during or shortly after male anthesis, top obtuse or acute, margin often irregularly undulate, base outside yellowish green with whitish spots and streaks or with a purplish hue and whitish spots or very pale pinkish white with small, dark green, punctiform spots and large, rounded, whitish spots, margin pinkish, inside dark maroon, limb outside yellowish green, or bright pale green with whitish spots, the margin without spots and flushed with purple, inside pale yellowish white with bright green stripes along the margin or the latter entirely bright green with some faint whitish spots on the dorsal side, base of spathe within densely clothed with small, shortly ridge-like warts, this part producing a fair amount of fluid during female anthesis that is being collected in the spathe base. Spadix in small specimens shorter than spathe, otherwise longer, 9–35(–55) cm long, shortly stipitate, stipe ca. 1 cm long.

Distribution—Southern Thailand, Malay Peninsula, Indonesia (Sumatra, ?eastern Kalimantan; in scrub, in evergreen forest, on limestone, common in lowland forest, and in open and rocky places, 0–850 m. alt.).

Notes—As in *A. paeoniifolius* (and many other species), the relative dimensions of parts of the inflorescence in specimens of *A. prainii* are extremely variable as a function of the edaphic condition of the tubers (e.g. the appendix varies from nearly globose in small specimens via fusiform to strongly inflated in large specimens). *Amorphophallus prainii* is near to *A. paeoniifolius* in morphology as well as in chromosome number of 2n = 28, which is a rare number in the genus. Marked differences between them are the white or greenish spathe color of *A. prainii*, its shorter style, the smooth petiole and peduncle. *Amorphophallus hirsutus* differs from *A. prainii* in the longer style, the maroon spathe and in having short

bristle-like hairs on the upper part of the appendix, which is always truncate. *Amorphophallus prainii* is a very common species in southern Thailand and all of West Malaysia.

Cultivation—Grow in a rich soil. The tuber may be stored dry when dormant. The tuber will slowly be replaced by daughter tubers when mature.

Amorphophallus preussii (Engl.) N.E. Br.

Tuber depressed-globose, to ca. 10 cm in diam., lacking offset development. Leaf solitary; petiole to 70 cm long, dark greenish with dark brown or blackish, often confluent spots; lamina to 80 cm in diam.; leaflets elongate-elliptic, lanceolate or obovate, to 28 cm long. Inflorescence developing before the leaf, long-peduncled; peduncle to 60 cm long, as petiole; spathe erect, not constricted, to 15 cm long, outside greenish purple to whitish, with purple veins and purple spots, inside dirty whitish, the base dark purple and with very short hairlike papillae. Spadix shorter than spathe, to 8 cm long.

Distribution—Cameroon.

Notes—A quite remarkable, though inconspicuous species. The morphology of the spathe and spadix is much more reminiscent of Asian species than of African. Therefore it cannot be confused with any of the African species and the inflorescence most closely resembles the Asian *A. longituberosus* from which it differs in part in having a globose tuber and an unlobed stigma.

Cultivation—Although only recently introduced into cultivation, *A. preussii* seems to grow well in a well-drained soil but to date not much is known about its longevity in cultivation.

Fig. 172. *A. preussii*: inflorescence.

Fig. 173. *A. preussii*: spathe cut open.

Fig. 174. *A. pusillus*: inflorescence (half buried).

Fig. 175. *A. pusillus*: inflorescence exposed, spathe cut open.

Amorphophallus pusillus Hett. & Serebr.

Tuber short, elongate, slightly irregular, to 3.5 cm long, ca. 2 cm in diam., weighing ca. 10 gr, dirty white to pale brownish, producing small, globose offsets. Leaf solitary; petiole to ca. 8 cm long, ca. 3 mm in diam.; lamina to ca. 30 cm in diam.; leaflets 5, elliptic, acute-acuminate, to ca. 11 cm long, ca. 5 cm in diam., upper side moderately glossy dark or mid-green, with or without round, white spots, most numerous and confluent near the midrib. Inflorescence ± short-peduncled, half buried; peduncle hypogeal, 0.2–2 cm long, 1–2.5 mm in diam., white, smooth. Spathe broadly triangular, tubular, 2–3 cm long, 2.5–3.4 cm in diam., acute-apiculate, limb poorly differentiated, short-triangular, base truncated, lower 0.5–0.8 cm connate, remaining part convolute, outside pale pinkish with darker veins, a pale brownish hue and some scattered, larger, irregular blackish spots, near the margin and near the top confluent to uniformly blackish brown, inside base pale violet, upwards sharply delimited by a narrow, dark violet margin, above that as on the outside but slightly paler, base within smooth with slightly raised veins or more distinctly ridged, and with a few, scattered, shallow elevations. Spadix sessile, longer than spathe, 4.4–6.5 cm long.

Distribution—South Vietnam (in dipterocarp forest on sand).

Notes—*Amorphophallus pusillus* is the smallest species and possesses many (near) unique characters. Quite surprising is the existence of individuals with variegated leaves and those with entirely green leaves. Its general likeness is to *A. harmandii* Engl. & Gehrm. (Cambodia), the latter differing in being larger, having a long peduncle, the spathe being entirely epigeal, spathe base convolute, having 2- or 3-locular ovaries and 2-4-staminate male flowers.

Cultivation—Grows well in a well-drained, average potting soil. The tuber must be left in the soil when resting.

Fig. 176. *A. pygmaeus*: inflorescence (photo: B. v.d. Zwaan).

Fig. 177. *A. pygmaeus*: spadix (detail) (photo: B. v.d. Zwaan).

Amorphophallus pygmaeus Hett.

Tuber elongate, or globose, rarely branched, brown, ca. 4 cm in diam. and ca. 4 cm long. 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., rachises narrowly winged only in the distal branches; leaflets elliptic-lanceolate, obovate or oblong, base long or short-decurrent or constricted, 3–10 cm long, 1.0–6.0 cm in diam., upper surface very dark velvety green, lower side flushed with purple-red. Inflorescence solitary, long-peduncled; peduncle like petiole but longer, 18–36 cm long, 0.5–0.8 cm in diam. (base); spathe triangular, base 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.

Distribution—Central and eastern Thailand (in crevices on limestone, 200–500 m).

Note—*Amorphophallus pygmaeus* resembles *A. parvulus* but the appendix is shorter and thicker, the stigmas often hemispheric. Compared to *A. brevispathus* it has much smaller leaves, a smaller spadix and a connective which does not rupture at anthesis. The leaf is very beautifully velvety green on the upper surface, while the lower surface is entirely reddish brown.

Cultivation—Grow in an average, rich soil. The tuber can be stored dry during resting.

Fig. 178. *A. sagittarius*: inflorescence.

Fig. 179. *A. sagittarius*: spadix (detail).

Amorphophallus sagittarius Steenis.

Tuber subglobose, yellowish brown, ca. 6 cm in diam., ca. 4–5 cm high, no offsets but gradually disintegrating into new tubers, accessory buds in slightly raised groups. Leaf solitary; petiole smooth, slender, turgid, 30–40 cm long, ca. 1 cm in diam. (base), ground color varying from dark green near the base to mid-green above, marbled with slightly paler, bright green spots with a bicolored margin, viz. very pale whitish green and blackish green, to the top of the petiole nearly covering the entire surface; lamina 60–80 cm in diam.; leaflets elliptic-lanceolate, acuminate, 6–23 cm long, 2.5–9 cm in diam., upper surface moderately glossy green, lower surface greyish green, venation impressed in the upper surface. Inflorescence solitary, short- to medium long-peduncled; peduncle 12–21 cm long, 0.5–0.8 cm in diam., as petiole or with an extra brownish hue; spathe erect, 13–16 cm long, 9–10 cm in diam., ovate or ovate-lanceolate, obtuse or acute, more or less twisted near the top, outside base pale brown with large or small, pale green or white, isolated or partly confluent spots, inside whitish green or off-white, limb outside largely maroon, glossy, inside maroon, glossy, base within with many small warts. Spadix subequalling or equalling the spathe, sessile, 13–15.5 cm long.

Distribution—Indonesia, western Java.

Notes—*Amorphophallus sagittarius* is the smallest species on Java. The relatively short peduncle, the spadix equalling the spathe, easily distinguish it from small specimens of *A. variabilis* Bl. The short petioled leaf with the wide blade distinguish this species in the vegetative state.

Cultivation—Grow in a well-drained soil. The tuber must not be stored dry.

Fig. 180. *A. salmoneus*: spathe and spadix (photo: B. v.d. Zwaan).

Fig. 181. *A. salmoneus*: spadix (detail) (photo: B. v.d. Zwaan).

Amorphophallus salmoneus Hett.

Tuber depressed-globose, 4–15 cm in diam., 3–9 cm high, white, surface slightly irregular through shallow raised areas, developing several offsets, these subglobose, at first entirely attached to the tuber, loosening the next growing season or reabsorbed entirely, ca. 2 cm in diam. Leaf solitary; petiole smooth, entirely green or with a few scattered, small, white dots, rather turgid, 5–70 cm long, to ca. 2.5 cm in diam. (base); lamina to 110 cm in diam.; leaflets elliptic-lanceolate, long acuminate (acumen 3–4 cm long), base shortly decurrent, upper side 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. (base); spathe ovate-triangular, acute, 9–20 cm long, 6–10 cm in diam. (at broadest point), lower 3.5–6 cm convolute, tubular with a slight apical constriction, outside pale whitish green or pale magenta, inside pale green, 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 the top third part. Spadix sessile, 9.5–20 cm long, equalling the spathe; between the male and female parts a zone with slightly rugulose, semi-flattened sterile male flowers (staminodes).

Distribution—Philippines, Palawan, and Langen Island (in soil pockets on limestone slopes).

Notes—*Amorphophallus salmoneus* resembles *A. krausei* (see descr.) but differs from it a.o. in appendix structure (longer and verrucate), shape of the spathe (tubular base), shape of stigma (bilabiate) and leaf structure (leaflets shorter and broader). The geog-

raphy of *A. salmoneus* is somewhat remarkable, since its closest relatives are all found much more westward (Thailand).

Cultivation—Easily grown in a rich soil. The tuber may be stored dry when resting.

Amorphophallus scaber Serebr. & Hett.

Tuber subglobose or depressed-globose, to ca. 20 cm in diam. and ca. 15 cm high, dark brown with numerous, strongly thickened, annular root scars, seasonally developing offsets, these rhizomatous, to ca. 20 cm long and ca. 2 cm in diam. Leaf solitary or paired; petiole to 180 cm long and ca. 6 cm in diam. at the base, strongly scabrate-verrucate, background color in juvenile plants usually dark brown and with scattered whitish spots, in mature plants dark olive-green (the base somtimes nearly black with a pinkish hue), nearly entirely covered by large, rounded to elliptic, confluent, whitish or pinkish, large spots with a dark green center, to the top of the petiole grading to whitish green and elliptic, verrucae elongate and often laterally fused; lamina to ca. 180 cm in diam.; leaflets elliptic, elliptic-oblong or lanceolate, often asymmetric, acuminate, subcoriaceous, 6–22 cm long and 3.5–9 cm broad, base decurrent on one side, primary and secondary veins deeply impressed, upper side green, margin at first reddish violet, later whitish. Inflorescence solitary, near sessile or short-peduncled; peduncle densely verrucate, paler than petiole, (1-)5–10 cm long, 0.9–2.2 cm in diam.; spathe erect, broadly ovate, for the greater part convolute, hooded, only slightly opened at anthesis, coriaceous, 16–30 cm long, 15–

Fig. 182. *A. scaber*: inflorescence (photo: A. Vogel).

Fig. 183. *A. scaber*: spathe cut open.

32 cm in diam., apex acute, base strongly truncated, base and limb separated by a shallow constriction, outside dirty green or grey with a greenish hue, with scattered, whitish circular spots and more numerous blackish, punctiform spots, limb often with a brownish or purplish hue, base inside very dark maroon, verrucate, limb inside bright pale green with occasional small, white spots and a brownish upper margin. Spadix subsessile, shorter than spathe and largely hidden by it, 9–25 cm long.

Distribution—Vietnam, Laos.

Notes—*Amorphophallus scaber* belongs to an as yet informal species-group with *A. hirsutus, A. koratensis, A. opertus, A. paeoniifolius,* and *A. prainii,* and which are recognized by their tubers having large, annulate, thickened root scars, elongate offsets, large, lobed stigmas, very long and narrow anthers and often scabrate-echinate petioles. *Amorphophallus scaber* mostly resembles *A. koratensis* and *A. opertus,* especially because these species share the hooded, narrowly opening spathe. *Amorphophallus koratensis* differs in having smaller dimensions and a much smaller, massive, acute, triangular appendix, sometimes with deep cracks at the base; *A. opertus* differs a.o. in having entire stigmas and unilocular ovaries. All other species of this group possess campanulate spathes. The leaf of *A. scaber* seems unique in this group in carrying reddish violet margined leaflets.

Cultivation—Grow in a fertile soil with added loam. The tuber may be stored dry when dormant.

Fig. 184. *A. smithsonianus*: inflorescence.

Fig. 185. *A. smithsonianus*: spadix (detail).

Amorphophallus smithsonianus Sivad.

Tuber depressed-globose, circumference irregular through raised areas, 2–9 cm in diam., to ca. 4 cm high, pale brown, smooth, gregarious through gradual offsetting. Leaf solitary; petiole 27–58 cm long, 1.1–1.9 cm in diam. at the base, smooth, pale greyish green with numerous, small whitish spots; lamina ca. 50 cm in diam.; leaflets oblong-elliptic, 6–16 cm long, 2.5–6 cm in diam., acuminate, margin finely serrate, upper surface moderately glossy mid-green. Inflorescence solitary, long-peduncled; peduncle largely covered by the largest cataphyll, 11–14 cm long, 0.6–0.9 cm in diam., as petiole; spathe very broadly ovate, broader than long, 4–5.5 cm long, 5.5–6 cm in diam., acute, base and limb not differentiated, outside pale green or greenish yellow, near the top with minute purple dots; inside as outside but base dark purplish and densely covered with slightly elongate, fleshy, small warts. Spadix sessile, longer than spathe, 21–30 cm long, between male and female parts a short zone of globose sterile male flowers (staminodes); appendix strongly arching.

Distribution—Southwestern India (in humus on rocks and in rock crevices in evergreen forests).

Notes—The general morphology of *A. smithsonianus* is similar to that of *A. sylvaticus* of southern India and Sri Lanka. The latter differs in having entire leaf-margins, a stipitate spadix, staminodes semi-flattened, stigmas 2–3-lobed and pollen verrucate. The serrate leaf margins at once set *A. smithsonianus* apart from all other species.

Cultivation—Readily grown in a rich mixture with some added loam. The tubers can be stored dry when resting. In cultivation this species stays very long in leaf and may flower very shortly after the leaf has died down. If not planted in time, the inflorescence bud will desiccate and abort.

Fig. 186. *A. sparsiflorus*: inflorescence (photo: A. Hay). Fig. 187. *A. sparsiflorus*: spathe cut open (photo: A. Hay). Fig. 188. *A. sparsiflorus*: population in leaf, incl. seedlings (photo: M. Sizemore).

Amorphophallus sparsiflorus Hook. f. (syn.: *A. microspadix* Engl. & Gehrm., *nom. illeg.*).

Tuber globose. Leaf solitary; petiole ca. 40 cm long, slender, pale red-brown with dark purplish brown spots, developing an intercalary bulbil on top, this obtriangular in longitudinal section, ca. 2 cm long and 1.5 cm in diam.; lamina ca. 50 cm in diam., with very few, large segments, these green shaded with red or entirely red-brown, rachises very short, narrowly winged; leaflets elliptic-lanceolate, acuminate, 19–23 cm long, 4–6 cm in diam. Inflorescence solitary, short-peduncled; peduncle 2.5–7 cm long; spathe erect, elongate-triangular, acute, 14 cm long, ca. 5 cm in diam., outside pale red-brown with dark purplish brown spots, basal margin of the limb revolute, inside reddish brown with scattered, rounded, white spots, base within with numerous interconnected ridges, epidermal cells distinctly conic. Spadix sessile, shorter than spathe, 9.5 cm long.

Distribution—West Malaysia.

Notes—The very lax disposition of the flowers in this species makes it distinct from all other Asiatic species. The leaves of seedlings are entirely reddish brown. *Amorphophallus sparsiflorus* is related to both *A. bufo* and *A. manta*, sharing with these the shape and peculiar color pattern of the spathe, but it is much smaller than either of those two.

Cultivation—Grow in a very well-drained, loose soil. The tuber must be left in the soil when dormant.

Fig. 189. *A. stuhlmannii*: inflorescence and developing leaf (photo: Royal Bot. Gard. Kew).

Amorphophallus stuhlmannii (Engl.) Engl. & Gehrm.

Tuber depressed-globose, to 30 cm in diam., offsetting behavior unknown. Leaf solitary; petiole to 250 cm long, purple pink with green spots, or dark green with purple spots [ssp. *congoensis* (Hawkes) Ittenb.]; lamina to 3 m in diam.; leaflets oval, to 22 cm long. Inflorescence developing alongside the emerging leaf, long-peduncled; peduncle to 150 cm long, as petiole. Spathe to 60 cm long, with only a faint constriction between base and limb, base outside olive-green with whitish spots, inside purple and covered with hairs, limb outside olive-green to purple, with whitish greenish spots, towards the margin becoming purple, inside purple (?). Spadix longer than spathe, to 90 cm long.

Distribution—Tanzania, Zaire.

Notes—*Amorphophallus stuhlmannii* is the tallest of the African species and differs from all other congeners in the long, acute conical lobes of the style. In general stature it resembles *A. angolensis*.

Cultivation—Not known in cultivation.

Amorphophallus titanum (Becc.) Becc. ex Arcang. (syn.: *A. selebicus* Nakai).

Tuber depressed-globose, up to 65 cm in diam., up to 40 cm high, weighing up to ca. 75 kg., surface brown with many grouped accessory buds, inside dirty white, very soft, greasy, no offset development. Leaf solitary; petiole 1–ca. 5 m long, 20–30 cm in diam. (base), turgid, smooth, green or dark green, with large, oval to rounded, pale green spots; lamina up to 7 m in diam.; leaflets elliptic-lanceolate, up to 40 cm long, 13 cm in diam.,

Fig. 190. *A. titanum*: inflorescence (photo: Rijksherbarium Leiden).

Fig. 191. *A. titanum*: spathe cut open.

acuminate, leathery, upper side green, moderately glossy. Inflorescence solitary, short-peduncled; peduncle ca. 30–70 cm long, ca. 10–15 cm in diam., colored as petiole, lengthening in fruit (up to ca. 150 cm long); spathe campanulate, very broadly triangular, 40–160 cm long, limb spreading, rim-shaped, margin plicate and with many, small, triangular, obtuse lobes, veins of the limb strongly developed, raised, outside base pale green with whitish spots, to the margin suffused with dirty purplish brown, inside base purplish, above that a broad, dirty yellowish zone, limb dark purplish brown, base within verrucate; the entire spathe shed at fruiting. Spadix sessile, much longer than spathe, ca. 1–3 m long.

Distribution—Indonesia, Sumatra (frequently in semi-open spaces in young secondary forest, more rarely in shaded places in primary forest. In flat terrain and on steep hillsides, alt. 0–1200 m).

Notes—The discovery of *A. titanum* by Beccari in 1878 stirred much disbelief among European botanists until the first specimen in cultivation flowered in June 1889 at Kew. The species cannot easily be confused with any of its congeners since its dimensions are unique. The inflorescence (excl. peduncle) is the largest found in the entire Araceae family. On Sumatra, the dimensions of the leaf are only matched by *A. gigas* (see descr.) but the latter has a much more complicated color pattern on the petiole, and the leaflets are considerably smaller and less leathery. *Amorphophallus titanum* also possesses the largest individual female flowers of the entire genus and the largest berries (to ca. 5 cm long). *Amorphophallus selebicus* Nakai was said to be found on Sulawesi. A note by v. Steenis, accompanying the holotype, states that this locality is in error. Nakai mentions the development of "bulblets" by this species, which remain attached to the main tuber. Nakai probably observed the development of accessory tubers from activated accessory buds on the main tuber. This is usually seen when the main shoot is damaged or is disturbed in its normal speed of development.

Cultivation—Grow in a very rich but well-drained soil (and buy an XXL pot!). The tuber is best left in the soil when resting.

Amorphophallus tonkinensis Engl. & Gehrm.

Tuber depressed-globose, at least 9 cm in diam., brown, somewhat glossy, rootscars slightly raised, no offsets observed. Leaf solitary; petiole ca. 80 cm long, ca. 2.5 cm in diam. at the base, smooth, turgid, background color pale greyish green with a clear bluish flush near the base and on the subterraneous part, spots whitish, often broader than long, irregularly shaped, scattered over the entire surface short, longitudinal, blackish lines; lamina highly dissected, ca. 110 cm in diam.; leaflets lanceolate, 8.5–24 cm long, 3.5–6 cm in diam., long acuminate. Inflorescence solitary, long-peduncled; peduncle as petiole, 22–50 cm long, ca. 1 cm in diam. Spathe erect, oval, 8–20 cm long, ca. 5–17 cm in diam., strongly concave, top arching over spadix or erect, base shortly convolute, outside green with a few transverse, whitish spots, inside whitish green with small, punctiform or slightly elongate verrucae, outside limb dark green with an obscure blackish purplish flush and a few scattered, small whitish dots, inside bright green with a few small, whitish spots. Spadix sessile, shorter than or nearly as long as spathe, 7.5–17 cm long.

Distribution—North and central Vietnam.

Notes—*Amorphophallus tonkinensis* resembles *A. yunnanensis* strongly but differs in having a very different petiole patterning, long acuminate leaflets, a sessile spadix, and

Fig. 192. *A. tonkinensis*: inflorescence.

Fig. 193. *A. tonkinensis*: spathe cut open.

a twice as large stigma. Though *A. tonkinensis* is clearly a member of a species group with a.o. *A. yunnanensis, A. corrugatus,* and *A. kachinensis,* it differs from all in having a sessile spadix.

Cultivation—Grow in a well-drained soil. The tuber must be left in the soil when dormant.

Amorphophallus variabilis Bl.

Tuber depressed-globose, to ca. 15 cm in diam., to ca. 8 cm high, white, producing numerous annual offsets, these shortly spindle-shaped, ca. 1–1.5 cm long. Leaf solitary or occasionally two; petiole to 120 cm long, ca. 3.5 cm in diam. (base), smooth or slightly rugose at the base, entirely green (var. *immaculatus* Hassk.) or a green, olive-green or dark brown background color, variously variegated with large and small, confluent and free, oval, rounded or elongate spots of dark green, white, greyish green, extremely variable; lamina to 125 cm in diam.; leaflets elliptic to elliptic-lanceolate, acuminate to long-acuminate, 4–34 cm long, 2–12 cm in diam., upper surface moderately glossy, mid-green. Inflorescence solitary, long-peduncled; peduncle as petiole, 8–120 cm long, 0.4–3 cm in diam. (base); Spathe erect, elongate triangular, acute, a slight constriction between base and limb, 6–23 cm long, 5–20 cm in diam., limb near the base suddenly narrowed, margin of limb strongly reflexed, outside entirely green or dirty green with scattered, small, black dots, to the margin suffused with brown, the veins pale greenish, inside base maroon, reddish brown, orange or yellowish, the rest creamy white, limb inside creamy white, pale green or pale reddish brown, base within with numerous, small, laterally

Fig. 194. *A. variabilis*: spathe and spadix.

Fig. 195. *A. variabilis*: spadix (detail) (photo: B. v.d. Zwaan).

flattened warts and oozing out a clear fluid during anthesis. Spadix sessile, usually much longer than spathe, 9–58 cm long.

Distribution—Indonesia: Java, Madoera, and the Kangean Archipelago (common everywhere on Java in secondary vegetations with some shade but never in deep shady forest, in plantations, in teak forests and in villages, in many soil types but never in swampy places, 0–700 m alt.).

Notes—*Amorphophallus variabilis* has repeatedly been reported from outside Java (e.g. Philippines, Thailand, India, Sri Lanka, Malaysia) but these are all misidentifications. *Amorphophallus variabilis* is similar to *A. asper* (Sumatra) but the latter has a different pollen type and a green spathe on a maculate peduncle, a combination not known in *A. variabilis*. Unfortunately, very little is known about *A. asper*.

Cultivation—Grow in any average soil with some added loam. The tuber may be stored dry when resting.

Fig. 196. *A. yuloensis*: inflorescence (photo: A. Vogel).

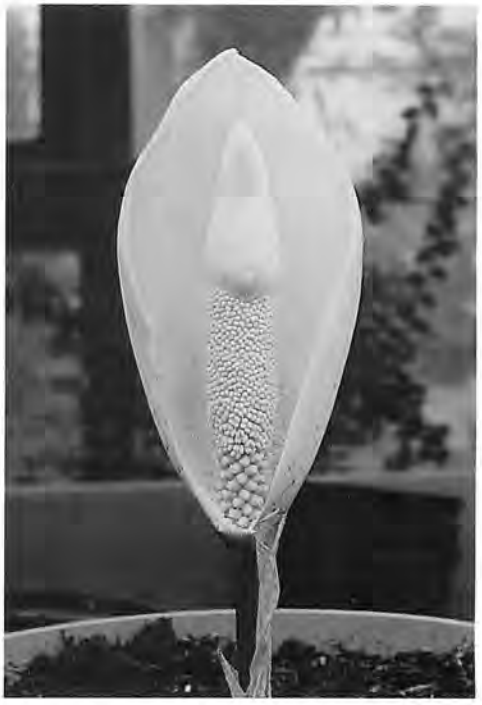

Fig. 197. *A. yuloensis*: spathe cut open (photo: B. v.d. Zwaan).

Amorphophallus yuloensis H. Li.

Tuber ca. 10 cm in diam., subglobose, lacking offset development. Leaf solitary; petiole ca. 60 cm long, uniformly pale green, or with a few darker striations/spots the top transforming into a half-epiphyllar bulbil; lamina ca. 80 cm in diam.; leaflets elongate-elliptic, to ca. 15 cm long, to ca. 8 cm in diam., pale green. Inflorescence short-peduncled; peduncle to 10 cm long, to 8 mm in diam., smooth, dark olive-green with fine, darker, short striations/spots; spathe erect, concave, margins incurvate, 11 cm long, 10 cm in diam., broadly ovate, obtuse, outside base pale greenish with small, punctate blackish green dots, center very pale pinkish with similar dots, upper part dirty creamish with scattered, greyish black dots, inside base pale pink with numerous white verrucae, upper part dirty cream; spathe on second day open to the base. Spadix subsessile, shorter than spathe, 8.5 cm long, producing a lemon-like scent. Berries blue.

Distribution—China (Yunnan).

Notes—The description here presented is based upon one flowering specimen, of which the identification has not yet been confirmed but seems to be correct. *Amorphophallus yuloensis* at first glance seems close to *A. bulbifer* but differs in the half-epiphyllar bulbils, distinct style, stigma diameter much smaller than ovary diameter, ovary bilocular, pale green (vs. red). Generally this species has smaller dimensions. The presence of blue berries and the concave spathe indicate that *A. yuloensis* may belong to the informal *A. yunnanensis* group (see descr.).

Cultivation—Of easy cultivation in any average, rich soil. The tuber may be stored dry when dormant.

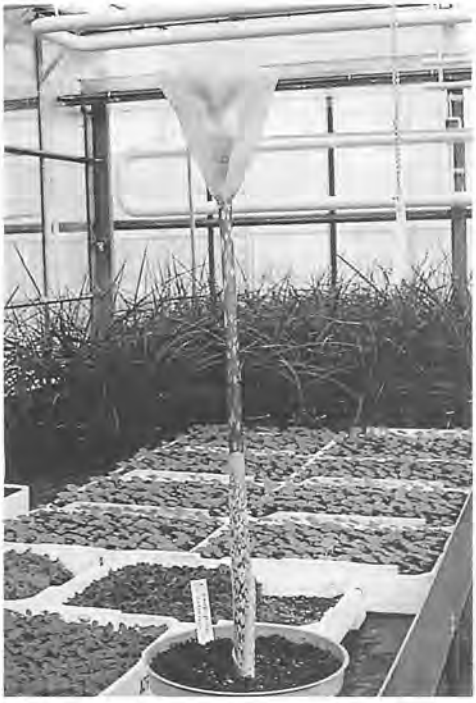

Fig. 198. *A. yunnanensis*: inflorescence (photo: B. v.d. Zwaan).

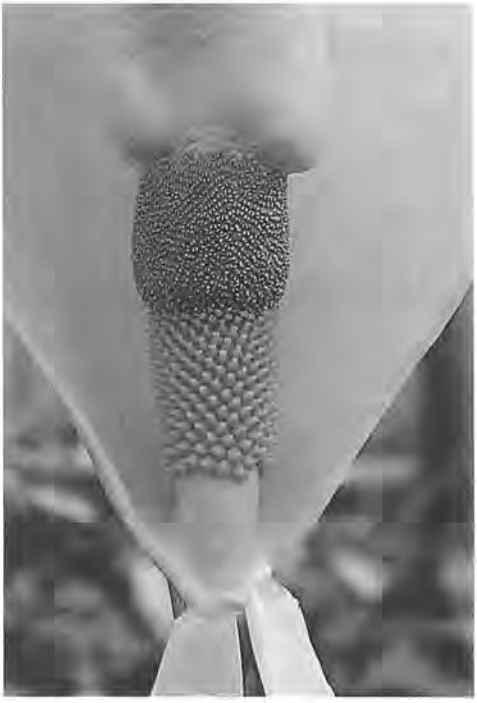

Fig. 199. *A. yunnanensis*: spadix (detail) (photo: B. v.d. Zwaan).

Amorphophallus yunnanensis Engl. (syn.: *A. kerrii* N.E.Br.).

Tuber depressed-globose, to 13 cm in diam. and 9 cm high, dark brown, white or yellow inside, seasonally developing several offsets; offsets rounded or elliptic, sessile, to 1.2 cm in diam. and 2.5 cm long. Leaf solitary; petiole smooth, medium to dark olive-green or dark olive-brown with several rhombic or elliptic-elongate, pale whitish greenish spots, 10–80 cm long, 0.5–2.5 cm in diam. (base); lamina highly dissected, to 140 cm in diam.; leaflets elliptic, top acuminate, base broadly decurrent, 10–40 cm long, 5–13 cm in diam., upper side dark green, often with a bluish sheen when young, margin often narrowly violet, lower side paler. Inflorescence solitary, long-peduncled; peduncle 13–60 cm long, 1–2 cm in diam. (base), colored as petiole; spathe erect, concave, shortly overarching the spadix, broadly ovate, obtuse or acute, 9–29 cm long, 4–15 cm in diam., base shortly convolute, inside base smooth or with a few scattered, punctiform warts, outside white or pale greenish white, rarely dark green, sometimes near the base with paler, occasionally ring-like spots, or sometimes flushed with pale pinkish, the margin sometimes pinkish, inside pale greenish white without spots, limb outside dirty creamish, sometimes with faint spotting, margin sometimes pale pinkish violet, inside creamish or pale greenish white, the margin sometimes pale pinkish-violet. Spadix much shorter than spathe, 3–15 cm long, stipitate, stipe 0.5–2.5 cm long, pale green with whitish spots. Berries one- or two-seeded, at first green, at maturity turning blue and finally violet.

Distribution—China (Yunnan), northern Thailand, North Vietnam (in shaded places in primary, evergreen or mixed evergreen/deciduous forest, on metamorphic bedrock, in rich soils, 100–3300 m.).

Notes—*Amorphophallus yunnanensis* is very similar in appearance to *A. putii* but the

latter has a spadix subequalling the spathe and a different color pattern on petiole, peduncle, and spathe. *Amorphophallus kachinensis* and *A. corrugatus* also resemble *A. yunnanensis*. Both species, however, have a unilocular ovary and an often deeply fissured, stipitate appendix and the spathe mottled with reddish purple spots, especially on the inner side.

Cultivation—A strong growing species in a rich soil. The tuber may be stored dry when dormant.

Amorphophallus zenkeri (Engl.) N.E. Br.

Tuber depressed-globose, to 10 cm in diam, lacking offset development. Leaf solitary, developing well before the inflorescence and then quickly dying down; petiole to 130 cm long, greenish, the base with reddish to purplish spots; lamina to 100 cm in diam.; leaflets elongate-oval to broadly oval, to 20 cm long. Inflorescence developing after the leaf, short-peduncled; peduncle to 8 cm long; spathe broadly urceolate, to 24 cm long, base and limb separated by a constriction, base outside greenish pinkish purple with rounded, bright green spots, inside basal part purple and with whitish to purplish hairs, upwards a narrow whitish to bright green zone, lamina short and sometimes collar-shaped [ssp. *mannii* (N.E. Br.) Ittenb.], outside purple but the base whitish greenish with small dark green or brownish spots, inside glossy or dull purple. Spadix longer than spathe, to ca. 60 cm long.

Distribution—Cameroon, Nigeria, Equatorial Guinea (Fernando Po).

Fig. 200. *A. zenkeri*: inflorescence.

Fig. 201. *A. zenkeri*: spadix (detail).

Notes—A species with a magnificently colored spathe interior in which purple and whitish zones contrast strongly. Its flowering behavior (leaf well before inflorescence) deviates from all other African species, and most Asian ones as well. It resembles *A. canaliculatus* but the latter has a strongly grooved appendix base.

Cultivation—Easily grown in a well-drained rich soil. The tuber must be left in the soil when dormant.

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