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The Genus *Alocasia* (Araceae-Colocasieae) in West Malesia and Sulawesi

A. HAY

Royal Botanic Gardens Sydney, Mrs Macquaries Road, Sydney 2000, Australia

Abstract

Alocasia (Schott) G. Don is revised for West Malesia and Sulawesi. Thirty one species are recognised, including one extremely variable species, *A. longiloba* Miq. *s. l.*, in which seven incompletely delineable informal entities are further recognised. Ten species are new to science. The history, geography, ecology and morphology of the genus and conservation status of its species are discussed and foci for further study are briefly delineated. A key to species is provided. Approximately 25% of names are epi- or neotypified owing to lack of adequate original material - a situation deriving mainly from the horticultural history of the genus. New synonyms include *A. margaritae* L. Linden & Rodigas, *A. ovalifolia* Ridl., *?A. crassinervia* Engl. = *A. puber* (Hassk.) Schott; *A. imperialis* L. Linden, *A. guttata* N.E. Br., *A. villeneuvei* L. Linden = *A. scabriuscula* N.E. Brown; *A. porphyroneura* Hallier f. = *A. princeps* W. Bull; *A. grandis* N.E. Br. = *A. macrorrhizos* (L.) G. Don; *A. nobilis* Hallier f, = *A. inornata* Hallier f.; *A. bantamensis* Koord., *A. crassifolia* Engl. = *A. alba* Schott; *A. lowii* Hook., *A. korthalsii* Schott, *A. denudata* Engl., *A. putseyzii* N.E. Br., *A. eminens* N.E. Br., *A. watsoniana* Mast., *A. curtisii* N.E. Br., *A. cuspidata* Engl. = *A. longiloba* Miq. *s. l.*. *Alocasia perakensis* Hemsl. is reinstated. Indian *Alocasia montana* (Roxb.) Schott is considered a synonym of *A. macrorrhizos*.

Contents

Aims, Scope and Limitations

The present review is, as with previous papers on this genus covering other parts of Malesia (Hay & Wise, 1991; Hay, in press), limited to an 'alpha-taxomonic' review of the species as a precursor to a treatment for Flora Malesiana (see Hay, 1994b) and aims to bring understanding of the genus to a basis point for more intensive phylogenetic, molecular, biogeographic and ecological analyses. *Alocasia* species are widely cultivated as ornamental plants and often abundant in the herb layer and gap phase of forests, and there is an urgent need for the means of identification of species. Defining species through standard herbarium-based methods is difficult, as the plants are generally unpleasant to collect and unsuited to herbarium preservation, often having enormous leaves and rhizomes, soft parts, often complex and bulky synflorescences, ephemeral inflorescences and irritant sap, and they are phenotypically variable. Moreover, they are highly attractive to herbarium beetles and the percentage of specimens with well preserved floral parts is minute.

Field work and the assembling of a living collection, in which sterile field-collected plants can be brought to flower, has been an essential prerequisite to this revision. While this has enabled many species to be described from fresh material, there still remain a number known only from herbarium specimens, and a number in which variability has to be interpreted almost solely from the inadequate resource of dried material. Many cultivated accessions have been cited, from which further preserved material will be distributed to relevant herbaria in due course. The convention I have used in citing these is to give the RBG Sydney Accession Number as well as the original collection number. Wild-collected vouchers bear only the original collection number, while preserved specimens made from the cultivated plants bear both numbers.

Infrageneric species groups have been recognised informally, as it is beyond the scope of the present work to engage in the rigorous analysis of species relationships that would justify formal infrageneric nomenclature. Comment on the coherence or otherwise of the informal groups may be found under each in the body of this paper. The division of the genus into two formal sections based on stigma shape, as proposed by Engler &

Krause (1920) is plainly unsatisfactory. It splits the Longiloba Group, for example, presumably on misobservation, and aligns, in Sect. Ensolenanthe, *A. zebrina* Schott ex van Houtte (Philippines) with *A. cuprea* and members of the *A. longiloba* complex - a very probably heterogeneous assemblage.

History

The first Malesian *Alocasia* species were attributed, as were many monoecious aroids before the advent of Schott, to the genus *Arum*. In the pre-Linnean period, Rumphius (1747) illustrated two 'species' (within which he recognised further 'species' in his discussion), *Arum indicum sativum* and *Arum sylvestre*. The former was the widespread *Alocasia macrorrhizos* (L.) G. Don, for which, as the genus becomes better understood in the wild state, there is a growing body of evidence that it is a cultigen associated almost entirely with human habitation and agriculture as an inferior starch crop. *Arum indicum sativum* was taken up by Loureiro (1790) as *Arum indicum* Lour., the basionym of *Alocasia indica* (Lour.) Spach, now recognised as a synonym of *A. macrorrhizos*. *Arum sylvestre* has remained of obscure identity, though Hasskarl (1844) considered it perhaps identical with West Malesian *Colocasia pubera* Hassk. (= *Alocasia puber* (Hassk.) Schott). That interpretation seems incorrect, however, and it seems more plausible that *Arum sylvestre* is *A. aequiloba* N.E. Br., an East Malesian species.

The generic name *Alocasia* was first attributed to Necker by Rafinesque (1837: 64) for some aroid species now in *Arisaema*. The name was earlier used by Schott (1832), the first significant specialist in the taxonomy of Araceae, as a section in *Colocasia*. That concept of *Alocasia* was raised to generic rank by Don in Sweet (1839), with the Indochinese *A. cucullata* (Lour.) G. Don as the type. The name has been used in Schott's and Don's sense ever since, with Nicolson (1963) proposing it be conserved over *Alocasia* Rafinesque. Early species now in the genus were described or combined in *Colocasia* for some time after Don with Kunth (1841) transferring *Arum indicum* Lour. into *Colocasia* and Hasskarl (1842) misapplying *Colocasia odora* Roxb. to (probably) *Alocasia macrorrhizos* and *Colocasia montana* (Roxb.) Kunth to *Alocasia flemingiana* (a species newly described here). In 1844 he called one of the earliest described (post-Linnean) Malesian endemic *Alocasia* species *Colocasia pubera* Hassk. Hasskarl further recognised several forms of *Alocasia macrorrhizos* (now best regarded as cultivars) in *Colocasia*. However, from Miquel (1855) onward, *Alocasia* has been consistently treated by botanists of Malesian aroids, including Hallier, Ridley, Hemsley, Koorders, and more recently Backer & Bakhuizen and Hotta as a genus distinct from *Colocasia*, though

probably deliberately misleading to commercial competitors.

This has resulted both in a high level of new synonymy, and, together with the WWII destruction of the herbaria at Vienna and Berlin, where the two great figures in Araceae taxonomy, Schott and Engler, worked, a particularly large number of cases of difficulty in interpreting the application of names in this genus, requiring the neotypification or epitypification of no less than a quarter of them.

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Ecology

Alocasia species are predominantly lowland tropical plants of 'ever-wet' areas. A few species, such as *A. perakensis* and *A. kerinciensis* are montane elements, though few occur above about 1200 m alt. and none above about 2000 m alt. in the region under study here. Some species, such as *A. princeps*, have wide altitudinal ranges. Several species, such as *A. sarawakensis*, *A. minuscula* and *A. puber* show a preference for or restriction to swampy habitats, while others, such as *A. princeps* and *A. beccarii*, are restricted to well-drained sites. Several are facultative or obligate lithophytes, including *A. longiloba* 'watsoniana', *A. longiloba* 'lowii', *A. principiculus*, *A. puteri*, *A. pangeran, A. ridleyi*, *A. venusta* and *A. reversa*.

Detailed information is often lacking, but some species are associated with or confined to particular substrates. *Alocasia melo* is confined to ultramafic areas. *A. reversa*, *A. venusta*, *A. ridleyi*, *A. puteri*, *A. pangeran*, *A. principiculus* are confined to limestone areas. *A. minuscula* is known only from peat swamp forest. Several species do not appear to be much influenced by substrate - for example, *A. cuprea* is found on sandstone, limestone and in ultramafic areas, and *A. princeps* occurs on a wide variety of substrates, limestone, sandstone, shale and so on.

The genus can be broadly divided into gigantic species, which are associated with open sites - gap phase of forests, landslips, river banks, open swamps, road-sides and plantations - such as *Alocasia robusta, A. sarawakensis*, *A. alba*, *A. puber*, and smaller elements that are generally found within forest. *Alocasia scabriuscula* and *A. inornata*, and to a lesser extent, some elements of the *A. longiloba* complex can be found both within forest and in open conditions.

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Geography and Endemism

Few Malesian *Alocasia* species are widespread, other than those distributed directly by human activity, such as *A. macrorrhizos*. Borneo is the main node of diversity, endemism and richness in *Alocasia*, with a second node in New Guinea/Australia which, though slightly less speciose than the Philippines, is taxonomically distinct (Hay & Wise, 1991; Hay, 1994a). The ratios of endemic species to total species (calculated excluding *A. macrorrhizos* and including entities of the *A. longiloba* complex) for the main land masses in Malesia are as follows: Malay Peninsula - 1:8; Sumatera - 3:8; Java: 2:4; Borneo - 20:23; Philippines - 14:14; Sulawesi - 3:4; Papuasia - 12:12; [Australia - 1:1].

Of the informal infrageneric groups recognised here, the Puber Group group has four species, two Bornean endemics, one Philippine endemic and one species from Java and the Malay Peninsula, possibly also represented in Sumatera. This group appears to be closely allied to the Scabriuscula Group, which is endemic to, richly represented and abundantly common in Borneo, including two highly variable complex entities - *Alocasia scabriuscula* and *A. princeps* - each with several narrowly defined localised segregates. The Longiloba Group is predominantly West and Central Malesian, extending from the central highlands of Vietnam to the Philippines and Sulawesi. With the exception of Philippine and Sulawesi segregates, it is treated here as one species including localised, sometimes sympatric 'topospecific' entities that merge globally into a single presently intractable complex. It is most diverse in Borneo and Sumatera. The Cuprea Group is mainly Bornean, with a single endemic representative in each of Sumatera and the Malay Peninsula. Remaining species have been very provisionally placed in an alliance with *A. macrorrhizos* as the Macrorrhizos Group, which occurs from mainland Asia and thoughout the Malesian range of the genus except Borneo. However, this grouping may prove heterogeneous on further study.

Conservation Status

One outcome of a taxonomic study is to highlight species that are known from very few collections or that are known from only a few localitites and which may therefore be rare and in need of protection. However, before listing those species, it should be emphasised that conservation status of course requires verification on the ground, preferably by local botanists. Nevertheless, existing herbarium records are a start in evaluating how abundant or localised the species may be.

The following species are known from very few collections and/or localities: Sumatera - *Alocasia kerinciensis*, Borneo - *A. melo*, *A. minuscula*, *A. pangeran*, *A. principiculus*, *A. puteri*, *A. reginae*, *A. reginula*, *A. venusta* and Sulawesi - *A. suhirmaniana* and *A. celebica*, the latter known only from its type, collected over a century ago in Sulawesi.

The following wide-ranging species are known from few collections in certain main subdivisions of the Malesian Archipelago while being more frequent elsewhere: *Alocasia puber* in the Malay Peninsula and Sumatera, and *A. longiloba* 'watsoniana' in the Malay Peninsula and Borneo.

Many of these, especially *Alocasia melo*, *A. principiculus*, *A. reginae*, *A. reginula*, *A. suhirmaniana*, *A. venusta* and A. *longiloba* 'watsoniana' are highly ornamental (as indeed are less rare species such as *A. reversa*, *A. cuprea* and certain forms of *A. inornata*, *A. longiloba*, *A. perakensis*, *A. princeps* and *A. scabriuscula*). On the one hand they are potentially threatened by unsustainable unscrupulous collecting from the wild, and on the other they are open to *ex situ* conservation (in a broad sense) through the medium of ornamental horticulture sustained by tissue culture. Indeed, a number of species have been successfully micropropagated, especially in the U. S. A., and are available for sale over the internet. With increasing ease of developing and implementing tissue culture protocols for micropropagation, there is great potential for commercially developing these plants within their countries of origin at the same time as relieving collecting pressure on limited wild plant populations. A horticultural account describing a large number of cultivars in some detail was given by Burnett (1984), though there is a pressing need to stabilise the nomenclature of the cultivars and to align it, where appropriate, with the botanical nomenclature.

Structure and Terminology

The stem, typically of most Araceae, is a physiognomically unbranched sympodium. The number of foliage leaves per module is variable between and within species and individuals, but during flowering episodes in some species it may be reduced to one. In some species, e.g. *A. kerinciensis*, foliage leaves alternate with cataphylls within a module. In such instances the cataphyll performs the role of protecting the subsequent emerging leaf. That role in other species is performed by the sheath of the next oldest foliage leaf. Those species with regularly interspersed cataphylls typically have very short leaf sheaths, while those without interspersed cataphylls have longer sheaths. A prophyll and usually at least one cataphyll is always associated with the initiation of a new vegetative module.

The vascular system of the petiole divides, as it runs into the blade,

into three principal veins - the anterior costa (midrib) and two posterior costae which support the anterior and posterior lobes of the blade respectively. The shape of the posterior lobes of the leaf is sometimes of diagnostic importance. Terms used here to describe them are for the most part self-explanatory, such as 'acute', 'obtuse', etc. The posterior lobes are assymetric, the outer sides being united with the anterior lobe, while the inner sides (i.e. those that face each other across the sinus) are free (unless the leaf is peltate). In some instances, such as the Scabriuscula Group, the shape of the piece of lamina on the 'inside' of each posterior lobe may need to be used for identification purposes. For these parts I have used terms such as 'lanceolate', 'ovate', etc. even though the posterior lobe is not symmetrical about the posterior costa. Thus, 'inner side of posterior lobe lanceolate' means that the inside piece of lamina is shaped like a longitudinally bisected lanceolate leaf (Fig. 1).

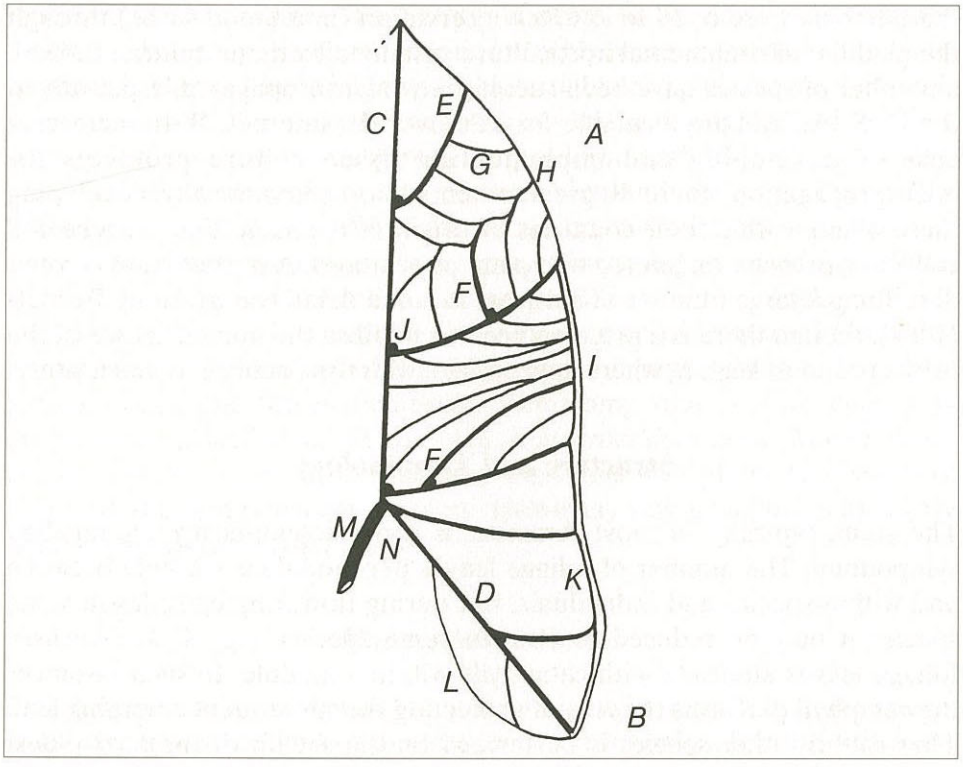

Figure 1. Diagram of *Alocasia* leaf blade
A. anterior lobe; B. posterior lobe; C. anterior costa; D. posterior costa; E. primary lateral vein; F. subsidiary vein (with axillary gland); G. secondary vein; H. sector with interprimary collective vein formed by meeting of secondary veins; I. sector with interprimary collective vein not formed; J. axillary gland; K. intramarginal vein; L. inner side of posterior lobe; M. petiole; N. sinus.

Primary veins run pinnately off both sides of the anterior costa and pedately off the outer (anterior) side of each posterior costa. Glands, of unknown function, are found in the axils of the primary veins on the abaxial surface of the leaf, and may also occur scattered over the surface of the petiole. Secondary venation arises direct from the costae and from the primary lateral veins and is typically colocasioid: secondary veins arising from the primary lateral veins typically run initially at a wide angle from the primary venation and are then deflected towards the margin of the blade. In some species the secondary veins unite between the primary veins into more or less sinuous interprimary collective veins. These may be very well developed and distinct, and while they are a useful feature for distinguishing some species, the state intergrades with a complete absence of interprimary veins and some species evince a variety of intermediate states. In some species (e.g. *Alocasia suhirmaniana*), some secondary veins are intermediate in thickness between the normal secondary venation and the primary veins, and they may even bear glands in their axils like the primary venation. These are termed subsidiary veins. The primary and secondary veins run into a marginal vein, or in some species a distinct intramarginal vein (e.g. *A. peltata*). The primary and secondary venation patterns in those species with interprimary collective veins is highly suggestive of derivation by connation of leaflets or segments of a pinnate or pinnatifid leaf. Indeed, more or less deeply pinnatifid leaves occur sporadically in the genus in different species groups, e.g. Philippine *A. sanderiana* W. Bull (Longiloba Group), Papuasian *A. brancifolia* (Schott) A. Hay (Xenophya Group) and Philippine *A. portei* Schott (Macrorrhizos Group), and (radiately) divided leaves are found in the allied relict Seychelles endemic genus *Protarum* Engl. (Hay & Mabberley, 1991).

Seedling leaves, where known, are peltate with partially to completely connate posterior lobes, a condition which may or may not persist into various stages of subadulthood and which may be retained altogether in the Cuprea Group. *Alocasia reversa* is variable in this respect and may have all peltate leaves, no peltate leaves or mixed states as adult plants.

In most, if not all species, the rhizome produces at or below soil level a number of short slender branched or unbranched stolons terminating in more or less globose cormels. These remain dormant for protracted periods, often until the stolons that bear them have decayed. Conditions that stimulate either their production or their release from dormancy are unclear, and while cormels are often produced in large quantities, the plants are typically solitary, though very dense, apparently clonal, populations may occur.

Except in the most diminutive species where the inflorescence is solitary (e.g. *Alocasia minuscula*), the vegetative module is terminated by

a synflorescence composed of pairs of inflorescences forming bimodular synflorescence subunits (Fig. 2). Each consists of a cataphyll subtending a terminating inflorescence (i.e. peduncle with spathe and spadix) and a second inflorescence arising in the axil of the cataphyll and itself subtended by a bicarinate prophyll. A relay axis develops from the axil of the leaf (or leaf homologue) immediately below the first cataphyll of the bimodular subunit. It bears first a bicarinate prophyll and then, depending on whether or not the relay module is initially vegetative, a foliage leaf (which may or

Figure 2. Schematic representation of synflorescence construction in *Alocasia*
Left: synflorescence subunits of cataphyll, inflorescence, prophyll and inflorescence (contained in dotted outlines), interspersed with foliage leaves. Right: synflorescence subunits repeated with the foliage leaves substituted by cataphylls - making a compound synflorescence, followed by resumption of vegetative growth. = foliage leaf; = cataphyll; = inflorescence; = prophyll. Note that in the two-dimensional diagrams, some prophylls are followed by leaves or cataphylls that appear superposed and all other organs appear distichous. This is not the case in life, where all organs are produced in three-dimensional phyllotactic spirals. Organ numbers within the dotted lines appear constant throughout the genus (except in species with solitary inflorescences); with respect to outside the dotted lines, a prophyll is a constant feature at the beginning of modules, but additional cataphylls may be present in either case between the prophyll and the first cataphyll of the synflorescence subunit.

may not be preceded by one or more vegetative cataphylls) or another bimodular synflorescence subunit. If a foliage leaf has been produced, the module may continue to produce foliage leaves and the flowering episode has consisted simply of two inflorescences - the usual case, for example, in *A. reversa*. Alternatively, the foliage leaf may be followed immediately by another pair of inflorescences and another relay axis with a single foliage leaf and so on, so that the flowering episode consists of a compressed sympodium of bimodular flowering units displaced into physiognomically lateral positions and interspersed with foliage leaves, as in *A. macrorrhizos*. If, however, the first relay axis is not initially vegetative, a second pair of inflorescences follows upon the first, and a third and fourth and so on, each arising from the axil of the cataphyll subtending the previous subunit. Eventually the flowering episode ceases and the last relay axis bears a foliage leaf, which emerges from the centre of a larger or smaller sympodial cluster of inflorescence pairs - up to about 20 in robust species such as *A. sarawakensis*. After rapid resumption of vegetative growth, the stem may bear a ring of physiognomically lateral infructescences below the leaf crown of the new vegetative module, e.g. in *A. robusta*.

The spathe is divided into a convolute thicker lower portion - the 'lower spathe' - housing the female zone of the spadix and persisting into fruiting, and a thinner, ephemeral open limb (this part is also convolute and persistent in some East Malesian species of the Xenophya Group). The two portions of the spathe are differentiated by a constriction so that the lower part is globose to ovoid. The spadix, as is the general case in Araceae, is protogynous and at the time of stigma receptivity the spathe constriction loosens, providing pollinators access to the pistils; simultaneously the inflorescence may emit a detectable scent - highly fragrant to an odour of decay - which appears to be produced from the inside of the lower spathe and not from the floral organs themselves (e.g. *A. alba*, *A. robusta*) or from the appendix (e.g. East Asian *A. odora* (Lodd.) Spach). At this time the spathe limb is generally erect. At the end of female anthesis, the spathe constriction closes and grips the spadix and scent production ceases. There is a sterile zone between the male and female zones of the spadix and typically the spathe constriction is level with this so that after female anthesis the female zone is isolated from the male zone. Male anthesis then occurs. The pollen is mealy and drops to collect between the lip of the limb and the spadix or in a trough-like annular fold that has developed at the base of the limb.

Pollination has not been observed in detail (but see van der Pijl (1933) who described pollinator attraction by deceit in *A. puber*), though one might speculate that in order to leave the lower spathe chamber, insects must force their way between the spadix and the spathe constriction

and pick up pollen as they leave. However, while many species have the sterile zone of the spadix and the spathe constriction aligned, this is not universal. The Scabriuscula Group, for example, usually has part or even all of the male zone contained within the lower spathe chamber. What the implications of this are for pollination mechanisms and breeding systems is unknown.

The female zone of the spadix consists of naked pistils. The sterile zone, or interstice, is partly or entirely covered with truncate neuter organs (synandrodia), which often but not always appear to be of two types. The lower whorl(s) (with respect to the spadix) may be composed of smaller, often more prominent structures than the upper ones and they commonly react differently (remaining white) in alcohol to the wider upper ones which closely resemble the male flowers except for the absence of pollen thecae (Plate 1). This differentiation of the neuter organs is much clearer

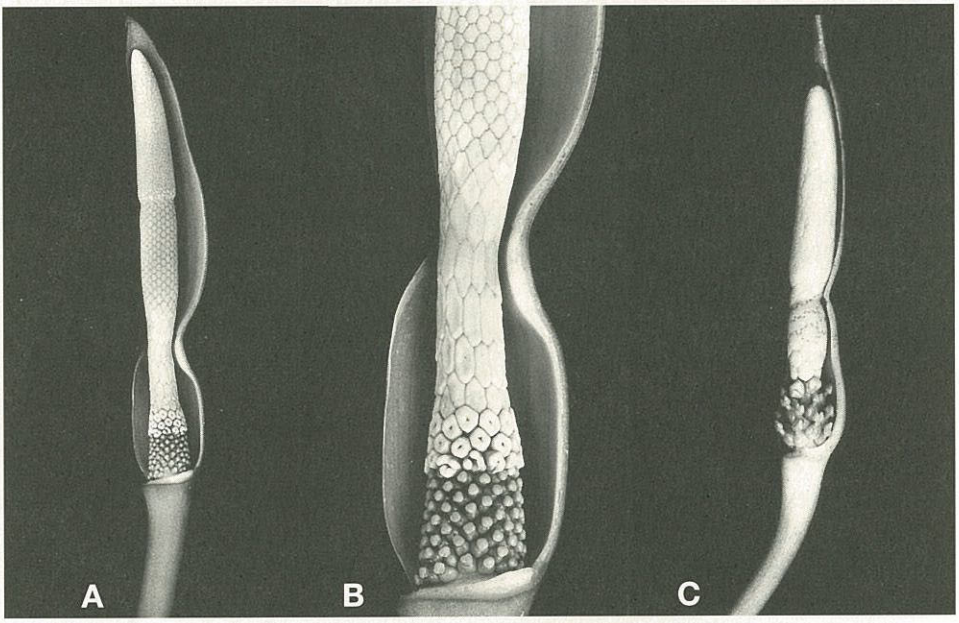

Plate 1. Inflorescence structure in *Alocasia*
A. Whole spadix of (extra-Malesian) *Alocasia odora* (Lodd.) Spach [RBG Sydney Acc. No. 940137, voucher NSW], ca. 25 cm long, showing, from the base, female zone, large sterile interstice, male zone of regularly hexagonal synandria and terminal appendix; lower spathe containing female zone and most of sterile interstice, constriction corresponding with upper part of interstice and limb subtending the male zone and appendix. B. Detail of lower part of same spadix showing interstice with basal free staminodial neuter organs, then connate staminodial organs and upper synandrodial neuter organs. C. Spadix of *A. principiculus* [*Hay et al. 12162*], ca. 5 cm long, with reduced sterile interstice of a few lax lower staminodial neuter organs and above, whorls of sterile synandria; remaining fertile synandria with pollen thecae visible as dark dots; both fertile zones contained within the lower spathe chamber. Pollen thecae not visible in *A. odora* as they are overtopped by the synconnective.

in *Alocasia odora*, and sometimes in *A. alba*, where the lowermost neuter organs are not in connate groups, but instead partially encircle the uppermost pistils clearly in the positions of staminodes. The next whorl (with respect to the spadix) of neuter organs consists of united 'staminodes' with a central hole, seemingly where the pistil would be. There is then one or more similar whorls followed by an abrupt transition to structures resembling sterile synandria. This situation closely resembles that in the relict *Protarum*, which differs in having all the pistils regularly subtended by staminodes. Comparison with *Protarum* suggests that the organs of the sterile interstice in *Alocasia* are differently derived in the lower and upper parts of that zone - in the lower part by connation of staminodes, in the upper by sterilisation of synandria. The rhombohexagonal synandria - fertile male flowers - are generally 4–6-merous and consist of connate truncate stamens. The body of the male flower is here termed the synconnective and the vertical pollen thecae are attached throughout their length to its flanks. Typically the thecae reach the top of the synandrium and open through apical pores. However, in some species the synconnective is expanded over the top of the thecae which release pollen from apical slits into the spaces between the synandria.

The upper part of the spadix forms a well-developed sterile appendix, which is at least sometimes thermogenic (as may be the male zone). The appendix surface is occasionally smooth, but is more usually sinuously, longitudinally and finely channelled - apparently formed of irregular elongate compressed synandrodia.

After anthesis, only the female part of the spadix and the lower spathe remain, the rest rotting and falling away. As the fruits develop and expand, the peduncle generally elongates and the lower spathe enlarges, sometimes becoming conspicuously coloured (e.g. *A. balgooyi* A. Hay). When the fruits ripen, the fruiting spathe dehisces to reveal them, analogous to arillate seeds in a capsule. The fruits are orange to red, odourless as far as is known, fleshy and contain one to several seeds a few millimetres in diameter.

Distinguishing *Alocasia* from *Colocasia*

Traditionally, these two genera, which are undoubtedly closely allied and frequently confused with one another, have been separated on the basis of ovule number and placentation - many ovules on parietal placentas in *Colocasia*, few on basal placentas in *Alocasia* (e.g. Mayo, Bogner & Boyce, 1997: 90). These rather academic states are not really of practical use in field identification. However, they translate in the fruiting plants into

markedly different dispersal syndromes apparently (though not observed in West Malesia) involving birds in *Alocasia,* in marked contrast to the mammal dispersal syndrome of *Colocasia* where the fruits are smelly and inconspicuously coloured with many tiny seeds in slimy mucilage (see Hay, 1996).

In respect of synflorescence architecture, *Alocasia* may be readily distinguished from *Colocasia* by its bimodular synflorescence subunits. Inflorescence multiplication in *Colocasia* is achieved in such a way that the whole synflorescence is equivalent to one bimodular unit in *Alocasia.* Where the inflorescence terminating the vegetative module has only one further inflorescence in the axil of its subtending cataphyll in *Alocasia* (with the synflorescence being built up by relay axes), in *Colocasia* the second inflorescence has a third in the axil of its prophyll and so on up to ca. 8 in *Colocasia gigantea.* The relay axis in *Colocasia* is vegetative and thus the whole synflorescence is displaced to a quasi-lateral position on one side of the shoot.

Foci for Further Study

The iterative taxonomic process in the genus as a whole needs additional data - from further collections throughout the range but especially from Kalimantan, Aceh (Sumatera) and Sulawesi, and from additional data sources, such as macromolecular analysis. Three areas stand out as potentially fruitful subjects for intensive analysis - the problem of circumscribing two species groups and of developing biological species concepts in the genus.

First, the *Alocasia longiloba* complex: this is treated here as an ochlospecies - a taxon where locally discrete entities coexist but globally merge. Such taxa are being recognised under whatever label with increasing frequency in the Malesian flora. Whether this example is ontologically 'real' or whether the term is a smoke screen for the taxonomic 'too hard basket' (cf. Gentry, 1990), the *A. longiloba* complex is extremely interesting not only because of the enormous amplitude of its apparent continuum of variation, but also because of the large and fragmented land area, which the threads of the continuum pervade. On present understanding, forms may discreetly coexist in Sabah, for example, but merge in Sarawak, or discretely coexist in both Borneo and the Malay Peninsula, but merge in Sumatera. The precise nature and history of these patterns, uncovered at geological, ecological, morphological and molecular levels would doubtless provide valuable insights to speciation processes.

Second, the Scabriuscula Group: confined to Borneo, this group

appears to be in active and recent speciation. There are two wide-ranging highly variable species, *A. scabriuscula* and *A. princeps*, rather narrowly differentiated from one another, each with a small set of diminutive, geographically confined and sometimes edaphically specialised segregates. Again, how the elements are related and what processes and historical events may be driving speciation and maintaining their differentiation are intriguing questions relating to the evolution of diversity in Borneo.

Third, the development of biological species concepts in the genus: *Alocasia* inflorescences are structurally and behaviourally complex and next to nothing is known in detail about how they work, beyond observations of spathe behaviour during the phases of anthesis (see above under 'Structure'). Mechanisms for biological species differentiation may reside in some or all of the following parameters (or indeed others) and their impact on pollinators and breeding systems:

- differing flowering times
- differing synflorescence architecture
- differing colours
- differing odours
- differing patterns of odour production during anthesis
- differing sources of odour in the inflorescence
- differing patterns of thermogenesis during anthesis (at least partly independent of odour production)
- differing sites of thermogenesis
- corresponding differing patterns of infra-red radiation and, perhaps, visibility
- differing proportions of staminodial and synandrodial neuter organs in the insterstice
- differing proportions of the fertile male zone within the lower spathe chamber.

Now that a preliminary taxonomic framework exists, the way is open for those resident in the region to be making comparative systematic studies of reproductive biology in the genus.

A Note on Types

Several types designated in this paper consist of specimens occupying more than one herbarium sheet or of paintings executed on more than one sheet. The ICBN clearly defines types as specimens (or images) and not sheets, bottles or any other incidental object whose status as an entity is defined merely by mechanics of curation and not by the biological nature of the specimens concerned. Many specimens of Araceae, and, of course,

many other taxa, such as palms, are each preserved in numerous sheets, bags, bottles or combinations of those. This is a necessity arising from the size of the parts of many of the species, which are quite incompatible with standard herbarium methods of preservation based in the neatness of temperate twigs and wildflowers. While there may be some good reason for preferring that types be single objects, it would plainly be ludicrous in plants where only a fragment of a whole leaf can be mounted on a single herbarium sheet or where leaf and inflorescence require separate accommodation, to elevate one fragment of the same specimen to higher status than another or to altogether disqualify a complete and maximally informative specimen from serving as a type. It is beneficial to indicate the number of sheets, so that it is clear how many sheets should be examined.

ALOCASIA

Alocasia (Schott) G. Don in Sweet, Hort. Brit. Ed. 3 (1839) 631; Schott, Oesterr. Bot. Wochenbl. 2 (1852) 59; Miq., Fl. Ind. Bat. 3 (1855) 205; Schott, Syn. Aroid. (1856) 44; Schott, Prodr. Syst. Aroid. (1860) 144; Engl. in A. & C. DC., Monogr. Phan. 2 (1879) 497; Hook. f., Fl. Brit. Ind. 6 (1894) 524; Engl. in Koord., Meded. Lands Plantentuin 19 (1898) 299; Ridl., Mat. Fl. Mal. Pen. 3 (1907) 16; Koord., Exkurs.-Fl. Java 1 (1911) 261-261; K. Krause in Engl., Pflanzenr. 71 (IV.23E) (1920) 71; Merr., J. Straits Br. Roy. Asiat. Soc. special number (1921) 104; Koord., Fl. Tjibodas 6 (1922) 36; Ridl., Fl. Mal. Pen. 5 (1925) 97; Henderson, Mal. Wildfl. Monoc. (1954) 224; Backer & Bakh.f., Fl. Java 3 (1968) 118; A. Hay & Wise, Blumea 35 (1991) 503; nom. cons., non *Alocasia* Necker (1790), see Nicolson (1963) - *Colocasia* Schott sect. *Alocasia* Schott, in Schott & Endl., Melet.Bot. (1823) 18. - Type: *Alocasia cucullata* (Lour.) G. Don. (*Arum cucullatum* Lour.).

[*Ensolenanthe* Schott, Bonplandia 9 (1861) 368 - no binomials were proposed].

Xenophya Schott, Ann. Mus. Lugd.-Bat. 1 (1863) 124; Nicolson, Blumea 16 (1968) 116. Type: *Xenophya brancifolia* Schott ('*brancaefolia*') [= *Alocasia brancifolia* (Schott) A. Hay].

Schizocasia Schott ex Engl., Bot. Jahrb. Syst. 1 (1880) 186; K. Krause in Engl., Pflanzenr. 71 (IV.23E) (1920) 115; Bunting, Baileya 10 (1962) 112. Type: *Schizocasia acuta* Engl. [≡ *Alocasia brancifolia*].

Panzhuyuia Z.Y. Zhu, J. Sichuan Chinese Med. School 4 (5) (1985) 49 -

Type: *Panzhuyuia omeiensis* Z.Y. Zhu [= *Alocasia cucullata* (Lour.) G. Don].

Massive, sometimes arborescent, to small erect, decumbent or creeping terrestrial or lithophytic herbs with irritant juice; *stems* sympodial, sometimes bearing multiple cataphylls; *leaves* glabrous to scabrid or pubescent, solitary to multiple; *petiolar sheath* persistent to deliquescent; *leaf blade* simple, deeply pinnatifid to entire, sagittate to hastate to rarely almost lanceolate and then basally auriculate, peltate or not, sometimes strikingly coloured and/or bullate, membranous to strongly coriaceous or subsucculent; primary lateral veins pinnate, usually with conspicuous glands in their axils on the lower leaf surface; secondary venation reticulate, arising along the primary veins and costae, often uniting between the primary veins to form interprimary collective veins, or these ill-defined or absent; *inflorescences* sweet- to foul-smelling, rarely solitary, usually in pairs orientated parallel to the circumference of the stem, the pairs sometimes in series interspersed with leaves (with inflorescences appearing lateral) or interspersed with cataphylls (with inflorescences appearing as a terminal cluster); peduncles usually short or hidden within subtending leaf sheath or cataphyll, occasionally subequalling the petioles; *spathe* constricted; the limb persistent to deciduous, variably coloured purple to green, yellow or white, sometimes spotted or streaked; *spadix* stipitate or not, shorter than to subequalling the spathe; *female zone* free or sometimes partly adnate to the spathe; pistils naked; ovaries unilocular to (usually incompletely) plurilocular; stigma button-like to stellate, sessile or not; male and female zones separated by a *sterile interstice* of at least one (very rarely incomplete) whorl of sterile male flowers (synandrodia), more usually of several whorls, the lower morphologically and ?physiologically differentiated from the upper, the interstice usually but not always attenuate and corresponding to spathe constriction; *male zone* of mostly 4–6-sided male flowers composed of united stamens (synandria); *appendix* well developed, pointed to blunt, smooth to somewhat rugose; *fruits* mostly red to orange berries, contained within the persistent spathe base; fruiting spathe dehiscing at maturity; seeds ca. 3–5 mm diam., albuminous.

Distribution: Indomalesia, ca. 65 species with *A. macrorrhizos* (L) G. Don now naturalized pantropically; in Malesia 57 indigenous species and one widely cultivated (*A. cucullata*); 31 species in West Malesia and Sulawesi.

Habitat: Primary and secondary forests, early regrowth and open swamps, sometimes lithophytic, rarely rheophytic; primarily in everwet conditions, but some species tolerant of quite strong seasonality; predominantly in the lowlands, extending from sea level to lower and mid-montane zones.

Key to Species and Species Complexes

1a. Leaf blades not peltate 2
1b. Leaf blades distinctly (shallowly to completely) peltate in adult plants 22

2a. Secondary venation distinctly prominent abaxially *and* forming well-defined interprimary collective veins 3
2b. Secondary venation not prominent abaxially, or, if prominent, then *not* forming well-defined interprimary collective vein 5

3a. Petiole and abaxial leaf blade pubescent (Java, ?Sumatera, Malay Peninsula) ..... **1. A. puber**
3b. Petiole and abaxial leaf blade glabrous in adult plants (beware juvenile *A. sarawakensis*) 4

4a. Lower spathe green; spathe constriction level with sterile interstice (Java) ..... **18. A. alba**
4b. Lower spathe ivory, marked red-purple; spathe constriction within male zone (Borneo) ..... **2. A. sarawakensis**

5a. Leaf blade membranous, often immense, abaxially waxy-glaucous (Borneo, Natuna Islands)..... **3. A. robusta**
5b. Leaf blade of various sizes and textures, not waxy-glaucous (though sometimes abaxially grey-green) 6

6a. Leaf blade thickly coriaceous; posterior costae not naked in the sinus; all secondary venation obscure in the dry state; petiole finely pubescent (Sulawesi) ..... **23. A. celebica**
6b. Not this combination 7

7a. Male zone of spadix completely exserted from lower spathe chamber (not Borneo except *A. macrorrhizos*) 8
7b. Male zone of spadix partly or wholly within lower spathe chamber (Borneo) 13

8a. Thecae of synandria not overtopped by synconnective (pores visible on surface of male zone); stigma stellate (with pointed lobes) (S. Malay Peninsula, E. Sumatera) ..... **22. A. longiloba 'denudata'**
8b. Thecae of synandria overtopped by synconnective; stigma not lobed or lobes rounded 9

9a. Posterior costae (usually) with lamina to the sinus; spathe limb coriaceous; synandria very numerous and small (ca. 1 mm diam., dry); fruiting spathe (usually) red (Sulawesi) ..... **19. A. balgooyi**
9b. Posterior costae naked in the sinus; spathe limb more or less membranous; synandria ca. 2 mm diam. or more (dry); fruiting spathe green 10

10a. Inflorescence pairs in a central cluster; leaves distinctly leathery coriaceous, either (rarely) purple throughout or with the petiole apically purple (Malay Peninsula, Sumatera) ..... **17. A. inornata**
10b. Inflorescence pairs interspersed with foliage leaves; leaves more or less membranous and not thus coloured 11

11a. Secondary venation very fine but distinctly darker than abaxial ground colour, forming interprimary collective veins (Sumatera) ..... **21. A. arifolia**
11b. Secondary venation not forming interprimary collective veins 12

12a. Massive plants with leaf blades ca. 80 cm long (or more); primary venation not gathered into a distinct intramarginal vein (widespread in association with people) ..... **16. A. macrorrhizos**
12b. Smaller plants with leaf blades ca. 35 cm long; primary venation running into a distinct intramarginal vein (Java) ..... **20. A. flemingiana**

13a. Leaf blade narrowly to broadly ovato-sagittate, nearly always stiffly leathery to subsucculent 14
13b. Leaf blade hastato-sagittate, triangular in outline, mostly rather thinly leathery 18

14a. Adaxially leaf blade grey-green and distinctly dark green about main veins 15
14b. Adaxially leaf blade of various colours but not variegated 16

15a. Abaxially leaf blade purple; anterior costa with ca. 6 primary lateral veins on each side, with conspicuous subsidiary veins (Sarawak, Semengoh) ..... **31. Alocasia sp. A**
15b. Abaxially leaf blade not purple; anterior costa with 2–3 primary lateral veins on each side; subsidiary veins absent (S. Sarawak) ..... **14. A. reversa**

16a. Inflorescence pairs solitary *and* secondary venation adaxially impressed (scattered in Borneo) ..... **5. A. reginae**

16b. Inflorescence pairs clustered or if solitary then secondary venation not impressed 17

17a. Posterior lobes ca. half or more the length of the anterior; blade stiffly leathery (S. Sarawak - lithophytic on or terrestrial in close association with limestone) ..... **8. A. ridleyi**
17b. Posterior lobes less than to ca. half the length of the anterior; blade thickly coriaceous to subsucculent; (widespread in Borneo - terrestrial and not especially associated with limestone) ..... **4. A. scabriuscula**

18a. Terrestrial 19
18b. Lithophytic on limestone 20

19a. Petiole mottled with wavy oblique zones of dense brown lines, occasionally scabrid; spathe dusky brownish mauve, the limb darker; lower spathe narrowly ovoid; limb mostly narrowly lanceolate (Sabah) ..... **10. A. wongii**
19b. Petiole variously and more or less haphazardly marked with lines and/or dots, smooth or occasionally faintly bumpy (glands), but not scabrid; spathe mostly ivory to yellowish ivory, variously marked or not with pink to purple, and/or purple-margined; lower spathe broadly ovoid; limb more or less oblong (widespread in Borneo) ..... **9. A. princeps**

20a. Male zone of spadix completely within lower spathe chamber; leaf blades distinctly grey-green adaxially (Sabah, E. Kalimantan) ..... **13. A. principiculus**
20b. Male zone of spadix partly exserted from lower spathe chamber; leaf blades dark to bright green adaxially (Sabah) 21

21a. Leaf blade bright green adaxially; inner side of posterior lobe ovate; male zone more or less adjunct to female zone or interstice short, not attenuate, formed of 1–2 whorls of synandrodia resembling synandria ..... **12. A. puteri**
21b. Leaf blade dark green adaxially; inner side of posterior lobe elliptic to narrowly ovate; interstice elongate, partly naked, with neuter organs resembling staminodes below and resembling synandria above ..... **11. A. pangeran**

22a. Leaf blades more or less membranous and pendent, often solitary or only 2–3 together, often adaxially dark green with whitish major veins (sometimes adaxially concolorous), often purple-backed, shallowly to deeply peltate; stigma stellate with pointed lobes; insterstice

corresponding with spathe constriction and male zone completely exserted 23

22b. Leaf blades variously coriaceous, pendent or not, few to several together, mostly not variegated, deeply to almost completely peltate; stigma not lobed or lobes rounded; interstice and part or all of male zone within lower spathe chamber (except *A. kerinciensis*) 24

23a. Petiole glabrous; spathe limb greenish white (widespread) ..... **22. A. longiloba complex**

23b. Petiole minutely and densely pubescent; spathe limb purple-black (Sulawesi) ..... **24. A. suhirmaniana**

24a. Leaf blades metallic greenish brown adaxially, bullate between primary veins; lower primary veins diverging at first at more than 90° (Sabah) ..... **30. A. cuprea**

24b. Not this combination 25

25a. Adaxial leaf surface rugose with the tertiary venation raised (Sabah) ..... **7. A. melo**

25b. Adaxial leaf surface smooth or with secondary venation impressed 26

26a. Adaxial leaf blade dark green with whitish impressed primary and secondary venation; spadix with appendix reduced (origin unknown) ..... **6. A. reginula**

26b. Leaf blade not variegated, or if variegated then main veins and neighbouring blade darker than the rest; appendix well developed 27

27a. Leaf blade with conspicuous intramarginal and marginal vein 28

27b. Leaf blade with more or less conspicuous marginal vein only 29

28a. Blade broadly ovate to ovate, with the base rounded; male zone exserted from lower spathe (S.W. Sumatera) ..... **29. A. kerinciensis**

28b. Blade broadly to narrowly elliptic, with the base cuneate; male zone within the lower spathe Borneo) ..... **28. A. peltata**

29a. Primary lateral veins numerous, 8–10 on each side of midrib; secondary venation striate; (Sarawak - in peat swamp forest) ..... **27. A. minuscula**

29b. Primary lateral veins much fewer; secondary venation clearly colocasioid, but not forming interprimary collective veins 30

30a. Leaf blade (ovate to) narrowly ovate to oblanceolate; connate posterior lobes attenuate; male zone of spadix within lower spathe chamber 31
30b. Leaf blade oblong-elliptic; connate posterior lobes cuneate; male zone only partly included within the lower spathe chamber (Sarawak - on limestone) 32

31a. Leaf blade (coriaceous to) thickly coriaceous to subsucculent, 14 x 6 to 34 x 12 cm; spathe ca. 6 cm long. (Malay Peninsula, usually above 1000 m) ..... **25. A. perakensis**
31b. Leaf blade coriaceous, 9 x 2.2 – 18 x 6 cm; spathe ca. 4 cm long; (N.W. Borneo, usually below 1000 m) ..... **26. A. beccarii**

32a. Leaf blade dark green throughout and somewhat darker around mid-veins; inflorescences to ca. 6 together; stigma mostly tri-lobed (Niah, Sarawak) ..... **15. A. venusta**
32b. Leaf blade grey-green and dark blue-green around veins; inflorescences solitary to paired; stigma mostly bi-lobed (S. Sarawak) ... **14. A. reversa**

Puber Group

Species 1—3

Massive arborescent or decumbent plants; *leaves* several together, often hairy; *inflorescences* numerous in succession not interspersed with foliage leaves, usually with horizontal elliptic often dark red glands on the lower spathe; *male zone* of spadix held partly within lower spathe chamber.
Note: The group includes the three west Malesian species described below and Philippine *A. maquilingensis* Merr. The species are elements of gap phase, secondary forests and open swamps.

1. Alocasia puber (Hassk.) Schott

Alocasia puber (saepe '*pubera*') (Hassk.) Schott, Syn. Aroid. (1856) 47; Miq., Fl. Ind. Bat. 3 (1856) 209; Schott, Prodr. Syst. Aroid. (1860) 146; Engl. in A. & C. DC., Monogr. Phan. 2 (1879) 500; Koord., Exkurs.-Fl. Java 1 (1911) 261; K. Krause & Engl., Pflanzenreich 71 (IV.23E) (1920) 79; Koord., Exkurs.-Fl. Java 4 (1923) 197, fig. 398; Ridl., Fl. Mal. Pen. 5 (1925) 99; Backer & Bakh. *f.*, Fl. Java 3 (1966) 119. - *Colocasia pubera* Hassk., Cat. Bog. (1844) 302. - Neotype: Indonesia, Java, Djampangs, Cicurug, 1914, *Backer 17192* (BO, designated here).

Alocasia margaritae L. Linden & Rodigas, Ill. Hort. 33 (1886) 155; Anon., Kew Bull. (1888) 92; Engl. & K. Krause, Pflanzenr. 71 (IV.23E) (1920) 92. - Type: L. Linden & Rodigas, Ill. Hort. 33 (1886) t. 611. Epitype: Java, Desa Ciomas, Kampung Pabuaran, Serang, West Java, 12 Dec 1997, *Yuzammi 297017* (BO, NSW, designated here - see below).

Alocasia ovalifolia Ridl., J. Straits Br. Roy. Asiat. Soc. 41 (1904) 47; Ridl. Materials Fl. Mal. Pen. 3 (1907) 18; Engl. & K. Krause, Pflanzenr. 71 (IV.23E) (1920) 109; Ridl., Fl. Mal. Pen. 5 (1925) 99. - Type: Malaysia, Perak, Sungei Larut, July 1888, *L. Wray Jr. 2457* (SING, lecto, selected here; K, isolecto; see discussion below).

?*Alocasia crassinervia* Engl., Pflanzenr. 71 (IV.23E) (1920) 82. - Type: Indonesia, cult. Hort. Bogor, Jan/Feb 1906, *A. Engler 4101* (B!, holo) - see note under *A. sarawakensis.*

[*Caladium pubigerum* Bl., mss]

Robust to massive herb; *stem* erect to decumbent, to ca. 10 cm diam.; *leaves* several together; *petiole* to ca. 1.1–1.5 m long, sheathing in the lower ca. 1/3, green to dark red, sparsely glandular, it and abaxial lamina venation sparsely to densely hairy; hairs straight, short, ca. 0.5 mm long, colourless fresh, becoming yellowish brown when dry; *blade* usually sagittate, occasionally broadly ovato-sagittate, to ca. 80 cm x 70 cm; *anterior lobe* ca. 60 cm long, widest at about the base; anterior costa with ca. 10 primary lateral veins on each side, diverging at ca. 50°, with rather conspicuous glands in their axils; primary veins distally often bearing subsidiary veins (with glands in their axils) running the same course as the secondary venation; secondary veins rather prominent abaxially, numerous and close-spaced, running into well defined interprimary collective veins; posterior costae diverging mostly at ca. 90°, naked in the sinus for up to 4 cm; *posterior lobes* ca. 30 cm long, more or less triangular, rarely rounded; *inflorescences* appearing as clusters in the centre of the leaf crown, up to ca. 14 together not interspersed with foliage leaves; peduncle hardly exserted from subtending bracts; *spathe* ivory white, suffused purple, especially near the base of the limb margins, with scattered purple horizontal elliptic glands especially near the junction of spathe and peduncle, 9–18 cm long; lower spathe narrowly ovoid, somewhat angular in cross section, differentiated from the limb by an initially rather weak constriction about 1/3 of the way from the base of the spathe and corresponding to about midway along the length of the male zone of the spadix; limb more or less cucullate at first, leathery-membranous, broadly lanceolate with the tip

obtuse, sometimes conspicuously apiculate, initially sharply reflexed at the base, forming an annular trough, the rest erect, then entirely reflexed; *spadix* slightly shorter than the spathe, ca. 6–15 cm long, very shortly stipitate; *female zone* 1–2 cm long, subcylindric; ovaries very pale green, subglobose, close-packed, ca. 1.2 mm diam., style short, slender, ca. 1 mm long; stigma ivory, cap-like, weakly 3–4-lobed; *sterile interstice* hardly more slender than the fertile zones, ca. 2 whorls of flat white synandrodia ca. 2 mm diam.; *male zone* yellowish ivory, half within and half exserted from the lower spathe chamber, ca. twice as long as female zone; synandria mostly rhombohexagonal and ca. 2 mm diam., sometimes united into irregular horizontal bands; synconnective impressed, not overtopping the thecae; *appendix* pale apricot, about half the length of the spadix, about as thick as the male zone, slightly narrowed at its base and distally tapering to a pointed tip; *fruiting spathe* ca. 4 cm long.

Habitat: In open swampy areas, and wet places in open forests, sea level to ca. 1000 m alt.

Distribution: West to central Java, ?southern Sumatera, Peninsular Malaysia.

Notes: 1. No Hasskarl material has been located that might be the type of *A. puber*. In the protologue, Hasskarl cited *Arum sylvestre* Rumph. (Herb. Amb. 5: 310, t. 107) as a synonym, but with doubt indicated by 'an'. Rumphius' concept of *Arum sylvestre* included more than one 'species', though only one was illustrated. The plate, which does not appear to be of a Javan plant at all, bears insufficient resemblance to *A. puber* in the sense of Schott and subsequent authors, to warrant using it as the type. It gives no indication of the characteristic features of pubescence on the leaves and horizontal red markings on the lower spathe that Hasskarl mentions for *C. puber* and, which indicate that Hasskarl's and Schott's concepts are almost certainly of the same species. Moreover, it shows a configuration of inflorescences paired amongs the leaves, which is also not characteristic of this species. It is probable that Rumphius' plate is of the east Malesian *Alocasia aequiloba* N.E. Br. Hence there is no alternative but to designate a neotype. There are very few fertile Javan collections to select from, *Backer 17192* being the most complete.

2. *Alocasia margaritae* L. Linden & Rodigas was described from Javan material cultivated in Europe. No herbarium material has been located. The illustration in the protologue is of a sterile, immature plant, but the description includes reference to the puberulent petioles typical of *A. puber* and the depicted leaf shape is not incompatible with that species. *A. margaritae* appears to be no more than a particularly strongly red-brown

coloured variant of *A. puber* and it is epitypified accordingly to remove all doubt.

3. The identity Ridley (1904) intended for *Alocasia ovalifolia* is obscured by various muddles. The description in the protologue is scant and sloppy. The leaf is said to have 20 pairs of 'nerves', which I understand to be primary lateral veins. I know of no species of *Alocasia*, with the exception of the gargantuan Bornean *Alocasia robusta* that has this many. The spathe is said to be up to six inches long, while the dimensions given for its components, the lower part and the limb, add up to four and a half inches. On top of these incongruities, the description records no distinctive features by means of which it could be matched with known Malay Peninsula species. Four syntypes were cited thus: 'Johore, base of Gunong Panti; Selangor, Tras Route at the 15th mile Pahang Track (*Ridley 8487*), Ginting Peras, Bukit Kutu; Perak, Sungei Larut (*Wray 2457*), Larut Hills; Penang, Moniots Road (*Curtis*).' All of these are missing from or perhaps misplaced in the Singapore herbarium and are not duplicated elsewhere, with the exception of *Wray 2457*. That specimen is of *Alocasia puber*, but it is not annotated by Ridley with any name and by no-one as *A. ovalifolia*. I suspect therefore that it was cited in error; indeed it was later cited as *A. puber* in Ridley's Flora, while other previously cited material remained under *A. ovalifolia* (Ridley 1925: 99). Other specimens, not syntypes but which might guide interpretation of *A. ovalifolia*, are equivocal. There are two collections made by Ridley and annotated by him with this name. One is *Ridley s.n.* (SING) with the locality 'Thaiping Hills'; this is *Colocasia esculenta*. The other is *Ridley 13392* (SING), collected at Batu Caves in 1908 (but not cited in the Flora). This latter is of a common Malay Peninsula species (see *A. inornata* Hallier *f.*) which seems very unlikely to have been overlooked by Ridley as a species distinct from other *Alocasia* in the Malay Peninsula. It seems probable to me, in spite of his bad description, his citation of *Wray 2457* and his misdetermination of a plant in another genus as *A. ovalifolia*, that the plant in *Ridley 13392* is what Ridley intended *A. ovalifolia* to be. Nevertheless, the ICBN demands lectotypification from among the syntypes (Art. 9.9). An alternative is not to lectotypify, and simply leave the issue open in the hope that the remaining syntypes turn up one day. However, since the name *Alocasia ovalifolia* has never been taken up by subsequent authors [Henderson and Furtado, for example, both misapplied other names to this species (i.e. *A. inornata*) on herbarium sheets, which suggests they had never seen the other syntypes either] and cannot be said to be in current use, there seems to be no pressing need to do other than simply dispose of the name on the basis of the identity of the one syntype that is available. *Alocasia ovalifolia* is therefore reduced to the synonymy of *A. puber*.

4. Backer & Bakh. *f.* (1968: 119) pointed out that the epithet '*pubera*' is grammatically incorrect, and amended it to *puber* without elaboration. It is evident that Hasskarl intended the epithet to refer directly to the hairiness of the leaves and peduncles, for in the description he used the adjectival '*puberis*' (in the ablative plural) referring specifically to those parts of the plant that are hairy. It would appear that he used the word as though it were a 'group A' adjective such as *glaber*, which it is not. *Puber* (or *pubes*) is used in mediaeval and classical latin as a noun referring to adolescence, and *puber* was used in classical latin specifically of plants as an adjective referring to juiciness (which Hasskarl also described in the protologue of this plant, but without using this word). In botanical latin *puber* (or preferably *pubes*) could be used as a substantive epithet for hairiness, and *puberula* as an adjectival epithet for hairy [see Oxf. Lat. Dict., ed. P.G.W. Clare, 1982]. Since Bakh. *f.* has already chosen one of these alternative corrected forms, I follow him.

5. *Alocasia puber* is apparently very rare in the Malay Peninsula, having been collected there only four times, and only once at all recently (*Chua FRI 26675*). Although Javan representatives have been collected more frequently, there is very little fertile material from which to judge intraspecific variability, but the Malay Peninsula element seems to have a rather smaller inflorescence. The collections made by Corner also show rather widely rounded posterior lobes to the leaf blade in contrast to the more typical triangular shape in Java, and it may be that the Malay Peninsula element could be recognised as a segregate subspecies once it is better known. However, it evidently has the same habitat preference as *A. puber* in Java.

6. A single collection from Sumatera (*Praetorius s.n.)* determined by Schott as *A. macrorrhizos*, is apparently of this or a closely allied species, being quite densely hairy on the leaf underside, with rather prominent secondary venation forming well defined interprimary collective veins. The specimen, from Palembang, is sterile

Other specimens seen: PENINSULAR MALAYSIA: Terengganu, Besut, Sg. Kemia, foothills of G. Lawit, *Chua FRI 26675* (KEP); Terengganu, Kemaman, Ulu Kajang, *Corner 30138* (SING); Johore, Mawai Rd., *Corner s.n.* (SING); Johore, Jason Bay, Mile 4, Block 1, *Sinclair 10869* (E, SING); Perak, Sg. Larut, *Wray 2457* (K, SING). SUMATERA: Palembang, *Praetorius s.n.* (L). JAVA: Tjidadapi Tjibeber, Preanger, Cadas Kabang, *Bakhuizen 2484* (BO); *Blume s.n.* (L) & *792* (L); Bidara Tjina, *Edeling s.n.* (BO); Tjiloewar, nr Bogor, *Hallier s.n.* (BO); Danau Situgunung, *Hay & Yuzammi 14001* (NSW); Djapara Ngarongan, *Koorders 34996b* (BO, L); Bantam, Lebakkidoel, G. Kantjana, *Koorders 41042b* (BO); *Kuhl & van Hasselt s.n.* (L); Djasinga, 45 km W of Bogor, *Nicolson 938* (BO); Tjitjadas, Batavia, *van Steenis 5364* (BO); Cult. Bogor, *Wigman s.n.* (BO); Blok Cimanuk, Rawa

Danau Natural Reserve, Serang, West Java, *Yuzammi 297013* (BO, NSW), *Yuzammi 297016* (BO, NSW); Desa Ciomas, Kampung Pabuaran, Serang, West Java, *Yuzammi 297007* (BO, NSW), *Yuzammi 297017* (BO, NSW); *Zollinger 472* (K).

2. Alocasia sarawakensis M. Hotta

Alocasia sarawakensis M. Hotta, Acta Phytotax. Geobot. 22 (1967) 159, fig. 6, G-L. - Type: Malaysia, Sarawak, Mardi, along Sungei Melinau, 14 Mar 1964, *M. Hotta 1439* (KYO, holo; n.v.)

[?*Alocasia crassinervia* Engl., Pflanzenr. 71 (IV.23E) (1920) 82. - Type: Indonesia, cult. Hort. Bogor, Jan/Feb 1906, *A. Engler 4101* (B, holo) - see note below.]

[*Alocasia puber* (*'pubera'*) sensu auct. non (Hassk.) Schott: Hotta, Acta Phytotax. Geobot. 22 (1967) 158.]

Massive arborescent herb; *stem* more or less erect, to ca. 15 cm diam., to 70 cm tall; *leaves* several together with the blades erect to oblique; *petiole* to 130 cm long, sheathing in the lower 1/3–2/5, pale dull green, very slightly rough, with numerous glands mainly in the sheathing portion, these ellipsoid, ca. 4 mm long, aligned along the axis of the petiole, red at first, later turning yellow, in juveniles often ringed with blackish purple; *blades* somewhat glossy mid-green above, paler below, glabrous in adult plants, abaxially hairy in juveniles, cordato-sagittate, ca. 90 cm x 80 cm; *anterior lobe* ca. 60 cm long, with the margins slightly undulate; *posterior lobes* ca. 35 cm long, rounded, held somewhat above the plane of the anterior lobe; posterior costae diverging at ca. 80–90°, naked in the sinus for ca. 2 cm; primary lateral veins 10–12 on each side of the anterior costa diverging at ca. 45°, their distal portions often emitting subsidiary veins, especially on side facing posterior lobes; secondary veins forming very well-defined interprimary collective veins; costae and primary veins whitish abaxially, green adaxially; primary and secondary venation very prominent abaxially, more or less flush adaxially; glands conspicuous in axils of primary veins and very large at junction of petiole with costae, yellowish green; *inflorescences* very numerous, to ca. 40 crowded in the centre of the leaf crown from within which the relay axis eventually appears, paired and subtended by somewhat persistent (thence marcescent-deliquescent) ca. 30 cm long lanceolate cataphylls bearing glands; peduncles ca. 30–40 cm long, mostly hidden within the cataphylls, with a few scattered glands, pale dull green, ca. 2 cm diam.; *spathe* ca. 19 cm long; lower spathe 7 cm x 2.5 cm and somewhat flattened, white with a basal ring of confluent glands, these at first shiny white, becoming purple, the remainder of the lower

spathe with scattered ellipsoid glands aligned transverse to the long axis of the spathe and somewhat clustered at about 2/3 of the way up the lower spathe; spathe limb white, to 12 cm long, erect at female anthesis, then sharply reflexed and rolled back at male anthesis, broadly lanceolate, to 5 cm wide, horizontally wrinkled abaxially; *spadix* to ca. 16 cm long, stipitate for ca. 5 mm, stipe white; *female zone* 2.5 cm long ca. 1.5 cm wide at base, distally somewhat tapering; ovaries whitish ivory, sub-globose, ca. 1.5 mm diam; style very slender, ca. 1 mm long; stigma abruptly wider than style, ± rounded and inconspicuously 2–3-lobed, like the style, ivory; *sterile interstice* ca. 1 x 1 cm, hardly attenuate; synandrodia flat-topped, ivory, rhomboid, ca. 3 mm long; *male zone* 3 cm x 1 cm, partly within the lower spathe chamber; synandria ± hexagonal, opening by apical pores not overtopped by synconnective, 6–8-merous, ivory; *appendix* apricot coloured, 9 cm long, 1.5 cm diam., tapering to a point, the surface covered with horizontally elongate, sinuous staminodes; *fruiting spathe* white, dehiscing longitudinally; fruits red.

Distribution: Endemic to Borneo; in Sabah and Sarawak, with one doubtful record from Kalimantan.

Habitat: Common in open swampy places; often seen in roadside ditches; encountered in swampy places in forest as a hairy juvenile; from sea level to ca. 1200 m altitude.

Notes: 1. This species is easily distinguished from *A. robusta* and *A. macrorrhizos*, which sometimes all occur together and resemble each other in the very large broad leaves and preference for open habitats, by the very prominent venation on the abaxial side of the leaf blade, forming well defined interprimary collective veins. It can be distinguished further from *A. robusta* by having the posterior costae naked in the sinus and the abaxial side of the lamina not glaucous. However, occasional specimens are intermediate (e.g. *Agama & Valera 9887*): they suggest that some hybridization may take place where the two species occur together.

2. *Alocasia sarawakensis* is far more common that the meagre number of herbarium collections would suggest, perhaps because it (and *A. robusta*) is mistaken for *A. macrorrhizos* and threrefore not considered worth collecting. Aside from the leaf venation characteristics, it is amply distinguished from *A. macrorrhizos* by the basically white spathe with red markings, and by the arrangement of the inflorescences in a large central cluster, where the spathe of *A. macrorrhizos* is green and yellow, and the inflorescence pairs are interspersed with foliage leaves. Moreover, while

A. sarawakensis (and *A. robusta*) are found widely in disturbed places, *A. macrorrhizos* is hardly ever encountered more than a short distance from human habitation, suggesting that it is not a native Bornean plant at all, while *A. sarawakensis* and *A. robusta* are Bornean endemics (the latter also in the Natuna Islands).

3. *Alocasia crassinervia* Engl. was described from a seedling cultivated at Bogor, said to have been from Borneo. The type consists of a single early juvenile pubescent leaf, which could be from *A. sarawakensis*. However, it could equally be a juvenile of *A. puber*, which grows in the vicinity of Bogor. In the event that it could be demonstrated clearly that the type of *A. crassinervia* is of the Bornean species, I would recommend conserving the name *Alocasia sarawakensis*.

4. I have not seen the Bornean specimens determined by Hotta (loc. cit.) as *A. puber* (*Hotta 14175* and *14231*), but it seems highly probable that these hairy sterile plants are juveniles of *A. sarawakensis*. The only collection of this species from Kalimantan *(Burley et al. 596)* is identified with some doubt, as the usually characteristic persistent horizontal glands on the lower spathe appear to be lacking. The specimen is in fruit. The leaf matches this species more than any other known Bornean element.

Other specimens seen: SABAH: Semporna, Timbun Mata F.R., *Agama & Valera 9887* (K, SING); Kinabatangan Besar, Kori Timber Camp, *Cuadra A2144* (all seedlings: BO, KEP mixed - see also *A. robusta*, K, L, SING); Sepilok, Forest Research Centre grounds, *Hay 10010* (SAN, spirit only); Lahad Datu Rd, ca. 10 mi ex jnct Sandakan-Kota Kinabalu Rd, *Hay 10013* (SAN); Cult. RBG Sydney Acc. No. 950366 ex Ulu Dusun, *Hay 10029* (NSW); Cult. RBG Sydney Acc. No. 950374, Madai Falls, *Hay 10037* (NSW); Cult. RBG Sydney Acc. No. 960547 ex Tibau Forest Station, Kinabatangan, *Hay 12138* (NSW); Cult. RBG Sydney Acc. No. 960577 ex 2.5 km above Maliau Falls, G. Rara F.R., *Hay 12056* (NSW); Cult. RBG Sydney Acc. No. 960597 ex Kinabatangan, Kalabakan Virgin Jungle Reserve, *Hay 12017* (NSW); Semporna, Timpun Mata F.R., Mapat R., *Keith BNB 7419* (A, KEP, K, L). KALIMANTAN: Headwaters of Sg. Kahayan, 5km N.E. of Haruwu Vill., *Burley et al. 596* (KEP, K, SING).

3. Alocasia robusta M. Hotta

Alocasia robusta M. Hotta, Acta Phytotax. Geobot. 22 (1967) 159, fig. 6, A-F; A. Hay in Plant Talk 5 (1996) 25, un-numbered photo. - Type: Malaysia, Sarawak, Bintulu, at the foot of Bukit Kana, 22 Nov 1963, *M. Hotta 15502* (KYO, holo - n.v., L, iso).

Colocasia gigantea sensu auct. non (Bl.) Hook.*f.*: Ridl., J. Straits Br. Roy. Asiat. Soc. 44 (1905) 178 & Merr., Enum. Bornean Pl. (1921) 107.

Gigantic arborescent herb to palmiform tree to 6 m tall with clear sap that almost instantly turns orange on contact with air; *stem* erect to decumbent, 15–30 cm diam. (the base swelling to ca. 40 cm), smooth; *leaves* several together; *petiole* smooth, somewhat glaucous, pale green to pinkish brown, ca. 1.5–3.5 m long, sheathing in the lower 1/3, with scattered flat ± circular glands; *blade* ovato-sagittate, ca. 1.5–4 m long, ca. 80 cm to 2.5 m wide, slightly glossy mid-green adaxially, abaxially waxy glaucous, the margin entire to slightly sinuate; *anterior lobe* up to ca. 3.2 m long, widest at the base; anterior costa with 10–18 primary lateral veins diverging at ca. 70–80°; secondary venation not prominent, not forming interprimary collective veins; *posterior lobes* to ca. 90 cm long, rounded; posterior costae diverging at ca. right angles, bearing lamina right into the sinus (in juveniles peltate until leaf blades are ca. 30 cm long); *inflorescences* ca. (10–)30–40 crowded together in the centre of the leafy crown, subtended by robust broadly lanceolate deliquescent to marcescent cataphylls; peduncles stout, hardly exserted from the cataphylls, ca. 15–20 cm long; spathe to ca. 20 cm long, constricted at ca. 4–5 cm from the base; lower spathe pale greenish ivory with few to numerous shiny colourless to (?or becoming) dark red horizontal glandular markings, ovoid, ca. 2.5 cm diam.; limb cowl-like, by male anthesis the base sharply reflexed then the rest erect, forming a pollen-filled trough at the bottom, deep purplish pink to greyish ivory faintly suffused pink, ca. 15 cm long x 6 cm wide; *spadix* somewhat shorter than the spathe, ca. 15–19 cm long, sessile to very shortly stipitate; *female zone* subpyramidal, trigonous, 2–3 cm long, ca. 2 cm diam at base, tapering to ca. 1.5 cm diam. distally; pistils ivory; ovary subglobose, faintly longitudinally ridged, ca. 1.5 mm diam.; style slender, ca. 0.5 mm long or absent; stigma button-like to faintly 3–4-lobed; *sterile interstice* slightly wider than female zone, reduced to 1–2 whorls of small yellow synandrodia with the staminodes incompletely fused; *male zone* ca. 4 cm long, much expanded (ca. 2 cm diam.) in the part distal to the spathe constriction, below the spathe constriction ca. 1.2 cm diam; synandria rhombohexagonal, 1.5–2 mm diam., ivory, with the thecae overtopped by the synconnective; *appendix* dirty pale yellow to ivory, slightly constricted at base, narrower than distal part of male zone, tapering gradually to a fine point; *fruiting spathe* whitish, sometimes borne quasi-laterally in a ring on the trunk below the leaf crown and then pendulous, the spathe dehiscing longitudinally; fruits reddish orange, rather small, ca. 4 mm diam., mostly single-seeded.

Distribution: Widespread in Borneo, though mainly in the northwest, and with one record from the Natuna Islands.

Habitat: Wet but well-drained open disturbed places, road sides, plantations, river banks, land slides, canopy gaps in lowland to lower montane forest.

Notes: 1. A magnificent arborescent herb with, in the biggest examples, certainly the largest undivided leaf of any herbaceous plant (not counting the habitually tattering leaves of the biggest Musaceae) and challenging the few palms with large undivided leaves. It is strikingly glaucous on the underside. It is common and widespread in northern Borneo at low elevations, and it is remarkable that it was not described until 1967. From a distance it resembles, but is much larger than, *A. macrorrhizos*, with a rather similar subtriangular ovato-sagittate leaf outline, which may account for it having been overlooked. Vegetatively it may be distinguished by the posterior costae with lamina to the sinus and the glaucous abaxial side to the lamina. The seedlings, even when quite large, have peltate leaves with the undersides glaucous and the whole glabrous (cf. *A. sarawakensis*). The inflorescences are very different from those of *A. macrorrhizos*, both in their clustered arrangement, and the thick marcescent/deliquescent cataphylls (bits of which often adhere to the open spathe), the ivory horizontally red-marked lower spathe and the thick greyish to purplish limb.

2. Though they are morphologically almost identical, plants I have observed in the living state in Sarawak and Sabah differ in the spathe limb colour and inflorescence odour. In the former, the spathe limb is purple and the inflorescence smells of decomposing beef extract; in the latter, the spathe limb is sometimes greyish, slightly suffused with purple, and sweetly fragrant. This may suggest that they are biologically differentiated by having differing pollinators, and warrants further investigation. In plants at Sepilok, I observed that the odour is produced from the inside of the lower spathe, not the spadix.

3. The sap turns orange on exposure - a feature not common in *Alocasia*, but known in allied *Colocasia gigantea.*

4. Possible hybridity with *A. sarawakensis* was noted under that species. *Hay 10039* (cult. RBG Sydney Acc. No. 950376) appears in the vegetative state to be intermediate between *A. robusta* and *A. wongii*. At the Madai Falls, Sabah, the two putative parents grow together.

5. Ridley's Bornean record of *Colocasia gigantea* (reiterated by Merrill, loc. cit.), was based on a sighting at 'Byte Estate' near Sandakan, with no

specimen preserved. *Colocasia gigantea* is unknown in Borneo, but bears some resemblance to *Alocasia robusta* - particularly in the large size and glaucousness of the leaf blade. It seems probable that Ridley, who was interested in Araceae, would have encountered *Alocasia robusta*, which is a common plant in northern Borneo, and I can only assume that this record is his misidentification of it.

Other specimens seen: NATUNA ISLANDS: Pulau Bunguran, E of G. Ranai, *van Steenis 1117* (BO); SARAWAK: Cult. RBG Sydney Acc. No. 940569 from Kubah National Park, Matang, *Hay et al. 9416* (NSW). BRUNEI: Temburong Prov., Batu Apoi F.R., *Poulsen et al. 43* (E, K). SABAH: Mt Kinabalu, E shoulder, *Chew et al. 574* (K); Lahad Datu Rd, ca. 10 mi from jnct Sandakan-Kota Kinabalu Rd, *Hay 10012* (SAN); Cult. RBG Sydney Acc. No. 950378 ex Madai Falls, *Hay 10041* (NSW); Elopura, Leila Rd., Sandakan, *Kadir A2698* (KEP, SING). KALIMANTAN: Central East Borneo, W. Koetai, No 45 Kombeng, *Endert 5234* (BO, K, L).

Scabriuscula Group

Species 4—7

Small to very robust lithophytic to terrestrial herbs; *leaves* coriaceous, leathery to subsucculent; petioles glabrous to scabrid, occasionally pubescent, often ornamented with purple lines, dots and circles; secondary venation generally flush with the lamina abaxially and adaxially, sometimes impressed adaxially, sometimes prominent abaxially; *inflorescences* (2–)several to many together not interspersed with foliage leaves; *spathes* typically with the ground colour white to ivory or yellowish, occasionaly brownish pink throughout, with purple dots and/or margins, sometimes the limb wholly suffused purple to brown, usually constricted at a level well above the sterile interstice of the spadix, sometimes level with the interface of the male zone and the appendix; *spadix* typically ivory throughout - including the ovaries; stigmas typically with two drop-shaped lobes suberect; *fruiting spathe* generally white.

Notes: 1. This group is endemic to Borneo and appears closely allied to the more widespread but less speciose Puber group, sharing the multiple inflorescences, white, often purple-marked spathes constricted in the male zone. The Puber group is relatively different ecologically, however, evidently associated with open sites, disturbed places and the gap phase of forest, while this group generally is associated with more shaded situations (though *A. scabriuscula* itself is sometimes found in open sites).

2. The Scabriuscula Group is taxonomically difficult, with, as currently understood, two widespread highly variable species, *Alocasia scabriuscula*

and *A. princeps,* and a number of local segregates, which may be difficult to differentiate morphologically at the extremes of their variation. Interpreting herbarium material is exceptionally difficult in this group. There is a strong need for more field-based data on their ecology, phenology and pollination biology. Only *Alocasia melo, A. principicula* and *A. reginula* are very clearly defined morphospecies, the latter known only from cultivated plants.

3. A curious feature of the Scabriuscula Group, noted already for the Puber Group, is the common positioning of the spathe constriction above the base of the male zone of the spadix such that all or part of the male zone is held within the lower spathe chamber. More usually in this genus, the spathe constriction corresponds in position with the sterile interstice and tightening of the constriction between female and male anthesis appears to be a mechanism that precludes self-fertilisation, preventing pollen from falling into the lower spathe chamber. It might seem that the arrangement of (some of) both fertile zones within the lower spathe chamber could allow self-fertilisation, which might in turn promote the formation of local entities through inbreeding. However, self fertilisation does not appear to take place in this group, as cultivated plants do not set seed spontaneously (though in the field there does seem to be an extremely high level of fruit production). Moreover, the *A. longiloba* complex (q.v.), which also has highly complex variation patterns, has the more usual relationship between the sterile interstice and the spathe constriction. Whatever the explanation, both these groups appear to be undergoing active evolution.

4. Alocasia scabriuscula N.E. Br.

Alocasia scabriuscula N.E. Br., Gard. Chron. 12 (2) (1879) 296; Ridl., J. Straits Br. Roy. Asiat. Soc. 44 (1905) 179; Engl. & K. Krause, Pflanzenr. 71 (IV.23E) (1920) 79. - Type: Cult. RBG Kew ex N.W. Borneo, Aug 19 1879, *N.E. Brown s.n.* (K, holo, 3 sheets).

Alocasia imperialis L. Linden ex N.E. Br., Gard. Chron. n.s. 21 (May 1884) 711 - *Alocasia guttata* var. *imperialis* (L. Linden ex N.E. Brown) N.E. Br., Ill. Hort. 31 (Dec 1884) 185, t. 541. - Type: Cult. Comp. Cont. d'Hort., Gand, 10 Sep 1884, *Anon. s.n.* (K, holo).

Alocasia guttata N.E. Br., Ill. Hort. 31 (Dec 1884) 185, syn. nov. - Type: Cult. Hort. Veitch ex Lawas R., N.W. Borneo, Jan 1879, *N.E. Brown s.n.* (K, holo, 2 sheets).

Alocasia villeneuvei L. Linden & Rodigas, Ill. Hort. 34 (1887) 59; Anon., Kew Bull. (1888) 92 ('*villaneuvii*'); Ridl., J. Straits Br. Roy. Asiat. Soc. 44 (1905) 179; Engl. & K. Krause, Pflanzenr. 71 (IV.23E) (1920) 86; Merr., Enum. Bornean Pl. (1921) 106 ('*villanuevei*'). - Type: Ill. Hort. 34 (1887) t. 21. Epitype: Brunei Darussalam, Temburong, Gunong Retak, 13 Mar 1991, *R.J. Johns 6721* (K, designated here).

[*Alocasia porphyroneura* auct. non Hallier *f.*: Engl. & K. Krause, Pflanzenr. 71 (IV.23E) (1920) 100, p.p. quoad specim cit. *Hallier 328*]

[?*Alocasia reginae* sensu auct. non Linden ex N.E. Br.: M. Hotta, Acta Phytotax. Geobot. 22 (1967) 156 ('*regia*')]

Robust herb ca. 0.5–1.2 m tall; *rhizome* ca. 5–10 cm thick; *leaves* several together; *petioles* typically spreading and proportionately rather short - about equalling the length of the blade, ca. 40–100 cm long, smooth to scabrid or sparsely to densely minutely pubescent, rarely plain pale grey-green, usually ornamented with irregular sparse to dense purple-brown dots, circles and longitudinally aligned broken fine lines, sheathing in the lower ca. 1/3; *blade* ovato-sagittate to broadly ovato-sagittate, ca. 40–85 cm long, adaxially dark to light grey-green and sometimes conspicuously darker along the main venation, abaxially pale grey-green to rich purple, occasionally flushed purple on both surfaces, very thickly leathery to almost succulent; *anterior lobe* widest at ca. 1/4 of the way distal to the petiole insertion, the apex acute to obtuse; anterior costa with (4–)5–8 primary lateral veins on each side diverging at 45–60° and with conspicuous green, purple or purple-ringed axillary glands, these sometimes also present in the axils of the larger secondary veins; secondary venation ± flush with the lamina to somewhat impressed on both surfaces (depending on thickness of blade), often abaxially obscure or conversely sometimes conspicuous through pigmentation of the bordering lamina, forming more or less well-defined interprimary collective veins; *posterior lobes* ca. 1/3–1/2 the length of the anterior, usually acute, sometimes rounded, the inner sides usually narrowly to very narrowly oblanceolate, sometimes wider becoming ovate; posterior costae diverging at 60–120°, naked in the sinus for ca. 2–4 cm, rarely with lamina to the sinus, but never peltate as adult plants; *inflorescences* several together in a tight low cluster; peduncle hardly or not exserted from the subtending cataphylls and leaf sheaths; cataphylls ovate, rather fleshy, often marked like the petiole; *spathe* greenish to yellowish white to ivory, often speckled purple, sometimes suffused purple throughout or the limb purple, (7–)9–10 cm long, constricted (2–)2.5–3(–5) cm from the base; lower spathe thick, narrowly to broadly ovoid; limb

oblong to ovate, 2–3 cm wide, eventually completely reflexed, the tip apiculate to acuminate for 1.5 cm; *spadix* very shortly stipitate for ca. 1.5 mm, (5.5–)6–7 cm long; *female zone* (1–)ca. 1.5 cm long, subcylindric to slightly conic, squat, (0.8–)1.2–1.5 cm wide at base; ovary pale green to cream, ovoid, 1–2 mm long; style slender, 0.5–1 mm, facing diagonally out- and up-wards; stigma cream (turning yellow in spirit) mostly 2-lobed; *sterile interstice* (4–)7–8 mm long, somewhat narrower than female zone at base and ca. 3–4 mm diam., narrowly obconic, basally ca. 2 whorls of somewhat lax white subcylindric synandrodia ca. 1.5 mm diam., distally composed of ca. 3 whorls of synandrodia ca. 2–3 mm diam., closely resembling synandria; *male zone* ivory, ca. 1.5–2 cm long, 5–7 mm diam., often somewhat constricted level wth spathe constriction, (1/4–)1/3–1/2 (–2/3) within the lower spathe chamber; synandria 2–3 mm diam., rhombohexagonal to somewhat irregular; thecae not overtopped by synconnective; *appendix* ivory, (2–)2.5–3 cm long, tapering to slightly spindle shaped, 5–7 mm diam. at base, the tip usually slightly obtuse; *fruiting spathe* ca. 4.5 cm long broadly ovoid, white, usually speckled purple.

Distribution: Endemic to Borneo, widespread.

Habitat: Lowland forest to hill forest to ca. 1200 alt., often in disturbed areas, in swampy to well-drained sites, river banks, occasional on roadsides and in plantations.

Notes: 1. As conceived here, this is a highly variable species. Typical forms have ovatsagittate and thick, dark to mid grey-green leaves with the inner sides of the posterior costae very narrowly oblanceolate. These forms conform with the type of *A. guttata* N.E. Br. Rather less common are large forms with well developed, broad posterior lobes, which conform with the type of *A. scabriuscula*. There are intermediates. There is also very considerable variation in the thickness of the leaf blade, from distinctly though rather thinly leathery, to blades almost 5 mm thick and virtually succulent. The petiole varies considerable in texture from finely pubescent to scabrid to smooth.

2. *Alocasia scabriuscula* s. l. is only narrowly distinguished morphologically from *A. ridleyi* (q.v.), which has relatively longer posterior lobes, longer peduncles, a more slender inflorescence and is a limestone element confined to SW Sarawak.

3. Of the specimens cited below, *Beaman et al. 7451* is tentatively ascribed to this species. It differs in the rather long posterior lobes, long peduncles

and paired infructescences. *Hay 9381* has unusually thinly textured leaves and atypically small inflorescences, with the spathe only ca. 7 cm long, but conforms in other respects. *Poulsen 235* is evidently taken from an exceptionally robust plant, as the lower spathe is ca. 5 cm long.

4. There are a number of colour variations, including specimens with red-purple leaf undersides or the leaves entirely suffused with purple (e.g. *Afriastini 406*).

5. No original material has been found that could serve as a type of *Alocasia villeneuvei*. The protologue, though singing the praises of this plant in horticulture, contains almost no botanical information. However, it is attributed to Borneo. Dimensions are not given, but the plant is clearly robust. The description does mention brown spotting on the petioles, which is clearly apparent in the illustration. This feature is found in some forms of the *A. princeps* complex, and to varying intensity in *A. sarawakensis*, *A. reginae* and *A. scabriuscula*. The illustration is not of high quality, but *A. sarawkensis* can be eliminated as there is no sign at all in the plate of that species' conspicuous interprimary collective veins. Moreover, it is hardly ornamental. The leaves are too broad and the petioles relatively too short for any larger forms of the *A. princeps*. *Alocasia reginae* is small and characteristicaly has the inner side of the posterior costae narrowly lanceolate, while the plant depicted has broadly developed lamina there, which matches the type of *A. scabriuscula*. Furthermore, the upper side of older leaves is depicted dark dull grey-green which is also typical of this species. *Alocasia villeneuvei* is therefore epitypified accordingly. The epitype, *Johns 6721*, has broad posterior lobes, matching well those apparent in the original illustration of *A. villeneuvei*.

6. *Alocasia imperialis* and *A. reginae* may have been first described by Linden, just prior to N.E. Brown, in an 1883 or 1884 catalogue of the Compagnie Continentale d'Horticulture Gand. However, I have not been able to locate the relevant issues. The plants were exhibited by the Compagnie in May 1884 at the International Exhibition of the Imperial Society of Horticulture at St Petersburg, on which Brown reported in the Gardener's Chronicle in the same year, describing (validly but unintentionally) *Alocasia imperialis*. There he also mentioned and briefly described *A. reginae*, but said it was the same species as *A. imperialis*, thus invalidating it.

Other specimens seen: SARAWAK: Santubong, *Carrick & Enoch JC/191* (SING); Cult. RBG Sydney Acc. No. 940505 ex Niah Caves area along track from Niah town, *Hay et al.*

9354 (NSW); Cult. RBG Sydney Acc. No. 940471 ex 2.5 km past Kemena R. bridge on Bintulu-Sibu Rd., *Hay et al. 9317* (NSW); Cult. RBG Sydney Acc. No. 940531 ex Kg Sentah, nr Kuching, *Hay et al. 9381* (NSW); Kuching, *Hewitt 6* (SING); Semunsan Wildlife Sanctuary, *Kiew RK885* (KEP); Anap, Ulu Muput Kanan, path to Bukit Kemantan, *Paie S19507* (US); Matang, *Ridley s.n.* (SING); Santubong, *Ridley s.n.* (SING). BRUNEI: Temburong Distr., Bukit Biang, *Forman 897* (K) & *931* (K); Temburong, Batu Apoi F.R., Sg Baki, *Poulsen 108* (K); Temburong, Batu Apoi F.R., Sg Temburong, *Poulsen 235* (K) SABAH: Ranau Distr., Pinosuk Plateau, W Mesilau R. at waterworks dam, *Beaman et al. 7451* (K, US); Cult. RBG Sydney Acc. No. 960516 ex 2.5 km above main Maliau Falls, G. Rara F.R., *Hay et al. 12045* (NSW); Cult. RBG Sydney Acc. No. 960520 ex Kinabatangan, Kalabakan VJR, *Hay et al. 12006* (NSW). KALIMANTAN: Central Kalimantan, sei Sampit, Kualakuayan, *Afriastini 406* (BO); Pulau Lemoehoetan, *Hallier 328* (L).

5. Alocasia reginae L. Linden ex N.E. Br.

Alocasia reginae L. Linden ex N.E. Br., [Gard. Chron n.s. 21 (1884) 711 ('*regina*'; invalidly published - not accepted by author)]; Ill. Hort. 32 (1885) 11, t. 544; Engl. & K. Krause, Pflanzenr. 71 (IV.23E) (1920) 82 ('*regina*'). - Type: Cult. RBG Kew ex Hort. Compagnie Continentale d'Horticulture Gand, Nov 1883, *N.E. Brown s.n.* (K, holo).

Small herb 20–30 cm tall; *rhizome* ca. 1.5 cm diam.; *leaves* 2–4 together; petiole 10–25 cm long, sheathing in the lower 1/4–1/3, sparsely to densely minutely pubescent, green to densely spotted purple; blade broadly ovato-sagittate to ovato-sagittate, 13–25 cm long, thickly leathery, dark green, paler abaxially or flushed purple throughout; margin entire to slightly and irregularly sinuate; *anterior lobe* widest ca. 1/3 of the way from the base, the apex acute to obtuse and then apiculate; anterior costa with 3–4 abaxially pubescent primary lateral veins on each side diverging at 60° (proximal)–45° (distal) and with small axillary glands; secondary venation adaxially impressed, abaxially flush with the lamina to somewhat impressed (dry), conspicuous and apparently broad (ca. 1 mm) owing to pigment in the bordering lamina, forming mor-or-less well-defined interprimary collective veins at least in the outer part of the blade; *posterior lobes* 1/3–2/5 the length of the anterior, the inner sides very narrowly oblanceolate; posterior costae naked in the sinus for 4 mm to 1 cm, basally diverging at ca. 90–100° then somewhat to abruptly back-turned; *inflorescence* pairs solitary; peduncles ca. 1/3 the length of the petiole at anthesis (not or hardly elongating in fruit), subtended almost throughout their length by very narrowly lanceolate cataphylls; *spathe* ca. 5–7 cm long, constricted ca. 1.5–2 cm from the base; lower spathe ovoid, white, sometimes spotted purple; limb narrowly ovate, white and spotted to suffused purple; *spadix* distinctly shorter than to subequalling the spathe, sessile, ca. 5 cm long; *female zone* 1 cm long; pistils flask-shaped; style short, ca. 0.5 mm; stigma 2–3-lobed; *interstice* 3–5 mm long, partly naked to covered with synandrodia;

male zone subcylindric, 9–15 mm long ca. 1/4–3/4 held within the lower spathe chamber; synandria rhombohexagonal, ca. 1.5 mm diam.; thecae not overtopped by synconnective; *appendix* 1–2 cm long tapering to somewhat obtuse, ca. 3 mm diam (dry); *fruiting spathe* ovoid, ca. 2.5 cm long.

Distribution: Endemic to Borneo, known from only three–localities in Sarawak and Central Kalimantan.

Habitat: On the floor of primary lowland rain forest: *Jermy 13579* on alluvial soil with residual limestone karst; ca. 40–270 m altitude.

Notes: 1. This species is evidently closely allied to the variable *Alocasia scabriuscula*, differing in the smaller size overall, inflorescences in single pairs, relatively much longer peduncle and the long, narrow inflorescence cataphylls.

2. The description is pieced together from four incomplete collections. The type differs from the only other flowering specimen, *Jermy 13579*, in having a larger proportion of the male zone exserted from the lower spathe and in having the interstice covered with synandrodia.

3. Hotta (1967: 156) cited several specimens from Brunei and Sarawak as this species. I have not seen any of the collections concerned, but it would appear from his notes (loc. cit.), in which he gives significantly larger dimensions, that these specimens are probably of *A. scabriuscula.*

4. *Alocasia reginae* has been in cultivation in the U.S.A. for some years, under the name *Alocasia* Elaine. An image may be found at http://www.skg.com/alocasia4.html, and the cultivar is also illustrated in Burnett (1984: 77, fig. 4).

Other specimens seen: SARAWAK: Limbang Distr., Sg. Terikan, *Chew 1183* (GH, K, L, SING); G. Mulu National Park, around Sg. Berar Camp, *Jermy 13579* (K). KALIMANTAN: Headwaters of Sg. Kahayan, 5 km NE of Haruwu Village, *Burley et al. 527* (GH).

6. Alocasia reginula A. Hay, *sp. nov.*

Ab *Alocasia melo* folii lamina atrovirida haud rugosa, nervis albidis impressis, spathae lamina et appendice valde brevioribus differt. - TYPUS: Cult. U.S.A., Florida, Jul 1998, *D. Fisk s.n.* (NSW, holo).

Small herb to ca. 25 cm tall; *leaves* several together; *petioles* ca. 18 cm long,

sheathing in the lower ca. 1/3; *blade* elliptic to ovate, ca. 15 cm long, 8–11 cm wide, thickly coriaceous, almost completely peltate save for a shallow retuse notch between the tips of the connate posterior lobes, apically acute to obtuse and mucronate for ca. 1 cm, adaxially very dark matt green, abaxially paler and flushed purple; anterior costa with 2–3 primary lateral veins on each side, diverging at ca. 90° (proximal ones) to 45° (distal ones); primary veins adaxially whitish, somewhat impressed, abaxially with inconspicuous axillary glands; secondary venation somewhat impressed adaxially, more or less flush with the lamina abaxially (the larger ones somewhat prominent abaxially in the dry state and adaxially whitish), forming interprimary collective veins towards the margin only; *posterior lobes* about 2/5 the length of the anterior, with the posterior costae diverging at ca. 30°; *inflorescences* paired, subtended by short, broad cataphylls; peduncle very short, hidden within cataphyll; *spathe* ca. 5* cm long, white with scattered purple flecks on the lower part; lower spathe ca. 2.5 cm long, ovoid to subcylindric, separated from limb by a rather weak constriction; limb much reduced, erect even after anthesis, broadly lanceolate, ca. 2 cm long; *spadix* sessile, somewhat shorter than spathe, ca. 4.5* cm long; *female zone* about 1/4 of the length of the spadix; *sterile interstice* a single whorl of close-packed synandrodia, not attenuated; *male zone* cylindric, about half the length of the spadix, about 2/5 as wide as long, ivory; synandria with the thecae not overtopped by synconnective; *appendix* about 1/4 of the length of the spadix, much reduced, narrowly conic; *infructescence* unknown.

Distribution: ?Borneo (see notes).

Habitat: Unknown.

Notes: 1. This plant is known only in cultivation, but it is clearly quite distinct from any known species. It exhibits few if any characteristics which might suggest that it is of hybrid origin, and is therefore described here as a new species. The description is based on dried leaves sent to me by Mr Dewey Fisk (Florida) and on images posted on the internet (http://u1.netgate.net/~kk/Araceae/Alocasia/Black_Velvet.html and http://www.skg.com/alocasia2.html). Since there is no scale on the images, the dimensions above indicated '*' are estimates. *Alocasia reginula* is well-established in cultivation under the U.S.A. trade-mark cultivar name Black Velvet, and has been successfully micropropagated (see http://www.agristarts.com/tech.htm).

2. The origin of *Alocasia reginula* is unclear. Scott Hyndman (*pers. comm.*),

who named the cultivar, obtained material from Lyon Arboretum in Hawaii purportedly having been in turn obtained from a Japanese collector in Borneo. In aspect it appears to belong in the Bornean *A. scabriuscula* group.

3. The specific epithet means 'little queen', following the several regal epithets that have been used in this group.

7. Alocasia melo A. Hay, P.C. Boyce & K.M. Wong

Alocasia melo A. Hay, P.C. Boyce & K.M. Wong, Curtis's Bot. Mag. 14 (1997) 82, pl. 315. - Type: Cult. RBG Kew from material collected in Sabah, Malaysia by Mrs S. Collenette s.n., Accession No. 1960 - 443 (holotype K, isotype K spirit coll. no. 22427!).

Small herb ca. 25–35 cm tall; *stem* to ca. 3 cm diam., erect, short; *leaves* to ca. 4 together, their bases overlapping; *petiole* ca. 14–19 cm long, pale green, glabrous, smooth, sheathing and sparingly purple-spotted in the lower 1/5; wings of sheath rather broadly triangular; leaf *blade* very broadly ovate to sub-orbicular, 18–25 cm x 15 cm, rugose and bullate and deep somewhat bluish green adaxially, smooth and pale greenish white abaxially, coriaceous, almost completely peltate; *anterior lobe* ca. 12.5–16 cm long, the tip broadly acute to obtuse and then shortly acuminate for ca. 1 cm and/or apiculate; *posterior lobes* to 8.5 cm long, united for 75–90% of their length; posterior costae diverging from one another at ca. 20–30°, poorly developed and not or hardly differentiated in size from the primary venation arising from the anterior costa; primary lateral veins 3–4 on each side of anterior costa, diverging at 90° (most proximal) to 45° (most distal), adaxially deeply impressed, abaxially more or less flush with lamina and dark green, irregularly bearing veins intermediate in thickness between primary and secondary venation, running the same course as the latter; secondary venation deeply impressed adaxially, abaxially somewhat raised and concolorous with abaxial lamina, arising at a wide angle (c. 80°) from the primary venation and running to form quite well-defined interprimary collective veins; tertiary venation strongly raised adaxially into an irregular honeycomb pattern, abaxially imperceptible; *inflorescences* paired, subtended by conspicuous broadly lanceolate persistent cataphylls ca. 8–10 cm long; peduncle ca. 5 cm long; *spathe* ivory-white, 9–16 cm long, constricted slightly less than half way from the base; lower spathe purple-spotted, especially towards the insertion of the peduncle, ovoid, ca. 1.5 cm wide; spathe limb broadly lanceolate, strongly reflexed by male anthesis, the tip acuminate for ca. 1 cm, margins translucent, the entire limb swiftly withering and marcescent (in cultivation; probably deciduous or deliquescent

in nature); *spadix* shortly stipitate, much shorter than spathe, ca. 5 cm long, with the male and female zones enclosed within the lower spathe; *female zone* 1.2 cm long, 1.3 cm wide at base, tapering distally; ovaries pale green, ca. 1.5–2.2 mm diam., ovoid; style virtually none, stigma 2–3-lobed, orange-brown; *sterile interstice* much narrower than female zone, ca. 5 mm long, 1.2 mm thick, bearing a few somewhat distant white synandrodia; *male zone* cylindric, pale ivory-white, 1.3 cm long, 4–6 mm thick; synandria rhombohexagonal, 1–2 mm across; thecae not overtopped by synconnective, opening by apical pores; *appendix* ivory-white to pinkish, cylindric-subclavate, 1.7 cm long, 4 mm thick; *fruiting peduncle* ca. 12 cm long; fruiting spathe ovoid, ca. 4 cm long; ripe fruit unknown.

Distribution: Endemic to Sabah, Borneo.

Habitat: Rain forest on ultramafic rock: in rock crevices and on thin soil along steep banks of fast-flowing streams, 120–400 m.

Notes: 1. This species is the only one so far known to be confined to ultramafic substrate, though Sulawesi *Alocasia balgooyi* (qv) shows a rather strong association with it.

2. The peculiar finely and strongly rugose adaxial leaf surface appears to be unique in the genus, and *A. melo* would appear to have potential for horticultural exploitation.

Other specimens seen: SABAH: Labuk, Sg. Porog, *Collenette 502* (K); Cult. Royal Botanic Gardens Sydney, Acc. No. 960489 ex Tongod, G. Tingkar, *Hay & Wong 12001*, (NSW); Beluran, Porog, W side of Bidi Bidu nr Kubar Labuk, *Meijer 41241* (K, L, SAN); cult. Royal Botanic Gardens Sydney, Acc. No. 950381 ex Tongod, G. Tingkar, *Radin s.n.* (NSW, sterile).

Alocasia princeps Complex

Species 8—15

Very robust to small terrestrial or lithophytic herbs; *petioles* smooth to asperous, sheathing in the lower 1/9–1/3, concolorous and bright mid-green to purple-brown or variously marked with oblique zones of close-spaced longitudinal brownish lines or with scattered longitudinal thin or thick purple-black lines and dots; *blades* triangular to narrowly triangular in outline, hastato-sagittate to sagittate, rarely ovato-sagittate, mostly rather thinly leathery to strongly coriaceous, but not subsucculent, usually very dark green adaxially, occasionally grey-green; secondary veins mostly flush

with the lamina adaxially and abaxially, occasionally abaxially somewhat prominent and adaxially slightly impressed, not forming interprimary collective veins, or these poorly formed and then only towards the blade margin; posterior lobes about 1/3 to subequalling the length of the anterior, acute, the inner side ovate to very narrowly lanceolate (lamina rarely almost entirely lacking on inner side of poserior costa); posterior costae naked in the sinus; *inflorescences* (2–)several– ca. 10 together, not interspersed with foliage leaves; *spathe* usually white to ivory to pale yellow throughout, marked with purple dots on the lower spathe, the limb often with a thin purple margin, or spathe dirty pinkish brown and then sometimes sparsely mottled darker and with the limb darker in colour throughout, or spathe greenish; *spadix* sessile, somewhat shorter than the spathe, pistils usually somewhat acroscopic, ovoid, close-packed to barely touching one another, mostly ivory to pale yellow-green throughout (including stigma); style slender; stigma 2(–3)-lobed, the lobes drop-shaped and suberect to spreading; *interstice* sometimes partly naked or with the synandrodia loosely packed, or densely covered with synandrodia; *male zone* subcylindric, often partly to wholly within the lower spathe chamber, ivory; synandria with the thecae not overtopped by synconnective and opening by apical pores; *appendix* ivory to very pale violet; *fruiting spathe* (ovoid to) globose, more or less the same colour as the flowering lower spathe, 2–5 cm diam., dehiscing longitudinally from the top.

Distribution: Endemic to Borneo; there widespread, but with a concentration of variation in northwest Borneo. *Alocasia princeps* itself is widespread (though it is interpreted here rather broadly, particularly with respect to material from Kalimantan), while *A. ridleyi*, *A. wongii*, *A. pricipiculus*, *A. puteri* and *A. pangeran* are localised segregates.

Notes: 1. This complex consists of a number of very similar, closely related elements and presents the greatest difficulties for interpretation of species limits in the genus. Members of the complex cohere in their relatively long, erect petioles, narrowly triangular leaf blades, which are thinly leathery to leathery but not subsucculent (cf. *A. scabriuscula*), relatively elongate inflorescences with tapering appendices (cf. *A. scabriuscula*). In other respects, the group is very similar to *A. scabriuscula*, and *Alocasia ridleyi* is intermediate, approaching it in its stiffly leathery leaves and relatively short, squat inflorescences. Nevertheless in aspect that species is fairly clearly nearer to *A. princeps* than to *A. scabriuscula*. Within the limitations imposed by the material that there is to work with and the timetable for this Flora Malesiana precursor, the treatment of this group, more than any other, should be regarded as no more than a basis for further studies, not

only in the way of further collecting and field observation, particularly in Kalimantan, but also studies both at the lower, molecular level, and at the higher, ecological level of population and pollination biology. It is not unreasonable to speculate that this group is in active speciation.

2. Where I have been able to study the plants in the field and in cultivation, it has been possible to recognise species segregated from *A. princeps s.l.* Given the difficulties of interpreting herbarium material in this group, I suspect that study of living plants in or from other parts of the range would enable the recognition of further segregates - particularly in Kalimantan Selatan, and further refinement of the concept of *A. princeps*.

3. Members of the *Alocasia princeps* complex have been frequently misidentified as *Alocasia denudata* (see *A. longiloba* 'denudata'), which is restricted to southern Malay Peninsula and Sumatera, and which is not closely related to *A. princeps*. They can be quickly differentiated on the basis of the spathe, which in *A. longiloba* 'denudata' is green in the lower part and yellowish in the limb, while in this group the spathe is generally ivory coloured with various patterns of purple, and by the stigmas, which are stellate and 3–4-lobed in the *A. longiloba* group and generally bi-lobed with drop-shaped lobes in the *A. princeps* complex. *A. longiloba* has distinctly membranous cataphylls, becoming papery and fibrous on drying, whereas those of this group are comparatively leathery in the fresh state.

8. Alocasia ridleyi A. Hay, *sp. nov.*

Ab *Alocasia scabriuscula* in habitu calcicola, folii lamina plus producta, minus crassa, superne atro-viridi, spatha valde albida vel rosea differt. - TYPUS: Cult. RBG Sydney Acc. No. 940541 ex Malaysia, Sarawak, Bau, *Hay et al. 9388* (NSW, holo; iso, K, KEP, L, SAR, SING (to be distributed)).

[?*Alocasia denudata* auct. non Engl.: Ridl., J. Straits Br. Roy. Asiat. Soc. 44 (1905) 178.]

Small to robust herb ca. 45–ca. 1 m tall; *rhizome* 3–6 cm thick; *leaves* several together; *petioles* 35–50(–85) cm long, smooth or rarely scabrid, suberect to somewhat spreading, pale green and unmarked or with few to dense purple-brown dots and lines to flushed purple-brown throughout, sometimes with scattered small circular glands, sheathing in the lower ca. 1/5; *blade* narrowly ovato-sagittate to ovato-sagittate, ca. 15–30(–50) cm long; stiffly leathery, dark green adaxially and shining when young, becoming dull, paler abaxially; *anterior lobe* widest ca. 2–6 cm distal to petiole insertion; anterior costa with 3–4(–6) primary lateral veins, diverging

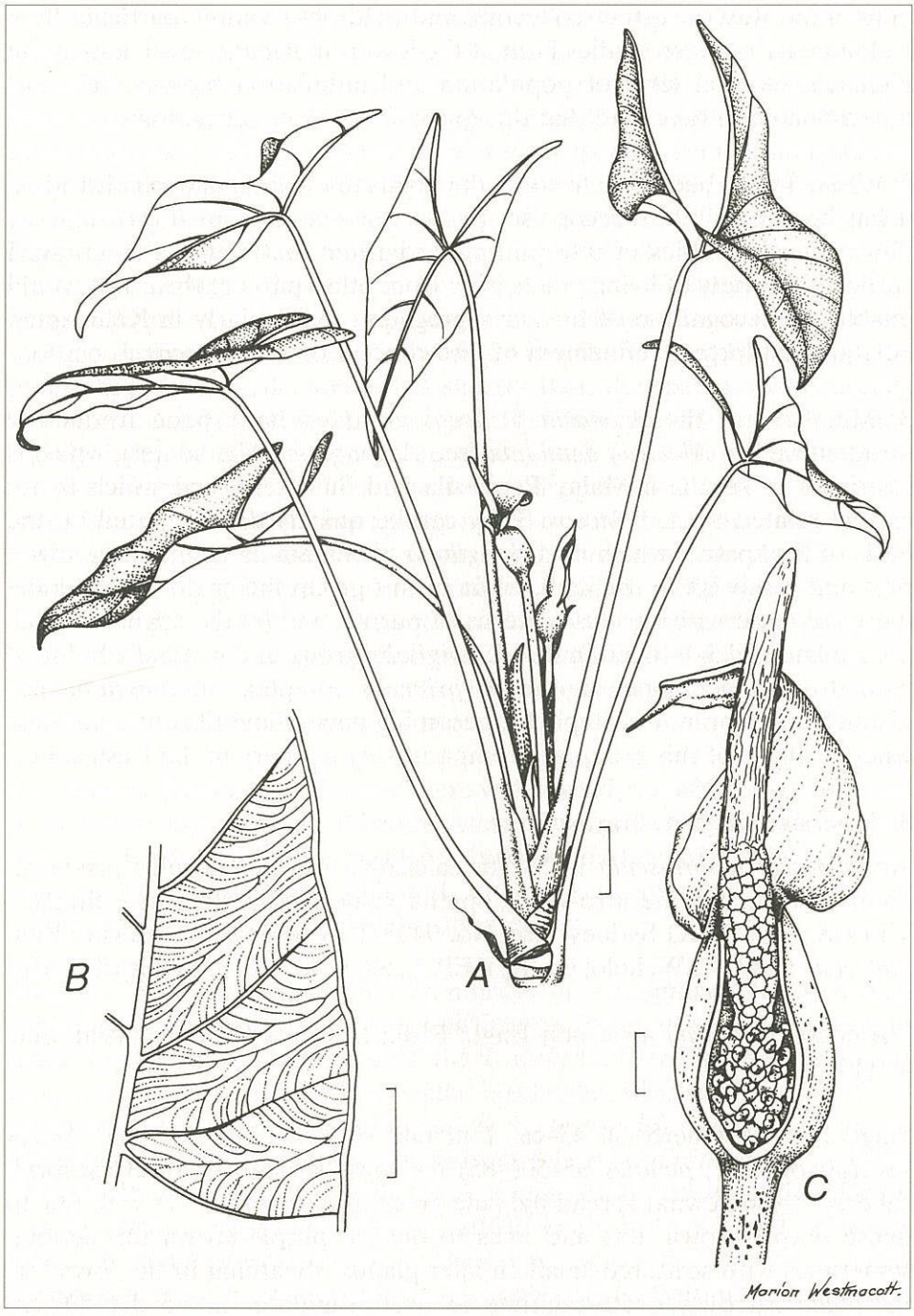

Figure 3. ***Alocasia ridleyi*** **A. Hay**
RBG Sydney Acc. No. 940541 - A. habit; B. venation; C. inflorescence with part of spathe removed. - Scale: A, bar = 4 cm; B, bar = 2 cm; C, bar = 8 mm.

at ca. 70° (proximal ones) to 50° (distal ones); axillary glands conspicuous (when petiole heavily pigmented) or not (when petiole not so); secondary venation flush on both surfaces, or very slightly prominent abaxially, not or hardly forming interprimary collective veins (these sometimes present in robust specimens); *posterior lobes* more than 1/2 to subequalling the length of the anterior, the inner sides narrowly to very narrowly (ob)lanceolate; posterior costae diverging at 60–90°; *inflorescences* several together; peduncle ca. 8–15 cm long, somewhat exserted from the cataphylls; *spathe* white to pink, sometimes with purple spots, 7–10(–13) cm long; lower spathe ovoid to pyriform, 2–4 cm long; limb oblong-lanceolate, erect then completely reflexed; *spadix* somewhat shorter than the spathe, very shortly stipitate for 1.5 mm, 6–9 cm long; *female zone* 1.5–2 cm; ovaries subglobose, close-packed, ca. 2 mm diam.; style very short, 0.25–0.5 mm long; stigma 2–3-lobed, turning yellowish in spirit; *interstice* 0.5–1 cm long, slightly attenuate, 4–5 mm diam., composed of 2–3 whorls of more or less close-packed rhombo-hexagonal synandrodia ca. 1.5–2 mm diam.; *male zone* 1.5–2 cm long, 1/4–1/2 within the lower spathe chamber, usually slightly constricted level with the spathe constriction; synandria ivory, rhombo-hexagonal, ca. 2 mm diam.; *appendix* tapering, 2–3 cm long, slightly narrower than male zone, 5–6 mm diam. at base; *fruiting peduncle* elongating, to ca. 13 cm long; fruiting spathe broadly ovoid, white, sometimes with red spots; longitudinally dehiscent; fruits orange-red.

Distribution: Restricted to S.W. Sarawak.

Habitat: In forest on limestone at low elevation.

Notes: 1. *Alocasia ridleyi* is named for H.N. Ridley, who took a special interest in Aroids of Borneo (Ridley, 1905), and who was the first to collect this species.

2. *Alocasia ridleyi* is evidently very closely allied to *A. scabriuscula*, which also has ovato-sagittate leathery leaf blades and narrowly lanceolate posterior lobes. It differs in the very dark green adaxial leaf surface, relatively longer petioles, relatively narrower leaf blades and somewhat more elongate posterior lobes. The leaves are stiffly coriaceous, but are not subsucculent as those of *A. scabriuscula* often are. The spathe is recorded as white to pink, whereas that of *A. scabriuscula* is generally greenish white to yellowish, speckled with purple (though the latter feature is sometimes present in *A. ridleyi*, as indeed it is in several species in this group). In all these respects, this species is somewhat intermediate between A. *scabriuscula* and *A. princeps*. These differences seem quite trivial, but

they are correlated with a restricted geographic distribution and association with limestone substrate. Even within its restricted distribution, *A. ridleyi* exhibits a high level of variability; *Nicolson 1285* is exceptionally robust.

Other specimens seen: SARAWAK: Seburan, Bau, *Anon. 14596* (K); Ist Division, Bukit Rawan, Tebakang area, *Awa & Paie S45245* (K); nr Bau, *Bogner 1433* (US); Bau, *Brooke 9895* (L), *10797* (BM, L); Bidi Cave, *Clemens & Clemens 21920* (BO, K); Cult. RBG Sydney Acc. No. 940545 ex G. Gading, Lundu, *Hay et al. 9392* (NSW); Bukit Krian [?= G. Kerian], *Madison 7344* (K); Bau limestone hills, G. Setiak (SE of G. Doya), *Martin S38666* (K); vicinity of Bau, *Nicolson 1285* (L, US); Bau, *Purseglove P4467* (GH, K, L, SING); Bau, *Ridley 11715* (K, SING); Cult. RBG Sydney Acc. No. 942741 ex Bau, *Vogel s.n.* (NSW).

9. Alocasia princeps W. Bull

Alocasia princeps W. Bull, Retail List (1888) 7; ?N.E. Brown, Kew Bull. (1889) 76. - Neotype: Malaysia, Sabah, Mt Kinabalu, Dallas, 27 Aug 1931 *Clemens & Clemens 26213* (BM, neo; K, SING, isoneo; designated here - see below).

Alocasia porphyroneura [Engl. ex Hallier *f.*, Bot. Jahrb. Syst. 25 (1898) 25, nom. nud. & Notizbl. Koenigl. Bot. Gart. Berl. 2 (1898) 185, nom. nud.] Hallier *f.*, Bull. Herb. Boiss. ser. 2, 1 (7) (June 1901) 671, nom. illeg. (incl. *A. princeps* W. Bull); Engl. & K. Krause, Pflanzenr. 71 (IV.23E) (1920) 100; M. Hotta, Acta Phytotax. Geobot. 22 (1967) 156.

Robust to very robust herb ca. 0.8–1.8 m tall; *rhizome* ca. 5–10 cm diam.; *leaves* ca. 4 together; *petioles* suberect, to ca. 1.6 m long, sheathing in the lower 1/4–1/3, smooth to slightly rough but not scabrid, dark brownish green, very faintly mottled with an oblique wavy pattern, paler distally, varying to thickly and densely, haphazardly marked with longitudinally aligned purple-brown lines and dots, occasionally with few scattered slightly raised circular glands ca. 2 mm diam.; *blade* to ca. 55 cm long, leathery but not subsucculent, dark green and shining at least when young, paler and sometimes more or less faintly flushed purple beneath, hastato-sagittate, triangular to narrowly triangular in outline, the margin entire to slightly sinuate and undulate; *anterior lobe* widest at base; anterior costa with 3(–5) primary lateral veins on each side diverging at ca. 60°, often purple-tinged, with conspicuous axillary glands; secondary venation flush on both surfaces, fine and usually purple-tinged, not or hardly forming interprimary collective veins; *posterior lobes* subequalling the anterior, narrowly lanceolate to ovate; posterior costae diverging at ca. 90°; *inflorescences* several (ca. 6) to numerous together, subtended by somewhat leathery marcescent green to pinkish or chocolate brown cataphylls marked similarly to the petioles; *spathe* white

Figure 4. ***Alocasia princeps*** **W. Bull**
RBG Sydney Acc. No. 950357 - A. habit; B. venation; C. petiole ornamentation; D. inflorescence with part of spathe removed. - Scale: A, bar = 5 cm; B, bar = 2 cm; C, bar = 4 mm; D, bar = 8 mm.

to yellowish ivory, ca. 11 cm long, constricted at ca. 3 cm; lower spathe ovoid, somewhat to densely spotted purple; limb oblong lanceolate, usually with purple margins, occasionally pink-tinged to bright purple throughout, reflexed and rolled back, the tip acuminate for 1–2 cm; *spadix* ivory throughout or the female zone very pale green, distal parts sometimes suffused rose, very shortly stipitate for ca. 2 mm, ca. 8 cm long; *female zone* ca. 1.5 cm long, subcylindric, ca. 1 cm diam.; ovaries subglobose, ca. 1.5 mm diam.; style ca. 0.5 mm, slender; stigma mostly bi-lobed, yellowing in spirit; *interstice* ca. 5 mm long, slightly attenuate, ca. 4 mm diam.; synandrodia lax and ca. 1 mm diam. in the lower 2 mm, the remainder 2–3 dense whorls of more or less rhombohexagonal synandrodia; *male zone* ca. 2 cm long, 1/2 within the lower spathe chamber, subcylindric, somewhat constricted level with the spathe constriction, ca. 5 mm diam.; synandria rhombohexagonal, ca. 1–2 mm diam. (larger in the lower part of the zone), ivory; *appendix* 3.5–4 cm long, slightly narrower than the male zone, 4–5 mm diam., tapering gradually to a point, ivory to flushed pink; *fruiting peduncle* to ca. 20 cm long; fruiting spathe broadly ovoid, ca. 3–4 cm diam, white, sometimes spotted purple.

Distribution: Widespread and common in Borneo.

Habitat: In rain forest generally on well-drained slopes and ridgetops, on a variety of substrates including basalt and limestone, from more-or-less sea level to ca. 1200 m altitude.

Notes: 1. *Alocasia princeps* was described from a sterile plant from 'the Malay Archipelago' in an 1888 retail horticultural catalogue produced by the British nurseryman William Bull. The description is by no means exhaustive but nevertheless is quite detailed about leaf texture, shape and colour, and it does not seem to fit anything other than the species defined here. The following year the description appeared in Kew Bulletin, very slightly re-worded, in an anonymously compiled list of the previous year's new plants. Since N.E. Brown was the aroid authority at Kew at the time, it seems quite probable that he contributed at least those plants to that list, if not compiled the list entirely himself. Hallier (loc. cit.) had seen *A. princeps* growing at Kew (though not until 1897) and considered it the same as his *A. porphyroneura*. Hallier evidently did not think *A. princeps* had been properly published, but since it had been, and since he placed it, albeit attributed to Brown and not Bull, in the synonymy of *A. porphyroneura*, I conclude that the latter is superfluous.

Although Brown usually preserved material of new aroids in cultivation at Kew, no identifiably original material nor illustration exists, which fixes the application of *A. princeps* or can directly assist in its

interpretion. The leaf is described as having 'deeply sinuate' margins, which is extreme for this species, in which the leaf margin is usually more or less entire, sometimes somewhat undulate and occasionally shallowly sinuate (Hallier described the leaf margin of *A. porphyroneura* as repand-sinuate and strongly undulate, which fits better the states I have observed). However, 'deeply sinuate' is perhaps open to a variety of interpretations, and the state may even have been somewhat exaggerated by Bull for marketing purposes. Although, as has been said, there is no original material bearing this name at K, a sterile specimen nevertheless exists there obtained from Bull, allegedly originating from the Philippines, dated Aug 11 1887 and with Bull's number 4454/5. It is simply annoted '*Alocasia*' in Brown's hand. It matches Bull's catalogue description of *A. princeps* closely (except that the leaf margin is shallowly sinuate), and is clearly not Philippine, conforming exactly to *Alocasia princeps* in the sense here. It seems likely that this specimen is from the original plant Bull introduced and perhaps only subsequently called *Alocasia princeps*.

Since Hallier had seen what is presumed to be the original plant and considered it the same as *A. porphyroneura*, which he had described in considerable detail and of which he had preserved material, I consider that *A. princeps* should be neotypified accordingly. This interpretation is to some extent further supported by the only preserved material I have come across originally annotated with this name: a plant cultivated at the Peradeniya Gardens, Ceylon, collected by Alston in 1926 (*Alston 794*, K!) and which clearly falls within the present concept of *A. princeps*. The designated neotype collection is one of few that is fertile, of known wild provenance and that exists in duplicate.

Other specimens seen: SARAWAK: Betong, Saribas F.R., *Anderson 8507* (L); Hose Mts, Mujong, Ulu Temalad, *Ashton S17639* (L); Simpang Tiga, Ulu Mayeng, Kabu, *Chai S19219* (US); Baram Distr., G. Api foothills, *Chew 1099* (GH, K, SING); Lingga, *Hullett s.n.* (SING); 4th Div., Garden of Eden, Mulu National Park, *Primack S42403* (K). BRUNEI: Temburong Distr., Sg. Temburong at Kuala Belalong, *Boyce et al. 384A* (K); Temburong, headwaters of Sg. Temburong to NE Guning Retak, *Johns 6733* (K); Temburong Prov., Batu Apoi F.R., Sg. Belalong, *Poulsen 18* (K); Temburong Prov., Batu Apoi F.R., Sg. Enkiang, *Poulsen 264* (K). SABAH: Kudat Distr., Pulau Balembangan, NE inner side of Telok Lung, *BCS-EFA-LM et al.* (sic) *SAN 86716* (L); Mt Kinabalu, Ulu Liwagu and Ulu Mesilau, *Chew et al. 1954* (K, SING); Mt Kinabalu, Dallas, *Clemens & Clemens 26134* (BO) & *26268* (BM, SING); Penibukan, *Clemens & Clemens 30519* (BM, SING) & *31161* (BM, K, SING) & *32095* (BM, BO, GH, L, SING); Mabul Isl., *Creagh s.n.* (K); Moyog, along rd Kota Kinabalu-Tambunan, 24 mi SE of Kota Kinabalu, *Croat 53102* (MO); Kinabatangan Besar, Kori Timber Camp, *Cuadra A2153* (BO, K, KEP, L, SING); Nungkok Mt, *Darnton 443* (BM); Kinabalu, Tenompok, *Clemens & Clemens 29148* (BM, BO, GH, K, L) & *29149* (BM, SING) & 29150 (SING)); Cult. RBG Kew EN 441-63 ex Sapong estate, nr Tenom, *Giles & Woolliams s.n.* (K); Cult. RBG Sydney Acc. No.950357 ex Kinabatangan, Gua Batu Puteh, *Hay et al. 10015* (NSW; fertile voucher SAN); Cult. RBG Sydney Acc. No. 960560 ex 2.5 km above main Maliau Falls, G. Rara F.R., *Hay et al. 12039* (NSW). Cult.

RBG Sydney Acc. No. 960467 ex Tibau Forest Station, Kinabatangan, *Hay et al. 12140* (NSW); Lahad Datu, Selangan Island F.R., Semporna, *Keith A1519* (K, KEP, L) & *7658* (SING) & *9281* (KEP, SING) & *9286* (KEP); Bajau, Mt Sidungol, *Keith 9295* (K, KEP, SING) Keringau Distr., Camp C area Tiulan, *Maikin Lantoh 102054* (K); Ranau, ca. 3 mi NW of Kg Pinawanti, *SAN 76856* (K). KALIMANTAN: Sungei Utung, *Amdjah 356* (BO); East Kalimantan, Balikpapan, PT. ITCI area, *Darnaedi 431* (BO); Kalimantan Selatan, G. Halauhalau (G. Besar), Pegunungan Meratus, Barabai, *Dransfield 2870* (BO); Kalimantan Selatan, Djaro Dam, Muara Uja, *Dransfield & Saerudin 2210* (BO) & *2217* (BO); Kalimantan Selatan, 2km S of Djaro Dam, Muara Uja, *Dransfield & Saerudin 2296* (BO); Central East Borneo, W. Koetai, *Endert 2702* (BO, L); Cult. Hort. Bogor, *Hallier s.n.* (BO); Lombok Utan, *Hallier 358* (BO, L); Amai Ambit, *Hallier 3455* (BO); East Kalimantan, Loa Haur, W of Samarinda, *Kostermans 6810* (BO, K); East Kalimantan, Nanukan Island, *Kostermans 8784* (BO); Kutei, G. Beratus, piek van Balikpapan, *Meijer 653* (BO); East Kalimantan, Nunukan, N of Tarakau, *Meijer 2033* (BO) & *2168* (BO) & *2300* (BO)

10. Alocasia wongii A. Hay, *sp. nov.*

Ab *Alocasia princeps* inflorescentia tenuiore, spatha brunneo-rosacea, spathae lamina fusca, inflorescentia mascula minus exserta, petiolo *Alocasia longiloba* 'denudata' simulans sed tenuiore saepe aspero differt. TYPUS: Cult. RBG Sydney Acc. No. 960457 ex Madai Caves, *Hay et al. 12180* (NSW, holo: iso, K, KEP, L, SAN – to be distributed).

Terrestrial herb ca. 60(–90) cm tall; *rhizome* ca. 2.5–4 cm diam.; *petioles* smooth or asperous, slender, erect, grey-green, tinged pinkish at the base, densely mottled in an oblique pattern of crowded longitudinally aligned fine dark brown lines, sheathing in the lower 1/5–1/8; *blade* ca. 3/4 the length of the petiole, hastato-sagittate, narrowly triangular, dark (grey-)green above, paler below; *anterior lobe* widest at the base, the margin sometimes slightly undulate; anterior costa with 2–3 primary lateral veins on each side diverging at ca. 45–80(–90)°; axillary glands inconspicuous, sometimes conspicuous at the junctions of costae and petiole; secondary venation flush with the lamina to somewhat prominent abaxially and sometimes markedly divaricating, forming ill-defined interprimary collective veins towards the margin or these absent; *posterior lobes* rather slender, subequalling the anterior, the inner sides lanceolate to ovate; posterior costae diverging at ca. 100°, naked in the sinus for 2–4 cm; *inflorescences* to ca. 6 together; cataphylls membranous, mottled pinkish brown and green, marcescent; peduncle ca. 10 cm long, pale dirty pinkish; *spathe* ca. 7–8 cm long; lower spathe pear-shaped to ellipsoid, ca. 3 cm long, pale brownish pink, the mottling often forming vertical streaks; constriction usually oblique; limb narrowly (to broadly) lanceolate, distally tapering, brownish pink, distinctly darker than the lower spathe; *spadix* 5–7 cm long, very shortly stipitate for ca. 1 mm; female zone pale green; pistils somewhat distant - barely touching; ovaries subglobose; style slender, ca. 0.5 mm

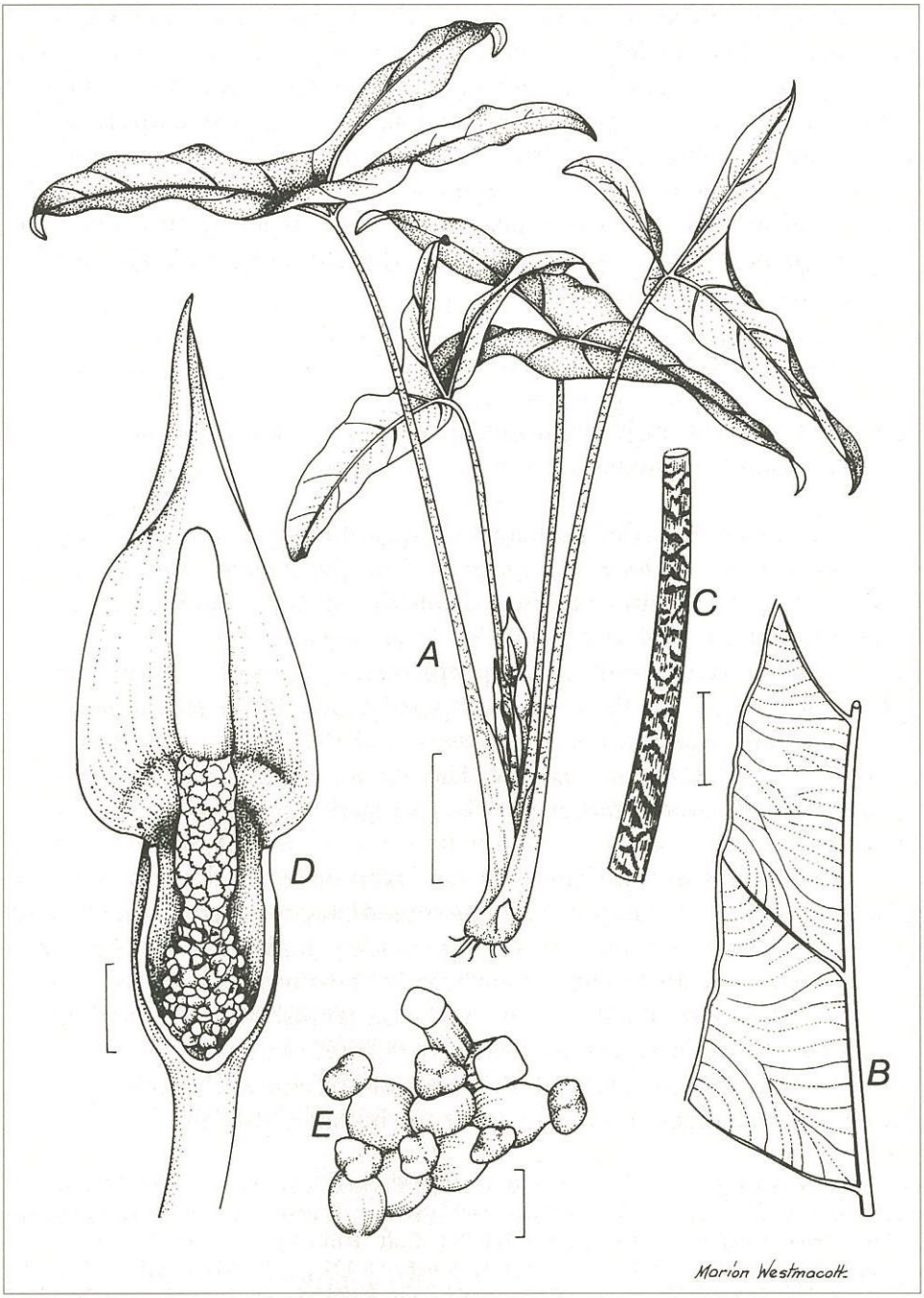

Figure 5. ***Alocasia wongii*** **A. Hay**
RBG Sydney Acc. No. 960478 - A. habit; B. venation; C. petiole ornamenation; D. inflorescence with part of spathe removed; E. pistils and two staminodes. - Scale: A, bar = 8 cm; B, C, bar = 2 cm; D, bar = 8 mm; E, bar = 1 mm.

long, abruptly differentiated from the ovary; stigma 2-lobed; *interstice* ca. 5 mm, partly naked, slightly attenuate, 3–5 whorls of synandrodia, the lower ones lax; *male zone* ca. 1.2–1.5 cm long, ca. 4 mm diam., cylindric, somewhat constricted at level of spathe constriction, 3/4 to almost entirely within lower spathe chamber; synandria rhombo-hexagonal, ca. 2 mm diam., not overtopped by synconnective; *appendix* ca. 3 cm long, somewhat constricted at base, ca. 4 mm diam. near base, tapering to a blunt tip; *fruiting spathe* ovoid, to 4.5 cm long, off white to dusky pink with vertical darker streaks.

Distribution: Northeastern Sabah.

Habitat: Terrestrial in lowland mixed dipterocarp forest on well-drained and occasionally inundated sites at low elevation.

Note: A fairly well-defined and geographically coherent element distinguished from *Alocasia princeps* s.s. by the generally more slender stature, the petiole with markings distinctive in the complex but almost identical to those typically found in *Alocasia longiloba* 'denudata'. The spathes are suffused a rather dirty purple-brown or violet-brown, with the limb somewhat darker than the lower spathe. The lower spathe in flower and the fruiting spathes are less rotund, and the limb shorter and more slender than in *Alocasia princeps*. The spadix is more slender with the pistils and synandrodia rather loosely arranged and the male zone is less exserted.

Populations in the vicinity of Sandakan have distinctively asperous petioles and the secondary venation is somewhat prominent abaxially and, towards the leaf margin, forms rather widely and loosely divaricating interprimary collective veins. Elsewhere in the range, e.g. at Madai, the petioles are smooth, the secondary venation is flush with the lamina and only faintly forms interprimary collective veins if at all.

Alocasia wongii is named in honour of Dr Wong Khoon Meng, who has contributed much to knowledge of the botany of Sabah.

Other specimens seen: SABAH: Tongod, Ulu Sg. Pinangah, *Amin & Ismail SAN 107302* (K); Bettotan, nr Sandakan, *Boden Kloss 19095* (SING); Tongod, ridge of Bukit Mengalas-Kalas, *Dewol Sundaling SAN 93149* (GH, K); Cult. RBG Sydney Acc. No. 950375 ex Madai Falls, *Hay et al. 10038* (NSW; fertile voucher SAN); Cult. RBG Sydney Acc. No. 950358 ex Ulu Dusun, *Hay et al. 10021* (NSW); Cult. RBG Sydney Acc. No. 960478 ex 2.5 km above main Maliau Falls, G. Rara F.R., *Hay et al. 12068* (NSW); Kabili, Sandakan, *Keith 4969* (K, SING) & *9951* (K); Sepilok F.R., *Kiew RK 757* (KEP); Tawau Dist., Gemok Hill F.R., *Madani & Sigin SAN 111570* (KEP); Sandakan, *Ramos 1580* (K, US).

11. Alocasia pangeran A. Hay, *sp. nov.*

Ab *Alocasia principicula* folio fusco-viridi, inflorescentia majore, interstitio valde attenuato partim nuda, inflorescentia mascula dimidium exserta differt. - TYPUS: Cult. RBG Sydney Acc. No. 960509 ex Malaysia, Sabah, Lahad Datu, Madai Caves, *Hay et al. 12175* (NSW, holo; iso, K, KEP, L, SAN, SING - to be distributed).

Lithophytic herb to ca. 60 cm tall; *leaves* ca. 4 together; *petioles* to ca. 60 cm long, often somewhat spreading, smooth, dark green, sheathing in the lower ca. 1/7; leaf *blade* variable, sagittate to hastate, triangular in outline, dark green adaxially, paler abaxially, ca. 20–35 cm long; *anterior lobe* widest at the base, the tip acute and slightly acuminate; anterior costa with 3 primary lateral veins on each side, diverging at 45–60°; axillary glands inconspicuous; secondary venation flush with the lamina on both surfaces, not forming interprimary collective veins, or these sporadic, ill-defined and only in the outer part of the blade; *posterior lobes* more than 1/2 to subequalling the anterior, widely spreading or not, acute to narrowly rounded, the inner sides elliptic to narrowly obovate; posterior costae diverging at ca. 120°, straight (when leaf hastate) or somewhat back-curved (when leaf sagittate); *inflorescences* to 6 together; peduncle ca. 15 cm long, subtended by lanceolate cataphylls 8–14 cm long; *spathe* ca. 11 cm long, constricted ca. 2.5 cm from the base; lower spathe ovoid, greenish ivory; limb ca. 8.5 cm long, lanceolate, acuminate for ca. 2 cm, ivory; *spadix* subsessile, stipitate for 1.5 mm, 8 cm long; *female zone* 1 cm long; pistils facing diagonally upward, ovaries subglobose, ca. 2 mm diam.; stigma more or less sessile, bilobed; *interstice* 8 mm long, naked and attenuate in the lower 5 mm with scattered small synandrodia, in the upper part with 1–2 whorls of close-packed synandrodia; *male zone* ivory, 1.5 cm long, 6 mm diam., 1/2 exserted from the lower spathe chamber and constricted level with the spathe constriction; synandria ca. 2 mm diam., rhombo-hexagonal; thecae not overtopped by synconnective; *appendix* subcylindric, isodiametric with male zone, distally tapering; *fruiting peduncle* about half the length of the petiole; fruiting spathe broadly ovoid, white.

Distibution: Endemic to Sabah, known only from Madai Caves, where it is abundant.

Habitat: In soil and humus pockets on limestone outcrops and boulders in mixed lowland dipterocarp forest at ca. 400 m alt.

Note: This species is distinguished from *Alocasia princeps* by its calcicolous lithophytic habit, smaller stature, more slender inflorescence, relatively

Figure 6. ***Alocasia pangeran*** **A. Hay**
RBG Sydney Acc. No. 960509 - A. habit; B. venation; C. inflorescence with part of spathe removed; D. pistils; E. lower neuter organs; F. synandria. - Scale: A, bar = 4 cm; B, bar = 2 cm; C, bar = 1 cm; D, E, F, bar = 2 mm.

longer lower spathe and lax interstice. It coexists with the terrestrial *A. wongii* and the lithophytic *A. puteri* (q.v.).

The specific epithet is a princely title in Malay, alluding to the relationship of this species to *Alocasia princeps*. For further discussion see under *Alocasia puteri.*

12. Alocasia puteri A. Hay, *sp. nov.*

Ab *Alocasia pangeran* A. Hay lamina folii claro-viride, lobis posticis intus ovatis, inflorescentia breviori, interstitio neutro brevissimo crasso vel nullo, inflorescentia mascula minus exserta, stigmate trilobato differt. - TYPUS: Cult. RBG Sydney Acc. No. 960603 ex Malaysia, Sabah, Lahad Datu, Madai Caves, *Hay et al. 12178* (NSW, holo; iso, K, KEP, L, SAN, SING - to be distributed).

Lithophytic herb to ca. 60 cm tall; *rhizome* ca. 3 cm diam.; *leaves* ca. 3 together; *petioles* more or less erect, to ca. 50 cm long, bright green, very faintly mottled slightly darker green, sheathing in the lower 1/6; *blades* hastato-sagittate to slightly ovato-sagittate, ca. 30 cm long, bright green adaxially, somewhat paler abaxially, thinly leathery; *anterior lobe* widest at or slightly above the base, the apex acute to obtuse and apiculate for ca. 1 cm; anterior costa with 2–3 primary lateral veins on each side diverging at 45–70°; axillary glands very inconspicuous; secondary venation flush with the lamina on both surfaces, faint, forming poorly defined interprimary collective veins in the outer part of the blade; *posterior lobes* acute, more or less equalling the anterior, the inner sides ovate, peltate even in subadult plants but eventually free; posterior costae naked in the sinus for ca. 2 cm, diverging at ca. 60°; *inflorescences* ca. 4 together; cataphylls lanceolate, to ca. 7 cm long; peduncles exserted, to 15 cm long; *spathe* ca. 8 cm long, constricted 2 cm from the base; lower spathe ovoid, greenish ivory; limb lanceolate, green; *spadix* subequalling the spathe, minutely stipitate; *female zone* ca. 6 mm long; pistils subglobose, ca. 2 mm diam., pale greenish ivory, more or less outward-facing; style short, ca. 0.5 mm, sharply differentiated from the ovary and stigma; stigma (2–)3-lobed; *sterile interstice* more or less lacking, the male zone adjunct to the female with some of the lowermost synandria incompletely fertile, or one to two whorls of close-packed synandrodia resembling the synandria, not or hardly attenuated; *male zone* ivory, cylindric, ca. 1.8 cm long ca. 4 mm diam., 2/3 within the lower spathe chamber, somewhat constricted level with the spathe constriction; synandria rhombo-hexagonal, ca. 2 mm diam., the thecae not overtopped by synconnective; *appendix* ivory, basally isodiametric with male zone, tapering; *infructescence* unknown.

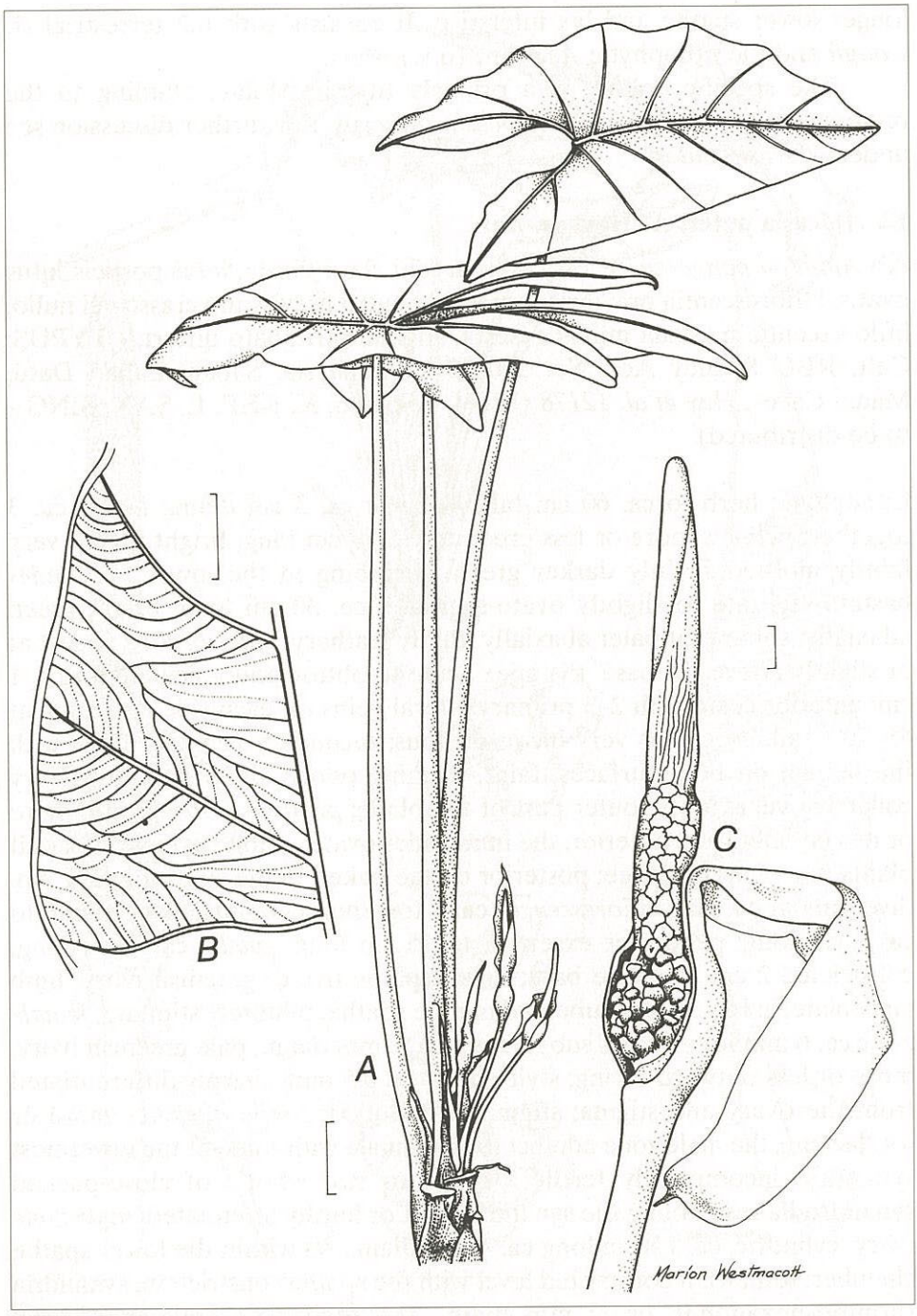

Figure 7. ***Alocasia puteri*** **A. Hay**
RBG Sydney Acc. No. 960603 - A. habit; B. venation; C. inflorescence with part of spathe removed. - Scale: A, bar = 4 cm; B, bar = 2 cm; C, bar = 4 mm.

Distribution: Endemic to Sabah, known only from Madai Caves where it is uncommon.

Habitat: In soil pockets on limestone outcrops and boulders in mixed lowland dipterocarp forest, at ca. 400 m altitude.

Notes: 1. The specific epithet, Malay for 'princess', alludes to the relationship with *Alocasia princeps* and to this species' coexistence with *A. pangeran*.

2. *Alocasia puteri* occurs together with and in the same habitat as *A. pangeran*. They can be differentiated by the former's bright green leaf colour (unusual for this entire species group) vs darker green, the broader posterior lobes, more upright petiole, tendency for the leaves to be peltate in sub-adult plants, virtually lacking sterile interstice of the apendix vs a long partially naked interstice of lax synandrodia, and the stigma being usually 3-lobed vs generally 2-lobed. Moreover, at the time of original collecting both of these species at Madai Caves, plants of *A. pangeran* were extensively in fruit, while no plants of *A. puteri* were in either flower or fruit, suggesting they may be isolated by flowering time.

13. Alocasia principiculus A. Hay, *sp. nov.*

Ab *Alocasia princeps* W. Bull stature valde minore, habitu calcicola lithophytica, pedunculo longo, inflorescentia mascula haud exserta differt. - TYPUS: Cult. Royal Botanic Gardens Sydney Acc. No. 960576 ex Malaysia, Sabah, Kinabatangan Distr., Gomantong Caves, originally collected 24 Apr 1996, *Hay et al. 12162* (NSW, holo; iso, K, L, KEP, SAN, SING – to be distributed).

Small more or less lithophytic herb; *rhizome* ca. 1.5–2 cm diam.; *leaves* several together; *petioles* ca. 20–30 cm long, sheathing in the lower 1/7–1/6, grey-green to dark purple-brown, becoming paler distally, somewhat spreading, smooth; *blade* ca. 20(–25) cm long, hastato-sagittate, narrowly triangular in outline, occasionally somewhat ovato-sagittate, sometimes some subadult leaves peltate, dull to slightly glossy, distinctly grey-green above, paler below, very thinly leathery; *anterior lobe* ca. 9–14 cm long, widest at base; anterior costa with 2(–3) primary lateral veins on each side, diverging at ca. 45–60°; secondary venation flush with the lamina, forming poorly defined interprimary collective veins towards the margin; axillary glands inconspicuous; *posterior lobes* ca. 2/3 the length or subequalling the anterior, the inner sides lanceolate; posterior costae diverging at ca. 60–90°; *inflorescences* mostly 2 together (1–4); peduncles much extended

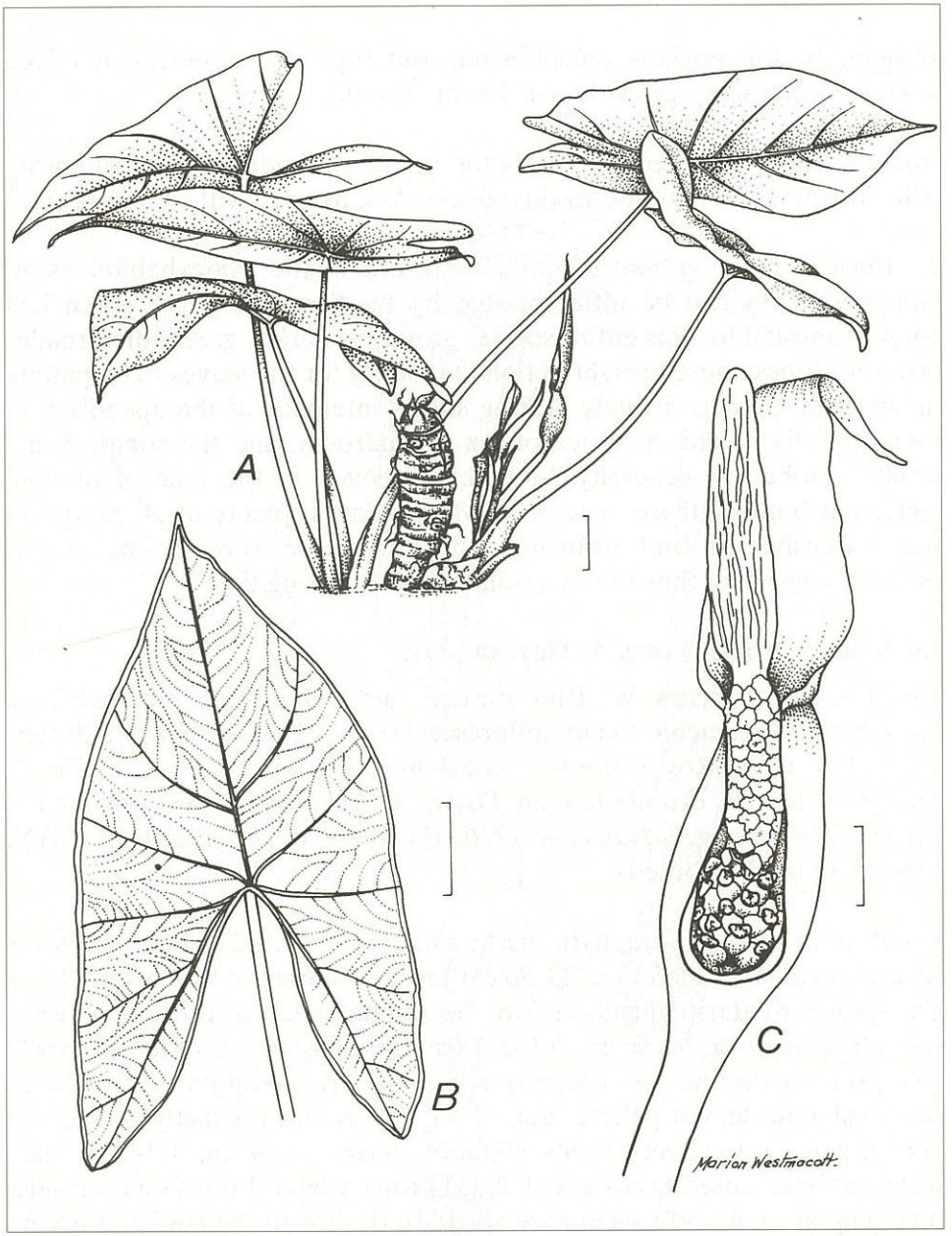

Figure 8. ***Alocasia principiculus*** **A. Hay**
RBG Sydney Acc. No. 960576 - A. habit; B. venation; C. inflorescence with part of spathe removed. - Scale: A, B, bar = 2 cm; C, bar = 8 mm.

from the cataphylls, ca. 1/3–2/3 the length of the petioles; cataphylls lanceolate, ca. 7 cm long; *spathe* ca. 6–7 cm long; lower spathe ovoid, ivory to yellowish ivory, ca. 2 cm long; limb lanceolate, pale green faintly suffused brown; *spadix* ca. 5 cm long; *female zone* ca. 1 cm long; pistils not or hardly touching one another, pale green; ovaries ovoid, ca. 1.5 mm diam., facing diagonally up, pale greenish yellow; style short, ca. 1 mm; stigma white, bilobed; *interstice* ca. 4 mm long, attenuate, 2–3 whorls of loosely arranged synandrodia (sometimes partly naked); *male zone* ca. 8 mm to 1 cm long, pale ivory, completely within the lower spathe chamber; *appendix* ivory, ca. 2.5–3.5 cm long, 4 mm diam., slightly constricted at junction with male zone corresponding to spathe constriction; *fruiting peduncle* subequalling petioles.

Distribution: Endemic to Borneo: Sabah and East Kalimantan.

Habitat: Lowland rain forest, on and among limestone boulders; sea level to 600 m altitude.

Notes: 1. The substantive epithet, meaning 'little prince', is the diminutive of *princeps*, alluding to the small stature and relationship of this species.

2. *Alocasia principiculus* differs from other members of the *A. princeps* complex in its small overall size, grey-green, thinly leathery leaves, relatively long peduncles and in the male zone being held entirely within the lower spathe chamber.

Other specimens seen: SABAH: Sandakan Forest District, Elopura, Gomantong, *Cuadra A1489* (BO, BRI, K, KEP, L, SING); 20 mi S of Sandakan, Gomantong Caves Hill, *Wood A4602a* (L). KALIMANTAN: East Kalimantan, Berouw, Mt Bungaan, *Kostermans 13781* (L).

14. Alocasia reversa N.E. Br.

Alocasia reversa N.E. Brown, Gard. Chron. 8 (2) (1890) 38; Hook.f. in Curtis's Bot. Mag. Ser. 3, 52 (1896) t. 7498; Usteri, Beitr. Kenntn. Philipp. (1905) 130; K. Krause & Engl., Pflanzenr. 71 (IV.23E) (1920) 95; Merr. Enum. Philipp. Fl. Pl. 1 (1922) 185. - Type: Cult. RBG Kew ex Hort. Sander, Apr 1890, *N.E. Brown s.n.* (K, holo).

Small herb to ca. 35 cm tall (often less); *rhizome* short, condensed, erect to decumbent, ca. 3 cm diam.; *leaves* several together, irregularly interspersed with marcescent brown lanceolate cataphylls to ca. 7 cm long; *petioles* ca. 10–20(–30) cm long, sheathing in the lower ca. 10–15%; *blades* thinly

leathery, in adult plants all peltate or (usually) mixed peltate and non-peltate, occasionally none peltate, ovate to rather narrowly ovato-sagittate, 14 x 6 cm to 22 x 10 cm, widest at or slightly distal to junction of petiole, glossy dark green about the midrib and primary veins adaxially, the rest grey-green; *anterior lobe* acute, with the tip abruptly acuminate for ca. 1 cm; anterior costa with 3–4(–5) primary lateral veins on each side, diverging at ca. 90° proximally, the distal ones at ca. 60°, running almost straight to the margin and joining a submarginal vein; axillary glands not conspicuous; secondary venation fine, not forming interprimary collective veins, or these very poorly defined, flush with the lamina; *posterior lobes* about 1/2–2/5 the length of the anterior, united for 50–90% of their length or free, when maximally united the base of the lamina rounded except for an acute notch; posterior costae diverging at ca 15° when blade peltate, or at ca. 90° when not peltate but then soon curved back (so posterior lobes not widely divergent) and naked in the sinus for ca. 1 cm; *inflorescences* 1–2 together, subtended by lanceolate marcescent brown cataphylls; peduncle ca. 10 cm long at anthesis, often exceeding the petioles at fruiting; *spathe* ca. 6 cm long; lower spathe ca. 2 cm long, ovoid, pale green; limb paler green to ivory edged purple with the colour extending into the constriction ventrally, at first erect, then sharply deflected, oblong lanceolate, mucronate for ca. 6 mm; *spadix* somewhat shorter than the spathe, white except for bright green ovaries, stipitate for ca. 3 mm; *female zone* 1 cm long; pistils somewhat loosely packed, flask-shaped, ca. 1.5 mm diam., facing obliquely upwards; style slender, ca. 0.5 mm long; stigma 2-lobed; *sterile interstice* ca. 4 mm long, not much attenuated and situated within the chamber of the lower spathe, lower synandrodia irregular in shape, ca. 2 mm diam., upper ones rhombo-hexagonal; *male zone* ca. 1 cm long, 4 mm diam., subcylindric, slightly constricted ca 2/3 from the base corresponding to spathe constriction; synandria rhombo-hexagonal ca. 2 mm diam., 4–6-merous, the thecae opening by apical pores, synconnective not expanded; *appendix* about isodiametric with male zone, ca. 2 cm long, gradually tapering to a blunt point, faintly longitudinally channelled; *fruiting spathe* broadly ovoid, ca. 2 cm long, eventually reflexed, pinkish to orange; berries bright orange to red.

Distribution: Borneo, endemic to Sarawak

Habitat: In forest over limestone, often on boulders, to 300 m altitude.

Notes: 1. This species, first described from cultivation in Britain following introduction by Sander & Sons, was originally attributed to the Philippines and consequently cited by some later authors as a Philippine plant. No

authentically Philippine material of this species has been found however, and it must be assumed that Sander's attribution was a mistake, or deliberately misleading - a practice, according to Burnett (1984), of competing nurserymen of the time.

2. This and the following species appear in their inflorescence structure to belong in the Scabriuscula Group. They differ in their (usually) peltate leaves and the frequent (but ?irregular) cataphylls among the foliage leaves, which suggests relationship with the Cuprea Group.

3. A clone of *Alocasia reversa* is traded in Singapore under the cultivar name *Alocasia* 'Hana'. An image may be found at http://www.springleaf.com.sg/hana.html.

Other specimens seen: SARAWAK: Kuching Distr., Tiang Bekap, Padawan Rd, *Anderson 10095* (K, L, SING); Cult. RBG Edinburgh Acc. no. 67.1612 ex Bukit Serapat, ca. 13 mi from Kuching on Semenggang Rd, *Burtt & Martin 4745* (E); Kuching Distr., Tiang Bekap, Mt Mentawa, *Chew 670* (GH, K, L, SING), *1292* (GH, K, SING); Along Kuching-Padawan Rd, 10 mi SW of main Kuching-Serian Highway, *Croat 53183* (MO); Bukit Manok, Padawan, 38 mi from Kuching, *Erwin & Paul S.27408* (K, US); Zuab (CHECK), *Hewitt s.n.* (K); Bidi, *Hewitt 4* (SING); Bukit Mentawa off 32nd Mile Padawan Rd, Kuching, 1st Div., *Mamit S.32673* (K, L, SING, US); Gat, *'Native Collector' D106* (E); Cult. RBG Sydney Acc. no. 942723 ex cult. Hort. Leiden Acc. no. 933071 ex N of Padawan, *Vogel s.n.* (NSW); Bukit Payang, 10 km Tebakang-Tebedo Rd, Ist Div., *Yii & Othman S.46241* (K, KEP).

15. Alocasia venusta A. Hay, *sp. nov.*

Ab *Alocasia reversa* planta robustiore, folio tenuiter oblongo-ovato atro-viride, inflorescentibus 4–6 in synflorescentia confertis, pedunculo breviore, inflorescentia majore, stigmate trilobato differt. - TYPUS: Cult. RBG Sydney Acc. No. 940504 ex Niah National Park, path between Niah town and Niah caves, *Hay et al. 9346* (NSW, holo).

Lithophytic herb to 45 cm tall; *rhizome* condensed, to 3 cm thick; *leaves* to 6 together, interspersed with marcescent cataphylls ca. 5 cm long; *petiole* to ca. 40 cm long, sheathing in the lower 1/9; *blade* ca. 27–35 cm long, completely peltate, stiffly leathery, shiny very dark bluish green adaxially and somewhat darker about the main veins, somewhat paler abaxially, oblong-ovate, ca. 9–12 cm wide; *anterior lobe* widest at the base, the apex acute, acuminate for 1.5 cm; anterior costa with 3 primary lateral veins on each side, diverging at ca. 60–80°, drying flush with the lamina, with very inconspicuous axillary glands; secondary venation fine, not forming interprimary collective veins, almost striate; combined *posterior lobes* cuneate, somewhat elevated, ca. 8 cm long, ultimately with a shallow retuse notch between the posterior costae; posterior costae diverging at ca. 15°;

inflorescences 4–6 together not interspersed with foliage leaves, subtended and equalled to exceeded in length by lanceolate cataphylls to 10 cm long; peduncle ca. 6 cm long at anthesis; *spathe* ivory, suffused and spotted purple, ca. 9 cm long, constricted at ca. 3 cm from the base; lower spathe ovoid; *spadix* ca. 7 cm long, stipitate for 1–4 mm with the stipe obliquely inserted; *female zone* 1–1.5 cm long, subcylindric, slightly conic; ovaries ovoid, ca. 1.5 mm diam; style ca. 1 mm long; stigmas mostly 3-lobed with drop-shaped diagonally upward-facing lobes; *sterile interstice* 3–4 mm long, partly naked, with 1–2 whorls of synandrodia; *male zone* 1.5 cm long, narrowly conic, ca. 4 mm diam. at base, 3/4 held within lower spathe chamber; synandria ivory, rhombo-hexagonal, ca. 2 mm diam.; thecae not overtopped by synconnective; *appendix* subcylindric, slightly narrowed at the base, then more or less isodiametric with top of male zone, tapering, ca. 4 cm long; *infructescence* unknown.

Distribution: Endemic to Borneo, known only from the Niah Caves area, northern Sarawak.

Habitat: Lithophytic on limestone in swamp-forest at ca. 200 m altitude.

Notes: 1. This species is evidently closely allied to *Alocasia reversa*. It differs in the more robust habit, the more complex synflorescence (inflorescences solitary to paired in *A. reversa*), shorter peduncles, more densely arranged pistils and trifid stigmas. The leaves are all completely peltate and narrowly oblong-ovate, whereas they are often mixed peltate and non-peltate in *A. reversa*, especially in more robust forms approaching *A. venusta* in size. The leaf blades of *A. reversa* are conspicuously variegated. *Alocasia venusta* is geographically disjunct from *A. reversa*, which is known only from SW Sarawak.

2. The specific epithet alludes to the plant's highly ornamental qualities. It does not appear yet to have entered commercial horticulture, in which it has potential.

Macrorrhizos Group

Species 16—21

Moderately to very robust herbs; inflorescence pairs mostly interspersed with foliage leaves, occasionally clustered; spathe constriction corresponding with sterile interstice of the spadix; thecae of synandria overtopped by synconnective.

The species in this group are of somewhat doubtful affinity, but the group extends throughout Malesia except Borneo (other than *A. macrorrhizos* itself).

16. Alocasia macrorrhizos (L.) G. Don

Alocasia macrorrhizos (saepissime '*-rrhiza*') (L.) G. Don in Sweet, Hort. Brit. ed. 3 (1839) 631 ('*-rrhizon*'); Schott in Oesterr. Bot. Wochenbl. 4 (1854) 409; Engl. in A. & C. DC., Monogr. Phan. 2 (1879) 502; Engl. in Koord., Meded. Lands Plantentuin. 19 (1898) 300; Ridl., J. Straits Br. Roy. Asiat. Soc. 44 (1905) 178; Koord., Exkurs.-Fl. Java 1 (1911) 261; Merr., Interpr. Herb. Amboin. (1917) 130; K. Krause & Engl., Pflanzenr. 71 (IV.23E) (1920) 84, fig. 15; Furtado in Gard. Bull. Straits Settlem. 11 (1941) 244–257- *Arum macrorrhizon* L., Sp. Pl. (1753) 965; - *Colocasia macrorrhiza* (L.) Schott in Schott & Endl., Melet. Bot. (1832) 18. - Type: *Arum maximum macrorrhizon zeylanicum* Herm., Parad. Bat. (1698) t. 73 (lecto; selected by Furtado, 1941).

Arum indicum Lour., Fl. Cochinch. (1790) 536; ed. Willd. (1793) 655; Roxb., Fl. Ind. ed. 2, 3 (1832) 498. - *Colocasia indica* (Lour.) Kunth, Enum. Pl. 3 (1841) 39. - *Alocasia indica* (Lour.) Spach, Hist. Nat. Veg. Phan. 12 (1846) 47; Schott, Oesterr. Bot. Wochenbl. 4 (1854) 410; Engl. in A. DC, Monogr. Phan. 2 (1879) 501 & Bot. Jahrb. Syst. 25 (1898) 23; Ridl., J. Straits Br. Roy. Asiat. Soc. 44 (1905) 178; Koord., Exkurs.-Fl. Java 1 (1911) 262; K. Krause & Engl., Pflanzenr. 71 (IV.23E) (1920) 87; Backer & Bakh.f., Fl. Java 3 (1968) 119. - *Caladium indicum* C. Koch, Berl. Allg. Gartenz. (1857) 136. - Type: *Arum indicum sativum* Rumph., Herb. Amboin. 5 (1747) t. 106 (lecto; selected by Nicolson, 1979).

Colocasia indica var. *atroviridis* Hassk., Flora 25(2), Beibl. 1 (1842) 8 = *Alocasia macrorrhizos* (L.) G. Don. - Type: None designated; based on Rumphius' very brief description of a second 'species' of *Arum indicum sativum* Rumph., Herb. Amb. 5 (1747) 308.

[*Colocasia odora* (*'odorata'*) sensu auct. non (Roxb.) Brongn.: Hassk., Flora 25 (2), Beibl. 1 (1842) 9; see Hay (1996)]

Arum montanum Roxb., Fl. Ind. 3 (1832) 497. - *Colocasia montana* (Roxb.) Kunth, Enum. Pl. 3 (1841) 40. - *Alocasia montana* (Roxb.) Schott, Oesterr. Bot. Wochenbl. 4 (1854) 410. - Type: India, Orissa, Circars, *Roxburgh drawing No. 248* (CAL, K). **Plate 2.**

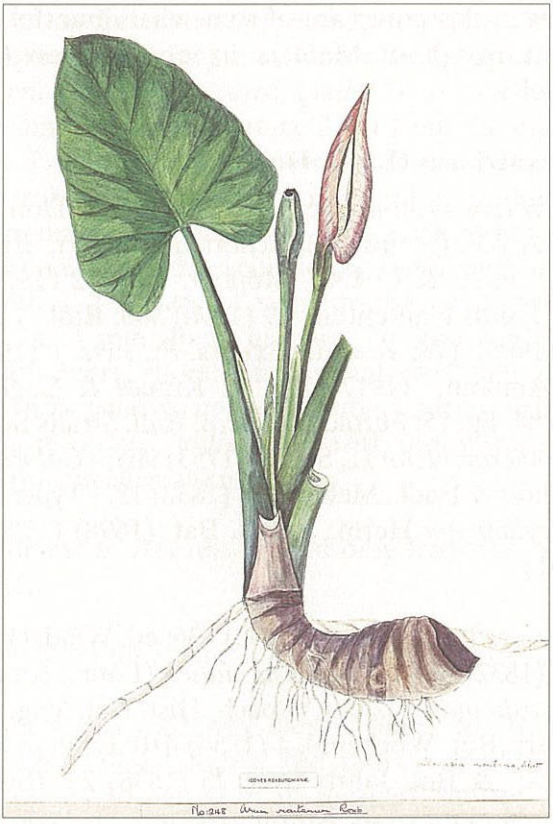

Plate 2. Type of *Arum montanum* Roxb.
Icones Roxburghianae 248 (K, copyright R.B.G., Kew).

[*Alocasia grandis* N.E. Brown, Gard. Chron. n.s. 25 (2) (1886) 390, nom. illeg., non *Alocasia grandis* Clemenc., Rev. Hort. 40 (1868) 380 (see below)].

Massive pachycaul with the *stem* decumbent or erect, to 4 m tall; *petioles* to 1.3 m long, sheathing in lower 1/3–1/2; *blades* ovato-sagittate, bluntly triangular in general outline, held more or less erect, with the margin entire to very slightly; *anterior lobe* ca. 70 cm to over 1 m long, ca. 60–90 cm wide at base, with ca. 9 rather distant primary lateral veins on each side of the anterior costa diverging at ca. 60°; glands in axils of primary veins on abaxial side distinct; secondary venation flush with the lamina or but slightly raised abaxially, not forming interprimary collective veins or these poorly defined; *posterior lobes* ca. 1.3–1/2 the length of the anterior, somewhat rotund, often overlapping; *inflorescences* paired among the leaf bases, subtended by membranous cataphylls; peduncles barely exceeding the cataphylls at anthesis; *spathe* rather variable in length, ca. 13–35 cm long, constricted about 1/6th of the way from the base; lower part green,

ovoid; limb broadly oblong-lanceolate, cowl-like at anthesis, later reflexed, then deliquescent, membranous, pale yellow; *spadix* slightly shorter than the spathe, shortly stipitate; *female zone* 1–2 cm long, ca. 1.5 cm diam.; ovaries pale green, ca. 3 mm diam.; stigma sessile, 3–5-lobed, the lobes conic, yellow; *sterile interstice* slightly shorter than to equalling the female zone, whitish, very slightly narrowed corresponding to the spathe constriction, composed of rhombo-hexagonal synandrodia ca. 2.5 mm diam., the lower ones paler, incompletely connate or with a central hole, the upper ones resembling synandria; *male zone* cylindric, ca. 3–7 cm long, ca. 2 cm diam., whitish; synandria rhombo-hexagonal, convex-topped due to cap-forming synconnective, ca. 2 mm diam; *appendix* yellowish, slightly thicker than the male zone at the base, thence tapering, equalling to considerably exceeding half the length of the spadix, staminodial; *fruiting spathe* ca. 8 cm long, longitudinally dehiscent, green; berries scarlet.

Distribution: IndoMalesia to Oceania. It is not clear where, if anywhere, this species occurs wild. It has evidently been distributed widely in tropical Asia in prehistoric times as a subsistence crop and is now pantropical by introduction as an ornamental.

*Habita*t: Road sides, waste places, gardens, mostly in wet sites at low to medium elevation.

Notes: 1. A number of ornamental varieties have been recognised, which were discussed by Furtado (1941). As cultivated plants they should be named as cultivars within the domain of the International Code of Nomenclature for Cultivated Plants. One element, *Alocasia macrorrhizos* var. *rubra* (Hassk.) Furtado, was discussed further by Bunting & Nicolson (1963), who considered it sufficiently distinct from other varieties as to be recognised as a distinct species - *Alocasia plumbea* van Houtte (Fl. des Serres 21 (1875) t. 2206). While differing somewhat from other forms of *Alocasia macrorrhizos* in dimensions and leaf shape, it is not known except in cultivation, and I doubt that it is more than a sport of *A. macrorrhizos*. *Alocasia grandis* N.E. Br., introduced to cultivation in Britain from 'the East Indian Islands' appears to be the same element.

2. This species does not appear to be a wild plant at all in Malesia, though the situation in the Philippines, where there is indirect evidence for natural hybridisation with *A. portei* Schott, is unclear. No collections exist that are from places unequivocally away from human habitation, and I have never encountered it in the field except closely associated with human settlement. Arguably *Alocasia macrorrhizos* is a cultigen.

3. *Alocasia grandis* N.E. Brown, based on a specimen Brown took from a plant cultivated at Kew ex Hort. Bull, 10 Sep 1886 (K!), is evidently the same or very similar to *Alocasia macrorrhizos* var. *rubra*. It is, however, illegitimate due to the pre-existence of *Alocasia grandis* Clemenc. The identity of the latter is not clear.

4. Discussion of the identity of *Alocasia montana* (Roxb.) Schott can be found under *Alocasia flemingiana*. The type is reproduced in Pl. 2.

Other specimens: PENINSULAR MALAYSIA: Negeri Sembilan, Kuala Pilah Rd., *Burkill 1648* (SING); Kelantan, Khota Baru, *Gimlette s.n.* (SING); Selangor, Genting Simpah F.R., *Nicolson 1145* (US), Telok Gading, *Md Nur 3002* (SING). SINGAPORE: Botanic Gardens, *Sinclair 8340* (K, US). SABAH: Sandakan, *Kadir A2698* (K, L); Kelawat, Kota Belud, *Keith 6787* (SING); Kuala Napagun, *Keith 9345* (SING); JAVA: Buitenzorg cult., *Bakhuizen 8169* (L); Java, Buitenzorg, *Hallier 1893* (L); Java, *Horsfield s.n.* (K); Java, Batavia, *Junghuhn s.n.* (L); Java, *Kuhl & van Hasselt s.n.* (L); Java, *Zollinger 472* (L).

17. Alocasia inornata Hallier *f.*

Alocasia inornata Hallier f., Meded. Herb. Leiden 26 (1915) 7; Engl. & K. Krause, Pflanzenr. 71 (IV.23E) (1920) 86. - Neotype: Indonesia, Sumatera, Riau Province, Tigapulu Mts., 5 km W of Talanglakat on Rengat-Jambi Road, Bukit Karampal area, 13 Nov 1988, *J.S. Burley, Tukirin et al. 1444* (K, neo; KEP, SING, US, isoneo; designated here).

Alocasia nobilis Hallier f., Meded. Herb. Leiden 26 (1915) 6. - Type: Indonesia, Java, Cult. Hort. Bogor ex Deli, Sumatera, 14 Jan 1896, *H. Hallier s.n.* (L, holo)

Robust herb to 1.3 m tall; *stem* erect to decumbent, to ca. 8 cm diam; *leaves* several together, glabrous to minutely pubescent on the petiole and abaxial lamina; *petiole* ca. 50 cm – 1 m long, sheathing in the lower 1/3–1/2, pale green to pale chocolate brown with the apical 1–6 cm deep purple, or the whole purple throughout, otherwise more or less unmarked; *blade* sagittate to broadly ovato-sagittae, distinctly but not very thickly leathery, to ca. 50 (–80) cm long and up to 40 (–50) cm wide, slightly olive mid-green to suffused brownish chocolate to deep purple throughout and slightly shining adaxially, paler and dull abaxially; *anterior lobe* widest at or slightly above the base, the tip mostly obtuse and apiculate for ca. 1 cm; anterior costa with 4–7 primarly lateral veins on each side diverging at ca. 65–45°, with prominent glands in their axils abaxially; secondary venation flush with the lamina abaxially and adaxially, forming not very well-defined slightly sinuous to almost straight interprimary collective veins; *posterior lobes* ca. 1/2 the length of the anterior, rounded to acute, the inner side

lanceolate to narrowly ovate to subrhomboid; posterior costae naked in the sinus for ca. 1.5 cm; *inflorescences* rather slender, (2–)several together, forming a cluster in the centre of the crown and not interspersed with foliage leaves; peduncle mostly hidden within leaf sheaths and cataphylls, pubescent if the leaves are; cataphylls semi-persistent; *spathe* ca. 12 cm long; lower spathe rather narrowly ovoid, green, ca. 2 cm long, separated from the limb by a rather weak constriction level with the basalmost part of the male zone of the spadix or with the sterile interstice; limb to ca. 4 cm wide, as first erect and cucullate with the basalmost part reflexed, then wholly reflexed, pale greenish yellow to white, deciduous after anthesis; *spadix* subequalling the spathe, stipitate for ca. 3 mm; *female zone* ca. 1 cm long, ca. 7 mm diam.; ovaries flattened subglobose, somewhat lobed, green, ca. 1.5–2 mm diam.; stigma sessile, about 1.2 mm wide, of 3–5 rounded lobes, white; *sterile interstice* basally as broad or broader than female zone, distally attenuate, ca. 7 mm long, composed of numerous white to pale apricot synandrodia, the lowermost sometimes with the staminodes incompletely united, the rest closely resembling the synandria; *male zone* cylindric, ca. 1.5–2 cm long, ca. 7 mm diam., white; synandria hexagonal, 1.5 mm diam., slightly convex-topped; thecae overtopped by synconnective and opening by short apical slits; *appendix* to 7.5 cm long, slender, basally isodiametric with male zone, tapering very gradually to a point, pale orange-yellow to yellowish ivory; *fruiting spathe* green, to ca. 6 cm long, ovoid.

Distribution: Southern parts of Peninsular Malaysia (not recorded from Singapore) and Sumatera.

Habitat: This species has wide ecological amplitude and is found in disturbed places in forest, scrub, swampy areas, river banks, sometimes on limestone, from sea level to ca. 1200 m altitude.

Notes: 1. *Alocasia inornata* was described from a sterile plant cultivated at Bogor, originally collected by Jaheri from Deli, Sumatera. Preserved material neither of the cultivated plant nor of the original field collection has been located. However, Hallier's description includes reference to the leaves being pubescent and the petiole being purple at the apex, and there can be little doubt that this name is applicable to the species defined here. The neotype here designated is weakly pubescent, reference is made in the notes to the petiole being purple at the top (this feature becomes obscured on drying) and the specimen includes a well-preserved inflorescence. While the colour of the petiole apex may seem trivial, purple pigmentation is present at that point in all living plants I have seen of this species, both in Sumatera and in Peninsular Malaysia, and appears to be a diagnostic feature.

The exception is cases where the entire leaf is suffused with purple - the condition of the type of *A. nobilis*. Pubescence on the other hand is not a constant feature of Sumateran specimens and apparently is absent from Peninsular Malaysian ones.

2. *Alocasia nobilis* was also described from cultivation at Bogor and the cultivated plant also originated from a collection by Jaheri from Deli. The description includes reference to the inflorescence, though this does not appear to have been preserved. The leaf, besides being suffused purple throughout, is at the extreme of narrowness overall and reduction of the posterior lobes for this species, but it connects with rather than falls outside the rest of the morphological range, *Lörzing 5061* being an intermediate example. As might be expected if the leaf is suffused purple, the spathe is described as being so too, where typically in *A. inornata* it is green in the lower part and pale greenish yellow to white in the limb.

3. It was possible that the name *Alocasia ovalifolia* Ridl. had priority, if syntype material of that species could have been located that is conspecific with *A. inornata*. The issues around this uncertainty are discussed under *A. puber* (q.v.) in the synonymy of which *A. ovalifolia* has been placed on the basis of the identity of the only syntype so far located and on which *A. ovalifolia* has been lectotypified in order to dispose of the name.

4. The distinguishing combination of features of this species includes, in addition to the purple-topped petiole, the slender spadix, the spathe constriction corresponding with the basalmost part of the male zone or the interstice, the narrowly tapering appendix, the large, sessile, rounded 3–5-lobed stigma and syandria with the thecae overtopped by synconnective.

Other specimens seen: PENINSULAR MALAYSIA: Pahang, Pulau Tioman, *Burkill s.n.* (SING), Cult. RBG Sydney, Acc. No. 893742 *Goodwin 16* (NSW), *Md Nur 18890* (BO, SING); Selangor, Forest Research Institute, Kepong. *Croat 53294* (K); Cult. RBG Kew Acc. No. 472-82.05004 ex Selangor, Ulu Gombak, *Hay s.n.* (K); Cult RBG Sydney, Acc. No. 940101 ex Selangor, Batu Caves, *Hay 9057* (NSW); Cult. RBG Sydney, Acc. No. 940338 ex Pahang, Semangoh Pass, *Hay 9271* (NSW); Pahang, Fraser's Hill, *Henderson 11389* (BO); Perak, Gua Badak, Lenggong, *Henderson 23836* (BO, SING); Selangor, Batu Caves, *Ridley 8168* (K, SING), 13392 (SING); Selangor, Anak Takun, Templer Park, *Sang JS33* (KEP). SUMATERA: Atjeh, NE of Kroengloeas, E of Troemon, *Asdat 74* (L); G. Koerintji, *Bünnenmeijer 9222* (BO) & *10354* (BO, L); NE Sebessi Island, Docters van Leeuwen-*Reijnvaan 5139* (BO); East Coast, Karo Highlands, E of Berastagi, *Hamel & Rahmat si Toroes 631* (L); Cult. RBG Sydney Acc. No. 970531 ex Lembah Anai Nature Researve, *Hay & Yuzammi 13105* (NSW); Sibolangit, *Lörzing 5061* (BO); Karohoogvlakte bij Lingga, *Lörzing 6274* (BO); South Sumatera, Enggano, *Lütjeharms 3856* (BO, GH, K, L) & *4745* (BO, K, L); W. Sumatera, Pesisir selatan Kerintji, Mt Kerintji, nr Pondok Patjet, *Meijer 6219* (L); Batoe Island, *Raap 8* (BO).

18. Alocasia alba Schott

Alocasia alba Schott, Oesterr. Bot. Wochenbl. 2 (1852) 59; Miq., Fl. Ned. Ind. (1855) 210; Schott, Syn. Aroid. (1856) 48; Schott, Prodr. Syst. Aroid. (1860) 149; Engl., in A. & C. DC., Monogr. Phan. 2 (1879) 500; Hook. *f.*, Fl. Brit. India. 6 (1894) 528; Engl. & K. Krause, Pflanzenr. 71 (IV.23E) (1920) 84. – NEOTYPE: *Alocasia alba* Schott, Icones no. 86-88 (W, lecto; designated here) [fiche 68: d6-d8 in the microfiche edition].

Alocasia bantamensis Koord., Bull. Jard. Bot. Buitenzorg III, 1 (1918) 162, figs 11–13; K. Krause & Engl., Pflanzenr. 71 (IV.23E) (1920) 84; Koord., Exkurs.-Fl. Java 4 (1923) 195-196, fig. 395-396; Backer & Bakh.f., Fl. Java 3 (1968) 119. - TYPE: Indonesia, Java, Bantam, Danoe-moeras, 26 May 1912, *Koorders 41445*b (L, lecto; selected here).

Alocasia crassifolia Engl., Pflanzenr. 71 (IV.23E) (1920) 82; Koord., Fl. Tjibodas 6 (1922) 36; Burnett, Aroideana 7 (1984) 134, fig. 101. - TYPE: Indonesia, Java, cult. Hort. Bogor, Jan-Feb 1906, *Engler 4101* (B, holo).

[*Alocasia macrorrhizos* ('*-rrhiza*') sensu auct. non (L.) G.Don: Backer & Bakh.f., Fl. Java 3 (1968) 119].

Massive pachycaul, stout, up to 2 m tall; *leaves* several together, held erect; *petiole* greenish, whitish at the sinus, with scattered yellowish glands, up to 170 cm long, sheathing for about 1/3 its length, wings of sheath persistent, straight to recurved; *blade* thick, tough, usually slightly bullate, green above, light yellowish-green below, broadly ovato-sagittate to cordato-sagittate, margin entire; *anterior lobe* ca. 80 cm long, ca. 75 cm wide at base, the tip shortly acuminate; anterior costa with up to 11 primary veins diverging at an angle of about 40°–60°, prominent on both surfaces, with conspicuous small flat glands in the axils on the abaxial side; secondary veins sunken adaxially, prominent abaxially, interprimary collective vein well-defined; submarginal vein 1–2 mm from margin; *posterior lobes* obtuse, ca. 45 cm long from the sinus; *inflorescences* in groups of up to ca. 10 at a centre of leaf crown, not interspersed with foliage leaves (but occasionally pairs produced singly); peduncle up to 38 cm long, like the petiole with scattered small broadly elliptic glands; *spathe* to ca. 17 cm long, constricted at level of sterile zone of spadix, lower spathe broadly ovoid-cylindric, ca. 5 cm from the base, green, the limb reflexed between male zone and sterile zone, thinly leathery, greenish yellow to greenish white; *spadix* cylindrical, ca. 15 cm long, sessile to very shortly stipitate; *female zone* ca. 1.7–2.2 cm long, 1–1.4 cm wide, with ca. 60–100 close-packed pistils; ovary green, ovoid to subglobose, 2–3 mm in diam.; style abruptly-differentiated from

ovary and c.. 1 mm long, to lacking; stigma white, 2–3-lobed, the lobes rounded; *sterile interstice* ca. 1–1.6 cm long, with ca. 5–6 whorls of rhombo-hexagonal synandrodia, the lowermost whorls isodiametric with female zone and resembling connate staminodes, the upper portion attenuate and resembling sterile synandria; *male zone* white, ca. 2.5–3.5 cm long, ca. 1–1.5 cm wide; synandria white, swollen-topped, rhombo-hexagonal, 2 mm diam., thecae overtopped by synconnective, opening through apical slits; *appendix* ivory, ca. 5.5–8 cm long, tapering, smooth to faintly rugose and composed of irregular sinuous staminodes, basally isodiametric to or slightly narrower than the male zone; *fruiting peduncle* to ca. 25 cm long; fruiting spathe broadly ovoid, to 6 cm long: fruit ellipsoid, orange, 5 mm.

Distribution: Java, widespread at low to medium elevation. Plants sighted by me in 1996 near Telukbetung along the Palembang road in SE Sumatera may also be of this species. Circumstances prevented my collecting specimens.

Habitat: In open spots in forest and beside roads and fields, mainly in swampy sites, but also on well drained soils.

Notes: 1. Schott evidently described this species from cultivated material known in horticultural circles of the time as *Colocasia alba* and *Homalomena alba* (the former apparently never validly published, the latter not in the sense of *H. alba* Hassk.). Schott did not know the origin of the plant, though he indicated it was probably Malesian (*'verosimiliter in insulis Archipelagi Indiae orientalis'*). No collector or collection was cited in the protologue, but illustrations were prepared which are here designated as the neotype. They show the distinctive venation of this species, and give the clear impression of its characteristically coriaceous and slightly bullate leaves. That the plant illustrated was very probably the same one as that described in the protologue is suggested by the illustration of the ovaries (in Ic. 87) which appear abortive and which were described by Schott in the protologue as *'ovariis (in spadicibus omnibus speciminis nostri) rudimentariis'*. This appears to be a teratum: the pistils of other specimens of this species are normal.

2. Engler (1879: 500) attributed *Alocasia alba* to Sri Lanka, on the basis of a Burmann specimen at G. Although I have not seen this specimen, the attribution of *A. alba* to Sri Lanka appears to be erroneous, an opinion shared implicitly or explicitly by Brown (1884: 870), Hooker (1894: 528) and Trimen (1898: 360), who attributed it to Java. Moreover, Nicolson (1987: 55) did not include *Alocasia alba* in his treatment for Sri Lanka,

where the only species approaching it is the amply distinct *A. macrorrhizos*.

3. Backer & Bakhuizen (1968: 119) misapplied the name *Alocasia macrorrhizos* to what, from their description, specimen annotations and synonymy, is clearly this species. For the species correctly named *A. macrorrhizos*, they used its synonym *A. indica* (Lour.) Spach. What lead them to make the misapplication is not apparent.

4. The function of the distinctive glands on the petiole and peduncle, which resemble those in the axils of the primary veins, is not clear. At female anthesis the inflorescence is sweetly fragrant with the scent produced from the inside of the lower spathe.

Other specimens seen: JAVA: Buitenzorg, *Boerlage s.n.* (L); W. Java, Batavia, Solear, Tjisoka, *Eyma s.n.* (L); Cult. RBG Sydney Acc. No. 892944 ex Bogor, *Hay 4087* (NSW); W. Java, Curug Sawer, *Hay & Yuzammi 14002* (NSW); Bawean, G. Tunggangan, *Karta 30* (BO, L); Djapara, Ngarengan, *Koorders 34996* (L); Hort. Bogor, *Koorders 42804* (L); Preanger, Tasikmalaya, Pendjaloe, *Koorders 44346* (L); *Kuhl & van Hasselt s.n.* (L); *Mousset 589* (BO); Bantam, Danoe Moeras, *van Steenis 10513* (L); Hort. Bogor, Teijsmann s.n. (L); Kediri, Pandan, Djeroek, *Thorenaar 290* (BO).

19. Alocasia balgooyi A. Hay, *sp. nov.*

Ab *Alocasia macrorrhizos* (L.) G. Don costis posticis haud vel vix nudis, spathae lamina coriacea breviore, inflorescentia femina et interstitio neutro longioribus tenuioribus, synandriis minoribus, spatha fructifera rubra differt. - TYPUS: Indonesia, South Sulawesi, Soroako, Malili Road, 29 Jun 1979, *M. van Balgooy 3812* (BO, holo; GH, K, L, iso).

Robust to massive herb 1–3 m tall; *rhizome* stout (?diam.), clothed in fibrous leaf base remains; *leaves* several together; petiole ca. 70–100 cm (?or more) long, glabrous, sheathing in the lower 1/3–1/2; *blade* broadly ovato-sagittate to cordato-sagittate, ca. 50–100 cm long, membranous; *anterior lobe* widest slightly above the base, the apex obtuse and apiculate; anterior costa with 5 (?or more) primary lateral veins on each side diverging at 45–70°; axillary glands inconspicuous; secondary venation not or hardly raised abaxially, not or hardly forming interprimary collective veins; *posterior lobes* 1/2–3/4 the length of the anterior, obtuse, the inner sides ovate to more or less rhomboid; *inflorescences* in pairs ?interspersed with foliage leaves; peduncle ca. 30 cm long; *spathe* ca. 17–20 cm long, constricted 3–4 cm from the base with the constriction corresponding with the sterile interstice of the spadix; lower spathe narrowly ovoid to ovoid, thick; limb oblong-lanceolate, coriaceous, erect and later reflexed and somewhat persistent, thence deciduous, greenish cream; *spadix* somewhat shorter than

to subequalling the spathe, ca. 14 cm long, stipitate for ca. 4 mm and the stipe inserted obliquely; *female zone* 2 cm long, ca. 5 mm wide; pistils close-packed, globose-cuboid, ca. 2 mm diam.; stigma sessile, bluntly 3-lobed, ca. 1 mm diam.; *sterile interstice* 1–1.5 cm long, distinctly attenuate, ca. 3 mm thick, composed of numerous small synandrodia resembling the synandria; *male zone* 3–4 cm long , cylindric, 5–6 mm diam., cylindric; synandria very numerous, small, ca. 1 mm diam.; thecae overtopped by synconnective; *appendix* 4–5.5 cm long , slightly narrower than the male zone, deeply longitudinally channelled, tapering to a point; *fruiting peduncle* to ca. 50 cm long; fruiting spathe broadly ovoid to spindle-shaped, 6–12 cm long, creamish green, becoming bright red.

Distribution: Endemic to Sulawesi.

Habitat: Low to mid-elevation forests, sometimes in swamp forest *(Kjellberg 2396),* or on slopes, often in disturbed places and on ultrabasic soils; sea level to 1200 m altitude.

Notes: 1. The description is pieced together from fragmentary dry specimens. This species appears at least superficially similar to *A. macrorrhizos*, though clearly differing in the leaves with the posterior costae usually not naked in the sinus, the thick and relatively short spathe limb, longer peduncle, the relatively longer and narrower female and sterile zones of the spadix, the smaller and more numerous synandrodia and synandria, and the red fruiting spathe.

2. *Alocasia balgooyi* is named for Dr Max van Balgooy, who first drew attention to this new species.

Other specimens seen: SULAWESI: Menado, Poso, above baroega S. Malei, *Eyma 1670 (BO, L);* nr Malino, *Eyma 3460* (BO, L); Malili, *Kjellberg 2396* (BO) & *2116* (BO); Matamo Lake nr Soroako, NE of Malili, *Meijer 11120* (BO); Larona, W of Towuti lake, E of Malili, *Meijer 11298* (BO); N Sulawesi, Dumoga Bone National Park, Gorontalo Distr., Sg. Olama below G. Gambuta, *Millikin 976* (K); Tangguma, Poli-polia, Kolaka, *Prawiroatmodjo & Maskuri 1530* (BO); N shore of Lake Matano, E of Nuha, *de Vogel 5840* (K).

20. Alocasia flemingiana Yuzammi & A. Hay, *sp. nov.*

Ab aliis speciebus javanicis statura minore, folii lamina adulta haud peltata nervo intramarginale praedita, interstitio neutro et spathae constrictio congruentibus, stigmate lobato sessili, synconnectivo expanso differt æ TYPUS: Indonesia, West Java, Ciseeng, 25 km NNW of Bogor, 28 Jan 1961, *Nicolson 848* (L, holo; BO, US, iso).

[*Colocasia montana* auct. non (Roxb.) Kunth: Hassk., Pl. Jav. Rar. (1848) 148.]

[*Alocasia montana* auct. non (Roxb.) Schott: Miq., Fl. Ned. Ind. 3 (1855) 209, p.p., quoad loc. 'Java'; Engl., in A. & C. DC., Monogr. Phan. 2 (1879) 499, p.p., quoad loc. 'Java'; Hook.*f.*, Fl. Brit. India 6 (1894) 525, p.p., quoad loc. 'Java'; Koord., Exkurs.-Fl. Java 1 (1911) 261; K.Krause & Engl., Pflanzenr. 71 (IV.23E) (1920) 77, p.p., quoad loc. 'Java'; Koord., Exkurs.-Fl. Java 4 (1923) 194, fig. 393, non fig. 394 - i.e. *Alocasia montana* s.s. (= *Alocasia macrorrhizos*)]

[*Alocasia heterophylla* sensu auct. non (Presl) Merrill: Backer & Bakh.*f.*, Fl. Java 3 (1968) 120.]

Small herb, ca. 50 cm tall; *rhizome* to ca. 3.5 cm diam.; *leaves* several together; *petiole* green, sometimes mottled reddish purple, sometimes purple-streaked, 25–55 cm long, sheathing in the lower about 1/4–1/3 of its length; *blade* mid-green adaxialy, green-yellowish abaxially, sagittate to broadly ovato-sagittate, thin, membranous, glabrous on both surfaces; *anterior lobe* ca. 25 cm long, ca. 19 cm wide, the tip acuminate, ca. 1 cm long, anterior costa with 3 or 4 primary veins on each side, diverging at ca. 40°–60°, prominent abaxially; primary veins often bearing small flat glands in the axils abaxially, running to a distinct submarginal vein ca. 1–3 mm from margin; secondary veins flush to lamina, interprimary collective veins absent or poorly differentiated; *posterior lobes* acute, up to ca. 16 cm long, inner sides elliptic to obovate; posterior costae diverging at ca. 90–110°, naked in the sinus for 0–1 cm; *inflorescences* in pairs interspersed with foliage leaves; peduncle, ca. 2/3 the length of the petiole at anthesis, elongating in fruit, up to ca. 31 cm long; *spathe* white to greenish white, ca. 10–15 cm long, lower spathe ovoid, ca. 2–4 cm long, constricted level with top of sterile zone of spadix (to half way along male zone); limb narrowly-oblong and falling after anthesis; *spadix* somewhat shorter than to subequalling the spathe, ca. 8–11 cm long, slender, stipitate for ca. 0.5 cm; *female zone* to 1 cm long, with ca. 40 pistils; ovary globose, ca. 2 mm diam.; stigma sessile, ca. 1 mm diam., 2–3 lobed, the lobes bluntly pointed; *sterile interstice* hardly to somewhat attenuate, ca. 5 mm long, ca. 3 whorls of rounded to rhombo-hexagonal synandrodia; *male zone* 1.5 cm long, 5 mm wide; synandria rhombo-hexagonal to rhomboid, 1 mm diam., thecae somewhat displaced to overtopped by synconnective, opening through apical slits; *appendix* 6.5 cm long, tapering, cream; *fruiting spathe* becoming white.

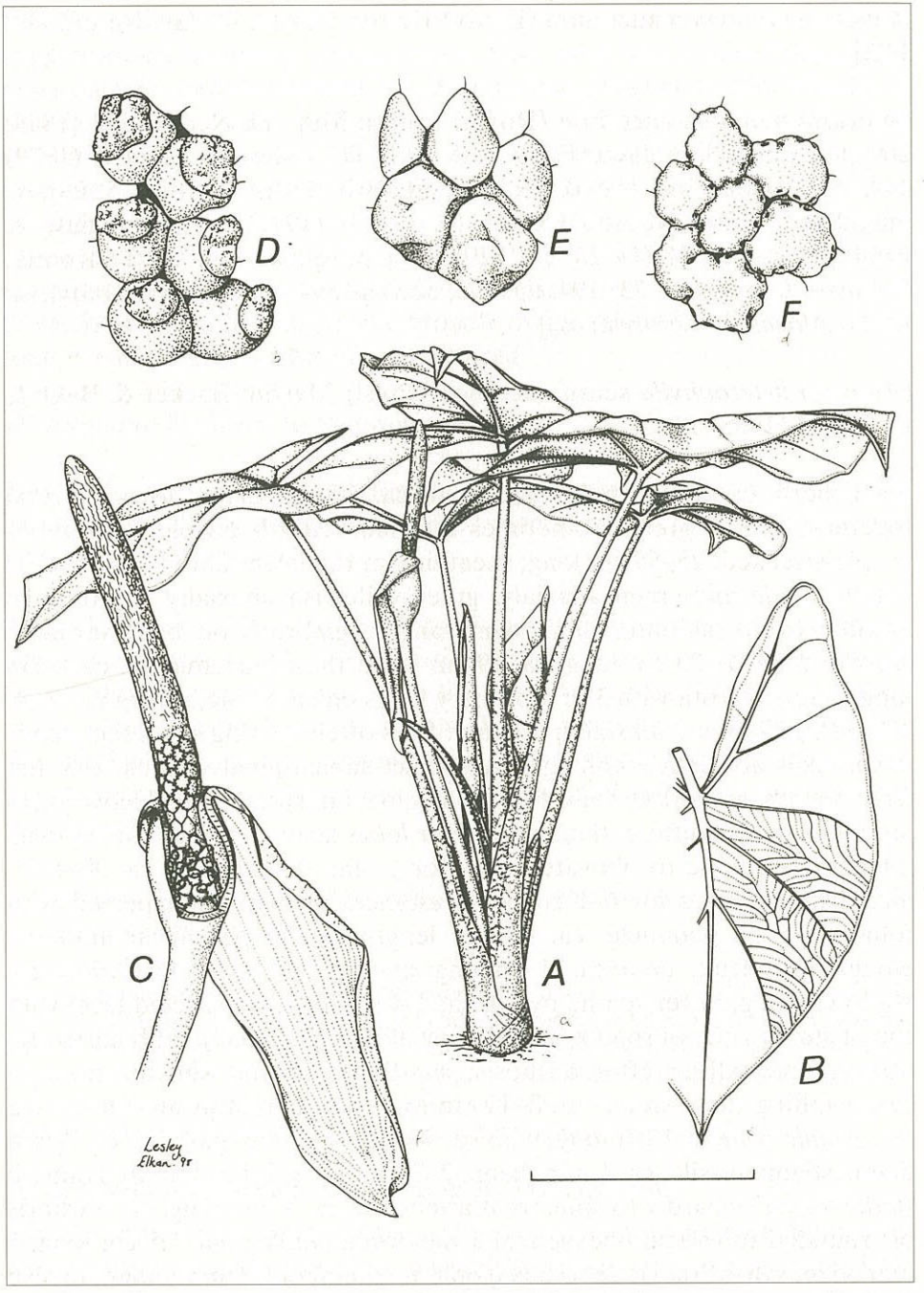

Figure 9. ***Alocasia flemingiana*** **Yuzammi & A. Hay**
RBG Sydney Acc. No. 980045. A. habit; B. venation; C. inflorescence with part of spathe removed; D. pistils; E. neuter organs; F. synandria. - Scale: bar to A, B = 8 cm, to C = 32 mm, to D, E, F = 6 mm.

Distribution: Endemic to Java; widespread in West Java and sporadic in Central Java.

Habitat: Found in teak-forest, swamp-forest, disturbed forest, on volcanic soils, sometimes over limestone, from sea level to ca. 1000 m altitude. *Murata et al J-2042* (BO) recorded that this species was found on 'rocky sea coast'. This seems an unlikely habitat for *Alocasia*, and possibly there has been an error in labelling of this specimen.

Notes: 1. The rationale behind the application of *Colocasia montana* or *Alocasia montana*, both based on *Arum montanum* - which Roxburgh had coined for a plant from the Northern Circars in the Indian state of Orissa - to Javan material remains obscure, doubly so since the identity of *Arum montanum* is itself unclear. The earliest misapplication appears to have been that of Hasskarl (loc. cit.) who made the connection on the basis that his Javan plant and *Arum montanum* were both 'stemless', followed by Miquel and, much later, Koorders. Hooker (1894) also noted in his Flora of British India that *A. montana* extended to Java. That opinion was not followed by Backer & Bakh. *f.* (1968) - though they in turn misapplied *Alocasia heterophylla* (Presl) Merr. to this species.

Arum montanum Roxb. first appeared in Hortus Bengalensis (1814: 65) as a nomen nudum, and the first valid publication was in Roxburgh's Flora Indica 3 (1832: 497). There, he wrote:

'I long considered this to be A. [Arum] *macrorrhizon, but changed my opinion on observing that Forster, who must have seen and examined that species in its recent state, says, the flowers are hermaphrodite; there being six sessile, twin anthers surrounding each germ, and that the stigma is orbicular. There are no traces of stamina, anthers or glands round the germs of my* [Roxburgh's] *plant; and the stigma is regularly three or four-lobed. In short, a very perfect Arum, or Caladium according to Ventenat'.*

Roxburgh did not record from where he took Forster's observation, but it was probably his dissertation on esculent plants (Forster, 1786), where he said of *Arum macrorrhizon* [I am indebted to Dan Nicolson for this]:

'Fructificatio a charactere generico aliquanto recedit, floculis in spadice omnibus et singulis hermaphoditis...COR. nulla./ STAM. Filamenta nulla. Antherae sex, spadice adnatae, didymae, singulo stylos cingunt./ PIST. Germen subrotundum. Stylus solitarius, brevis, crassiusculus, apice depressus. Stigma maculata orbiculata in apice styli....'

Arum macrorrhizon L. is the basionym of *Alocasia macrorrhizos* (L.) G. Don, and there is little doubt that either Forster's observation, or the way Roxburgh interpreted it, or the identification of the plant Forster observed, was incorrect. That being so, the probability is raised that *A. montana* is identical with *A. macrorrhizos*, as Roxburgh had originally thought. Neither Kunth, Schott, nor Engler and Krause, nor authors of floristic accounts of *Alocasia* in India have cited any additional specimens when treating *Alocasia montana*, simply reiterating descriptions obviously based on Roxburgh's protologue and the incomplete and rather naive illustration which, unless pertinent preserved material comes to light (Forman's (1997) account of Roxburghian species does not include *A. montanum*), will form the type. In the absence of evidence to the contrary, it would seem reasonable to treat *Alocasia montana* (Roxb.) Schott as an Indian synonym *of A. macrorrhizos* (q.v.), at least provisionally; however, epitypification of *Arum montanum* will be dealt with elsewhere. Suffice to say that, even without unequivocally disposing of the name *Alocasia montana* (Roxb.) Schott, there appears no tangible basis for applying the name of a 'species' known from a bare description and a poor painting of a plant from Orissa and resembling *Alocasia macrorrhizos*, to plants of a species apparently endemic to Java and bearing little resemblance to *A. macrorrhizos*, on the sole basis of 'stemless' habit - a characteristic of juveniles of most if not all species of *Alocasia*.

2. *Alocasia flemingiana* was incorrectly identified as *Alocasia heterophylla* (Presl) Merrill by Backer & Bakh. *f.* (1968). However, these species are readily distinguished by the following features: *A. flemingiana* has the lamina ovato-sagittate, with the margin entire, the leaf is only peltate in juvenile plants, and the sterile zone has relatively small synandrodia; *Alocasia heterophylla* has the lamina narrowly (hasto-) sagittate, sometimes deeply peltate in adult plants, with the margin sometimes undulate and the sterile zone with large synandrodia filling the upper part of the lower spathe chamber.

3. The specific epithet acknowledges Conrad D. Fleming's generous sponsorship of field work on Malesian Araceae, including Yuzammi's field work in Java during December 1997.

Other specimens seen: JAVA: Hort. Bogor, *Adelbert 400* (L); Banjumas, Tjilatjap, *Backer 21009* (BO); Java, Batavia, *Backer 34987* (BO); Java, Preanger, Tjadas Malang, *Bakhuizen. 1379* (BO); Preanger, Tjadas Malang, Tjidadap, Tjibeber, *Bakhuizen 1930* (BO); Madjalengka, Cirebon, *Beumée 1753* (BO); Pekalongan, Margasari, *Beumée 1767* (BO); Banjumas, *Beumée 4845* (BO); Batavia, Krawang, *Beumée 5397* (BO); Bidara Tjina, *Edeling s.n.* (BO); Tjiampea bij Buitenzorg, *Koorders 30810*b (BO); Pelabuhan Ratu, *Koorders*

*34459*b (BO), *Koorders 34463*b (BO), *Nicolson 935* (BO, US), *Nicolson 957* (BO); Cultuur Sepakaeng, Oengaran, Telomojo, Ambarawa, Semarang, *Koorders 35968*b (BO); Depok, Buitenzorg, *Koorders 42817*b (BO, L); Kranhau, West of Pelabuhan Ratu, W. Java, *Murata, Kato, Mogea J-2042* (BO); Depok, W. Java, *van Ooststroom 12609* (L); Tjilatjap, *Rivière s.n.* (L). Java, Preanger, Tjibodas, *Sapiin 85* (BO); Tjirebon, Telaga Erang, *Vermeulen 6* (BO); Miramere, Pamempek, West Java, *Yuzammi 297042* (NSW); Miramere, Pamempek, West Java, *Yuzammi 297043* (NSW).

21. Alocasia arifolia Hallier *f.*

Alocasia arifolia Hallier f., Bull. Herb. Boiss. Sér 2, 1 (1901) 670, fig. 11; Engl. & K. Krause, Pflanzenr. 71 (IV.23E) (1920) 79. - Type: Cult. Hort. Bogor ex Sumatera, Deli, Permandian, 1 Apr. 1896, *H. Hallier 105d,* (BO, holo; Herbarium Bogoriense sheets 100563 and 100564).

Herb to 70 cm tall; *stem* erect to decumbent, to ca. 30 cm long, 2–4 cm diam.; *leaves* several together; *petiole* ca. 20–50 cm long, finely but densely puberulent to finely scabrid to glabrous, sheathing in the lower ca. 1/4–1/3, mid-green to purplish brown; *blade* sagittate to hasto-sagittate, somewhat glossy mid/dark green adaxially, paler below, membranous to thinly coriaceous, to ca. 30 cm long; *anterior lobe* to ca. 22 cm long, widest at base, to 16 cm wide; anterior costa with 3–5(–6) primary lateral veins on each side, diverging at ca. 45–60°, with inconspicuous axillary glands, sometimes abaxially puberulent; secondary venation flush with lamina when fresh, somewhat prominent abaxially when dry, fine but abaxially conspicuous, forming undulating to zig-zag interprimary collective veins and running to a rather conspicuous submarginal vein ca. 1.5–2 mm from the margin; *posterior lobes* acute, to ca. 15 cm long; posterior costae diverging at obtuse to very obtuse angles, naked in the sinus for up to 3 cm; *inflorescences* paired, the pairs interspersed with foliage leaves; peduncle to ca. 6 cm; *spathe* 5.5–9 cm long; lower spathe 1–1.5 cm long, separated from the limb by an abrupt constriction, ovoid; limb oblong to oblong lanceolate, apiculate for up to 1 cm, greenish white, sometimes suffused purple-brown, erect, then reflexed; *spadix* subequalling the spathe, 4.5–8 cm long, shortly stipitate; stipe white, ca. 3 mm long; *female zone* ca. 8 mm long; ovaries subglobose, green, ca. 1.5 mm diam.; style very short, ca. 0.5 mm long; stigma white, 3–4-lobed, the lobes rounded; *sterile interstice* ivory, hour-glass shaped, corresponding with spathe constriction, ca. 7 mm long, ca. 3 whorls of rhombo-hexagonal synandrodia; *male zone* short, about equalling female zone, ca. 6 mm diam.; synandria ivory, rhombo-hexagonal, 2–3 mm diam.; thecae opening by apical pores overtopped by synconnective; *appendix* somewhat constricted at base, the rest slightly narrower than male zone, finally tapering to a point, pale apricot; *fruiting peduncle* to ca. 20 cm long; fruiting spathe ovoid, ca. 2.5 cm long.

Distribution: Endemic to Sumatera, recorded from few, scattered localities.

Habitat: Low montane forest 400–1300m alt., often near streams, but not rheophytic.

Notes: 1. The two sheets that comprise the type, as interpreted here, consist of a leaf and an inflorescence respectively. However, it is not entirely clear that they represent the same collection (the second is undated and has no collection number), though they are both collected from the Bogor Botanic Garden. I am in no doubt that they are of the same species and they are both determined as *A. arifolia* by Hallier *f.* It would be desirable to designate an unambiguous epitype, but, as yet, complete, authentically provenanced material is not available.

2. Relationships of *Alocasia arifolia* are not readily apparent, but the arrangement of inflorescences and the synandria with the synconnective overtopping the thecae suggest alliance to Javan *A. flemingiana*.

Other specimens seen: SUMATERA: Cult. RBG Sydney Acc. No. 942737 ex cult. Hort. Leiden Acc. No. 940819 ex Sumatera, *Vogel s.n.* (NSW); Cult. RBG Sydney Acc. No. 970498 ex West Sumatera, G. Gadut, *Hay et al. 13069* (NSW); Mentawi Islands, Siberut Island, *Iboet 26* (BO); Lampung Prov., Mt Tanggamus, *Jacobs 8265* (L); Aceh, Gajolanden, Bivak Aer Poetih waterfall, nr Pendeng, *van Steenis 9283* (BO);

Longiloba Group

Species 22—24

Growth pattern strongly rhythmic, with a pronounced delay between flowering and resumption of leaf-production; cataphylls thinly membranous, degrading into rather sparse fibres; *leaves* solitary or few together, the *blades* mostly peltate and pendulous, often purple-backed and/or with white major venation; interprimary collective veins absent to very pronounced and zig-zagged; *spathe* limb opening wide and deciduous; *spadix* stipitate; stipe white; ovaries green with white to yellowish stellate stigmas; *sterile interstice* attenuate and corresponding with spathe constriction; *male zone* ivory; thecae not overtopped by synconnective; *appendix* pale orange-pink to yellow, occasionally ivory.

Distribution: About four species from Indochina to West Malesia, the Philippines and Sulawezi.

Note: This group coheres on the basis of its highly uniform inflorescence

morphology, strongly rhythmic growth and membranous, fibrous cataphylls, and leaves with usually peltate, often dark green, purple-backed and white veined blades. There is nevertheless a great deal of variation in leaf blade shape, colour and venation. It is represented by three morpho-geographically circumscribable species - Philippine *A. sanderiana* W. Bull and *A. boyceana* A. Hay ined. and Sulawesi *A. suhirmaniana* Yuzammi & A. Hay. The fourth 'species' is a taxonomically intractable complex centred on West Malesia, extending into mainland Asia to the north and Sulawesi to the east, here treated as the *Alocasia longiloba* complex. Seventeen names have been proposed for Malesian elements within this complex.

22. Alocasia longiloba Miq.

Alocasia longiloba Miq., Bot. Zeit. 14 (1856) 561 & Fl. Ind. Bat. 3 (1856) 207; Schott, Prodr. Syst. Aroid. (1860) 153; Engl. in A. & C. DC., Monogr. Phan. 2 (1879) 506; Hook.*f.*, Fl. Brit. India 6 (1894) 527; Hallier f., Bull. Herb. Boiss. 7 (1898) 607; Ridl., J. Straits Br. Roy. Asiat. Soc. 44 (1905) 179; K. Krause & Engl., Pflanzenr. 71 (IV.23E) (1920) 103; Backer & Bakh.*f.*, Fl. Java 3 (1968) 118); M. Hotta, Acta Phytotax. Geobot. 22 (1967) 156. Type: Indonesia, Java, Tjikoja, 15 Aug 1856, *Zollinger 601* (L, holo; B, BM, K, P iso).

Caladium veitchii Lindley, Gard. Chron. (1859) 740. - *Alocasia veitchii* (Lindley) Schott ('*veitchi*'), Ann. Mus. Lugd.-Bat. 1 (1863) 125; Koord., Exkurs.-Fl. Java 1 (1911) 261. - *Alocasia lowii* var. *veitchii* (Lindley) Engl. in A. DC., Monogr. Phan. 2 (1879) 508; Engl. & K. Krause, Pflanzenr. 71 (IV.23E) (1920) 107. Neotype: Java, without date, L sheet nos. 898. 87 115 & 898. 87 116, *Kuhl & van Hasselt 12* (L, designated here).

Caladium? lowii Lem., Ill. Hort. 10 (Jan 1863) descr. ad t. 360. Type: Ill. Hort. 10 (1863) t. 360.

Alocasia lowii Hook., Curtis's Bot. Mag. (May 1863) descr. ad t. 5376; Engl. in A. & C. DC., Monogr. Phan. 2 (1879) 508; Ridl., J. Straits Br. Roy. Asiat. Soc. 44 (1905) 178 ('*lawii*'); Ridl., Mat. Fl. Mal. Pen. 3 (1907) 18; Engl. & K. Krause, Pflanzenr. 71 (IV.23E) (1920) 106; Ridl., Fl. Mal. Pen. 5 (1925) 98; M. Hotta, Acta Phytotax. Geobot. 22 (1967) 156. - Type: Cult. RBG Kew ex Hort. Low, *Anon. s.n.* (K!, holo). [Not based on *Caladium lowii*; see Hay in Hay *et al.*, Blumea Suppl. 8 (1995) 16].

Alocasia korthalsii Schott in Miq., Ann. Mus. Bot. Lugd.-Bat. 1 (Nov 1863) 124; Engl. in A. & C. DC., Mongr. Phan. 2 (1879) 509 & Bot. Jahrb. Syst.

25 (1898) 25; Ridl., J. Straits Br. Roy. Asiat. Soc. 44 (1905) 179; Engl. & K. Krause, Pflanzenr. 71 (IV.23E) (1920) 108, fig. 25; M. Hotta, Acta Phytotax. Geobot. 22 (1967) 156. - Type: Indonesia, Kalimantan, G. Sakumbang, *Korthals s.n.* (L, holo).

Alocasia singaporensis Linden, Gartenfl. 14 (1865) 252. - Neotype: Cult. R.B.G. Kew, 12 Feb 1879, *N.E. Brown s.n.* (K; designated here - see below).

Alocasia lowii var. *picta* Hook.*f.*, Curtis's Bot. Mag. (1865) descr. ad t. 5497. - Type: Bot. Mag. (1865) t. 5497.

Alocasia thibautiana Mast., Gard. Chron. 9 (1878) 527; N.E. Br., Ill. Hort. 28 (1881) 72, t. 439; N. E. Br., Gard. Chron. ser. 3, 17 (1895) 485, fig. 68. Neotype: Cult. RBG Kew ex Hort. Veitch, 25 Jan 1879, *N.E. Brown s.n.* (K, designated here).

Alocasia amabilis W. Bull, Retail List 143 (1878) 9. - Neotype: Cult. RBG Kew ex Hort. Bull, 20 Sep 1878, *N.E. Brown s.n.* (K, designated here).

Alocasia denudata Engl. in A. & C. DC., Monogr. Phan. 2 (1879) 507; Hook.f., Fl. Brit. Ind. 6 (1893) 525; Ridl., J. Straits Br. Roy. Asiat. Soc. 44 (1905) 178; Ridl., Mat. Fl. Mal. Pen 3 (1907) 17; Engl. & K. Krause, Pflanzenr. 71 (IV.23E) (1920) 100; Ridl., Fl. Mal. Pen. 5 (1925) 97; Corner, Gard. Bull. Sing. Suppl. 1 (1978) 73, 100. Type: Singapore, *Gaudichaud 106* (G, holo, n.v.; P iso).

Alocasia putzeysii (*'putzeysi'*) N.E. Br., Ill. Hort. 29 (1882) 11; N.E. Br., Gard. Chron. ser. 2, 19 (1883) 501, fig. 75; Engl. & K. Krause, Pflanzenr. 71 (IV.23E) (1920) 108. - Type: Cult. RBG Kew ex Hort. Linden, Dec 1881, *N.E. Brown s.n.* (K, holo).

Alocasia eminens N.E. Br., Gard. Chron. ser. 3, 1 (1887) 105; anon., Kew Bull. (1888) 91. - Type: Cult. RBG Kew ex Hort. W. Bull (no. 3954), 10 Nov 1886, *N.E. Brown s.n.* (K, holo).

Alocasia watsoniana Mast., Gard. Chron. ser. 3, 13 (1893) 442; Engl. & K. Krause, Pflanzenr. 71 (IV.23E) (1920) 109; Burnett, Aroideana 7 (1984) 128, figs. 93-94. - Type; Gard. Chron. ser. 3, 13 (1893) 569, fig. 83. Epitype: Cult. RBG Kew ex Hort. Sander, April 1893, *N.E. Brown s.n.* (2 sheets) (K, designated here).

Alocasia curtisii N.E. Br., Kew Bull. (1894) 347; Engl. & K. Krause,

Pflanzenr. 71 (IV.23E) (1920) 106. - Type: Cult. RBG Kew ex Malaysia, Penang, 16 July 1894, *N.E. Brown s.n.* (K, holo).

Alocasia cuspidata Engl., Bot. Jahrb. Syst. 25 (1898) 25; Engl. & K. Krause, Pflanzenr. 71 (IV.23E) (1920) 102. - Type: Indonesia, Kalimantan, Dusson Timor, Telang, *Grabowski s.n.* (B, holo).

Alocasia denudata var. *elongata* Engl., Pflanzenr. 71 (IV.23E) (1920) 100, fig. 21, A-E. - Type: Singapore Botanic Garden, December 1905, *Engler 3803* (B, holo; presumed destroyed). Neotype: Singapore, Seletar forest behind Rifle Range, 29 Aug 1948, *J. Sinclair 5020* (E, designated here - see below).

Small to robust herbs ca. 40–150 cm tall; terrestrial to lithophytic; *rhizome* generally elongate, erect to decumbent, often completely exposed, sometimes swollen and sub-cormous, ca. 8–60 cm long, 2–8cm diam., usually bearing remains of old leaf bases and cataphylls; growth markedly rhythmic with renewal growth delayed after flowering; vegetative modules often unifoliar (to 3-leaved), subtended by conspicuous lanceolate papery-membranous often purplish-tessellate cataphylls degrading to papery fibres; *petioles* glabrous, purple-brown to pink to green, often strikingly obliquely mottled chocolate brown, ca. 30–120 cm long, sheathing in the lower ca. 1/4 or less; *blades* often pendent, shape and venation extremely variable, peltate (except 'denudata'), plain mid-green throughout to adaxially dark green and abaxially rich purple, often adaxially with the major venation white to pale grey-green and sometimes with the lamina bordering the main veins grey-green, hasto-sagittate and triangular in outline to ovato-sagittate and shield-shaped, 27–65(–85) cm long x 14–ca. 40 cm wide, with the widest point anterior to the petiole insertion to near the tips of the posterior lobes; anterior costa with 4–8 primary lateral veins on each side, the proximal ones diverging at ca. 60–100°, the angle decreasing in distal veins and the course more or less straight to the margin to markedly acropetally deflected; axillary glands conspicuous abaxially at the junctions of the main veins and costae; secondary venation obscure to conspicuous abaxially, mostly arising from the primary veins at a wide angle then sooner or later deflected towards the margin, forming variously well-defined interprimary collective veins or these absent, concolorous with the abaxial lamina or sometimes markedly paler; interprimary collective veins when present weakly undulating to strongly zig-zagging at broadly acute angles; *posterior lobes* ca. 3/4 to 1/2 the length of the anterior lobe, when peltate united for (5–)10–66% of their length; posterior costae straight to pedately incurved; *inflorescences* (solitary to) paired, with up to 4 pairs in succession

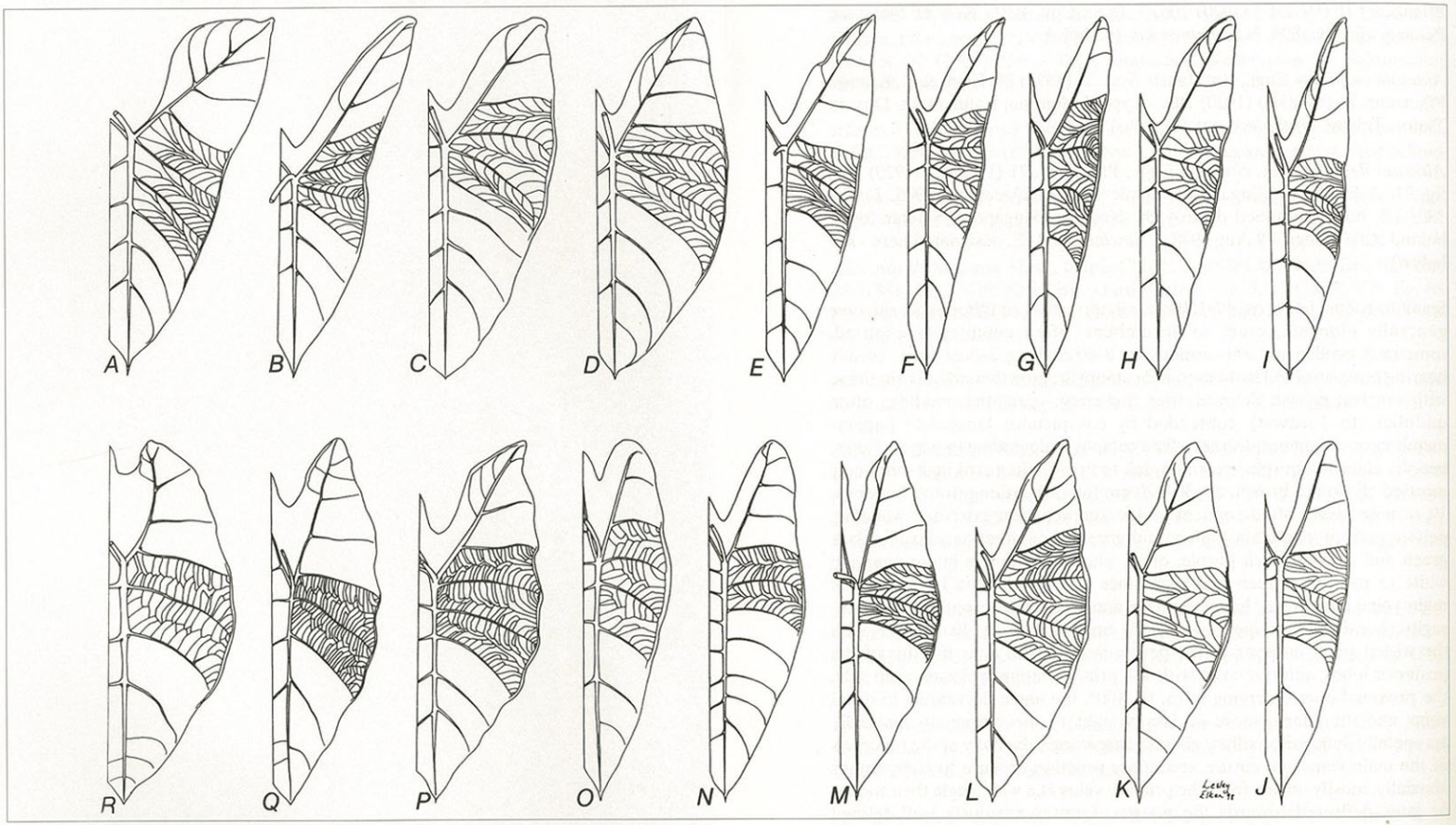

Figure. 10. ***Alocasia longiloba*** **Miq. s. l.**
Leaf blades showing a continuum of variation, some exemplifying entities recognised in the text. - A. 'denudata'; D. 'thibautiana'; F, 'longiloba'; K, 'lowii'; M, 'korthalsii'; O, 'putseyzii'; R, 'watsoniana'. - Scale: 1/5 approx. (not all drawn to exactly the same scale). A. 901379 - *Hay s.n.*, Singapore; B. 940485 - *Hay 9332*, Bintulu, Sarawak, C. 940102 - *Hay 9058*, Batu Caves, Selangor; D. 821121 - cult. unknown origin; E. 940355 - *Hay 9288*, Fraser's Hill, Pahang; F. 942735 - *Vogel s.n.,* Sarawak; G. 950372 - *Hay 10035*, Kebun Cina, Sabah; H. 940138 - *Hay 9142*, Bukit Tanka, Negeri Sembilan; I. 904647 - *Boyce 384*, Temburong, Brunei; J. 940165 - *Hay 9069*, Bukit Larut, Perak; K. 940064 - *Hay 9019*, Kaki Bukit, Perlis; L. 940047 - *Hay 9001*, Kangar, Perlis; M. 940462 - *Hay 9308*, Bintulu, Sarawak; N. 970528 - *Hay 13002*, Lembah Anai, West Sumatera; O. 942718 - *Vogel s.n.*, Bau, Sarawak; P. 970474 - *Hay 13036*, Kerinci Seblat NP, Jambi; Q. *Lörzing 4804*, Sibolangit, Sumatera; R. 920745 - *Dearden s.n.,* Long Jowe, Sarawak. Six-figure numbers are all Royal Botanic Gardens Sydney Accession numbers with vouchers at NSW.

without interspersed foliage leaves; peduncles ca. 8–18 cm long, usually resembling the petioles in colour and markings, erect at first, then often declinate, elongating and then erect in advanced fruit, subtended by a series of progressively larger cataphylls resembling those of the vegetative phase; *spathe* ca. 7–17 cm long, abruptly constricted ca. 1.5–3.5 cm from the base; lower spathe green, ovoid to subcylindric; limb pale green, membranous, lanceolate, canoe-shaped and longitudinally in-curved, eventually reflexing after male anthesis; *spadix* somewhat shorter than to subequalling the spathe, ca. 6–13 cm long, stipitate, with the stipe conic, whitish, to 5 mm long; *female zone* 1–1.5 cm long; ovaries subglobose, ca. 1.5–2 mm diam., green; stigma subsessile or on a slender style to ca. 0.5 mm long, white, acutely and conspicuously 3–4-lobed, the lobes pointed, more or less spreading; *sterile interstice* 7–10 mm long, narrower than the fertile zones, corresponding with the spathe constriction; lower synandrodia often with incompletely connate staminodes, the rest elongate rhombo-hexagonal, flat-topped; *male zone* subcylindric, somewhat tapered at the base, 1.2–2.5 cm long, 4.5–8 mm thick, ivory; synandria more or less hexagonal, ca. 2 mm diam., 4–6-merous; thecae opening by apical pores not overtopped by synconnective; *appendix* 3.5–9 cm long, about the same thickness as the male zone and demarcated from it by a faint constriction, subcylindric, distally gradually tapering to a point, faintly rugose to rugose in the lower part, very pale orange to bright yellow; *fruiting peduncle* to 25 cm long; fruiting spathe ovoid, ca. 4–7 cm long; fruits orange-red.

Distribution: Indochina to West and Central Malesia excluding the Philippines.

Habitat: In rainforest and swamp-forest floor, regrowth, on boulders in forest and on exposed cliffs and ravines at low to medium elevation.

Notes: 1. In developing a classification that reflects what is at present known of this complex, I have avoided reducing its elements blithely to a single species without a clear qualification that it is not equivalent to a 'simple' species of low variation content. However, the complex cannot have forced onto it overstated and simplistic hierarchical discontinuities that would be implied in recognising separate species and/or infraspecific taxa within it on the basis of currently available evidence (cf. Gentry, 1990).

Like many *Alocasia* species, the elements of this complex freely hybridise in cultivation, but within this group hybrid series involving three or four 'species' are recorded (see Burnett, 1984), confirming their close relationship. Many of the formally named parent forms are highly

ornamental and striking, and the horticultural community may be irritated by their disappearing as named species. However, there is no reason why these names cannot be transposed into the nomenclature for cultivated plants as cultivars or cultivar groups. The background to the description of 'species' within this complex has been largely horticultural, through the introduction of the finest and most striking forms to European stove culture in the 19th Century. These forms represent what I have called the 'peak variants' in the complex, and I have used their types and associated nomenclature as a framework for the informal infraspecific classification proposed here. The entities proposed cannot at present be regarded as more than peaks in an overall continuum of variation and so not all specimens encountered can be categorically accomodated in this classification. Nevertheless, there are perceptible but incompletely resolved geographical patterns to the variation, and some ecological variation, which is somewhat but incompletely correlated with morphological variation and geographic pattern, discussed under the relevant 'peak variants'. The key provided to these variants must be regarded as a guide only to 'typical' forms, and no pretence is made that by using it all specimens encountered can be unequivocally identified.

2. This complex can be considered an ochlospecies since, while there is a continuum of variation globally, at particular localities sharply differing forms may coexist and evidently behave locally as discrete sympatric 'topospecies'. A rigorous analysis of variance might reveal statistically significant narrow discontinuities, which could form the basis for species distinctions at the global level. However, at present, carrying out such an anlysis is impeded by the inadequate and very uneven sampling over the range, exacerbated by the incompatibility of this genus with standard herbarium preservation methods. As a consequence of this incompatibility, collections consist of conveniently sized leaves or fragments which cannot be deemed comparable between individuals when the plants are known to show considerable plasticity of form depending on age and environmental factors.

The local coexistence of distinct forms presupposes the existence of local reproductive isolating mechanisms regardless of whether or not these might translate into the defintion of species within the complex globally. The percentage of specimens preserved directly from the wild that bear inflorescences is extremely low and inadequate to form a basis for detecting isolation mechanisms based on flowering time. Moreover, there is an almost total dearth of ecophysiological data on finer aspects of phenology, which are known to be complex in this genus involving intricate patterns of flux in thermogenesis (Leick, 1915 - n.v., cited in Grayum, 1990) possibly

associated with scent production and the differentiation of pollinator preferences.

3. Lindley described *Caladium? veitchii* from a cultivated plant obtained from Borneo. No original material has been located, and Lindley did not illustrate it. When Schott (1863) made the combination in *Alocasia*, he cited a collection by Kuhl and van Hasselt, from Java, in addition to noting the original provenance Borneo. Since Schott was the world authority on aroids at the time and had established an enormous collection of living plants, it is highly probable that he knew *Caladium veitchii* first hand. I therefore consider it enough to be guided by Schott's interpretation and designate the *Kuhl & Hasselt* specimen as the neotype.

4. The above-cited illustration of *A. watsoniana* is of a sterile plant, though it shows the distinctive bullate blade and in-curved posterior costae. It does not actually accompany the protologue, having appeared in an issue of Gardeners' Chronicle one month later. However, the caption includes direct reference to the protologue. Whether or not direct connection may be inferred between the illustration and the protologue, application of the name requires to be established more firmly. The above-selected epitype is preserved from a flowering cultivated plant of, evidently, the same clone introduced by Sander & Co, which Masters described.

5. No material was preserved of *Alocasia thibautiana* when it was first described, nor was it illustrated. The designated neotype consists of two sheets annotated by N.E. Brown 'from the type plant'. Both consist of leaf only. A third sheet, dated 12 November 1881 consists of a dried inflorescence.

6. Linden's description of *Alocasia singaporensis* is extremely scant, reading, from the German, 'From Singapore. The large leaf is arrow-shaped, with large spreading basal lobes and of dark green colour'. Assuming the provenance Singapore alludes to origin from the wild, this description can only match *Alocasia longiloba* 'denudata'. Material preserved by Brown at Kew under the name *A. singaporensis* is indeed of that entity.

7. *Alocasia denudata* var. *elongata* Engl. was differentiated from the typical variety by the narrower lobes of the leaf blade. The designated neotype well exemplifies this state. The illustration that accompanied the protologue is not good enough to serve as the type in the absence of the material it was apparently based on. There are no details of leaf venation and the lower part of the spadix is stylised.

8. *Alocasia amabilis* W. Bull was validly published in the above-cited retail list, and is neotypified with material preserved by Brown at Kew from a plant obtained from Bull under that name.

KEY TO THE PEAK VARIANTS

1a. Leaf blade of adult plant not distinctly pendent, not peltate (S. Malay Peninsula, E Sumatera) ..... **'denudata'**
1b. Leaf blade of adult plant pendent, peltate 2

2a. Leaf blade narrowly triangular in general outline (ca. 3 times as long as broad) or sometimes slightly hastate (throughout range of species) ..... **'longiloba'**
2b. Leaf blade broadly triangular to broadly oval in general outline (ca. 2 times as long as broad), not hastate 3

3a. Posterior lobes of leaf united for at least half their length 4
3b. Posterior lobes of leaf united for less than half their length 5

4a. Interprimary collective veins zigzagging at acute angles (Peninsular Malaysia, Sumatera, Borneo) ..... **'watsoniana'**
4b. Interprimary collective veins more or less undulate (Borneo) ..... **'korthalsii'**

5a. Interprimary collective veins zigzagging at ca. right angles; secondary venation paler than blade ground colour (Sumatera) ..... **'putzeysii'**
5b. Interprimary collective veins weakly formed to indiscernible; secondary venation concolorous with leaf blade 6

6a. Blade broadly triangular (Peninsular Malaysia, NW Borneo) ..... **'lowii'**
6b. Blade broadly ovato-sagittate (northern Peninsular Malaysia, ?NW Borneo) ..... **'thibautiana'**

a. 'denudata'

- *Alocasia singaporensis* Linden - *Alocasia denudata* Engl. - *Alocasia denudata* var. *elongata* Engl.

Terrestrial herb to ca. 1m tall; *leaves* 1–3 together; *petiole* to 80 cm (often less), mostly rather densely obliquely mottled chocolate, the ground colour occasionally bright pink; *blade* green, sagittate, usually not pendent, with the primary venation not or barely of a different colour from that of the

lamina; *posterior lobes* subequalling the anterior; posterior costae naked in the sinus for up to 7 cm; interprimary collective veins absent to weakly formed and then only slightly undulating.

Distribution: Southern Malay Peninsula and E . Sumatera.

Habitat: In rain forest and regrowth understorey at low elevation.

Note: This entity is qualitatively distinct from others on the basis of its non-peltate leaves, which are not as makedly pendulous as they are in the rest of the complex. However, even quite advanced sub-adult plants have peltate leaves, which are identical to *A. longiloba* 'lowii'. It is geographically fairly coherent, but intergrades in Sumatera, through very shallowly peltate forms, with 'longiloba' (e.g. *Docters van Leeuwen-Reijnvaan 11790* (BO)) and 'putzeysii' (e.g. *Meijer 6859* (L)) variants.

Were this entity to be recognised as a separate species, *A. singaporensis* would have priority over *A. denudata*. However, *A. denudata* ha been a name in wide use, while *A. singaporensis* has never been taken up to any significant extent, and I would recommend that *A. denudata* be proposed for conservation.

Selected other specimens seen: PENINSULAR MALAYSIA: Malacca, Pulau Nangka, *Burkill 2641* (K); Selangor, Kuala Langat, nr Klang, *Burkill 4102* (SING); Johore, Jason Bay, *Corner s.n.* (SING); cult. RBG Sydney Acc. no. 940260 ex Johor, G. Panti via Kg Lukit, *Hay et al. 9192* (NSW); Johore, Kluang F.R., *Holttum 9235* (K, SING); Johore, 20th Milestone, Kota-Tinggi - Jemalung Rd, *Nicolson 1229* (US); Sembilan Islands, Pulau Rembia, *Sinclair 76443* (KEP); Dindings, Lumut, *Ridley s.n.* (SING). SINGAPORE: Jurong Rd, *Burkill 255* (SING); Mandai Rd., *Burkill 11432* (SING); Singapore Botanic Garden, *Croat 53241* (B, K); Cult. RBG Sydney Acc. no. 901379 ex Singapore Botanic Garden Rain Forest, *Hay s.n.* (NSW); Singapore Botanic Garden Jungle, *Nicolson 1007, 1120, 1121* (all US); Bukit Timah, Upper Fern Valley Ravine, *Nicolson 1106* (US); 'Woodlands', *Ridley s.n.* (SING); Chan Chu Kang, *Ridley s.n.* (SING), Changi, *Ridley s.n.* (SING); Tuas, *Ridley s.n.* (SING); Bukit Timah, *Ridley s.n.* (K, SING), Kranji, *Ridley s.n.* (SING); Kg. Pulau Damar Darat, *Sinclair 6874* (E, US). SUMATERA: Siberut Island, *Boden-Kloss 11438* (SING); Banka, P. Pinang, G. Mangkol, *Bünnenmeijer 2124* (BO); Riau Archipelago, Belobang, *Bünnenmeijer 7696* (BO, L); Cult. RBG Sydney Acc. no. 970448 ex Jambi Prov., 100km along rd Jambi-Palembang, *Hay et al. 13007* (NSW); Mentawi Islands, Siberut Island, *Iboet 26* (BO, L, SING); SE Bangka, Lobok Besar, *Kostermans 266* (BO); Malacca Straits, Pulau Bukala, *Sinclair 76419* (KEP).

b. 'longiloba'

- *Alocasia longiloba* Miq. s. str. - *Alocasia cuspidata* Engl. - ?*Caladium veitchii* Lindl. - *Alocasia veitchii* (Lindl.) Schott - *Alocasia lowii* var. *veitchii* (Lindl.) Engl. - *Alocasia amabilis* W. Bull.

Generally terrestrial (occasionaly lithophytic) sometimes robust herb, to ca. 1m (1.5m) tall (usually ca. 60 cm); *leaves* solitary to 3 together; petiole to 80 cm tall (usually ca. 40 cm), mottled dark green to chocolate; *blade* hasto-sagittate, rather narrowly triangular, dark to very dark green, usually with the major venation grey-green adaxially, *posterior lobes* 1/2–2/3(–3/4) the length of the anterior, peltate for (5–)10–30% of their length, acute; secondary venation initially widespeading, then sooner or later deflected towards the margin; interprimary collective veins absent to weakly formed and zig-zag at widely obtuse angles.

Distribution: Central Vietnam and Thailand to Peninsular Malaysia, Sumatera, Borneo, Java and Sulawesi.

Habitat: In rain forest and regrowth understorey, in swampy areas and well drained slopes, occasionaly on rocks, at low to medium elevation; in Sulawesi from sea level to ca. 2000 m altitude.

Note: This form is very widespread. In Borneo and Peninsular Malaysia it intergrades with *A. longiloba* 'lowii', which typically has broader leaf blades and is generally lithophytic. In Sumatera it intergrades with *A. longiloba* 'putzeysii' (e.g. Hay *et al.* 13080). All the collections from Sulawesi are sterile. Those plants have extremely shallowly peltate leaves.

Selected other specimens seen: PENINSULAR MALAYSIA: Perak, Taiping Waterfall, *Furtado s.n.* (SING); Cult. RBG Sydney Acc. no. 940165 ex Perak, Thaiping, Bk Larut, *Hay et al. 9069* (NSW); Selangor, Ulu Langat, *Millard 1866* (SING). SUMATERA: Asahan, Silo Maradja, *Bartlett 6441* (US); Aceh, G. Leuser Nature Resrve, Upper Mamas R., ca. 15 km W of Kutacane, *de Wilde & de Wilde-Duyfjes 19001* (L); Cult. RBG Sydney Acc. no. 970459 ex Jambi Prov., 120 km along rd Sungei Penuh - Bangko, *Hay et al. 13018* (NSW); Cult. RBG Sydney Acc. no. 970509 ex West Sumatera, Padang, Gunung Gadut, *Hay et al. 13080* (NSW). JAVA: West Java, Bogor, *Boerlage s.n.* (L); Bantam, Lebak Kidoel, G. Kancana, *Koorders 40970b* (L); Preanger, Tasik Malaja, Pendjalu, *Koorders 44348b*, (L); West Java, W of Djasinga, Djankapa forest reserve, *Meijer 2947* (BO); Batavia, Wanajasa, *Wisse 1237* (L). KALIMANTAN: Pulau Lampei, *Korthals s.n.* (L); East Borneo, Berau distr., *Kostermans 21838* (L); West Kalimantan, Pontianak, S. Raja, *Mondi 15* (L). SARAWAK: Matang F.R., 10 mi W of Kuching, *Nicolson 1271* (US); Bako National Park, 20 mi NE of Kuching, *Nicolson 1307* (US); Kuching, *Ridley 12250* (SING); Binatang, Pulau Bruit, *Sanusi bib Tahir 9219* (L). BRUNEI: Temburong Distr., Sg. Temburing at Kuala Belalong, *Boyce 359, 384* (both K); Belait Distr., Sg. Liang Arboretum, *Foreman & Blewett 1082* (K); Bangarmassing, *Motley 1131* (L); Belait District, Rasau, *van Niel 4247* (L). SABAH: Cult. RBG Sydney Acc. no. 950372 ex Sandakan, Kebun Cina, *Hay et al. 10035* (NSW); cult. RBG Sydney Acc. no. 960481 ex Sepilok F.R., *Hay et al. 12152* (NSW); Cult. RBG Sydney Acc. no. 960512 ex G. Rara F.R., ca. 2.5 km above main Maliau Falls, *Hay et al. 12050* (NSW). SULAWESI: Masamba, Takala-Teboro, *Eyma 1460* (BO); E Central Sulawesi, Morowali Prov., *Grimes 1906* (K); Central Celebes, Mt Nokilalaki, *Meijer 9859* (L); Makassar, Malinoboren, *Rant 440* (BO); Enrakang Distr., Latmojong Mts, Bunteh Tjejeng, *Sands 193* (K);

c. 'putzeysii'

- *Alocasia putzeysii* N.E. Br.

Terrestrial (?always) herb to ca. 90 cm tall; *leaves* 1–3 together; petiole to ca. 80 cm, brown-mottled or more or less concolorous brownish purple; *blade* narrowly ovato-sagittate, rather shallowly peltate (to ca 20% of the depth of the posterior lobes), nearly always purple-backed; secondary venation conspicuous, forming weakly zig-zag interprimary collective veins.

Distribution: Sumatera.

Habitat: On rainforest floor, usually on slopes at low to medium elevation.

Note: This element is distinguished from 'watsoniana' by the straight posterior costae diverging at a wider angle, the more triangular leaf outline and the less deeply peltate posterior lobes. The interprimary collective vein is mostly less markedly zig-zag in course, though *Hay et al. 13102* comes from a population in which some individuals have the venation pattern typical of 'watsoniana', though the leaf shape is of 'putzeysii'. The secondary venation is typically paler in colour than the ground colour of the lamina on either the adaxial side or both sides. This element links 'watsoniana' with 'longiloba'. *Meijer 6859* resembles 'denudata' in its long posterior lobes distinctly elliptic on the inner sides, but matches 'putzeysii' in other respects.

The type of *Alocasia putzeysii* is of a leaf only, but it is quite distinctive. The shape is narrowly ovato-sagittate with the posterior lobes 2/3 the length of the anterior and peltate for ca. 20% of their length. The interprimary collective veins form a weakly zig-zag pattern and the secondary venation is paler than the ground colour. In the protologue, *A. putzeysii* was attributed to Java, however, this form matches Sumateran material, not Javan. That the attribution to Java was in error appears to be confirmed by N.E. Brown's notes on the type specimen, where he states the provenance as Sumatera, 'Atchin' (?= Aceh) Province.

Specimens seen: SUMATERA: Cult. RBG Sydney Acc. No. 970528 ex W. Sumatera, Lembah Anai, *Hay et al. 13102* (NSW); W. Sumatera, Taram, E of Pajakumbuh, *Meijer 6859* (L); 'West Coast', *Micholitz s.n.* (K);

d. 'watsoniana'

- *Alocasia watsoniana* Mast

Mainly lithophytic but also terrestrial moderately robust herb to ca. 1.25 m

tall; *leaf* usually solitary (–3 together); *petiole* purplish, not or faintly mottled; *blade* ovato-sagittate, shield-shaped, to ca. 60 (–85) cm long, adaxially dark green with strikingly whitish major venation, abaxially purple, sometimes shallowly undulate on the margin, often bullate with long narrow wrinkles running between and more or less perpendicular to the primary veins and arranged more or less concentrically around the insertion of the petiole; proximal primary venation diverging at a very wide angle (to over 90°), distal primary veins diverging at ca. 45°; secondary venation rather dense, arising at a very wide angle and uniting into an interprimary collective veins very strongly zig zagging at acute angles; *posterior lobes* rounded acute, united for over half their length; posterior costae diverging at ca. 45–90° then somewhat incurved in the manner of the posterior rhachises of a pedate leaf.

Distribution: Peninsular Malaysia, Sumatera, Borneo.

Habitat: Terrestrial and on cliffs and on boulders in forest, sometimes on limestone, from sea level to ca. 700m.

Notes: In Sumatera this element closely approaches, in its blade shape and secondary venation pattern, and occasionally intergrades with, 'putzeysii', but that typically has less deeply peltate leaves, straight posterior costae and blades that are not bullate. The two evidently differ to some extent ecologically, *A. longiloba* 'putzeysii' found usually on forest floor, while *A. longiloba* 'watsoniana' appears generally lithophytic, at least in Borneo and Peninsular Malaysia. Unfortunately in those Sumateran specimens most closely conforming to 'watsoniana', habitat details are not clear, though *Hay et al. 13036* is terrestrial. Within the Bornean and Peninsular Malaysian part of the range, it appears sharply distinct morphologically from other elements of the *A. longiloba* complex. If ecological differentiation between the Sumateran and these other repesentatives of 'watsoniana' could be demonstrated more clearly, the Bornean and Peninsular Malaysian element should perhaps be regarded as a distinct (and in that case, new) species, and Sumateran 'putzeysii' and 'watsoniana' might be more usefully recognised as a single, though still fuzzily circumscribed, local variant of the *A. longiloba* complex.

Selected other specimens seen: PENINSULAR MALAYSIA: Perak, Kuala Dipang, *Curtis s.n.* (SING); Perak, Kampar, G. Tempurong, *Ng FRI 5834* (FRIM, L). SUMATERA: Cult. RBG Sydney, Acc. No. 970474 ex Jambi, Kerinci Seblat National Park, above Lempur Vill., *Hay et al. 13036* (NSW); Sibolangit, *Lörzing 4804* (BO). KALIMANTAN: [without locailty] *Amdjah 165* (BO); Kalimantan Timur, foot of G. Batukenye, along Sg. Belayan,

NW of Tabang, *Murata et al. 1519* (BO); Bidang Menabei, *Winkler 1064* (E, L). SARAWAK: Cult. RBG Sydney, Acc. No. 920745 ex Long Jowe, *Dearden s.n.* (NSW); SABAH: Cult. RBG Sydney, Acc. No. 960609 ex Kinabatangan, Kalabakan Virgin Jungle Reserve, *Hay et al. 12012* (NSW).

e. 'korthalsii'

- *Alocasia korthalsii Schott*

Moderately robust terrestrial herbs, *rhizome* rather slender, to ca. 2.5 cm diam; *leaf* usually solitary (–4 together); *blade* ovatosagittate, shield-shaped, to ca. 40 cm long x 17 cm wide, widest ca. 3 cm anterior to the petiole insertion, plain mid-green on both sides to deep purple abaxially and then deep green adaxially, not usually with contrastingly pale major venation; anterior costa with 3–4 primary lateral veins, the proximal ones diverging at ca. 85°, the distal at ca. 45°; secondary venation arising at a wide angle, thence deflected towards the margin and forming rather weakly undulating interprimary collective veins; posterior costae diverging at ca. 45° or less; *posterior lobes* peltate for ca. 60% of their length, the free part rounded to rounded-acute; *inflorescences* mostly at the smaller end of the size range for this complex, with the spathe limb rather markedly cucullate; appendix ivory to yellow.

Distribution: Borneo.

Habitat: Terrestrial on rainforest floor mainly at low elevation (*Purseglove & Shah P4749* at ca. 1200 m).

Notes: This form is distinguishable from the other shield-shaped leaved member of this complex, 'watsoniana', by the smaller rhizome and inflorescence, more cucullate spathe limb, undulating interprimary collective veins and (in Borneo) terestrial habit. *A. longiloba* 'korthalsii' intergrades with *A. longiloba* 'lowii' in Sarawak. In Sabah it is found, e.g. at Sepilok, mixed and not intergrading with *A. longiloba* 'longiloba'. The population I have seen near Bintulu, Sarawak, is mostly of unifoliar individuals with dark green, purple-backed leaves, while the above-mentioned population at Sepilok is of multifoliar individuals with plain green leaves.

Other specimens seen: KALIMANTAN: Kalimantan Timur, 10-20 km N of Sebulu, *Murata et al. 703* (BO). SARAWAK: Cult. RBG Sydney Acc. no. 940462 ex 2.3 km from Kemena R. bridge towards Sibu, *Hay et al. 9308* (NSW); G. Pueh, *Purseglove & Shah P4749* (SING); Tambusan, *Ridley s.n.* (SING). SABAH: Cult. RBG Sydney Acc. no. 960519 ex Sepilok F.R., *Hay et al. 12153* (NSW); Danum, *Lambert TB6* (E).

f. 'thibautiana'

- *Alocasia thibautiana* Mast. - *Alocasia curtisii* N.E. Br.

Robust, often lithophytic, herb usually with the rhizome somewhat swollen, subcormescent; *leaves* 1–several together; *blades* broadly ovato-sagittate, to ca. 50 cm long, peltate for ca. 25% of the length of the posterior lobes, plain mid green throughout to dark green, red-backed and with whitish primary adaxial venation; secondary venation not or hardly forming interprimary collective veins.

Distribution: Peninsular Malaysia, ?Sarawak.

Habitat: Terrestrial or on limestone rocks at low elevation.

Note: Intergrades with 'lowii'. Leaves of juveniles of this form strongly resemble 'korthalsii'. I recognise this entity around its extreme form, which has not only rather shallowly peltate, ovato-sagittate leaves with no or weak interprimary collective veins, but also a distinctive swollen and abbreviated corm-like stem. The type of *A. thibautiana* is alleged to be from Borneo. Some wild-collected specimens from Borneo are intermediate between this entity and 'lowii', though I have seen no authentically Bornean material, which corresponds directly with 'thibautiana'.

Other specimens seen: PENINSULAR MALAYSIA: Penang, Waterfall, *Curtis s.n.* (SING); Cult. RBG Sydney Acc. no. 940064 ex Perlis, Kaki Bukit, Gua Kelam, *Hay et al. 9019* (NSW); Pahang, Pulau Tioman, Pulau Tulai, *Henderson 18506* (SING);

g. 'lowii'

- *Alocasia lowii* Hook. f. - *Alocasia lowii* var. *picta* Hook.f. - *Alocasia eminens* N.E. Br.

Robust, often lithophytic, herb ca. 70cm –1.5 m tall; *leaves* (1–)2–4 together; *petiole* usually obliquely mottled dark green or chocolate, sometimes unmottled; *blade* sagittate, rather broadly triangular in outline, usually dark green with contrastingly paler major venation adaxially, sometimes purple-backed, sometimes concolorous green throughout; *anterior lobe* sometimes slightly ovate, ca. 30–70 (–90) cm long, generally widest about level with or slightly distal to the insertion of the petiole (occasionally widest almost at the tips of the posterior lobes); anterior costa with ca. 4 primary lateral veins on each side, the proximal ones diverging at ca. (100–)80°, the distal ones at ca. 45°; secondary venation arising from the primary at a wide angle then soon deflected towards the margin and forming

ill-defined interprimary collective veins or these absent; posterior costae straight, diverging at ca. 45–90°; *posterior lobes* shallowly peltate - for 10–15% of their length, acute.

Distribution: Peninsular Malaysia, NW Borneo.

Habitat: In forest, often on rocks including limestone at low to medium elevation, extending into quite markedly seasonal areas.

Notes: 1. This element represents little more than a robust aspect of *A. longiloba* 'longiloba', with which it intergrades, indeed ascription of a considerable number of collections to one or other of these is somewhat arbitrary. The anterior lobe is typicaly relatively wider and the posterior lobes relatively longer than in typical 'longiloba', and in this respect it approaches 'denudata'. *Alocasia veitchii* (Lindley) Schott, whose basionym is earlier than *A. lowii*, falls in between. If it was classed in the same group as specimens conforming to 'lowii', it would of course formally have priority, however, it seems to me marginally closer to 'longiloba' and since the nomenclatural framework used here is anyway informal, rules of priority need not apply in the event that another worker interpreted *A. veitchii* as falling within the 'lowii' variant. The epithet 'lowii' is more widely used by both botanical and horticultural collectors. In Borneo *A. longiloba* 'lowii' also intergrades with 'korthalsii' in a few instances, for example *Chew 709* and *Jacobs 5476* (see below).

Selected other specimens seen: PENINSULAR MALAYSIA: Kedah, Langkawi Is, P. Bumbon Besar, *van Balgooy 2293* (L); Perak, Kuala Kangsar, logging road up G. Bubu from Manong, *Boyce 706* (KEP); Malacca, Pulau Nangka, *Burkill 2641* (SING); Kelantan, Kota Bahru, *Gimlette 5962* (SING); Cult. RBG Kew ex Negeri Sembilan, Pasoh F.R., *Hay 2005* (K); Cult. RBG Kew ex Kedah, Langkawi Is., Pulau Dayang Bunting, *Hay 2032* (K); Cult. RBG Sydney, Acc. no. 940047 ex Perlis, Kangar, Bukit Lagi, *Hay et al. 9001* (NSW); Cult. RBG Sydney Acc. no. 940102 ex Selangor, Batu Caves, *Hay et al. 9058* (NSW); Cult. RBG Sydney Acc. no. 940138 ex Negeri Sembilan, Bukit Tangga, nr Jelabu, *Hay et al. 9142* (NSW); Cult. RBG Sydney Acc. no. 940355 ex Pahang, Bukit Fraser, *Hay et al. 9288* (NSW); Selangor, Sg. Tinggi, *Md Nur 34111* (A); Pahang, Ulu S. Krau, NE G. Benom, *Whitmore FRI 3135* (K). BRUNEI: Belait Melilas, Kuala Ingei, Melilas side of Belait R., *Thomas 216* (K); Temburong Distr., Bukit Belalong, *Wong 1417* (K). SARAWAK: Kuching district, Tiang Bakap, Mt Maja, *Chew 709* (L); Ist division, 30 km SW of Kuching, Sebuaran Bau, *Jacobs 5476* (L).

23. Alocasia celebica Engl.

Alocasia celebica Engl. in Koord., Meded. s'Lands Plantentuin 19 (1898) 299; Engl. & K. Krause, Pflanzenr. 71 (IV.23E) (1920) 106. - Type: Indonesia, Sulawesi, Minahassa Prov., Ratatotok, 25 Mar 1895, *S. H. Koorders 16162β* (B, holo).

Herb ca. ?1.5 m tall; *rhizome* ca. 4 cm diam., clothed in old cataphyll bases; *leaves* two together subtended by papery fibrous marcescent cataphylls; *petiole* ca 35 cm long, sheathing in the lower 1/4, densely and minutely pubescent, mottled with an oblique zig-zag pattern; *blade* somewhat ovato-sagittate, 36 cm long, rather thickly coriaceous; *anterior lobe* widest ca. 3 cm above the petiole insertion, the apex acute; anterior costa with 6 primary lateral veins on each side, diverging at 80–60° and running almost straight to the margin; axillary glands inconspicuous; secondary venation obscure; *posterior lobes* about half the length of the anterior, acute, distally slightly out-turned, the inner sides oblanceolate; posterior costae diverging at ca. 60°, not naked in the sinus (leaf blade very slightly peltate? - sinus obscured on holotype); *inflorescence* unknown.

Distribution: Endemic to Sulawesi, known only from the type collection.

Habitat: Unknown; the type was collected at 200 m altitude.

Notes: 1. The affinities of this species are not clear from the type, which is sterile. However, the papery-fibrous cataphylls, mottled petioles and (almost) peltate leaf suggest the Longiloba Group. The obscurity of the secondary venation is due to the thickness of the leaf blade, which is not a feature of any other member of this group. Koorders and Engler & Krause overlooked the pubescence on the petiole, which also occurs, among Sulawesi species, in *A. suhirmaniana* (q.v.), from which *A. celebica* is amply distinct.

2. The holotype has three Koorders numbers on it: the field number *2587* attached to the specimen; the Herb. Koordersianum number *16162ß* on a label dated 25 Mar 1895 giving the provenance Ratatotok (as in the protologue), and a Museum Botanicum Berolinense label dated 3 Jul 1895 with the number *Koorders 19750* and the provenance Ratahan.

24. Alocasia suhirmaniana Yuzammi & A. Hay

Alocasia suhirmaniana Yuzammi & A. Hay, Telopea 7 (1998) 303, fig. 1. - Type: Cult. Kebun Raya Bogor ex SE Sulawesi, Kabupaten Kolaka, 23 Jun 1997, *Yuzammi s.n.* (BO, holo; NSW, photo).

Terrestrial herb to ca. 65 cm tall; *rhizome* 13–15 cm long, ca. 3 cm diam.; *leaves* 1–3 together; *petiole* to ca. 60 cm long, sheathing in the lower 1/5–1/4, yellowish green, densely longitudinally and obliquely mottled purple-

brown, minutely and densely puberulous, subtended by papery-membranous cataphylls; *blade* broadly ovato-sagittate, to ca. 55 cm long, peltate, pendent, thinly leathery, with the margin somewhat undulate, glossy dark green adaxially with the major venation pale grey-green, dark purple abaxially; anterior lobe widest about 1/4 of the way from the base, the tip broadly acute to obtuse, shortly apiculate; anterior costa with up to 8 primary lateral veins on each side, diverging at 80–45°, with conspicuous purple glands in their axils abaxially; subsidiary veins frequent in the outer part of the blade; secondary venation otherwise inconspicuous, forming undulating interprimary collective veins; *posterior lobes* acute, about 1/2–2/3 the length of the anterior, united for 1/2–2/3 of their length; posterior costae more or less straight, diverging at ca. 35–45°; *inflorescence* pairs solitary (?always), subtended by papery membranous cataphylls to ca. 11 cm long; peduncle to 24 cm long, minutely puberulent in the upper part, purple-brown; *spathe* ca. 12 cm long, deep purple, slender, glabrous, abruptly constricted at ca. 2 cm from the base; lower spathe subcylindric; limb narrowly lanceolate; *spadix* somewhat shorter than the spathe, ca. 10 cm long, slender, very shortly stipitate for 4 mm, stipe ivory; *female zone* ca. 1.2 cm long; ovaries greenish yellow; stigma bluntly 2–4-lobed, subsessile, yellow; *sterile interstice* ca. 0.5 cm long, attenuate, level with spathe constriction; lowermost synandrodia strongly lobed, the rest rhombo-hexagonal, ca. 1.5 mm diam.; *male zone* ca. 2 cm long, 1 cm diam., cylindric; synandria rhombo-hexagonal, the tops impressed, ca. 2 mm diam., yellowish ivory; thecae opening by apical pores somewhat laterally displaced by overgrowth of the synconnective; *appendix* ca. 6 cm long, 8 mm diam. at base, slightly constricted at junction with male zone, the rest cylindric, then tapering in the upper 1/3, yellowish, somewhat rugose in the lower half; *infructescence* unknown.

Distribution: Endemic to SE Sulawesi.

Habitat: In damp shady spots in lowland rain forest on slopes, sometimes over limestone.

Note: This species is distinguished from other members of the Longiloba Group by its puberulent petioles, blackish-purple spathe and somewhat marginally expanded synconnectives.

Other specimen seen: SULAWESI: SE Sulawesi, Tolala, *Kjellberg 2428* (BO).

Cuprea Group

Species 25—30

Leaves more or less completely peltate, interspersed with cataphylls; spadix generally distinctly shorter than the spathe; male zone often mostly or completely within the lower spathe.

Note: This group includes six species, four Bornean, one from each of the Malay Peninsula and Sumatera. The vegetative characteristics that define it do not seem to be matched by distinctive reproductive features and it is not clear that this group is natural. It may be linked to the Scabriuscula group via *A. reversa* and the *A. princeps* complex.

25. Alocasia perakensis Hemsl.

Alocasia perakensis Hemsl., J. Bot. 25 (1887) 205. - Type: Malaysia, Perak, Birch's Hill, *Wray 29* (K, holo; iso K, SING).

[*Alocasia beccarii* sensu auct. non Engl.: Hook.*f.*, Fl. Brit. Ind. 6 (1893) 527; Ridl., Mat. Fl. Mal. Pen. 3 (1907) 17; Engl. & K. Krause, Pflanzenr. 71 (IV.23E) (1920) 95, pro parte quoad *A. perakensis* in synon. et specim. cit. Mal. Pen.; Ridl., Mat. Fl. Mal. Pen. 3 (1907) 16 & Ridl., Fl. Mal. Pen. 5 (1925) 97 pro parte quoad specim cit.; Henderson, Mal. Wildfl. Monoc. (1954) 225, excl. fig 134 (i.e. *A. beccarii s.s.*)].

Herb to ca. 75 cm tall (often smaller); *stem* creeping to decumbent, somewhat elongate - the internodes as long as or longer than wide, ca. 2.5 cm diam.; *leaves* several along the stem, (?)irregularly interspersed with lanceolate cataphylls to 8 cm long and drying red-brown; *petiole* to ca. 40 cm long, sheathing in the lower 1/4, grey-green to purple-brown; *blades* dark green to grey-green, ovate to elliptic, peltate, coriaceous to thickly coriaceous and subsucculent, 14 x 6 – 34 x 13 cm; *anterior lobe* widest ca. 2–4 cm distal to insertion of petiole, the tip broadly acute, acuminate for ca. 1.5 cm, the margin mostly entire, occasionally somewhat sinuous in the lower part; anterior costa with 2–3(–4) primary lateral veins on each side, diverging at ca. 45–60°, running to a submarginal vein ca. 1 mm from the margin; secondary venation not forming interprimary collective veins, mostly inconspicuous, but, like primary venation, adaxially impressed in dry state in thickly coriaceous leaves; *posterior lobes* completely united except for a shallow retuse notch, rarely with an acute notch to ca. 1 cm deep, together cuneate to slightly attenuate, 1/3–1/2 the length of the anterior lobe; posterior costae subparallel; *inflorescence* solitary to paired; peduncle about half to

subequalling the length of the petioles; *spathe* greenish yellow to white, ca. 6 cm long; lower spathe ovoid, ca. 3 cm long; limb narrowly ovate, at first erect, then reflexed; *spadix* shorter than spathe, ca. 5 cm long, stipitate for 4 mm; *female zone* ca. 7 mm long; pistils few - ca. 15, rather large - ca. 4 mm long; ovary globose, 2.5 mm diam.; style 1.5 mm long; stigma prominently 2–3-lobed; *sterile interstice* ca. 2.5 mm long, a single whorl of synandrodia; *male zone* 1.5 cm long, entirely within and filling the upper half of the lower spathe chamber, conic - ca. 8 mm diam. at base narrowing to 5 mm at apex corresponding with spathe constriction; synandria relatively large - 4 mm diam., more or less hexagonal, 3–5-merous; thecae opening by apical pores not overtopped by synconnective; *appendix* narrowly cylindric, ca. 2.5 cm long, 4 mm diam., deeply grooved, white to yellowish; *fruiting peduncle* subequalling the petioles; fruiting spathe ovoid, ca. 4 cm long, the spathe dehiscing longitudinally; berries bright red.

Distribution: Endemic to Peninsular Malaysia.

Habitat: In montane forests, in leaf litter and on rocks, mostly at 1100–1525 m altitude. Ridley (ll. cc.) noted it as low as 650 m (2000 feet), probably based on his collection from Kuala Teku.

Notes: Although *Alocasia perakensis* has not been accepted as an entity distinct from *A. beccarii* by any author since its first description, they are readily distinguishable, though evidently closely related, allopatric species. *Alocasia perakensis* is on the whole much more robust, the leaves are generally more leathery - sometimes almost succulent, and the connate posterior lobes are cuneate rather than attenuate, the stem is more elongate, the bracts between the leaves are less frequent, the inflorescence, though structurally very similar to that of *A. beccarii*, is about twice the size, and the spathe is greenish yellow to whitish. With the exception of two high altitude collections from Mt Kinabalu (Sabah), doubtfully attributed here to *A. beccarii* (q.v.), it has a higher altitudinal range than that species. Although quite a number of collections have been made, this species is poorly known in flower and the description of the inflorescence is prepared from a single spirit collection (*Hay et al. 9280*).

Other specimens seen: PENINSULAR MALAYSIA: Pahang, Cameron Highlands, *Batten Pool s.n.* (SING); Perak, Larut, trail from Bk. Larut to G. Hijau, *Boyce 681* (K, KEP); Perak, G. Hijau, *Burkill & Haniff 12769* (SING); Negeri Sembilan, Ladang Gadis, *Carrick 692* (SING); Selangor, along old abandoned rd to Genting Highlands, *Croat 53321* (K); Perak, Genting Highlands, *Croat 53338* (K); Perak, G. Hijau, *Mohd. Haniff & Mohd. Nur 2350* (K, SING); Cult. RBG Sydney Acc. No. 940347 ex Pahang, Bukit Fraser, *Hay et al. 9280* (NSW); Pahang, No. 5 Camp, Cameron Highlands, *Henderson FMSM 11666* (BO); Perak, Larut Hill, Thaiping, *Long 6* (K); Selangor, top of Fraser's Hill, along path from

Red Cross to Wray's Cottage, *Nicolson 1175* (US), *1178* (US); Pahang, Cameron Highlands, along S path to G. Beremban, *Nicolson 1194, 1201* (both SING, US); Pahang, Fraser's Hill, *Mohd. Nur 10548* (SING); Pahang, Boh Plantation, Cameron Highlands, *Mohd. Nur s.n.* (SING); Pahang, Fraser's Hill, below Methodist Mission, *Purseglove P.4283* (GH, K, L, SING); Pahang, Kuala Teku, *Ridley s.n.* (K); Perak, *Scortechini s.n.* (K, SING); Perak, Maxwell's Hill, path to G. Hijau, *Mohd. Shah & Sidek 1071* (K, SING); Kelantan, G. Stong, *Symington 37727* (KEP).

26. Alocasia beccarii Engl.

Alocasia beccarii Engl., Bull. Soc. Tosc. di Ort. 4 (1879) 300 & in Becc, Malesia 1 (1882) 293, t. 16, figs 1–4; Ridl., J. Straits Br. Roy. Asiat. Soc. 44 (1905) 179, pro parte excl. specim. cit. Ridley, Matang (i.e. *Alocasia peltata* M. Hotta); Engl. & K. Krause, Pflanzenr. 71 (IV.23E) (1920) 95, fig. 19, A–D, pro parte excl. *A. perakensis* in synon. et. specim. cit. Ridley, Matang); Mayo, Bogner & Boyce, Genera of Araceae (1997) pl. 104(i), M (non pl. 104(ii), i.e. *Alocasia kerinciensis* A. Hay). - Type: Borneo, Sarawak, Matang, *O. Beccari PB 1674* (FI, holo).

Small herb 12–28 cm tall; *stem* slender, 5–10 mm diam., condensed with the internodes usually somewhat wider than long; *leaves* several together, irregularly but frequently interspersed with lanceolate cataphylls to 5 cm long and drying red-brown; *petioles* green, sometimes flecked pale mauve, 6–16 cm long, sheathing in the lower 1/7 or less; *blades* narrowly elliptic to ovate to narrowly obovate, mid-green above, paler below, coriaceous, 9 x 2.7–18 x 6 cm; *anterior lobe* widest usually ca. 1/4 of the way distal to petiole insertion, occasionally level with petiole insertion, occasionally 1/2 way distal to petiole insertion; margin occasionally somewhat sinuate; anterior costa with 2–3 primary lateral veins on each side, diverging at ca. 45–60° and running to a submarginal vein 0.5–1 mm from the margin; axillary glands inconspicuous; secondary venation not forming interprimary collective veins; *posterior lobes* almost completely connate save for a shallow retuse notch, (1/4)1/3–2/5 the length of the anterior lobe, together attenuate; posterior costae subparallel; *inflorescence* solitary to paired; peduncle subequalling the petioles; *spathe* whitish, ca. 4 cm long, constricted ca. 1.5–2 cm from the base; lower spathe narrowly ovoid, distally somewhat curved adaxially; limb narrowly oblong-lanceolate; *spadix* shorter than the spathe, very shortly stipitate; *female zone* 4 mm long, a few loosely packed large pistils, or reduced to a single whorl; pistils ca. 3 mm long; ovary globose-ovoid, 2.5 mm diam.; style ca. 0.5–1 mm long, slender; stigma prominently ?2-lobed; *sterile interstice* a single whorl of synandrodia ca. 1.5 mm diam., or reduced to a single synandrode and the rest naked; *male zone* conic, 5–8 mm long, entirely within and filling the upper spathe chamber; synandria large, ca. 3 mm diam., 3–4-merous, thecae not

overtopped by synconnective; *appendix* pale apricot, narrowly cylindric, 1.3–2 cm long, ca. 3 mm diam.; *fruiting peduncle* hardly longer than flowering peduncle; fruiting spathe ovoid, ca. 2 cm long; ripe fruit orange to orange-red.

Distribution: Endemic to N.W. Borneo.

Habitat: In forest on slopes at low elevation - to ca. 850 m, possibly to 1500 m on G. Kinabalu (but see note below), often among or on boulders, often over sandstone.

Notes: 1. This name has been used, in the literature and/or on herbarium sheets, for five West Malesian species of rather small plants sharing various manifestations of a distinctive more or less elliptic entirely peltate leaf blade - *A. beccarii s.s., A. kerinciensis*, *A. minuscula*, *A. peltata* and *A. perakensis*. Of these, *A. peltata* and *A. kerinciensis* have very conspicuous intramarginal veins and are montane species, *A. minuscula* has distinctive striate venation, very large synandrodia and is restricted to lowland peat swamp-forest, and *A. perakensis* is much more robust than *A. beccarii* and is a montane element restricted to Peninsular Malaysia. *A. beccarii* itself is distinguished by the combination of absence of intramarginal leaf vein, more or less condensed stem, secondary venation arising from the costae and primary veins, small size compared to *A. perakensis* and occurrence at low elevation in non-swampy sites. Further discussion of its distinction from *A. perakensis* can be found under that species.

2. The two collections from G. Kinabalu cited below differ from *A. beccarii* in the strict sense in having relatively broader posterior lobes with the tips less markedly acute, less completely joined and slightly out-turned at the tips. The leaf texture appears to be more membranous. The venation is nevertheless typical for *A. beccarii*. The altitude from which they were collected (4000–5000 ft) is significantly higher than collections of *A. beccarii s.s.*, and it is possible that they represent another species in this group. Neither collection is in flower.

Brooke 8680, from Keranji, Sarawak, is anomalous in having oblanceolate leaves, with very reduced posterior lobes.

Other specimens seen: SARAWAK: Kuching, *Brooke 8318* (L); Keranji, *Brooke 8680* (L). BRUNEI: N. Temburong, Bukit Biang, *Ashton A172* (K); Belait Distr., Ulu Ingei, Bukit Batu Patam, *Boyce et al. 274* (K); Temburong Distr., Bangar, Bukit Patoi, *Boyce et al. 350* (K); Temburong, Batu Apoi, Bukit Gelagas, *Simpson & Marsh 2271* (K). SABAH: Kinabalu, Penibukan, *Clemens & Clemens 31548 & 50499* (both SING); Sipitang Distr., W slope of G. Lumaku, *Wood 798* (K).

27. Alocasia minuscula A. Hay, sp. nov.

Ab *A. beccarii* lamina folii tenuiora, venis striatis, venis primariis duplo numerosis, sylvam palustrem incolenti differt. TYPUS: Borneo, Sarawak, Betong Distr., Saribas Forest Reserve, 14 Aug 1957, *J.A.R. Anderson 8364* (L, holo; BO, K, iso);

Diminutive herb 10–20 cm tall; *stem* suberect, ca. 1 cm diam, condensed, rooting along its length and clothed in old leaf bases and marcescent cataphylls; *leaves* several to 9 together, interspersed with papery-membranous cataphylls to ca. 5.5 cm long (these occasionally bearing reduced petiole and blade); *petiole* 5–10 cm long, sheathing in the lower ca. 1/7; *blade* narrowly ovate to oblanceolate, 8 x 2–13 x 3 cm, peltate, coriaceous, pale abaxially; *anterior lobe* 7–10.5 cm long, the tip acuminate for ca. 1 cm; anterior costa with 8–10 primary lateral veins on each side, diverging at 60–45° then somewhat up-curved and joining a marginal vein; primary lateral veins much darker than blade abaxially in dry specimens and the majority not visibly reaching the midrib; secondary venation obscure on both sides of the blade, striate, arising from the midrib; *posterior lobes* almost completely united save for a ca. 2 mm incision at the extreme base of the leaf; combined posterior lobes attenuate, 1–2 cm long; *inflorescence* solitary; peduncle about the same length as the petioles at anthesis, later extending somewhat; *spathe* 3.5–4 cm long; lower spathe narrowly ovoid, 1.5–2 cm long, separated from limb by a weak constriction; limb ca. 2 cm long, lanceolate, colours unknown; *spadix* shorter than the spathe, ca. 2 cm long, stipitate for ca. 3 mm, the fertile zones entirely within the lower spathe; *female zone* 3 mm long; pistils few, ca. 10, bottle-shaped, more or less acroscopic, 1.5 mm long, style ca. 0.5 mm long; stigma small, weakly ?3-lobed; *sterile interstice* ca. 2 mm long, the thickest part of the spadix, ca. 2.5 mm diam.; synandrodia inflated, more or less rhomboid, ca. 2 mm diam.; *male zone* 5 mm long, subcylindric, 2.2 mm diam.; synandria few, ca. 12, irregular, ca. 1.5 mm diam., more or less 4-merous, mainly composed of loosely adherent thecae, the synconnective not well developed; *appendix* ca. 6 mm long, 1 mm diam., cylindric; *fruiting spathe* ca. 1.5 cm diam.; berries red-orange.

Distribution: Endemic to Sarawak.

Habitat: In lowland peat swamp forest.

Notes: The specific epithet derives from the fact that this is the smallest presently known species in the genus. *Alocasia minuscula* can be readily distinguished from *A. beccarii* and *A. peltata*, which it closely resembles, in

its narrow peltate leaf shape and reduced posterior lobes, and in its diminutive stature, by the distinctive pattern of leaf venation. The primary veins are much more numerous, and characteristically some appear, in the dried state, not to reach the midrib. The secondary venation is obscure on both sides of the blade, but it appears on the abaxial side that the secondary venation arises hardly or not at all from the primary veins, nearly all the secondary veins running directly into the midrib - a condition more usually associated with striate-veined genera such as *Schismatoglottis*. Moreover, *Alocasia minuscula* appears restricted to swamp forest, while *A. beccarii* and *A. peltata* are hill and montane forest species. The description is based entirely on dried material.

Other specimens seen: SARAWAK: Tuso Peninsula, *Anderson 2129* (SING); Sibu, Naman F.R., *Anderson 9299* (K, L); Simanggang, *Brooke 10764* (L).

28. Alocasia peltata M. Hotta

Alocasia peltata M. Hotta, Acta Phytotax. Geobot. 22 (1967) 156, fig. 5, A-E. - Type: Borneo, Sarawak, Bintulu, eastern ridge of Bukit Kana, 20 Nov 1963, *M. Hirano & M. Hotta 1464* (KYO, holo, n.v.)

Alocasia peltata var. *muluensis* M. Hotta, op. cit.: 158, fig. 5, F. - Type: Borneo, Sarawak, Mardi, Gunung Mulu, 16 Mar 1964, *M. Hotta 14513* (KYO, holo, n.v.).

[*Alocasia beccarii* sensu auct. non Engl.: Ridl., J. Straits Br. Roy. Asiat. Soc. 44 (1905) 179 & 49 (1907) 48; Engl. & K. Krause, Pflanzenr. 71 (IV.23E) (1920) 95, pro parte quoad specim. cit. *Ridley s.n.*, Sarawak, Matang.]

Small herb to ca. 30 cm tall; *stem* more or less elongate, slender, sprawling, with internodes to 2 cm long; *leaves* several along the stem, regularly alternating with papery membranous lanceolate cataphylls to 4 cm long; *petiole* to 16 cm long, sheathing in the lower 1/10; *blade* narrowly elliptic to oblong ovate, 12 x 3 – 28 x 10 cm, peltate, somewhat to thickly leathery, glossy green or suffused purple adaxially, paler abaxially, drying with the venation somewhat to markedly impressed adaxially; *anterior lobe* 9–12 cm long, widest more or less level with petiole insertion, the tip acuminate for 1.5 cm; anterior costa with two primary lateral veins on each side (subopposite) diverging at ca. 60° and running straight or somewhat upcurved into a conspicuous intramarginal vein (2–)3–6 mm from the margin; secondary venation not forming interprimary collective veins, inconspicuous to invisible in thickly leathery forms; *posterior lobes* completely united or with a slight retuse notch, 3–6 cm long, together

cuneate, ultimately truncate; *inflorescence* solitary; peduncle about half as long as to equalling the petiole; spathe ca. 5 cm long, green; lower spathe narrowly ovoid, ca. 2 cm long; limb lanceolate, ca. 3 cm long, separated from the lower spathe by a weak constriction; *spadix* somewhat shorter than the spathe, to 3 cm long, stipitate for 2 mm; *female zone* 4 mm long; pistils few - ca. 12, 2 mm long, flask-shaped, more or less acroscopic; style distinct, almost 1 mm long; stigma weakly 2–3-lobed; *sterile interstice* a single inconspicuous whorl of synandrodia, not attenuate; *male zone* fully within the lower spathe, ca. 9 mm long, ca. 3 mm diam. at base, tapering to ca. 1 mm diam. at junction with appendix and corresponding with spathe constriction; synandria 3-merous, with anthers only dorsally, not laterally connate; thecae opening by apical pores not concealed by synconnective; *appendix* white, 1.5 cm long (much reduced in *Burtt & Woods 2121*), narrowly spindle-shaped, ca. 2 mm wide at widest; *fruiting spathe* obovoid, with the peduncle elongating; fruits red-orange.

Distribution: Borneo, scattered localities in Sarawak, Brunei and central Kalimantan.

Habitat: In mossy forest floor on ridges at ca. 1200 m altitude.

Notes: 1. This species rather closely resembles Sumateran *A. kerinciensis* (q.v.), sharing the pronounced intramarginal vein and regularly alternating foliage leaves and cataphylls, and the (usually) elongate stem with internodes longer than wide. It differs in the more slender leaves and spathe, the more elongate appendix, the male zone entirely within the lower spathe, the less robust synandria and longer pistils.

2. Hotta (loc. cit.) distinguished the variety *muluensis* on the basis of slightly smaller leaf size and longer peduncle. The material he described was in various stages post anthesis, and it appears that the peduncle continues to elongate as the fruits ripen. I am doubtful that the lower and upper leaf length extremes of 21 cm and 19 cm that he cites respectively for the typical and segregate varieties can be viewed as sufficiently significant to warrant their recognition.

Other specimens seen: SARAWAK: Bakelalan, *Brooke 10559* (US); 4th Div., G. Mulu, *Burtt & Woods 2121* (E); Matang, *Ridley s.n.* (SING). BRUNEI: Temburong, valley N of Pagon Ridge, *Wong & Weber Booth 1903* (K). KALIMANTAN: Central Kalimantan, Bukit Raya, SE side, ca. 10 km NNW of Tumbang Tosah, *Mogea 3856* (BO, K, KEP).

29. Alocasia kerinciensis A. Hay, *sp. nov.*

Ab *A. perakensis* Hemsl. caudice producto tenuiore, foliis et cataphyllis

alternantibus, lamina minus incrassata, venis intramarginalibus valde conspicuis, inflorescentia parviore, inflorescentia mascula exserta differt. TYPUS: Indonesia, Sumatera, Gunung Kerinci, 16 Apr 1920, *Bünnenmeijer 9511* (L, holo; BO iso).

[*Alocasia beccarii* sensu auct. non Engl.: Mayo, Bogner & Boyce, Genera of Araceae (1997) fig. 104(ii).]

Small terrestrial herb; *rhizome* elongate, slender, stiff, decumbent-creeping, epigeal, ca. 1 cm diam., to ca. 40 cm long, with internodes to 5 cm long; *leaves* several, alternating with cataphylls, with leaf-cataphyll internodes subequalling cataphyll-leaf internodes; cataphylls membranous, narrowly oblong-lanceolate, to 8 cm long, drying red-brown; *petiole* to ca. 25 cm long, sheathing in the lower 1/5th or less, wing of sheath basally broad, membranous, like the cataphylls in colour and texture; *blades* stiffly membranous, dull mid-green, broadly to narrowly ovate, peltate with the posterior lobes almost completely joined, ca. 13 x 6 –16 x 9 cm, widest ca. 1 cm distal to petiole insertion, the tip broadly acute to obtuse and shortly acuminate, base rounded with a retuse notch; anterior costa with 2–3 primary lateral veins on each side diverging at up to 100° (proximal) to 45° (distal) and running into a conspicuous intramarginal vein ca. 3–5 mm from the margin; secondary venation forming ill-defined interprimary collective veins; venation more or less flush with the lamina abaxially and adaxially; *inflorescence* solitary, rarely paired; peduncle subequalling the petioles; *spathe* 5–6.5 cm long; lower spathe ovoid, ca. 1.5 cm long, separated from limb by a pronounced constriction; limb broadly lanceolate; *spadix* shorter than the spathe, 3–4.5 cm long, shortly stipitate; *female zone* ca. 7 mm long; ovaries globose, ca. 1 mm diam., expanding to ca. 3 mm diam while inflorescence still fully intact; style very short apically expanded into a 3-lobed stigma; *sterile interstice* ca. 7 mm long, narrowed above corresponding to spathe constriction; synandrodia more or less rhomboid, 1.2–3 mm long; *male zone* ca. 1 cm long, subcylindric, ca. 4 mm diam.; synandria 4–5-merous, rhombo-hexagonal; synconnective somewhat inflated; thecae opening by apical pores; *appendix* about isodiametric with male zone at base, subcylindric, tapering in upper third, ca. 1.2–2 cm long, white; *fruiting spathe* ovoid, ca. 2 cm long; berries globose, ca. 4 mm diam.

Distribution: Sumatera, known only from an area between G. Kerinci to Lake Kerinci straddling the border of West Sumatera and Jambi Provinces.

Habitat: On montane forest floor at 1500-2000 m altitude.

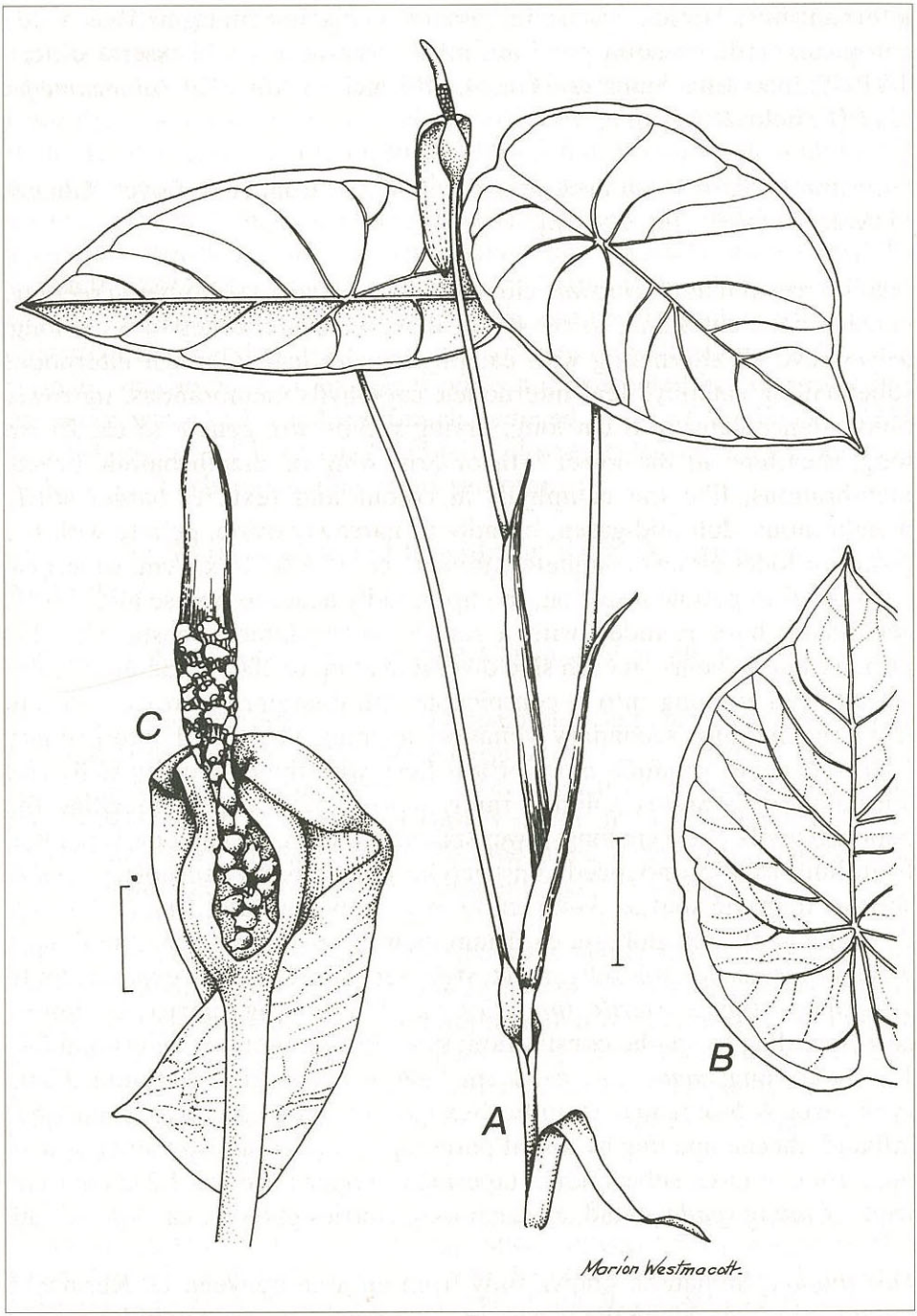

Figure 11. ***Alocasia kerinciensis*** **A. Hay**
Bünnenmeijer 9511 - A. habit; B. venation; C. inflorescence with part of spathe removed. - Scale: A, B, bar = 2 cm; C, bar = 4 mm.

Other specimens seen: SUMATERA: W. Sumatera, G. Kerinci, *Bunnenmeijer 9106, 9308, 9416, 10128* (all BO); *9195, 10321* (both BO, L); Cult. RBG Sydney Acc. no. 970481 ex Jambi Prov., Kerinci Seblat National Park, above Lempur Village, *Hay et al. 13046* (†, no voucher);

30. Alocasia cuprea (C. Koch & Bouché) C. Koch

Alocasia cuprea (C. Koch & Bouché) C. Koch, Wochenschr. Vereines Befoerd. Gartenbanes Koenigl. Preuss. Staaten 4 (1861) 141; Engl. in A. & C. DC., Monogr. Phan. 2 (1879) 509; Ridl., J. Straits Br. Roy. Asiat. Soc. 44 (1905) 179; Engl. & K. Krause, Pflanzenr. 71 (IV.23E) (1920) 110; Merr., Bibliogr. Enum. Bornean Pl. (1921) 104; Merr., Pl. Elmer. Born. (1929) 26; Burnett, Aroideana 7 (1984) 76, figs 2 & 3. - *Caladium cupreum* C. Koch & Bouché, Ind. Sem. Hort. Berol., Appendix (1854) 6. Type: Not located, presumed destroyed at B. Neotype: Cult. RBG Kew ex Borneo, *N.E. Brown s.n.*, May 11th 1876 (K; designated here).

[*Gonatanthus cupreus* C. Koch, Wochenschr. Vereines Befoerd. Gartenbanes Koenigl. Preuss. Staaten 4 (1861) 141 - nom. in synon.]

[? *Caladium metallicum* Ed. Otto, Hamburger Garten- Blumenzeitung (1853) 517, nom. subnud.; Koch, Berlinen. Allg. Gartenzeitung. 1 (1857) 135].

[*Colocasia cuprea* Engl., Araceae Exsiccatae et Illustratae No. 253 [date not ascertained, see Hay *et al.* (1995:174)]. - ?sphalm. pro *Alocasia cuprea*].

[*Alocasia metallica* Schott, Oesterr. Bot. Wochenbl. 4 (1854) 410, nom. nud.; Schott, Syn. Aroid. (1856) 46 (nom. superfl. pro *Caladium cupreum*); Hook., Bot. Mag. 86 (1860) t. 5190; Lemaire, Ill. Hort. 8 (1861) pl. 283; van Houtte, Fl. des Serres & Jardins 21 (1875) t. 2208-9].

Herb to ca. 80 cm tall; *rhizome* decumbent, to ca. 6 cm diam.; *leaves* several together, each (?always) subtended by two marcescent reddish brown cataphylls, the first ca. 1/4 and the second ca. 1/2 the length of the petiole; *petiole* to ca. 70 cm long, green, faintly mottled brown or greenish brown throughout, sheathing in the lower 1/5th; *blades* coriaceous, hanging, ovate, bullate between the main veins, to ca. 60 cm long x 40 cm wide, adaxially glossy bronze-green, darker near the primary veins, abaxially deep purple, with a hyaline colourless margin ca. 1.5 mm wide; *anterior lobe* with the tip obtuse and abruptly and shortly acuminate; anterior costa with 8–11 primary lateral veins on each side, proximal ones diverging at ca. 100° then arching forward and outward to join a submarginal vein - more distal primary veins diverging at ca 60°; all primary veins with very

conspicuous axillary glands abaxially; secondary veins forming well-defined undulating interprimary collective veins; *posterior lobes* completely united except for a shallow retuse notch, rounded; posterior costae diverging at ca. 20°; *inflorescences* paired, not forming multiple series, subtended by cataphylls similar to those subtending the leaves; peduncle similar to the petiole, to ca. 22 cm long; *spathe* green to greenish purple, ca. 10 cm long; lower spathe oblong ovoid, ca. 4.5 cm long ca. 2 cm diam; limb about equalling the lower spathe, at first erect and cucullate, then sharply deflexed, separated from the lower spathe by an abrupt constriction; *spadix* considerably shorter than the spathe - ca. 6 cm long, very shortly stipitate, cylindric except appendix; *female zone* narrowly cylindric, ca. 2 cm long x 8 mm wide; ovaries subglobose, longitudinally 3–4-ribbed; stigma raised on a very short slender style, conspicuously 2–4-lobed; *sterile interstice* not attenuate, isodiametric with male and female zones, ca. 2 whorls of rhomboid synandrodia; *male zone* cylindric, 2/3rds or all within the lower spathe, 2 cm long; synandria rhomboid, 4–6-merous, with the synconnective raised above but not overcapping the thecae; thecae opening by apical pores; *appendix* white, spindle-shaped, blunt, faintly irregularly channelled, ca. 2 cm long, constricted at union with male zone; *fruit* unknown.

Distribution: Borneo, endemic to Sabah.

Habitat: On slopes in rain forest, over a wide variety of substrates including ultramafics, sandstone and limestone, ca. 1000–1500 m altitude.

Notes: 1. Confusion around the use of the epithet '*metallica*' was discussed by Bunting and Nicolson (1963). Because of historical confusion over the identity of *Caladium cupreum*, the epithet *metallica* has been applied botanically both to what is here called *A. cuprea* (e.g. Hooker, loc. cit.) and to a form of *Alocasia macrorrhizos* [*A. indica* var. *metallica* Schott = *A. macrorrhizos* var. *rubra* (Hassk.) Furtado (which in turn, if to be regarded as a species separate from *A. macrorrhizos*, should be called *Alocasia plumbea* van Houtte)].

Assuming they are synonymous, the priority of *Caladium cupreum* is based on the paucity of the description in Otto (loc. cit) such that the earlier *Caladium metallicum* Otto is to be regarded as invalid. When Schott (loc. cit.) first published *Alocasia metallica*, he included *Caladium cupreum* as a synonym, thus rendering *A. metallica* superfluous.

It can be clearly inferred that Schott intended *A. metallica* to be applied to, and interpreted *Caladium cupreum* as applicable to, a species different from what is currently called *Alocasia cuprea*. This is evident from Schott's later work, when *A. metallica* was reduced to varietal status

under *Alocasia indica* (= *A. macrorrhizos)* (Schott, 1860: 145). *Caladium cupreum* was still a synonym in Schott's view.

It appears that Koch considered his *A. cuprea* and Schott's *A. metallica* different species, though as the type of *Caladium cupreum* has not been found, it is not possible to prove the correct application of this name. Confounding matters, there is at K an outline, drawn by N.E. Brown, of a specimen from Koch's herbarium, allegedly the type of *Caladium cupreum*, but resembling *Alocasia macrorrhizos* - hence implying that *Alocasia metallica* Schott and *Caladium cupreum* may be conspecific, as Schott had indicated. However, material of *A. cuprea* in the sense here, preserved at K, has the annotation by N.E. Brown - 'A specimen of this was sent by me to Carl Koch, for comparison with his type of *A. cuprea*, & in reply he stated that it was certainly his *A. cuprea* & not *A. metallica* Schott'. This, together with the fact that Engler, who would almost certainly have seen the type at Berlin, applied the name *Alocasia cuprea* to this species, leads me to conclude that this application is correct. Moreover, *Alocasia cuprea* has been and currently is widely used, both botanically and horticulturally, in the sense used here. The accordingly designated neotype is the sheet annotated by N.E. Brown as above.

2. *Alocasia cuprea* has long been recognised as one of the most spectacular and bizarre foliage plants in the genus and is a parent of several interspecific horticultural hybrids (see Engler & Krause, 1920: 112; Burnett, 1984: 142). Its occurrence in the wild is sporadic, but it sometimes occurs in very densely abundant local populations (K.M. Wong, *pers. comm.*).

Other specimens seen: SABAH: Kinabalu, N of Mesilau Camp, *Allen AK 66-38* (SING); Cult. RBG Sydney Acc. no. 912634 ex cult. RBG Edinburgh Acc. no. 19852175 ex Kinabalu, Marai Parai, *Argent s.n.* (NSW); Kinabalu, Penibukan, nr Dahobang R., *Clemens & Clemens 40588* (SING); Elphinstone Prov., Tawao, *Elmer 20471* (BO, GH, K, L, SING); Cult. RBG Sydney Acc. no. 960584 ex Maliau Basin, G. Rara F.R., 2.5 km above main Maliau Falls, *Hay et al. 12092* (NSW, voucher SAN); Kinabalu, S. Dahobang, *Holttum s.n.* (SING); Cult. RBG Sydney Acc. no. 841539 ex Tenom, Kallang Falls, *Wallace 84/206* (no voucher);

Inadequately Known Species

31. Alocasia sp. A.

Herb to ca. 40 cm tall; *leaves* several together, glabrous; *petiole* ca. 30 cm long, sheathing in the lower ca. 1/3, green, spotted purple; *blade* ovato-sagittate, to ca. 30 cm long, coriaceous, somewhat bullate, adaxially grey-green, dark green about the main veins, abaxially purple; *anterior lobe* widest somewhat above the base, the tip acute to obtuse and apiculate;

anterior costa with 5–6 primary lateral veins on each side, diverging at 80–50°, with conspicuous axillary glands abaxially; secondary venation forming abaxially and adaxially conspicuous subsidiary veins themselves forming interprimary collective veins in the outer part of the leaf blade, the remaining secondary venation obscure abaxially, faint adaxially; *posterior lobes* acute, about 1/2 the length of the anterior, the inner sides very narrowly lanceolate; posterior costae diverging at ca. 90°, naked in the sinus for ca 1 cm; *inflorescence* unknown.

Distribution: Sarawak.

Habitat: Reported from forest floor among limestone rocks.

Notes: 1. Plants of this species are cultivated in the Semenggoh botanic garden, near Kuching, and are said to have been collected from the wild locally (P. Boyce, *pers. comm.*).

2. This highly ornamental plant is traded in the U.S.A. under the name *Alocasia guttata* var. *imperialis* or *Alocasia guttata* Imperialis. An image may be found at http://www.skg.com/alocasia3.html. This species is evidently allied to *A. scabriuscula* (which includes *A. guttata*) and *A. reginae*, differing from both in the variegated leaf blade, and from the former in its smaller stature and bullate blade, and from the latter in being glabrous and more robust with a larger number of primary lateral veins. I would suggest to the horticultural community that either an altogether new cultivar name is formally proposed or that the plant be called *Alocasia* Imperialis and that a standard be designated and preserved to fix the application of the cultivar name Imperialis to this particular clone, so that there is no longer any ambiguity about whether or not the plant is the same as *A. guttata* var. *imperialis*.

Doubtful Species and Records

Alocasia pallida C. Koch & Bouché, Ind. Sem. Hort. Berol., App. (1854) 5.

If a type ever existed of this, it was presumably destroyed in the bombing of Berlin. Koch & Bouché described it from sterile material without provenance, compared it with *Alocasia montana*, which itself appears to be a synonym of *A. macrorrhizos*, and distinguished it (trivially) on the basis of the 'stemless' habit of *A. montana*. They further compared it with *A. alba* Schott, noting that the latter differed in its slightly peltate leaves

(which it does have as a juvenile, like most species in the genus). Engler (1879) and Engler & Krause (1920) placed *A. pallida* in the synonymy of *A. alba*. However, since Engler's interpretation of *A. alba* appears to have been associated with material only from Sri Lanka (where that species in the strict sense does not naturally occur), there is some doubt about their determination. It seems likely that this is a synonym and variant of *A. macrorrhizos*.

Alocasia warburgii Engl., Bot. Jahrb. Syst. 25 (1898) 25 (= *Alocasia heterophylla* (Presl) Merr.).

Engler cited *Warburg 15723* from Sulwesi in the protologue; the specimen (and a Philippine syntype) is presumed destroyed at B. Engler later concluded that *A. warburgii* was conspecific with *A. heterophylla*, a distinctive Philippine species of which no other Sulawesi material has been found (Hay, in press).

Alocasia wavriniana Mast., Gard. Chron. 21 (1898) 241, fig. 98 (= *Alocasia lauterbachiana* (Engl.) A. Hay).

This was originally attributed to Sulawesi, but no material with this provenance authenticated has been found. *Alocasia lauterbachiana* is from New Guinea and the Bismarck Archipelago (Hay & Wise, 1991).

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Librarian at K for permission to reproduce the type of *Arum montanum*. I also thank Dewey Fisk for providing very informative material of *Alocasia* in his cultivated collection. I would also like to thank Ian McLellan, Randy Sing and nursery staff of the RBG Sydney for cultivating the living plants cited here, Lesley Elkan and Marion Westmacott for the botanical drawings, Suzanne Bullock for the photographs in Plate 1, and Clare Herscovitch for stoic technical assistance and curation of the living Aroid collection at Sydney. Peter Boyce, Ruth Kiew and Dr Dan Nicolson (US) provided constructive criticism of the manuscript.

References

Alderwerelt van Rosenburgh, C.R.W.K.van, 1920, 1922. New or noteworthy Malayan Araceae I. *Bulletin Jardin Botanique Buitenzorg.* III, **1**: 359–389. - Ditto II. Ibid. **4**: 163–229. - Ditto III. Ibid. **4**: 320–347.

Backer, C.A. & R.C. Bakhuizen van den Brink, 1968. *Flora of Java*, Vol. III. Wolters-Noordhof N.V., Groningen.

Blume, C.L. 1823. *Catalogus der gewassen 's Lands Plantentuin.* Batavia.

Blume, C.L. 1836/7. Collectanea ad monographiam Aroidearum. *Rumphia.* **1**: 71–154.

Brown N.E., 1884. Supplement to G.W. Johnson (ed.), *The Gardeners' Dictionary*. G. Bell & Sons, London.

Bunting, G.S. 1962. The genus *Schizocasia* (Araceae). *Baileya.* **10**: 112–120.

Bunting, G.S. & D.H. Nicolson, 1963. The *Alocasia plumbea* confusion. *Baileya.* **11**: 142–146.

Burnett, D. 1984. The cultivated *Alocasia. Aroideana.* **7**: 67–163.

Engler, A. 1879. Araceae. Pp. 1-681 in A. & C. de Candolle (eds.), *Monographiae Phanerogamarum.* Vol. 2. Masson, Paris.

Engler, A. & K. Krause 1920. Araceae-Colocasioideae. *Das Pflanzenreich.* **71** (IV.23E): 1–139. Engelman, Leipzig.

Forman, L.L 1997. Notes concerning the typification of names of William Roxburgh's phanerogams. *Kew Bulletin.* **52**: 513–534.

Forster, J.G.A. 1786. *De plantis esculentis insularum oceani australis commentatio botanica.* Haude & Spener, Berlin.

French, J.C., M. Chung & Y. Hur, 1995. Chloroplast DNA phylogeny of the Ariflorae. Pp 255-275 in P. Rudall et al. (eds.), *Monocotyledons: Classification and Evolution.* Vol. I. Royal Botanic Gardens Kew.

Furtado, C.X. 1941. *Alocasia macrorrhiza* and its varieties. *Gardens Bulletin Singapore.* **11**: 244–257.

Gentry, A.H. 1990. Herbarium taxonomy versus field knowledge - is there an attainable solution? *Flora Malesiana Bulletin. Special Vol.* **No. 1**: 31-35.

Grayum, M.H. 1990. Evolution and Phylogeny of the Araceae. *Annals Missouri Botanical Garden.* **77**: 628–697.

Hasskarl, J.K. 1842. Plantarum genera et species novae aut reformatae javenses. *Flora.* **25** (2), Beibl.1: 1–16.

Hasskarl, J.K. 1844. *Catalogus Plantarum in Horto Botanico Bogoriensi Cultarum, alter.* Batavia.

Hay, A. 1994a. *Alocasia simonsiana* - a new species of Araceae from New Guinea. *Blumea.* **38**: 331–333.

Hay, A. 1994b. Araceae - an internationally co-ordinated major family for the accelerated Flora Malesiana Project. *Flora Malesiana Bulletin.* **11**: 5–8.

Hay, A. 1996. A new Bornean species of *Colocasia* Schott (Araceae-Colocasieae), with a synopsis of the genus in Malesia and Australia. Sandakania. **7**: 31–48.

Hay, A. (in press). A revision of the genus *Alocasia* (Schott) G. Don (Araceae-Colocasieae) in the Philippine Islands. *Nordic Journal Botany.*

Hay, A., J. Bogner, P.C. Boyce, W.L.A. Hetterscheid, N. Jacobsen & J. Murata, 1995. Checklist and Botanical Bibliography of the Aroids of Malesia, Ausralia and the Tropical Western Pacific. *Blumea.* Suppl. 8. Rijksherbarium/Hortus Botanicus, Leiden University.

Hay, A. & D.J. Mabberley, 1991. 'Transference of Function' and the origin of aroids: their significance in early angiosperm evolution. *Botansiche Jahrbücher für Systematik.* **113**: 339–428.

Hay, A. & R. Wise, 1991. The genus *Alocasia* (Araceae) in Australasia. *Blumea.* **35**: 499–545.

Hooker, J. D. 1894. *The Flora of British India.* Vol. 6. Reeve & Co., London.

Hotta, M. 1967. Notes on Bornean plants. II. *Acta Phytotaxonomica et Geobotanica.* **22**: 153–162.

Koorders, S.H. 1911. *Exkursionsflora von Java* .Vol. 1. G. Fischer, Jena.

Kunth, C.S. 1841. *Enumeratio Plantarum.* Vol. 3. J.G. Collae, Stuttgart & Tübingen.

Leick, E. 1915. Die Erwärmungstypen der Araceen und ihre blütenbiologische Deutung. *Berichte der Deutschen Botanischen Gesellschaft.* **33**: 518–525.

Loureiro, J. de, 1790. *Flora Cochinchinensis.* Lisbon.

Mayo, S.J., J. Bogner & P.C. Boyce, 1997. *The Genera of Araceae.* Royal Botanic Gardens, Kew.

Miquel, F.A.W. 1855/1856. *Flora van Nederlandsch Indië.* Vol. 3. Van der Post, Amsterdam.

Nicolson, D.H. 1963. Nomina conservanda proposita: *Alocasia* (Schott) G. Don. *Taxon.* **12**: 208–209.

Nicolson, D.H. 1968. The genus *Xenophya* Schott. *Blumea.* **16**: 115–118.

Nicolson, D.H. 1979. Araceae. Pp. 438–460 in A.C. Smith (ed.), *Flora Vitiensis Nova*, vol. 1. Pacific Tropical Botanic Garden, Lawai.

Nicolson, D.H. 1987. Araceae. Pp. 17–101 in M.D. Dassanayake & F.R. Fosberg (eds.) *Flora of Ceylon*, Vol. 6. Amerind, New Dehli.

Noltie, H.J. 1994. Araceae. Pp. 121–210 in *Flora of Bhutan*, Vol. 3, Part 1. Royal Botanic Garden Edinburgh.

Pijl, L. van der, 1933. Welriekende vliegenbloemen bij *Alocasia pubera. Tropische Natuur.* **22**: 210–214.

Rafinesque, C.S., 1837. *Flora Telluriana.* Vol. 3. Philadelphia.

Ridley, H.N. 1904. Some new Malayan plants. *Journal Straits Branch Royal Asiatic Society.* **41**: 31–51.

Ridley, H.N. 1905. The aroids of Borneo. *Journal Straits Branch Royal Asiatic Society.* **44**: 169–188.

Ridley, H.N. 1925. *Flora of the Malay Peninsula*. Vol. 5. Reeve & Co., London.

Roxburgh, W. 1814. *Hortus Bengalensis*. Mission Press, Serampore.

Roxburgh, W. 1832. *Flora Indica*. (Ed. 2, Carey). Thacker & Co., Calcutta.

Rumphius, G. 1747. *Herbarium Amboinense*. Vol. 5. Amsterdam.

Schott, H.W. 1832. Aroidearum synopsis. Pp. 15–22 in H.W. Schott & S.L. Endlicher, *Meletemata Botanica*. Gerold, Vienna.

Schott, H.W. 1853–1857. *Aroideae*. Gerold, Vienna.

Schott, H.W. 1856. *Synopsis Aroidearum*. Mechitarists' Press, Vienna.

Schott, H.W. 1858. *Genera Aroidearum Exposita*. Hölzel, Vienna.

Schott, H.W. 1860. *Prodromus Systematis Aroidearum*. Mechitarists' Press, Vienna.

Schott, H.W. 1861. Aroideologisches. *Bonplandia*. **9**: 367–369.

Schott, H.W. 1863. Araceae. *Annales: Museum Botanicum Lugduno-Batavum. Lugd.-Bat.* **1**: 122–131.

Sweet, R. 1839. *Hortus Brittanicus*. [Ed. 3, G. Don]. Ridgeway, London.

Trimen, I.H. 1898. *A Handbook to the Flora of Ceylon*. Part IV (ed. J.D. Hooker). Dulau & Co., London.

Ventenat, E.P. 1801. *Description des plantes nouvelles....dans le jardin de J.M. Cels*. Paris.

Zhu, Z.Y., 1985. *Panzhuyuia* Z.Y. Zhu - a new genus of Araceae from Emeishan China. *Journal Sichuan Chinese Medical School*. **4** (5): 49–52.

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