

ARISTOLOCHIACEAE (Ding Hou, Leyden)

Perennial herbs, more commonly woody at the base, undershrubs or shrubs, erect, scrambling or scandent, sometimes high lianas. Rhizome not rarely tuberous. Branches often slightly swollen and jointed at nodes. Hairs simple, uni- or multicellular, short ones often with a hooked apex. *Leaves* simple, spiral or alternate, petioled (without an abscission zone), exstipulate; midrib usually prominent beneath, elevated or flat above; nervation commonly palmate, or pinnate, nerves often obliquely extending towards the margin. *Flowers* bisexual, actinomorphic or zygomorphic, solitary, fasciculate, or in axillary or cauligerous, racemose, paniculate or cymose inflorescences, usually only one or two flowers open at a time; bracts present and often persistent; pedicel often hardly distinct from the ovary. *Calyx* petaloid, gamosepalous, 3- (or 6-) lobed or 1-lipped; lobes valvate or induplicate. *Petals* (in Mal.) absent. *Disk* (?) 0, rarely present (e.g. a few *Thottea* spp.). *Stamens* 6 (4 or 5 in some extra-Mal. *Aristolochia* spp.) or 6–c. 36 (–46), in 1 whorl or in 2 (3 or 4) whorls (*Thottea*); filaments free or slightly mutually united at the base, and/or almost completely adnate to the style column to form a gynostemium; anthers free (*Thottea*) or dorsally united with the style column (*Aristolochia*), each consisting of 2 thecae with 4 pollen sacs, extrorse, rarely introrse (extra-Mal. spp.), dehiscent longitudinally. *Ovary* inferior (rarely half-inferior in extra-Mal. genera), 4–6-carpellate, 4–6-celled, syncarpous (or \pm apocarpous in extra-Mal. *Saruma*); placentae parietal (distinct when young, then intruding and connivent axially, thus often seemingly axile); ovules usually many, anatropous, in 1 or 2 vertical rows in each locule of the ovary, horizontal or pendulous; style-column 3–many-lobed, sometimes some of the lobes redivided; stigmas or stigmatic tissue apical, lateral, or on the surface of style lobes. *Fruits* capsular or siliquiform (follicular or cocci in extra-Mal. genera), 4–6-celled; dehiscent apically towards the base (basipetal, e.g. *Thottea*) or basally towards the apex (acropetal, e.g. most *Aristolochia*); septicidal, rarely septifragal (some extra-Mal. *Aristolochia*) or bursting irregularly (extra-Mal. *Asarum*); rarely indehiscent (W. African *Pararistolochia*). Seeds many in each locule (1-seeded in extra-Mal. *Euglypha*), often coated with remains of placental tissue (membranous when dry), horizontal or pendulous, variously shaped; ovate, deltoid or triangular, flat, convex-concave, or longitudinally curved, or oblong (and triangular in cross-section), rugose, finely verrucose, or smooth, immarginate (*Thottea*; *Aristolochia*, p.p.) or winged (*Aristolochia*, p.p.); albumen fleshy, copious; embryo minute, cotyledons two, distinct.

Distribution. There are 7 genera, *Aristolochia* worldwide, *Asarum* over the northern hemisphere, *Thottea* in continental Southeast Asia and Malesia, *Pararistolochia* in tropical Africa, and 3 monotypic genera, viz. *Saruma* in China, *Holostylis* and *Euglypha* in South America. As to number of species, *Aristolochia* is by far the largest with some 300 spp., largely concentrated in the New World, especially in Central and South America, in Malesia with 28 spp.; *Asarum* (incl. *Hexastylis* and *Heterotropa*) with possibly some 70 spp. in northern temperate regions, *Thottea* with 26 spp., of which 22 in Malesia, and *Pararistolochia* with 12 spp. in West Africa.

Ecology. In Malesia *Aristolochiaceae* occur mostly locally, often sporadic, exceptions being *Thottea tomentosa* which may be a locally common undershrub and *Aristolochia tagala* which is often a common slender twiner in thickets. Usually the species are confined to the primary forest, from the lowland to montane stations, in various forest types, dryland and swampy forest, on limestone, in secondary forest and bamboo groves, only a few species ascending to 1500–2250 m altitude.

Aristolochiaceae as host plants for butterflies. Certain groups of *Papilionidae* are bound to *Aristolochiaceae* as a host plant and this is true of Malesian *Aristolochia* and *Thottea*. EHRlich & RAVEN (1964) have made a survey and found that in the family *Papilionidae*, the swallow tail butterflies having 3 subfamilies, the holarctic and oriental subfamily *Parnassiinae* with 5 genera, feed only on *Aristolochiaceae*. In the tropical worldwide subfamily *Papilioninae* with 3 tribes, the tribe *Troidini* is almost confined to *Aristolochiaceae* as host plant. The bond between the butterflies and their host may be different, some are monophagous, others are oligophagous (feeding on a few species) and still others are polyphagous.

Obviously there is a choice, coinciding with the taxonomy of the butterflies and the phytochemistry of the host plants. EHRlich & RAVEN use the term 'co-evolution' in this respect, but it should be pointed out that in this case the benefit is only for the butterflies (*i.e.* their larvae); they do not serve in pollination; in proper co-evolution both parties are interdependent.

It is found by entomologists that the female butterflies are attracted by the scent of the plant to lay their eggs. The evolving caterpillars feed on the host and in the herbarium one may find traces of this, in the way of leaf perforations or erose leaf margins; the larvae also feed on new shoots and buds. Pupae are generally found near the base of the stem of the host, and that is in some very large rain-forest lianas far away from the foliage of the host.

Several entomologists have published on the relations of *Aristolochiaceae* and butterflies in Malesia, *e.g.* STRAATMAN (on N. Sumatra, SE. New Guinea, Queensland, and the Solomons), IGARASHI (on the Philippines and New Guinea), while HAUGUM listed them from the Papuan region. I gave a summary (1983) and JACOBS a review (1982).

Literature: EHRlich & RAVEN, *Evolution* 18 (1964) 586–608; HAUGUM, *The Lepidoptera group of 1968, Newsletter* 2 (1981) 171–184; DING HOU, *Blumea* 29 (1983) 223–249; IGARASHI, *Food plants of Papilionidae* (1979); JACOBS, *Fl. Males. Bull.* 35 (1982) 3747–3749; STRAATMAN & NIEUWENHUIS, *Tijdschr. Entom.* 104 (1961) 31–41; J. Lep. Soc. 16 (1962) 99–103; *ibid.* 23 (1969) 69–76; *ibid.* 25 (1971) 58–64.

Pollination. Already two centuries ago SPRENGEL suggested insect pollination in *Aristolochia* and a century ago HILDEBRAND found the flowers proterogynous and concluded to cross-pollination. As a matter of fact the flowers represent a beautiful trap with a 'slide zone' on the limb above the tube which is inside usually provided with retrorse hairs preventing insects to leave during anthesis. They are trapped in the utricle which provides them with nectar and usually also other food substance of glands. BAKER *c.s.* (1973) added that also stigmatic secretions containing amino-acids would add to the nutritional potential in the utricle. The insects, mostly flies, sometimes also ants, are attracted to the flowers by the putrescent odour, sometimes an offensive smell of decaying meat, emitted during anthesis by the flower or its stalk, and this occurs also in other genera of the family. PETCH (1924) found that some species are visited by only one kind of fly, but in other species he found up to 13 different kinds; the two native Ceylon species were visited by one kind of fly only. In some intricate-built flowers of South American species insects are guided to the sexual organs by a window-pane in the utricle. After the flower withers, and the hairs have lost turgescence, the insects can crawl out, loaded with pollen and can visit another flower, leading to cross-pollination.

This is only a generalization, as it appears from the very large study by PETCH (1924) that there is a great variability among the species: mostly flowers open at daybreak or shortly before and wither after 24 hours, but there are species which show a second-day revival; some have no food bodies; in some species the tube is wide and flies can easily escape; in other species the tube has

no hinged hairs. For that reason one cannot give a single answer to whether cross-pollination is necessary for the setting of the fruit in all species.

BURCK (1890, 1892) made extensive experiments, including bagging flowers *etc.*, on three exotic species in the Botanic Gardens at Bogor (*viz.* *Aristolochia barbata*, *A. elegans* and *A. ornithocephala* = *A. brasiliensis*) and concluded that they are autogamous. PETCH (1924) studied in detail some dozen species at Peradeniya in Ceylon and concluded that, 'although *Aristolochias* are adapted for cross-fertilization, some species can be self-fertilised. It is evident that all grades of self-fertility or self-sterility may be expected within the genus.'

Observations on pollination in *Thottea* are very scant; its flowers are regular and open and do not offer a complicated structure as in *Aristolochia*. They emit also a putrid smell, are mostly dark-coloured and their flower is also proterogynous, as BACKER (1918) observed in *Apama tomentosa* at Bogor. He stated that this species propagates very well vegetatively by stooling and that very few fruits are produced, both in cultivation and in the field in bamboo groves at Depok. BACKER observed flies visiting the flowers; he hypothesized that cross-pollination might be possible during the transition period from the female to the male stage. As a matter of fact I found (1981) the styles or style-lobes (with their stigmas or stigmatic surfaces) reflexed or twisted at anthesis, facilitating contact with pollen grains, which I found germinated in flowers of *Thottea triserialis*. Self-pollination and fertilisation may hence also occur in *Thottea*.

For *Asarum* reports also vary and both self-pollination and cross-pollination by flies or fungus gnats seem to occur (VOGEL, 1978).

Literature: BACKER, Trop. Natuur 7 (1918) 177–183, 4 fig. (on *Apama*); *ibid.* 8 (1919) 133–138, 150–155, 161–168, fig. 5–15; H.G. BAKER *c.s.* in Brantjes (ed.), Pollination and dispersal (1973) 47–60; BURCK, Ann. Jard. Bot. Btzg 8 (1890) 149–157, t. 23; Bot. Zeit. 50 (1892) 121–129, 137–144, t. 3; CAMMERLOHER, Oest. Bot. Z. 72 (1923) 180–198; t. 5–6; DING HOU, Blumea 27 (1981) 314; *ibid.* 29 (1983) 223–249; LEEMAN, Bull. Soc. Bot. Genève 19 (1927) 149–159, fig. 98–107; K.L. LU, Syst. Bot. 7 (1982) 150–157, t. 1–3 (both on *Asarum*); PETCH, Ann. R. Bot. Gard. Perad. 8 (1924) 1–108, t. 1–5; PFEIFER, Ann. Mo. Bot. Gard. 53 (1966) 119–120; S. VOGEL, Flora 167 (1978) 329–366, fig. 1–12.

Morphology. Habit. In Malesia there are two main habit types: 1) perennial herbs which are often woody at the base; they are either a) erect undershrubs or shrub-like, up to 3 m high, sometimes slightly higher as in most species of *Thottea* and some of *Aristolochia* (*e.g.* *A. humilis*, *A. macgregorii*, *A. sericea*, *etc.*) or b) spreading, scrambling or twining up to several metres high, as in *Thottea corymbosa* and some species of *Aristolochia* (*e.g.*, *A. glaucifolia*, *A. jackii*, *A. linne-mannii*, *A. minutiflora*, *etc.*); and 2) woody twiners or high lianas from a few metres up to *c.* 50 m high, with an old stem up to 2 (–4) cm \varnothing (most species of *Aristolochia*).

In absence of field data on the habit (erect or climbing) sterile specimens can hardly be identified to the genus (*Aristolochia* or *Thottea*). Sterile specimens of erect plants can be discriminated if they are sufficiently ample; see the paragraph 'leaf architecture' under *Thottea*.

As to the direction of twining, I do not know whether it is constant for the species of *Aristolochia*. I observed that plants of *A. tagala*, *A. ringens* and *A. foveolata* germinated from seeds and, growing in my office, appear to have no definite direction to twist and may go either right or left as stated by MENNINGER (Flowering vines of the world, 1970, 91–99, phot. 42–45).

Lianas of *Artistolochia* twining on high trees bear leaves often at the top and flowers and/or fruits at the lower part of the stem. Occasionally only 'leafless' fertile herbarium specimens were available because the leaves were difficult to locate or to collect.

Roots and rootstocks. The roots, sometimes also root-like tubers, of (some) *Aristolochia* are fleshy, sometimes with bitter taste, and of various shapes (*e.g.* globose, ovoid, cylindric, fusiform, turnip-shaped, *etc.*), which are characteristic for some species. They have sometimes been collected, recorded and used for species delimitation (*cf.* DAVIS & KHAN, Notes R. Bot. Gard. Edinb. 23, 1961, 515–546; LIANG, Acta Phytotax. Sinica 13, 1975, 10–28; CHOW & HWANG, *l.c.* 108–109). From Malesia nothing is known about root structure.

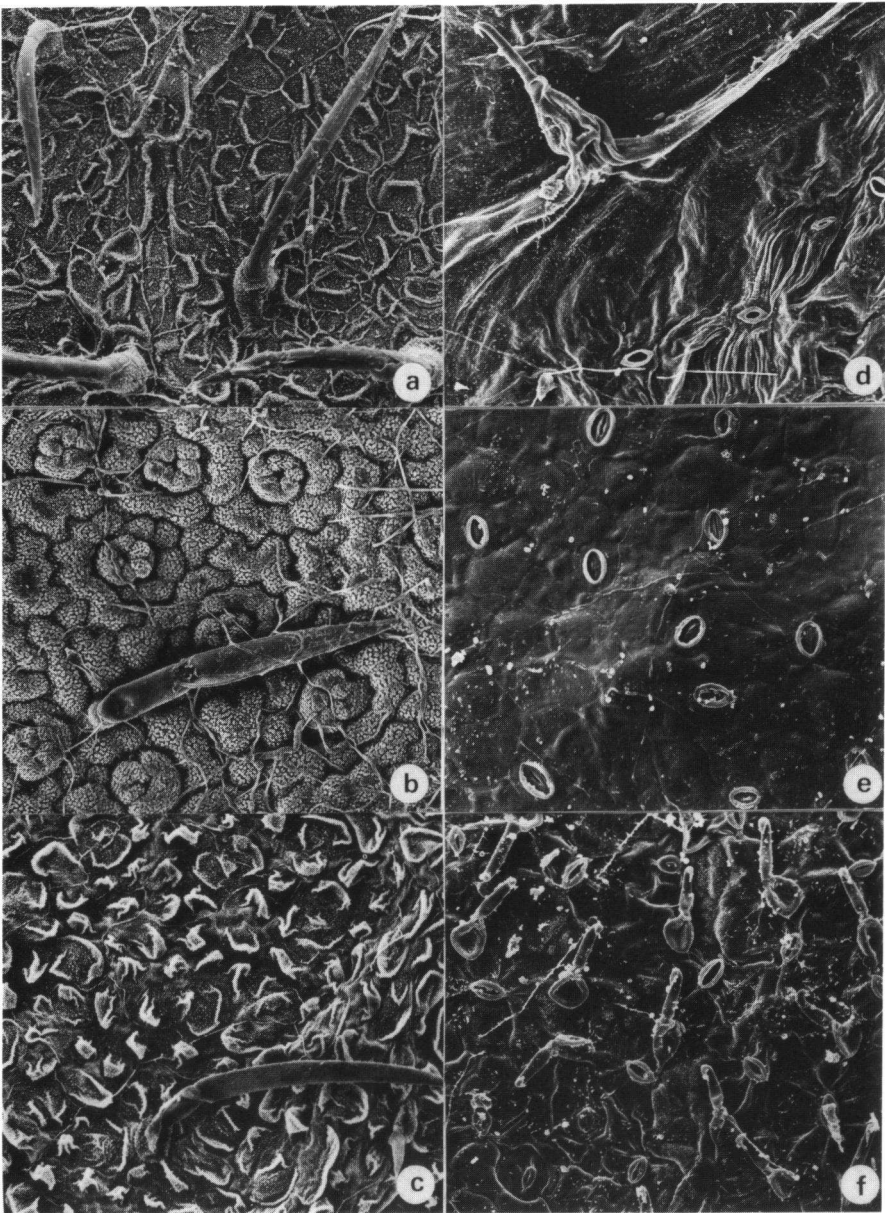


Fig. 1. Scanning electron micrographs showing features of leaf undersurfaces. — *a–c. Thottea*: *a. T. corymbosa* (GRIFF.) DING HOU, *b. T. dependens* (PLANCH.) KLOTZSCH, *c. T. muluensis* DING HOU. — *d–f. Aristolochia*: *d. A. macgregorii* MERR., *e. A. gaudichaudii* DUCHARTRE, *f. A. tagala* CHAMISSO. All $\times 270$ (*a* & *c* hairs and mostly curved or hooked thickenings, *b* hair and ring- or loop-shaped papillae, *d* hooked hair and stomata with striae, *e* glabrous surface and scattered stomata with raised rim, *f* scattered hooked hairs and stomata with raised rim) (*a* CARRICK 1489, *b* SIDEK BIN KIAH 295, *c* ARGENT *c.s.* 760, *d* BARTLETT 15090, *e* BW 11439, *f* WEBER 1074).

The recumbent rootstocks or rhizomes of *Thottea* and some *Aristolochia* species develop offshoots or runners, which sprawl on the ground or produce erect stems. When the motherplant dies, these stems become free and grow on as separate individual plants, a method of vegetative propagation.

The stems of woody vines of *Aristolochia* are mostly terete, or sometimes slightly flattened (fig. 16), and are up to 4 cm or more in diameter. The bark of the old stems is corky and is often longitudinally fissured or prominently ridged or sometimes rather smooth.

On a cross-section one can observe, by using a handlens, conspicuous anatomical features of the *Aristolochiaceae*: the vascular bundles are arranged in a ring and widely separated from one another by the broad medullary rays. On the cross-section of a rather flattened stem, where the cambium is more active towards two opposite directions, the vascular bundles elongate accordingly and the whole section appears like the numeral '8' (cf. METCALFE & CHALK, *Anatomy of Dicotyledons* 2, 1965, 1114, 1117, f. 237, 268; PONCY, *Adansonia* 17, 1978, 466, 476, f. 1).

The '8'-shaped appearance of the cross-section of the stem has been used as one of the generic characters for separating the tropical African *Pararistolochia* from *Aristolochia* (with circular stem) (cf. PONCY, *l.c.*). In Malesia old stems of *Aristolochia decandra* and *A. coadunata* are sometimes also flattened. Fig. 16.

Leaves. Leaves of *Aristolochiaceae* can provide useful characters especially for identification of sterile collections. Fig. 1, 8. However, in some species, they are heteromorphic or very variable in shape, size, texture, etc.; they vary sometimes also between those of fertile and vegetative branches, apical and lower parts of a (high) woody vine, juvenile and adult stages, etc. (e.g. in *Aristolochia dielsiana*, *A. tagala*, *A. zollingeriana*; *Thottea tomentosa*).

The leaves of Malesian *Aristolochia* vary in size; the largest known to me occur in *A. dielsiana* measuring up to 37 by 23 cm; according to R. STRAATMAN they can reach to 100 by 70 cm.

The leaves are usually distinctly petioled. The petiole is often more than 2 cm long, sometimes up to 13 cm; it is very short only in a few species, e.g., *Aristolochia macgregorii* (c. 3 mm), *A. sericea* (2–5 mm). In *Thottea* petioles are usually short.

The leaf does not possess an abscission zone either on the petiole or at its base. The old or dried leaf just hangs on the plant for some time and then breaks irregularly from the petiole, leaving no scar on the stem. This is very characteristic for the species of this family.

The undersurface of the leaf has interesting sculpture features or ornamentation, e.g. hair types or density of hairs, cuticular thickenings or markings, protuberances of epidermal cells, etc., which are useful as diagnostic characters, especially for identification of sterile collections (cf. Blumea 27, 1981, 310–311, f. 5–33). Fig. 1. For example, *Thottea dependens* has papillae forming rings or curves (fig. 1b), *T. muluensis*, *T. pennilobata*, and a few others show crescent, curved or hooked thickenings (fig. 1c), *Aristolochia macgregorii* has stomata with extended striae of thickenings (fig. 1d). Such characters can easily be examined under a normal binocular with a magnification up to about $\times 60$; sometimes they can even be observed with a handlens.

Also the venation types are often characteristic; the main ones are illustrated in fig. 8.

Series of axillary buds. In some species of *Thottea* and *Aristolochia* sometimes 2 or 3 (–5) buds occur in a leaf axil, especially in the terminal one. These buds may develop into flowering and/or vegetative branches, e.g. in *Thottea corymbosa*, *Aristolochia sericea*, *A. gaudichaudii*, etc. (cf. SCHMIDT in E. & P. *Nat. Pfl. Fam. ed.* 2, 16b, 1935, 210–211, f. 106; DELAIGUE, *Soc. Bot. Fr., Mém.* 1971, 167–177, f. 1–6).

Flowers. The flower in *Aristolochiaceae* is probably essentially provided with a calyx and a corolla, but the latter is almost always suppressed. It is still present in the monotypic Chinese genus *Saruma* which is assumed to be the most primitive of the family. It is also found as 3 rudimentary, subulate segments in *Asarum canadense*, as a relict feature.

Flowers are very important for species delimitation. Unfortunately, for many Malesian species flowering material is scanty in the herbarium. Some tropical species of *Aristolochia* have rather large flowers, the largest being the neotropical *A. grandiflora* Sw., with a limb up to 50 cm wide

and a total flower length up to 3 m, a serious competitor of *Rafflesia* which is mostly held as the largest flower in the world. In contrast with this, *Aristolochia* flowers have often a thin, delicate texture difficult to handle in dried material.

The flowers in *Aristolochia* open only one or two, or a few at a time. The flowering duration is often very short, one to a few days. They are sometimes deformed after pressing and drying. The flowers of *Aristolochia* deliquesce sometimes rapidly; they also fall and decay quickly following pollination and fertilization (cf. PFEIFER, Ann. Mo. Bot. Gard. 53, 1966, 119).

The flowers are bisexual; they emerge terminally or laterally in the axils of leaves or bracts, and/or cauligerous; they are solitary, fasciculate, or arranged in cymes, racemes or panicles. The flowering branches or rachides are sometimes with spacious internodes (e.g., *Aristolochia jackii*, *A. schlechteri*) or strongly reduced with internodes hardly visible (e.g., *A. crassinervia*, *A. sericea*). The flowers are pedicelled. There is often hardly any external distinction visible between the pedicel and the ovary; they have been treated here as one unit.

The perianth or calyx is 3-lobed and actinomorphic in *Thottea*. In *Aristolochia* it is rather specialized and usually zygomorphic; it consists of three (sometimes not sharply separated) parts: utricule, tube and limb. Between the perianth and the ovary, there is often a constriction or articulation, sometimes with a lobed rim where the perianth breaks off from the fruit.

The utricule is the basal inflated part of the perianth. It is often globose, subglobose, ellipsoid, ovoid or obovoid. On the inner surface of the utricule, there are usually two symmetrically placed glandular, usually ellipsoid swellings at the apical part. They are food bodies, composed of dense glandular hairs, serving for imprisoned insects (cf. PETCH, Ann. R. Bot. Gard. Perad. 8, 1924, 28). Sometimes there are two small bosses or depressions shown on the outer surface corresponding to the position of the food bodies inside (cf. CURTIS' Bot. Mag. t. 7429). Some Malesian species have six such glandular food bodies (e.g., *Aristolochia foveolata*, *A. papillifolia*). The distal end of the utricule is gradually or abruptly narrowed into a cylindric tube which may be straight or curved. The base of the 'tube', specially in some extra-Malesian species, slightly elongates and projects into the utricular cavity; the flange-like part inside the cavity has been called syrinx (cf. PFEIFER, Ann. Mo. Bot. Gard. 53, 1966, 116, f. 1). The tube gradually or abruptly and slightly enlarges its size at the apical part and merges with the expanded limb. For the diameter of the tube, only the cylindric, middle part has been taken.

The limb is 1-lipped (in many species), sometimes distinctly 3-lobed (e.g., *Aristolochia decandra*, *A. momandul*), occasionally rim-like and obscurely 3-lobed (*A. coadunata*), or rarely 6-lobed (*A. schlechteri*).

The colour of the perianth appears sometimes to vary with the developing stage of the flower, as recorded in field notes. It is characteristic in some species. Unfortunately, I could not use it in keys, because it has only erratically been recorded in field notes.

Perianth of Aristolochia. As mentioned above, the perianth of *Aristolochia* should be regarded as homologous with a calyx and of course be homologous with the perianth in other genera of the family (e.g. *Asarum*, *Thottea*). In several species it is also 3-lobed, but in many others it is entire. Some authors have, however, a different opinion about its morphological derivation.

LORCH (Evolution 13, 1959, 415–416, f. 1) observed a shoot of *Aristolochia maurorum* bearing a series of teratological leaves and proposed a new interpretation of the perianth of this genus. He stated that 'the perianth is the metamorphosed first leaf of a lateral branch' and '... agrees in form with an involute normal foliage leaf.'

HAGERUP (Bull. Res. Counc. Israel 10, sect. D, 1961, 348–351, f. 1–14) studied both the venation and the development of the leaf and the perianth of *Aristolochia* (especially *A. elegans*). He concluded that 'The perianth is *not* compounded of several united leaves but consists of only a single leaf (like the spathe of the *Araceae*).'

GUÉDÈS (Flora, ser. B, 158, 1968, 167–179, f. 1–5) and TRIONG CHUI HUONG (Morph. and taxon. studies on some Aristolochiaceae plants in Singapore, 1979/80, 43–45, not published) made comparative, morphological studies on the vegetative leaf and the perianth of *Aristolochia* (e.g.,

A. clematitis, *A. grandiflora*, *A. peltata*). Their results confirmed the interpretation and findings of LORCH and HAGERUP.

It should be remarked that the *Aristolochia* species, studied morphologically and anatomically by the three authors all possess a 1-lipped perianth. Their thesis should be tested for species in which the limb is rim-like or obscurely 3-lobed (e.g. *A. coadunata*, *A. griffithii*), or distinctly 3-lobed (e.g. the tropical West African species of *Pararistolochia*; and *A. decandra*, *A. momandul*), and the 6-lobed species *A. schlechteri*.

Stamens and styles. The number and arrangement of the stamens in *Thottea* show an interesting series of reduction. Fig. 4–7. The stamens in this genus range from 36 (–46) (e.g. *T. grandiflora*) to as few as 6 (e.g. *T. tomentosa*); they are from free and arranged in 4 series (*T. parviflora*), through partly free and in 3 (*T. triserialis*) or 2 series (most of the species), to united with the style column and just in 1 series (several species, e.g. *T. corymbosa*).

In *Aristolochia* the stamens are adnate to the style column to form a gynostemium. All Malesian species have 6 stamens, except *A. decandra* which has 10. Fig. 15. Each anther consists of two thecae with four microsporangia (pollen sacs) (cf. JOHRI & BHATNAGAR, *Phytomorphology* 5, 1955, 124–125, f. 8, 44–47; NAIR & NARAYANAN, *Lloydia* 24, 1961, 199–200, f. 1–3). The thecae of a stamen are in some *Aristolochia* species (e.g. *A. jackii*) separated from each other by a rather broad connective.

The styles appear to be free in *Thottea parviflora*. They are united with the stamens into a short column (gynostemium) in all other species of *Thottea* and *Aristolochia*. The style column may be discoid or obtuse at apex and then divides, or sometimes redivides, into a number of slender or finger-like lobes. The number of styles or style lobes varies in species of *Thottea* from c. 20 (e.g. *T. macrophylla*) to only 2 or 3 (e.g. *T. paucifida*; fig. 5). In Malesian *Aristolochia* the style has 6 lobes (except 3 in *A. coadunata* and 10 in *A. decandra*).

The lobes of style column (or gynostemium) are glabrous (often sticky when fresh) or sometimes (densely) hairy (covered with hooked and/or straight hairs or papillae). In *Thottea*, they are erect or spreading when young and often reflexed or irregularly twisted at anthesis (cf. DING HOU, *Blumea* 27, 1981, 311–314, f. 38–50).

In *Aristolochia*, changes occur in the structure and shape of the style lobes at anthesis. When young, they are distinctly separate from one another. At first the style lobes may be rather thin with longitudinally reflexed margins and their basal parts covering the apices of the unopened anthers. At anthesis, the style lobes slightly swell, flatten, and become erect and adherent; their apical parts bend inward, and the anthers become exposed. The lobes form then almost a funnel; their apical parts and inner surfaces have a rather thick layer of slime (cf. BACKER, *Trop. Natuur* 8, 1919, 134–136, f. 1–4; PFEIFER, *Tax. rev. pentand. sp. Aristolochia*, 1970, 8–9, f. 1).

In herbarium specimens of both *Aristolochia* and *Thottea* I observed that the style lobes are sometimes covered with pollen grains which even may have germinated. These lobes certainly possess stigmatic surface. However, some botanists assume that the lobes are not true stigmas, and that the connectives of the anthers have assumed stigmatic functions (cf. BURCK, *Ann. Jard. Bot. Btzg* 8, 1890, 151–153, f. 4–8; WILLIS, *Dict. Fl. Pl. Ferns*, rev. by AIRY SHAW, 8th ed., 1973, 92). This idea seems a bit far-fetched, as for example *Aristolochia coadunata* has only 3 style lobes, but the usual 6 stamens. Also in *Thottea* the number of stigmatic lobes does not correspond with the number of stamens; in *T. tomentosa*, with 6 stamens the number of lobes is 3 or 4.

Ovary and placentation. The ovary is inferior (but half inferior in extra-Malesian monotypic *Saruma* and some species of *Asarum*). It is linear, cylindrical or fusiform, and is 4- to 6-carpellate and syncarpous (apocarpous in *Saruma*).

The placentas are parietal when young and gradually become imperfectly 4–6-celled. Whenever I dissected a flower, I observed that the placentation appears to be axile. The pseudo-axile appearance is due to intrusion and fusion of the placental partitions in later stages (cf. LEEMANN, *Bull. Soc. Bot. Genève* 19, 1927, 140–146, f. 82–92; JOHRI & BHATNAGAR, *Phytomorphology* 5, 1955, 123–124, f. 1–7).

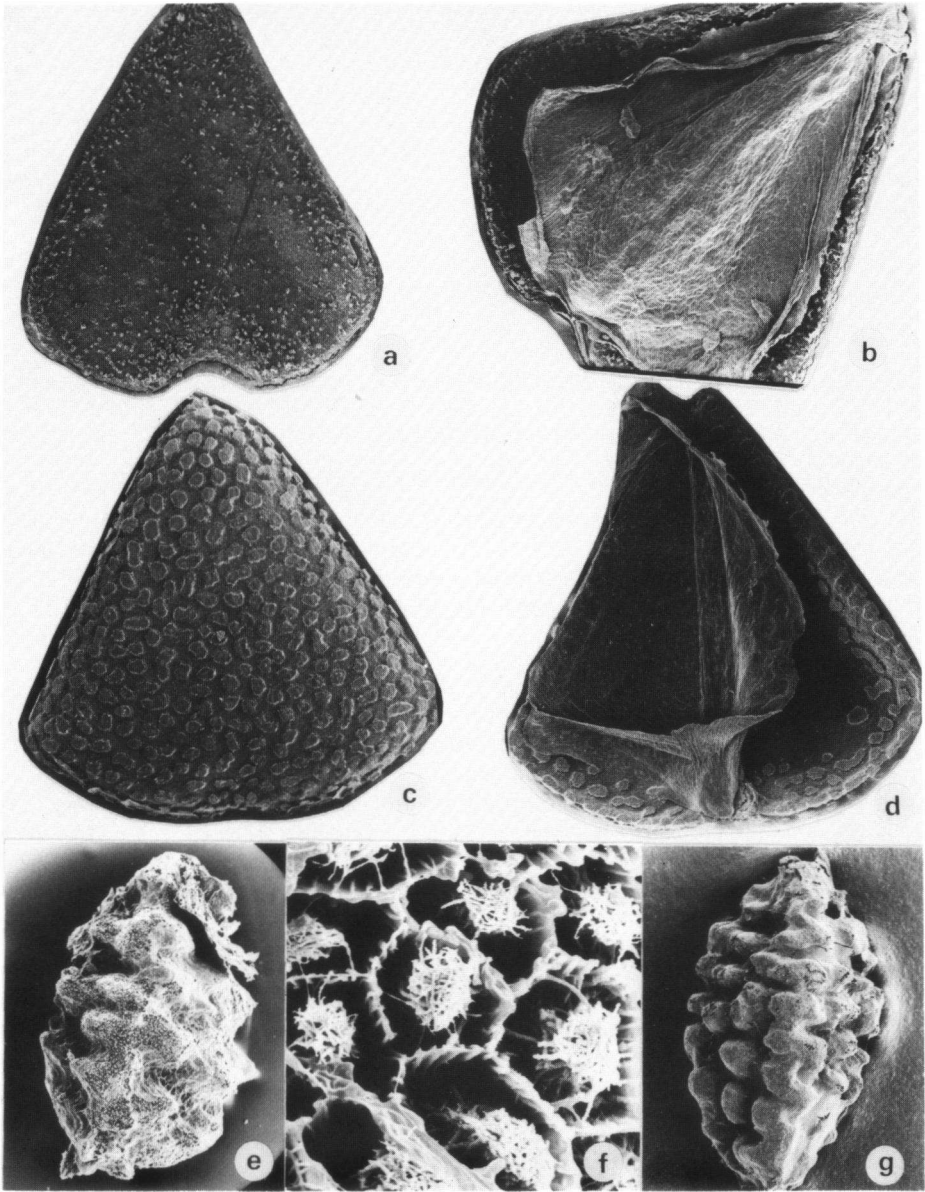


Fig. 2. Scanning electron micrographs of seeds. — *a–d. Aristolochia*: *A. transtillifera* DING HOU, *a*, undersurface, showing testa with finely granulate thickenings, $\times 12$, *b*, upper surface, showing the funicle with laterally dilated extension flattened against the seed, $\times 15$; *A. philippinensis* WARB., *c*, undersurface, showing testa with rather coarse, wart-like thickenings, $\times 15$, *d*, upper surface, showing the funicle with laterally dilated extension covering the seed, $\times 15$. — *e–g. Thottea*: *T. macrantha* (BOERL.) DING HOU, *e*, seed with coating tissue partially peeled off, $\times 20$, *f*, surface view of the testa, with periclinal walls peeled off, showing a bundle of fibrous thickenings in each cell lumen, $\times 700$; *T. reniloba* DING HOU, *g*, seed with tuberculate testa, coated with dried, membranous tissue, $\times 21$ (*a* & *b* SAN 19008, *c* & *d* PNH 10592, *e* & *f* LÖRZING 12434, *g* DE WILDE & DE WILDE-DUYFJES 18829).

The ovules are anatropous and bitegmic (*cf.* JOHRI & BHATNAGAR, *l.c.* 128–132, f. 48–54; NAIR & NARAYANAN, *Lloydia* 24, 1961, 200–201, f. 11–15). They are usually numerous and are horizontally or pendulously superposed in one or two series in each locule of the ovary.

Fruits and seeds. Fruits and seeds are very characteristic for the *Aristolochiaceae*. The fruits are usually capsular (*e.g.* *Aristolochia*; fig. 17) or siliquiform (*Thottea*; fig. 4) (but follicular in the extra-Malesian *Saruma* and cocci in *Euglypha*). They are 4–6-loculed, usually dehiscent, septical, acropetal (and the opened, hanging fruit basket-like as characteristic in *Aristolochia*; fig. 17), or basipetal. They are indehiscent in the tropical African *Pararistolochia* and possibly also in the New Guinean *Aristolochia dielsiana* (see there). They are usually glabrous or rarely hairy (*Thottea*) (*cf.* SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b, 1935, 220–222, f. 116–117).

The size of the fruits is very variable: in Malesian representatives: the length ranges from *c.* 1 cm (*e.g.* *Aristolochia sericea*) to 20 (–38) cm (*e.g.* *A. dielsiana*; *Thottea tricornis*) and the width from *c.* 0.5 cm (*Thottea*) to *c.* 4 cm (*Aristolochia*).

The fruit wall is often slightly lignified (but strongly lignified in *Pararistolochia* and some *Aristolochia* species). The valves of the capsules in *Aristolochia* can sometimes easily be separated in epi-, meso- and endocarpy.

The seeds are usually numerous, horizontally or pendulously superposed, and immersed in the spongy cellular tissue in each locule of the capsules (but only one seed developed in extra-Mal. *Euglypha*). They may be divided into two main types according to their general appearance: 1) compressed and flat (*Aristolochia*, *Asarum* and *Holostylis*) and 2) oblong, fusiform, or broadly ovoid, obscurely or distinctly triangular (*Thottea*). Fig. 2. However, the flat seeds sometimes may be longitudinally slightly or strongly concave (*e.g.* *Aristolochia singalagensis*; *Thottea curvisemen* and *Thottea sp.*).

The seeds are not winged or with a rim-like or marginal wing (*Aristolochia*). They are often slightly or prominently transversely corrugate or rugose (*Thottea*) and are smooth or warty on the testa (*Aristolochia*). The irregular surface of the testa in *Aristolochia* is due to unequal divisions and outgrowth of the epidermal cells (*cf.* JOHRI & BHATNAGAR, *Phytomorphology* 5, 1955, 133, f. 90–91).

In *Aristolochia* the seeds in many species have an almost unique feature in that the large funicle is rather fleshy, thick, dilated laterally, flattened against the upper surface of the seed and generally larger than it (JOHRI & BHATNAGAR, *l.c.*; CORNER, *Seeds Dicot.* 1, 1976, 73–74; *ibid.* 2, 1976, f. 27–29). This fleshy funicle is equivalent to an elaiosome and is important in seed dispersal. In the dry state it becomes almost membranous and usually covers the seed (fig. 2b, d).

In *Thottea*, after the coating membranous tissue is removed, the testa cells appear as reticulations or papillae; each of these cells has a strong thickening projecting into the cell lumen. If the soft tissue of the testa has been removed or brushed off, one can easily observe the two layers of crossed fibres of the tegument (*cf.* SOLEREDER, *Bot. Jahrb.* 10, 1889, 504–507, t. 13, f. 19–21; JOHRI & BHATNAGAR, *Phytomorphology* 5, 1955, 133–137, f. 83–95; CORNER, *Seeds Dicot. l.c.*; DING HOU, *Blumea* 27, 1981, 314–315, f. 51–69). Fig. 2e–g.

According to CORNER (*l.c.*) the attachment of the integument along the course of the raphe and the development of two layers of crossed fibres in the tegument forming the mechanical layer of the seed coat are the chief characters of the seeds in *Aristolochiaceae*. He also stated that the tegument of *Caricaceae* seems strikingly similar to the one of this family in having the same set of crossed fibres.

The endosperm of the seeds in *Aristolochiaceae* is copious and fleshy. The embryo is minute with two distinct cotyledons and is enclosed in the endosperm close to the hilum (*cf.* JOHRI & BHATNAGAR, *l.c.*).

Seed germination and seedlings. The seed germination of some species of *Aristolochia* and *Asarum* (*s.l.*) has been reported as epigeal, with the cotyledons spreading above the ground.

In *Aristolochia*, during germination, the radicle protrudes through the hilum or near it or through the testa. The cotyledons are rather fleshy, suborbicular or broad-ovate, with simple

venation (midrib with a few lateral nerves or veins). The first two leaves are opposite; they develop from almost the same plane as the cotyledons and are at right angles with them. The foliage leaves, following the first pair mentioned above, are scattered (cf. LUBBOCK, Contribution to our knowledge of seedlings 2, 1892, 444–446, f. 624; TIONG CHUI HUONG, Morph. and taxon. studies on some Aristolochiaceae pl. in Singapore, 1980, 27–28, pl. 4 & 5, f. 4 & 5, not published).

Seed dispersal. The winged seed of some *Aristolochia* species may help in dispersal. More important seems the elaiosome (fleshy funicle) which is probably attractive to ants.

Anatomy (for oil cells, silicified cells and crystals see under Phytochemistry). METCALFE & CHALK (1950) provided a general survey of the vegetative anatomy of the family: hairs simple unicellular or uniseriate and/or with a hooked terminal cell with silicified tip ('bracket hairs'). Stomata usually anomocytic. Stems typically with broad medullary rays. Secondary phloem occasionally with stone cells but devoid of fibres. Wood with very wide vessels in climbers, but rather narrow ones in erect species. Vessels with simple perforations and coarse pits. Fibres with bordered pits (especially conspicuous in *Aristolochia*). Parenchyma paratracheal, often scanty. Rays mostly wide and forming broad interfascicular bands, but narrow (up to 3-seriate) in some species of *Apama* (= *Thottea*), heterocellular. GUÉDÈS (1968) described the petiole anatomy of some *Aristolochia* species; ALEYKUTTY & INAMDAR (1980) provided detailed accounts of hair types in the family; PHILIP (1983) reported on the diverse ontogeny of the stomatal complex in species of *Aristolochia* and on the predominance of paracytic stomata in *Aristolochia leuconeura*.

Vegetative anatomy is in agreement with the view that *Aristolochiaceae* are related to the *Magnoliales*.

Literature: ALEYKUTTY & INAMDAR, Fedde, Rep. 91 (1980) 95–108; GUÉDÈS, Flora, Jena 158B (1968) 167–179; METCALFE & CHALK, Anatomy of the Dicotyledons II, Oxford (1950); PHILIP, Curr. Sci. 52 (1983) 223–224. — P. BAAS.

Palynology. The pollen of *Aristolochiaceae* varies in size between 27 µm in *Saruma henryi* and 73 µm in *Aristolochia grandiflora* and is generally spherical-suboblate or ellipsoidal. Two main types can be recognized, the first of which is restricted to *Saruma*. This genus has monocolpate, reticulate pollen which is rather primitive and similar to the basic type found in *Chloranthaceae*, *Annonaceae* and in many monocotyledons. The second, more derived type found in the remaining genera is characterized both by a variable aperture configuration and exine structure.

In *Aristolochia* the pollen grains are inaperturate, indistinctly monocolpate or periporate and the exine may be psilate, scabrate, echinate or areolate. *Pararistolochia* has an indistinctly outlined distal aperture and differs from the preceding genus mainly in its rugulate-areolate exine. The pollen of *Asarum* is inaperturate or irregularly pericollpate-periporate and this variation may even occur in a single species (*Asarum virginicum*). The exine has separated verrucae.

Thottea pollen is generally inaperturate, but indistinctly monocolpate or periporate grains have been reported also. The exine is verrucate-areolate. In *T. paucifida* the areolae are hardly developed, while in *T. dependens*, *T. dinghoui*, *T. macrantha*, *T. tomentosa* and *T. tricornis* the areolae are widely spaced, thin-walled and not centrally supported by columellae. The intervening exine here is tectate-columellate. Densely spaced areolae are found in *T. grandiflora* and *T. parviflora* and in these species the columellae are reduced to the margins of thin-walled areolae. In the former species the areolae are perforated by rather large holes. *T. corymbosa* is deviating in the larger, rather densely spaced areolae which are finely perforated and supported by rather densely spaced columellae.

With the exception of *Saruma*, the genera of *Aristolochiaceae* cannot be separated on pollen morphological characters, although some species may be distinct. The comparatively primitive *Saruma* pollen type indicates that the taxonomic relations of the family are with *Magnoliales*.

Literature: G. ERDTMAN, Pollen morphology and plant taxonomy, Angiosperms (1952) 61–62; D. LOBREAU-CALLEN, Adansonia 17 (1978) 470–472; J.W. WALKER, Amer. J. Bot. 61 (1974) 1112–1137; Linn. Soc. Symp. Series 1 (1976) 251–308. — J. MULLER.

Phytochemistry. The chemical characters of *Aristolochiaceae* have been summarized and

discussed from a taxonomic point of view by HEGNAUER (1960, 1964) and a comprehensive phytochemical review of the family was given by MUNAVALLI & VIEL (1969).

Members of the family tend to deposit SiO_2 and calcium oxalate in their tissues. Heavy silicification of cell walls (hairs, epidermis, mesophyll) and cell lumina (silica bodies of various shapes) is especially frequent in the tropical members of the three genera in Malesia. Calcium oxalate occurs in the form of prismatic and needle-shaped crystals which are accompanied or replaced in species of *Aristolochia* by druses.

All members of the family possess oil cells producing appreciable amounts of essential oil of taxon-specific composition. These idioblasts occur in roots, rhizomes, leaves and flowers. Depending on taxa and chemodemes monoterpenes, sesquiterpenes or (and) phenylpropanoids are the main constituents of these essential oils.

The nitrophenanthrenes called aristolochic acids and debilic acid and the biogenetically related phenanthrenoid aristolactams occur practically everywhere in *Aristolochia* and have been traced in species of *Thottea* and *Asarum*.

Consideration of the chemistry leads to the conclusion that the affinity of *Aristolochiaceae* is closest with *Annonaceae* as suggested formerly by VON WETTSTEIN. The most convincing evidence comes from the co-occurrence of heavy silicification, essential oil in idioblasts and benzyloquinoline alkaloids and their degradation products. Both families should be included in *Polycarpiceae* (compare, e.g., *Magnoliiflorae*, DAHLGREN, 1980).

Literature: DAHLGREN, Bot. J. Linn. Soc. 80 (1980) 91–124; HEGNAUER, Pharmazie 15 (1960) 634–642; Chemotaxonomie der Pflanzen 3 (1964) 184–199, 639; MUNAVALLI & VIEL, Ann. Pharm. Franç. 27 (1969) 449–464, 519–533, 601–614. — Editor's extract from a large report of R. HEGNAUER.

Chromosomes. In *Aristolochiaceae*, chromosome data have been reported for about 90 species of mainly the two (large) genera, viz. *Aristolochia* and *Asarum* (*s.l.*, incl. *Heterotropa* and *Hexastylis*) and only one species of *Apama* (= *Thottea*).

In *Aristolochia* the somatic chromosomes have been reported as $2n = 8, 10, 12, 14, 24, 26, 28, 32$. The number in this genus is, with some deviations, rather uniform: $2n = 14$ (in most of the tropical species) and $2n = 28$ (in most of the temperate zones) (*cf.* GREGORY, 1956). There is one widely distributed species, occurring also in Malesia, *A. tagala*, having $2n = 14$; I examined the material of this species from Celebes and New Guinea and obtained the same number. The other numbers occur very unfrequently: $2n = 12$ (or 24) four times, $2n = 8, 10, 16, 32$ each once, mostly for extra-tropical species.

In the extra-Malesian genus *Asarum* (*s.l.*) the chromosomes of many species have been reported mostly with $2n = 24$ (for Asiatic species) and $2n = 26$. There are only a few species with $2n = 36, 40, \text{ or } 48$.

For the genus *Thottea*, there is only one species of *Apama* (= *Thottea*) from India being known with $2n = 26$ (*cf.* FEDOROV, 1969).

There is still no chromosome information known for the three monotypic genera, viz. *Euglypha*, *Holostylis* and *Saruma*.

Literature: DARLINGTON & WYLIE, Chromosome Atlas ed. 2, 1955, 29; A.A. FEDOROV (ed.), Chromosome numbers of flowering plants, 1969, 58–59; M.P. GREGORY, Amer. J. Bot. 43, 1956, 110–112, tab. 1 & 2, fig. 1–154; R.J. MOORE (ed.), Index to plant chromosome numbers, Regn. Veget. 90, 1973, 162–163; *ibid.* 91, 1974, 31; *ibid.* 96, 1977, 26–27; TANAKA, Bot. Mag. Tokyo 49, 1935, 709–746, f. 1–43.

Taxonomy. Though certainly natural, the family is rather heterogeneous: small creeping or erect herbs and large woody lianas, flowers regular or zygomorphic, stamens 6 to many, perianth simple or double, *etc.* Several genera have outstanding structures: *Asarum* has a leathery capsule bursting irregularly, *Aristolochia* has a bent, zygomorphic complicated flower, the curious South American genus *Euglypha* has also a utricle but not a bent flower and besides has a fruit consisting of 6 one-seeded cocci attached to a sort of columella, the South American genus *Holostylis* is like

Aristolochia in flower, but its flower is also straight and does not possess a utricle, *Thottea* has up to 4 whorls of stamens (up to 36–46), and the Chinese genus *Saruma* has a double perianth and 6 half-way free follicles.

Whether the West African genus *Pararistolochia* can be maintained is liable to doubt. KEAY (Fl. W. Trop. Afr. ed. 2, 1, 1, 1954, 77) distinguished it from *Aristolochia* by: 'Fruit indehiscent, elongated, strongly ribbed, cucumber-like', but these characters seem also to occur in the New Guinean *A. dielsii* SCHMIDT (see p. 105). — Editor.

Affinities. In the past many suggestions have been made and there is unanimity that most characters point to the assemblage of primitive families in the Dicotyledones, especially through those of the genus *Saruma*. Since WAGNER's research (Oest. Bot. Z. 57, 1907, 265–271) the general opinion prevails that among the living plants the closest affinity is with *Annonaceae* in the general *Magnoliales* concept.

Uses. Some American *Aristolochia* species are cultivated for their (rather large) beautiful flowers as ornamentals, e.g. *A. brasiliensis* MART. & ZUCC., *A. elegans* MART. & ZUCC., *A. gigantea* MART. & ZUCC., *A. grandiflora* Sw., *A. ringens* VAHL, etc.

In Malasia some indigenous *Aristolochia* and *Thottea* species are locally cultivated as food plants for the larvae of the beautiful (swallowtail) butterflies, for commercial purposes.

Some members of the *Aristolochiaceae* have been used for drugs, medicine, or medicinal products, especially in the Far East and Southeast Asia. According to published records, such plants or their derivatives have been applied to remedy snake bites, stomach-ache, dysentery, rheumatic affections, colds, headache, toothache, or to reduce swellings and high blood pressure, etc. Aristolochic acid has been reported possessing the capacity to reduce growth of certain types of cancer in mice. For medicinal uses of Malasian plants see the records under the species concerned. For further details one should consult the following literature.

Literature: BROWN, Minor Prod. Philip. For. 3 (1921) 183; BURKILL, Dict. (1935) 188–189, 239–240, 2156–2157; CHOW & HWANG, Acta Phytotax. Sinica 13 (1975) 108–109; HEYNE, Nutt. Pl. (1927) 596–597; LIANG, Acta Phytotax. Sinica 13 (1975) 10–28; PERRY, Medic. Pl. E. & SE. Asia (1980) 45–48; PFEIFER, Ann. Mo. Bot. Gard. 53 (1966) 121; QUISUMBING, Medic. Pl. Philip. (1951) 254–256; SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 225–226.

Notes for collectors. For proper identification flowers are essential. In many cases sterile material is insufficient. Field notes should include information on flower colour and its variation with age of the flowers. As flowers are often delicate in texture, it is advisable to insert some dry material inside the flower before drying, e.g. wool, dry moss, or thin paper, which facilitates later examination in the herbarium. Colour photographs and flowers in liquid are desirable.

If possible, roots should be collected; nothing is known about them in Malasian species.

In several species fruits are not yet known; attention should be given to their development to maturity and release of seeds.

KEY TO THE GENERA

1. Flowers actinomorphic. Perianth narrowed at the base and gradually, slightly widened towards the apex, always 3-lobed. Stamens 6–c. 36 (–46), in 1 or 2, rarely 3 or 4, whorls. Capsules usually siliquiform, elongated, ± 4-angular, 5–10 mm wide, 4-celled. Seeds oblong, ellipsoid, or broadly ovoid, in cross-section usually 3-angular. Stems usually erect, bearing small, bract-like leaves in the lower half, then one small leaf, followed by normal foliage leaves **1. *Thottea***
1. Flowers zygomorphic. Perianth curved, consisting of 3 parts: the inflated basal utricle, the narrowed and neck-like tube, and the elongated, enlarged, or expanded, often 1-lipped, sometimes 3 (–6)-lobed limb. Stamens 6 (10 in *A. decandra*), always in 1 whorl. Capsules not siliquiform, often 6-angular or -ridged, (10–) 15–40 mm wide, 6-celled. Seeds ovate, deltoid, or triangular, often flat. Stems usually scandent, also in erect species, bearing only foliage leaves **2. *Aristolochia***

1. THOTTEA

ROTTBOELL, Nye S amling Kongel. Danske Vidensk. Selsk. Skr. 2 (1783) 529; KLOTZSCH, Monatsb. Akad. Berlin (1859) 588; DUCHARTRE in DC. Prod. 15, 1 (1864) 428; SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 232; DING HOU, Blumea 27 (1981) 303. — [*Alpam* RHEEDE, Hort. Malab. 6 (1686) 51, t. 28.] — *Apama* LAMK, Encycl. M eth. Bot. 1 (1783) 91; Tabl. Encycl. M eth. (1823) t. 640; SCHMIDT, *vide supra*. — *Bragantia* LOUR. Fl. Coch. (1790) 528; ed. Willd. (1793) 645, non VANDELLI (1771). — *Ceramium* BL. Bijdr. (1826-27) 1134, non ROTH (1797), nec ADANSON (1763). — *Munnickia* BL. ex RCHB. Consp. (1828) 85. — *Vanhallia* SCHULT. in R. & S. Syst. 7 (1829) xviii & 166. — *Trimeriza* LINDL. Bot. Reg. (1832) sub t. 1543, in note. — *Asiphonia* GRIFF. Trans. Linn. Soc. 19 (1845) 333. — *Lobbia* PLANCH. in Hook. Lond. J. Bot. 6 (1847) 144. — *Strakaea* PRESL, Epim. Bot. (1851) 221. — Fig. 1–8.

Herbs, woody at the base, or undershrubs, rarely shrubs, single or tufted, simple or (sparsely) branched, erect, sometimes rhizomatous or scrambling. *Stems* bearing small, bract-like leaves in the lower 2/3–1/2, then one smaller leaf, followed by normal foliage leaves; (young) branches or branchlets sometimes zigzag. *Leaves* entire; petiole grooved above. *Flowers* actinomorphic, axillary or subradical, solitary or a few on short branches, in spicate or racemose, cymose or corymbose, or cincinnal, usually few-flowered inflorescences. Bract usually opposite to the flower. *Flower buds* (not including the ovary) often distinctly triangular in top view. *Perianth* broad-campanulate, urceolate, bowl- or cup-shaped, 3-lobed; lobes valvate, caducous. *Disk* (?) 0, rarely cupular, adnate to the perianth tube with the apical part free and ring-like (e.g. *T. tomentosa*). *Stamens* 6–c. 36 (–46) in 1 or 2, rarely 3 or 4 whorls, free or adnate to the style column. *Ovary* 4-angular, 4-celled; style (2–) 5–20-lobed, lobes linear or linear-lanceolate. *Capsules* usually siliquiform, elongate, variable in length, 5–10 mm wide, \pm 4-angular, sometimes cruciform in cross-section, dehiscing apically towards the base, or splitting from the central part towards both ends. *Seeds* oblong, ellipsoid, or broadly ovoid, usually 3-angular in cross-section, rarely boat-shaped, often coated with remains of the placenta; testa crustaceous or hard, usually (transversally) rugose, or deeply furrowed, rarely rather smooth or sparse granular.

Distr. Indo-Malesia (c. 26 spp.): India (4 spp.), Sri Lanka (1), Bangladesh (1), Burma (3), Thailand (4), Vietnam (2), China (Hainan, 1), and Malesia (22): Sumatra, Malay Peninsula, Java, Borneo, Philippines, and Celebes.

Ecol. Often growing sporadically, occasionally locally abundant, in shady places in tropical lowland forest, rarely up to c. 1200 m.

Notes. *Thottea* species possess a distinctive leaf architecture: the lower half or two-thirds of the stem carries many (8–12) small, scale- or bract-like, alternate reduced leaves, followed by a single small leaf, which is in turn followed by normal foliage leaves. This was observed by VAN STEENIS in Hortus Bogoriense on specimens of *T. borneensis* and *T. macrantha* and found to be a constant feature in all herbarium specimens with a complete stem.

The occurrence of these three leaf types in this sequence on a single stem has proved useful to recognize

sterile specimens from some erect species of *Aristolochia* (e.g. *A. philippinensis* and *A. sericea*) which have a similar habit, but the stems of which carry only the normal foliage leaf type.

SYNOPSIS OF SPOTTING CHARACTERS

Species are indicated by their numbers

- Stem bearing 1–5 (mostly 2 or 3) leaves at the apical part: 9, 20.
 Leaf with 3 prominent nerves, reaching often to the apex, connected with almost parallel and transverse veins: 19.
 Leaves with lateral nerves pinnately arranged more or less at regular intervals; venation on the lower surface prominently and closely reticulate: 11, 13.
 Leaves villous or densely tomentose beneath and hairs covering almost the whole surface: 7, 8, 20 (young leaves).
 Leaf base distinctly cordate, the sinus rather narrow and the auricles or basal lobes often overlapping: 4 (*p.p.*), 5, 6.
 Leaves distinctly papillate beneath; papillae forming rings or curves: 14.
 Flowers with funnel-shaped perianth, up to c. 12.5 cm long, the largest in this genus: 4.
 Flowers with folded perianth more or less round in outline in side view, c. 7 cm \varnothing , base cordate: 3.
 Flowers with stamens arranged in 4 whorls: 1.
 Flowers with stamens arranged in 3 whorls: 2.
 Flowers with 6 stamens in 1 whorl; style lobes covered with (often hooked) hairs at the upper part: 20.
 Flowers with 6 stamens in 1 whorl; anthers with connectives distinctly protruding 0.5–1 mm beyond them: 22.
 Style lobes 2 or rarely 3, glabrous: 9.
 Seeds boat-shaped, rather smooth and only sparsely granulate on both surfaces: 7.

KEY TO THE SPECIES

1. Stamens arranged in 4 whorls (shown distinctly in flower buds) or appearing scattered (in open flowers)
 1. **T. parviflora**
1. Stamens arranged in 1 to 3 whorls.
 2. Stamens arranged in 3 whorls 2. **T. triserialis**
 2. Stamens arranged in 1 or 2 whorls.
 3. Stamens arranged in 2 whorls.
 4. Perianth base prominently cordate, in side view with 2 distinct auricles. Perianth of the (mature) flower, folded in side view, rounded in outline, c. 7 cm \varnothing ; sinus 1–1.5 cm deep. (Leaves unknown)
 3. **T. straatmanii**
 4. Perianth base obtuse or rounded (in side view).
 5. Leaf base distinctly cordate, the sinus rather narrow and the auricles or basal lobes often overlapping.
 6. Flowers large; perianth up to c. 12 cm long when mature 4. **T. grandiflora**
 6. Flowers smaller; perianth less than 3 cm long when mature.
 7. Perianth c. 23 mm long, deeply 3-lobed; lobes triangular, inner surface densely covered with papillae and glandular hairs. Stamens with papillate filaments. Style lobes 18–20 5. **T. macrophylla**
 7. Perianth 8–10 mm long, shallowly or obscurely lobed; lobes nearly semi-orbicular or triangular, inner surface densely covered with (mainly hooked) hairs. Stamens with glabrous filaments. Style c. 12 lobes 6. **T. robusta**
 5. Leaf base obtuse, rounded, or cuneate.
 8. Leaves with hairs densely covering the whole lower surface, so the latter usually hidden; hairs bent at right angles near the base and parallel to the surface.
 9. Hairs on the lower leaf surface appearing very thin in dry state and sticking together (resembling a layer of gelatine). Perianth lobes with the margin not reflexed at anthesis. Seeds flattened, boat-shaped, rather smooth 7. **T. curvisemen**
 9. Hairs on the lower leaf surface appearing thicker and free from one another. Perianth lobes with the margin reflexed at anthesis. Seeds \pm ellipsoid, triangular, strongly rugose 8. **T. borneensis**
 8. Leaves with hairs rather loosely or sparsely covering the lower surface, so the latter always visible; hairs irregularly spreading, curved or twisted.
 10. Flowers large; perianth up to c. 12 cm long when open 4. **T. grandiflora**
 10. Flowers much smaller; perianth at most 4.5 cm long.

- 11. Stamens 3 in the upper whorl, 9 in the lower. Style 2- or 3-lobed 9. *T. paucifida*
- 11. Stamens 6–15 (–18) in the upper whorl, 9–15 (–24) in the lower. Style (4–) 5–19-lobed.
- 12. Perianth shallowly or obscurely lobed, sometimes ± entire.
- 13. Leaf venation loosely reticulated, veins or veinlets often parallel to one another. Inflorescences at the upper part of stem, in the axils of foliage leaves. Fruits twisted, 15–25 cm long, densely hairy 10. *T. tricornis*
- 13. Leaf venation closely reticulated. Inflorescences near the base of stem, in the axils of bract-like, reduced leaves. Fruits straight, less than 10 cm long, sparsely hairy or almost glabrous 11. *T. beccarii*
- 12. Perianth distinctly lobed, often divided to c. half or more of its length.
- 14. Perianth tube cylindric (c. 1.5 cm long) 12. *T. rhizantha*
- 14. Perianth tube campanulate, short cupular, obscure, or 0.
- 15. Leaves with distinctly pinnate, often rather evenly spaced nerves; venation closely reticulate (almost tessellate), prominent beneath 13. *T. philippinensis*
- 15. Leaves with 1 or 2 pairs of basal nerves and some lateral ones from the midrib, not evenly spaced; venation loosely reticulate, slightly elevated beneath.
- 16. Leaves with the inner pair of basal nerves emerging from the base. Inflorescences at the upper part of stem, in the axils of foliage leaves.
- 17. Perianth campanulate, 15–25 mm long; contracted at the lower 1/3 and then erecto-patent, glabrous outside; lobes triangular, flat 14. *T. dependens*
- 17. Perianth short-cupular, 10–13 mm long, sparsely puberulous outside; lobes reniform, the margin reflexed at anthesis 15. *T. reniloba*
- 16. Leaves with the inner pair of basal nerves emerging near the base or a few mm from it. Inflorescences at the basal part of stem or near the ground, in the axils of bracts or reduced leaves (almost cauligerous).
- 18. Perianth c. 15 mm long, lobed to c. 2/3 of the length 16. *T. pennilobata*
- 18. Perianth 25–45 mm long, lobed up to c. half of the length.
- 19. Perianth lobes semi-orbicular, 10 by 15 mm, at apex subrounded or slightly apiculate 17. *T. celebica*
- 19. Perianth lobes triangular, 20–25 by c. 20 mm, at apex acuminate ... 18. *T. muluensis*
- 3. Stamens arranged in 1 whorl.
- 20. Leaves with the inner pair of basal nerves extending to the apex, joined by predominantly rather close, transverse, parallel veins. Inflorescences corymbose or paniculate 19. *T. corymbosa*
- 20. Leaves with the inner basal pair of nerves extending usually to c. half, rarely more, of the length, joined by rather loose, transverse and reticulate veins. Inflorescences usually spicate or racemose.
- 21. Plant bearing 1–5 (often 2 or 3) foliage leaves. Leaves densely tomentose or villous beneath especially when young. Inflorescences near the base of stem. Style lobes densely covered with (hooked) hairs at the apical part 20. *T. tomentosa*
- 21. Plant bearing many foliage leaves. Leaves pubescent or puberulous beneath. Inflorescences at the upper part of stem. Style lobes glabrous.
- 22. Perianth lobes broadly rounded, c. 12 by 4 mm, emarginate. Stamens 9–12; connective not protruding beyond the anthers 21. *T. macrantha*
- 22. Perianth lobes ovate to lanceolate, 8–15 by 5–8 mm, apex acute, acuminate, or obtuse. Stamens 6; connective protruding c. 0.5 mm beyond the anthers 22. *T. sumatrana*

1. *Thottea parviflora* RIDLEY, J. Str. Br. R. As. Soc. n. 57 (1911; nec 1910) 89; Fl. Mal. Pen. 3 (1924) 17; SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 232; BURK. Dict. 2 (1935) 2157; DING HOU, Blumea 27 (1981) 305, f. 38–40, 70D. — Fig. 7n–p.

Erect shrub, up to 2 m high. Branches subterete or obscurely angular, c. 7 mm ø, pubescent. *Leaves* chartaceous, ovate, obovate, broad-elliptic, elliptic, or lanceolate, 10–26 by 4.5–9 cm; apex acuminate; base rounded, cuneate, or attenuate; sparsely puberulous or almost glabrous above, puberulous beneath; basal nerves 2 or 3 pairs, emerging 2–5 mm from the

midrib above the base, similar to the lateral nerves, ascending upward to 2/3 or more of the blade, the outer 1 or 2 pairs much weaker and shorter; lateral nerves 6–9 pairs, elevated beneath, flat but distinct, or slightly elevated above; veins ± parallel and scalariform, sometimes ± transverse at the basal part between the inner pair of basal nerves, connected with parallel or reticulate veinlets, elevated beneath, faint above; petiole 3–7 mm, puberulous. *Inflorescences* axillary, often in the axils of leaf scars, usually simple and spiciform, up to 1.5 cm long; bracts lanceolate, 1–4 mm long, puberulous on both surfaces. Pedicel



Fig. 3. *Thottea grandiflora* ROTTB., $\times 1/3$. Possesses the largest flowers in the genus. Singapore (Photogr. CORNER).

and ovary very short, c. 6 mm long, densely puberulous. *Perianth* white, whitish green with a pink basal patch inside, pale pink or pink, pale purplish or violet, discoid, 2–4 mm long, c. 6 mm \emptyset , with longitudinal and loosely reticulate veins, loosely puberulous outside and papillate inside, glabrescent; lobes semi-orbicular, 1.5–3 by 3.5–4.5 mm. *Stamens* (15–) 20–22, in 4 whorls (can easily be observed in young buds); filaments 0.4–1 mm, short-hairy; anthers oblong, c. 0.7 mm long. *Style* almost branched from the base, c. 1.7 mm, lobes usually 4 or 5, glabrous. *Capsules* slender, up to 9 cm long, acute or pointed at both ends, obscurely 4-angular, slightly twisted, loosely puberulous. *Seeds* ellipsoid, 3–3.5 by 1.5 mm, triangular, irregularly and transversely corrugated.

Distr. Peninsular Thailand; in *Malesia*: Malay Peninsula (Kedah, also Langkawi, Perak, Kelantan, Pahang, Selangor).

Ecol. In lowland forest, occasionally in swampy forest, up to 150 m; in Thailand occasionally found also on granitic rock in the forest, up to 700–1055 m. *Fl.* March–July, *fr.* March–August.

Uses. Rootstock is eaten with rice for remedy of coughs.

Vern. *Chudok*, Pahang.

2. *Thottea triserialis* DING HOU, Blumea 27 (1981) 330, f. 35, 41, 42.

Shrublet of 120 cm high. Branches terete, c. 5 mm \emptyset , pubescent. *Leaves* chartaceous, elliptic, broad-elliptic, slightly obovate, or ovate, 23–34 by 11–23 cm; apex acuminate or acute; base rounded or obtuse in outline but cordate (sinus narrow, 0.5–0.75 cm deep, auricles overlapping or touching each other); glabrous above, sparsely pubescent beneath; basal nerves 2–3 pairs, starting almost from the insertion of the petiole, the inner one ascending upward to 1/2–2/3 of the blade, similar to the lateral ones, the outer 1 or 2 short and weak; lateral nerves 7 or 8 pairs, prominently elevated below, often flat but distinct above; veins scalariform, connected with loosely reticulate or straight veinlets, elevated beneath, obscure above; petiole very short or obscure, sometimes up to c. 5 mm, pubescent. *Inflorescences* in the axils of foliage leaves or their scars, spiciform, solitary or fasciculate, 3–5 cm long, pubescent; bracts lanceolate, elliptic, or oblanceolate, 3–15 mm long, pubescent. *Pedicel* and ovary 18–20 mm long, densely pubescent. *Perianth* pink or pinkish brown, cupular, 10–15 mm long, slightly contracted at the lower 1/3–1/2, almost orbicular in outline when open (10–15 mm \emptyset), veins loosely reticulate, sparsely puberulous on both surfaces; tube short, terete, c. 5 mm long; lobes semi-orbicular, 5–10 by 11–15 mm, apex acute or cuspidate. *Stamens* in 3 whorls: upper row 5–8, middle 7–12, lower 12–16; filaments hairy,

0.5–1 mm; anthers oblong, c. 1.25 mm long. *Style* column c. 2 mm long, lobes 11–20, 1.5–2 mm, glabrous. *Capsule* (very young) siliquiform, 12 cm long, pubescent. *Seeds* flat (?).

Distr. *Malesia*: Borneo (Sarawak: Lundu Distr.; G. Pueh). Twice collected.

Ecol. In primary lowland dipterocarp forest, on gentle ridge slope, 600–1080 m. *Fl. fr.* April.

Note. Vegetatively not distinguishable from *T. macrophylla* and *T. robusta*. The inner surface of the perianth is glabrous; it is densely hairy in the other two species (glandular hairs in the former, mainly hooked-hairy ones in the latter). The stamens are arranged in 3 whorls, a unique character in the genus.

3. *Thottea straatmanii* DING HOU, Blumea 28 (1983) 352, f. 6.

Plant c. 2.5 m high. *Leaves* not preserved, (from a sketch) ovate-oblong, c. 30 cm long. *Inflorescence* cauligerous, spiciform, 2 cm long, puberulous, internodes 7–10 mm long; bracts leafy, ovate, 4.5–13 by 2.5–8 mm, puberulous on both surfaces. *Pedicel* and ovary c. 17 mm long, puberulous. *Perianth* when folded in side view \pm orbicular in outline, c. 7 cm \emptyset , cordate at base, sinus c. 12 mm deep, distinctly bi-auriculate; perianth deeply lobed, lobes \pm orbicular, c. 7 cm \emptyset , puberulous outside, loosely glandular hairy inside, veins rather loosely reticulate. *Stamens* in 2 whorls: upper row c. 18, lower c. 24; filaments glabrous, very short or 0; anthers oblong, 1.5–2 mm long. *Style* column c. 3 mm long, lobes c. 12, c. 1.5 mm. *Capsule* siliquiform, slightly curved, 15–21 cm long, slightly 4-angular, narrowed at both ends, puberulous. *Seeds* broad-ellipsoid, triangular, 3.5 by 2 mm, transverse-rugose, deeply grooved.

Distr. *Malesia*: NE. Sumatra (East Coast: Laut Tador).

Ecol. Growing very locally in wet shady places in open forest, at c. 100 m.

Notes. In flower size the second largest in the genus (perianth c. 7 cm in diam.), next to *T. grandiflora* (12.5 cm).

Closely related to *T. reniloba* with which it shares the spaced bracts and distinct internodes, the deeply lobed perianth, 2-whorled stamens, pubescent capsules and deeply grooved seeds, but different by larger, \pm orbicular perianth lobes, the higher number of stamens (upper whorl c. 18, lower c. 24) and the transverse-rugose seeds.

The forest of the type locality is now destroyed.

4. *Thottea grandiflora* ROTTBOELL, Nye Samling Kongel. Danske Vidensk. Selsk. Skr. 2 (1783) 529, t. 2; BENN. & BROWN, Pl. Jav. Rar. 1 (1838) 45; GRIFF. Trans. Linn. Soc. 19 (1845) 325, t. 36; Ann. Sc. Nat. Bot. 7 (1847) 328; Notul. 4 (1854) 346; Ic. Pl. Asiat. (1854) t. 530 & 531; MIQ. Fl. Ind. Bat. 1, 1 (1858)

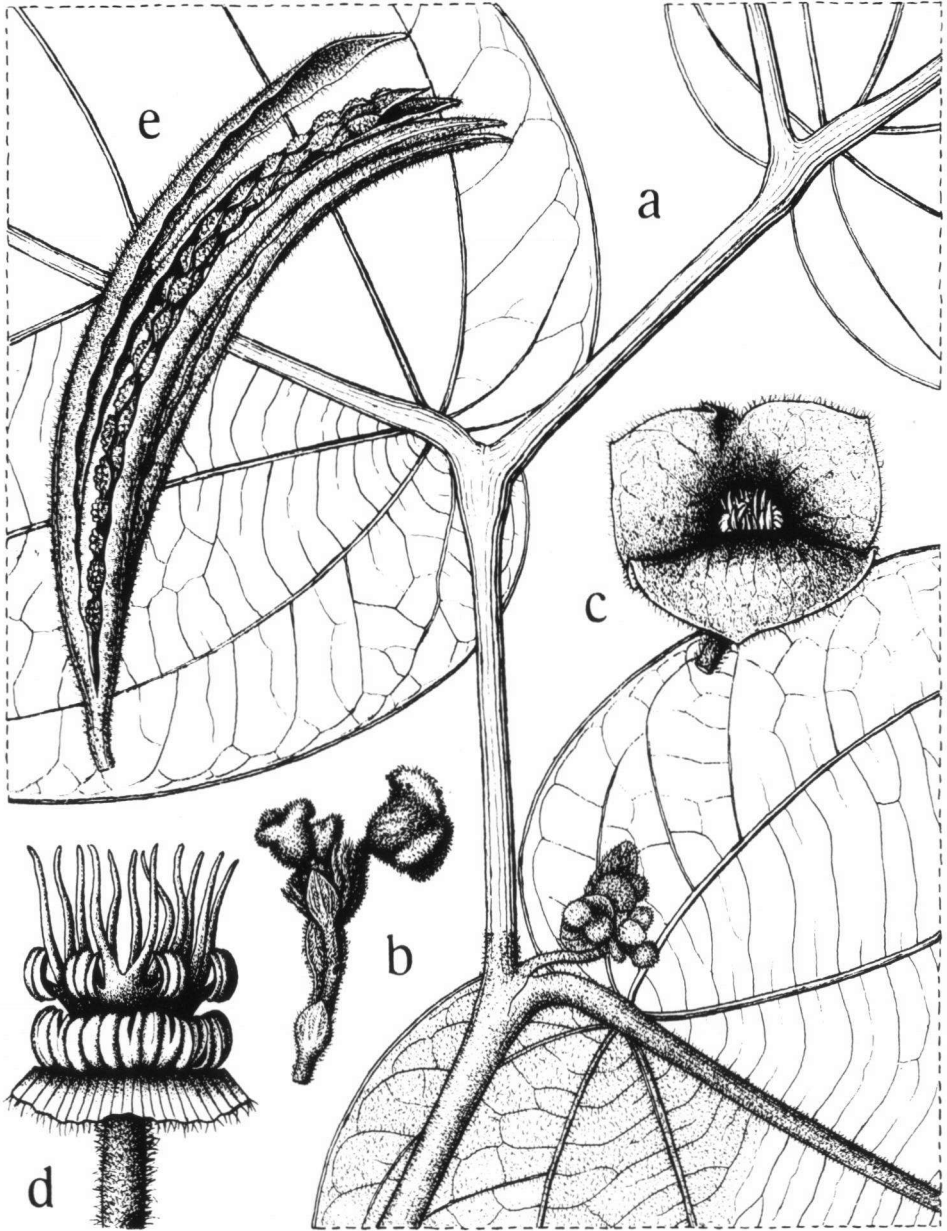


Fig. 4. *Thottea robusta* STEEN. *a.* Habit, nat. size, *b.* young inflorescence, *c.* open flower, both $\times 2$, *d.* gyno-stemium, $\times 7$, *e.* dehiscent fruit, nat. size (VAN STEENIS 1270).

1068; KLOTZSCH, Monatsb. Akad. Berl. (1859) 5 & 9, t. 1 f. 3; DUCHARTRE in DC. Prod. 15, 1 (1864) 428; HOOK. f. Fl. Br. India 5 (1886) 74; SOLEREDER, Bot. Jahrb. 10 (1889) 429 & 478; in E. & P. Nat. Pfl. Fam. 3, 1 (1889) 272; RIDL. J. Str. Br. R. As. Soc. n. 33 (1900) 127; KING & GAMBLE, J. As. Soc. Beng. 75, ii (1912) 27; RIDL. Fl. Mal. Pen. 3 (1924) 16; HEYNE, Nutt. Pl. (1927) 596; BURK. Dict. 2 (1935) 2156; SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 232; HEND. Mal. Wild Fl. (1951) 424, f. 383; DING HOU, Blumea 27 (1981) 308, f. 8–10, 317, f. 62. — Fig. 3.

Erect shrub, up to 2 m high. Branches terete, c. 1 cm \varnothing , villous. *Leaves* coriaceous, obovate, elliptic, ovate-oblong, or lanceolate, (15–) 20–30 (–45) by 9–10 (–25) cm; apex acute, short-acuminate, sometimes cuspidate; base obtuse, sometimes subcordate, rarely cuneate; villous, glabrescent or almost glabrous above, hispid-pubescent beneath; basal nerves 2 or 3 pairs, the inner one obliquely extending upward to c. half the blade, the outer one weaker and shorter, running along the margin; lateral nerves 10–12 pairs; all nerves prominent below, slightly elevated above; veins \pm parallel or reticulate, elevated below, distinct above; petiole 0.5–1.5 cm, villous. *Inflorescences* usually at the lower part of the stem in the axils of (fallen) leaves, simple or sparsely branched, sometimes branched near the base and seemingly fascicled, spiciform or racemiform, 1–7 cm long, villous; bracts lanceolate or elliptic, 1–3 cm long, villous on both surfaces. Pedicel and ovary up to 4 cm long, villous. *Perianth* deep claret-coloured and purple mottled, funnel-shaped, up to c. 12.5 cm long and as broad at the mouth (largest flower in this genus), with distinct and reticulate veins; pubescent without especially on the venation, puberulous inside, usually glabrescent; tube about half the length of the perianth; lobes triangular or suborbicular, 5–6 by 6–7 cm, acute or rounded at the apex. *Stamens* in 2 whorls: upper row c. 15 (–18), lower c. 15 (–24); filaments glabrous, very short; anthers oblong, c. 1.5–2 mm long. *Style* column short; lobes 8–19, c. 2.5 mm. *Capsules* slender, 10–15 cm long, straight or twisted, 4-angular, pubescent. *Seeds* ellipsoid, 3–4 mm long, trigonous, acute at both ends, rugose-tubercled.

Distr. Peninsular Burma (Moulmein); in *Malesia*: Malay Peninsula (Perak, Trengganu, Pahang, Negri Sembilan, Malacca, Johore, Singapore).

Ecol. In lowland forest, up to 600 m. *Fl. fr.* almost all year round.

Vern. *Grobo*, Malacca; *sel-wohl*, Pahang.

5. *Thottea macrophylla* BECC. Nuov. Giorn. Bot. Ital. 2 (1870) 5, t. 1: f. 1–6; STEEN. Bull. Jard. Bot. Btzg III, 12 (1932) 205; SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 232; DING HOU, Blumea 27

(1981) 312, f. 34, 330.

Erect shrub. Branches terete, c. 5 mm \varnothing , pubescent. *Leaves* coriaceous, elliptic-obovate, or obovate, 23–35 by 14–20 cm; apex acuminate; base obtuse or rounded in outline, shallow-cordate, sinus narrow, with auricles slightly overlapping each other; glabrous above, pubescent beneath; basal nerves 3 pairs, the inner pair similar to lateral ones, extending upward to c. 2/3 of the blade, outer 2 much weaker and shorter, close to the margin; lateral nerves c. 7 pairs, prominent below, distinct or slightly elevated above; veins crossbar-like, parallel, scalariform, veinlets transverse or reticulate, elevated and prominent beneath, distinct or obscure above; petiole 0.5–1 cm long, pubescent. *Inflorescences* in the axils of foliage leaves, solitary or sometimes 2, spiciform, c. 1.5 cm long, densely pubescent; bracts elliptic, obovate or oblanceolate, 3.5–9 by 1.5–3 mm, densely puberulous on both surfaces. Pedicel and ovary 17–20 mm long, densely puberulous. *Perianth* campanulate, c. 23 mm long, up to c. 45 mm \varnothing , deeply 3-lobed, outer surface with distinctly pubescent reticulations, less hairy between the veins, inner surface densely covered with papillae and glandular hairs (appearing carpet-like); tube very short; lobes triangular, c. 18 by 24 mm, short-acuminate. *Stamens* in 2 whorls: upper row 10 or 11, lower 16 or 17; filaments papillate, 0.5–1 mm; anthers oblong, c. 1.5 mm long. *Style* column c. 3 mm long; lobes 18–20, c. 3 mm long, glabrous. Capsules unknown.

Distr. *Malesia*: Borneo (Sarawak: Mt Matang). Twice collected.

Ecol. In forest, c. 750 m. *Fl.* April & July.

6. *Thottea robusta* STEEN. Bull. Jard. Bot. Btzg III, 12 (1932) 205, f. 11; SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 232; DING HOU, Blumea 27 (1981) 330, f. 36, 37, 57–60. — Fig. 4.

Erect shrub, 3–4 m high. Branches terete, c. 1 cm \varnothing , villous on young parts, glabrescent. *Leaves* chartaceous, variable in shape and size, obovate, subrhomboidal, ovate-oblong to oblong-lanceolate, 17.5–40 by 7.5–25 cm; apex acute or acuminate; base broadly rounded in outline and distinctly cordate, the auricles overlapping each other; glabrous above, pubescent or villous beneath, especially on the midrib and venation; basal nerves 2 or 3 pairs, emerging flabellately from the base, the inner one ascending upward to \pm halfway, similar to the lateral nerves in thickness and appearance, the outer 1 or 2 much weaker and shorter and close to the margin; lateral nerves 6–8 pairs, prominent beneath, distinct or slightly elevated above; veins transverse, parallel and scalariform, connected with crossbar-like or reticulate veinlets, elevated below, distinct or obscure above; petiole stout, 0.5–1.5 cm, densely pubescent. *Inflorescence* in the axils of foliage leaves, solitary or

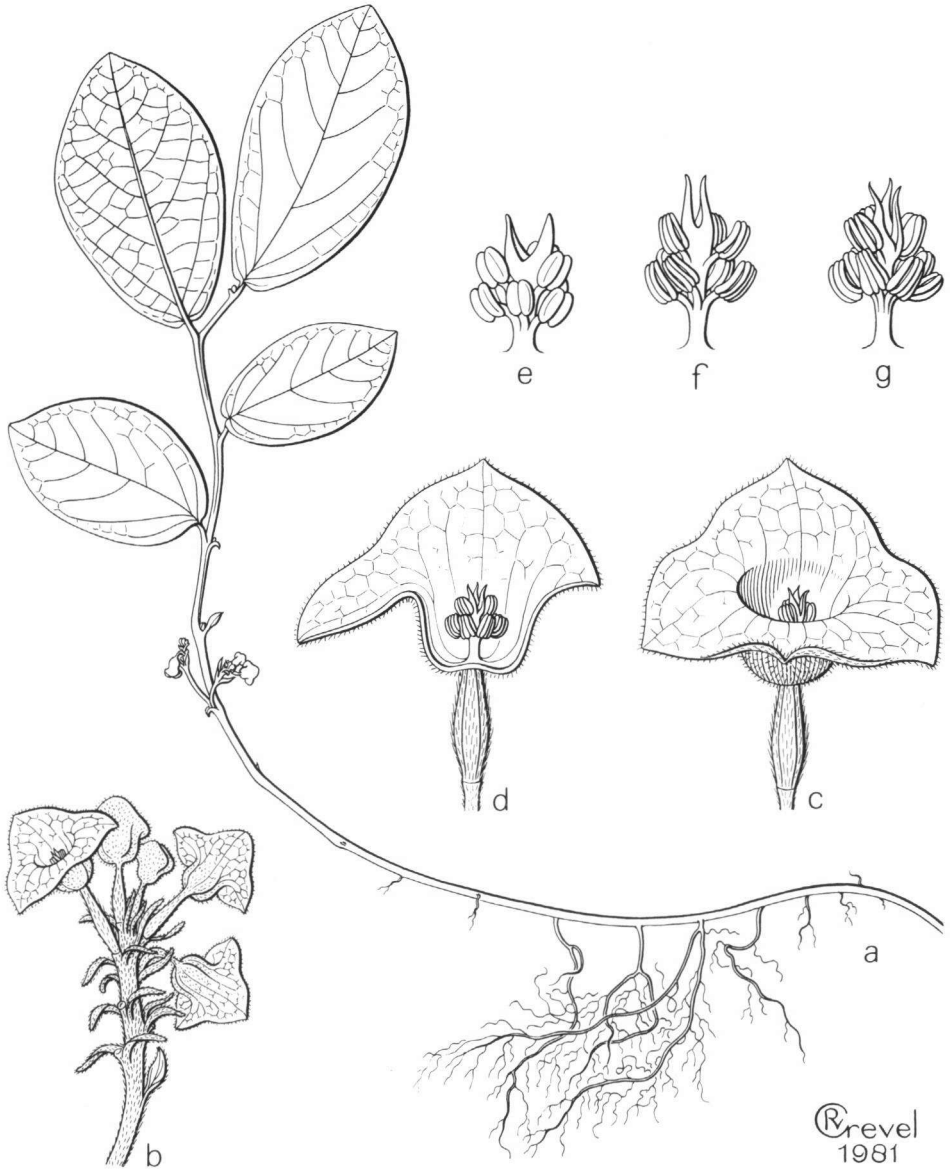


Fig. 5. *Thottea paucifida* DING HOU. a. Habit, $\times \frac{1}{2}$, b. inflorescence, $\times 2$, c-d. flowers, $\times 4\frac{1}{2}$, e-g. gynoecium, with 2- or 3-fid style, $\times 9$ (BROOKE 10009). Courtesy of Blumea.

in fascicles of 2 or 3, sometimes sparsely shortly branched, spiciform, 0.5–3.5 cm long, densely villous; bracts ovate to spatulate, crowded, 5–9 mm long, densely pubescent or villous. Pedicel and ovary short, c. 5 mm, densely pubescent or villous. *Perianth* pale wine-red, shallowly broad-campanulate, 8–10 mm long, c. 17 mm \emptyset ; outer surface with strongly prominent, villous reticulations, less hairy between the veins; inner surface densely covered with short (mainly hooked) hairs; tube 3–5 mm long, shallowly or obscurely lobed, lobes nearly semi-orbicular or triangular, c. 5 by 10 mm. *Stamens* in 2 whorls: upper row 7 or 8, lower c. 14; filaments glabrous, 0–0.7 mm; anthers oblong, 0.7–1 mm long. *Style* column short, c. 1.5 mm long, lobes c. 12, glabrous. *Capsules* narrow spindle-shaped, straight or falcate, not or only slightly twisted at the top, 8–11.5 cm long, villous. *Seeds* ovoid, c. 4 by 2 mm, trigonous, tuberculate.

Distr. *Malesia*: Natuna Islands (NW off Borneo) (Bunguran: E. slope of G. Ranai); once collected.

Ecol. Primary forest, along stream, c. 250 m. *Fl. fr.* April.

Vern. *Kaju ribal*, M.

7. *Thottea curvisemen* DING HOU, *Blumea* 27 (1981) 320, f. 32, 33, 64–66.

Erect shrub, 1–1.30 m high. Branches subterete, 4–6 mm \emptyset , pubescent. *Leaves* chartaceous, broad-elliptic or elliptic, 18.5–26 by 9–18 cm; apex acuminate; base rotund; glabrous above, sericeous beneath; basal nerves 2 (rarely 3) pairs, the inner one ascending obliquely upward to halfway, the outer 1 or 2 weak and short, close to the margin; lateral nerves 6–9 pairs; veins distinctly crossbar-like; nerves and veins prominent beneath, visible rarely distinct above; petiole c. 1 cm, pubescent. *Inflorescences* axillary, in axils of bracts or reduced leaves, spiciform, c. 3 cm long, puberulous; bracts elliptic or slightly obovate, 2.5–3 mm long, both surfaces puberulous. Pedicel and ovary 7–12 mm long, puberulous. *Perianth* bright purple, short-cupular, c. 12.5 mm long, with distinct, longitudinal veins, sparsely puberulous outside, densely glandular hairy inside; tube short-cupular, c. 9.5 mm long; lobes arcuate, c. 3 by 10 mm, obscurely cuspidate at the apex. *Stamens* in 2 whorls: upper one 8–10, lower 11–14; filaments glabrous, 1–1.5 mm; anthers oblong, 1–1.5 mm long. *Style* column c. 2 mm long; lobes 6–12, radiate, c. 1.5 mm long. *Capsule* (only one seen) narrow fusiform, 4.5 by 0.6 cm, straight, distinctly 4-angular, almost glabrous. *Seeds* flattened, boat-shaped, broad-ellipsoid in side view, c. 2–2.5 mm long, \pm obtuse or truncate at both ends (depending on the position in the fruit), rather smooth with only sparse granules on both surfaces.

Distr. *Malesia*: Borneo: Sarawak (Kapit: Bukit

Raya, Pelagus), once collected.

Ecol. In lowland dipterocarp forest, 240 m, on slopes of steep ridges. *Fl. fr.* August.

Note. Allied to *T. borneensis*.

8. *Thottea borneensis* VALET. *IC. Bog.* (1908) t. 261; SCHMIDT in E. & P. *Nat. Pfl. Fam. ed.* 2, 16b (1935) 232, f. 120P; DING HOU, *Blumea* 27 (1981) 321, f. 29–31.

Erect shrub up to 2 m high. Branches terete, up to 2 cm \emptyset , glabrous. *Leaves* chartaceous, elliptic, ovate-oblong, or obovate, 17–27 (–30) by 6.5–14 (–19) cm; apex acute, acuminate, sometimes cuspidate; base obtuse or cuneate; glabrous above, densely sericeous beneath; basal nerves 2 pairs, the inner one as prominent as the lateral ones, extending upward to 2/3 or more of the blade, the outer one very weak and short; lateral nerves 5–8 pairs, prominent beneath, distinct above; veins and veinlets transverse or slightly curved, \pm scalariform, or loosely reticulate, slightly elevated below, visible or obscure above; petiole 1–1.5 cm, slightly pubescent. *Inflorescences* axillary, simple or sparsely branched near base, 4–7 cm long, with one or a few flowers at the apical part, pubescent; bracts many, ovate or lanceolate, 1–3 mm long, densely puberulous outside, sparsely puberulous or glabrous inside. Pedicel and ovary 7–12 mm long, densely puberulous. *Perianth* cupular, 8–12 mm long, c. 15 mm \emptyset , dark purple; densely pubescent outside, sparsely puberulous inside; tube 4–6 mm long; lobes semi-orbicular or broadly ovate, 4.5–6 by 4.5–9 mm, erect, at anthesis the marginal part reflexed and the base biauriculate. *Stamens* in 2 whorls: upper row 10–13, lower 14–17; filaments glabrous, c. 0.5 mm; anthers oblong, c. 1 mm long. *Style* column obscure; lobes 9, radiately ascending, c. 1 mm long. *Capsules* siliquiform, pendulous, twisted, 9 cm long. *Seeds* \pm ellipsoid, c. 5 by 2 mm, strongly rugulose.

Distr. *Malesia*: Sumatra (West Coast: Padang) and Borneo (Landak; Kapuas: Mt Biang). Cultivated in the Hort. Bogor., from plants collected by TEYSMANN in Borneo, under the numbers XI-B-XIII. 76 & 134.

Ecol. *Fl.* Sept.–Nov. No other field ecological data recorded.

Note. See the note under *T. reniloba*.

9. *Thottea paucifida* DING HOU, *Blumea* 27 (1981) 324, f. 23, 24, 71. — Fig. 5.

Undershrub, creeping below and rooting, then ascending, up to 30 cm high. Branches subterete, c. 3 mm \emptyset , puberulous, glabrescent. *Leaves* chartaceous, 4.5–8 by 2.5–4.5 cm; apex acute or obtuse; base rotund or obscurely cordate; sparsely pubescent on both surfaces; basal nerves 1 or 2 pairs, usually thinner than the lateral ones, ascending upward to about

halfway; lateral nerves 4–6 pairs, slightly elevated below, distinct or faint above; veins crossbar-like and loosely reticulate, distinct or faint below, obscure above; veinlets obscure; petiole 2–3 mm, pubescent. *Inflorescences* axillary, in the axils of fallen leaves near the basal part of the stem, spiciform, simple or once branched, 1–3 cm long, puberulous; bracts linear, 2–5 mm long, densely puberulous on both surfaces. Pedicel and ovary 4.5–5 mm long, densely puberulous. *Perianth* cream colour, cupular, 6 mm long, with loose reticulations; tube 3 mm long, densely papillate inside; lobes subrotund or triangular, 3 by 3.5 mm, sparsely puberulous inside, apiculate at the apex. *Stamens* in 2 whorls: upper row 3, lower 6; filaments glabrous, 0–1 mm; anthers oblong, c. 0.5 mm long. *Style* column 1.25 mm long; lobes 2 or 3, c. 0.5 mm. Capsules unknown.

Distr. Malesia: Borneo (Sarawak: Div. 5, Lawas); once collected.

Ecol. On the banks of a stream through stands of rubber and other trees. *Fl.* May.

Note. Allied to *T. tomentosa*, but leaves lax-pubescent underneath, perianth without annular ridge in the apical part of the tube, 9 stamens in 2 whorls, and 2 (or 3) glabrous style lobes.

10. *Thottea tricornis* MAINGAY ex HOOK. f. *Fl. Br. India* 5 (1886) 74; SOLEREDER, *Bot. Jahrb.* 10 (1889) 430 & 506; KING & GAMBLE, *J. As. Soc. Beng.* 75, ii (1912) 29; RIDL, *Fl. Mal. Pen.* 3 (1924) 16; SCHMIDT in E. & P. *Nat. Pfl. Fam. ed.* 2, 16b (1935) 232; DING HOU, *Blumea* 27 (1981) 318, f. 2, 17, 18, 43, 44, 61, 70B. — *Fig. 7f–i.*

Erect shrub, up to 2 m high. Branches terete or slightly angular, c. 1 cm ϕ , pubescent. *Leaves* chartaceous or subcoriaceous, elliptic, lanceolate, obovate-oblong, or oblanceolate, 20–30 by 8.5–16 cm; glabrous above, pubescent beneath; apex acute or acuminate; base cuneate or rounded; basal nerves 2 pairs, emerging from the base, the inner one ascending upward reaching to c. 2/3 or higher, similar to the lateral ones, the outer one weak and short; lateral nerves 6–8 pairs, prominently elevated beneath, slightly elevated above; veins transverse, scalariform, connected by crossbar-like or reticulate veinlets, elevated beneath, often faint above; petiole 5–17 mm, pubescent. *Inflorescences* in the axils of foliage leaves, racemi- or paniculiform, up to 5 cm long, pubescent; bracts ovate, lanceolate, or linear, 3–6 mm long, puberulous. Pedicel and ovary 1.25–2 cm, densely pubescent or velvety. *Perianth* magenta or violet, campanulate, slightly contracted at the lower part, 1.5–2 cm long, suborbicular or six-angular in outline, 2.5–3.5 cm ϕ , densely pubescent outside, inner surface densely covered with glandular hairs and appearing mat-like; obscurely lobed, lobes triangular, 5–10 by 16–30 mm, apex acute or mu-

ronate. *Stamens* in 2 whorls, upper row 6–10, lower 10–14; filaments glabrous, c. 1 mm; anthers oblong, c. 1 mm long. *Style* column c. 2 mm long; lobes 5–13, c. 1.5 mm, glabrous. *Capsules* slender, rather long, 15–25 cm long, slightly curved or twisted, 4-angular, densely pubescent or velvety. *Seeds* oblong, 4–5 by 2 mm, trigonous, coarsely granulate.

Distr. Peninsular Thailand (Chawng), and *Malesia:* Malay Peninsula (Perak, Pahang, Selangor, Malacca).

Ecol. Undergrowth in forest, 300–600 m. *Fl.* Feb.–May, *fr.* Feb.–Aug.

Vern. *Melada*, Selangor; *telinga kelawar*, Pahang.

11. *Thottea beccarii* DING HOU, *Blumea* 27 (1981) 315, f. 25, 26, 51, 52.

Erect shrublet, 75–120 cm high. Branches \pm terete, 0.5–0.7 cm ϕ , lower part rather straight, upper part slightly zigzag, slightly pubescent, glabrescent. *Leaves* firmly chartaceous, elliptic, rarely lanceolate or oblanceolate, 20–35 by 7.5–15 cm; apex short-acuminate; base cuneate; sparsely pubescent above when young, glabrescent, often almost glabrous when old, pubescent beneath; nerves 6–9 pairs, usually pinnate, usually the basal pair for 0.5–0.7 cm united with the midrib, ascending up to 1/2–2/3 of the blade, sometimes one weak, short pair starting from the very base and extending along the margin; veins and veinlets closely reticulate, or \pm crossbar-like; both nerves and veins prominent below, obscure above; petiole very short, 5–7 mm, slightly pubescent. *Inflorescences* near the basal part of stem, 1 or 2 in an axil of a scale-like leaf, c. 5 cm long, spiciform, slightly puberulous; bracts lanceolate, linear, or oblanceolate, 5–6 mm long, rarely 2-lobed, sparsely puberulous on both surfaces. Pedicel and ovary 15–17.5 mm long, sparsely puberulous. *Perianth* cupular, 12–17.5 mm long, 20–25 mm ϕ , obscurely lobed; tube c. 10 mm long; lobes arcuate, 3–5 by 15–20 mm, slightly acute at the apex. *Stamens* in 2 whorls: upper row 7–10, lower 13 or 14; filaments hairy (?) or glabrous, 0.3–0.6 mm; anthers oblong, c. 1 mm long. *Style* column c. 2 mm long; lobes c. 10, erect, c. 1 mm long. *Capsules* siliquiform, 6.5–9 cm long, 4-angular, straight, narrowed and pointed at both ends, sparsely hairy or almost glabrous. *Seeds* broad-ellipsoid or subglobose, obscurely triangular on cross-section, 2 by 1.5–1.3 mm, prominently rugose, with transverse bars and tubercles, deeply furrowed.

Distr. Malesia: Sumatra (Padang and Asahan), 4 collections.

Ecol. At c. 360 m. *Fl. fr.* August.

Vern. *Kaju pinggu batu*, Asahan.

Notes. Allied to *T. borneensis* but differing by the closely reticulate venation and scattered hairs; in *T. borneensis* the venation is scalariform or loosely

reticulate and hairs are densely matted beneath.

Also allied to *T. tricornis* by the closely reticulate venation and inflorescences near the base of the stem, in the axils of bract-like reduced leaves, and further by the fruit and seed.

12. *Thottea rhizantha* BECC. Nuov. Giorn. Bot. Ital. 2 (1870) 6, t. 1: 7–10; SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 232, f. 120K; DING HOU, Blumea 27 (1981) 311, f. 45–47.

Erect shrub or treelet, up to c. 1.25 m high. Branches terete, c. 1 cm \varnothing , densely tomentose or villous, sometimes glabrescent. *Leaves* subcoriaceous, elliptic, oblanceolate, or oblong, 21–42.5 by 9.5–16.5 cm, apex acuminate; base cuneate or obtuse; glabrous above, tomentose beneath especially on the midrib, nerves and veins; basal nerves 2 pairs, emerging from the base, the inner one extending upward to about halfway, similar in thickness and appearance to the lateral ones, occasionally with some secondary nerves, outer one very weak, short and close to the margin; lateral nerves 8–10 pairs, elevated and prominent beneath, distinct or flat above; veins usually transverse and scalariform, connected with crossbar-like or loosely reticulate veinlets, elevated beneath, often faint or invisible above; the petiole c. 5 mm, densely pubescent. *Inflorescences* near the base of the stem, in the axils of bracts, few-branched, paniculiform or racemiform, internodes spacious, villous; bracts ovate, c. 10 mm long, villous. Pedicel and ovary 10–15 mm, pubescent. *Perianth* outside faintly violet tinged, inside violet at the base, white at the top, or red with white, funnel-shaped, 3–3.5 cm long, c. 3.5 cm \varnothing , with distinct longitudinal and loosely reticulate veins, pubescent outside, glandularly hairy inside; tube cylindrical, c. 1.5 cm long; lobes suborbicular, 1.5–2 by 1.2–2 cm, apical part rounded, acute, or rarely apiculate. *Stamens* in 2 whorls: upper row 6–8, lower 13–15; filaments glabrous, 0–0.5 mm; anthers oblong, c. 1.5 mm long. *Style* column 2.5 mm long, lobes 5–7, c. 1.5 mm, glabrous. Capsules unknown.

Distr. Malesia: Sumatra (Djambi: Sg. Lesing near Pauh); Borneo (Sarawak: Bellaga near Bintulu; Kapit Distr.).

Ecol. In primary hill forest on sandstone substratum, mixed dipterocarp forest on ridge, or on ridge in old secondary forest, up to 500 m.

Uses. Roots boiled in water is taken to cure gonorrhoea in Sarawak.

Vern. Sumatra: *mai-mai*, Sg. Lesing; Sarawak: *keh*, Punan lang.

13. *Thottea philippinensis* QUIS. Philip. J. Sc. 41 (1930) 322, t. 2; DING HOU, Blumea 27 (1981) 306, f. 1; *ibid.* 29 (1983) 242. — **Fig. 8a.**

Erect undershrub up to c. 70 cm high. Branches

subterete, c. 0.5 cm \varnothing , pubescent. *Leaves* thin-coriaceous, lanceolate to narrow-lanceolate, oblong-elliptic or elliptic-lanceolate, 16–26 (–39) by 4–9 (–13) cm; apex acuminate; base rounded or cuneate; glabrous above, pubescent beneath; nerves pinnate, basal pair weak and short, close to the margin, up to 1/4–1/3 of the blade; lateral nerves 8–13 pairs, elevated and prominent beneath, slender above; veins and veinlets closely reticulate, prominent beneath, rather faint above; petiole c. 5 mm, pubescent. *Inflorescences* at the basal part of the stem, in the axils of reduced leaves, spiciform, up to 5 cm long, pubescent. Bracts elliptic, 2–5 mm long, puberulous on both surfaces. Pedicel and ovary 8–13 mm, densely puberulous. *Perianth* light bluish purple, blue and pink, or dark red outside and whitish inside, campanulate, 16–22 mm long, 10–20 mm \varnothing , with loosely reticulate veins, puberulous outside, glandular hairy inside; tube 10–15 mm long; lobes triangular or semi-orbicular, 6–7 by 11–16 mm, apex acute or apiculate (the apical part usually incurved and the apex seemingly obtuse). *Stamens* in 2 whorls: upper row 8–10, lower 12–14; filaments glabrous, 1–1.5 mm; anthers oblong, 1.3 mm long. *Style* column 5–7 mm; lobes 4–6, glabrous. *Capsule* fusiform (only open, empty valves seen), c. 3 cm long, pubescent. Seeds not seen.

Distr. Malesia: Philippines (Mindanao: Lanao Prov.) and Borneo: Sarawak (4th Div., Lambir Nat. Park). Twice collected.

Ecol. In dipterocarp forest and on sheltered sandstone cliff, 150–450 m. *Fl. fr.* March, Sept.

Vern. *Taguibunon*, Lanao.

Note. See the note under *T. celebica*.

14. *Thottea dependens* (PLANCH.) KLOTZSCH, Monatsbl. Akad. Berl. (1859) 589; DUCHARTRE in DC. Prod. 15, 1 (1864) 428; HOOK. f. Fl. Br. India 5 (1886) 74; SOLEREDER, Bot. Jahrb. 10 (1889) 429; in E. & P. Nat. Pfl. Fam. 3, 1 (1889) 272; RIDLEY, J. Str. Br. As. Soc. n. 33 (1900) 127; KING & GAMBLE, J. As. Soc. Beng. 75, ii (1912) 28; GRESHOFF, Meded. Lands Pl. Tuin 29 (1930) 132; BURK. & HANIFF, Gard. Bull. S. S. 6 (1930) 240; SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 232, f. 120 L–O; BURK. Dict. 2 (1935) 2156; DING HOU, Blumea 27 (1981) 311, f. 5–7. — *Lobbia dependens* PLANCH. in Hook. Lond. J. Bot. 6 (1847) 144, t. 3; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1068. — **Fig. 1b.**

Erect shrub, up to 2.5 m high. Branches subterete, c. 0.5 cm \varnothing , glabrous. *Leaves* chartaceous, elliptic, obovate, rarely ovate, 12–29 by 5–15 cm; apex acuminate; base cuneate or acute; glabrous above, sparsely puberulous or pubescent, sometimes seemingly glabrous beneath; basal nerves 2 pairs, the inner one similar to lateral nerves, extending upward to about halfway, the outer one weak, short, close to



Fig. 6. *Thottea penitilobata* DING HOU. *a.* Habit, $\times \frac{1}{2}$, *b.* basal part of flowering stem, $\times \frac{1}{2}$, *c.* inflorescence, nat. size, *d-e.* flowers, $\times 2$, *f.* gynostemium, $\times 5$. — *T. muluensis* DING HOU. *g.* Inflorescence on stem, $\times \frac{1}{2}$, *h.* flower, nat. size, *i.* gynostemium, $\times 5$ (*a-f* ARGENT c.s. 691, *g-i* ARGENT c.s. 760). Courtesy of Blumea.

the margin; lateral nerves 6–9 pairs, elevated and prominent below, less so above; veins transverse or \pm parallel and reticulate, slightly elevated on both surfaces; petiole 5–10 mm, glabrous. *Inflorescences* at the basal part of the stem, in the axils of leaves or fallen leaves, or cauliflorous, simple or sparsely branched, up to 4 (–7) cm long, pubescent; bracts lanceolate, oblanceolate or elliptic, 6–9 mm long, densely puberulous on both surfaces. Pedicel and ovary 7–15 mm long, pubescent. *Perianth* pale yellow with center and margin streaked with claret-colour, brown, deep reddish pink, dark purple outside and pink inside, or purple; campanulate, contracted at the lower 1/3 and then erecto-patent, 15–25 mm long, c. 25 mm ϕ , glabrous on both surfaces; tube urceolate, c. 10 mm long; lobes triangular, 6–10 (–15) by 10–15 (–25) mm, acute, each with longitudinal (c. 7) and reticulate veins. *Stamens* in 2 whorls: upper row 7–10, lower 13–16; filaments glabrous, 1–2 mm; anthers oblong, c. 1.5 mm long. *Style* column c. 4 mm long; lobes (4–) 6–9, spreading, c. 3 mm long. *Capsules* slender, 5–10 cm long, 4-angular, straight or slightly twisted at the apical part. *Seeds* ellipsoid, trigonous, 3–4 mm long, acute at both ends, rugose-tubercled.

Distr. Malesia: Malay Peninsula (Perak, Dingdings, Trengganu, Pahang, Selangor, Penang, Singapore).

Ecol. In forest, up to c. 500 m. *Fl.* March–Oct., *fr.* Jan.–Nov.

Uses. Leaves used as medicine for cutaneous disease.

Vern. Tlinga berwang, Perak.

Note. See also the note under the Bornean *T. mu-luensis*.

15. *Thottea reniloba* DING HOU, *Blumea* 27 (1981) 326, f. 19, 20, 53. — **Fig. 2g.**

Erect subshrub, up to 2.5 m high. Branches \pm curved, terete or slightly compressed, 0.5–1 cm ϕ , pubescent. *Leaves* chartaceous, oblanceolate, lanceolate, or elliptic, 15–29 by 5.5–14 cm; apex acuminate; base cuneate or obtuse; glabrous, sometimes slightly pubescent on the midrib above, loosely pubescent beneath; basal nerves 2 pairs, the inner one starting near the base, ascending up to 2/3 or higher, similar to the lateral ones in thickness and appearance, the outer one weak and short, close to the margin; lateral nerves 5–8 pairs, occasionally with shorter ones between them, elevated beneath, faint above; veins transverse, scalariform, connected with crossbar-like or loosely reticulate veinlets, slightly elevated below, flat or obscure above; petiole 4–10 mm, pubescent. *Inflorescences* in the axils of foliage leaves, simple or sparsely branched, up to 8.5 cm long, spici- or racemiform, internodes spacious, puberulous; bracts oblanceolate to spatulate, or nar-

row-elliptic, 3–7 mm long, puberulous on both surfaces. Pedicel and ovary rather long, 14–30 mm, puberulous. *Perianth* dirty purplish red, or dark brown, short-cupular, 10–13 mm long, 15–20 mm ϕ , veins rather loosely reticulate, sparsely puberulous outside, slightly (glandular) hairy inside; tube 5–6 mm long; lobes reniform, 5–7 by 11–20 mm, margin reflexed at anthesis. *Stamens* in 2 whorls: upper row 9–12, lower 9–14; filaments glabrous, very short; anthers oblong, c. 1 mm long. *Style* column short, c. 1.5 mm long; lobes 8 or 9, c. 2 mm, glabrous. *Capsules* (rather young) pendent, siliquiform, twisted, narrowed at both ends, puberulous. *Seeds* ellipsoid, c. 2.5 by 1.5 mm, tubercled, deeply furrowed.

Distr. Malesia: Northern Sumatra (Atjeh: Gunung Leuser Nature Reserve; Tapanuli: Div. Padang; East Coast: Asahan and Upper Bila).

Ecol. In lowland forest, at base of steep sandstone rock or over basalt rock, up to 125 m. *Fl.* April–Sept., *fr.* July.

Note. The flowers remind of *T. borneensis*; differs from that species by loosely pubescent (not densely sericeous) leaf undersurface, venation at base reticulate (not transverse), rachis with spaced bracts and long internodes, perianth without a distinct annular fold or ridge inside the mouth of the tube, and reniform lobes.

16. *Thottea penitilobata* DING HOU, *Blumea* 27 (1981) 324, f. 14–16, 72A. — **Fig. 6a–f.**

Erect shrub, c. 1 m high. Branches terete, c. 0.5 cm ϕ , slightly puberulous or glabrescent. *Leaves* chartaceous, oblanceolate or elliptic, (12–) 16–22 by 5–9.5 cm; apex acuminate; base cuneate or slightly obtuse; glabrous above, sparsely puberulous beneath; basal nerves 2 pairs, the inner one similar to the lateral nerves, emerging near the base and obliquely ascending halfway, the outer one very weak, short, and close to the margin; lateral nerves 4–7 pairs, elevated beneath, distinct above; veins transverse or scalariform, connected by transverse or reticulated veinlets, slightly elevated beneath, visible or rather obscure above; petiole 0.5–0.7 cm, subterete, sparsely puberulous. *Inflorescences* near the basal part of the stem, in axils of reduced leaves, simple or rarely with short branches, spiciform, 3–6.5 cm long, puberulous; bracts ovate or lanceolate, 2–7 mm long, puberulous on both surfaces. Pedicel and ovary c. 6 mm long, sparsely puberulous. *Perianth* c. 15 mm long, deeply lobed, sparsely puberulous outside, glabrescent, densely (glandular) papillate on the inner surface except glabrous at the apical and marginal parts of the lobe; veins invisible outside, obscurely reticulate near marginal parts of lobes; tube very short; lobes broad-ovate or suborbiculate, 10–12 by c. 11 mm, acute, short-acuminate, or obtuse. *Stamens* in 2 whorls: upper row 10, lower c. 14; filaments glabrous, very

short; anthers oblong, c. 1.25 mm long. *Style* column short; lobes (6-) 10-14, 1.5-2 mm, glabrous. Capsules unknown.

Distr. *Malesia*: Borneo (Sarawak: 4th Div., Gunong Mulu Nat. Park; Kalimantan: Kalteng Prov.); twice collected.

Ecol. On bank at riverside in lowland rain-forest and in primary dipterocarp forest, 40-150 m. *Fl.* Nov., Jan.

Vern. *Kayu manis*, Kalimantan.

Note. Closely allied to *T. muluensis*, from which it cannot be separated in sterile state, but quite different in flower structure: perianth 1.5 cm long, deeply lobed, with broad or suborbicular lobes; 10-12 style lobes; in *T. muluensis* the perianth is 3.7-4.5 cm long, only lobed halfway, with triangular lobes; 7 style lobes.

17. *Thottea celebica* DING HOU, *Blumea* 27 (1981) 318, f. 21, 22, 70A. — Fig. 7a-e.

Erect undershrub, up to 70 cm high. Branches terete, 5-7 mm \varnothing , pubescent. *Leaves* chartaceous to coriaceous, 22.5-32 by 6.5-9 cm; apex acuminate; base obtuse; glabrous above, sparsely puberulous beneath; basal nerves 2 pairs, the inner one branching from the midrib c. 4 mm above the base and extending upward to about halfway, the outer one much weaker and shorter and close to the margin; lateral nerves c. 10 pairs; veins transversal or reticulate; nerves and veins elevated and prominent beneath, less so above; petiole short, c. 0.5 cm, puberulous. *Inflorescences* at the base of the stem, simple, spiciform, 5.5 cm long, puberulous; bracts elliptic, 4-8 mm long, sometimes 2-lobed, puberulous on both surfaces. Pedicel and ovary c. 12.5 mm long, puberulous. *Perianth* dark purplish red, campanulate, c. 25 mm long, c. 30 mm \varnothing , with several longitudinal veins distinct outside, obscure inside, puberulous, glabrescent outside, glandular hairy inside, especially at the lower 1/3; tube cupular, the lower half contracted and cylindrical (c. 6 mm long); lobes semi-orbicular, c. 10 by 15 mm, subrotund or slightly apiculate at the apex. *Stamens* in 2 whorls: upper row 10-12, lower 12-15; filaments glabrous, 1-2 mm; anthers 1-1.7 mm long. *Style* column c. 1 mm long; lobes c. 12, erect, c. 2 mm long. *Capsules* (very young) slender, 4-angular, twisted, c. 4 cm long, sparsely puberulous.

Distr. *Malesia*: Central Celebes (Lambarese, NE. Palopo); once collected.

Ecol. Open shady places in forest at low altitude. *Fl.* & very young fr. July.

Note. The only species so far known from Celebes. Allied to *T. philippinensis*, which has a closely reticulate prominent venation underneath the leaves, a slightly shorter perianth not contracted in the lower third, and 4-6 style lobes against c. 12 in *T. celebica*.

18. *Thottea muluensis* DING HOU, *Blumea* 27 (1981) 322, f. 72B. — Fig. 1c, 6g-i.

Erect shrub, c. 1 m high. Branches terete, c. 6 mm \varnothing , glabrous. *Leaves* chartaceous, elliptic, lanceolate, or oblanceolate, 15-29 by 5-12 cm; apex acute to acuminate; base cuneate; glabrous above, sparsely puberulous beneath; basal nerves one pair, emerging slightly above the base and ascending to about halfway; lateral nerves 6-10 pairs; nerves elevated and prominent below, flat and distinct above; veins transverse, scalariform, connected with loosely reticulated veinlets, elevated below, visible or obscure above; petiole c. 1 cm, sparsely puberulous. *Inflorescences* at the basal part of the stem or near the ground, usually in the axils of bracts, single or sparsely branched near the base, racemiform, 12-14 cm long, puberulous; bracts lanceolate, 5-10 mm long, puberulous on both surfaces. Pedicel and ovary 9-11 mm long, puberulous. *Perianth* dark purplish or dark purplish maroon, campanulate, 37-45 mm long, with longitudinal and reticulate veins, sparsely puberulous on both surfaces; tube 17-20 mm long; lobes triangular, 20-25 by c. 20 mm, acuminate. *Stamens* in 2 whorls: upper row 9, lower 12; filaments glabrous, very short, c. 1.3 mm; anthers oblong, 0.7-1 mm long. *Style* column c. 3 mm long; lobes 7, c. 1.5 mm, glabrous. Capsules unknown.

Distr. *Malesia*: Borneo (Sarawak: Gunong Mulu Nat. Park).

Ecol. Somewhat open position in lowland forest, c. 35 m. *Fl.* Oct.-Nov.

Uses. Said to be used for birth control by Punan people.

Note. Allied to *T. dependens* which has, however, the undersurface of the leaf covered by papillae forming rings or loops and a glabrous perianth. See also note under *T. penitilobata*.

19. *Thottea corymbosa* (GRIFF.) DING HOU, *Blumea* 27 (1981) 320, f. 4. — *Bragantia corymbosa* GRIFF. *Trans. Linn. Soc.* 19 (1845) 335; *Ann. Sc. Nat. Bot.* 7 (1847) 340; *Miq. Fl. Ind. Bat.* 1, 1 (1858) 1068; KLOTZSCH, *Monatsb. Akad. Berl.* (1859) 591, t. 1, f. 4; DUCHARTRE in DC. *Prod.* 15, 1 (1864) 429; HOOK. *f. Fl. Br. India* 5 (1886) 73; SOLEREDER, *Bot. Jahrb.* 10 (1889) 431. — *Asiphonia piperiformis* GRIFF. *Trans. Linn. Soc.* 19 (1845) 333; *Ann. Sc. Nat. Bot.* 7 (1847) 338; *Notul.* 4 (1854) 344; *Icon. Pl. Asiat.* 4 (1854) t. 528, f. 1. — *Strakaea melastomaefolia* PRESL, *Epim. Bot.* (1851) 221. — *Asiphonia sp.* GRIFF. *Notul.* 4 (1854) 346; *Icon. Pl. Asiat.* 4 (1854) t. 528, f. 2. — *Bragantia melastomaefolia* DUCHARTRE in DC. *Prod.* 15, 1 (1864) 429; WARBURG, *Pflanzenwelt* 1 (1913) 521. — *Apama corymbosa* (GRIFF.) WILLD. ex SOLEREDER in E. & P. *Nat. Pfl. Fam.* 3, 1 (1889) 272; O.K. *Rev. Gen. Pl.* 1 (1891) 563; KING &

GAMBLE, J. As. Soc. Beng. 75, ii (1912) 25; MOORE, J. Bot. 63 (1925) 83; HEYNE, Nutt. Pl. (1927) 596; BURK. Dict. 1 (1935) 188; SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 233; HEND. Mal. Wild Fl. (1951) 420, f. 382A-C. — Fig. 1a, 8d.

Shrub, spreading, sometimes scrambling, up to 5 m high. Branches terete, up to 2 cm ϕ , densely puberulous. Leaves chartaceous or subcoriaceous, ovate to lanceolate, elliptic or elliptic-oblong, sometimes ovate, 6.5–17.5 by 2.5–8.5 cm; apex cuspidate or acuminate; base cuneate, rounded or obtuse; upper surface glabrous except scattered puberulous on the midrib, nerves and veins, lower surface puberulous; basal nerves 2 pairs, the inner one as prominent as the midrib (the leaf appearing as 3-ribbed), ascending upward and reaching often to the apical part of the blade, the outer one much weaker, close to the margin, shorter than the inner one; lateral nerves 0–3 pairs, when present usually at the upper half of the blade; veins transverse, parallel (\pm perpendicular to the midrib), joined by crossbar-like or loosely reticulate veinlets; nerves and veins elevated and prominent beneath, slightly elevated and rather fine above; petiole subsessile to c. 8 mm, puberulous. Inflorescences terminal and/or axillary in the upper leaf-axils, few- and lax-branched, paniculiform or corymbose, up to 10 cm long, puberulous; bracts subulate or linear, up to 8 mm long, puberulous. Pedicel and ovary 7–20 mm, puberulous. Perianth yellow, greenish or cream coloured outside, pale lilac inside, 3–3.5 mm long, when spreading c. 7 mm ϕ , densely puberulous outside, glabrous inside, veins invisible, deeply 3-lobed; lobes broad-ovate or suborbicular, 2.5–3 by 2.5–3.5 mm, apex acute. Stamens in 1 whorl, 7–10, rarely more; filaments 0 or obscure; anthers oblong, c. 1 mm long, covered with short, hooked hairs. Style column obscure, lobes 4, glabrous. Capsules slender, long, up to 38 cm long, 4-angular, slightly twisted, puberulous. Seeds ovoid, trigonous, 4–6 by 2.5–3.5 mm, rugose.

Distr. *Malesia*: Widely distributed but scattered in Sumatra and the Malay Peninsula (incl. Penang); Borneo (Kalimantan: Bukit Kasian), once collected.

Ecol. In forest, sometimes on the edge of forest, occasionally in shaded forest in limestone zone, from the lowland up to 1050 m. Fl. fr. all the year round.

Uses. Pounded leaves are put inside the hollow of the tooth to remedy toothache. The central part of the roots is chewed along with betel-nut as a diuretic, if needed, during confinement (BURKILL, l.c.).

Vern. Sumatra: (*andor*) *lasi*, *bandar puluh*, Asahan, *kadudu rimbu*, Djambi, *subie siang*, Riouw (Kuala Belitai). Malay Peninsula: *akar chambai olar*, *a. julong bukit*, *a. serai*, *andor lasi*, *bunga changi ular*, *èkor pelandok*, *jangat*, *lerkor*, *mahjar pahit*, *tin-jau biuti*, M.

20. *Thottea tomentosa* (Bl.) DING HOU, Blumea 27 (1981) 328, f. 48, 49. — *Ceramium tomentosum* Bl. Bijdr. (1826-27) 1135. — *Bragantia tomentosa* Bl. En. Fl. Jav. (1827) 82; BENN. in Benn. & Brown, Pl. Jav. Rar. 1 (1838) 43, t. 11; GRIFF. Trans. Linn. Soc. 19 (1845) 336; LINDL. Veg. Kingd. (1846) 794; GRIFF. Ann. Sc. Nat. Bot. 7 (1847) 340; ZOLL. Syst. Verz. 2 (1854) 118; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1068; DUCHARTRE in DC. Prod. 15, 1 (1864) 431; HOOK. f. Fl. Br. India 5 (1886) 73, *incl. var. lanuginosa* HOOK. f.; CLARKE, J. Linn. Soc. Bot. 25 (1889) 61; SOLEREDER, Bot. Jahrb. 10 (1889) 431; RIDL. J. Str. Br. R. As. Soc. n. 57 (1910) 89; *ibid.* n. 59 (1911) 161. — *Vanhallia tomentosa* J.A. & J.H. SCHULTES, Syst. Veg. 7 (1829) 166. — *Bragantia blumii* LINDL. Bot. Reg. 18 (1832) *sub t.* 1543, in note; Veg. Kingd. (1846) 793, f. 526. — *Cyclodiscus tomentosus* KLOTZSCH, Monatsb. Akad. Berl. (1859) 592. — *Apama tomentosa* ENGL. ex SOLEREDER in E. & P. Nat. Pfl. Fam. 3, 1 (1889) 272; O. K. Rev. Gen. Pl. 1 (1891) 563; KING & GAMBLE, J. As. Soc. Beng. 75, ii (1912) 25, *incl. var. lanuginosa* (HOOK. f.) K. & G. l.c. 26; BACK. Trop. Natuur 7 (1918) 179, f. 1–4; *ibid.* 8 (1919) 164; BEUMÉE, *ibid.* 8 (1919) 15; RIDL. Fl. Mal. Pen. 3 (1924) 15; MOORE, J. Bot. 63 (1925) Suppl. 83; KOORD. Exk. Fl. Java 4 (Atlas) (1926) 589, f. 871; HEYNE, Nutt. Pl. (1927) 596; STEEN. Bull. Jard. Bot. Btzg III, 12 (1932) 204; BURK. Dict. 1 (1935) 189; SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 234, f. 120A–G; KANJILAL.c.s. Fl. Assam 4 (1940) 30; HEND. Mal. Wild Fl. (1951) 423, f. 382E; BACK. & BAKH. f. Fl. Java 1 (1963) 162. — *Bragantia affinis* PLANCH. ex ROLFE, Kew Bull. (1913) 265; MERR. En. Philip. 2 (1923) 120. — *Bragantia brevipes* MERR. Philip. J. Sc. 17 (1920) 248; En. Philip. 2 (1923) 120. — *Apama affinis* WEISSE, Ber. Deut. Bot. Ges. 45 (1927) 235; SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 234. — *Apama brevipes* WEISSE, Ber. Deut. Bot. Ges. 45 (1927) 235; SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 234.

Subwoody herb, from creeping base erect to erecto-patent, 10–35 cm; stems one to several or sometimes many together, usually simple. Branches rather slender, c. 5 mm ϕ , bearing 1–5 (often 2 or 3) foliage leaves at the apical part, furrowed or slightly angular, tomentose. Leaves chartaceous or subcoriaceous, variable in shape and size even on one plant, ovate, elliptic or broadly elliptic, elliptic-oblong, ovate or oblanceolate, rarely suborbiculate, (4–) 7–18 (–24) by (1.7–) 3–15 (–17) cm; apex acute, acuminate, or obtuse; base obtuse, rounded, sometimes subcordate or cordate; glabrous above, densely pubescent, tomentose or villous beneath especially when young, sometimes glabrescent; basal nerves 2, rarely 3 pairs, starting from the base and ascending upward to more than halfway, similar to the lateral nerves, the outer 1 or 2 rather faint and short, close

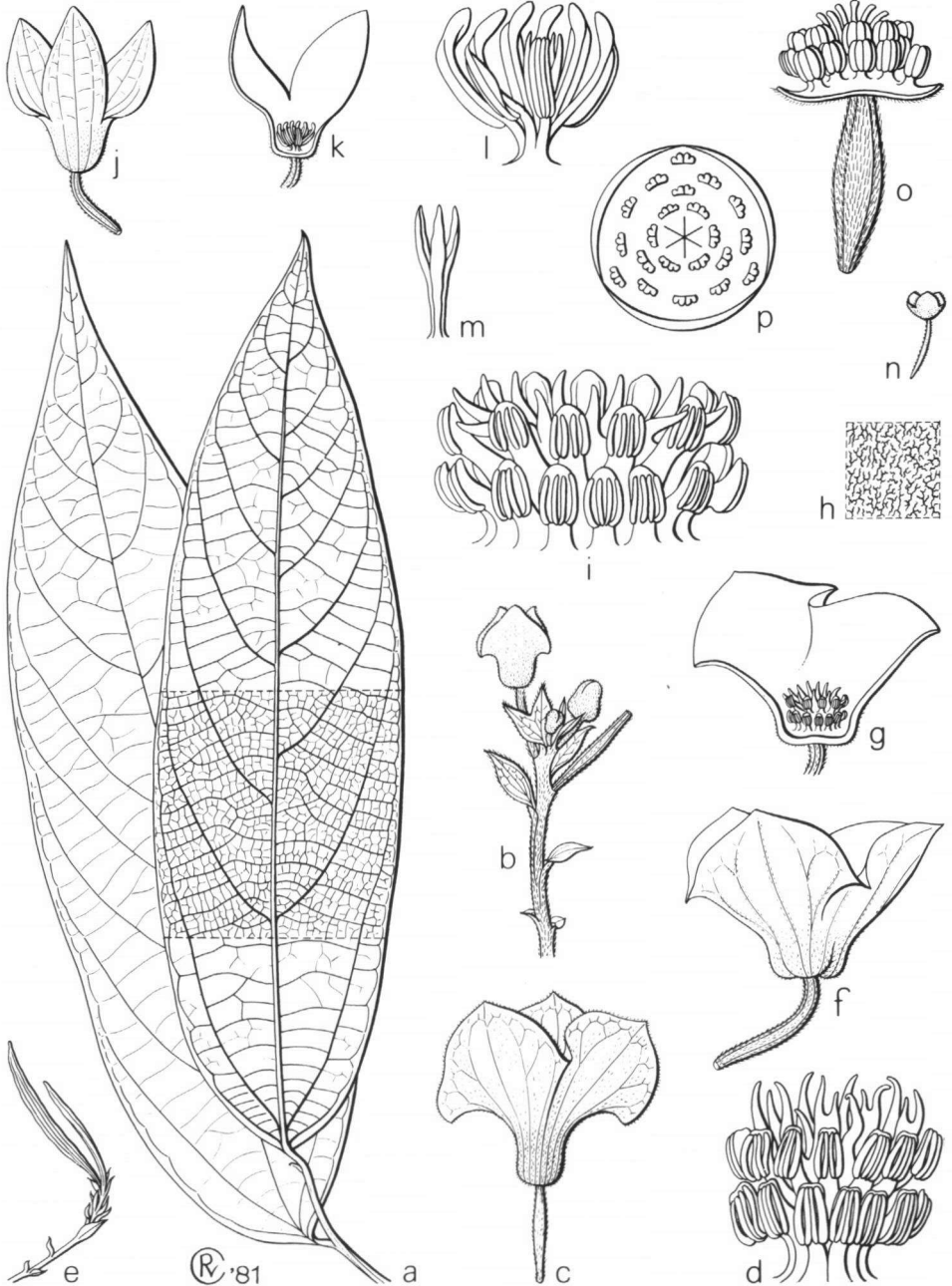


Fig. 7. *Thottea celebica* DING HOU. *a*. Habit, $\times \frac{1}{2}$, *b*. inflorescence, *c*. flower, nat. size, *d*. gynostemium, $\times 5$, *e*. young infructescence, $\times \frac{1}{2}$. — *T. tricornis* MAINGAY. *f*–*g*. Flowers, nat. size, *h*. indument of inner surface of perianth, $\times 10$, *i*. gynostemium, $\times \frac{1}{2}$. — *T. sumatrana* (MERR.) DING HOU. *j*–*k*. Flowers, nat. size, *l*. gynostemium, $\times 5$, *m*. 3-lobed style, $\times 5$. — *T. parviflora* RIDL. *n*. Flower, nat. size, *o*. ditto, perianth removed, $\times 5$, *p*. floral diagram showing 4 whorls of stamens (*a*–*e* STRAATMANS *s.n.*, *f*–*i* VAN BALGOOY 2627, *j*–*m* KOSTERMANS 284, *n* VAN BEUSEKOM & PHENGLAI 694, *o*–*p* GEESINK & SANTISUK 5101). Courtesy of Blumea.

to the margin; lateral nerves 4–9 pairs, joined by rather closely reticulate and loosely crossbar-like veins and veinlets, elevated beneath, distinct sometimes obscure above; petiole 5–15 mm, pubescent. *Inflorescences* near the base of the branches, sometimes hidden under fallen leaves, in the axils of bracts or not well developed (small) leaves, often simple and spiciform, up to c. 12 cm long, pubescent; bracts lanceolate to linear, up to c. 10 mm long, pubescent. Pedicel and ovary 8–22 mm long, densely pubescent. *Perianth* pale yellow, yellow with purple, purple, pale red, or red (colour changing with age of the flower), urceolate-campanulate, 6–12.5 mm long, 12–16 mm \emptyset , with longitudinal and loosely reticulate veins, pubescent outside, glabrous inside; tube 3–5 mm long, with a thin 'disk' adnate to the inner side, slightly protruding above the tube (c. 0.5 mm) like a narrow rim; lobes broadly ovate, suborbicular, or subreniform, 3–7.5 by 4–8 mm. *Stamens* 6, in 1 whorl; filaments glabrous, 1–1.5 mm; anthers oblong, 1.5–2 mm long, connective slightly produced beyond the anthers. *Style* column c. 2 mm long; lobes 3 (or 4), 1.5–2 mm, hairy often at the apical part. *Capsule* slender, 3.5–5 (–15), often obscurely 4-angular, pubescent, glabrescent. *Seeds* oblong, trigonous, c. 4 by 2 mm, rugose.

Distr. India (Assam: Manipur & S. Andaman Is.), Bangladesh (Sylhet), Burma (Moulmein), South Vietnam (Bien Hoá), Peninsular Thailand; in *Malesia*: Malay Peninsula (throughout), Sumatra, West & Central Java, and Philippines (Jayabas, Alabat I., Panay, Mindanao), not yet found in Borneo. Cultivated in Hort. Bog. n. XI-B-XIII-138.

Ecol. In shady, moist places in forest, sometimes in bamboo or teak forest, occasionally in secondary forest, rarely on limestone, locally sometimes common, from the lowland up to 1200 m. *Fl. fr.* often all the year round.

Uses. In Malaya the plant is used for poulticing skin-complaints and boils (along with *Illigera*). In Java the stems and leaves may be pounded and the juice swallowed for coughs. The roots and leaves are used as a diuretic during confinement. In W. Java also used against snake-bites (BURKILL, *l.c.*; HEYNE, *l.c.*).

Vern. Malay Peninsula: *kaneb*, *kemed*, *serèngkong*, M. Java: *singa dapur*, *s. depa*, J; *kaliwaro*, *singa depa*, S.

Notes. *T. tomentosa* is the widest ranging species of the genus. It is the only species in Java.

Fruits are surprisingly rare and hitherto accepted as indehiscent. However, in a Thailand collection it had split with 4 valves.

The species is allied to the Indian *T. siliquosa* (LAMK) DING HOU and the Bornean *T. paucifida* (see note under the latter); *T. siliquosa* has 9 stamens in 3 groups, the anthers dorsally and the style lobes densely hooked-hairy.

21. *Thottea macrantha* (BOERL.) DING HOU, *Blumea* 27 (1981) 321. — *Bragantia macrantha* BOERL. *Handl.* 3 (1900) 64; VALET. *Icon. Bog.* 3 (1908) *sub t.* 260, *emend.* — *Apama macrantha* WEISSE, *Ber. Deut. Bot. Ges.* 45 (1927) 234, in obs.; STEEN. *Bull. Jard. Bot. Btzg III*, 12 (1932) 204; SCHMIDT in E. & P. *Nat. Pfl. Fam. ed. 2*, 16b (1935) 234, f. 120H–J. — *T. hirsuta* RIDLEY, *J. Mal. Br. R. As. Soc.* 1 (1923) 87. — *Fig.* 2e–f.

Herb woody at base, or shrub-like, up to 4 m high. Branches terete, 5–7 mm \emptyset , pubescent or hirsute. *Leaves* chartaceous to subcoriaceous, obovate to oblanceolate, elliptic-oblong, or lanceolate, (13–) 25–36 (–41) by (5–) 8–12.5 (–21) cm; apex short-acuminate or acuminate, sometimes apiculate, base cuneate; glabrous above, pubescent beneath; basal nerves 2 or 3 pairs, the inner one starting from the base or c. 5 mm above it, ascending upward and reaching to more than halfway, similar to the lateral nerves, the outer 1 or 2 much weaker and shorter, close to the margin; lateral nerves 7–10 pairs, elevated and prominent beneath, slightly elevated or flat above; veins transverse, scalariform, some loosely reticulate, joined by weaker crossbar-like or loosely reticulate veinlets, slightly elevated beneath, visible or obscure above; petiole 5–8 (–15) mm, hirsute. *Inflorescences* axillary, 1–3, often in axils of foliage leaves, simple or sparsely branched, spiciform or racemiform, rarely paniculiform, up to 7 cm long, pubescent; bracts oblanceolate, those at the lower part shorter, pubescent outside, glabrous inside. Pedicel and ovary 15–18 mm, pubescent. *Perianth* reddish or dark brown and puberulous outside, white and glandular-hairy inside, campanulate, c. 20 mm long and wide; tube c. 8 mm long; lobes broadly rounded, c. 12 by 4 mm, emarginate, reflexed. *Stamens* in 1 whorl, 9–12, patent or reflexed; filaments c. 3.5 mm, glabrous; anthers oblong, 1.2–2 mm long. *Style* column short, lobes 9–12, c. 2 mm, glabrous. *Capsules* erect, elongate, up to 11 cm long, 4-angular, pubescent, glabrescent. *Seeds* ellipsoid, c. 3 by 1.5 mm, transverse-rugose.

Distr. *Malesia*: Northern Sumatra (Atjeh, Sibolangit, Taram, Ketambe, Deli, Asahan). Cultivated in Hort. Bog. *sub n.* XI-B-XIII-133.

Ecol. In primary and young forest, mostly on slopes, sometimes in secondary forest, rare, sometimes locally abundant, in lowland up to 450 m. *Fl. fr.* Feb.–Sept.

Vern. *Ambolas tombak*, Asahan.

Note. RIDLEY described *T. hirsuta* to have 2 whorls of stamens, but the single flower of the type I examined has the stamens in one whorl.

22. *Thottea sumatrana* (MERR.) DING HOU, *Blumea* 27 (1981) 328, f. 70C. — *Apama sumatrana* MERR. *Pap. Mich. Ac. Sc.* 23 (1937) 178. — *Fig.* 7j–m.

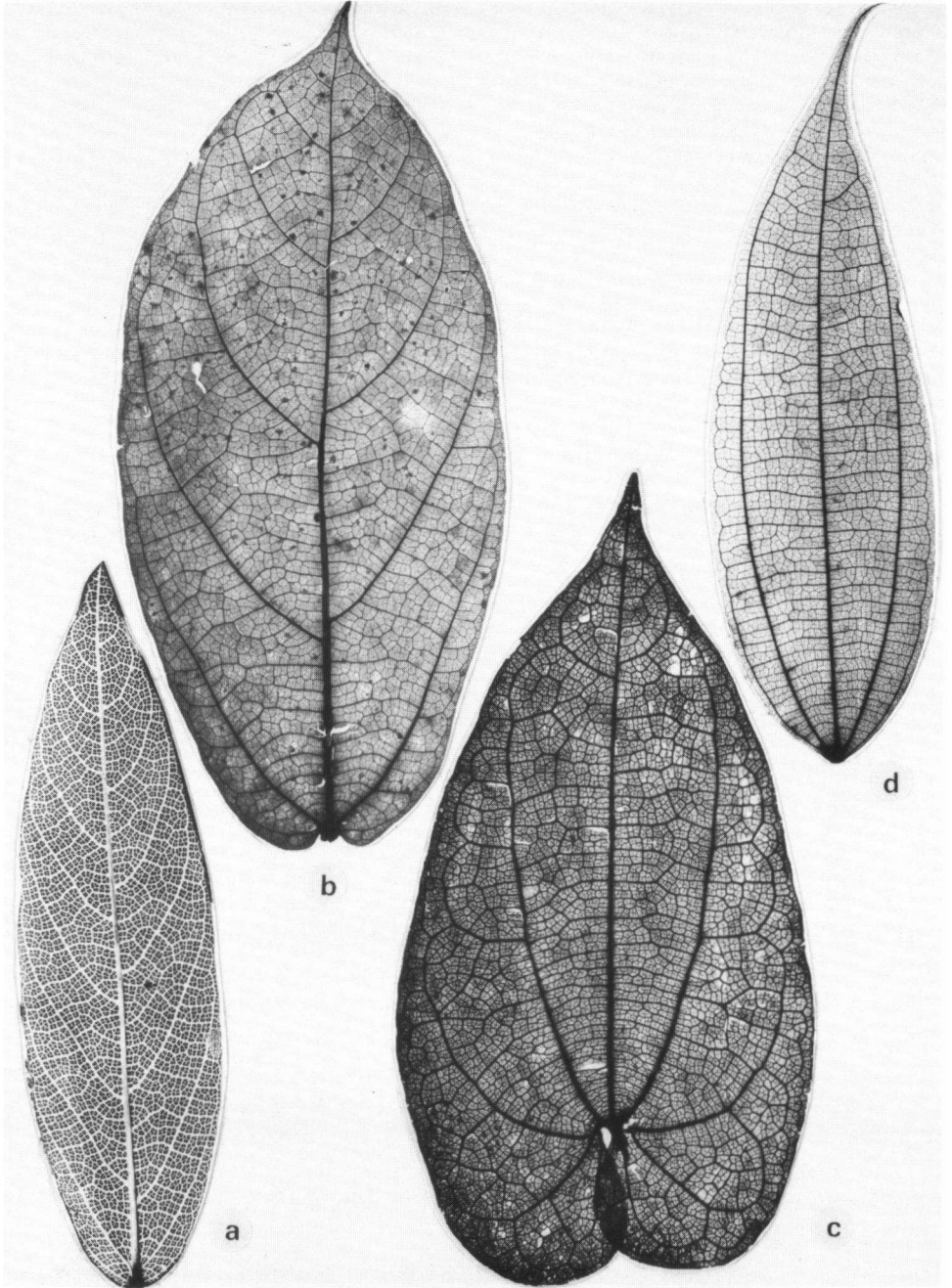


Fig. 8. Samples illustrating leaf venation patterns: *a* & *c* densely reticulate, *b* loosely reticulate, *d* trabeculate. — *a*. *Thottea philippinensis* QUIS., $\times 2/3$ (FB 30249). — *b*. *Aristolochia momandul* SCHMIDT, $\times 3/5$ (NGF 27848). — *c*. *A. crassinervia* SCHMIDT, $\times 4/5$ (NGF 45343). — *d*. *Thottea corymbosa* (GRIFF.) DING HOU, $\times 2/3$ (Hou 732). (*a* undersurface of not cleared leaf, *b*–*d* cleared leaves).

Herb woody at base, shrub-like, up to 1 m high. Branches sulcate or irregularly angular, c. 5 mm ϕ , sparsely pubescent. *Leaves* chartaceous, elliptic, lanceolate, obovate, rarely oblanceolate, 10–21 by 4.5–7.5 cm; apex acute, acuminate, or short-acuminate; base obtuse, rotund, or cuneate; glabrous above, pubescent beneath; basal nerves 2 or 3 pairs, the inner one ascending upward to about halfway, similar to the lateral nerves, the outer 1 or 2 much weaker and shorter, close to the margin; lateral nerves 8–14 pairs, joined by transverse, subparallel, scalariform or sometimes loosely reticulate veins and veinlets, elevated beneath, often obscure above, petiole 3–5 (–10) mm, pubescent. *Inflorescences* axillary, usually in the axils of foliage leaves, spiciform or racemiform, solitary or rarely 2 in an axil, pubescent; bracts crowded, lanceolate, elliptic, oblanceolate or spatulate, 3–10 mm long, pubescent outside, glabrous inside. Pedicel and ovary 5–10 mm long, pubescent. *Perianth* dirty yellowish white, inside blackish red, or dark-red, campanulate, or funnel-shaped, 14–20 mm long, c. 12 mm ϕ , veins loosely reticulate, sparsely puberulous outside, glabrous inside; tube c. 5 mm long; lobes ovate to lanceolate, 8–15 by 5–8 mm, apex acute, acuminate, or obtuse. *Stamens* 6, in 1 whorl; filaments glabrous, c. 1 mm;

anthers oblong, c. 1 mm long (excl. the protruding connective). *Style* column c. 2 mm long, lobes 3, 1–2 mm, glabrous. *Capsules* slender, up to 16 cm long, cylindrical or slightly angular, twisted, sparsely pubescent. *Seeds* ovoid, trigonous, c. 4.5 by 2.5 mm, transversely rugose.

Distr. Peninsular Burma (Ta Pe) and Peninsular Thailand (Pattani and near Neckey); in *Malesia*: Northern Sumatra (Tapanuli: Padang Lawas; East Coast: Laut Tador & Gedong Biara Estates) and N. Malay Peninsula (Perlis and Kedah).

Ecol. In lowland forest, by stream, on sandy loam soil, up to c. 150 m. *Fl. fr.* April–August.

Note. Sterile specimens are difficult to identify. In flower easily recognized by a deeply lobed perianth, 6 stamens in one whorl, anthers with a protruding connective, and 3 style-lobes.

Insufficiently known

Thottea sp. DING HOU, *Blumea* 27 (1981) 329.

In Kalimantan (Sg. Dingei) JAHERI (n. 790, BO) collected an as yet undescribed species. It resembles *T. tomentosa*, but the single immature flower possesses 2 whorls of stamens. Better material is needed for a proper description.

2. ARISTOLOCHIA

LINNÉ, *Sp. Pl.* (1753) 960; KLOTZSCH, *Monatsb. Akad. Berlin* (1859) 593; DUCHARTRE in DC. *Prod.* 15, 1 (1864) 432; SCHMIDT in E. & P. *Nat. Pfl. Fam.* ed. 2, 16b (1935) 235; HOEHNE, *Fl. Bras.* 15 (1942) 23; PFEIFER, *Ann. Mo. Bot. Gard.* 53 (1966) 122; *Tax. Rev. Pentam. Sp. Aristolochia* (1970) 15; DING HOU, *Blumea* 29 (1983) 223. — **Fig. 1, 2, 8–18.**

Herbaceous perennials, undershrubs or shrubs, usually scandent, scrambling, twining, or climbing, sometimes high lianas, often with prostrate or tuberous rhizomes or rootstocks; vegetative parts upon breaking or only the flowers often with a bad, mostly putrid smell. (Old) woody stems mostly with a thick-corky and fissured bark, showing broad, medullary rays on cross-section. *Leaves* entire, sometimes 3-lobed (irregularly up to 7-lobed in extra-Malesian *spp.*). Petiole grooved above. *Flowers* usually zygomorphic, rarely actinomorphic, solitary, fasciculate, or in inflorescences (cymose, racemose, spicate, paniculate), axillary or cauligerous. *Perianth* straight, curved, or S-shaped, inflated at the basal part (utricle), then contracted or narrowed above in an often cylindrical or funnel-shaped part (tube), gradually elongated, enlarged and expanded into the 1-lipped or 3 (–6)-lobed limb, the utricle often inside provided with 2 (–6) glandular bodies. *Stamens* mostly 6 (4, 5, or more in extra-Malesian *spp.*) (10 in the Malesian *A. decandra*), adnate to the style column in a gynostemium. *Ovary* oblong or elongate, slightly 6-angular and 6-celled (5-celled in extra-Malesian *spp.*); style column mostly 6-lobed (5-lobed in extra-Malesian *spp.*). Fruits capsular,

6-celled (5-celled in extra-Malesian *spp.*), dehiscent (dehiscing usually acropetally, rarely basipetally: *A. singalagensis*) or indehiscent (*A. dielsiana*?, and extra-Malesian *spp.*). *Seeds* ovate, deltoid, or triangular, often winged, flat, convex-concave, or slightly longitudinally curved; testa crustaceous or hard, finely verrucose or smooth; funicle often fleshy, thickened, usually covering the whole seed, usually persistent on the seed as an elaiosome, membranous when dry.

Distr. About 400 species, widely distributed mainly throughout the tropics and subtropics and some in the warm temperate regions, also in Australia; throughout *Malesia*: 28 species.

Ecol. Usually scattered, only rarely locally abundant, in primary forests, sometimes in (old) secondary forests or in thickets, occasionally occurring in beach or swampy forest, limestone regions, or submontane to montane forest; mostly at low and medium altitudes, sometimes found higher, above 1500 m, up to 2250 m (in Papua New Guinea).

For the relation with butterflies, pollination in relation to flower morphology, seed dispersal, *etc.*, I refer to the general chapters.

Morph. See the general chapters, also for chromosomes, phytochemistry, anatomy and palynology.

Uses. See the general chapters.

Notes. In the key and descriptions the pedicel and ovary are taken as a whole, like under *Thottea*, because these organs merge imperceptibly.

For the diameter of the floral tube, only the cylindric middle part is used for size.

In general flowering material is necessary for correct identification.

In Malesia a number of exotic species is cultivated; a dozen of these are entered in the key by BACKER & BAK-HUIZEN *f.*, *Flora of Java* 1 (1963) 162–164.

For convenience of identification, local keys for islands have been added to the general key.

GENERAL KEY TO THE SPECIES

based on fertile specimens

1. Leaves deeply 3-lobed, in shape reminding of the letter 'W'.
2. Leaf base shallowly concave, subcordate, or almost truncate, rarely cuneate. Inflorescences with small, not amplexicaul bracts *c.* 1.5 mm long. Seeds distinctly winged 1. *A. jackii*
2. Leaf base cuneate. Inflorescences with conspicuous, amplexicaul bracts 7–10 (–15) mm long. Seeds not winged 2. *A. curtisii*
1. Leaves never deeply 3-lobed as above, mostly entire.
3. Leaves villous or densely tomentose underneath, often concealing the surface (especially when young).
4. Perianth limb distinctly 3-lobed; lobes triangular, 3 by 4.5–6 cm, obtuse. (Fruit dehiscing from the apex downward; seeds strongly convex-concave) 3. *A. singalagensis*
4. Perianth limb rim-like, the limb 0.5–1 cm wide, obscurely 3-lobed. (Fruit unknown) 10. *A. coadunata*
3. Leaves shortly, minutely, or sparsely hairy on the undersurface (surface always exposed), or glabrous on both surfaces.
5. Leaves glabrous on both surfaces.
6. Leaf base subtruncate, slightly concave, obtuse, or rounded, sometimes slightly cuneate. (Seeds not winged).
7. Plants erect, up to *c.* 1 m high. Leaves with pinnately arranged lateral nerves. Petiole less than 1 (–2) cm long. Perianth 1-lipped 18. *A. philippinensis*
7. Twiners or stout climbers, up to 15 m high. Leaves palmately nerved. Petiole 3–12 cm long.
8. Leaves distinctly papillate beneath; 5-nerved, joined by reticulate veins. Flowers 1-lipped 13. *A. papillifolia*
8. Leaves smooth beneath; 3- or 5-nerved, joined by \pm transverse veins. Flowers unknown 14. *A. transtillifera*
6. Leaf base subcordate or cordate (usually adult leaves), or subtruncate (especially when young in *A. gaudichaudii*).
9. Perianth puberulous outside; limb narrow-elliptic, 5–6 cm long 22. *A. leytenis*
9. Perianth glabrous outside; limb obovate to oblanceolate, 1.7–2.5 cm long.
10. Perianth tube 8–12 mm long; limb obovate or oblanceolate, 17–20 mm long. Fruits oblong 4–6 by *c.* 3 cm. Seeds winged 27. *A. gaudichaudii*

10. Perianth tube 16–19 mm long; limb obovate-oblong, 20–25 mm long. Fruits unknown 8. *A. klossii*
5. Leaves shortly, minutely, or sparsely hairy on the undersurface.
11. Plants erect, up to c. 1 m high.
12. Petiole (20–) 30–40 mm long. Seeds verrucose only on the marginal part beneath, smooth above 19. *A. humilis*
12. Petiole at most 10 mm long. Seeds verrucose on both surfaces.
13. Leaf base obtuse or rounded, subacute or cuneate. Perianth with reflexed tube 17. *A. samarensis*
13. Leaf base distinctly cordate, sometimes slightly cordate, very rarely associated with some obtuse ones. Perianth straight, sometimes slightly curved.
14. Leaf base deeply cordate, auricles often overlapping or surrounding the stem 20. *A. macgregorii*
14. Leaf base slightly cordate, rarely associated with some obtuse ones, auricles obscure or 0 21. *A. sericea*
11. Twiners or lianas, much taller, up to many metres high.
15. Perianth 6- or 3-lobed.
16. Perianth 6-lobed 24. *A. schlechteri*
16. Perianth 3-lobed.
17. Perianth 19–21 cm long. Stamens 10. Style-column 10-lobed. Leaves suborbicular or broad-ovate, deeply cordate, palmately 5- or 7-nerved 16. *A. decandra*
17. Perianth less than 9 cm long. Stamens 6. Style column 6-lobed.
18. Flower buds or perianth lobes with the apical 20–30 mm strongly contracted or narrowed and often tail-like when dry (easily broken).
19. Perianth lobes suborbicular, c. 10 mm \varnothing , with an apical tail-like part c. 20 mm long 11. *A. momandul*
19. Perianth lobes triangular to narrow-triangular, 35–50 by 12–14 mm at the bases (apical 25–30 mm often tail-like when dry) 25. *A. dielsiana*
18. Flower buds or perianth lobes without a tail-like apical part as above. Perianth lobes triangular, 5–6 by 8–10 mm, apex obtuse or retuse 26. *A. engleriana*
15. Perianth 1-lipped.
20. Leaf base often rounded or obtuse, not cordate.
21. Inner pair of basal nerves reaching nearly the leaf apex joined by 10–14 pairs of loose, transverse or slightly curved cross-veins. Perianth without a stipe; limb ovate-oblong or lanceolate, 6–9 by 3–3.5 cm 15. *A. naviculilimba*
21. Leaves with 1 pair of basal nerves reaching upward to about halfway; lateral nerves 4 or 5 pairs, obliquely ascending to the margin. Perianth with a distinct stipe of 5 mm; limb oblong, much smaller, 2.7 by 0.7 cm 12. *A. rumphii*
20. Leaf base cordate or subcordate.
22. Leaf veins and veinlets closely reticulate or foveolate-reticulate, prominent beneath. Cf. fig. 8c.
23. Perianth with a distinct stipe of 3–5 mm. Seeds winged. Leaves variable in shape and size 5. *A. zollingeriana*
23. Perianth without a stipe. Seeds not winged.
24. Perianth limb ovate-oblong, 30 by 14–16 mm. Seeds triangular, c. 5 by 4 mm, verrucose on both surfaces 4. *A. foveolata*
24. Perianth limb linear, 20 by 4 mm. Seeds triangular or deltoid, 7 by 6–7 mm, rather smooth or obscurely muriculate on both surfaces 23. *A. crassinervia*
22. Leaf veins and veinlets loosely reticulate, distinct or obscure beneath. Cf. fig. 8b.
25. Leaves triangular or deltoid. (Leaves palmately 5-nerved. Perianth with a distinct stipe of c. 2.5 mm. Seeds winged) 28. *A. linnemannii*
25. Leaves often ovate, ovate-oblong, or lanceolate.
26. Leaves with 3–5 pairs of lateral nerves from the midrib, obliquely ascending. Perianth with a distinct stipe.
27. Perianth limb 20–30 (–40) mm long. Seeds winged 9. *A. tagala*
27. Perianth limb 50–60 mm long (ripe seeds unknown) 22. *A. leytenis*
26. Leaves without lateral nerves from the midrib. Perianth without a stipe.
28. Basal nerves 2 (or 3 pairs), the inner pair ascending upward to c. 2/3 of the blade. Flowers small: utricle 3–6 mm long, tube 2.5–5 mm long, limb 11–12 mm long . 6. *A. minutiflora*
28. Basal nerves 1 pair, ascending upward to the apex. Flowers larger: utricle 10–12 mm long, tube 5–11 mm long, limb 15–25 mm long 7. *A. glaucifolia*

KEY TO THE SPECIES

Sumatra, Malay Peninsula and neighbouring islands

1. Leaves deeply 3-lobed, in shape often reminding of the letter 'W'.
2. Leaf base shallowly concave, subcordate, or almost truncate, rarely cuneate. Inflorescences with small, not amplexicaul bracts (c. 1.5 mm long). Seeds distinctly winged 1. *A. jackii*
2. Leaf base cuneate. Inflorescences with conspicuous amplexicaul bracts (7–10, rarely up to 15 mm long). Seeds not winged 2. *A. curtisii*
1. Leaves entire.
 3. Leaves villous or densely tomentose underneath, often concealing the surface (especially when young).
 4. Perianth limb distinctly 3-lobed; lobes triangular, 3 by 4.5–6 cm, obtuse. (Fruit dehiscing from the apex downward; seeds strongly convex-concave) 3. *A. singalagensis*
 4. Perianth limb rim-like, the limb 0.5–1 cm wide, obscurely 3-lobed. (Fruit unknown) 10. *A. coadunata*
 3. Leaves shortly, minutely, or sparsely hairy underneath (surface always exposed), or glabrous.
 5. Leaf veins and veinlets closely reticulate or foveolate-reticulate, prominent beneath.
 6. Perianth without a stipe. Seeds not winged 4. *A. foveolata*
 6. Perianth with a distinct stipe of 3–5 mm. Seeds winged 5. *A. zollingeriana*
 5. Leaf veins and veinlets loosely reticulate, distinct or obscure beneath.
 7. Perianth without a stipe. Seeds not winged. (Leaves thin-chartaceous).
 8. Leaves palmately 5 (–7)-nerved, papillate beneath 6. *A. minutiflora*
 8. Leaves 3-curvinerved, with irregular (finely reticulate, wax) thickenings and scattered black dots (secretory cells) beneath 7. *A. glaucifolia*
 7. Perianth with a distinct stipe. Seeds winged. (Leaves chartaceous).
 9. Leaf with the two basal lobes widely separate from each other (sinus 7–9 cm wide at the base). Perianth limb obovate-oblong, 10–14 mm wide; apex slightly retuse or mucronate 8. *A. klossii*
 9. Leaf with the two basal lobes close to each other or often connivent at the base. Perianth limb lanceolate to narrowly lanceolate, 6–8 mm wide; apex acute 9. *A. tagala*

KEY TO THE SPECIES

Java, Lesser Sunda Is., Moluccas, Celebes and neighbouring islands

1. Leaves deeply 3-lobed, in shape often reminding of the letter 'W' 1. *A. jackii*
1. Leaves entire.
 2. Leaves villous or densely tomentose on the undersurface. Perianth with the tube bent backward and contacting closely laterally with the utricle; limb rim-like, obscurely 3-lobed 10. *A. coadunata*
 2. Leaves shortly or minutely hairy beneath. Perianth straight or slightly curved; limb distinctly 3-lobed or 1-lipped.
 3. Flower buds with a distinct, long tail-like apex c. 20 mm long (easily broken when dry). Limb distinctly 3-lobed. Capsules oblong or ellipsoid, 5.5–9 by 3.5–4 cm, strongly 6-ridged. (Seeds not winged, rather smooth on both surfaces) 11. *A. momandul*
 3. Flower buds without a long tail-like apex. Limb 1-lipped. Capsules short-cylindric, subglobose, slightly pyriform, or oblong, 2–4 by 1.5–3 cm, often slightly 6-ridged.
 4. Leaf base obtuse, sometimes slightly cuneate, rarely truncate. Seeds not winged ... 12. *A. rumphii*
 4. Leaf base cordate. Seeds winged.
 5. Leaf veins and veinlets closely reticulate, densely covered with minute hairs beneath (examining with a hand lens or under the dissecting microscope). Perianth lobes obovate-oblong, 25–30 by 10 mm, longitudinally reflexed at anthesis. Seeds 4–5 by 4 mm (incl. the c. 0.6 mm broad wing) 5. *A. zollingeriana*
 5. Leaf veins and veinlets loosely reticulate, sparsely shortly hairy or (nearly) glabrous beneath. Perianth lobes lanceolate to narrowly lanceolate, 20–30 (–40) by 6–8 mm, not longitudinally reflexed at anthesis. Seeds 8.5–10 mm long and wide (incl. the c. 2 mm broad wing) 9. *A. tagala*

KEY TO THE SPECIES

Borneo

1. Leaves deeply 3-lobed, in shape often resembling the letter 'W' 1. *A. jackii*
1. Leaves entire.

2. Leaf base not cordate, but obtuse or rounded, shallowly concave, subtruncate, or slightly cuneate.
3. Leaves glabrous beneath.
 4. Leaves distinctly papillate beneath (handlens or binocular), 5-nerved, joined by reticulate and transverse veins 13. *A. papillifolia*
 4. Leaves not papillate beneath, 3 (-5)-nerved, joined by transverse veins 14. *A. transtillifera*
3. Leaves minutely hairy beneath especially on the venation 15. *A. naviculilimba*
2. Leaf base distinctly cordate.
 5. Petiole 10-13 cm long. Flowers large: utricle 5-6 cm long, tube c. 5 cm long, limb 4-9 cm long, 3-lobed. Stamens 10 16. *A. decandra*
 5. Petiole much shorter. Flowers much smaller. Perianth 1-lipped. Stamens 6.
 6. Leaf veins and veinlets closely foveolate-reticulate, prominent beneath. Utricle with 6 (or 2) glandular bodies inside. (Seeds not winged) 4. *A. foveolata*
 6. Leaf veins and veinlets loosely reticulate or transverse, distinct or rather faint beneath. Utricle with 2 glandular bodies inside.
 7. Leaf undersurface papillate (under the binocular). Perianth without a stipe; utricle 3-6 mm long, tube 2.5-5 mm long, limb 11-12 mm long. Seeds not winged 6. *A. minutiflora*
 7. Leaf undersurface not papillate. Perianth with a distinct stipe; utricle 3-9 mm long, tube 5-10 (-15) mm long, limb 20-30 (-40) mm long. Seeds distinctly winged 9. *A. tagala*

KEY TO THE SPECIES

Philippines

1. Leaves deeply 3-lobed, in shape often resembling the letter 'W' 1. *A. jackii*
1. Leaves entire, very rarely remotely minutely toothed (*A. philippinensis*).
2. Leaf base obtuse or rounded, subacute, or cuneate. (Plants erect, up to c. 1 m high).
 3. Perianth with tube and limb bent backward and parallel to the utricle. Utricle 35 mm long, tube 10-15 mm long, limb 45 mm long. Seeds verrucose on both surfaces. Petiole 6-10 mm long 17. *A. samarensis*
 3. Perianth straight. Utricle 6-7 mm long, tube 5-15 mm long, limb 18-25 mm long.
 4. Leaves glabrous on both surfaces. Petiole 4-8 (-20) mm long. Seeds verrucose beneath and marginal part above 18. *A. philippinensis*
 4. Leaves glabrous above, sparsely short-hairy beneath. Petiole (20-) 30-40 mm long. Seeds verrucose only on the marginal part beneath, smooth above 19. *A. humilis*
2. Leaf base distinctly cordate, sometimes slightly or shallowly cordate, very rarely associated with some obtuse ones (*A. sericea*).
 5. Erect plants up to 1 m high. Petiole 2-10 mm long.
 6. Leaf base deeply cordate; auricles often overlapping or surrounding the stem .. 20. *A. macgregorii*
 6. Leaf base slightly or shallowly cordate, rarely associated with some obtuse ones; auricles obscure or 0 21. *A. sericea*
 5. Twiners or climbers. Petiole 20-70 mm long.
 7. Leaf veins and veinlets foveolate-reticulate, prominent beneath. Utricle with 6 (or 2) glandular bodies inside. Seeds not winged 4. *A. foveolata*
 7. Leaf veins and veinlets often loosely, rarely closely, reticulate, or transverse, distinct or rather faint beneath. Utricle with 2 glandular bodies inside. Seeds distinctly winged (not known in *A. leytenensis*).
 8. Leaf veins and veinlets (closely reticulate) densely covered with minute hairs beneath (handlens or binocular). Seeds (proper) verrucose on both surfaces 5. *A. zollingeriana*
 8. Leaf veins and veinlets (loosely reticulate) sparsely short-hairy or (nearly) glabrous beneath.
 9. Perianth tube 20 mm long, limb 50-60 mm long. Mature seeds not known 22. *A. leytenensis*
 9. Perianth tube 5-10 (-15) mm long, limb 20-30 (-40) mm long. Seeds verrucose beneath, less so above 9. *A. tagala*

KEY TO THE SPECIES

New Guinea and neighbouring islands

1. Leaves deeply 3-lobed, in shape often reminding of the letter 'W' 1. *A. jackii*
1. Leaves entire.
 2. Leaf veins closely reticulate, prominent beneath. Fruits cylindric or oblong, 2.5-4.5 by 2-3 cm, minutely granular. Leaves cordate, auricles usually much overlapping; apex acuminate 23. *A. crassinervia*

2. Leaf veins loosely reticulate and some crossbar-like, often slightly elevated beneath.
3. Perianth limb 6-lobed. (Leaf base cordate)..... 24. *A. schlechteri*
3. Perianth limb 3-lobed or 1-lipped.
4. Perianth without a stipe; limb 3-lobed. Seeds not winged.
5. Flower buds or perianth lobes with the apical 20–30 mm strongly contracted or narrowed and often tail-like when dry (easily broken).
6. Perianth lobes suborbicular, c. 10 mm ϕ , with an apical tail-like apex c. 20 mm long
11. *A. momandul*
6. Perianth lobes triangular to narrow-triangular, 35–50 by 12–14 mm at the base, apical 25–30 mm often tail-like when dry..... 25. *A. dielsiana*
5. Flower buds or perianth lobes without a tail-like apical part. Perianth lobes triangular, 5–6 by 8–10 mm, apex obtuse or retuse..... 26. *A. engleriana*
4. Perianth with a distinct stipe; limb 1-lipped. Seeds distinctly winged.
7. Leaves glabrous. Perianth limb obovate or oblanceolate, 17–20 by 8–12 mm. Seeds (incl. wing) transverse-oblong, 6–11.5 by 12–16 mm, smooth on both surfaces..... 27. *A. gaudichaudii*
7. Leaves minutely hairy or sparsely short-hairy beneath. Seeds (incl. wing) triangular, 6–10 by 5–10 mm, usually verrucose on both surfaces.
8. Leaves triangular or deltoid in outline, minutely hairy beneath. Inflorescences 2–3 (–15) mm long; internodes condensed, obscure or invisible; bracts minute, c. 1 mm long. Perianth lobes oblong, c. 20 mm long..... 28. *A. linnemannii*
8. Leaves variable in shape and size, ovate, ovate-oblong, rarely suborbicular, sparsely shortly hairy beneath. Inflorescences 20–60 mm long; internodes spacious, distinct; bracts up to 10 mm long. Perianth lobes lanceolate, 20–30 (–40) mm long..... 9. *A. tagala*

1. *Aristolochia jackii* STEUD. Nom. Bot. ed. 2, 1 (1840) 132; Miq. Sum. (1860) 150; DING HOU, Blumea 29 (1983) 230. — *A. hastata* JACK, Malay Misc. 2, 7 (1822) 6 [reimpr. in Hook. J. Bot. 1 (1834) 362; GRIFF. Calc. J. Nat. Hist. 4 (1843) 358; TRÜBNER, Oriental Series II, 2 (1887) 249], *nom illeg.*, non H.B.K. (1817), *nec* NUTTALL (1818); KLOTZSCH, Monatsber. Akad. Berl. (1859) 597, JACK *sphalm.* as JACQUIN, excl. ZOLLINGER 2744; DUCHARTRE in DC. Prod. 15, 1 (1864) 482; MERR. J. Arn. Arb. 33 (1952) 217. — *A. unguifolia* MASTERS, J. Linn. Soc. Bot. 14 (1875) 494; Gard. Chron. n.s. 14 (1880) 116, f. 28; HOOK. f. in Curtis' Bot. Mag. 121 (1895) t. 7424; RIDLEY, J. Str. Br. R. As. Soc. n. 33 (1900) 126; KING & GAMBLE, J. As. Soc. Beng. 75, ii (1912) 30; SCHMIDT, Bot. Jahrb. 58 (1923) 488; RIDLEY, Fl. Mal. Pen. 3 (1924) 18; SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 241; HEND. Mal. Nat. J. 6 (1951) 422, f. 381C. — *A. tripartita* BACK. Trop. Natuur 8 (1919) 161 & 165, f. 14; Bull. Jard. Bot. Btzg III, 2 (1920) 322; SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 241; BACK. & BAKH. f. Fl. Java 1 (1963) 162. — Fig. 9.

Undershrub, spreading or twining, up to 10 m high. Branches obscurely angular, 3–5 mm ϕ , glabrous. Leaves chartaceous or subcoriaceous, broadly or transversely ovate or suborbicular in outline, 11–23 by 15–24 cm, deeply 3-lobed, in shape often reminding of the letter 'W', glabrous; base emarginate, subcordate, or almost truncate, rarely cuneate; midlobe usually obovate- or ovate-oblong, 5.5–20 by 6.5–10 cm, apex obtuse or acute, rarely short acuminate; lateral lobes oblong, falcate or semilunar,

curved upward, sometimes spreading almost horizontally, 4–15 by 2.5–6 cm, rounded or obtuse at the apex; midrib with 2 or 3 pairs of lateral nerves; basal nerves 2, each once or twice branched (the leaf seemingly 5–7-nerved); nerves elevated and prominent beneath, rather less so above; veins loosely transverse or reticulate, slightly elevated on both surfaces; petiole 2–7 cm, glabrous. Inflorescences in axils of foliage leaves, spiciform or racemiform, up to c. 7 (–25) cm long, internodes distinct; bracts rather loose, ovate, c. 1.5 mm long, glabrous beneath, short-hairy above. Pedicels and ovary 1.5–3 cm, glabrous. Perianth purple-brown or -red, or purple, slightly curved, 7.5–11 cm long, glabrous outside; utricle ellipsoid or obovoid, 2–3.5 cm long, with a stipe of 6–7 mm, inside hairy, with 2 ellipsoid, glandular bodies; tube 2–3.5 cm long, hairy inside; limb 1-lipped, oblong or ovate-oblong, elliptic, or spatulate, erect or reclined, 3.5–4.5 by 2–2.5 cm, tomentose or villous on the upper surface and mouth of the tube. Stamens 6; anthers ellipsoid-oblong, c. 1.5 mm long. Style column 5–7 mm long, 6-lobed; lobes conical, with a prominent annular ring at their base. Capsules oblong, 5–6 by 2.5 cm, 6-angular, glabrous. Seeds triangular-orbicular, 4–5 by 5–7 mm (excl. wing), lower surface smooth except a few warts at the apical and basal ends, upper surface slightly ridged at the centre; marginate, the wing 3–5 mm wide.

Distr. *Malesia*: N. Sumatra (Medan, Sibolangit, Asahan, Natal), Malay Peninsula (Pahang, Jarak I. in Malacca Strait, Singapore), Java (Preanger, Nusa Kambangan I., Mt Wilis), Borneo: Sabah (Labuan,



Fig. 9. *Aristolochia jackii* STEUD. NW. Kalimantan, near Njarumkop (Photogr. Father A. ELSENER, H52, Oct. 1964).

Tuaran), NW. Kalimantan (Njarumkop), SW. Philippines (N. Palawan), New Guinea (?) (Sepik and Madang Distr.). Cultivated in Hort. Bog. *sub n.* XV-D-46.

Ecology. In forest, sometimes in swampy forest behind the sea coast, from sea level up to 1200 m. *Fl.* Feb., June, Nov., *fr.* Jan., Feb., April, Sept., Oct.

Vern. Sabah: *tawayagon*, Tuaran; New Guinea: *bagup*, Sepik.

Notes. Closely related to *A. curtisii*, sharing deeply digitately 3-lobed leaves, spaced flowers and bracts, and a 1-lipped perianth, but easily distinguished from it by a truncate, emarginate or subcordate leaf base, much smaller bracts (c. 1.5 mm), a longer perianth (7.5–11 cm), and winged seeds.

Professor JUMALON (Cebu-city, Philippines), who raised plants from seeds from Palawan, recorded that leaves can attain 50 by 30 cm, or even more.

2. *Aristolochia curtisii* KING, Ann. Bot. Gard. Calc. 5 (1896) 161, t. 195; GAMBLE, Kew Bull. (1910) 78;

KING & GAMBLE, J. As. Soc. Beng. 75, ii (1912) 32; RIDLEY, Fl. Mal. Pen. 3 (1924) 18; DING HOU, Blumea 29 (1983) 227.

Climber up to 5 m high. Branches obscurely sulcate or slightly angular, c. 3 mm ϕ . *Leaves* chartaceous, deeply 3-lobed (broadly hastately 3-lobed when young), 10–23 by 10–30 cm; base cuneate; glabrous on both surfaces; middle lobe oblanceolate, 8–18 by 2–6.5 cm, acuminate; lateral lobes spatulate, slightly incurved, 6.5–14 by 2.5–5.5 cm, rounded at the apex; nervation pedately flabellate, 3-nerved at the base; outer nerves at first along the margin, then giving off: a) 2 interior nerves to the central lobe and each of them ascending upwards to the apex, and b) often 2 exterior nerves for each of the outer lobes, respectively, extending to the apex; midrib and nerves elevated and prominent beneath, rather less so above; veins loosely transverse and reticulate, distinct beneath, rather faint above; petiole 5–10 cm, subterete. *Inflorescences* in the axils of foliage leaves, 1–3, spiciform, up to 6.5 cm long, glabrous, internodes distinct; bracts amplexicaul, conspicuous, reddish, ovate to lanceolate, 7–10 (–15) mm long, glabrous. Pedicel and ovary 6–8 mm long, glabrous. *Perianth* blue and crimson, straight, with obscure venation, glabrous; utricle ellipsoid, 20 by 8 mm; tube cylindrical, 10 by 1 mm; limb 1-lipped, linear, 20 by 1 mm. *Stamens* 6, filaments with very small anthers. *Style* column very short, 6-lobed. *Capsules* oblong, 3–4 by 1.5 cm, obscurely 6-ribbed, obtuse. *Seeds* broad-ovate, not winged, c. 5 by 4 mm, granular on both surfaces, funicle spindle-shaped, c. 4.5 by 2 mm.

Distr. Peninsular Thailand (Khaw Pok Hill, Khsoon) and in *Malesia*: Malay Peninsula (Penang).

Ecology. In dense forest, 150–450 m. *Fl.* March, *fr.* June–August.

Note. Closely allied to *A. jackii* STEUD.

3. *Aristolochia singalagensis* KORTH, *ex* DING HOU, Blumea 29 (1983) 224, f. 1, 2a, 3c & d, 7a.

Liana up to 20 m high. Stems terete or slightly flattened, 1–1.5 (rarely more) cm ϕ ; branchlets tomentose or villous, glabrescent. *Leaves* subcoriaceous, suborbicular, broadly ovate, sometimes ovate, rarely ovate-oblong, (14–) 24–33 by (6–) 11–24 cm; apex acuminate or shortly so; base cordate, sinus 1.5 (–3) cm deep; upper surface pubescent on the midrib and nerves; undersurface villous or densely tomentose, glabrescent; basal nerves one pair reaching upward to halfway or higher; lateral nerves pinnate, 4 or 5 pairs, prominent beneath, distinct, sometimes depressed above; veins crossbar-like or reticulate, slightly elevated with distinct areoles beneath, rather obscure above; petiole stout, terete, (3–) 6–14 cm, c. 5 mm ϕ , villous or tomentose, glabrescent. *Inflorescences* cauligerous, solitary, racemiform, axis c. 4 cm

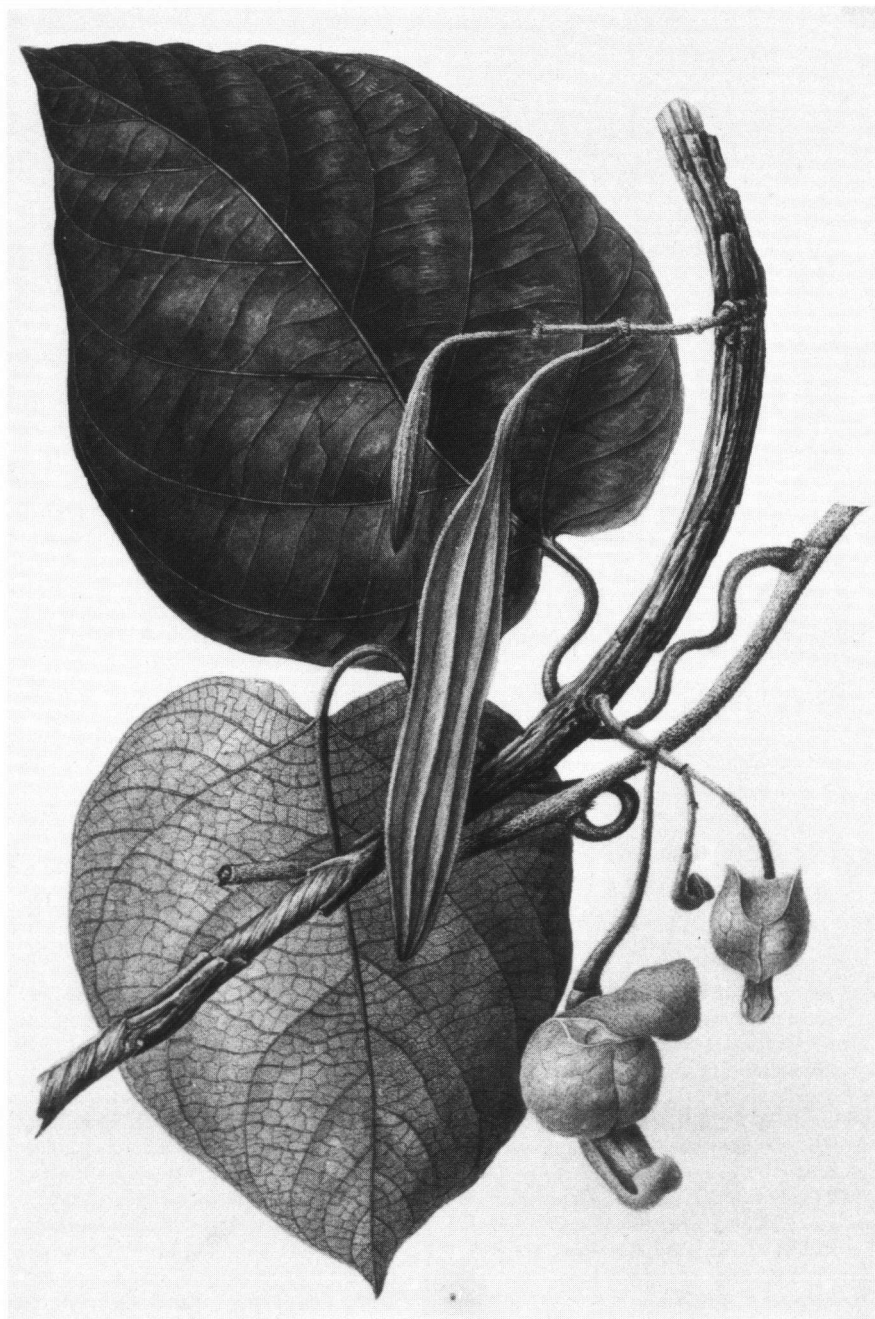


Fig. 10. *Aristolochia singalagensis* KORTH. ex DING HOU. Photograph of a coloured drawing in L made after the living plant; leaves $\times 1/3$, twig with flowers and fruit $\times 1/2$.

long, internodes spacious, tomentose or densely pubescent; bracts small, triangular, c. 3 mm long, densely pubescent. Pedicel and ovary up to 7 cm long, tomentose or pubescent. *Perianth* pale yellowish green, pubescent outside; utricle cylindrical, c. 7 by 1–1.5 cm, the apical 1–1.5 cm strongly bent backward; tube cylindrical, 4 by 0.6–1.2 cm, closely parallel to the utricle; limb deeply 3-lobed, lobes triangular, 3 by 4.5–6 cm, apex obtuse. Stamens and style column unknown. *Capsules* elongate-oblong, 14–15 by 2.5–3 cm, 6-ridged, dehiscing from the apex downward, tomentose or pubescent. *Seeds* convex on the lower side and ovoid-like in side view or seen from beneath, not winged, c. 8 by 5 mm, deeply concave on the upper side with a prominent, central, longitudinal, septum-like funiculus, testa smooth on both surfaces.

Distr. *Malesia*: Sumatra (Atjeh, near Pematang Siantar, Mt Singalang, Palembang).

Ecol. At edge of grassy marshland in the forest, along a trail in depleted forest, and on flat forest ridge, (c. 350–) 750–1700 m.

Taxon. *A. singalagensis* is closely allied to the Himalayan *A. griffithii* DUCHARTRE and the Chinese *A. kwangsiensis* LIANG with which it shares all essential structural characters of the leaves, flowers, fruit and seed. It can be distinguished from them by the different size of the flora parts and the deeply 3-lobed perianth, of which the lobes are pale yellowish green on the inner surface (not pinkish purple or purple).

Sterile specimens may resemble *Phytocrene* species (*Icacinaeae*), but can readily be distinguished by the absence of an abscission zone in the petiole, hence leaving no scar after withering.

Style column and stamens are as yet unknown.

4. *Aristolochia foveolata* MERR. Philip. J. Sc. 13 (1918) Bot. 280; En. Philip. 2 (1923) 119; IGARASHI, Food Pl. Papilionidae (1979) t. 26 (fig. on the lower right) & 27, as *Aristolochia* sp. 2; LIU & LAI, Quart. J. Taiwan Mus. 33 (1980) 247; DING HOU, Blumea 29 (1983) 227. — *A. kaoi* LIU & LAI, Fl. Taiwan 2 (1976) 573, t. 411; Hsu (ed.), The Rare & Threatened Plants of Taiwan (1980) 45, col. phot.

Twiner up to 10 (–40) m high. Old stems terete, 1.5–2 cm \varnothing , bark corky, longitudinally fissured or ridged. Branches terete, 2–6 mm \varnothing , striate, glabrous. *Leaves* chartaceous to coriaceous, ovate to lanceolate in outline, sometimes broad-ovate, rarely sub-orbicular, 7–18 (–24) by (3–) 4–8 (–21) cm; apex acuminate, rarely cuspidate; base cordate, sinus 1–2.5 cm deep, sometimes auriculate with auricles overlapping, rarely shallowly cordate, concave, or subtruncate (especially when young); glabrous above, densely puberulous beneath; nervation palmate, appearing as 5 (–7)-nerved; inner pair of

nerves nearly reaching the apex; outer pair much shorter, branched at the base with 1 or 2 branches extending to the margin or auricles; nerves prominent beneath, distinct above, joined by closely foveolate-reticulate and crossbar-like veins and veinlets; veins and veinlets slightly elevated and prominent beneath, distinct or rather faint above; petiole 2–4 (–7.5) cm, glabrous. *Inflorescences* in axils of leaves or cauligerous, often with very short branches, internodes hardly visible and flowers almost fasciculate; bracts lanceolate, 4–5 mm long, minutely hairy on both surfaces. Pedicel and ovary 28–40 mm long, slightly twisted, glabrous. *Perianth* maroon or purple-brown, at first straight or horizontal then curved, veins faint, glabrous outside, with scattered, glandular hairs inside; utricle subglobose, c. 7 mm \varnothing , not stiped, with 6 (or 2) glandular, ellipsoid bodies (c. 2 by 1 mm) (6, rarely 2, depressions shown on the outer surface); tube 10–14 by 2.5 mm; limb 1-lipped, ovate-oblong, 30 by 14–16 mm. Gynostemium c. 2.5 mm long. *Stamens* 6; anthers oblong, c. 1 mm long. *Style* 6-lobed, lobes triangular, 1.5 mm long, with an annular ring at the base. *Capsules* cylindrical or obovoid, not angular or ridged, 2.5–4 by 1.5 cm, glabrous (minutely granulate examined with hand lens). *Seeds* triangular, c. 5 by 4 mm, not winged, verrucose on both surfaces; funicle broadened, membranous, and covering the upper surface.

Distr. China (Taiwan); in *Malesia*: NE. Sumatra, Malay Peninsula (Trengganu), Borneo (Sabah: Mt Kinabalu, Sandakan; Sarawak: Upper Rejang R. and Kuching; Kalimantan: Landak R.), Philippines (Catanduanes and Palawan). Fig. 11.

Ecol. In primary, sometimes in secondary forest, often at low and medium altitudes, sometimes found at 1500–2100 m. *Fl.* May–Aug., Dec., *fr.* May, Oct., Dec.

Taxon. The species resembles *A. tagala* in leaf

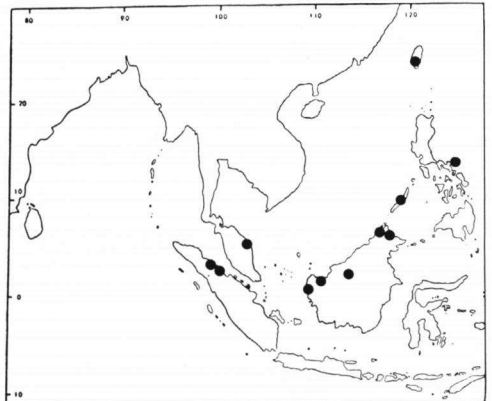


Fig. 11. Localities of *Aristolochia foveolata* MERR.

shape (usually with cordate base) and the 1-lipped perianth but is easily to distinguish from that species by the palmate nervation of the leaves, the undersurface being distinctly foveolate-reticulate and densely puberulous, the perianth which is not strongly contracted and stipe-like at base, and the immarginate seeds.

Notes. The leaves are rather variable in shape and size (ovate to lanceolate, rarely suborbicular, and $l = 7/3, 9\frac{1}{2}/5, 12/9, 18/11, 24/21$ cm) and leaf base (deeply cordate with auricles sometimes overlapping to cordate or subtruncate). This variability may well occur in one specimen, as was observed in the field and in specimens which I cultivated.

The species is often collected by entomologists as the larvae of the butterfly *Trogonoptera brookiana* feed on it. Near Berastagi (NE. Sumatra) it is even locally cultivated for this purpose.

5. *Aristolochia zollingeriana* MIQ. Fl. Ind. Bat. 1, 1 (1858) 1066; DUCHARTRE in DC. Prod. 15, 1 (1864) 482; BACK. Trop. Natuur 8 (1919) 162, f. 15, 165; KOORD. Ekk. Fl. Java 4 (Atlas) (1926) 591, f. 873; SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 241; BACK. & BAKH. f. Fl. Java 1 (1963) 162; DING HOU, Blumea 29 (1983) 232, f. 2c, 3a & b. — *A. hastata* (non JACK, *sphalm.* as JACQUIN) KLOTZSCH, Monatsb. Akad. Berl. (1859) 597, *quoad* ZOLLINGER 2744. — *A. ramosii* MERR. Philip. J. Sc. 29 (1926) 478. — *A. kankauensis* SASAKI, Trans. Nat. Hist. Soc. Form. 21 (1931) 251; LIU & LAL, Fl. Taiwan 2 (1979) 572; Hsu (ed.), The Rare & Threatened Plants of Taiwan (1980) 45, col. phot. — *A. roxburghiana* ssp. *kankauensis* (SASAKI) KITAMURA, Acta Phytotax. Geobot. 20 (1962) 135. — *A. tagala* (non CHAMISSO) HATUS. Fl. Ryukyu (1971) 243; WALKER, Fl. Okin. S. Ryukyu Is. (1976) 424. — *A. tagala* var. *kankauensis* (SASAKI) YAMAZAKI, J. Jap. Bot. 50 (1975) 341, as '*hankaensis*'.

Undershrub or a twiner up to 5 m high. Branches terete, c. 3 mm \varnothing , sulcate, glabrous. *Leaves* chartaceous, variable in shape and size even on one specimen, ovate or ovate-oblong, sometimes deltoid, reniform, or suborbicular, 4–15 by 2.5–12 cm; apex usually acuminate, rarely acute or obtuse; base cordate or shallowly cordate, sometimes sagittate, auricles separate from each other, rounded at the end, sinus 1–3 cm deep, glabrous above, minutely puberulous beneath; midrib and basal nerves palmately 5-nerved, the midrib with 1–3 pairs of lateral nerves; basal nerves 2 pairs, the inner pair ascending to 2/3, sometimes almost to the apex of the blade, the outer pair much shorter, spreading toward the margin at the basal part of the blade, each of them with a few side branchlets; nerves slightly elevated beneath, distinct or sometimes rather faint; veins closely reticulate, some transverse, distinct or sometimes rather

faint beneath; petiole 2–5 (–7) cm, glabrous. *Inflorescences* in the axils of foliage leaves, the very short rachis (up to c. 16 mm long) with condensed internodes and bracts, glabrous; bracts ovate or triangular, c. 1 mm long, glabrous. Pedicel and ovary c. 18 mm, glabrous. *Perianth* green and dark purple, veins longitudinal and reticulate, glabrous outside; utricle subglobose, c. 7 mm \varnothing , with a distinct stipe of 3–5 mm, sparsely hairy inside, with 2 glandular, orbicular bodies (c. 1 mm \varnothing); tube straight or sometimes bent at anthesis almost at a right angle with the utricle and ovary, c. 13 by 2.5 mm, sparsely hairy inside; limb 1-lipped, obovate-oblong, 23–30 by 10 mm, longitudinally reflexed at anthesis, apex retuse, upper surface glabrous except the slightly hairy margin. *Stamens* 6; anthers oblong, c. 1 mm long. *Style* column c. 4 mm long, 6-lobed; lobes lanceolate, c. 1.5 mm long, with a distinct annular ring at the base. *Capsules* short-cylindric, 2–3 by 1.5–2 cm, slightly 6-ridged, glabrous. *Seeds* triangular, winged, 4–5 by 4 mm (incl. the c. 0.6 mm wide wing), densely verrucose on both surfaces, upper surfaces sometimes covered with a membranous funicle appendage.

Distr. S. Ryukyu Is., Taiwan; in *Malesia*: Philippines (Luzon, Mindoro, Cebu, Bohol, Salupiri I.), NE. Sumatra (Pematang Siantar) and SE. Java (Besuki Res.: Puger).

Ecol. In forest or along forest edges, sometimes in rocky situations and on limestone hills, up to c. 300 m. *Fl.* April, Aug., Oct., Nov., *fr.* Feb.–June.

Vern. Philippines: *ubi-ubihan*, Tag.

Notes. The leaves of this species are very variable in shape, size, texture, etc. The leaf base can be shallowly cordate (with two divergent lobes), or sagittate (with a deep sinus and two \pm parallel lobes). The leaves on the specimens collected from Sumatra and Java are ovate-oblong and sagittate at the base, but those from the southern Ryukyus and Taiwan are often deltoid, ovate, or suborbicular, and shallowly cordate at the base. However, there are intermediate forms among the specimens from the Philippines; sometimes various leaf forms are even found in one specimen.

The polymorphism of the leaves in the present species can be compared with that found in the well known Japanese *A. kaempferi* WILLD.

Some of the leaf forms are similar to those of *A. foveolata*, in shape and indumentum underneath, but that species is quite different in flowers and seed.

A. zollingeriana closely resembles *A. tagala*, but can easily be distinguished: in the first the undersurface of the leaves is minutely hairy and with distinct areolation, in the latter it is sparsely short-hairy, rarely glabrous and with obscure areolation. In flower, fruit and seed the two are different.

The leaves of *A. zollingeriana* resemble those of the Japanese *A. kaempferi* WILLD.; the undersurface

of the leaves in the first is rather densely minute-hairy, in the latter there are loosely appressed hairs. Fertile specimens of *A. kaempferi* differ by absence of a stipe-like part of the perianth base, perianth curved in the middle, more or less V-shaped, limb suborbicular in outline, obscurely 2-lobed, and seed concave-convex, not winged.

6. *Aristolochia minutiflora* RIDLEY *ex* GAMBLE, Kew Bull. (1910) 79, *incl. var. dolabrata* GAMBLE; KING & GAMBLE, J. As. Soc. Beng. 75, ii (1912) 31; RIDLEY, Fl. Mal. Pen. 3 (1924) 18.

Scandent shrub or climber, up to 10 m high. Branches 3–10 mm \varnothing , sulcate, twisted, glabrous. *Leaves* thin-chartaceous, lanceolate sometimes ovate in outline, (5.5–) 12–14 by (2.5–) 5.5–7 cm; apex acuminate or cuspidate; base cordate, sinus 7–20 mm deep, 12–20 mm wide, auricles rounded at the base; glabrous above, loosely puberulous beneath; basal nerves 2 (–3) pairs, palmate, slightly elevated below, distinct above, inner pair of nerves ascending obliquely and slightly curved inward, up to *c.* 2/3 of the blade; veins usually loosely reticulate, some transverse, rather fine, distinct beneath, faint above; petiole 2–6.5 cm, glabrous. *Inflorescences* in the axils of foliage leaves, spiciform, up to *c.* 3.5 cm long, internodes very short or obscure, sparsely puberulous or almost glabrous; bracts lanceolate, 2–4 mm long, shortly hairy on both surfaces. Pedicel and ovary 9–12 mm, sparsely minutely hairy. *Perianth* green, red and light grey, straight, sparsely shortly hairy outside, glabrescent or almost glabrous; utricle broad-ovoid or subglobose, 3–6 by 2.5–6 mm, not stiped, sparsely hairy inside, with 2 ellipsoid, glandular bodies; tube 2.5–5 by 1 mm, short-fimbriate inside; limb 1-lipped, narrow-lanceolate to linear, 11–12 by 2–3 mm, veins loosely reticulate, rather faint, glandular hairs usually at the lower half of the upper surface. *Style* column *c.* 1 mm long, obscurely 6-lobed, with a distinct, annular ring. *Stamens* 6; anthers oblong, *c.* 0.3 mm long. *Capsules* oblong-obovoid, 1.7–2.5 by *c.* 1.2 cm, 6-ridged, distinctly transversely rugose outside (marked by the seeds). *Seeds* ovate, *c.* 5 by 4 mm, not winged, granulate on both surfaces.

Distr. Malesia: Malay Peninsula (Dindings, Perak, Johore), Borneo (Sarawak: Kelabit Highlands; Sabah: Mt Kinabalu, Sandakan; NE. Kalimantan: Mt Buduk Rakik).

Ecol. In primary forest, sometimes found in swampy forest, or old secondary forest, from lowland up to 1300 m. *Fl.* March–Aug., *fr.* Aug., Sept.

7. *Aristolochia glaucifolia* RIDLEY, Kew Bull. (1925) 88; DING HOU, Blumea 29 (1983) 228, f. 2d.

Twiner up to *c.* 8 m high. Branches terete, 1.5–3 mm \varnothing . *Leaves* thin-chartaceous, ovate (in outline),

5–13 by 4–6 cm; apex acuminate; base cordate, auricles almost oblong, 1.5–3 by 1–2 cm, rounded, the sinus 1.5–3.5 cm deep, glabrous above, lower surface sparsely shortly hairy, sometimes glaucous; basal nerves 1 pair, ascending upward to the apex, each with 1–3 branches along the inner margin of the auricles, slightly elevated beneath, faint above; veins loosely transverse or reticulate, distinct beneath, obscure or invisible above; petiole subterete, 3–7 cm, glabrous. *Inflorescences* in the axils of foliage leaves, rarely cauligerous, spiciform, up to 2 cm long, slightly short-hairy; bracts ovate, 2–10 (–20) mm long, sparsely puberulous on both surfaces. Pedicels and ovary 6–13 mm long, sparsely puberulous, glabrescent. *Perianth* pale yellowish green and somewhat purplish at the base, brownish, or dark brown, straight, with loosely reticulate veins, glabrous outside; utricle broad-ellipsoid, 10–12 by *c.* 5 mm, sparsely, shortly hairy inside, with 2 glandular, elliptic bodies (1.5–2 mm long); tube cylindrical, 5–11 by 1–2.5 mm, sparsely hairy inside; limb 1-lipped, narrow lanceolate, 15–25 by 3–6 mm, shortly hairy on the upper surface. *Stamens* 6; anthers oblong, *c.* 0.6 mm long. *Style* column *c.* 1.5 mm long; lobes 6, triangular, *c.* 0.5 mm long, with a continuous, annular ring at their base. *Capsules* ellipsoid, 2.5–3 by 1.5 cm, slightly 6-ridged. *Seeds* triangular, 4 by 3.5 mm, not winged, granular on both surfaces, central part of the upper surface with a longitudinal ridge.

Distr. Malesia: Sumatra (northern part: Atjeh, Mt Sinabung, Kabandjahe, Petani Valley, Sibolangit, Singgalang; central western part: Batu I., Mt Kerintji, Pajakumbuh; southern part: Bencoolen).

Ecol. In primary forest, sometimes in old secondary forest, 500–1550 m. *Fl.* Feb.–Dec., *fr.* March, May, Sept.

Note. The plants of this species are easy to recognize by the rather thin-chartaceous, cordate-sagittate leaves glaucous underneath. According to BROOKS they are the food plant of *Papilio helenae* CUM.

8. *Aristolochia klossii* RIDLEY, Kew Bull. (1926) 78; DING HOU, Blumea 29 (1983) 231.

Scandent shrub. Branches *c.* 6 mm \varnothing , twisted, sulcate, glabrous. *Leaves* chartaceous, broad-ovate or deltoid in outline, 13.5–15 by 11.5–15 cm; apex obtuse or acute; base cordate or shallowly cordate, lobes rounded, the sinus 2–2.5 cm deep, 7–9 cm at the widest part; glabrous on both surfaces; basal nerves 1 pair, curved, ascending to the apex, each basal nerve branched quite near the base, thus almost forming another basal pair, elevated and prominent below, distinct sometimes slightly depressed above; veins loosely reticulate or transverse, slightly elevated below, faint above; petiole 4.5–6.5 cm, glabrous. *Inflorescences* in the axils of foliage leaves, racemiform, up to 6 cm long, sparsely puberulous or almost

glabrous; bracts ovate, c. 4 mm long, densely shortly hairy on the margin. Pedicel and ovary 8–20 mm, glabrous. *Perianth* deep crimson, white at base, limb pinkish, edge crimson, straight, with distinct, longitudinal and reticulate veins, glabrous outside, utricle ellipsoid, 10–15 by 5–8 mm, with a stipe of 3 mm, sparsely hairy inside, glandular bodies 2, ellipsoid, c. 2 mm long; tube 16–19 mm long, with scattered, glandular hairs inside; limb 1-lipped, obovate-oblong 20–25 by 10–14 mm, apex slightly retuse or mucronate, with scattered, glandular hairs on the upper surface. *Stamens* 6; anthers ellipsoid or oblong, c. 0.7 mm long. *Style* column c. 4.5 mm long, 6-lobed; lobes with basal parts united, projecting and forming an annular ring. Capsules unknown.

Distr. *Malesia*: Sumatra (Mentawai Is.: Sipora; Bandarbaru). Twice collected.

Ecol. Fl. Oct.

Notes. The leaves resemble those of *A. gaudichaudii* from the Moluccas and New Guinea.

More material and especially fruits are desirable.

9. *Aristolochia tagala* CHAMISSO, *Linnaea* 7 (1832) 207, t. 5, f. 3; KLOTZSCH, *Monatsb. Akad. Berl.* (1859) 597; DUCHARTRE in DC. *Prod.* 15, 1 (1864) 480; F.-VILL. *Nov. App.* (1880) 174; VIDAL, *Phan. Cuming.* (1885) 138; *Rev. Pl. Vasc. Filip.* (1886) 218; SOLEREDER, *Bot. Jahrb.* 10 (1889) 464; FORB. & HEMSL. *J. Linn. Soc. Bot.* 26 (1891) 363; KOORD. *Minah.* (1898) 567; MERR. *Publ. Govt. Lab. Philip.* 27 (1905) 72; KING & GAMBLE, *J. As. Soc. Beng.* 75, ii (1912) 30; MERR. *Fl. Manila* (1912) 186; *Int. Rumph.* (1917) 209; *Sp. Blanc.* (1918) 135; BACK. *Trop. Natuur* 8 (1919) 151, f. 7–12, 166; BROWN, *Bull. Bur. For. Philip.* (1921) 183; C.T. WHITE, *Proc. R. Soc. Queensl.* 34 (1922) 30; MERR. *En. Philip.* 2 (1923) 120; RIDLEY, *Fl. Mal. Pen.* 3 (1924) 18, excl. f. 136 (= *A. indica*); GAMBLE, *Fl. Pres. Madras pt 7* (1925) 1202; MOORE, *J. Bot.* 63 (1925) *Suppl.* 83; HEYNE, *Nutt. Pl.* (1927) 597; KOIDZUMI, *Fl. Symb. Orient.-Asiat.* (1930) 16; MERR. *Gard. Bull. S. S.* 8 (1935) 131; SCHMIDT in E. & P. *Nat. Pfl. Fam. ed.* 2, 16b (1935) 241; BURK. *Dict.* 1 (1935) 239; MERR. *Comm. Lour.* (1935) 142; KANJILAL c.s. *Fl. Assam* 4 (1940) 28; HOEHNE, *Fl. Brasil. Fasc.* 6 (vol. 15, 2) (1942) 136, t. 120; MERR. & PERRY, *J. Arn. Arb.* 23 (1942) 384; *ibid.* 29 (1948) 153; QUIS. *Medic. Pl. Philip.* (1951) 255; HEND. *Mal. Wild Fl.* (1951) 421, f. 381A & B; L.S. SMITH, *Proc. R. Soc. Queensl.* 68 (1957) 45; LIANG, *Acta Phytotax. Sin.* 13 (1975) 17, f. 1, 5; BACK. & BAKH. *f. Fl. Java* 1 (1963) 163; KAO, *Fl. Hainan* 1 (1964) 327, f. 163; H. KENG, *Mal. Seed Pl.* (1969) f. 58; *ibid.* ed. 2 (1978) f. 59; LIANG, *Acta Phytotax. Sin.* 13 (1975) 17, f. 1, 5; LIU & LAI, *Fl. Taiwan* 2 (1976) 576; ANONYMOUS, *Icon. Cormophyt. Sin.* 1 (1972) 548, f. 1096; IGARASHI, *Food Pl. Papilionidae* (1979) t. 12; PERRY, *Medic. Pl. E. &*

SE. Asia (1980) 47; DING HOU, *Blumea* 29 (1983) 232. — *Peponaster major* RUMPH. *Herb. Amb.* 5 (1747) 474. — *A. acuminata* LAMK. *Encycl.* 1 (1783) 254; WILLD. *Sp. Pl.* 4 (1805) 157; SPRENG. *Syst. Veg.* 3 (1826) 751; BL. *En. Pl. Jav.* 1 (1827) 81; ROXB. *Fl. Ind. ed.* Carey 3 (1832) 489; WIGHT, *Icon. Pl. Ind. Or.* (1844) t. 771; MIQ. *Fl. Ind. Bat.* 1, 1 (1858) 1066; DALZELL & GIBSON, *Bombay Fl.* (1861) 224. — *A. longifolia* ROXB. [*Hort. Beng.* (1814) '102']; *Fl. Ind. ed.* Carey 3 (1832) 490. — *A. timorensis* DECNE, *Ann. Mus. Hist. Nat. Paris III*, 3 (1834) 368; *Herb. Timor. Descr.* (1835) 40; MIQ. *Fl. Ind. Bat.* 1, 1 (1858) 1066; KLOTZSCH, *Monatsb. Akad. Berl.* (1859) 597; DUCHARTRE in DC. *Prod.* 15, 1 (1864) 481; BRITTEN in Forbes, *Wand.* (1885) 515; *ENGL. Bot. Jahrb.* 7 (1886) 453; LAUT. *Bot. Jahrb.* 52 (1914) 105. — *A. indica* (non L.) BLANCO, *Fl. Filip.* (1837) 282; ed. 2 (1845) 197; ed. 3, 1 (1877) 349; F.-VILL. *Nov. App.* (1880) 174. — *A. roxburghiana* KLOTZSCH, *Monatsb. Akad. Berl.* (1859) 596, excl. WALLICH n. 2704 (= *A. indica*); F.-VILL. *Nov. App.* (1880) 174; DUCHARTRE in DC. *Prod.* 15, 1 (1864) 480, *incl. β angustifolia* DUCHARTRE; *HOOK. f. Fl. Br. India* 5 (1886) 75; SOLEREDER, *Bot. Jahrb.* 10 (1889) 460; LAUT. *Bot. Jahrb.* 52 (1914) 106; BOLDINGH, *Zakfl. Landb. Java* (1916) 37; KOORD. *Exk. Fl. Java* 4 (Atlas) (1926) 590, f. 872; SCHMIDT in E. & P. *Nat. Pfl. Fam. ed.* 2, 16b (1935) 241. — *A. moluccana* DUCHARTRE in DC. *Prod.* 15, 1 (1864) 438, *nom. superfl.*, new name for *A. longifolia* ROXB. (1832). — *A. japonica* MIQ. *Ann. Mus. Bot. Lugd.-Bat.* 2 (1866) 136; *Prol. Fl. Jap.* (1866) 68. — *A. megalophylla* K. SCH. in K. SCH. & HOLTR. *Fl. Kais. Wilh. Land* (1889) 104; *WARB. Bot. Jahrb.* 13 (1891) 300; K. SCH. *Notizbl. Berl.-Dahl.* 2 (1898) 113; K. SCH. & LAUT. *Fl. Deut. Schutzgeb. Südsee* (1900) 302; RECHINGER, *K. Ak. Wiss. M.-N. Kl. Wien* 89 (1913) 549; LAUT. *Bot. Jahrb.* 52 (1914) 106; SCHMIDT in E. & P. *Nat. Pfl. Fam. ed.* 2, 16b (1935) 241; PEEKEL, *Illustr. Fl. Bismarck Arch.* (MS) 4 (1947) *sub f.* 528. — *A. mindanaensis* WARB. in Perkins, *Fragm. Fl. Philip.* (1905) 169; MERR. *En. Philip.* 2 (1923) 119. — **Fig. 1f.**

Twinner, up to 20 m high. Branches terete, slightly furrowed, 3–5 mm ø, glabrous. *Leaves* variable in shape and size, ovate, ovate-oblong, rarely suborbicular, 6–20 (–27) by 4–10 (–16) cm; apex acute or acuminate; base cordate, auricles rounded, often connivent, the sinus up to 3.5 cm deep; glabrous or nearly so above, sparsely shortly hairy, or subglabrous beneath; basal nerves 2 pairs, the inner one ascending upward to more than 2/3 of the blade, similar in appearance to the lateral nerves, the outer one much shorter and weaker, often branched; lateral nerves 3–5 pairs, elevated below, slightly elevated or faint above; veins loosely reticulate or crossbar-like, distinct below, obscure above; petiole 2–6 cm,

slightly hairy. *Inflorescences* in the axils of foliage leaves, racemiform or paniculate, 2–6 cm long, slightly hairy, glabrescent, or glabrous; bracts ovate to lanceolate, up to 10 mm long, puberulous on both surfaces. Pedicel and ovary 10–18 mm long, sparsely hairy, glabrescent. *Perianth* pale yellowish with purple throat, pale or sordidly green with purple, purplish, or dark reddish brown, straight or slightly curved, venation faint, sparsely hairy, glabrescent outside; utricle broad-ovoid or subglobose, 3–9 by 3–7 mm, with a stipe of 1–3 mm, hairy inside, with 2 glandular, ovoid bodies (c. 0.7 mm long); tube 5–10 (–15) by c. 2.5 mm, hairy inside; limb 1-lipped, lanceolate to narrow-lanceolate, 20–30 (–40) by 6–8 mm, apex acute, hairy on the upper surface. *Style* column c. 3 mm long, 6-lobed; lobes conical, c. 1.5 mm long, at base forming an annular ring. *Stamens* 6; anthers oblong, c. 1 mm long. *Capsules* subglobose, slightly pyriform, or oblong, 3–4 by 2–3 cm, often 6-ridged, glabrous. *Seeds* triangular, winged, 8.5–10 mm long and wide (incl. the c. 2 mm wide wing), granular beneath, much less so above; funicle with membranous extension covering the upper surface (dry state).

Distr. Widely distributed in India, Sikkim, Sri Lanka, Bangladesh, Burma, Thailand, Cambodia, Vietnam, China; *Malesia* (throughout), New Ireland, New Britain, Solomon Is., Australia (Queensland). Cultivated in Hort. Bog. *sub n.* XV-D-40 and XV-K-AXI-9.

Ecol. In forests and thickets, often at low and medium altitudes (0–800 m), sometimes up to c. 1350 m (e.g. New Guinea). *Fl. fr.* all the year round.

Uses. The powdered roots are said to be tonic, carminative, and emmenagogic, and a very efficient remedy for infantile tympanites if they are pulverized and applied to the abdomen (QUISUMBING, *l.c.*).

In Ambon, the leaves, ground with curcuma and warmed, are smeared on the abdomen and the limbs when they are swollen; or they are made into a paste for use against such a skin disease as formication (HEYNE, *l.c.*; BURKILL, *l.c.*).

Vern. Sumatra: *běngkuh-běngkuh, kěping-kěping, olor sěngkuh-kěping*, Simalur. Malay Peninsula: *akar ara bukit, akar kětola huta, akar pětola hutatan*, M. Java: *kalajar* or *kalaijar*, S; *kapassan, prodjon, pujan*, J. Timor: *wunbewa*. Bunguran Is. (= Groot Natoena): *mili utan*, M. Philippines (MERRILL, 1923, *l.c.*): *altán, malauibi, parolparulan, tala-talarum, timbangan, timbang-timbangan*, Tag., *goan-goan*, Bis., *kamkamaulau*, Ig., *nageris, taointadoin*, Iik. Celebes: *kunit*, Manado. Moluccas: *jawepplèwè*, Weda, *sasa baru*, Ternate. New Guinea: *kobi*, Garaina, *kolura*, Bangwe, *mangkapudpak*, Biak, *sisidi*, Merauke.

10. *Aristolochia coadunata* BACK. Trop. Natuur 8

(1919) 154, f. 13, 167; Bull. Jard. Bot. Btzg III, 2 (1920) 320; BACK. & BAKH. *f. Fl. Java* 1 (1963) 164; STEEN. Mountain Fl. Java (1972) *sub t.* 4, 1; DING HOU, *Blumea* 29 (1983) 227. — Fig. 12.

a. var. coadunata.

Scandent, high liana, 10–50 m long. Branches subterete or slightly flattened, 0.5–1.2 cm \varnothing , young parts densely pubescent, glabrescent. *Leaves* subcoriaceous, ovate-oblong to lanceolate, rarely ovate, 7.5–33 by 4–12 cm; apex acuminate, short-acuminate, or acute; base slightly cordate, basal lobes rounded (and the sinus 0.5–1 cm deep, sometimes obscure); upper surface pubescent especially on midrib and nerves, glabrescent; undersurface villous or densely tomentose, glabrescent; basal nerves one pair, reaching upward to 1/3–1/2 of the blade, lateral nerves 4–7 pairs, pinnate, veins rather closely reticulate; both nerves and veins elevated beneath, distinct or faint, sometimes depressed or bullate above; petiole 3–9 cm, pubescent. *Inflorescences* in axils of foliage leaves, rarely cauligerous, solitary or fasciculate, racemiform, up to 2 cm long, pubescent; bracts ovate, c. 1.5 mm long, densely pubescent or tomentose. Pedicel and ovary 4–8 mm, pilose. *Perianth* dark purple with yellow throat, geniculate, sigmoid, pubescent outside, venation obscure; utricle ovoid-tubular, 2.5–3 by 0.7 cm, the apical part bent backward, hairy at the lower half inside; tube cylindrical, 3–4.5 by 0.6 cm, closely laterally in contact with the utricle, the basal part inside slightly projecting into the utricle cavity, almost glabrous inside; limb rim-like, 1.5–3 cm \varnothing , the rim 0.5–1 cm wide, very obliquely positioned on the tube, obscurely 3-lobed. *Stamens* 6; filaments short; anthers oblong, 2–2.5 mm long. *Style* column 5–7 mm long; lobes 3, triangular, c. 1 mm long. Fruit unknown.

Distr. *Malesia*: Sumatra (Berastagi; Mt Kerintji), West to East Java (Priangan: Mts Malabar & Pandajan; Mt Lawu, above Pudjon, probably Mt Kawi, SE. Mt Smeru, G. Pendil on Mt Idjen).

Ecol. In primary, occasionally in secondary, mountain forest, 1000–2100 m. *Fl.* April, June, Oct., Nov.

Taxon. Closely allied to the Himalayan *A. saccata* WALL. from which it differs by the smaller, non-saccate flowers which have the perianth tube in close contact with the utricle.

b. var. bosschii BACK. Trop. Natuur 8 (1919) 154, 168; Bull. Jard. Bot. Btzg III, 2 (1920) 321; BACK. & BAKH. *f. Fl. Java* 1 (1963) 164.

Similar to var. *coadunata*, except the perianth limb entirely sulphureous.

Distr. *Malesia*: West Java (Preanger: Talun) Only known from the type.

Ecol. In primary forest, 1600 m

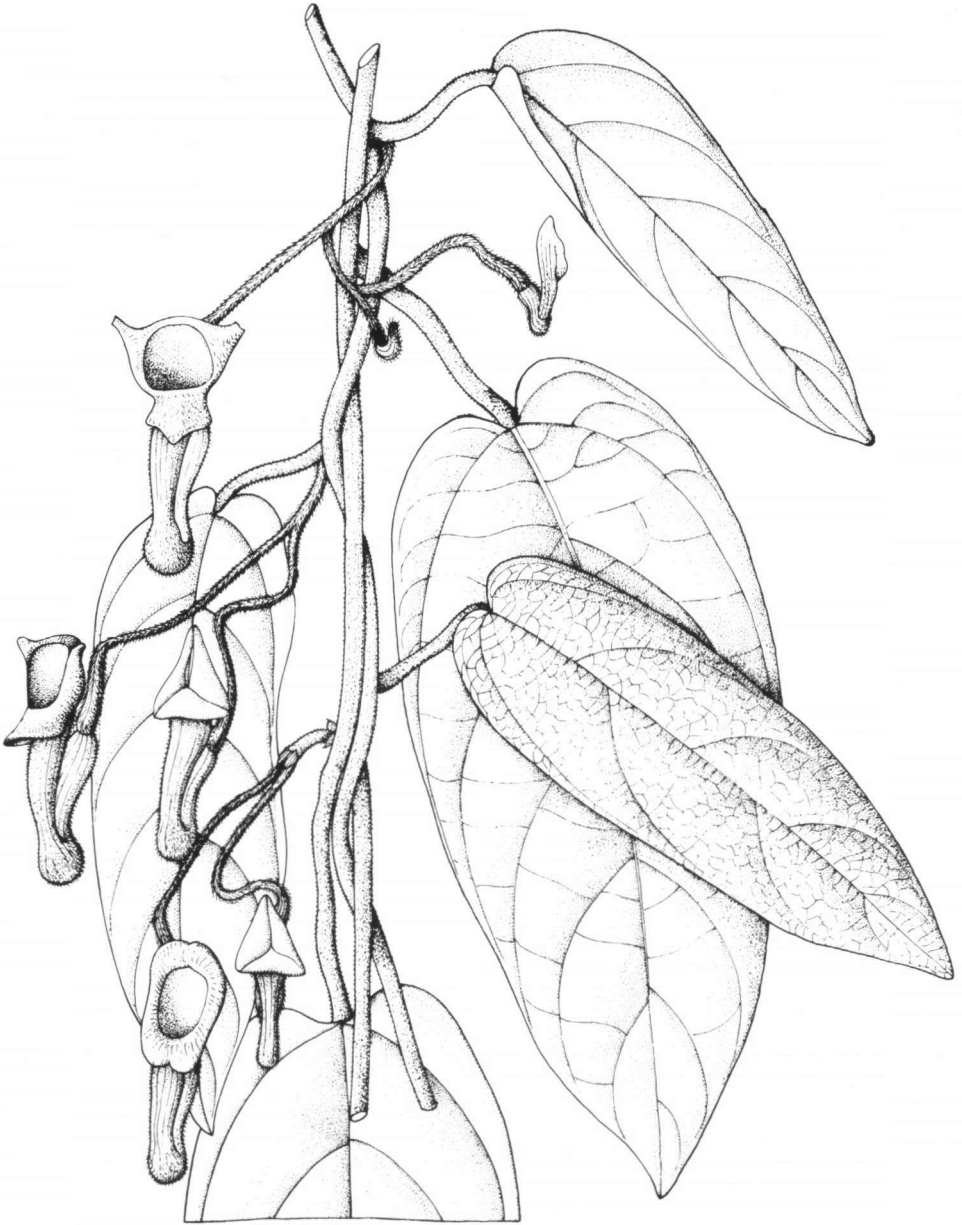


Fig. 12. *Aristolochia coadunata* BACK. After a coloured drawing made for VAN STEENIS, Mountain Flora of Java, $\times 2/3$. West Java, Mt Papandajan, Tegal Pandjang, July 1940 (VAN STEENIS 12625).

11. *Aristolochia momandul* K. SCH. in K. Sch. & Hollr. Fl. Kais. Wilh. Land (1889) 105; K. Sch. & LAUT. Fl. Deut. Schutzgeb. Südsee (1900) 302; LAUT. Bot. Jahrb. 52 (1914) 106; DING HOU, *Blumea* 29 (1983) 239, f. 5a, 6b, 7c. — *A. pithecurus* RIDLEY, J. Bot. 52 (1914) 296; MOORE, J. Bot. 61 (1923) Suppl. 40; SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 241; IGARASHI, Food Pl. Papilionidae (1979) t. 24. — *A. gracilifolia* SCHMIDT, Bot. Jahrb. 58 (1923) 490; MERR. & PERRY, J. Arn. Arb. 23 (1942) 383. — *A. dictyophlebia* MERR. & PERRY, J. Arn. Arb. 29 (1948) 152. — Fig. 8b.

Twiner up to 6 m, sometimes scrambling on (tall) tree top up to 30 m. Old stem terete, 2.2–4 cm \varnothing ; branches terete, c. 4 mm \varnothing , short-hairy, glabrescent. *Leaves* chartaceous to coriaceous, lanceolate, elliptic, or ovate, (7–) 10–25 (–43) by (2–) 3–11 (–21) cm; apex acuminate, short-acuminate, rarely cuspidate; base subcordate, deeply cordate (especially plants from rather lower altitude), or slightly concave, rarely rounded or subtruncate (especially when young, or in plants from rather higher altitude); sinus 0–1 (–5) cm; subglabrous or glabrous above, shortly hairy especially on the midrib, nerves and veins; nerves elevated and prominent beneath, less so above; basal nerves 1 pair, ascending upwards to c. 1/2–2/3 of the blade, branched at base; lateral nerves 3–5 pairs; veins reticulate or crossbar-like, prominent beneath, distinct or sometimes faint above; petiole (1–) 2–3.5 (–7) cm, densely hairy. *Inflorescences* in axils of leaves, or cauligerous, paniculiform, rachis 4–19 (or more) cm long, with spacious internodes, densely hairy; bracts minute, densely hairy. Pedicel and ovary c. 20 mm long, densely hairy. *Perianth* straight or with slightly curved tube, white or pale green with purple venation, dull wine purple with yellow or orange yellow, longitudinal veins distinct, reticulations rather faint, densely hairy outside, with scattered hairs inside; with a contraction between perianth and ovary, no stipe; utricle obovoid, c. 10 by 7 mm; tube gradually enlarged toward apical part, c. 12 by 10 mm; limb an obovoid body with a long filiform tail composed of the ends of the lobes; limb 3-lobed (very rarely with an additional filiform fourth lobe); lobes suborbicular, c. 10 mm \varnothing , with an apical tail-like appendage (easily broken off) c. 20 mm. *Stamens* 6; anthers oblong, 1.2–1.7 mm long. Gynostemium c. 3.5 mm long; style 6-lobed; lobes triangular, 1.5–2 mm long, each lobe with the basal part slightly extended outward or downward. *Capsules* golden yellow or brilliant orange when ripe, oblong or ellipsoid, 5.5–9 by 3.5–4 cm, strongly 6-ridged, smooth (fine-granular under a hand lens); mostly found indehiscent, but obviously finally dehiscent. *Seeds* triangular or deltoid, 9–10 mm long and wide, smooth on both surfaces, not winged.

Distr. Malesia: Moluccas (Halmahera), West New Guinea (Sorong, Oransbari, Andai, Jappen, Biak); Papua New Guinea (Sepik, Madang, Morobe, Central Distr.), New Britain.

Ecol. In primary forest, beach forest, sometimes occurring in limestone areas on rocky peak; at low and medium altitudes, sometimes found up to 1650 m. *Fl.* Jan.–July, *fr.* Jan.–June, Sept., Oct.

Uses. Sap from the vine said to be used in 'papeda' (sago-porridge) (VINK BW 17561, L).

Vern. West New Guinea: *ba*, Oransbari lang.; Papua New Guinea: *momandul*, Madang.

Notes. The leaves of the present species are very variable, in shape, size, texture, and base, but flowers and fruit are uniform, the tailed buds and lobes being very characteristic.

As already pointed out by SCHUMANN it is related to *A. deltantha* F. v. M. from Queensland, from which it can be distinguished by the tail-like apex of the perianth lobes; in *A. deltantha* the perianth is hardly lobed. The leaf variability is in both the same.

A. momandul was described on fruiting material. In 1914 LAUTERBACH associated flowering material with it (FORBES 621, the type of *A. pithecurus* RIDLEY). Because the species cannot be distinguished from *A. schlechteri* on vegetative characters, it will be essential to have fruit of the latter, to check whether LAUTERBACH's conclusion was correct. LAUTERBACH erroneously described his material to have 6 perianth lobes.

12. *Aristolochia rumphii* KOSTELETSKY, Allg. Med.-Pharm. Fl. 2 (1883) 465; MERR. Int. Rumph. (1917) 209; HEYNE, Nutt. Pl. (1927) 596; DE WIT, Rumph. Mem. Vol. (1959) 348; PERRY, Medic. Pl. E. & SE. Asia (1980) 47; DING HOU, *Blumea* 29 (1983) 232, f. 2b. — *Radix puluronica* RUMPH. Herb. Amb. 5 (1747) 476, t. 177. — *A. indica* (non L. 1753) L. in Stickman, Herb. Amb. (1754) 25, *quoad Radix puluronica* RUMPH.; FILET, Bot. Tuin Weltevr. (1855) 50; BISCHOP GREVELINK, Pl. Ned. Ind. (1883) 268. — Fig. 15e.

Climber. Branches c. 2 mm \varnothing , smooth, glabrous. *Leaves* thin-chartaceous, oblong, elliptic-oblong, ovate-oblong, narrow-lanceolate, 7–12.5 by (1–) 3–5.5 cm; apex acuminate; base obtuse, sometimes slightly cuneate, rarely truncate; glabrous, minutely shortly hairy beneath, glabrescent; 1 pair of basal nerves, ascending upward to about halfway the blade, lateral nerves 4 or 5 pairs distinct sometimes faint beneath, rather faint above; veins loosely transverse or reticulate, often faint beneath, obscure above; petiole 1.5–2.5 cm, glabrous or sometimes sparsely short-hairy. *Inflorescences* in axils of foliage leaves, usually very short, sometimes up to c. 5 cm long, racemiform and with distinct internodes; bracts ovate, 1.5–2 mm long, hairy on the margin, glabrescent. Pedicel and

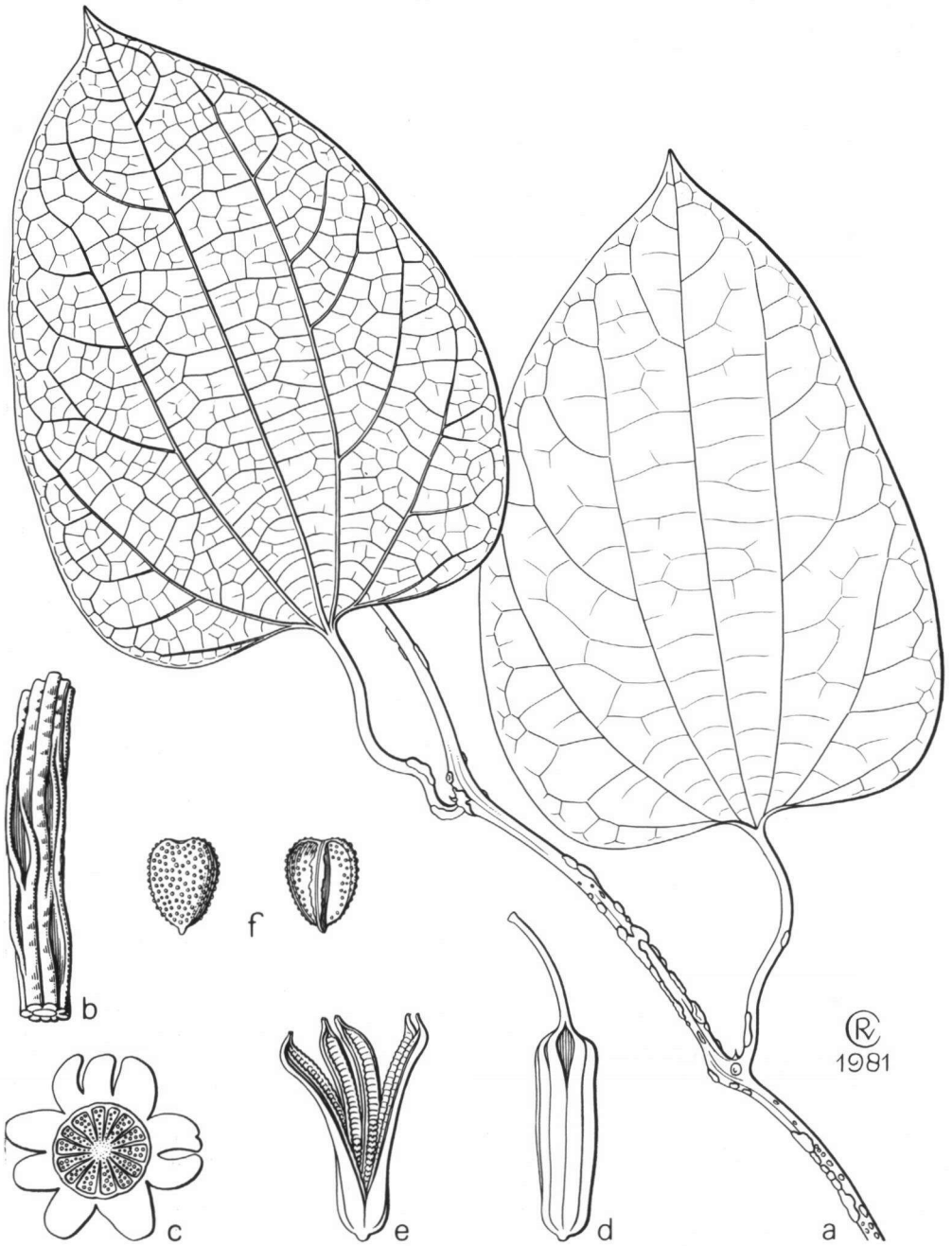


Fig. 13. *Aristolochia papillifolia* DING HOU. *a.* Habit, note lenticels, *b.* old stem with thick furrowed bark, both $\times \frac{1}{2}$, *c.* CS of ditto, note medullary rays and vascular bundles, $\times 2$, *d-e.* opening of fruit, $\times \frac{1}{2}$, *f.* immarginate seed, dorsal and ventral (*a-c* SAN 34658, *d-f* SAN 17334). Courtesy of Blumea.

ovary 10–30 mm, minutely hairy, glabrescent. *Perianth* green with brown limb, straight or with the limb slightly bent, minutely hairy outside; utricle subglobose, c. 6 mm \emptyset , with a distinct stipe of 5 mm, hairy inside, 2 glandular, subglobose bodies (c. 0.3 mm \emptyset); tube 17 by 1.5 mm, sparsely hairy inside; limb oblong, 27 by 7 mm, hairy above, glabrescent, margin reflexed. *Style* column c. 2 mm long, 6-lobed; lobes lanceolate, c. 1 mm long, basal parts projecting and forming an annular ring. *Stamens* 6; anthers oblong, c. 0.7 mm long. *Capsules* short cylindrical, c. 2.2 by 1.5 cm, 6-ridged. *Seeds* triangular, 5 by 5–5.5 mm, verrucose on both surfaces, not winged.

Distr. *Malesia*: SW. Celebes (Pangkadjene), Kajaudi Is. (halfway Flores), Lesser Sunda Islands (Sumba, Flores, Timor), Moluccas (Ambon, not seen; Kai and Tenimber Is.).

Ecol. In light forest, grass field and thickets, up to c. 100 m. *Fl.* April–June, *fr.* March–July.

Uses. A decoction of a piece of the root or of small twigs (less powerful than root) is used to treat stomach-ache, spasm and constipation, and also intermittent fever. On trips travellers often take a piece of root or lowest part of a stem about the length of a finger and drink the decoction from it as tea (RUMPHIUS, *l.c.*; HEYNE, *l.c.*; PERRY, *l.c.*).

Vern. *Akar pulurun*, Ambon, *tuhe tutunu*, Banda, *warosbot*, Tenimber I.

Notes. One fertile specimen, collected on a hill above Ende (Flores) by Father J.J. LOETERS (*n.* 2092, L) has one flower and one fruit which match those of the present species, though its leaves are very narrow, c. 1 cm wide (fig. 15e).

A. rumphii is closely allied to *A. indica* from Southeast Asia (mainly Ceylon and India), similar in leaf characters and a 1-lipped perianth with a distinct stipe-like base. It can be distinguished from *A. indica* by the few-flowered inflorescences with distinct internodes, a longer pedicel and ovary, up to 3 cm (in *A. indica* up to 1.5 cm), the longer stipe of the utricle, c. 5 mm (2.5 mm in *A. indica*), the rather long perianth tube up to 17 mm (against c. 8 mm), smaller capsules, c. 2–3 cm (against 4–5 cm), and immarginate seeds (distinctly winged in *A. indica*).

13. *Aristolochia papillifolia* DING HOU, Blumea 28 (1983) 346, f. 3, 5A–C. — Fig. 13.

Stout climber, up to 15 m high. Old stem terete, 1.5–2.5 cm \emptyset . Branches subterete or slightly flat, 5–7 mm \emptyset , glabrous. *Leaves* subcoriaceous, broad-ovate or ovate, 13–19 by 9–15.5 cm; apex acute or short-acuminate; base almost truncate, slightly concave, or rounded; glabrous above, glabrous but papillate in the areolae beneath; nerves palmate, basal nerves 2 pairs, each nerve with a few lateral, oblique branches, the inner pair of nerves reaching the apex, the outer pair much shorter; nerves elevated and

prominent beneath, distinct above; veins loosely transverse or reticulate, slightly elevated beneath, faint above; petiole stout, terete, glabrous, 6–12 cm. Bracts linear, 3.5–5 mm long, glabrous. Pedicel and ovary 3–4 cm, glabrous. *Flowers* cauligerous, fasciculate. *Perianth* straight, veins loosely reticulate, glabrous outside; utricle ellipsoid or subglobose, 6–7.5 by 5–6 mm, flanged at the base, hairy inside, with 6 ellipsoid or orbicular, glandular bodies (c. 1.5 mm long); tube 15–20 by 2 mm, hairy inside; limb 1-lipped, linear, 45–50 by 7–12 mm, papillate on the upper surface. *Stamens* 6; anthers oblong, c. 0.7 mm long. *Style* column 2 mm long, 6-lobed; lobes deltoid, c. 1 mm long, basal parts forming a distinct annular ring. *Capsules* cylindrical, 6.5 by 1.2 cm, slightly 6-furrowed, obtuse on both ends. *Seeds* broad-ovate, c. 4 by 3 mm, granular on both surfaces, not winged.

Distr. *Malesia*: Borneo (Sabah: Sandakan, Tongod, Tawau Distr.; Sarawak: Gunung Buri).

Ecol. Ridge top in primary forest, hill slope in disturbed mixed dipterocarp forest, and also in secondary forest, up to c. 600 m. *Fl.* May, *fr.* June, July.

Notes. On the undersurface of the leaves the areolae are papillose, and cavities containing one stoma are surrounded by papillate cells (magnitude $\times 40$); this is a unique character among the Malesian species.

The 1-lipped perianth has 6 glands inside the utricle, a character only known from *A. foveolata* and a West African species.

14. *Aristolochia transtillifera* DING HOU, Blumea 28 (1983) 348, f. 4, 5. — Fig. 2a–b.

Twiner. Branches terete, 3.5–6 mm \emptyset , slightly striate, glabrous. *Leaves* subcoriaceous, ovate-oblong, oblong-elliptic, rarely ovate, 16–20 by 6.5–10 cm; apex short-acuminate; base obtuse, sometimes slightly concave, or subtruncate, glabrous; basal nerves 2 pairs, the inner one ascending to the apex, elevated and prominent beneath, slightly depressed above, the outer pair shorter and much weaker, ascending close to or along the margin, slightly elevated beneath, obscure or invisible above; veins distinctly transverse, joined by closely reticulate veinlets, slightly elevated beneath, obscure or invisible above; petiole terete, 3–8 cm. *Flowers* unknown. *Infructescences* cauligerous, very short, condensed, bracteate, knobby; bracts lanceolate, 2–6 mm long, slightly puberulous on both surfaces, glabrescent. *Capsules* cylindrical, 3–3.5 by 1.2 cm, obtuse at both ends, glabrous, smooth (but finely verrucose under a hand lens); pedicel c. 3.5 cm. *Seeds* triangular, 5 by 4–4.5 mm, subcordate at the base, not winged, finely verrucose on both surfaces, funicle with a thin expanded appendage covering the upper surface of the seed.

Distr. *Malesia*: Borneo (Sabah: Beaufort Distr.). Once collected.

Ecol. Hill side, primary forest, c. 30 m.

Notes. Though the species is as yet only known in fruit, it stands out by the glabrous, subcoriaceous leaves with obtuse to sometimes slightly concave base and clearly trabeculate venation with close reticulations.

It may be related to *A. foveolata* and *A. papillifolia*, but differs by these leaf characters.

15. *Aristolochia naviculilimba* DING HOU, *Blumea* 28 (1983) 344, f. 2.

Liana, up to 15 m high. Branches subterete, 3–6 mm ϕ , glabrous. *Leaves* chartaceous, elliptic, 10–15 by 5.5–8 cm; apex shortly acuminate; base rounded or obtuse, rarely slightly concave; glabrous above, minutely hairy beneath especially on the venation; basal nerves 2 pairs, the inner pair and the midrib elevated, prominent beneath, distinct above, ascending obliquely and slightly curved nearly reaching the apex of the blade; outer pair of basal nerves rather weak, running along the margin; the longitudinal nerves joined by 10–14 loosely transverse or slightly curved nervules or stronger veins, slightly elevated beneath, distinct or faint above; veins and veinlets loosely reticulate, distinct or faint on both surfaces; petiole c. 3 cm, glabrous. *Flowers* (detached) cauligerous, on brachyblasts, internodes condensed, obscure; bracts lanceolate or lineate, 3–4.5 mm long, shortly hairy on both surfaces. Pedicel and ovary c. 3 cm long, glabrous. *Perianth* dull yellow with dark purple stripes and markings, curved, distinctly longitudinally 6-nerved or -veined, glabrous outside; utricle subglobose, 10–12 by 9–10 mm, abruptly contracted and collar-like at the base, densely hairy inside, with 2 ellipsoid, glandular bodies (3–4 mm long); tube often at right angles with the utricle, cylindrical, c. 15 by 3 mm, glabrous inside; limb 1-lipped, ovate-oblong or lanceolate, naviculiform in side view when young, 60–90 by 30–35 mm, longitudinally incurved, inner surface almost glabrous, except sparsely short-hairy at the basal part. *Stamens* 6; anthers oblong, c. 1 mm long. *Style* column c. 3.5 mm long,

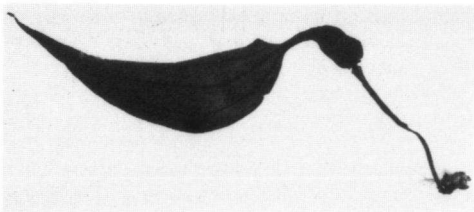


Fig. 14. *Aristolochia naviculilimba* DING HOU. Lateral view of flower, $\times 2/3$ (CLEMENS 20292).

6-lobed, with an annular ring at the base; lobes triangular, c. 1.5 mm long. Capsules unknown.

Distr. *Malesia*: Borneo (Sarawak: Lundu Distr., Mt Poi; W. Kalimantan: Mt Kasian & Mt Liang Gagang); 3 collections.

Ecol. In forest, c. 600 m. *Fl.* June, Oct.

Notes. The epithet alludes to the boat-shaped limb.

Superficially the leaves of this species resemble those of *A. transtillifera* in shape, but they are chartaceous, puberulous beneath, with 10–14 rather loose transverse cross-veins and reticulate veins.

16. *Aristolochia decandra* DING HOU, *Blumea* 28 (1983) 343, f. 1. — Fig. 15a–d, 16.

Liana. Old stem slightly flattened, 0.7–1.2 cm ϕ , rather smooth, glabrous. Branches slightly flattened, 5–7 mm ϕ , smooth, glabrous, often with a series of 3 or 4 buds in the leaf axil. *Leaves* firmly chartaceous, suborbicular or broad-ovate in outline, 13.5–22.5 by 11.5–18.5 cm; glabrous above, sparsely minutely hairy beneath; apex acuminate; base deeply cordate, sinus 3–4 cm deep, auricles with almost rounded ends, separate from each other, sometimes overlapping; glabrous above, sparsely minutely hairy underneath; basal nerves 2 pairs, the inner pair ascending to the apical part of the blade, the outer pair much shorter and giving off at its base a strong branch resembling a third basal nerve pair; midrib with 2–3 pairs of lateral nerves; nerves elevated, prominent beneath, distinct or sometimes rather faint above; veins loosely transverse and reticulate, slightly elevated beneath, faint or invisible above; petiole stout, subterete except the apical part, 10–13 cm long. *Inflorescences* in axils of fallen leaves or cauligerous, paniculiform, up to 15 cm long, puberulous; bracts ovate, c. 2.5 mm long, puberulous on both surfaces. Pedicel and ovary 4–5 cm, puberulous. *Perianth* bright yellow or yellowish green, straight except the apical part of the tube together with limb curved or bent, with longitudinal and loosely reticulate veins, puberulous outside; utricle broad-ellipsoid, 5–6.5 by 3.5–4 cm, flanged at the base, without a contracted stipe, with 2 glandular, ellipsoid bodies (c. 1.5 mm long); tube c. 5 by 1.5–2 cm, hairy inside, especially dense at the apical part, basal part projecting a band-like syrinx (c. 1.5 mm wide) into the cavity of utricle; limb 3-lobed, lobes linear, up to c. 9 by 1 cm, glandular hairy on the inner surface. *Stamens* 10; anthers oblong, c. 4 mm long. *Style* column 10 mm long, 10-lobed; lobes lanceolate, 2–3 mm long, usually hairy in the apical part. Capsules unknown.

Distr. *Malesia*: Kalimantan (Lower Serawai R.: Manga Landu & Lebang Hara, c. 112°30' E, 0°30' S). Two collections. Cultivated in Hort. Bog. *sub n.* XI-A-61, XI-D-32A & 40A, originated from the Bor-

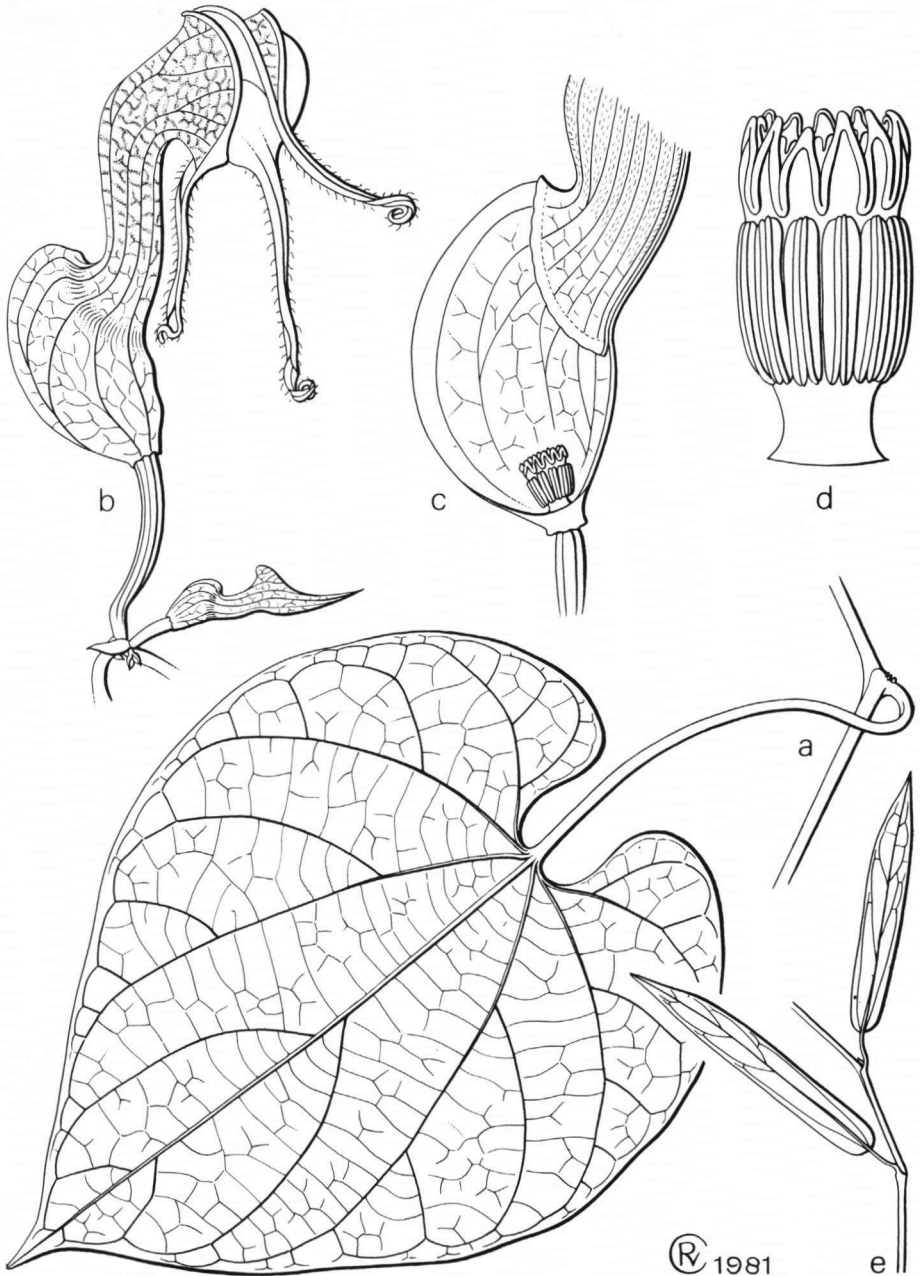


Fig. 15. *Aristolochia decandra* DING HOU. *a*. Leafy twig; *b*. young bud and open flower, both $\times \frac{1}{2}$; *c*. LS of lower part of perianth showing the gynostemium inside the utricle and the base of the tube slightly elongating and projecting into the utricular cavity, nat. size, *d*. gynostemium, $\times 5$. — *A. rumphii* KOSTELETSKY. *e*. Leafy twig, $\times \frac{1}{2}$ (*a* HANS WINKLER 1256, *b* after a drawing of a living specimen in Hort. Bog., Dec. 1945, in L., *c-d* HANS WINKLER 373, *e* LOETERS 2092). Courtesy of Blumea.

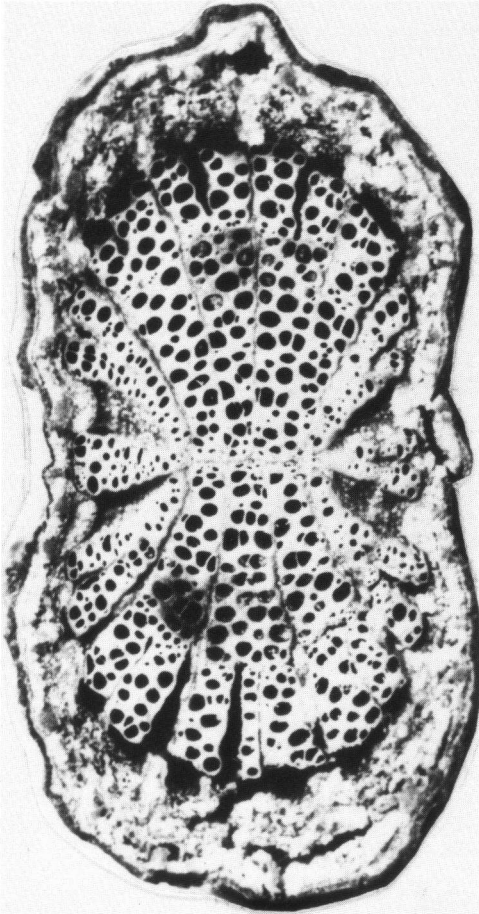


Fig. 16. *Aristolochia decandra* DING HOU. CS of flattened stem, medullary rays and wood sections with vascular bundles elongating in two directions, $\times 5\frac{1}{2}$ (HANS WINKLER 1256).

nean collection of P. DAKKUS.

Ecol. Primary forest, on river bank, 80–180 m. Fl. Nov., Jan.

Vern. *Toro bakai*, Dajak.

Note. The only Malesian species with 10 stamens, the others always having 6. In flower it approaches the West African species of *Pararistolochia*. Unfortunately, it seems that the species is no longer extant in the Botanic Gardens at Bogor.

17. *Aristolochia samarensis* MERR. Philip. J. Sc. 11 (1916) Bot. 178; En. Philip. 2 (1923) 120; SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 241.

Apparently erect plant c. 1 m high. Branches terete, striate, glabrous. *Leaves* thin-chartaceous, elliptic, 15–25 by 6–8.5 cm; apex acuminate, base cuneate; glabrous; basal nerves one pair, rather weak and short, ascending close to the margin up to $1/3$ – $1/2$ of the blade; lateral nerves 6 pairs, slightly elevated beneath, rather faint above; veins loosely reticulate, some crossbar-like, distinct beneath, obscure or invisible above; petiole 6–10 mm, glabrous. *Inflorescences* in the axils of leaves, racemiform, rachis up to 1 cm long, with condensed internodes, puberulous; bracts ovate to lanceolate, 4–6 mm long, puberulous on both surfaces. Flowers not seen (characters based on MERRILL, *l.c.*). Pedicel and ovary 7 mm, glabrous. *Utricle* ellipsoid, c. 3.5 cm long; tube reflexed, 1–1.5 cm long; limb 1-lipped, narrowly oblong, 4.5 by 1 cm, apiculate-acuminate. *Stamens* 6; anthers ellipsoid, c. 1.5 mm long. *Style* column c. 6 mm long, 6-lobed; lobes narrowly oblong, c. 3 mm long. *Capsule* ovoid, c. 1.5 cm long, prominently ridged. *Seed* triangular, 4.5 by 3.5 mm, not winged, verrucose on both surfaces.

Distr. *Malesia*: Philippines (Samar: Catubig R at Pinipisakan). Once collected.

Ecol. In damp forests near river at low altitude.

18. *Aristolochia philippinensis* WARB. in Perkins, *Fragm. Fl. Philip.* (1905) 170; MERR. *En. Philip.* 2 (1923) 119; SCHMIDT in E. & P. *Nat. Pfl. Fam. ed. 2*, 16b (1935) 241; *Quis. Medic. Pl. Philip.* (1951) 254; IGARASHI, *Food Pl. Papilionidae* (1979) t. 16; PERRY, *Medic. Pl. E. & SE. Asia* (1980) 47. — Fig. 2c–d.

Erect shrubby plant up to c. 1 m high. Old stem terete, 4 cm \varnothing , slightly irregularly ridged. Branches terete, 5–10 mm \varnothing , slightly striate, sparsely puberulous, glabrescent, or glabrous. *Leaves* membranous or chartaceous, lanceolate, elliptic, or oblanceolate, 8.5–24 by 3.5–8.5 cm; apex acuminate or cuspidate; base obtuse, sometimes slightly cuneate; margin entire, rarely remotely minutely toothed; glabrous on both surfaces, sometimes sparsely short-hairy on the midrib, nerves and reticulations beneath; basal nerves 1 pair, faint, ascending close to the margin at the basal part of the blade; lateral nerves 5–8 pairs, slightly elevated on both surfaces; veins loosely reticulate, some crossbar-like, distinct sometimes faint on both surfaces; petiole 4–8 (–20) mm, glabrous. *Inflorescences* in axils of foliage leaves, spiciform or racemiform, rachis up to 2 (–6) cm long, with distinct internodes, sparsely shortly hairy or glabrous; bracts lanceolate, 2–4 mm long, shortly hairy on both surfaces, glabrescent. Pedicel and ovary 6–8 mm, sparsely hairy. *Perianth* straight, longitudinal and reticulate veins distinct, glabrous outside; utricle ovoid or ellipsoid, 6–7 by 5 mm, with a distinct stipe (3–4 mm) flanged at base; hairy inside, glandular bodies 2, obscurely orbicular, c. 0.7 mm \varnothing ; tube c. 15

by 2 mm, with scattered, glandular trichomes inside; limb 1-lipped, oblanceolate or narrow-oblanceolate, 18–25 by 3–6 mm, with scattered glandular trichomes, glabrescent. *Stamens* 6; anthers oblong, c. 1 mm long. *Style* column c. 4 mm long, 6-lobed; lobes triangular, 1–1.5 mm long, with an annular ring at the base. *Capsules* subglobose, shortly cylindric, or oblong-ellipsoid, 1.5–2.5 by 1.5 cm, glabrous. *Seeds* triangular or deltoid, 4–4.5 by 4 mm, not winged, verrucose beneath and marginal part above, funicle broadened and covering the upper surface.

Distr. Malesia: Philippines (Luzon, Mindoro, Bancalan I., Mindanao).

Ecol. In thickets and forest at low and medium altitudes, up to 900 m. *Fl.* March, June–Sept., *fr.* Jan., March–May, Aug., Sept., Nov., Dec.

Uses. Decoction of the roots is used in the Philippines as a stomachic and emmenagogue (QUISUMBING, l.c.).

Vern. Barubó, Neg., *ruso-pusoan*, Rizal, *tám-bal-balanding*, Zambales.

19. *Aristolochia humilis* MERR. Philip. J. Sc. 13 (1918) Bot. 9; En. Philip. 2 (1923) 119.

Low erect undershrub, up to c. 40 cm high. Stem terete, 5–10 mm \varnothing , with only 4–7 leaves, young parts sparsely puberulous, glabrescent. *Leaves* membranous to chartaceous, elliptic, rarely ovate, 8–25 by 5–11 cm; apex acute, slightly obtuse, or short-acuminate; base rounded or subacute; glabrous above, sparsely short hairy on the nerves beneath; and reticulations; 1 pair of basal nerves ascending close to the margin upward to c. 1/3 of the blade, much weaker than other nerves; lateral nerves 5–7 pairs, slightly elevated beneath, distinct sometimes faint above; veins loosely reticulate, some transverse, distinct beneath, rather faint above; petiole (2–) 3–4 cm, sparsely shortly hairy. *Inflorescences* in the axils of bracts and/or foliage leaves, rachis 2–3 cm long, with condensed internodes and bracts; bracts ovate, oblong, or lanceolate, 4–6 mm long, puberulous outside, glabrous inside. Pedicel and ovary 6–7 mm long, glabrous. *Perianth* straight, venation faint, glabrous outside, papillate inside; utricle oblong, ellipsoid or subglobose, c. 6 by 3–5 mm, with a distinct stipe (c. 2 mm) slightly flanged at base; tube 5–7 mm long; limb 1-lipped, oblanceolate, 18 by 4–6 mm. *Stamens* 6; anthers oblong, c. 0.7 mm long. *Style* column 1.5 mm long, 6-lobed; lobes triangular, c. 0.5 mm long, with an annular ring at the base. *Capsules* oblong-ellipsoid, 2–2.5 by 1.5 cm. *Seeds* triangular, convex-concave, c. 6 by 4.5 mm, verrucose on marginal part beneath, glabrous, covered above by the membranous appendage of the funicle, not winged.

Distr. Malesia: Philippines (Luzon: Tayabas). Twice collected.

Ecol. In damp forests along streams at low alti-

tude. *Fl. fr.* May.

Vern. Tangotong-gubat, Tag.

20. *Aristolochia macgregorii* MERR. Philip. J. Sc. 5 (1910) Bot. 174; En. Philip. 2 (1923) 119. — Fig. 1d.

Erect shrubby plant up to 1 m high. Stems subterete, 3–5 mm \varnothing , striate, pubescent. *Leaves* chartaceous, lanceolate or slightly elliptic, 11–17 by 3–6.5 cm; apex acuminate, rarely acute; base cordate, sinus 0.5–1 cm deep, auricles often overlapping or surrounding the stem; shortly hairy on both surfaces, especially on midrib, nerves and veins; basal nerves often 2 pairs, inner pair ascending to halfway the blade, outer pair very short and weak; lateral nerves 2 or 3 (–6) pairs; nerves slightly raised or nearly flat on both surfaces; veins often reticulate, some crossbar-like, flat, distinct, rarely faint on both surfaces; petiole c. 3 mm, pubescent. *Inflorescences* in axils of foliage leaves, spiciform; rachis with condensed internodes up to 1.5 cm long, pubescent; bracts lanceolate, 3–6 mm long, pubescent on both surfaces. Pedicel and ovary c. 5 mm, pubescent. *Perianth* yellowish, erect, with rather faint reticulation, pubescent outside; utricle subglobose, c. 4 mm \varnothing , basal part contracted and stipe-like (0.7 mm long); tube cylindric, 10–16 by 2–2.5 mm; limb lanceolate, c. 20 by 3 mm, acuminate, pubescent on the inner surface. *Stamens* 6; anthers 1 mm long. *Style* column short, very obscurely lobed. *Capsules* oblong-ellipsoid, c. 1.5 by 1 cm, sparsely short-hairy. *Seeds* deltoid, c. 3 mm long and wide, not winged, verrucose on both surfaces.

Distr. Malesia: Philippines (Babuyan Is.: Dalupiri I. & Camiguin I.).

Ecol. In littoral thicket, up to 350 m. *Fl.* Aug., Nov., *fr.* Aug., Oct., Nov.

21. *Aristolochia sericea* BLANCO, Fl. Filip. (1837) 283; ed. 2 (1845) 198; ed. 3, 1 (1877) 350; MERR. Publ. Govt. Lab. Philip. 27 (1905) 72; Sp. Blanc. (1918) 134; BROWN, Bull. Bur. For. Philip. 22, 3 (1921) 183; MERR. En. Philip. 2 (1923) 120; SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 241; QUIS. Medic. Pl. Philip. (1951) 255; PERRY, Medic. Pl. E. & SE. Asia (1980) 47. — *A. imbricata* MAST. J. Linn. Soc. Bot. 14 (1875) 494; SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 241. — *Bragantia corymbosa* (non GRIFF.) F.-VILL. Nov. App. (1880) 174. — *A. membranacea* MERR. Philip. J. Sc. 14 (1919) 381; En. Philip. 2 (1923) 119; SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 241.

Erect shrubby plant up to c. 0.5 m high. Stem terete, c. 3 mm \varnothing , densely pubescent, glabrescent. *Leaves* thin-chartaceous or membranous, lanceolate or oblong-lanceolate, 7–15 by 2–5 cm; apex acuminate; base slightly or shallowly cordate, sometimes the sinus up to 5 (–10) mm deep, rarely obtuse;

sparsely shortly hairy above, hairy especially dense on the venation beneath; basal nerves 2 pairs, inner pair reaching c. 1/3 of the blade, similar to the lateral nerves, outer pair weaker and very short, close to the margin; lateral nerves c. 5 pairs, rather faint beneath, faint or obscure above; petiole 2–5 mm, densely hairy. *Flowers* few (one developing at a time), on very short, bracteate rachides (less than 10 mm long) in axils of foliage leaves; bracts lanceolate or elliptic, 3–4 mm, rarely leafy up to 20 mm long, shortly hairy on both surfaces. Pedicel and ovary 4.5–5 mm, densely hairy. *Perianth* straight, sometimes slightly curved, reticulation rather distinct, hairy outside; utricle ovoid or ellipsoid, 2.5–5 by 2–2.5 mm, with a distinct stipe (1.5–2 mm) dilated at the base as a cap on top of the ovary, hairy inside, with 2 glandular, ellipsoid bodies (c. 0.6 mm long); tube 5–10 by 1 mm, with short, glandular hairs inside; limb 1-lipped, oblong, 11–15 by 3–4.5 mm, acute or acuminate. *Stamens* 6; anthers ellipsoid, c. 0.6 mm long. *Style* column c. 0.7 mm long, 6-lobed; lobes lanceolate, c. 1 mm, with an annular ring at the base. *Capsules* subglobose, c. 1 cm ϕ , densely hairy, usually glabrescent. *Seeds* triangular, c. 2.5 by 1.5 mm, not winged, verrucose on both surfaces; funicle with membranous extension covering the upper surface.

Distr. Malesia: Philippines (Luzon: Cagayan, Ilocos Norte, Union, Batangas).

Ecol. In dry thickets at low and medium altitudes up to 350 m. *Fl.* Aug., Dec., *fr.* April, May, July, Aug., Dec.

Uses. The entire fresh plant is used as a carminative, emmenagogue and febrifuge. The root, macerated in local spirituous liquors, is administered post-partum as a uterine tonic; this drug is said to be a violent abortive (QUISUMBING, *l.c.*).

22. *Aristolochia leytensis* MERR. Philip. J. Sc. 10 (1915) Bot. 4; En. Philip. 2 (1923) 119; SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 241.

Slender vine. Branches terete, sulcate, 2–6 mm ϕ , glabrous. *Leaves* chartaceous or membranous, ovate or broad-ovate, 12.5–21.5 by 8–12.5 cm; apex acuminate; base cordate, sinus (1–) 2–3 cm deep, auricles separate from each other, sometimes overlapping at the base; glabrous on both surfaces, sometimes slightly puberulous on midrib, nerves and veins beneath when young, glabrescent; basal nerves 1 pair, ascending upward to 2/3–3/4 of the blade, forked at base; lateral nerves c. 3 pairs; nerves elevated and prominent beneath, distinct or flat above; veins loosely reticulate, some crossbar-like, distinct beneath, rather faint above; petiole (2–) 4–7 cm, glabrous. *Inflorescences* in the axils of foliage leaves, racemiform, rachis up to 3 cm long, with visible internodes, sparsely puberulous or glabrous; bracts ovate to lanceolate, 2–3 mm long, puberulous on

both surfaces especially on the margin. Pedicel and ovary 17–22 mm, puberulous. *Perianth* straight or slightly curved, with a distinct stipe (4–5.5 mm), venation visible, puberulous outside, hairy inside; utricle subglobose, 5–7 mm ϕ , with 2 glandular, suborbicular bodies (c. 0.5 mm ϕ); tube c. 20 by 4 mm; limb 1-lipped, narrow-elliptic, 50–60 mm. *Stamens* 6; anthers oblong 0.6–1 mm long. *Style* column c. 4 mm long, 6-lobed; lobes triangular, c. 1 mm long, with an annular ring around the base. *Capsules* (young) subglobose or short-cylindric, c. 1.5 cm ϕ .

Distr. Malesia: Philippines (Leyte, Samar).

Ecol. In thickets and forests near or along streams at low altitudes. *Fl.* Feb.–March, Aug., *fr.* Aug., Sept.

Vern. Maraburakán, S.L. Bis.

23. *Aristolochia crassinervia* SCHMIDT, Bot. Jahrb. 58 (1923) 491; in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 241; MERR. & PERRY, J. Arn. Arb. 29 (1948) 153; IGARASHI, Food Pl. Papilionidae (1979) t. 23; DING HOU, Blumea 29 (1983) 234, f. 4, 5b. — Fig. 8c, 17.



Fig. 17. *Aristolochia crassinervia* SCHMIDT, showing the common basket shape of the dehisced, hanging capsule in the genus, with seven loose seeds, nat. size (HUTTON *s.n.*).

Liana, old stem up to c. 1.5 cm ϕ . Branches rather terete, 4–5 mm ϕ , with some prominent lenticels, glabrous. *Leaves* subcoriaceous, (5–) 8–19 by (4–) 5–12 cm; apex acuminate or short-acuminate; base cordate, with a narrow sinus up to 2.5–3 cm deep; auricles usually overlapping, rounded at apex; glabrous above, minutely hairy beneath; basal nerves 2 (–3) pairs, the inner pair similar to the midrib, ascending to near the apex of the blade, the outer one much shorter, with branches extending upward or to the auricles, elevated and prominent beneath, distinct above; lateral nerves hardly distinguishable from the veins; veins closely reticulate, elevated and prominent beneath, faint or invisible above; petiole (2–) 6–8 cm, sparsely shortly hairy or almost glabrous. *Inflorescences* cauligerous, rarely also in axils of leaves, racemiform, rachis up to 3 cm long, internodes very short or condensed, sometimes the bracteate flowering rachis very short and flowers appearing fascicled; bracts lanceolate, 5–10 mm long, sparsely minutely hairy on both surfaces, glabrescent. Pedicel and ovary c. 20 mm, glabrous. *Perianth* white or reddish, no stipe at the base, with a contraction between perianth and ovary, glabrous outside, venation rather faint; utricle subglobose, c. 7 mm ϕ , hairy inside, with 2 glandular, round bodies (c. 0.5 mm ϕ); tube c. 7 by 2 mm, glandular-hairy inside; limb 1-lipped, linear, c. 20 by 4 mm, with glandular hairs on the inner surface. *Stamens* 6; anthers oblong, c. 0.7 mm long. *Gynostemium* c. 1 mm long; style 6-lobed; lobes triangular, c. 0.5 mm long, the basal part of each lobe slightly extended outward (c. 0.3 mm long and wide). *Capsules* yellowish when mature (NGF 45343), hard, tardily dehiscent, cylindrical or oblong, not ridged or angular, 2.5–4.5 by 2–3 cm, minutely granular. *Seeds* triangular or deltoid, 7 by 6–7 mm, not winged, rather smooth or obscurely muriculate on both surfaces; funicle broadened and covering the upper surface.

Distr. Solomon Is. (Ysabel, Malaita); in *Malesia*: New Guinea (Sepik, Morobe and Milne Bay Distr.).

Ecol. In primary, sometimes in secondary, forests, on rough, rocky, wet ground, on edge of creek, or along stream, from lowland up to 1500 m. *Fl.* June, *fr.* June, Aug., Sept., Oct.

Vern. Solomon Is.: *kwalokame*, Kwara'ae name.

Notes. Among the New Guinea species the leaves are characteristic: subcoriaceous to coriaceous, prominently palmately 5 (–7)-nerved, with a prominent closely reticulate venation, and a deeply cordate base with the auricles often overlapping.

It seems allied to *A. foveolata*.

24. *Aristolochia schlechteri* LAUT. in K. Sch. & Laut. Nachtr. Fl. Schutzgeb. (1905) 260; Bot. Jahrb. 52 (1914) 107; DING HOU, Blumea 29 (1983) 241, f. 6c.

Twiner or scrambling vine. Old stem terete, 1.5 cm ϕ . Branches terete, 2–5 mm ϕ , pubescent when young, glabrescent. *Leaves* subcoriaceous or chartaceous, elliptic-lanceolate, oblanceolate, (10–) 17–26 by (2.5–) 5–9 cm; apex acuminate; base cordate with distinct auricles, or shallowly cordate with obscure auricles, sinus (0.5–) 1–2 cm deep; glabrous or sparsely shortly hairy above, short-hairy beneath; nerves prominent beneath, distinct above; basal nerves 1 pair, ascending upward to halfway the blade, lateral nerves 4 or 5 pairs; veins loosely reticulate or crossbar-like, slightly elevated beneath, rather faint above; petiole 2–3.5 cm, shortly hairy. *Inflorescences* in axils of leaves, or cauligerous, usually 1 or 3, simple or spiciform, borne on a knob-like, very short branch; rachides up to 16 cm long, with spacious internodes, densely shortly hairy; bracts very small, triangular or lanceolate, c. 1 mm long, densely hairy. Pedicel and ovary c. 22 mm long, densely hairy. *Perianth* slightly curved, whitish or creamy white with green, brown or purple distinct venation; with a contraction between perianth and ovary; pubescent outside, with rather scattered glandular hairs inside; utricle ellipsoid or obovoid, c. 15 by 8–11 mm; tube 17–23 mm long, variable in width (5–8 mm ϕ) in one flower; limb prominently 3 + 3-lobed: 3 triangular lobes (20–25 by 15 mm) and 3 alternate lobes (each lobe triangular, 15–20 by 10–15 mm, apical part, c. 50 mm, lacinate and tail-like when dry). *Stamens* 6; anthers oblong, 1.5–2 mm long. *Style* column c. 7 mm long, 6-lobed; lobes lanceolate, 2.5 mm long. Capsules not seen.

Distr. *Malesia*: Papua New Guinea (Sepik, Madang and Morobe Distr.).

Ecol. In primary forest, beside a river or on rocky ridge. *Fl.* Jan., July, Aug., Dec., *fr.* June.

Vern. New Guinea: *pengeramboi*, Sepik Distr., Waskuk, *yogwa*, Wagu.

Note: Among Malesian species this is unique in possessing a 6-lobed perianth. In leaves it cannot be distinguished from *A. momandul*. Whether the capsules or seeds are different could as yet not be ascertained.

25. *Aristolochia dielsiana* SCHMIDT, Bot. Jahrb. 58 (1923) 490; in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 241; DING HOU, Blumea 29 (1983) 235, f. 6a.

Liana, up to 15–40 m high, c. 2 cm ϕ . Branches c. 5 mm ϕ , shallowly longitudinally sulcate, shortly hairy. *Leaves* often coriaceous, broad-ovate, ovate, lanceolate, rarely narrow-lanceolate, 19–37 by 4.5–23.5 cm (sometimes up to 100 by 70 cm); apex acuminate, rarely apiculate; base slightly sinuate or shallowly cordate; \pm truncate, rarely cordate, sinus 0–1 cm deep; shortly hairy on both surfaces, especially on midrib, nerves and veins; nerves elevated and prominent beneath, slightly elevated above;

basal nerves 1 pair, ascending upward to 1/2–3/4 of the blade, each nerve with a weaker, short branch at the base; lateral nerves 3–5 pairs; veins crossbar-like or reticulate, slightly elevated and prominent beneath, main veins distinct above; petiole 2.5–6 cm, often densely shortly hairy. *Inflorescences* cauligerous, 1 or 2 borne on a brachyblast of the (old) stem, rachides up to 11 (–29) cm long, with spaced internodes; bracts very small, densely hairy. Pedicels and ovary 15–30 mm, densely hairy. *Perianth* (bud) straight or slightly curved, greenish white with purple venation, pale green outside with 3 lobes orange-yellow and purple inside, or light yellowish purple with purple veins and becoming dark purple when open; longitudinal veins distinct, loose reticulations faint; shortly hairy outside especially on the veins, glandular hairs scattered inside; utricle obovoid or ellipsoid, 10–15 by 5–10 mm, no glandular bodies inside visible; tube 30–35 mm long, enlarged toward the apical part (c. 15 mm \emptyset); limb 3-lobed, lobes triangular to narrow-triangular, 35–50 mm long, 12–14 mm wide at the base, gradually narrowed towards the apex, apical part (25–30 mm) lacinate and often tail-like when dry. *Stamens* 6; anthers oblong, 1.7–2 mm long. *Gynostemium* 5.5 mm long, lower part (c. 1 mm) stipe-like; style 6-lobed, lobes linear, 2.5–3 mm long, no annular ring at the base. *Capsules* green or light yellowish green, oblong, up to 20 (–30) by c. 4 cm, indehiscent (?), 6-ridged, smooth, sparsely shortly hairy, glabrescent. *Seeds* triangular or deltoid, 9 by 8.5–9 mm, slightly longitudinally concave above, convex beneath, smooth on both surfaces, not winged.

Distr. Malesia: West New Guinea (Idenburg R.); Papua New Guinea (Sepik, Central & Northern Distr.).

Ecol. In primary forest, rarely in secondary forest, from the lowland up to 800 (–1200) m. *Fl.* May, June, July, Oct., Dec., *fr.* June, July, Dec.

Notes. In flower bud the present species resembles *A. schlechteri*, but the latter has in anthesis 6 perianth lobes.

It is the host of one of the largest butterfly species of *Rhopalocera*, *Ornithoptera alexandra*, in New Guinea. Mr. R. STRAATMAN reported upon it, under the erroneous name '*A. schlechteri*' (J. Lepidopt. Soc. 25, 1971, 58–64) that 'the flower is shaped like a starfish with three long arms and is dark purple-brown with a yellow heart. The green fruit is shaped like a cucumber, 20–30 cm long, strongly ribbed lengthwise and has a rough skin. It matures slowly and when fully rotten the seeds fall to the ground and are carried away by rainwater over generally short distances, resulting in a number of plants growing in a restricted area.'

Flower colour is not always reported the same: HOOGLAND & CRAVEN noted the perianth to be pale

green outside, the lobes orange-yellow and purple inside, BRASS said flowers greenish white, tinged and veined with purple.

26. *Aristolochia engleriana* SCHMIDT in Fedde, Rep. 23 (1927) 288; DING HOU, Blumea 29 (1983) 238, f. 5b, 7b. — *A. ledermannii* SCHMIDT, Bot. Jahrb. 58 (1923) 489, *non* ENGLER 1911.

Small to moderately high twiner. Old stem subterete or slightly flattened, 8–10 mm \emptyset , shallowly furrowed. Branches terete, 1.5–2.5 mm \emptyset , rather smooth, shortly hairy when young, glabrescent. *Leaves* subcoriaceous or chartaceous, lanceolate, ovate-elliptic, obovate to oblanceolate, (5–) 8–15 (–19) by (2–) 4.5–6 (–7) cm; apex acuminate, cuspidate; base obtuse, rounded, cuneate, or broadly truncate; glabrous above, sparsely minutely hairy on midrib, nerves and veins below, glabrescent; nerves elevated beneath, distinct above; basal nerves 1 pair, ascending to 1/3–3/4 of the blade; lateral nerves 2–5 pairs, sometimes hardly distinct from veins; loosely reticulate or crossbar-like veins slightly elevated beneath, often faint above; petiole terete, 5–25 (–35) mm, shortly hairy. *Inflorescences* in the axils of leaves, or cauligerous, spiciform, rachides up to c. 4 cm long, internodes distinct, shortly hairy; bracts minute, densely hairy. Pedicel and ovary 15–20 mm. *Perianth* almost straight except the slightly curved tube, whitish with violet-brown venation, or orange yellow (but tube light purplish red with scattered white spots), longitudinal veins visible or distinct, reticulations loose, obscure, shortly hairy outside, glandular-hairy inside, with a contraction between perianth and ovary; utricle obovoid or ellipsoid, c. 15 by 7 mm, no glandular bodies seen; tube 15–20 mm long, narrowed at basal part (c. 2.5 mm \emptyset), the rest c. 6 mm \emptyset ; limb 3-lobed, lobes triangular, 5–6 by 8–10 mm, obtuse or retuse (no tail-like appendage seen). *Stamens* 6; anthers oblong, c. 1.5 mm. *Gynostemium* c. 3.5 mm long, with a distinct stipe-like part (c. 1 mm); style 6-lobed; lobes lanceolate, c. 2 mm long, no annular ring at the base. *Capsule* bright orange, ellipsoid, or pyriform (type description), 6–9.5 by 2–4.5 cm, 6-ridged, smooth. *Seeds* triangular, c. 11 by 9 mm, smooth on both surfaces, not winged.

Distr. Malesia: West New Guinea (Malingdam); Papua New Guinea (Sepik, Western, Eastern, and Southern Highlands Distr.). Fig. 18.

Ecol. Low montane or montane, sometimes mossy forests, (1260–) 1830–2250 m, once at 600–700 m (Mt Bosavi). *Fl.* March, Sept., *fr.* Jan., Sept., Oct.

Vern. Papua New Guinea: *ya waenuw kunguwp*, Wola language.

Notes. From other New Guinea species easily recognizable by the 3-nerved leaves with a non-cordate base (base rounded, obtuse, broadly truncate, sometimes cuneate) and a pyriform fruit.

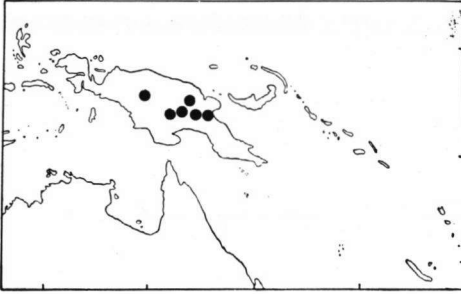


Fig. 18. *Aristolochia engleriana* SCHMIDT, localities in New Guinea.

IGARASHI (Food Pl. Papilionidae, 1979, t. 22) gave a photograph, under the name *A. schlechteri*, which is probably the present species.

27. *Aristolochia gaudichaudii* DUCHARTRE, Ann. Sc. Nat. Bot. 2 (1854) 72, t. 6, f. 3–5; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1067; KLOTZSCH, Monatsb. Akad. Berl. (1859) 597; DUCHARTRE in DC. Prod. 15, 1 (1864) 481; LAUT. Bot. Jahrb. 52 (1914) 105; ROEPKE, Trop. Natur 24 (1935) 80, f. 5; SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 241; IGARASHI, Food Pl. Papilionidae (1979) t. 26 (fig. on the left & top right); DING HOU, Blumea 29 (1983) 238. — *A. roxburghiana* (non KLOTZSCH) WARB. Bot. Jahrb. 13 (1891) 300. — Fig. 1e.

Twiner, sometimes creeper, up to 20 m high. Old stem terete, rather smooth, c. 1.2 cm ϕ . Branches terete, c. 4 mm ϕ , striate, glabrous. *Leaves* chartaceous, ovate, broad-ovate, triangular or deltoid in outline, 11–22 by 10–18 cm; apex acute or short-acuminate; base subtruncate (especially when young), subcordate or cordate (usually adult leaves; with the sinus up to 2.5 cm deep; sometimes with 2 divergent, rounded auricles); glabrous; midrib and nerves palmate; basal nerves 2 pairs, similar to the midrib, inner pair ascending to the apex, outer pair much shorter, elevated beneath, distinct above; lateral nerves hardly distinguishable from the veins; veins slightly elevated beneath, distinct or faint above, major veins connecting the inner pair of nerves and midrib, \pm transverse at the lower 1/3 or 1/2 of the blade, reticulations rather loose; petiole 2.5–8.5 cm, glabrous. *Inflorescences* in the axils of leaves, with rachis up to 6 cm long, or cauligerous (often with several mostly simple branches, arising from a knob or spot of the stem, up to 14 cm long), branches usually spiciform, with spacious internodes; bracts ovate or triangular, 0.7–1.5 (–5) mm long, glabrous but ciliate on the margin. Pedicel and ovary 10–14 mm, glabrous. *Perianth* straight or slightly curved, with

variable colours recorded as white, yellow, pale green with pinkish tinge, green to brownish, brown red or dark brown red, with a distinct stipe (3–4 mm) slightly dilated at base, longitudinal and reticulate veins distinct, glabrous outside; utricle broad-ellipsoid, 8–15 by 5–9 mm, sparsely hairy inside, with 2 glandular, ellipsoid bodies (c. 1.5 mm long); tube 8–12 by 1.5–2 mm, with scattered glandular trichomes inside; limb 1-lipped, obovate or oblanceolate, 17–20 by 8–12 mm, with scattered glandular trichomes on the inner surface. *Stamens* 6; anthers oblong, c. 1 mm long. *Style* column 3.5–4 mm long, 6-lobed; lobes lanceolate, c. 1.5 mm long, with an annular ring at the base. *Capsules* oblong, 4–6 by c. 3 cm, glabrous. *Seeds* (incl. wing) transverse-oblong, 6–11.5 by 12–16 mm; seed proper deltoid 6–8 by 6–8 mm, smooth on both surfaces, with a central, longitudinal ridge above; wing 2.5–4 mm broad.

Distr. *Malesia*: Moluccas (Batjan, Ceram) and New Guinea (Sorong, Manokwari, Fak Fak, Sidei, Toronta, Sepik) and neighbouring islands: Job I., Rawak (Waigeo), Schouten & Biak Is., and New Ireland.

Ecology. In primary forest, sometimes in beach, secondary and swampy forests, clearing ground and thickets at low altitudes. *Fl.* April, June, July, Sept., Oct., Dec., *fr.* May, Aug., Sept., Oct., Dec.

Vern. New Guinea: *daprijo*, Irian, *surwerro*, Papua.

28. *Aristolochia linnemannii* WARB. Bot. Jahrb. 13 (1891) 301; K. SCH. & LAUT. Fl. Deut. Schutzgeb. Südsee (1900) 302; LAUT. Bot. Jahrb. 52 (1914) 105; DING HOU, Blumea 29 (1983) 239, f. 2f.

Scrambler or climber, c. 6 m long. Branches terete, c. 2.5 mm ϕ , sulcate, glabrous. *Leaves* chartaceous, triangular or deltoid in outline, 5–8 by 4.5–6 cm; apex short-acuminate or acute; base shallowly cordate, sinus broad, up to c. 1 cm deep; glabrous above, minutely hairy beneath; basal nerves 2 pairs, slightly elevated beneath, distinct above; inner pair ascending to the apex, outer pair much shorter, up to c. 1/3 of the blade; veins reticulate beneath, rather faint above; petiole 1.5–2.5 cm, glabrous. *Inflorescences* in the axils of leaves, fasciculate, rachides condensed, very short, usually 2–3 mm long, sometimes one of the branches up to 10 (–15) mm, glabrous; bracts minute, triangular or deltoid, c. 1 mm long, glabrous. Pedicel and ovary 15–30 mm, glabrous. *Perianth* oblique or slightly curved, venation distinct, glabrous outside, with a distinct stipe (c. 2.5 mm) slightly expanded at base; utricle subglobose, c. 6 mm ϕ , sparsely hairy inside, with 2 glandular, elliptic bodies (c. 2 mm long); tube c. 17 by 2 mm, with scattered, glandular hairs inside; limb 1-lipped, oblong, c. 20 by 10 mm, obtuse or slightly mucronulate, margin reflexed, with scattered, glandular hairs on

the inner surface, glabrescent. *Stamens* 6; anthers oblong, c. 0.7 mm long. *Gynostemium* c. 2.5 mm long; style 6-lobed; lobes triangular, c. 0.5 mm long, basal parts united and extended outward as an annular ring. *Capsules* glabrous, broad-ellipsoid or subglobose, 2.5 by 1.7–2.5 cm, 6-ribbed or 6-angular, obtuse. *Seeds* winged, triangular, c. 6 by 5 mm (incl. c. 1 mm wide wing), seed proper with wart-like granules densely covered beneath, sparsely above, funicle obscure.

Distr. Malesia: West New Guinea (Div. Hollandia), Papua New Guinea (Morobe Distr.: former Finschhafen). Two collections.

Ecol. In thickets or along the road at low altitude. *Fl. fr.* July.

Doubtful species

The following two species of *Aristolochia* were described by O.C. SCHMIDT (see below). The types were collected at Lordberg, Sepik region, NE. New Guinea, c. 1000 m alt., by LEDERMANN in Nov.-Dec. 1912. These types were lost in B during World War II. Duplicates of them may be extant but as yet have not been found. From the New Guinean (flowering) specimens of *Aristolochia* examined, I cannot find specimens to match the descriptions. I have extracted the essential characters from the original descriptions as follows:

Aristolochia lauterbachiana SCHMIDT, Bot. Jahrb. 58 (1923) 488. — Type: LEDERMANN 9883 (B, lost), Sepik region, NE. New Guinea.

Leaves unknown. Inflorescences curled, few-flowered, axis densely pilose; bracts minute, subtriangular, c. 1 mm long and wide, densely pilose. Pedicel c. 13 mm long. Flowers white, red-striate and -spotted, unilabiate, c. 6.5 cm long, densely pilose; utricle obovoid, c. 14 mm long; tube enlarged at the apical part, c. 22 mm long; limb lingulate, c. 20 mm long, apex narrowed; ovary c. 10 by 1.5 mm, densely pilose. Fruit unknown.

Aristolochia novoguineensis SCHMIDT, Bot. Jahrb. 58 (1923) 489. — Type: LEDERMANN 10362 (B, lost), Sepik region, NE. New Guinea.

Leaves subcoriaceous, lanceolate, 16–18 by 3–5 cm, smooth, apex caudate, up to 2.5 cm long, base rounded or truncate, nerves 3 at the base; petiole 3–3.5 cm long. Inflorescences curled, multi-flowered; bracts minute, densely pilose. Pedicel c. 12 mm long. Flowers white, purple-nerved, c. 8.5 cm long, 1-lipped; utricle ovoid, c. 12 mm long; tube curved, c. 18 mm long; limb narrow-lingulate, c. 38 mm long; ovary c. 12 by 2 mm, densely pilose. Fruit unknown.