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SERIES I - SPERMATOPHYTA

Flowering Plants

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Revisions

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CHLORANTHACEAE (B. Verdcourt, Kew)

Erect or straggling herbs, shrubs or trees, sometimes monoecious or dioecious, the herbs sometimes rhizomatous; branches sometimes jointed at the nodes, sometimes without vessels (*Sarcandra*). *Leaves* simple, decussate or sometimes whorled in fours, serrate, crenate or dentate, the teeth often thickened at the apex, penninerved, usually petiolate; petioles more or less connected at the base at least by a transverse line or connate into a distinct sheath; in *Ascarina* often alternating with leafless internodes which have the petiolar sheath; stipules minute to fairly conspicuous, subulate, borne on the petiole bases or sheath, occasionally pectinate. *Flowers* much reduced, without perianth, fully unisexual or essentially bisexual with the reduced anther-bearing organ adnate to the side of the ovary; arranged in spicate, paniculate, or capitate axillary or terminal inflorescences. — *Male flowers* bracteate or not, apparently consisting of 1–5 stamens, or in *Hedyosmum* consisting of numerous anthers in a cone-like structure; if 3 then the whole forming a fused 3-lobed organ sometimes enveloping the female flower by its edges, the central anther with 2 or aborted loculi and the laterals with single loculi, simply lobed or with connectives slightly to considerably produced so that the whole organ is 3-fingered; if with only 2 anther locelli then these on either side of a thickened filament plus connective. — *Female flowers* naked or enclosed by a cupular bract, the perianth adnate to the ovary, often minutely or shortly dentate at the apex and the ovary thus inferior; ovary 1-locular; stigma sessile or style short; truncate, 2-lipped, depressed or subcapitate (or horseshoe-shaped in one species), rarely linear or clavate. *Ovule* solitary, orthotropous, pendulous, bitegmic and crassinucellate. *Drupes* fleshy, small, ovoid or globose, sometimes more or less 3-sided in *Hedyosmum*, free or united into a mass by the bracts; endocarp hardened and crustaceous. *Seeds* subglobose, exarillate, with copious fleshy or oily endosperm and minute embryo, the cotyledons divaricate or scarcely formed.

Distribution. Four genera with about 80 species. Since VESTER'S (1940) small-scale map the family (*Ascarina*) has been found in Madagascar. It is mainly tropical but *Ascarina* extends south to North Island of New Zealand (fig. 6) and *Chloranthus* and *Sarcandra* extend north to Japan, China, Korea and the eastern U.S.S.R. (Ussuri).

Ascarina occurs in the Pacific and reaches New Guinea and the Philippines with a distinct section *Madascarina* in NE. Madagascar; *Chloranthus* and *Sarcandra* are widely distributed in Malasia, India, Indochina and China. *Hedyosmum* occurs in the New World from Mexico to Brazil and Peru and in the West Indies with one species occurring in the Old World in S. China, W. Sumatra, Borneo and Celebes (fig. 8).

The family is now absent from Africa, W. Asia, Australia, and much of America.

HUMBERT & CAPURON (1955) when describing *Ascarinopsis* (= *Ascarina* sect. *Madascarina*) speak of it as part of the most ancient floristic element in Madagascar, a survival from the Cretaceous flora and AUBRÉVILLE (1976) considers it as an Australo-Papuan element similar to *Hibbertia*, *Dillenia*, *Evodia*, *Protium* (& America), *Macadamia*, *Elaeocarpus*, *Weinmannia* (& America), *Bubbia*, etc.

The complete absence of *Chloranthaceae* from tropical Africa at the present time is paralleled in many other groups with trans-Pacific distributions. The discovery of the fossil pollen type *Clavatipollenites* there could indicate that something very like *Ascarina* once occurred in Africa. The

family might appear to owe its present distribution to a Gondwanaland origin in the Early Cretaceous or even earlier, the absence from Australia and Africa being attributed to climatic vicissitudes. *Clavatipollenites* (see later) is known from the Early Cretaceous of the U.S.A. (Maryland), England, Israel, Patagonia, South & Central Africa, Brazil, Australia, etc.; and probable Oligocene-Early Miocene deposits of South Africa (Cape Province) (COETZEE, 1981); and if all these refer to *Ascarina* or some closely allied genus then a different course of distribution is indicated. It seems the family may have been well distributed and common in the past but it is equally apparent that migrations involving any kind of stringent climatic deterioration are not feasible. *Ascarina lucida* for example was formerly (10,000–5,000 BP) abundant in New Zealand but is now much reduced due to increase of frost and drought (MCGLONE & MOAR, 1977).

References: AUBRÉVILLE, *Adansonia* II, 15 (1976) 302; COETZEE, *S. Afr. J. Sc.* 77 (1981) 341; COETZEE & MULLER, *Ann. Mo. Bot. Gard.* 71 (1984) 1092, f. 11; HUMBERT & CAPURON, *C. R. Ac. Sc. Paris* 240 (1955) 28, fig.; MCGLONE & MOAR, *New Zeal. J. Bot.* 15 (1977) 485–489; VESTER, *Bot. Arch.* 41 (1940) 349, f. 144.

Fossils. As far as I am aware no undoubted fossils of parts of the plants other than pollen are known, but leaves with chloranthoid characters have been found in the Lower Cretaceous Potomac Group (UPCHURCH, 1984). Several Lower Cretaceous pollen types have been referred to the family, but can hardly refer to the recent genera. Pollen of recent genera is also known from various strata. These are dealt with elsewhere (see p. 126 and 143).

Reference: UPCHURCH, *Amer. J. Bot.* 71 (1984) 192–202.

Ecology. The species are all moist evergreen forest species, many ascending into submontane forests. They occur from 0 to 3300 m in Malesia.

Dispersal. The white-fruited *Chloranthus erectus* (= *officinalis*) is dispersed by birds according to RIDLEY (Disp. 1930: 410) and the red-fruited *Sarcandra glabra* must also be.

Pollination. VAN DER HAMMEN & GONZÁLEZ (1960) have shown that *Hedyosmum* is wind-pollinated and has a high pollen production, but it has usually been assumed that the forest-dwelling *Chloranthus* and *Sarcandra* are insect-pollinated but I have traced no recorded observations. Some collectors mention scent.

Reference: VAN DER HAMMEN & GONZÁLEZ, *Leidse Geol. Meded.* 25 (1960) 261–315.

Floral morphology. PAYER as long ago as 1857 investigated the floral morphology of *Chloranthus spicatus* and found that during the early stages of development the median lobe of the anther-bearing organ appears first, soon followed by the two laterals which are distinct in origin but immediately join up to form the 3-lobed organ and later still the ovary arises as a half-moon-shaped outgrowth with the curved side towards the bract. ARMOUR (1906) investigated the morphology of the flower. The minute scale at the base of the anther-bearing organ on the ovary in some species has been looked on as a perianth but it is not vascularised and probably simply an outgrowth. The anther-bearing organ in '*C. chinensis*' (probably *C. erectus* = *officinalis*) has been described as bearing four anther-lobes each composed of two pollen-sacs, usually regarded as corresponding to three stamens, of which the median one has two anther-lobes and the lateral ones reduced to one and the traces are consistent with this, but development gives no evidence of reduction of the lateral stamens, nor whether the flowers are to be regarded as reduced or the reverse. In *Sarcandra glabra* the anther-bearing organ is usually described as a single stamen, the position of the two anther-lobes resembling that of a normal Angiosperm stamen but the presence of two traces suggests a derivation from an organ similar to that of *Chloranthus* by total reduction of the median anther-lobes and reduction in width.

These curious structures have been looked on as separate male and female flowers joined and simulating a bisexual flower, e.g. by HOOKER *f.*, but most authors (e.g. ARMOUR) have considered the flowers to be bisexual and SWAMY & BAILEY'S (1950, 1953) studies of the vascularisation of the structure support this. They could, however, be considered as very reduced inflorescences derived from mixed cymules of male and female flowers such as occur in *Ascarina*, but there is no evidence from vascularisation to support this.

In *Sarcandra* the bract has a single trace; the carpel a double or single median strand and ventral strands close or separated; staminal trace double and joining median traces or single and free to below the bract or one free and one joined.

ENDRESS (1971) investigated the female flowers of *Hedyosmum mexicanum* and the following is taken from his own summary. The flowers are free and not partly fused with each other nor with the inflorescence axis. The perianth region extends not only to the free 3-lobed perianth-tube and three double wings on the flower ridges, but also to the periphery of the whole flower below the style. The 3-lobed perianth is initiated as the first floral organ, contrary to the occasional small protrusions below the stamen attachment in *Chloranthus*. The fruit is a kind of drupe, the wings of the flowers forming the outer subfleshy part and the periphery of the flower body the inner hard part. The ovary wall tissue degenerates around the growing and ripening seed, the fruit wall thus consisting mainly or completely of perianth tissue. The gynoecium lacks distinct signs of pseudomonomy and seems to be truly monocarpellate. It is distinctly ascidiform at least up to the style-base with an oblique or transverse ventral slit, the styler canal and with ventral median placentation appearing markedly laminar at anthesis. Except for the 3 bundles of the atropous bitegmic and crassinucellate ovule there are no independent ovary bundles.

LEROY (1981, 1983a, 1983b) considers the male structures, formerly universally interpreted as inflorescences of bractless flowers much reduced to single stamens, to be strobiloid male flowers, each bearing several hundred spirally arranged stamens and closely resembling a gymnospermous cone-like male flower. This reinterpretation considered in conjunction with monosulcate pollen similar to pollen known from the Lower Cretaceous and adaptation to wind pollination suggests that the male *Hedyosmum* flower is one of the most primitive Angiosperm flowers still existing. Male *Ascarina* flowers with either 3–5 stamens or 1–3 stamens and *Hedyosmum* male flowers with very numerous stamens are homologous and it is suggested easily derived from a common ancestor.

References: ARMOUR, New Phytol. 5 (1906) 49–55, pl. 3–4; ENDRESS, Bot. Jahrb. 91 (1971) 39–60; LEROY, XIII Int. Bot. Congr. Abstr. (1981) 136; Taxon 32 (1983) 169–175; C. R. Ac. Sc. Paris 296 (1983) 747–752; PAYER, Traité d'organogénie comparée de la fleur, Paris 1 (1857) 422; SWAMY, J. Arn. Arb. 34 (1953) 385–399; SWAMY & BAILEY, J. Arn. Arb. 31 (1950) 121–125.

Anatomy. This has been very thoroughly investigated by SWAMY (1953) and SWAMY & BAILEY (1950). An outstanding feature is the lack of vessels in the xylem in *Sarcandra*. The other genera have vessels but they are relatively unspecialised, *Chloranthus* being the least advanced. In *Sarcandra* tracheary elements in the secondary xylem are arranged in \pm undisturbed radial series as seen in transverse section; tracheids in the region of the first year's growth measure nearly 1.9 mm and have very extensive overlapping ends similar to other vesselless dicotyledons indicating a cambium of very primitive type, and unusually long fusiform initials. The wood in *Hedyosmum* is of a very unspecialised type; parenchyma paratracheal as incomplete sheaths around the vessels; rays sometimes up to 1 mm wide, multiseriate rays composed of almost entirely upright cells; fibres with simple pits and occasionally septate wall rather thin; in *Ascarina* the parenchyma is apotracheal and the multiseriate rays of square to procumbent cells. *Ascarina* and *Hedyosmum* have nodes typically of the unilacunar type with 2 vascular strands in the leaf of *Ascarina* and 5 in *Hedyosmum*, the lateral pairs larger; *Chloranthus* and *Sarcandra* have modified unilacunar nodes with 5 vascular strands in the petiole, 2 much larger and extending most of the length of the midrib, the intermediate small trace disappearing about half-way but formed by the fusion of 2 minor branches of the larger traces at nodal level; the two small lateral strands come from a different gap. In *Hedyosmum* the stipular sheath formed from the connate petiole bases consists of collenchymatous tissue and supports the stem during intercalary growth. Lateral branches are initiated in the leaf-axils but are attached to the parent axis above the node at maturity; cork formed on the inner surface of the sheath brings it into intimate contact with the stem. There is a pulvinus on the stem at the upper margin of the sheath. In *H. arborescens* and related species the nodal sheath develops by pushing beyond the apical growing point and surrounding it, tightly

closed above the bud and affording it protection. In *Sarcandra* and *Chloranthus* the stomata have 1–2 subsidiary cells oriented parallel to the guard cells whilst in *Ascarina* and *Hedyosmum* there is a rosette of 4–6 ordinary epidermal cells.

BARANOVA (1983) reported that the laterocytic type of stomatal apparatus occurs in *Chloranthus*, *Sarcandra* and sometimes *Hedyosmum* along with other types. This type is known from a very heterogeneous mixture of families.

MELVILLE (1962) stated the 2 leaf traces in *Ascarina* can unite at various levels in the petiole or lamina and form a single vein, but in *Chloranthus* and *Sarcandra* each of the initial pair of traces forks, resulting in bundles, the middle pair reuniting to give a final triple trace. In *Hedyosmum* a trace of 5 bundles results from the bifurcation of the two outer bundles of such a triple trace. He points out these types are also to be found in both the Pteridosperms and *Cordaitales*.

Mucilage canals are present in the petiole, larger veins and also in the margins of the pith in *Hedyosmum*, in some species also containing sphaerocrystalline masses. Small clustered crystals are recorded in the inner part of the cortex. Stone cells are scattered in the cortex of younger stems of *Sarcandra* with larger groups in the pith; in older pith these cells form conspicuous transverse diaphragms alternating with plates of parenchymatic cells, but these diaphragms are absent from *Chloranthus*. Ethereal oil cells occur in the mesophyll of the leaf.

References: BARANOVA, Brittonia 35 (1983) 93–102; MELVILLE, Kew Bull. 16 (1962) 39–40; SWAMY, J. Arn. Arb. 34 (1953) 385–399; SWAMY & BAILEY, J. Arn. Arb. 31 (1950) 121–125.

Palynology. WALKER (1976) summarised the palynology of this very euryalynous family as follows: "pollen grains anasulcate, inaperturate, with 'colpoid complexes' or colpoid streaks, polycolpoidate or polycolpate, heteropolar, apolar or isopolar; boat-shaped-elliptic, globose-oblate or globose, tectate or semi-TECTATE; more or less psilate, fossulate, scabrate, rugulate or reticulate; monads; medium-sized to small". He noted that polycolpate grains derived from monosulcate ones occur only in this family and in *Aristolochiaceae*, stating that the polycolpate/polyporate pollen found in the two families must be considered unique in its clear monosulcate derivation. KUPRIANOVA (1981) has given much data on the pollen of several species. Grains of *Chloranthaceae* are remarkably similar to those of the oldest known fossil Angiosperm pollen: *Clavatipollenites* COUPER at first known only from the Lower Cretaceous of England, Israel (N. Negev), Maryland (U.S.A.), and Patagonia. KUPRIANOVA (1967) was the first to claim that *Clavatipollenites* and *Ascarina* are congeneric; COUPER (1960) had earlier noted the strong similarity, and it is clear that there is at least close relationship. A very strong case has been made for the conspecificity of *Clavatipollenites evittii* (California, Maestrichtian) and *Ascarina lucida*. MULLER (1981) summarised the fossil pollen records of the *Clavatipollenites-Ascarina* complex. In New Zealand there are records from the Maestrichtian to the present day, bridging the gap between Cretaceous and recent. A virtually continuous record from the Albian to the Eocene has recently been discovered in Australia where elimination from the continent may have been due to increasing aridity. A record has also been published from the 90° ridge in the Indian Ocean from Oligocene deposits. In Europe there are records from the Aptian, Albian and Cenomanian with probably extension to the Barremian. LAING (in Ferguson & Muller, 1970) gave a Barremian record from England. Apart from the eastern U.S.A. record there have been finds from California and Chile (Maestrichtian), Bahamas (Cenomanian), Falkland Plateau (Palaeocene), Central Africa (Albian, Aptian and possibly Barremian), South Africa (probably Oligocene to early Miocene), and Brazil (and once again possibly eliminated from the latter three by climatic deteriorations). DOYLE (1977) commented on the various types of *Clavatipollenites* pollen and compared the finely clavate-retipilate forms from the Lower Cretaceous with *Ascarina*, the coarser clavate irregularly aperturate ones with *Hedyosmum* and the reticulate nearly inaperturate type with *Sarcandra*. Considered in conjunction with the distribution of the recent species, a purely Gondwanaland distribution does not cover all the main facts of fossil distribution and either some of the latter are misidentified or a Pangaea type theory now largely discarded by most workers must be resorted to. The family must have been widespread and common in the Lower Cretaceous, only a few species lingering on to the present day.

References: COETZEE, S. Afr. J. Sc. 77 (1981) 341; COETZEE & MULLER, Ann. Mo. Bot. Gard. 71 (1984) 1092, f. 11; COUPER, New Zeal. Geol. Surv. Palaeont. Bull. 32 (1960) 1–87; DOYLE, Bull. Cent. Rech. Explor. Prod. Elf-Aquitaine (1977) 451–473; KUPRIANOVA, Pollen et Spores 9 (1967) 95–100; Bot. Zhurn. USSR 26 (1981) 3–15; LAING in Ferguson & Muller, Linn. Soc. Symp. Ser. 1 (1976) 15–25; MULLER, Bot. Rev. 47 (1981) 9–12; WALKER in Beck, Origin & Early Evolution of Angiosperms (1976) 269.

Chromosomes. EHRENDORFER *et al.* (1968) compiled lists of numbers for primitive families and gave *Hedyosmum arborescens* $n = 8$; *Sarcandra glabra* $2n = 30$; *Ascarina rubricaulis* $2n = 28$; *Chloranthus serratus* $n = 14$ & $2n = 30$; *C. spicatus* $2n = 30$; *C. japonicus* $2n = 30$; *C. fortunei* $2n = 60$. He stated that from these data it can be seen that there are still true diploids in the family: $x = 8$, further secondary polyploid base numbers $x_2 = 14$ and 15 and continuing infragenetic polyploidy ($4x_2$). EHRENDORFER stated (in Beck, 1976) that “*Chloranthaceae* demonstrate progressive elimination of diploids ($n = 8$), major representation on the $4x$ level ($n = 14$ and 15 , the latter from $7 + 8$?) and occasional origin of $8x$ ($n = 30$)”, corresponding in part with the *Piperales*.

References: EHRENDORFER *et al.* Taxon 17 (1968) 337–468; in Beck, Origin & Early Evolution of Angiosperms (1976) 228–229.

Phytochemistry. Even to the collector the aromatic smell suggests relationship with the *Piperaceae*. In 1964 HEGNAUER complained that the chemistry of this family had scarcely been touched. BATE-SMITH (1962) found in the hydrolysed leaf-extract of *Chloranthus erectus* (= *officinalis*) none of the otherwise very widespread phenols save for β -coumaric acid and in this respect it resembles many *Piperaceae*. The ethereal oils which undoubtedly exist have so far not been chemically investigated.

KUBITZKI & REZNIK (1966) in their investigation of flavonoids as systematic characters investigated 4 species of *Chloranthus*, 7 of *Hedyosmum* and 5 of *Ascarina* and found them to contain traces to massive amounts of the two derivatives of flavanole, quercetin and k mpferol, the former dominating. SHIO & HIGUCHI (1981) have demonstrated the presence of a gymnosperm type of lignin, guaiacyl lignin in *Sarcandra glabra* and *Chloranthus spicatus*.

References: BATE-SMITH, J. Linn. Soc. Bot. 58 (1962) 95–173; HEGNAUER, Chemotaxonomie der Pflanzen 3 (1964) 428; KUBITZKI & REZNIK, Beitr. Biol. Pfl. 42 (1966) 445–470; SHIO & HIGUCHI, Wood Res. Kyoto Univ. 67 (1981) 43–46 [from For. Prod. Abstr. 5 (1982) no 2121].

Taxonomy. Early placings of *Chloranthus* were various and mostly wide off the mark. LINDLEY, who first recognised the family (1821) placed them in *Piperales* and his clear view has been supported by many authors (BENTHAM & HOOKER, 1880, 1883; ENGLER, 1894; ARMOUR, 1906; SWAMY, 1953; HOWARD, 1970; BEHNKE, 1975; BURGER, 1977) with arguments from various disciplines (morphology, anatomy, phytochemistry, pollen). After digesting a wholesale literature on the subject (1985), I believe this comes at least close to the correct affinity. The most probable conclusion from the floral structure appears to be that *Chloranthaceae* is a group of *Piperales* presenting in some points, especially in the structure of the ovary, primitive characters in common with the majority of the *Archichlamydeae*, while in other aspects modifications of the flowers are shown. A.C. SMITH (1972) found them more primitive than other elements of the *Laurales* and repeated (1981) that *Chloranthaceae* is best assigned to its own order, *Chloranthales*, validated by LEROY (1983). HUTCHINSON (1973) and CRONQUIST (1981) retain the family in *Piperales*, but this then remains a matter of choice.

It is certainly clear that the small, insignificant family *Chloranthaceae* is one of great importance in the study of primitive flowering plants whose ancestry points to high age, probably even to the Early Cretaceous, judging from the affinity of the pollen to *Clavatipollenites*. Unusual generic ranges also point towards early time, viz. one species of otherwise neotropical *Hedyosmum* in Indo-Malesia and one species of *Ascarina* in Madagascar even representing a separate section.

References: ARMOUR, New Phytol. 5 (1906) 49–55, pl. 3 & 4; BEHNKE, Ann. Mo. Bot. Gard. 62 (1975) 647–663; BENTHAM & HOOKER *f.*, Gen. Pl. 3 (1880) 133–135, (1883) 1220–1221; BUR-

GER, Bot. Rev. 43 (1977) 345–393; CRONQUIST, Integr. Syst. Class. (1981) 83–85; ENGLER, Nat. Pfl. Fam. 3, 1 (1894) 12–14; HOWARD, Bot. J. Linn. Soc. 63, Suppl. 1 (1970) 195–214; HUTCHINSON, Fam. Fl. Pl. ed. 3 (1973) 513–519; LEROY, Taxon 32 (1983) 169–175; LINDLEY, J. Collect. Bot. (1821) *sub t.* 17; A.C. SMITH, J. Ind. Bot. Soc. Jubilee Vol. 50A (1972) 215–226; Fl. Vit. Nova 2 (1981) 97; SWAMY, J. Arn. Arb. 34 (1953) 375–408; VERDCOURT, Kew Bull. 40 (1985) 218–224.

Generic delimitation. This is very decisive. The genera with fully unisexual flowers or dioecious inflorescences with marked proterandry, *Ascarina* (including *Ascarinopsis*) and *Hedyosmum* are clearly distinct from *Chloranthus* and *Sarcandra* in which the male floral parts are adnate to the ovary. In *Ascarina* both male and female flowers can be bracteate, but the male flower has only 1–5 anthers, whereas in *Hedyosmum* the male flowers have numerous anthers arranged in a cone with basal involucre and the female flowers are enclosed in highly developed cupular bracts. Morphologically *Chloranthus* and *Sarcandra* are more closely inter-related than the other two. *Sarcandra* is well characterised by its single stamen with anther cells on a club-shaped organ and particularly by its vessel-less xylem; *Chloranthus* can occasionally have a single stamen but then it is of a different structure, e.g. as in *C. multistachys* PEI. HUTCHINSON and others maintained *Tricercandra* A. GRAY distinct from *Chloranthus* on account of the fused male floral parts being produced into long narrow lobes ('connectives') but there are intermediates between this and the simple 3-lobed state found in typical *Chloranthus* which has been even more emphasised by new discoveries in China; it is not even possible to maintain it as a section. *Ascarinopsis* can on the other hand be kept as a section of *Ascarina* there being some distinctive characters such as 2–5 stamens and the curious disposition of two leafless nodes between the leafy ones.

Uses. The Chinese grow *Chloranthus spicatus* in pots for its fragrant aromatic leaves and it was formerly grown on a large scale in Java in one montane locality and used for imparting a scent to native tea and is apparently still used on a small scale for this purpose. BURKILL (1935) reported that leaves and flowers are left in contact with the tea whilst it is drying; they are later discarded or left to add bulk to the tea. Its use has been claimed to be deleterious. Among medicinal uses are as a poultice on carbuncles and boils, as a diaphoretic and excitant, as a cure for malaria but said to be poisonous in overdose, for back-ache and as a tea-like drink for treating coughs. *Chloranthus erectus* (= *officinalis*) is also used medicinally and as a tea, both the leaves and the roots being used. HEYNE (1927) gives extensive medicinal uses for the latter. It has a sudorific effect and is used in cases of fever and as a restorative during some phases of venereal disease; also as a stimulant and mixed with *Cinnamomum* bark as an antispasmodic during parturition.

DOSEDLA reported (GILL, 1979) that formerly the leaves of *Chloranthus erectus* (= *officinalis*) were eaten together with pork as an offering in House Tambaran in the Hagen area of New Guinea. Areas where the plant grew were avoided; today the whole plant which stains the hands green on touching is taboo. VELDKAMP (*in sched.*) reported that in S. Borneo the branches are boiled and the slightly peppery tasting concoction drunk by women to prevent conception.

Sarcandra glabra has also been used to scent tea or add bulk and used in Indonesia for the same purposes as *Chloranthus erectus*. In the Philippines an infusion is said to be useful in treating headaches, asthma and 'internal pains'. It is also used in Chinese medicine for bone fractures, contusions and in the form of a leaf-decoction as an astringent treatment for vomiting. FRAKE reported (PNH 37989 & 38204) that on Mindanao the leaves are pounded and applied to ulcers and CHAI (S 35411) that the warm leaves are used for sprains. HEYNE also mentions that when tea-planting started in Java the cultivation of *Chloranthus* was forbidden by the Dutch.

References: BURKILL, Dict. Econ. Prod. Mal. Pen. 1 (1935) 535; GILL, Ann. Naturh. Mus. Wien 84 (1979) 426; HEYNE, Nutt. Pl. Ned. Ind. (1927) 533–534; PERRY & METZGER, Medic. Pl. E. & SE. Asia (1980) 78–79.

Note. The drawings on the four plates were made by Mrs. MAUREEN CHURCH, at Kew.

KEY TO THE GENERA

1. Flowers essentially bisexual, the male part adnate to the ovary.
2. Anther-loculi 4 (in Mal.) on a 3-lobed organ interpreted as 3 fused stamens with central 2-locular anther and a 1-locular anther on each side. Leaves of widespread species usually finely serrate. Fruit white, greenish or yellowish, rarely tinged violet or pinkish, the tip sometimes dark violet-purple
 1. Chloranthus
2. Anther-loculi 2 on a narrowly clavate organ, *i.e.* apparently one stamen with a 2-locular anther. Leaves usually very coarsely serrate. Fruit red, rarely black 2. Sarcandra
1. Flowers truly unisexual or apparently so (in Mal.).
3. Male flowers bracteate with 1-2 (-5) stamens; female flowers naked. Shrubs or trees 2.5-24 m tall
 3. Ascarina
3. Male flowers with involucre and numerous stamens in a cone-like structure; female flowers in rounded ovate bracts with long caudate apices. Herbs or subshrubs 4. Hedyosmum

1. CHLORANTHUS

SWARTZ, Phil. Trans. R. Soc. 77 (1787) 359; SOLMS-LAUB. in DC. Prod. 16, 1 (1869) 473; BENTH. in B. & H. Gen. Pl. 3 (1880) 134; ARMOUR, New Phytol. 5 (1906) 49, pl. 3 & 4, *p.p.*; SWAMY, J. Arn. Arb. 34 (1953) 375; MAEKAWA, J. Jap. Bot. 45 (1970) 289, f. 1-5; FANG WU-KUO, Acta Phytotax. Sin. 18 (1980) 220. — *Nigrina* THUNB. Nov. Gen. (1783) 58; Fl. Jap. (1784) 65; Nova Acta Soc. Sc. Upsal. 7 (1815) 142, t. 5. — *Stropha* NORONHA, Verh. Bat. Gen. K. W. ed. 15 (1791) Art. IV.4 & ed. 2 (1827) 66, *nomen*; *cf.* STEEN. in Essays in Biohistory *etc.*, Regn. Veget. 71 (1970) 376. — *Cryphaea* BUCH.-HAM. Edinb. J. Sc. 2 (1825) 11, *non* MOHR in Weber (1814), *nec* BRIDEL (1822). — **Fig. 1-3.**

Shrubs or perennial erect or straggling herbs, glabrous and aromatic; stems jointed at the nodes. *Leaves* decussate, or sometimes subverticillate in whorls of 4, serrate; petiole bases connected by a transverse line or shortly connate; stipules mostly small. *Spikes* terminal, slender, sometimes branched, sometimes leafy at the base, the flowers each in the axil of persistent mostly subopposite bracts along the spicate opposite side branches. *Flowers* essentially bisexual, the male part usually a 3-lobed organ adnate to the ovary and sometimes enveloping it forming a fleshy mass, the lobes ('connectives') short and broad or longer or distinctly narrow and elongate, in some species almost or quite free, or in one species not noticeably lobed and reduced to \pm nothing but 1-3 anthers; anthers 1-3, the introrse locelli variously arranged, either 3 'anthers', one median with 2 approximate, or \pm separated locelli and one on each lateral edge with single locelli, or 2 lateral 1-locellate anthers and usually no median one (but this can vary in a population), or 1-3 anthers joined and the lobed organ practically or quite obsolete with one 2-locellate anther and usually two lateral 1-locellate anthers. *Ovary* naked; stigma subsessile, truncate. *Drupes* usually white, fleshy. *Seeds* subglobose, minutely apiculate, narrowed below, invested by the thin fibrous endocarp, the seed-coat with a lignified endotestal palisade.

Distr. About 20 *spp.* extending from Japan, China and extreme East U.S.S.R. to India, Ceylon and *Malaysia* as far as New Guinea.

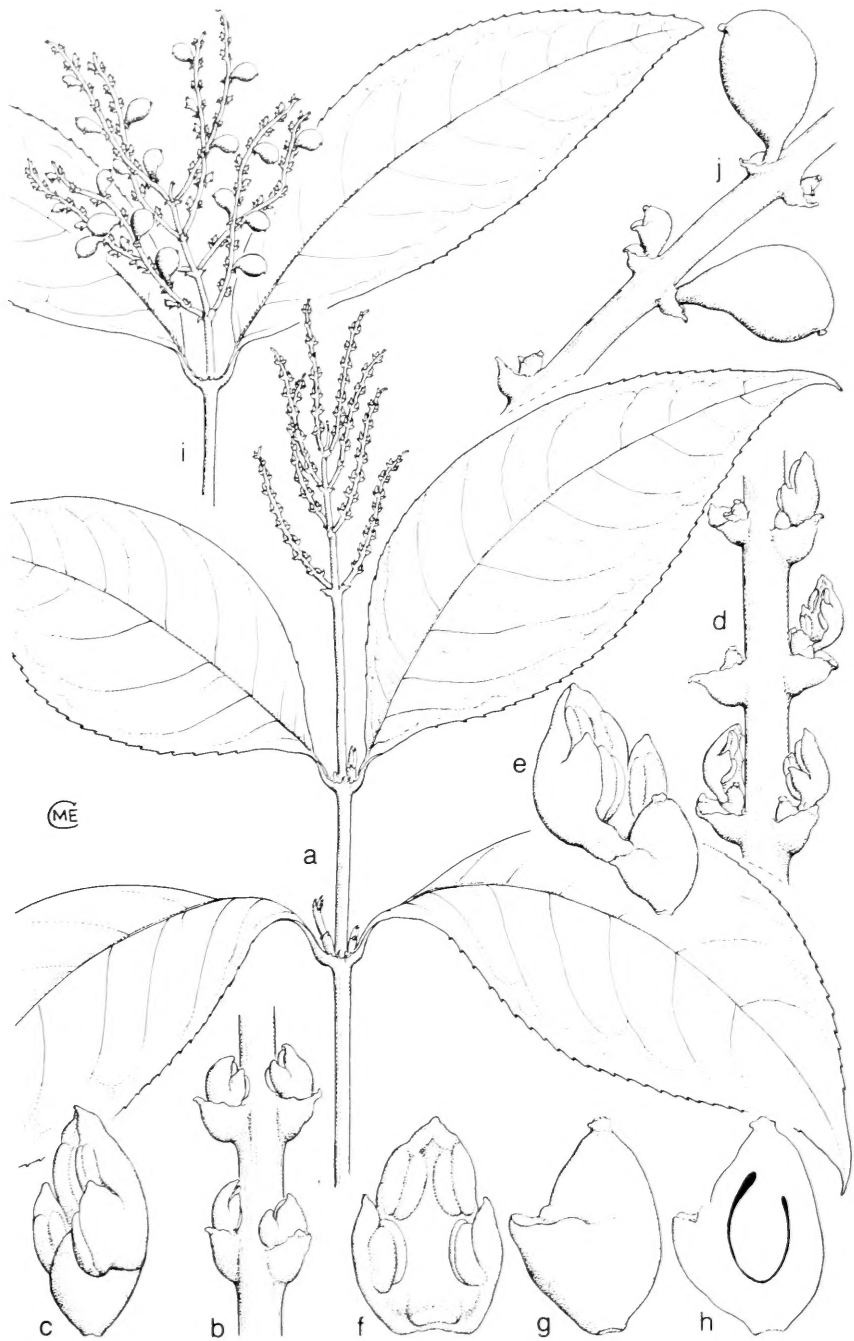


Fig. 1. *Chloranthus erectus* (BUCH.-HAM.) VERDCOURT. *a*. Flowering branchlet, $\times 2/3$, *b*. portion of young inflorescence, $\times 6$, *c*. young flower, $\times 16$, *d*. portion of older inflorescence, $\times 6$, *e*. mature flower, $\times 16$, *f*. anthers, $\times 20$, *g*. ovary, $\times 30$, *h*. LS ovary, $\times 30$, *i*. fruiting branchlet, $\times 2/3$, *j*. fruits, $\times 4$ (*a-c* ANDERSON S 20818, *d-h* VAN ROYEN 3626, *i-j* CHAI S 35523).

Taxon. Various authors have advanced subdivisions but there is no unanimity of opinion and this will have to wait for a monograph of the entire genus.

Paly. n. Grains subspherical averaging about 22.5 by 30 μ m, polycolpate with 3–8 colpi but often much modified reaching the poles in a few species but often short and appearing as slender unsculptured wavy meridional streaks and in some species only distinguishable as very faint tenuous short zigzag lines; exine with finely reticulate-pitted sculpture.

Floral morph. (see also general section). The staminal organ of *Chloranthus* has commonly been interpreted as 3 connate stamens and the available evidence suggests that it actually developed in this way from the concrescence of 3 stamens rather than the expansion of a single stamen and acquisition of supernumerary locelli (SWAMY, 1953). Where the central lobe of the male flower usually bears no anther cells, e.g. in *C. japonicus*, there is actually a good deal of variation showing an almost continuous range from rudiments to almost perfect anther cells in the same spike (MAEKAWA, 1970).

KEY TO THE SPECIES

1. Perennial unbranched herbs or subshrubby herbs with \pm subverticillate leaves in fours congested at top of stem. Anther-bearing organ with 3 distinct narrow lobes 3. *C. henryi*
1. Branched subshrubs or shrubs with decussate leaves. Anther-bearing organ shortly 3-lobed or 3-crenate.
 2. Leaves usually long acuminate, 8–29 by 3–13 cm, usually finely shallowly glandular-serrate. Fruits and stamens white 1. *C. erectus*
 2. Leaves usually \pm obtuse, 5–12.5 by 2–4 cm, crenate-serrate. Fruits and stamens green or yellowish (cultivated) 2. *C. spicatus*

1. *Chloranthus erectus* (BUCH.-HAM.) VERDCOURT, Kew Bull. 40 (1985) 217. — *C. erectus* SWEET, Hort. Suburb. Lond. (1818) 28, *nomen*; WALL. Cat. (1832) 230, *n.* 6881, *nomen*. — *Cryphaea erecta* BUCH.-HAM. Edinb. J. Sc. 2 (1825) 11, t. 2. — *C. officinalis* BL. En. Pl. Jav. 1 (1827) 79; Fl. Jav., *Chloranthaceae* (1829) 10, t. 1; CORDEMOY, Adansonia 3 (1863) 298; SOLMS-LAUB. in DC. Prod. 16 (1869) 474; HOOK. f. Fl. Br. India 5 (1886) 100; FORBES & HEMSLEY, J. Linn. Soc. Bot. 26 (1891) 369; K. SCH. & LAUT. Fl. Deut. Schutzgeb. Südsee (1900) 263; Nachtr. (1905) 241; LECOMTE, Fl. Gén. I.-C. 5 (1910) 94; PULLE, Nova Guinea 8 (1911) 623; GAMBLE, J. As. Soc. Beng. 75 (1912) 33; KOORD. Exk. Fl. Java 2 (1912) 40; GIBBS, J. Linn. Soc. Bot. 42 (1914) 129; MERR. En. Philip. 2 (1923) 21; RIDL. J. Mal. Br. R. As. Soc. 87 (1923) 89; BURK. & HOLT. Gard. Bull. S. S. 3 (1923) 69; RIDL. Fl. Mal. Pen. 3 (1924) 52; BURK. & HEND. Gard. Bull. S. S. 3 (1925) 411; RENDLE, J. Bot., Suppl. 63 (1925) 85; BARTLETT, Pap. Mich. Ac. Sc. Arts Lett. 6 (1926) 48; RIDL. Kew Bull. (1926) 78; HEND. Gard. Bull. S. S. 4 (1928) 308; MALM in Fedde, Rep. 34 (1934) 270; BURK. Dict. (1935) 535; PEI, Sinensia 6 (1935) 667, f. 1; METCALF, Fl. Fukien 1 (1942) 39; HEND. Mal. Nat. J. 6 (1951) 443, f. 400; HARA, Fl. East. Himal. 1 (1966) 44; MEIJER, Bot. Bull. Herb. For. Dept. Sandakan 10 (1968) 32. — ? *C. elatior* R. BR. ex SIMS, Bot. Mag. (1820) 48 *sub* t. 2190, *nomen*; LINK, En. Pl. Berol. 1 (1821) 140; CORDEMOY, Adansonia 3 (1863) 299; BACK. & BAKH. f. Fl. Java 1 (1963) 175; KENG, Orders & Fam. Mal. Seed Pl. (1969) 122, f. 73; ed. 2 (1978) f. 74; HARA, Fl. East. Himal. 2 (1971) 14; C.Y. WU, Fl. Yunna-

nica 1 (1977) 18, f. 5/1–3; QIN & SHA in Fang, Fl. Sichuanica 1 (1981) 138, f. 58; WU KUO-FANG, Fl. Reipubl. Pop. Sin. 20 (1982) 84, t. 26/6–10. — *C. inconspicuus* (non SWARTZ) BLANCO, Fl. Filip. ed. 2 (1845) 54. — *C. salicifolius* PRESL, Epim. Bot. (1851) 231. — **Fig. 1–3.**

Shrubby herb, subshrub or small shrub, 0.3–3 m, rarely epiphytic, \pm aromatic when crushed; nodes distinctly swollen, sometimes purplish. *Leaves* bright green, glossy above in life, oblong-lanceolate to elliptic- or ovate-oblong, 8–29 by 3–13 cm, usually long-acuminate at the apex, cuneate at the base, rather thin, the margin rather finely shallowly (rarely more coarsely) glandular-serrate, with c. 9 pairs of nerves, sometimes purple beneath; petiole 0.75–1.7 cm; stipules minute, subulate. *Inflorescences* scented, with 5–13 spikes 2.5–5 cm long; bracts sheathing; ovate, acute. Anther-bearing organ yellow, between green and white or violet-white, 3-lobed, 1.2–1.6 mm long; median anther 2-locellate; lateral anthers 1-locellate. *Ovary* enclosed by the male part. *Fruit* white, cream or rarely tinged violet or pinkish, the tip sometimes dark violet-purple, succulent, glossy, 5–7 mm ϕ . *Seed* yellowish white.

Distr. Continental SE. Asia from Nepal to Yunnan and Andaman Is., and throughout *Malesia* to New Guinea (incl. New Britain and New Ireland).

Ecol. Primary and secondary forest, including *Pandanus* and palm, *Araucaria*, and *Nothofagus-Castanopsis* in montane forest, often on limestone, sometimes riverain or in boggy areas, mainly lowland, (20–)50–1450(–2535) m. *Fl.* Jan.–Dec. RIDLEY (Disp., 1930) stated that it is bird dispersed.



Fig. 2. *Chloranthus erectus* (BUCH.-HAM.) VERDCOURT in fruit near Njarumkop, NW. Kalimantan (A. ELSENER 30, 5-8-1964).

Taxon. The epithet *elatior* has come into wide usage but there is no BROWN specimen at the BM or any LINK specimen now extant at B, so it is not possible to be certain what was actually intended, since the description given by LINK is fragmentary, his type being sterile. I agree with VAN STEENIS (*in litt.*) that the name is better discarded in favour of one which is unambiguous and of which the type is available.

BUCHANAN-HAMILTON'S faulty drawing and description have misled authors as to the identity of *Cryphaea erecta*, but the examination of the type (E) left no doubt.

Vern. Sumatra: *garaman gadjah, harostulang, lelada-rima*, Alas, *sēbah, si-enēm-berugi, s.e.-bēngi, s.e.-bērnih*, Karo, *si-pukhor-lisak*; Java: *karas tulang, kerastulang, kras tulang, manik, muni, pulu dengen, sukattam, ujah, ujahon*; Borneo: *bētuk*, Sarawak, Kelabit, *dikut-dikut, langut-langut, luai*, Kinabatangan, *lalamak*, Murut, *lambayau*, Labuk, *lud*, Bangyi, *mongkitir*, Mub; Philippines: *babbainm di dup dup hug, pangutug*, If., *banwalimatok*, Palawan, *barau-barau*, Luzon-Laguna Prov., *bēlekbut, sunulampóng, vimug*, Sub., *buro*

bonlao, Negros, *tul-an hinbad*, Samar, *tunggáo* Tagb.; New Guinea: *kaha*, Bulolo-Garaina, *kuggé-bálts*, Hagen, *kundiewdia*, Madang, Saidor, *moluh-muluh, silibe*, Dani, *namakebuya*, Kainantu-Okapa, *rumukembalo*, Kagua, *sohkumo*, Orokaiva-Mumuni, *tjalangan*, Enga, Poio; New Britain: *angore*.

Note. Judging by dried material specimens from New Ireland have larger fruits but the constancy of this needs checking in the field. Sterile material of *Chloranthus erectus* (= *officinalis*) with more toothed leaves than usual can be difficult to distinguish, but *Sarcandra glabra* usually dries with more reddish brown coloured foliage.

2. *Chloranthus spicatus* (THUNB.) MAKINO, Bot. Mag. Tokyo 16 (1902) 180; MERR. Trans. Am. Phil. Soc. n.s. 24 (1935) 127; PEI, Sinensia 6 (1935) 668, f. 2; Bot. Bull. Acad. Sinica 1 (1947) 114; STEWARD, Man. Vasc. Pl. Lower Yangtze Valley (1958) 70, f. 43; MANSFIELD, Die Kulturpfl. Beih. 2 (1959) 13; BACK. & BAKH. f. Fl. Java 1 (1963) 176; OHWI, Fl. Japan (1965) 361; C.Y. WU, Fl. Yunnanica 1 (1977) 18, f. 5/4-6; QIN & SHA in Fang, Fl. Sichuanica 1



Fig. 3. *Chloranthus erectus* (BUCH.-HAM.) VERDCOURT. Njarumkop, NW. Kalimantan (A. ELSENER 30, 15-8-1964).

(1981) 139; WU KUO-FANG, Fl. Reipubl. Pop. Sin. 20 (1982) 83, t. 26/1-5. — *C. inconspicuus* SWARTZ, Phil. Trans. R. Soc. 77 (1787) 359, t. 15; L'HERIT. Sert. Angl. (1788) 35, t. 2; BENTH. Fl. Hongk. (1861) 334; MIQ. Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 129; SOLMS-LAUB. in DC. Prod. 16 1869) 474; FORBES & HEMSLEY, J. Linn. Soc. Bot. 26 (1891) 368; ENGLER in E. & P. Nat. Pfl. Fam. 3, 1 (1894) 13, f. 12; LECOMTE, Fl. Gén. 1.-C. 5 (1910) 95; KOORD. Exk. Fl. Java 2 (1912) 42, f. 3; BRITTEN, J. Bot. 55 (1917) 344; BURK. Dict. (1935) 535. — *Nigrina spicata* THUNB. Nov. Gen. (1783) 58; Fl. Jap. (1784) 65. — *Nigrina spicifera* LAMK, Ill. Gen. 1 (1792) 295 & (1791) t. 71. — *C. indicus* WIGHT, Ic. Pl. Ind. Or. 6 (1853) t. 1945. — *C. obtusifolius* MIQ. Fl. Ind. Bat. 1, 1 (1856) 802.

Small glabrous shrub, 0.5-1.5 m, with ascending or \pm spreading branches. *Leaves* oblong-ovate or ovate-elliptic to elliptic, 4-13.5 by 2-8.5 cm, rather obtuse or at least not or scarcely acuminate at the apex, cuneate at the base, rather coarsely crenate-serrate, nerves 4-6 pairs; petiole 0.4-1.2 cm; stipules membranous, linear, 2-3 mm, mucronate. *Inflorescences* terminal with 10-20 ascending spikes 2-5 cm long; peduncles 3-8 cm; bracts 1.5 mm;

bracteoles 1 mm. *Anthers* 3, the central with 2 locelli and the laterals 1-locellate, the cells \pm 0.5 mm long. *Fruit* green or yellowish, 4 by 2 mm, narrowed at the base.

Distr. China but widely cultivated elsewhere in eastern Asia; in *Malesia* cultivated in Java (e.g. Parakansalak) and Sumatra (West Coast); 700-920 m. *Fl.* Jan.-Dec.

3. *Chloranthus henryi* HEMSLEY, J. Linn. Soc. Bot. 26 (1891) 367; HAND.-MAZZ. Symb. Sin. 7 (1929) 156; PEI, Sinensia 6 (1935) 679, f. 6; Bot. Bull. Acad. Sinica 1 (1947) 115; WU KUO-FANG, Fl. Reipubl. Pop. Sin. 20 (1982) 92, t. 28/9-13. — *C. philippinensis* MERR. Philip. J. Sc. 7 (1912) Bot. 259; En. Philip. 2 (1923) 22. — *C. verticillatus* MERR. Philip. J. Sc. 10 (1915) Bot. 3; En. Philip. 2 (1923) 22. — *C. oldhamii* (non SOLMS-LAUB.) MERR. & QUIS. Philip. J. Sc. 82 (1953) 324.

Herb 20-40 cm; stem simple, glabrous or pubescent towards the apex, with 3-5 leafless nodes bearing paired scales 6-9 mm long, which are caducous or perhaps not developed in some specimens; rootstock said to be aromatic. *Leaves* in whorls of (?3-4) at apex of stem, elliptic to broadly elliptic or obovate-elliptic, 8-15.5 by 3.5-9.5 cm, narrowly long-acuminate at apex, cuneate at base, margin sharply serrate, serrations terminated by prominent thick glands, glabrous, or shortly pubescent on the 5-9 pairs of nerves beneath; petiole 2-7 mm, glabrous or pubescent. *Inflorescence* terminal; peduncle slender, 7.5-13 cm long with 2-3(-4) spikes 2-6 cm long; secondary peduncles 0.5-1.2 cm, sparsely pubescent; bracts ovate, \pm 1.5 mm long. *Male part* attached about the middle of the ovary, white; central lobe 2.2-3 by 1 mm (4 by 1.2 in original description of *C. verticillatus*), lateral lobes 1.5-1.8 by 0.6-0.8 mm, all rounded at apex; anther cells about half as long as lobes, 2 on central lobe, one on each lateral lobe, 0.8-1 mm long. *Ovary* \pm ovoid, narrowed from near middle to a \pm triangular apex, 1.5(-2?) by 1 mm. *Fruits* white?

Distr. China; in *Malesia*: Philippines (Luzon: Ifugao, Mt Polis; Bayninan, Banaue, Cagayan, Abulug R.).

Ecol. Forest; banks of irrigation canals; 250-1200 m. *Fl.* Jan.-Feb.

Vern. hayad, If.

Note. When describing *C. verticillatus* MERRILL suggested it might be nearest to *C. henryi*, but later MERRILL and QUISUMBING synonymised it with *C. oldhamii* SOLMS-LAUB. MERRILL also compared *C. philippinensis* with *C. henryi* but stated the former had much smaller flowers. *Chloranthus henryi* is variable particularly in regard to the ratio of the length of the anther cells to that of the lobes of the male part which vary from about a 1/2 to more usually 1/4 to

1/3, but some Chinese material is very similar to that from the Philippines and for the present I am content to consider them conspecific. The above description does, however, refer only to Philippine material. A

better range of material from China and the Philippines may show constant differences and that subspecies can be recognised.

2. SARCANDRA

GARDNER, Calc. J. Nat. Hist. 6 (1846) 348; SWAMY & BAILEY, J. Arn. Arb. 31 (1950) 127; VERDCOURT, Kew Bull. 39 (1984) 66. — **Fig. 4.**

Shrubs or shrublets with nodose jointed branchlets. Primary and secondary xylem without vessels. *Leaves* decussate or sometimes appearing subverticillate where nodes are congested, pinnately nerved, usually coarsely serrate, serrations thickened at apex; petiolar sheath short, with short setaceous stipules on its margin. *Flowers* essentially bisexual, in lax terminal spikes with c. 3 main branches, each with up to c. 12 flowers; bracts boat-shaped. *Male part* reduced to a club-shaped or \pm discoid organ usually interpreted as a filament and connective of a single stamen bearing 2 locelli, adnate about 2/3 of the way up the abaxial side of the ovary and with a cushion-like fold below the point of attachment; locelli latrorse or introrse, opening lengthwise, usually separated but sometimes touching at their tips. *Ovary* ovoid, 1-locular; ovule pendulous, bitegminal, crassinucellate; stigma sessile depressed and subcapitate. *Drupe* nearly invariably red, 1-seeded, obovoid, bearing the scar of the fallen male part on its anterior face; pericarp succulent, the epidermis without stomata. *Seed* pendulous with membranous testa; innermost cell layer of outer integument developing into a lignified palisade of radially elongate cells with 1–several crystals, the cell cavity becoming filled with an internal reticulum of lignin.

Distr. Two species in Ceylon, India, Burma, Indochina to China and Japan, one of which in *Malesia*: Malay Peninsula, Sumatra, Java, Borneo, Lesser Sunda Is., Philippines, New Guinea. A map (now out of date) was published by SUESSENGUTH & GALL, Mitt. Bot. Staatssamml. München 1 (1953) 351.

Taxon. There is no doubt that SWAMY is correct in maintaining this genus, well-characterised by the vesselless xylem, characteristically shaped male part of the flower with 2 locelli and with 1 or 2 traces rather than 3, presence of stone cells, dorsal carpel traces, characteristic pollen, nearly invariably red fruits *etc.* Confusion has occurred in the nomenclature of the species occurring in S. India and Ceylon (VERDCOURT, 1984).

Palyn. Grains spherical about 28 μ m diameter, acolpate, the exine coarsely reticulate.

Morph. It is logical to treat the flowers as bisexual flowers since the two staminal traces usually join with the median carpel traces although flower is really a vague term for combinations of structures of different origins; variants exist, however, which have a single staminal trace free at least to below the bract.

1. *Sarcandra glabra* (THUNB.) NAKAI, Fl. Sylv. Koreana 18 (1930) 17, t. 2; SWAMY & BAILEY, J. Arn. Arb. 31 (1950) 117; OHWI, Fl. Japan (1965) 361; MEIJER, Bot. Bull. Herb. For. Dept. Sandakan 10 (1968) 33; HORIKAWA, Atlas Fl. Japan 1 (1972) map 28; LIU TANG-SHUI, Fl. Taiwan 2 (1976) 566, t. 410; C.Y. WU, Fl. Yunnanica 1 (1977) 21, f. 6/5–7; QIN & SHAW in Fang, Fl. Sichuanica 1 (1981) 135, f. 57; WU KUO-FANG, Fl. Reipubl. Pop. Sin. 20 (1982) 79, f. 25/1–5; VERDCOURT, Kew Bull. 40 (1985) 216. — *Bladhia glabra* THUNB. Trans. Linn. Soc. Lond. 2

(1794) 331. — *Chloranthus monander* R.Br. ex SIMS, Bot. Mag. (1821) t. 2190. — *Ardisia glabra* (THUNB.) DC. Trans. Linn. Soc. Lond. 17 (1834) 123. — *Chloranthus brachystachys sensu* BENTH. Fl. Hongk. (1861) 334, *p.p.*; SOLMS-LAUB. in DC. Prod. 16 (1869) 475; FORBES & HEMSLEY, J. Linn. Soc. Bot. 26 (1891) 367, *p.p.*; REHDER, J. Arn. Arb. 10 (1929) 111, *p.p.*, *non* Bl. *s.str.* — *Chloranthus denticulatus* CORDEMOY, Adansonia 3 (1863) 296. — *Chloranthus glaber* (THUNB.) MAKINO, Bot. Mag. Tokyo 26 (1912) 386. — **Fig. 4.**

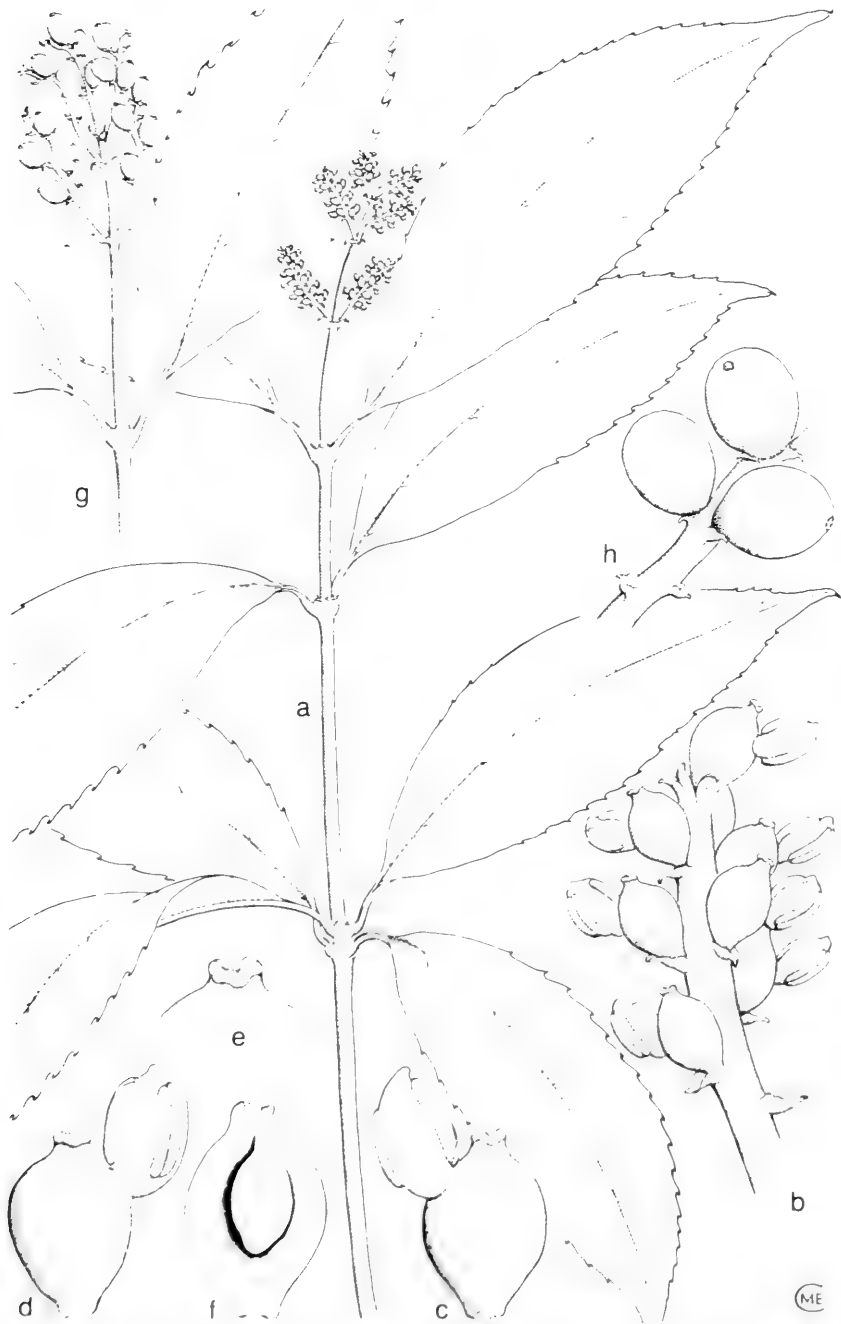


Fig. 4. *Sarcandra glabra* (THUNB.) NAKAI. *a*. Flowering branchlet, $\times 2/3$, *b*. part of inflorescence, $\times 6$, *c*. flower, back view, $\times 10$, *d*. flower, front view, $\times 10$, *e*. stigma, $\times 16$, *f*. LS ovary, $\times 16$, *g*. fruiting branchlet, $\times 2/3$, *h*. fruits, $\times 2$ (*a-f* PURSEGLOVE 4097, *g* KALKMAN 5319, *h* NOOTEBOOM & CHAI 1825, spirit material).

For further references and synonymy see under *ssp. brachystachys*.

Glabrous shrub or half-woody herb, 0.6–3 m tall; stems up to 1.5 cm ϕ with \pm swollen nodes, longitudinally ridged when dry; bark \pm smooth. Leaves elliptic-oblongate, lanceolate or narrowly elongate-elliptic, 2–20 by 1–8 cm, long-acuminate, cuncate at the base, \pm subcoriaceous, coarsely or shallowly very sharply serrate or dentate-serrate, the teeth with thickened points; lateral nerves in 5–10 pairs; stipules small, linear-subulate, c. 1.5 mm long; petiole 0.4–1.7 cm. Inflorescences greenish or \pm white, 3–8 cm long, the spikes rather dense, 1–3.5 (–5) cm long; paired bracts 3 mm long; bracteoles oblong, 1 mm long, sometimes \pm trifid. Male part 1.3–2 mm long, 1–1.3 mm wide, the anther cells extending from half to the whole length or almost so, c. 1.3 mm long. Female part flask-shaped or subglobose, 1–1.5 mm long; stigma up to 1 mm wide. Fruit at first yellow, becoming red or bright orange, very rarely black, 4–7 mm ϕ (dry), shining. Seed pale, yellowish or cream.

Distr. Continental SE. & E. Asia, throughout *Malesia*.

Note. The typical *ssp. glabra* occurs in N. & Central China, Korea, Japan and the Ryukyu Islands. Some specimens from NW. India and S. China are somewhat intermediate.

KEY TO THE SUBSPECIES

1. Male structure with anther cells about as long as the structure itself, the non-antheriferous part much reduced *ssp. brachystachys*
1. Male structure with anther cells much shorter, the non-antheriferous part (*i.e.* apparent 'filament') well-developed. E. Asia *ssp. glabra*

ssp. brachystachys (BL.) VERDCOURT, Kew Bull. 40 (1985) 216. — *Ascarina serrata* BL. En. Pl. Jav. 1 (1827) 80. — *Chloranthus brachystachys* BL. Fl. Jav., *Chloranthaceae* (1829) 13, t. 2; BENTH. Fl. Hongk. (1861) 334; SOLMS-LAUB. in DC. Prod. 16 (1869) 479; FORBES & HEMSLEY, J. Linn. Soc. Bot. 26 (1891) 367; STAPF, Trans. Linn. Soc. Lond. II, 4 (1894) 217; C.B. ROB. Philip. J. Sc. 4 (1909) Bot. 70; LECOMTE, Fl. Gén. I.-C. 5 (1910) 95; KOORD. Exk. Fl. Java 2 (1912) 41, f. 4; GIBBS, J. Linn. Soc. Bot. 42 (1914) 129; RIDL. J. Mal. Br. R. As. Soc. 8 (1923) 89; MERR. En. Philip. 2 (1923) 21; BURK. & HOLTT. Gard. Bull. S. S. 3 (1923) 70; RIDL. Fl. Mal. Pen. 3 (1924) 53, f. 140; RENDLE, J. Bot. Suppl. 63 (1925) 85; BARTLETT, Pap. Mich. Ac. Sc. Arts Lett. 6 (1926) 48; REHDER, J. Arn. Arb. 10 (1929) 111, *p.p.*; MALM in Fedde, Rep. 34 (1934) 270; BURK. Dict. (1935) 535.

— *Chloranthus hainanensis* PEI, Sinensia 6 (1935) 674. — *S. hainanensis* (PEI) SWAMY & BAILEY, J. Arn. Arb. 31 (1956) 128, f. 4/15–17; C.Y. WU, Fl. Yunnanica 1 (1977) 21, f. 6/1–4; WU KUO-FANG, Fl. Reipubl. Pop. Sin. 20 (1982) 80, f. 25/6–11. — *Chloranthus glaber sensu* BACK. & BAKH. f. Fl. Java 1 (1963) 175, *non* (THUNB.) MAKINO *s.str.* — *S. glabra auctt. mult.*; MEIJER, Bot. Bull. Herb. For. Dept. Sandakan 10 (1968) 33; KENG, Orders & Fam. Mal. Seed Pl. (1969) 123, f. 74 & ed. 2 (1978) f. 75.

Male structure with anther cells almost equalling it, *i.e.* the non-antheriferous part much reduced.

var. *brachystachys*

Fruits red.

Distr. NE. India (Assam, Manipur, Naga Hills), Bangladesh, Burma, Thailand, N. Vietnam, S. China (incl. Hainan), and throughout *Malesia*.

Ecol. Evergreen, both lowland and lower montane forest, secondary forest, heath forest, moist ground ridge forest, sometimes by water, also eroded limestone slopes with thin 'mos' soil, ridge podsolized soil, shingle banks and stream beds, shaly slopes; 135–2550 m. Fl. Feb., April–June; fr. Jan.–May, Aug.–Nov.

Vern. Sumatra: *kaju aek, k. duri-duri, k. si dētu aek, k. si marsangkat, si dētu rapping, si marduri-duri, si rapping bulung*, Batak; Java: *atukan, pēngan dukiki*; Lesser Sunda Is.: *lawi-nata, nio-kodé* (= monkey's coconut), Flores; Philippines: *baga-baga, puti-selimbangan*, Sub., *bagen-hoho, holog di namuyug*, If., *apot, damoko, enem, gapas, umuum*, Ig., *baga-baga, puti-selimbangan*, Sub., *gumok*, Buk., *kari-kari*, Bag., *total*, Yak., *em-em*, N. Luzon; New Guinea: *brok, brok-mugup*, Sepik, Telefomin, *kaguna, tsui 'alagebo*, S. Highlands, Kutubu.

Notes. Field notes and spirit material show that the fruit is much larger in life, *e.g.* 9–15 by 7–10 mm.

Sterile material of *Chloranthus erectus* with much more coarsely toothed leaves than usual can be difficult to distinguish, but *Sarcandra glabra* usually dries with more reddish brown coloured foliage rather than a grey-green colour.

var. melanocarpa (RIDL.) VERDCOURT, Kew Bull. 40 (1985) 217. — *Chloranthus brachystachys* BL. *var. melanocarpus* RIDL. J. Mal. Br. R. As. Soc. 87 (1923) 89.

Differs in having black fruits.

Distr. *Malesia*: N. Sumatra (Berastagi, West Hill; Lake Toba, Gunung Batu, Lopang, 10 km ESE of Prapat).

Ecol. Montane rain-forest, 1400–1500 m.

Note. I had dismissed RIDLEY's variety as a casual variant, but its recollection in the same general

area suggests a population of black-fruited specimens exists; since the fruit is uniformly described as red throughout its range the occurrence of such a variety seems worth emphasising.

3. ASCARINA

J. R. & G. FORST. Char. Gen. (1775) 59; ed. 2 (1776) 117; CORDEMOY, *Adansonia* 3 (1863) 302; SOLMS-LAUB. in DC. Prod. 16 (1869) 477; BENTH. in B. & H. Gen. Pl. 3 (1880) 134; SWAMY, Proc. Nat. Inst. Sc. India 19 (1953) 371; v. BALGOOY, *Blumea*, Suppl. 5: Pacif. Pl. Areas 2 (1966) map 64; A. C. SMITH, J. Arn. Arb. 57 (1976) 405; MOORE, J. New Zeal. Bot. 15 (1977) 491; JÉRÉMIE, *Adansonia* II, 20 (1980) 273; A. C. SMITH, Fl. Vit. Nova 2 (1981) 98; JÉRÉMIE, Fl. Nouv. Caléd. et Dép. 11 (1982) 171; RAWLINGS, J. New Zeal. Bot. 12 (1974) 564. — *Ascarinopsis* HUMBERT & CAPURON, C. R. Ac. Sc. Paris 240 (1955) 28, fig.; AUBRÉV. *Adansonia* II, 15 (1976) 302. — **Fig. 5.**

Shrubs or small or sometimes quite large trees, usually apparently dioecious or monoecious, glabrous, aromatic, the branches jointed at the nodes and the bases of the internodes sometimes swollen. *Leaves* decussate, often coriaceous, obtusely serrate, the serrations often gland-tipped; petiolar sheath very short; stipules very small, subulate; in *sect. Madagascarina* JÉRÉMIE and some species of *sect. Ascarina* there are two intermediary aphyllous nodes with eventually deciduous sheaths 2–6 mm long between successive pairs of leaves the stipular collar made up of the petiole-bases bearing 2 pairs of small teeth under 5 mm long. *Flowers* basically in much condensed biparous sessile cymes borne in the axil of a bract with an abaxial male flower and 1 or 2 adaxial female flowers with bracts and bracteoles (if 2-flowered), essentially representing a bisexual flower; sometimes 1–2 stamens are associated with 1–2 rudimentary or functional adaxial carpels which develop much later; but mostly inflorescences reduced to single male flowers or 1–2 female flowers and appearing monoecious or dioecious. — *Male flowers* bracteate, reduced to 1–2 subsessile anthers with parallel linear locelli opening lengthwise or in *sect. Madagascarina* with 2–5 (usually 3) sessile stamens with bilocular anthers. — *Female flowers* consisting of a naked sessile ovoid-globose ovary without outer bracts or with 2 often caducous inner bracts and if flowers paired then with bracteoles also; stigma sessile, truncate or 2-lipped or in *sect. Madagascarina* horseshoe-shaped. *Fruits* purplish grey turning black, obovoid, with thin succulent exocarp and stony smooth or verrucose unspecialised endocarp; epidermis without stomata. *Seeds* ovoid, flattened, with smooth testa, the seed coat with unlignified endotestal palisade but with lignified fibrous exotegmen.

Distr. 12 species in Madagascar, Pacific Islands (widespread from Solomons to the Marquesas), New Caledonia and New Zealand; in *Malesia* 4 spp.: Borneo, Celebes, Philippines, New Guinea. **Fig. 6.**

Ecol. Mostly in montane or submontane rain-forest, 450–3300 m; in both lowland and montane rain-forest in New Zealand and at lower and medium altitudes elsewhere in the Pacific.

Palyn. Grains spherical, about 30 µm diameter, monocolpate, with fine faint pitted-reticulate sculpture.

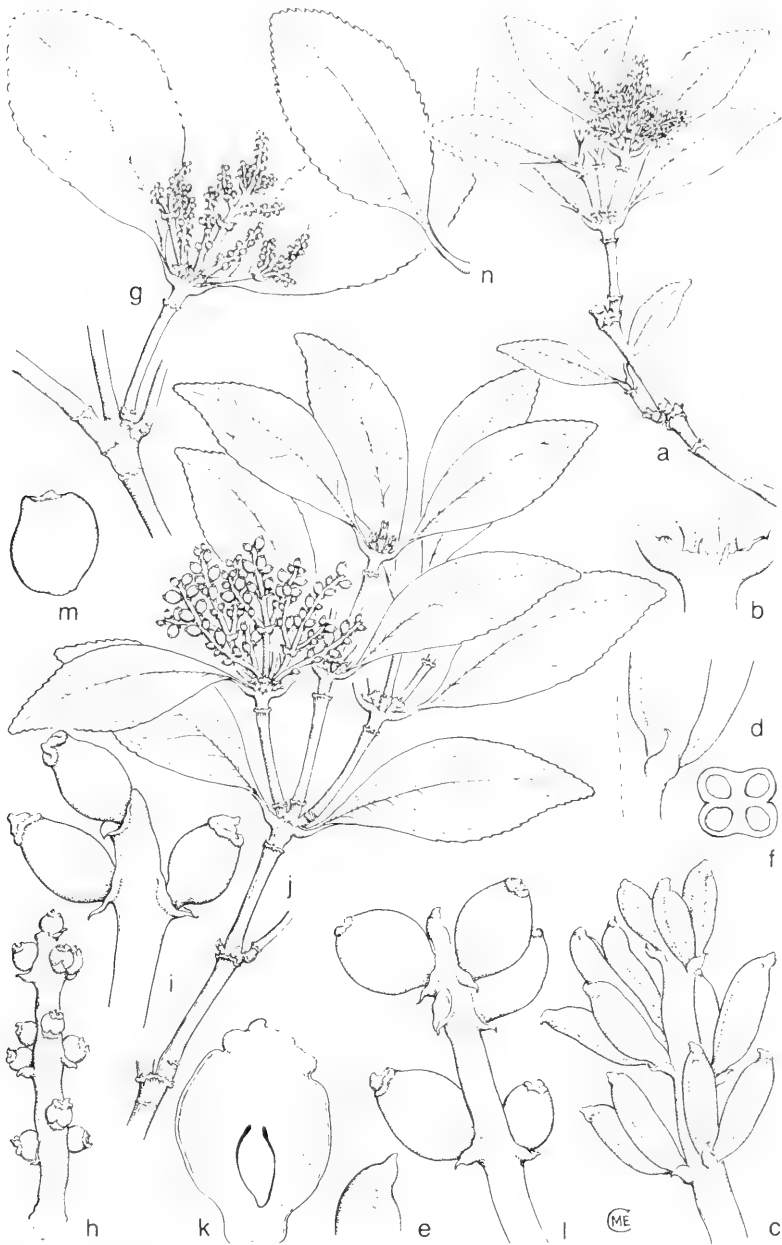


Fig. 5. *Ascarina philippinensis* C.B. Rob. *a*. Male flowering branchlet, $\times 2/3$, *b*. stipules, $\times 4$, *c*. portion of male inflorescence, $\times 8$, *d*. base of anthers showing bract, $\times 16$, *e*. apiculate apex of anther, $\times 14$, *f*. TS anther, $\times 16$, *g*. female flowering branchlet, $\times 2/3$, *h*. female inflorescence, $\times 4$, *i*. portion of older female inflorescence, $\times 6$, *j*. female fruiting branchlet, $\times 2/3$, *k*. LS ovary, $\times 16$, *l*. fruits, $\times 4$, *m*. seed, $\times 6$, *n*. leaf, $\times 2/3$ (*a-f* VAN ROYEN & SLEUMER 6075, *g-h* RAMOS & EDAÑO BS 30647, *i* VAN ROYEN & SLEUMER 8127, *j-m* VAN ROYEN & SLEUMER 5898, *n* VAN BALGOOY?).

Taxon. The species of *sect. Ascarina* fall into two groups, a predominantly western Pacific group with a single bract subtending the flower and male flowers with two stamens and the other mostly eastern Pacific group with 3 bracts and 1 stamen.

Floral biology. *Ascarina* species have usually been assumed to be dioecious but A.C. SMITH (1976) pointed out that he had seen specimens which were monoecious with male and female inflorescences on the same branchlet. RAWLINGS (1974) published an observation made in 1972 by J. DON that a solitary tree of *A. lucida* produced copious pollen and later was loaded with drupes thus disproving that the genus is dioecious. It was noted that flowers were produced in the early spring, developing very slowly during August and September and that the drupes did not mature until the following spring and did not fall until after new flowers had formed. Even earlier in 1971 J. GODLEY studied a plant in flower and suspected it might be a hermaphrodite with very strong protandry. MOORE (1977) showed that *A. lucida* exhibits a peculiar type of monoecism where a male flower is represented by a single stamen and commonly accompanied by two female flowers which mature distinctly later or in other compound inflorescences a stamen and single accompanying ovary mature almost simultaneously. In essence there is a reduced biparous sessile cyme which resembles a bisexual flower and has in fact been accepted as a single flower. CORDEMOY (1863) long ago suggested that the 'single flower' of *Chloranthus* is in reality a little glomerulus, a biparous sessile cyme. JÉRÉMIE (1980) also comments on this subject and states that generally male and female flowers are on different plants but exceptionally certain specimens present flowers of 1 or 2 stamens and one or two rudimentary but sometimes functional carpels in an adaxial position *i.e.* falsely hermaphrodite with \pm marked protandry but true monoecism also occurs. SMITH (1981) has accepted that this condensed biparous cyme with male and female flowers is the basic inflorescence in the genus. A survey of the herbarium material of *A. philippinensis* has not revealed anything but dioecious plants.

KEY TO THE SPECIES

1. Leaves rounded or only very shortly acuminate at the apex. Flowers with a single subtending bract; male flowers with 2 stamens. Endocarp smooth.
 2. Leaves subsessile, the petiole short and thick, about 2 mm long; blades narrowed to rounded or subcordate at base 3. *A. subsessilis*
 2. Leaves distinctly petiolate, the petioles slender, 0.4–1.5 cm long; blades cuneate at base.
 3. Fruits 1.2–2 mm long, with thinner more finely wrinkled exocarp (dry material), in more lax terminal and axillary inflorescences, the distances between the fruits greater and inflorescence-branches more slender 2. *A. maheshwarii*
 3. Fruits 2–3 mm long, with thicker more coarsely wrinkled exocarp, in lax to usually very densely congested terminal inflorescences, the distances between the fruits shorter and inflorescence-branches usually much stouter 1. *A. philippinensis*
1. Leaves distinctly long-acuminate at the apex. Flowers with 3 subtending bracts; male flowers with 1 stamen. Endocarp warty-papillate 4. *A. diffusa*

1. *Ascarina philippinensis* C.B. ROB. Philip. J. Sc. 4 (1909) Bot. 70; MERR. En. Philip. 2 (1923) 22; SWAMY, Proc. Nat. Inst. Sc. India 19 (1953) 375, f. 2; MEIJER, Bot. Bull. Herb. For. Dept. Sandakan 10 (1968) 32, fig.; A.C. SMITH, J. Arn. Arb. 57 (1976) 409; v. ROYEN, Alpine Fl. New Guinea 3 (1979) 1256. — *A. reticulata* MERR. Philip. J. Sc. 12 (1917) Bot. 263; En. Philip. 2 (1923) 22; HEINE in Fedde, Rep. 54 (1951) 226.

Small to medium-sized tree, 7.5–24 m, σ to c. 35 (–60) cm, sometimes a shrub or treelet 2–4 m at high altitudes; twigs very brittle; bark very variable, white, grey or dark reddish brown, very rough and flaky to slightly to distinctly fissured, the fissures widely spaced, deep, bordered with yellowish scar tissue; inner bark straw to orange or pale brown, fibrous; blaze off-white to pale brown; cambium yellow;

low; wood pinkish straw, turning \pm orange, the rays well marked, with no exudate or sapwood described as yellow or straw-coloured and heartwood purplish or dull brownish. *Leaves* very variable, elliptic, oblong, ovate or obovate, 3.2–14(–18) by 1.5–8.5 (–10) cm, rounded or obtuse to very shortly acuminate at apex, cuneate at base, rather fleshy or leathery, glossy, \pm paler beneath, crenate with thickened tips to crenations; nerves 8–11 pairs; petiole 0.4–1.5 cm; stipules linear to ovate-boat-shaped, 1–2.5 mm long, often caducous; intermediate leafless nodes often present, with sheaths up to 6.5 mm long. *Inflorescences* terminal compound spikes with several branches usually spreading from a central axis, 1.5–3 cm long, the final branches spiciform with 4–8 flowers; bracts ovate, up to 1.5–3 by 1–2 mm. — *Male flowers* whitish or pale greenish yellow with



Fig. 6. The disjunct distribution of the genus *Ascarina* FORST. The single species in Madagascar (not indicated here) is the sole representative of the sect. *Madascarina* LEROY & JÉRÉMIE (*Ascarinopsis* HUMB. & CAPURON). Localities of sect. *Ascarina* after Pacific Plant Areas 2, map 64.

2 collateral stamens and rarely a third adaxial one; anthers c. 3 by 1–1.5 mm, the projecting connective subacuminate. — *Female flowers* and fruits congested, the inflorescence-branches usually 0.5–2 cm long, the flowers usually not separated by more than 2 mm; ovary green; stigma brownish. *Fruits* with spicy aroma, green turning purple-black. Endocarps straw-coloured, sublenticular, 2.5 by 2 by 1.3 mm, keeled.

Distr. Malesia: N. & Central Borneo, Celebes, Philippines (Luzon, Panay, Mindanao), New Guinea (incl. New Britain & Manus I.).

Ecol. In New Guinea usually *Nothofagus* dominated rain-forest, understorey in montane forest, 450–2850(–3300, on Mt Wilhelm) m. *Male fl.* June, July, Sept.; *ripe fr.* June–Aug.

Vern. New Guinea: *gwa*, Wagu, *jamarapara*, Kapaukoe, *kengapa*, Hagen, Wankl, *kogile gol*, Sinasina lang., Nimai dialect, *kokun*, *pohn*, *tipitangan*, Togoba, *kondomapi*, S. Highlands, Mt Ne, *maskinen*, Mendi, *moyok*, Washuk, *obilak*, Enga, *penge mange*, S. Highlands, SE. Mt Giluwe.

2. *Ascarina maheshwarii* SWAMY, Proc. Nat. Inst. Sc. India 19 (1953) 377, f. 3; CORNER, Phil. Trans. R. Soc. Lond. B 255 (1969) 576; A.C. SMITH, J. Arn. Arb. 57 (1976) 411.

Small to medium-sized, dioecious tree 3–15 m, with broad trunk 15–55 cm \varnothing ; rarely with thick buttresses to 1 m; bark pale grey to dark brown, smooth or fissured; blaze dull brown; wood soft, white or straw-coloured. *Leaves* elliptic to somewhat obovate, 6–14 by 3–8 cm, shortly acuminate at the apex, narrowly cuneate at the base, crenate or crenate-dentate, the tips of the crenations with brown to black thickenings (hydathodes), dark green and shiny; nerves 12–20 pairs; petiole 0.4–2 cm; stipules triangular-subulate, 0.5–1.5 mm long from a narrow sheath; leafless nodes with short to cylindrical sheaths 3–10 mm long bearing leaf vestiges about 1 mm long. *Inflorescences* green, terminal but often also borne in axils of upper leaves (up to 4 nodes below apex); branches 5–8, slender, (1–)2.5–3.5 cm, each unbranched or again branched, the flowers well spaced with internodes 2–8 mm; lower bracts of inflorescence similar to sheaths at leafless nodes, the upper longer, 0.5–1.5 mm long; bracteoles supporting the flowers deltoid, 0.5 mm long or almost obsolete. — *Male flowers* with 2 yellowish anthers 2–3 mm long. — *Female flowers* with cream ovary and unequally bilobed sessile stigma. *Fruits* drying yellow-brown but said to be black (WHITMORE), translucent green or greenish cream, ovoid, 1.2–2

mm long, exocarp thin and finely wrinkled (dry state); endocarp \pm discoid, straw-coloured, smooth.

Distr. Solomon Is.; in *Malesia*: Papua New Guinea (Milne Bay, Morima Range), incl. Manus & Bougainville Is.

Ecol. Primary rain-forest, also open forest and hillside forest, 450–750 m. *Male fl.* July, *fr.* June, Oct.

Note. Although SMITH (1976) speaks of this 'very distinct species' characterised particularly by having additional axillary inflorescences, slender long inflorescence branches with spaced flowers and smaller fruits with less wrinkled exocarp, examination of extensive material of *A. philippinensis* shows that the situation is not so simple. *Ascarina maheshwarii* is very uniform in the Solomon Is., even on different islands, but all the characters can be found in various specimens of *A. philippinensis* which is very variable over its wide range; small fruits are found for instance in RAU 158 (Onim) and VINAS & WIAKABU LAE 59447 but both have typical *philippinensis* foliage; long inflorescence branches occur in some material from the Cycloop Mts which have, however, larger more wrinkled fruits and foliage of *philippinensis*.

3. *Ascarina subsessilis* VERDCOURT, Kew Bull. 40 (1985) 213, f. 1.

Medium-sized, dioecious tree 15–24 m, 8–35 (–50) cm ϕ ; bark pale grey-brown to dark brown, fissured; wood straw-coloured or light brown. *Leaves* elliptic or oblong-elliptic, rarely narrowly obovate, 5–14 by 3–9 cm, rounded at the apex, narrowed, rounded or subcordate at the base, shallowly crenate, rather fleshy in life, drying thick and with minutely rugulose surface, the costa sometimes dividing the leaf somewhat asymmetrically, subsessile; nerves 10–15 pairs; petiole thick, c. 2 mm; stipules minute, c. 1 mm long; leafless nodes present with sheaths 2–6 mm long bearing lateral leaf-vestiges 0.8–1.5 mm long, rugulose in dry state. *Inflorescences* terminal, branched and occasionally a simple unbranched one from a lower node. *Male* 2 cm long, 3-branched at the base, the main branch with side branchlets c. 5 mm long; anthers c. 3 mm long. — *Female* 1.5–4 cm long with 3–5 main branches each with 5–7 rather thick branchlets 1.5–2.5 (–3) cm; lower bracts similar to the leaf-vestiges at leafless nodes, the upper again similar but with the lateral projections longer, lanceolate, longitudinally folded, 4.5 mm long; bracteoles supporting flowers deltoid, scarcely 1 mm long; female flowers not seen. *Fruits* greenish white (presumably becoming dark when ripe?), ovoid, \pm congested; exocarp strongly wrinkled in the dry state; endocarp c. 1 mm long (mature?), smooth.

— **Distr.** *Malesia*: Papua New Guinea (Morobe, Southern, Western & Eastern Highlands). Cf. VERDCOURT, l.c., map 1.

COURT, l.c., map 1.

Ecol. Montane rain-forest, partly secondary forest on limestone ridge, 1830–3200 m. *Male fl.* Aug., *fr.*, Nov., Jan., June–Sept.

Vern. New Guinea: *pom*, Hagen, *tomil*, Sinasina lang., Nimai dialect, *wabaliok*, *wabialak*, Enga, *wabaljok*, Enga-Kepilam, *masnene* Mendi.

4. *Ascarina diffusa* A.C. SMITH, J. Arn. Arb. 57 (1976) 415, f. 5–10; Fl. Vit. Nova 2 (1981) 99, f. 35a & b. — *A. lanceolata* (non HOOK. f.) *auct.*; SWAMY, Proc. Nat. Inst. Sc. India 19 (1953) 377, p.p.

Shrub to small or medium-sized tree, dioecious or monoecious, 4–15 (–25) m tall with open spreading crown; trunk 7–10 cm ϕ ; young stems reddish; bark light grey to brown, smooth; blaze red and wood white, soft. *Leaves* elliptic-lanceolate to lanceolate, 4–17 by 1.5–4.5 cm, distinctly acuminate at the apex, cuneate at the base, minutely to coarsely serrate, save near the base, thinly coriaceous; nerves 12–25 pairs; petioles slender, 0.5–2.7 cm; stipules 1–3 mm long on leaf sheaths 1–5 mm long; leafless nodes occur. *Inflorescences* green, yellowish or purple, many-flowered, lax, terminal and in the upper axils; main axis 3-branched, the central branch again 2–3-branched but some axillary inflorescences simple; individual branches slender, 3–12 cm long, the flowers closely placed, each subtended by 3 bracteoles scarcely 1 mm long; lower main bracts of inflorescence up to c. 1 cm long consisting of a sheath with lateral projections; upper bracts ovate-acuminate, 3 mm long. *Inflorescence* glomerules consisting basically of an abaxial male flower and adaxial female flower but more usually unisexual. — *Male flowers* with 1 stamen; anthers 2–4 mm long, scarcely 1 mm wide (reported purple in Fiji specimen), with a minute deltoid apical projection. — *Female flowers*: ovary green, ovoid, 1.5 mm long; stigma between translucent and white or purple, 0.8–1.3 mm wide. *Fruit* ellipsoid, 2–3 by 1.2–2.5 mm; exocarp thin and slightly wrinkled in dry state; endocarp rounded ellipsoid, \pm 1.5 by 1.2 mm, compressed, the margin keeled, surfaces warty-papillate.

Distr. Solomon Is., New Hebrides, Fiji, Samoa, Cook Is.; in *Malesia*: Papua New Guinea (New Britain: Mt Talawe; Bougainville).

Ecol. Rain-forest, cloud-forest with *Pandanus*, 900–1800 m. *Male fl.* Feb., Aug., *fr.* May.

Vern. New Britain: *pot*, Talasea.

Note. There is considerable difference between the foliage and inflorescence length of the single New Britain specimen seen and those from Bougainville (3 specimens), but bearing in mind the variation throughout its range this seems of no significance. FRODIN observed flower buds (young fruits?) red-violet whitish at tip and inflorescence purple but elsewhere the inflorescence is described as yellowish.

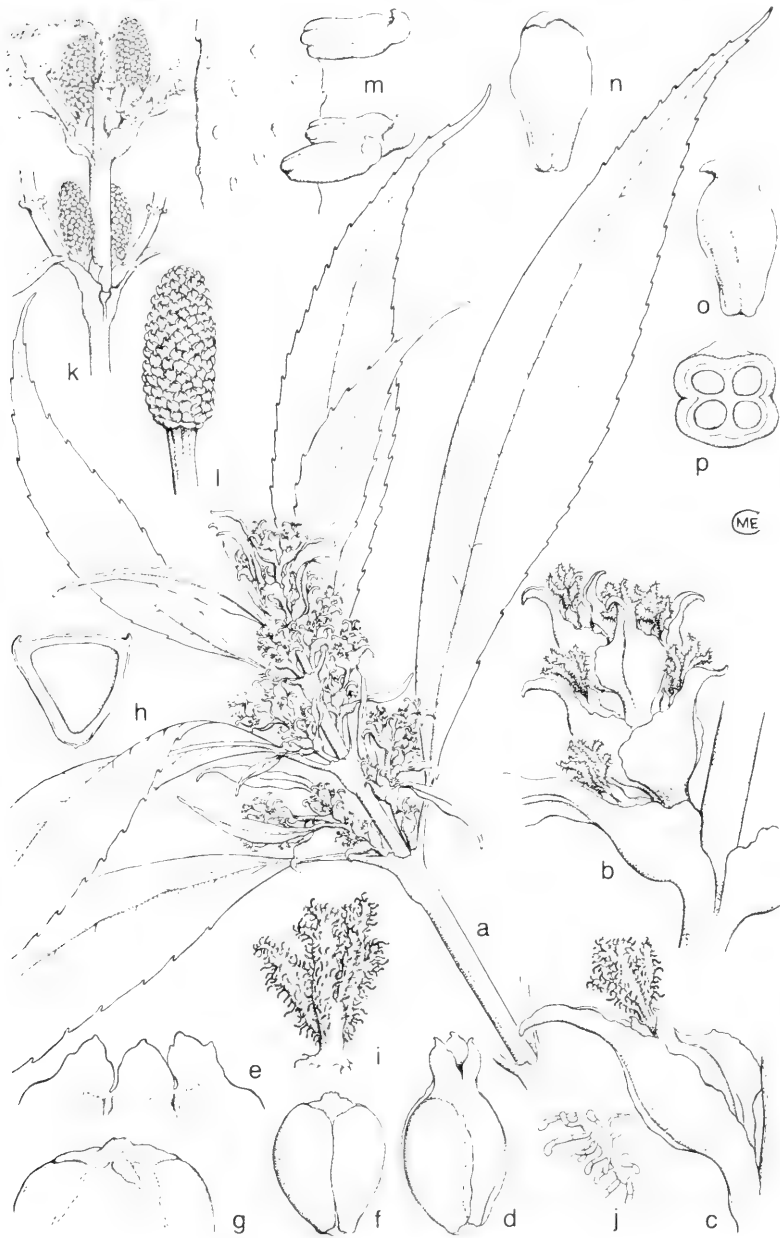


Fig. 7. *Hedyosmum orientale* MERR. & CHUN. *a.* Female flowering plant, $\times 2/3$, *b.* female inflorescence, $\times 4$, *c.* female flower and bract, $\times 6$, *d.* female flower, stigma removed, $\times 8$, *e.* perianth spread out, $\times 10$, *f.* ovary, $\times 10$, *g.* ovary opened to show ovule, $\times 16$, *h.* TS ovary, $\times 10$, *i.* stigma, $\times 10$, *j.* portion of stigma lobe to show multicellular hairs, $\times 24$, *k.* part of male plant, nat. size, *l.* young male flower, $\times 2$, *m.* portion of expanded male flower, $\times 8$, *n.* front view of anther, $\times 12$, *o.* side view of anther, $\times 12$, *p.* TS of anther, $\times 16$ (*a-j* S 16539, *k-p* BURTT 12775, spirit material).

4. HEDYOSMUM

SWARTZ, Prod. Veg. Ind. Occ. (1788) 84; CORDEMOY, Adansonia 3 (1863) 302; SOLMS-LAUB. in DC. Prod. 16 (1869) 479; BENTH. in B. & H. Gen. Pl. 3 (1880) 135; ENGLER in E. & P. Nat. Pfl. Fam. 3, 1 (1894) 13; SWAMY, J. Arn. Arb. 34 (1953) 402; ENDRESS, Bot. Jahrb. 91 (1971) 39; LEROY, Abstr. XIII Int. Bot. Congress (1981) 136; Taxon 32 (1983) 169; C. R. Ac. Sc. Paris 296 (1983) 747.

— Fig. 7.

Herbs, shrubs or trees, monoecious or dioecious; branches often jointed at the nodes, often exuding a gelatinous aromatic exudate when cut. *Leaves* decussate, mostly serrate, the serrations often tipped with glands (? hydathodes); petiolar sheath mostly with marginal subulate or pectinate stipules. *Inflorescences* axillary or terminal, sometimes united with the stem near their base; flowers truly unisexual; individual inflorescences unisexual but the compound inflorescences often with female flowers above and male flowers on lower branches. In some species the flowers are partly fused amongst themselves and with the axis. — *Male flowers* cone-like, solitary or paniculate, with involucre and very numerous bilocellate anthers, filaments absent or very short; locelli parallel opening lengthwise, at first 2-celled; connective shortly appendaged or subpeltate above the loculi. — *Female flowers* variously capitate or paniculate, distinctly bracteate; perianth-tube adnate to the ovary, limb very short, 3-toothed; style very short, stigmatose at apex or stigma sessile, rarely linear or clavate, often caducous; outer and inner integuments of ovary 3 cells thick. *Drupes* free, or united by the bracts into a dense mass, globose or ovoid, often 3-sided or 3-ribbed, sometimes crowned with persistent perianth lobes, the fleshy wall formed partly by the accrescent perianth; exocarp juicy; endocarp hard; seed coat unspecialised.

Distr. About 35 *spp.*, almost entirely in the New World from Mexico to Peru and Brazil and West Indies, a single species in SE. Asia, extending into *W. Malesia*.

Paly n. ERDTMAN (1952) described the pollen of *H. brasiliense* as 1-sulcate or 1-sulcooidate (?), sometimes provided with a number of thin branched and irregularly placed apertural areas, which in optical section can convey the impression of a polycolpoidate grain. According to SWAMY (1953) the grains tend to be larger than in other genera of the family up to 35 μ m and are generally polycolpate resembling *Chloranthus* but the furrows are often localised at a pole or other locus and the ends joined or reduction in number of the furrows resulting in aecolpate grains occurs in some species; the exine is finely reticulate-pitted. MULLER (1981) reported that pollen grains of this genus have been found in Upper Miocene deposits in Mexico, Guyana and Colombia and suspects DOYLE may have been correct in comparing irregularly aperturate forms from the Lower Cretaceous with this genus.

References: ERDTMAN, Pollen morphology and plant taxonomy (1952) 111–112; MULLER, Bot. Rev. 47 (1981) 9–12; SWAMY, J. Arn. Arb. 34 (1953) 392–393.

Floral morph. LEROY (1981, 1983) has suggested that what has usually been considered to be an inflorescence of unistaminate, naked, ebracteate, male flowers is in fact itself a strobiloid male flower bearing several hundred spirally arranged stamens, an extremely primitive structure which correlates with the 'Lower Cretaceous' type monosulcate pollen and adaptation to wind pollination. I have accepted this interpretation as being the more plausible.

Dr P. RUDALL of the Jodrell Laboratory (Kew) has cut sections of the axis of material collected by B.L. BURTT in Sarawak. It contains 8 bundles and only single bundles enter the stamens, which is not at variance

with the theory. ENDRESS' comments (1971) on the female flower have already been mentioned in the general section (see p. 125).

BURGER (1977) considered that both the female flower (the most complex in the family) and the male (the most reduced) were derived from simple flowers resembling those of *Chloranthus* and *Sarcandra*, an idea of course totally at variance with that of LEROY. The 3-lobed covering of the female flowers of *Hedyosmum* truly suggests reduction and fusion from an ancestor with a 3-parted perianth. In some species this tissue becomes succulent and white in fruit, an aril-like adaptation for dispersal by birds. It may have arisen by modification of 3 adnate staminodes and the dorsal and lateral positions of the ribs and alternation of the vascular bundles of the ribs with those of the ovary supports this idea.

References: BURGER, Bot. Rev. 43 (1977) 361; ENDRESS, Bot. Jahrb. 9 (1971) 39–60; LEROY, XIII Int. Bot. Congr. Abstracts (1981) 136; Taxon 32 (1983) 169–175; C. R. Ac. Sc. Paris 296 (1983) 747–752.

1. *Hedyosmum orientale* MERR. & CHUN, Sunyatsenia 5 (1940) 36, t. 5; WU KUO-FANG, Fl. Reipubl. Pop. Sin. 20 (1982) 95, f. 30. — *H. nutans* (non Sw.) MERR. Lingn. Sc. J. 5 (1927) 29. — *Hedyosmum* sp. STEEN. Bull. Jard. Bot. Btzg III, 13 (1933) 182.

Dioecious glabrous herb or subshrub, 1–2.5 m tall; stems long, often straggling at the base, brittle and juicy above, up to 2 cm ø, smelling like ginger-root; branches often drooping; upper internodes often condensed, particularly in young plants so that petiolar sheaths overlap. Leaves lanceolate to linear-oblong, 9–22 by 1.5–4 cm, thin, long acuminate at the apex, narrowly cuneate at the base, the margins rather closely serrate, the serrations apically thickened, more or less obtuse; lateral nerves 20–30 pairs, fine, ± raised; petioles 0.6–2(–3.5) cm, longer on one side, each pair joined to form a sheath 6–15 by 6–8 mm. — *Male flowers* few in panicles, the floral axes 2–4.3 cm, the stalks c. 1 cm; very young flowers cone-like, about 1 cm long with a basal oblique ring 6 mm wide of c. 13 acute or bifid bractlets; stamens about 300, anther locule 1.2 mm (2 mm *in vivo*) long, the connective appendage compressed, acute, 0.5–1 mm long, asymmetrically incurved. — *Female inflorescences* green, paniculate, c. 5 by 2 cm, the few branches 1–1.5 cm, ± few-flowered; bracts rounded ovate, c. 5–6 by 5 mm with a long caudate apex 3–6 mm long, c. 1 mm wide; sepals 3, triangular, 1–1.2 mm long and wide, entire, crenate or ± dentate. *Ovary* somewhat 3-angled, genuinely monocarpellate; stigma greenish with red tips, essentially lanceolate in outline, 2–2.2 mm long, irregularly lobulate, covered with several-celled hairs; tip of ovary with triangular impressed area with mammillate centre. *Fruit* ellipsoid, 3–4 mm long, ± 3-angled, crowned by the calyx.

Distr. S. China (Hainan; Kwangsi-Tonkin border; S. Vietnam: Kontum); in *Malesia*: Sumatra Westcoast Residency (Lubuk Sulasi; Laras Talang),

N. Bencoolen (Bt Daun), Borneo (West: Bt Tibang; Sarawak: Hose Mts, base of Bt Kajang, Bt Sarpan-dai; Bt Kenawang: Usun Apau), and Central Celebes (Palu Distr.: near Lake Lindu, G. Njilalaki, and west slope of Mt Poroka, Timbu). Fig. 8.

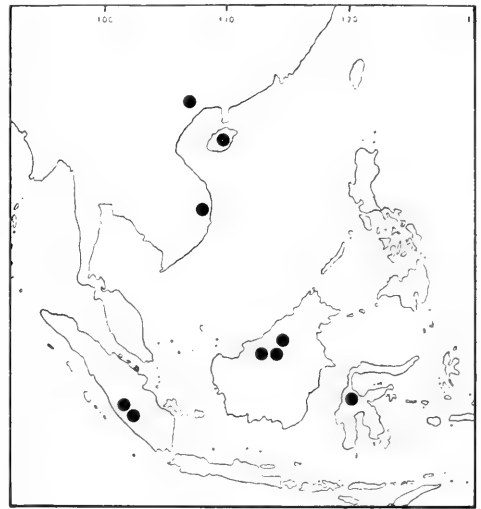


Fig. 8. Localities of *Hedyosmum orientale* MERR. & CHUN.

Ecol. Forest on dacite hillside, in ridge forest and foot of wet cliff, with conifers and *Fagaceae*, 1000–2365 m. *Fl.* March–April, *fr.* March–July.

Note. In the BM there is a HORSFIELD specimen of the genus, labelled *in sched.* *H. sumatranum*, which is the earliest collected specimen from the Old World.

SPHENOSTEMONACEAE (C.G.G.J. van Steenis, Leyden)

The taxonomic position and rank of the only genus *Sphenostemon* has a chequered history. In the course of time it has, under various names, been attributed to the *Aquifoliaceae* (by BAILLON, as *Sphenostemon*, 1875), to the *Icacinaceae* (as a species of *Phlebocalymna*, by F. VON MUELLER, 1875), to the *Guttiferae* (as *Nouhuysia*, by LAUTERBACH, 1912), and to the *Trimeniaceae* (by GIBBS, as *Idenburgia*, 1917).

BAILEY & SWAMY (1953) and BAILEY (1956) examined the anatomy and concluded that the genus could not belong to either *Guttiferae* or *Trimeniaceae* *cq.* *Monimiaceae*, but they gave no clear alternative. When I summarised the complete generic synonymy (1955), I found it likely to retain *Sphenostemon* in *Aquifoliaceae*.

Another opinion approached that of F. VON MUELLER, *viz.* that by INGLE & DADSWELL (1961) who suggested, on the strength of the wood anatomy, a likeness with *Platea* in the *Icacinaceae*, and possibly also an affinity to *Polyosma* (*Saxifragaceae*).

HUTCHINSON (1959) and AIRY SHAW (1972) stuck to the Monimiaceous affinity, and I must admit that there is a distinct resemblance, in androecium in particular, with *Trimenia*, but this is overruled by the anatomical and other differences. They felt possibly also strengthened by the fact that LOESENER (1942) had expelled *Sphenostemon* from the *Aquifoliaceae*, and had suggested affinity with *Theaceae* or *Ochnaceae*, or as representative of a separate family.

In a good overview BERNARDI (1964) concluded that *Sphenostemon* should remain in *Aquifoliaceae*. In this he is followed by CRONQUIST (1981).

A very thorough anatomical research of *Aquifoliaceae* led BAAS (1975) to the conclusion that *Sphenostemon* is anatomically allied to both *Aquifoliaceae* and *Icacinaceae*, probably more to the latter. In fact, in comparing the macromorphological characters it appears that all of them occur in *Icacinaceae*. He proposed that the genus should be accommodated in a family of its own, an idea already advanced by AIRY SHAW (1972), allied to both *Aquifoliaceae* and *Icacinaceae*; this view is also held by THORNE (1983). The removal of *Sphenostemon* from *Aquifoliaceae* is well sustained by the seed structure. The fruit was mostly defined as a drupe containing a pyrene. BAILEY (1956) showed that the sclerified tissue is, however, not derived from the endocarp and that the fleshy envelope of it is really the whole of the pericarp. He accepted the sclerified tissue as derived from the testa. I expressed my doubt about this interpretation to Dr. W.A. VAN HEEL (Leyden), who found that the sclerified tissue surrounding the seed is of chalazal nature and that the seed belongs to a type characterized by CORNER (1976) as pachychalazal, a peculiar feature occurring in a limited number of families, amongst them *Icacinaceae*, but not *Aquifoliaceae*. Although not too fond of split families, I feel this new observation gives additional strength to recognize *Sphenostemon* representing a family of its own.

DICKISON & BAAS (1977) noted a remarkable similarity in vegetative anatomy and some gross morphological features between *Sphenostemon* and *Paracryphiaceae*, a monotypic family from New Caledonia. This is compatible with the gradually accepted transfer of *Aquifoliaceae*, *Icacinaceae*, and *Sphenostemonaceae* from the heterogeneous order of the *Celastrales* to the *Theales*.

References: P. BAAS, *Blumea* 22 (1975) 311–407, especially 339–340; H.E. BAILLON, *Bull. Mens. Soc. Linn. Paris* no 7 (1875) 53; Adansonia 11 (1875) 307; I.W. BAILEY, *J. Arn. Arb.* 37 (1956) 360–365, 9 fig.; I.W. BAILEY & B.G.L. SWAMY, *J. Arn. Arb.* 34 (1953) 77–87, fig. 1–3, tab. 1–3; L. BERNARDI, *Candollea* 19 (1964) 199–205; E.J.H. CORNER, *The seeds of dicotyledons* (1976) 5–6; A. CRONQUIST, *Integrated system, etc.* (1981) 720; W.C. DICKISON & P. BAAS, *Blumea* 23 (1977) 417–438, especially 429–431; L.S. GIBBS, *Contrib. Flora & Phytogr. Arfak Mts* (1917) 136; J. HUTCHINSON, *Families of flowering plants*, ed. 2, 1 (1959) 139; *The genera of flowering plants* 1 (1964) 124; H.D. INGLE & H.E. DADSWELL, *The anatomy of the secondary xylem of SW. Pacific tree species and their taxonomy*, in mimeogr. 12 pp. pamphlet offered in a symposium of the 10th Pacif. Sci. Congr., Hawaii (1961) especially 5–7, table 1; C. LAUTERBACH, *Nova Guinea* 8 (1912) 844; TH. LOESENER, in *E. & P. Nat. Pfl. Fam.* ed. 2, 20b (1942) 36; F. VON MUELLER, *Fragmenta phytographiae Australiae* 9 (1875) 151; H.K. AIRY SHAW, *Kew Bull.* 27 (1972) 325–326; in Willis, *Dict.* ed. 8 (1973) 1087; C.G.G.J. VAN STEENIS, *Svensk Bot. Tidskr.* 49 (1955) 19–23; R.F. THORNE, *Nordic J. Bot.* 3 (1983) 103.

1. SPHENOSTEMON

BAILL. Bull. Mens. Soc. Linn. Paris *no* 7 (1875) 53; Adansonia 11 (1875) 307; STEEN. Svensk Bot. Tidskr. 49 (1955) 19. — *Nouhuysia* LAUT. Nova Guinea 8 (1912) 844; ENGLER in E. & P. Nat. Pfl. Fam. ed. 2, 21 (1925) 197; STEEN. Acta Bot. Neerl. 1 (1952) 94, f. 2; HATUS. Bot. Mag. Tokyo 65 (1952) 109. — *Idenburgia* GIBBS, Fl. Phyt. Arfak (1917) 136, f. 10, 11; GILG & SCHLTR, Bot. Jahrb. 58 (1923) 246, f. 2; PERKINS, Gatt. Monim. (1925) 23, f. 14. — **Fig. 1.**

Shrubs or small trees. *Leaves* simple coriaceous, exstipulate, almost entire to distinctly glandular-dentate, penninerved, scattered, subopposite to pseudo-whorled, articulate at base. *Racemes* terminal or axillary, bracteate at base, at most as long as the leaves. Floral bracts early caducous. *Flowers* bisexual, actinomorphic, the pedicel articulate at the base, all opening about simultaneously, white. *Sepals* 4, free, decussate, widely imbricate, mostly hooded, sometimes less convex, rounded, outer ones mostly \pm saccate at base, and with prominent midrib. *Petals* free, 0 or 4 similar to the sepals but of more fleshy texture, all caducous at anthesis. Disk 0. *Stamens* 1-seriate, 4, 6, or 8–13, \pm sessile, after being exposed appearing as a globular body, sometimes with a few (1–3) flimsy appressed persistent appendages added (? staminodes), at anthesis free and expanded; connective firm, brown outside; anther-cells introrse and lengthwise dehiscent. *Ovary* superior, sessile on a thickened receptacle, often with grooves from the pressure of the stamens in bud, \pm fusiform or cylindric, capped by a fleshy, cap-shaped, sessile, slightly bisected stigma; cells 2, each with one pendent, apically attached, apotrophic ovule. *Pseudo-drupe* broad-ellipsoid to subglobular, not rarely asymmetric, crowned by the stigma. *Pericarp* fleshy, finally black. *Seed(s)* 1 and having the shape of the fruit, or 2 and then plano-convex. *Embryo* small, surrounded by a thick, chalazal envelope, of which the outer layer is hard and bony and whether or not ruminant functioning as and superficially resembling the structure of a pyrene; this bony layer sometimes ridged outside and star-shaped in CS.

Distr. New Caledonia, N. Queensland and *East Malesia*: New Guinea (incl. also New Britain, New Ireland and adjacent isles), Moluccas (Ceram) and Central Celebes. Four species in New Caledonia, 1 in Queensland and 3 in New Guinea.

Ecol. Montane rain-forest.

Morph. The New Caledonian species differ from the others in having 4 petals; all of them have few stamens (4 or 6) and often subtire leaves. According to BAAS (1975) they are also distinct from the species of *ser. Apetalae* in their vegetative anatomy. As exposed in the introduction, the structure of the seed is different from that hitherto assumed as a pyrene with the bony tissue derived from the endocarp; or, as BAILEY (1956) assumed, from the testa. As a matter of fact the fleshy 'pericarp' is on its inside lined by an epidermis against the bony tissue. The bony tissue, continued inside by soft tissue, is again demarcated against the seed proper; the envelope of the seed is derived from the chalaza which, during development of the fruit, completely surrounds the seed. In *ser. Apetalae* the bony outer part of the pachychalaza extends ruminations in the soft part of it.

However, in the New Caledonian *S. pachycladus* of *ser. Sphenostemon*, the bony outer part of the pachychalaza is circular, without ruminations. Unfortunately I have not succeeded to obtain ripe fruit of the other three New Caledonian species to check the structure of their seed, although I found a slight indication of it in *S. oppositifolius* HÜRL.

TAXON. The differences found between the New Caledonian species and those from East Malesia and Queensland induce me to raise the series to the rank of section, as follows.

Section *Sphenostemon*

Ser. Sphenostemon; STEEN. Svensk Bot. Tidskr. 49 (1955) 21.

Petals 4. Stamens 4 or 6. Sclerified outer tissue of the pachychalaza in fruit circular, not ruminated. Leaves with a hypodermis and closed vascular system in midrib.

Distr. Four species in New Caledonia.

Section *Apetalae* (STEEN.) STEEN., *stat. nov.*

Ser. Apetalae STEEN. Svensk Bot. Tidskr. 49 (1955) 22.

Petals absent. Stamens 6 or 9–13. Sclerified outer tissue of the pachychalaza in mature fruit ruminated in its softer inner tissue. Leaves without a hypodermis and with a simple open vascular system. Anatomy different from species of *sect. Sphenostemon*.

Distr. North Queensland and East Malesia.

KEY TO THE SPECIES

1. Stamens (5–)6. Inflorescences short, 1–2 cm. Pedicels even in fruit only c. 1/2 cm. Leaves usually not conspicuously toothed to almost entire.
2. Racemes puberulous, few-flowered. Stigma grooved, cupular, appressed to fruit apex, 2–3 mm ϕ . Habit rather delicate, twigs thin. Leaves ovate- to obovate-lanceolate, acute-acuminate to caudate, 5–11 by 1 3/4–3 1/4 cm; petiole 4–7 mm **2. *S. arfakensis***
2. Racemes mostly glabrous. Stigma punctate in flower, flat and \pm elevated in fruit, hardly 3/4 to 1 mm wide, not cap-shaped and grooved. Habit not delicate, twigs rather sturdy. Leaves mostly oblanceolate, rather short- and mostly blunt-acuminate, 5–13 by 2 1/2–4 cm; petiole 10–20 mm **3. *S. lobosporus***
1. Stamens 8–13. Inflorescences 1 1/2–11 cm in fruit. Pedicels in flower 1/2–1 1/2 cm, in fruit up to 2 cm. Stigma sessile, grooved and cap-shaped, appressed to fruit apex, 2–3 mm ϕ . Leaves almost always conspicuously toothed **1. *S. papuanus***

1. *Sphenostemon papuanus* (LAUT.) STEEN. & ERDTMAN, Svensk Bot. Tidskr. 49 (1955) 22; v. ROYEN, Alpine Fl. New Guinea 3 (1982) 1252, f. 399. — *Nouhuysia papuana* LAUT. Nova Guinea 8 (1912) 844; STEEN. Acta Bot. Neerl. 1 (1952) 97, f. 2; HATUS. Bot. Mag. Tokyo 65 (1952) 110. — *Idenburgia novoguineensis* GIBBS, Fl. Phyt. Arfak (1917) 137, f. 10. — *Idenburgia pachyphylla* GILG & SCHLTR. Bot. Jahrb. 58 (1923) 246, f. 2 A–M. — *Idenburgia elaeocarpoides* GILG & SCHLTR. l.c. 247, f. 2 N–X. — *Idenburgia pauciflora* A.C. SMITH, J. Arn. Arb. 22 (1941) 234. — *Nouhuysia pauciflora* (A.C. SMITH) STEEN. Acta Bot. Neerl. 1 (1952) 97; HATUS. Bot. Mag. Tokyo 65 (1952) 109. — *Nouhuysia novoguineensis* (GIBBS) HATUS. Bot. Mag. Tokyo 65 (1952) 109. — *Nouhuysia pachyphylla* (GILG & SCHLTR) HATUS. l.c. — *Nouhuysia elaeocarpoides* (GILG & SCHLTR) HATUS. l.c. — *S. pauciflorum* (A.C. SMITH)

STEEN. & ERDTMAN, Svensk Bot. Tidskr. 49 (1955) 22. — **Fig. 1.**

Treelet or tree, (2–)5–25 m tall, 4–50 cm ϕ , glabrous or innovations and inflorescences short-hairy or with small brown scales; branchlets rather sturdy; blaze and wood mostly orange brown. Leaves pseudo-opposite to pseudo-verticillate (3–7 leaves), coriaceous, dentate, elliptic to lanceolate or oblanceolate to obovate, rounded to acuminate at apex, distinctly nerved and veined, venation above sometimes shallowly sulcate, underneath pale or whitish green *in vivo*, 2 1/2–19 by 1 1/2–7 cm; petiole 1/2–3 cm. Racemes terminal and axillary or on short shoots, 1 1/2–11 cm at base mostly bracteate; bracts 4–10 by 3–5 mm, ciliate. Flowers white. Pedicels 3–15 mm, in fruit up to 20 mm. *Sepals* convex to hooded, the outer \pm saccate at base, midrib elevated. *Petals* 0. *Stamens* 8–13, close together, thick, \pm

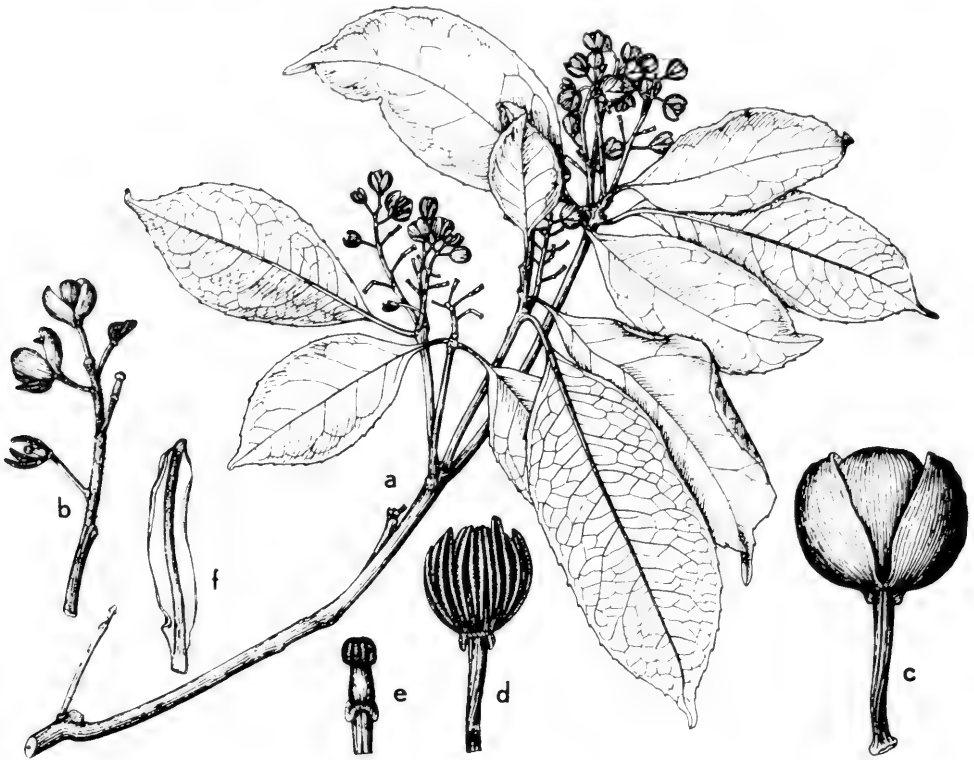


Fig. 1. *Sphenostemon papuanus* (LAUT.) STEEN. & ERDTMAN. *a.* Habit, $\times 1/2$, *b.* inflorescence, nat. size, *c.* ripe bud, *d.* flower during anthesis, *e.* pistillum, all $\times 3$, *f.* anther, dorsal side, $\times 5$ (RUTTEN 2240).

triangular in CS, the connective dark brown, occasionally with 1–3 flimsy appendages adhering to the stamen-globe, later the stamens spreading. *Ovary* fusiform, thick, 2 mm; stigma sessile, slightly bilobed, cap-shaped, appressed, both with impressions from the stamens. *Fruit* broad-ellipsoid or obovoid, rarely oblique, very rarely with a stipe-like base, $1\frac{1}{2}$ – $2\frac{1}{2}$ by $\frac{3}{4}$ – $1\frac{3}{4}$ cm, via red finally black. *Seeds* 1–2, broadly ellipsoid, (if 2) plano-convex, smooth or ribbed (lobed in CS); stigmatic cap 3–4 mm ϕ .

Distr. *Malesia*: Central Celebes, Moluccas (Ceram), and New Guinea (incl. Goodenough, Ferguson, New Britain and New Ireland Is.).

Ecol. A subsidiary small tree in primary mixed montane forest, or mossy forest, often associated with *Nothofagus*, *Quintinia*, *Elaeocarpus*, *Myrtaceae* and *Libocedrus*, also in old secondary forest, sometimes fire-induced; (500–)800–3000(–3300) m, rather common. *Fl.* June–Jan., *fr.* Jan.–Dec., not seldom *fl.* and *fr.* together; *c.* 130 collections.

Vern. Though no uses are mentioned the plant is

well known, carrying a large number of names in New Guinea: *bukhane*, Mt Ne, W. Highl., *kemenabubodereh*, *kin nababoderreh*, Chimbu: Masul, *keramura*, *wehnagenaja*, Mairi: Watabung, *kibamo*, Kutubu, W. Highl., *konge*, Wahgi: Minj, *kup*, Hagan: Togoba, *mandam*², Sila lang., *medaboh*, Mt Ambua, *mem*, Mendi, *meme*, Mendi, Tomba, *mem(i)*, Enga, *menseh*², Tanah Merah, *mime*, Merimanta, *mogoro*, *mokoro*, *morogl*, *mororo*, Kapauku, *omipa*, Asaro: Kefamo, *ounatrok*, Hindenburg Ra., Sepik, *patiba*, Hagen, Minj, *soka*, Naho lang. New Britain: *napun*, *newala*, Mt Talawe.

Notes. By the large increase of specimens available (in 1952 *c.* 24, now *c.* 130) the variability has shown up and *S. pauciflorum* cannot be upheld. The number of tangible differential characters used in the key in 1952 has also become more vague.

This variability extends to the indument; several specimens (8) carry small brown scales on the racemes and innovations, in 7 the racemes and innovations are hairy to puberulous, the hairs sometimes

mixed with scales, 5 specimens have more or less bulate leaves and are hairy, some 8 specimens have ridged seeds, 3 have both ridged seeds and some hairs. In 8 specimens I found 1, 2 or 3 flimsy appendages which adhere to the anther-globe. Formerly I assumed that they could represent reduced petals (4 true petals are found in the New Caledonian species) but as these appendages are not decussate and persist with the stamen whorl, I am now inclined to regard them as reduced stamens. These independent variations do not allow to distinguish further taxa.

2. *Sphenostemon arfakensis* (GIBBS) STEEN. & ERDTMAN, Svensk Bot. Tidskr. 49 (1955) 22. — *Idenburgia arfakensis* GIBBS, Fl. Phyt. Arfak (1917) 139, f. 11. — *Nouhuysia arfakensis* (GIBBS) STEEN. Acta Bot. Neerl. 1 (1952) 97; HATUS. Bot. Mag. Tokyo 65 (1952) 110.

Shrub or small tree, 5 m. Twigs rather delicate. Leaves lanceolate, to oblanceolate, distinctly acute-acuminate, rather obscurely toothed, to almost entire, tending to be opposite, not in pseudo-whorls, 5–11 by 1 3/4–3 1/4 cm; petiole thin, 4–7 mm. Racemes short, puberulous, few-flowered, c. 2–3 cm. Buds 5 mm. Sepals shallow-convex, not hooded. Stamens 6. Stigma grooved, cupular, appressed to the apex of the ovary, 2–3 mm ø. Fruit 10 by 7 mm.

Distr. *Malesia*: New Guinea (Arfak Mts), 2 collections.

Ecol. On open summit of Mt Kubré, c. 2700 m. Fl. Dec.

Notes. Though some dozen collections of *Sphenostemon* were made on the Arfak Mts, the only specimen known, besides the type (GIBBS 6003), is KOSTERMANS 2217, found near Angi Gita Lake at 1800 m.

By the stigma it resembles *S. papuanus* and differs from *S. lobosporus*, but the 6 stamens point the re-

verse way. By its delicate habit it differs from both.

3. *Sphenostemon lobosporus* (F.v.M.) L.S. SMITH, Proc. R. Soc. Queensl. 68 (1957) 43. — *Phleboclymna lobospora* F.v.M. Fragm. 9 (1875) 151.

Tree, 5–9 m high, c. 20 cm ø. Leaves elliptic, obovate, or oblanceolate, mostly almost entire, opposite or 3 or 4 in pseudo-whorls, marginal teeth usually few and faint, apex acuminate, 5–10 by 2–4 cm; petiole 1–1 1/2 cm. Racemes short, few-flowered, 1–2 cm, mostly glabrous. Pedicels 3–5 mm in fruit. Bracts 4 1/2–5 mm. Stamens (5–)6. Ovary slender, hardly ridged; stigma small knob-shaped. Fruit as in the other species, but crowned by a punctate stigma which is also in fruit non-appressed and hardly 1 mm ø.

Distr. N. Queensland (Cook & S. Kennedy Distr.); in *Malesia*: SE. New Guinea (Milne Bay Distr.: Simpson Ra.; Mt Dayman; W. Highl. Prov.: Jimi valley); 3 collections.

Ecol. Subsidiary tree in mixed, montane rainforest, 1200–1500 m (in Queensland 500–1150 m). Fl. Aug., fr. June, Aug.

Notes. Of the three specimens from Papua, one (SCHODDE 5550) has flowers and fruit which enabled to examine the stamens: one flower had 6 and another 5 + a staminode. This specimen agrees also in the inconspicuously dentate leaf margin. The other sheet (BRASS 23154) has only fruits, but the stigma is typical for *S. lobosporus*; however, it has distinctly dentate leaves and racemes up to 5 cm in fruit, which is atypical for *S. lobosporus*. The third specimen (For. Coll. Herb. Bulolo 8458) has hairy infructescences, the two others being glabrous, reducing differences with *S. arfakensis* to the stigma only!

In Queensland the species attains a height of 6–24 m and a stem diameter of 50 cm.

ELAEAGNACEAE (J.F. Veldkamp, Leyden)¹

This small family has a typical northern hemisphere range; it is absent from South America, extends in Eurasia only to the Mediterranean and in Southeast Asia to Malesia and NE. Queensland. There are 3 genera of which *Elaeagnus* occurs throughout the range (20–50 spp.), *Shepherdia* occurs only in North America (c. 3 spp.), and *Hippophaë* occurs throughout Eurasia (c. 3 spp.). The habitat is chiefly in steppes and along coasts, but in SE. & E. Asia, Malesia and N. Queensland *Elaeagnus* is found as a substage liana in the everwet rain-forest, showing no special preference for seasonal climates.

A characteristic feature is the universal occurrence of an often dense indument of scales and frequent occurrence of short-shoot thorns.

About the affinity three opinions prevail. BENTHAM & HOOKER *f.* (1880) placed the family near the *Thymelaeaceae* and this position in the *Thymelaeales* was still upheld by MELCHIOR (1964) and supported by RAO (1974). Most authors, e.g. RENDLE (1952) follow VON WETTSTEIN (1911), who accommodated the family in the *Myrtiflorae*. CRONQUIST (1981) included it in his *Rosidae*-order *Proteales*, but wondered whether this was not an artificial place. He also pointed out affinities to the *Thymelaeaceae* which he included in the *Rosidae*-order *Myrtales*, but remarked (*l.c.* 603) that "As a putative member of the *Myrtales*, the *Elaeagnaceae* would stand out like a sore thumb on anatomical as well as floral morphological grounds, but an evolutionary relationship via the *Thymelaeaceae* cannot be ruled out on the basis of present evidence. For the present it will do no harm to retain the *Proteaceae* and *Elaeagnaceae* in the same order. When more evidence is available it may become necessary to restore the order *Elaeagnales* and insert it in a position following the *Myrtales*."

The latter view was held by TAKHTAJAN (1969), who in 1980, however, placed the *Elaeagnales* with the *Elaeagnaceae* as its only family next to the *Rhamnales* in the *Celastranae*, which super-order he placed next to the *Proteanae*, which include the *Proteales*. The *Thymelaeaceae* he put in the *Malvnae* and the *Myrtales* in the *Myrtanae*. Such a relationship with the *Rhamnales* was also proposed by HUTCHINSON (1926, 1959, 1973) and THORNE (1983).

DAHLGREN (1975) recognizes *Elaeagnales* but does not make a decision about affinity other than those mentioned.

Pollen structure does not lead to an unequivocal opinion about affinity (LEINS, 1967).

Fossil pollen considered to represent *Elaeagnus* dates from the Oligocene (MULLER, 1981).

References: BENTHAM & HOOKER, *Genera Plantarum* 3 (1880) 203; CRONQUIST, *An integrated system etc.* (1981) 603, 606; DAHLGREN, *Bot. Notis.* 128 (1975) 119–147, especially p. 134; HUTCHINSON, *Fam. Fl. Plants* 1 (1926) 245; ed. 2 (1959) 342; ed. 3 (1973) 424; LEINS, *Graa Palynol.* 7 (1967) 390–399; MELCHIOR, *Syllabus der Pflanzenfamilien* ed. 12, 2 (1964) 320; MULLER, *Bot. Review* 47 (1981) 87; V.S. RAO, *J. Ind. Bot. Soc.* 53 (1974) 156–161; RENDLE, *Classification Fl. Pl.* 2 (1952) 372; TAKHTAJAN, *Flowering Plants* (1969) 229; *Bot. Review* 46 (1980) 225–359; THORNE, *Nordic J. Bot.* 3 (1983) 105; VON WETTSTEIN, *Handb. Syst. Bot.* (1911) 669.

ELAEAGNUS

TOURN. *ex* LINNÉ, *Sp. Pl.* 1 (1753) 121; *Gen. Pl.* ed. 5 (1754) 57; SCHLECHTEND. in DC. *Prod.* 14, 2 (1857) 606; MAXIM. *Mél. Bot.* 7 (1870) 559; SERV. *Bull. Herb. Boiss.* II, 8 (1908) 381; *Beih. Bot. Centralbl.* 25, 2 (1909) 1 ('Mon. Eléagn.); 'T HART & VELDK. *Blumea* 26 (1980) 393. — **Fig. 1, 2.**

Shrublets, shrubs, rarely trees, or (in Mal.) woody climbers, branching monopodially, with stellate scales; older parts usually armed with thorns derived from short-shoots. *Leaves* spiral, simple, entire. *Flowers* usually bisexual, in axillary

(1) Introduction by the General Editor.

inflorescences, or pseudo-terminal, cymose, actinomorphic, 4(–5–8)-merous, often scented. Bracteoles absent. *Perianth* simple; tube \pm cylindric, quadrangular, constricted above the ovary, then inflated ('limb'); perianth-segments (in Mal.) 4, valvate. *Disk* usually inconspicuous, intra-staminal. *Stamens* (in Mal.) 4, alternitepalous, inserted in the throat; anthers dorso-versatile, introrse with 2 longitudinal slits. *Ovary* superior, 1-locular; style 1; stigma unilateral, elongated. *Ovule* 1, basal, anatropous. *Fruit* a drupe, enclosed in the enlarged fleshy perianth-tube, usually with 8 longitudinal ribs; exocarp fleshy, mesocarp bony or leathery, endocarp woolly pubescent inside (in Mal.). *Seed* 1; endosperm absent (in Mal.), rarely scanty; embryo straight.

Distr. About 20–?45 *spp.* over the northern hemisphere through tropical Southeast Asia and Malesia to N. Queensland; in *Malesia* 2 *spp.*

Ecol. Primary and secondary rain-forest, without a preference for dry regions or a seasonal climate, from the lowland up to c. 2100 m.

Taxon. SERVETTAZ (1908, 1909) made an excessively detailed classification of the genus, splitting up the classical species into a number of others, subspecies, and varieties. This work is often more an impediment than a help in the study of the taxonomy of *Elaeagnus*. The delimitating characters used by SERVETTAZ have usually been drawn from too few specimens, and his use of the shape, size, colour, and consistency of the leaves and the colour of the flowers has proven to be of little value, as these generally are individual features of the specimens, but not of taxa. He had a very confusing way of citing his material. In Malesia he distinguished 6 *spp.* and a number of infraspecific taxa. Later authors have recognized only one, joining all into *E. latifolia*, or two, *E. conferta* and *E. triflora*. I agree with the latter opinion, although it may be remarked that the differences between these two species and *E. latifolia* are only slight. The differences seem to be clear-cut when flowers are available, but vegetative material is impossible to identify. None of SERVETTAZ' infraspecific taxa could be maintained.

The Malesian species of *Elaeagnus* belong to *sect. Elaeagnus (sect. Sempervirentes, nom. inval., SERVETTAZ, 1909)*.

Uses. The Malesian species are usually misidentified as *E. latifolia* and the possibly different uses of the species can therefore not be disentangled. HEYNE (Nutt. Pl. 1927, 1152) mentioned the presence of more or less edible, sourish fruits (*areuj susumunding* or *areuj dudurenan*) and of extremely acid ones (*areuj dudurenan*). This may be due either to the presence of various races of one or both species, or it may be of specific significance.

Field notes. Flowers fragrant, white, cream, pale yellow, whitish and brown dotted, pale inside. Fruit pinkish to glossy red or pale brown, when ripe juicy and sweet to very acid. Measurements of the fruit are taken from dry specimens in the herbarium; they are much smaller than in the living state; collectors hardly ever measure them in the field.

KEY TO THE SPECIES

The term 'limb' means the inflated, quadrangular part of the perianth between the constriction of the tube and the perianth segments.

1. Flowers tubulose-campanulate; limb 4.5–7 mm long. Style straight, sparsely scaly at base only. Perianth segments (2–)3–4 by 2–3.25 mm. Continental Southeast Asia **E. latifolia**
1. Flowers trumpet-shaped; limb 1–4 mm long. Style at apex hook-shaped.
2. Limb 3.5–4 mm long, sometimes thickened at base. Style densely stellate-scaly, especially near the base. Perianth segments (1–)1.5–2 by 1.5–2 mm **1. E. conferta**
2. Limb 1–3(–4) mm long. Style glabrous, rarely with some stellate scales at base. Perianth segments 2–4(–5) by 2–3 mm **2. E. triflora**

1. *Elaeagnus conferta* ROXB. [Hort. Beng. (1814) 11, *nomen*] Fl. Ind. 1 (1820) 460; ed. Carey 1 (1832) 440; A. RICH. Mém. Soc. Linn. Paris 1 (1823) 385, 405; SCHLECHTEND. in DC. Prod. 14, 2 (1857) 612; Linnaea 30 (1859–60) 367; *ibid.* 32 (1863) 301; KURZ. For. Fl. Burma 2 (1877) 331; SERV. Bull. Herb. Boiss. II, 8 (1908) 389, *incl. ssp. javanica* (BL.) SERV. *et ssp. dendroidea* (SCHLECHTEND.) SERV.; Beih. Bot. Centralbl. 25, 2 (1909) 89, 91, f. 5.1, *incl. ssp. euconferta* SERV., *var. calcuttensis* SERV., ? *var. malaccensis* SERV., *var. septentrionalis* SERV., *et var. silhetensis* SERV.; LECOMTE, Fl. Gén. I.-C. 5 (1915) 181; BACK. & BAKH. f. Fl. Java 2 (1965) 86; 'T HART & VELDK. Blumea 26 (1980) 396, with full synonymy and discussion. — *E. javanica* BL. Bijdr. (1826) 638; SCHLECHTEND. in DC. Prod. 14, 2 (1857) 614; Linnaea 30 (1859–60) 377; BACK. in Heyne, Nutt. Pl. (1927) 1152. — *E. arborea* ROXB. *var. dendroidea* SCHLECHTEND. in DC. Prod. 14, 2 (1857) 612. — *E. gaudichaudiana* SCHLECHTEND. l.c. 612; Linnaea 30 (1859–60) 370; SERV. Bull. Herb. Boiss. II, 8 (1908) 390; Beih. Bot. Centralbl. 25, 2 (1909) 103; MERR. Trans. Am. Phil. Soc. II, 24 (1935) 279. — *E. dendroidea* SCHLECHTEND. Linnaea 30 (1859–60) 362. — **Fig. 1a–d.**

Evergreen woody climber, occasionally erect, up to 12 m, innovations silvery scaly. Axillary buds 2, collateral. *Leaf* elliptic to obovate, 6.5–11(–12.5) by 3.5–5(–5.5) cm, base obtuse, sometimes rounded, apex acute to acuminate; nerves 5–8 pairs, loop-shaped; blade above with a slightly immersed midrib, below brown to silvery scaly. Petiole 8–11 mm. *In-florescences* 1–5(or 6)-flowered fascicles; bracts up to 2 mm long. Pedicels 1–2(–3) mm. *Flowers* trumpet-shaped, 6–8 mm long; tube 1.5–2(–2.5) by c. 1 mm ϕ ; limb 3.5–4 by 1.5–2.5(–3) mm ϕ , about twice as long as the perianth-segments; these triangular to broadly ovate, (1–)1.5–2 by 1.5–2 mm, inside with stellate scales. *Filaments* filiform, broadly winged towards the base, 0.5–1.5 mm long; anthers (0.5–)1(–1.5) mm long. *Ovary* 1–2 by c. 0.5 mm ϕ , glabrous. *Style* terminally hook-shaped, exerted for (0.5–)1–2 mm above the throat, densely stellate-scaly; stigma 1–2 mm long. *Fruit* ellipsoid, up to 35 by 15 mm ϕ (spirit); seed and peanut-shaped embryo to 20 by 7 mm ϕ ; radicle up to 3 mm long.

Distr. Continental SE. Asia: Nepal, India (Assam), through Bangladesh, Burma (Pegu), Indochina, Andamans & Nicobars, to *Malesia*: Malaya (P. Penang, Perak), Sumatra, throughout Java (Bogor, Priangan, Semarang, Madiun, Surabaya).

Ecol. Rather rarely recorded, in bamboo and mixed deciduous, and in evergreen forests; 400–2000 m.

Vern. Java: *areuj dudurenan*, *a. susumunding*, *kakaduan*, *meligi*, *S.*

NOTES. 'T HART & VELDKAMP (1980) at length dis-

cussed the typification and location of the types of the complicated synonymy. *Elaeagnus gaudichaudiana* has been included, the type of which came from Indochina. MERRILL (1935) suggested in his evaluation of LOUREIRO's species (*Flora Cochinchinensis*, 1790) its conspecificity with *Octarillum fruticosum* LOUR. (*E. fruticosa* (LOUR.) CHEVAL.), which he claimed to be the only representative of *Elaeagnus* in Indochina. As the LOUREIRO specimen in the BM is sterile, and SERVETTAZ distinguished 3 species in Indochina, this conclusion cannot be accepted. It may be further noted that LOUREIRO described his species with solitary flowers, while *E. conferta* usually has several-flowered fascicles which are only occasionally reduced to one flower. *Elaeagnus conferta* is thus the oldest name available of certain application.

Field notes. Usually climbing, rarely a tree, with reddish brown bole. Flowers yellowish, pendulous. Fruit orange-red when ripe, juicy, delicious but acid, up to 4 by 2 cm ϕ .

2. *Elaeagnus triflora* ROXB. [Hort. Beng. (1814) 11, *nomen*] Fl. Ind. 1 (1820) 459; ed. Carey 1 (1832) 439; SERV. Bull. Herb. Boiss. II, 8 (1908) 390, *incl. ssp. rigida* SERV., *ssp. obsoleta* SERV., *ssp. polymorpha* SERV. *et ssp. tetragonia* SERV.; Beih. Bot. Centralbl. 25, 2 (1909) 104, *incl. var. brevipes* SERV. *et var. longipes* SERV.; BACK. & BAKH. f. Fl. Java 2 (1965) 86; 'T HART & VELDK. Blumea 26 (1980) 398. — *E. latifolia* (non L.) A. RICH. Mém. Soc. Linn. Paris 1 (1823) 386, 404; MOR. Syst. Verz. (1846) 70; MIQ. Pl. Jungh. 2 (1852) 173, *incl. forms*; ZOLL. Syst. Verz. 2 (1854) 117; SCHLECHTEND. in DC. Prod. 14, 2 (1857) 610, *p.p.*, *incl. var. triflora* SCHLECHTEND.; Linnaea 30 (1859–60) 347; KURZ, Nat. Tijd. N. I. 27 (1864) 172; BENTH. Fl. Austr. 6 (1873) 39; HOOK. f. Fl. Br. India 5 (1886) 202, *p.p.*; FORB. & HEMS. J. Linn. Soc. Bot. Lond. 26 (1894) 403, *p.p.*; GILG in E. & P. Nat. Pfl. Fam. III, 6a (1894) 251, *p.p.*; GAMBLE, J. As. Soc. Beng. 75, ii (1912) 267; KOORD. Exk. Fl. Java 2 (1912) 658; RIDL. J. Fed. Mal. St. Mus. 8 (1917) 81; MERR. Sp. Blanc. (1918) 279; RENDLE, J. Bot. 63 (1925) Suppl. 90, *p.p.*?; C.T. WHITE, Contr. Arn. Arb. 4 (1933) 75; VON MALM in Fedde, Rep. 34 (1934) 282. — *E. ferruginea* A. RICH. Mém. Soc. Linn. Paris 1 (1823) 387, 404; MIQ. Pl. Jungh. 2 (1852) 173; SCHLECHTEND. in DC. Prod. 14, 2 (1857) 610; Linnaea 30 (1859–60) 350; *ibid.* 32 (1863) 303; SERV. Bull. Herb. Boiss. II, 8 (1908) 390, *incl. ssp. sumatrana* SERV.; Beih. Bot. Centralbl. 25, 2 (1909) 110, *incl. var. richardia* SERV. *et var. atrovirens* SERV. — *E. philippinensis* PERROTTET, Mém. Soc. Linn. Paris 3 (1824) 114; MERR. Sp. Blanc. (1918) 279; En. Philip. 3 (1923) 134; QUIS. Medic. Pl. Philip. (1951) 638; LIU & LAI, Quart. J. Taiwan Mus. 33 (1980) 247. — *E. rigida* BL. Bijdr. (1826) 639; MIQ. Pl. Jungh. 2 (1852) 173; SCHLECHTEND. in DC. Prod. 14, 2 (1857)

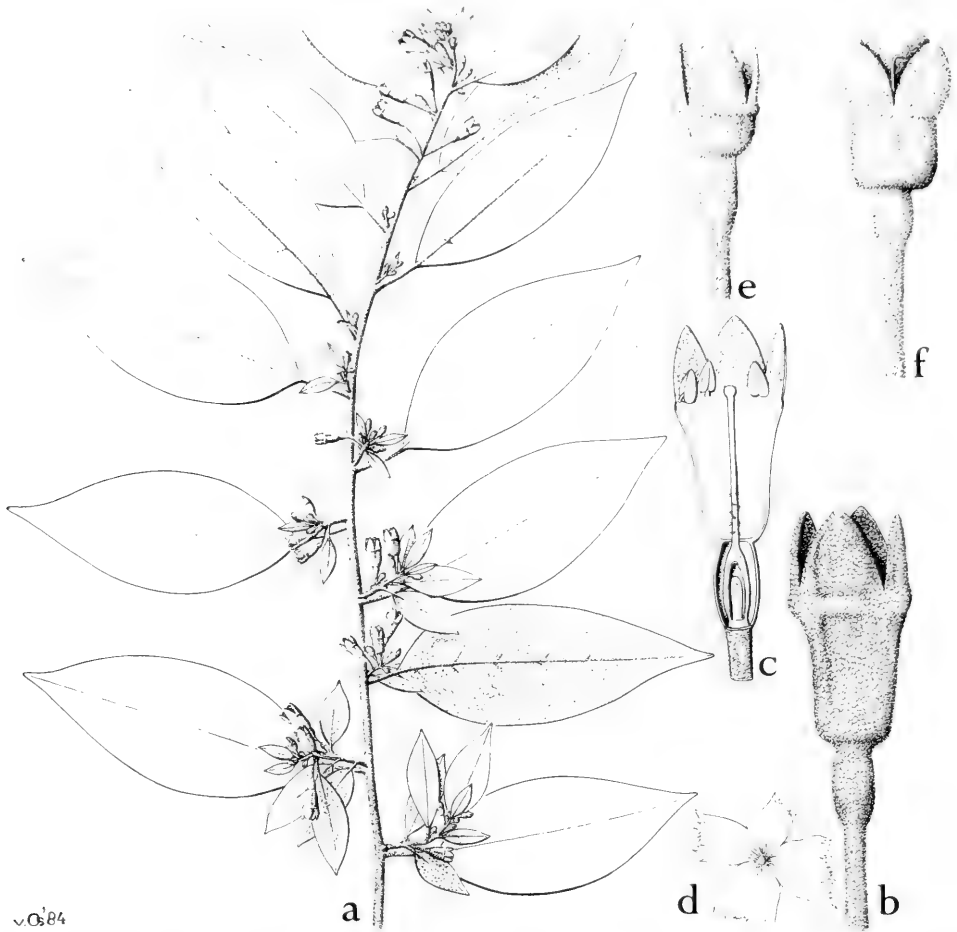


Fig. 1. *Elaeagnus conferta* ROXB. a. Habit, $\times 1/2$, b, c. flowers, $\times 3$, d. scale, $\times 25$. — *E. triflora* ROXB. var. *brevilimbata* 'T HART. e. Flower, $\times 3$. — *E. triflora* ROXB. var. *triflora*. f. Flower, $\times 3$ (a–d ARENS 34, e HOOGLAND 4537, f LÖRZING 8523).

614; Linnaea 30 (1859–60) 376. — *E. angustifolia* (non L.) BLANCO, Fl. Filip. 1 (1837) 74; ed. 2 (1845) 53; ed. 3, 1 (1877) 100. — *E. perrottetii* SCHLECHTEND. in DC. Prod. 14, 2 (1857) 613, *nom. superfl.*; MIQ. Fl. Ind. Bat. 1, 1 (1858) 981. — *E. cumingii* SCHLECHTEND. in DC. Prod. 14, 2 (1857) 613; SERV. Bull. Herb. Boiss. II, 8 (1908) 391, *incl. ssp. perrottetii* SERV. *et ssp. philippinensis* SERV. — *E. rostrata* SERV. Bull. Herb. Boiss. II, 8 (1908) 392; Beih. Bot. Centralbl. 25, 2 (1909) 113, f. 5: 40–42. — *E. zollingeri* SERV. Bull. Herb. Boiss. II, 8 (1908) 392; Beih. Bot. Centralbl. 25, 2 (1909) 112, f. 5: 36–39. — Fig. 1e, f.

KEY TO THE VARIETIES

1. Limb 2–3(–4) mm long, subequal to 1.5 times as long as the segments. Style glabrous or rarely with some stellate scales at base **a. var. triflora**
1. Limb 1–1.5 mm long, about half as long as the perianth segments. Style glabrous
b. var. brevilimbata

a. var. triflora — Fig. 1f.

Evergreen woody climber, occasionally shrubby, up to 10 m high, innovations silvery scaly. Axillary

buds 2, collateral. *Leaf* elliptic to oblong, 1.5–10(–12) by (0.3–)1–4(–6) cm, base obtuse, sometimes rounded, apex acuminate, sometimes acute; nerves 5–8 pairs, loop-shaped; blade above with a slightly immersed midrib, below brown to silvery scaly. *Petiole* (4–)5–6(–7) mm. *Inflorescences* 1–3(–8)-flowered fascicles; bracts up to 2 mm long. *Pedicels* 2–5(–7) mm, elongated in fruit to 8 mm. *Flowers* trumpet-shaped, 6–9 mm long; tube 1.5–2.5 by c. 1 mm ϕ ; limb 2–3(–4) by (1.5–)

2–2.5(–3) mm ϕ , slightly shorter than to 1.5 times as long as the perianth segments; these broadly ovate, (2–)2.5–4(–5) by 2–3 mm, inside sometimes with stellate scales. *Filaments* filiform to cone-shaped, 0.3–1 mm long; anthers (0.5–)1(–1.5) mm long. *Ovary* 1–2 by 0.5(–1) mm ϕ , glabrous. *Style* filiform, terminally hook-shaped, exerted for (0.5–)1–2 mm above the throat, glabrous, rarely with a few scattered stellate scales at base; stigma 1–2 mm long. *Fruit* ellipsoid, up to 4 by 2 cm (in spirit), seed and peanut-like embryo up to 17 by 6 mm; radicle up to 3 mm long.

Distr. N. Queensland, throughout *Malesia*, incl. also New Britain. Also in Botel Tobago, SE. of Taiwan. Not in New South Wales.

It cannot be ruled out that this species occurs in continental Asia as well under some other name. Although not all names have been checked for that area, so far none were discovered which should have been included here.

Ecol. Primary rain-forest, swamp forest, secondary scrub with *Gleichenia*, sometimes gregarious, from the lowland up to 1800 m.

Uses. The ripe fruit is given to children suffering from amoebic dysentery (SULIT, 1934, cited by QUISUMBING, 1951, *sub E. philippinensis*). CHOPRA (1933, *ex QUISUMBING, l.c.*) stated that the flowers are astringent and cardiac.

Vern. Sumatra: *hail-hail*, Toba-Batak, *kail-kail*, Karo-Batak. Java: (*areuj* or *daun*) *dudurènan*, *empos*, *kakduan*, *kitjepot*, *leutik*, S. *berbikuda*, *godong wadang*, *ketadak*, Md. Bali: *kelintju*. Philippines: *bantap*, Sul., *banekan*, Bon., *kopapei*, *padias*, Ig., *lagot*, Buk., *malaimus*, P. Bis.

Note. Field note. Shrub or woody climber. Flowers strongly scented.

b. var. *brevilimbata* 'T HART, *Blumea* 26 (1980) 400 (*'brevilimbatus*?). — *E. triflora* ROXB. *ssp. tetragonia* (non SERV.): MERR. & PERRY, *J. Arn. Arb.* 22 (1941) 267. — **Fig. 1c.**

Leaf with (5–)6–11 pairs of nerves; *petiole* (2–)3–4(–5) mm long. *Inflorescences* 1–4 (or 5)-flowered fascicles. *Flowers* 4–7.5 mm long; tube 1.5–2 by c. 1 mm ϕ ; limb 1–1.5 by 1.5–2 mm ϕ , \pm half as long as the perianth segments; these broadly ovate, 2–3 by (1.5–)2(–2.5) mm, stellate-scaly inside. *Fruit* 15–17 mm long. *Seed* up to 12 by 4.5 mm; embryo up to 9 mm long.

Distr. N. Queensland and in *Malesia*: throughout New Guinea.

Ecol. Primary rain-forest, *Castanopsis*-forest, swampy secondary forest; (0–)450–1600(–2125) m alt.

Note. Field notes. Climber or scrambling shrub, to 30 m high. Flowers grey green, white, yellow, very fragrant. Fruit red, fleshy.

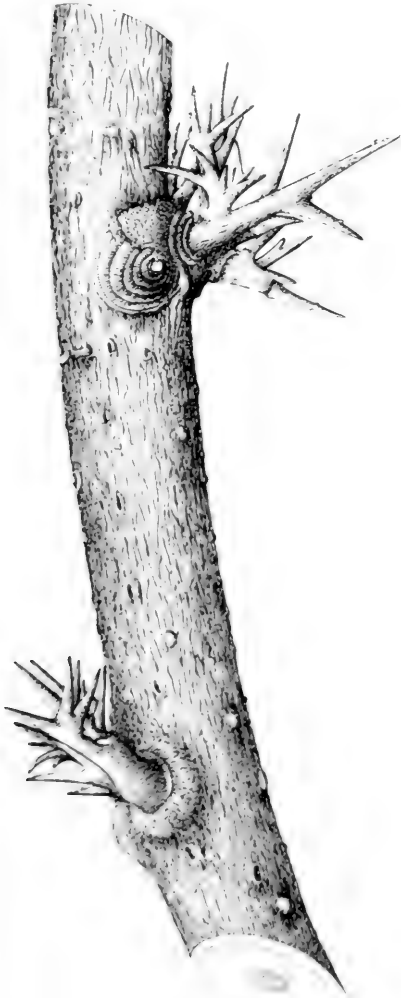


Fig. 2. Stem thorns on the stem of an *Elaeagnus liane* (West Java, Tjibodas; VAN STEENIS 11162), $\times 1/2$.

Uncertain

Elaeagnus conferta ROXB. var. ***palescens*** SERV.
Beih. Bot. Centralbl. 25, 2 (1909) 96. — This is based
on KORTHALS *s.n.* from Sumatra (in L), but its identity
remains uncertain as the specimens are sterile.

Dioecious woody or sometimes herbaceous climbers, rarely erect shrubs or trees (*Cocculus sp.* in Mal.); tubers sometimes present (*Stephania spp.*); sometimes producing exudate or rarely latex (*Fibraurea*; *Tinomiscium*). Wood often with concentric rings or arcs of vascular bundles separated radially by interfascicular rays, or vascular bundles in one ring; wood sometimes yellow. Young shoots often tendrilliform. Young stems usually drying longitudinally striate. Stipules absent. *Leaves* spiral, simple (rarely trifoliolate *extra*-Mal.), often palmatinerved at base and sometimes peltate, or penninerved, margin usually entire, sometimes broadly crenate (rarely dentate *extra*-Mal.), sometimes deeply 3–5-lobed; petiole often swollen at base, sometimes also at apex, sometimes leaving a raised discoid scar on the stem. *Inflorescences* axillary or on defoliate branches or cauliflorous; solitary or fasciculate, various in form, often cymes, thyrses or pseudoracemes, branching of cymes rarely umbelliform (*Stephania spp.*), flowers rarely in a disciform capitulum (*Stephania spp.*); female usually fewer-flowered than male, female rarely with accrescent bracts (*Cissampelos spp.*). *Flowers* small, usually green, yellow or white, actinomorphic or female sometimes zygomorphic. *Sepals* usually in 1–2(–4) whorls of 3, or 1 whorl of 4, the outer whorl(s) smallest, imbricate but the innermost whorl sometimes valvate and sometimes \pm connate, sepals rarely spirally arranged (*Hypserpa*); in female sometimes reduced to 1 or 2. *Petals* mostly 3–6 in 1 or 2 whorls or 0, free or sometimes \pm connate, usually smaller than the sepals, rarely larger (*Sarcopetalum*), the lateral edges or lobes often inflexed and sometimes clasping the opposite stamen, often glandular within; in female sometimes reduced to 1 or 2. *Stamens* mostly 3 or 6, sometimes 9 or up to *c.* 40, often free and opposite a petal, or variously connate, sometimes forming a peltate synandrium, connective sometimes adaxially or abaxially thickened, rarely terminally prolonged (*Macrococculus*); anthers introrse to extrorse with dehiscence longitudinal to transverse. Staminodes sometimes present in female, usually subulate. *Carpels* free, usually 3 or 6, sometimes 1 or to 12 (to *c.* 30 in *extra*-Mal. *Tiliacora*), sometimes borne on a short gynophore; style terminal when present; stigma often sessile, reflexed and lobed or divided. Pistillodes 0 in male. *Ovules* 2 reducing to 1 in development, attached ventrally. *Fruits* of 1–6 (–10) drupes sometimes borne on an enlarged \pm globose, discoid or columnar carpophore which is rarely shortly branched (*Anamirta*, *Tiliacora*). *Drupes* sometimes narrowed at base into a stipe, style-scar terminal, ventral or close to base; exocarp membranous to coriaceous, mesocarp fleshy; endocarp usually bony, rarely papyraceous to crustaceous (*Pycnarrhena spp.*), rugose, tuberculate, spiny, ridged or variously ornamented on at least the dorsal surface, sometimes smooth or surface fibrous,

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usually with a condyle, *i.e.* a ventral sometimes hollow intrusion into the seed-cavity around which the seed is curved, or a ventral groove, cavity or chamber; the condyle when hollow often 2-chambered and with 2 lateral or ventral apertures, or condyle septiform or lamelliform, then sometimes centrally perforate. *Seed* often horseshoe-shaped or subannular, sometimes straight and \pm broadly ellipsoidal or deeply cup-shaped; endosperm present or absent, sometimes ruminate. *Embryo* usually either elongate and with semiterete or flattened contiguous cotyledons or flat and very thin with divaricate foliaceous cotyledons, sometimes broadly ellipsoidal with thick contiguous cotyledons, rarely cotyledons much folded (*Arcangelisia*); radicle very small.

Distribution. The family is almost entirely tropical, the exceptions being *Menispermum*, a northern temperate genus with 2 disjunct species in North America and Northern Asia, and a few species of *Cocculus* which extend into North America and temperate Asia.

There are 73 genera in the family and of these 30 occur in Asia, 30 in Africa, 22 in America and 10 in Australia to the Pacific. Of the 25 Malesian genera 20 occur in continental Asia, and 6 occur in Africa of which 2 (*Cissampelos* and *Cocculus*) are also in America. Of the Malesian genera 9 are shared with Australia and of these 6 extend into Asia; *Legnephora* is limited to Central and East Malesia, *Carronia* and *Sarcopetalum* occur in New Guinea. Only 2 of the Malesian genera are endemic, *Chlaenandra* and *Macrococculus*, both in New Guinea.

Fossils. As can be expected from a widely distributed, pantropical family with no special means of dispersal and belonging to assumed primitive ancestry, early fossils are extant. The most certainly well-identified taxa are from the fruit which is characteristic and date from the Eocene. I assume they will be later located in the Upper Cretaceous. Leaf fossils have been described from the Lower Cretaceous to the Oligocene, but these records must be regarded with caution since the leaf morphology of *Menispermaceae* occurs in many other families.

Fossilized endocarps assigned to or allied to modern Southeast Asian genera of *Menispermaceae* have been found in the Early Eocene (Ypresian) London Clay Flora and other Lower Tertiary floras of Southern England. Species of *Tinospora* were described by REID & CHANDLER (1933) and CHANDLER (1961, 1962). A species of *Diploclisia* appears in CHANDLER (1961: 161–162, t. 16/14–17), a *Parabaena* in CHANDLER (1964) and a *Tinomiscium* in CHANDLER (1961: 149–150, f. 17, t. 15/18–21). *Daviscarpum* which resembles *Limacia* in its larger lateral condylar cavities is described in CHANDLER (1978: 20, t. 3/6–8) together with *Atriaecarpum* on p. 21, t. 4/4–10, which resembles *Tinosporeae*; another fossil genus of the latter affinity is *Microtinomiscium* in REID & CHANDLER (1933: 164, t. 4/5–6).

R.A. SCOTT (1956) has discussed the fossil endocarps of *Tinosporeae* found in the Eocene Clarno formation in Oregon, U.S.A. These differ from the living representatives in having very thick walls containing lacunae. SCOTT suggested that the endocarps of modern *Parabaena*, especially the complex *P. megalocarpa*, can be derived from the fossil *Chandlera* by reduction of the outer endocarp wall, and similarly modern *Tinospora* and *Odontocarya* (tropical America) endocarps can be derived from the fossil *Odontocaryioides* by reduction.

Leaf fossils identified with modern Malesian genera, especially *Cocculus* and *Cissampelos*, are known from the Lower Cretaceous to the Oligocene. Many of the records are listed in THANKA-MONI (1984) and among these are *Anamirta* in Alaska (Mid Eocene) and ?*Arcangelisia* in Washington, U.S.A. (Mid Eocene).

Fossil pollen seems not to have been recorded, according to MULLER (1981).

References: CHANDLER, Flora Pipe Clay series Dorset (1962) 61–62, t. 8/4–10; Lower Tertiary Flora Southern England I (1961) 154, t. 32/40; *ibid.* 4 (1964) 112, t. 2/17–19; *ibid.* 5 (1978) 20, t. 3/6–8; MULLER, Fossil pollen records of extant Angiosperms; Bot. Rev. 47 (1981) 141; REID

& CHANDLER, London Clay Flora (1933) 165–167, t. 4/7–12; SCOTT, Evolution 10 (1956) 74–81; THANIKAIMONI, Trav. Sect. Sc. Techn. Inst. Français Pondichéry 18 (1984) 129–132.

Ecology. Mostly climbing in lowland to montane forest, often where the canopy is interrupted, e.g. along river-banks, margins of forest or in clearings. *Cocculus orbiculatus* mostly occurs near the sea-shore in Malesia. It has been demonstrated in Thailand by H. BÄNZIGER (1982) that various *Menispermaceae*, but especially *Tinospora*, form an important link in the biological chain which leads to extensive damage to certain fruit crops, especially longan (*Dimocarpus longan*) and citrus, including mandarin. The damage is caused principally by the noctuid moth *Othreis ful-lonia*, whose larvae feed mainly on leaves of *Tinospora*, or on other *Menispermaceae* when *Tinospora* is not available. The species of *Tinospora* involved are typical components of secondary vegetation where forest has been destroyed or disturbed. Destruction of forest in Thailand thus encourages the spread of *Tinospora* which in turn promotes the increase of the moth which damages the fruit crops.

Pollination. Since the plants are dioecious and often grow very remote from one another, the problem arises as to how pollination is effected. According to BÄNZIGER's observations (pers. comm.) in Thailand, the pollinators of *Menispermaceae* are small *Diptera* and *Hymenoptera* and possibly also small *Coleoptera* and *Lepidoptera*. These insects are undoubtedly attracted by the scent of the flowers. Nectar is produced apparently by the petals which are often very small, nectary-like and glandular. In the case of *Anamirta cocculus*, which bears flowers in great profusion, the scent can be detected by man at a distance of 50 m. The leaves of at least some species, e.g. *Cyclea barbata* and *Stephania japonica*, produce a fragrance which becomes evident when they are kept in a closed container. It is therefore possible that the leaves may also play a rôle in attracting insects.

Altitude. In Malesia *Menispermaceae* is a typical lowland family, most species ascending to the hills below 1000 m altitude. Still one third of the species ascends above that altitude, 27 in all. Among those 4 are found as high as 1200 m, 1 up to 1300 m, 1 to 1400 m, 3 to 1500 m, 4 to 1600 m, 3 to 1700 m, 5 to 1800 m, 4 to 2000 m, 1 to 2100 m, and one is even found at 2800 m altitude. Except for 5 of the 27, these ranges extend continuously from the lowland or lower hills up to submontane altitude, e.g. *Stephania capitata* which ranges from the lowland to 2000 m. The 5 species which do not occur in the lowlands are: *Albertisia megacarpa*, 1500–1600 m, *Cyclea kinabaluensis*, 1700–2800 m (Mt Kinabalu), *Legnephora acuta*, 1750 m, *Pycnarrhena tumefacta*, 1200–2000 m (Mt Kinabalu), and *Stephania montana*, 1300–2700 m. The number of montane to lower-subalpine species is thus very small.

Seasonal climate. The great majority of species are bound to the everwet vegetation types or are indifferent to climatic conditions. Only three are not and occur exclusively in regions subject to a seasonal climate. They are: *Anamirta cocculus*, which shows a distinct preference for a seasonal climate and is therefore absent from the everwet Sunda shelf belt (Malaya, Borneo, West Java, Philippines, and only once collected in N. Sumatra). The second species is *Sarcopetalum harveyanum*, an Australian species also recorded from SW. New Guinea. The third is *Tinospora subcordata*, collected in Timor, the Tenimbar Is. and S. New Guinea (Merauke eastwards to Tarara).

Soils. Under the ecology of the species the soils are mentioned on which specimens were collected, according to the field notes. There seems often no distinct preference, e.g. for *Pycnarrhena tumefacta* (in E. Borneo) is mentioned: loam and limestone; sandy; lime and sandstone.

Only a few species show preference, e.g. for limestone and calcareous rocks: *Cocculus trilobus*, *Anamirta cocculus* (in E. Java), *Tinospora trilobata*, *T. merrilliana*, *T. dissitiflora* (coral shores), *T. glabra* (also on the sandy beach, probably calcareous), *T. baenzigeri* (Christmas I.), *Tinomicium petiolare* (Java).

Dispersal. Positive records on dispersal are almost absent, obviously due to lack of observations and botanists interested in this matter. BECCARI noted that fruits of *Macrococculus pomiferus* and *Chlaenandra ovata* are eaten by cassowaries. RIDLEY (1930) mentioned that the orange-yellow

drupes of *Fibraurea tinctoria* (= *F. chloroleuca*) are transported by civet-cats and birds and that the drupes of *Limacia oblonga* (= *L. velutina*) are dispersed by civet-cats. According to Dr. M. LEIGHTON (personal comm.) fruits of *Arcangelisia flava* and *Coscinium fenestratum* are eaten and dispersed by orang-utans, gibbons and macaques.

Also man may have in recent time contributed to dispersal on intention, knowing the medicinal properties of species. Thus it is here suggested that drupes of *Tinospora crispa* and *T. baenzigeri* may have been introduced by Singapore migrant workers in Christmas I. (Indian Ocean) working for the phosphate mines.

References: BÄNZIGER, Mitt. Schweiz. Entom. Ges. 55 (1982) 213–240; RIDLEY, Dispersal of plants (1930).

Morphology. Tuberos roots. Many menisperms produce thickened roots or tubers but unfortunately these are scarcely known. In field work they should be given attention.

Habit. An exception to the general climbing habit of the family is *Cocculus laurifolius*, which is an erect shrub or small tree.

Stems. The young stems when dry are often longitudinally ridged, the ridges corresponding to the vascular rays. The bark on old stems is sometimes characteristic for certain genera or species: in *Tinospora* it is usually parchment-like, becoming detached; in *Fibraurea* it becomes pale buff-coloured, contrasting with the blackish petioles. The stems often bear prominent cup-like thickenings from which the petioles arise.

White latex exudes from the cut stems of *Fibraurea* and *Tinomiscium* and it has been reported by RIDLEY in *Cocculus orbiculatus*.

The wood is yellow, owing to berberine, in *Arcangelisia*, *Coscinium*, and *Fibraurea*.

Leaves. The petiole is often swollen and geniculate at the base and sometimes swollen at the apex. The swollen regions have the function of turning the lamina to face the maximum light, an important need when the plant is climbing its way through dense levels in the forest canopy. The anatomical nature of these structures was investigated by CZAPEK (1909), RUDOLPH (1909), SPERLICH (1910).

The leaves are always clearly peltate in *Stephania*; they are peltate or not in *Cissampelos*, *Coscinium*, *Cyclea*, *Diploclisia*, and *Sarcopetalum*; in *Haematocarpus* they can be slightly peltate or not peltate; in the other genera they are not peltate (in *Mal. spp.*).

The nervation is usually tripli- or more nerved to palmatinerved at the base, but in *Albertisia*, *Carronia*, *Macrococculus* and *Pycnarrhena* the leaves are mostly penninerved but sometimes the lowermost nerves are crowded at the base.

Domatia occur in *Tinospora spp.* (pockets of glandular patches) and in *Arcangelisia* (hollow with margin of the aperture hairy) and *Anamirta* (hairy patches).

Inflorescences. The basic unit in the family is a cyme, as in *Cissampelos* and *Pericampylus*. The cymes are reduced and fascicled in *Albertisia*, *Macrococculus* and *Pycnarrhena*; they are often racemously arranged in a pseudopanicule, *i.e.* a thyrses, and when the cymes are reduced to a single flower a pseudoraceme results as in *Pachygone*, *Sarcopetalum*, *Tiliacora*, *Tinomiscium* and *Tinospora spp.* In *Coscinium* the cymes are condensed to dense heads of flowers racemously arranged. The cymes are umbelliform in *Stephania spp.* and these are sometimes racemously arranged; in *Stephania capitata* and *S. dictyoneura* the cyme is condensed to a disciform capitulum with the flowers sessile on a fleshy discoid base.

The inflorescences are often axillary, but sometimes in the axils of fallen leaves; in *Diploclisia* (*Mal. spp.*) and *Macrococculus* they arise only from old, leafless stems. In some species, *e.g.* *Stephania spp.*, the position can vary from axillary to ramiflorous.

Flowers. The flowers although small show considerable variety. They are generally composed of trimerous whorls with one or more whorls of each organ. Evolutionary trends of a similar nature involving fusion and reduction are seen in the sepals, petals and stamens. The sepals of the innermost whorl are valvate in *Carronia*, *Limacia* and *Tiliacora* but connate in a thick, fleshy tube in *Albertisia*. The single whorl of sepals in *Cyclea* can be free or connate. The usually minute pet-

als are often glandular and appear to function as nectaries. With their lateral edges often incurved, sometimes clasping the opposite stamens, they form small pockets which apparently hold nectar. The petals are connate in *Cissampelos*, free or connate in *Cyclea*, but absent in *Anamirta*, *Arcangelisia*, *Coscinium*, and *Fibraurea*, rarely absent in *Pycnarrhena*. *Sarcopetalum* is unusual in the family in having petals larger than the sepals. Asymmetrical female flowers with the sepals and petals reduced to 1 or 2 occur in *Cissampelos* and some *Stephania* spp. The carpels which are always free, are reduced to 1 in *Cissampelos*, *Cyclea* and *Stephania*.

The androecium displays considerable diversity in the family, both in the form of the stamens and the degree of fusion. The stamens are free in about half the genera, while the filaments are connate to varying degrees in the rest. In *Coscinium*, only the inner 3 stamens are connate while in *Macrococculus* it is the outer ring of 6 which are slightly joined at the base. The stamens are completely fused into a peltate synandrium in *Cissampelos*, *Cyclea*, *Parabaena* and *Stephania*. Dehiscence of the anthers varies from vertical to oblique to horizontal, but at the same time the apical part of the stamen may be curved over. In *Tinomiscium* the small anthers are sometimes immersed in the thick connective. In *Fibraurea* the prominent collar below the anther may represent a petal fused to the filament.

Drupes. The fruits provide some of the most useful characters for generic classification in the family. The fruit consists of 1 or more drupes depending on the number of carpels. Curvature of the drupes is frequently evident; it is caused by the greater enlargement during development of the dorsal side compared with the ventral side. This process can result in the apparent bending over on the ventral side of the apex towards the base, bringing the style close to the base. This process produces a horseshoe-shaped endocarp and seed in the *Menispermeae*. The curvature can also be lateral with the lateral edges curving round towards the ventral side. Curvature in both directions results in a hollow boat-shaped or cup-shaped endocarp (e.g. most *Coscinieae* and *Tinosporeae*). Either type of curvature results in a ventral intrusion into the endocarp: this ventral part of the endocarp which intrudes into the seed-cavity or forms a ventral cavity is known as the condyle, which in its various forms provides useful characters to distinguish genera.

Curvature of the pericarp and endocarp (with seed) can occur independently, for example in *Albertisia* where the style-scar is close to the base of the drupe, indicating curvature, the endocarp and seed remain straight. On the other hand, in *Chlaenandra* where the style-scar is terminal, the endocarp and seed are deeply cup-shaped and curved around a deeply intrusive, clavate condyle.

The curvature in growth of the drupes of many genera is probably a device allowing a number of free carpels to enlarge considerably in development while remaining attached to the very small receptacle. Another means to the same end is provided by the development in many genera of a carpophore which separates the drupes of one flower. At anthesis the tiny carpels may sit on an insignificant gynophore which as the carpels develop enlargens into the carpophore. In many genera this may be no more than a subglobose lump from which the drupes diverge. In *Macrococculus* the carpophore is discoid with up to 10 drupes radiating from the margin, while in *Tiliacora* and *Anamirta* it develops a short branch below each drupe. Sometimes the base of the drupe itself is narrowed into a stipe as in *Haematocarpus*, *Macrococculus* and *Tinomiscium*. In *Stephania capitata* some dozens of minute sessile female flowers are closely packed on a discoid inflorescence, and as each drupe develops it becomes elevated on a long stalk, which is probably a carpophore.

Endocarp. The form of the endocarp, its degree of curvature, if any, and the nature of the condyle provide important generic characters. The endocarp is frequently ornamented or sculpted, especially on the convex dorsal surface, with a great variety of projections or patterns which are often useful in delimiting species, if not genera.

In the horseshoe-shaped to subannular endocarps of the *Menispermeae*, lateral dome-shaped extensions over both sides of the central septum produce a 2-chambered condyle in *Hypserpa* and *Limacia*. This process is partially developed in some *Cocculus* spp., while loss of the central septum leads to a 1-chambered condyle in *Cyclea*. The 2 lateral chambers just mentioned correspond

to the 2 chambers or channels in the ventrally deeply intrusive condyles of *Anamirta*, *Coscinium* and *Chlaenandra*, where lateral curvature of the seed-cavity has been carried much further. A similar structure but in a much less developed form is seen in some *Tinosporeae* where the ventral concavity is sometimes divided longitudinally into 2 by a median ridge.

Seed. The large straight ellipsoidal seed without endosperm and with large thick cotyledons is presumably the primitive state and is exemplified by *Albertisia*, *Macrococculus* and *Pycnarrhena* (all *Tiliacoreae*). The more derived seeds are imbedded in copious endosperm; they are curved and narrow with elongate collateral cotyledons as in most *Menispermeae*, or they have very thin foliaceous divaricate cotyledons as in *Tinosporeae* and *Coscinieae* (part).

The primitive seed-types seen in *Pycnarrhena* associated with a straight drupe having the style-scar terminal and usually a very thin crustaceous endocarp suggests that the drupe of *Pycnarrhena* is the earliest type extant in the family. *Pycnarrhena* also has a primitive leaf-type in the family, the nervation being pinnate and not 3- or more-nerved at the base.

References: CZAPEK, Ber. Deut. Bot. Ges. 27 (1909) 404–407; RUDOLPH, l.c. 411–421; SPERLICH, *ibid.* 28 (1910) 57–59; Untersuchungen an Blattgelenken. I. Reihe (1910).

Pollen morphology. The pollen is small (rarely exceeding 20 μm on polar axis). Spheroidal to prolate in shape; single, isopolar; tricolporate, tricolpate, occasionally triporate and, more rarely, apparently inaperturate. The ornamentation ranges from perforate to coarsely reticulate, sometimes the muri are granular-papillose or transversely ridged (segmented). There is a well-developed columellate sexine approximately twice as thick as the nexine. In transmission electron microscopy differential staining shows there is a distinct foot layer and endexine present.

Pollen morphology does not delimit tribal boundaries but is useful in distinguishing genera, groups of genera and, sometimes, species. The triporate pollen of *Stephania* has a coarsely reticulate tectum with sparsely distributed coarse granules in the lumina; there is a distinct endopore. The pollen of *Coscinium* is also triporate but the endoapertures are indistinct and the reticulum has small, dense granules in the lumina. *Cissampelos* and *Cyclea* have angulaperturate, obovate-spheroidal, tricolporate pollen. The apertures are covered by a smooth operculum.

The apertures of *Tiliacora* are very obscure or absent. *Tiliacora triandra* can be separated easily from the other species by its granular-papillose muri. *Macrococculus* has distinctive rugulate ornamentation.

Some species of *Tinospora* have distinct aperture margins which fuse on the poles. This pollen type has a coarsely reticulate tectum and lolongate (*i.e.* elongated in the plane of the polar axis) endoapertures. *Tinomisium* and *Fibraurea* are the only other Malesian genera for which lolongate endoapertures have been recorded.

The genera *Albertisia*, *Carronia*, *Aspidocarya*, *Chlaenandra* and *Parabaena* are tricolpate. More or less spheroidal or broadly lolongate (*i.e.* elongated in the plane of the equatorial axis) endoapertures of varying size are present in the other genera of the region. These genera have perforate to reticulate ornamentation and are not always easy to distinguish.

References: FERGUSON, Pollen morphology of the tribe *Triclisieae* of the *Menispermaceae* in relation to its taxonomy: Kew Bull. 30 (1975) 49–75; Pollen morphology of the tribe *Coscinieae* of the *Menispermaceae* in relation to its taxonomy: Kew Bull. 32 (1978) 339–346; HARLEY, Pollen morphology and taxonomy of the tribe *Fibraureae* (*Menispermaceae*): Kew Bull. 40 (1985) 553–565; HARLEY & FERGUSON, Pollen morphology and taxonomy of the tribe *Menispermeae* (*Menispermaceae*): Kew Bull. 37 (1982) 353–366; THANIKAIMONI, Morphologie des pollens des *Ménispermacées*: Trav. Sect. Sc. Techn. Inst. Français Pondichéry 5 (4) (1968) 1–56. — I.K. FERGUSON (Kew).

Cytology. The cytology of the *Menispermaceae* is relatively little-known and chromosome counts have been made in only a few species in seven of the 25 known Malesian genera, *viz.* *Tiliacora*, *Tinospora*, *Anamirta*, *Cocculus*, *Cissampelos*, *Cyclea* and *Stephania*. The chromosomes of these genera, and in fact of the entire family, are very small with the diploid numbers $2n = 24$ or 26 being the most frequent and $2n = 22$ being less common (THANIKAIMONI, 1984). Polyploidy

is relatively rare, with the tetraploid numbers $2n = 48$ being recorded in *Cyclea peltata* by MATHEW (1958) and $2n = 50$ in *Cocculus orbiculatus* (= *C. trilobus*) by NAKAJIMA (1937), the latter being wrongly quoted as $2n = 52$ by THANIKAIMONI.

Interestingly, in male plants of *Cocculus orbiculatus* a single heteromorphic bivalent was observed at meiosis by NAKAJIMA. This report is doubly significant, firstly because sex chromosome heteromorphy is generally uncommon, even in the dioecious plants among which it should be expected to occur universally, secondly and more importantly because only a single heteromorphic chromosome pair was observed by NAKAJIMA, indicating that considerable structural changes must have occurred in the chromosomes of this species since it first arose as an allotetraploid, probably from an original hybridization between $2n = 24$ and $2n = 26$ plants.

Chromosome number and morphology can sometimes provide information on the closeness of relationship of genera or even of families, but because true chromosome homology cannot be confirmed between members of different families due to their widespread genetic incompatibility it is difficult and often unreliable to propose inter-family relationships simply on the basis of similarities of chromosome shape, size and number. Nevertheless, RAVEN (1975) has used this information to indicate a chromosomal affinity between the *Menispermaceae* and the taxonomically related *Lardizabalaceae*, in which diploid chromosome numbers of $2n = 28, 30$ and 32 are common. The *Berberidaceae*, another family in the *Ranunculales* which is classified near to the *Menispermaceae*, appears from a gross chromosomal standpoint to be related less closely to the *Menispermaceae* than the *Lardizabalaceae*, having $2n = 12, 16$ and 28 as the most common chromosome numbers (FEDOROV, 1969).

The suggestion by FORMAN (see below) that *Sabia* (*Sabiaceae*) is a near ally of the *Menispermaceae* finds some support from information available on its chromosome numbers, since SUGIURA (1936) found $2n = 24$ small chromosomes in *S. japonica*.

References: FEDOROV, Chromosome numbers of flowering plants (1969) (in Russian); MATHEW, Proc. Indian Acad. Sc. B 47 (1958) 274–286; NAKAJIMA, Cytologia, Fujii Jub. Vol. (1937) 282–292; RAVEN, Ann. Missouri Bot. Gard. 62 (1975) 724–764; SUGIURA, Cytologia 7 (1936) 544–595; THANIKAIMONI, Trav. Sect. Sc. Techn. Inst. Français Pondichéry 18 (1984) 95. — P.E. BRANDHAM (Kew).

Affinities. There is general agreement that the *Menispermaceae* belong in the order *Ranunculales* (= *Berberidales*) close to the *Lardizabalaceae* and *Berberidaceae*. This view is followed in the recent classifications of families by TAKHTAJAN (1980), CRONQUIST (1981), DAHLGREN (1983) and THORNE (1983). The *Menispermaceae* share with both *Lardizabalaceae* and *Berberidaceae* small, mostly 3-merous flowers with stamens often 6 and opposite the often nectariform petals. The *Menispermaceae* share with the *Lardizabalaceae* a mostly twining woody climbing habit, unisexual flowers, carpels distinct and often 3 or more; shared with *Berberidaceae* is the presence of benzyl-isoquinoline alkaloids (including berberine) and aporphine alkaloids.

Another probable relative of *Menispermaceae* is *Sabia* Colebr., as originally suggested by BLUME (1851) when he first described *Sabiaceae*, then monogeneric. *Sabia* is a genus of climbing shrubs with curved drupes containing sculpted endocarps. The flowers which are bisexual and pentamerous (unlike *Menispermaceae*) are remarkable in having the stamens, petals and sepals all opposite one another. This arrangement can easily be derived from the doubly trimerous, *i.e.* hexamerous flowers, which often occur in the *Menispermaceae* and in which, owing to the alternating trimerous whorls of sepals, petals and stamens these organs are all opposite one another. MIERS while working on *Menispermaceae* placed *Sabia* between that family and *Lardizabalaceae* (see LINDLEY, 1853). HOOKER *f.* & THOMSON (1855) considered the genus intermediate between *Schizandraceae* and *Menispermaceae*. The subsequent, and probably mistaken, inclusion of *Meliosma* and *Ophiocaryon* in *Sabiaceae* led later authors to place *Sabiaceae* in the *Sapindales*, but in his recent system of family classification CRONQUIST (1981) tentatively placed *Sabiaceae* in the *Ranunculales* near *Menispermaceae*.

References: BLUME, Mus. Bot. Lugd. Bat. 1 (1851) 369; CRONQUIST, An integrated system of

classification of flowering plants (1981) 140; DAHLGREN, *Nordic J. Bot.* 3 (1983) 143; HOOKER f. & THOMSON, *Flora Indica* (1855) 208; LINDLEY, *Vegetable Kingdom* ed. 3 (1855) 467a–467b; TAKHTAJAN, *Bot. Review* 46 (1980) 261; THORNE, *Nordic J. Bot.* 3 (1983) 85–117.

TAXONOMY. In his excellent monograph DIELS (1910) divided the family into 8 tribes, which are not completely separable. In his key to the tribes DIELS was obliged to key out 2 genera and part of another separately, and furthermore some of his distinctions between tribes do not hold. Of the 8 tribes, 5 occur in Malesia, but 2 of these, *Fibraureeae* and *Tinosporeae* should probably be combined, as suggested by BARNEBY (1972). Previously BARNEBY and KRUKOFF accepted DIEL'S tribes in their work on American genera as did TROUPIN in his monograph of African *Menispermaceae* (1962). Although I do not consider these tribes to be altogether satisfactory, for convenience I retained them in my series of papers on the family (1956 *seq.*). There is a clear need for a complete review of the generic classification and delimitation in the family from a multidisciplinary approach, but until such reassessment is carried out on a world-wide basis it does not seem worthwhile making partial and possibly temporary adjustments to the existing tribal framework, although provisionally I include *Fibraureeae* under *Tinosporeae*. For the correct names of the 8 tribes see FORMAN (1982).

Generic delimitation also raises problems, especially when a world-wide view is taken. The genera in one continent can be keyed out fairly readily, but when genera are compared between continents some of the supposed distinctions break down. Thus *Tinospora* in the Old World is probably not distinct from *Odontocarya* in America and *Chasmanthera* in Africa. Until the genera have been reviewed on a world-wide basis I prefer largely to maintain the *status quo*, apart from sinking *Epinetrum* (Africa) into *Albertisia* and *Fawcettia* (Australia) into *Tinospora*. These adjustments do not affect other genera whereas further piecemeal changes although desirable would cause further problems.

The tribes in Asia are characterized by the following combinations of characters.

Cosciniaceae — Sepals imbricate. Petals 0. Stamens either all or only the inner 3 connate. Carpels 3–6. Drupe with style-scar sublateral towards base or lateral. Endocarp smooth or fibrillo-pilose, subglobose with condyle obsolete, or subhemispherical with condyle deeply intrusive and 2-chambered. Endosperm present, sometimes ruminant. Seed broadly ellipsoidal or cup-shaped. Embryo with thin foliaceous divaricate cotyledons which are sometimes much folded.

Menispermeae — Sepals usually free in 1–few whorls or sometimes connate when in 1 whorl, the innermost whorl sometimes valvate, or sepals spiral. Petals (0–)3–6(–9), sometimes connate. Female flowers with perianth sometimes reduced to 1–2 parts. Stamens free or partly connate or united into a peltate synandrium. Carpels 1–6. Drupe strongly curved with style near base. Endocarp with \pm horseshoe-shaped dorsal region usually ornamented with projections or transverse ridges; condyle deeply intrusive, either lamelliform and \pm obovate with the seed-cavity curved around its margin or hollow with 1–2 chambers, sometimes perforate. Endosperm usually present, but absent in *Pachygone*. Seed elongate, strongly curved. Embryo elongate and curved with narrow contiguous cotyledons.

Tiliacoreae — Sepals imbricate or inner whorl valvate and sometimes connate. Petals rarely absent (Mal. *spp.*). Stamens free or connate. Carpels 3–10 (Mal. *spp.*). Drupe with style-scar near base or lateral. Endocarp smooth, wrinkled, rugose or coarsely reticulate; straight and condyle absent or curved with condyle intrusive and septiform. Endosperm usually absent, but present and ruminant in *Tiliacora*. Seed ellipsoidal, straight. Embryo with thick accumbent cotyledons or elongate and strongly curved with elongate contiguous cotyledons.

Tinosporeae (incl. *Fibraureeae*) — Sepals imbricate, rarely connate at the base. Petals 6 or 0. Stamens free or united into a peltate synandrium. Carpels 3(–4). Drupe with style-scar terminal. Endocarp spiny, verrucose, rugose or smooth; condyle a ventral hollow or longitudinal groove or deeply intrusive and clavate. Endosperm present, sometimes ventrally ruminant. Seed usually straight and ventrally hollowed or grooved, sometimes cup-shaped. Embryo with foliaceous divaricate or imbricate cotyledons.

References: BARNEBY, Mem. N.Y. Bot. Gard. 22 (1972) 144–148; DIELS, Pfl. R. Heft 46 (1910); FORMAN, The *Menispermaceae* of Malesia and adjacent areas I–XII: Kew Bull. (1956–1984); The correct names for the tribes of *Menispermaceae*. Kew Bull. 37 (1982) 368; TROUPIN, Monogr. Menisp. afric.; Acad. R. Sc. d'Outre-Mer, Cl. Sc. & Médic., Mém., N.S. vol. 13, fasc. 2 (1962).

Comparative phytochemistry. All members of the family seem to produce phenylalanine- and tyrosine-derived isoquinoline alkaloids (HEGNAUER, 1969, 1973; THORNER, 1970; SIWON, 1982). Aporphines, bisbenzylisoquinolines, and quaternary and intensely coloured protoberberines such as berberine and its allies are most typical of the family. In some genera these more usual types of isoquinoline alkaloids are accompanied by less common or even rare types of benzylisoquinoline-related alkaloids. Such types of Menispermaceous alkaloids are the hasubanans, the azafluoranthenes and related tropolo-isoquinolines, and the dibenzazonines and related *Erythrina* alkaloids. Moreover, in recent time, pavine-type and aristolactam-type alkaloids were detected in the family. Alkaloid chemistry clearly allocates *Menispermaceae* to *Polycarpiceae* with the position of one of its more specialized members. Other groups of constituents which seem to be rather characteristic of the family are the bitter and more or less toxic principles, which are sesquiterpenoids like picrotoxin or diterpenoids such as columbin and tinophyllone (HEGNAUER, 1969, 1973). It is perhaps not solely accidental that quaternary protoberberine alkaloids like berberine, columbamine, jatrorrhizine and palmatine and diterpenoid bitter principles such as tinophyllone also occur in some genera of *Rutaceae*. A third group of phyto-constituents, the cyclitols, is known to be accumulated by members of several genera of Menispermaceous plants; it is represented by the diastereoisomeric cyclohexanepentols (+)-quercitol (quercitol) and (–)-quercitol (viburnitol); they are presently known to occur in the genera *Cissampelos*, *Cocculus*, *Cyclea*, *Legnephora*, *Menispermum*, *Pachygone*, *Stephania*, *Tiliacora*, and *Triclisia*. The phenolic constituents were studied only superficially hitherto. Leaves contain flavanols or flavones, or both, but seem to lack representatives with trihydroxylated B-ring and true tannins. All other classes of phyto-constituents were neglected by phytochemists. Nevertheless, some incidental observations might prove in future to be taxonomically relevant. In this respect 5-octadecenoic acid is an important fatty acid of seed triglycerides of *Dioscoreophyllum cumminsii* (HEGNAUER, 1969, 1973), and occurrence of the cyanogenic glucoside taxiphyllin in *Stephania japonica* (unpublished observation) should be mentioned. The rare *cis*-5-octadecenoic acid is one of the main fatty acids of seed oils in the Ranunculaceous genera *Aquilegia* and *Thalictrum*, and taxiphyllin and biogenetically related tyrosine-derived glycosides are the usual cyanogenic compounds of Gymnosperms, Monocots, and *Polycarpiceae*. A cyanide group is also present in the non-cyanogenic glucoside menisdauricin of *Menispermum dauricum*; this type of compound, however, seems to be rather erratically distributed in Angiosperms.

References: HEGNAUER, Chemotaxonomie der Pflanzen 5 (1969) 73–95, 428–431, 456; *ibid.* 6 (1973) 783; suppl. in prep.; SIWON, A pharmacognostic study of some Indonesian medicinal plants of the family *Menispermaceae*; Thesis Univ. Leiden (1982); THORNER, Phytochemistry 9 (1970) 157–187. — R. HEGNAUER.

Uses. From the paragraph on phytochemistry it appears that the family abounds in species with many different alkaloids and HEYNE (1927), BURKILL (1935) and QUISUMBING (1951) have mentioned that many species are used medicinally. Japanese chemists have been very interested in the past; also in the neotropics much research has been performed, e.g. by KRUKOFF *c.s.* Notes on these uses, for all kinds of illnesses, external and internal, have been recorded here under the following species (see there):

Anamirta cocculus (L.) W. & A.

Cissampelos pareira L.

Cocculus trilobus DC.

Coscinium fenestratum (GAERTN.) COLEBR.

Fibraurea tinctoria LOUR.

Limacia oblonga HOOK. f. & TH.

Pericampylus glaucus (LAMK) MERR.

Stephania capitata (BL.) SPRENG.

Tinospora crispa (L.) HOOK. f. & TH.

Tinospora glabra (BURM. f.) MERR.

Minor uses mentioned are: extracting yellow dye from the plants, use as a fish-poison, use of

the stems for basketry, making belts, etc. *Tiliacora triandra* is used as a flavouring in cooking in Thailand. Fruit of *Anamirta cocculus* was in the past century extensively used in the adulteration of beer. Of a few species the fruits are edible, e.g. of *Albertisia papuana*, *Limacia oblonga*.

References: BURKILL, Dictionary of the economic products of the Malay Peninsula (1935); HEYNE, Nuttige Planten van Nederlandsch-Indië (1927); QUISUMBING, Medicinal plants of the Philippines (1951).

Possible confusion with other families has occurred occasionally when specimens are in the sterile state, even with *Liliaceae*. See under excluded names.

Confusion could occur with *Aristolochia* (*Aristolochiaceae*), the leaves of which have similar venation, but they do not produce an abscission layer and wither away without leaving a leaf-scar (cf. DING HOU, *Blumea* 29, 1983, 22).

According to SLEUMER (*Fl. Mal.* 1, 7, 1971, 80) the leaves of *Phytocrene* (*Icacinaceae*) are similar in shape and venation to those of various genera of *Menispermaceae*; also the petiole emerges from a shallow cup-like thickening of the stem which also often occurs in *Menispermaceae*. In the latter, however, the petiole is generally swollen in the uppermost and maybe also in its basal part, which is never the case in *Phytocrene*.

Confusion could occur with *Passifloraceae*, which have, however, tendrils; the leaves in *Adenia* possess in addition 2 large basal glands on the leaves. *Cucurbitaceae* have also tendrils. Confusion could also occur with *Dioscorea*, but the leaves in this genus have mostly distinctly trabeculate cross-venation. *Sabia* (*Sabiaceae*) has pinnate venation, which is rare in *Menispermaceae*.

More difficult are *Miquelia* (*Icacinaceae*) and *Erythralium* (*Olcaceae*); both have triplinnate-venation. *Cardiopteris* (*Cardiopteraceae* or *Icacinaceae*) has however very similar leaves.

Hints to Collectors. Since the plants of this family are always dioecious, it is necessary to search for both male and female individuals, which may be quite distant from one another. Female inflorescences are often fewer-flowered than the male, which makes them less conspicuous. Fruits are very important, especially for the endocarp characters.

When the inflorescences are on leafless stems, make certain that the foliage being collected really comes from the same climber and not from another growing with it. Note any uncertainty in this respect.

The colour of the wood in the stems of the bigger lianes should be noted as well as the presence and colour of any latex or sap.

Attention should be given to the underground parts; presence or absence of tubers or stolons should be recorded.

Spot-characters to aid identification of Malesian *Menispermaceae*

I. Vegetative characters

Erect tree or shrub: *Cocculus laurifolius*.

Wood yellow: *Arcangelisia*, *Coscinium*, *Fibraurea*.

Stems strongly tuberculate: *Tinospora crispa*.

Bark detaching as a parchment-like layer: *Tinospora* spp.

Bark pale contrasting with blackish petioles: *Fibraurea* (often).

White latex present: *Fibraurea*, *Tinomiscium* (evident in herbarium specimens when any part is broken).

Leaves very finely and closely striate on upper surface: *Tinomiscium*.

Leaves whitish tomentellous beneath, large: *Coscinium*.

Domatia (pocket or aperturate) or glandular patches in basal and/or main nerve axils, leaves large: *Anamirta*, *Arcangelisia* (upper surface of leaf papillose over insertion of petiole), *Tinospora* spp.

Petiole rugulose, leaves narrow: *Tiliacora*.

Nervation penninerved (base with lowermost nerves sometimes crowded but not clearly 3-nerved): *Albertisia*, *Carronia*, *Macrococculus* and *Pycnarrhena*.

II. Flowering characters

Inflorescence a fascicle: *Albertisia*, *Macrococculus* (on old wood), *Pycnarrhena*.

Inflorescence pseudoracemose: *Pachygone*, *Sarcopetalum*, *Tiliacora*, *Tinomiscium* (red-hairy), *Tinospora* spp.

Umbelliform cymes and peltate leaves: *Stephania* spp.

Flowers sessile and crowded on a fleshy disciform head: *Stephania capitata* and *S. dictyoneura*.

Inner sepals connate in a thick fleshy tube: *Albertisia*.

Inner sepals valvate: *Carronia*, *Limacia*, *Tiliacora*.

Petals larger than sepals: *Sarcopetalum*.

Stamens completely united into a peltate synandrium: *Cissampelos*, *Cyclea*, *Parabaena*, *Stephania*.

Stamens with filaments \pm connate: *Albertisia*, *Anamirta*, *Arcangelisia*, *Coscinium* (inner only), *Hypserpa* spp., *Macrococculus* (outer only), *Pycnarrhena*, *Sarcopetalum*.

Female perianth zygomorphic: *Cissampelos*, *Stephania* spp.

III. Fruit characters

Carpophore bearing 3–9 drupes with a short branch below each drupe: *Anamirta*, *Tiliacora*.

Carpophore clavate up to 4 cm long, bearing 3 transversely subovoid drupes over 2 cm long: *Arcangelisia*.

Drupe narrowed at the base into a stipe: *Haematocarpus*, *Macrococculus*, *Tinomiscium*.

Drupes stalked and crowded, many arising from a disciform capitulum: *Stephania capitata* and probably *S. dictyoneura* (fruits unknown).

Drupe with style-scar terminal (*Tinosporeae*): *Chlaenandra*, *Coscinium*, *Fibraurea*, *Tinomiscium*, *Tinospora*.

Drupes subglobose, pale-tomentellous, 2.8–3 cm \varnothing : *Coscinium*.

Endocarp globose, c. 4 cm \varnothing , densely covered with branched spines: *Chlaenandra*.

Endosperm absent: *Carronia*, *Haematocarpus*, *Macrococculus*, *Pachygone*, *Tiliacora*.

Notes on using the generic keys. In addition to the strictly contrasting characters, some further characters are included in the male and female keys as an aid to identification.

Fruits are necessary when using the female key. Some details of the endocarp, including the shape of the seed-cavity, are sometimes evident from the external appearance of the dried drupe when the pericarp is thin and dries close to the endocarp. In other cases it is necessary to expose at least part of the endocarp.

It may be necessary to cut the drupe in half, usually transversely in relation to the base, to see details of the condyle, endosperm and cotyledons.

The condyle is a ventral development of the endocarp which intrudes into the seed-cavity or forms a ventral cavity.

SCIENTIFIC KEY TO THE GENERA

1. Seeds without endosperm.
 2. Condyle obsolete or septiform. TILIACOREAE (except *Tiliacora*).
 3. Condyle obsolete. Seed straight, broadly ellipsoidal. Stamens often more than 6 and \pm connate.
 4. Drupe with style-scar below the apparent apex. Sepals all free.
 5. Drupes not narrowed at base into a stipe, 3–6 on a \pm globose carpophore. Endocarp usually papyraceous to crustaceous and \pm smooth, sometimes thick, bony and verrucose. Stamens 6–18, usually connate for most of length; connective not prolonged **1. Pycnarrhena**
 5. Drupes narrowed at base into a stipe, 5–10 radiating from the margin of a disciform carpophore. Endocarp thick and bony, dorsally covered with a coarse open network of ridges, ventrally smooth. Stamens 9, 3 inner free surrounded by 6 slightly joined at base; connective prolonged into a tongue **2. Macrococculus**
 4. Drupe with style-scar near base. Inner sepals connate in a fleshy tubular calyx. Stamens *c.* 18–24, connate in a conical cluster **3. Albertisia**
 3. Condyle an elongate septum around which the seed is sharply bent. Stamens 6, free.
 6. Inner sepals valvate. Leaves penninerved **4. Carronia**
 6. Sepals all imbricate. Leaves triplinerved **5. Haematocarpus**
 2. Condyle hollow with a central aperture on both sides of endocarp. (MENISPERMEAE *p.p.*) **15. Pachygone**
1. Seeds with endosperm.
 7. Drupe with style-scar terminal. Embryo with foliaceous cotyledons. TINOSPOREAE (incl. *Fibraureae*).
 8. Petals 3 or 6.
 9. Stamens free.
 10. Endocarp globose, covered with series of branched spines. Condyle clavate, 2-chambered, deeply intruding into the seed cavity. Stamens with flattened elliptic filaments broader than the anthers **7. Chlaenandra**
 10. Endocarp not spiny. Stamens with \pm terete filaments not broader than the anthers.
 11. Endocarp knobbly, papillose or smooth with a ventral aperture or elongate depression; condyle sometimes forming a ventral cavity. Endosperm usually ventrally ruminant. Plant without a laticiferous system. Leaves not striate above **8. Tinospora**
 11. Endocarp rugose to rugulose, strongly compressed dorsiventrally without a ventral aperture or depression; condyle obsolete. Endosperm not ruminant. A laticiferous system present throughout the plant. Leaves finely and closely striate above **10. Tinomisium**
 9. Stamens united in a peltate synandrium. Endocarp spiny, the condyle forming a ventral concavity or an enclosed inflated chamber **9. Parabana**
 8. Petals 0. Endocarp subellipsoidal, smooth with condyle forming a narrow ventral groove **11. Fibraura**
 7. Drupe with style-scar near base or on one side.
 12. Embryo with foliaceous, divaricate cotyledons. Seed broadly ellipsoidal or deeply cup-shaped. Petals 0. COSCINEAE.
 13. Condyle obsolete. Seed broadly ellipsoidal. Carpophore clavate. Anthers 9–12 in a sessile cluster **12. Arcangelisia**
 13. Condyle deeply intruding into the seed-cavity. Seed deeply cup-shaped.
 14. Condyle deeply 2-lobed, hollow. Carpophore shortly branched below the drupes. Anthers 30–35 in a stalked cluster. Inflorescence in a panicle **13. Anamirta**
 14. Condyle \pm peltate, unlobed. Carpophore globose. Stamens 6, the outer 3 free with 1-locular introrse anthers, the inner 3 with connate filaments and 2-locular latrorse anthers. Inflorescence a raceme of peduncled balls of flowers **14. Coscinium**
 12. Embryo elongate with narrow, semi-terete or flattened cotyledons lying close together. Seed elongate, strongly curved, \pm horseshoe-shaped. Petals present, at least in male flowers.
 15. Endosperm ruminant. Condyle septiform (TILIACOREAE *p.p.*) **6. Tiliacora**
 15. Endosperm not ruminant. Condyle usually obovate in outline with the seed curved around its margin, sometimes hollow and 1–2-chambered. MENISPERMEAE (except *Pachygone*).
 16. Sepals spirally arranged, imbricate, variable in number, 7–12. Stamens 9–40, free or connate. Carpels 2–3 (Mal. *spp.*) **16. Hypserpa**
 16. Sepals in whorls of 3 or in one united whorl.
 17. Carpels 3–6. Stamens free or only filaments connate.
 18. Inner sepals valvate. Condyle hollow, 2-chambered **17. Limacia**

18. Inner sepals imbricate. Condyle \pm lamelliform.
 19. Petals thick and fleshy, much larger than the sepals. Stamens with connate filaments
- 18. Sarcopetalum**
19. Petals smaller than sepals or absent in female flowers. Stamens free.
 20. Petals entire, sometimes absent in female flowers.
 21. Condyle obovate to rotund in outline. Inflorescences axillary, cymes or thyrses.
 22. Petals absent in female flowers. Anthers dehiscing with transverse \pm introrse slits, the cells separated abaxially by the thickened connective. Endocarp with an entire dorsal median wing or ridge and prominent lateral curved or cucullate crests bordering the condyle, the dorsal region smooth (Mal. *spp.*)
- 19. Legnephora**
22. Petals present in female flowers. Anthers dehiscing with longitudinal latrorse slits, the cells parallel and close together. Endocarp without a dorsal median wing or ridge and lateral crests, dorsally covered with short pointed processes
- 20. Pericampylus**
21. Condyle elongate, very narrow with the seed sharply bent around it. Inflorescences from old woody stems (Mal. *spp.*), long racemes of cymes (Mal. *spp.*)
- 21. Diploclisia**
20. Petals bifid or emarginate. Endocarp dorsally verruculose or transversely ridged, with an aperture on both lateral faces leading to a lateral cavity
- 22. Cocculus**
17. Carpel 1. Stamens completely connate in a peltate synandrium with the anthers horizontal around the margin.
 23. Female inflorescences with accrescent bracts (Mal. *sp.*). Flowers 4-merous. Petals connate
- 23. Cissampelos**
23. Female inflorescences without accrescent bracts.
 24. Inflorescences thyrsoid or pseudoracemose. Condyle hollow, 1-chambered. Flowers 4-merous. Petals free or connate
- 24. Cyclea**
24. Inflorescences composed of umbelliform cymes or disciform capitula. Condyle lamelliform. Flowers 3-4-merous. Petals free.
- 25. Stephania**

KEY TO THE GENERA BASED ON MALE PLANTS

1. Upper surface of leaves very finely and closely striate. Inflorescences racemose on leafless stems, usually ferruginous-tomentose
- 10. Tinomiscium**
1. Upper surface of leaves not striate.
 2. Leaves triplinerved, the main basal pair of nerves extending almost to the leaf-apex.
 3. Woody climber. Sepals and petals marked with reddish lines or spots. Inflorescence a panicle or raceme
- 5. Haematocarpus**
3. Erect shrub or small tree. Sepals and petals not marked with lines or spots. Inflorescence a cyme or short raceme of cymes
- 22. Cocculus laurifolius**
2. Leaves not triplinerved.
 4. Inner 3 sepals connate in a fleshy tubular calyx, minute outer sepals free. Stamens c. 18-24, connate in a conical cluster
- 3. Albertisia**
4. Sepals free or if connate then calyx of one whorl only.
 5. Petals thick and fleshy, much larger than sepals. Inflorescences pseudoracemose. Leaves peltate or subpeltate
- 18. Sarcopetalum**
5. Petals smaller than sepals or absent.
 6. Sepals 7-12, spirally arranged, not in distinct whorls. Stamens 9-40, free or connate. Inflorescences cymose or thyrsoid
- 16. Hypserpa**
6. Sepals in one or more distinct whorls.
 7. Connective prolonged into a flattened tongue. Stamens 9, the outer 6 joined at base, the inner 3 free. Inflorescences fasciculate on old stems
- 2. Macrocculus**
7. Stamens without a prolonged connective.
 8. Stamens united or at least partly connate at the base, or only the inner 3 stamens connate.
 9. Stamens completely united in a peltate or clavate synandrium, the anthers in a horizontal ring.
 10. Inflorescences composed of umbelliform cymes or disciform capitula. Leaves peltate
- 25. Stephania**
10. Inflorescences cymose, thyrsoid or pseudoracemose. Leaves peltate or not.

11. Inflorescence a peduncled, corymbose cyme. Sepals 4. Petals connate in a cup. Leaves peltate
23. *Cissampelos*
11. Inflorescences thyrsoid or pseudoracemose, or if cymose then sepals 6 in 2 whorls and petals 6.
12. Sepals 4(-5), free or connate. Petals 4, free or connate. Inflorescences thyrsoid or pseudoracemose. Leaves sometimes peltate 24. *Cyclea*
12. Sepals 6, free in 2 whorls. Petals 6, free. Inflorescences thyrsoid or cymose. Leaves not peltate 9. *Parabaena*
9. Stamens with the filaments \pm connate or only the inner stamens connate.
13. Inflorescence a raceme of peduncled balls of flowers. Stamens 6, the outer 3 free, the inner 3 joined. Leaves tomentellous (often whitish) below 14. *Coscinium*
13. Inflorescence a panicle, cyme or fascicle.
14. Lower surface of leaves with domatia in axils of main nerves. Leaves palmately nerved at base. Inflorescence a panicle. Anthers in a globose cluster.
15. Flowers pedicellate. Anthers 30-35 in a stalked cluster 13. *Anamirta*
15. Flowers sessile or subsessile. Anthers 9-12 in a sessile cluster 12. *Arcangelisia*
14. Leaves lacking domatia, penninerved or subpalmately nerved at base. Inflorescence a cyme or fascicle. Stamens 6-18 with the filaments \pm joined 1. *Pycnarrhena*
8. Stamens all free.
16. Petals absent. Stamens with thick filaments, a prominent collar evident below the anther. Inflorescence a lax panicle. Wood yellow 11. *Fibraurea*
16. Petals present. Stamens without a prominent collar below the anther. Wood not yellow.
17. Inner 3 sepals valvate.
18. Sepals glabrous or subglabrous. Inflorescence a pseudoraceme. Petiole rugulose 6. *Tiliacora*
18. Sepals tomentellous to densely pilose. Petiole not rugulose.
19. Inflorescence a cyme or lax pseudopanicle 17. *Limacia*
19. Inflorescence narrowly thyrsoid, the branches subspicate 4. *Carronia*
17. Inner 3 sepals imbricate.
20. Main basal nerves and their main outer lateral branches extending to the leaf-margin.
21. Inflorescences on old leafless stems, long racemes of cymes 21. *Diploclisia*
21. Inflorescences axillary.
22. Anthers dehiscent with longitudinal latrorse slits, the cells parallel and close together. Leaves usually broadly and shallowly crenate 20. *Pericampylus*
22. Anthers dehiscent with transverse \pm introrse slits, the cells separated abaxially by the thickened connective. Leaves usually entire or subentire 19. *Legnephora*
20. Main basal nerves and their main outer lateral branches breaking up or anastomosing well within the leaf-margin.
23. Inflorescence a large panicle up to c. 50 cm long with lateral branches up to 15 cm, borne on old leafless stems. Stamens with flattened elliptic filaments broader than the anthers
7. *Chlaenandra*
23. Inflorescences much smaller and narrower, pseudoracemose, pseudospicate, narrowly thyrsoid or narrowly pseudopaniculate, axillary or on leafless stems. Stamens with filaments not broader than the anthers.
24. Petals bifid. Inflorescence a cyme or a raceme of cymes 22. *Cocculus orbiculatus*
24. Petals entire.
25. Inflorescences yellowish tomentose to pubescent, always axillary and pseudoracemose. Leaf-base rounded to truncate or very obtuse (rarely subcordate) 15. *Pachygone*
25. Inflorescences glabrous, puberulous or hispidulous, axillary or on leafless stems, various in form. Leaf-base often cordate 8. *Tinospora*

KEY TO THE GENERA BASED ON FEMALE PLANTS

1. Upper surface of leaves very finely and closely striate. Inflorescences racemose on leafless stems, usually ferruginous-tomentose 10. *Tinomiscium*
1. Upper surface of leaves not striate.
2. Leaves triplinerved, the main basal pair of nerves extending almost to the leaf-apex.

3. Woody climber. Drupes ellipsoidal, 40–45 mm long. Sepals and petals streaked with reddish lines or spots **5. Haematocarpus**
3. Erect shrub or small tree. Drupes rotund in outline, c. 4 mm long. Sepals and petals not marked with lines or spots **22. Cocculus laurifolius**
2. Leaves not triplinerved.
4. Inflorescences with accrescent rotund bracts becoming up to 1.5 cm long and persisting at fruiting stage, often obscuring the 5 mm long pubescent drupes. Leaves peltate, tomentose to puberulous. Slender climber **23. Cissampelos**
4. Inflorescences without accrescent bracts.
5. Inflorescences composed of umbelliform cymes or disciform capitula. Drupe with style-scar near base, 4–11 mm long. Endocarp compressed, \pm obovate in outline with a sometimes perforate lamelliform condyle surrounded by a horseshoe-shaped seed cavity, dorsally ornamented with projections of various forms or transverse ridges **25. Stephania**
5. Inflorescences not of umbelliform cymes or disciform capitula.
6. Seed and seed cavity straight or broad and concave or deeply cupular.
7. Seed and seed cavity deeply cup-shaped, surrounding the thickly clavate, sometimes 2-lobed, deeply intrusive condyle. Drupes subglobose. Leaves palmately nerved at base.
8. Lower surface of leaves with domatia in axils of main nerves. Drupes 9–11 mm ϕ **13. Anamirta**
8. Leaves without domatia. Drupes over 25 mm ϕ .
9. Drupes 40–45 mm ϕ , glabrous. Endocarp covered with branched spines. Leaves glabrous **7. Chlaenandra**
9. Drupes 28–30 mm ϕ , tomentellous. Endocarp not spiny. Leaves tomentellous (usually whitish) on lower surface **14. Coscinium**
7. Seed and seed cavity *either* straight, \pm ellipsoidal and endocarp with condyle absent, inconspicuous or forming a longitudinal groove, *or* seed dorsiventrally flattened and concave and endocarp with condyle forming a ventral cavity, concavity or inflated chamber.
10. Seed \pm ellipsoidal filled by large embryo with thick cotyledons, endosperm absent. Leaves penninerved, sometimes with some subbasal nerves.
11. Drupes narrowed at base into a pronounced stipe, 5–10 radiating from margin of a disciform carpophore. Endocarp 3–6 cm long, bony, covered dorsally with a coarse open network of ridges, ventrally smooth. Inflorescences fasciculate on protuberances on old wood. Leaves densely reticulate. **2. Macrocculus**
11. Drupes with base not narrowed into a stipe, 3–6 on a knob-like carpophore. Endocarp *either* papyraceous to crustaceous and \pm smooth to wrinkled *or* bony and verrucose.
12. Drupes subcompressed-ellipsoidal, tomentellous with style-scar near base, 2.5–6 cm long. Inner sepals connate into a fleshy tube **3. Albertisia**
12. Drupes subglobose or broadly ellipsoidal, glabrous puberulous or tomentellous with style-scar below the apparent apex, 0.8–3 cm long. Sepals all free **1. Pycnarrhena**
10. Seed largely filled with endosperm which surrounds the very thin embryo. Leaves palmately nerved at base or with basal nerves diverging from midrib slightly above the base.
13. Lower surface of leaves with hollow domatia in axils of main nerves, leaf papillose on upper surface around insertion of petiole. Drupes 2.2–5.5 cm long with style-scar on one side, borne on a clavate carpophore up to 4 cm long. Endocarp covered with a fibrous layer, condyle inconspicuous or absent **12. Arcangelisia**
13. Lower surface of leaves without domatia or only present in basal nerve-axils. Drupes with terminal style-scar.
14. Basal nerves of the leaf diverging from the mid-rib several mm above the base. Endocarp rather smooth, subellipsoidal, 2.0–2.5 cm long, the condyle forming a ventral narrow longitudinal groove. Inflorescence a lax panicle. Wood yellow **11. Fibraurea**
14. Basal nerves arising from the base of the leaf. Endocarp variously ornamented or smooth, often \pm rotund in outline but sometimes subellipsoidal. Wood not yellow.
15. Endocarp spiny, the condyle forming a ventral concavity or an enclosed inflated chamber. Endosperm not ruminant **9. Parabaena**
15. Endocarp rugose, papillose or smooth with the condyle forming *either* a ventral cavity with a central external aperture, *or* a ventral elongate depression. Endosperm usually ventrally ruminant **8. Tinospora**
6. Seed and seed cavity elongate and strongly curved, semi-annular to horseshoe-shaped.

16. Drupes 6–7 mm long borne on a shortly branched 3–4 mm long carpophore. Carpels 8–9. Petioles rugulose **6. Tiliacora**
16. Drupes not on a conspicuous carpophore. Carpels 1–6. Petioles not rugulose.
17. Leaves penninerved. Drupes and narrowly thyrsoïd inflorescences tomentellous ... **4. Carronia**
17. Leaves with base palmately 3–7-nerved. Drupes glabrous to pubescent.
18. Petals fleshy, larger than the sepals. Drupes semicircular in outline, (4–)6 mm long. Endocarp ornamented dorsally with pointed processes and/or transverse ridges, laterally concave. Seed and seed cavity semi-annular. Leaves subpeltate or peltate with petiole inserted up to 3 mm from basal margin, fine reticulation prominent especially on lower surface. Woody stems verruculose
18. Sarcopetalum
18. Petals, if present, much smaller than the sepals. Seed and seed cavity mostly \pm horseshoe-shaped.
19. Inflorescences from old woody stems, consisting of very long racemes of cymes, up to c. 50 cm long. Drupes narrowly obovate in outline, 15–30 mm long. Seed and seed cavity deeply horseshoe-shaped with the 2 arms \pm parallel **21. Diploclisia**
19. Inflorescences axillary. Drupes obovate to rotund in outline.
20. Endocarp with an entire dorsal median wing or ridge and laterally spreading curved or cucullate crests bordering the condyle, the dorsal region smooth (Mal. *spp.*). Petals absent
19. Legnephora
20. Endocarp without a dorsal median wing or prominent ridge and lateral crests, the dorsal region sometimes ornamented, e.g. verruculose, ridged or spinulate. Petals present.
21. Seed without endosperm, cotyledons large and thick, collateral. Endocarp rather smooth with a small central perforation on both lateral faces **15. Pachygone**
21. Seed with endosperm surrounding the narrow embryo.
22. Drupes 14–25 mm long. Dorsal region of endocarp smooth or only slightly rugose. Condyle hollow, 2-chambered. Inner sepals valvate **17. Limacia**
22. Drupes less than 12 mm long. Dorsal region of endocarp often ornamented. Condyle lamelliform or hollow. Inner sepals imbricate.
23. Leaves with main basal nerves and their main outer lateral branches leading directly to the margin, which is usually broadly and shallowly crenate. Endocarp laterally concave, dorsally covered with short pointed processes, condyle lamelliform, imperforate
20. Pericampylus
23. Leaves with main nerves breaking up well within the entire margin. Endocarp with thick, hollow condyle, often perforate.
24. Condyle 1-chambered with or without a small lateral perforation on each side. Endocarp with a ventral perforation, dorsal surface with \pm papilliform processes and/or transverse ridges in longitudinal rows. Drupes 5–8 mm long. Carpel 1. Sepals 2 or 3. Petals entire. Leaves sometimes peltate **24. Cyclea**
24. Condyle with 2 distinct lateral chambers each with a large lateral aperture. Endocarp not ventrally perforate. Carpels (2–)3 or 6. Sepals 6–12. Leaves never peltate.
25. Drupes 6–12 mm long. Dorsal surface of endocarp rugose. Carpels (2–)3. Sepals spiral, 7–12. Petals entire **16. Hypserpa**
25. Drupes 4–5 mm long. Dorsal surface of endocarp closely and irregularly wrinkled-papillose. Carpels 6. Sepals 6(–9) in 2(–3) whorls. Petals bifid **22. Cocculus orbiculatus**

1. PYCNARRHENA

MIERS [Ann. Mag. Nat. Hist. ser. 2, 7 (1851) 44, *nomen*] ex HOOK. *f.* & TH. Fl. Ind. 1 (1855) 206; MIERS, Ann. Mag. Nat. Hist. ser. 3, 20 (1867) 11; Contr. Bot. 3 (1871) 351; DIELS, Pfl. R. Heft 46 (1910) 48; FORMAN, Kew Bull. 26 (1972) 405; *ibid.* 30 (1975) 97, 99; *ibid.* 33 (1979) 568. — *Antitaxis* MIERS [Ann. Mag. Nat. Hist. ser. 2, 7 (1851) 44, *nomen*], *ibid.* ser. 3, 20 (1867) 12; Contr. Bot. 3 (1871) 354, t. 142. — *Batania* HATUS. Mem. Fac. Agric. Kagoshima Univ. 5 (1966) 29.
— **Fig. 1.**

Lianes or scandent shrubs. *Leaves* with petioles swollen at the base and usually at apex, leaving a prominent cup-like scar on the stem; lamina usually penninerved and \pm elliptic, sometimes (in Mal., *P. insignis*) with lower nerves crowded at base and ovate. *Inflorescences* axillary or ramiflorous, mostly cymose, the peduncles sometimes 1-flowered and fascicled. — *Male flowers*: sepals 6–15 in whorls of 3, imbricate, the outer ones minute, inner ones largest (in *P. ozantha* the innermost sometimes smaller), rotund and concave; petals 3–6, or 0 in *P. ozantha*, minute, mostly broadly obovate; stamens variable in number, 6–18, tightly clustered with the filaments usually connate for most of their length (shortly connate in *P. lucida*). — *Female flowers*: sepals and petals as in male; staminodes 0; carpels 3–6 with recurved stigmas. *Drupes* \pm subglobose with style-scar on the ventral side below the apex, arising from the margin of a swollen \pm globose carpophore; endocarp usually thin, papyraceous to crustaceous and smooth to wrinkled, but in *P. ozantha* bony and verrucose; endosperm absent; seed broadly ellipsoidal, cotyledons large and thick, very slightly curved.

Distr. S. China and SE. Asia throughout *Malesia* to Queensland; 9 spp.

Notes. The genus *Pycnarrhena* has proved very difficult to revise owing to the inadequacy of the material available. Of the nine species recognized, the fruits of one are unknown, while the flowers (of both sexes) and inflorescences are unknown for another. In addition, female flowers are unknown for four species. Since fruits and inflorescences provide the most useful characters for separating species of this genus, the lack of some of this essential information is a major disadvantage in framing a taxonomic revision. Moreover, there is considerable variation between specimens in their foliage, and without other correlated characters, it has been most puzzling in certain instances to decide exactly where to draw the boundary between species. For these reasons I have been unable to frame a practical key which will work in general for single specimens, *i.e.* male or female, but the information incorporated in it will limit considerably the different possibilities when naming.

KEY TO THE SPECIES

1. Leaves ovate, base broadly cordate 1. *P. insignis*
1. Leaves \pm elliptic, base rounded to acute.
 2. Petals present, clearly differentiated from the sepals. Carpels 3(–4). Endocarp crustaceous, smooth to wrinkled.
 3. Male inflorescences fasciculate, the peduncles mostly 1-flowered.
 4. Drupes glabrous.
 5. Male flowers laxly fascicled, pedicels 3–5(–10) mm; lamina 6–9(–12) by 2.5–4(–5.5) cm, drying \pm flat, lateral nerves not markedly impressed on upper surface 2. *P. lucida*
 5. Male flowers densely clustered, pedicels up to 2 mm; lamina 10–17 by 3.5–7 cm, drying subbullate, main lateral nerves impressed on upper surface. Bengal, E. Himalaya, ?N Burma ... *P. pleniflora*
 4. Drupes minutely tomentellous or puberulous. Male flowers on pedicels 5–10 mm. Lamina 8–12(–18) by 3–6(–8) cm 3. *P. longifolia*
 3. Male inflorescences cymose (female peduncles sometimes 1-flowered).
 6. Drupes minutely puberulous. Leaves often markedly bullate 4. *P. manillensis*
 6. Drupes glabrous. Leaves usually not bullate.
 7. Drupes 8–10 mm ϕ . Infructescences branched, slender, elongate up to 7 cm long 5. *P. novoguineensis*
 7. Drupes 15–30 mm ϕ , drying smooth (when ripe). Infructescences usually with rather thick peduncles, usually unbranched and fascicled when axillary, but branched when ramiflorous . 6. *P. tumefacta*
 2. Clearly differentiated petals absent (occasionally 1). Carpels 4–6. Drupes 12–20 mm ϕ , drying shrivelled, glabrous. Endocarp thick, very hard, verrucose 7. *P. ozantha*

1. *Pycnarrhena insignis* (HATUS.) FORMAN, Kew Bull. 33 (1979) 568. — *Batania insignis* HATUS. Mem. Fac. Agric. Kagoshima Univ. 5 (1966) 29, 70, f. 1.

Scandent shrub c. 10 m. Young stems striate, glabrous, 2–5 mm ø, bearing raised, discoid petiole-scars; older stems rather smooth or obscurely wrinkled. *Leaves* with glabrous petioles (2–)3–4 cm, broadened at the very base, geniculate and drying minutely wrinkled towards the apex; lamina ovate, base broadly and shallowly cordate, apex shortly and obtusely acuminate, 9–14.5 by 6.5–10.5 cm, lateral nerves 6–8 pairs, the lowest 2–3 pairs arising close together near the base, the midrib, lateral nerves and conspicuous reticulate tertiary venation slightly raised on both surfaces, glabrous, thinly coriaceous. *Flowers and inflorescences* unknown. *Infructescence* axillary, subterminal or arising from the axils of fallen leaves, cymose, c. 4 cm long, at first minutely puberulous, peduncles slender, 5–10 mm, terminating in a depressed-subglobose carpophore 6–7 mm ø bearing around its margin c. 6 drupes or their scars. *Drupes* red, ± broadly ellipsoidal, drying deeply wrinkled, c. 2 cm long, glabrous, exocarp thinly coriaceous, mesocarp drying very thin, endocarp chartaceous; embryo reniform, 9–10 mm long, cotyledons very thick, slightly curved.

Distr. *Malesia*: Philippines (Batan I.: Mahatao).
Ecol. Thickets, 100 m.

Note. CUTLER, who examined the leaf-anatomy in the genus (Kew Bull. 30, 1975, 41–48, pl.) examined the leaf-anatomy of the species and found that it agrees in all essential characters with that of the genus.

2. *Pycnarrhena lucida* (TEJSM. & BINN.) MIQ. Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 87; BECC. Malesia 1 (1877) 159; BOERL. Cat. Hort. Bog. 1 (1899) 43; DIELS, Pfl. R. Heft 46 (1910) 49; BACK. Schoolfl. (1911) 39; KOORD. Exk. Fl. Java 2 (1912) 230; YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 34; BACK. & BAKH. f. Fl. Java 1 (1963) 154; FORMAN, Kew Bull. 26 (1972) 408. — *Cocculus lucidus* TEJSM. & BINN. Nat. Tijds. N. I. 4 (1853) 397; Ned. Kruidk. Arch. 3 (1855) 394; MIQ. Fl. Ind. Bat. 1, 2 (1858) 82. — *Antitaxis fasciculata* MIERS [Ann. Mag. Nat. Hist. ser. 3, 20 (1867) 14, *nomen*], Contr. Bot. 3 (1871) 356; HOOK. f. & TH. Fl. Br. India 1 (1872) 106; KING, J. As. Soc. Beng. 58, ii (1889) 388. — *Antitaxis calocarpa* KURZ, J. Bot. 13 (1875) 324; Fl. Burma 1 (1877) 57. — *P. fasciculata* (MIERS) DIELS, Pfl. R. Heft 46 (1910) 50; RIDL. Fl. Mal. Pen. 1 (1922) 108. — *P. calocarpa* (KURZ) DIELS, Pfl. R. Heft 46 (1910) 51.

Leaves with slender petioles, puberulous at first, later glabrescent, 0.8–1.7 cm; lamina elliptic, apex acuminate, base acute to obtuse, 6–9(–12) by 2.5–4(–5.5) cm, main lateral nerves c. 6 pairs, reticulation conspicuous and prominent on both surfaces, glab-

rous (rarely puberulous along midrib and main nerves on lower surface). *Inflorescences* axillary or ramiflorous, fasciculate; peduncles 1- (or few-) flowered, 3–5(–10) mm, usually puberulous. — *Male flowers*: sepals 9–12, outer ones minute, puberulous, inner 3–6 larger, rotund to broadly rotund, 1.25 by 1.25–1.75 mm, glabrous; petals 3, cuneiform, 0.5–0.75 mm long; stamens 6–12, 0.5 mm, shortly connate. — *Female flowers* unknown. *Drupes* red, globose, 8–15 mm ø, glabrous; endocarp crustaceous.

Distr. Hainan, Cambodia, Thailand, Andaman & Nicobar Is.; in *Malesia*: Malaya (Perak, Malacca), Central W. Sumatra, W. Java (incl. P. Panaitan in Sunda Strait).

Ecol. Forests, up to 500 m, in *Casuarina equisetifolia* stands near the shore on P. Panaitan, on limestone in Peninsular Thailand.

Note. A single collection from W. Java (KOORDERS 26732) with flowers twice the normal size for this species is the type of *P. montana* BACK. In other respects this collection resembles *P. lucida*, but its taxonomic status remains in some doubt. See at the end of the genus.

3. *Pycnarrhena longifolia* (DECNE ex MIQ.) BECC. Malesia 1 (1877) 160; DIELS, Pfl. R. Heft 46 (1910) 52; FORMAN, Kew Bull. 26 (1972) 410. — *Cocculus longifolius* DECNE ex MIQ. Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 84. — *Antitaxis longifolius* (DECNE ex MIQ.) MIERS, Contr. Bot. 3 (1871) 357. — *Antitaxis cauliflora* MIERS [Ann. Mag. Nat. Hist. ser. 3, 20 (1867) 14, *nomen*], Contr. Bot. 3 (1871) 356. — *P. cauliflora* (MIERS) DIELS, Pfl. R. Heft 46 (1910) 52; BACK. Schoolfl. (1911) 40; HALL. f. Meded. Rijks-herb. 12 (1912) 10; KOORD. Exk. Fl. Java 2 (1912) 230; YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 33; BACK. & BAKH. f. Fl. Java 1 (1963) 154.

Leaves with petioles usually puberulous, 1.8–2.5 cm; lamina elliptic to narrowly elliptic to lanceolate-elliptic, apex abruptly to gradually acuminate, base obtuse to rounded, 8–12(–18) by 3–6(–8) cm, lateral nerves 6–8 pairs, midrib often puberulous below, surfaces otherwise glabrous. *Inflorescences* ramiflorous, fasciculate, peduncles 1-flowered. — *Male flowers* with minutely puberulous pedicels, 5–10 mm; outer sepals 2–4, minute; inner sepals yellow, 3, concave, rotund, 2 mm long, thick and fleshy except towards margin; petals 3, oblate, 0.75–1 mm long; stamens 7–12, tightly clustered, c. 0.5 mm long. — *Female flowers*: outer sepals 1–2, minute, puberulous; inner sepals yellow, 4–6, 2.25 mm long; petals 3, ± broadly obovate, 1.5–2 mm, glabrous, thick; carpels 3–4, 1 mm long, subellipsoidal, style short, recurved. *Drupes* borne on unbranched puberulous to subglabrous peduncles 7–20 mm, globose, 12–15 mm ø, minutely tomentellous or puber-

ulous; endocarp crustaceous.

Distr. *Malesia*: Central & S. Sumatra (also Sebesi I. and P. Panaitan in Sunda Strait), Central Java, Lesser Sunda Is. (Lombok, Sumba, Sumbawa, Flores, Timor).

Ecol. Forests, up to 700 m.

Vern. Sumba: *punduk*.

4. *Pycnarrhena manillensis* VIDAL, Rev. Pl. Vasc. Filip. (1886) 45; DIELS, Pfl. R. Heft 46 (1910) 52; in Elmer, Leaf. Philip. Bot. 4 (1911) 1163; MERR. Fl. Manila (1912) 203; W.H. BROWN, Minor Prod. Philip. For. 3 (1921) 186; MERR. En. Philip. 2 (1923) 144; QUILAN & SANTOS, Nat. Appl. Sc. Bull. Philip. 3 (1933) 353; QUIS. Medic. Pl. Philip. (1951) 297; FORMAN, Kew Bull. 26 (1972) 411; PANCHO, Vasc. Fl. Mt Makiling 1 (1983) 275, f. 82. — *P. elliptica* DIELS, Pfl. R. Heft 46 (1910) 54; in Elmer, Leaf. Philip. Bot. 4 (1911) 1163; MERR. En. Philip. 2 (1923) 144; Philip. J. Sc. 29 (1926) 367; YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 33.

Leaves with puberulous to subglabrous petioles, 1–3 cm; lamina ± elliptic to oblong-elliptic (sometimes narrowly oblong-elliptic in Mindanao), usually ± bullate, apex acuminate, base obtuse to rounded (or subcordate), (9–)11–18 by (2.5–)4–8 cm, lateral nerves, c. 6 pairs, strongly impressed above and conspicuously joined near the margin, the fine reticulation raised on both surfaces, upper surface glabrous, beneath usually puberulous. — *Male inflorescence* axillary, cymose, well-branched, many flowered, 2.5–4 cm long, puberulous. — *Male flowers* with puberulous pedicels up to 3 mm; outer sepals 2–5, minute, puberulous; inner sepals 4–7, rotund to broadly elliptic, 1.5–2 mm long, glabrous or lightly puberulous outside; petals 2–4, obovate, 0.75–1 mm long; stamens 10–15, 0.75–1 mm long. — *Female flowers* unknown. *Infructescence*: peduncles usually bearing 1 to 3 fruits, axillary and very short, 0.5–1 cm, or ramiflorous and up to 2 cm. *Drupes* globose or subreniform, 1–1.5 cm long, minutely puberulous; endocarp crustaceous.

Distr. *Malesia*: Philippines (Luzon, Panay, Samar, Leyte, Alabat, Negros, Mindanao, Basilan, Camotes, Sulu Is.).

Ecol. Thickets and forests, up to 1600 m. Fl. May–Nov., fr. July–March.

Uses. Infusions prepared from the roots and powdered bark are used medicinally for a variety of ailments. Various alkaloids have been extracted from this species: see QUISUMBING (1951, *l.c.*), BRUCHHAUSEN *et al.* (Arch. Pharm. 293, 1960, 454, 785) and THORNBER (Phytochem. 9, 1970, 164, 172).

Vern. Philippines: *ambal*, *mamangal*, Tag., *haluot*, C. Bis., *huluot*, Bis.

Note. The anatomy of the leaves and stem have

been described by DIPASUPIL (Proc. 8th Pac. Sc. Congr. 1957, 348–380).

5. *Pycnarrhena novoguineensis* MIQ. Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 87; BECC. Malesia 1 (1877) 158; DIELS, Pfl. R. Heft 46 (1910) 54; KANEH. & HATUS. Bot. Mag. Tokyo 56 (1942) 472; FORMAN, Kew Bull. 26 (1972) 412. — *P. australiana* F. v. M., Vict. Nat. 3 (1886) 61; F.M. BAILEY, Queensl. Fl. 1 (1899) 35. — *P. grandis* K. SCH. & LAUT. Fl. Deut. Schutzgeb. Südsee (1900) 313; DIELS, Pfl. R. Heft 46 (1910) 54; Nova Guinea 14 (1923) 80. — *P. sayeri* DIELS, Pfl. R. Heft 46 (1910) 55.

Leaves with glabrous to sparsely puberulous petioles 1.5–3.5 cm; lamina elliptic or oblong-elliptic, apex acuminate, base obtuse to rounded, 18–28 by 4.5–8(–9.5) cm, lateral nerves 6–9 pairs, often impressed above, venation obscure or prominent on both surfaces. *Inflorescences* axillary or ramiflorous, branched, 1.5–7 cm long, puberulous (the ramiflorous inflorescences are larger and more branched than the axillary ones). — *Male flowers* with pedicels up to 3 mm, or sessile; outer sepals 1–2, minute; inner sepals 3–6, ± rotund, concave, 2–2.25 mm long; petals 3–4 obovate, 1 mm long; stamens 9–16, the cluster c. 0.5 mm long. — *Female flowers* with pedicels, sepals and petals ± as in male flowers; carpels 3, subellipsoidal, 1 mm long. *Infructescence* slender, branched, up to 7 cm, often rather elongate. *Drupes* yellow, globose, 0.8–1 cm ø, glabrous; endocarp crustaceous.

Distr. Australia (Queensland); in *Malesia*: New Guinea (in West common, in East only 1 coll.), incl. Misool I.

Ecol. Forests at low altitude, up to 50 m. According to a field note the male flowers are heavily scented.

6. *Pycnarrhena tumefacta* MIERS [Ann. Mag. Nat. Hist. ser. 3, 20 (1867) 12, *nomen*], Contr. Bot. 3 (1871) 353; BECC. Malesia 1 (1877) 159; DIELS, Pfl. R. Heft 46 (1910) 53; MERR. En. Born. (1921) 248; YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 34; FORMAN, Kew Bull. 26 (1972) 414. — *Cocculus celebicus* BOERL. Cat. Hort. Bog. (1899) 40. — *P. borneensis* DIELS, Pfl. R. Heft 46 (1910) 53; MERR. En. Born. (1921) 248; YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 32. — *P. celebica* (BOERL.) DIELS, Pfl. R. Heft 46 (1910) 53; MERR. Philip. J. Sc. 7 (1912) Bot. 266; En. Philip. 2 (1923) 144; YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 33. — *P. merrillii* DIELS, Pfl. R. Heft 46 (1910) 52; in Elmer, Leaf. Philip. Bot. 4 (1911) 1163; MERR. En. Philip. 2 (1923) 144. — *P. membranifolia* MERR. Philip. J. Sc. 20 (1922) 382; En. Philip. 2 (1923) 144. — *P. balabacensis* YAMAMOTO, Trans. Nat. Hist. Soc. Taiwan 34 (1944) 224, t. 1. — *P. batanensis* YAMAMOTO, *l.c.* 226, t. 3. — *P. castanopsidifolia*

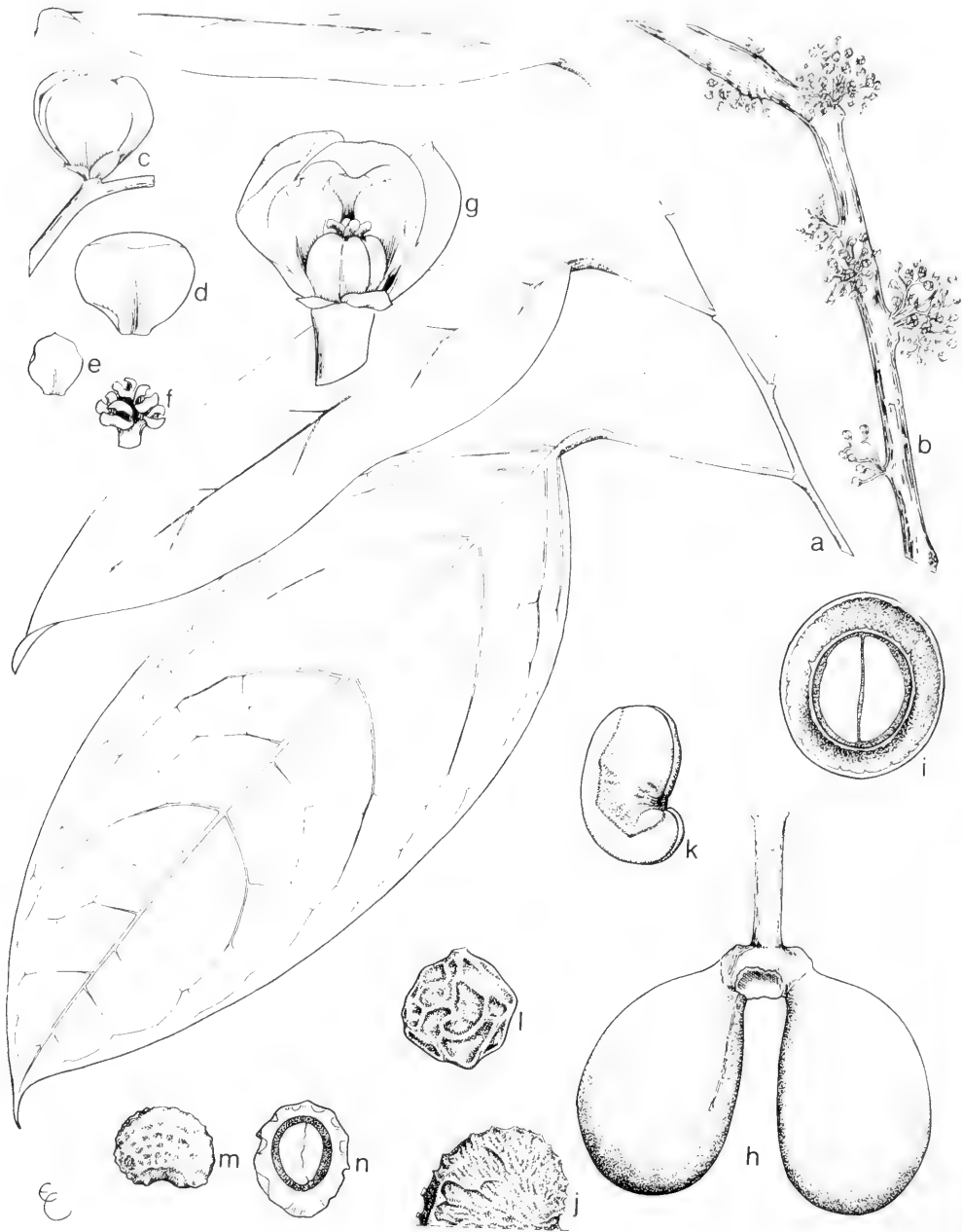


Fig. 1. *Pycnarrhena tumefacta* MIERS. a. Habit, $\times 2/3$, b. male inflorescences, $\times 2/3$, c.. male flower, $\times 8$, d. inner sepal, e. petal, f. stamens, all $\times 10$, g. female flower, front sepals and petals removed, $\times 8$, h. part of infructescence, i. TS of drupe, j. part of endocarp, k. seed, all nat. size. — *P. ozantha* DIELS. l. Drupe, m. endocarp, n. TS of drupe, all nat. size (a–b RSNB 4633, c–f DE VOGEL 4449, g RSNB 4436, h–k SAN 9413, l–n NGF 24162).

lia YAMAMOTO, l.c. t. 2 ('*castanopsisifolia*'). — **Fig. 1a-k.**

Leaves with glabrous to tomentellous petioles, 1–6 cm, sometimes markedly swollen and geniculate at apex; lamina narrowly to broadly elliptic, oblong-elliptic or oblanceolate-elliptic, apex acuminate, base rounded, obtuse or acute, 10–32 by 3.5–14 cm, main lateral nerves 6–9 pairs, venation often prominent on both surfaces, glabrous apart from midrib on lower surface which is sometimes puberulous, especially near the base. — *Male inflorescences* axillary or ramiflorous, cymose, few to several clustered together, 1–3 cm long, puberulous. — *Male flowers* sessile or on puberulous pedicels up to 3 mm; sepals pale green to white or yellow, outer sepals 2–4, minute, often puberulous; inner sepals 4–6, ± rotund, concave, 1.5–2.25 mm long, glabrous; petals 3–6, ± broadly obovate 0.75–1.5 mm long; stamens 6–18 in a cluster c. 0.75 mm long. — *Female inflorescences* similar to male but less branched, or unbranched (i.e. 1-flowered peduncles). — *Female flowers* (from RSNB 4436, Mt Kinabalu) on puberulous pedicels up to 15 mm long; outer sepals 3, broadly triangular, 1 mm long; inner sepals 4, ± broadly elliptic, rather thick, 2.5–3.5 mm long; petals 3, broadly obovate, thin, 2 mm long; carpels 3–4, subellipsoidal, 1 mm long, stigma recurved. (One immature female flower of JAHERI 1679 had 6 inner sepals, 2 petals and 4 carpels.) *Infructescence* when axillary usually fasciculate and peduncles unbranched, peduncles rather thick, 1–3 cm; when ramiflorous then branched and up to 7 cm. *Drupes* yellow to red, globose to broadly subellipsoidal, 1.5–3 cm long, glabrous; endocarp crustaceous, finely wrinkled.

Distr. Melanesia (Solomons); in *Malesia*: New Guinea (West, ?East), S. Moluccas (Kei Is., Halmahera), N. Moluccas (Obi I.), Celebes (Sangihe Is.), Philippines (Mindanao, Mindoro, Luzon, Palawan), Borneo (incl. Banguay I.) and Kangean Is. (Kaju Waru and Sipandjang Is.) off E. Java.

Ecol. Forests and thickets, up to 400 m, around Mt Kinabalu in N. Borneo at 1200–2000 m. The substratum in N. Borneo was defined as loam, sandstone and limestone. In Sarawak in peat-swamp forest. In Halmahera in disturbed primary forest on dry hillside with loose porous clayey soil. In N. Moluccas (Obi I.) on transition between coral sand beach and red porous nickel soil. *Fl.* Jan.–Sept., Dec., *fr.* Jan.–Dec.

Vern. Sarawak: *akah badi*, *aker tulang*. Halmahera: *ogumi besi*. Mindanao: *duluput*. W. New Guinea: *tekan*.

Notes. Some rather distinctive forms are apparent, which may later prove to be distinct species, but with the incomplete material so far available they are regarded here as all conspecific. Specimens from the peat-swamp forests of Sarawak have large, coarsely

reticulate leaves, and those from Mt Kinabalu have leaves with long petioles. In the Philippines, apart from the more typical, larger-leaved form, there is also a small-leaved plant exemplified by the synonym *P. castanopsisifolia*.

The extent of branching of the inflorescences depends on their position on the plant: those on younger, leafy stems are less branched than those on stems which are old and leafless. There is therefore a considerable difference between simple, short, axillary infructescences and those which are branched, elongate and ramiflorous. Herbarium specimens normally only show one or the other of these types.

The flowers are very fragrant.

The specimens cited in FORMAN (1972) from New Hebrides, New Ireland and New Britain belong to *P. ozantha*.

7. *Pycnarrhena ozantha* DIELS, Bot. Jahrb. 52 (1915) 187; FORMAN, Kew Bull. 26 (1972) 416. — *P. papuana* KANEH. & HATUS. Bot. Mag. Tokyo 56 (1942) 473. — **Fig. 11-n.**

Young stems and petioles puberulous, later glabrescent. *Leaves* with petioles (0.8–)1.2–2.3 cm; lamina mostly elliptic to oblong-elliptic, base rounded to cuneate, apex acuminate, 9–22 by 3–8 cm, lateral nerves 6–8 pairs, linking towards the margin, reticulation prominent below, glabrous apart from midrib below. *Inflorescences* axillary or ramiflorous, fasciculate (or few-flowered racemes *teste* DIELS). — *Male flowers* on puberulous pedicels 4–7 mm: sepals yellow, c. 10, glabrous, the larger inner ones rotund, 2–2.5 mm long, sometimes the innermost smaller; petals absent (occasionally 1); stamens 9–15, 1 mm tightly clustered. — *Female flowers*: sepals 12–15; petals absent; carpels 4–6, 1 mm. *Drupe* yellow to red, on slender 7–15 mm peduncle (incl. carpophore), subglobose, 1.2–2 cm ø, drying shrivelled with the surface forming irregular ridges, glabrous; endocarp bony, slightly curved, subreniform, bearing c. 5 dorsal rows of warty protuberances.

Distr. New Hebrides (Vanuatu); in *Malesia*: New Guinea, New Britain, New Ireland.

Ecol. Forests up to 1600 m. Among limestone outcrops (New Ireland), on coral limestone (New Hebrides), on red clay-loam with occasional basic volcanic boulders (New Britain). *Fl.* March, July, Sept., Dec., *fr.* Jan., March, Aug., Oct.

Vern. NE. New Guinea: *dodadud*, *Bilia*, *aikel*, *Amele*, *boak*, *Dumpu*.

Notes. The leaves are fragrant when crushed (CHEW RSNH 345) and the flowers are strongly scented (RAYNAL & GILLISON RSNH 16425). This species is notable in the genus for the lack usually of clearly differentiated petals and for the hard, bony, dorsally verrucose endocarp. The fruit wrongly described for this species in FORMAN, Kew Bull. 30

(1975) 98 was part of a mixed collection and represents *Macrococculus pomiferus* BECC.

The alkaloids of this species were investigated by LODER & NEARN in a study of tumour-inhibitory plants (Aust. J. Chem. 25, 1972, 2193).

Uncertain

Pycnarrhena montana BACK. [Bekn. Fl. Java (em. ed.) fam. 34 (1941) p. 7, descr. neerl.], Blumea 5

(1945) 493; BACK. & BAKH. f. Fl. Java 1 (1963) 154.

The plant represented by the above type-collection is possibly referable to *P. lucida* (see there) except that the flowers are much larger: the larger interior sepals 2.5 mm long; petals 3–4 (some laterally joined), oblate, 1 by c. 1.5 mm. The type-collection (KOORDERS 26732) with male flowers made in 1897 is the only one known. In absence of further material I prefer to regard *P. montana* as a species of uncertain status.

2. MACROCOCCULUS

BECC. Malesia 1 (1877) 160; DIELS, Pfl. R. Heft 46 (1910) 55, f. 18; Bot. Jahrb. 52 (1915) 187; Nova Guinea 14 (1923) 80; FORMAN, Kew Bull. 26 (1972) 418. — Fig. 2i–k.

Liane. Older branchlets producing conspicuous swollen cups around the bases of the petioles. *Leaves* with petioles swollen at the base and apex, lamina not or only slightly peltate, ± ovate, penninerved. *Inflorescences* cauliflorous, fasciculate. — *Male flowers* long-pedicellate; sepals in 5–6 whorls of 3 (*i.e.* 15–18 all together), imbricate; the outer 3–4 whorls minute, the inner 2–3 whorls much larger; petals 6, thick and fleshy; stamens 9 (a ring of 6 stamens slightly joined at the base surrounding 3 inner ones); anther-cells distinct, dehiscing by lateral, longitudinal slits; connective prolonged into a flattened tongue, filaments flattened. — *Female flowers* unknown; young infructescences indicate 5–10 carpels. *Drupe* large with style-scar lateral (adaxial) and inconspicuous, subglobose, narrowed at base into a stipe, radiating from margin of disciform carpophore; endocarp thinly bony, dorsally bearing a coarse network of ridges, ventrally smooth. Seed broadly ellipsoidal, covered with a reticulate membrane; endosperm absent; embryo straight, cotyledons very thick, partly rugulose, radicle short, thick.

Distr. *Malesia*: New Guinea (incl. New Britain, New Ireland). Monotypic.

Notes. BECCARI stated that the cotyledons are fused together into a solid mass from which the radicle is not differentiated, and that in these respects *Macrococculus* differs from *Pycnarrhena*. In the fruit of CLEMENS 631, however, the cotyledons are free, and when split apart the small radicle is discernible lying between the cotyledons at one end. Although *Macrococculus* appears to be very closely allied to *Pycnarrhena*, it is desirable, I feel, to maintain it as a distinct genus which can be distinguished especially by the stamens with their distinctive tongue-like prolongations and well developed, flattened filaments. The large fruits with a thick and bony endocarp, the more or less ovate, penninerved leaves and numerous sepals are further diagnostic features of *Macrococculus*.

1. *Macrococculus pomiferus* BECC. Malesia 1 (1877) 161; Bot. Jahrb. 52 (1915) 187; Nova Guinea 14 (1923) 80; FORMAN, Kew Bull. 26 (1972) 418. — Fig. 2i–k.

Branchlets glabrous becoming rather pale and mottled. *Leaves* with glabrous petioles 3–10 cm, in-

serted at the basal margin of the lamina (or 1–2 mm from it); lamina ovate, lanceolate-ovate or broadly elliptic, base slightly cordate to obtuse, apex acuminate, 8–25 by 5–13 cm, lateral nerves 5–6 pairs, both surfaces usually densely reticulate and glabrous, stiffly chartaceous to subcoriaceous. *Inflores-*

cences fasciculate, borne on protuberances on old wood. — *Male flowers* yellow on slender puberulous pedicels 1–4 cm; outermost sepals minute, scarcely 1 mm long, puberulous, larger inner 2 (or 3) whorls ± broadly elliptic, 2.5–3.5 mm long; petals 6, rotund to cuneate, 1.5 mm long, thick and fleshy; stamens 3 mm long, the outer 6 in a ring with their flattened filaments slightly joined at the base surrounding the 3 inner free stamens, the connective-appendages incurved. — *Female flowers* unknown but young infructescences indicate 5–10 carpels, pedicel becoming thickened, 2.5–3.5 cm. *Drupes* red, globose, or subpyriform, up to 10 by 8 cm (BECCARI), glabrous,

smooth; endocarp 3–6 cm ø, dorsally bearing 3–5 raised longitudinal ridges which are connected by anastomosing ridges forming a loose network.

Distr. *Malesia*: New Guinea (incl. New Britain, New Ireland).

Ecol. Forests, from sea-level to 1000 m.

Uses. BECCARI stated that the fruits are often eaten by cassowaries.

NOTE. The fruits and infructescences described under *Pycnarrhena ozantha* DIELS in FORMAN, Kew Bull. 30 (1975) 98 belong to *M. pomiferus*, the specimens being a mixture with leaves of *Pycnarrhena*.

3. ALBERTISIA

BECC. *Malesia* 1 (1877) 161; DIELS, Pfl. R. Heft 46 (1910) 97, f. 35; FORMAN, Kew Bull. 30 (1975) 82; *ibid.* 39 (1984) 113. — **Fig. 2a–h.**

Lianes. Branchlets bearing prominent discoid petiole-scars. *Leaves* with petioles conspicuously swollen at both ends; lamina ± elliptic, penninerved with 1–2 pairs of subbasal nerves (in *Mal. spp.*), the lateral nerves running alongside the midrib for some mm before departing from it. — *Male inflorescences* axillary or ramiflorous, cymose or fasciculate. — *Male flowers* with (1 or 2) outer whorls of 3 minute triangular sepals, the inner 3 sepals connate into a fleshy, corolliform tube with a minute apical opening; petals 3 or 6 (or 0 in *extra-Mal. spp.*), minute, fleshy; stamens *c.* 18–24, connate into a conical synandrium, anthers 2-celled, transversely dehiscent. — *Female inflorescences* mostly reduced to solitary flowers. — *Female flowers* (only known in *A. papuana*) with sepals and petals as in the male; staminodes 6; carpels 4–6 (–12 in *extra-Mal. spp.*), elongate-ovoid attenuated into a subulate style. *Drupes* radiating from the margin of a swollen, tomentellous carpophore terminating the peduncle, ± ellipsoidal, subcompressed, style-scar close to base, tomentellous; mesocarp granular (when dry); endocarp ± ellipsoidal, crustaceous or thinly woody, surface sublaevigate or slightly wrinkled. *Seed* straight or only slightly curved, ± ellipsoidal, without endosperm; cotyledons very thick.

Distr. 12 *spp.* in tropical and subtropical Africa; 5 *spp.* in Indo-Malesia, 3 of which in *Malesia*.

Notes. By merging the African genus *Epinetrum* the size and range of the genus was distinctly enlarged.

In the key to the Malesian species given below it should be noted that there were relatively few male flowers available for dissection; they had either 3 or 6 petals. With further material this difference may not prove to be constant.

KEY TO THE SPECIES

1. Lamina drying bullate, broadly elliptic to subobovate, 24–41 by 9–18 cm. Male flowers with 6 petals. Fruits *c.* 4 cm long 1. *A. crassa*
1. Lamina not drying bullate, narrower in shape and smaller than above. Petals 3.
2. Drupes 5–6 cm long. Lamina 9–13 (–15) by 3.5–4.5 (–6) cm. Male flowers in fascicles 2. *A. megacarpa*
2. Drupes 2.5–3.8 cm long. Lamina generally 19–32 by 7–14 cm. Male flowers in axillary or ramiflorous fascicles 3. *A. papuana*

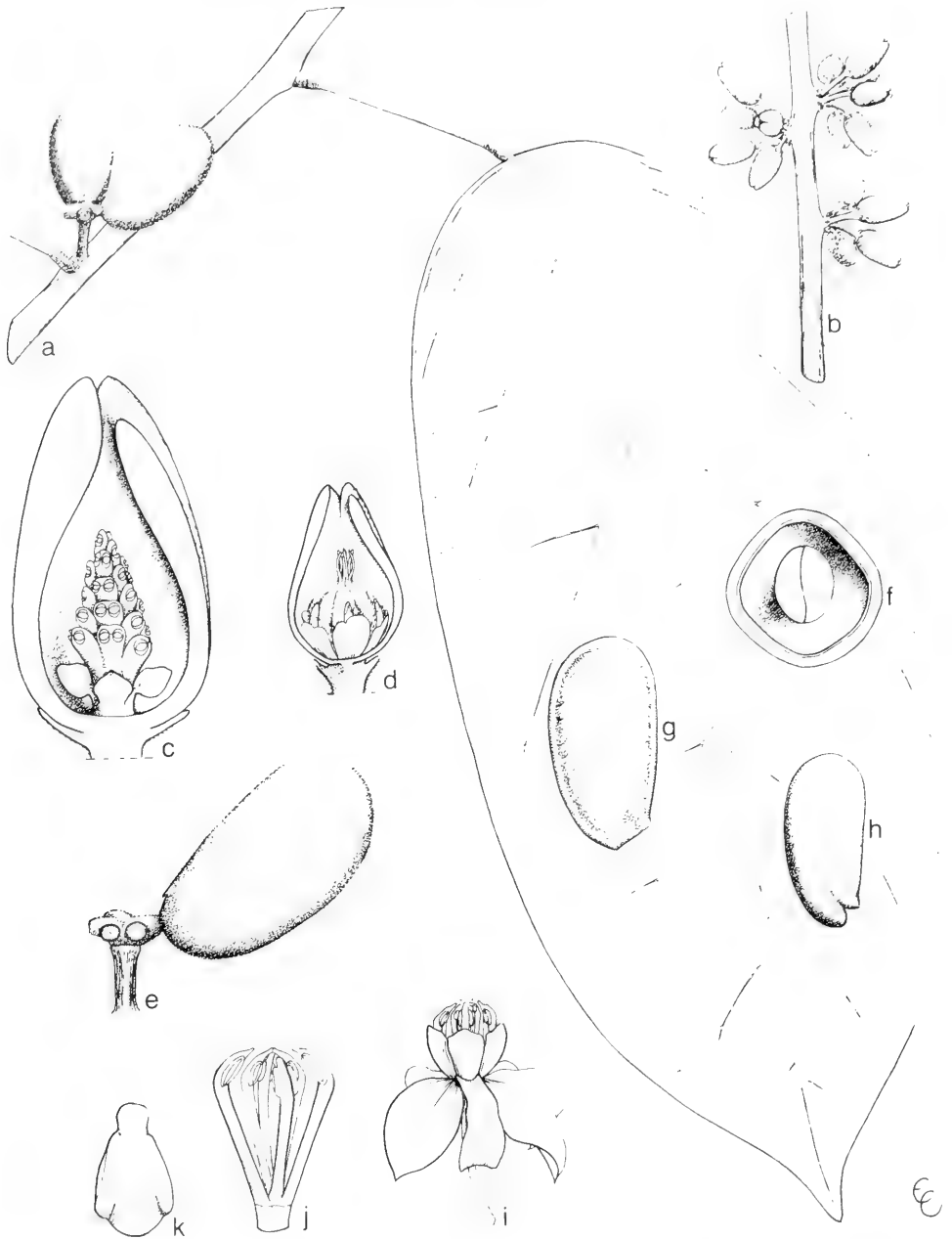


Fig. 2. *Albertisia papuana* BECC. *a.* Habit with infructescence, $\times 2/3$, *b.* male inflorescences, $\times 2/3$, *c.* male flower with half of inner calyx removed, $\times 4$, *d.* female flower with half of inner calyx removed, $\times 4$, *e.* drupe on carpophore, *f.* TS of drupe, *g.* endocarp, *h.* seed, all nat. size. — *Macrococculus pomiferus* BECC. *i.* Male flower, $\times 4$, *j.* stamens, $\times 12$, *k.* dorsal view of anther, $\times 30$ (*a, e-h* FORMAN 6A, *b-c* FORMAN 413, *d* FORMAN 6B, *i-k* NGF 20760).

1. *Albertisia crassa* FORMAN, Kew Bull. 30 (1975) 85.

Liane. Branchlets at first minutely tomentellous, later glabrescent, smooth. *Leaves* with petioles strongly thickened and tomentellous at base and apex, otherwise subglabrous, 5–8(–17) cm; lamina broadly elliptic or subovate, base cuneate (or rounded), apex abruptly and obtusely or long and very acutely acuminate, 24–41 by 9–18 cm, lateral nerves 3–4 pairs with the inner subbasal pair ascending beyond the middle of the lamina, nerves and reticulation prominent on both surfaces, strongly bullate, glabrous, thinly coriaceous. *Inflorescences* apparently axillary, otherwise unknown. — *Male flowers* ?fascicled; sepals: outer 3(+3) to 1.5 mm, tomentellous, inner calyx yellow, 10 mm, externally tomentellous; petals 6, thick and fleshy, broadly ovate, lateral lobes inflexed, 1 mm; synandrium 4–5 mm bearing c. 20 anthers. — *Female flowers* unknown. *Infructescence* a solitary peduncle in the axil of a leaf-scar. *Drupe* yellow, oblong-ellipsoidal, c. 4 by 2.7 cm, peduncle 4 mm ϕ , 1.5 cm long (incl. carpophore); endocarp 2.7–3 cm long, crustaceous with wall scarcely 1 mm thick.

Distr. *Malesia*: Malay Peninsula (Pahang, Selangor), 2 coll.

Ecol. In forests, 200 m.

Vern. *Akar cherat*, Temuan.

2. *Albertisia megacarpa* DIELS ex FORMAN, Kew Bull. 30 (1975) 85.

Large liane. Branchlets puberulous, glabrescent, smooth. *Leaves* with petioles swollen and sometimes puberulous at base and apex, otherwise subglabrous, 2.5–4.5 cm; lamina elliptic or elliptic-lanceolate, base cuneate, apex acuminate, 9–13(–15) by 3.5–4.5(–6) cm, main lateral nerves 4–5 pairs, nerves and reticulation prominent on both surfaces, glabrous but midrib sometimes puberulous below towards base, thinly coriaceous. — *Male flowers* in few-flowered fascicles in the axils of leaf-scars; pedicels tomentellous, 4–6 mm; sepals tomentellous, outer 3(?+3) triangular, 1 mm, inner calyx 5 mm; petals 3, unguiculate-ovate, recurved, 1 mm; synandrium 4 mm bearing c. 18 anthers. — *Female flowers* unknown. *Drupe* ellipsoidal, 5–6 by 3.5–4 cm, peduncles 1–1.5 cm long, 2–3 mm ϕ in the axils of leaf-scars on older branches; endocarp 3.5–4.7 by 1.8–2.3 cm, slightly rugose, with wall fibrous-woody, 2 mm thick.

Distr. *Malesia*: Malay Peninsula (Pahang: Cameron Highlands), 2 coll.

Ecol. Hill forest, 1500–1600 m.

3. *Albertisia papuana* BECC. *Malesia* 1 (1877) 162; BOERL. Cat. Hort. Bog. 1 (1899) 44, incl. *var. banca-na* BOERL. et *var. buruensis* BOERL.; DIELS, Pfl. R. Heft 46 (1910) 97, f. 13c–d & 35; FORMAN, Kew Bull. 30 (1975) 87. — **Fig. 2a–h.**

Large liane. Branchlets at first tomentellous, later glabrescent, rather smooth, drying blackish. *Leaves*: petioles with tomentellous swellings at both ends, otherwise subglabrous, 2–10 cm; lamina elliptic-oblong or elliptic, base cuneate to broadly rounded, apex acuminate, (11–)19–32 by (4–)7–14 cm, 1–2 pairs of subbasal nerves apart from 3–4 pairs of lateral nerves, nerves and reticulation raised on both surfaces, glabrous, upper surface often shining, thinly coriaceous. *Inflorescences* axillary and on older, leafless stems. — *Male flowers* in fascicles: pedicels 4–6 mm, tomentellous; outer sepals 3+3, 1.5 mm long, tomentellous; inner calyx creamy white to yellow, 10 mm long, externally tomentellous; petals 3, fleshy, oblate, scarcely 1 mm long, lateral margins inflexed; synandrium 5 mm long consisting of 24 stamens in 6 vertical rows of 4. — *Female flowers* solitary: pedicel and outer sepals similar to male, inner calyx 6 mm long; petals 6, \pm obovate, 1 mm long, glabrous; staminodes subulate, 2 mm; carpels 4–6, elongate-ovoid, 2.5 mm long, tomentellous, attenuated into a 1 mm long, subulate, glabrous style. *Drupe*s orange, oblong-ellipsoidal to obovoid-ellipsoidal, 2.7–3.8 by 2–2.6 cm, on peduncle c. 4 mm thick and 10 mm long; endocarp with a marginal raised ridge, 3 by 1.7 cm, smooth, crustaceous.

Distr. Thailand (Peninsular); in *Malesia*: N. Sumatra, Banka, W. Java, Borneo (Sarawak, ?Sabah), S. Celebes, Moluccas (Buru), New Guinea (incl. Aru Is.).

Ecol. Primary rain-forest at low altitude.

Uses. According to CHIN 2760 the plant is widely cultivated in Barak Distr., Sarawak for the leaves which are used as a flavour-enhancer in cooking; also the fruits are edible.

Vern. Sarawak: *bekai*, Kenyah.

Notes. Apart from complete material collected in New Guinea, isolated fruiting or sterile specimens from a wide geographical range appear to belong to this species. Fuller material is needed for confirmation.

Two collections from Sabah (KLOSS 19175 & 19179) are possibly *A. papuana*, but in their hairy stems and leaves resemble *A. mecistophylla* (MIERS) FORMAN from ASSAM.

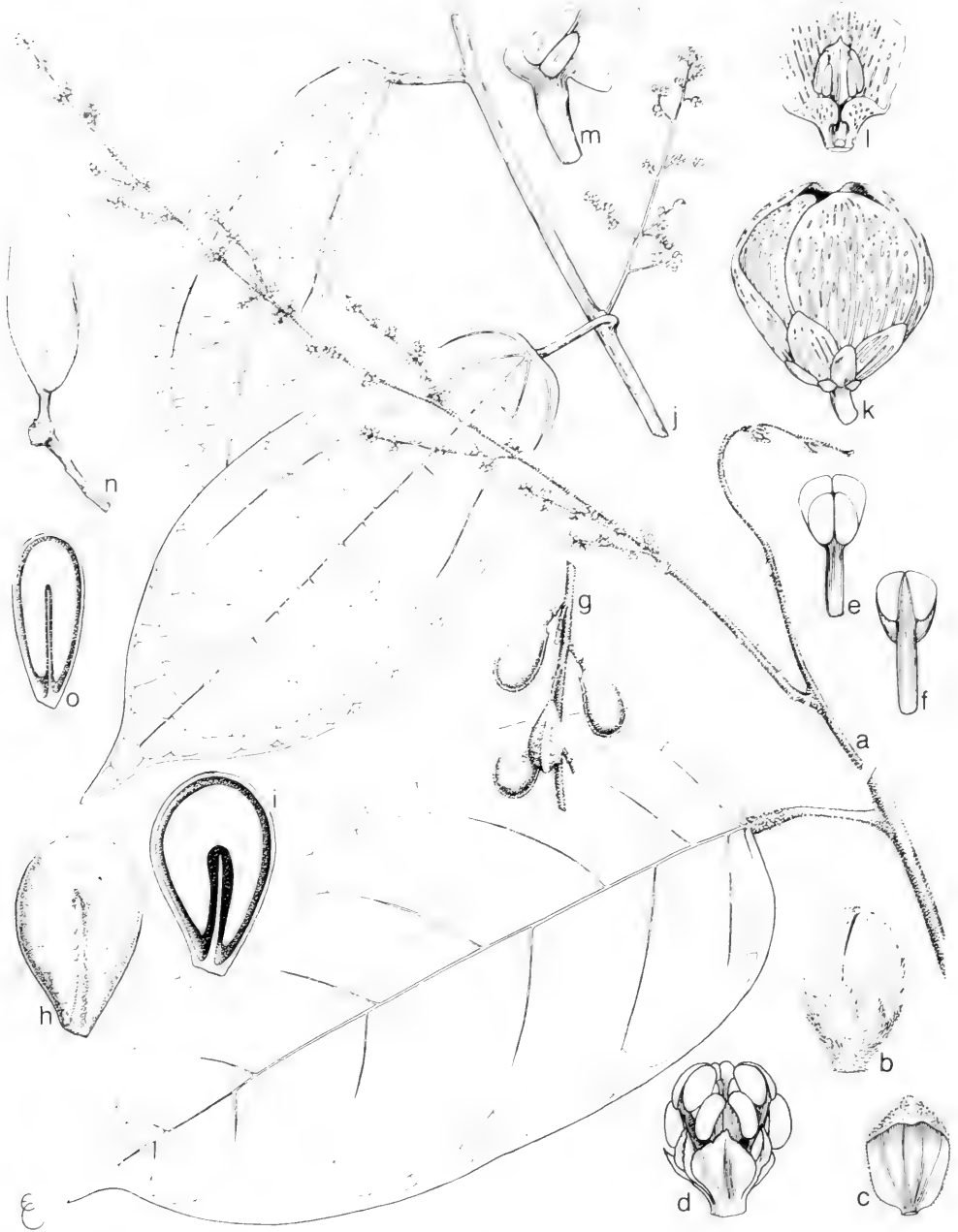


Fig. 3. *Carronia thyrsoflora* (BECC.) DIELS. *a*. Leaf with male inflorescence on young terminal part of shoot, $\times 2/3$, *b*. male bud with valvate inner sepals, $\times 10$, *c*. inner sepal, $\times 15$, *d*. male flower with sepals removed, *e*. stamen adaxial view, *f*. *ibid.* abaxial view, all $\times 20$, *g*. part of infructescence with drupes, $\times 2/3$, *h*. endocarp, $\times 2$, *i*. LS of endocarp (white) showing curved seed (white), $\times 2$. — *Haematocarpus subpeltatus* MERR. *j*. Habit, male plant, $\times 2/3$, *k*. male bud, $\times 8$, *l*. petal with stamen, adaxial view, *m*. *ibid.* side view showing adaxial projection, both $\times 20$, *n*. drupe on carpophore, *o*. LS of endocarp (white) showing curved seed (white), both $\times 2/3$ (*a-f* NGF 17701, *g-i* NGF 97719, *j-m* BS 33750, *n-o* Kloss 18690).

4. CARRONIA

F. v. M. Fragm. 9 (1875) 171; DIELS, Pfl. R. Heft 46 (1910) 75, f. 26; FORMAN, Kew Bull. 30 (1975) 94. — *Bania* BECC. Malesia 1 (1877) 161. — **Fig. 3a–i.**

Lianes. Branchlets often bearing prominent discoid petiole-scars. *Leaves* with lamina \pm elliptic, penninerved. *Inflorescences* axillary, terminal or ramiflorous, pseudo-spicate or thyrsoid (composed of pseudo-spikes), the flowers in congested clusters. — *Male flowers*: sepals 9–30 in whorls of 3, the inner ones larger, subcoriaceous, externally densely pilose, internally glabrous, the innermost whorl(s) valvate; petals 6, minute, \pm unguiculate; stamens 6, free, anthers introrse with vertical or oblique slits. — *Female flowers*: sepals and petals as in male; staminodes 0; carpels 6, densely pilose; styles erect, or recurved, subulate, glabrous. *Drupes* narrowed at base into a stipe or subsessile on gynophore, subobovoid or elongate-obovoid with style-scar near the base; endocarp with or without a dorsal ridge, surface knobbly, slightly rugose or almost smooth, condyle forming a longitudinal septum; seed horseshoe-shaped, endosperm absent, cotyledons thick, semi-cylindrical.

Distr. 2 spp. in Australia (New South Wales, Queensland) and 1 sp. in *Malesia*: New Guinea.

1. *Carronia thyrsoflora* (BECC.) DIELS, Pfl. R. Heft 46 (1910) 76, f. 26A–H; FORMAN, Kew Bull. 30 (1975) 96. — *Bania thyrsoflora* BECC. Malesia 1 (1877) 161; WARB. Bot. Jahrb. 18 (1893) 193; K. SCH. & LAUT. Fl. Deut. Schutzgeb. Südsee (1900) 315. — **Fig. 3a–i.**

Stems tomentellous at first, later glabrescent. *Leaves* with tomentellous to glabrous petioles 3–5 cm; lamina elliptic to ovate-elliptic, base rounded to slightly cordate, apex acuminate, 14–30 by 7–14 cm, main lateral nerves 7–8 pairs, the lowest 1–2 pairs arising at the base, upper surface glabrous with nerves usually drying impressed, lower surface softly pubescent to glabrous, stiffly papyraceous. — *Male inflorescences* ramiflorous or terminal, narrowly thyrsoid up to 22 cm with lateral branches up to 3.5 cm, greyish-brown tomentellous. — *Male flowers*:

cream-white sepals densely pale greyish-brown pilose outside, c. 9; innermost sepals valvate, broadly elliptic, concave 1.5 mm long; petals 6, unguiculate-ovate, 0.5 mm long, \pm equal; stamens 6, 0.75 mm long, anthers dehiscing vertically. — *Female inflorescences* similar to male, lateral branches less than 2 cm long. — *Female flowers* with c. 12 outer smaller sepals, inner sepals ovate, 1.5 mm long; petals as in male; carpels 6, gibbous-ovoid, 1 mm long, densely pilose; style subulate, recurved, glabrous. *Drupes* creamy grey to red borne on tomentellous stipes 2–4 mm long, subobovoid, 13–15 mm long, drying smooth without a prominent dorsal ridge, tomentellous; endocarp rather smooth with only a very weak dorsal ridge.

Distr. *Malesia*: New Guinea.

Ecol. Forests at low altitudes.

5. HAEMATOCARPUS

MIERS, Ann. Mag. Nat. Hist. ser. 3, 13 (1864) 124; *ibid.* ser. 3, 19 (1867) 194; Contr. Bot. 3 (1871) 323, t. 134; DIELS, Pfl. R. Heft 46 (1910) 56; FORMAN, Kew Bull. 26 (1972) 419; *ibid.* 30 (1975) 81. — *Baterium* MIERS, Ann. Mag. Nat. Hist. ser. 3, 13 (1864) 124. — *Fibraureopsis* YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 91, t. 1, p.p.; FORMAN, Kew Bull. 30 (1975) 81. — **Fig. 3j–o.**

Lianes. *Leaves* not peltate or very slightly peltate; lamina \pm elliptic, triplinerved. *Inflorescences* axillary, terminal or cauliflorous; paniculate or racemose. — *Male flowers*: sepals and petals streaked with dark red lines and spots;

sepals 12–15 in whorls of 3, imbricate, composed of 2 large inner whorls and 2–3 much smaller outer whorls; petals 6, the inner 3 auriculate at the base and clasping the opposite stamen; stamens 6, free, connective enlarged, projecting inwards (adaxially). — *Female flowers*: sepals and petals as in male flowers; staminodes 6, minute; carpels 6, style reflexed. *Drupe* large (c. 4 cm long), oblong-ellipsoidal, narrowed at the base into a stalk, style-scar near base; endocarp smooth with a thin inner longitudinal septum (*i.e.* condyle) around which the seed is bent double; endosperm absent; cotyledons long and thick, radicle short.

Distr. SE Asia (Assam, Bangladesh, Peninsular Thailand, Andaman Is.); in *Malesia*: Sumatra, W. Java, Borneo, Celebes and the Philippines.

Notes. The scanty material of this genus is inadequate to decide with certainty how many species should be recognized. It is difficult to assess the significance of some of the rather marked differences between specimens. In view of the nature of the material available I feel that the broader view of HOOKER *f.* & THOMSON of species is preferable and I therefore recognize only two species in the genus.

Baterium was first reduced by DIELS (1910).

KEY TO THE SPECIES

1. Leaves not peltate **1. *H. validus***
 1. Leaves peltate (petiole inserted c. 1 mm from basal margin of lamina) **2. *H. subpeltatus***

1. *Haematocarpus validus* (MIERS) BAKH. *f. ex* FORMAN [*nom. illegit.* in BACK. & BAKH. *f.* Fl. Java 1 (1963) 154], Kew Bull. 26 (1972) 420. — *Fibraurea haematocarpus* HOOK. *f.* & TH. Fl. Ind. 1 (1855) 204. — *Baterium validum* MIERS, Ann. Mag. Nat. Hist. ser. 3, 13 (1864) 124. — *H. comptus* MIERS, *ibid.* ser. 3, 19 (1867) 197, *nom. illegit.*; Contr. Bot. 3 (1871) 326, t. 134; DIELS, Pfl. R. Heft 46 (1910) 58, f. 54; BACK. Bekn. Fl. Java (em. ed.) 3 (1941) fam. 34: p. 8; YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 34. — *H. thomsonii* MIERS, Ann. Mag. Nat. Hist. ser. 3, 19 (1967) 197; Contr. Bot. 3 (1871) 325, t. 134; HOOK. *f.* & TH. Fl. Br. India 1 (1872) 106; DIELS, Pfl. R. Heft 46 (1910) 58; KANJILAL & DAS, Fl. Assam 1 (1934) 57. — *H. incusus* MIERS, Contr. Bot. 3 (1871) 327.

Branchlets slightly puberulous or glabrous. *Leaves*: petioles 1.2–3.5 cm, glabrous, attached at the margin of the lamina; lamina elliptic, slightly ovate-elliptic or slightly obovate-elliptic, rounded or obtuse at the base, acuminate (or rounded) at the apex, 7–16 by 3–8.5 cm, nervation mostly prominent, especially below. *Inflorescences* axillary, cauliflorous (or terminal) paniculate or subracemose, slightly puberulous or glabrous, up to 50 cm long with lateral branches up to 9 cm. — *Male flowers* on pedicels 2–4 mm; sepals, the outer ones minute (less than 1 mm long), ciliate, the inner ones larger, elliptic, 3 mm long, glabrous; petals ± broadly elliptic, 1.5–2 mm long; stamens 1 mm long with the connective much swollen on the adaxial side. — *Female*

flowers: sepals and petals as in male flowers; staminodes rod-like, 0.5 mm; carpels ovoid-ellipsoidal, 1 mm long, style sharply reflexed, about half the length of the carpel. *Drupe* red, obovoid-ellipsoidal, glabrous, 4.5 by 2.5 cm; embryo 3.5 cm long (measurements from material in alcohol).

Distr. SE. Asia; in *Malesia*: Sumatra (Atjeh, 1 coll.; Simalur I., 2 coll.; S. Palembang), W. Java (Priangan; Tjadasmalang, 1 coll.).

Ecol. In forests, 400–1200 m.

Ver n. W. Java: *areuy katyamang*, S; Simalur I.: *olor palinggam dotan, olor sigalinggam*, M.

Note. The very few known specimens of this species show a considerable range of characters, especially amongst the Assam specimens, three of which MIERS regarded as three distinct species.

2. *Haematocarpus subpeltatus* MERR. Philip. J. Sc. 14 (1919) 383; En. Philip. 2 (1923) 145; FORMAN, Kew Bull. 26 (1972) 421. — *Fibraurea chloroleuca* (non MIERS) MERR. Un. Cal. Publ. Bot. 15 (1929) 59. — *Fibraureopsis smilacifolia* YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 91, t. 1, *p.p.* — *Fibraurea elliptica* YAMAMOTO, Trans. Nat. Hist. Soc. Taiwan 34 (1944) 229, f. 4. — Fig. 3j–o.

Branchlets sparsely puberulous, glabrescent. *Leaves*: petioles 1.2–3 cm, glabrous or subglabrous, attached at c. 1 mm from the base of the lamina; lamina elliptic, subobovate-elliptic or ovate-lanceolate, base rounded to cordate, acuminate at the apex, 8–16 by 4–7 cm, nervation prominent on both sur-

faces. *Inflorescences* axillary or cauliflorous, 4–20 cm, either laxly paniculate with flowers mostly subsessile or racemose and few-flowered with pedicels 5–11 mm, sparsely puberulous or glabrous. — *Male flowers* mostly subsessile; sepals ciliate, especially the outermost minute ones, inner larger sepals elliptic, 3.5–4.5 mm; petals ± broadly elliptic, 3–3.5 mm; stamens 1 mm, connective produced on adaxial side into a thin vertical wing. — *Female flowers* un-

known. *Drupe* red, oblong-ellipsoidal, glabrous, 4 by 1.5 cm; seed 2.7 cm long (measurements from dried specimen).

Distr. *Malesia*: Sarawak (Kuching, 1 coll.), E. Borneo (W. Kutai: Belajan R., 1 coll.), N. Borneo (Tawao, Sandakan, 2 coll.), Celebes (NE. 1 coll., SE. 1 coll.), Philippines (Luzon, 2 coll.).

Ecol. Forests, from sea-level to 100 m.

6. TILIACORA

COLEBR. Trans. Linn. Soc. 13 (1821) 53; MIERS, Ann. Mag. Nat. Hist. ser. 3, 14 (1864) 252; Contr. Bot. 3 (1871) 75, t. 104; HOOK. f. & TH. Fl. Ind. (1855) 186; Fl. Br. India 1 (1872) 99; DIELS, Pfl. R. Heft 46 (1910) 59, f. 20–22; TROUPIN, Monogr. Menisp. afric. (1962) 47; FORMAN, Kew Bull. 30 (1975) 89; *ibid.* 37 (1982) 369. — **Fig. 9i–m.**

Lianes. Branchlets bearing prominent discoid petiole-scars. *Leaves* petiolate; lamina pinnately nerved, often with steeply ascending basal nerves, thus subpalmately nerved at base. *Inflorescences* axillary or cauliflorous, pseudo-racemose, composed of few-flowered, peduncled cymes or solitary flowers especially in female inflorescences. — *Male flowers*: sepals 6–12, the outermost smallest, the 3 innermost much larger and valvate (or subimbricate in Australian *sp.*); petals 3 or 6, minute; stamens 3–9, free (in Asia), anthers dehiscent with oblique or longitudinal slits, introrse. — *Female flowers*: sepals and petals as in male; staminodes absent; carpels (3–)8–12(–30 in Africa) inserted on a gynophore; style recurved or stigma sessile. *Drupes* subobovoid, stipitate (borne on branches of carpophore), remains of style near base; endocarp subobovoid with a straight groove running up the middle of each side, condyle forming a longitudinal septum, ornamented dorsally with transverse, branched ridges or almost smooth; seed horseshoe-shaped, endosperm deeply ruminate (in Asia); cotyledons elongate, flattened.

Distr. 19 species in tropical Africa and 2 in SE. Asia of which 1 in *Malesia* (Malaya), and 1 endemic in N. Australia.

1. *Tiliacora triandra* (COLEBR.) DIELS, Pfl. R. Heft 46 (1910) 62; RIDL, Fl. Mal. Pen. 1 (1922) 110; BURK. Dict. (1935) 2161; GAGNEP. Suppl. Fl. Gén. 1–C. (1938) 130; MARTIN, Introd. Ethnobot. Cambodge (1971) 62; FORMAN, Kew Bull. 30 (1975) 92. — *Cocculus triandrus* COLEBR. Trans. Linn. Soc. 13 (1821) 64. — *Menispermum triandrum* ROXB. [Hort. Beng. (1814) 72, *nomen*], Fl. Ind. ed. Carey 3 (1832) 816. — *Limacia triandra* (COLEBR.) HOOK. f. & TH. Fl. Ind. (1855) 188; Fl. Br. India 1 (1872) 100; MIERS, Contr. Bot. 3 (1871) 112; MIQ. Fl. Ind. Bat. 1, 2 (1858) 80; KURZ, Fl. Burma (1877) 55; KING, J. As. Soc. Beng. 58, ii (1889) 382; GAGNEP. Fl. Gén. 1–C. 1 (1908) 146. — **Fig. 9i–m.**

Stems puberulous to glabrous, striate. *Leaves* with puberulous to glabrous, rugulose petioles 0.5–2 cm; lamina elliptic, lanceolate or sometimes subovate, base cuneate to rounded (to subcordate), apex acute to obtuse, often acuminate, 6.5–11(–17) by 2–4(–8.5) cm, with 3–5 subpalmate basal nerves apart from 2–6 pairs of lateral nerves, main nerves tending to link up towards the margin, midrib on lower surface rugulose near the base, glabrous, stiffly papyraceous. *Inflorescences* axillary or cauliflorous, pubescent, 2–8(–17) cm long bearing 1–few-flowered peduncled cymes c. 0.5 cm long. — *Male flowers* yellow; inner sepals broadly elliptic 2 mm long, subglabrous; petals 3 or 6, cuneate, emar-

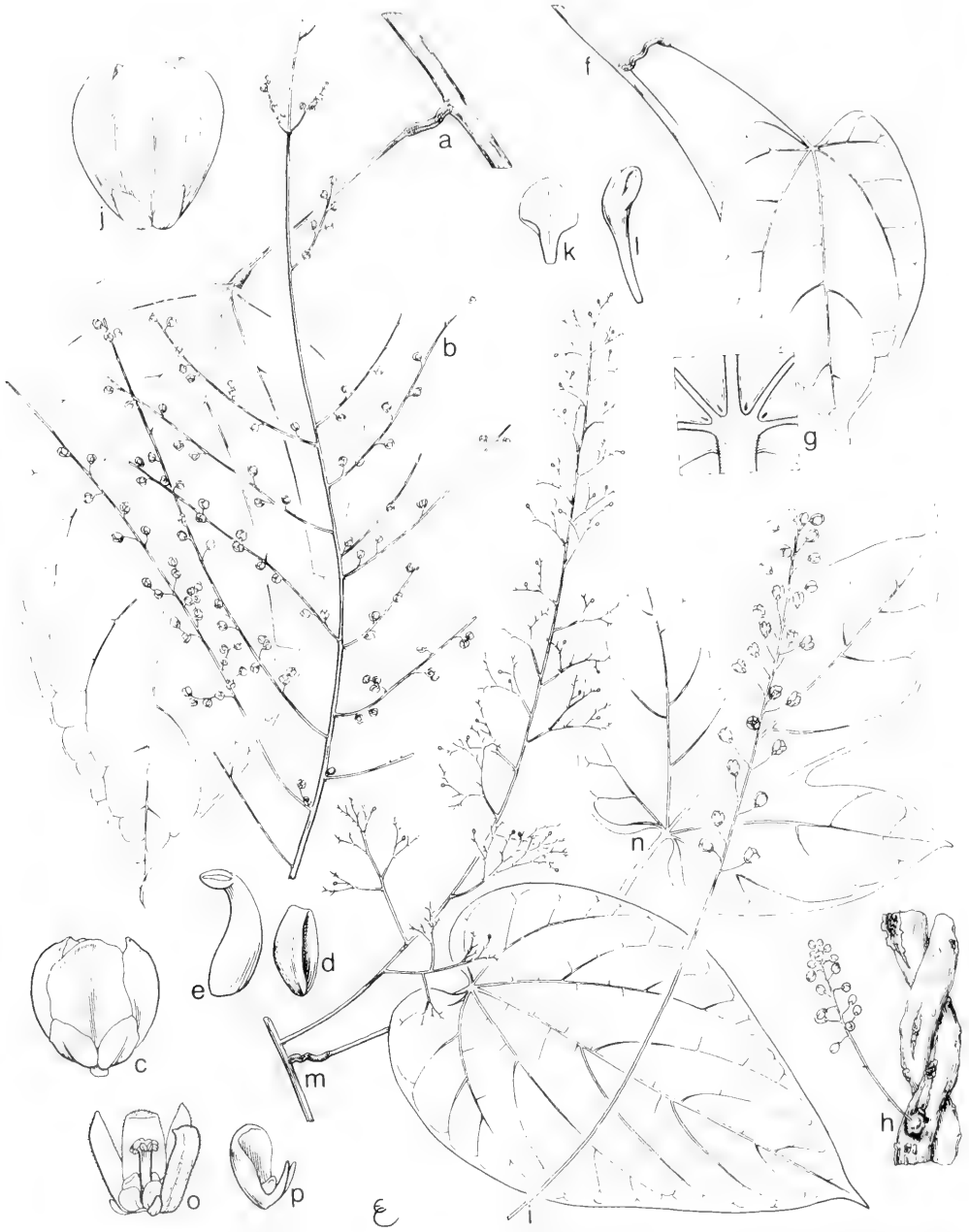


Fig. 4. *Chlaenandra ovata* MIQ. a. Leaf, $\times 1/2$, b. male inflorescence, $\times 1/2$, c. male flower, $\times 6$, d. petal, $\times 12$, e. stamen, $\times 12$. — *Tinospora glabra* (BURM. f.) MERR. f. Leaf, $\times 1/2$, g. domatia at leaf base, $\times 4$, h. young male inflorescence arising from old stem, $\times 1/2$, i. male inflorescence, $\times 1/2$, j. male flower, k. petal, l. stamen, all $\times 6$. — *Parabaena megalocarpa* MERR. m. Unlobed leaf with male inflorescence, $\times 6$, p. petal, side view, $\times 12$ (a NGF 47855, b–e SCHODDE 4443, f–g, i–l FORMAN 418, h JACOBS 4769, m SAN 1428, n–p S 36012).

ginate, 1 mm long, glabrous; stamens 3, clavate, 1.5–2 mm long. — *Female flowers*: inner sepals orbicular, 2 mm long, externally puberulous; petals 6, oblong-elliptic, 1 mm long; carpels c. 8–9, less than 1 mm long, borne on short branches of a glabrous gynophore; stigma sessile. *Drupe*s red, borne on a carpophore 3–4 mm long with branches 2–3 mm long, subcompressed, obovoid, 7–10 by 6–7 mm, glabrous; endocarp transversely and irregularly ridged.

Distr. S. Burma (once), Assam (Khasya), Thailand, Cambodia, Laos, Vietnam; in *Malesia*: Malaya (Kedah, Trengganu; also in Penang & Langkawi Is.), 4 coll.

Ecol. In Thailand: limestone hills, evergreen forest near sea and also by the side of streams in scrub

jungle at low altitudes up to 200 m; in Vietnam: on rocky and clayey soils up to 800 m; in Malaya: Kedah Peak at 1300 m alt.

Uses. Leafy shoots mixed with other plants are used in Cambodia for the preparation of a medicine for dysentery (MARTIN, 1971). Used for cordage in Vietnam. Widely used in Thailand as a flavouring in cooking.

Note. *Tiliacora triandra* was recorded from Fraser Hill (BURKILL & HOLTUM 8620) and Bukit Kutu (RIDLEY *s.n.*) in Malaya by BURKILL & HOLTUM (Gard. Bull. S. S. 3, 1923, 34). These records were based, however, on misidentified specimens of *Cyclea elegans* KING in the Singapore Herbarium.

7. CHLAENANDRA

MIQ. Ann. Mus. Bot. Lugd.-Bat. 4 (1863) 83; BECC. Malesia 1 (1877) 144; DIELS, Pfl. R. Heft 46 (1910) 131; FORMAN, Kew Bull. 39 (1984) 114, f. 1M–N. — *Porothea* K. SCH. in K. Sch. & Laut., Nachtr. Fl. Deut. Schutzgeb. Südsee (1905) 263. — Fig. 4a–e, 5m–n.

Large woody climber. *Leaves* with petiole swollen and geniculate at base, swollen at apex; lamina \pm ovate, entire, palmatinerved at base. *Inflorescences* borne on old, leafless stems, paniculate. — *Male flowers*: sepals 12 in 4 whorls of 3, the outermost whorls minute, the inner 2 whorls much larger and subequal; petals 6; stamens 6 with broad flattened filaments much broader than the small anthers. — *Female inflorescences* and flowers unknown. *Infructescences* paniculate, borne on old leafless stems, carpophores very short. *Drupe*s large; endocarp bony, densely covered with branched spines partly joined in longitudinal rows; condyle deeply intrusive into the seed-cavity and containing a hollow chamber subdivided by a thin median wall; seed deeply concave, curved around the intrusive condyle, with abundant endosperm, cotyledons very broad, radicle very short.

Distr. *Malesia*: New Guinea. Monotypic.

1. *Chlaenandra ovata* MIQ. Ann. Mus. Bot. Lugd.-Bat. 4 (1863) 84; BECC. Malesia 1 (1877) 144; DIELS, Pfl. R. Heft 46 (1910) 131, f. 48; RENDLE, J. Bot. 61, Suppl. (1923) 4; FORMAN, Kew Bull. 39 (1984) 115, f. 1M–N. — *Tinospora megalobotrys* LAUT. & K. SCH. Fl. Deut. Schutzgeb. Südsee (1900) 311. — *Porothea petiolata* K. SCH. in K. Sch. & Laut., Nachtr. Fl. Deut. Schutzgeb. Südsee (1905) 263. — Fig. 4a–e, 5m–n.

Large woody climber, entirely glabrous. Young stems finely striate, bearing prominent discoid petiole-scars; old stems covered with rough, ridged bark. *Leaves* with petioles 5–9 cm, strongly thick-

ened and geniculate in basal 1–1.5 cm, also shortly thickened at apex; lamina ovate, 12–19 by 7–12 cm, base rounded or slightly cordate, apex acuminate, palmately 3–5-nerved at base with 3–4 pairs of distal lateral nerves which run alongside midrib for several mm before departing from it, reticulation fine and prominent on both surfaces, thinly coriaceous. — *Male inflorescences* borne on old, leafless stems, paniculate, up to c. 50 cm long with spreading lateral branches up to 15 cm. — *Male flowers* on pedicels up to 5 mm: sepals yellowish, 6 minute outermost sepals less than 1 mm long, 6 main sepals broadly obovate to oblate, concave, 2–2.5 mm long; petals 6, broadly

elliptic, 1.25 mm long; stamens 6, 2 mm long, filaments flattened, elliptic, much broader than the anthers. — *Female inflorescences* and flowers unknown. *Infructescences* c. 50–60 cm long, lateral branches up to 20 cm, fruit-peduncles 2–3 cm, carpophores subdiscoid, 1–2 mm long. *Drupes* reddish with glaucous bloom, ovoid to globose, 5–6 cm σ when fresh, 4–4.5 cm σ when dry; endocarp subglobose, c. 4 cm σ , densely covered with branched spines c. 5 mm long partly joined in longitudinal rows, the hollow intrusive condyle with a ventral external opening bordered with spines, the seed-cavity a hollow subhemisphere (*i.e.* cupular). *Seed* con-

forming to the seed-cavity, ventrally deeply concave, (according to BECCARI) the dorsal surface irregular, with copious uniform endosperm.

Distr. *Malesia*: New Guinea.

Ecol. Lowland swamp- and rain-forest, and periodically flooded riverine forest, on sandy clay or clay, up to 1200 m. BECCARI stated that the fruits, like the large fruits of *Macrococcus pomiferus* BECC., are avidly eaten by cassowaries. *Fl.* March–April, Sept.; *fr.* July–Jan.

VERN. W. New Guinea: *iebwooneer*, Kebar; SE. New Guinea: *pfagabuba*, Kutubu.

8. TINOSPORA

MIERS, Ann. Mag. Nat. Hist. ser. 2, 7 (1851) 35; HOOK. *f.* & TH. Fl. Ind. (1855) 182; MIERS, Ann. Mag. Nat. Hist. ser. 3, 13 (1864) 315; Contr. Bot. 3 (1871) 30; HOOK. *f.* & TH. Fl. Br. India 1 (1872) 96; DIELS, Pfl. R. Heft 46 (1910) 133, f. 49; TROUPIN, Monogr. Menisp. afric. (1962) 191; BACK. & BAKH. *f.* Fl. Java 1 (1963) 157; FORMAN, Kew Bull. 36 (1981) 379; *ibid.* 39 (1984) 112. — *Hypsipodes* MIQ. Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 82. — *Fawcettia* F. v. M. Fragm. 10 (1877) 93; F.M. BAILEY, Queensl. Fl. 1 (1899) 29; DIELS, Pfl. R. Heft 46 (1910) 133. — **Fig. 4f–1, 6, 7.**

Woody climbers. Stems with bark often becoming detached on drying, sometimes pergamentaceous. *Leaves* with petiole swollen and geniculate at base, lamina often \pm cordate, margin usually entire, occasionally dentate, rarely 3-lobed, palmatinerved mostly with 3–5 basal nerves and 1–3 pairs of distal lateral nerves, sometimes with domatia or glandular patches present in the basal nerve-axils. *Inflorescences* thyrsoïd, pseudopaniculate, pseudoracemose or pseudospicate, in some species not coetaneous with the leaves. — *Male flowers*: sepals usually free, rarely joined at base, 6 (occasionally 1–3 additional minute outer ones present), outer 3 usually smaller, sometimes subequal, sepals \pm elliptic, often membranous; petals 6, occasionally 3, often broadly cuneate-ovate with the lateral edges inrolled, usually fleshy and often glandular-papillose externally towards the unguiculate base; stamens 6 and free (in Asia). — *Female flowers*: sepals and petals similar to male except petals often narrower; staminodes 6, subulate; carpels 3, curved-ellipsoidal, stigma reflexed with short, pointed lobes. *Drupes* borne on a short or columnar carpophore, style-scar terminal; endocarp bony, dorsally convex and often verrucose or tuberculate, ventrally with central aperture leading to a cavity (the condyle) or with shallow longitudinal groove; seed with endosperm usually ruminant.

Distr. An Old World genus of 32 species: 7 in tropical Africa, 2 in Madagascar, 23 in Asia to Australia and the Pacific, throughout *Malesia*.

Ecol. An important study by Dr. H. BÄNZIGER on fruit-piercing moths in Thailand (Mitt. Schweiz. Entomol. Ges. 55, 1982, 213–240) has demonstrated the important role played by species of *Tinospora* in the bio-

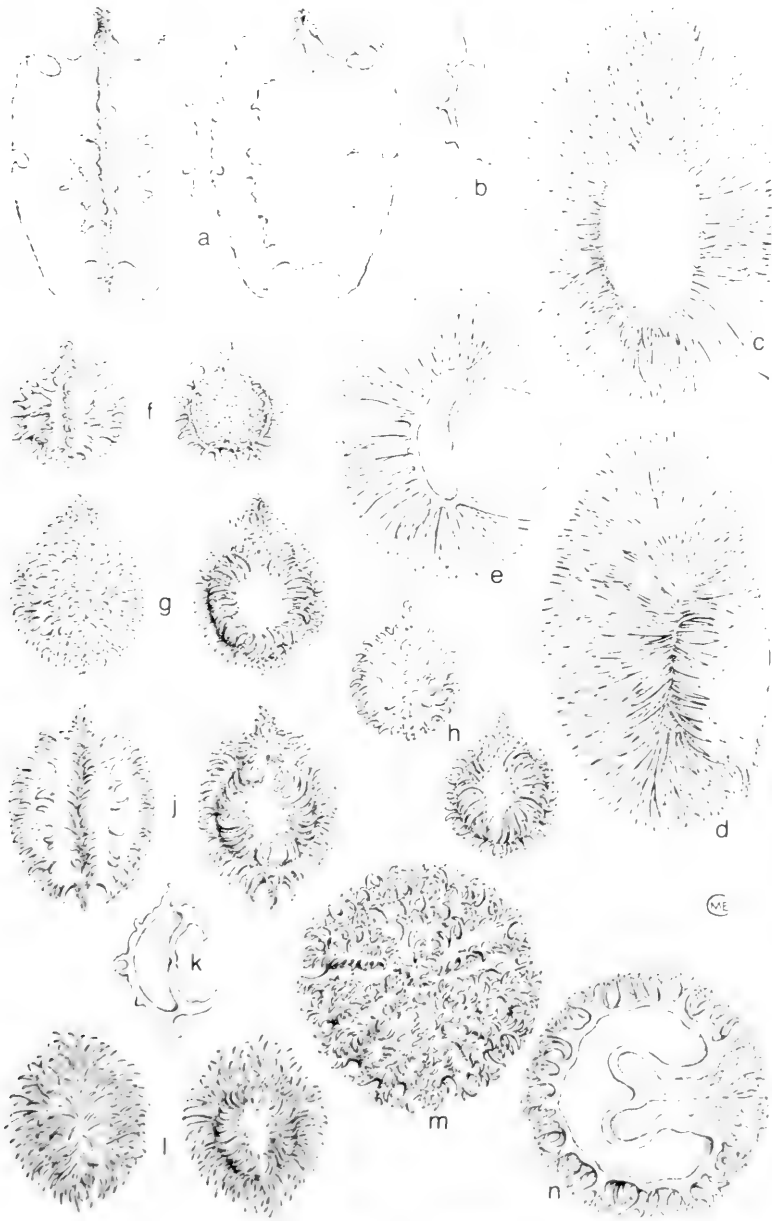


Fig. 5. Endocarps of *Tinosporeae*. *a-b*. *Aspidocarya uvifera* HOOK. f. & TH. *a*, dorsal and ventral views, *b*, in CS; *c-e*. *Parabaena megalocarpa* MERR. *c*, ventral view, *d*, lateral view, *e*, in CS; *f*. *P. sagittata* MERR. ex HOOK. f. & TH. dorsal and ventral views; *g*. *P. elmeri* DIELS, dorsal and ventral views; *h*. *P. denudata* DIELS, dorsal and ventral views; *j-k*. *P. tuberculata* BECC. *j*, dorsal and ventral views, *k*, in CS; *l*. *P. echinocarpa* DIELS, dorsal and ventral views; *m-n*. *Chlaenandra ovata* MIQ. *m*, lateral abaxial view, *n*, in CS. All $\times 3$ (*a-b* GAMBLE 9682, *c-e* CLEMENS 26222, *f* GAMBLE 9712, *g* LOHER 1975, *h* BS 43053, *j-k* NGBF 1065, *l* ELMER 14224, *m-n* SCHODDE 2428). Drawn by Mrs. M. Church. Courtesy Kew Bulletin.

logical chain which leads to extensive damage to certain fruit crops in Thailand. Longan (*Dimocarpus longan* LOUR.) and citrus including mandarin are the main crops damaged by noctuid *Lepidoptera* which feed on the sap by piercing the skin of the fruits. In Thailand the moth mainly responsible is *Othreis fullonia*. Dr. BÄNZIGER has demonstrated that the chief host plants for the larval stage are *T. sinensis* and *T. crispa* throughout Thailand and *T. baenzigeri* in Central, S. and NE. Thailand. Other species of *Menispermaceae* also act as hosts for the larvae, especially in periods when these species of *Tinospora* are leafless during the dry season, which is more prolonged in the north. These three species of *Tinospora* in Thailand are typical components of secondary vegetation, where forest has been destroyed or disturbed. The exceptional capacity of these climbers to survive damage and to regenerate from detached lengths of stem encourages their spread in these disturbed habitats. It is therefore apparent that destruction of forests in Thailand leads to the spread of *Tinospora*, which in turn promotes the increase of noctuid moths, which damage the fruit crops.

Morph. There are various types of inflorescence in the genus and the flowers also vary appreciably. The flowers are basically arranged in cymes, but these are sometimes reduced to single flowers, which can be sessile. The inflorescences can be apparently paniculate, racemose or spiciform. A thyse, consisting of a raceme of lax cymes, occurs in *T. trilobata*. A pseudopaniculate inflorescence occurs in *T. dentata* and *T. dissitiflora*, and apparently also in *T. arfakiana* and *T. hirsuta*, where only infructescences are known.

The sepals of *T. trilobata* are unusual in being connate at the base, while in the other species they are completely free. Most species have unequal sepals, the outer whorl of three being smaller, but in *T. dentata*, *T. homosepala*, *T. sumatrana*, *T. trilobata* and sometimes in *T. sagittata* they are subequal. In *T. tinosporoides*, *T. trilobata* (and occasionally in *T. cordifolia* and *T. merrilliana*) there are up to three minute sepals in an additional outer whorl. The petals are generally 6 in number, opposite to the equal number of stamens, but in *T. crispa* only the outer whorl of three petals usually develops. Although minute in size, the petals do vary in form between species but fortunately we do not have to rely on them in order to distinguish the species.

Phytochemistry. BISSET (Kew Bull. 36, 1981, 377; *ibid.* 39, 1984, 100) discussed the fairly numerous researches on alkaloids and bitter substances found in the species, and provided a bibliography.

Uses. Various species are used for medicinal purpose; see for example under *T. crispa*.

Notes. *Tinospora* has proved particularly difficult to revise owing to the incompleteness of the material of several species and the fact that some species flower when the plants are leafless.

If complete material were known for all the species, it should not be difficult to provide separate keys for male flowering, female flowering and fruiting plants. Male flowers, female flowers or fruits are unknown for some species, and it is therefore impossible at present to provide a key using only morphological characters which would work for every single specimen, whether flowering or fruiting.

KEY TO THE SPECIES

1. Leaves deeply 3-lobed **1. *T. trilobata***
1. Leaves not deeply lobed, margin entire, toothed or only slightly lobed.
 2. Leaf-margin irregularly toothed (Taiwan) ***T. dentata***
 2. Leaf-margin entire or slightly lobed.
 3. Leaves very narrow, 0.4–2 cm broad (Australia) ***T. angusta***
 3. Leaves broader.
 4. Leaves hairy (sometimes sparsely) beneath.
 5. Leaves sagittate to hastate (China, Vietnam) ***T. sagittata***
 5. Leaves \pm ovate.
 6. Leaves puberulous above, tomentellous or rather densely puberulous beneath (SE. Asia, S. China, Hongkong, Hainan) ***T. sinensis***
 6. Leaves glabrous above.
 7. Fine reticulation not or scarcely visible on both surfaces, which dry minutely wrinkled; uncinat hairs absent from main nerves beneath **2. *T. merrilliana***
 7. Fine reticulation raised on both surfaces; some uncinat hairs present on main nerves beneath **3. *T. hirsuta***
 4. Leaves glabrous beneath.
 8. Leaves narrowly elliptic to elliptic.
 9. Leaf-base sagittate **4. *T. celebica***
 9. Leaf-base rounded or subtruncate **5. *T. glandulosa***
 8. Leaves \pm ovate, rotund or triangular.

10. Inflorescences appearing when plant is leafless.
11. Stems strongly tuberculate (tubercles may be little-developed on young stems). Leaves lacking hollow domatia in basal nerve-axils. Petals usually 3. Endocarp 11–13 mm long. **6. *T. crispa***
11. Stems not tuberculate; petals 6.
12. Leaves with a pair of hollow domatia on lower surface in basal nerve-axils. Petals usually 6. Endocarp 7–9 mm long **7. *T. baenzigeri***
12. Leaves with glandular patches on lower surface in basal nerve-axils, \pm triangular with sides straight or sometimes concave towards base. Endocarp shortly pointed at both ends (Australia) ***T. smilacina***
10. Inflorescences appearing together with leaves.
13. Leaves 18–28 by 11–23 cm, thinly coriaceous, lacking domatia or glandular patches in basal nerve-axils. Endocarp 1.7–2.4 cm long, surface very smooth, whitish **8. *T. arfakiana***
13. Leaves smaller and thinner, sometimes with domatia or glandular patches in basal nerve-axils. Endocarps not as above.
14. Leaves drying matt and minutely wrinkled, fine reticulation not or scarcely visible on either surface, main nerves usually impressed on upper surface. Petals unguiculate, apically subreniform and markedly thickened. Endocarp thinly crustaceous, broadly elliptic in outline, 7–8 mm long, surface smooth or obscurely tuberculate **2. *T. merrilliana***
14. Characters not combined as above.
15. Inflorescences with lateral branches, at least towards base. Leaves with very fine, raised reticulation, glandular patches present in basal nerve-axils. Flower-pedicels 5–10 mm. Endocarps 10–12 mm long, strongly tuberculate **9. *T. dissitiflora***
15. Inflorescences unbranched.
16. Flowers in sessile clusters; inflorescences sometimes zigzag. Endocarps 3.5–4.5 cm long.
17. Sepals subequal **10. *T. sumatrana***
17. Sepals unequal, the outer 3 much smaller than the inner 3 **11. *T. macrocarpa***
16. Flowers pedicellate; inflorescences always straight. Endocarps up to 2.5 cm long.
18. Leaves with a pair of domatia in basal nerve-axils. Endocarp 2–2.5 cm long, the surface bearing scattered spinules **12. *T. teijsmannii***
18. Leaves with glandular patches or domatia (rarely neither) in basal nerve-axils. Endocarp 6–8 mm long, pointed at both ends.
19. Leaves with domatia usually present in basal nerve-axils (replaced by glandular patches in New Guinea). Flower-pedicels 8–12 mm. Outer sepals much smaller than inner sepals **13. *T. glabra***
19. Leaves with glandular patches in basal nerve-axils. Flower-pedicels 1–5 mm.
20. Male inflorescences 4–7 cm long; male flower-pedicels 1–2.5 mm. Drupes borne on a \pm subglobose or shortly 3-branched carpophore, 1.5–2 mm long (Australia) . ***T. smilacina***
20. Male inflorescences (5–)7–15 cm long; male flower-pedicels 4–5 mm. Drupes borne on a columnar carpophore, 4–5 mm long **14. *T. subcordata***

1. *Tinospora trilobata* DIELS, Pfl. R. Heft 46 (1910) 144; WINKLER, Bot. Jahrb. 49 (1913) 369; MERR. En. Born. (1921) 249; YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 96; FORMAN, Kew Bull. 36 (1981) 381, f. 1A.

Slender climber. Stems drying striate, bearing short to long rigid hairs. *Leaves*: petioles 3–12 cm, hispid to hispidulous; lamina deeply 3-lobed, lobes subelliptic to subtriangular and acuminate at the apex, base deeply cordate, 9–18 by 10–16 cm, both surfaces hispid or hispidulous, papyraceous. — *Male inflorescences* supra-axillary, thyrsoid consisting of a raceme of lax cymes, hispidulous, 15–22 cm long, lateral branches 3–4.5 cm. — *Male flowers* on slender pedicels c. 5 mm; sepals yellow, joined at the base, glabrous or sparsely hispidulous, 1–2 additional minute outermost sepals present, outer 3 narrowly

elliptic, 2.5–3 mm long, inner 3 broadly elliptic, 2–2.5 mm long; petals 6, cuneate, fleshy with lateral edges incurved, 1 mm long and broad; stamens 6, very short and thick, 1–1.5 mm long, filaments thickened apically and adaxially with the anthers horizontal and extrorse. — *Female flowers* and *fruits* unknown.

Distr. Malesia: Borneo; 6 coll.

Ecol. Primary forest, 100–1000 m, in Sarawak recorded on limestone.

Note. A very distinctive species in the genus on account of its deeply lobed leaves, sepals joined at the base and form of the stamens. It is unfortunate that the fruits have not yet been collected; they are needed to confirm the generic position of the species.

2. *Tinospora merrilliana* DIELS, Pfl. R. Heft 46

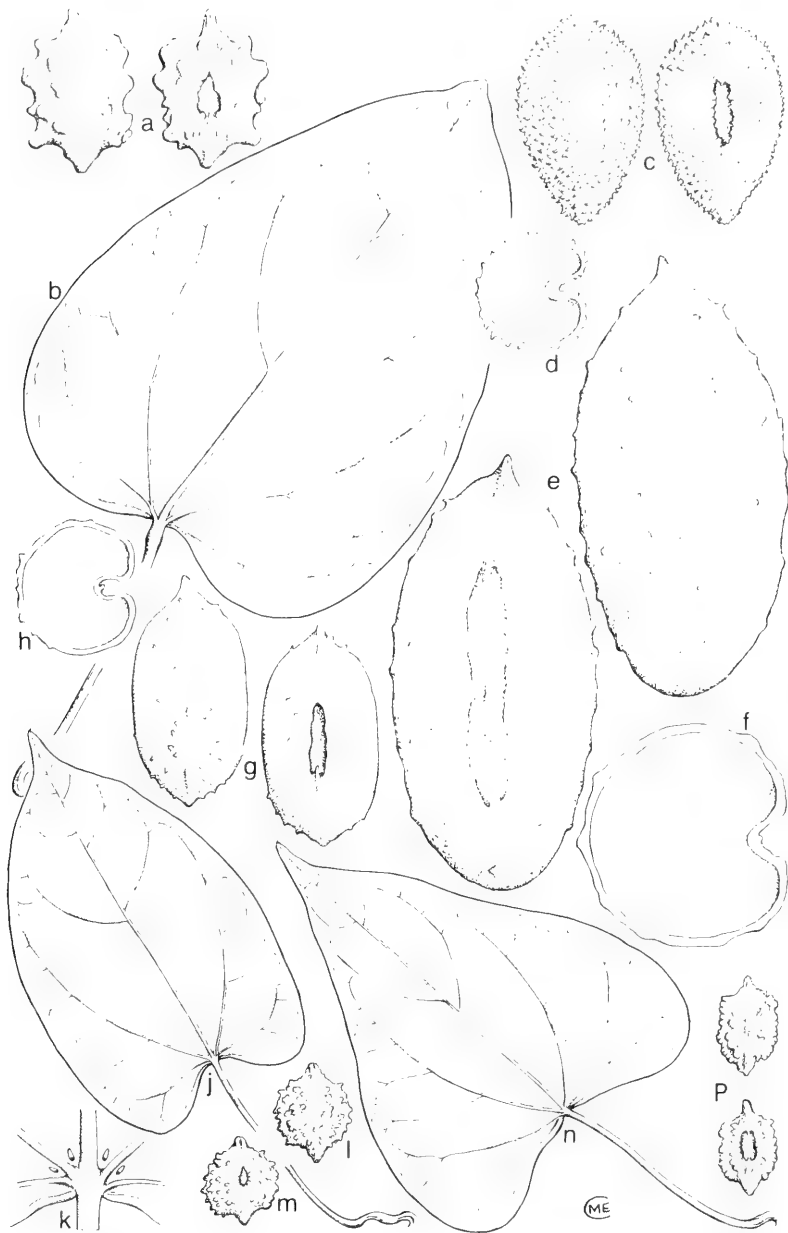


Fig. 6. *Tinospora dissitiflora* (LAUT. & K. SCH.) DIELS. *a*. Endocarp, dorsal and ventral views, $\times 2$. — *T. tinosporoides* (F. v. M.) FORMAN. *b*. Leaf, $\times 2/3$, *c*. endocarp, dorsal and ventral views, *d*. in TS, all $\times 2$. — *T. macrocarpa* DIELS. *e*. Endocarp, dorsal and ventral views, *f*. in TS, all $\times 2$. — *T. teijsmannii* BOERL. *g*. Endocarp, dorsal and ventral views, *h*. in TS, all $\times 2$. — *T. glabra* (BURM. f.) MERR. *j*. Leaf, $\times 2/3$, *k*. leaf base with domatia, $\times 4$, *l*–*m*. endocarp, dorsal and ventral views, $\times 2$. — *T. subcordata* (MIQ.) DIELS. *n*. Leaf, $\times 2/3$, *p*. endocarp, dorsal and ventral views, $\times 2$ (*a* NGF 44584, *b* NSW 90151, *c*–*d* FAWCETT *s.n.*, *e*–*f* KL 2190, *g*–*h* Hort. Bogor., *j*–*k* FORMAN 418, *l*–*m* JACOBS 4758, *n* ZIPPELIUS *s.n.*, *p*. KOCH *s.n.*). Drawn by Mrs. M. Church. Courtesy Kew Bulletin.

(1910) 137; in Elmer, Leaflet. Philip. Bot. 4 (1911) 1164; MERR. En. Philip. 2 (1923) 146; FORMAN, Kew Bull. 36 (1981) 389, f. 1H-K. — *T. negrotica* DIELS, Pfl. R. Heft 46 (1910) 137; in Elmer, Leaflet. Philip. Bot. 4 (1911) 1164; MERR. En. Philip. 2 (1923) 146; YAMAMOTO, Trans. Nat. Hist. Soc. Taiwan 34 (1944) 307, incl. var. *monticola* YAMAMOTO. — *T. havilandii* DIELS, Pfl. R. Heft 46 (1910) 138; MERR. En. Born. (1921) 249; YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 217. — *Parabaena amplifolia* DIELS, Pfl. R. Heft 46 (1910) 146; MERR. En. Born. (1921) 249; YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 96. — *T. hastata* ELMER, Leaflet. Philip. Bot. 10 (1939) 3760. — *Fawcettia merrilliana* (DIELS) YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 230.

Slender woody climber. Stems up to 1 cm ϕ ; young stems 2–3 mm ϕ drying striate, puberulous or glabrous; older stems covered with raised corky lentils. *Leaves*: petioles 2–9 cm, puberulous (sometimes hispidulous) or glabrous, geniculate and slightly swollen at base; lamina narrowly ovate to ovate (or broadly ovate) or triangular, base truncate to deeply cordate or hastate with acute basal lobes, apex acuminate, 7–22 by 3–16.5 cm, palmately 5–7-nerved at base, main nerves usually impressed on upper surface and prominent below, both surfaces glabrous or sometimes puberulous (or hispidulous) along nerves especially below, both surfaces drying matt and minutely wrinkled, texture stiffly papyraceous, domatia absent. — *Male inflorescences* axillary or arising from older leafless stems, pseudo-racemose (or narrowly 'paniculate'), solitary or several arising together, 5–16 cm long, very slender, puberulous, mostly without flowers in lower half. — *Male flowers* on pedicels 1–5 mm; sepals pale green, very thin, glabrous or sparsely puberulous, (sometimes with 1–2 additional outermost oblong sepals 0.5 mm long), outer 3 \pm ovate, 0.5–1.5 mm long, inner 3 obovate to spatulate, 1.5–2.5 mm long; petals 6, unguiculate with subreniform limb, 1.5 mm long, apically fleshy; stamens 6, narrowly clavate, 2 mm long. — *Female flowers* and *inflorescences* unknown. *Infructescences* narrowly pseudo-paniculate, up to 40 cm, pendent with long slender peduncle up to 23 cm, puberulous. *Drapes* pinkish white or white, radiating from a subglobose carpophore 1–2 mm ϕ on a peduncle 4–6 mm; pericarp glabrous, drying close to endocarp, the endocarp thinly crustaceous, usually pale, broadly elliptic in outline, 7–8 mm long, dorsally with an obscure medium ridge, surface smooth or obscurely tuberculate, ventrally flattish with elliptic aperture leading to deeply intrusive condyle.

Distr. *Malesia*: Borneo, Philippines (Palawan, Luzon, Catanduanes, Panay, Mindanao) and NE. Celebes (Minahassa).

Ecol. Forests up to 1800 m and in Luzon in thickets on limestone cliffs, in Palawan on limestone hill.

Fl. Nov.–May, *fr.* Febr.–Oct.

Vern. Philippines: *cangogang*, *pisok*, Luzon; *balang-batang*, Negros; *columpangi*, *kari*, *laganat*, Mindanao.

Note. This species varies considerably in leaf-shape. Most specimens from Mt Kinabalu have small ovate leaves which are truncate or only moderately cordate at the base. From central and eastern Borneo the leaves may be large and deeply cordate. Some specimens from the Philippines and Celebes are hastate with acute basal lobes, as exemplified by the synonym *T. hastata* ELMER.

3. *Tinospora hirsuta* (BECC.) FORMAN, Kew Bull. 36 (1981) 391, f. 2A–D. — *Aspidocarya hirsuta* BECC. Malesia 1 (1877) 136. — *Parabaena hirsuta* (BECC.) DIELS, Pfl. R. Heft 46 (1910) 147, *p.p.* *quoad typum*.

Woody climber. Stems puberulous, sometimes soon glabrescent, drying striate and developing a subnitidous bark with scattered small lentils. *Leaves*: petioles 8–10 cm, puberulous; lamina ovate to broadly ovate, base cordate, apex long-acuminate, 14–18 by 8.5–12 cm, main nerves impressed above, prominent below, reticulation very fine and prominent on both surfaces, upper surface glabrous, on lower surface main nerves hispidulous with some hairs uncinata at the tip, puberulous along finer nerves, papyraceous, domatia absent. — *Male flowers* and *inflorescences* unknown. — *Female flowers* unknown. *Infructescence* arising from older leafless stems, narrowly paniculate, 18–25 cm, puberulous, lateral branches c. 1–1.5 cm, upper branches reduced to single pedicel 0.5 cm. *Drapes* white, borne on a subglobose carpophore 2 mm ϕ ; endocarp cream-whitish, crustaceous, subrotund or broadly elliptic in outline, slightly keeled at the apical end, 8–11 by 8 mm, the surface covered with moderately scattered very small pointed tubercles, ventrally flattish with elliptic aperture leading to a globose condyle deeply intrusive in the seed-cavity.

Distr. *Malesia*: Borneo (Sarawak; G. Kenepai); 3 coll.

Ecol. Alluvial forest in valley floor at c. 60 m.

4. *Tinospora celebica* DIELS, Pfl. R. Heft 46 (1910) 143; FORMAN, Kew Bull. 36 (1981) 392, f. 2E–F.

Slender woody climber, entirely glabrous. Stems drying substriate. *Leaves*: petioles 4.5(–7, *teste* DIELS) cm, geniculate near base; lamina narrowly elliptic, base sagittate with small acute lobes, apex acuminate, 10–12 by 3.5–4.5 cm; reticulation fine, raised on both surfaces, stiffly papyraceous, domatia present beneath in basal nerve axils. — *Male* and *female flowers* and *inflorescences* unknown. *Drapes* (pericarp unknown) with endocarp bony, rather oblong in outline with squarish corners but shortly pointed at base and apex, 7 by 5 mm, whole surface

granular-rugulose, dorsal side also slightly and irregularly tuberculate, ventrally with shallow, small central depression, condyle only slightly intrusive into seed-cavity.

DISTR. *Malesia*: N. Celebes (Gorontalo); 1 coll.

NOTES. A unicate from Sarawak may belong to this species (S 36766), at c. 530 m in poor forest with mostly small trees and numerous climbers on igneous derived brownish-yellow sandy soil. Its leaves have the very characteristic shape of those of *T. celebica* except that the short lobes of the hastate base are bluntly pointed and not acute; the petioles are shorter, being about 3 cm. The single detached pseudo-racemose infructescence (unknown in *T. celebica*) is 19 cm long; the fruits are borne on slender pedicels 5–8 cm, each terminating in a narrow clavate carpophore 4 mm long. The drupes have slightly larger endocarps, 10 by 6 mm, and are more prominently ornamented with thin ridges irregularly interrupted and sometimes divided into sharp points; the surface of the endocarp is generally rough.

With so very little material known of both the Celebes and Sarawak plants, it is not possible to be sure of the significance of the differences and whether or not these two specimens are conspecific.

5. *Tinospora glandulosa* MERR. J. Str. Br. R. As. Soc. n. 85 (1922) 171; YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 96; FORMAN, Kew Bull. 36 (1981) 394, f. 2G–H.

Woody climber, entirely glabrous. Stems drying striate when young, with scattered raised lenticels, developing a papery later subcoriaceous bark. *Leaves*: petioles 4–5 cm; lamina elliptic, base rounded or subtruncate, apex long-acuminate, 10–13 by 4–6 cm, 3(–5)-nerved at the base and with 4–6 pairs of distal lateral nerves, reticulation raised on both surfaces, stiffly papyraceous, domatia with distinct apertures present beneath in the main nerve-axils. — *Flowers* unknown. *Infructescence* arising from older, leafless region of stem, 25 to over 60 cm, sub-racemose with one or two pedicels 7–10 mm arising together in the axil of a 1–2 mm long bract, sometimes short lateral branches 2–4 cm long present towards the base. *Drupes* 10 mm long, drying irregularly very wrinkled and angled borne on columnar carpophores 3–4 mm long; endocarp ± broadly elliptic in outline, abruptly pointed at base and apex, 9 by 6 mm, surface granular with irregular scattered pointed protuberances, ventrally flattish with a central elliptic aperture.

DISTR. *Malesia*: N. Borneo (Sabah: Sandakan) and NE. Celebes (Minahassa); 3 coll.

Ecol. Climbing bamboo forest at low altitude.

NOTE. This species is distinctive in its elliptic leaves and long infructescences sometimes with short lateral branches in the lower part. The reticulate

venation of the leaves and the domatia each with a distinct aperture are very much as in *T. glabra* and *T. celebica*, to which *T. glandulosa* appears closely allied.

6. *Tinospora crispa* (L.) HOOK. f. & TH. Fl. Ind. 1 (1855) 183; MIERS, CONTR. Bot. 3 (1871) 34; GAGNEP. Fl. Gén. I.-C. 1 (1908) 132; KIRTIKAR & BASU, Indian Medic. Pl. 1 (1918) 48, t. 34; CREVOST & PÉTELOT, Bull. Econ. Indoch. n.s. 1-1929, n. 199 (1929) 30 with accompanying plate and figure; MERR. J. Arn. Arb. 19 (1938) 341; BACK. & BAKH. f. Fl. Java 1 (1963) 158; LIEN, Acta Phytotax. Sin. 13 (1975) 37; FORMAN, Kew Bull. 36 (1981) 394, f. 3A–C; *ibid.* 39 (1984) 113. — *Funis jelleus* RUMPH. Herb. Amb. 5 (1747) 44, f. 1. — *Menispermum crispum* LINNÉ, Sp. Pl. ed. 2 (1763) 1468. — *Menispermum tuberculatum* LAMK, Encycl. Méth. 4 (1797) 96. — *T. rumphii* BOERL. Cat. Hort. Bog. (1901) 116, *nom. illegit.*; DIELS, Pfl. R. Heft 46 (1910) 135; MERR. Int. Rumph. (1917) 220; Sp. Blanc. (1918) 145; En. Philip. 2 (1923) 146; SANTOS, Philip. J. Sc. 35 (1928) 187, t. 1; QUIS. Medic. Pl. Philip. (1951) 300, *p.p.* — *T. tuberculata* (LAMK) BEUMÉE ex HEYNE, Nutt. Pl. 1 (1927) 69; BURK. Dict. (1935) 2164. — **Fig. 7a–c.**

For a complete synonymy, see FORMAN (1981).

Woody climber up to c. 15 m, entirely glabrous. Stems drying striate when young but later becoming very prominently tuberculate, containing an exceedingly bitter milky sap, producing very long filiform aerial roots. *Leaves*: petioles 5–15(–30) cm; lamina broadly ovate to orbicular, base deeply to shallowly cordate, apex usually long-acuminate, 7–14(–25) by 6–12(–24) cm, palmately 5–7-nerved at the base, very thinly papyraceous, domatia usually absent although a flat pocket sometimes present in axil of basal nerves beneath. Inflorescences not coetaneous with the leaves. — *Male inflorescences* arising from the older, leafless stems, often a few together, pseudo-racemose, very slender, (5–)9–20 cm long, flowers in 1–3-flowered fascicles. — *Male flowers* on filiform pedicels 2–4 mm; sepals pale green, outer 3 ± ovate, thickened at base, 1–1.5 mm long, inner 3 obovate, unguiculate or acute at base, 3–4 mm long; petals 3, only the outer whorl usually developed (sometimes 1–3 reduced inner petals present), narrowly oblanceolate, flat, lacking papillae, 2 mm long; stamens 6, 2 mm long. — *Female inflorescences* similar to male but shorter, 2–6 cm, with flowers mostly arising singly along the axis. — *Female flowers*: sepals and petals as in male; staminal nodes 6, subulate, scarcely 1 mm long; carpels 3, ellipsoidal, 2 mm long, stigma very shortly lobed. *Infructescences* (from Assam and Burma specimens) bearing lateral peduncles 1.5–2 cm terminating in a subpyramidal 2–3 mm long carpophore below which usually persist reflexed ovate sepals 2 mm long.

Drupes orange, ellipsoidal, 2 cm long (when fresh), with whitish endocarp, \pm ellipsoidal, 11–13 by 7–9 mm, surface obscurely rugulose or almost smooth, with a conspicuous dorsal ridge and with a small elliptic ventral aperture, condyle deeply intrusive into seed-cavity.

Distr. Bengal, Assam, Burma, Cambodia, Yunnan; in *Malesia*: Malaya (incl. Singapore I.), W. Java (incl. Christmas I.), Lesser Sunda Is. (Sumbawa), and the Philippines (Luzon, Mindoro, Mindanao).

In Christmas I. (Indian Ocean) it may have well been introduced in the past by immigrant workers.

Ecol. In Thailand in mixed deciduous forest and village hedgerows up to 900 m, also cultivated. In the Philippines recorded from primary forest (Mindanao) and at 1000 m (Mindoro: Mt Yagaw). Also cultivated as a medicinal plant in Ceylon and India.

Uses. BURKILL (1935, under *T. tuberculata*) lists the many medicinal uses of this plant. The Malays drink an infusion of the stem as a vermifuge and of the whole plant to treat cholera.

According to CREVOST & PÉTELOT (1929, *l.c.*) the species was introduced into northern Vietnam (Tonkin) by the Sisters of St. Vincent de Paul under the name of liane-quinine (= *dây ki nin*) and it was cultivated by various Christian communities; but it was also known elsewhere in the region. It is used by local people to treat fevers and jaundice. The stem is cut into small pieces and scraped, then it is infused in boiling water, which after cooling is drunk. The stems can also be dried and pounded into a powder, which is used as quinine. This powder mixed with fodder is used to fatten horses and cattle by stimulating their appetite; a similar use is reported from N. Thailand by BÄNZIGER.

MERRILL (1918, under *T. rumphii*) stated that this is perhaps the most generally used medicinal plant in the Philippines. It contains an extremely bitter principle and it is known in the Philippines together with the more common *T. glabra* as *makabuhay*, but *T. crispa* is more effective in use. The bitter principle of *makabuhay* has been investigated by MARANON (Philip. J. Sc. 33, 1927, 357), who found it to be glucosidal. QUISUMBING's account of the species (as *T. rumphii*) and its uses in his Medic. Pl. Philip. (1951) 300 deals in part with *T. glabra*.

According to THORNER (Phytochem. 9, 1970, 167), berberine has been reported in *T. crispa*, but this could be based on misidentified material of *T. glabra*.

The anatomy of the stem and leaf has been described by SANTOS (Philip. J. Sc. 35, 1928, 187).

Vern. Java: *akar pahat, andawali, brotowali, putrowali*; Sarawak: *daun akar wali*; Philippines: *makabuhay, meliburigan*, Mindanao.

- Notes. Female flowers and fruit were described from *extra-Mal.* specimens as they are as yet un-

known from Malesia. Even in continental Asia fruits are rare, at least rarely collected.

Writing at the end of the 17th century, RUMPHIUS gave a long and detailed account of this species accompanied by an illustration showing the characteristic broad, deeply cordate and long-acuminate leaves, together with the stem densely covered in raised tubercles, which the artist had incorrectly arranged in longitudinal lines. RUMPHIUS stated that this climber was brought to Amboina around 1690 and it flowered, when leafless, in Nov. 1691. He mentioned its bitter sap and explained that the Javanese and Balinese names meant 'bitter rope', and therefore he gave it the Latin name *Funis felleus*. He also described the medicinal uses of the plant in Java and Bali.

The confusion about the application of the name *Menispermum crispum* L., lasting for two centuries, originated from LINNÉ, who cited the correct plate in RUMPHIUS, but the wrong name, '*Funis quadrangularis*', which is a *Cissus* (*Vitaceae*).

As a result of intensive searches in Thailand, Dr. BÄNZIGER finally succeeded in collecting the fruits of *T. crispa*, which proved to be clearly different from those of *T. baenzigeri*.

The stems have a remarkable capacity when cut into pieces to remain succulent and alive for a long period: the dried sap effectively seals the cut ends. RUMPHIUS stated that when originally brought to Amboina about 1690, the coiled stems had been in a closed box for some months, and when planted they soon produced shoots. In confirmation of this property, several portions of stem some 15 cm long were received at Kew in Oct. 1977, collected by Dr. BÄNZIGER in Thailand some 10 to 12 months previously, yet some were still green and succulent, the tissue apparently still living.

In Thailand, according to BÄNZIGER, leaves are present during the rainy season April–May to Nov.–Dec. or later if growing in a humid place. Plants flower late Jan.–March; the flowers are scented. Fruits were collected in April and May.

The typical number of petals in this species is 3, only the outer whorl developing, contrasting with 6 in the closely allied *T. baenzigeri*. There are, however, specimens which have in addition 1 to 3 petals of the inner whorl (usually reduced) together with the warty stems characteristic of *T. crispa*. It could be that there has been some hybridisation between the two species, whose areas of distribution overlap in Central Thailand.

7. *Tinospora baenzigeri* FORMAN, Kew Bull. 36 (1981) 399, f. 3D–G; *ibid.* 39 (1984) 113. — Fig. 7d–g.

Allied to *T. crispa*, but differing by: Old stems up to 6 cm ϕ , bearing scattered pustular lenticels but



Fig. 7. *Tinospora crispa* (L.) Hook. f. & Th. *a*. Leaf, $\times 2/3$, *b*. stem, nat. size, *c*. endocarp, dorsal and ventral views, $\times 2$. — *T. baenzigeri* FORMAN. *d*. Leaf, $\times 2/3$, *e*. leaf base showing pocket-domatia, $\times 4$, *f*. stem, nat. size, *g*. endocarp, dorsal and ventral views, $\times 2$. — *T. smilacina* BTH. *h*–*j*. Leaves, $\times 2/3$, *k*. leaf base showing glandular patches, $\times 4$, *l*. endocarp, dorsal and ventral views, $\times 2$ (*a* BÄNZIGER 71-6, *b* BÄNZIGER 71-21, *c* BÄNZIGER 86, *d*–*e* BÄNZIGER 30-10, *f* BÄNZIGER 30-14, *g* BÄNZIGER 30-17, *h* SCHULTZ 711, *j* PARKER 477, *k* LAZARIDES 6531, *l* MUST 1289). Drawn by Mrs. M. Church. Courtesy Kew Bulletin.

lacking prominent tubercles. *Leaves* with a pair of hollow domatia present in axils of basal nerves on lower surface. *Flowers* with 6 petals. *Drupe*s yellow, radiating from a subglobose carpophore 1 mm long on peduncle 5–7 mm; pericarp drying very thin; endocarp thinly bony, blackish grey, 7–9 by 5–6 mm, broadly elliptic in outline, rounded at base, slightly keeled at apex, with a weak dorsal ridge, surface papillose or almost smooth.

Distr. Thailand, S. Vietnam; in *Malesia*: SW. Java (Christmas I., Indian Ocean).

Ecol. In Thailand, according to Dr. Bänziger, leaves form at the beginning of the rainy season (April–May) and persist until the end of the rainy season (Oct.–Nov.). Flowering begins mid-Dec. and lasts until mid-Febr., the individual plants remaining in flower for about one month. The flowers have a strong but pleasantly fragrant scent. Fruits appear from mid-Jan.

In Christmas I. (see below) male flowers and leaves were collected in Dec. 1980 and between June and Sept. 1981.

According to Dr. BÄNZIGER it is most common in Central Thailand in areas with a prolonged dry season of 4–6 months, although it also occurs in parts of S. Thailand with a rather wet climate; it often occurs in open areas, sometimes on an isolated tree, at altitudes up to about 400 m. The species is apparently absent from the northern parts of Thailand where low temperatures occur. KERR collected specimens from scrub-land, scrambling over bushes, and from wasteland around Bangkok.

Vern. A few specimens from Thailand collected by KERR and MARCAN bear the same vernacular names *ching cha li* and *chincha chali* as are used for *T. crispa*, but *T. baenzigeri* does not appear to be in general use for medicinal purposes. This may be connected with the fact that the bitter substances present in the stems of *T. baenzigeri* are different from those in *T. crispa*.

Notes. Stem material was phytochemically analysed by LACHALY & SCHNEIDER (Arch. Pharm., Weinheim, 314, 1981, 251–256) under the erroneous identification *T. cordifolia*.

A most surprising extension of the range is the occurrence in Christmas I. (Indian Ocean), where it was found in 3 localities (1980) and where it grows as a climber enveloping small trees on the shore terraces, and covering limestone pinnacles, in one place together with *T. crispa*. This raises the possibility that it may have been introduced together with that species. On the other hand, *T. baenzigeri* may in the future be found to occur in other localities, e.g. Java, Sumatra, and thus prove to have a wider distribution than is now realized. *Tinospora baenzigeri*, with its inconspicuous flowers appearing when the plant is leafless, may yet be eluding collection in unsuspected territory.

A noticeable feature of the Christmas I. material is that the flower pedicels can be as long as 13 mm compared with a maximum of c. 4 mm in specimens from Thailand. Otherwise all the distinctive characters of *T. baenzigeri* are present in the Christmas I. specimens.

8. *Tinospora arfakiana* BECC. *Malesia* 1 (1877) 140, excl. *infloresc.*; FORMAN, *Kew Bull.* 36 (1981) 407, f. 4F–H; *ibid.* 89 (1984) 114. — *Tinomisium arfakianum* (BECC.) DIELS, *Pfl. R.* Heft 46 (1910) 116, excl. *infloresc.* — *Parabaena scytophylla* DIELS, *Bot. Jahrb.* 52 (1915) 189.

Woody climber, entirely glabrous. Stems rather smooth without conspicuous lenticels when young, bark on old stems with raised elongate lenticels, c. 5–10 mm. *Leaves*: petioles 10–15 cm; lamina ovate, cordate or slightly so at the base, acuminate to broadly acuminate at the apex, 18–28 by 11–23 cm, palmately 5–7-nerved at the base, with a series of short tertiary nerves running at right angles to the midrib, nervation very prominent below, less so above, thinly coriaceous. — *Male and female flowers* unknown. *Infructescences* cauliflorous, paniculate towards the base with lateral branches up to 12 cm, pseudo-racemose towards apex, 18–70 cm. *Drupe*s red, 1(–3) on peduncles 8–15 mm, drying smooth, broadly ellipsoidal, ventrally flattened and slightly concave, 17–24 by 14–18 mm, pericarp drying very thin; endocarp very smooth and whitish, wall 1 mm thick with ventral elongate groove divided by a longitudinal septum, condyle intruding into the seed-cavity. *Seed* ellipsoidal, ventrally concave; embryo with the broad flat, slightly overlapping cotyledons enclosed in entire endosperm, radicle median, cylindrical.

Distr. *Malesia*: New Guinea; 4 coll.

Ecol. Primary forest, in the Vogelkop at only 30 m, in E. New Guinea at 600–700 m and in montane rain-forest at 1500 m.

9. *Tinospora dissitiflora* (LAUT. & K. SCH.) DIELS, *Pfl. R.* Heft 46 (1910) 144; FORMAN, *Kew Bull.* 36 (1981) 408. — *Aspidocarya dissitiflora* LAUT. & K. SCH. *Fl. Deut. Schutzgeb. Südsee* (1900) 312. — *Aspidocarya stenothyrsus* K. SCH. *Nachtr. Fl. Deut. Schutzgeb. Südsee* (1905) 264. — *T. peekelii* DIELS, *Bot. Jahrb.* 52 (1915) 188. — **Fig. 6a.**

Slender woody climber, entirely glabrous. Stems striate when young, lenticellate, later developing a pergamentaceous subnitidous bark, drying wrinkled. *Leaves*: petioles 6–13 cm; lamina ovate to broadly ovate, base slightly cordate or truncate, apex abruptly acuminate, 11–16 by 7.5–12 cm, reticulation very fine and raised on both surfaces, stiffly papryaceous, glandular patches present in basal nerve axils beneath. — *Male inflorescences* axillary or arising from

older, leafless stems, pseudo-paniculate, 13–20 cm long, the lower lateral branches up to 3.5 cm. — *Male flowers* on very slender pedicels 5–10 mm; sepals pale green, outer 3 ovate, 1.5–1.8 mm long, inner 3 broadly elliptic, 4.5–5.5 mm long; petals 6, broadly spatulate to obovate-cuneate, externally papillose in basal region, 2.5–3 mm long; stamens 6, narrowly clavate, 3–5 mm long. — *Female inflorescences* pseudo-paniculate towards the base, pseudo-racemose towards the apex with the flowers in fascicles, c. 30–40 cm long. — *Female flowers* (known only from buds): sepals and petals similar to male; staminodes 6, subulate, 0.7 mm long; carpels 3, ellipsoidal, 1.3 mm long including spreading slightly lobed stigma. *Drupes* red, usually only one developing on each 3 mm long columnar carpophore, on peduncles 1.3–2.5 cm, very knobby when dry with pericarp drying close to endocarp; endocarp bony, strongly and irregularly tuberculate, rather oblong in outline with squarish corners but pointed at base and apex, 10–12 by 7–8 mm, ventrally flattish with a large elliptic cavity (*i.e.* the condyle).

Distr. *Malesia*: New Guinea (incl. New Britain and New Ireland; rare in W.).

Ecol. Lowland rain-forest and swamp-forest at low altitudes up to 300 m, also on coral shores.

Note. This species is easily recognizable by its drupes and inflorescences and also by its leaves which show (when dried) a very fine raised reticulation on both surfaces.

10. *Tinospora sumatrana* (SCHEFF.) BECC. *Malesia* 1 (1877) 139; BOERL. *Cat. Hort. Bog.* 1 (1899) 36, *p.p.*; *ibid.* 2 (1901) 118; DIELS, *Pfl. R. Heft* 46 (1910) 144; FORMAN, *Kew Bull.* 36 (1981) 411, 421. — *Limacia sumatrana* SCHEFF. *Obs. Phytogr.* pt 3 (1872) 76, t. 9; *Nat. Tijd. N. I.* 32 (1873) 398.

Woody climber, entirely glabrous. Stems striate with pustular lenticels, later covered with a smooth pergamentaceous bark. *Leaves*: petioles 3.5–8 cm; lamina broadly ovate to ovate, base cordate to truncate, apex acuminate, 8–12 by 4.5–8 cm, papillose patches sometimes (esp. in young leaves) obscurely visible in basal nerve-axils on lower surface, surfaces drying matt with reticulation obscure, papyraceous. — *Male inflorescences*: a few arising together from the older, leafless stems, unbranched, very slender, zigzag or not, 7–15 cm long, flowers in spaced retrorse fascicles of c. 3, each fascicle subtended by a retrorse bract 1 mm long. — *Male flowers*: minute, sessile; outer 3 sepals elliptic, 2 mm long, inner 3 sepals elliptic, concave, 1.5 mm long; petals 6, oblong with lateral edges incurved, 1 mm long; stamens 6, 1 mm long. — *Female inflorescences* and flowers unknown. *Infructescences* unbranched, 20 cm. *Drupes* 3 on stout peduncles 1.5 cm, subnavicular-ellipsoid, 4.5 by 1.5–2 cm, pericarp (dried) very thin, endocarp

thinly bony, 1 mm or less thick, slightly verrucose with a prominent apical carina and a shallow ventral groove scarcely intruding into the large seed-cavity; seed subhemicylindrical, ventrally flattened and with a median groove, endosperm ventrally transversely ruminate; embryo (BECCARI) with divaricate broad thinly foliaceous cotyledons, radicle terete, superior.

Distr. *Malesia*: S. Sumatra (Lamongan Distr.), Billiton I.; 2 coll.

Notes. This species is very closely related to *T. macrocarpa* from Malaya, with which it shares its major distinctive features. The inner and outer sepals, however, are subequal in *T. sumatrana*, and on this basis the two species are regarded as distinct.

T. sumatrana var. *hanadae* YAMAMOTO, *J. Soc. Trop. Agric.* 16 (1944) 94. The type (Sarawak, Kuching, HANADA B015) has not been traced: the status of this varietal name based on a sterile specimen must remain uncertain.

11. *Tinospora macrocarpa* DIELS, *Pfl. R. Heft* 46 (1910) 141; RIDL, *Fl. Mal. Pen.* 1 (1922) 103; FORMAN, *Kew Bull.* 36 (1981) 412, f. 5E–F. — *T. uliginosa* (non MIERS) HOOK. *f.* & TH. *Fl. Br. India* 1 (1872) 97. — **Fig. 6e–f.**

Scandent shrub, entirely glabrous. Stems striate with pustular lenticels, later covered with a smooth pergamentaceous bark. *Leaves*: petioles (2–)5–10 (–16) cm; lamina broadly ovate to ovate (or elliptic-ovate), base cordate to truncate (or rounded), apex acuminate, 6–13(–21) by (3.5–)6–10(–17) cm, surface drying matt with reticulation rather obscure, papillose patches sometimes present in basal nerve-axils beneath, very thinly to stiffly papyraceous. — *Male inflorescences*: a few arising together from the older, leafless stems, unbranched, very slender, sometimes slightly zigzag, 7–20 cm long; flowers in spaced fascicles (sometimes retrorse) of c. 3 flowers; each fascicle subtended by a retrorse bract 0.5–1 mm long. — *Male flowers*: minute, subsessile (pedicels up to 0.5 mm); outer 3 sepals broadly elliptic, 0.8 mm long, inner 3 sepals broadly elliptic, concave, 1.5–2 mm long; petals 6, oblong with lateral edges incurved, 1 mm long; stamens 6, 0.8 mm long. — *Female inflorescences* and flowers unknown. *Infructescences* rather slender and unbranched, 19–27 cm long, bearing very prominent discoid scars. *Drupes* 3 on stout peduncles 1–2 cm, orange-yellow, ellipsoidal, 3.5–4.5 by 1.5–2 cm, style subterminal; pericarp (dried) very thin; endocarp thinly bony, mostly less than 1 mm thick, papillose-tuberculate or almost smooth with a dorsal carina more pronounced towards the apex, and with an elongate ventral groove which only slightly intrudes into the large seed-cavity. *Seed* ellipsoidal, ventrally grooved, containing copious, ventrally ruminate endosperm; embryo with divergent, thin, foliaceous cotyledons with fine-

ly lobed margins, radicle cylindrical, superior.

Distr. *Malesia*: Malaya (Wellesley, Selangor, Malacca, also in Penang and Singapore Is.), ?Borneo (Sabah); 7 coll.

Ecol. Presumably in forest, in Wellesley at 150 m.

Vern. *Akar kepayang, buah pelay tedong*, Te-muan.

Notes. Very closely related to *T. sumatrana*; the latter has subequal sepals, while in *T. macrocarpa* the outer sepals are much smaller than the inner ones.

I gave a lengthy discussion on the very limited and incomplete specimens, which presented certain problems (FORMAN, 1981).

One collection in fruit from Sabah is probably *T. macrocarpa* (or *T. sumatrana*).

12. *Tinospora teijsmannii* BOERL. Cat. Hort. Bog. (1901) 117; DIELS, Pfl. R. Heft 46 (1910) 141; MERR. En. Born. (1921) 249; YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 96; FORMAN, Kew Bull. 36 (1981) 414, f. 5G-H; *ibid.* 39 (1984) 114. — **Fig. 6g-h.**

Slender woody climber, entirely glabrous. Stems drying striate, later developing scattered raised lenticels. *Leaves*: petioles 4–10 cm; lamina broadly cordate, often obtuse at insertion of petiole within the broad basal sinus, apex acuminate, 10–13 by 9–12 cm, one pair of domatia present in basal nerve-axils beneath, very thinly papyraceous. — *Male inflorescences* and *flowers* unknown. — *Female inflorescences* a few arising together from older leafless stems, pseudo-racemose, lax, 25–30 cm long, the flowers arising 1–2(–3) together. — *Female flowers* with pedicels 9–12 mm; outer 3 sepals ovate, 2 mm long, inner 3 sepals elliptic, 3 mm long; petals 6, narrowly obovate, 0.8 mm long; staminodes 6, subulate, 1 mm long; carpels 3, 1.5 mm long including shortly divided stigma, borne on a pyramido-globose gynophore. *Drapes* 1–3 on peduncles 12–20 mm, arising from main axis of infructescence, ellipsoidal, 20–25 by c. 15 mm, pericarp drying thin in loose folds around endocarp; endocarp thinly bony, 16–18 by 9–10 mm, surface bearing sparsely scattered very short pointed tubercles, otherwise smooth, with a dorsal carina more pronounced towards the apex, and with an elongate ventral groove intruding about 1/3 way into seed-cavity. *Seed* ellipsoidal, ventrally grooved.

Distr. *Malesia*: Borneo, only known from the type, cultivated in Hortus Bogoriensis, collected by TEJSMANN.

13. *Tinospora glabra* (BURM. f.) MERR. J. Arn. Arb. 19 (1938) 340; YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 95; BACK. & BAKH. f. Fl. Java 1 (1963) 157; FORMAN, Kew Bull. 36 (1981) 414, f. 5J-M. — *Menispermum glabrum* BURM. f. Fl. Ind. (1768) 216 ('316'), *excl. syn.* RHEEDE. — *Cocculus coriaceus* BL.

Bijdr. (1825) 25. — *Cocculus bantamensis* BL. l.c. 26. — *Dioscorea spiculata* BL. En. Pl. Jav. 1 (1827/28) 22, *excl. syn.* RUMPH.; HALL. f. Meded. Rijksherb. 1 (1911) 41. — *Dioscorea aculeata* (non L.) ZOLL. & MOR. Syst. Verz. (1845/46) 92. — *Cocculus crispus* [non (L.) DC.] HASSK. Pl. Jav. Rar. (1848) 166. — *T. uliginosa* MIERS, Ann. Mag. Nat. Hist. ser. 3, 13 (1864) 321; Contr. Bot. 3 (1871) 35; HOOK. f. & TH. Fl. Br. India 1 (1872) 97; BECC. Malesia 1 (1877) 139; KING, J. As. Soc. Beng. 58, ii (1889) 378; BACK. Fl. Bat. 1 (1907) 34; Voorl. (1908) 8. — *T. reticulata* MIERS, Ann. Mag. Nat. Hist. ser. 3, 13 (1864) 321; Contr. Bot. 3 (1871) 36; DIELS, Pfl. R. Heft 46 (1910) 143; in Elmer, Leaflet. Philip. Bot. 4 (1911) 1164; MERR. Fl. Manila (1912) 204; En. Philip. 2 (1923) 146; Philip. J. Sc. 29 (1926) 368; SANTOS, *ibid.* 35 (1928) 198, t. 5; YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 95; HATUS. Mem. Fac. Agric. Kago-shima Un. 5 (1966) 30; PANCHU, Vasc. Fl. Mt Makiling 1 (1983) 279, f. 83. — *T. pseudo-crispa* BOERL. *ex BACK.* Fl. Bat. 1 (1907) 35, *nomen in syn.* — *T. crispa* [non (L.) HOOK. f. & TH.], *saepe p.p., incl.* DIELS, Pfl. R. Heft 46 (1910) 143, *pro maj. parte*, t. 49D-O. — *T. andamanica* DIELS, Pfl. R. Heft 46 (1910) 141. — *T. coriacea* (BL.) BEUMÉE *ex HEYNE*, Nutt. Pl. 1 (1927) 619; BACK. Onkr. Suiker. (1930) 248, t. 259 (1936). — **Fig. 4f-l, 6j-m.**

Woody climber, entirely glabrous. Stems striate when young, becoming warty (with raised lenticels) and later developing a smooth thin papery bark which often becomes detached on drying. *Leaves*: petioles 4–8(–12) cm; lamina oblong-ovate or narrowly to broadly ovate, base cordate to truncate, with basal lobes rounded or obtusely pointed, apex acuminate, 7–12(–15) by 5–9(–13) cm reticulation raised on both surfaces, papyraceous, domatia with distinct apertures usually present beneath in basal nerve-axils, the floor of the domatia carpeted with glands, occasionally domatia absent but glandular patches present (e.g. in New Guinea). — *Male inflorescences* axillary or arising from older, leafless stems, pseudo-racemose, slender, lax, 10–20 cm, not or sparsely flowered in the lower 1/3 to 1/2, flowers solitary or in fascicles of 2–5 in the axil of a subulate bract 1 mm long. — *Male flowers* on very slender pedicels 8–12 mm; sepals yellow, greenish (or white), outer 3 narrowly ovate 1 mm long, inner 3 broadly elliptic, concave 4–5 mm long; petals 6, broadly cuneate-obovate with lateral edges incurved, externally papillose at base, 2–3 mm long; stamens 6, clavate, 3–5 mm long. — *Female inflorescences* similar to male but up to 35 cm. — *Female flowers*: sepals and petals as in male but inner sepals 3 mm long; staminodes 6, subulate, 0.5–1 mm; carpels 3, ellipsoidal, 1.5 mm, including reflexed lobed stigma, borne on a subglobose gynophore 1–1.5 mm long. *Drapes* red, radiating from unbranched short to columnar

carpophore 2–4 mm long on peduncle 4–10 mm arising from main axis of infructescence; pericarp drying thin and close to endocarp; endocarp thinly bony, 6–8 by 4–5 mm, subrotund or subelliptic in outline, pointed at base, keeled at apex, dorsally convex with a median ridge and irregularly tuberculate, ventrally flattish with a small elliptic aperture to condyle.

Distr. From Hainan and S. Andaman to the Solomon Is. (Reef and Rennell Is.); in *Malesia*: Malaya, Sumatra (incl. Krakatoa in Sunda Strait), Java (incl. Nusa Barung and Madura Is.), Lesser Sunda Is. (all), Borneo, Philippines (all islands), S. Moluccas (Ternimber Is.), E. New Guinea (incl. Normanby I. and New Britain).

Ecol. In a great number of situations in littoral rain-forest and *Casuarina equisetifolia* forest, mangrove and on sandy beaches, often inland in disturbed forest and shrubberies, secondary growths, very frequently on limestone (Java, Sumba, Timor) and on black soils under seasonal conditions; up to 500 m.

Morph. The anatomical structure of the stem and leaf of *T. glabra* was investigated by SANTOS (1928, *l.c.*).

As a rule the outer sepals are much smaller than the inner ones, but exceptionally (PNH 17161) the sepals vary from subequal in some flowers to very unequal in others. This approaches the closely allied species *T. homosepala* DIELS, where the sepals are equal.

The inflorescences of the species are characteristically unbranched, but in the anomalous PNH 9142 the infructescences have a few lateral branches up to 4 cm, rather similar to those of *T. glandulosa* MERR.

Specimens from New Guinea differ in certain respects from the rest of the material. Domatia are lacking on the lower surface of the leaves, where they are normally present in the basal nerve-axils. There occur instead, in these positions, flat glandular-papillose patches similar to the glandular areas that are found within domatia. The female inflorescences are only 8–10(–15) cm, which is shorter than in material from west of New Guinea. In LAE 52539 and CLEMENS 11066 the endocarps have a larger ventral aperture than is usual; the carpophore of LAE 52539 is shortly and divaricately branched, one branch below each fruit.

Uses. In the Philippines this species is used for a variety of medicinal purposes, e.g. burnt leaves used to treat pinworms; ground bark is applied to sore breasts of nursing mothers. Together with *T. crispa* this species is known in the Philippines as *makabuhay*, but apparently *T. crispa* is medicinally more effective. The account of *makabuhay* in QUISUMBING (Medic. Pl. Philip. 1951, 300) is given under the name *T. rumphii* BOERL., a synonym of *T. crispa*,

but the description in part refers to *T. glabra*. QUISUMBING mentions a number of medicinal uses as well as reports of alkaloids: some of these may refer to *T. glabra*. The species is also used in the Philippines for baiting wild pigs by mixing sliced roots with *Ipomoea batatas*.

The alkaloid berberine has been reported in *T. crispa* (THORNER, Phytochem. 9, 1970, 167). The material tested, however, may well have been *T. glabra* since the correctness of its identification is uncertain.

Vern. Flores: *wasé wages*; Philippines: *papaitan*, Palawan, *makabuhay*, *tabin tabin*, Mindoro, *makabuhay*, Luzon, *manongal*, Panay, *agmamali*, *casopo*, *glingu melibutigan*, *sangawnaw*, Mindanao; *nono*, New Britain.

Notes. In his original description of *Menispermum glabrum*, BURMAN incorrectly cited as a synonym 'Cit-amerdu' of RHEEDE, Hort. Malab. 7 (1688) 39, t. 21. RHEEDE's description, however, clearly implies that his plant had hairy stems and leaves; it is, in fact, part of the basis of the later name *Menispermum malabaricum* LAMK, which is now a synonym of *Tinospora sinensis* (LOUR.) MERR.

The type of *Menispermum glabrum* BURM. f. is a specimen in the DELESSERT Herbarium at Geneva, which was acquired by BURMAN from the herbarium of PRYON.

14. *Tinospora subcordata* (MIQ.) DIELS, Pfl. R. Heft 46 (1910) 136; FORMAN, Kew Bull. 36 (1981) 419. — *Hypsipodes subcordatus* MIQ. Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 82; VALET. Bull. Dép. Agric. Ind. Néerl. 10 (1907) 11. — *T. polygonoides* DIELS, Pfl. R. Heft 46 (1910) 136; J. Arn. Arb. 20 (1939) 73. — **Fig. 6n, p.**

Small woody climber, entirely glabrous. Stems drying striate when young, later becoming minutely verruculose and bearing scattered raised lenticels. **Leaves:** petioles 2.5–9 cm; lamina triangular to broadly triangular, base broadly cordate to truncate with rounded, sometimes subhastate, basal lobes, apex acute, 6–10 by 4–9 cm, reticulation raised on both surfaces, papyraceous, glandular patches present on lower surface in axils of main nerves. — **Male inflorescences** axillary, pseudo-racemose, (5–)7–15 cm long, the lower half without flowers, arising singly or 2–3 directly from the leaf-axils, or sometimes 2–3 arising from very short 1–1.6 cm long axillary shoot, flowers mostly in fascicles of 3–4. — **Male flowers** on slender pedicels 4–5 mm; sepals white, outer 3 ± ovate, 1–1.5 mm long, inner 3 elliptic, 4 mm long; petals 6, obovate-cuneate, 1.5 mm long, fleshy, externally minutely papillose-glandular near base; stamens 6, narrowly clavate with filament broadened apically, 3.5–4.5 mm long. — **Female inflorescences** pseudo-racemose, the flowers arising

singly. — *Female flowers* on pedicels 4–6 mm; sepals and petals similar to male but slightly smaller and petals thin; staminodes 6, oblong, 0.5 mm long; gynophore columnar, 1 mm long; carpels 3, gibbose-ellipsoidal, 1 mm long, stigma flat and expanded with margin minutely lobed. *Infructescences* racemose, 7–9 cm. *Drupe*s red, radiating from columnar gynophore 4–5 mm long on peduncles 5–8 mm; pericarp drying thin; endocarp bony, ± elliptic in outline, shortly pointed at base, strongly keeled (in

outline pointed) at apex, 7 by 4 mm, dorsally with a median ridge, surface coarsely and irregularly tuberculate and also minutely rugulose, ventrally with elliptic aperture to shallow ventral cavity.

Distr. Malesia: Lesser Sunda Is. (Timor), S. Moluccas (Tenimber Is., Selaru I.), S. New Guinea (Merauke, Mabaduan, Wassi Kussa; Tarara).

Ecol. Largely in lowland vegetation subject to a distinct dry season.

9. PARABAENA

MIERS, Ann. Mag. Nat. Hist. ser. 2, 7 (1851) 35, 39; HOOK. *f.* & TH. Fl. Ind. (1855) 181; BENTH. in B. & H. Gen. Pl. 1 (1862) 34; MIERS, Ann. Mag. Nat. Hist. ser. 3, 14 (1864) 51; Contr. Bot. 3 (1871) 57; HOOK. *f.* & TH. Fl. Br. India 1 (1872) 95; DIELS, Pfl. R. Heft 46 (1910) 145; FORMAN, Kew Bull. 39 (1984) 103. — **Fig. 4m–p, 5c–l.**

Slender woody climbers. *Leaves* with petiole swollen and geniculate at base, lamina often cordiform or hastate, rarely deeply 3–5-lobed, margin entire or repand-dentate, palmatinerved at base, papyraceous. *Inflorescences* axillary, cymose or thyrsoïd (a raceme or panicle of cymes). — *Male flowers:* sepals 6, free, equal or the inner 3 broader; petals 6, often minute, sometimes with a pair of thickenings or projecting lobes on basal inner surface; synandrium usually peltate with the anthers situated around the margin usually dehiscing transversally. — *Female flowers* occasionally functionally hermaphrodite: sepals and petals as in male; staminodes 6, minute but these occasionally developing into claviform polliniferous stamens; carpels 3, stigma reflexed, lobed or lacinate. *Drupe*s 3, borne on subglobose carpophore; endocarp bony, dorsal and lateral surfaces variously ridged or spiny, sometimes with prominent dorsal ridge as well as basal and apical keels, condyle represented by a ventral concavity sometimes bordered by incurved spines or developed into an inflated ventral chamber, seed-cavity flattened. *Seed* with copious endosperm; embryo with very thin divaricate broad cotyledons and prominent radicle.

Distr. Continental SE. Asia (1); *Malesia:* N. Borneo (1), Philippines (3) and New Guinea & Solomons (1), in all 6 *spp.*

KEY TO THE SPECIES

Based on male flowering material

N.B.: female inflorescences usually shorter and less branched

1. Inflorescences usually repeatedly dichotomously branched; leaves often sagittate with pointed basal lobes and margin often repand-dentate (Nepal to Yunnan, NE. India, Andaman Is., Indochina) **P. sagittata**
1. Inflorescences with a distinct main axis bearing lateral branches; leaves mostly ovate or cordiform with entire or subentire margins (rarely 3–5-lobed).
2. Inflorescences glabrous, 5–18 cm long; synandrium with apical conical appendage. Leaves cordiform to broadly cordiform, glabrous (or sparsely hispidulous below) **5. P. echinocarpa**

2. Inflorescences pubescent or, if subglabrous, then 18–35 cm long; synandrium flat or domed at apex.
3. Inflorescences elongate, mostly 23–36 cm long, narrow with \pm equal lateral branches 2–6 cm long; anthers with vertical slits. **1. *P. megalocarpa***
3. Inflorescences shorter or, if over 20 cm long, then with lowermost lateral branches longest and decreasing upwards; anthers with transverse slits.
4. Lamina ovate to narrowly ovate, rather sparsely pubescent below; sepals equal **3. *P. denudata***
4. Lamina cordiform to broadly cordiform or broadly ovate, usually very pubescent below, inner sepals broader.
5. Inflorescences 7–15 cm long, narrow, rather densely pubescent. **2. *P. elmeri***
5. Inflorescences 18–35 cm long with spreading lateral branches up to 12 cm long, patent-hispidulous to subglabrous. **4. *P. tuberculata***

KEY TO THE SPECIES

Based on fruiting material (dried fruits)

1. Fruits subellipsoid, 2.2–2.8 cm long, hispid **1. *P. megalocarpa***
1. Fruits irregular in shape and much smaller, glabrous.
2. Inflorescences usually repeatedly dichotomously branched; fruits 5–6 mm long with conspicuous apical keel and dorsal ridge of endocarp visible; leaves often sagittate with pointed basal lobes and margin often repand-dentate (Nepal to Yunnan, NE. India, Andaman Is., Indochina) ***P. sagittata***
2. Inflorescences with a distinct main axis bearing lateral branches; fruits 7–11 mm long; leaves mostly ovate or cordiform with entire or subtire margins.
3. Inflorescences rather densely pubescent. Leaves pubescent below **2. *P. elmeri***
3. Inflorescences with scattered hairs or glabrous.
4. Lamina ovate to narrowly ovate **3. *P. denudata***
4. Lamina cordiform to broadly cordiform.
5. Fruits strongly ridged, the endocarp bearing a prominent dorsal ridge produced at the ends into basal and apical keels and also bearing prominent thin lateral wings; leaves usually pubescent below **4. *P. tuberculata***
5. Fruits lacking clear dorsal and lateral ridges, not or scarcely pointed at the ends, dorsal surface of endocarp densely covered with slender patent spines; leaves glabrous (or sparsely hispidulous below) **5. *P. echinocarpa***

1. *Parabaena megalocarpa* MERR. Un. Calif. Publ. Bot. 15 (1929) 59; YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 97; FORMAN, Kew Bull. 36 (1981) 392; *ibid.* 39 (1984) 105, f. 1C–E. — *P. hirsuta* (non BECC.) DIELS, Pfl. R. Heft 46 (1910) 147, *p.p. quoad* HAVILAND 2833. — **Fig. 4m–p, 5c–e.**

Young stems hispid to hispidulous or puberulous. Leaves with hispid to shortly pubescent petioles 5–14 cm; lamina ovate to broadly ovate or deeply 3–5-lobed with narrow sinuses, base cordate, apex acuminate, 12–25 by 8–18.5 cm, margin entire, both surfaces hispid to hispidulous. — *Male inflorescences* supra-axillary (or terminal), elongate, a raceme of cymes, (12–)23–36 cm, the lateral branches 2–6 cm, puberulous. — *Male flowers* on pedicels 1–1.5 mm: sepals yellow or cream, papillose or puberulous, main outer sepals narrowly elliptic, 2–2.5 mm long, inner sepals broader, 2–2.5 mm long; petals rotund, 0.5–0.75 mm long with 2 basal inwardly projecting lobes, or these joined together; synandrium cylindrical, thick, 1.25 mm long; anthers with vertical slits. — *Female inflorescences* pseudo-racemose or with lateral branches cymose or racemose, 9–15

cm. — *Female flowers*: sepals and petals similar to male; staminodes 1 mm; carpels 1.5 mm. *Drapes* yellow turning red, subellipsoidal, hispid with fine spines of endocarp projecting through pericarp when dry, 2.2–2.8 cm long, peduncles c. 5 mm; endocarp resembling a hedgehog, densely covered with long thin patent spines, apart from the closed inflated ventral chamber, c. 2 cm long, seed-chamber dorsiventrally very compressed.

Distr. *Malesia*: Borneo (Sarawak, Sabah).

Ecol. Forests, including riparian forests, up to 900 m. *Fl. fr.* Jan.–Dec.

Uses. The fruit is stated to be edible and sour.

Vern. Sabah: *paruka-paruka*; Sarawak: *akar pelir-udok*, Iban.

Note. This species shows a number of strong resemblances to *Tinospora trilobata* DIELS, especially when the leaves are deeply lobed and hispid. Both species have similar supra-axillary, very long thyrsoid inflorescences.

2. *Parabaena elmeri* DIELS, Pfl. R. Heft 46 (1910) 147; in Elmer, Leafl. Philip. Bot. 4 (1911) 1164;

MERR. En. Philip. 2 (1923) 147; YAMAMOTO, Trans. Nat. Hist. Soc. Taiwan 34 (1944) 308, *incl. var. philippinensis* (MERR.) YAMAMOTO; PANCHO, Vasc. Fl. Mt Makiling 1 (1983) 277; FORMAN, Kew Bull. 39 (1984) 107, f. 1G. — *P. philippinensis* MERR. ex DIELS, Pfl. R. Heft 46 (1910) 148; in Elmer, Leaf. Philip. Bot. 4 (1911) 1164; MERR. En. Philip. 2 (1923) 147. — **Fig. 5g.**

Stems moderately to lightly pubescent, glabrescent. *Leaves* with pubescent petioles 5–11 cm; lamina broadly ovate or deltoid-ovate, base cordate or sagittate-cordate (or subtruncate), apex acuminate, 10–16(–23) by 8–12(–23) cm, margin entire or remotely dentate, both surfaces pubescent, usually more densely beneath. *Inflorescences* axillary, composed of a raceme or narrow panicle of cymes, slender, 7–15 cm long, usually densely pubescent. — *Male flowers* on pedicels 1–2 mm; sepals 2 mm long, glabrous, outer ones ± elliptic, inner ones broadly elliptic; petals oblong, 0.75 mm long, flat; synandrium 1 mm long, anthers with transverse slits. — *Female flowers*: sepals subequal, 2 mm long; petals lanceolate, 0.75 mm long; staminodes oblong, 0.5 mm long; carpels ovoid-ellipsoidal, 1.25 mm long with recurved, lobed stigma. *Drupes* drying irregularly ridged, 8–10 mm long, on pubescent pedicels c. 2 mm, glabrous; endocarp broadly elliptic in outline with conspicuous apical keel, dorsally bearing subadpressed spinules and fimbriate or toothed diagonal ridges with the margin encircled by a skirt-like toothed ridge, the large ventral cavity bordered by a thin incurved toothed margin.

Distr. *Malesia*: Philippines (Mindoro, Luzon).

Ecol. Thickets and forests at low to medium altitudes. *Fl.* Febr., May–July, *fr.* Febr., July–Oct.

Vern. Mindoro: *bugbog-puro*.

3. *Parabaena denudata* DIELS, Pfl. R. Heft 46 (1910) 147; in Elmer, Leaf. Philip. Bot. 4 (1911) 1164; MERR. En. Philip. 2 (1923) 147; FORMAN, Kew Bull. 39 (1984) 108, f. 1H. — **Fig. 5h.**

Stems up to c. 1.3 cm ø, sparsely pubescent when young. *Leaves* with petioles pubescent to subglabrous, 4–10 cm; lamina ovate to narrowly ovate with base truncate to cordate, or sagittate, apex mostly long-acuminate, 8–15 by 3–9 cm, margin entire or repand-denticulate, upper surface subglabrous, lower surface lightly pubescent with prominent fine reticulation. *Inflorescences* axillary, a raceme or panicle of cymes, very slender with delicate ultimate branching, 9–20 cm long, shortly pubescent. — *Male flowers* on pedicels c. 1 mm: sepals greenish white, equal, elliptic to obovate, 2 mm long, glabrous; petals broadly obovate-cuneate, 0.5 mm long; synandrium 1 mm long, anthers with transverse slits. — *Female flowers* not seen. *Drupes* drying spinulate-muricate with conspicuous apical keel, 7–8 mm

long, glabrous on puberulous pedicels c. 5 mm; endocarp 7 by 6 mm, rotund in outline (excluding apical keel), dorsally bearing a median double row of short spines which lead into a prominent apical keel, rest of dorsal surface bearing short spines with the surface between them rather rough, ventral cavity bordered by radial incurved spines surrounding a central aperture.

Distr. *Malesia*: Philippines (Luzon, Samar, Negros, Bohol, Mindanao, Basilan).

Ecol. In Negros along rivers and in thickets in damp ravines at 700–750 m. *Fl.* Febr.–May, *fr.* Aug.

4. *Parabaena tuberculata* BECC. *Malesia* 1 (1877) 137, *p.p. excl. fruct.*; DIELS, Pfl. R. Heft 46 (1910) 148; *p.p.*: C.T. WHITE, J. Arn. Arb. 10 (1929) 208, 212; FORMAN, Kew Bull. 39 (1984) 108, f. 1J–K. — *Stephania cinnamns* K. SCH. in K. Sch. & Hollr., Fl. Kaiser Wilh. Land (1889) 44. — *P. myriantha* K. SCH. in K. Sch. & Laut., Nachtr. Fl. Deut. Schutzgeb. Südsee (1905) 264 (*'myriaditha'*, *sphalm.*); DIELS, Pfl. R. Heft 46 (1910) 149; RENDLE, J. Bot. 61 Suppl. (1923) 4. — *P. cinnamns* (K. SCH.) DIELS, Pfl. R. Heft 46 (1910) 149. — *P. psilophylla* DIELS, l.c. 148; KANEH. & HATUS. Bot. Mag. Tokyo 56 (1942) 472. — **Fig. 5j–k.**

Young stems pubescent, sometimes sparsely so. *Leaves* with pubescent (or subglabrous) petioles 5–13 cm; lamina broadly cordiform to rotund, base cordate with rounded or sometimes obtusely angled basal lobes or truncate, apex abruptly acuminate, 10–22 by 9–22 cm, margin entire or sometimes repand-denticulate, both surfaces pubescent (or subglabrous), fine reticulation prominent on lower surface. *Inflorescences* axillary, apparently paniculate, 18–35 cm long with spreading to retrorse lateral branches, the lower ones up to 12 cm, patent-hispidulous to subglabrous. — *Male flowers* on pedicels 1–2 mm: sepals white or yellow, 2.5 mm, externally sparsely pubescent to glabrous, the outer 3 ± elliptic, the inner 3 broader and concave; petals ± rhomboid, 1 mm long, fleshy with lateral thickenings; synandrium c. 1 mm long, sometimes domed at apex, anthers with transverse slits. — *Female flowers* on pedicels 3–4 mm: sepals and petals similar to male; staminodes minute, peg-like c. 0.25 mm long but sometimes (as in lectotype) stamen-like, c. 0.75 mm long; carpels 1 mm long, stigma lacinate with 3–6 reflexed lobes. Plants with all flowers hermaphrodite sometimes occurring, these with 6, free stamens c. 0.75 mm long. *Drupes* white (or red) radiating from subglobose carpophore 1–1.5 mm ø terminating a glabrous pedicel 3–4 mm, drying strongly ridged, ± broadly elliptic in outline and abruptly pointed at both ends, 9–11 mm long, glabrous; endocarp broadly elliptic in outline, with a prominent median

dorsal ridge (composed of a double row of closely set spines) produced at both ends into basal and apical keels, and two thin prominent lateral wings which are continuous or composed of separate spines, with further small spines present over dorsal surface, ventral surface with a ring of radially incurved spines bordering a ventral chamber and leaving a central oval aperture.

Distr. Solomon Is.; in *Malesia*: New Guinea.

Ecol. Secondary rain-forest, *Pometia-Intsia* forest with much regrowth, river-side and cane-brakes in floodedbed, up to 1000 m. *Fl. fr.* Jan.–Dec.

Vern. W. New Guinea: *kakoep*, Biak; NE. New Guinea: *simuganbang*, Waskuk, *jehmu*, Wagu.

Note. For a full discussion of this species see FORMAN (1984). Some elements must be discarded from the original material; a lectotype was selected; it does not occur in the Aru Is. and in Timor; the bisexual flowers BECCARI mentioned are anomalous in his specimen.

5. *Parabaena echinocarpa* DIELS, Philip. J. Sc. 8 (1913) Bot. 157; MERR. En. Philip. 2 (1923) 147; YAMAMOTO, Trans. Nat. Hist. Soc. Taiwan 34 (1944) 307, incl. var. *pubescens* YAMAMOTO; FORMAN, Kew Bull. 39 (1984) 110, f. 1L. — **Fig. 5 I.**

10. TINOMISCIUM

MIERS [Ann. Mag. Nat. Hist. ser. 2, 7 (1851) 44, *nomen*] ex HOOK. f. & TH. Fl. Ind. (1855) 205; MIERS, Ann. Mag. Nat. Hist. ser. 3, 13 (1864) 489; Contr. Bot. 3 (1871) 44; DIELS, Pfl. R. Heft 46 (1910) 115; FORMAN, Kew Bull. 40 (1985) 542, f. 1. — **Fig. 8.**

Woody climbers containing white latex in a laticiferous system which extends throughout the plant. Stems ferruginous-pubescent when young. *Leaves* ± ovate to elliptic, base 3–5-nerved, petioles usually long, bent and swollen at base and sometimes at apex, upper surface when dry revealing the laticiferous system as a fine, dense network of ± parallel ridges. *Inflorescences* racemose arising from old, leafless stems, usually ferruginous-tomentose. — *Male flowers*: sepals 9 in 3 whorls of 3, the outermost whorl much smaller than the inner ones; petals 6 with the lateral edges incurved; stamens 6, variable, sometimes apiculate, the anthers sometimes immersed in the thickened connective, dehiscence longitudinal to transverse. — *Female flowers*: sepals and petals as in male; staminodes 6, very narrow; carpels 3, stigma lobed. *Drupes* 3, radiating from discoid carpophore, style-scar terminal; endocarp compressed, elliptic to subovate in outline; seed flat, endosperm present, cotyledons thin, flat, imbricate, radicle small.

Distr. Assam, Burma, Nicobar Is., Thailand, Yunnan, Indochina; almost throughout *Malesia*, except the Lesser Sunda Is. Monotypic.

Stems glabrous. *Leaves* with glabrous (or subglabrous) petioles 5–18 cm; lamina cordiform to broadly cordiform or broadly triangular-ovate, base deeply to shallowly cordate or truncate, apex acuminate, 9–15(–25) by 7–13(–20) cm, margin entire, both surfaces glabrous (or sparsely hispidulous below). *Inflorescence* axillary, a panicle of cymes, slender, 5–18 cm, glabrous. — *Male flowers* on pedicels 1–2 mm: sepals subequal, elliptic to oblanceolate, 2.25–3 mm long, glabrous, petals elliptic, 1 mm long; synandrium 1.5 mm long with apical conical appendage, anthers with transverse slits. — *Female flowers* not seen. *Drupes* whitish, drying irregularly rugose, 8–9 mm long, glabrous, on glabrous pedicels 4–5 mm; endocarp broadly elliptic to subrotund in outline, dorsally densely covered with slender patent spines, apical keel moderately or little developed, ventral cavity covered by a thin wall with the central aperture bordered by a radially fimbriate incurved margin or by flattened incurved spines.

Distr. *Malesia*: Philippines (Luzon, Polillo, Leyte, Mindanao, Camiguin de Misamis).

Ecol. Thickets and forests at altitudes up to c. 500 m. *Fl.* April–June, Nov., *fr.* April, Nov.–Dec.

Vern. Polillo I.: *baya-bayatian*, Dum.

1. *Tinomisium petiolare* HOOK. f. & TH. Fl. Ind. (1855) 205; MIQ. Fl. Ind. Bat. 1, 2 (1858) 87; MIERS. Contr. Bot. 3 (1871) 45, t. 94; HOOK. f. & TH. Fl. Br. India 1 (1872) 97; KING, J. As. Soc. Beng. 58, ii (1889) 379; RIDL. J. Str. Br. R. As. Soc. n. 33 (1900) 42; GAGNER, Fl. Gén. I.—C. 1 (1908) 127, t. 14/1—10; DIELS, Pfl. R. Heft 46 (1910) 33, f. 16A & B, 118; RIDL. J. Str. Br. R. As. Soc. n. 54 (1910) 14; MERR. En. Born. (1921) 248; RIDL. Fl. Mal. Pen. 1 (1922) 105, t. 9; NORMAN, J. Bot. 62, Suppl. (1924) 5; BURK. & HEND. Gard. Bull. S. S. 3 (1925) 344; HEYNE, Nutt. Pl. (1927) 618; HEND. Gard. Bull. S. S. 4 (1928) 219; BURK. Dict. (1935) 2163; YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 41; BACK. & BAKH. f. Fl. Java 1 (1963) 157; THOTHATHRI *et al.* Bull. Bot. Surv. India 15 (1976) 15; FORMAN, Kew Bull. 40 (1985) 542, f. 1. — *T. phytocrenoides* KURZ *ex* TEUJM. & BINN. Nat. Tijd. N. I. 27 (1864) 36; SCHEFF. *ibid.* 32 (1873) 394, t. 3; BOERL. Cat. Hort. Bog. 1 (1899) 37; DIELS, Pfl. R. Heft 46 (1910) 117, f. 42; BACK. Schoolfl. (1911) 42; KOORD. Enk. Fl. Java 2 (1912) 233; HEYNE, Nutt. Pl. (1927) 618; BURK. Dict. (1935) 2136; YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 40; STEENIS-KRUSEMAN, Bull. Org. Sc. Res. Indon. 18 (1953) 35; BACK. & BAKH. f. Fl. Java 1 (1963) 157. — *T. pyrrobotryum* MIQ. Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 81. — *T. javanicum* MIERS [Ann. Mag. Nat. Hist. ser. 3, 13 (1864) 490, *nomen*], Contr. Bot. 3 (1871) 45. — *T. elasticum* BECC. Malesia 1 (1877) 141; DIELS, Pfl. R. Heft 46 (1910) 116; KANEH. & HATUS. Bot. Mag. Tokyo 56 (1942) 474. — *T. philippinense* DIELS, Pfl. R. Heft 46 (1910) 116; in Elmer, Leaf. Philip. Bot. 4 (1911) 1164; W. H. BROWN, Minor Prod. Philip. For. 3 (1921) 186; MERR. En. Philip. 2 (1923) 146; BURK. Dict. (1935) 2163; QUIS. Medic. Pl. Philip. (1951) 299; PANCHO, Vasc. Fl. Mt Makiling 1 (1983) 279, f. 83. — *T. molle* DIELS, Philip. J. Sc. 8 (1913) Bot. 157; MERR. En. Philip. 2 (1923) 146. — **Fig. 8.**

Large woody climber to 30 m, exuding white latex when cut. Old stems coarsely striate, glabrous, up to c. 2.5 cm ϕ ; young leafy stems conspicuously striate, ferruginous-pubescent at first, later glabrescent. *Leaves*: petioles 6–21 cm, often rather slender, puberulous to glabrous, bent and slightly swollen at base and sometimes also at apex; lamina ovate to broadly ovate or elliptic, base truncate to cordate or obtuse, apex acuminate, 11–25(–29) by 4.5–20 cm, base 3–5-nerved with 2–3(–4) pairs of distal lateral nerves, nervation prominent on lower surface, upper surface (when dry) covered with a dense network of \pm parallel hair-like ridges, glabrous, lower surface puberulous to glabrous, stiffly papyraceous. *Inflorescences* arising several together from protuberances on old stems, racemose, (5–)8–28(–35) cm, ferruginous-tomentose, rarely glabrous. — *Male flowers* on puberulous pedicels 2.5–5 mm; 3 outer

sepals triangular-ovate to narrowly triangular, 1–2 mm long, lightly puberulous to glabrous; 6 main inner sepals white to yellow, elliptic, 4–5 mm long, reflexed at anthesis, glabrous or externally lightly puberulous (rarely tomentellous); petals broadly elliptic, 2.5–3.5 mm long, erect and contiguous at anthesis, concave with lateral edges incurved, glabrous; stamens with or without apiculus, 2–2.5 mm, anthers either immersed in the thickened connective or rather prominent, dehiscence longitudinal to transverse. — *Female flowers*: sepals and petals as in male; staminodes linear-oblong, acute, 3 mm; carpels curved-ellipsoidal, 2 mm long, stigma shortly multi-lobed. *Drupe*s at first green with white spots, later white to yellow (or orange), containing white latex, radiating from discoid carpophore terminating pedicels 1–2 cm, drying \pm compressed-ellipsoidal, glabrous, base narrowed into a short stalk; endocarp compressed, narrowly to broadly elliptic or subovate in outline, 2–3.5 by 1–2 cm, base rounded to obtuse, apex obtuse to sharply acute, surface obscurely to strongly rugose or rugulose.

Distr. India (incl. Nicobar Is.), Burma, Thailand, Yunnan, Vietnam; in *Malesia*: Sumatra, Malaya, W. Java, Borneo (incl. Natuna Is.), Philippines (Luzon, Mindanao), New Guinea.

Ecol. In forests up to 1400 m, but most collections from below 500 m, on a variety of soils including limestone (Java). *Fl. fr.* Jan.–Dec. The flowers are fragrant; POILANE 29891 (Vietnam) indicates that the odour is like that of methyl-salicylate (oil of wintergreen).

Uses. The milky exudate is used against dental caries (Vietnam), to alleviate sprue and fever (VAN STEENIS-KRUSEMAN, *l.c.*), and diluted it is used as an eyewash (Philippines; see BROWN, *l.c.*, under *T. philippinense*). The fruits are used as fish-poison (Philippines; BURKILL, *l.c.*, under *T. philippinense*), yet WHITMORE in his field-notes for FRI 3381 stated that the seeds are edible and sweet. The plant (? fruits) is used as a rat-poison in S. Sumatra (BURKILL, *l.c.*, under *T. phytocrenoides*), while the roots and stems are used medicinally in Java.

Vern. Thailand: *parai hortawng*; Malaya: *akar mumbulu*, *akar pelis kura*, *lumpaung*; Java: (*akar*) *ki konèng*, *S. kuniran*, *ojod konèng*, *ojod tjatjing*, *seriawan susun*, *susun*, *susun sapi*, J; W. Borneo: *kunyet utan*, Natuna Is.; SW. Borneo: *hujan panas*, Karimata Arch.; Philippines: *lagtang*, *maglabtang*, Luzon, *calumpangi*, Mindanao.

Note. In his monograph DIELS (1910) recognized 7 species although he commented that these were very close and that their number should perhaps be reduced. The characters used by DIELS to distinguish the species were: shape and indumentum of leaves, and sizes of inflorescences, flower-pedicels and sepals. With the abundant material of the genus now

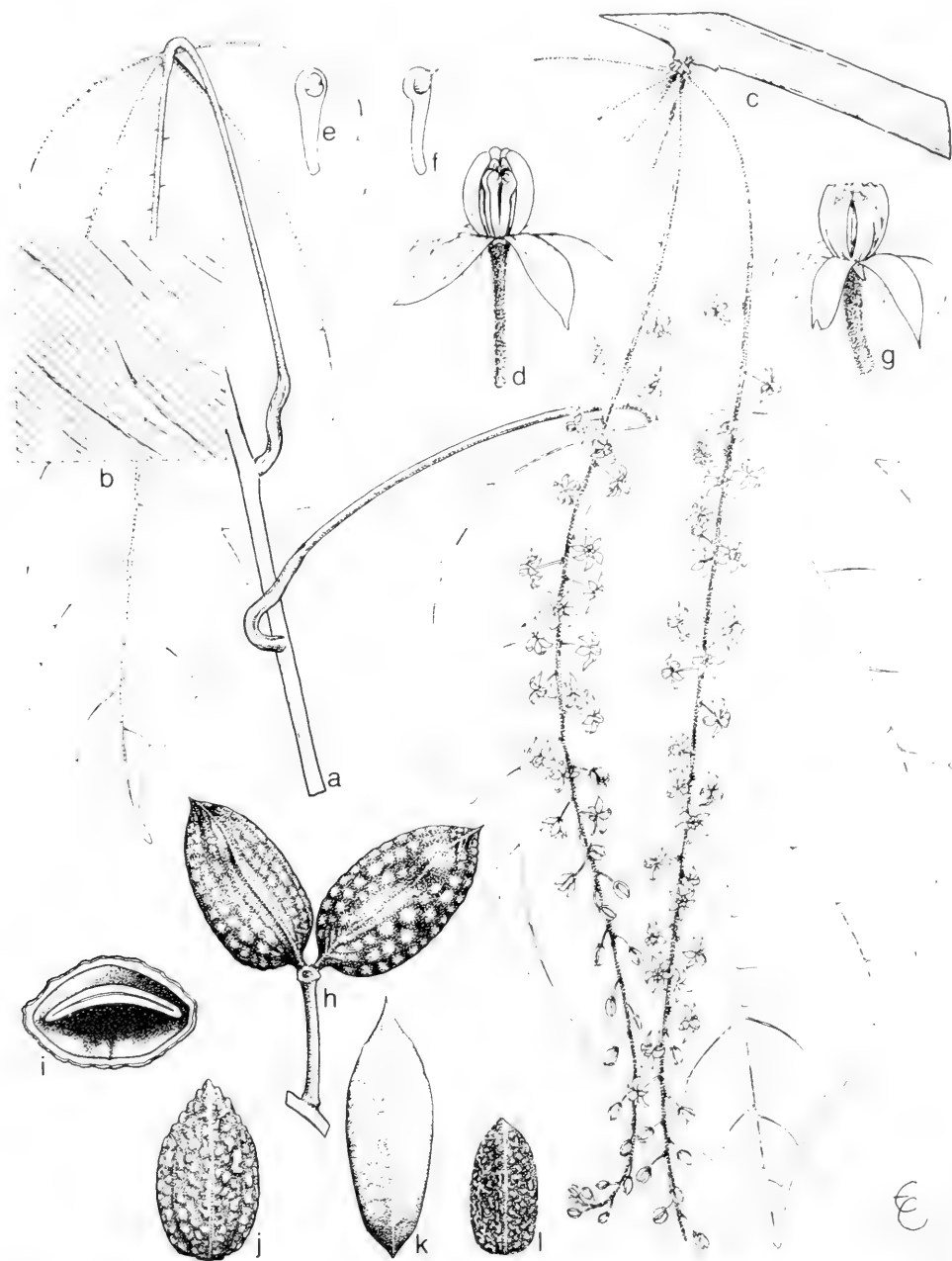


Fig. 8. *Tinomiscium petiolare* Hook. f. & Th. *a*. Habit, $\times 2/3$, *b*. detail of lower leaf surface, $\times 20$, *c*. male inflorescences, $\times 2/3$, *d*. male flower, front petals removed, $\times 4$, *e*-*f*. varying stamens, $\times 15$, *g*. female flower, all petals and front staminodes removed, $\times 4$, *h*. drupes, ventral view, nat. size, *i*. TS of drupe containing compressed seed, $\times 1\ 1/2$, *j*-*l*. varying endocarps, dorsal views, nat. size (*a*-*b*, *h*-*j* S 36494, *c*-*d* KOSTERMANS 19354, *e*-*f* UNESCO 238, *g* FRI 3381, *k* PNH 4850, *l* DE WILDE 16507).

available, it is clear that there is much variation in the characters and that they can no longer be used to draw taxonomic distinctions. The stamens and endocarps have also proved to be very variable. The stamens can be conspicuously apiculate or the apiculus can be completely lacking; both conditions can occur in the same flower. The anthers vary from being

prominent, *i.e.* projecting from the connective, with vertical slits to being immersed in the connective with horizontal slits; intermediate examples also occur. The endocarps are very variable in shape and surface ornamentation and also vary in the degree of flattening.

11. FIBRAUREA

LOUR. Fl. Coch. (1790) 626; MIERS, Ann. Mag. Nat. Hist. ser. 3, 13 (1864) 487; Contr. Bot. 3 (1871) 41; DIELS, Pfl. R. Heft 46 (1910) 119; FORMAN, Kew Bull. 40 (1985) 546. — **Fig. 9a–h.**

Woody climbers with yellow wood, entirely glabrous. Older stems with greyish buff bark, irregularly and coarsely striate; young stems smoothly and finely striate. *Leaves* ± elliptic to ovate, base 3(–5)-nerved with the main basal laterals running alongside the midrib for several (–15) mm before curving outwards, with 2–4 pairs of distal lateral nerves. *Inflorescences*: lax panicles, often ramiflorous. — *Male flowers*: 6 main sepals with 2–3 minute outer ones; petals 0; stamens 3 or 6, the filament thick with a prominent collar around the base of the anthers, dehiscence longitudinal to oblique. — *Female flowers*: sepals as in male; petals 0; staminodes 6, subulate; carpels 3, stigma cleft-like. *Drupes* radiating from a small knob-like carpophore, drying coarsely wrinkled; endocarp subellipsoidal with ventral narrow longitudinal groove; *seed* subellipsoidal, with narrow longitudinal groove, endosperm abundant around the embryo, cotyledons thin, foliaceous.

Distr. Two species, one wide-spread in the Nicobar Is., Burma, Indochina, S. China, and *Malesia*: Sumatra and Malaya to Celebes and the Philippines, the other one endemic in S. China and Indochina.

Ecol. Both species have yellow wood but field-notes of *F. tinctoria* also mention the presence of a white latex or sticky sap. Although not mentioned in the field-notes for *F. recisa*, it may well occur in that species also.

Note. There has been some confusion about the identity of LOUREIRO's type species, a matter discussed by FORMAN, *l.c.*

KEY TO THE SPECIES

1. Stamens 3. Wall of endocarp very thin, firmly crustaceous, less than 0.5 mm thick. S. China, Indochina
F. recisa

1. Stamens 6. Wall of endocarp much thicker, hard and rigid, c. 1 mm thick **1. F. tinctoria**

1. Fibraurea tinctoria LOUR. Fl. Coch. (1790) 626; HOOK. *f.* & TH. Fl. Ind. (1855) 204; MIQ. Fl. Ind. Bat. 1, 2 (1858) 87; Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 81; MIERS, Contr. Bot. 3 (1871) 41; HOOK. *f.* Fl. Br. India 1 (1872) 98; SCHEFF. Obs. Phyt. 3 (1872) 73, t. 4; KURZ, J. As. Soc. Beng. 43, ii (1874) 60; FOR. Fl. Burma 1 (1877) 53; BECC. Malesia 1 (1877) 142; GAGNEP. Fl. Gén. 1.-C. 1 (1908) 135; MERR. Trans.

Am. Phil. Soc. n.s. 24 (1935) 157; FORMAN, Kew Bull. 40 (1985) 549. — *Cocculus rimosus* BL. Bijdr. (1825) 24. — *F. chloroleuca* MIERS [Ann. Mag. Nat. Hist. ser. 3, 13 (1864) 489, *nomen*], Contr. Bot. 3 (1871) 42, t. 93; KING, J. As. Soc. Beng. 58, ii (1889) 380; RIDL. Trans. Linn. Soc. Bot. II, 3 (1893) 274; BOERL. Cat. Hort. Bog. 1 (1899) 37; RIDL. J. Str. Br. R. As. Soc. n. 33 (1900) 42; DIELS, Pfl. R. Heft 46

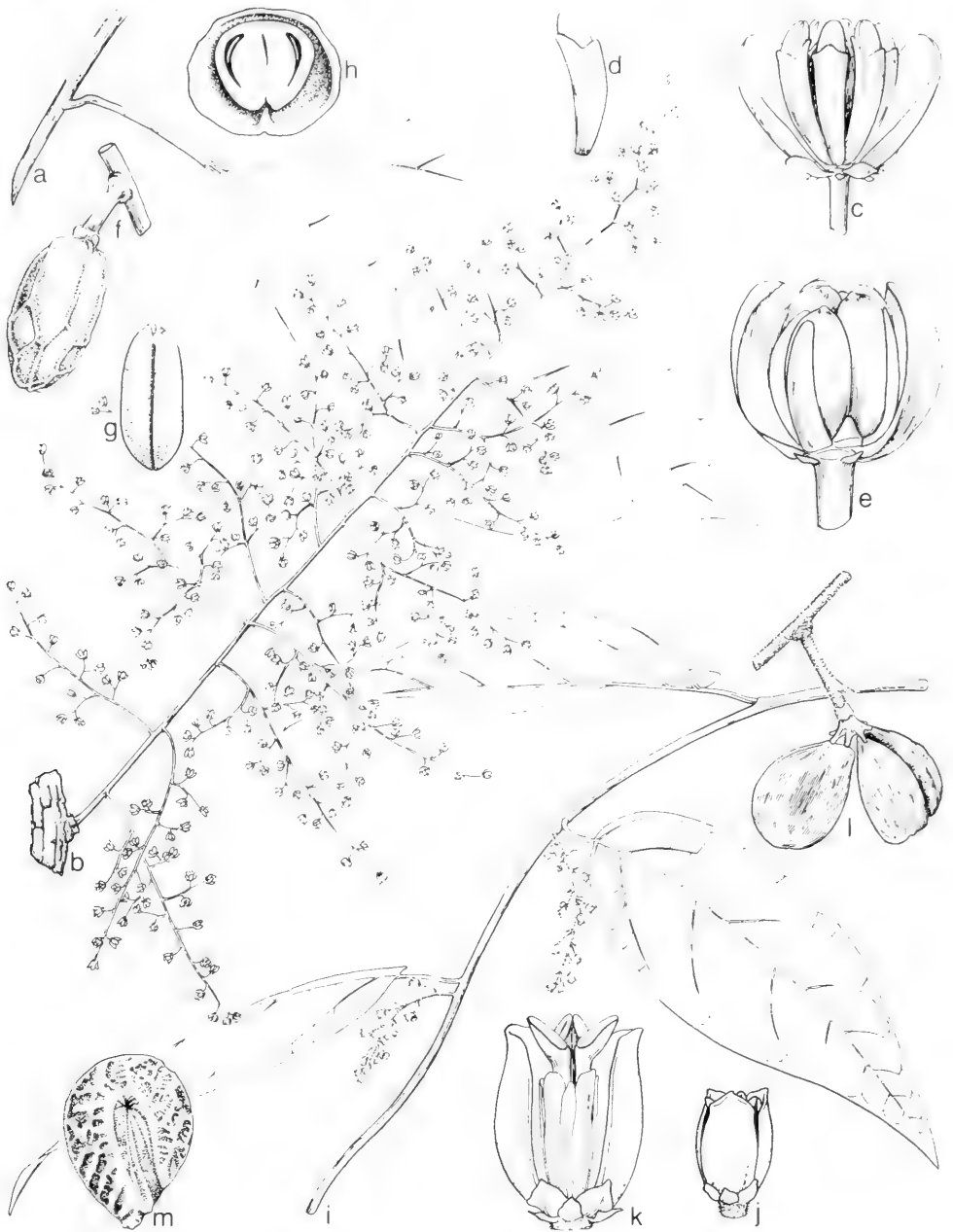


Fig. 9. *Fibraura tinctoria* LOUR. a. Leaf, b. male inflorescence, both $\times 2/3$, c. male flower, front sepals removed, d. stamen, side view, both $\times 10$, e. female flower, front sepals and staminode removed, $\times 6$ (from spirit material), f. drupe, g. endocarp, both $\times 2/3$, h. TS of endocarp showing section of seed, mainly endosperm, with 2 separated thin cotyledons, $\times 1 1/2$. — *Tiliacora triandra* (COLEBR.) DIELS. i. Habit, male plant, $\times 2/3$, j. male flower with valvate inner sepals, $\times 10$, k. male flower with front inner sepal removed, $\times 15$, l. drupes on branched carpophore, $\times 2$, m. endocarp, $\times 3$ (a, e FORMAN 76, b–d FORMAN 77, f–h SAN 26487, i–k CURTIS 447, l–m COLLINS 119).

(1910) 120; BACK. Schoolfl. (1911) 42; KOORD. Exk. Fl. Java 2 (1912) 233; MERR. En. Born. (1921) 248; RIDL. Fl. Mal. Pen. 1 (1922) 105; MERR. En. Philip. 2 (1923) 146; BURK. & HEND. Gard. Bull. S. S. 3 (1925) 344; NORMAN, J. Bot. 64, Suppl. (1926) 142; DIELS & HACKENB. Bot. Jahrb. 60 (1926) 307; HEYNE, Nutt. Pl. (1927) 619; BURK. Dict. (1935) 1000; YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 41; BACK. & BAKH. f. Fl. Java 1 (1963) 157. — *F. fasciculata* MIERS, Contr. Bot. 3 (1871) 43. — *F. laxa* MIERS, Contr. Bot. 3 (1871) 43; DIELS, Pfl. R. Heft 46 (1910) 120; MERR. En. Born. (1921) 249; YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 42. — **Fig. 9a-h.**

Large woody climber up to c. 40 m. Stem up to 5 cm ø, containing white latex, young shoot-tips tendrilliform. *Leaves*: petioles (2-)4-13 cm, often drying blackish at least at the swollen base; lamina elliptic, elliptic-ovate to ovate or oblong-elliptic, base sometimes subpeltate, usually rounded, apex acuminate, often shortly so, (9-)11-21(-28) by (3.5-)5-14 cm, upper surface often drying greyish and smooth with reticulation obscure, thinly coriaceous. *Inflorescences* axillary or ramiflorous, c. 10-38 cm with lateral branches up to 12 cm. — *Male flowers* sweetly scented, on pedicels up to 5 mm or sessile; main sepals white or yellow, broadly elliptic, concave, 2.5-4 mm long; stamens 6, 2-2.5 mm long, filament thickly columnar, incurved, anthers rather elongate and narrowly rounded at apex with lateral longitudinal slits. — *Female flowers*: sepals and petals as in male; staminodes subulate, 2 mm; carpels ellipsoidal, 1.75 mm long, stigma cleft-like, small. *Infructescences* often ramiflorous up to c. 55 cm. *Drupe* yellow to orange on pedicels 6-15 mm; endocarp 2-2.5 cm long, wall c. 1 mm thick, hard and rigid.

Distr. NE. India (Manipur, Nicobar Is.), Burma, Thailand, Indochina; in *Malesia*: Malaya, Su-

matra (incl. Enggano I.), Java, Borneo, NE. Celebes, Philippines (Dinagat I., N. of Mindanao).

Ecol. In Thailand recorded up to c. 100 m, locally common in dry evergreen forest, also in bamboo forest and scrub; in Vietnam at c. 1200 m on clayey soil in forest with undergrowth of tea bushes. In Malaya at low altitudes in primary forest, dense bamboo forest, lowland secondary and disturbed forest, along riverside and on rocky coast. In Sumatra at 1000 m. In Sarawak locally abundant in peat swamp forest, also in primary lowland forest and in secondary forest at 1000 m. In Brunei on yellow sandy loam in secondary forest and in mixed peat swamp forest. In Sabah up to 900 m in primary and secondary forest on ultrabasic, sandstone and stony blackish soil, in logged forest and along river banks. *Fl.* Jan.-Oct., *fr.* Jan.-Dec.

Uses. The stems are used medicinally in Malaya, as a stomach medicine in Sarawak, also for dyeing and for cordage. HEYNE (1927) and BURKILL (1935) recorded various uses, against dysentery, diabetes and headache; alkaloids occur; the yellow dye is possibly berberine, but see BISSET in FORMAN, *l.c.* 540.

Vern. Peninsular Thailand: *kamin kua, kumin kua, man miet*; Malaya: *sekunyit*, Johore; Sumatra: *akar kunyit, akar stupai, olor labai*, Simalur I.; Bangka: *akar mangkédun*, M; Java: *areuj gember, areuj ki konèng*, S, *peron*, J; Sarawak: *akar badi, akar kunyit, akar penawar*, Iban, *war birar*, Murut.

Notes. In his key, DIELS (*l.c.* 1910) distinguished *F. laxa* by its tricomposite male inflorescences up to 50 cm compared with *F. chloroleuca* with bicomposite male inflorescences up to 20 cm. This distinction is not valid when all the material now available is considered: indeed, the type of *F. laxa*, the only specimen of that species cited by DIELS, has a single inflorescence no longer than c. 38 cm.

12. ARCANGELISIA

BECC. Malesia 1 (1877) 145; DIELS, Pfl. R. Heft 46 (1910) 103; FORMAN, Kew Bull. 32 (1978) 333; FERGUSON, *l.c.* 341; WILKINSON, *l.c.* 350.

Lianes. *Leaves* palmately nerved at base with small papillose region on upper surface above insertion of petiole; hollow domatia with the aperture sometimes fringed with hairs present in the axils of the nerves and main veins, lamina otherwise glabrous. *Inflorescences* axillary or cauliflorous, paniculate with lateral branches spicate or subspicate. — *Male flowers* sessile or subsessile; sepals 9-10, glabrous, the outermost 3-4 minute, larger inner sepals 3+3; petals 0; synandrium a sessile, globose cluster of 9-12 anthers. — *Female flowers* (DIELS, *l.c.*) with sepals \pm as in male; petals 0; staminodes present (? number); carpels 3, stigma broad. *Infructescence* with club-shaped unbranched carpophores. *Drupe* transversely subovoid or subglobose with style-scar lateral, large; endo-

carp not sculptured but bearing a layer (continuous or broken) of radially arranged fibres; condyle inconspicuous or absent; seed broadly ellipsoidal; endosperm deeply ruminant; cotyledons apparently divergent and much folded (according to BECCARI and MAINGAY).

Distr. Two species in Hainan, S. Thailand, Indochina; in *Malesia*: Malaya to New Guinea.

Palyn. Pollen of *Arcangelisia* was described by FERGUSON (Kew Bull. 32, 1978, 341).

Notes. There are clearly two species: the wide-spread, small-fruited *A. flava* and the large-fruited New Guinea endemic *A. tympanopoda*, which can unfortunately only be identified in fruiting condition. Miss WILKINSON (*l.c.*) found that there are stomatal-anatomical differences in the leaf; FERGUSON (*l.c.*) found no difference in the pollen.

There is no indication that *A. tympanopoda* occurs outside New Guinea.

KEY TO THE SPECIES

1. Fruits transversely subovoid, 2.2–3 cm long, 2.5–3.3 cm broad (long axis); endocarp covered with a dense mat of radially arranged fibres **1. *A. flava***
1. Fruits subglobose, 4.5–5.5 cm ø; endocarp bearing an interrupted layer of radially arranged fibres, which form a dense dorsal ridge as well as thin lateral transverse plates **2. *A. tympanopoda***

1. *Arcangelisia flava* (L.) MERR. Int. Rumph. (1917) 222; W.H. BROWN, Minor Prod. Philip. For. 2 (1921) 388; *ibid.* 3 (1921) 67, 185; MERR. En. Born. (1921) 248; En. Philip. 2 (1923) 145; HEYNE, Nutt. Pl. (1927) 621; HOLTH. & LAM, Blumea 5 (1942) 180; YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 36; HEINE in Fedde, Rep. 54 (1951) 226; BACK. & BAKH. *f.* Fl. Java 1 (1963) 155; FORMAN, Kew Bull. 32 (1978) 334; PANCHO, Vasc. Fl. Mt Makiling 1 (1983) 281, f. 85. — *Tuba flava* RUMPH. Herb. Amb. 5 (1747) 38, t. 24. — *Menispermum flavum* LINNÉ, Herb. Amb. (subm. Stickman) (1754) 18; Syst. ed. 10 (1759) 992. — *Menispermum flavescens* LAMK, Encycl. Méth. 4 (1797) 98. — *Cocculus flavescens* (LAMK) DC. Syst. 1 (1817) 520; Prod. 1 (1824) 97. — *Anamirta flavescens* (LAMK) MIQ. Fl. Ind. Bat. 1, 2 (1858) 79. — *Anamirta lemniscata* MIERS [Ann. Mag. Nat. Hist. ser. 3, 14 (1864) 51, *nomen*], Contr. Bot. 3 (1871) 54, t. 97/1–6. — *Anamirta luctuosa* MIERS, Contr. Bot. 3 (1871) 55. — *A. lemniscata* (MIERS) BECC. Malesia 1 (1877) 147; BOERL. Cat. Hort. Bog. 1 (1899) 38; DIELS, Pfl. R. Heft 46 (1910) 106, f. 38; BACK. Schoolfl. (1911) 40; DIELS in Elmer, Leaf. Philip. Bot. 4 (1911) 1163; Nova Guinea 8 (1912) 869; KOORD. Exk. Fl. Java 2 (1912) 232. — *A. inclyta* BECC. Malesia 1 (1877) 147. — *Anamirta loureiri* PIERRE, For. Fl. Coch. (1885) t. 110; KING, J. As. Soc. Beng. 58, ii (1889) 379. — *Mirtana loureiri* (PIERRE) PIERRE, Bull. Soc. Bot. Fr. 52 (1905) 490. — *A. loureiri* (PIERRE) DIELS, Pfl. R. Heft 46 (1910) 104; RIDL. Fl. Mal. Pen. 1 (1922) 107; BURK. & HEND. Gard. Bull. S. S. 3 (1925) 344. — *Tinospora havilandii* DIELS, Pfl. R. Heft 46 (1910) 138, *p.p.*, *quoad folia*.

Plant glabrous apart from leaf-domatia. Stems with yellow wood and exuding yellow sap when cut, bearing prominent cup-like petiole-scars. *Leaves*: petioles (4–)7–15(–20) cm, swollen at both ends, geniculate at base; lamina usually ovate, elliptic-ovate or broadly ovate, base usually rounded, truncate or slightly cordate, apex abruptly acuminate, (10–)12–25 by (5.5–)8–19 cm, palmately 5-nerved at the base and with 1–3 pairs of lateral nerves usually arising from above halfway along the midrib, main nerves prominent, especially below, both surfaces usually drying matt with a rather obscure reticulum, coriaceous; hollow domatia present on lower surface in the axils of main nerves, with the aperture frequently puberulous. *Inflorescences* axillary or cauliflorous, paniculate, slender, 10–50 cm, lateral branches spicate or subspicate, 1–5 cm. — *Male flowers* sessile or subsessile subtended by an ovate bracteole c. 1 mm long which is strongly thickened at the base; 3–4 minute outer sepals less than 1 mm long, 3+3 larger inner sepals elliptic, ovate or narrowly obovate, 1.5–2.5 mm long; synandrium 0.5–1 mm long. — *Female flowers* (DIELS) with 6 main sepals narrowly oblong with the apex becoming reflexed, 2.5–4 mm long; stamens minute, scale-like; carpels 3, 1.5 mm long, stigma broad, sessile, papillose. *Infructescences* cauliflorous, usually branched, (5–)7–30(–45) cm, with thickened axis and branches, 3–6 mm ø, the fruits plus carpophores borne on the lateral branches; 1–3 borne together on a club-shaped, unbranched carpophore swollen at the apex, up to 4 cm. *Drupes* yellow, slightly laterally compressed, transversely subovoid, 2.2–3 by 2.5–3.3 cm (long axis), 2–2.5 cm thick, drying finely

rugulose, glabrous; endocarp woody, surface covered with a dense mat of radially arranged fibres.

DISTR. Hainan, Indochina, S. Peninsular Thailand; in *Malesia*: N. & Central Sumatra, Malaya (incl. Langkawi), Central Java, throughout Borneo and Philippines, Central & N. Celebes, N. Moluccas (Talaud Is., Halmahera), New Guinea.

Ecol. Forests at altitudes up to 1000 m, sometimes near river banks. On limestone hill, low altitudes in N. Celebes.

Vern. Thailand: *hap*; Sabah: *takop*.

Notes. Alkaloids found in this species are berberine, columbamine, jatrorrhizine and palmatine, according to THORNER (Phytochem. 9, 1970, 160). JEWERS *et al.* (*l.c.* 663) reported the same alkaloids, but not columbamine, from extracts of stems and roots.

Details of the primary xylem elements were given by ZAMORA (Philip. Agric. 50, 1966, 439, f. 899-912).

The fruits are eaten and dispersed by orang-utans, gibbons and macaques in E. Borneo (information from Dr. M. LEIGHTON, Harvard Univ.).

2. *Arcangelisia tympanopoda* (LAUT. & K. SCH.) DIELS, Pfl. R. Heft 46 (1910) 106, f. 39; FORMAN, Kew Bull. 32 (1978) 337. — *Macrococculus tympa-*

nopodus LAUT. & K. SCH. Fl. Deut. Schutzgeb. Südsee (1900) 314.

Incompletely known. *Leaves* apparently indistinguishable from those of *A. flava*, except for stomata (see notes under the genus). — *Male inflorescences* and *flowers* apparently as in *A. flava*. — *Female flowers* unknown. *Infructescence* cauliflorous, 23-60 cm, either slender, 2-3 cm σ , unbranched, terminating in a carpophore, or branched with main axis to 5 mm σ ; carpophore thick, claviform, to 4 cm long, 2 cm σ at apex. *Drupes* yellow, subglobose, slightly laterally compressed with a faint longitudinal dorsal ridge running all round, 4.5-5.5 cm σ , surface drying finely granular, glabrous; endocarp woody, surface bearing an interrupted layer of radially arranged fibres, these forming a dense dorsal ridge as well as thin lateral, transverse plates.

DISTR. *Malesia*: New Guinea.

Ecol. Secondary forest on clay soil, well drained alluvial soil, from forest edge overhanging water, up to 350 m.

Note. The difference between the two forms of infructescence is remarkable. Since they both bear similar large-sized fruits, it must be concluded that they both belong to this species. The position on the plant, *e.g.* whether on older or younger stems, may determine the form of the infructescence.

13. ANAMIRTA

COLEBR. Trans. Linn. Soc. 13 (1821) 52; BENTH. in B. & H., Gen. Pl. 1 (1862) 35; MIERS, Ann. Mag. Nat. Hist. ser. 3, 14 (1864) 49, t. 97; Contr. Bot. 3 (1871) 49; HOOK. *f.* Fl. Br. India 1 (1872) 98; DIELS, Pfl. R. Heft 46 (1910) 108, f. 10, 40; FORMAN, Kew Bull. 32 (1978) 329. — **Fig. 10h-j, 11.**

Large lianes, almost entirely glabrous. *Leaves* palmately nerved at the base, hairy domatia present in the axils of the nerves and main veins. *Inflorescences* usually cauliflorous (male sometimes axillary), paniculate. — *Male flowers* pedicellate: usually 2 minute outer sepals with 3 + 3 concave, imbricate larger inner sepals, becoming reflexed; petals 0; synandrium consisting of a shortly stalked globular cluster of c. 30-35 transversely dehiscent anthers. — *Female flowers*: sepals as in male; petals 0; staminodes 6, minute; carpels 3(-4) arising laterally from a central conical gynophore which greatly lengthens in fruit, stigma recurved. *Drupes* subreniform-globose, style-scar sublateral, borne on short terminal divergent branches of a thickened columnar carpophore continuous with peduncle (*i.e.* flower-pedicel); pericarp very thin; endocarp woody with reticulate surface, bearing 2 small sublateral perforations on the ventral (concave) side, with a deeply intrusive bilobed condyle around which the subhemispherical seed lies, each lobe of the condyle being hollow and leading to one of the external perforations; endosperm copious; embryo with divaricate, thin, foliaceous cotyledons much larger than the radicle.

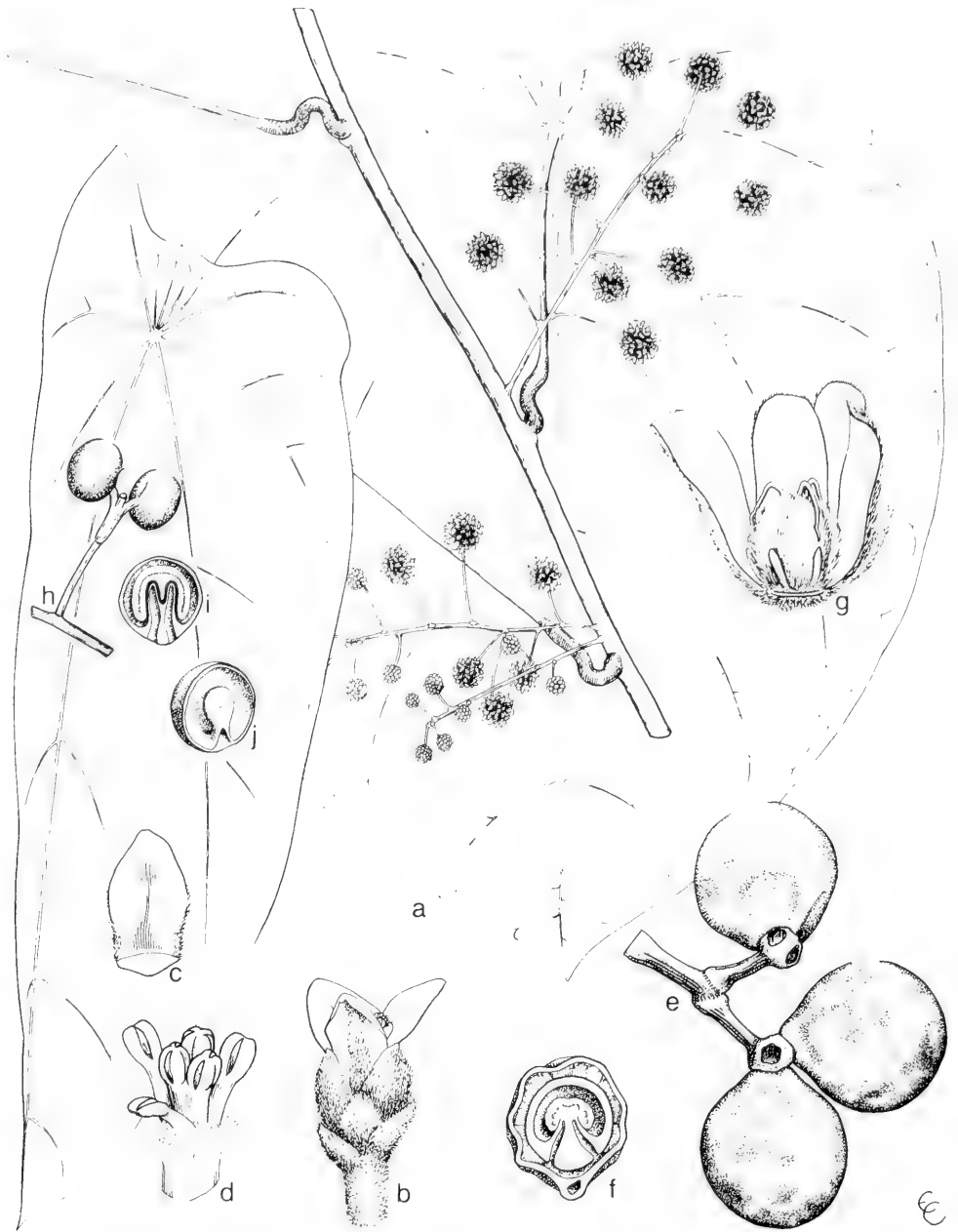


Fig. 10. *Coscinium fenestratum* (GAERTN.) COLEBR. *a*. Habit, male plant, $\times 2/3$, *b*. male flower, $\times 8$, *c*. inner sepal, inner view, $\times 10$, *d*. stamens, $\times 20$, *e*. infructescence, $\times 2/3$, *f*. LS of drupe, $\times 2/3$. — *C. blumeianum* MIERS ex HOOK. *f.* & TH. *g*. Female flower, front sepals removed, $\times 6$. — *Anamirta cocculus* (L.) WIGHT & ARN. *h*. Part of infructescence with branched carpophore, nat. size, *i*. LS of drupe, $\times 1\ 1/2$, *j*. half of drupe without seed showing one lobe of bilobed hollow condyle, $\times 1\ 1/2$ (*a* VAN BALGOOY 2426, *b-d* DE WILDE 12588, *e-f* KOSTERMANS 13932, *g* MAINGAY 118/2, *h-j* FORBES 3391).

Distr. Ceylon and India to Indochina; throughout *Malesia*. Monotypic.

Palyn. Pollen of *Anamirta cocculus* was described by FERGUSON (Kew Bull. 32, 1978, 340).

1. *Anamirta cocculus* (L.) WIGHT & ARN. Prod. 1 (1834) 446; *ARN. Ann. Sci. Nat.* ii, 2 (1834) 65, t. 3; in *Hook. f. & Th., Fl. Ind.* (1855) 185; *MIQ. Fl. Ind. Bat.* 1, 2 (1858) 78; *Ann. Mus. Bot. Lugd.-Bat.* 4 (1868) 80; *HOOK. f. Fl. Br. India* 1 (1872) 98; *SCHIEFF. Nat. Tijds. N. I.* 32 (1873) 395; *BECC. Malesia* 1 (1877) 143; *HEMSL. Rep. Chall. Bot.* 1 (1885) 118; *ENGL. Bot. Jahrb.* 7 (1886) 455; *K. SCH. & HOLLER. Fl. Kaiser Wilh. Land* (1889) 44; *K. SCH. Notizbl. Berl.-Dahl.* 2 (1898) 116; *BOERL. Cat. Hort. Bog.* 1 (1899) 37; *DIELS, Pfl. R. Heft* 46 (1910) 108, f. 10, 40; *BACK. Schoofl.* (1911) 41; *DIELS in Elmer, Leafl. Philip.* Bot. 4 (1911) 1165; *KOORD. Exk. Fl. Java* 2 (1912) 232; *MERR. Int. Rumph.* (1917) 221; *Sp. Blanc.* (1918) 145; *W.H. BROWN, Minor Prod. Philip. For.* 1 (1920) 375; *ibid.* 3 (1921) 79, 185; *MERR. En. Philip.* 2 (1923) 145; *HEYNE, Nutt. Pl.* (1927) 620; *KANEH. & HATUS. Bot. Mag. Tokyo* 56 (1942) 471; *YAMAMOTO, J. Soc. Trop. Agric.* 16 (1944) 37; *BACK. & BAKH. f. Fl. Java* 1 (1963) 156; *FORMAN, Kew Bull.* 32 (1978) 329; *PANCHO, Vasc. Fl. Mt Makiling* 1 (1983) 281. — *Natsiatum RHEEDE, Hort. Mal.* 7 (1688) t. 1. — *Tuba baccifera* RUMPH. *Herb. Amb.* 5 (1747) 35, t. 22. — *Menispermum cocculus* LINNÉ, *Sp. Pl.* (1753) 340; *GAERTN. Fruct. I.* (1788) 219, t. 70; *ROXB. Fl. Ind. ed. Carey* 3 (1832) 807; *BLANCO, Fl. Filip.* ed. 1 (1837) 809. — *Menispermum lacunosum* LAMK, *Encycl. Méth.* 4 (1797) 98. — *Cocculus populifolius* DC. *Syst.* 1 (1817) 519; *Prod.* 1 (1824) 97; *DECNE, Nouv. Ann. Mus. Paris* 3 (1834) 423; *SPAN. Linnaea* 15 (1841) 163. — *A. jucunda* MIERS, *Contr. Bot.* (1871) 55. — **Fig. 10h–j, 11.**

For complete synonymy, see FORMAN (1978).

Young stems and petioles usually drying pale greyish straw-coloured, striate, glabrous. *Leaves* with glabrous petioles 6–18(–26) cm, swollen at both ends, geniculate at the base; lamina ovate to broadly ovate, base cordate to truncate (or broadly obtuse), apex usually acuminate, 16–28 by 10–24 cm, palmately 3–5(–7)-nerved at base and with 4–5 pairs of lateral nerves running ± parallel with the main, *i.e.* distal, pair of basal nerves, the lateral nerves linked together with scalariform veins; lower surface with reticulum clearly visible and slightly raised, drying pale straw-coloured against a pale grey-brown background, midrib and nerves very prominent; upper surface drying slightly darker, subnitidous, midrib prominent; glabrous on both surfaces apart from pockets of hairs in the axils of the nerves and main veins, thinly coriaceous. *Inflorescences* 16–40 cm with lateral branches 2–5 cm, glabrous, bracteoles *c.* 0.5 mm long. — *Male flowers* with glabrous pedicels becoming up to 2–3 mm; sepals white, yellow or pale green, outer sepals 2, scarcely 1 mm long, inner sep-

als 6, broadly elliptic, 2.5–3 by 2 mm, glabrous, apart from often minutely papillose margin; synandrium 1.5–2 mm long. — *Female flowers*: pedicels and sepals as in male; staminodes 6, minute, scarcely 0.25 mm; carpels 3(–4), curved-ellipsoidal, 1.5–2 mm; stigma thick, recurved. *Inflorescences* wholly glabrous, lateral branches up to 15 cm; carpophore (3–)6–16 mm, continuous with pedicel 8–20 mm. *Drupes* white, 9–11 mm long, glabrous; endocarp subreniform-globose, surface reticulate-rugulose with a weak dorsal groove; cotyledons ± narrowly elliptic 5–7 mm long, 2 mm broad.

Distr. Ceylon, India, Thailand, Indochina; in *Malesia*: N. Sumatra (once), E. Java (twice), Lesser Sunda Is. (Sumba, Flores, Alor, Timor, Wetar, Damar, Babar), Moluccas (Tenimber, Kei, Ceram, Sula Is., Halmahera), Philippines (Luzon, Mindoro, Basilan, Mindanao), New Guinea (incl. Aru Is.).

Ecol. Lowland, in a variety of conditions, on banks of rivers and streams, coastal forest, savannahs, on basalt, limestone and sandy soil, both in rain-forest conditions and in seasonal climates, but judging from the scanty occurrence in Java and Sumatra and absence in Malaya and Borneo, with a distinct preference for seasonal conditions, it accounts for the high frequency in the Lesser Sunda Is.

Uses. The stem produces bast-fibres. The fruits are used as a fish-poison and are also used to kill lice in the hair. They are a source of picrotoxin, which has proved to be a mixed crystallate of picrotoxinin, which is a violent convulsant poison, and picrotin, which is very much less toxic. Picrotoxin has been used in the treatment of schizophrenia and is an effective antidote for barbiturate and morphine poisoning. A review of the chemical constituents and pharmacological properties is given by QUISUMBING (*Medic. Pl. Philip.* 1951, 290, 1030) and in *Wealth of India, Raw Materials* 1 (1948) 75.

According to FLÜCKIGER & HANBURY (*Pharmacographia* ed. 2, 1879, 31–33) the fruits have been known in Europe at least since the 16th century when they were being imported via Alexandria and other centres in the Middle East. They are well figured in GERARDE's *Herbal* of 1597. In the 1633 edition, p. 1548 he stated that they were 'well known in shoppes by the name of *Cocculus Indicus*, some call them *Cocci Orientales* . . . They are used with good success to kill lice in children's heads . . . In England we use the fruit called *Cocculus Indi* in powder mixed with flower, hony, and crummes of bread to catch fish with, it being a numbing, soporiferous, or sleeping medicine, causeth the fish to turn up their bellies, as being senceless for a time.' In 1635 the fruits were subject in England to an import duty of 2s. per



Fig. 11. *Anamirta cocculus* (L.) WIGHT & ARN. in flower (male). Central Thailand, Saraburi (Photogr. H. BÄNZIGER).

pound. HOOKER *f.* & THOMSON (1855) reported of the fruits that 'in England they are extensively used in the adulteration of beer.'

Vern. Sumatra: *waran pisang*, Alas; Lesser Sunda Is.: *kruppe*, Sumba; Philippines: *array*, Mindanao, *lagtang*, *ligtang*, Luzon.

Notes. The anomalous stem-structure was de-

scribed by SANTOS (Philip. J. Sc. 44, 1931, 385-407). Details of the primary xylem elements were given by ZAMORA (Philip. Agric. 50, 1966, 437-440, f. 961-973).

According to BROWN (1920, *l.c.*) the flowers are fragrant; the field notes on some Philippine specimens describe the odour as unpleasant.

14. COSCINIUM

COLEBR. Trans. Linn. Soc. 13 (1821) 51; HOOK. *f.* & TH. Fl. Ind. 1 (1855) 177; BENTH. in B. & H. Gen. Pl. 1 (1862) 35; MIERS, Contr. Bot. 3 (1871) 19; HOOK. *f.* Fl. Br. India 1 (1872) 98; DIELS, Pfl. R. Heft 46 (1910) 110; FORMAN, Kew Bull. 32 (1978) 324. — **Fig. 10a-g.**

Large lianes. *Leaves* often peltate, palmately nerved, lamina tomentellous, often whitish below. *Inflorescence* supra-axillary or ramiflorous, composed of a raceme of peduncled \pm globose heads of flowers. — *Male flowers*: sepals 9, imbricate in 3 whorls, externally sericeous; petals 0; stamens 6, the outer 3 free with 1-locular introrse anthers, the inner 3 with connate filaments and with 2-locular latrorse anthers. — *Female flowers*: sepals as in male; petals 0; staminodes 6; carpels 3; densely pilose, style filiform recurved. *Infructescence* with globose carpophore. *Drupes* (only known in *C. fenestratum*) subglobose, tomentellous, style-scar sublateral, endocarp covered with anastomosing fibrous ridges, condyle deeply intrusive, thickly clavate and containing 2 ducts, each linking the seed-cavity with a pore on the basal surface of the endocarp; *seed* subglobose, hollow, enveloping the condyle, endosperm surrounding the divaricate, folded and divided cotyledons.

Distr. Two species: Ceylon, India, Thailand, Indochina; in *W. Malesia*: Malaya, Sumatra, W. Java, Borneo.

Palyn. Pollen of *Cosciniium* was described by FERGUSON (Kew Bull. 32, 1978, 342).

KEY TO THE SPECIES

1. Lamina \pm broadly ovate, less than 1 1/2 times as long as broad, peltate or not; upper surface drying fairly smooth. Male flowers in several-flowered heads c. 7 mm ϕ **1. *C. fenestratum***
1. Lamina elongate, more than 1 1/2 times as long as broad, peltate with petiole inserted 1.5 to 5 cm from margin; upper surface often drying rugose with main nerves markedly impressed. Male flowers in many-flowered heads c. 13 mm ϕ **2. *C. blumeanum***

1. *Cosciniium fenestratum* (GAERTN.) COLEBR. Trans. Linn. Soc. 13 (1821) 65; HOOK. Bot. Mag. (1852) t. 4658; HOOK. *f.* & TH. Fl. Ind. (1855) 178; MIQ. Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 80; MIERS, Contr. Bot. 3 (1871) 22, t. 88; HOOK. *f.* & TH. Fl. Br. India 1 (1872) 99; SCHEFF. Nat. Tijd. N. I. 32 (1873) 395, t. 5; BECC. Malesia 1 (1877) 144; KING, J. AS. Soc. Beng. 58, ii (1889) 381; BOERL. Cat. Hort. Bog. 1 (1899) 38; RIDL. J. Str. Br. R. As. Soc. n. 33 (1900)

42; DIELS, Pfl. R. Heft 46 (1910) 113, f. 41H-N; BACK. Schoolfl. (1911) 41; MERR. En. Born. (1921) 248; Philip. J. Sc. 29 (1926) 367; YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 38, *incl. var. macrophyllum* YAMAMOTO *et var. ovalifolium* YAMAMOTO, *l.c.* 39; BACK. & BAKH. *f.* Fl. Java 1 (1963) 156; FORMAN, Kew Bull. 32 (1978) 325. — *Menispermum fenestratum* GAERTN. Fruct. 1 (1788) 219, t. 45, f. 5. — *C. wallichianum* MIERS [Ann. Mag. Nat. Hist. ser. 2, 7

(1851) 37, *nomen*], Contr. Bot. 3 (1871) 23; DIELS, Pfl. R. Heft 46 (1910) 112; RIDL. Fl. Mal. Pen. 1 (1922) 106; BURK. Dict. (1935) 669. — *C. blumeinum* (non MIERS ex HOOK. f. & TH.) MIQ. Fl. Ind. Bat. 1, 2 (1858) 77, *p.p.*; HOOK. f. & TH. Fl. Br. India 1 (1872) 99, *p.p.*; SCHEFF. Nat. Tijds. N. I. 32 (1873) 396, t. 6; BECC. Malesia 1 (1877) 144; KING, J. As. Soc. Beng. 58, ii (1889) 381, *p.p.*; BOERL. Cat. Hort. Bog. 1 (1899) 38, *incl. var. epeltatum* BOERL.; RIDL. Fl. Mal. Pen. 1 (1922) 106, *p.p.*; HEYNE, Nutt. Pl. (1927) 621; YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 38. — *C. maingayi* PIERRE, Fl. Coch. (1885) sub t. 112 ('*maingayi*', *sphalm.*). — *C. miosepalum* DIELS, Pfl. R. Heft 46 (1910) 113; BACK. Schoolfl. (1911) 41; KOORD. Exk. Fl. Java (1912) 232; BACK. & BAKH. f. Fl. Java 1 (1963) 156. — *C. peltatum* MERR. Un. Cal. Publ. Bot. 51 (1929) 59. — **Fig. 10a-f.**

Large liane with yellow wood and sap. Branchlets terete, obscurely ridged or smooth, brownish tomentose at first, later glabrescent, becoming whitish, bearing prominent disciform petiole-scars. *Leaves*: petioles at first brownish tomentose, 3–16 cm, often conspicuously swollen at both ends, geniculate at base, inserted up to 0.8–(2.7) cm from basal margin of lamina; lamina usually broadly ovate or ovate, rarely subpanduriform with basal, lateral lobes, base broadly rounded, truncate or shallowly cordate, rarely broadly obtuse, apex acuminate, 11–33 by 8–23 cm; upper surface glabrescent, usually drying smooth, midrib and other main nerves sunken, lower surface often whitish tomentellous with fine reticulation visible, palmately 5–7-nerved at base and also usually two pairs of distal lateral nerves, thinly coriaceous. *Inflorescences*: flowers in several-flowered globose heads 6–7 mm ϕ on peduncles 10–30 mm, arranged in a raceme 5–11 cm, supra-axillary or from older, leafless stems; inflorescences arising singly or a few together, axis and branches slender, brown tomentose or tomentellous, bracts subulate, 4–5 mm long. — *Male flowers* sessile or with pedicels up to 1 mm; sepals densely sericeous-pilose externally, glabrous within, broadly elliptic to obovate, the inner 3–6 spreading, yellow, 1.5–2 mm long; outermost sepals smaller, 1–1.5 mm long, inserted lower; stamens 6, 1 mm long. — *Female flowers*: sepals as in male flowers; staminodes 6, claviform, 1 mm long; carpels 3, curved-ellipsoidal, 2 mm long, densely pilose; style filiform, recurved. *Infructescence* with carpophore globose, tomentellous, 7–8 mm ϕ , bearing 1–3 drupes. *Drupes* subglobose, tomentellous, brown to orange or yellowish, 2.8–3 cm ϕ ; pericarp drying woody, c. 1 mm thick; endocarp bony, 2.2–2.5 cm ϕ ; wall 3 mm thick covered with anastomosing fibrous ridges; condyle deeply intrusive, thickly clavate. *Seed* whitish, subglobose, enveloping the condyle; endosperm present and within this are

immersed the divaricate, much folded and divided cotyledons.

Distr. Ceylon, S. India, Cambodia, Vietnam; in *Malesia*: Malaya, Sumatra (incl. Banka), W. Java, Borneo.

Ecol. Primary lowland forest; soils include granitic sand (Banka) and sandstone (Sabah).

Uses. The wood produces a yellow dye (used together with *Curcuma* in Cambodia). A decoction of the stem and leaves is used medicinally. It has been known in Europe as False calumba, being a substitute for *Calumba* (*Jateorhiza*). The plant has alleged antiseptic properties and is used in Malaya to dress wounds and ulcers. The species is used as an ingredient for arrow poisons in Malaya (BISSET & WOODS, Lloydia 29, 1966, 194). According to the notes on S 32149 and 33332 from Sarawak, the effects of intoxication can be avoided if the roots are chewed and the juices swallowed before drinking.

GRESHOFF (Meded. Lands Pl. Tuin 25, 1898, 22) recorded that the leaves contain picrotoxin-like bitter substances. Like most previous authors, GRESHOFF wrongly applied the name *C. blumeinum* to the present species. Alkaloids found by JEWERS *et al.* (Phytochem. 9, 1970, 663) were: palmatine, berberine and jatrorrhizine. The record of the same three alkaloids by THORNER (Phytochem. 9, 1970, 163) under *C. blumeinum* probably refers to this species. Further alkaloids were reported by SIWON *et al.* (Planta Medica 38, 1980, 24).

Vern. Malaya: *akar kuning*, (*kunyt-kunyt*) *babu*, *kopak*, *kupak*, *tol*; Banka: *akar kunyit*; Java: *akar kuning*; Borneo: *abang asuh*, Sabah, *binap kokop*, *upak-upak*, E. Borneo, *perawan*, *dipang*, Sarawak.

Note. The fruits are eaten and dispersed by orang-utans, gibbons and macaques in E. Borneo (information from Dr. M. LEIGHTON, Harvard Univ.).

2. *Coscinium blumeinum* MIERS [Ann. Mag. Nat. Hist. ser. 2, 7 (1851) 37, *nomen*] ex HOOK. f. & TH. Fl. Ind. (1855) 179; MIQ. Fl. Ind. Bat. 1, 2 (1858) 77, *p.p.*; MIERS, Contr. Bot. 3 (1871) 23; HOOK. f. & TH. Fl. Br. India 1 (1872) 99, *p.p.*; KING, J. As. Soc. Beng. 58, ii (1889) 381, *p.p.*; DIELS, Pfl. R. Heft 46 (1910) 113, f. 41A–G; RIDL. Fl. Mal. Pen. 1 (1922) 106, *p.p.*; FORMAN, Kew Bull. 32 (1978) 328. — **Fig. 10g.**

Large liane. Branchlets terete, obscurely ridged or smooth, pale fawn to brownish at first, later glabrescent and whitish, bearing prominent disciform petiole-scars. *Leaves*: petioles whitish tomentose, 6–20 cm, conspicuously swollen at both ends, inserted 1.5–5 cm from basal margin of lamina; lamina oblong, lanceolate-oblong or narrowly ovate, occasionally subpanduriform, base broadly rounded or

truncate, apex acuminate, 15–35 by 6–20 cm, above glabrous, often drying \pm bullate, beneath whitish tomentellous with fine reticulation visible, palmately 7–11-nerved at base with 2–3 pairs of distal lateral nerves, thinly coriaceous. *Inflorescences*: flowers in globose (or slightly elongate) densely and \sim -flowered heads 10–13 mm ϕ on peduncles 10–25 mm arranged in a raceme 12–14 mm, supra-axillary or arising from older leafless stems, axis and branches of inflorescence stout and brown tomentose, bracts inconspicuous, scale-like, 1–2 mm long. — *Male flowers* with pedicels 1.5–2 mm; sepals densely sericeous-pilose externally, glabrous within, inner 3–6 spreading at anthesis, broadly elliptic to spatulate-obovate, 2.5–3 mm long, the outermost 3 elliptic, 1.5–2 mm long, inserted lower; stamens 6, 1 mm long. — *Female flowers*: 6 larger inner sepals oblong

to oblanceolate, 4–4.5 mm long, staminodes 6, carpels 3 as in *C. fenestratum*. *Drupes* unknown.

Distr. Peninsular Thailand; in *Malesia*: Malaya (Penang and Pangkor I.).

Ecol. In Peninsular Thailand recorded from evergreen forest at c. 300 m, and on Terutao I. at 15 m.

Notes. This distinctive species has a restricted distribution. The name *C. blumeanum* has often been wrongly applied to specimens of the more widely distributed *C. fenestratum*, thus resulting in a long-standing confusion between the two species.

There is no indication in the available field-notes that the wood is yellow as in *C. fenestratum*.

Mature fruits have apparently never been collected. It would be most interesting to know how they compared with those of the other species.

15. PACHYGONE

MIERS, *Ann. Mag. Nat. Hist.* ser. 2, 7 (1851) 37; HOOK. *f.* & TH. *Fl. Ind.* 1 (1855) 202; MIERS, *Contr. Bot.* 3 (1871) 328; DIELS, *Pfl. R. Heft* 46 (1910) 241, f. 80; FORMAN, *Kew Bull.* 12 (1958) 457; *ibid.* 22 (1968) 374. — *Tristichocalyx* F. v. M. *Fragm.* 4 (1863) 27. — **Fig. 12g–i.**

Woody climbers. *Leaves* \pm ovate, base 3- to 5-nerved. *Inflorescences* axillary, pseudo-racemose. — *Male flowers*: sepals 6(–12), inner ones larger, imbricate; petals 6, auriculate towards base; stamens 6. — *Female flowers*: sepals and petals similar to male, staminodes 6, carpels 3, glabrous, style reflexed, stigma entire. *Drupe* curved with style-scar near base, subcompressed-obovoid; endocarp rather smooth, with a dorsal median groove and on each lateral face a small central sublunate perforation leading to the central hollow condyle. *Seed* strongly curved; endosperm absent; cotyledons large, thick.

Distr. China, SE. Asia, Malesia, Australia and Polynesia. In *Malesia* 1 sp.; 11 more have been described from surrounding regions, but this number will probably have to be reduced.

1. *Pachygone ovata* (POIR.) HOOK. *f.* & TH. *Fl. Ind.* 1 (1855) 203; MIQ. *Fl. Ind. Bat.* 1, 2 (1858) 86; MIERS, *Ann. Mag. Nat. Hist.* ser. 3, 19 (1867) 321; MIQ. *Ann. Mus. Bot. Lugd.-Bat.* 4 (1868) 87, *incl. var. rotundifolia* MIQ. *et var. dasyphylla* MIQ.; MIERS, *Contr. Bot.* 3 (1871) 331, t. 135; HOOK. *f.* & TH. *Fl. Br. India* 1 (1872) 105; BECC. *Malesia* 1 (1887) 158; BOERL. *Cat. Hort. Bog.* 1 (1899) 43; K. SCH. & LAUT. *Fl. Deut. Schutzgeb. Südsee* (1901) 315; VALETON, *Bull. Dép. Agr. Ind. Néerl.* 10 (1907) 12; DIELS, *Pfl. R. Heft* 46 (1910) 243, f. 80; FORMAN, *Kew Bull.* 12 (1958) 457; *ibid.* 22 (1968) 374, with a full synonymy. — *Cissampelos ovata* POIR. *Encycl. Méth. Bot.* 5 (1804) 10; DC. *Syst.* 1 (1817) 537; *Prod.* 1 (1824) 102. — *Cocculus brachystachyus* DC. *Syst.* 1 (1817) 528; *Prod.* 1 (1824) 99; DECNE, *Ann. Nouv. Mus. Paris* 3

(1834) 424; SPAN. *Linnaea* 15 (1841) 163. — *Cocculus leptostachyus* DC. *Syst.* 1 (1817) 528; *Prod.* 1 (1824) 99; DECNE, *Ann. Nouv. Mus. Paris* 3 (1834) 424; SPAN. *Linnaea* 15 (1841) 163. — *P. pubescens* BENTH. *Fl. Austr.* 1 (1863) 58; DIELS, *Nova Guinea* 8 (1910) 283; *Pfl. R. Heft* 46 (1910) 245; WINKLER, *Bot. Jahrb.* 49 (1913) 369; MERR. *En. Born.* (1921) 250; YAMAMOTO, *J. Soc. Trop. Agric.* 16 (1944) 103. — *P. brachystachya* (DC.) MIERS, *Ann. Mag. Nat. Hist.* ser. 3, 19 (1867) 321; *Contr. Bot.* 3 (1871) 334. — *P. leptostachya* (DC.) MIERS, *Ann. Mag. Nat. Hist.* ser. 3, 19 (1867) 321; *Contr. Bot.* 3 (1871) 335; DIELS, *Pfl. R. Heft* 46 (1910) 244. — *P. hebephylla* MIERS [*Ann. Mag. Nat. Hist.* ser. 3, 19 (1867) 321, *nomen*], *Contr. Bot.* 3 (1871) 333; DIELS, *Pfl. R. Heft* 46 (1910) 245; BACK. *Schoolfl.* (1911) 45;

KOORD. Exk. Fl. Java 2 (1912) 235; YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 103; BACK. & BAKH. f. Fl. Java 1 (1963) 159. — *Limacia nativitatis* RIDL. J. Str. Br. R. As. Soc. n. 45 (1906) 170. — *P. zeylanica* SANT. & WAGH, Bull. Bot. Surv. India 5 (1963) 107, *nom. illeg.*, cf. FORMAN, Kew Bull. 22 (1968) 374. — **Fig. 12g-i.**

For complete synonymy, see FORMAN (1958, 1968).

Woody climber up to 15 m or more high. Branchlets puberulous to pubescent with yellowish hairs, later glabrescent. *Leaves*: petioles 2.5–4 cm, yellowish pubescent to glabrous; lamina ovate to ovate-lanceolate or broadly ovate, (5–)7–11 by 3–7.5(–12) cm, apex obtuse to acutely acuminate, mucronate, base truncate, rounded or very obtuse (rarely subcordate), 3–5-nerved; lateral nerves 1–2 pairs; both surfaces softly pubescent to glabrous; papyraceous. *Inflorescences* axillary, solitary or 2–3 arising together, pseudo-racemose with flowers often in small clusters of about 3–5 along main axis, 4–17 cm long, yellowish tomentose to pubescent. — *Male flowers* yellow on pedicels 1–3(–7) mm; sepals 6(–12), outer 3(–6) bracteoliform, ± elliptic, 1–2 mm long, puberulous outside, inner 3(–6) elliptic to rotund, 1.5–2.5 by 1.25–1.5 mm, glabrous or sparsely hairy outside;

petals 6, ± oblong, with basal auricles clasping opposite stamen, 1–1.5 mm long, glabrous; stamens 6, filaments slender, 1.25–1.5 mm. — *Female flowers*: sepals and petals similar to male, carpels 3, ± ovoid, 0.75 mm long, style flattened, staminodes 6, minute. *Drupe*s on pedicels c. 3–5 mm long, subcompressed, ± obovoid, 7–8 by 6 mm, 5 mm thick, glabrous, rather smooth.

Distr. Ceylon, India, through Malesia to NE. Australia; in *Malesia*: N. Borneo, Java (incl. Christmas I.), Lesser Sunda Is. (Timor), S. Celebes, Moluccas (Sula Is.: Mangoli), New Guinea.

Ecol. On seashores and in lowland forests, up to 100 m, also in seasonal regions.

Vern. Java: *geureung ikan*; N. Borneo: *luod*, Bajau dial.

Notes. DIELS maintained as distinct 4 of the species listed above, viz. *P. ovata*, *P. pubescens*, *P. leptostachya* and *P. hebephylla*.

It appears that there is, in fact, only one species of *Pachygone* in Malesia with a variable leaf shape, becoming broader eastwards, and with considerable variation in the degree of hairiness on the leaves. The inflorescence, floral and fruit characters are rather constant.

16. HYPSERPA

MIERS [Ann. Mag. Nat. Hist. ser. 2, 7 (1851) 40, *nomen*], *ibid.* ser. 3, 14 (1864) 363; Contr. Bot. 3 (1871) 100; DIELS, Pfl. R. Heft 46 (1910) 205; FORMAN, Kew Bull. 12 (1958) 451. — *Selwynia* F. v. M. Fragm. 4 (1864) 153. — **Fig. 12a-f.**

Scandent shrubs or woody climbers. Stems with young growing tips sometimes tendrilliform. *Leaves* ± ovate to elliptic, base 3–7-nerved with the side nerves sometimes supra-basal. *Inflorescence* axillary or supra-axillary, cymose or thyrsoid. — *Male flowers*: sepals 7–12, spirally arranged, glabrous or subglabrous, outer ones minute and bracteoliform, inner ones larger, imbricate; petals 5–9, fleshy; stamens 9–40, free or connate. — *Female flowers*: sepals and petals similar to male; staminodes 0–several; carpels 2–3, stigma entire, reflexed. *Drupe*s curved, subcompressed-obovoid to -globose with style-scar near base; endocarp laterally convex with 2 lateral cavities each with an external aperture, dorsally rugose to rugulose. *Seed* horseshoe-shaped, narrow, embedded in endosperm.

Distr. From China and tropical SE. Asia (incl. Ceylon) to Australia and Polynesia; throughout *Malesia*. In all 6 *spp.*

KEY TO THE SPECIES

1. Inflorescences glabrous 1. *H. laurina*
 1. Inflorescences hairy

2. Leaf-base mostly 3-nerved. Inflorescences 0.5–1.5(–2.5) cm broad. Stamens 9–10(–14), free for most of their length 2. *H. nitida*
 2. Leaf-base mostly 5–7-nerved. Inflorescences 1.5–5 cm broad. Stamens about 20–40, connate
 3. *H. polyandra*

1. *Hypserpa laurina* (F. v. M.) DIELS, Pfl. R. Heft 46 (1910) 209, f. 72; FORMAN, Kew Bull. 12 (1958) 452. — *Selwynia laurina* F. v. M. Fragm. 4 (1864) 153. — *H. selwynii* F. v. M. Fragm. 9 (1875) 82. — *Limacia selwynii* (F. v. M.) BAILEY, Queensl. Fl. 1 (1899) 30. — *H. parvifolia* KANEH. & HATUS. Bot. Mag. Tokyo 56 (1942) 471.

Woody climbers, entirely glabrous (bracts and axillary buds sometimes puberulous). *Leaves*: petioles 1–1.5(–3) cm; lamina elliptic to oblong-elliptic, 7–12 by 3–4.5 cm, apex obtuse, often minutely emarginate, base broadly cuneate to rounded, ± 5-nerved; lateral nerves 2–3 pairs; stiffly papyraceous. — *Male inflorescences* thyrsoid, very lax, 4–15(–20) by 1–4(–9) cm. — *Male flowers* green or white on pedicels 1–5 mm long; sepals 7–9, outer 2–3 about 1 mm long, inner, 5–6 ± rotund, 1.5–2 mm ø; petals (rarely 5–)7–9, ± obtriangular 0.75–1 mm long; stamens 11–15, free (but with occasional connate pairs). — *Female inflorescences* and flowers unknown. [*Infructescence* 6–8 cm long, teste DIELS.] *Drupes* red on pedicels about 5 mm, broadly obovate in outline, 12 by 9 mm, 8 mm thick. Endocarp dorsally obscurely rugose, laterally convex and smooth.

DISTR. Queensland and *E. Malesia* (SW. Papua).
 Ecol. Rain-forest and *Imperata* fields.

2. *Hypserpa nitida* MIERS in Hook., Kew J. Bot. 3 (1851) 258; Contr. Bot. 3 (1871) 102; DIELS, Pfl. R. Heft 46 (1910) 210; FORMAN, Kew Bull. 12 (1958) 453; *ibid.* 22 (1968) 361. — [*Cocculus cuspidatus* WALL. Cat. n. 4960 (1831/32), *nomen*.] — *Limacia cuspidata* HOOK. f. & TH. Fl. Ind. 1 (1855) 189; Fl. Br. India 1 (1872) 100; SCHEFF. Nat. Tijds. N. I. 32 (1873) 397, t. 8. — *Limacia microphylla* Miq. Fl. Ind. Bat., Suppl. 1 (1861) 386. — *H. cuspidata* (HOOK. f. & TH.) MIERS, Ann. Mag. Nat. Hist. ser. 3, 14 (1864) 365; Contr. Bot. 3 (1871) 102, t. 108; BECC. Malesia 1 (1877) 149; BOERL. Cat. Hort. Bog. (1899) 39, *incl. var. microphylla* (MIQ.) BOERL.; DIELS, Pfl. R. Heft 46 (1910) 207; in Elmer, Leaflet. Philip. Bot. 4 (1911) 1165; MERR. En. Born. (1921) 249; RIDL. Fl. Mal. Pen. 1 (1922) 111; MERR. En. Philip. 2 (1923) 147; BURK. Dict. (1935) 1219; YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 97. — *Limacia borneensis* MIQ. Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 83. — *H. heteromera* MIERS [Ann. Mag. Nat. Hist. ser. 3, 14 (1864) 365, *nomen*], Contr. Bot. 3 (1871) 104; DIELS, Pfl. R. Heft 46 (1910) 210; MERR. En. Born. (1921) 249; YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 98. — *H. praevaricata* MIERS [Ann. Mag. Nat. Hist. ser. 3, 14 (1864) 365, *nomen*], Contr. Bot.

3 (1871) 103. — *H. propensa* MIERS [*l.c.* 365, *nomen*], *l.c.* 105; BECC. Malesia 1 (1877) 149. — [*H. triflora* (non (DC.) MIERS) MIERS, Ann. Mag. Nat. Hist. ser. 3, 14 (1864) 365; Contr. Bot. 3 (1871) 106, *p.p. non quoad Cocculus triflorus* DC.; KING, J. As. Soc. Beng. 58, ii (1889) 384; RIDL. J. Str. Br. R. As. Soc. n. 33 (1900) 42.] — *H. borneensis* (MIQ.) BECC. Malesia 1 (1877) 149. — *H. jagorii* DIELS, Pfl. R. Heft 46 (1910) 211; in Elmer, Leaflet. Philip. Bot. 4 (1911) 1165; MERR. En. Philip. 2 (1923) 148. — *Phytocrene loheri* MERR. Philip. J. Sc. 7 (1912) Bot. 293; En. Philip. 2 (1923) 492, *p.p.*, leaves only. — *H. nandiniifolia* YAMAMOTO, Trans. Nat. Hist. Soc. Taiwan 34 (1944) 310, f. 5. — **Fig. 12a–f.**

Scandent shrub. Branchlets sparsely to densely pubescent with yellowish hairs when young, later glabrescent. *Leaves*: petioles 0.8–2 cm, sparsely to densely pubescent; lamina very variable in shape, lanceolate, lanceolate-elliptic, broadly elliptic or ovate (rarely narrowly oblong-elliptic), 4–12 by 1.5–7 cm, apex obtusely (rarely acutely) acuminate or obtuse, usually mucronulate, base obtuse to rounded or truncate (rarely acute), usually 3-nerved with the side nerves supra-basal; main lateral nerves c. 2 pairs, often indistinct; both surfaces usually glabrous, sometimes pubescent (especially in Celebes and the Philippines); papyraceous to subcoriaceous. *Inflorescences* cymose to paniculate, 1–4(–12) by 0.5–1.5(–2.5) cm, yellowish pubescent. — *Male flowers* yellow on pubescent pedicels 1–2 mm; sepals 7–11, outer ones minute and bracteoliform, subtriangular, scarcely 1 mm long, puberulous outside, inner 4–5 ± ovate-rotund, 2.5 by 1–1.75 mm, glabrous; petals 5, obovate, c. 1 mm long; stamens 9–10 (–14), connate at the base only, free above, 1–1.75 mm long. — *Female flowers*: sepals and petals as in male; carpels 2, ± ellipsoid, scarcely 1 mm long; stigma plate-like. *Drupes* yellow to red on pedicels, 1–4 mm, subglobose, (5–)6–8 mm ø. Endocarp rugulose, sometimes perforate.

DISTR. Ceylon, India, Assam, Lower Burma, Thailand, Indochina; in *Malesia*: S. Sumatra (incl. Banka and Riouw), Malaya (incl. Langkawi, Penang and Singapore), Borneo, Philippines (throughout) and Celebes.

Ecol. Forest, from sea-level to 2000 m.

Vern. Banka: *akar sentjaw*; Malaya: *akar minjak*; N. Borneo: *akar suganda*; Philippines: *lalapau, mamana*, Sub.

Note. The size, shape and degree of hairiness of the leaves of this species vary considerably. In general the leaves tend to be more hairy in Celebes and

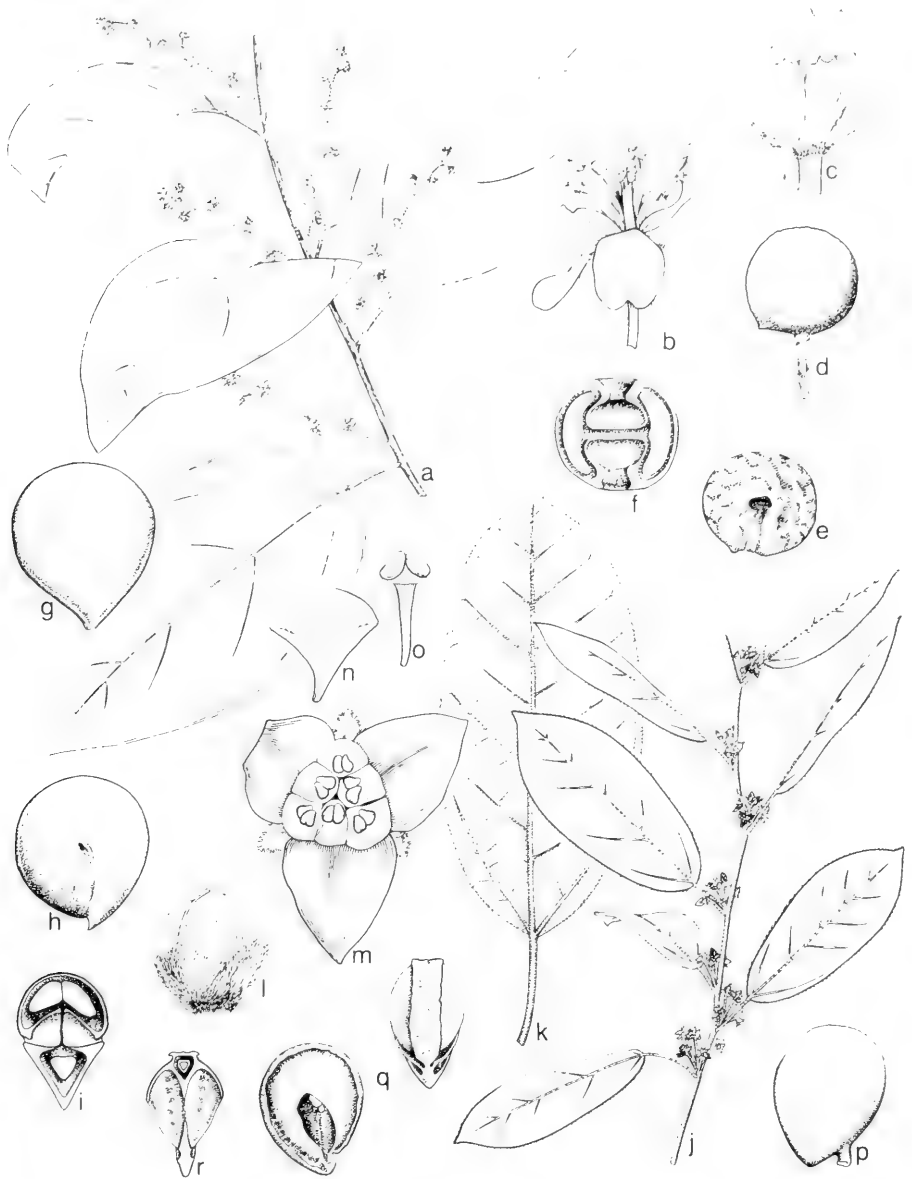


Fig. 12. *Hypserpa nitida* MIERS. a. Habit, male plant, $\times 2/3$, b. male flower, $\times 8$, c. female flower, front sepals and petal removed, $\times 8$, d. drupe, e. endocarp, f. CS of endocarp showing the central 2-chambered condyle and the seed (white) cut through twice, all $\times 3$. — *Pachygone ovata* (POIR.) HOOK. & TH. g. Drupe, h. endocarp, i. LS of endocarp showing the seed curved around the hollow condyle, all $\times 3$. — *Limacia scandens* LOUR. j. Habit, male plant, $\times 2/3$, k. leaf, $\times 2/3$, l. bud, $\times 8$, m. male flower, $\times 8$, n. petal, $\times 15$, o. stamen, $\times 15$, p. drupe, q. endocarp, lateral and median views, r. LS of endocarp, all nat. size (a SANA492, b SAN 32243, c CLEMENS 40880, d-f SAN 22153, g-i BRANDERHORST 136, j, l-o RIDLEY 10182, k SF F732, p-r CHEW WEE LEK 246).

Philippines, while further west they are usually glabrous. The inflorescences are usually short (1–4 cm) but they can become very long (up to 12 cm) in Philippine specimens and in those from Celebes. There are all kinds of intermediates between the small, glabrous leaved form with short inflorescences and the larger, glabrous or hairy leaved form with long inflorescences. It has therefore not been possible to maintain more than one species, nor has it been possible to recognise distinct infraspecific taxa.

3. *Hypserpa polyandra* BECC. Malesia 1 (1877) 148; WARB. Bot. Jahrb. 13 (1891) 315; K. SCH. & LAUT. Fl. Deut. Schutzgeb. Südsee (1901) 315; DIELS, Pfl. R. Heft 46 (1910) 213; WHITE, J. Arn. Arb. 10 (1929) 212; FORMAN, Kew Bull. 12 (1958) 455; *ibid.* 22 (1968) 360. — *H. selebica* BECC. Malesia 1 (1877) 148; DIELS, Pfl. R. Heft 46 (1910) 212. — *Limacia monilifera* BURK. in Hook., Ic. Pl. (1899) 2585. — *H. monilifera* (BURK.) DIELS, Pfl. R. Heft 46 (1910) 209. — *H. raapii* DIELS, l.c. 212; YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 98. — *H. latifolia* MIQ. ex DIELS, Pfl. R. Heft 46 (1910) 213.

Scandent shrub or woody climber up to c. 40 m. Branchlets minutely yellowish puberulous to glabrescent or tomentose. *Leaves*: petioles 2–4.5(–6) cm, puberulous or tomentose; lamina ovate to ovate-elliptic, 6–17 by 4–11 cm, apex shortly and often abruptly acuminate, or obtuse, sometimes mucronulate, base obtuse to rounded and sometimes abruptly cuneate, 5–7-nerved; lateral nerves 1–3 pairs; both surfaces sparsely puberulous to glabrous or tomentose; stiffly papyraceous to coriaceous. *Inflorescences* pseudo-paniculate, 2.5–11 by 1.5–5 cm, ± triangular in outline, yellowish puberulous or tomentose. — *Male flowers* yellow, subsessile or with pedicels up to 1 mm; sepals 7–12, outer 2–5 ± triangular to rotund, 0.5–1 mm long, puberulous outside, inner (4–)5–7 ± rotund, 2–3 mm ø, margin sometimes minutely ciliolate; petals (5–)7–8, very variable in

shape, 0.75–1 mm long, margin often undulate; stamens c. 20–40, connate, 1.5–2 mm long. — *Female flowers*: sepals and petals similar to male; carpels 3, ± ellipsoid, 0.75 mm long. *Drupes* white or red on pedicels up to 2 mm long or subsessile, subrotund to obovate in outline, 7–8 mm long and broad, 4–6 mm thick. Endocarp rugulose, perforate.

Distr. Australia (Queensland), New Hebrides, Solomons, Carolines; in *Malesia*: New Guinea (incl. Aru Is.), Moluccas (Ternate), SE. Celebes, Lesser Sunda Is. (Flores, Timor), W. Sumatra (Batu Is.).

Ecol. Mangrove swamps and lowland mixed rain-forest, up to 1200 m. *Fr.* July, Nov., *fl.* March, May, July, Nov.

Uses. Bark after being pounded and powdered is applied to the head as a treatment for headaches in Bougainville I.

Notes. *Hypserpa raapii* was distinguished by DIELS from *H. polyandra* by the number of inner sepals being 4 in the former and 6 in the latter. *H. raapii* is still only represented by the solitary, male type specimen (RAAP 607) which does indeed usually have 4 inner sepals, but 5 also occur. Since (4–)5–7 inner sepals are found in *H. polyandra*, and RAAP 607 agrees in all other respects with that species it is not possible to maintain *H. raapii* as a distinct species.

This results in a rather curious distribution for *H. polyandra*, since RAAP 607 was collected in the Batu Is. west off Sumatra while *H. polyandra* is only known otherwise in S. and E. Malesia.

var. tomentosa FORMAN, Kew Bull. 22 (1968) 360.

Differs from the type variety in having tomentose branches, leaves (mainly beneath) and inflorescences, these being in the type variety glabrescent or minutely puberulous.

Distr. East New Guinea (Morobe Distr.).

Ecol. Regrowths and near rivers and lakes, 70–1200 m.

Vern. *Brewa*, Herzog Ra., Buang dial.

17. LIMACIA

LOUR. Fl. Cochinch. (1790) 620; HOOK. f. & TH. Fl. Ind. 1 (1855) 187, *p.p.*; MIERS, Contr. Bot. 3 (1871) 108; DIELS, Pfl. R. Heft 46 (1910) 213; FORMAN, Kew Bull. 12 (1958) 447. — **Fig. 12j–r, 13.**

Woody climbers. Stems with young growing tips sometimes tendrilliform. *Leaves* with base 3- or 5-nerved. *Inflorescences* axillary or supra-axillary, cymose or pseudo-paniculate. — *Male flowers*: sepals 6 (or 9), in whorls of 3, tomentose, inner whorl valvate and larger than outer whorl(s); petals 6, concave; stamens 6, free; rudimentary carpels 3 or 0. — *Female flowers*: sepals and petals similar to male; staminodes 6 or 0; carpels 3, tomentose, style reflexed, stigma entire. *Drupes* with style-scar near base, subcompressed-obovoid, abruptly nar-



Fig. 13. Habit of *Limacia blumei* (BOERL.) DIELS in the Botanic Gardens, Bogor (XVI.D.7) (Photogr. L.L. FORMAN).

rowed at base into a short stipe; endocarp laterally convex containing 2 large lateral cavities each with a large external aperture and separated internally by a septum with a small central hole, dorsally bearing a raised longitudinal band, surface smooth or slightly rugose. *Seed* horseshoe-shaped, narrow, embedded in endosperm.

Distr. Tropical SE. Asia (Lower Burma, Thailand, Indochina); in *Malesia*: Sumatra, Malaya, Borneo (W., Sarawak, Sabah), Java, Lesser Sunda Is. (Sumba, Timor), SE. Celebes (Buton I.), Philippines (Mindanao); 3 spp.

Note. HOOKER f. & THOMSON considered *Hypserpa* as a synonym of *Limacia*, but nearly all subsequent authors have retained the two genera as distinct. *Limacia* differs from *Hypserpa* in having the sepals in distinct whorls of three, those of the inner whorl being valvate. In *Hypserpa* the sepals are all imbricate, irregular in number and not arranged in whorls.

KEY TO THE SPECIES

1. Leaf-base 5-nerved, petals tomentose 1. *L. blumei*
 1. Leaf-base 3-nerved, petals glabrous.
 2. Young stems velvety tomentellous. Inflorescence a lax pseudo-panicle, male up to 16 cm long. Drupes 14–20 mm long 2. *L. oblonga*
 2. Young stems tomentose. Inflorescence a peduncled congested cyme, less than 3 cm long. Drupes 20–25 mm long 3. *L. scandens*

1. *Limacia blumei* (BOERL.) DIELS, Pfl. R. Heft 46 (1910) 215; BACK. Schoolfl. (1911) 43; MERR. Philip. J. Sc. 7 (1912) Bot. 266; EN. Philip. 2 (1923) 148; YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 99; FORMAN, Kew Bull. 12 (1958) 448; *ibid.* 22 (1968) 362. — *Cocculus blumei* BOERL. Cat. Hort. Bog. 1 (1899) 40. — **Fig. 13.**

Woody climber up to 15 m or more high. Branchlets densely puberulous at first, later glabrescent. *Leaves*: petioles 2–5 cm, puberulous; lamina ovate to elliptic-ovate, 10–26 by 5–16 cm, apex acute with long mucronate acumen, base cunate to rounded, 5-nerved; lateral nerves 2–3 pairs, sparsely to moderately puberulous and very finely reticulate on both surfaces; papyraceous. *Inflorescences* cymose, few flowered, 0.75–1.5 cm long, puberulous. — *Male flowers* cream on pedicels 1–2 mm; sepals 6 or 9, tomentose, outer 3 or 6 minute up to 0.75 mm long, inner 3 elliptic, 2 by 1.25 mm; petals 6, tomentose, broadly elliptic, 1 mm long; stamens 6, sublinear, glabrous, 1.5 mm; rudimentary carpels 3. — *Female flowers* (from RAMOS & EDANO 49144): sepals and petals larger than in male; carpels 3, obliquely subellipsoid, 2 mm long, style elongate, grooved, staminodes 6, linear, 1 mm. *Drupes* unknown.

Distr. Thailand (Lower) and *Malesia*: Borneo (Sabah), Java, Lesser Sunda Is. (Sumba, Timor), SE. Celebes (Buton I.), Philippines (Mindanao: Davao).

Ecol. Thickets and forests at low altitude.

Note. This rare species was described in 1899 from plants cultivated in the Botanic Gardens at Bogor, all said to have come from Java. One of these plants, *n.* XVI.D.7, was still alive and strongly growing in 1956, when in May I collected male flowering material from it. No other collections are known from Java. The records from Thailand, Borneo, Sumba and Celebes are based on single sterile collections.

2. *Limacia oblonga* HOOK. f. & TH. Fl. Ind. 1 (1855) 189; MIQ. Fl. Ind. Bat. 1, 2 (1858) 80; MIERS, CONTR. Bot. 3 (1871) 109; HOOK. f. & TH. Fl. Br. India 1 (1872) 100; KING, J. As. Soc. Beng. 58, ii (1889) 382; DIELS, Pfl. R. Heft 46 (1910) 214; RIDL. Fl. Mal. Pen. 1 (1922) 109; BURK. & HEND. Gard. Bull. S. S. 3 (1925) 344; HEND. *ibid.* 4 (1928) 220; BURK. Dict. 2 (1935) 1343; FORMAN, Kew Bull. 12 (1958) 448. —

L. distincta MIERS, CONTR. Bot. 3 (1871) 111, t. 109. — *L. inornata* MIERS, l.c. — *L. velutina* HOOK. f. & TH. var. *glabrescens* KING, J. As. Soc. Beng. 58, ii (1889) 383.

Woody climber up to about 10 m. Branchlets, petioles and inflorescences covered with a very short, velvety, ± yellow-brown indumentum. *Leaves*: petioles 1.5–4 cm; lamina elliptic, oblong-elliptic, broadly elliptic or elliptic-obovate, 9–25 by 3–10 cm, apex usually acutely acuminate, mucronulate, base acute to rounded, 3-nerved; lateral nerves 4 pairs, prominent on lower surface; both surfaces glabrous apart from puberulous midrib; papyraceous. — *Male inflorescences* pseudo-paniculate, often about 3 arising together, 5–16 cm long, with very slender branches. — *Male flowers* greenish yellow, subsessile: sepals 9, ± ovate, tomentose, outer 3 minute, 0.5 mm long, middle 3, 0.75 mm long, inner 3, 1.5 mm long and broad; petals 6, obovate, 0.75 mm long, glabrous; stamens 6, claviform, 0.75 mm. — *Female inflorescences* similar to male but shorter, 1–4 cm long, branches thickening when in fruit. — *Female flowers*: sepals and petals ± as in male; carpels 3, obliquely ellipsoidal, 1 mm long, stigma auriculate; staminodes linear. *Drupes* yellow, obliquely obovate in outline, 14–20 by 12–16 mm, puberulous to glabrescent.

Distr. Lower Thailand; in *Malesia*: W. Malaya (from Penang and Perak to Singapore), Sumatra (E. Coast), Borneo (Sarawak).

Ecol. Primary and secondary forests up to about 350 m, on deep brown sandy loam in Sarawak. *Fl.* Sept., Nov., *fr.* June, Aug., Oct.

Uses. Root extract applied to sore eyes; possibly contains berberine (BURKILL, 1935). Fruits edible, sweet (VAN BALGOOY 2155, Malaya).

Vern. Malaya: *akar china*, *akar kuning*, *akar kunyit-kunyit*.

3. *Limacia scandens* LOUR. Fl. Cochinch. (1790) 620; HOOK. f. & TH. Fl. Ind. (1855) 189; MIERS, CONTR. Bot. 3 (1871) 109; DIELS, Pfl. R. Heft 46 (1910) 214; MERR. Trans. Am. Phil. Soc. n.s. 24 (1935) 157; FORMAN, Kew Bull. 12 (1958) 449. — *Cocculus limacia* DC. Syst. 1 (1817) 526. — *Menispermum limacia* (DC.) SPRENG. Syst. 2 (1825) 155. — [*Cocculus velutinus* WALL. Cat. n. 4970 (1831/32), *nomen.*] — *L. velutina* HOOK. f. & TH. Fl. Ind. 1 (1855) 189; MIQ.

Fl. Ind. Bat. 1, 2 (1858) 80; MIERS, Contr. Bot. 3 (1871) 110; HOOK. f. & TH. Fl. Br. India 1 (1872) 100; BECC. Malesia 1 (1877) 151; KURZ, For. Fl. Burma 1 (1877) 55; RIDL. J. Str. Br. R. As. Soc. n. 33 (1900) 42; GAGNEP. Fl. Gén. I.-C. 1 (1908) 144; DIELS, Pfl. R. Heft 46 (1910) 215; in Elmer, Leaflet. Philip. Bot. 4 (1911) 1165; KOORD. Exk. Fl. Java 2 (1912) 234; RIDL. Fl. Mal. Pen. 1 (1922) 109; MERR. En. Philip. 2 (1923) 148; NORMAN, J. Bot. 62 (1928) Suppl. 5; HEND. Gard. Bull. S. S. 4 (1928) 220; YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 98; HEND. Mal. Nat. J. 6 (1951) 417, t. 378. — *L. cerasifera* BECC. Malesia 1 (1877) 150; DIELS, Pfl. R. Heft 46 (1910) 215; MERR. En. Born. (1921) 249 (*'cerasifolia'*); YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 98. — **Fig. 12j-r.**

Woody climber. Young branchlets, petioles and inflorescences yellowish to golden-brown (or rusty) tomentose, branchlets later glabrescent, young shoots sometimes tendrilliform. *Leaves*: petioles 1–3 cm; lamina ovate-elliptic, elliptic or obovate-elliptic, 7–17 by 3–8 cm, apex usually broad and abruptly cuspidate, or obtusely apiculate (occasionally long acuminate), base cuneate to rounded, 3-nerved; lateral nerves 4–6 pairs; both surfaces at first yellowish to golden-brown pubescent or tomentose, especially

on lower surface along the nerves, later glabrescent; stiffly papyraceous. *Inflorescences* up to 2.5 cm, composed of about 2–6 densely flowered cymes, 4–5 mm across with peduncles (3–)10–20 mm. — *Male flowers* green to white, subsessile; sepals 9, ovate, tomentose, outer 3 1 by 0.75 mm, middle 3 1.25 by 1 mm, inner 3 2.5–3.25 by 1.75–2.5 mm, thick; petals 6, obovate, unguiculate, 1 by 0.75–1 mm, glabrous; stamens 6, claviform, 1 mm, filaments usually sparsely pilose adaxially. — *Female flowers*: sepals and petals \pm as in male, petals clasping linear staminal nodes; carpels 3, \pm obliquely ellipsoidal, 1.5 by 1.25 mm, stigma auriculate. *Drupe* obliquely obovate in outline, 20–25 by 16–20 mm, pubescent to glabrescent.

Distr. SE. continental Asia (Lower Burma, Lower Thailand, Annam, S. Indochina); in *Malesia*: Central & S. SUMATRA (INCL. LINGGA), W. MALAYA (PENANG TO SINGAPORE), W. BORNEO (SW. SARAWAK, BRUNEI), ?JAVA, PHILIPPINES (DIELS, *l.c.*).

Ecol. Secondary growths and open habitats, at low altitude; common in Singapore and parts of Malaya; in Sumatra also in primary swamp forest.

Note. For discussion concerning the identity of LOUREIRO's type see FORMAN (1958).

18. SARCOPETALUM

F. v. M. Pl. Vict. 1 (1860) 26, t. suppl. 3; DIELS, Pfl. R. Heft 46 (1910) 252, f. 85; FORMAN, Kew Bull. 22 (1968) 361. — **Fig. 15m-p.**

Woody climbers. *Leaves* subpeltate or peltate. *Inflorescences* axillary or arising from old, leafless stems, pseudoracemes. — *Male flowers*: sepals (2–)3–5, minute; petals 3–5, thick and fleshy, larger than sepals; stamens with the filaments connate in a column; anthers 3–4, free, arising horizontally from the top of column. — *Female flowers*: sepals and petals as in male; staminodes equal in number to the petals, free; carpels 3–6, stigma recurved, divided at apex into 2–3 subulate points. *Drupe* curved with style-scar near base; endocarp subsemicircular in outline with the base and apex separated by a short, \pm straight edge, dorsally spinulose and/or ridged, laterally concave. Seed semi-annular. *Embryo* subterete embedded in endosperm; cotyledons elongate, flattened.

Distr. Monotypic. E. Australia (Victoria, New South Wales, Queensland); in *Malesia*: S. New Guinea.

1. *Sarcopetalum harveyanum* F. v. M. Pl. Vict. 1 (1860) 27, t. suppl. 3; MOORE, Handb. Fl. N.S.W. (1893) 20; BAILEY, Queensl. Fl. 1 (1899) 32; DIELS, Pfl. R. Heft 46 (1910) 252, f. 85; J. Arn. Arb. 20 (1939) 73; BEADLE *et al.* Handb. Vasc. Pl. Sydney (1962) 137, f. 29/B; FORMAN, Kew Bull. 22 (1968) 361. — **Fig. 15m-p.**

Leaves with petioles 4–10 cm long inserted almost

at or up to 3 mm from the basal margin of the lamina; lamina broadly ovate or deltoid-ovate, base deeply or shallowly cordate, apex acuminate or obtuse, apiculate at the tip, 9–15 by 7–12 cm, reticulation prominent on both surfaces, glabrous, papyraceous. — *Male inflorescences* c. 4 cm long, minutely puberulous, bearing minute, narrowly lanceolate bracteoles, 2 mm long. — *Male flowers* with pedicels

2–3 mm long; sepals \pm triangular, c. 1 mm long, margin irregularly dentate; petals very fleshy, \pm broadly cuneate, 2 mm long, 1.5 mm thick; synandrium 1.5 mm long. — *Female inflorescences* 4–16 cm long. — *Female flowers*: sepals and petals as in male; staminodes minute, 0.5 mm long; carpels semi-ovoid, 1.5 mm long. *Drupe* red, glabrous; endocarp 6 by 5 mm, dorsally covered with numerous, \pm scattered sharp points, these sometimes partly arranged in transverse rows.

Distr. E. Australia; in *Malesia*: S. New Guinea (Lake Daviumbu, Middle Fly; Wassi Kussa), 2 col-

lections.

EcOl. Whereas the Papuan collections have been found at low altitude, the Queensland ones are found montane (1000–1200 m). All are recorded from 'rain-forest', but the Papuan localities are subject to a seasonal climate. Fr. Sept., Jan.

Notes. The endocarps from Papua differ slightly in ornamentation from the Australian specimens but seem to represent merely a regional variation.

Although suspected to be toxic to livestock in Australia, feeding tests have proved negative (EVERIST, Poison. Pl. Austr. rev. ed. 1981, 527).

19. LEGNEPHORA

MIERS, Ann. Mag. Nat. Hist. ser. 3, 19 (1867) 89; Contr. Bot. 3 (1871) 287; DIELS, Pfl. R. Heft 46 (1910) 222, f. 76; FORMAN, Kew Bull. 22 (1968) 369; *ibid.* 27 (1972) 275, f. 1. — **Fig. 14, 15g–h.**

Woody climbers. *Leaves* palmately 3–7-nerved at the base, \pm broadly ovate. *Inflorescences*: pedunculate cymes, one to few supra-axillary or racemosely arranged. — *Male flowers*: sepals 6, outer 3 usually narrower than inner 3; petals 6 with sides folded inwards around the opposite stamen, glabrous; stamens 6, free; anthers dehiscing transversely, \pm introrse, the cells separated abaxially by the thickened connective. — *Female flowers*: sepals 6–9; petals 0; staminodes 6, claviform; carpels 3; stigmas recurved, flattened. *Drupe* curved with style-scar near base; endocarp rotund to obovate in outline with entire dorsal wing and prominent lateral horseshoe-shaped or cucullate crests. *Seed* curved; embryo imbedded in endosperm, narrow with radicle slightly longer than cotyledons.

Distr. E. Australia, Solomon Is.; in *Malesia*: New Guinea, Lesser Sunda Is. (Timor), Moluccas, Philippines. In all 5 *ssp.*

Note. Single collections confirm the genus in the Lesser Sunda Is. (Timor) and Solomons (Santa Cruz), but in the absence of fruits the species are uncertain.

KEY TO THE SPECIES

1. Leaves long and finely acute at the apex, entirely glabrous. Endocarp 8–9 mm long with a dorsal wing 1 mm broad and lateral cucullate crests 2–3 mm broad **1. *L. acuta***
1. Leaves rounded or broadly pointed at the apex, hairy, at least on the petioles.
 2. Lateral crests on endocarp with fimbriate margins. Endocarps 9–11 by 10–11 mm. Australia ***L. moorei***
 2. Lateral crests on endocarp with margins entire or bearing a few teeth.
 3. Endocarps up to 6 mm long.
 4. Endocarps 4–5 mm long with lateral crests scarcely 1 mm broad, bearing a few teeth along the margins. Sepals tomentellous **2. *L. philippinensis***
 4. Endocarps 6 mm long with lateral cucullate crests 3 mm broad, entire at the margins. Sepals sparsely puberulous **3. *L. microcarpa***
 3. Endocarps 10–18 mm long, with a dorsal 3–4 mm broad wing, and lateral 4–5 mm broad cucullate crests **4. *L. minutiflora***

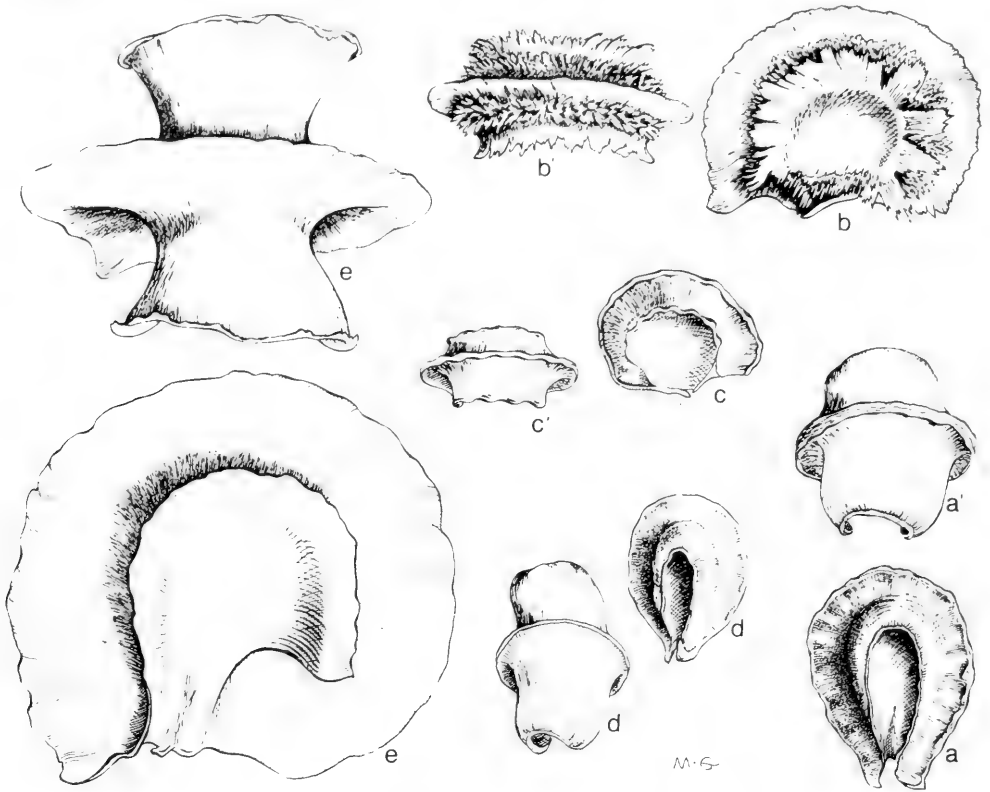


Fig. 14. Endocarps of *Legnephora* MIERS. — *L. acuta* FORMAN, a, side view, a', top view. — *L. moorei* (F. v. M.) MIERS, b, side view, b', top view. — *L. philippinensis* FORMAN, c, side view, c', top view. — *L. microcarpa* FORMAN, d, side view, d', top view. — *L. minutiflora* (K. SCH.) DIELS, e, side view, e', top view. All $\times 5$ (a MANNER & STREET 344, b CLEMENS 43871, c. PNH 10020, d NGF 21169, e CLEMENS 8682). Courtesy Kew Bulletin.

1. *Legnephora acuta* FORMAN, Kew Bull. 27 (1972) 276, f. 1A. — **Fig. 14a.**

Stems glabrous apart from pubescent leaf-axils. *Leaves*: petioles glabrous, 3–4.5 cm; lamina elliptic-ovate, apex long and finely acute, base broadly obtuse, 7.5–10 by 3.5–5.5 cm, glabrous, reticulation prominent on both surfaces, 3-nerved at the base, thinly coriaceous. — *Male flowers* unknown. — *Female inflorescences* composed of a few cymes arranged in a raceme, 1–2 per axil, 4.5–6 cm, subglabrous. — *Female flowers* pedicellate; outermost sepals 1–2, less than 1 mm, slightly puberulous, main sepals 6, elliptic, 2.5 mm, glabrous; staminodes 5–6 less than 1 mm, apex bilobed; carpels 1 mm, stigma reflexed. *Drupe* obovoid, 8–9 mm, glabrous; endocarp 8 mm, bearing a narrow dorsal wing 1 mm broad and lateral cucullate wings 2–3 mm long, surface smooth.

Distr. Malesia: E. New Guinea (Western Highlands); 1 coll.

Ecol. Primary and old secondary forests on shale, 1750 m.

Vern. *Gawa kun*, Maring.

2. *Legnephora philippinensis* FORMAN, Kew Bull. 27 (1972) 278, f. 1C. — **Fig. 14c.**

Young stems both yellowish-hispid and yellowish-puberulous (indumentum mixed). *Leaves*: petioles hispid, sometimes also puberulous, 7–16 cm; lamina broadly ovate, apex acute with a pubescent mucro, base slightly cordate or truncate, 8–17 by 6.5–14.5 cm, both surfaces sparsely to moderately pubescent, 7-nerved at the base, stiffly papyraceous. — *Male flowers* unknown. — *Female inflorescences* supra-axillary, cymose, 3–8 cm on peduncles 1.2–5.5 cm, branches tomentellous. — *Female flowers* shortly

pedicellate; sepals 9 in 3 whorls, tomentellous, outermost 3 very narrowly oblong, 1.5 mm, middle 3 narrowly elliptic, 2.5 mm, inner 3 broadly elliptic, 2.5 mm; staminodes 6, 1.25 mm, narrowly obtriangular, puberulous; carpels 1 mm, densely pilose, stigma broadly infundibular and recurved. *Drupe* (?young) pubescent; endocarp subrotund in outline, 4–5 mm ϕ , c. 2 mm thick, dorsal wing c. 1 mm broad, lateral crests scarcely 1 mm broad with toothed margins.

Distr. *Malesia*: Philippines (Mindanao, Mt Kantanglad), 1 coll.

3. *Legnephora microcarpa* FORMAN, Kew Bull. 27 (1972) 278, f. 1D. — Fig. 14d.

Young stems yellow-puberulous. *Leaves*: petioles yellow-tomentellous to -puberulous, 2–6 cm; lamina broadly ovate to broadly elliptic, apex rounded or obtuse sometimes with a fine mucro, base cordate, truncate or rotund, (6–)8–11.5 by (4.5–)6–11 cm, yellow-tomentellous below, sparsely puberulous or subglabrous above, reticulation prominent and dense above, 3–5-nerved at the base, stiffly papyraceous. — *Male inflorescences*: cymes 2–3.5 cm, peduncles 1–2 cm, puberulous. — *Male flowers* shortly pedicellate; sepals \pm equal, elliptic, 1.5 mm, sparsely puberulous outside; petals broadly rhomboid, 0.75 mm, glabrous; stamens 0.75–1 mm. — *Female flowers* unknown. *Infructescence* c. 6 cm long with peduncle c. 3 cm, puberulous. *Drupe* 6 mm ϕ , glabrous; endocarp 5–6 mm with a narrow dorsal ridge less than 1 mm high, bearing extended lateral cucullate crests 3 mm long, surface smooth.

Distr. *Malesia*: E. New Guinea (Morobe Distr.: Bulolo), 2 coll.

Ecol. Forests, 800–1200 m.

4. *Legnephora minutiflora* (K. SCH.) DIELS, Pfl. R. Heft 46 (1910) 222; FORMAN, Kew Bull. 27 (1972) 279, f. 1E. — *Tinospora minutiflora* K. SCH. & LAUT. Nachtr. Fl. Deut. Schutzgeb. Südsee (1905) 262. — *L. nyctericaarpa* DIELS, Bot. Jahrb. 52 (1915) 189. — *Phytocrene malacothrix* SLEUMER, Notizbl. Berl.-Dahl. 15 (1941) 361; Blumea 17 (1969) 237; Fl. Mal. 1, 7 (1971) 80, 83. — Fig. 14e, 15g–h.

Stems and petioles covered with a fulvous indumentum of either short hairs or long, straight hairs, or both mixed together. *Leaves*: petioles (2.5–)4.5–8 cm; lamina broadly ovate, suborbicular or broadly elliptic, apex broadly pointed to rounded, often with a puberulous mucro, base cordate, truncate or rounded, sometimes subpeltate, (6–)8–20 by (5–)7–20 cm; beneath usually puberulous (sometimes subtomentose or subglabrous), above glabrescent, 3–5-nerved at the base, stiffly papyraceous. — *Male inflorescences* subumbelliform, 2.5–6 cm long with peduncles 1–4 cm, puberulous. — *Male flowers* green or white on slender pedicels up to 4 mm; sepals 6, outer 3 narrowly elliptic, 2 mm long, inner 3 broadly elliptic, 2 mm long, tomentellous; petals 6, 0.5 mm long; stamens 6, 0.75 mm long, anthers dehiscing transversely. — *Female inflorescences* similar to male. — *Female flowers*: sepals as in male flowers; staminodes 6, narrowly oblong 1 mm long, glabrous; carpels 1 mm long, densely pilose, stigma recurved. *Drupe* when dry similar to endocarp in size and shape, densely fulvous-pilose when young, indumentum becoming sparser; endocarp rotund in outline, 1–1.8 cm ϕ , dorsally bearing a very thin wing, 3–4 mm broad, laterally bearing cuculliform crests projecting 4–5 mm and with entire margins.

Distr. *Malesia*: S. Moluccas (Tenimber Is.: Jamdena) and New Guinea (incl. New Ireland).

Ecol. Rain-forest, from sea-level to 1800 m.

20. PERICAMPYLUS

MIERS Ann. Mag. Nat. Hist. ser. 2, 7 (1851) 36; *ibid.* ser. 3, 14 (1864) 369; Contr. Bot. 3 (1871) 116; DIELS, Pfl. R. Heft 46 (1910) 216, f. 74 & 75; FORMAN, Kew Bull. 22 (1968) 365. — Fig. 15a–f.

Woody climbers. *Leaves* not peltate (in *Malesia*), palmately nerved. *Inflorescences* axillary, cymose and subumbelliform, pedunculate, cymes solitary or fasciculate. *Flowers*: sepals 9, the outermost 3 narrow and minute, the inner 6 imbricate and concave, the innermost 3 broader than the others; petals 6, cuneate. — *Male flowers* with stamens 6, free (in *Malesia*); anthers dehiscing longitudinally. — *Female flowers* with 6 filamentose staminodes; carpels 3; stigma deeply bifid, recurved. *Drupe* curved with style-scar near base; endocarp rotund in outline, dorsally covered with short pointed processes, laterally concave, condyle septiform, imperforate; seed horseshoe-shaped; embryo enclosed in

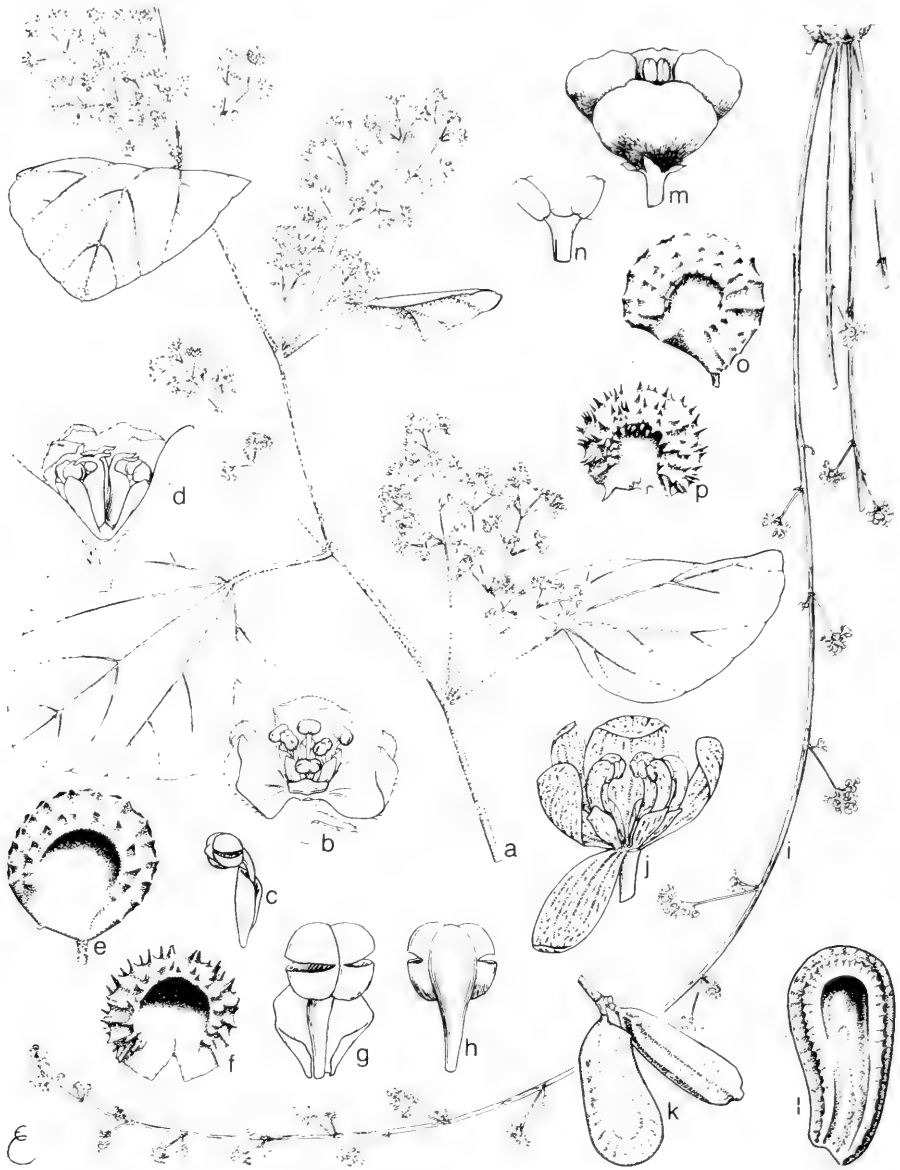


Fig. 15. *Pericampylus glaucus* (LAMK) MERR. a. Habit, male plant, $\times 2/3$, b. male flower, one sepal removed, $\times 14$, c. stamen with petal, $\times 30$, d. female flower, front sepal, petal and staminode removed, $\times 12$, e. drupe, $\times 4$, f. endocarp, $\times 4$. — *Legnephora minutiflora* (K. SCH.) DIELS. g. Stamen with petal, adaxial view, h. stamen, abaxial view, both $\times 36$. — *Diploclisia kunstleri* (KING) DIELS. i. Male inflorescence, $\times 1/2$, j. male flower, one inner sepal removed, $\times 9$, k. drupes on carpophore, $\times 2/3$, l. endocarp, nat. size. — *Sarcopetalum harveyanum* F. v. M. m. Male flower, $\times 9$, n. stamens, $\times 15$, o. drupe, $\times 3$, p. endocarp, $\times 3$ (a–c BACKER 17053, d DE VOGEL 3736, e–f CLEMENS 27416, g–h PLEYTE 71, i–j HAVILAND 1814, k–l STONE FSC 330, m–n FLETCHER 19042, o–p BRASS 7714).

endosperm, elongate and narrow, terete, radicle much longer than the subterete cotyledons.

Distr. About 2–3 *spp.* in tropical and subtropical Asia; one throughout *Malesia*.

1. *Pericampylus glaucus* (LAMK) MERR. Int. Rumph. (1917) 219; W.H. BROWN, Minor Prod. Philip. For. 1 (1920) 375; MERR. En. Born. (1921) 250; En. Philip. 2 (1923) 148; Philip. J. Sc. 29 (1926) 368; BURK. Dict. 2 (1935) 1693; HOLTH. & LAM, Blumea 5 (1942) 180; YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 99; HEND. Mal. Nat. J. 6 (1951) 416, t. 376; BACK. & BAKH. f. Fl. Java 1 (1963) 158; FORMAN, Kew Bull. 22 (1968) 366; PANCHE, Vasc. Fl. Mt Makiling 1 (1983) 283, f. 86. — *Menispermum glaucum* LAMK, Encycl. Méth. 4 (1797) 100, based on '*Folium lunatum minus*' RUMPH. Herb. Amb. 5 (1747) 40, t. 25, f. 1. — *Cocculus glaucus* (LAMK) DC. Syst. 1 (1817) 521; MIQ. Fl. Ind. Bat. 1, 2 (1858) 82. — *Cocculus incanus* COLEBR. Trans. Linn. Soc. Lond. 13 (1822) 57; SCHEFF. Nat. Tijds. N. I. 32 (1873) 398, t. 10. — *Cocculus corymbosus* BL. Bijdr. (1825) 24. — *Cocculus lanuginosus* BL. l.c. — *Clypea tomentosa* BL. l.c. 27. — *Stephania tomentosa* (BL.) SPRENG. Syst. Veg. ed. 16, 4 (Cur. Post.) (1827) 316; HASSK. Pl. Jav. Rar. (1848) 170. — *Cocculus cinereus* ZOLL. & MOR. Syst. Verz. (1846) 38. — *P. incanus* (COLEBR.) HOOK. f. & TH. Fl. Ind. (1855) 194; MIQ. Fl. Ind. Bat. 1, 2 (1858) 83; Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 85; MIERS, Contr. Bot. 3 (1871) 118; HOOK. f. & TH. Fl. Br. India 1 (1872) 102; BECC. Malesia 1 (1877) 151; KING, J. As. Soc. Beng. 58 (1889) 385; K. SCH. & HOLLER. Fl. Kais. Wilh. Land (1889) 44; BOERL. Cat. Hort. Bog. 1 (1899) 41; K. SCH. & LAUT. Fl. Deut. Schutzgeb. Südsee (1901) 311; BACK. Fl. Bat. 1 (1907) 37; Voorl. Schoolfl. (1908) 9; DIELS, Pfl. R. Heft 46 (1910) 217, f. 74; BACK. Schoolfl. Java (1911) 43; DIELS in Elmer, Leafl. Philip. Bot. 4 (1911) 1165; KOORD. Exk. Fl. Java 2 (1912) 234; KIRTIKAR & BASU, Ind. Medic. Pl. 1 (1918) 58; RIDL. Fl. Mal. Pen. 1 (1922) 112; BURK. & HEND. Gard. Bull. S. S. 3 (1925) 344; HEND. *ibid.* 4 (1928) 220. — *P. lanuginosus* (BL.) MIQ. Fl. Ind. Bat. 1, 2 (1858) 83. — *P. membranaceus* MIERS, CONTR. Bot. 3 (1871) 122; DIELS, Pfl. R. Heft 46 (1910) 220; RIDL. Fl. Mal. Pen. 1 (1922) 112; YAMAMOTO, J. Soc. Trop. Agr. 16 (1944) 100. — *Cissampelos pareira* (non L.) RIDL. Fl. Mal. Pen. 1 (1922) 114; HEND. Gard. Bull. S. S. 4

(1928) 220. — **Fig. 15a–f.**

Woody climber. Young stems yellowish-tomentose, older stems glabrescent, longitudinally ridged. *Leaves* with yellowish-tomentose petioles 3–7 cm; lamina broadly triangular-ovate, margin usually broadly and shallowly crenate, apex apiculate, usually broadly rounded, or obtuse, sometimes acute, base shallowly cordate or truncate, sometimes obtuse, 5–10 cm long and broad; palmately 5-nerved, lower surface tomentose or softly pubescent, upper surface sparsely pubescent; margin shallowly crenate; papyraceous. *Inflorescences* yellowish-tomentose, 2–4 cm long. — *Male flowers* white or yellow with pedicels c. 1 mm; sepals 9, hairy outside, outer 3 narrow, minute c. 0.5 mm long, middle 3 oblanceolate, inner 3 obovate, all 1 mm long; petals 6, obconate, 0.5 mm long, glabrous; stamens 6, 0.75 mm long. — *Female flowers*: sepals and petals as in male flowers; staminodes 6, filamentose; carpels 0.5 mm long; stigma bifid recurved. *Drupe* purple to black, glabrous; endocarp rotund in outline, 5 mm ø, dorsally bearing 2 rows of c. 15 pointed projections, each of which is linked by a ridge to a laterally pointing projection, the latter being arranged in 2 lateral rows.

Distr. Throughout the generic range and throughout *Malesia*.

Ecol. Primary and secondary forests and thickets, up to 1700 m.

Uses. Stems used for tying and basketry. Sap used as an eye medicine.

Vern. (Only names taken from specimens examined are listed). Malaya: *akar mumpanang*, *akar tali gasing*; Java: *areuj geureung*, S.; Sumbawa: *se-kompalai*; Talaud I.: *talimba-as*; Halmahera: *goumale*, Tidorese; Ternate: *ginato*; Philippines: *bugbug*, Mindoro, *malabawugan*, *silong-pugo*, Luzon; *maripari*, Biliran; *gapus nibid*, Mindanao; further *sec.* MERRILL (1923): *botang-bótang*, C. Bis., *gapisilid*, Sub., *hah-ún*, Yak., Sul., *lagauat*, Bag., *pamago*, Bik., *pisok*, Ig., *silong-pugo*, *tugian-tugian*, Tag.

Note. The field-notes for RSNB 2615 from Mt Kinabalu record a tuber 30 cm broad.

21. DIPLOCLISIA

MIERS, Ann. Mag. Nat. Hist. ser. 2, 7 (1851) 37; Contr. Bot. 3 (1871) 280; DIELS, Pfl. R. Heft 46 (1910) 224, f. 77; FORMAN, Kew Bull. 22 (1968) 362. — **Fig. 15i–l.**

Woody climbers. *Leaves* sometimes peltate. Inflorescences supra-axillary and cymose (but not in Malesia), or cauliflorous and composed of a raceme of cymes. — *Male flowers*: sepals 6, outer 3 narrower than inner 3; petals 6 with sides folded inwards around the opposite stamen; stamens 6, free; anthers dehiscent with a transverse slit. — *Female flowers*: sepals and petals as in male flowers; staminodes 6, filamentose with rudimentary anthers; carpels 3; stigmas recurved, flattened with margins dentate. *Drupe* laterally compressed, obovate (*extra*-Mal.) or narrowly obovate and curved in outline with style-scar close to base; endocarp dorsally bearing many transverse ridges, with an elongate curved depression on each lateral face (Mal. *spp.*). *Seed* (Mal. *spp.*) narrowly horse-shoe-shaped, sharply curved around the deeply intrusive narrow condyle; embryo narrow, radicle much shorter than the flat cotyledons; endosperm scanty.

Distr. 3 *spp.* in tropical continental SE. Asia and throughout *Malesia* as far as W. New Guinea, not yet recorded from the Lesser Sunda Is. The third species in S. China.

Note. The only constant difference between the two Malesian species is in the fruits. No floral or inflorescence differences were found.

KEY TO THE SPECIES

1. Endocarp 14–20 by 8–11 mm, lacking a median dorsal ridge. Leaves usually not peltate **1. *D. glaucescens***
 1. Endocarp (19–)25–30 by 16–17 mm with a pronounced median dorsal ridge. Leaves peltate

2. *D. kunstleri*

1. *Diploclisia glaucescens* (BL.) DIELS, Pfl. R. Heft 46 (1910) 225, f. 77A–L; BACK, Schoolfl. Java (1911) 44; DIELS in Elmer, Leaf. Philip. Bot. 4 (1911) 1166; KOORD. Exk. Fl. Java 2 (1912) 235; MERR. En. Philip. 2 (1923) 148; BACK & BAKH. f. Fl. Java 1 (1963) 158; FORMAN, Kew Bull. 22 (1968) 363, *p.p.* (excl. *D. kunstleri*), with full discussion and synonymy. — *Cocculus glaucescens* BL. Bijdr. (1825) 25; MIQ. Fl. Ind. Bat. 1, 2 (1858) 82; Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 84; SCHEFF. Nat. Tijd. N.I. 32 (1873) 399. — *Cocculus macrocarpus* W. & A. Prod. (1834) 13. — *D. macrocarpa* (W. & A.) MIERS, Contr. Bot. 3 (1871) 280, t. 127/20–28; BECC. Malesia 1 (1877) 152; BOERL. Cat. Hort. Bog. 1 (1899) 41.

Woody climber recorded up to 30 m long, totally glabrous. Stem up to 5 cm ø, finely striate when young. *Leaves* usually not peltate with petioles 5–12 cm long; lamina broadly ovate to suborbicular, apex rounded to acute, base rounded to cordate, 6–11 by 6–11 cm; fine reticulation more obvious on the sometimes glaucous lower surface, margin sometimes broadly and shallowly crenate, chartaceous. *Inflorescences* cauliflorous, up to 52 cm long and 7 cm wide. — *Male flowers* pale yellow with pedicels 2–4 mm long; sepals 6, strongly marked (*in sicco*) by a dark brown reticulum, outer 3 elliptic, 2.5 mm long, inner 3 broadly elliptic, 2.5 mm long; petals 6, ovate-rhombic, 1 mm long, apex acute or emarginate;

stamens 6, 2 mm long, anthers dehiscent with a transverse slit. — *Female flowers*: sepals and petals as in male flowers; staminodes 6, filamentose; carpels 2 mm long. *Drupe* yellow to orange; endocarp elongate, ± narrowly obovate in outline, slightly curved, 14–20 mm long, 8–11 mm broad, dorsally ornamented with many transverse ridges, lacking a median dorsal ridge.

Distr. S. China, India, Ceylon, Burma, Thailand, Indochina; in *Malesia*: Sumatra, Java, Celebes, Philippines, ?Moluccas (Halmahera, Sula Is., Ceram), ?W. Guinea.

Ecol. In forests, up to 600 m. *Fl.* Feb., June, Oct.; *fr.* ?.

Vern. Java: *areuj geureung*, *geureung*, S, *slururut*, *tjlurut*, J.

Notes. The leaves are occasionally peltate. Collections from the Moluccas with peltate leaves and from W. Guinea with both peltate and non-peltate leaves are possibly *D. glaucescens*, but fruits are needed from these regions for confirmation.

The only fruiting collections known from Malesia are two from the Philippines: from Mindanao with peltate leaves (*teste* DIELS) and from Sulu Is. with non-peltate leaves.

2. *Diploclisia kunstleri* (KING) DIELS, Pfl. R. Heft 46 (1910) 227, f. 77M–N; MERR. En. Born. (1921) 250;

RIDL. Fl. Mal. Pen. 1 (1922) 107; MASAMUNE, En. Phan. Born. (1942) 274. — *Cocculus kunstleri* KING, J. As. Soc. Beng. 58, ii (1889) 384. — *D. glaucescens* (non (KING) DIELS) *sensu* FORMAN, Kew Bull. 22 (1968) 363, p.p. — Fig. 15i-l.

Characters as for *D. glaucescens* except: Leaves peltate with petioles inserted (1-)10-28 mm from basal margin. *Drupe* glaucous: endocarp (19-) 25-30 by 16-17 mm with a pronounced median dor-

sal ridge.

Distr. *Malesia*: Malaya, Borneo.

Ecol. In primary and secondary forests, sometimes by streams, up to 1500 m. Fl. April-Oct.; fr. May-Nov.

Vern. Sabah: *bakauk, takob*; Sarawak: *akar tuak*, Kenyah.

Note. According to S 34725, the stem produces a yellowish exudate and the flowers are fragrant.

22. COCCULUS

DC. Syst. Veg. 1 (1817) 515, *nom. cons.*; MIERS, Contr. Bot. 3 (1871) 253; DIELS, Pfl. R. Heft 46 (1910) 227, f. 78 & 79; FORMAN, Kew Bull. 15 (1962) 479; *ibid.* 22 (1968) 372; *ibid.* 29 (1974) 477, t. 14 & 15. — *Nephroia* LOUR. Fl. Cochinch. (1790) 565. — *Holopeira* MIERS, Ann. Mag. Nat. Hist. ser. 2, 7 (1851) 42, *nomen*; *ibid.* ser. 3, 19 (1867) 27; Contr. Bot. 3 (1871) 270, t. 126. — Fig. 16.

See for a complete synonymy FORMAN (1962).

Slender woody climbers, erect shrubs or small trees. *Leaves* not peltate, rarely lobed (in Mal. *spp.*). *Inflorescences* cymose or thyrsoid. — *Male flowers*: sepals 6-9 in 2-3 whorls, the outer sepals smallest; petals 6, bifid or emarginate at apex, with basal inflexed auricles clasping the opposite stamen; stamens 6, free. — *Female flowers*: sepals and petals as in male; staminodes 6 (in Mal. *spp.*); carpels 3 or 6, styles subulate, reflexed. *Drupes* curved with style-scar near base, obovate or rotund in outline; endocarp dorsally verruculose or ridged and with a curved aperture on both lateral faces. *Seed* curved almost into a ring, broad, dorsiventrally flattened; endosperm very thin; embryo with liguliform cotyledons.

Distr. Central & North America, Africa, SE.-E. Asia, *Malesia* (Malaya, Sumatra, Java, Philippines) to Polynesia. In all 8 *spp.*

Notes. I made a special study (1974) of the ornamentation patterns of the endocarp of 7 species which show a remarkable variety, even allowing them to be identified by a key and from SEM photographs.

The leaf-epidermal characters of the genus were investigated by D.K. Ferguson in Kew Bull. 29 (1974) 483-492, tt. 16-21.

KEY TO THE SPECIES IN MALESIA

1. Slender climber. Lamina usually broadest below the middle, not acute at both apex and base; basal pair of nerves about equally prominent as the main lateral nerves, usually not running parallel to the margin and usually becoming indistinct at or below the middle of the lamina. Carpels 6 1. *C. orbiculatus*
1. Erect shrub or small tree. Lamina broadest at or slightly above the middle, both apex and base acute; basal pair of nerves much stronger than the lateral nerves, running \pm parallel to margin and continuing prominently beyond the middle of the lamina. Carpels 3 2. *C. laurifolius*

1. *Cocculus orbiculatus* (L.) DC. Syst. 1 (1817) 523; Prod. 1 (1824) 98; FORMAN, Kew Bull. 22 (1968) 374; *ibid.* 29 (1974) 479, t. 15A-G. — *Menispermum orbiculatum* L. Sp. Pl. (1753) 341. — *Menispermum*

trilobum THUNB. Fl. Jap. (1784) 194. — *C. trilobum* (THUNB.) DC. Syst. 1 (1817) 522; DIELS, Pfl. R. Heft 46 (1910) 232, f. 78A-L; in Elmer, Leaflet. Philip. Bot. 4 (1911) 1166; SPRAGUE, Bot. Mag. 139 (1913)



Fig. 16. *Cocculus orbiculatus* (L.) DC. *a*. Habit, male plant from Malaya, $\times 2/3$, *b*. leaf shape occurring in Java, $\times 2/3$, *c*. bud showing the sepals, *d*. male flower, *e*. petal with stamen, *f*. female flower, *g*. petal with staminode, all $\times 10$, *h*. 4 of 6 drupes (dried) from one flower, $\times 2$, *i*. drupe (dried), $\times 2$, *j*. endocarp, $\times 6$. — *C. laurifolius* DC. *k*. Habit, male plant, $\times 2/3$, *l*. male flower, *m*. petal with stamen, *n*. female flower, all $\times 10$, *o*. 2 of 3 drupes (dried) from one flower, $\times 2$, *p*. endocarp, $\times 6$ (*a*, *c*–*e* FRI 5038, *b* COMMERSON s.n., *f*–*g* BS 27231, *h*–*j* POORE 1140, *k*–*m* WINIT 97 (Thailand), *n* FORMAN 36, *o*–*p* EVRARD 535 (Vietnam)).

t. 8489; MERR. En. Philip. 2 (1923) 149; FORMAN, Kew Bull. 15 (1962) 480, f. 1; BACK. & BAKH. f. Fl. Java 1 (1963) 159. — *Nephroia sarmentosa* LOUR. Fl. Coch. 2 (1790) 565. — *Menispermum ovalifolium* VAHL ex PERS. Syn. Pl. Ench. Bot. 2 (1807) 628. — *C. ovalifolium* (VAHL ex PERS.) DC. Syst. 1 (1817) 526; BL. Bijdr. (1825) 25; HASSK. Tijds. Nat. Gesch. Physiol. 10 (1843) 132; MAIER, Nat. Tijds. N. I. 3 (1852) 465; MIQ. Fl. Ind. Bat. 1, 2 (1858) 81; Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 84; SCHEFF. Nat. Tijds. N. I. 32 (1873) 399, t. 11; BECC. Malesia 1 (1877) 151; BOERL. Cat. Hort. Bog. 1 (1899) 39; BACK. Fl. Bat. 1 (1907) 36; Voorl. Schoolfl. (1908) 8; RIDL. Fl. Mal. Pen. 1 (1922) 110. — *C. triflorus* DC. Syst. 1 (1817) 529. — *C. cynanchoides* PRESL, Rel. Haenk. 2 (1830) 79. — *Limacia kunstleri* KING, J. As. Soc. Beng. 58, ii (1889) 383; RIDL. Trans. Linn. Soc. II, Bot. 3 (1893) 274; J. Str. Br. R. As. Soc. n. 33 (1900) 42. — *C. sarmentosus* (LOUR.) DIELS, Pfl. R. Heft 46 (1910) 233; BACK. Schoolfl. Java (1911) 44; DIELS in Elmer, Leafl. Philip. Bot. 4 (1911) 1166; KOORD. Exk. Fl. Java 2 (1912) 231; MERR. Philip. J. Sc. 13 (1918) Bot. 10, incl. var. *stenophyllus* MERR.; En. Philip. 2 (1923) 149; BEUMÉE, Hand. N. I. Nat. Congr. (1925) 175; MERR. Trans. Amer. Phil. Soc. n.s. 24 (1935) 156; YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 102; HEND. Mal. Nat. J. 6 (1951) 417, t. 377. — *Nephroia elegans* RIDL. J. Str. Br. R. As. Soc. n. 54 (1910) 15. — *C. elegans* (RIDL.) RIDL. Fl. Mal. Pen. 1 (1922) 111. — **Fig. 16a–j.**

For the full synonymy of this species see FORMAN (1962).

Slender climber. Stems herbaceous or slightly woody, 1–1.5 mm ø, in leaf-bearing parts, puberulous to subglabrous. Leaves with puberulous petioles 5–10(–20) mm; lamina variable in shape, in Malaya and Sumatra usually elliptic to ovate-elliptic, in Java usually ovate to triangular-ovate, in the Philippines ± narrowly elliptic to very broadly elliptic, apex usually rounded, sometimes acute or emarginate, with a mucronate tip, base obtuse to truncate, rarely acute, 3–10 by 1–5.5 cm; base 3- (or 5-)nerved; both surfaces thinly puberulous to glabrous; papyraceous. — *Male inflorescences* axillary and terminal, the flowers in peduncled cymes 0.8–1.5 cm long which are often solitary when axillary, or arranged in a narrow thyrse up to 7 cm, puberulous throughout with yellowish hairs. — *Male flowers* white, glabrous throughout, borne on pedicels 1–2 mm; sepals in 3 whorls of 3, outermost whorl minute, often with one or more parts lacking, middle whorl up to 1 mm long, inner whorl with sepals obovate to rotund 1–2.5 mm long; petals 6, ± oblong with the apex divided into 2 acute lobes, with 2 incurved lobes shortly above the base clasping the filament of the stamen opposite, 1–1.5 mm long; stamens 6, 1 mm long. — *Female inflorescences* axillary and terminal, much

fewer-flowered than in the male, appearing racemose, up to 5 cm long. — *Female flowers* on bracteolate 'pedicels' c. 5 mm long (i.e. glabrous pedicel + puberulous inflorescence-branch); sepals and petals as in male; staminodes 6, minute, 0.3 mm long, glabrous; carpels 6, glabrous, 0.75 mm long; style slender, curved outwards. *Drupe*s dark blue, rotund in outline, 4–5 mm ø, glabrous; endocarp with a small curved aperture on both sides, dorsally ornamented with branched ridges.

DISTR. Eastern Himalayas, east to China, Japan, Taiwan and Hawaii; in *Malesia*: NE. Sumatra, Malaya (also Penang & Singapore), W.–Central Java, Philippines (Luzon, Mindanao, Batan Is.). In Réunion and Mauritius possibly as an introduction.

Ecol. Often climbing over trees and shrubs by the sea-shore, inland sometimes on limestone terraces and found associated with other coastal plants (cf. BEUMÉE, 1925).

NOTES. The extensive synonymy of this species is largely the result of combining four species which have previously been recognized as distinct, viz., *C. trilobus* (THUNB.) DC., *C. sarmentosus* (LOUR.) DIELS, *C. mollis* HOOK. f. & TH., and *C. ferrandianus* GAUDICH.

The material now available is considerably more than that available to DIELS (1910). The specimens I have examined display great variability in the leaves with regard to shape and degree of hairiness, which completely obscures the distinctions set out by DIELS in that part of his key which separates the above-mentioned four species. It now seems apparent that the epithets '*trilobus*', '*sarmentosus*', '*mollis*' and '*ferrandianus*' are applicable only to forms each of which is more dominant in a different part of the total area of the species, but which are linked together by so many intermediates that the recognition of infraspecific taxa is impracticable.

I have discussed in detail (1962, under *C. trilobus*) the great variation in shape and indumentum of the leaves in relation to the geographical distribution of the species. This variation has resulted in the extensive synonymy which I gave in full (*l.c.*).

RIDLEY has twice recorded the stems as being laticiferous, under *Limacia kunstleri* KING, Trans. Linn. Soc. II, Bot. 3 (1893) 274, and under *C. elegans* (RIDL.) RIDL. Fl. Mal. Pen. 1 (1922) 111.

2. *Cocculus laurifolius* DC. Syst. 1 (1817) 530; DELESS. Ic. Pl. 1 (1820) 25, t. 97; COLEBR. Trans. Linn. Soc. 13 (1822) 65; HOOK. f. & TH. Fl. Ind. (1855) 191; MIQ. Fl. Ind. Bat. 1, 2 (1858) 81; Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 84; HOOK. f. & TH. Fl. Br. India 1 (1872) 101; SCHEFF. Nat. Tijds. N. I. 32 (1873) 393, t. 12; BOERL. Cat. Hort. Bog. 1 (1899) 39, incl. var. *angustifolius* (HASSK.) BOERL. et var. *triplineris* BOERL. *l.c.* 40; K. & V. Bijdr. 9 (1903) 95; DIELS, Pfl.

R. Heft 46 (1910) 239, f. 79; BACK. Schoolfl. Java (1911) 45; KOORD. Exk. Fl. Java 2 (1912) 231; MERR. En. Philip. 2 (1923) 149; BURK. Dict. 1 (1935) 594; YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 102; FORMAN, Kew Bull. 15 (1962) 485; BACK. & BAKH. f. Fl. Java 1 (1963) 159; FORMAN, Kew Bull. 29 (1974) 479, t. 15A-G. — *C. angustifolius* HASSK. Cat. Hort. Bog. (1844) 172; WALP. Rep. 5 (1846) 17; HASSK. Pl. Jav. Rar. (1848) 167. — *Holopeira laurifolia* (DC.) MIERS, Ann. Mag. Nat. Hist. ser. 3, 19 (1867) 29; MIERS, Contr. Bot. 3 (1871) 276. — *Holopeira australis* MIERS [Ann. Mag. Nat. Hist. ser. 3, 19 (1867) 29, *nomen*], Contr. Bot. 3 (1871) 277. — **Fig. 16k-p.**

Erect shrub or tree up to 6 m, with main stem up to 12 cm ø. Branchlets glabrous. *Leaves*: petioles 3–6(–10) mm; lamina elliptic or oblanceolate-elliptic, apex acute, often rather attenuate, base usually acute, occasionally cuneate, 7–11(–15) by 3–5.5 cm, base strongly 3-nerved with the basal nerves running almost parallel to the margin beyond the middle of the lamina; both surfaces glabrous, stiffly papyraceous. — *Male inflorescences* axillary, composed of cymes arranged in a thyrses, or sometimes consisting of a single cyme, 0.5–4 cm long, glabrous or sparsely puberulous; bracts subulate, 1 mm long, frequently puberulous. — *Male flowers* yellow, glabrous throughout, borne on pedicels up to 1 mm; sepals in 2 whorls of 3, all ± broadly elliptic, outer sepals 0.5–0.75 mm long, inner sepals 1–1.25 mm long; petals 6, cuneate, apex emarginate or divided into 2 rounded lobes, also with 2 incurved lateral lobes clasping the stamen opposite, 0.5 mm long; stamens

6, 0.75 mm long. — *Female inflorescences* similar to male but fewer-flowered thus appearing subracemose. — *Female flowers* on pedicels up to 5 mm, sepals and petals as in male flowers; staminodes 6, minute; carpels 3, each with slender reflexed style. *Drupe*s rotund in outline, c. 4 mm ø, glabrous; endocarp with a small curved aperture on both sides, finely ridged over the dorsal surface.

Distr. India to Nepal, Burma, S. China, Japan, Taiwan, Indochina and Thailand; in *Malesia*: Sumatra, throughout Java, Philippines (Palawan, Luzon, Mindoro).

Ecol. Open woodland, thickets, grassland, riverbanks, teak and banana plantations up to 1500 m.

Uses. BURKILL (1935) records the presence of an alkaloid in the bark which has an action similar to that of curare, and is known as coccoline or coclaurine.

Vern. Java: *ki patjar, tedjan, S.*

Notes. In contrast to *C. trilobus*, *C. laurifolius* displays remarkably little variation in its leaf-shape. This may be connected with the fact that this species is not a climber, but an erect shrub or small tree, one of the rare examples of this life-form in the family. Judging from dried material, the fruits appear to be much less fleshy than those of *C. trilobus*, but notes on their size and colour in the fresh state are lacking.

Although the species occurs in Thailand and Indochina and again in Sumatra and Java, it apparently does not occur in the Malay Peninsula.

Cultivated as an ornamental in milder parts of Europe and North America.

23. CISSAMPELOS

LINNÉ, Sp. Pl. (1753) 1031; DC. Syst. 1 (1817) 531, *p.p.*; Prod. 1 (1824) 100, *p.p.*; WALP. Rep. 1 (1842) 96, *p.p.*; MIERS, Contr. Bot. 3 (1871) 127; DIELS, Pfl. R. Heft 46 (1910) 283, f. 91; FORMAN, Kew Bull. 22 (1968) 355. — **Fig. 17.**

Scandent shrubs or lianes. *Leaves* peltate or not peltate. — *Male inflorescences*: flowers in axillary, peduncled, corymbose cymes, these solitary or fascicled (and sometimes borne along an axillary shoot bearing reduced leaves, but not normally so in Malesia). — *Male flowers*: sepals 4, obovate; petals connate into a cupuliform corolla (rarely free in *extra-Malesian spp.*); stamens connate into a peltate synandrium, anther-cells 4 (in *Malesian sp.*). — *Female inflorescences* axillary, thyrsoid, elongate, composed of fascicles arising in the axils of accrescent ± orbicular bracts (these not accrescent in some *American spp.*). — *Female flowers*: sepal 1; petal 1 (rarely 2–3 in *extra-Malesian spp.*); staminodes 0; carpel 1. *Drupe* curved with style-scar near base, pubescent; endocarp bearing dorsally 2 rows of transverse ridges; seed horseshoe-shaped; embryo embedded in endosperm, elongate, narrow, terete, cotyledons flattened, radicle as long as or longer than the cotyledons.

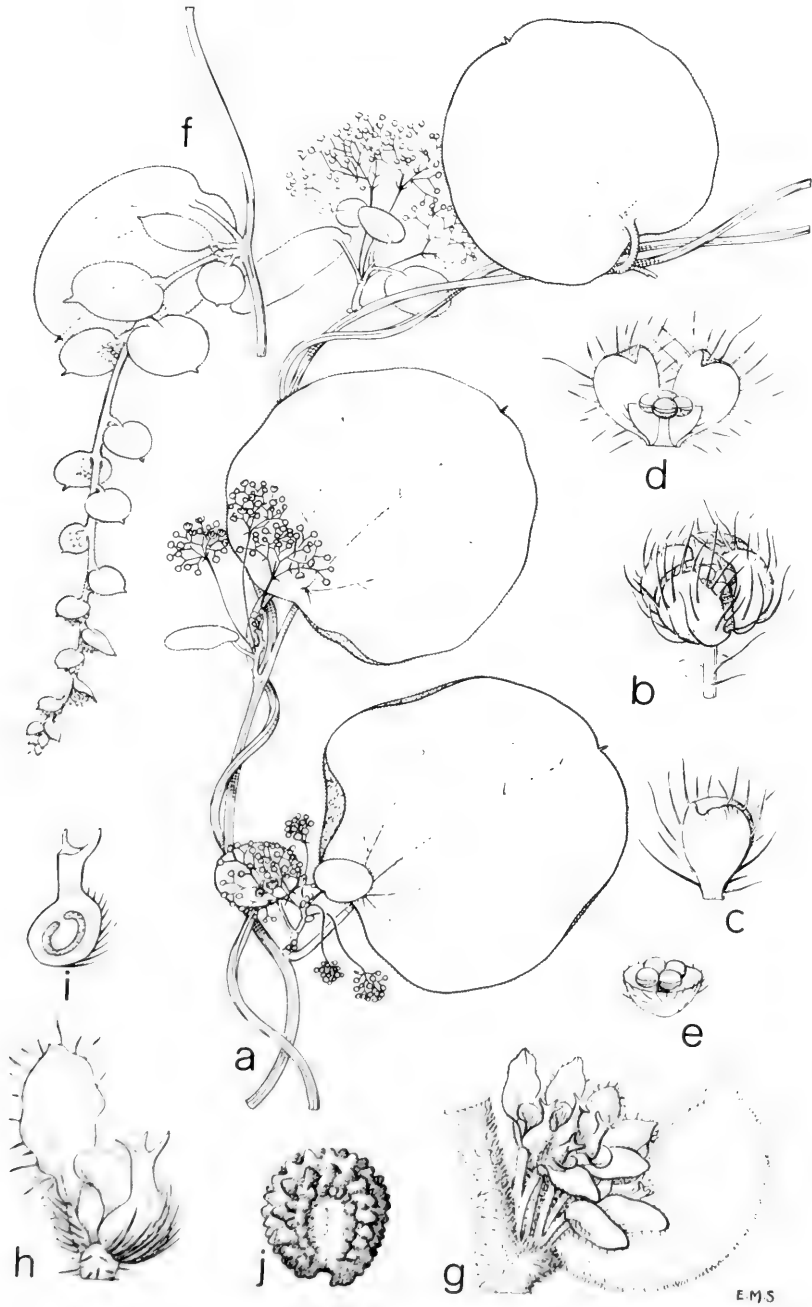


Fig. 17. *Cissampelos pareira* L. var. *hirsuta* (DC.) FORMAN. a. Habit, male plant, $\times 2/3$, b. male flower, c. sepal, d. male flower with 2 front sepals and front half of corolla removed, e. corolla and stamens, all $\times 13$, f. habit, female plant, $\times 2/3$, g. part of female inflorescence, cymule and bracts, $\times 7$, h. female flower, $\times 13$, i. LS of carpel, $\times 13$, j. endocarp, $\times 3$. Courtesy Flora of Tropical East Africa.

Distr. Pantropical, with 20–25 species. Only one species with one variety in Malesia.

1. *Cissampelos pareira* LINNÉ var. *hirsuta* (BUCH. ex DC.) FORMAN, Kew Bull. 22 (1968) 356; PANCHÓ, Vasc. Fl. Mt. Makiling I (1968) 286, f. 87. — *C. pareira* LINNÉ, Sp. Pl. (1753) 1031, *p. p. quoad* 'β'; HOOK. f. & TH. Fl. Ind. (1855) 199; MIQ. Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 85, *incl. var. orbiculata* (DC.) MIQ.; HOOK. f. & TH. Fl. Br. India I (1872) 103; SCHEFF. Nat. Tijds. N. I. 32 (1873) 401, *incl. var. peltata* SCHEFF.; BECC. Malesia I (1877) 156; KING, J. As. Soc. Beng. 58, ii (1889) 386; BOERL. Cat. Hort. Bog. I (1899) 43; GAGNEP. Fl. Gén. I.-C. I (1908) 149; DIELS, Pfl. R. Heft 46 (1910) 286, f. 91, *incl. var. typica* DIELS; in Elmer, Leaf. Philip. Bot. 4 (1911) 1167; MERR. Fl. Manila (1912) 204; Sp. Blanc. (1918) 144; W.H. BROWN, Minor Prod. Philip. For. 3 (1921) 186; MERR. En. Born. (1921) 251; En. Philip. 2 (1923) 149; BURK. Dict. 1 (1935) 559; KANEH. & HATUS. Bot. Mag. Tokyo 56 (1942) 471; YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 144; TROUPIN, Bull. Jard. Bot. Brux. 25 (1955) 140; Monogr. Menispr. Afric. (1962) 274. — *C. convolvulacea* WILLD. Sp. Pl. 4 (1805) 862; DC. Syst. 1 (1817) 536; Prod. 1 (1824) 101; MIERS, Contr. Bot. 3 (1871) 196; HASSK. Pl. Jav. Rar. (1848) 171, *incl. var. hirsuta* (DC.) HASSK. — *C. discolor* DC. Syst. 1 (1817) 534; Prod. 1 (1824) 101; A. GRAY, Bot. U.S. Expl. Exped. (1854) 38, *incl. var. cardiophylla* A. GRAY. — *A. cumingiana* TURCZ. Bull. Soc. Imp. Nat. Moscou 27 (2) (1855) 283. — **Fig. 17.**

For further synonyms see DIELS (1910: 288), TROUPIN (1962: 274) and FORMAN (1968: 356).

Scandent shrub. Old stems woody. Leafy stems slender, densely to sparsely pubescent (or puberulous) to glabrous. *Leaves* with densely to sparsely pubescent or puberulous petioles, 2–9 cm, inserted 1–18 mm from basal margin of lamina; lamina ± broadly ovate, base rounded, truncate or cordate, apex mostly acuminate (in Mal.), sometimes very obtuse, mucronate at the tip, 4.5–11 by 4.5–12 cm, lower surface tomentose to pubescent or puberulous, upper surface sparsely pubescent or puberulous, sometimes tomentose; palmately 5–7-nerved, chartaceous. — *Male inflorescences*: flowers in subcorymbose, peduncled cymes, 2–4 cm long, pubescent, solitary or a few arising in a fascicle. — *Male flowers* green to yellowish on pedicels 1–2 mm; sepals 4, obovate, 1.25–1.5 mm long, pilose outside; corolla cupuliform, c. 0.5 mm long, puberulous outside; synandrium c. 0.75 mm long. — *Female inflorescences* thyrsoid, narrow, up to 18 cm, composed of a pseudoraceme of fascicles, each fascicle in the axil of an accrescent, ± suborbicular bract, up to 1.5 cm long, puberulous to tomentose. — *Female flowers* on pedicels 1–1.5 mm; sepal 1, broadly obovate, 1.5 mm long; petal 1, broadly cuneate-obovate, 0.75 mm long; ovary scarcely 0.5 mm long, pilose,

about equal in length to the thick, glabrous style; stigma divaricately 3-lobed. *Drupe* orange or red, pubescent, with endocarp obovate in outline, 5 mm long, dorsally bearing 2 rows of 9–11 very prominent, transverse ridges, lateral faces of condyle bordered by a horseshoe-shaped ridge.

Distr. Pantropical, through continental South-east Asia, Australia (Queensland); in *Malesia*: N. Borneo, Philippines (throughout), Celebes (incl. Kabaena I.), Lesser Sunda Is. (Lombok, Sumbawa, Flores, Wetar, Timor), Moluccas (Halmahera, Ceram, Tenimber Is.), New Guinea (incl. Aru Is.). Not known from Sumatra, Malaya, and Java.

Ecol. Recorded from primary and secondary forests and thickets, climbing over trees or river-banks, up to 1300 m.

Uses. According to W.H. BROWN (1921) the root when brewed is considered diuretic, lithotriptic, pectoral and febrifugal; pounded leaves are used for snake-bites and as an antiscabious remedy.

Vern. Philippines: *abobo*, C. Bis., *bangbángau*, *kaláad*, *kalkaláad*, *kuskusípa*, Ilk., *batang-bátang*, *gulagulamánan*, *kalakalamáyan*, *makabó-o*, *sansáu*, *sinchá-o*-*sincháuan*, *sinsau-sinsauán*, Tag., *hampapáre*, *himpapára*, *sampáre*, Bis., *kauas*, Sub., *malarrúto*, Ibn., *samang*, Bon.; Moluccas: *mangaloke*, Ceram.

Notes. *Cissampelos pareira* L. has been erroneously recorded from Malaya and Java in several publications. Records for Malaya were given by RIDLEY (Fl. Mal. Pen. 1, 1922, 114) and by HENDERSON (Gard. Bull. S. S. 4, 1928, 220). From an examination of the relevant specimens in the Singapore Herbarium, it is clear that these records are based on misidentified specimens of *Pericampylus glaucus* (LAMK) MERR.

The origin of the erroneous records for Java was MIQUEL (Fl. Ind. Bat. 1, 2, 1859, 85), where, under *C. pareira*, MIQUEL listed as a synonym *Stephania capitata* (BL.) SPRENGEL together with the synonyms of the latter species. Clearly, therefore, MIQUEL was misidentifying *Stephania capitata* with *C. pareira*, as indeed he later admitted (Ann. Mus. Bot. Lugd.-Bat. 4, 1868, 86). The Sundanese vernacular name 'ojat tjam-tjoear' given by MIQUEL resembles 'tjamtjau', which commonly refers to *Stephania capitata* and also to *Cyclea barbata* MIERS. As a result of MIQUEL's misidentification, the name *C. pareira* still persists in publications on the flora of Java, although the occurrence there of the species is sometimes mentioned as being doubtful. The following works on Javanese plants record *C. pareira*: BACKER, Schoolfl. Java (1908) 47; KOORDERS, Exk. Fl. Java 2 (1912) 237; BACKER, Bekn. Fl. Java (em. ed.) 3 (fam. 34) (1941) 19; BACKER & BAKH. f. Fl. Java 1 (1963) 160, with doubt.

24. CYCLEA

ARNOTT *ex* WIGHT, Ill. Ind. Bot. 1 (1840) 22; MIERS, Contr. Bot. 3 (1871) 234; DIELS, Pfl. R. Heft 46 (1910) 309, f. 93; FORMAN, Kew Bull. 14 (1960) 68; *ibid.* 34 (1980) 565. — **Fig. 18.**

Slender woody climbers. *Leaves* often peltate, palmately nerved. *Inflorescences* axillary, terminal or cauliflorous, pseudoracemose or thyrsoid. — *Male flowers*: sepals 4(–5), free or connate into a 4(–5)-lobed calyx; petals 4, free or connate into a \pm cup-shaped corolla or rarely 0; stamens connate into a peltate synandrium, anthers 4–5 dehiscent transversely. — *Female flowers*: sepals and petals 1 (*extra-Mal.*), 2–3, rarely petals 0; staminodes 0; carpel 1, stigma 3–5-fid. *Drupes* curved with style-scar near base, obovate to rotund in outline, sometimes pubescent; endocarp bony with the condyle a central cavity around which the seed is curved, perforate ventrally between style-scar and base, often perforate laterally, dorsally ornamented with 3–6 rows of tubercles. *Seed* horse-shoe-shaped; embryo narrow, terete, embedded in endosperm.

Distr. India to Central and S. China, Thailand, Indochina; in *Malesia*: Sumatra, Malaya, Java, Borneo, Philippines. About 29 *spp.*, of which 9 in *Malesia*.

Note. Species with free sepals are now included in *Cyclea*; the calyx of the male flowers is distinguished from that of *Stephania* by the single whorl of sepals in contrast to the two whorls in *Stephania*. The inflorescences of *Cyclea* and *Stephania* can easily be distinguished. *Cyclea* has thyrses (in some species the lateral branches are reduced to sessile clusters along the main axis), whereas in all Asiatic species of *Stephania* the inflorescence is umbelliform or composed of umbelliform parts, which are sometimes reduced to peduncled, disciform capitula. It is noteworthy that the fruits of *Stephania* are always glabrous although they are sometimes hairy in *Cyclea*.

KEY TO THE SPECIES

1. Inflorescences unbranched; flowers densely crowded in spaced, sessile clusters 1. *C. kinabaluensis*
1. Inflorescences thyrsoid.
 2. Lamina lanceolate to ovate-lanceolate, usually glabrous below 2. *C. elegans*
 2. Lamina broader, mostly broadly ovate, pubescent below.
 3. Young stems bearing short hairs interspersed or not with long, straight spreading hairs; sepals of male flowers only shortly connate.
 4. Lamina not peltate 3. *C. atjehensis*
 4. Lamina peltate.
 5. Petiole inserted 1–5 mm from basal margin of lamina.
 6. Lower surface of leaves tomentose; upper surface with a very dense, raised reticulation 4. *C. merrillii*
 6. Lower surface sparsely hairy; upper surface with a very lax, scarcely raised reticulation 5. *C. insularis*
 5. Petiole inserted more than 6 mm from basal margin of lamina.
 7. Lamina 15–21 cm long. Male inflorescence with rhachis and branches stiff and straight, the flowers in congested peduncled cymes. Endocarp bearing 2 rows of c. 8 transverse ridges. 6. *C. robusta*
 7. Lamina 7.5–12.5 cm long. Male inflorescence very slender and flexuose, the flowers in lax cymose clusters without obvious peduncles. Endocarp bearing 4 rows of c. 14 papilliform tubercles 7. *C. cauliflora*
 3. Young stems bearing only long, straight, spreading hairs; sepals of male flowers united for at least half their length.
 8. Flowers male.
 9. Calyx glabrous or subglabrous; petals free 8. *C. laxiflora*
 9. Calyx puberulous.
 10. Petals free 9. *C. peregrina*

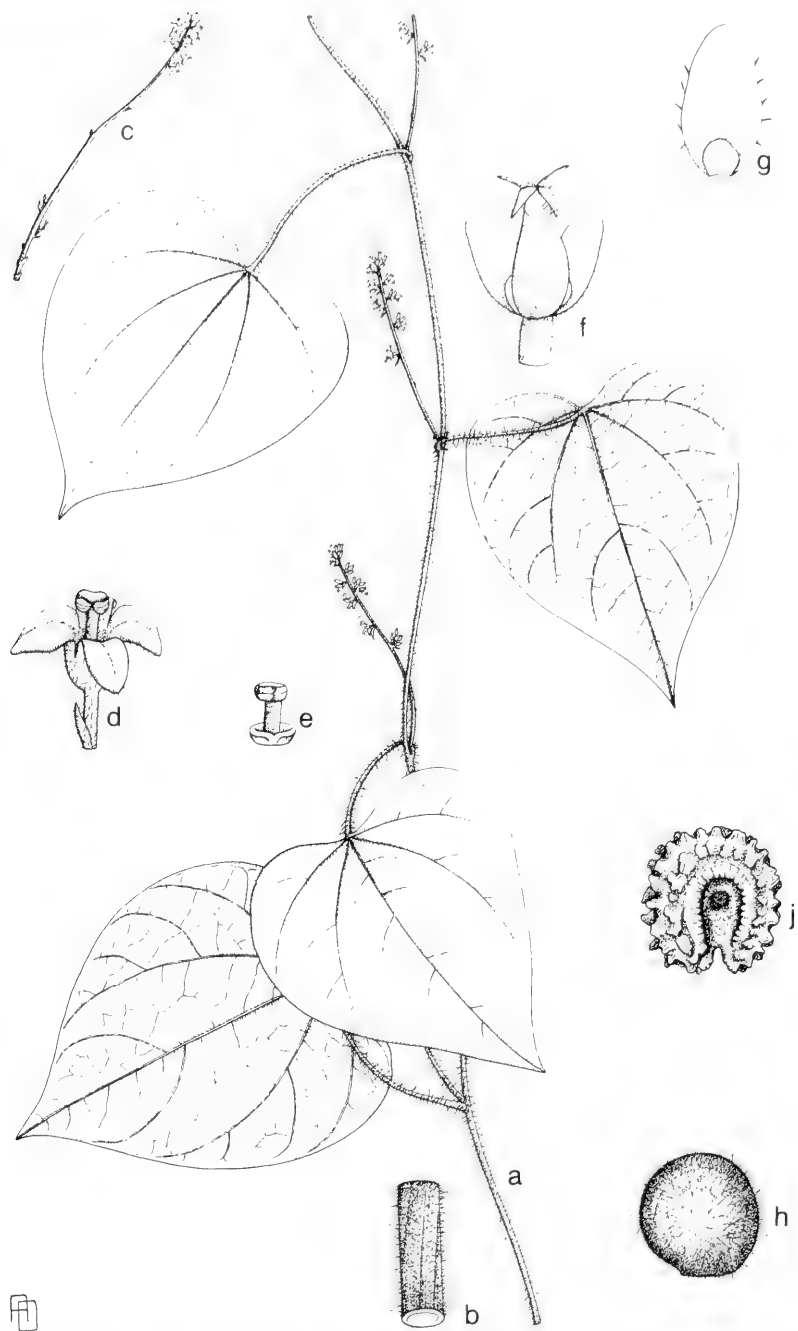


Fig. 18. *Cyclea atjehensis* FORMAN. *a.* Habit with female inflorescences, $\times 1/2$, *b.* portion of stem, $\times 4$, *c.* male inflorescence, $\times 2/3$, *d.* male flower (in spirit), $\times 10$, *e.* corolla and synandrium of male flower, $\times 10$, *f.* female flower, abaxial view, $\times 16$, *g.* sepal and petal of female flower, $\times 20$, *h.* fruit (in spirit), $\times 2\ 2/3$, *j.* endocarp, $\times 4$ (*a-b* BÄNZIGER 65-11, *c-e* BÄNZIGER 65-15, *f-g* BÄNZIGER 65-10, *h-j* BÄNZIGER 65-8).
 Drawn by Mrs. A. Davies. Courtesy Kew Bulletin.

- 10. Petals connate 10. *C. barbata*
- 8. Flowers female.
- 11. Flowers clearly spaced in lax clusters.
- 12. Young carpels glabrous or subglabrous 8. *C. laxiflora*
- 12. Young carpels puberulous 9. *C. peregrina*
- 11. Flowers tightly crowded in subglobose heads; carpels tomentose 10. *C. barbata*

1. *Cyclea kinabaluensis* FORMAN, Kew Bull. 14 (1960) 69.

Slender woody climber. *Leaves* with petioles 3–6 cm long inserted c. 1 mm above basal margin; lamina deltoid-ovate to triangular-ovate, apex long and finely acuminate, base very obtuse, truncate or cordate, palmately 5–7-nerved, 7–12.5 by 4.5–10 cm, both surfaces sparsely puberulous or glabrous with a fine and prominent reticulation, stiffly papyraceous. — *Male inflorescences* axillary, unbranched, 4–7 cm long with the flowers in sessile clusters 0.5–1 cm apart. — *Male flowers* green, sessile; sepals 4, basally connate or almost free, broadly obovate 1.5–2 mm long; synandrium subdiscoid, slightly lobed at the margin, 0.5–1 mm long, fleshy, glabrous. — *Female inflorescences* similar to male, up to 13 cm long. — *Female flowers*: sepals 2 or 3, free, obovate or subreniform, 1 mm long, externally puberulous; petals 2 or 3, free or basally connate, ± cuneate to reniform, 0.75 mm long, glabrous; carpel subellipsoidal, 1 mm long, stigma 3–5-lobed. *Drupe*s sessile, rotund in outline, 7 mm ø, glabrous or subglabrous. Endocarp bearing 4 dorsal rows of tubercles.

Distr. *Malesia*: North Borneo (Mt Kinabalu).
Ecol. In forest, 1700–2800 m.

var. *hispid*a FORMAN, Kew Bull. 14 (1960) 70.

Differs from *var. kinabaluensis* in its glabrous inflorescences and flowers, and hispid branchlets. In the type variety inflorescences, stems and petioles are golden-brown puberulous.

Known only from one specimen.

2. *Cyclea elegans* KING, J. As. Soc. Beng. 58, ii (1889) 387; DIELS, Pfl. R. Heft 46 (1910) 311; RIDL, Fl. Mal. Pen. 1 (1922) 115; BURK. & HEND. Gard. Bull. S. S. 3 (1925) 344; AIRY SHAW, Kew Bull. 1939 (1940) 538; YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 145; FORMAN, Kew Bull. 14 (1960) 71. — *C. caudata* MERR. J. Str. Br. As. Soc. n. 85 (1922) 172; YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 145. — *C. acuminatissima* MERR. Pap. Mich. Ac. Sc. 24 (1939) 68. — [*C. tonkinensis* (non GAGNEP.): YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 145.] — *C. scyphigera* SUESSENG. & HEINE, Mitt. Bot. Staatssamml. Münch. 2 (1950) 59, incl. f. *angustifolia* SUESSENG. & HEINE; HEINE in Fedde, Rep. 54 (1951) 227.

Slender climber, up to c. 4 m. Stems woody, 1.5–4 mm ø, puberulous to glabrous. *Leaves*: petioles 2–3 cm, minutely puberulous to glabrous, inserted at, or

up to 5(–12) mm from, basal margin; lamina lanceolate or ovate-lanceolate, apex usually attenuately acuminate to caudate, sometimes abruptly acuminate, base rounded, truncate or cordate, 6–15 by (2–) 3–4(–5.5) cm; palmately 3–5-nerved; both surfaces usually glabrous but sometimes lightly pubescent below, papyraceous. *Inflorescences* axillary, narrowly thyrsoid, 7–17 cm, puberulous, female sometimes a compound thyrse up to c. 40 cm terminating a lateral shoot. — *Male flowers* yellow, borne on puberulous pedicels up to 1.5 mm; calyx subcampanulate, shortly 4-lobed, 1 mm long, 1.25 mm broad, glabrous; corolla entire, broadly cyathiform, 0.75 by 1 mm, glabrous; synandrium not exerted, 1 mm long. — *Female flowers* greenish borne on puberulous pedicels at first 0.5 mm and later up to 1.5 mm; petals and sepals early caducous; sepals 2, ± broadly elliptic, 1 by 0.5 mm, minutely puberulous outside; petals 2, subrotund, 0.5 mm long, glabrous; carpel obliquely ovoid 0.75 mm long, glabrous, stigma obscurely and bluntly lobed. *Drupe*s on pedicels 1–2 mm, obliquely obovate in outline, 6–7 by 5–6 mm, 3 mm thick, glabrous; endocarp bearing 3 rows of papilliform tubercles on both faces.

Distr. *Malesia*: Sumatra, Malaya, Borneo.
Ecol. Forests at 300–1800 m.

3. *Cyclea atjehensis* FORMAN, Kew Bull. 14 (1960) 72; *ibid.* 34 (1980) 565, f. 3. — *C. barbata* (non MIERS): CRAIB, Fl. Siam. En. 1 (1925) 71. — **Fig. 18.**

Slender woody climber, 2–5 m. Stems densely covered with a mixture of yellow hairs c. 2 mm long together with much shorter hairs, eventually glabrescent. *Leaves* with petioles 6–8.5 cm long covered with both long and short hairs; lamina not peltate, deltoid ovate, apex acuminate, base ± truncate (in Mal.) and laterally sublobed, palmately 5-nerved, 11–14 by 9–10 cm, upper surface softly pubescent especially along the nerves, lower surface subtomentose, thinly papyraceous. — *Male inflorescences* axillary or on older, leafless stems, narrowly thyrsoid, 4.5 cm long, 0.8 cm broad, yellowish pubescent, flowers in short lateral cymes. — *Male flowers* on 1–2 mm pedicels; sepals 4, shortly connate at the base, oblong, 2 mm long, externally pilose; corolla reduced to a fleshy disc 0.25 mm long; synandrium 1 mm long. — *Female inflorescences* similar to male, but larger. — *Female flowers* on pedicels 0.5 mm long; sepals 2, subopposite, elliptic, 1 mm long, externally pilose; petals 2, episepalous, broadly obovate, 0.25 mm long, fleshy.

Carpel subellipsoidal, 1 mm long, puberulous becoming hispid, stigma with 4–5 spreading, subulate lobes. *Infructescences* on older, leafless stems up to 19 cm by 2.5 cm, with the drupes crowded on short lateral branches. *Drupes* very shortly pedicellate or sessile, covered with both long and short hairs, rotund in outline, 5 mm ϕ . Endocarp bearing 6 dorsal rows of tubercles.

Distr. Thailand; in *Malesia*: N. Sumatra (Atjeh).

Ecol. Young secondary growth in newly felled forests at 700–1260 m.

Note. The female flowers are described from specimens from Thailand.

4. *Cyclea merrillii* DIELS, Pfl. R. Heft 46 (1910) 312, f. 93F; in Elmer, Leaf. Philip. Bot. 4 (1911) 1167; MERR. En. Philip. 2 (1923) 151, *p.p.*; FORMAN, Kew Bull. 14 (1960) 72; PANCHO, Vasc. Fl. Mt. Makiling 1 (1968) 286.

Slender climber. Stems herbaceous or slightly woody, 1–2 mm ϕ , puberulous and also bearing long, spreading hairs. *Leaves* with tomentose or glabrescent petioles 2–5 cm, inserted 1–5 mm above the basal margin; lamina broadly ovate to triangular-ovate, apex acuminate, terminating in a long, fine micro, base rounded, truncate or subcordate, 7–14 by 5–12 cm, palmately nerved with 5 main ascending nerves; upper surface pubescent at first, later glabrescent, very finely reticulate; lower surface tomentose; papyraceous. — *Male inflorescences* axillary (? also cauliflorous), thyrsoid, 6–12(–23) cm long, yellowish pubescent to tomentose; flowers borne in small cymose clusters on lateral branches up to 1(–4) cm. — *Male flowers* with pedicels *c.* 1 mm; sepals 4, free, \pm oblanceolate-elliptic, 1.5 by 0.75 mm, pubescent outside; corolla campanulate, margin subentire, 1 mm long, glabrous; synandrium *c.* 1 mm long. — *Female inflorescences* similar to male but also terminal. — *Female flowers* on pedicels 1–2 mm; sepals 2, obovate, 1–1.25 by 0.75 mm, densely pilose outside; petals 2, obovate, 1 by 0.5 mm, sparsely pilose outside; carpel \pm ellipsoidal, very densely pilose, 1 mm long, style short, glabrous, stigma laciniately 4–5-lobed. *Drupes* unknown.

Distr. *Malesia*: Philippines (Luzon, Panay).

Ecol. Thickets and forests at low and medium altitudes.

Vern. Philippines: *abiab*, P. Bis., *malatúgi*, Negr.

5. *Cyclea insularis* (MAKINO) HATUS. Mem. Fac. Agric. Kagoshima Un. 5, 3 (1966) 29, *incl. var. luxurians* HATUS. — *Cissampelos insularis* MAKINO, Bot. Mag. Tokyo 24 (1910) 227.

Slender climber. Stems sparingly long-pubescent with short hairs also present, at least on young parts. *Leaves* with petioles 3–11 cm inserted 1–2 mm from

basal margin; lamina deltoid-ovate to reniform, 6.5–10 by 6–12 cm, palmately 7–8-nerved, base broadly to deeply cordate, apex broadly acuminate to broadly obtuse, upper surface sparsely hairy with lax reticulation, lower surface rather sparsely long-pubescent, hairs more dense along the nerves, thinly papyraceous. *Inflorescences* axillary, narrowly thyrsoid up to 18 cm long (female shorter) with lower lateral branches up to 2 cm long, puberulous. — *Male flowers* with pedicels 0.5 mm long; sepals 4–5, joined at base, ovate, 2 mm long, sparsely pubescent; petals united into a cup-shaped corolla 1 mm long; synandrium 1.5 mm long. — *Female flowers*: sepals 2, elliptic, 0.5 mm long; petals 2, rotund, 0.25 mm long; carpel glabrous or sparsely hispid, scarcely 1 mm long, short style with divaricately 3-lobed stigma. *Drupes* pink, subrotund in outline, 5 mm diam., sparsely hispid; endocarp dorsally and laterally set with 6 rows of short blunt angular points, *c.* 18–20 per row, with a small slit-like aperture on both lateral faces.

Distr. Japan; in *Malesia*: Philippines (Batan I., Mt Iraya).

Ecol. In thickets and forest slopes at 100–300 m. *Fl.* May, Nov.; *fr.* May.

6. *Cyclea robusta* BECC. *Malesia* 1 (1877) 157; DIELS, Pfl. R. Heft 46 (1910) 316; MERR. En. Born. (1921) 251; YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 145; FORMAN, Kew Bull. 14 (1960) 73; *ibid.* 22 (1968) 360.

Climber. Stems 2–6 mm ϕ , puberulous and patently hispid when young, later glabrescent and woody. *Leaves* with puberulous (later glabrescent) petioles 6–11 cm, inserted 2–4 cm from the base of lamina; lamina triangular-ovate to broadly ovate, apex gradually acuminate and terminating in a micro, base truncate (or slightly emarginate), 15–21 by 9–17 cm; palmately 11–14-nerved; above glabrous, subnitidous, beneath subtomentose, very prominently and finely reticulate, stiffly papyraceous. — *Male inflorescences* cauliflorous, thyrsoid, 30–35(–55) cm long, yellowish pubescent, lower branches up to 8 cm, flowers borne in peduncled congested cymose clusters. — *Male flowers* with pedicels about 1 mm; sepals 4, almost free, elliptic to oblanceolate, puberulous outside, 1.5 by 0.5–0.75 mm; corolla turbinate, margin crenulate, glabrous, scarcely 1 mm long; synandrium 1.5 mm long. — *Female flowers* unknown. *Infructescence* cauliflorous and thyrsoid, similar to the male inflorescence, and 25 cm long. *Drupes* on pedicels 4.5 mm, rotund in outline, 6–7 mm ϕ , sparingly puberulous; endocarp bearing 2 rows of *c.* 8 transverse \pm bilobed ridges, condyle slightly inflated.

Distr. *Malesia*: Borneo (West, Sarawak, and Sabah); 5 coll.

Ecol. Once recorded from forests at 300 m.

7. *Cyclea cauliflora* MERR. Philip. J. Sc. 26 (1925) 452; En. Philip. 4 (1926) 248; FORMAN, Kew Bull. 14 (1960) 74.

Slender climber. Stems 1–6 mm ϕ , woody, puberulous or sparsely hispid when young, later glabrescent. *Leaves*: petioles puberulous, 3–7 cm, inserted 11–22 mm above the basal margin; lamina broadly ovate to suborbicular, apex abruptly acuminate to subcaudate, acumen finely mucronate, base truncate to cordate, 7.5–12.5 by 6.5–11 cm; palmately 11–13-nerved; glabrous or subglabrous above, subtomentose below; submembranous. — *Male inflorescences* axillary or cauliflorous (sometimes having the appearance of a terminal or cauliflorous flowering stem from which the leaves have fallen), 15–120 cm, laxly and repeatedly branched, puberulous, flowers in cymose clusters, bracts linear, tomentose, up to 5 mm. — *Male flowers* white, borne on pedicels 1–1.5 mm; sepals 4, free, elliptic, 1.5–2 by 0.5 mm, pubescent outside; corolla campanulate, margin entire, 1 mm long, glabrous, synandrium 1 mm long. — *Female inflorescences* ?cauliflorous, c. 30 cm, with lower lateral branches up to 3(–5) cm, puberulous; flowers in rather dense clusters arranged along lateral branches, bracts as in male inflorescences. — *Female flowers* borne on pedicels 1–1.25 mm; sepals 2, variable in shape, \pm rotund, 0.75 mm long, pilose outside; petals ?none; carpel obliquely ellipsoidal, 1 mm long, densely pilose; style 0.25 mm, glabrous, lacinatedly 4- or 5-lobed, lobes 0.75 mm. *Drupe*s on pedicels 3–5 mm, rotund in outline, 5 mm ϕ , sparsely puberulous; endocarp bearing 4 longitudinal rows of c. 14 papilliform tubercles, both faces smooth with slight depression at centre and bordered by prominent ridge.

Distr. *Malesia*: Philippines (Luzon, Mindoro, Catanduanes, Leyte, Negros).

Ecol. Once recorded from a forested ridge at 460 m.

Notes. In the specimens of RAMOS & EDANO 28836 and 75112 which I have examined, the long male inflorescences have been coiled round with leafy stems in such a manner that it is extremely difficult to follow the course of the inflorescences and their branches. It seems probable that the apparently long (up to 120 cm) flowering shoots really represent a succession of axillary panicles from which the subtending leaves have fallen. There are several undoubtedly axillary inflorescences about 15 cm long.

In the two specimens of RAMOS 41103 which I have seen, the female inflorescences are completely detached, and their position on the plant is uncertain.

Cyclea apoensis YAMAMOTO, Trans. Nat. Hist. Soc. Taiwan 34 (1944) 312 is probably a synonym of this species. The type (ELMER 11272, Mindanao) with very young fruits has narrower leaves.

8. *Cyclea laxiflora* MIERS [Ann. Mag. Nat. Hist. ser. 3, 18 (1866) 19, *nomen*], Contr. Bot. 3 (1871) 241; DIELS, Pfl. R. Heft 46 (1910) 317; RIDL, Fl. Mal. Pen. 1 (1922) 114; BURK. & HEND. Gard. Bull. S. S. 3 (1925) 344; BURK. & HANIFF, *ibid.* 6 (1930) 171; BURK. Dict. 1 (1935) 722; HEND. Mal. Nat. J. 6 (1951) 415, t. 375; FORMAN, Kew Bull. 14 (1960) 75. — *C. peltata* (non (LAMK) HOOK. f. & TH.) BECC. *Malesia* 1 (1877) 157, *p.p.*; RIDL, J. Str. Br. R. As. Soc. n. 33 (1900) 43, '*var. arnotti* MIERS'. — *C. kort-halsii* DIELS ex NORMAN, J. Bot. 62 (1924) Suppl. 5, *nomen*.

Slender climber up to c. 15 m. Stems hispid to glabrous, herbaceous or slightly woody. *Leaves* with pubescent, usually hispid, petioles (1.3–)4–6.2 cm, inserted 8–22 mm above the basal margin; lamina triangular-ovate, deltoid-ovate or broadly ovate, apex acutely acuminate with acumen finely mucronate, base truncate to slightly emarginate, 9–16 by 5–13.5 cm, margin usually hispid; palmately 9–11-nerved; sparsely hispid to glabrescent above, fairly densely hispid to puberulous or subtomentose below; papyraceous. — *Male inflorescences* axillary, flowers borne in clusters on a lax thyrse 15–55 by 10–20 cm, puberulous. — *Male flowers* with pedicels 1–2 mm; calyx white or cream, turbinate, glabrous or subglabrous, 1–1.5 mm long, lobes 4, broadly triangular, about half the length of tube; petals 4, free, 0.5 mm long, glabrous; synandrium c. 1 mm long, shortly exerted. — *Female inflorescences* cauliflorous (? always), similar to male, 10–35 by 2.5–10 cm. — *Female flowers* on pedicels c. 0.5 mm; petals and sepals unknown (? early caducous); carpel curved-ellipsoidal, 1 mm long, pilose or glabrous, stigma with 3 filiform, divaricate lobes. *Drupe*s white, obliquely obovate to rotund in outline, 5–8 by 4–6 mm, sparsely pubescent; endocarp bearing 3 rows of papilliform tubercles on both faces.

Distr. Extreme Lower Thailand (Pattani); in *Malesia*: Sumatra (incl. Banka), Malay Peninsula (common) and Anambas Is. (Siantan).

Ecol. Hedges, cultivated land, scrub, coastal and secondary forest; 0–1200 m.

Uses. According to BURKILL a decoction made from the roots is used medicinally for fever, piles, following childbirth and as a vermifuge for children.

Vern. Malaya: *akar gasing bukit*, *a. pahit*, *a. rempenang*, *a. tèrong kemang (kemar)*, *chawan, me-tinum tikus*.

Note. Although DIELS described the inflorescences as cauliflorous, the male inflorescences are clearly axillary, as can be seen even in some of the specimens he cited. In a few examples, the leaf subtending the inflorescence has fallen.

9. *Cyclea peregrina* MIERS [Ann. Mag. Nat. Hist. ser. 3, 18 (1866) 20, *nomen*], Contr. Bot. 3 (1871)

242; DIELS, Pfl. R. Heft 46 (1910) 316; MERR. En. Born. (1921) 251; YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 145; FORMAN, Kew Bull. 14 (1960) 76.

Slender climber. Stem 1.5–4 mm ϕ , hispid when young, later glabrescent and woody. *Leaves* with puberulous to glabrescent petioles 2–3 cm inserted 9–16 mm above the basal margin; lamina broadly ovate, apex acutely acuminate with acumen finely mucronate, base slightly emarginate, 7.5–10.5 by 5.5–9 cm; palmately 11–12-nerved; subglabrous above, puberulous below; papyraceous. — *Male inflorescences* cauliflorous, 14 by 5 cm, puberulous, flowers crowded in dense clusters on lateral branches. — *Male flowers* subsessile or with puberulous pedicels up to 0.5 mm; calyx turbinate, sparsely puberulous, 1.25 mm long, lobes 4, broadly triangular, almost equal to length of tube; petals 4, free, 0.25 mm long, glabrous; synandrium 1 mm long, scarcely exerted. — *Female inflorescences* similar to male. — *Female flowers* sessile; sepals and petals unknown; carpel curved-ellipsoidal, 1 mm long, puberulous, stigma 3-laciniate. *Drupes* subrotund in outline, 5 by 5 mm, puberulous; endocarp bearing 3 rows of papilliform tubercles on both faces.

Distr. *Malesia*: SE. Borneo.

Note. This species, known only from two specimens collected by MOTLEY at Bandjarmasin about a century ago, is intermediate between *C. barbata* and *C. laxiflora*, having the hairy calyx and dense inflorescence of the former together with the minute, free petals of the latter. It is significant that these two species are not known from Borneo. If more material of *C. peregrina* becomes available it may prove to be conspecific with *C. laxiflora*. The dense inflorescence of MOTLEY 684, although bearing open flowers, may possibly be immature with the buds having opened on drying. Furthermore, sparsely hairy calyces do occasionally occur in *C. laxiflora*.

10. *Cyclea barbata* MIERS [Ann. Mag. Nat. Hist. ser. 3, 18 (1866) 19, *nomen*], Contr. Bot. 3 (1871) 237; DIELS, Pfl. R. Heft 46 (1910) 314; BACK, Schoolfl. (1911) 47; KOORD. Exk. Fl. Java (1912) 237; CRAIB, Fl. Siam. En. 1 (1925) 70; HEYNE, Nutt. Pl. (1927) 618; BURK. Dict. 1 (1935) 721; GAGNEP. Suppl. Fl. Gén. I.-C. 1 (1938) 139, *p.p.*; YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 144; FORMAN, Kew Bull. 14 (1960) 77; BACK. & BAKH. f. Fl. Java 1 (1963) 161. — *C. peltata* [non (LAMK) HOOK. f. & TH.] MIQ. Fl. Ind. Bat. 1, 2 (1858) 86, *p.p.*; SCHEFF. Nat. Tijd. N. I. 32 (1873) 393, t. 15; BOERL. Cat. Hort. Bog. 1 (1899) 43; BOORSMA, Teysmannia 11 (1900) 515; BACK. Fl. Bat. 1 (1907) 40; Voorl. Schoolfl. (1908) 9. — *C. wallichii* DIELS, Pfl. R. Heft 46 (1910) 315. — *C. ciliata* CRAIB, Kew Bull. 1922 (1922) 230; Fl. Siam. En. 1 (1925) 71.

Slender climber, up to c. 5 m. Roots tuberous.

Stems herbaceous or woody, hispid when young, later glabrescent. *Leaves* with hispid petioles 3–6.5 cm, inserted 6–25 mm above the basal margin; lamina ovate, deltoid-ovate or broadly ovate, apex acutely acuminate to obtuse with a finely mucronate acumen, base slightly emarginate, truncate or rounded, 6–17.5 by 4–12.5 cm, margin often hispid; palmately 9–12-nerved; hispid to subglabrous above, puberulous to tomentose below, occasionally hispid along nerves; papyraceous. — *Male inflorescences* axillary or cauliflorous, 7–12(–30) by 0.5–4(–12) cm, puberulous; flowers in dense, subcapitate, hairy clusters interruptedly borne on short lateral branches 1–4(–7) cm. — *Male flowers* with pedicels 1–2 mm, calyx greenish, turbinate, puberulous, 1.5–2 mm long, lobes 4 (or 5), triangular, about half the length of tube; corolla gamopetalous, turbinate, margin truncate or obtusely lobed, 0.75 mm long, glabrous; synandrium 1.5–2 mm long, usually exerted. — *Female inflorescences* similar to male but usually broader, 11–19 by 3–7 cm. — *Female flowers* sessile in dense heads; sepals 2, rhomboid to obovate, 0.5 mm long and broad, pilose on outer surface; petals 2, \pm reniform, opposite to and much broader than sepals, 0.5 by 0.75–1 mm, glabrous; ovary curved-ellipsoidal, 1 mm long, densely pilose, stigma 3-laciniate. *Drupes* obliquely obovate to rotund in outline, 5–7 mm long, 4–5.5 mm broad, puberulous; endocarp bearing 3 rows of papilliform tubercles on both faces.

Distr. Assam, Burma, Thailand, Cochinchina; in *Malesia*: NW Sumatra (Simalur I.), P. Sebesi and Krakatoa Is. in Sunda Strait, W.–E. Java.

Ecol. In forests (including teak and bamboo forest) and in alang² fields, 0–1000 m.

Uses. The leaves are commonly used in Java to prepare a refreshment in the form of a jelly called 'tjintjau'. This is usually eaten together with a sweet syrup. The leaves are crushed in water and the mixture left to set. The jelly is also regarded as a stomach-medicine. According to HEYNE, the roots attain considerable size and when dried are used medicinally: a brew prepared from them is used as a prophylactic against fever. The very bitter taste is due to the alkaloid 'cycleine'. The starch content of the roots is high, and there is about 10% fat content.

Vern. Simalur I.: *olor kalimenang*, *o. labana uding*; Java: *areuj tarawulu*, *tjamtjau*, *S. djudju*, *kepleng*, *krotok*, *J. kelemaju telur*, *terung kemau*, *tjintjau*, Md.

Notes. Three collections by KOORDERS differ in some respects from the rest of the material. These are KOORDERS 27853, 34037 (both from Central Java) and 38535 (E. Java). DIELS annotated the Bogor specimens of these numbers as '*Cyclea korthalsii* DIELS', a name later published as a *nomen nudum* by NORMAN (*l.c.*), where it was applied to FORBES 2622a

from Sumatra, which belongs to *C. laxiflora* MIERS. In the index to collectors' numbers in DIELS' monograph these three KOORDERS numbers are all referred to '*Cyclea tomentosa*', a name which I have not been able to find elsewhere. However, DIELS cited the same numbers under his general treatment of *C. barbata*.

In these specimens the lamina is smaller and narrower (5–8 cm long, 2.5–5 cm broad) than typical *C. barbata* and the petiole is inserted only 1–2 mm from the basal margin of the lamina. The stems differ in being puberulous and not hispid. The numbers 34037 and 38535 are in fruit. Number 27853 bears young

male buds and very few open flowers, of which two were dissected and were both found to have one petal completely free from the rest of the gamopetalous corolla. I am uncertain of the taxonomic value of the above differences. These collections may be provisionally regarded as representing aberrant forms of *C. barbata*.

DIELS placed *C. barbata* in his key under '*Synandrium inclusum*', although the synandrium is usually exerted. *Cyclea wallichii*, which DIELS originally described and placed under '*Synandrium exsertum*' in his key cannot be distinguished from it and is accordingly reduced.

25. STEPHANIA

LOUR. Fl. Coch. 2 (1790) 608; MIERS, Contr. Bot. 3 (1871) 210; DIELS, Pfl. R. Heft 46 (1910) 259; FORMAN, Kew Bull. 11 (1956) 43; *ibid.* 22 (1968) 352. — *Clypea* BL. Bijdr. (1825) 26; MIERS, Contr. Bot. 3 (1871) 205. — **Fig. 19, 20.**

Climbers, mostly slender. Stems woody or herbaceous. Roots sometimes tuberous. *Leaves* with petioles usually geniculate at base; lamina peltate, usually \pm ovate to suborbicular, palmately 8–13-nerved. *Inflorescences* axillary or arising from old, leafless stems, usually composed of peduncled umbelliform cymes which are solitary or racemosely arranged, at least the 1st(–2nd) orders of branching umbellate (in *Mal. spp.*), the ultimate branching sometimes irregular, or sometimes the cymes condensed to disciform capitula. — *Male flowers* symmetrical: sepals free, imbricate, 6 or 8 in two equal or unequal whorls, or only 2–3 in *S. capitata*, usually \pm obovate; petals free, 3 or 4 or 2–3 in *S. capitata*, usually \pm broadly obovate with lateral margins often involute; stamens connate into a peltate synandrium, anther-cells 4–8 dehiscent transversely. — *Female flowers* symmetrical or asymmetrical: sepals 1–8, petals 2–4, both similar to male; carpel 1, style very short or absent, stigma shortly lobed or divaricately lacinate. *Drupes* obovoid with style-scar near base, glabrous; endocarp bony, dorsally bearing a horseshoe-shaped band of 2 or 4 longitudinal rows of processes or transverse ridges, condyle often perforate. *Seed* horseshoe-shaped. Embryo with cotyledons \pm equalling the radicle, surrounded by endosperm.

Distr. About 35 *spp.* in the warmer parts, mostly tropics, of the three continents in the Old World; throughout *Malesia*.

Notes. The Malesian species of *Stephania* fall into DIELS' sections *Thamnothyrsa* and *Eustephania*. These sections are not maintained in the following account since the distinctions between them, which were based on the position and form of the inflorescence, are unreliable.

As to life-form, the species differ: *S. japonica*, *S. psilophylla* and *S. venosa* seem to have annual or seasonal stems, while *S. corymbosa* and *S. zippeliana* have perennial woody stems.

The form of the inflorescence is specifically important in *Stephania*; in all the Malesian species its organisation is based on one or more peduncled, umbelliform cymes, which show varying degrees of condensation in different species. In *S. montana* and *S. corymbosa* the cymes are lax and bear pedicellate flowers. In *S. japonica* the flowers are sessile in subcapitate globose clusters. Extreme condensation of the cyme-branches occurs in *S. capitata* and *S. dictyoneura* resulting in a solid, disciform receptacle on which the flowers are

very densely crowded. The composition of the inflorescence is usually either a solitary umbelliform cyme as in *S. japonica* and *S. venosa* or a racemose arrangement of umbelliform cymes as in the other species. The former composition is a character used by DIELS for his section *Eustephania* and the latter for his section *Thamnothyrsa*. In *S. psilophylla*, however, a racemose arrangement of cymes is usual but solitary cymes also occur.

Externally, the fruits of different species are similar; the differences are to be found internally. The remarkable ornamentation of the endocarp is usually distinct for each species. There are 2 or 4 rows of processes in the form of ridges, hooks, rods or plates, the rows running longitudinally along the dorsal surface of the endocarp. Each species has a characteristic range in the number and form of these processes.

KEY TO MALE PLANTS

(Note: The male of *S. dictyoneura* is not known but from female inflorescences it is clear that the species belongs next to *S. capitata* in this key.)

1. Inflorescences composed of umbelliform cymes.
 2. Flowers sessile or subsessile in dense clusters **1. *S. japonica***
 2. Flowers pedicellate.
 3. Inflorescences verruculose; peduncles of cymes arising retrorsely from main axis. Leaf-margin with wide, shallow crenations; petiole inserted 2–3 mm from base **2. *S. grandiflora***
 3. Inflorescences glabrous, papillose or puberulous; peduncles of cymes not retrorse along main axis. Leaf-margin not widely crenate; petiole inserted more than (6–)10 mm from base.
 4. Leaves submembranous, margin often slightly lobed, reticulation scarcely raised and usually drying reddish brown. Inflorescence usually a solitary axillary subumbel **3. *S. venosa***
 4. Leaves papyraceous to coriaceous.
 5. Inflorescences less than 1.5 cm long. Reticulation on lower surface of leaf very fine and raised **4. *S. reticulata***
 5. Inflorescences 3 cm or more long.
 6. Sepals unequal. Petals papillose-puberulous within. Upper surface of leaf often minutely subpapillose (large epidermal cells) **5. *S. corymbosa***
 6. Sepals \pm equal. Petals glabrous. Upper surface of leaf not subpapillose.
 7. Leaves with lax reticulation.
 8. Leaves triangular-orbicular to orbicular, apex rounded to very broadly obtuse **6. *S. salomonum***
 8. Leaves triangular to ovate, apex acute to obtuse.
 9. Umbelliform cymes 2–5 cm with primary rays less than 1 cm. Leaves ovate to ovate-triangular, apex obtuse **7. *S. moluccana***
 9. Umbelliform cymes 4–14 cm with primary rays more than 1 cm. Leaves triangular to narrowly triangular, apex very acute **8. *S. montana***
 7. Leaves with very fine reticulation.
 10. Leaves 5–9 by 4–8 cm. Inflorescences axillary, composed of very slender umbelliform cymes 2.5–6 cm long **9. *S. psilophylla***
 10. Leaves usually more than 16 by 10 cm. Inflorescences very large (over 30 cm long) usually on old, leafless stems, composed of stout umbelliform cymes over 10 cm long **10. *S. zippeliana***
 1. Inflorescences composed of peduncled disciform capitula.
 11. Leaves with a lax and rather obscure reticulation, apex often caudate; petiole inserted more than 10 mm from base **11. *S. capitata***
 11. Leaves with a close, raised reticulation, apex shortly acuminate; petiole inserted 3–7 mm from base **12. *S. dictyoneura***

KEY TO FEMALE PLANTS

1. Inflorescences composed of umbelliform cymes.
 2. Inflorescences verruculose. Leaf-margin with wide, shallow crenations; petiole inserted 2–3 mm from base **2. *S. grandiflora***

2. Inflorescences glabrous, papillose or puberulous. Leaf-margin not widely crenate; petiole inserted more than (6-)10 mm from base.
3. Leaves submembranous, margin often slightly lobed, reticulation scarcely raised and usually drying reddish brown. Inflorescence usually a solitary axillary cyme. Flowers asymmetrical: sepal 1, petals 2
3. *S. venosa*
3. Leaves papyraceous to coriaceous.
4. Drupes sessile or subsessile (excluding ultimate infructescence branchlets).
5. Leaves with a rather lax reticulation, often obscure on upper surface which is often minutely papillose. Endocarp generally suborbicular in outline with 4 dorsal rows of (10-)12-19 hooks. Female flowers asymmetrical. 5. *S. corymbosa*
5. Leaves with a fine reticulation usually visible on both surfaces. Endocarp obovate in outline with 2 or 4 dorsal rows of ridges or lamelliform projections. Female flowers symmetrical. 1. *S. japonica*
4. Drupes pedicellate, apart from occasional sessile ones.
6. Leaves with very fine reticulation visible on one or both surfaces.
7. Drupes 4-5 mm long. Leaves 5-9 by 4-8 cm. Endocarp with 2 or 4 dorsal rows of 7-9 ridges or papilliform processes. Inflorescences axillary 9. *S. psilophylla*
7. Drupes 7-10 mm long. Inflorescences usually on old, leafless stems.
8. Leaves 7-13 by 5-10 cm. Endocarp with 4 dorsal rows of 9-11 very prominent projections, the outer 2 rows lamelliform, dorsal surface very scabrid 4. *S. reticulata*
8. Leaves usually more than 16 by 10 cm. Endocarp with 4 dorsal rows of 9-14 short papilliform processes or low ridges (sometimes T-shaped), dorsal surface slightly rough or smooth 10. *S. zippeliana*
6. Leaves with a lax reticulation visible on both surfaces.
9. Leaves triangular-orbicular to orbicular, apex rounded to very broadly obtuse. 6. *S. salomonum*
9. Leaves triangular to ovate, apex acute to obtuse.
10. Leaves ovate to ovate-triangular, apex obtuse 7. *S. moluccana*
10. Leaves triangular to narrowly triangular, apex very acute. 8. *S. montana*
1. Inflorescences composed of peduncled, disciform capitula.
11. Leaves with a lax and rather obscure reticulation, apex often caudate; petiole inserted more than 10 mm from base 11. *S. capitata*
11. Leaves with a close, raised reticulation, apex shortly acuminate; petiole inserted 3-7 mm from base
12. *S. dictyoneura*

1. *Stephania japonica* (THUNB.) MIERS, Ann. Mag. Nat. Hist. ser. 3, 18 (1866) 14, *p.p.*, *excl.* CUMING 1160; Contr. Bot. 3 (1871) 213, *p.p.*, *excl.* CUMING 1160; DIELS, Pfl. R. Heft 46 (1910) 277; in Elmer, Leafl. Philip. Bot. 4 (1911) 1166; JUEL, Pl. Thunb. (1918) 245; W.H. BROWN, Minor Prod. Philip. For. 3 (1921) 186; GAGNEP, Suppl. Fl. Gén. I.-C. 1 (1938) 134; YAMAMOTO, Taiwania 1 (1948) 46; FORMAN, Kew Bull. 11 (1956) 49. — *Menispermum japonicum* THUNB. Fl. Jap. (1784) 193; LAMK, Encycl. Méth. 4 (1797) 96; WILLD. Sp. Pl. 4 (1806) 827. — *Cissampelos hernandiifolia* WILLD. Sp. Pl. 4 (1806) 861 (*'hernandiifolia'*); DC. Syst. 1 (1817) 533; Prod. 1 (1824) 100; ROXB. Fl. Ind. ed. Carey 3 (1832) 842. — *Cocculus japonicus* (THUNB.) DC. Syst. 1 (1817) 516; Prod. 1 (1824) 96, *incl. var. timoriensis* DC. — *Cocculus forsteri* DC. Syst. 1 (1817) 517; Prod. 1 (1824) 96; GUILLEMIN, Ann. Sci. Nat. II, 7 (1837) 370. — *Clypea discolor* BL. Bijdr. (1825) 26. — *S. discolor* (BL.) SPRENG. Syst. Veg. 4 (1827) 316; HASSK. Pl. Jav. Rar. (1848) 168; MIERS, Contr. Bot. 3 (1871) 224; BOERL. Cat. Hort. Bog. 1 (1899) 42, *incl. var. hernandiifolia* (WILLD.) BOERL.; BACK. Fl. Bat. 1 (1907) 39; Voortl. Schoolfl. (1908) 9; RIDL. J. Str. Br. R. As. Soc. n. 87 (1923) 52. — *Clypea glaucescens* DECNE,

Nouv. Ann. Mus. Paris 3 (1834) 423, t. 18; SPAN. Linnaea 15 (1841) 164. — *S. glaucescens* (DECNE) WALP. Rep. 1 (1842) 96; MIERS, Contr. Bot. 3 (1871) 214. — *S. hernandiifolia* (WILLD.) WALP. Rep. 1 (1842) 96; HOOK. f. & TH. Fl. Ind. 1 (1855) 196, *p.p.*; MIQ. Fl. Ind. Bat. 1, 2 (1858) 83; BENTH. Fl. Austr. 1 (1863) 57, *p.p.*; KURZ, Nat. Tijds. N. I. 27 (1864) 177; MIERS, Contr. Bot. 3 (1871) 222; MIQ. Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 85, *incl. var. genuina seu glabra et var. discolor* (BL.) MIQ.; HOOK. f. & TH. Fl. Br. India 1 (1872) 103; SCHEFF. Nat. Tijds. N. I. 32 (1873) 401; KURZ, J. As. Soc. Beng. 43, ii (1874) 61; BECC. Malesia 1 (1877) 154; KING, J. As. Soc. Beng. 58, ii (1889) 385; WARB. Bot. Jahrb. 13 (1891) 314; RIDL. Trans. Linn. Soc. II, 3 (1893) 274; K. SCH. Notizbl. Berl.-Dahl. 2 (1898) 116; BAILEY, Queensl. Fl. 1 (1899) 33, *p.p.*; K. SCH. & LAUT. Fl. Deut. Schutzgeb. Südsee (1901) 311; BRANDIS, Indian Trees (1906) 23; GAGNEP. Fl. Gén. I.-C. 1 (1908) 147; DIELS, Pfl. R. Heft 46 (1910) 279; BACK. Schoolfl. Java (1911) 46; KOORD. Exk. Fl. Java 2 (1912) 335; MERR. En. Born. (1921) 250; RIDL. Fl. Mal. Pen. 1 (1922) 113; BURK. & HEND. Gard. Bull. S. S. 3 (1925) 344; CRAIB, Fl. Siam. En. 1 (1925) 69; HEYNE, Nutt. Pl. 1 (1927) 617; BACK. Onkr. Suiker. 2 (1930) 247;

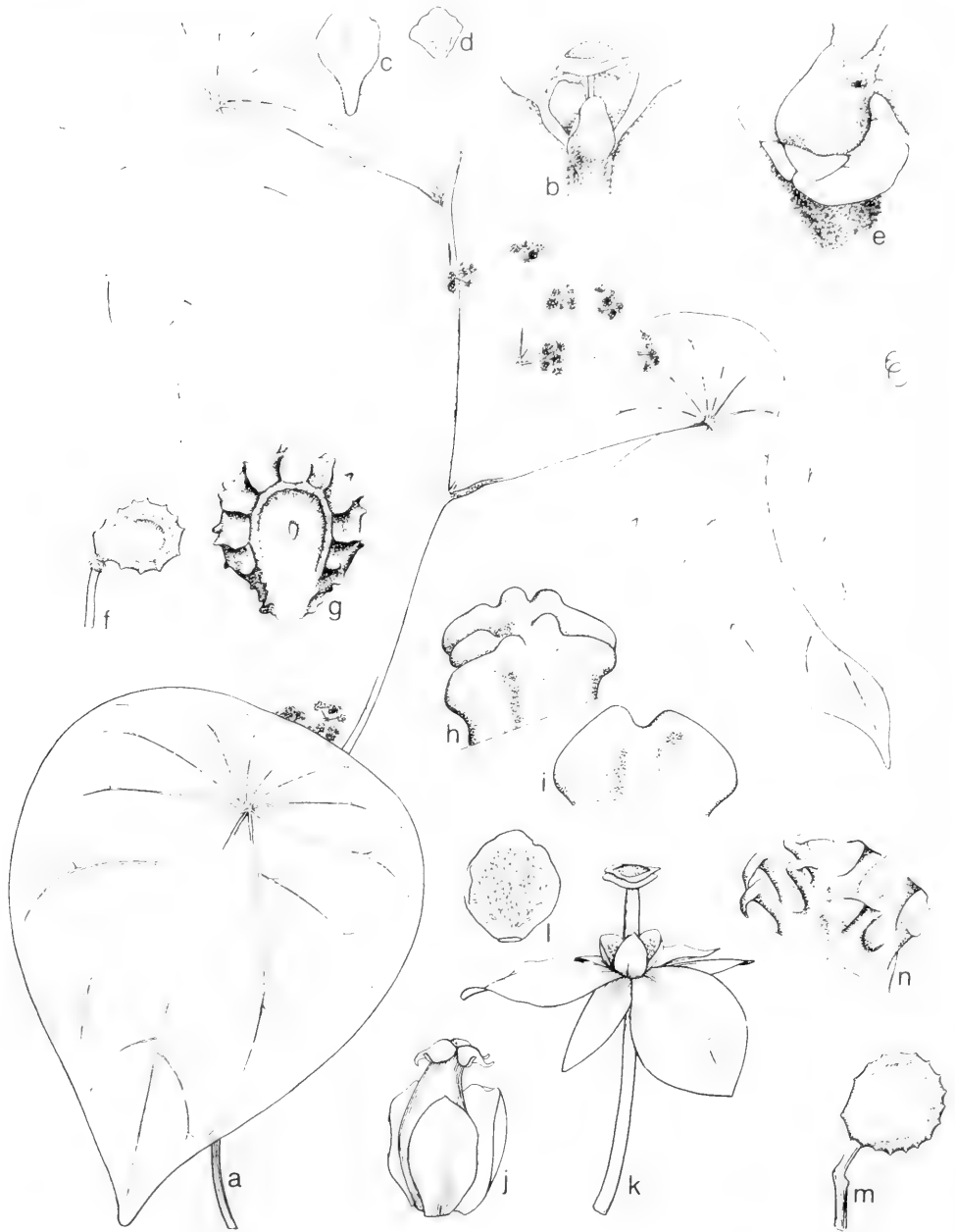


Fig. 19. *Stephania japonica* (THUNB.) MIERS. *a-d, f-h*. var. *timoriensis* (DC.) FORMAN, *e*. var. *discolor* (BL.) FORMAN, *g-i*. var. *japonica*. *a*. Habit, $\times 2/3$, *b*. male flower, $\times 20$, *c*. sepal, $\times 15$, *d*. petal, inner view, $\times 15$, *e*. female flower, $\times 20$, *f*. drupe, $\times 2$, *g*. endocarp, $\times 4$ with *h*. detail of ornamentation viewed along the median dorsal line, $\times 10$, *i*. variant of ornamentation, $\times 10$. — *S. venosa* (BL.) SPRENG. *j*. Female flower with 1 sepal and 2 petals, $\times 20$. — *S. corymbosa* (BL.) WALP. *k*. Male flower, $\times 10$, *l*. petal, glandular inner face, $\times 15$, *m*. drupe, $\times 2$, *n*. detail of ornamentation on endocarp, $\times 10$ (*a-d* ELBERT 3998, *e* S 40966, *f-h* ROBINSON 487, *i* BS 80201, *j* KOORDERS 25871, *k-l* BS 80080, *m-n* KLOSS 19126).

Atlas (1936) t. 258; BURK. Dict. 2 (1935) 2076; MERR. J. Arn. Arb. 19 (1938) 340; MASAM. En. Phan. Born. (1942) 276; YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 138; Taiwania 1 (1948) 48. — *S. forsteri* (DC.) A. GRAY, Bot. U.S. Expl. Exped. 1 (1854) 36; DIELS, Pfl. R. Heft 46 (1910) 278; Nova Guinea 8 (1910) 283; BACK. Schoolfl. Java (1911) 46; KOORD. Exk. Fl. Java 2 (1912) 336. — *S. concinna* MIERS [Ann. Mag. Nat. Hist. ser. 3, 18 (1866), 15, *nomen*] Contr. Bot. 3 (1871) 226. — *S. exigua* MIERS [Ann. Mag. Nat. Hist. ser. 3, 18 (1866) 16, *nomen*] Contr. Bot. 3 (1871) 228. — *S. hallieri* DIELS, Pfl. R. Heft 46 (1910) 281; MERR. En. Born. (1921) 250; MASAM. En. Phan. Born. (1942) 276; YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 140. — Fig. 19a-i.

For further names based on extra-Malesian types, see FORMAN (1965: 55).

Slender climber, 2–10 m. Root tuberous. Stem herbaceous or thinly woody, glabrous or crispatly puberulous. Leaves with glabrous or crispatly puberulous petioles 3–12 cm; lamina broadly triangular-ovate to ovate, (4–)6–12(–17) by 4–10(–14) cm, apex usually ± acuminate with the acumen usually obtuse and mucronulate but sometimes very acute or very obtuse, base broadly rounded to slightly cordate; fine reticulation usually visible on both surfaces, upper surface glabrous; lower surface glabrous or crispatly puberulous and also sometimes glaucous (due to very minute whitish papillae); ± papyraceous. — *Male inflorescence* an axillary compound umbelliform cyme 4–9 cm, bearing flowers in dense, subcapitate, cymose clusters, glabrous or puberulous, usually solitary, but occasionally paired or a few borne on an axillary shoot. — *Male flowers* green, white or yellow, sessile or subsessile; sepals 6 or 8, glabrous or puberulous outside, oblanceolate to spatulate, 0.75–1.25 mm; petals 3 or 4, glabrous, ± obdeltoide to suborbicular, 0.5–1 mm; synandrium 0.5–1 mm long, exsert or not. — *Female inflorescence* similar to male. — *Female flowers* with petals and sepals as in male but number of sepals often reduced; carpel ± ovoid, 0.75–1 mm. *Drupe* red, sessile or subsessile (occasionally with pedicels up to 2 mm long), ± obovate to suborbicular in outline, 4–8 by 4–6 mm. Endocarp usually perforate, dorsally bearing 2 longitudinal rows of about 8–10 transverse ridges which are often ± 2-lobed thus forming 4 distinct rows of processes, ± papilliform in the 2 inner rows and broader and often hooked in the 2 outer rows; surface between and around tubercles usually smooth, rarely rough.

Distr. Japan, S. China, Indochina, Thailand, India, throughout *Malesia*, N. & E. Australia, Polynesia.

Ecol. In hedges, thickets, river-banks, secondary growth and forests, from sea-level to 2000 m. *Fl. fr.* Jan.–Dec. (at least, in Java).

Uses. In *var. discolor* the tuberous root is bitter and very poisonous due to its picrotoxin content. It is used medicinally for fever, diarrhoea, urinary diseases and stomach-ache. Crushed leaves in water form a slightly gelatinous mass which is applied to breast infections. Although reported to be poisonous to livestock in Australia (WHITE, Queensl. Agric. J. n.s. 8, 1917, 230), feeding tests have proved negative (EVERIST, Pois. Pl. Austr. rev. ed., 1981, 528).

VERN. Java: *areuj gurrung*, *djado*, *djundju lalakeh*, *kepleng*, *ojod minyak*, *ondjo ondjo*, *seloro*, *sluru*, *tjiluru*, *tjimtjau minjak*; Moluccas: *ginato bobudo*, *gurnali babudo*, Ternate; New Guinea: *bidililim*, West; *worarugan*, East, Hagen-Chimbu.

NOTES. The very extensive synonymy of this species is the result of combining the synonyms quoted by DIELS for three species, which he recognized as distinct, *viz.* *S. forsteri* (DC.) A. GRAY, *S. hernandiifolia* (WILLD.) WALP. and *S. japonica* (THUNB.) MIERS. The only differences between these taxa concern the presence or absence of a puberulous indumentum on the lower surfaces of the leaves and on the inflorescences, as indicated in the key below. The degree of hairiness varies considerably but the great majority of the specimens I have examined can be placed in one of these three taxa, which occupy different but overlapping geographical areas. I therefore consider *S. forsteri*, *S. hernandiifolia* and *S. japonica* to be no more than varieties of one widespread species.

For a detailed discussion on the types see FORMAN (1956).

The endocarp of *S. japonica* was described by DIELS as imperforate. It is, however, usually perforate in all three varieties of this species.

KEY TO THE VARIETIES

1. Leaves glabrous below (region around insertion of petiole sometimes puberulous).
2. Inflorescences glabrous **a. var. japonica**
2. Inflorescences puberulous **b. var. timoriensis**
1. Leaves puberulous below (apart from region around insertion of petiole **c. var. discolor**

a. var. japonica

For synonymy, see FORMAN (1956: 49).

Plant entirely glabrous; the bracts and sepals (outer surface) sometimes papillose.

Distr. Ceylon, SW. Deccan, E. China, Korea, Japan, Taiwan, Tonga & Society Is.; in *Malesia*: Lesser Sunda Is. (Timor), Moluccas (Ceram), Philippines (Batan Is., Luzon, Mindoro, Negros, Palawan).

b. var. timoriensis (DC.) FORMAN, Kew Bull. 11

(1956) 49. — **Fig. 19a–d, f–h.**

For synonymy, see FORMAN (*l.c.*).

Leaves glabrous (sometimes sparsely puberulous on the lower surface around the insertion of the petiole). Inflorescences crispately puberulous.

Distr. E. Bengal to N. Australia and Polynesia (New Caledonia, Samoa, Tahiti); in *Malesia*: Central & E. Java, Lesser Sunda Is., SW. Celebes, Moluccas (Ceram, Ambon, Kei Is.), Papua New Guinea.

c. var. *discolor* (BL.) FORMAN, Kew Bull. 11 (1956) 49. — **Fig. 19e.**

For synonymy, see FORMAN (*l.c.*).

Leaves crispately puberulous below. Inflorescences crispately puberulous.

Distr. Tropical SE. Asia: S. China (Yunnan), India, Nepal, Burma, Thailand, Indochina to E. Australia; in *Malesia*: throughout, except the Philippines.

2. *Stephania grandiflora* FORMAN, Kew Bull. 22 (1968) 354.

Woody climber. Young stems, petioles and inflorescences verruculose. *Leaves* with petioles 3–5 cm inserted 2–3 mm from the basal margin; lamina triangular-ovate, 6–12 by 4.5–9 cm, base truncate, apex acute or obtuse, margin broadly and slightly crenate, reticulation dense, raised and very conspicuous on both surfaces, glabrous, thinly coriaceous. — *Male inflorescences* axillary, c. 22–35 cm long, composed of umbelliform cymes 10–12 cm long with peduncles 5–7 cm, arising retrorsely from the main axis. — *Male flowers* on slender pedicels, c. 2 mm; sepals 6 or 8, elliptic or broadly elliptic, 3–4 mm, glabrous; petals 3 or 4, cuneate-oblong, 3 mm with the lateral margins inflexed, apex truncate, glabrous; synandrium 3 mm long. — *Female flowers* unknown. *Drupe* yellow on pedicel up to 2 mm long, obovate in outline, 6 mm long. Endocarp imperforate with 4 dorsal rows of c. 13 processes, papilliform in the median rows, but consisting of transverse ridges, hooked on the outer margins in the lateral rows.

Distr. *Malesia*: East New Guinea (E., W. & S. Highlands).

Ecol. Primary and secondary forest by streams and in regrowth in logged areas, on peaty humic soil and humic soil over orange-brown clay at 2300–2700 m. *Fl.* June, July; *fr.* Feb., June, Sept., Oct.

Uses. Local people make abdominal belts from the stems.

Vern. *Kepilam, kwik*, Enga dial., *kuip*, Wabag, *kuru ponde*, Hagen Distr.

Note. This is a most distinctive species of *Stephania* in several respects. The leaves differ from those of other species in the wide and shallow crenations at the margin of the lamina, which is densely reticulate and comparatively thick in texture. The flowers are

the largest known in the genus. The inflorescences are remarkable in that the main branches, *i.e.* the peduncles of the umbelliform cymes, are directed backwards towards the base of the inflorescence, suggesting that the inflorescences are pendulous with the retrorse branches directed upwards.

3. *Stephania venosa* (BL.) SPRENG. Syst. Veg. 4 (1827) 316; WALP. Rep. 1 (1842) 96; DIELS, Pfl. R. Heft 46 (1910) 271; KOORD. Exk. Fl. Java 2 (1912) 336; MASAM. En. Phan. Born. (1942) 276; YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 141; FORMAN, Kew Bull. 11 (1956) 58; BACK. & BAKH. f. Fl. Java 1 (1963) 160 (*'venenosa'*); FORMAN, Kew Bull. 22 (1968) 352. — *Clypea venosa* BL. Bijdr. (1825) 27. — *S. prapatensis* YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 143. — *S. rotunda* (*non* LOUR.) MIQ. Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 86; SCHEFF. Nat. Tijds. N. I. 32 (1873) 401, t. 14; BECC. Malesia I (1877) 155; RIDL. J. Str. Br. R. As. Soc. n. 54 (1910) 15; *ibid.* n. 59 (1911) 67 (*'rotundifolia'*); Fl. Mal. Pen. 1 (1922) 113. — *S. hernandiifolia* [*non* (WILLD.) WALP.] RIDL. J. Str. Br. R. As. Soc. n. 59 (1911) 67. — **Fig. 19j.**

Slender climber up to c. 20 m, containing red sap. Root tuberous. Stem herbaceous, glabrous. *Leaves* with glabrous petioles (3–)6–22 cm; lamina broadly triangular-ovate, margin often slightly lobed, 6–20 by 6–20 cm, apex obtusely mucronulate, base slightly cordate; lower surface rather pale with a darker venation (*in sicco* usually reddish brown) very minutely papillose, otherwise glabrous; upper surface usually darker, glabrous; submembranous. — *Male inflorescences* an axillary, peduncled, umbelliform cyme, 6–15 cm, papillose (occasionally glabrous), usually solitary. — *Male flowers* yellow to orange with pedicels 1–2 mm; sepals 6, papillose outside, outer 3 ob lanceolate, 2–2.5 mm long; inner 3 obovate, unguiculate, 2–2.5 mm long; petals 3, obdeltoid-obovate, 1.25–1.5 mm long, glabrous; synandrium 1–1.75 mm long. — *Female inflorescence* similar to male. — *Female flowers* with pedicels about 1 mm, asymmetrical; sepal 1, elliptic-oblong to obovate, 1–1.25 by 0.5 mm, papillose or glabrous outside; petals 2, ± suborbicular to obdeltoid, 0.5–0.75 mm ø, glabrous. Sepal and petals on one side of the flower; carpel ± ellipsoid, 1–1.5 by 0.5–0.75 mm. *Drupe* red with pedicels up to 7 mm, obovate in outline, 6–9 by 5–6 mm. Endocarp perforate, dorsally bearing 4 longitudinal rows of 12–16 papilliform processes.

Distr. Andaman Is., Thailand, Vietnam, S. China (Yunnan); in *Malesia*: N. Sumatra, N. Malaya (Perlis, Langkawi Is.), Java, N. Borneo (Mt Kinabalu), Philippines (Luzon), and SW. Celebes.

Ecol. On hillsides, plains and mountains, scattered in forests up to 1600 m. On limestone in Malaya.

Vern. Java: *gorong bodas*.

Note. Some male specimens from Langkawi Is. have a fleshy scale on the inside of each petal which may indicate a distinct taxon.

4. *Stephania reticulata* FORMAN, Kew Bull. 11 (1956) 65; *ibid.* 22 (1968) 352; *ibid.* 39 (1984) 113.

Woody climber. *Leaves* with petioles 4–12 cm, glabrous or puberulous towards the apex; lamina triangular-ovate, 7–13 by 5–10 cm, apex usually attenuately acuminate, base truncate or broadly rounded, lower surface with reticulation very fine and raised, glabrous or sparsely puberulous towards the base of the nerves, upper surface with laxer reticulation, glabrous, papyraceous. — *Male inflorescences* axillary, less than 1.5 cm long, a solitary umbelliform cyme or a few cymes arising from a very short axis, glabrous. — *Male flowers* on pedicels 1.25–1.5 mm in dense subglobose clusters; sepals 6, elliptic or oblanceolate, 1–1.25 mm long; petals 3, broadly obovate, the lateral margins inflexed, 0.5 mm long; synandrium 0.75–1 mm long. — *Female inflorescences* similar to male but much larger. *Infructescence* axillary or on older, leafless stems, 4–14 cm long, subglabrous or puberulous. — *Female flowers* subsessile or on pedicels c. 0.5 mm long; sepals and petals similar to male; carpel 1 mm long. *Drupe* yellow to red on pedicel 3–5 mm, sometimes sessile, obovate to suborbicular in outline, 7–9 by 7–8 mm. Endocarp perforate with 4 dorsal rows of 9–11 projections irregularly divided at the apices, the 2 median rows \pm rod-like, the 2 outer rows lamelliform with the outer margins hooked, the whole dorsal surface very scarbid.

Distr. Tenasserim and Peninsular Thailand (Patlung; Pattani); in *Malesia*: W. Java and N. Borneo (Sarawak; Mt Kinabalu & Crocker Range).

Ecol. In forests, in continental Asia at c. 300–400 m, in W. Java 500–1000 m, in Sabah 1000–1700 m.

Notes. This species is clearly distinguished by its very small, axillary, male inflorescences bearing shortly pedicellate flowers, and also by the pedicellate fruits containing remarkable endocarps which dorsally bear 2 inner rows of \pm rod-like projections and 2 outer rows of thin, transverse, plate-like projections, which are hooked on the outer margin. The projections are irregularly divided at their tips and the whole dorsal surface of the endocarp between the projections is very rough.

BACKER & BAKH. *f.* (Fl. Java 1, 1963, 157) exclude this species from W. Java, but I disagree (*l.c.* 1968).

5. *Stephania corymbosa* (BL.) WALP. Rep. 1 (1842) 96; MIQ. Fl. Ind. Bat. 1, 2 (1858) 84; Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 86; BECC. Malesia 1 (1877) 155; DIELS, Pfl. R. Heft 46 (1910) 267; BACK. Schoolfl.

Java (1911) 46; KOORD. Exk. Fl. Java 2 (1912) 336; BACK. Bull. Jard. Bot. Btzig II, 12 (1913) 31; RIDL. J. Fed. Mal. Stat. Mus. 8 (1917) 14; Fl. Mal. Pen. 1 (1922) 113; MERR. En. Born. (1921) 250; BURK. & HEND. Gard. Bull. S. S. 3 (1925) 344; NORMAN, J. Bot. 64 (1926) Suppl. 142; MASAM. En. Phan. Born. (1942) 276; YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 137; FORMAN, Kew Bull. 11 (1956) 60, f. 4; BACK. & BAKH. *f.* Fl. Java 1 (1963) 160; PANCHO, Vasc. Fl. Mt. Makiling 1 (1983) 285. — *Clypea corymbosa* BL. Bijdr. (1825) 27. — *S. ramuliflora* MIERS [Ann. Mag. Nat. Hist. ser. 3, 18 (1866) 16, *nomen*], Contr. Bot. 3 (1871) 232. — ? *S. cauliflora* BECC. Malesia 1 (1877) 155; DIELS, Pfl. R. Heft 46 (1910) 267; HOLTH. & LAM, Blumea 5 (1942) 180. — *S. hernandiifolia* [non (WILLD.) WALP.] KOORD. Meded. Lands Pl. Tuin 19 (1898) 340. — *S. catosepala* DIELS, Pfl. R. Heft 46 (1910) 268; in Elmer, Leaf. Philip. Bot. 4 (1911) 1166; MERR. En. Philip. 2 (1923) 149, *p.p.*, *excl.* MERRILL 828, 9705 *et* SANTOS 31806. — *S. merrillii* DIELS, Pfl. R. Heft 46 (1910) 268; in Elmer, Leaf. Philip. Bot. 4 (1911) 1166; MERR. En. Philip. 2 (1923) 150; YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 137. — *S. ramosii* DIELS, Philip. J. Sc. 7 (1912) Bot. 265; MERR. En. Philip. 2 (1923) 150. — *S. menadonensis* DIELS *ex* KOORD.-SCHUM. Syst. Verz. (1914) 41, *nomen*. — ? *S. borneensis* YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 137. — **Fig. 19k–n.**

Woody climber, about 5–12 m, main stem about 1–2 cm ϕ . *Leaves* with glabrous petioles 3–19 cm; lamina broadly triangular-ovate to suborbicular (often narrowly triangular-ovate in Luzon), 3.5–13(–19) by 3–11(–17) cm, apex acute and usually abruptly acuminate, sometimes gradually narrowing or obtuse, base broadly rounded to truncate; margin sometimes revolute; reticulation rather lax, often obscure on upper surface, which is often minutely subpapillose (large convex epidermal cells), both surfaces glabrous; papyraceous to subcoriaceous. — *Male inflorescence* often borne on the older, leafless parts of the stem, but axillary on young shoots, 3–10(–15) cm long, composed of peduncled umbelliform cymes 1.5–9 cm long, racemously arranged, papillose-puberulous to glabrous. — *Male flowers* white, yellowish or orange with pedicels up to 3(–4) mm long; sepals 6, glabrous or subglabrous outside, outer 3 \pm narrowly oblong, 1.25–1.75 mm, apex obtusely pointed, inner 3 obovate; 1.25–1.5 mm, apex broadly rounded; petals 3, \pm broadly obtriangular, c. 0.75 mm long, apical margin membranous, lateral margins sometimes involute, papillose-puberulous inside towards base; synandrium 0.75–1 mm long. — *Female inflorescence* similar to male. *Infructescence* up to 20 cm or more. — *Female flowers* sessile, asymmetrical; sepals 3, \pm elliptic, 0.5 mm long; petals 1–2, broadly obtriangular, scarcely 0.5 mm long,

papillose or glabrous within; carpel \pm ellipsoidal, 0.75 by 0.5 mm. *Drupe*s red, sessile or subsessile (but ultimate branchlets of inflorescence sometimes look like pedicels), suborbicular to obovate in outline, 6–10 by 6–8 mm. Endocarp perforate, dorsally bearing 4 longitudinal rows of (10–)12–19 transversely hooked projections, the 2 inner rows directed inwards and those of the 2 outer rows directed outwards (rarely the hooks scarcely or not developed).

Distr. *Malesia*: Sumatra (incl. Simalur I.), Malaya (Maxwell's Hill, Perak), W. Java, Borneo, Philippines, S., Central & NE. Celebes.

Ecol. Occurring in thickets and forests up to 1800 m. *Fl. fr.* Jan.–Dec.

Uses. Stems used for tying in Sabah.

Vern. Java: *areuj geureung*, *geureng areni*; Sabah: *penaki*, *puruut*, Murut; Celebes: *karokas sela*.

Notes. In my revision (*l.c.* 1956: 62) I commented on the types of the synonyms, and discussed the variability.

DIELS (1910) distinguished between *S. corymbosa* (BL.) WALP., *S. cauliflora* BECC., *S. catosepala* DIELS and *S. merrillii* DIELS by using the following characters in his key: relative length of lamina and petiole, shape of sepals, leaf-texture, and thickness of synandrium-column. In the material I have examined, the distinctions made by DIELS are not reliable, nor do there seem to be any other characters which could be used to distinguish more than one species in this group.

The endocarp of *S. corymbosa* is characterized by the 4 dorsal longitudinal rows of transversely directed hooks, which are developed to various degrees of prominence in specimens from different localities. Only at the extreme eastern and western limits of the geographical range of the species are the hooks not, or only scarcely, developed, *i.e.* in Simalur I. and in Celebes.

6. *Stephania salomonum* DIELS in Rech., Bot. Zool. Ergebn. Samoa-Salomon 5 (1913) 110, f. 21.

Woody climber, entirely glabrous. *Leaves* with glabrous petioles (4–)7–10 cm inserted 2.5–6 cm from the basal margin; lamina triangular-orbicular to orbicular, apex rounded to very broadly obtuse, mucronate, 9–19 by 9–19 cm, reticulation lax, raised on both surfaces, glaucous below, margin slightly crenate-undulate, papyraceous. — *Male inflorescences* axillary or arising from leafless stems, slender, lax, c. 20–23 cm long, composed of a raceme of umbelliform cymes 4–9 cm long on peduncles 3–4 cm. — *Male flowers* on pedicels 1–2.5 mm; sepals 6, \pm equal, oblanceolate to obovate, 2 mm long, membranous; petals 3, broadly obdeltoid, 0.5–0.75 mm long, fleshy; synandrium 1 mm long. — *Female inflorescences* and *flowers* not seen (according to DIELS: long-pedunculate, 40–45 cm long).

Inflorescences 12(–?) cm long. *Drupe* red, on pedicels 2–4 mm, obovate, pointed at style-scar which projects below the base, 8–9 by 7 mm. Endocarp perforate with 2 dorsal median rows of c. 12 erect teeth with an equal number of short laterally directed projections on both sides, the whole dorsal surface papillose-rugulose.

Distr. Solomon Is. (Bougainville) and *Malesia*: New Guinea (East: Long I.; Admiralty Is.: Manus).

Ecol. Open disturbed area in forest and regrowth in deep gorge, up to 600 m. *Fl. may; fr.* Oct.

NOTE. KØIE & SAND.-OLSEN 1555 from Mussau I. has similar leaves and infructescences but the endocarps are different, suggesting a distinct species.

7. *Stephania moluccana* FORMAN, Kew Bull. 11 (1956) 68.

Woody climber c. 6–8 m high, entirely glabrous. *Leaves* with petioles 3–5 cm; lamina ovate or triangular-ovate, 6–13 by 4.5–8 cm, apex shortly obtuse or gradually narrowed to an obtuse tip, reticulation lax on both surfaces, papyraceous. — *Male inflorescences* on leafless woody stems, composed of umbelliform cymes 2–5 cm long with primary rays less than 1 cm and peduncle 1–4 cm arising from a slender axis 10–20 cm long. — *Male flowers* on filiform pedicels c. 2 mm; sepals 6, broadly oblanceolate or spatulate, 1.5–2 mm long; petals 3, obdeltoid, 0.75 mm long, fleshy; synandrium 1 mm long. — *Female flowers* unknown. *Infructescences* slender, c. 7–13 cm long. *Drupe* usually pedicellate up to 2 mm or sessile, orbicular-obovate in outline, 5 mm long. Endocarp imperforate with 4 dorsal series of 10–13 papiliform processes.

Distr. *Malesia*: Moluccas (Morotai, Ternate).

Ecol. In forests, in Morotai at 30 m, in Ternate at 1000 m.

NOTE. JACOBS 8682 (in fruit) from SE. New Guinea may belong to this species.

8. *Stephania montana* DIELS, Bot. Jahrb. 52 (1915) 189; FORMAN, Kew Bull. 11 (1956) 69. — ? *S. formanii* KUNDU & GUHA, Bot. Notis. 129 (1976) 259.

Slender climber. Stem glabrous. *Leaves* with glabrous petioles 3–6 cm; lamina triangular, narrowly triangular or subtriangular, (6–)9–14 by 5–9 cm; apex very acute, finely apiculate; base truncate to rounded, sometimes apiculate at the basal corners; reticulation lax, both surfaces glabrous, lower surface sometimes strigulose along the nerves; papyraceous. — *Male inflorescences* arising from leafless parts of the stem, very lax and slender, glabrous or papillose, composed of umbelliform cymes 4–14 cm long with primary rays mostly more than 1 cm, peduncles 3.5–8 cm, borne along a slender axis c. 40–50 cm. — *Male flowers* white or cream on pedicels up to c. 3 mm; sepals 6, obovate, 1.5 mm long, glabrous;

petals ?3, ± broadly obovate, 0.75 mm long, glabrous. — *Female flowers* unknown. *Infructescence* with peduncles of cymes 1–2 cm long. *Drupes* on pedicels 5–10 mm, rotund-obovate in outline, 5–6 by 4–5 mm. Endocarp ? perforate, dorsally bearing 4 longitudinal rows of 12–16 ± papilliform processes or short ridges.

Distr. *Malesia*: ?Philippines (Luzon), East New Guinea.

Ecol. Mossy forests at 1300–2070 m.

Notes. The material I have seen of this species is incomplete. The type specimen has only one leaf and a few flower buds. Fruits are known only from CARR 14221 (BM), and these are possibly immature. Nevertheless, the species appears to be distinct on account of its triangular leaves and long, slenderly branched and lax inflorescences. Only on the leaf of the type specimen are the basal corners of the lamina apiculate.

BS 23820 (in fruit) from Luzon may belong to this species, although the processes on the endocarp are transversely hooked.

Stephania formanii is represented by one collection with young male inflorescences. It probably belongs to this species.

9. *Stephania psilophylla* (PRESL) FORMAN, Kew Bull. 11 (1956) 63. — *Cissampelos psilophylla* PRESL, Reliq. Haenk. 2 (1835) 80; F.-VILL. Nov. App. (1880) 8. — *S. corymbosa* (non BL.) TURCZ. Bull. Soc. Nat. Hist. Mosc. 27, ii (1855) 281. — *S. hernandiifolia* [non (WILLD.) WALP.] VIDAL, Phan. Cuming. Philip. (1885) 93, *p.p.*, *excl.* CUMING 1533; Rev. Pl. Vasc. Filip. (1886) 45. — *S. japonica* [non (THUNB.) MIERS] MERR. En. Philip. 2 (1923) 149, *p.p.* — *S. catosepala* (non DIELS) MERR. En. Philip. 2 (1923) 149, *p.p.*

Slender climber. Stem herbaceous, up to 2 mm ø. *Leaves*: petioles 2–9 cm, glabrous or sometimes sparsely puberulous towards the top; lamina ovate to broadly ovate, 5–9 by 4–8 cm, usually acuminate towards the apex, base broadly rounded to very slightly cordate; very fine and regular, reticulation raised on both surfaces, glabrous, but lower surface sometimes puberulous around insertion of petiole; papyraceous. — *Male inflorescence* axillary (often slightly supra-axillary) consisting of very slender, compound umbelliform cymes 2.5–6 cm long, solitary or several along an axillary shoot, which is sometimes leafy; usually glabrous, sometimes puberulous; frequently with minute scales at the base. — *Male flowers* white, entirely glabrous with pedicels 1–2 mm, arranged in clusters; sepals (6 or) 8, elliptic to (broadly) oblanceolate, 1–1.5 mm, apex obtuse; petals (3 or) 4, broadly obovate to obdeltoïd, c. 0.5 mm long; *syndrium* about 0.5 mm long. — *Female inflorescence* similar to male but cymes usually solitary. — *Female*

flowers with very short pedicels, c. 0.5 mm, or sessile, entirely glabrous; sepals 3 or 4, ± elliptic about 0.75 by 0.25 mm; petals as in male; carpel ellipsoidal, 1 mm long. *Drupes* red with filiform pedicels 2–4 mm, obovate to broadly obovate in outline, 4–5 by 3.5–4 mm. Endocarp perforate, dorsally bearing 2 longitudinal rows of 7–9 transverse ridges which are sometimes transversely 2-lobed or divided, thus forming 4 longitudinal rows of papilliform processes: surface rugulose between ridges or processes.

Distr. *Malesia*: Philippines (Luzon).

Ecol. Primary forests and the edges of forests at 100–1300 m.

Note. This species has usually been confused with *S. japonica* (THUNB.) MIERS *var. japonica*, which also occurs in Luzon; but *S. psilophylla* can easily be distinguished from it by the pedicellate male flowers and fruits, and the very finely and regularly reticulate leaves.

10. *Stephania zippeliana* MIQ. Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 86, *p.p.*, *excl. folia*; SCHEFF. Ann. Jard. Bot. Btzg 1 (1876) 5; BECC. *Malesia* 1 (1877) 153; DIELS, Pfl. R. Heft 46 (1910) 266; Nova Guinea 8 (1912) 869; RIDL. Trans. Linn. Soc. II, 9 (1916) 16; DIELS, Nova Guinea 14 (1923) 80; KANEH. & HATUS. Bot. Mag. Tokyo 56 (1942) 474; FORMAN, Kew Bull. 11 (1956) 66; *ibid.* 22 (1968) 355. — *S. florulenta* BECC. *Malesia* 1 (1877) 153.

Large woody climber up to c. 20 m. Stem glabrous with supra-axillary tufts of triangular to subulate scales 1–3 mm long; main stems up to c. 1.5 cm ø, covered with flaky bark. *Leaves* with glabrous petioles (6–)10–19 cm; lamina broadly ovate to suborbicular (11–)16–22(–27) by (7–)10–17(–22) cm, apex very acutely acuminate or obtuse, base rounded, margin sometimes slightly repand; upper surface smooth and slightly shining, usually with a raised, very minute reticulation, sometimes ± minutely areolate; lower surface usually with minute, raised reticulation (often with minute epidermal ridges running along and between the nervules); papyraceous to coriaceous. — *Male inflorescences* very large (? up to c. 100 cm) arising from old, leafless stems, occasionally axillary, composed of compound umbelliform cymes 10–?30 cm long, with stout peduncles arranged racemously among and subumbellately at the end of a long axis, minutely puberulous to glabrous. — *Male flowers* white with pedicels 1–4 mm; sepals 6, ± oblong-elliptic, 1.25–2.5 mm long, glabrous; petals 3, usually ± broadly obovate, (0.25–) 0.75–1.5 mm long, glabrous; *syndrium* 0.5 mm long. — *Female inflorescence* similar to male but smaller. — *Female flowers*: sepals 3, petals 3, both similar to male; carpel c. 1 mm. *Drupe* on pedicel 2–6 mm, broadly obovate to suborbicular in outline, 7–10 by 6–8 mm. Endocarp perforate or im-

perforate, surface either rough all over, and dorsally bearing 4 longitudinal rows of 9–14 short papilliform processes (sometimes joined transversely) or surface smooth, and dorsally bearing \pm longitudinal rows of 9–10 T-shaped ridges.

Distr. Solomon Is. (San Cristobal, Guadalcanal), New Hebrides (Vanuata); in *Malesia*: New Guinea (incl. Misool) and Moluccas (Ceram, Tenimber Is.: Jamdena).

Ecol. In Ceram along the sea-shore, in New Guinea in forests up to 1500 m.

Note. The appearance of the lower leaf surface may vary from indistinct, fine reticulation to coarse reticulate venation but this seems to be due to age (METCALFE, Kew Bull. 11, 1956, 71).

11. *Stephania capitata* (BL.) SPRENG. Syst. Veg. 4 (1827) 316; MIQ. Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 86; SCHEFF. Nat. Tijd. N. I. 32 (1873) 401, t. 13; BECC. Malesia 1 (1877) 156; BOERL. Cat. Hort. Bog. 1 (1899) 42; DIELS, Pfl. R. Heft 46 (1910) 281; BACK. Schoolfl. Java (1911) 46; KOORD. Exk. Fl. Java 2 (1912) 336; MERR. En. Born. (1921) 250; RIDL. Fl. Mal. Pen. 1 (1922) 113; NORMAN, J. Bot. 62 (1924) Suppl. 5; BURK. & HEND. Gard. Bull. S. S. 3 (1925) 344; HEYNE, Nutt. Pl. 1 (1927) 617; HEND. Gard. Bull. S. S. 4 (1928) 220; MASAM. En. Phan. Born. (1942) 276; YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 141; FORMAN, Kew Bull. 11 (1956) 46; STEEN. Mt. Fl. Java (1972) pl. 33-1. — *Clypea capitata* BL. Bijdr. (1825) 28. — *Clypea acuminatissima* BL. l.c.; MIERS, Contr. Bot. 3 (1871) 206. — *S. acuminatissima* (BL.) SPRENG. Syst. 4 (1827) Cur. Post. 316 ('*acuminata*'); WALP. Rep. 1 (1842) 96. — *S. obvia* MIERS [Ann. Mag. Nat. Hist. ser. 3, 18 (1866) 15, *nomen*], Contr. Bot. 3 (1871) 226. — *S. longifolia* BECC. Malesia 1 (1877) 156. — *S. truncata* YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 142. — Fig. 20.

Slender woody climber up to c. 15 m, entirely glabrous. Roots tuberous, fusiform. *Leaves*: petioles (2–)3–5(–10) cm long; lamina lanceolate to broadly ovate, 6–17 by 2.5–10.5(–14) cm, apex usually attenuately acute or caudate, base broadly rounded to slightly cordate; reticulation usually rather lax and not prominent, \pm equally visible on both surfaces; papyraceous. — *Male inflorescences* usually axillary (sometimes borne on leafless parts of the stem) composed of several, peduncled, disciform capitula arising in the axils of persistent, triangular to linear bracts 1–2 mm along an axis usually less than 1 cm long, occasionally to 14 cm on old stems; capitula 3–6(–8) mm in ϕ on filiform peduncles up to 20 (–35) mm long. — *Male flowers* sessile, yellow to green, very densely crowded on a disciform receptacle; sepals 2–3, \pm oblong-elliptic, 0.5–0.75 mm long; petals 2–3, \pm obovate, 0.25 mm long; synandrium 1 mm long, exserted. — *Female inflorescence*

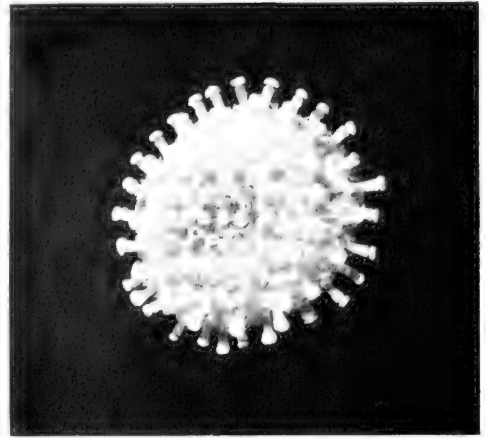


Fig. 20. *Stephania capitata* (BL.) SPRENG. Male inflorescences, side view, $\times 1 \frac{1}{3}$; top view of capitulum above, $\times 4$. Trang, Thailand (Photogr. H. BÄNZIGER).

as in male, but axis and peduncles thicker, especially at fruiting, also peduncles longer, up to 55 mm. — *Female flowers* with very short pedicels, about 1 mm,

sometimes partly united; sepals and petals as in male; carpel \pm ovoid or ellipsoidal. c. 1 mm long. *Drupe* red, with slender pedicels 5–10 mm, obovate (to sub-orbicular) in outline, sometimes attenuated towards the base (6–)8–11 by (5–)6–8 mm. Endocarp perforate, dorsally bearing 4 longitudinal rows of 10–14 capitate projections divaricately lobed at their apices (rarely the projections scarcely developed).

Distr. Thailand (Peninsular); in *Malesia*: Sumatra, Malaya, Java, Lesser Sunda Is. (Bali), N. & W. Borneo.

Ecol. Scattered on plains and mountains and in rain-forest from sea-level to 2000 m.

Uses. A substitute for *Cyclea barbata* (WALL.) MIERS in the preparation of 'tjintjau', a native preparation used for abdominal diseases and fevers (? leaves used).

Vern. Java: *akar talur, areuj geureung, areuj tjamtjau minjak, daun tjamtjau, gorong, sumpat kendi, tjamtjau, tjintaun*.

Notes. The axis of the inflorescence is usually less than 1 cm long, but on LÖRZING 5509 from Sumatra the axes are up to 14 cm and arise from an old leafless stem.

12. *Stephania dictyoneura* DIELS, Pfl. R. Heft 46 (1910) 281; YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 141; FORMAN, Kew Bull. 11 (1956) 48.

Slender woody climber, entirely glabrous. *Leaves*: petioles 2.5–4 cm, inserted 3–7 mm from the basal margin; lamina broadly triangular-ovate, 5–6.5 cm long and broad, apex shortly acuminate, acumen obtusely mucronulate, base truncate or slightly cordate; reticulation close and raised, especially beneath; stiffly papyraceous. — *Male inflorescences* and

flowers unknown. — *Female inflorescence* borne on older, leafless stem, composed of several, peduncled, disciform capitula, arising in the axils of subulate bracts 1–2 mm long, along an axis about 5 cm long; capitula c. 7 mm ϕ on peduncles c. 5 cm. — *Female flowers* very densely crowded on a disciform receptacle; sepals and petals \pm obovate, c. 0.5–0.75 mm long; carpel ellipsoidal c. 0.75 mm. *Fruits* unknown.

Distr. *Malesia*: Central W. Sumatra (Mt Singalang), only known from the type (BECCARI PS 8).

Ecol. Montane forest, 1600 m. *Fl.* June–July (female).

Notes. The specimens at Kew and Leiden are sterile but on one sheet of BECCARI PS 8 at Florence (FI) there is an incomplete female inflorescence which bears a single capitulum. This inflorescence arises from a leafless, slightly woody stem 3–4 mm ϕ .

This species is closely related to *S. capitata* (BL.) SPRENG, which also has inflorescences composed of dense capitula. *Stephania dictyoneura* DIELS is easily distinguished from *S. capitata* by its more broadly shaped leaves, which show a prominent and close reticulation, and by the insertion of the petiole which is 3–7 mm from the base of the lamina.

Doubtful

Stephania neoguineensis KUNDU & GUHA, Bot. Notis. 129 (1976) 257.

Only known from one collection from East New Guinea, E. Highlands Distr. (BRASS 32246). The single large detached male inflorescence and the male flowers agree with *S. montana* DIELS, but not the broadly triangular-ovate leaves.

Excluded

Aspidocarya kelidophylla LAUT. & K. SCH. Fl. Deut. Schutzgeb. Südsee (1901) 313, according to DIELS, Pfl. R. Heft 46 (1910) 320 = *Cardiopteris moluccana* BL. (*Cardiopteridaceae*).

Cocculus flavicans WALL. Cat. n. 4976 (1831/32), *nomen*, from Penang I. is, according to BURKILL, Gard. Bull. S. S. 4 (1929) 426 = *Anisophyllaea gaudichaudiana* BAILL. (*Rhizophoraceae*).

Heckelia nymanii K. SCH. in K. Sch. & Laut., Nachtr. Fl. Deut. Schutzgeb. Südsee (1905) 26 is, according to DIELS, Pfl. R. Heft 46 (1910) 320 = *Rhipogonum album* R. BR. (*Liliaceae*).

Jussiaea borneensis MERR. J. Str. Br. R. As. Soc. n. 85 (1922) 170 is, according to HARMS, Notizbl. Berl.-Dahl. 80 (1924) 717 = *Zanonia indica* L. (*Cucurbitaceae*).

Peripetasma polyanthum RIDL. J. Bot. 58 (1920) 147; Fl. Mal. Pen. 1 (1922) 103 is, according to PRAIN & BURKILL, Kew Bull. (1925) 66 = *Dioscorea stenomeriflora* PRAIN & BURK. (*Dioscoreaceae*).

Tinospora curtisi RIDL. J. Bot. 58 (1920) 148 is, according to FORMAN, Kew Bull. 36 (1981) 420 = *Zanonia indica* L. (*Cucurbitaceae*).



MONIMIACEAE (W.R. Philipson, Christchurch)

Evergreen shrubs or trees, rarely lianes. *Leaves* decussate, or rarely in whorls of three, exstipulate, simple, entire or dentate, with spherical oil cells in the lamina, bearing simple or stellate hairs or glabrous. *Inflorescence* terminal or axillary (when in axils of reduced bracts appearing supra-axillary), sometimes cauliflorous, cymose, paniculate, fasciculate or pleiochasial. *Flowers* unisexual or bisexual, actinomorphic or very rarely (*extra-Mal.*) oblique, receptacle usually well developed (perigynous), rarely reduced (hypogynous), \pm globose or urceolate to widely campanulate; tepals usually inconspicuous, sometimes larger and petaloid, rarely distinct sepals and petals (*extra-Mal.*), decussate, radial or spiral. — *Male flowers* with few to many stamens arranged in whorls or sometimes spirally or disposed irregularly; filaments usually strap-shaped, short, occasionally with 2 basal lobes; anthers 2–4 sporangiate, the loculi sometimes confluent above (or rarely below) opening by slits or valves. — *Female flowers* with or without staminodes; carpels few to many (rarely *extra-Mal.*, only one), sessile or stipitate, free or immersed in the receptacle, outer carpels of female flowers sometimes sterile; ovule solitary, erect or pendulous, crassinucellar, bitegmic or (*extra-Mal.*) unitegmic. *Fruits* of separate drupes or achenes, sometimes plumose, frequently enclosed in the persistent receptacle or exposed by various modes of splitting of the receptacle; endosperm copious, oily; embryo straight, cotyledons appressed or divergent, sometimes with serrate margins.

Distribution. About 33 genera with an estimated 320 species, mainly in the warmer parts of the southern hemisphere. There is a concentration of genera in Malesia (11 genera with 86 *spp.*) with extensions south and east into Australia and the SW. Pacific; further concentrations occur in the islands of the western Indian Ocean and in South America. The family is represented in Africa only by two small aberrant genera and occurs on the Eurasian mainland only in the Malay Peninsula, the Nicobar Islands and Peninsular Thailand.

The Malesian genera are either endemic or nearly so, with one or few species extending to the Solomon Islands (*Steghanthera*) or eastern Australia (*Levieria*, *Palmeria*, *Steghanthera*, *Kibara* and *Dryadodaphne*). *Wilkiea* has more species in Australia than in Malesia. Only *Kibara* extends slightly westwards into the Nicobar Islands and Thailand. The concentration of genera in New Guinea is striking: only *Matthaea* lies exclusively to the west of New Guinea, the family being represented in western Malesia, otherwise by one species each of *Steghanthera*, *Levieria* and *Palmeria*, and by four or five species of *Kibara*.

The Malesian genera fall within several subfamilies and each of these has a distinctive geographical relationship. *Levieria* is a member of the tribe *Hedycaryeae* with relationships in SW. Polynesia; *Dryadodaphne* falls within the subfamily *Atherospermatoidae*, a subfamily that is predominantly Australian; while *Palmeria* is most closely related to *Monimia* of the Mascarene Islands. The remaining genera (*Steghanthera*, *Matthaea*, *Kairoa*, *Faika*, *Parakibara*, *Wilkiea* and *Kibara*) form a closely knit group within the tribe *Mollinedieae* which is characteristic of the Malesian region.

Trimenia (*Piptocalyx*) is referred to the separate family *Trimeniaceae*.

The ratio of species to genera, in Malesia, is c. 8 : 1, but if the largest genus, *Kibara*, is omitted this reduces to c. 4.3 : 1. Five genera are represented by a single species. Fig. 1 & 2.

Fossils. MULLER (1981) pointed out that *Inaperturopollenites crispolensis* (DOYLE *et al.*, 1977) from the Lower Cretaceous is similar to that of *Hedycarya* pollen and that pollen of *Stellatopollis*

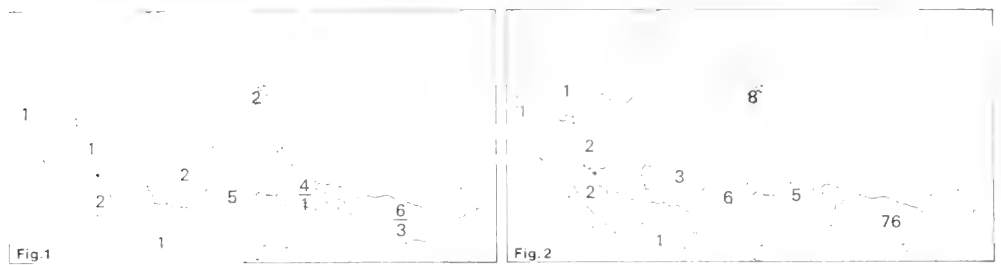


Fig. 1. Number of genera of *Monimiaceae* in Malesian islands; figures below the hyphen indicate endemic genera. — Fig. 2. Number of species of *Monimiaceae* in the Malesian islands.

barghoornii (DOYLE *et al.*, 1975) from the Middle Albian is comparable with that of *Daphnandra* and *Nemuaron* (from New Caledonia).

SCHODDE (1969) has little doubt that the two fossilized woods: *Atherospermoxyton* (KRÄUSEL, 1939) and *Protoatherospermoxyton* (MÄDEL, 1962) are correctly assigned to this family. He rejected as doubtful all leaf records from the northern hemisphere, but accepts as probable fossil leaves from Eocene-Oligocene and Early Miocene deposits in Argentina (*Laurelia armarillana*, BERRY, 1928, and *Laurelia guinazui*, BERRY, 1935) and from the Eocene-Oligocene of Seymour Island (*Laurelia insularis*, DUSÉN, 1908). Pollen grains of *Laurelia* are recorded in New Zealand from Middle Oligocene to the present (COUPER, 1960).

References: BERRY, Proc. U.S. Nat. Mus. 73 (1928) 21; Bot. Gaz. 96 (1935) 752; COUPER, Palaeont. Bull. 32, Geol. Surv. New Zeal. (1960) 1–87; DOYLE *et al.*, Pollen et Spores 17 (1975) 429–486; Bull. Centre Rech. Explor. Prod. Elf. Aquitaine 1 (1977) 451–473; DUSÉN, Wiss. Ergeb. Schwed. Sudpolar-exped. 3 (1908); KRÄUSEL, Abh. Bayer. Akad. Wiss. math.-naturw. Abt. NF 47 (1939) f. 3; MÄDEL in Muller-Stoll & Mädel, Trans. Geol. Soc. S. Afr. 65 (1962) 99; MULLER, Bot. Rev. 47 (1981) 9; SCHODDE, A monograph of the Atherospermataceae R. Br., Thesis, Univ. Adelaide (1969).

Ecology. Malesian *Monimiaceae* form an inconspicuous but remarkably consistent element of the understorey of rain-forests in New Guinea and to a much lesser degree of the rest of Malesia. They are most frequently straggling shrubs or treelets, occasionally reaching the stature of moderate trees, and more rarely are low to moderately high-climbing (c. 22 m) woody lianes. They occur in forests from sea-level to the limit of trees, their greatest frequency being in lower montane forest. They occur, though rarely, in coastal scrub on sandy soil or coral (e.g. *Kibara rigidifolia*) and in the zone of scrub above tree-line (e.g. *Kibara oligocarpella*).

Flower biology. The majority of the Malesian genera are either monoecious or dioecious, the only genus with bisexual flowers in Malesia being *Dryadodaphne*. Little is known of the floral biology of this family. SAMPSON (1969a) found that *Hedycarya arborea* is wind-pollinated. The greenish flowers lack nectar and no insects were observed to visit them. In *Laurelia novae-zelandiae* the paired lobes on the filaments secrete nectar which accumulates on the floor of the flower (SAMPSON, 1969b). Large numbers of bees and blowflies were observed visiting the flowers. The nectar consists mainly of sucrose with possibly traces of raffinose. GOTTSBERGER (1977) reported pollination of the neotropical genus *Mollinedia* by *Thysanoptera*. The female insects bore holes in male and female flowerbuds and deposit their eggs in the receptacles. The larvae develop in the buds, becoming adult as the flowers open. They emerge and transfer pollen to other flowers. Similar infestations of flowerbuds have been observed in the Malesian genera *Levieria* and *Kairoa* in which the male flowers open, as in *Mollinedia*, though no observations on pollination have been made in these genera. ENDRESS (1980) recorded similar insect infestation in species of *Wilkiea* and *Steganthera*, in which the male flowers have a restricted opening. The flowers of *Steganthera* are frequently so deformed by gall insects that their function appears to be impaired (personal observation on *S. ilicifolia* and other species).

The reception and germination of pollen on a non-carpellary hyperstigma, long suspected in *Hennecartia* (PERKINS & GILG, 1901) has been confirmed and extended to three other genera, *Tambourissa*, *Wilkiea* and *Kibara* (ENDRESS, 1979, 1980). A zone in the narrow entrance to the female receptacle secretes a mucilage which acts as a transmitting medium for the pollen tubes and is continuous from the outer surface of the receptacle to the carpels. As the mucilage connects all the stigmas in a receptacle it acts as an extragynoecial compitum.

The intensive field observations in the Malagasy region by LORENCE have considerably increased information on the floral biology of the family (LORENCE, 1980; ENDRESS & LORENCE, 1983). Seven species of *Tambourissa* were studied. Odour and possibly colour attract insects which were rewarded in male flowers with pollen and in female flowers with a sugary secretion or in some species by deceit. Some species are mainly dependent on flies and have short styles, whereas others with longer styles are visited mainly by beetles. Different flowering times contribute to reproductive isolation and hybridization was found to be extremely rare. LORENCE (1980, 1985) considered that *Monimia ovalifolia*, with a sweet odour, yellow to pink or orange receptacles, shallow open white male flowers and fully exposed stamens and styles, appears well adapted to the small syrphid flies that visit it.

Dispersal. The fruit-clusters of most Malesian genera consist of few to many drupes, usually black and shining when ripe, sessile or stipitate on receptacles, which are usually enlarged, fleshy and bright yellow and orange. In *Palmeria* the drupes are exposed when mature by the splitting of the receptacle. They are black or dark reddish brown and are borne on the inner side of the receptacle which is bright red or pink. All these structures are clearly suitable for dispersal by birds or animals, but no records of field observations of this in Malesia are known to me. LORENCE (1980, 1985) records dispersal by birds in Malagasy species of *Monimia* and *Tambourissa* which bear fruits of somewhat similar appearance to those of the Malesian genera. In *Dryadodaphne* fruit structure and means of dispersal are very different, though again this has only been inferred from their structure. The developing achenes are enclosed by the enlarged and indurated receptacle and this splits at maturity to release the ripe achenes. These are dry and spindle-shaped with a persistent aculeate style which becomes markedly plumose. The structure appears well adapted to wind dispersal.

Myrmecophily. The association of ants with the swollen nodes of *Stegantthera hospitans* was noted by BECCARI (1877). BECCARI concluded that the entry holes were excavated in the distended nodes by the ants (*Hypoclinea scrutator*). He also observed the presence of small homopterids (*Myzolecanium*) inside the hollow nodes. Only adult female scale insects were seen, and since these were too large to pass the entry holes, BECCARI speculated on the possible life cycles of the coccid and on their relationship to the ecology of the ants. Similar associations occur on other species of *Stegantthera* (*S. royenii*, *S. moszkowskii* and *S. ledermannii*) and also on species of *Kibara* (*K. ferox*, *K. latifolia*, *K. archboldiana* and *K. carrii*). Only *K. latifolia* of the Moluccas occurs outside New Guinea.

BECCARI referred to analogous ant associations in the stems of *Verbenaceae: Clerodendron*; *Euphorbiaceae: Pimelodendron*; *Myristicaceae: Myristica* and the rhizomes of the fern *Polypodium sinuosum* WALL. and of species of the Rubiaceae epiphytes *Myrmecodia* and *Hydnophytum* as well as some Melastomaceae epiphytes. In addition VAN STEENIS reported spindle-shaped twigs inhabited by ants in several other genera, e.g. in *Meliaceae: Aphanamixis*, *Chisocheton*; *Elaeocarpaceae: Elaeocarpus*; *Euphorbiaceae: Drypetes*, *Glochidion*, *Homalanthus*; *Leguminosae: Archidendron*; *Rubiaceae: Myrmeconuclea*, *Nauclea*; *Sapinduceae: Harpullia*, and *Symplocaceae: Symplocos*, and FORMAN added to these (*in litt.*) *Myristicaceae: Myristica subahulata* and *Proteaceae: Helicia macrostachya*. They occur mostly in a single species of these genera, but sometimes in several, e.g. in *Nauclea*.

References: BECCARI, Malesia 1 (1877) 186–193; ENDRESS, *Experientia* 35 (1979) 45; *Pl. Syst. Evol.* 134 (1980) 79–120; ENDRESS & LORENCE, *Pl. Syst. Evol.* 143 (1983) 53–81; GOTTSBERGER, *Pl. Syst. Evol. Suppl.* 1 (1977) 211–226; LORENCE, A systematic and eco-evolutionary study of

the *Monimiaceae* in the Malagasy region, Thesis, Washington Univ., St. Louis (1980); Ann. Mo. Bot. Gard. 72 (1985) 1–165; PERKINS & GILG, Pfl. R. Heft 4 (1901) 1–122; SAMPSON, (a) Austr. J. Bot. 7 (1969) 403–424; (b) New Zeal. J. Bot. 7 (1969) 214–240.

Morphology. Little is known in detail of the shoot morphology of the trees, shrubs and lianes of this family. In *Laurelia* the bole bears buttresses and the roots develop knee-pneumatophores. The bark is generally \pm smooth with only small fissures and flakes, an exception being *Kairoa* with prominent corky ridges on the main stems. Throughout the family phyllotaxis is decussate or rather rarely with the leaves in whorls of three (e.g. *Kibara rigidifolia*). Marked anisophylly occurs in *Glossocalyx*. The stems are terete or \pm quadrangular, except near the nodes which are somewhat flattened and dilated. The buds, both vegetative and reproductive, are usually enclosed in small scales and there may be more than one in an axil arranged either horizontally or vertically (LORENCE, 1980, 1985), the central bud usually developing first. In spite of the variety of leaf size, form, margin and indumentum, there is a family character which facilitates recognition in the field. This is due, principally, to the venation, which almost invariably is festooned brachidodromous with the secondary veins arising from the midrib at regular intervals and at uniform angles. An exception noted by LORENCE (1980, 1985) is *Ephippiandra*. Leaves are usually petiolate but may be amplexicaul (e.g. *Kibara ferox*). Leaf shape may vary with age. The juvenile leaves of *Steganthera hospitans* are much narrower than those of adult trees and juvenile specimens of *Kibara ferox* bear narrower and more dentate leaves than do adults. In *Kibara ferox*, however, the narrow ultimate branches of adult plants bear much narrower leaves than those of the basal parts of the shrub. Heterophylly also occurs in many *Tambourissa* species and in *Hortonia*.

Inflorescences usually occur in the axils of foliage leaves. When several are grouped among the terminal leaves of a shoot, apparently terminal leafy inflorescences are formed, and with the reduction of the leaves these may result in large panicles. It is doubtful, however, if the true terminal bud is involved in these inflorescences, the terminal (vegetative) bud aborting. Inflorescences often occur on basal parts of stems where the nodes bear much reduced scales. The upper parts of these stems continue as indeterminate foliage shoots. The presence of multiple buds at nodes which develop in succession allows inflorescences to persist on branches which have lost their foliage and to become strikingly cauliflorous. The branching of the inflorescences is cymose, the most simple element being a dichasium. However, several flowers or branches frequently arise from a single node, or alternatively, several pairs of flowers occur along a simple axis (pleiochasium — often referred to as racemose). As a result of combinations of these factors individual inflorescences range from solitary flowers, through fascicles of flowers or branches to rather simple cymes and more diffuse and complex paniculate cymes.

References: LORENCE, A systematic and eco-evolutionary study of the *Monimiaceae* in the Malagasy region, Thesis, Washington Univ., St. Louis (1980); Ann. Mo. Bot. Gard. 72 (1985) 1–165.

Anatomy. General accounts of the vegetative anatomy are given by MONEY, BAILEY & SWAMY (1950) and METCALFE & CHALK (1950). Of particular interest are 1) the universal presence of oil cells (HOBEIN, 1889; PERKINS, 1898), 2) the unilacunar node, with simple strands or arcs of strands entering the petiole, 3) the presence of hippocrepiform sclereids in the pericycle (but not in *Siparunoideae*) (MONEY, BAILEY & SWAMY, 1950). Hairs may be simple unicellular, often in fascicles from a common base, or stellate grading into peltate scales. Two-armed hairs have been reported for some genera, including *Matthaea*.

Phloem plastids. Most members of the *Monimiaceae* have been found to contain P-type plastids. Very consistently, the *Atherospermatoideae* have large protein crystals, protein filaments and starch (BEHNKE, 1981). Except for the genera *Monimia*, *Palmeria* and *Tambourissa*, the other subfamilies have been found to contain \pm small protein crystals besides the dominant starch grains.

References: BEHNKE, Nordic J. Bot. 1 (1981) 381–400; HOBEIN, Bot. Jahrb. 10 (1889) 51–74; METCALFE & CHALK, Anatomy of the Dicotyledons, Clarendon Press, Oxford (1950); MONEY,

BAILEY & SWAMY, J. *Arn. Arb.* 31 (1950) 372–404; PERKINS, *Bot. Jahrb.* 25 (1898) 547–577.

Wood anatomy. The characteristics of the secondary xylem have been described by the authors listed below. A particularly full assessment is given by FOREMAN (1983). Certain features have been found to characterize the subfamilies, for example the multiseriate rays of *Atherospermatoideae* and *Siparunoideae* are narrower than those of the *Monimioideae*, and simple perforation plates occur in *Monimia* and *Palmeria*. *Peumus* has the most distinctive xylem with spiral thickening in the vessels and simple perforation plates. The xylem of *Hortonia* has more primitive features than other genera.

References: BUTTERFIELD & MEYLAN, *Austr. J. Bot.* 20 (1972) 253–259; The structure of New Zealand woods, Wellington (1973); DADSWELL & RECORD, *Trop. Woods* 48 (1936) 1–30; FOREMAN, The morphology and phylogeny of the *Monimiaceae (sensu lato)* in Australia, Thesis, Univ. of New England, Armidale (1983); GARRATT, *Trop. Woods* 39 (1934) 18–44; HOBEIN, *Bot. Jahrb.* 10 (1889) 51–74; KUČERA & PHILIPSON, *New Zeal. J. Bot.* 15 (1977) 649–654; LEMESLE & PICHARD, *Rev. Gen. Bot.* 61 (1954) 69–95; LORENCE, A systematic and eco-evolutionary study of the *Monimiaceae* in the Malagasy region, Thesis, Washington Univ., St. Louis (1980); *Ann. Mo. Bot. Gard.* 72 (1985) 1–165; MATOS ARAUJO & FILHO, *Brazil Florestal* 4 (1973) 35–39, 41–45; *ibid.* 5 (1974) 57–60; Rodriguesia 27 (1974) 153–162; *Arq. Jard. Bot. Rio de Janeiro* 20 (1977) 15–20; METCALFE & CHALK, *Anatomy of the Dicotyledons*, Clarendon Press, Oxford (1950); DEN OUTER & VAN VEENENDAAL, *Acta Bot. Neerl.* 31 (1982) 265–274; PATEL, *New Zeal. J. Bot.* 11 (1973) 587–598; SCHODDE, A monograph of the family *Atherospermataceae* R. Br., Thesis, Univ. of Adelaide (1969); *Taxon* 19 (1970) 324–328; SOLEREDER, *Systematic anatomy of the Dicotyledons* (transl. Boodle & Fritsch), Clarendon Press, Oxford (1908); WELCH, *J. Proc. R. Soc. N.S.W.* 62 (1929) 350–365.

Floral anatomy. Development and vascularization are discussed by MONEY, BAILEY & SWAMY (1950), SAMPSON (1969a, b, c) and ENDRESS (1972, 1980). The little then known of embryology in the family was reviewed by DAVIS (1966) and BHANDARI (1971). Since then SAMPSON (1969a, c) and ENDRESS (1972, 1980) have added much information. The ovule is bitegmic and crassinucellate (unitegmic in *Siparuna*), pendulous with an upwardly directed micropyle or lateral to basal with a downwardly directed micropyle. The structure of the fruit and seed is described by ENDRESS (1972), CORNER (1976) and LORENCE (1980, 1985). The fruits are either an achene, often plumose, or they have a fleshy or leathery pericarp. The latter fruits are usually referred to as drupes because the endocarp consists of sclerotic cells. In some genera (e.g. *Palmeria*) the endocarp forms a substantial stony layer, in *Levieria* it is thinner but still strongly sclerotic, while in others, notably *Kibara*, the endocarp consists of a single papery layer. As these differences are of degree and intermediate states occur, the same term (drupe) is used throughout, even though the fruit of species with a thin endocarp might technically be better referred to as berries. In *Kibara* the mesocarp of the species examined consists of uniform soft-walled tissue, whereas in *Steganthera* all species examined had numerous nests of sclereids adjacent to the endocarp (possibly to be considered as part of the endocarp) with many oil cells in the outer mesocarp. The cotyledons are divergent in the *Monimieae* but in the *Mollinedieae* and *Atherospermatoideae* they are closely appressed. In *Hedycaryeae* both conditions occur: *Hedycarya* appressed, *Levieria* divergent. The endosperm is fleshy in most genera, but in *Kairoa* it is horny and in *Levieria* the central part of the endosperm is milky. Rarely (*extra-Mal.*) a 'stylar aril' overlies the upper part of the exocarp.

The form of stamens is variable in respect of the presence or absence of a pair of glands on the filaments; the number (2 or 4) of sporangia and the dehiscence by slits or valves. Stamen and anther development is described by ENDRESS (1980), FOREMAN (1983) and SAMPSON (1969b) and the morphology of the glands discussed by MONEY, BAILEY & SWAMY (1950), SAMPSON (1969c) and ENDRESS (1980). The different types of cytokinesis in *Monimioideae* and *Atherospermatoideae*, first described by SAMPSON (1969c), is extended by FOREMAN (1983) who discusses many aspects of androecial development.

References: BHANDARI, *J. Arn. Arb.* 52 (1971) 1–39, 285–304; CORNER, *The seeds of Dicotyle-*

dons 1 (1976) 194–197; DAVIS, Systematic embryology of the Angiosperms, New York (1966) 178–179; ENDRESS, Bot. Jahrb. 92 (1972) 331–428; Pl. Syst. Evol. 133 (1980) 79–120, 199–221; FOREMAN, The morphology and phylogeny of the *Monimiaceae* (*sensu lato*) in Australia, Thesis, Univ. of New England, Armidale (1983); LORENCE, A systematic and eco-evolutionary study of the *Monimiaceae* in the Malagasy region, Thesis, Washington Univ., St. Louis (1980); Ann. Mo. Bot. Gard. 72 (1985) 1–165; MONEY, BAILEY & SWAMY, J. Arn. Arb. 31 (1950) 372–403; SAMPSON, (a) Austr. J. Bot. 17 (1969) 403–424; (b) *l.c.* 425–439; (c) New Zeal. J. Bot. 7 (1969) 214–240.

Palynology. Reviews of the morphology of pollen grains in the family are given by MONEY, BAILEY & SWAMY (1950), ERDTMAN (1966), JÉRÉMIE *et al.* (1984), WALKER & DOYLE (1975), and WALKER (1976a, b). Studies on the family include: on *Hedycarya* SAMPSON (1969a, 1977, 1982), on *Laurelia* SAMPSON (1969b, 1975), on *Peumus* BARTH (1962), HEUSSER (1971), on *Monimia* and other Malagasy genera LORENCE (1980) and LORENCE, ZENGER & VINAY (1984). Inaperturate grains are typical of the family but the *Atherospermatoideae* have disulcate grains. Spinose grains occur in *Peumus*, *Monimia* and *Palmeria*. The grains remain in tetrads in some species of *Hedycarya* and *Kibaroopsis*.

References: BARTH, Mem. Inst. Oswaldo Cruz, Rio de Janeiro, 60 (1962) 405–420; ERDTMAN, An introduction to palynology, 1, Pollen morphology and plant taxonomy, New York (1966); HEUSSER, Pollen and spores of Chile, Univ. Arizona Press, Tucson (1971); JÉRÉMIE *et al.*, Pollen et Spores 26 (1984) 161–180; LORENCE, A systematic and eco-evolutionary study of the *Monimiaceae* in the Malagasy region, Thesis, Washington Univ., St. Louis (1980); LORENCE, ZENGER & VINAY, Grana 23 (1984) 11–22; MONEY, BAILEY & SWAMY, J. Arn. Arb. 31 (1950) 374–404; SAMPSON, (a) Austr. J. Bot. 17 (1969) 403–424; (b) *l.c.* 425–439; Grana 15 (1975) 153–157; *ibid.* 16 (1977) 61–73; *ibid.* 21 (1982) 9–14; WALKER (a) in Beck (ed.), Origin and early evolution of the Angiosperms, Columbia Univ. Press, New York (1976) 241–299; (b) in Ferguson & Muller (eds.), The evolutionary significance of the exine, Acad. Press, London (1976) 251–308; WALKER & DOYLE, Ann. Mo. Bot. Gard. 62 (1975) 664–723.

Chromosomes. The only count known to me based on Malesian specimens is that for *Kibara* (BORGMAN, 1964). Counts of Australian species of *Steganthera* and *Palmeria*, together with a few non-Malesian genera, will be found in the references below. From these counts it is considered that the basic number for the *Monimioideae* ($n = 19$) differs from that for the *Atherospermatoideae* ($n = 22$).

References: BORGMAN, Z. Bot. 52 (1964) 118–172; EHRENDORFER in Beck (ed.), Origin and early evolution of the Angiosperms, Columbia Univ. Press, New York (1976) 220–240; EHRENDORFER *et al.*, Taxon 17 (1968) 337–353; GADELLA *et al.*, Acta Bot. Neerl. 18 (1968) 74–83; GOLDBLATT, J. Arn. Arb. 55 (1974) 453–457; HAIR & BEUZENBERG, New Zeal. J. Sci. 2 (1959) 148–156; LORENCE, A systematic and eco-evolutionary study of the *Monimiaceae* in the Malagasy region, Thesis, Washington Univ., St. Louis (1980); Ann. Mo. Bot. Gard. 72 (1985) 1–165; MORAWETZ, Pl. Syst. Evol. 138 (1981) 157–172.

Phytochemistry. Chemical characters were summarized sixteen years ago (HEGNAUER, 1969). The benzyltetrahydroisoquinoline family of alkaloids (abbreviated: benzyloisoquinolines) and essential oils consisting mainly of phenylpropanoids and mono- and sesquiterpenoids were considered to be characteristic secondary metabolites of the family, but the lack of chemical knowledge for *Hortonioidae*, *Monimioideae* (except *Peumus boldus*) and *Siparunoideae* was stressed. Many members of the family are aluminium accumulators; this character, however, seems to be lacking in *Atherospermatoideae*. Phenolics were scarcely known, but predominance of the flavonols kaempferol, quercetin and isorhamnetin in leaves, and absence of flavones, flavonols with trihydroxylated B-ring and of galli- and ellagitannins had been reported. As a whole phytochemistry of *Monimiaceae* agreed perfectly with their inclusion in a group loosely termed woody polycarps. In the meantime more became known about the chemistry and distribution of benzyloisoquinolines (URZUA & CASSELS, 1978; HEGNAUER, in prep.) and polyphenolic com-

pounds, especially lignans (including neolignans) (HEGNAUER, in prep.). *Siparuna gilgiana* and *S. guyanensis* synthesize liriiodenine and related oxoaporphine alkaloids, and laurotetanine, N-methylaurotetanine and leurotisine were detected in three *Palmeria* species of New Guinea. The isolated position of *Daphnandra* with respect to alkaloid metabolism was stressed (URZUA & CASSELS, 1978); only bisbenzyltetrahydroisoquinoline alkaloids, including a number of compounds apparently restricted to the genus, have been isolated hitherto from six species. *Daphnandra aromatica* was transferred by SCHODDE to *Doryphota*; *Doryphora aromatica* yielded the aporphine isocorydine besides bisbenzylisoquinolines. *Dryadodaphne novoguineense* which is confined to New Guinea, synthesizes aporphines, oxoaporphines and the bisbenzylisoquinolines dryadine and dryadodaphnine. 4-Hydroxyaporphines, alkaloids with a very unusual substitution pattern were encountered in *Laureliopsis philippiana* (= *Laurelia philippiana*). It deserves mentioning that lignans which were known from *Trimeniaceae* only (*Piptocalyx*, *Trimenia*, HEGNAUER, 1969) have been detected in leaves of *Laurelia novae-zelandiae*; they yielded pinosresinoldimethyl-ether and yangambin. Lignans and many different types of neolignans are widespread in *Polycarpiceae*; they begin to form an outstanding chemical character of the order as a whole. Summarizing, old and new chemical evidence conforms with the classification of *Monimiaceae* with woody polycarps without contributing much to the question whether the family is nearer to *Magnoliaceae* and *Annonaceae* or to *Lauraceae*, i.e., whether inclusion in *Laurales* is more natural than inclusion in *Magnoliales*. Chemical evidence also agrees with the exclusion of *Amborellaceae*, *Austrobaileyaceae* and *Trimeniaceae* which all seem to lack benzylisoquinolines.

References: HEGNAUER, Chemotaxonomie der Pflanzen 5 (1969) 99–107, 431–432, 457; *ibid.* 8 (in prep.); URZUA & CASSELS, *Lloydia* 41 (1978) 98. — R. HEGNAUER.

Taxonomy. The family as first founded by DE JUSSIEU (1809) included genera representing most of the subfamilies at present recognized. The heterogeneous nature of these genera immediately instigated a series of proposals for the division of the family by the recognition of the *Atherospermataceae* or, more recently, into several smaller families. Concurrently other systematists have retained the original broad view of the family. Early proponents of splitting were R. BROWN (1814), BARTLING (1830) and LINDLEY (1853), but the broader view long prevailed among other systematists, principally ENDLICHER (1837), TULASNE (1855), BENTHAM & HOOKER (1880), PAX (1891), PERKINS & GILG (1901), PERKINS (1911, 1925), and MELCHIOR (1964). The more recent proposals to remove elements as distinct families include GIBBS (1917), PICHON (1948) and especially MONEY, BAILEY & SWAMY (1950) whose view that *Amborella* and *Trimenia* (*Piptocalyx*) should form separate families has been accepted ever since. The removal of further elements has continued, but opinion remains divided on this trend. A most important contribution by SCHODDE (1969) favoured the recognition of the *Atherospermataceae* and the same author later proposed the erection of *Siparunaceae* (SCHODDE, 1970). This was followed by *Hortoniaceae* (SMITH, 1972). Systematists currently favouring the broader view of the family include THORNE (1974), who briefly argues the case for amalgamation concluding 'The logical alternative treatment would be to expect five or more separate and obviously closely related families, an exercise in taxonomic inflation that would seem to serve no useful purpose.' The same view is taken by DAHLGREN (1980) and CRONQUIST (1981) and this treatment is adopted here.

Subdivision. The grouping of genera into subfamilies and tribes is still subject to debate. Generally speaking those authors taking a broad view of the family recognize the same subdivisions as the splitters but treat them as subfamilies or tribes. PERKINS (1925) adopted only two subfamilies, *Monimioideae* and *Atherospermoideae* with four and two tribes respectively. MELCHIOR (1964) followed MONEY, BAILEY & SWAMY (1950), omitting *Amborella* and *Trimenia*, and accepting two subfamilies, *Hortonioideae* and *Siparunoideae*. THORNE (1974) added a further subfamily by restricting the *Monimioideae* to *Monimia* and *Peumus*, and forming the *Mollinedioideae* for the several remaining genera. His reduction of SCHODDE's subfamily *Peumoideae* (SCHODDE, 1970) into his restricted *Monimioideae* is accepted by PHILIPSON (Nordic J. Bot., 1986, in press), who added *Palmeria* to this subfamily. Most Malesian genera fall into subfamily *Mollinedioideae*,

seven into tribe *Mollinedieae* and one *Levieria* into tribe *Hedycaryeae*. Two other subfamilies are represented by one genus each: *Atherospermatoideae* by *Dryadodaphne* and *Monimioideae* by *Palmeria*.

Generic limits. The family comprises several small distinctive genera whose definition is not difficult. It is perhaps only among the genera of the tribe *Mollinedieae* that generic limits become problematic and it is these genera which are abundant in Malesia. In the first place it is possible to distinguish those genera which receive their pollen on a hyperstigma secreted by prominent glands within the ostiole of the female receptacles. These are (in Malesia) *Kibara*, *Wilkiea* and *Faika*. *Kibara* is distinguished from the other two by the regular arrangement of its stamens. In *Wilkiea* and *Faika* the stamens are inserted irregularly over the inner surface of the male receptacles. These two genera are separated by the dehiscence of the anthers: in *Wilkiea* this is by a single horizontal or horseshoe-shaped slit, whereas in *Faika* it is by two vertical slits. The two genera are also well separated geographically. *Parakibara* cannot yet be placed by this system because its female flowers are not known. Three Malesian genera lack a hyperstigma. Of these *Steghanthera* is the largest and is closely related to *Matthaea*, a genus with a more westerly range, which differs by its anthers opening by two vertical slits. The third genus, *Kairoa*, is immediately distinguished by the male receptacles which open widely at anthesis to expose the very large number of stamens.

References: BARTLING, *Ordines Naturales Plantarum*, Dietrich, Göttingen (1830); BENTHAM & HOOKER, *Genera Plantarum* 3 (1880); R. BROWN in Flinders, *Voyage* 3 (1814); CRONQUIST, *An integrated system of classification of flowering plants*, New York (1981); DAHLGREN, *J. Linn. Soc. Bot.* 80 (1980) 91–124; ENDLICHER, *Genera Plantarum* 1 (1837); GIBBS, *Contr. phytogeography & flora Arfak Mts* (1917); DE JUSSIEU, *Ann. Mus. Nat. Hist. Nat. Paris* 14 (1809) 116–135; LINDLEY, *Vegetable Kingdom*, ed. 3 (1853); MELCHIOR in Engler, *Syllabus Pflanzenfamilien*, ed. 12 (1964); MONEY, BAILEY & SWAMY, *J. Arn. Arb.* 31 (1950) 372–404; PAX in E. & P. *Nat. Pfl. Fam.* 3, 2 (1891) 94–105; PERKINS, *Pfl. R. Heft* 49 (1911); Übersicht über die Gattungen der Monimiaceae, Leipzig (1925); PERKINS & GILG, *Pfl. R. Heft* 4 (1901) 1–22; PICHON, *Bull. Mus. Hist. Nat. Paris* 20 (1948) 383–384; SCHODDE, *Monograph of the family Atherospermataceae R. Br.*, Thesis, Univ. Adelaide (1969); Taxon 19 (1970) 324–328; SMITH, *J. Ind. Bot. Soc.* 50A (1972) 215–226; THORNE, *Aliso* 8 (1974) 147–209; TULASNE, *Arch. Mus. Nat. Hist. Nat. Paris* 8 (1855) 273–436.

Specific delimitation. The much greater amount of material now available, especially from the mountains of New Guinea, has revealed that many of the species described by earlier authors are conspecific, and has also brought to light many undescribed species. Unfortunately, a considerable number of the type specimens of earlier species have not been located, so that several specific names have been treated as insufficiently known species. The concept of a species in this family often appears less well defined than in many others. The larger genera include local species which are well segregated, but also more widespread species with an unusually wide range of variation. Undoubtedly some regional and local species will eventually be recognized within these large species, but this is not possible at present. The largest and most variable species are *Kibara coriacea*, *Steghanthera hirsuta*, *Palmeria arfakiana* and *Levieria squarrosa*.

Uses. A variety of minor local uses are reported by collectors. The wood of larger species may be used as stakes and for house-building, and the stems of *Palmeria spp.* for binding. The aromatic leaves of several *Palmeria* species are used for smoking or to provide salt. Meat is wrapped in leaves of *Kibara* possibly as a tenderizer. *Peumus (non-Mal.)* has many uses in Chile: the hard wood provides handles for implements and is converted to charcoal, the bark is used for tanning and dyeing, and the leaves for medicinal purposes. *Laurelia* produces useful timber.

Notes for collectors. Species will usually be located by the characteristic foliage or by the conspicuous fruits. As the fruits are not sufficient for generic determination, it is important to search for flowers. These are so inconspicuous that they are commonly dismissed as buds and not collected. If flowers cannot be found on the plant a search in the forest for other specimens will usually prove successful. Always search for examples of flowers of both sexes, and bear in mind that these may occur on separate plants. Examples of the fruits should be preserved in fluid.

KEY TO THE GENERA
(11. *Lauterbachia* not included)

1. Flowers hermaphrodite; anthers valvate; filaments of stamens with a pair of glands; fruits with persistent elongated plumose style (Subfam. ATHEROSPERMATOIDEAE) **1. Dryadodaphne**
1. Flowers unisexual; anthers dehiscent by slits; filaments without glands; style not persistent in fruit.
 2. Lianes; receptacle splitting irregularly when ripe to reveal drupes dispersed over its inner surface (Subfam. MONIMIOIDEAE) **2. Palmeria**
 2. Trees or shrubs, or if rarely scandent then fruit not as above (Subfam. MOLLINEDIOIDEAE).
 3. Male flower with a small, flat receptacle bearing relatively large rotund tepals; after anthesis female receptacle splitting irregularly from the ostiole; fruit a head of sessile drupes with the irregular rim of the receptacle reflexed below them (Tribe HEDYCARYEAE) **3. Levieria**
 3. Male flower with a globose or flask-shaped receptacle, either with a small ostiole or (in *Kairoa*) splitting open at anthesis to form a cup with sharply lobed margin; after anthesis upper half of female receptacle abscising as a calyptra; fruit a head of sessile or stipitate drupes with the annular scar of the calyptra below them (Tribe MOLLINEDIOIDEAE).
 4. Female receptacle with thickened glands inside the ostiole.
 5. Style-stigma subulate; anthers dispersed irregularly within the receptacle.
 6. Anthers dehiscent by a horseshoe-shaped slit **4. Wilkiea**
 6. Anthers dehiscent by two vertical slits **5. Faika**
 5. Stigma sessile obtuse; anthers disposed regularly in whorls of 4 or in decussate pairs.
 7. Stamens in several whorls of 4 **6. Parakibara**
 7. Stamens in two whorls (up to 4 stamens) **7. Kibara**
 4. Female receptacle without glands inside the ostiole.
 8. Male receptacle at anthesis a fleshy cup with rim split into acute lobes; stamens numerous (over 100); stigma short sessile; stems and branches with prominent irregular longitudinal ridges of cork **8. Kairoa**
 8. Male receptacle at anthesis with an ostiole surrounded by minute tepals; stamens few; branches \pm smooth.
 9. Anthers dehiscent by a single horizontal or horseshoe-shaped slit **9. Steganthera**
 9. Anthers dehiscent by two vertical slits **10. Matthaëa**

1. DRYADODAPHNE¹

S. MOORE, J. Bot. 61 (1923) 109; A.C. SMITH, J. Arn. Arb. 23 (1942) 442. — *Isomerocarpa* A.C. SMITH, J. Arn. Arb. 22 (1941) 250. — *Daphnandra* PERKINS, Bot. Jahrb. 52 (1915) 217, *p.p.*; Übersicht Gattungen Monim. (1925) 47, *p.p.* — *Levieria* KOSTERM. Rec. Trav. Bot. Néerl. 34 (1937) 605, *p.p.*; HUTCH. Gen. Fl. Pl. 1 (1964) 114, *p.p.* — **Fig. 3.**

Tall trees, young branches \pm tetragenous usually glabrous. *Leaves* dentate or almost entire. *Inflorescence* axillary, of dichasia or few-flowered pleiochasia, bracteoles broad enclosing the flowerbud, early caducous. *Flowers* bisexual, perianth and androecium on the rim of the hypanthium; tepals 8, in 2 whorls, oblong-elliptic, obtuse. — *Androecium* tetramerous, the outer 1–2 whorls of stamens with divergent ovate-deltate, planate to shallowly cupular, obtuse staminal glands and shortly apiculate to broadly rostrate, laterosely to \pm extrorsely dehiscent anthers, the inner whorls of lanceolate-deltoid to almost subulate staminodes. — *Gynoecium* of several free carpels, styles terminal; ovule

(1) The account of this genus is based on SCHODDI, A monograph of the family *Atherospermataceae* R. Br., unpublished thesis, University of Adelaide (1969).

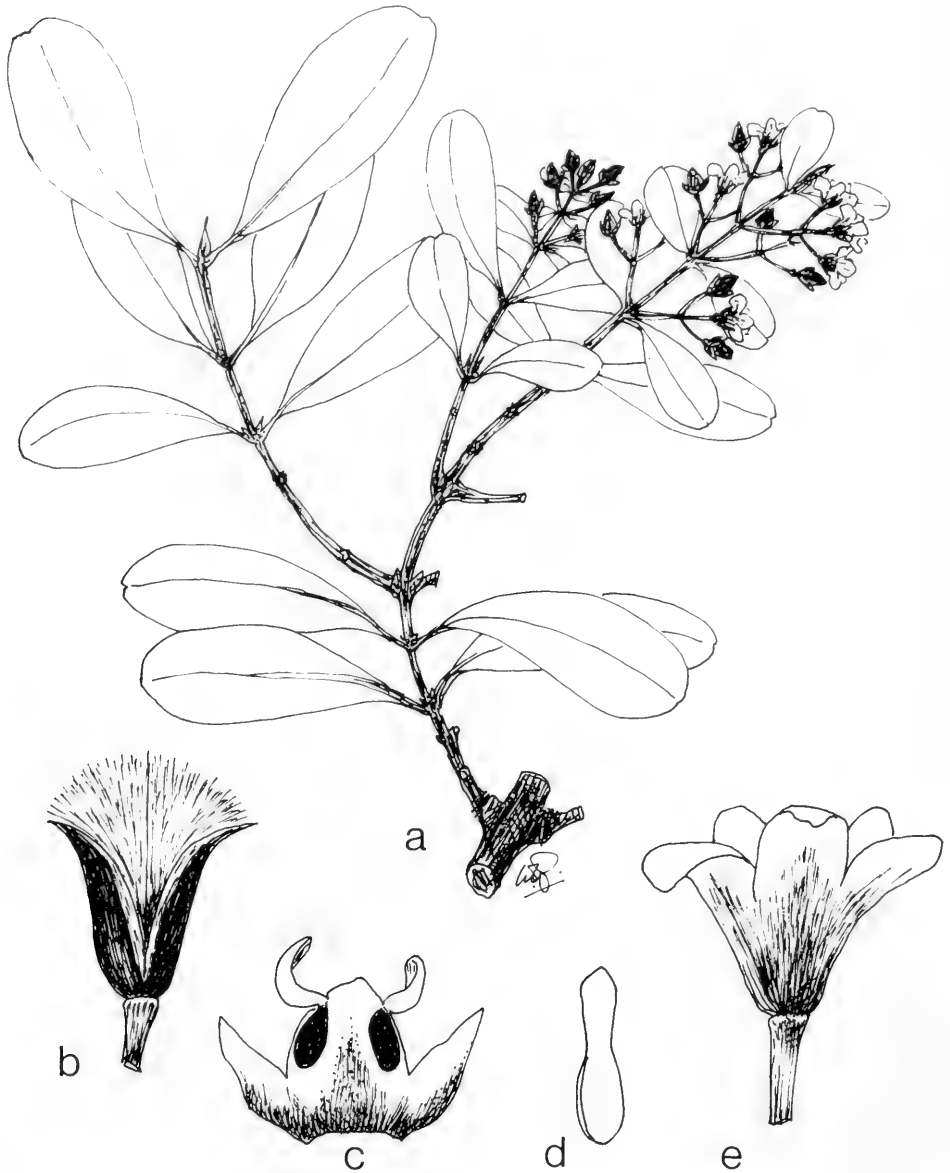


Fig. 3. *Dryadodaphne crassa* SCHODDE. a. Habit, nat. size, b. fruiting hypanthium, $\times 1\frac{1}{2}$, c. anther of outer whorl, $\times 14$, d. embryo, $\times 20$, e. open flower, $\times 7$ (a, c, e STREIMANN 8643, b NGF 28519, d SCHODDE 3144).

subbasal. Fruiting hypanthium cylindrical-ellipsoid, dehiscing into 4 (sometimes 2) equal valves. *Nutlets* narrowly ellipsoid to obclavate, silky hirsute on one side in deep pits, styles terminal, subulate.

Distr. Three species, Queensland (1 *sp.*), in *Malesia*: New Guinea (2 *spp.*).

Ecol. Montane rain-forest, (500–)600–2800 m. In New Guinea *D. crassa* is associated consistently with *Nothofagus* forest, and *D. novoguineensis* with lower altitude mixed forest.

Note. *Dryadodaphne* is the only representative of the *Atherospermatoideae* in *Malesia*. The New Guinea material was originally confused with *Daphnandra*, and any reports of that genus from *Malesia* refer to *Dryadodaphne*.

KEY TO THE SPECIES

1. Stamens 8 (very rarely 4); outer stamens (including appendages) broader than long with widely divergent \pm acute glands. Leaves obovate (rarely elliptic) with rounded, obtuse, frequently retuse apices. Tepals in \pm equal whorls, usually \pm pale cream green **1. *D. crassa***
1. Stamens 4, including appendages longer than broad, with slightly divergent \pm obtuse glands (but see *ssp. occidentale*). Leaves lanceolate to elliptic with attenuate to acuminate (rarely rounded obtuse) apices. Tepals in unequal whorls, usually pale maroon-brown, pinkish or purplish **2. *D. novoguineensis***

1. *Dryadodaphne crassa* SCHODDE, *sp. nov.* — *Iso-merocarpa novoguineensis* (PERKINS) A.C. SMITH, J. Arn. Arb. 22 (1941) 251, *p.p.* — *D. novoguineensis* (PERKINS) A.C. SMITH, *ibid.* 23 (1942) 443, *p.p.* — Fig. 3.

Arbor magna 20–30 m alta, folia comparate lata, obtusa saepe retusa, series tepalorum aequiformatae, plurimque virellae, stamina fugientia octo rare quattuor, cum apiculis brevibus, dehiscencia valvarum antherarum revera laterali, et glandulis divergentibus, late aliformibus, planis-cupulatis, ovatis-lanceatis, acutis vel aliquantum obtusis, 0.5–1.2 (–1.5) mm longis, et hypanthia fructificantia comparate brevia, (15–)18–23(–27) mm longa \times (5–)6–10(–11) mm lata, crasse lignaeque. — Type: SCHODDE & CRAVEN 4816 (CANB), Morobe Prov., Menyamyia Distr., Angebena ridge, c. 3 miles east of Aseki.

Tree to 20–30 m; branchlets usually tetragonous, glabrous, or young parts sometimes unevenly sordid buff tomentulose, or with scaly incrustation. Leaves narrowly to broadly ovate; sometimes rounded cuneate, infrequently elliptic (0.7–)2.5–6(–10) by (0.5–)1–3(–4) cm, base \pm narrowly cuneate, apex broadly, or less often narrowly, obtuse, frequently retuse, margin faintly undulate, or obscurely or obtusely crenulate, rarely markedly crenulate or entire, \pm markedly recurved, almost revolute towards the petiole, coriaceous or rarely thinly coriaceous, principal nerves conspicuous below, anastomosing towards the margin, glandular pits sparse to frequent; petioles up to 9 mm, or sometimes longer, deeply channelled above, glabrous. *Inflorescences* axillary, up to 3 cm long, or rarely longer, glabrous or tomentose distally, bearing few (rarely more than 5 but up to 11) flowers in a dichasium or a pleiochasium; bracts lanceolate deltate to ovate or oblong, (1.5–)2–3(–4) mm long, caducous; pedicels slightly or \pm conspicuously expanded under the hypanthium; bracteoles enclosing the hypanthium in bud. *Flowers*

with perianth pale cream or yellow-green, rarely whitish or reddish; hypanthium 1–2(–2.5) mm long, glabrescent or sparsely tomentulose; tepals 8 in 2 \pm equal whorls, broadly obtuse oblong-linguiform to elliptic, (1.5–)3–4.5(–5) by (1.5–)2–2.7(–3) mm. — *Androecium* in several series, the 2 outer whorls each with 4 stamens, outer stamens broader than long (1–)1.3–2 by (1.25–)1.5–2.5(–3) mm, with widely divergent, wing-like ovate to lanceolate-deltate, \pm acute staminal glands, and latrorsely dehiscent valves, inner stamens as broad as long, with shorter \pm obtuse glands and longer apiculate apices; staminodes narrowly to broadly lanceolate or deltoid to subulate, the outer often with vestigial glands. — *Gynoecium* of up to 15 carpels; styles exerted beyond the hypanthium as a slender column, stigmatic column narrowly conical, protruding beyond apices of staminodes to near apices of outer stamens. *Fruiting hypanthium* thickly lignified, dehiscent into 4 (rarely 2) equal valves, sparsely hairy within. *Nutlets* (3–)5–6 mm long, styles (5–)7–10 (–14) mm long, exerted beyond the hypanthium.

Distr. *Malesia*: New Guinea. Through the central mountains from Oranje Range to the Owen Stanley Range, and also in the Saruwaged Range, Huon Peninsula.

Ecol. Primary, or rarely old secondary, montane rain-forest, between 2000 and 2800 m in the north-western and central parts of its range, and between (1350–)1600–2400 m in the Eastern Highlands, Saruwaged and Owen Stanley Ranges. In fairly well-drained sites, usually on slopes and towards the crowns of mountains and ridges. Generally associated with forest dominated by *Nothofagus*. Towards the upper limit of its altitudinal range it extends into conifer forests dominated by species of *Libocedrus*, *Phyllocladus* and *Podocarpus*.

Uses. The timber is used in the Mt Hagen and Chimbu areas.

Vern. *Dafa*, Telefomin, *enman*, Banz, *katan*,

mongo a kuli, nopohn or *pohn, piljim*, Mt Hagen, *korgi*, Chimbu, *mowku, mugu, muk, Enga, munk*, Mendi, *onda* or *onde*, Aseki.

Note. Though the distinctness of the two New Guinea species has been recognized only comparatively recently, most individuals can be distinguished readily on leaf characters such as size, texture and shape. Leaves of saplings and those in deep shade tend to be larger and less coriaceous with narrower apices and planate margins. Trees from lower altitudes may show some features of *D. novoguineensis* suggesting the possibility of introgression. The most westerly collection (BRASS & VERSTEEGH 11194) is somewhat distinct, and further collections from this region are needed. Flowering and fruiting occur throughout the year, though an individual tree usually does not bear flowers and fruits together.

2. *Dryadodaphne novoguineensis* (PERKINS) A.C. SMITH, J. Arn. Arb. 23 (1942) 443, p.p. — *Daphnandra novoguineensis* PERKINS, Bot. Jahrb. 52 (1915) 217; Übersicht Gattungen Monim. (1925) 50. — *D. celastroides* S. MOORE, J. Bot. 61 (1923) 109. — *Daphnandra perkinsiae* GILG & DIELS, Notizbl. Berl.-Dahl. 9 (1925) 466. — *Isomercarpa novoguineensis* (PERKINS) A.C. SMITH, J. Arn. Arb. 22 (1941) 251, p.p.

KEY TO THE SUBSPECIES

1. Staminal glands ovate oblong, obtuse or shallowly cupular. Leaves (from crown) with acuminate, rarely rounded obtuse, apices and distinctly undulate-crenate margins. Fruiting hypanthium 2–4 times longer than broad. **a. ssp. *novoguineensis***
 1. Staminal glands lanceolate to ovate, rather acute. Leaves (from crown) with narrowly obtuse, hardly acuminate apices, and obscurely undulate-crenate, almost entire margins. Fruiting hypanthium 1 3/4–2 times longer than broad **b. ssp. *occidentalis***
- a. ssp. *novoguineensis* var. *novoguineensis***

Tree to 40 or 50 m, often buttressed; branchlets usually conspicuously tetragonous, glabrous or sometimes hispidulous or tomentulose. Leaves narrowly to broadly elliptic, sometimes lanceolate, (2–) 4–10(–12) by (0.7–)1.5 by 3.5(–4.5) cm, base truncate to widely or rarely narrowly cuneate, apex bluntly acuminate, very rarely narrowed, margin conspicuously undulate crenate, slightly to markedly recurved, ± coriaceous, principal nerves ± prominent below, anastomosing towards the margin, occasionally with sparse glandular pits; petioles up to 15 mm, sometimes longer, channelled above, glabrous, sometimes strigillose. *Inflorescences* axillary, up to

35 mm long, rarely longer, glabrous or glabrescent with sparse hairs sometimes persistent on bracteoles and perianth in buds, bearing few (rarely more than 5, but up to 11 flowers) in a dichasium or a pleiochasium; bracts lanceolate-deltate, rarely linear oblong, (1.5–)2.5–4 mm long, early caducous; pedicels rarely much expanded under the hypanthium, bracteoles enclosing the hypanthium in bud. *Flowers* with perianth reddish (rarely entirely cream-green); hypanthium 1–2(–2.5) mm long, glabrous to rather densely tomentulose; tepals 8, in 2 unequal whorls, the outer obtusely linguiform, sepaloïd, (2–)3–4(–6) by 1.5–3(–4) mm, the inner narrowed towards the apex, more petaloïd, (2–)2.7–3.5(–5) by (1.2–) 1.5–2.5(–3.5) mm. — *Androecium* in 2 or 3 series, the outer whorl of 4 stamens; stamens longer than broad, (1.3–)1.5–2(–2.5) by 1–1.7 mm, with slightly divergent, lanceolate or ovate-oblong obtuse, rarely acute staminal glands, and extrorsely dehiscent valves, the inner series of lanceolate, deltoid to subulate staminodes, the outer often with vestigial glands. — *Gynoecium* of up to 16 carpels, styles exerted beyond the hypanthium, stigmatic column narrowly conical, reaching apices of inner staminodes, rarely beyond. *Fruiting hypanthium* thickly lignified, (11–) 18–25(–35) mm long, dehiscent into 4 (rarely 2) equal valves, hairy within especially towards the rim. *Nutlets* (3–)5–6(–7) mm long, styles (5–)7–14(–15) mm long, exerted beyond the hypanthium.

Distr. Malesia: Papua New Guinea. Throughout the central mountains from the Hunstein Range to the Owen Stanley Range, and also in the Torricelli Mts and the Saruwaged Range.

Ecol. Primary montane rain-forest, and secondary forest as a remnant, 500–1950 m. In general at lower altitude than *D. crassa* and preferring gullies, slopes and fairly well-drained ridge crowns. Only rarely associated specifically with *Nothofagus* forest.

Uses. The bark is chewed and rubbed on the chest by Chimbu natives for certain illnesses.

Vern. Adengambi, Chimbu, *anona*, Akuna, *anonya, nasapu, Aiyura, kamo*, Okapa, *onda* or *onde*, Aseki.

Note. *D. crassa* may be distinguished from this species by its relatively broadly obtuse, frequently retuse leaves, generally cream-green flowers, equal whorls of tepals, two unequal whorls of stamens, broad wing-like staminal glands attached near to the base of the filament, shortly apiculate outer anthers, latrorse anther dehiscence, and shorter fruit.

var. macra SCHODDE, *var. nov.*

Laminae foliorum coronarum arborum saepe longiores quam 100 mm, latioresquam 35 mm, et petioli (1.5–)2–2.5(–3.5) mm crassi, inflorescentiae relative tomentulosae dense glauco-griseae vel alutaceae, et hypanthia fructificantia 35–45 mm longa. —

Type: SCHODDE & CRAVEN 5081 (CANB), Morobe Prov., Menyama Distr., Aseki Valley, c. 3 miles SE. of Aseki.

Differs from *var. novoguineensis* in the \pm densely glaucous-grey or pale brown tomentulose inflorescence, and in the larger leaves and fruiting hypanthia.

Distr. *Malesia*: Papua New Guinea, Enga Prov., Wabag Distr., Morobe Prov., Menyama and Wau Distr.

Ecol. Montane rain-forest, 1000–2400 m.

Note. Known only from within the range of *ssp. novoguineensis* and usually in close proximity to it.

2. *ssp. occidentalis* SCHODDE, *ssp. nov.*

Cortex relative asper fissuratusque, folia coronarum arborum relative anguste obtusa vix acuminata ad apices, et obscure undulato-crenata paene integra, glandulae staminum planae, lanceolatae ad ovate 0.7–1 mm longae, et hypanthia fructificantia

1 3/4–2 *plo longiora quam latiora*. — Type: BRASS & VERSTEEGH 11984 (L), Irian Jaya, 15 km SW. of Bernhard Camp, Idenburg River.

Differs from *ssp. novoguineensis* in the longer and flatter divergent staminal glands, the rounder apex and more entire margin of the leaf, the thicker fruiting hypanthium and the rougher dark-brown bark.

Distr. *Malesia*: Irian Jaya, Vogelkop Peninsula, Mt Nettoti; Wissel Lakes; Idenburg River.

Ecol. Primary montane rain-forest (*Nothofagus*) and mossy forest, 900–1900 m.

Vern. *Goekaai*, Kapauku lang.

Note. The three localities from which this species is known are far apart, but the specimens are uniform, especially as regards their staminal glands. *D. novoguineensis* apparently shows no clinal trend towards the characters of this species at the western end of its range. A considerable geographical gap (of c. 200–250 miles) separates the ranges of the two subspecies, as known at present.

2. PALMERIA

F. v. M. Fragm. 4 (1864) 151; A.DC. Prod. 16, 2 (1864) 657; BTH. Fl. Austr. 5 (1870) 291; PERKINS & GILG, Pfl. R. Heft 4 (1901) 64; PERKINS, Bot. Jahrb. 52 (1915) 214; Übersicht Gattungen Monim. (1925) 42; HUTCH. Gen. Fl. Pl. 1 (1964) 119; PHILIPSON, Blumea 28 (1982) 85, f. 1–3. — **Fig. 4–5.**

Woody lianes with opposite, entire leaves, usually bearing stellate hairs. Dioecious, with lateral or terminal cymose panicles or pleiochasia. — *Male flowers* bowl-shaped or saucer-shaped, with 4–7 tepals either incurved or spreading at anthesis to reveal the numerous stamens \pm sessile on the surface of the receptacle; anthers opening by longitudinal slits. — *Female flowers* globose or flask-shaped with c. 5 small obtuse tepals surrounding a minute ostiole; carpels sessile on the inner surface of the receptacle, interspersed with numerous bristles. *Receptacle* enlarging to become a \pm globose fruit, which splits open irregularly at maturity to reveal the drupes.

Distr. Australia and *Malesia*: 11 *ssp.* in New Guinea, of which 3 may also occur in Queensland and one extends to E. Sulawesi. Three further species have been described from Australia.

KEY TO THE SPECIES

1. Outer surface of receptacle glabrous 1. *P. hooglandii*
1. Outer surface of receptacle bearing hairs.
 2. Undersurface of leaf \pm glabrous 3. *P. arfakiana*
 2. Undersurface of leaf with indumentum.
 3. Undersurface of leaf bearing numerous simple hairs (and usually also some stellate hairs) 2. *P. gracilis*
 3. Undersurface of leaf bearing stellate hairs (occasionally also with a few simple hairs).
 4. Mature fruits c. 7–8 mm ϕ (before dehiscing). Achenes about 5 mm long when dry (known only from the Angi Lakes area) 4. *P. angica*

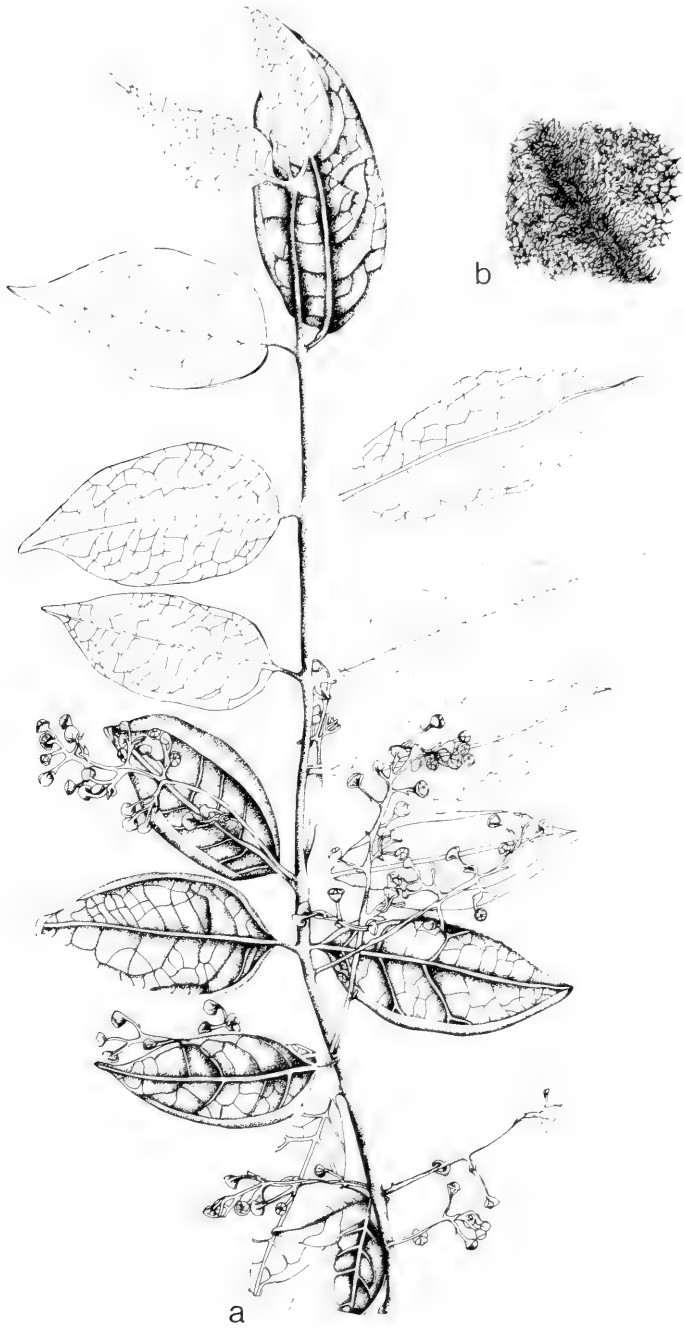


Fig. 4. *Palmeria clemensae* PHILIPSON. *a.* Habit of male twig, $\times 1/2$, *b.* portion of lower surface of leaf, $\times 5$ (*a* PULLEN 281, *b* VAN BALGOOY 957).

- 4. Mature fruits c. 15–20 cm ϕ (before dehiscent). Achenes about 7 mm long or longer when dry.
- 5. Stellate hairs of underside of leaf laxly or densely distributed but not matted to form a close felt.
- 6. Stellate hairs of the underside of leaf large (0.6–0.9 mm), generally distributed over the leaf surface, usually rather dense (but the leaf-surface clearly visible through them) 5. *P. brassii*
- 6. Stellate hairs of the underside of the leaf small (0.2–0.25 mm) occasionally generally distributed and dense, but often confined to leaf base and petiole (common throughout New Guinea) 3. *P. arfakiana*
- 5. Stellate hairs densely distributed over the undersurface of the leaf and matted together to form a close felt.
- 7. Felt on the underside of the leaf with a smooth even surface.
- 8. Leaves large (mostly over 12 cm long) (known from Morobe and Central Provinces) 6. *P. incana*
- 8. Leaves smaller.
- 9. Leaves small (less than 5 cm long) (known from the Murray Pass area) 7. *P. montana*
- 9. Leaves larger (Tari District westwards) 8. *P. hypargyrea*
- 7. Felt on the underside of the leaf with some larger hairs protruding above the general surface.
- 10. Veins on the underside of the leaf fringed with long hairs 9. *P. clemensae*
- 10. Veins on the underside of the leaf bearing tufted stellate hairs above the felt.
- 11. Leaves large (9 cm or longer) 10. *P. womersleyi*
- 11. Leaves smaller (6 cm or shorter) 11. *P. schoddei*

1. *Palmeria hooglandii* PHILIPSON, Blumea 28 (1982) 88.

Woody liane to 22 m high, branches and foliage glabrous. *Leaves* oblong-elliptic, occasionally lanceolate-elliptic, 7.5–15.5 by 1.7–6 cm, chartaceous, apex with an apiculum (often long and narrow), base cuneate, midrib slightly channelled above, prominent below, lateral veins c. 6, well-defined, meeting within the margin; petiole 0.75–1 cm. *Inflorescence* axillary and terminal, either simple unbranched pleiochasia (often grouped at the ends of branches to resemble panicles) or with long lateral branches forming a panicle-like inflorescence, the rachis 4.5–10 cm, with lateral branches up to 4 cm; male inflorescences often larger and more openly branched at anthesis than females. — *Male receptacles* bowl-shaped becoming almost disk-shaped at anthesis, c. 5.5 mm ϕ (without the tepals), margin produced into c. 5–7 irregular tepals, outer surface of tepals minutely pubescent; stamens c. 18, subsessile; anthers c. 0.75 mm. — *Female receptacle* globular, 2.5 mm ϕ , with a terminal ostiole surrounded by 5 minute obtuse tepals, a few microscopic hairs present on the tepals, the inner surface of the receptacle bearing long simple hairs between the carpels; carpels c. 8, tapering to filiform styles which project through the ostiole. Immature *fruit* globose or irregularly bulged, with an asymmetric beak, mature fruit not seen.

Distr. Malesia: Papua New Guinea (Southern Highlands, Enga, Western Highlands, Chimbu, Eastern Highlands, Morobe Prov.).

Ecol. A liane reaching 22 m in primary and secondary lower montane rain-forest, 1950–2800 m.

Vern. *Kende, kent, korinda*, all Enga, *boma*, Chimbu, *abiya*, Okapa.

**Note.* One of the most distinctive species, with both the vegetative parts and inflorescence glabrous

(only the tepals are minutely pubescent). Its distribution covers most of the Central Highlands from La-gaip to Okapa, with a single disjunct occurrence in the Cromwell Mts (Huon Peninsula). The flowers are described as creamy and scented. The drupes are purple-black on a bright red torus.

2. *Palmeria gracilis* PERKINS, Bot. Jahrb. 31 (1902) 745; Pfl. R. Heft 49 (1911) 39; PHILIPSON, Blumea 28 (1982) 89, f. 1b. — *P. fengeriana* PERKINS, Pfl. R. Heft 49 (1911) 39. — *P. paniculata* RIDL. Trans. Linn. Soc. Bot. II, 9 (1916) 144.

Woody liane, reaching 20 m, young parts covered with a lax indumentum of simple hairs, together with small stellate hairs especially on the flowers. *Leaves* usually ovate with broad rounded, cordate, or cuneate base, and a long narrow apiculum, more rarely elliptic with a short apiculum, 4–14.5 by 1.8–11.5 cm, membranaceous, midrib and lateral veins well-defined, upper surface with the remnants of simple hairs and small stellate hairs, or becoming glabrous except for simple hairs along the midrib and sometimes the principal veins and the margin, undersurface with a dense or sparser covering of curved simple hairs mixed with a varying number of small stellate hairs; petiole 2.5–10 mm, hairy. *Inflorescence* axillary and terminal, either simple pleiochasia, few-flowered and with a delicate rachis, or branching to the second degree with rather stouter rachis, 5–20 cm long, often produced profusely on lateral branches of limited growth; rachis, branches and pedicels with lax hairs and a varying amount of short dense stellate hairs; bracts linear, caducous. — *Male receptacle* saucer-shaped, 6–8 mm ϕ , with 5 recurved deltoid tepals, outer surface with long simple hairs and dense stellate indumentum; stamens c. 20–24, sessile, c. 1.25 mm long. — *Female receptacle* globose, c. 2.25 mm ϕ , outer surface with indumen-

tum as in male, inner surface with long bristles between the carpels; carpels c. 8–10, tapering to a long filiform reflexed style. Immature *fruit* subspherical with an asymmetric beak; mature fruit splitting into irregular lobes c. 2–2.5 cm long, densely bristly on both surfaces; drupes spherical, sessile, c. 7 mm long when dry.

Distr. *Malesia*: Irian Jaya (Vogelkop Peninsula, Japen I., Lake Habbema, Idenburg R.); Papua New Guinea (W. & E. Sepik, Southern, Western & Eastern Highlands, Morobe & Central Provinces).

Ecol. Woody liane reaching 20 m or more, in rain-forest, second growth or open scrubby areas with a wide altitudinal range (500–3000 m), but most frequent in lower montane rain-forest (*Castanopsis*, *Lithocarpus*, *Nothofagus*, *Podocarpus* or *Elaeocarpus* dominated).

Uses. For wrapping tobacco before being smoked in pipes or as cigarettes. When burnt to a fine ash, used as salt.

Vern. *Gapunga*, Koroba, *hompanofi*, Okapa, *kepundom*, Maring, *obirambiram*, Mendi, *fowndun*, Maring.

Note. One of the most widespread and frequent species, recognized by the simple curved bristles on the undersurface of the leaf. The size of the leaf is varied, as is the density of the indumentum, but the variability has no geographical or apparent ecological basis. The flowers are cream, in males with whitish stamens. The red or dark drupes are borne on a light red receptacle.

3. *Palmeria arfakiana* BECC. *Malesia* 1 (1877) 186; PERKINS, Pfl. R. Heft 4 (1904) 65; Bot. Jahrb. 52 (1915) 215; A.C. SMITH, J. Arn. Arb. 22 (1941) 245; KANEH. & HATUS. Bot. Mag. Tokyo 56 (1942) 254; PHILIPSON, Blumea 28 (1982) 90. — *P. warburgii* PERKINS, Pfl. R. Heft 49 (1911) 37, f. 13D–H. — *P. pulchra* PERKINS, l.c. 38. — *P. myriantha* PERKINS, Bot. Jahrb. 52 (1915) 214. — *P. myrtifolia* PERKINS, Übersicht Gattungen Monim. (1925) 43, *nomen*. — *P. puberula* A.C. SMITH, J. Arn. Arb. 22 (1941) 249. — *P. acuminata* KANEH. & HATUS. Bot. Mag. Tokyo 5 (1942) 251, f. 3F–G. — *P. parvifolia* KANEH. & HATUS. l.c., 255, f. 3A–E.

Woody liane, young branches hirsute or puberulous. *Leaves* usually oblong-elliptic or obovate, sometimes narrower or subrotund, (2.5–)12–20 by 1–9.5 cm, chartaceous to coriaceous, apex attenuated to a short or long apiculum, base rounded, truncate, or cuneate, upper surface of mature leaves with remnants of minute stellate hairs, especially at the base of the midrib, or glabrous, undersurface with minute stellate hairs forming a dense or open indumentum or virtually absent from the mature blade, persisting, if at all, on the midrib or near the base of the leaf, longer simple hairs may be present along the

midrib; petiole 3–15 mm long, either densely covered with minute stellate hairs or these may be sparse (almost absent) at maturity, longer simple hairs sometimes also present and abundant. *Inflorescence* axillary and terminal, paniculate, 7–20 cm long (rarely shorter), lower branches 1.5–3(–5) cm with few flowers or with tertiary branches, the rachis and branches usually with a greyish or cream tomentum or with sparse stellate hairs, rarely more or less glabrous at anthesis. — *Male receptacle* bowl-shaped becoming a flat disk at anthesis c. 6–8 mm ϕ , with c. 5 irregular tepals, outer surface with a short dense indumentum or with fewer minute stellate hairs, inner surface with short simple hairs; stamens c. 25, sessile c. 0.75–1.25 mm long. — *Female receptacle* urceolate, c. 2–2.5 mm high, outer surface with indumentum as in male, inner surface with long simple hairs; carpels c. 5–8(–16), with filiform styles. Immature *fruit* subspherical, beaked, splitting irregularly at maturity to reveal the red inner surface and black drupes.

Distr. *Malesia*: Central Celebes (E. Peninsula) and New Guinea: in uplands throughout the island from Vogelkop Peninsula to Milne Bay; also on Manus I. and New Britain.

Ecol. Liane, often strongly growing in primary rain-forest, mostly in the lower and upper montane zones, ascending to 3200 m, but occasionally as low as 100 m. Also in second growth and climbing over shrubs near the forest margin.

Uses. The leaves are burnt to make salt.

Vern. Papua New Guinea: *angore*, *laso*, Mendi, *bengop*, *pengop*, Hattam, *gawa kepundom*, Maring, *ibiwudediji*, *puquabou*, Tari, *kainagent*, *repalip*, *tsik*, Enga, *kangom*, Iaro R., *linore*, *mulkrima*, Telefomin, *njeng*, Hagen, Wankl, *tomenguntong*, Sailer, *xatapi*, Guale, Movoi.

Notes. The most frequent and widespread species of the genus. It is the only species known to occur on islands to the north of the New Guinea mainland and in Sulawesi.

The variety of forms included within the limits of this species as treated here is greater than is generally acceptable in one species. It is possible that future studies will recognize entities within this complex, and perhaps reinstate species here regarded as conspecific. However, it has proved impossible to subdivide on the basis of indumentum and leaf-size. Broadly speaking four groups may be recognized, though frequent intermediates link all of these: (i) a large-leaved form with adult leaves more or less glabrous except for small stellate hairs on the petiole and base of the leaf (*P. arfakiana sensu stricto*), (ii) a large-leaved form with the lower surface more or less densely and evenly covered with small stellate hairs, (iii) a smaller-leaved form (often with narrower more oblong blades) usually with the indu-

mentum persisting only near the leaf base (*P. pulchra*), (iv) a small-leaved form with few stellate hairs (*P. acuminata*, *P. parvifolia*). The first three forms are all frequent and widespread. The fourth appears to be confined to mountains to the west of the island (e.g. Arfak Mts, Wissel Lakes). The species described by KANEHIRA & HATUSIMA are here regarded as reduced subalpine states and reduced to synonymy; they may prove to be distinctive enough for specific status when better material becomes available, but the evidence available is that they are the end of a reduction series. The type of *P. myriantha* PERKINS represents the most glabrous state, with even the branches of the inflorescence more or less glabrous and the receptacles bearing a rather sparse coating of stellate hairs. However, similar collections occur throughout the range and must be regarded as one extreme of a continuous range of variation. I have not seen type material of *P. warburgii* PERKINS from Celebes (the only occurrence of the genus west of New Guinea), but plants collected in Celebes by EYMA fit the original description. The younger leaves are rather heavily coated below with small stellate hairs, but older leaves can approach the glabrous condition.

Although undoubtedly a liane, like all other species of *Palmeria*, it must vary in habit because a number of collectors describe it as a tree or sprawling shrub. The young foliage is tinged with red. The flowers are cream or yellowish. The black drupes are borne on a red or pink receptacle.

4. *Palmeria angica* KANEH. & HATUS. Bot. Mag. Tokyo 56 (1942) 252; PHILIPSON, Blumea 28 (1982) 92.

Woody liane to 3 m high, young branches with a greyish indumentum. *Leaves* oblong-elliptic, 4–8 by 2–4 cm, chartaceous or coriaceous, base rounded, apex shortly acuminate, the upper surface ± densely or sparsely stellate hairy, becoming glabrous, the undersurface densely stellate-pilose; petiole 7–8 mm long, closely pubescent. *Inflorescence* axillary, to 10 cm long, the rachis and branches with greyish stellate indumentum. — *Male flowers* not seen. — *Female receptacle* urceolate, 2.5 mm long (after flowering), with short dense indumentum on the outer surface, tepals 5, minute; carpels 7–8. *Fruits* subspherical, c. 8 mm ø, splitting irregularly; drupes c. 5 mm long when dry.

Distr. Malesia: West New Guinea (Mt Arfak, Angi Lakes).

Ecol. Scandent in low spinneys on the burnt and open summit of Mt Koebre at 2300 m.

Note. The small fruits appear to enclose a single drupe, which is considerably smaller than those of the other species.

5. *Palmeria brassii* PHILIPSON, Blumea 28 (1982) 92, f.

1d. — '*Palmeria fengeriana* PERKINS' A.C. SMITH, J. Arn. Arb. 22 (1941) 248, p.p.

Woody liane, to 20 high, young branches with a thick indumentum. *Leaves* usually broadly elliptic or slightly obovate or rotund, with a small blunt apiculum or occasionally with an attenuated apex, 8–22 by 4.8–12 cm, chartaceous, midrib prominent below, lateral veins c. 6, arched and meeting within the margin, upper surface of mature leaves covered with the scattered remnants of stellate hairs, which may form a dense pile above the midrib and principal veins and on the margins, lower surface covered with large stellate hairs with lax, shining, bristle-like arms, sometimes rather densely disposed but not obscuring the surface of the blade; a few simple hairs may occur among the stellate indumentum; petiole 10–17 mm, densely clothed in brown indumentum. *Inflorescences* axillary and terminal, covered with a short dense creamy or fulvous tomentum, elongate (to c. 40 cm) with relatively short opposite or subopposite lateral branches (5–8 cm long) or the inflorescence more paniculate with lateral branches 15–20 cm long (the male inflorescences frequently more lax than the female at anthesis); lateral branches bearing several opposite tertiary branches and caducous subulate bracts. — *Male receptacle* bowl-shaped, becoming almost a flat disk at anthesis, with c. 5 irregular tepals, c. 5 mm ø, outer surface with a dense covering of small stellate hairs, inner surface with short simple hairs between the stamens; stamens c. 20, sessile on the inner surface of the receptacle, c. 0.75–1 mm long, apex of the connective with a tuft of minute hairs. — *Female receptacle* urceolate, often asymmetric, 2–3 mm high at anthesis, outer surface with indumentum as in the male, inner surface with long simple hairs between the carpels; carpels c. 15 distributed over the inner surface of the receptacle, tapering to filiform styles which project through the ostiole, becoming reflexed. *Immature fruit* subspherical, or irregularly bulged, usually markedly asymmetric with a prominent beak to one side; at maturity the enlarged receptacle splits to form c. 5 coriaceous, very irregular lobes c. 2 cm long to which the ripe achenes are attached; drupes spherical, sessile, with a shining black surface, mesocarp succulent, endocarp stony, c. 7 mm long when dry.

Distr. Malesia: Papua New Guinea (Eastern Highlands, Morobe and Central Provinces).

Ecol. Woody liane on shrubs and trees in primary and secondary lower montane rain-forest (dominated by *Castanopsis*, *Lithocarpus*, *Nothofagus* or *Podocarpus*), occurring in ridge forest and also in swampy places with dark brown loam, 1200–2450 m.

Uses. Employed as lashing material.

Vern. *Nani*, Kassam, *arawe*, Finisterre Mts, *bo-ma*, Gumini, *arokot*, Ueli, Movoi.

Note. Characterized by its large leaves bearing a loose indumentum of large stellate hairs with shining, bristle-like, spreading arms. The flowers are described as white. The immature green, white-spotted fruits later split open to reveal black drupes on a red torus. *P. brassii* may be distinguished from *P. gracilis* by the predominance of stellate hairs, by the shape of the blade and by the longer inflorescence. Some specimens with more numerous simple hairs may also approach *P. gracilis* in leaf shape. They are possibly of hybrid origin. Of all the New Guinea species, *P. brassii* probably is most closely related to the Australian *P. scandens* from which it differs principally in the length of the inflorescence and the leaf shape.

6. *Palmeria incana* A.C. SMITH, J. Arn. Arb. 22 (1944) 245; PHILIPSON, Blumea 28 (1982) 94.

Woody liane, with young branches covered in greyish tomentum. *Leaves* elliptic-oblong, 9–18 by 3.5–8 cm, chartaceous, base rounded or broadly cuneate, apex shortly acuminate, upper surface becoming glabrous (except for puberulence above the midrib), lower surface evenly covered with a close, fine, greyish-white indumentum, midrib and arched lateral veins prominent below, impressed above; petiole 6–10 mm, puberulous. — *Inflorescence* densely greyish pubescent, axillary and terminal, narrowly paniculate, up to 12 cm, with branches c. 2–3 cm. — *Male flowers* globose, c. 2 mm ϕ (in bud), apex depressed with 5 tepals, outer surface densely covered with a close indumentum of stellate hairs; stamens c. 20–24, broadly deltoid, c. 0.75 mm long, sessile. — *Female flowers* not known. Immature *fruits* subspherical with an asymmetric beak; at maturity the enlarged receptacle ruptures irregularly to form coriaceous lobes c. 2 cm long; drupes subspherical, c. 7 by 5 mm, sessile.

Distr. *Malesia*: Papua New Guinea (Morobe Prov.: Wau Distr.; Central Prov.: Goilala Distr.).

Ecol. Liane scrambling over trees in primary forest at 1200 m.

Notes. Evidently a rare and local species, only twice collected. Lower surface of leaves covered with a smooth, even, greyish felt of close-set stellate hairs. This indumentum is similar to that of *P. hypargyrea*, but that western species has smaller leaves.

The original collection lacked flowers, but immature male flowers were provided by another. The flowers are described as cream, with a \pm unpleasant scent, and the drupes as black on a red torus.

7. *Palmeria montana* A.C. SMITH, J. Arn. Arb. 22 (1941) 247; PHILIPSON, Blumea 28 (1982) 95.

Woody liane to 3 m high, with slender branches covered with a greyish indumentum of minute stellate hairs. *Leaves* ovate to oblong-ovate or broadly ovate, 1.8–4.7 by 0.6–2.5 cm, chartaceous, base cu-

neate or rounded, apex curving into an acute apiculum, midrib slightly channeled above, prominent below, lateral veins rather obscure, upper surface of mature leaves glabrous or with sparse remnants of small stellate hairs, lower surface covered with a dense fine greyish white felt of stellate hairs; petiole to 5 mm long, puberulous. *Inflorescence*: axillary, few-flowered pleiochasia, c. 2 cm long, covered with a short dense indumentum, and bearing subulate bracts; pedicels 3–7 mm. — *Male receptacle* bowl-shaped, 4–5 mm ϕ at anthesis (without the tepals) with 5 or 6 deltoid, acute tepals, outer surface densely covered with minute stellate hairs, inner surface with short simple hairs; stamens 15–20, filaments c. 0.4 mm, anthers c. 0.8 mm long. — *Female receptacle* subglobose, 2–2.5 mm ϕ , with a terminal ostiole surrounded by 5 minute obtuse tepals, indumentum of outer surface similar to that of male, inner surface covered with long simple hairs between the carpels; carpels 10–15, tapering to filiform styles which project through the ostiole. Immature *fruit* subglobose, splitting at maturity to reveal 1–5 drupes.

Distr. *Malesia*: Papua New Guinea (Central Prov.).

Ecol. Sprawling over undergrowth in montane forest or climbing to 3 m, also in disturbed forest and tree-fern savanna, 2700–2850 m.

Notes. Known only from the vicinity of Murray Pass. Features which distinguish this small-leaved montane species from *P. schoddei* are given under that species.

The flowers are described as cream, and the drupes brown on a red receptacle.

8. *Palmeria hypargyrea* PERKINS, Bot. Jahrb. 52 (1915) 215; PHILIPSON, Blumea 28 (1982) 95, f. 1a. — *P. pulleana* PERKINS, Übersicht Gattungen Monim. (1925) 43, *nomen*. — *P. habbemensis* A.C. SMITH, J. Arn. Arb. 22 (1941) 246. — *P. dallmannensis* KAN. & HAT. Bot. Mag. Tokyo 56 (1942) 254, f. 4.

Woody liane; young branches with minute stellate hairs, often 4-angled. *Leaves* elliptic or narrowly elliptic, 5–11.5 by 2.5–4.5 cm, thinly coriaceous, base cuneate or rounded, apex shortly acuminate, obtuse or acute, upper surface becoming glabrous or retaining widely spaced remnants of stellate hairs, lower surface evenly covered with a close, fine indumentum (which may become thinner on the midrib and principal veins or rarely over the surface of the blade); petiole 5–9 mm long, puberulous. *Inflorescence* axillary and terminal, pleiochasia, 4–8(–13) cm long, lateral branches few-flowered, densely covered in greyish pubescence, except that the peduncle and rachis may become glabrous or bear only sparse minute stellate hairs; small caducous bracts below the branches and some pedicels. — *Male receptacle* saucer-shaped, c. 5 mm ϕ , with 5–6 deltoid tepals,

outer surface with a short dense indumentum; stamens c. 40, sessile, c. 0.75 mm long. — *Female receptacle* ovoid, c. 1.75 mm long, outer surface with indumentum as in male, inner surface with long simple bristles; carpels usually 3; style subulate. *Fruit* not seen.

Distr. Malesia: Irian Jaya (Nabire; Lake Habbema; Hellwig Mts); Papua New Guinea (West & East Sepik and Southern Highlands Prov.).

Ecol. Scrambling in primary rain-forest or over shrubs in young regrowth, 400–2800 m.

Vern. Oberonk, Mendi.

Note. Although there is considerable variation in the size of the leaves, correlated with the unusual altitudinal range, the shape of the leaves is rather uniform and the smooth, close, but fine indumentum of the lower leaf surface and of the inflorescence is characteristic. In the original material collected by LEDERMANN the fine felt of stellate hairs has partially or completely disappeared from the lower surface of some leaves, only a few scattered, slightly larger, stellate hairs remaining. However, the typical covering of hairs has persisted in some areas. The leaves are described as greyish or whitish beneath, though some specimens from higher altitudes appear light fawn, at least when dried. The flowers are cream.

9. *Palmeria clemensae* PHILIPSON, Blumea 28 (1982) 96, f. 2. — Fig. 4.

Woody liane; young branches covered with a fulvous or creamy indumentum. *Leaves* elliptic to broadly elliptic, with an apiculum (either long and attenuate or short), 7–15 by 3.5–7.3 cm, chartaceous or slightly coriaceous base truncate or rounded, midrib and principal veins prominent below, sometimes deeply impressed above, upper surface of mature leaves with scattered remnants of stellate hairs or glabrous, lower surface densely covered with a close felt of small stellate hairs and with longer soft hairs along the veins (usually forming a prominent fringe, rarely almost absent); petiole 5–10 mm, hairy. *Inflorescence* axillary and terminal, c. 7–20 cm long, covered with a dense fulvous or creamy indumentum, narrowly paniculate, side-branches few-flowered. — *Male receptacle* bowl-shaped becoming almost a flat disk at anthesis, with 5–7 irregular tepals, c. 8–10 mm ϕ , outer surface with a dense covering of short stellate hairs, inner surface with short simple hairs between the stamens; stamens c. 30–45, with broad filaments up to 0.5 mm long, anthers 0.75–1.5 mm long; filaments and connectives hairy. — *Female receptacle* urceolate, c. 2 mm high at anthesis, outer surface with indumentum as in the male, inner surface with long simple hairs between the carpels; carpels c. 8–12, tapering to filiform style. *Immature fruit* globose with a beak (often asymmetrical); at maturity the enlarged receptacle splits open to form

c. 5 coriaceous very irregular lobes c. 2 cm long; drupes subspherical, sessile; mesocarp succulent, endocarp stony, c. 7 mm long when dry.

Distr. Malesia: Papua New Guinea (Southern Highlands, Chimbu, Eastern Highlands, Morobe and Central Provinces).

Ecol. Lower montane and mossy forest (*Castanopsis*, *Litocarpus*, *Nothofagus*, *Podocarpus*, *Libocedrus* dominated), 1200–2750 m.

Vern. Kari, Chimbu.

Note. A widespread but rather rarely collected species, distinguished by the close felt of minute stellate hairs on the undersurface of the leaves, combined with longer soft bristly hairs along the veins. The species occurs in two forms. One has rather thin leaves with a close buff felt on the lower leaf surface, and with rather few and short bristles, whereas in the other form the leaf blade is more coriaceous with the veins deeply impressed above, the felt is paler (creamy white or fawn), and the bristles form conspicuous fringes along the veins. The second form may also have larger flowers, though the specimens available are inadequate to establish this conclusively. The first form is more frequent in the east (Morobe and Central Prov.) and the second in the west (Eastern and Southern Highlands Prov.), but in both regions specimens of both forms have been collected. The black drupes are sessile on a red torus.

10. *Palmeria womersleyi* PHILIPSON, Blumea 28 (1982) 98, f. 3. — Fig. 5.

Woody liane, repeatedly branched, often reaching the top of medium-sized trees; young branches covered with a fulvous indumentum. *Leaves* elliptic to broadly elliptic, 9–18 by 3.5–10 cm, chartaceous to coriaceous, base cuneate or rounded, apex broad with a short obtuse apiculum or more gradually narrowed to an acute apex, midrib slightly channelled above, prominent below, lateral veins c. 5, arched and meeting within the margin; upper surface of mature leaves with widely spaced remnants of stellate hairs, lower surface with a loose or close felt of stellate hairs together with a variable number of larger, more tufted, stellate hairs especially on the veins; petiole 8–17 mm long, densely covered with stellate hairs. *Inflorescences* axillary and terminal, pleiochasia, often produced profusely on short leafy lateral branches, coming to resemble panicles when the foliage abscises, covered with a short dense indumentum; pleiochasia 7–15 cm long, bearing opposite or verticillate short branches (c. 1.5–2 cm) each with a small number of flowers and minute subulate bracts mostly caducous before anthesis. — *Male receptacle* bowl-shaped, 7–9 mm ϕ at anthesis (without the tepals), with 5–7 irregular tepals eventually opening to disclose the numerous (30–40) stamens, outer surface with a dense covering of small stellate

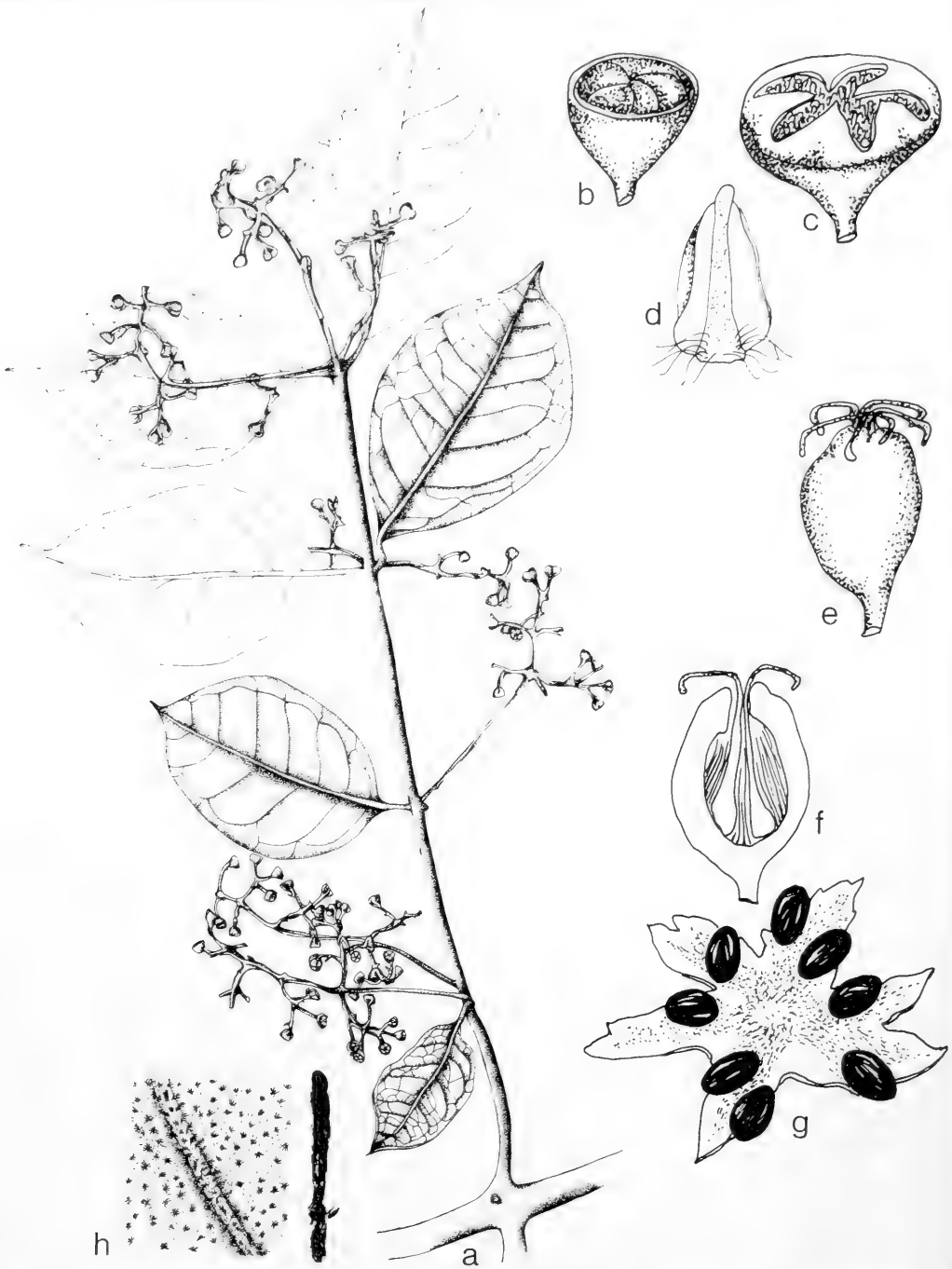


Fig. 5. *Palmeria womersleyi* PHILIPSON. *a*. Habit of male twig, $\times 1/2$, *b*. bud of male flower, *c*. same at anthesis, both $\times 6$, *d*. anther, $\times 15$, *e*. female flower, *f*. same in LS, both $\times 6$, *g*. receptacle, bearing achenes, nat. size, *h*. portion of lower surface of leaf, $\times 5$ (*a-c* HOOGLAND & SCHODDE 6787, *d* NGF 14005, *e-f* PHILIPSON 3721, *g* HOOGLAND & PULLEN 5429, *h* PHILIPSON 3690).

hairs, inner surface with very short simple hairs; anthers sessile, c. 0.75–1.25 mm long, the connective sometimes with short hairs at the base and apex. — *Female receptacle* cup-shaped, 2–3 mm ϕ at anthesis, upper surface concave with a small central ostiole, outer surface with indumentum as in male, inner surface covered with long simple hairs between the carpels; carpels c. 10–12, distributed over the inner surface of the receptacle, tapering to filiform styles (c. 2 mm long) which project through the ostiole, becoming reflexed. Immature *fruit* subspherical with an unusually asymmetric beak developed from the tepals; at maturity the enlarged receptacle ruptures irregularly to form c. 4–6 coriaceous arms 2–2.5 cm long to which the ripe achenes are attached; drupes spherical, sessile, with a shining black surface, mesocarp succulent, endocarp stony, 7 mm when dry.

Distr. Malesia: Papua New Guinea (Enga, Southern Highlands, Western Highlands and Eastern Highlands Provinces).

Ecol. A liane copiously branched over low shrubs or climbing high on forest trees in primary or secondary forest or open scrub, 1800–2600 m.

Uses. Leaves used for smoking (Wabag).

Vern. *Kombendegambeka*, Hagen, Towopa, *noldunkan*, Whaji, Minj, *hakappa*, Mairi, Watabung, *kibekelakkan*, Chimbu, Masul.

Note. A moderately large-leaved species which may be recognized by the close covering of stellate hairs on the lower leaf surface which are fulvous or rufous at least in dried specimens. The hairs are of two sizes: the smaller more numerous and forming a general felted tomentum; the larger more widely spaced and giving the leaf surface and especially the principal veins a tufted appearance. In fresh material the pubescence on the lower leaf surface appears either olive green, fulvous or rufous. Flowers fragrant, stamens white. Fruit with mature torus green outside and pink to bright red within; drupes black.

11. *Palmeria schoddei* PHILIPSON, *Blumea* 28 (1982) 100, f. 1c.

Woody liane to 25 m high, with slender branches

covered with a rough fulvous indumentum of stellate hairs. *Leaves* ovate, 3.3–6 by 1.5–2.5 cm, chartaceous, base rounded, narrowed to an acute apex, midrib slightly channelled above, prominent below, lateral veins conspicuous, upper surface of mature leaves with widely spaced remnants of small stellate hairs, lower surface covered with dense indumentum of small fulvous stellate hairs, with scattered slightly larger stellate hairs along the principal veins; petiole 7–10 mm long, covered in stellate hairs. *Inflorescence:* axillary, few-flowered pleiochasia, up to 5.5 cm long, covered with a dense fulvous tomentum and bearing subulate caducous bracts; pedicels opposite or subopposite, c. 5–7 mm. — *Male receptacle* bowl-shaped, c. 7 mm ϕ at anthesis (without the tepals) with 5 or 6 deltoid tepals, outer surface densely covered with an uneven stellate indumentum, inner surface with short simple hairs; stamens 20–25, with short filaments, anthers c. 0.8– mm long. — *Female flowers* not seen. Mature *fruits* with irregular coriaceous receptacular lobes 2 cm long, bearing sessile drupes 0.8 cm ϕ when dry.

Distr. Malesia: Papua New Guinea (Southern Highlands and Western Highlands Provinces).

Ecol. In forest climbing to 8 m or scrambling over low scrub at the margin of grassland, 2700–2900 m.

Vern. *Obe*, *yaso*, Mendi, *kena'ugl*, Enga, *dekaruek*, Melpa.

Note. Similar to *P. montana* A.C. SMITH, a montane species from the Wharton Range, but distinguished by leaf shape and size (larger and lacking an apiculum); coarser indumentum on the midrib; and by the larger flowers.

Insufficiently known

Palmeria hypochrysea PERKINS, *Bot. Jahrb.* 52 (1915) 215.

The species is known only from the type specimen (LEDERMANN 12404) which was destroyed during world war II. The description does not appear to fit any known species.

3. LEVIERIA

BECC. *Malesia* 1 (1877) 192; PERKINS & GILG, *Pfl. R.* Heft 4 (1901) 20; PERKINS, *Bot. Jahrb.* 52 (1915) 192; Übersicht Gattungen Monim. (1925) 20; PHILIPSON, *Blumea* 26 (1980) 373, f. 1–16. — **Fig. 6–8.**

Trees or shrubs, rarely climbing. *Leaves* exstipulate, glabrous when mature or more or less pubescent below, entire or dentate. Dioecious, with terminal or lateral cymose inflorescences. — *Male flowers* with a small receptacle bearing 8 rounded tepals enclosing numerous almost sessile stamens; connective project-



Fig. 6. *Levieria squarrosa* PERKINS. a. Twig of male plant (western form), $\times 1/2$, b. male flower, $\times 5$, and stamen, c. twig of female plant (eastern form), $\times 1/2$, d. female flower, $\times 4$, and in LS, $\times 5$, e. fruit, $\times 3/4$ (a PULLEN 5227, b BRASS 29090, c-d WOMERSLEY & FLOYD 6908).

ing; anthers opening up by longitudinal slits. — *Female flowers* ± globose with a small ostiole bounded by 4 irregular tepals. The margin of the receptacle soon becoming reflexed to expose the ovoid sessile drupes.

Distr. Queensland and *Malesia*: Celebes, Moluccas (Ceram, Ambon), New Guinea (incl. the Bismarck Archipelago).

Ecol. Mainly in lower montane rain-forest, between 1200 and 3000 m but descending to sea-level. Frequent in the shrub layer and lower canopy of rain-forest; persisting in regrowth areas, more rarely on shrubby hill-sides.

Note. Male plants of the genus may be recognized by the separate rounded tepals borne on a very small receptacle. Female plants in flower and fruit are distinguished by the developing drupes becoming exposed by a curling outwards of the receptacle together with the tepals on its margin. This type of fruit development distinguishes the *Hedyccaryae* from other tribes of the family. In the *Mollinedieae* the tepals and the upper part of the receptacle fall as a calyptra after flowering, leaving a distinct circular abscission scar. In the *Monimioideae* the receptacle encloses the developing carpels until they are mature.

KEY TO THE SPECIES

1. Undersurface of mature leaf glabrous.
 2. Leaves obovate or narrowly elliptic 1. *L. squarrosa*
 2. Leaves broadly elliptic to elliptic.
 3. Leaf about 5 cm long, or shorter 2. *L. orientalis*
 3. Leaf about 7 cm long, or longer 3. *L. nitens*
1. Undersurface of mature leaf with some indumentum (at least a few hairs at the base of the midrib).
 4. Indumentum of lower leaf surface confined to the midrib.
 5. Liane with small leaves (3 cm long, or less) 4. *L. scandens*
 5. Trees or shrubs, leaves longer than 3 cm.
 6. Lateral veins clearly defined, blade usually rhombic or obovate 1. *L. squarrosa*
 6. Lateral veins indistinct, blade narrowly elliptic 5. *L. acuminata*
 4. Indumentum of lower leaf surface extending to the lateral veins (and sometimes to the whole lamina).
 7. Leaf with a long narrow apiculum; blade small (usually 7 by 2.5 cm) 5. *L. acuminata*
 7. Apiculum, if present, shorter; blade larger (usually more than 8 cm long).
 8. Leaf oblong, hairs mostly straight and often sparse 6. *L. montana*
 8. Leaf obovate, hairs crisped and usually copious 7. *L. beccariana*

1. *Levieria squarrosa* PERKINS, Bot. Jahrb. 52 (1915) 196; A.C. SMITH, J. Arn. Arb. 22 (1941) 232; PHILIPSON, Blumea 26 (1980) 377, f. 1, 8, 9, 14. — *L. parvifolia* A.C. SMITH, J. Arn. Arb. 22 (1941) 233. — *L. montana* (non BECC.) KANEH. & HATUS. Bot. Mag. Tokyo 56 (1942) 249, f. 2. — Fig. 6.

Sparingly branched shrub or small tree, occasionally to 18 m; stems more or less densely covered with minute hairs at least when young, often becoming glabrous. Leaves chartaceous, obovate, or rhombic, 3–12 by 1–4 cm, in two principal forms with intermediate states frequent: 1) apex rounded or subacute, margin entire, glabrous; 2) with an acute apiculum, upper part of margin dentate, midrib below with obscure minute appressed hairs (rarely with dense but very short crisped hairs); midrib prominent, lateral veins arched and meeting within the margin; petiole 4–8 mm long, glabrous or minutely hairy. Dioecious. — *Male inflorescence* either small lateral pleiochasia (up to c. 4 cm long) or terminal

pleiochasia or panicles (up to c. 8 cm long); rachis and branches of panicles with a few pairs of pedicels (c. 8 mm long) and a terminal flower, minutely hairy, and with pairs of small lanceolate bracts below the pedicels and sometimes along the peduncle and rachis. — *Male flowers* more or less globose, 7 mm ø; receptacle small, bearing 8 tepals; 4 outer tepals rotund, subcoriaceous, with sparse hairs on the outer surface; 4 inner smaller, narrower, membranaceous, glabrous. *Stamens* numerous (c. 25 or more); connective acuminate; anthers subsessile, loculi lateral, separate. — *Female flowers* lateral or terminal, solitary or in few-flowered racemes (c. 4 cm long); receptacle coriaceous, broadly cupuliform (5–8 mm ø) with an irregularly cleft mouth (4 tepals may be more or less clearly defined); carpels numerous (c. 25 or more), c. 2 mm long, densely packed over the receptacle, obovoid, truncated distally and bearing a short style. *Drupes* numerous, ovoid, apex acute, glabrous, c. 9 by 5 mm when dry, sessile on a re-

curved leathery pilose receptacle.

Distr. *Malesia*: New Guinea (Vogelkop Peninsula to Owen Stanley Range).

Ecol. A laxly branched shrub in the undergrowth of rain-forest, sometimes semi-scandent, or a lower-storey tree up to 18 m high with rather dense leafy branches. Above 1800 m, ascending to 3000 m (rarely descending to 250 m). Montane and mossy forests of varying composition (*Podocarpus*, *Libocedrus*, *Nothofagus*, *Castanopsis*) and also in regrowth and marginal forest.

Vern. *Ang*, Hindenburg Ra., *eberak*, *mungomunk*, *tantan*, Mendi, *lekiem*, Kapauku, *kalipka*, *main-gobugont*, Minj, *kammakam*, *kamokam*, *Enga*, *kip*, *kunguma*, Togoba, *kolkola*, Eipomek, *kombo*, Onim, *timonksagu*, Wabag.

Notes. The bark is grey-brown, smooth with very shallow fissures; inner bark pinkish brown. The wood is heavy, light brown with wide, pale rays. Flowers yellowish green, drupes orange to reddish black on yellow receptacle.

The leaf shape is extremely variable, at first suggesting that two species are involved. Obtuse, entire, glabrous leaves occur in the eastern portion of New Guinea, whereas apiculate, dentate and obscurely tomentulose leaves occur towards the west. There is, however, a considerable area of overlap of the two forms (mainly between 144° E and 146° E) and in this region leaves with intermediate characters are abundant. Thus, although all specimens from the two ends of New Guinea are quite distinct in several characters, these two forms are connected by a broad zone in which it is impossible to separate them.

2. *Levieria orientalis* PHILIPSON, *Blumea* 26 (1980) 377, f. 2.

Tree to 10 m, shoots glabrous except for the youngest parts. *Leaves* glabrous, chartaceous, broadly elliptic or elliptic, c. 5 by 2.5 cm, broadly cuneate at the base, rounded apex produced in a short obtuse apiculum; margin with few widely spaced teeth; midrib prominent below; lateral veins rather obscure, arched and meeting within the margin; petiole 5–8 mm. Probably dioecious. Male flowers not seen. *Inflorescence* of terminal and lateral few-flowered cymes or flowers solitary. — *Female flowers* with a glabrous, coriaceous, globose receptacle, c. 3 mm \emptyset , the ostiole small with obscure tepallobes; carpels c. 20, densely packed over the receptacle, ovoid with a short style. *Drupes* ovoid, c. 8 by 6 mm, sessile on a reflexed sparsely hairy receptacle.

Distr. *Malesia*: Papua New Guinea (Milne Bay Prov.: Goodenough I.).

Ecol. A much branched tree, 8–10 m, occurring at the edge of forest at 1500 m.

Note. Drupes black on a yellow receptacle. The

glabrous, broad elliptic leaves suggest *L. nitens*, but are much smaller, and their short apiculum is obtuse.

3. *Levieria nitens* PERKINS in Perkins & Gilg, *Pfl. R. Hef* 4 (1901) 21, f. 3r–s; *Pfl. R. Hef* 49 (1911) 7, f. 3R–S; *Bot. Jahrb.* 52 (1915) 197, f. 3, 15; A.C. SMITH, *J. Arn. Arb.* 22 (1941) 232; PHILIPSON, *Blumea* 26 (1980) 379. — *Steganthera schlechteri* PERKINS, *Pfl. R. Hef* 49 (1911) 2 (*non L. schlechteri* PERKINS). — *L. rudolfii* PERKINS, *Bot. Jahrb.* 52 (1915) 196. — *Steganthera elliptica* A.C. SMITH, *J. Arn. Arb.* 22 (1941) 236.

Moderate to large tree, reaching 45 m; bole 25 m, buttressed, dbh 1 m, or a shrub sometimes with semi-scandent branches; young shoots with appressed, often golden hairs. *Leaves* glabrous, chartaceous, elliptic, broadly elliptic or oblong, 7–17 by 2.5–6 cm; base cuneate or attenuate; apex produced as an apiculum; margin entire or occasionally with a few small teeth; midrib prominent; lateral veins usually indistinct, arched and meeting within the margin; petiole 1–1.5 cm. Dioecious. *Inflorescence* of lateral or terminal pleiochasia or usually finely branched panicles, minutely hairy, c. 10–15 cm long; rachis bearing pairs or whorls of branches subtended by small bracts. — *Male flowers* globose, 3–4 mm \emptyset ; receptacle small; tepals 8, rounded; stamens numerous, connective projecting, anthers sessile. — *Female flowers* with a coriaceous cupuliform receptacle, c. 4 mm \emptyset , with an irregularly cleft ostiole; carpels numerous, densely packed over the receptacle, ovoid with short style. *Drupes* numerous, ovoid, 8–10 by 4–5 mm (when dry), sessile on a leathery, pilose receptacle with a reflexed margin.

Distr. *Malesia*: New Guinea (Vogelkop Peninsula to Huon Peninsula and Tufi).

Ecol. A tree to 45 m, though normally smaller and even shrubby; the branches sometimes sprawling or semi-scandent. Montane and mossy forest, associated with *Nothofagus*, *Castanopsis*, *Lithocarpus*, etc., also in regrowth and on scrubby slopes. Usually 500–1800 m, but occasionally descending almost to sea-level.

Notes. Bark smooth or becoming fissured, olive- or grey-brown; under bark pinkish. Wood soft, straw coloured, with large rays. Flowers greenish cream, drupes orange to black on yellow or orange receptacles.

The mature leaves are entirely glabrous, even at the base of the midrib, a character found in other *Levieria* species only in *L. orientalis* (which has smaller leaves and is confined to Goodenough I.) and in some specimens of *L. squarrosa* (which has leaves of a different shape). The lamina of *L. nitens* is broadly elliptic and apiculate, whereas that of *L. squarrosa* is narrowly obovate or elliptic and usually obtuse and not apiculate (in glabrous forms). Confusion is more

likely to occur between *L. nitens* and *L. montana*. In the latter species the leaf shape is often very similar to that of *L. nitens* and the inconspicuous hairs of the leaf may be confined to the underside of the midrib and may be largely lost by abrasion.

4. *Levieria scandens* PHILIPSON, *Blumea* 26 (1980) 381, f. 4, 10.

A woody liane, lateral shoots c. 1.5 mm ϕ , when young densely covered with minute appressed hairs. *Leaves* closely set along the branches; chartaceous, lanceolate to lanceolate-ovate, 2.5–3 by 0.8–1 cm, rounded or cuneate at the base, narrowed to a mucronulate apex; margin subrevolute with few irregular teeth; midrib prominent below, with a few obscure hairs on its lower part; lateral veins obscure; petiole c. 2 mm long, bearing minute hairs. Probably dioecious, female flowers not seen. *Inflorescence* usually of simple dichasia, minutely hairy, terminating the lateral branches and in their upper axils. — *Male flowers* globose, 2 mm ϕ (in bud); tepals 8, rounded, borne on a small receptacle; stamens c. 20, connective projecting, obtuse, anthers sessile.

Distr. Malesia: Papua New Guinea (West Sepik Prov., Telefomin Subprov.).

Ecol. Liane in montane forest, at 2100 m.

Note. The small lanceolate-ovate leaves are unmatched in any other species of the genus. Other species occasionally show straggling growth, but this species appears to be a true liane.

5. *Levieria acuminata* (F. v. M.) PERKINS, *Bot. Jahrb.* 25 (1898) 570; PHILIPSON, *Blumea* 26 (1980) 382, f. 5, 11. — *Mollinedia* ? *acuminata* F. v. M. *Fragm.* 5 (1866) 155.

Small tree to 15 m high; young shoots minutely pubescent. *Leaves* elliptic, c. 7–10 by 2–4 cm, membranous; base cuneate or attenuate; apex prolonged as a narrow acute apiculum; margin entire or with small teeth; midrib prominent; lateral veins indistinct, arched and meeting within the margin; midrib bearing inconspicuous hairs, or the whole lower surface finely tomentose; petiole 10–15 mm, usually glabrous. Dioecious. *Inflorescence* of terminal and axillary pleiochasia or panicles, the male being more finely branched and usually larger than the female, pubescent, rachis bearing pairs of small bracts. — *Male flowers* globose, 3–4 mm ϕ ; tepals c. 8, the outer broad and rounded; stamens numerous (c. 20–40), crowded on a small receptacle, connective projecting, reflexed, obtuse, anthers sessile. — *Female flowers* with a coriaceous, globose receptacle, c. 3 mm ϕ , the ostiole with 4 irregularly cleft tepals; carpels numerous, densely packed over the receptacle, ovoid with a short style; drupes ovoid, sessile on a reflexed receptacle.

Distr. Australia (N. Queensland) and *Malesia:*

Papua New Guinea (Central and Morobe Prov.).

Ecol. Small tree to 15 m, in primary rain-forest or second growth, 1200–3000 m, but descending to near sea-level in Queensland. The cream or greenish flowers are fragrant.

Note. This extension of the range of a Queensland species is based on five collections made by CARR in 1935–1936 and two collections by SCHODDE & CRAVEN in 1966. While some collections match Queensland specimens closely, others differ in the greater extent of the pubescence on the lower leaf surface.

6. *Levieria montana* BECC. *Malesia* 1 (1877) 193; PERKINS & GILG, *Pfl. R. Heft* 4 (1901) 21; PERKINS, *ibid.* Heft 49 (1911) 9; *Bot. Jahrb.* 52 (1915) 197; PHILIPSON, *Blumea* 26 (1980) 382, f. 6, 12. — *L. schlechteri* PERKINS, *Pfl. R. Heft* 49 (1911) 7. — *L. urophylla* PERKINS, *Bot. Jahrb.* 52 (1915) 93, f. 1. — *L. laxiflora* PERKINS, *l.c.* 195.

Shrub, sometimes semi-scandent, or small tree to 15 m high; young shoots densely covered with minute appressed hairs. *Leaves* membranaceous, broadly to narrowly oblong or elliptic, 4.5–13 by 1.5–6 cm; base acute or obtuse; apex narrowed more or less abruptly into an acute or obtuse apiculum; margin entire or occasionally with a few small teeth; midrib prominent; lateral veins arched and meeting within the margin; the midrib below bearing minute crisped or straight hairs, which usually extend on to the lateral veins and occasionally on to the entire lower surface of the lamina; petiole 6–14 mm. Dioecious. — *Male inflorescences* axillary and terminal, paniculate, 10–15 cm long, densely and minutely hairy; the rachis bearing pairs of pleiochasial branches subtended by small bracts. — *Male flowers* globose, 4–7 mm ϕ , receptacle small; tepals 7–8, outer rounded, subcoriaceous, hairy, inner smaller, membranaceous; stamens 25–50, connective projecting, anthers subsessile. — *Female inflorescence* similar to male or simple axillary and terminal racemes. — *Female flowers* with a coriaceous, globular, cupuliform receptacle, 5–8 mm ϕ , aperture irregularly cleft; carpels numerous, densely packed over the receptacle, ovoid with a short style. *Drupes* numerous, ovoid, 8 by 5 mm when dry, sessile on a leathery, pilose receptacle with a reflexed margin.

Distr. Malesia: Celebes, Moluccas (Ceram Ambon), New Guinea (Biak, Vogelkop, NW, Irian, Sepik Prov., Chimbu Prov., Finisterre Range, Huon Peninsula, Wagau-Garaina region of Morobe Prov.).

Ecol. A slender shrub, sometimes semi-scandent or epiphytic, or a small tree with drooping branches. In forest or scrub, often in lower montane rain-forest, 1200–1900 m, but in the western part of its range (NW, Irian, Biak, Moluccas) also near sea-level.

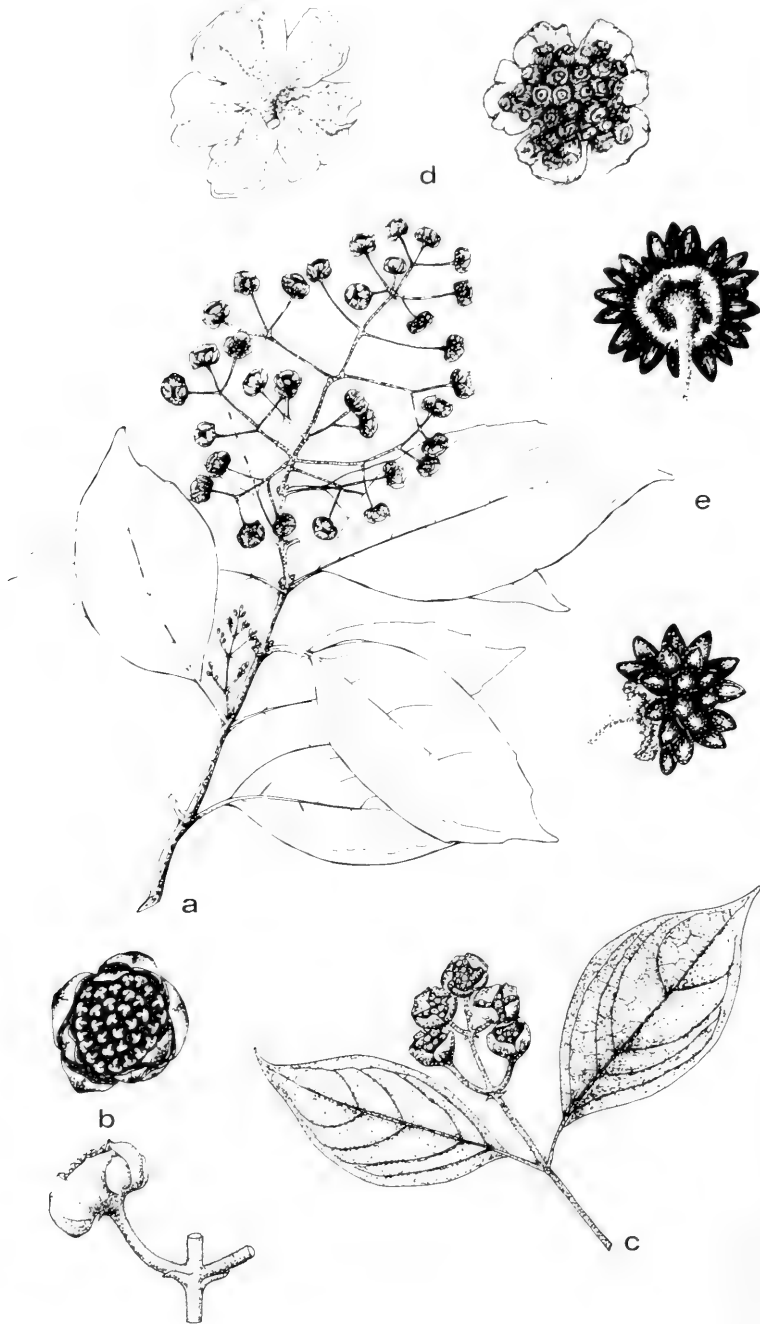


Fig. 7. *Levieria beccariana* PERKINS. a. Habit of male plant, $\times 1/2$, b. male flower, from side, $\times 3$, and from top, $\times 4$, c. twig of female plant, $\times 1/2$, d. female flowers after anthesis, $\times 1 1/4$, e. fruits, from behind and side, nat. size (a FISHER 83, b PULLEN 7910, c NGF 23781, d-e FLOYD & HOOGLAND 3997).

Uses. In the southern foothills of the Finisterre Range shrubs are preserved by villagers because the conspicuous pendulous fruits attract birds which are then shot from cover.

Vern. *Dandanggu*, Naho lang., *hoppetu*, Wagu, *mardichber*, *mardieber*, *mardiewer*, Biak, *woisingai*, Wasuk.

Notes. The bark is smooth grey-brown or fawn. The flowers are light yellow and the mature drupes are bright orange or deep purple, borne on firm fleshy yellow or orange-brown receptacles. The leaf is characteristically oblong-elliptic and apiculate, with short crisped or appressed hairs along the lower surface of the midrib, and sometimes also on the lateral veins, or even on the lower surface of the lamina. The degree of hairiness is variable, being most strongly developed on the type from the Arfak Mts. Size of the lamina and the degree of dentation of its margin are also variable. Leaves of juvenile shrubs are larger, broader, thinner in texture, and more dentate than those of adults.

PERKINS (1915) did not have the type of *L. montana* BECC. available when describing *L. urophylla* and was herself doubtful of the distinctness of this species. Unaccountably, she regarded *L. montana* as

glabrous, although the original description clearly refers to the indumentum of the lower surface of the leaf. There has been some confusion also concerning the use of the name *L. schlechteri* PERKINS. The type specimen is given as SCHLECHTER 17176, and is described as having glabrous leaves when mature. However, the labels of this number are named *L. laxiflora* PERKINS and the midribs bear minute hairs (in some specimens rather severely abraded). *Levieria schlechteri*, therefore, is here regarded as synonymous with *L. montana*.

7. *Levieria beccariana* PERKINS in Perkins & Gilg, Pfl. R. Heft 4 (1901) 21; *ibid.* Heft 49 (1911) 8, f. 3P-Q; Bot. Jahrb. 52 (1915) 193; PHILIPSON, Blumea 26 (1980) 383, f. 7, 13, 16. — *L. forbesii* PERKINS, Pfl. R. Heft 49 (1911) 7, f. 3L-O. — Fig. 7, 8.

Tree to 20 m, or shrub, sometimes semi-scandent; young shoots densely covered with minute hairs. Leaves chartaceous, broadly to narrowly obovate or elliptic, 6–15 by 2.6–7 cm; base cuneate; apex usually acute apiculate, sometimes obtuse; margin entire or occasionally dentate in its upper part; midrib prominent; lateral veins approaching the margin, the lower veins often ascending well beyond the middle



Fig. 8. *Levieria beccariana* PERKINS. In fruit. Papua New Guinea (Photogr. PHILIPSON).

of the blade; whole undersurface often russet or fawn, more or less densely covered in short curled or rarely lax hairs, or these confined to the principal veins; petiole 8–15 mm long, pubescent or glabrescent. Dioecious. *Inflorescence* of terminal and axillary panicles, those in the upper axils often combining to form a massive compound leafy panicle, the male rather more finely branched than the female; rachis bearing pairs of pleiochasial branches subtended by small bracts, tomentose. — *Male flowers* globose, 4–6 mm ϕ ; receptacle small; tepals rounded; stamens numerous, connective projecting, anthers sessile. — *Female flowers* with a coriaceous cupuliform receptacle 5–8 mm ϕ , with 4 irregularly cleft tepals; carpels numerous (c. 20–100), densely packed over the receptacle, ovoid with a short style. *Drupes* numerous, ovoid, 8 by 5 mm when dry, sessile on a leathery pilose receptacle with a reflexed margin.

Distr. Malesia: Papua New Guinea (on the central ranges from the Telefomin area to Milne Bay). This species does not overlap the range of *L. montana* except in the Wagau-Garaina area.

Ecol. Tree to 20 m, with a clear bole 30 cm ϕ and pendulous branches, or a slender, sometimes semiscandent shrub, occurring in montane and mossy forest of varying composition (*Nothofagus*, *Casta-*

nopsis, *Araucaria*); also in regrowth, 1200–2800 m.

Vern. *Dangrumon*, Chimbu, *gokey*, Wagau, *homa*, Hademari, *kiangap*, *komali*, Enga, *kombo kombo*, Upper Kangel, *lupulupu*, Sirunki, *matam-matam*, Managalese, *tangitang*, Tomba, *tsuk*, Porget, *ungude*, Oksapmin.

Notes. Bark smooth with very small fissures, greyish or reddish brown; inner bark pinkish, aromatic. Wood brittle, cream-brown, with prominent rays. Flowers greenish yellow, drupes orange to black on a yellow receptacle. The leaves are characteristically obovate with the lower veins ascending for much of the length of the lamina, but elliptical leaves and more spreading lateral veins are not infrequent. The midrib and lateral veins are usually densely clothed with minute crisped, often russet or fawn tomentum, and this frequently covers (if only sparsely) the whole lamina. These hairs may be short and crisp as in the type, or longer and more lax (as in the type of *L. forbesii*), but these differences are not considered of specific importance. One or two collections in which the tomentum is practically confined to the midrib approach rather closely to *L. montana* BECC. Since these specimens are from the region where the ranges of the two species meet (the Wagau-Garaina region of Morobe Prov.) it is probable that some admixture of the two species occurs there.

4. WILKIEA

F. v. M. Trans. Phil. Inst. Vict. 2 (1858) 64; PERKINS, Bot. Jahrb. 25 (1898) 569, t. 6D–E; PERKINS & GILG, Pfl. R. Heft 4 (1901) 57, f. 14–15; PERKINS, *ibid.* Heft 49 (1911) 26; Übersicht Gattungen Monim. (1925) 37; PHILIPSON, Blumea 26 (1980) 365, f. 1–5. — **Fig. 9.**

Shrubs or trees with opposite or verticillate, entire or serrate *leaves*. — *Male receptacle* \pm globose with small tepals surrounding an ostiole; stamens up to c. 30 irregularly spaced over the receptacle; anthers with a single horizontal or horseshoe-shaped slit. — *Female receptacle* \pm globose with tepals surrounding a small ostiole, thickened glands within the ostiole; carpels numerous (up to c. 100), sessile on the lower half of the receptacle, style subulate; upper half of the receptacle becoming detached by a circular scar. *Drupes* sessile or shortly stipitate.

Distr. Eastern Australia and *Malesia:* E. Papua New Guinea.

Ecol. In Malesia in montane rain-forest.

Note. One species occurs in Papua New Guinea, the genus otherwise being confined to Queensland and New South Wales. For separation of *Wilkiea* from *Kibara* see that genus.

1. *Wilkiea foremanii* PHILIPSON, Blumea 26 (1980) 365, f. 1–5. — **Fig. 9.**

Tree, densely hairy in all its parts. *Leaves* elliptic to elliptic-oblong, base rounded, apex rounded with

an apiculum to attenuated, margin entire, midrib prominent, main lateral veins c. 4–6 pairs, arched-ascending; petiole 7–10 mm. *Flowers* axillary, singly or in few-flowered cymes; peduncles (or pedicels)

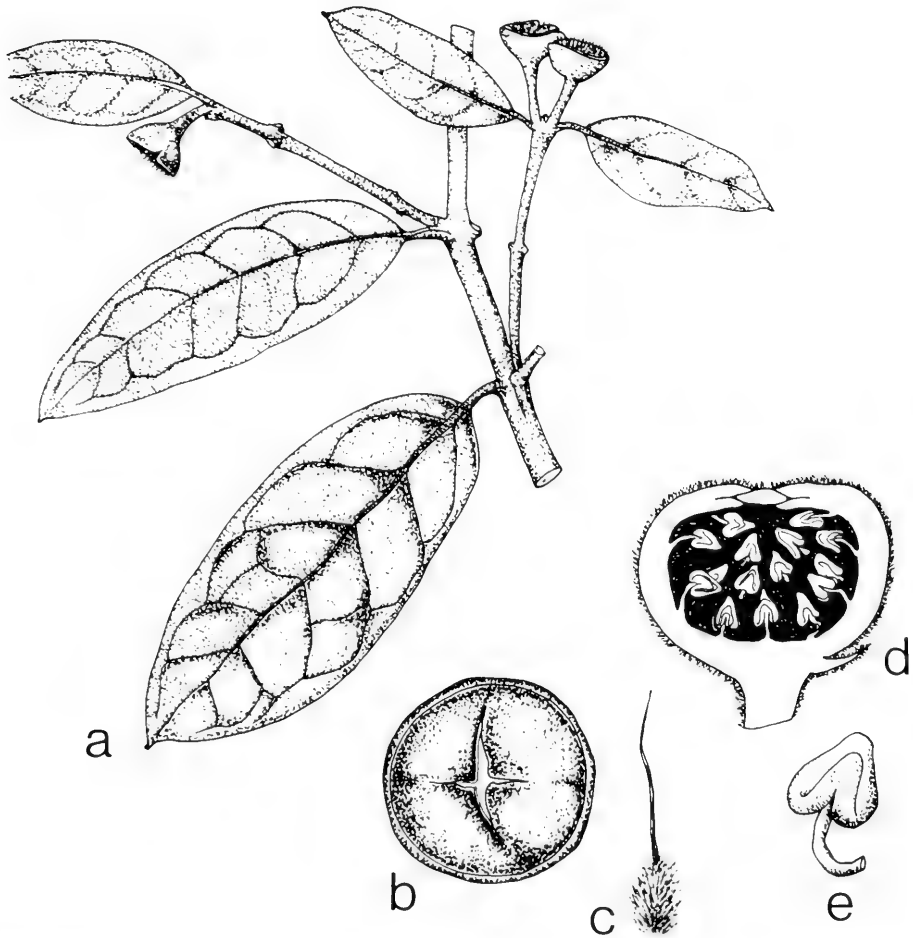


Fig. 9. *Wilkiea foremanii* PHILIPSON. *a.* Twig with female flowers, at time of abscission of calyptra, $\times 1/2$, *b.* calyptra, seen from above, $\times 2$, *c.* carpel with filiform style, $\times 5$, *d.* male flower, in LS, after dehiscence of anthers, $\times 5$, *e.* stamen, $\times 12\ 1/2$ (*a-c* NGF 48404, *d-e* FRODIN 672).

stout, up to 4 cm long, often with the scars of two bracts below the flower. — *Male flowers* globose with an ostiole surrounded by 6 tepals (4 + 2), *c.* 7 mm ϕ at anthesis; stamens *c.* 18–30, inserted over the inner surface of the receptacle, filaments *c.* 1 mm long, anther triangular, *c.* 1 mm long. — *Female flowers* globose, *c.* 10–15 mm ϕ at anthesis, leathery, hairy within, tepals 4, the upper half of the receptacle becoming detached after anthesis by a circular scar;

carpels numerous (*c.* 75–100), sessile on the lower half of the receptacle, 1.5 mm long, pubescent; style slender, 5 mm. Ripe fruit unknown.

Distr. *Malesia*: Papua New Guinea (Central Prov., Goilala Distr.).

Ecol. A small tree with light green, very hairy leaves (fulvous when dry), in mid-montane forest or regrowth, 2400–2600 m.

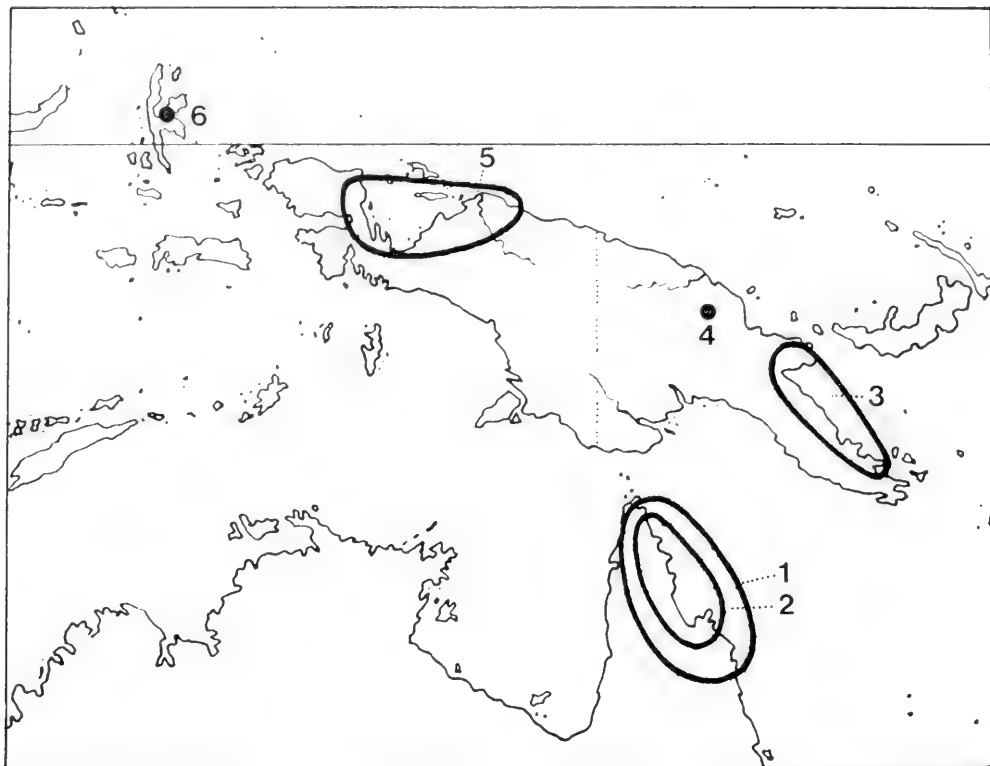


Fig. 10. Range of distribution of six monotypic genera of *Mollinedieae*. 1. *Tetrasyandra*; 2. *Austromatthaea*; 3. *Kairoa*; 4. *Lauterbachia*; 5. *Faika*; 6. *Parakibara*.

5. FAIKA

PHILIPSON, *Blumea* 30 (1985) 417, f. 1–2. — **Fig. 11, 12.**

Small tree with villose young branches and leaves. *Flowers* solitary in the leaf axils. ?Dioecious. — Receptacle of *male flower* ovoid, with a large ostiole surrounded by 3 decussate pairs of tepals. Stamens *c.* 24, inserted over the inner surface of the receptacle, anthers opening by two vertical slits; filament short. — Receptacle of *female flower* turbinate, with *c.* 5 decussate pairs of tepals (the inner swollen and glandular) and with 2–3 pairs of bracts at its base or on the lower outer surface, the upper part abscissing as a calyptra after anthesis, inner surface setulose. *Carpels* numerous, sessile, with a long subulate style stigma.

Distr. *Malesia*: W. New Guinea (Vogelkop Peninsula to the Cyclops Mts). Monotypic. Fig. 10. Ecol. In rain-forest.

1. *Faika villosa* (KANEH. & HATUS.) PHILIPSON, *Blumea* 30 (1985) 420. — *Stegantthera villosa* KANEH. & HATUS. *Bot. Mag. Tokyo* 50 (1942) 259, f. 7. — **Fig. 11, 12.**

Shrub or small tree, to 3 m; shoots densely villose.

Leaves oblong-elliptic, 24–44 by 6.5–13 cm, chartaceous, base cordate, apex apiculate, acute, bristly along the veins and on both surfaces, but the upper surface becoming ± glabrous, except for the midrib; midrib, lateral veins and reticulation prominently

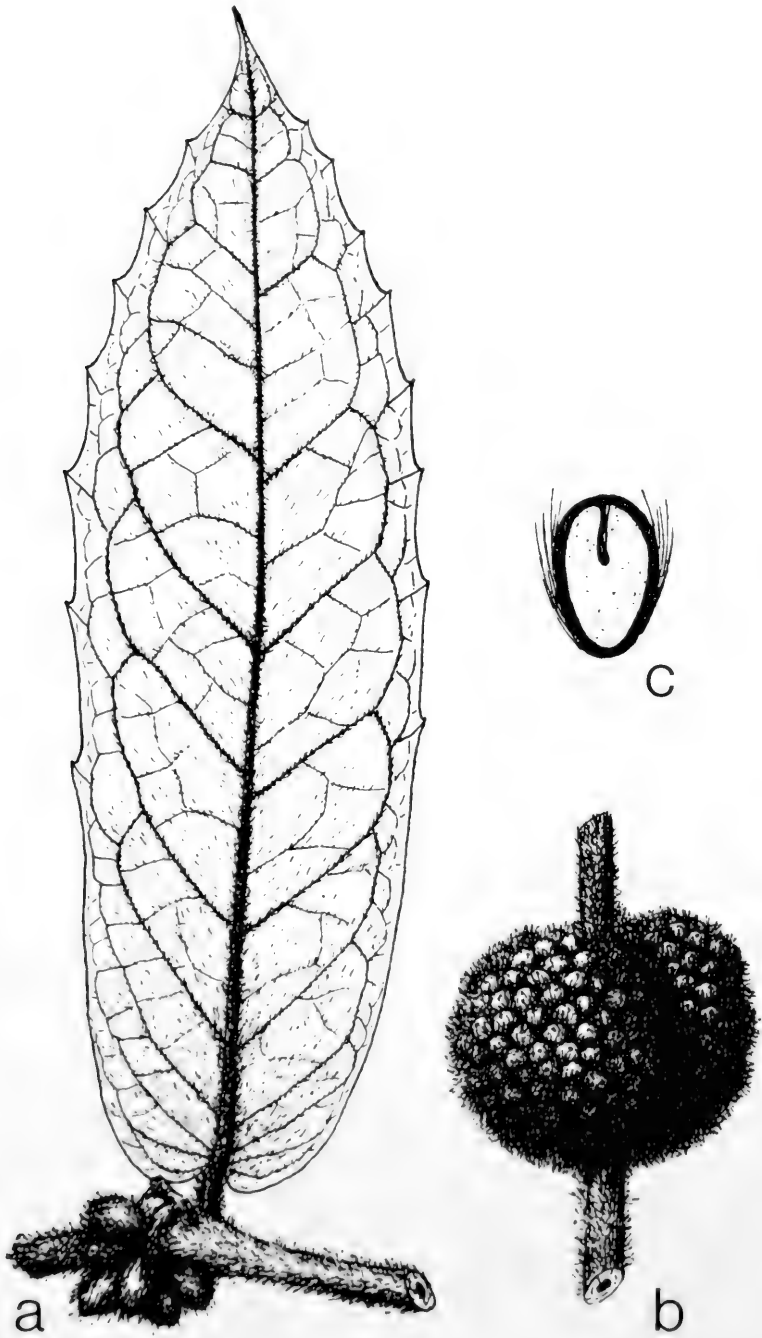


Fig. 11. *Faika villosa* (KANEH. & HATUS.) PHILIPSON. a. Habit, $\times 0.6$, b. young infructescence, $\times 0.8$, c. seed in LS, $\times 1.6$ (KANEHIRA & HATUSIMA 13975).

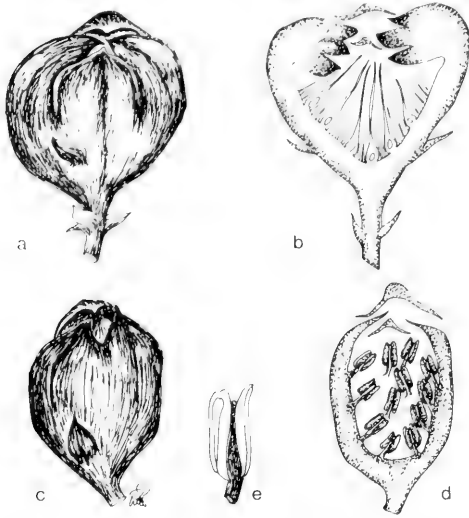


Fig. 12. *Faika villosa* (KANEH. & HATUS.) PHILIPSON. *a.* Female flower, *b.* the same in LS, *c.* male flower, *d.* the same in LS, all $\times 3 \frac{1}{4}$, *e.* stamen, $\times 10$ (*a*–*b* VAN ROYEN & SLEUMER 6082, *c*–*d* VAN ROYEN & SLEUMER 5729).

raised on the lower surface, impressed on the upper surface; petiole c. 5–6 mm, villose. *Inflorescence* axillary, flowers solitary, \pm sessile. — *Male flowers* obovoid, c. 55 mm long, glabrous, with 1–2 small triangular bracts usually near the base; tepals 6, triangular; stamens numerous (c.24) distributed irregularly over the inner surface of the receptacle, filament terete, connective separating the two anthers; anthers c. 1 mm long, each locule opening by a vertical slit. — *Female flowers* turbinate, c. 7 by 8 mm, glabrous, with 2–3 pairs of small deltoid bracts at or above the base; tepals c. 5 decussate pairs, the inner 3 pairs swollen and glandular, the inner surface setulose; carpels numerous, c. 3 mm long, sessile, with a long subulate style and stigma. *Infructescence* to c. 3 cm ϕ , woody, setulose, margin revolute; drupes ovoid, c. 15 by 10 mm, sessile, hirsute.

Distr. Malesia: West New Guinea (Vogelkop Peninsula, Wandammen Peninsula, Hollandia, Cyclops Mts). Fig. 10.

Ecol. Undergrowth in primary rain-forest, 100–1250 m.

Note. The villose stems and leaves are conspicuous. The older branches are smooth with pale grey-brown bark. The male flowers are yellowish, the female flowers orange, and the ripe drupes black.

6. PARAKIBARA

PHILIPSON, *Blumea* 30 (1985) 421, f. 3. — **Fig. 13.**

Small tree with opposite dentate leaves. *Inflorescence* an axillary fascicle. ?Dioecious. — Receptacle of *male flowers* obovoid, tepals 4; stamens c. 18, in decussate pairs inserted near the base of the receptacle; anthers opening by a single slit. — *Female flowers* and fruits not known.

Distr. Malesia: Moluccas (Halmahera). Monotypic. Fig. 10.

Note. The precise relationships of this genus cannot be determined in the absence of female flowers, but it cannot be doubted that it is a member of the *Mollinedieae*. The large and numerous stamens arranged in four regular and closely packed files are very distinctive.

1. *Parakibara clavigera* PHILIPSON, *Blumea* 30 (1985) 421, f. 3. — **Fig. 13.**

Small tree, shoots glabrous when mature. *Leaves* oblong-elliptic, c. 180 by 80 mm, stiffly chartaceous, base broadly cuneate, apex obtuse or shortly apiculate, margin irregularly dentate in the upper part, midrib and lateral veins prominent; petiole 10–12 mm. ?Dioecious. *Inflorescence* axillary, a condensed cyme forming a fascicle of a few flowers arising from a short peduncle; peduncle 2–3 mm long, with closely imbricated bracts, sparsely pubescent; pedicels c.

20 mm long, slender below but thickening towards the flower, sparingly pubescent. — *Male flower* ovoid, c. 9.5 by 6 mm; tepals 4, obtuse; stamens 3 mm long, c. 18 in decussate pairs forming 4 rows inserted on the lower part of the receptacle, filaments broad and fleshy, c. 2 mm long, sparingly pubescent, anthers erect, c. 1 mm long, triangular, opening by a single Δ -shaped slit. *Female flower* and fruit not seen.

Distr. Malesia: Moluccas (Halmahera: Pasir Putih). Fig. 10.

Vern. *O morihuhaka*.

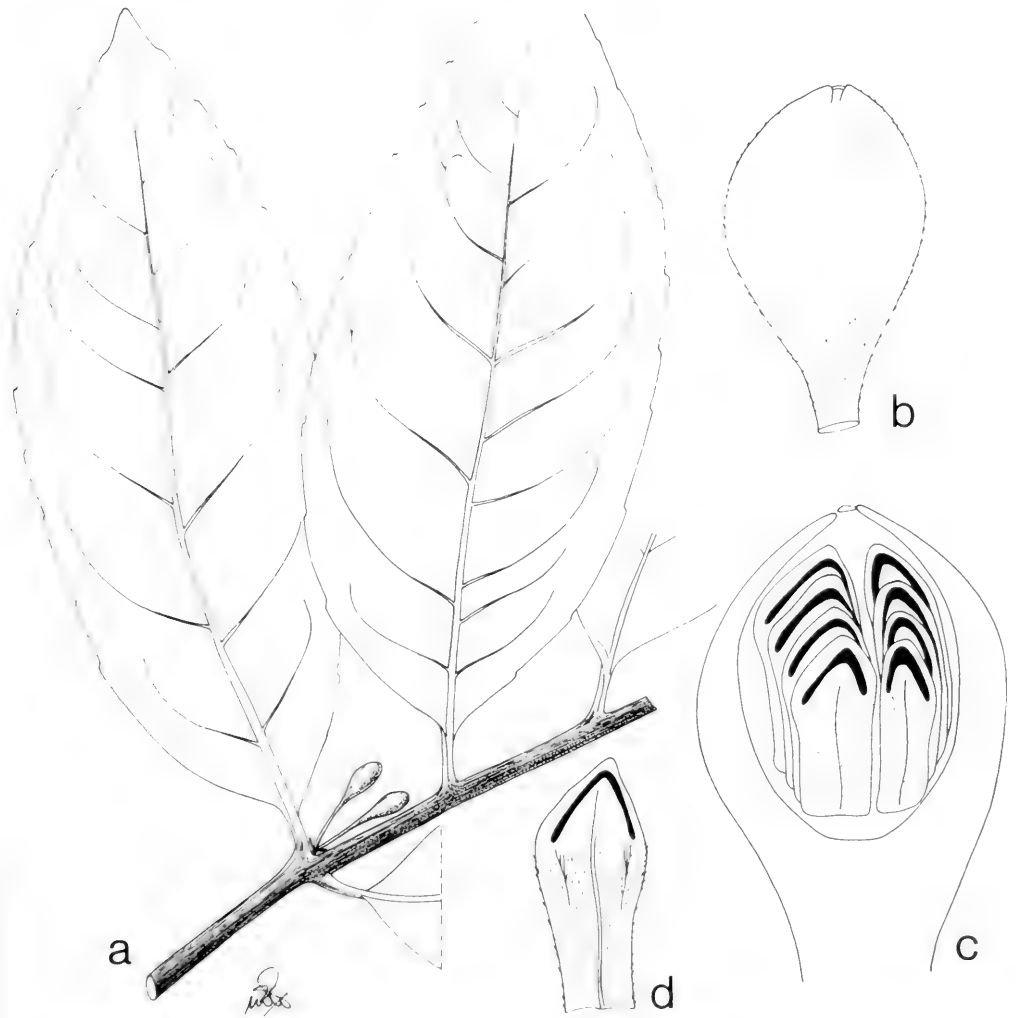


Fig. 13. *Parakibara clavigera* PHILIPSON. *a*. Twig with male inflorescence, $\times 1/2$, *b*. male flower, $\times 4$, *c*. the same in LS, $\times 5$, *d*. stamen, $\times 8$ (TAYLOR 2835 A).

7. KIBARA

ENDL. Gen. Pl. (1837) 314; PERKINS, Bot. Jahrb. 25 (1898) 570; Pfl. R. Heft 4 (1901) 58; *ibid.* Heft 49 (1911) 28; Bot. Jahrb. 52 (1915) 207; PHILIPSON, Blumea 30 (1985) 389, f. 1. — *Brongniartia* BL. Bijdr. 9 (1825) 423, non KUNTH. — *Sciadocarpus* HASSK. Flora 25, ii (1842) Beibl. 1: 20. — *Sarcodiscus* GRIFF. Notul. 4 (1854) 380. — Fig. 14–16.

Trees or shrubs, resting buds with cataphylls. *Leaves* usually pubescent at first, often becoming glabrous, entire or dentate, principal secondary veins

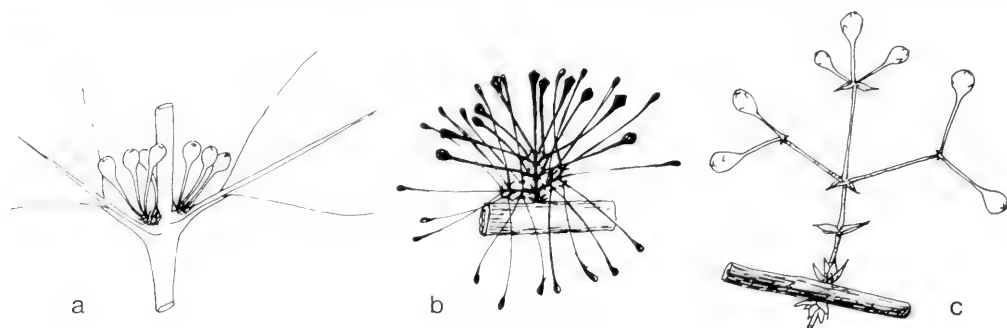


Fig. 14. Inflorescence types in *Kibara*. *a*. Fasciculate in *K. oblongata* PHILIPSON, *b*. condensed cyme in *K. molluccana* PERKINS, *c*. open paniculate cyme in *K. macrantha* PHILIPSON (*a* LAE 68853, *b* EYMA 2900, *c* HARTLEY 13691).

arched and meeting within the margin. Monoecious. *Inflorescence* lateral or terminal, cymose (racemose in *K. streimannii*), often pleiochasial, paniculate or fasciculate; pedicels usually thickening distally into the receptacle. — *Male flowers* usually smaller than the females, with a minute ostiole surrounded by 2–4 decussate pairs of tepals; androecium usually with 4 large outer stamens and up to 4 inner smaller stamens or staminodes which may be rudimentary and \pm connate, occasionally 5 stamens in the outer whorl or as few as 2 stamens present; anthers opening by a single slit, with a filament or subsessile. — *Female flowers* with the ostiole surrounded by about 5 decussate pairs of tepals; the inner pairs thickened and glandular; the upper half of the receptacle abscising as a calyptra after anthesis; carpels numerous, stigma obtuse sessile on the apex of the ovary. *Drupes* sessile or stipitate.

DISTR. Peninsular Thailand and Nicobar Is. to Queensland; in *Malesia*: throughout the area. In all 43 *spp.*, of which 39 in Malesia.

Ecol. Mostly understorey shrubs and small trees in rain-forest from sea-level to *c.* 2800 m; occasionally on sandy or coral beaches.

NOTES. *Kibara* is readily separated from *Steganthera* and *Matthaea* by the swollen glandular tissue which surrounds the inner rim of the ostiole (ENDRESS, *Pl. Syst. Evol.* 134, 1980, 79–120). *Wilkiea* has female receptacles very similar to those of *Kibara*, but these two genera can be distinguished by their male flowers. In most species the androecium of the two genera is distinctive: in *Kibara* there is a symmetrical group of four stamens (2 decussate pairs), within which there is unusually a group of up to four smaller stamens or often apparently infertile staminodes. In most *Wilkiea spp.* the numerous stamens (*c.* 8 or more) are inserted irregularly over the inner surface of the receptacle. Some species of *Kibara* occasionally may have 5 stamens in the outer group, or these may be reduced to 3 or even 2, in which case the inner reduced stamens are often absent. On the other hand, some individual flowers of *Wilkiea* have relatively few stamens (as few as 6 in *W. huegeliana* and as few as 4 in *W. macrophylla* (see ENDRESS, *l.c.*). In this event the genera are distinguished by the irregular insertion of the stamens in *Wilkiea* and the decussate arrangement in *Kibara*. The only species in which some doubt may occur is *K. rigidifolia* in which individual flowers with 3 or 5 stamens may not have them clearly arranged in a regular manner. When 6 stamens are present, the decussate arrangement is more definite. The nature of the stigma also serves to separate these two genera. In all species of *Kibara* the stigma forms an obtuse cushion or knob, whereas in *Wilkiea* it is more elongated and acute, being often subulate.

KEY TO THE SPECIES

In view of the large number of species, many incompletely known, and the paucity of well defined characters, it is recommended that more reliance than usual is placed on distribution when identifying specimens. Most species are local or regional, and while their ranges may not be fully known, they are unlikely to occur far from their known localities. It must also be borne in mind that several species are not included in this key because they are inadequately known. In addition to those listed at the end of the genus, 39. *K. symplocoides* is omitted from the key because the nature of its inflorescences is uncertain.

1. Leaves linear (leaf index 6) **1. K. roemerii**
1. Leaves broader (leaf index less than 4).
 2. Leaves shorter than 5 cm.
 3. Leaves coriaceous, apex obtuse or retuse (Vogelkop Peninsula) **2. K. oligocarpella**
 3. Leaves membranaceous, tapering to a long apiculum (Sepik region) **3. K. myrtooides**
 2. Leaves longer than 5 cm.
 4. Inflorescence shorter than, or little exceeding the petiole (c. 2 cm or less).
 5. Stems greatly expanded at the nodes (usually inhabited by ants).
 6. Leaves sessile, amplexicaul, margin strongly and sharply dentate (E. Papua New Guinea) **4. K. ferox**
 6. Leaves petiolate, base cuneate or truncate, margin entire.
 7. Leaves broadly ovate (Moluccas) **5. K. latifolia**
 7. Leaves elliptic-oblong (S. Papua New Guinea) **6. K. archboldiana**
 5. Stems not markedly expanded at the nodes.
 8. Inflorescence pubescent (young shoots also pubescent and hairs \pm persisting on mature foliage).
 9. Leaves stiffly chartaceous, teeth sharply spinulose, often \pm bullate (Western Highlands Prov.)
..... **7. K. karengana**
 9. Leaves softly chartaceous, dentations not spinulose.
 10. Leaves bullate (Morobe Prov.) **8. K. bullata**
 10. Leaves flat.
 11. Female receptacle and pedicel bearing several pairs of acute imbricating bracts (Moluccas)
..... **9. K. kostermansii**
 11. Female receptacle and pedicel without bracts (or at most small bracts widely spaced) (New Guinea).
 12. Pubescence of fine, pale, appressed hairs (SE. Papua New Guinea) **10. K. leachii**
 12. Pubescence of loose, curled, brownish hairs (Vogelkop Peninsula) **11. K. versteeghii**
 8. Inflorescence and mature foliage glabrous (buds and young foliage sometimes pubescent).
 13. Leaf blade larger than 10 cm.
 14. Leaf margin entire (Normanby I.) **12. K. oblongata**
 14. Leaf margin dentate.
 15. Leaf margin spinulose-dentate (Vogelkop Peninsula) **13. K. warensis**
 15. Leaf margin serrate.
 16. Leaf base tapering to the petiole, blade narrowly obovate (Rossel I.) **14. K. rosselensis**
 16. Leaf base broadly cuneate, blade oblong-elliptic (Vogelkop Peninsula) **15. K. royenii**
 13. Leaf blade shorter than 8 cm.
 17. Leaf apex with a slender apiculum (Eastern Highlands Prov.) **16. K. hartleyi**
 17. Leaf apex acute or obtuse, without an apiculum (Mt Shungol, Morobe Prov.) **17. K. shungolensis**
 4. Inflorescence considerably longer than the petiole (3 cm or usually much longer).
 18. Inflorescence with the lateral branches crowded on a short peduncle **18. K. moluccana**
 18. Inflorescence a simple or branched cyme with evident internodes separating the branches.
 19. Leaf blade small, membranaceous (usually under 10 by 3 cm). Inflorescence branches very slender (Torricelli Mts) **19. K. microphylla**
 19. Leaf blade larger (usually over 10 cm long, if not, then coriaceous).
 20. Male flowers racemously arranged along the inflorescence branches **20. K. streimannii**
 20. Male flowers cymosely arranged or solitary.
 21. Flowers 6 mm long at anthesis or longer, densely pubescent (Eastern Highlands & Morobe Prov.)
..... **21. K. macrantha**
 21. Flowers less than 5 mm long (or if 6 mm, then glabrous).
 22. Leaf margin dentate.

23. Stems greatly expanded at the nodes (usually inhabited by ants) (Central Prov.) **22. *K. carrii***
 23. Stems not markedly expanded at the nodes.
24. Dentations of leaf margin sharply spinulose **23. *K. elongata***
 24. Dentations of leaf margin not spinulose.
25. Pedicels strong.
26. Underside of mature leaf pubescent. Inflorescence a few-flowered cyme (Southern Highlands & Milne Bay Prov.) **24. *K. katikii***
 26. Underside of mature leaf glabrous or, if pubescent, inflorescence \pm paniculate.
27. Leaf blade usually broadly elliptic-ovate, more than 10 cm long, rounded to broadly cuneate base. Pedicels rigid (throughout Malesia) **25. *K. coriacea***
 27. Leaf blade usually elliptic, usually less than 10 cm long, base cuneate. Pedicels less rigid (SE. Papua New Guinea) **26. *K. papuana***
25. Pedicels delicate.
28. Inflorescence of simple pleiochasia. Outer stamens inserted at widest part of the receptacle (Star Mts, Telefomin region) **27. *K. nitens***
 28. Inflorescence of paniculate cymes. Stamens inserted near base of the receptacle (NW. Irian Jaya) **28. *K. fragrans***
22. Leaf margin entire (occasionally some leaves with few teeth near apex).
29. Undersurface of mature leaf pubescent.
30. Pubescence on inflorescence soft, not closely appressed (Southern Highlands & Milne Bay Prov.) **24. *K. katikii***
 30. Pubescence on inflorescence stiffly appressed.
31. Leaves acuminate, usually broadly elliptic (throughout Malesia) **25. *K. coriacea***
 31. Leaves obtuse, usually narrowly elliptic (Sabah, Celebes, Philippines, Biak I.) **29. *K. obtusa***
29. Undersurface of mature leaf glabrous.
32. Leaves stiffly coriaceous, broadly elliptic to subrotund (New Guinea highlands) **30. *K. laurifolia***
32. Leaves not as above.
33. Inflorescence pubescent.
34. Leaves acuminate, usually broadly elliptic (throughout Malesia) **25. *K. coriacea***
 34. Leaves obtuse, usually narrowly elliptic (Sabah, Celebes, Philippines, Biak I.) **29. *K. obtusa***
33. Inflorescence glabrous (young inflorescence \pm setulose in *K. sleumeri*).
35. Pedicels of male flowers elongated (20–45 mm).
36. Male flowers in separate inflorescences (Irian Jaya) **31. *K. flagelliformis***
 36. Male flowers on lower branches of inflorescences.
37. Leaf narrowly elliptic (Chimbu Prov.) **32. *K. chimbuensis***
 37. Leaf broadly elliptic or elliptic (Morobe & Central Prov.) **33. *K. fugax***
35. Pedicels of male flowers shorter than 20 mm.
38. Pedicels of female flowers noticeable thickened for c. 10 mm below the receptacle (New Britain, New Ireland) **34. *K. novobritanica***
 38. Pedicels of female flowers not strikingly thickened.
39. Male receptacle 4–6 mm long; anthers kidney-shaped. Leaf rigidly coriaceous.
40. Leaf oblong, apex rounded or retuse with a minute mucro, often 3-whorled (Western Prov., also in Queensland) **35. *K. rigidifolia***
 40. Leaf narrowly elliptic, apiculate, opposite (Sudest I.) **36. *K. sudestensis***
39. Male receptacle 1.5–2.5 mm long; anthers triangular. Leaf not rigidly coriaceous.
41. Leaves oblong, apex and base rounded (Vogelkop Peninsula) **37. *K. sleumeri***
 41. Leaves elliptic.
42. Leaves membranaceous (Sepik region) **38. *K. monticola***
 42. Leaves firmly herbaceous or chartaceous (SE. Papua New Guinea) . **26. *K. papuana***

1. *Kibara roemeri* (PERKINS) PERKINS, Bot. Jahrb. 52 (1915) 212; PHILIPSON, Blumea 30 (1985) 394. — *Matthaea roemeri* PERKINS, Pfl. R. Heft 49 (1911) 17.

A small tree, glabrous in all its parts. *Leaves* lanceolate or obovate-lanceolate, up to 25 by 4.2 cm, chartaceous, base broadly cuneate, apex apiculate, mar-

gin minutely dentate, midrib evident, lateral veins numerous and connected by a well-defined reticulation of minor veins, glabrous; petiole c. 5–10 mm, 2.5 mm wide, channelled above. *Inflorescence* and flowers unknown. *Drapes* narrowly ovoid, c. 16 by 7 mm, shortly stipitate.

Distr. *Malesia*: SW. Irian Jaya, ?Misool.

Ecol. Forest, 750 m.

Note. The stiff, lanceolate leaves, with sharply toothed margin are characteristic. A second collection consisting of a leafy shoot only, may belong to this species. It was made by TEUSMANN in Mysool I.

2. *Kibara oligocarpella* (KANEH. & HATUS.) PHILIPSON, *Blumea* 30 (1985) 394. — *Steganthera oligocarpella* KANEH. & HATUS. *Bot. Mag. Tokyo* 56 (1942) 257, f. 6.

Shrub to 1.8 m. *Leaves* oblong-elliptic to narrowly obovate, up to 3.3 by 1.5 cm, firmly coriaceous, base cuneate, apex obtuse or retuse, entire, midrib prominent, reticulation of veins evident below, glabrous; petiole to 4 mm. Monoecious. *Inflorescence* axillary or supra-axillary; flowers in simple cymes or solitary. — *Male flowers* ovoid, c. 2.5 mm long, pedicel 6–7 mm long; tepals 4, stamens 3–4. — *Female flowers* ± globose, c. 3 mm long; 4 tepals around the minute ostiole, several irregularly swollen pairs within; carpels 4–10, stigma obtuse. *Drupes* ovoid, c. 15 by 11 mm.

Distr. *Malesia*: West New Guinea (Vogelkop Peninsula, Arfak Mts, Angi Lakes).

Ecol. Open scrub (*Tristaniopsis*, *Dacrydium*), at c. 2400 m.

Note. The small, close-set, thick-leathery leaves (which dry a dark brown) are quite unlike any other species. The flowers are yellowish brown, and the ripe achenes black on a reddish brown receptacle. KANEHIRA & HATUSIMA attributed their material to *Kibara* on their herbarium labels, but published the species as a *Steganthera*. The material collected by SLEUMER & VINK, with female flowers, removes any doubt about this species being a *Kibara*.

3. *Kibara myrtooides* PERKINS, *Bot. Jahrb.* 52 (1915) 208; PHILIPSON, *Blumea* 30 (1985) 395.

Shrub to 2 m; young branches slender, with appressed tomentum. *Leaves* elliptic, 4–5 by 1.3–2.2 cm, membranaceous, base cuneate, apex long-acuminate, entire, midrib prominent, veins obscure, becoming glabrous except for the midrib below; petiole 3–5 mm long, pubescent, channelled above. *Inflorescence* axillary, in dichasia or solitary, pubescent. — *Male flowers* cupuliform, 2.5 mm ø, pedicel 3–5 mm long, pubescent outside, glabrous within; tepals 6, ovate; stamens 2, subsessile. — *Female flowers* solitary, arising above the axils, pedicel 10–15 mm, pubescent. Receptacle woody with very short stipes. *Drupes* ovoid, 20 by 12.5 mm.

Distr. *Malesia*: Papua New Guinea (Sepik region). Only known from type.

Ecol. Montane forest, in scrub with few large trees, 1400–1500 m. *Fl. fr.* August.

Note. The specimen available to me lacks flowers

so that the parts of the above account are derived from the original description. Since the androecium is so reduced and details of the female flower are not given, the assignment to *Kibara* must remain tentative. The foliage is quite unlike any other species.

4. *Kibara ferox* PHILIPSON, *Blumea* 30 (1985) 395. — **Fig. 15.**

Shrub or treelet to 3 m, glabrous, the nodes dilated with pores inhabited by ants. *Leaves* sessile, broadly cordate to oblong, up to 30 by 23 cm, coriaceous, the base amplexicaul, apex narrowing to a short or long apiculum, margin with small or coarse sharp dentations (the upper leaves and those of juvenile plants narrower and more dentate), veins and reticulations very prominent on the underside. ?Monoecious. *Inflorescence* of axillary fascicles (or rarely supra-axillary) borne on a very short bracteate peduncle; pedicels up to c. 10 mm, slender in male gradually widening into the flower, female thicker, becoming woody in fruit. — *Male flower* ovoid, 2 by 1.5 mm, 3 pairs of tepals; stamens c. 5, subsessile; anther broadly triangular with a single horseshoe-shaped opening. — *Female flower* globose, 4.5 by 4.5 mm, ostiole surrounded by 2 pairs of obscure tepals (additional pairs probably within the ostiole); upper part of the receptacular chamber with very thick irregular glands; carpels numerous, glabrous; stigma short, obtuse. *Drupes* sessile ovoid, c. 15 by 10 mm, verruculose when dry.

Distr. *Malesia*: Papua New Guinea (Madang Prov.; Ramu Distr.; Eastern Highlands Prov.: Kainantu Distr.; Morobe Prov.: Mumeng Distr., Wau Distr.; Central Prov.: Port Moresby Distr.).

Ecol. Lowland and lower montane rain-forest, 500–1550 m.

Vern. *Daraboro* (Madang Distr., Domainde).

Note. The sessile, cordate, coriaceous leaves are unlike those of any other species. The leaves on lower thicker branches are very broad and cordate, while those on the more slender branches are oblong. Juvenile plants have smaller, narrower and more dentate leaves. Swollen nodes with pores used by small black ants are also found in *K. carrii*, *K. latifolia* and *K. archboldiana*, and resemble those of some species of *Steganthera*. The flowers are yellowish green or pinkish. The drupes are black on an orange torus. The outer bark is light grey-green to brown, rough with vertical fissures.

5. *Kibara latifolia* PHILIPSON, *Blumea* 30 (1985) 396.

Shrub 1.5 m high, glabrous, with the branches prominently dilated at the nodes. *Leaves* broadly ovate to subrotund, 20–30 by 13–24 cm, chartaceous to coriaceous, base broadly cuneate to truncate, apex obtuse, entire, principal veins widely spaced, channelled above, prominent below, arched

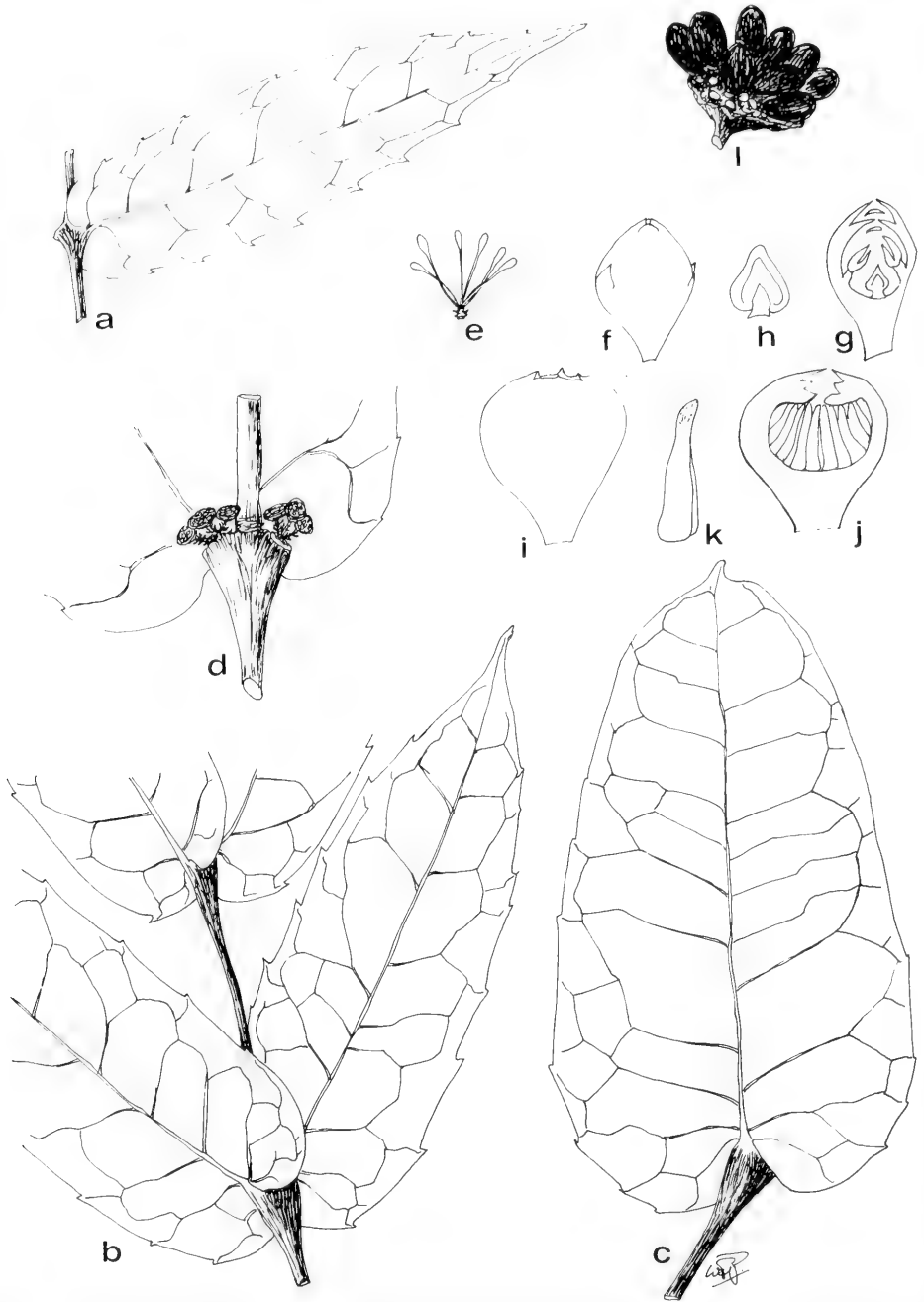


Fig. 15. *Kibara ferox* PHILIPSON. *a*. Leaf from upper branch, *b*. *ibid.* from middle branch, *c*. *ibid.* from lower branch, all $\times 1/2$, *d*. axillary fascicles of female flowers after anthesis, *e*. male inflorescence, both nat. size, *f*. male flower, *g*. the same in LS, both $\times 7 1/2$, *h*. stamen, $\times 15$, *i*. female flower, *j*. the same in LS, both $\times 4$, *k*. carpel, $\times 7 1/2$, *l*. fruit, $\times 1/2$ (*a-d*, *i-l* PHILIPSON & KAIRO 3640, *e-k* LAE 61573).

and meeting inside the margin, glabrous; petiole 12–18 mm long, deeply channelled above. *Flowers* not seen. *Infructescence* lateral, a subsessile umbel or compact cyme, peduncle stout, c. 2 mm long, branches (pedicels) c. 15 mm long; receptacle leathery, c. 10–13 mm ϕ , with c. 12–16 short thick stipes. *Drupe*s ovoid, c. 10–12 by 6–8 mm.

Distr. Malesia: Moluccas (Halmahera & Obi Is.). Two collections.

Ecol. In dense, low forest with little undergrowth at 15 m.

Note. Known from only two gatherings, neither with flowers. However, the broad leaves, swollen nodes, and the small infructescences are distinctive.

6. *Kibara archboldiana* A.C. SMITH, J. Arn. Arb. 22 (1941) 231; PHILIPSON, *Blumea* 30 (1985) 396.

Shrub to 4 m, with glabrous branches conspicuously swollen at the nodes. *Leaves* elliptic or elliptic-oblong, 15–36 by 6–14 cm, chartaceous, base broadly cuneate or rounded, apex with a slender apiculum 1–2 cm long, entire, midrib and principal veins conspicuous below, arched ascending and uniting within the margin, glabrous or \pm ephemeral minute pubescence on young foliage; petiole 5–25 mm, stout channelled above. Monoecious. — *Male inflorescence* axillary or supra-axillary, a few-flowered compact cyme or subfasciculate, c. 8 mm long, minutely puberulous, with small bracts; pedicel slender, c. 3–6 mm long, bracteolate. — *Male flowers* subglobose, 2–4 mm ϕ ; tepals 6, obtuse; stamens 6, the innermost 2 smaller. — *Female flowers* not seen. Old *infructescence* thickened and woody below the fruits; receptacle leathery 8–12 mm ϕ , stipes short (1–3 mm). *Drupe*s ovoid or narrowly ovoid-oblong, 16–23 by 8–10 mm.

Distr. Malesia: Papua New Guinea (Western, Gulf & Central Prov.).

Ecol. In rain-forest from near sea-level to 500 m.

Vern. Hooanu, Uraru lang.

Note. The two original collections agree in all respects. The only other collection (CONN *et al.* LAE 66299) has very similar foliage, but has broadly ovoid achenes instead of the very characteristic elongate fruit of the type, and apparently lacks the swollen nodes.

7. *Kibara karengana* PHILIPSON, *Blumea* 30 (1985) 396.

Scandent shrub or small tree to 6 m high, glabrous or with small brown strigose hairs on young parts, sometimes persisting on the petiole and underside of the midrib. *Leaves* ovate to oblong, 9–22 by 4–10 cm, stiffly chartaceous, often more or less bullate, base broadly cuneate, rounded or subcordate, apex shortly apiculate, margin with small or coarse indurated, sharp dentations, midrib, lateral veins and

reticulation of minor veins prominent below; petiole channelled above, to c. 8 mm long. Monoecious. *Inflorescences* axillary or supra-axillary, male and female flowers in separate inflorescences; simple triads or a small cymose panicle, 10–20 mm long, peduncle c. 2 mm long with minute bracts; *female* a few-flowered fascicle, pedicels becoming woody in fruit and elongating to 20–30 mm. — *Male receptacle* ovoid, 3 by 2.5 mm, tepals in 4 pairs; stamens 4–6, subsessile, anthers broadly triangular with a single horseshoe-shaped opening. — *Female receptacle* ovoid, 5 by 4 mm, sometimes pubescent, ostiole surrounded by minute tepals and bearing within large pendulous glands; carpels c. 12–18, pubescent with short obtuse stigma. Fruiting receptacle leathery, c. 10 mm ϕ . *Drupe*s \pm sessile, ovoid, c. 14 by 10 mm, surface (when dry) verruculose.

Distr. Malesia: Papua New Guinea (Western, Eastern & Southern Highland Provinces).

Ecol. Lower montane and mossy forest (*Nothofagus*, *Podocarpus*, *Pandanus*) and at forest/burnt grassland margin, between 2500–3000 m.

Uses. In the Minj District the plant is considered to be a male sex stimulant.

Vern. Gegnikl, kong-ambugont, Minj, *ogumbwarombigl*, Hagen.

Note. The ripe drupes are shining black borne on an orange receptacle.

8. *Kibara bullata* PHILIPSON, *Blumea* 30 (1985) 347.

Shrub to 2.5 m; young branches finely and densely pubescent. *Leaves* elliptic to elliptic-oblong, up to 17 by 8 cm, chartaceous, base broadly cuneate, apex long acuminate, margin dentate, midrib, lateral veins and reticulation prominent below, the upper surface raised between the veins (bullate), the pubescence persisting on the lower surface especially on the midrib and veins but disappearing from the upper surface; petiole c. 10–12 mm, channelled above, pubescent. Monoecious. *Inflorescences* axillary or supra-axillary, of short few-flowered fascicles; pedicel 2–4 mm long, densely pubescent. — *Male flowers* ovoid, 1.5 mm long, pubescent on the outer surface; 4 pairs of tepals; stamens 4 in the outer whorl 0.75 mm long, with 2 smaller central stamens; filament as broad as the anther, short and pubescent. — *Female flowers* similar to male but stouter, c. 2 mm long; tepals surrounding the ostiole minute, with large pendulous glands within; inner surface of the receptacle with hairs between the carpels; carpels c. 10, ovary pubescent, 0.8 mm long, stigma obtuse. Fruiting receptacle \pm sessile (peduncle undeveloped) with long radiating stipes (receptacle c. 6 mm ϕ , stipes c. 4–8 mm long). *Drupe*s ovoid, c. 18 by 10 mm.

Distr. Malesia: Papua New Guinea (Morobe Prov.).

Ecol. Rain-forest (*Anisoptera* and *Castanopsis*), 500–1000 m.

Note. The slightly bullate, pubescent leaves with a serrate margin, combined with a fasciculate inflorescence and sessile fruiting receptacles are distinctive. The black drupes are borne on an orange receptacle. Collected only twice. The specimen from Garaina has less dentate leaf margins and shorter thicker stipes below the achenes but agrees with the type in other respects.

9. *Kibara kostermansii* PHILIPSON, *Blumea* 30 (1985) 398.

Shrub to 4 m; young branches covered with strigose tomentum. *Leaves* elliptic to obovate (occasionally lanceolate), 14–22 by (3–)5–8(–10) cm, chartaceous, base cuneate or rounded, apex with an apiculum, margin dentate (at least in most leaves) with short, crisp hairs on the midrib, principal veins, and often \pm sparsely over the whole lower surface; petiole c. 10–14 mm, deeply channelled above. ?Monoecious. *Inflorescences* axillary, supra-axillary or terminal; male and female flowers in separate inflorescences. — *Male inflorescence* a few-flowered cyme, c. 10 mm long, hispid; peduncle 2 mm long bearing minute bracts and lateral branches (pedicels) subtended by bracts. — *Female flowers* solitary, borne on a short (2 mm long) bracteate peduncle (pedicel). — *Male flowers* obovoid, c. 2 mm long, receptacle hispid on the outer surface and bearing a pair of rounded bracts (? tepals), ostiole minute, surrounded by c. 3 pairs of tepals; stamens 4, anthers broadly triangular, subsessile. — *Female receptacle* hispid on the outer surface and bearing c. 2 pairs of acute ovate bracts, ostiole surrounded by 3–4 pairs of decussate rounded tepals, with large pendulous glands within the ostiole, inner surface of receptacle hispid, ovules with a blunt peg-like stigma. Pedicels becoming woody and longer in fruit (up to 15 mm); receptacle becoming woody, to 20 mm ϕ , including the stout stipes. *Drupe*s ovoid or ellipsoid, c. 15 by 10 mm.

Distr. *Malesia*: Moluccas (Halmahera, Batjan, Morotai).

Ecol. Primary forest, often at sea-level on limestone but reaching up to 500 m.

Vern. *Wajoka gogumini*, Halmahera, Tobelo dial.

Note. The pubescent dentate leaves and the small inflorescences are characteristic. Acute bracts like those on the pedicel and receptacle of the female flowers have not been seen on any other species. The ripe fruits are blue-black, borne on an orange or red receptacle.

10. *Kibara leachii* PHILIPSON, *Blumea* 30 (1985) 399.

Shrub or small tree, to 6.5 m; young branches, buds and young foliage covered in strigose hairs.

Leaves elliptic or narrowly elliptic, 14 by 5.5 cm, thinly chartaceous, base narrowly or broadly cuneate, apex with a short obtuse apiculum, or tapered to a long acute apiculum, margin finely or more coarsely dentate, midrib prominent below, lateral veins arched and uniting within the margin, traces of the tomentum persisting on the mature leaves, especially on the midrib below, or the blade more or less glabrous; petiole c. 5–10 mm, channelled above, strigose. Monoecious. *Inflorescences* terminal, axillary or supra-axillary, of compacted dichasia (fascicles) or with the peduncle evident, c. 10–20 mm long, strigose and bracteate. — *Male flowers* ovoid, 3 pairs of rounded tepals; 4 stamens in the outer whorl, 0–3 in the inner whorl. — *Female flowers* not seen. Peduncle below fruit remaining short or elongating slightly (to c. 10 mm), pedicel may also elongate under fruiting receptacle; receptacle becoming woody, c. 5 mm ϕ (without stipes), stipes short (up to c. 2 mm long), strigose or glabrous. *Drupe*s ovoid, 18 by 13 mm.

Distr. *Malesia*: Papua New Guinea (Central, Northern & Milne Bay Provinces).

Ecol. Lowland rain-forest and lower montane forest, 390–1370 m.

Note. The thinly chartaceous dentate leaves with compact inflorescences are distinctive. Most gatherings have narrower leaves than the type (chosen because in flower) with long narrow apicula.

11. *Kibara versteeghii* PHILIPSON, *Blumea* 30 (1985) 399.

Shrub to 5 m, young branches with dense crisp brown tomentum. *Leaves* elliptic, 11 by 3.8 cm, chartaceous, base cuneate, apex narrowed into an obscure apiculum, margin dentate, midrib and veins prominent below, lateral veins few, strongly arched and meeting within the margin, upper surface becoming \pm glabrous, lower surface retaining the crisp tomentum; petiole c. 10 mm, densely tomentose. Monoecious. *Inflorescence* axillary or terminal, of solitary flowers, fascicles, or short pleiochasia, pubescent in all parts. — *Male flowers* ovoid, 1.5 mm long, strigose on the outer surface; 3 pairs of rounded tepals; stamens 2 with 1 central staminode (only 2 flowers dissected); anther with a single horizontal opening; filament short, strigose. — *Female flowers* ovoid, 2.7 mm long, densely strigose on the outer surface and with hairs on the inner surface between the carpels, c. 4 pairs of tepals and prominent pendulous glandular swellings within the ostiole; carpels c. 12–15, ovary pubescent, stigma blunt. *Fruits* not seen.

Distr. *Malesia*: West New Guinea (Vogelkop Peninsula).

Ecol. Rather common shrub in *Nothofagus* forest and in old secondary forest, 1640–1950 m.

Note. The small, dentate, pubescent leaves are distinctive. The young leaves are described as brownish purple above and light red below. The dried leaves are a dull dark brown. The flowers are yellow.

12. *Kibara oblongata* PHILIPSON, *Blumea* 30 (1985) 400, f. 1a. — Fig. 14a.

Small tree, c. 5 m high, glabrous in all its parts. *Leaves* oblong, up to 31 by 12 cm, coriaceous or chartaceous, base broadly cuneate, apex obtuse to slightly retuse, margin entire, midrib prominent, lateral veins connected within the margin; petiole 15–20 mm, 4 mm wide, channelled above. ? Monoecious. *Inflorescences* axillary, fasciculate, pedicels c. 10 mm, wider towards the top; male flowers not seen. — *Female flowers* globose, c. 4 mm ϕ , ostiole surrounded by c. 3 pairs of rounded tepals and with swollen glands within; carpels c. 20, with a short obtuse stigma. Fruiting receptacle enlarged and woody, c. 15–20 mm ϕ , with short stout stipes 2–3 mm long. *Drupes* ovoid, 14 by 10 mm (? fully developed).

Distr. *Malesia*: Papua New Guinea (Morobe Prov.; Lae Distr.; Milne Bay Prov.; Esa'ala Distr., incl. Normanby I.).

Ecol. Lowland rain-forest, from sea-level to c. 65 m.

Note. The large glabrous oblong leaves resemble those of *K. mouluccana* but the inflorescence is distinct. Two collections have been made on Normanby I., a third collection from north of Lae appears to be identical.

13. *Kibara warenensis* KANEH. & HATUS. *Bot. Mag. Tokyo* 56 (1942) 249, f. 1; PHILIPSON, *Blumea* 30 (1985) 401.

Shrub to 2 m, glabrous. *Leaves* oblong or oblanceolate-oblong, 18–27 by 5.2–8.2 cm, coriaceous, base rounded to broadly cuneate, apex shortly acuminate or acute, margin spinulose dentate, midrib, lateral nerves and reticulation prominent below; petiole c. 10 mm. Monoecious. *Inflorescences* axillary, of compact fasciculate cymes, glabrous, c. 10 mm long. — *Male flowers* with pedicels c. 6–10 mm long, thicker distally; receptacle c. 1.8 mm long; tepals 6, minute; stamens 6, c. 1 mm long. — *Female flowers* not seen. *Drupes* ovoid, sessile on a woody receptacle, c. 20 mm ϕ .

Distr. *Malesia*: West New Guinea (Vogelkop Peninsula).

Ecol. Lowland rain-forest at c. 100 m.

Note. The glabrous fasciculate inflorescence combined with the spinulose dentate leaves are distinctive.

14. *Kibara rosselensis* PHILIPSON, *Blumea* 30 (1985) 401.

Small tree, 4 m; young branches finely pubescent.

Leaves narrowly obovate, 10–15 by 3–4.5 cm, subchartaceous, base narrowly cuneate, apex apiculate, margin dentate, midrib prominent below, lateral veins c. 7–9 pairs, arched ascending, glabrous at maturity; petioles to 15 mm long, channelled above. Monoecious. *Inflorescences* fasciculate (compacted cymes) c. 10–14 mm long, with small bracts around the peduncle and the bases of the pedicels; pedicels and usually the receptacle also bearing minute bracts. — *Male receptacle* subglobose, narrowed into the pedicel, c. 3 mm ϕ ; tepals in 3 pairs; stamens 4 in outer whorl, c. 3 in inner whorl. — *Female receptacle* similar, c. 4 mm ϕ , ostiole surrounded by c. 3 pairs of tepals and bearing within large pendulous glands; carpels c. 18. *Drupes* not seen, but described by the collector as ovoid, 20 by 16 mm.

Distr. *Malesia*: Papua New Guinea (Milne Bay Prov.).

Ecol. Low forest on ridge crest, 700 m.

Note. Male and female flowers in fascicles in the axils of the dentate leaves. The flowers are yellow and the ripe drupes black.

15. *Kibara royenii* PHILIPSON, *Blumea* 30 (1985) 401.

Shrub c. 3 m high, glabrous. *Leaves* narrowly oblong-elliptic, 21 by 6.5 cm, chartaceous, base cuneate, apex apiculate, apiculum obtuse, margin sharply serrate, midrib and lateral veins and their junctions prominent, main veins numerous (8–10 pairs) with subsidiary lateral veins between them and a prominent reticulation; petiole 15–20 mm, channelled above. Monoecious. *Inflorescences* axillary, of short compacted dichasia (fascicles), c. 10 mm long, one or more in an axil. — *Male flower* ovoid, c. 2 mm ϕ ; 4 pairs of tepals, the outer triangular, the inner rounded; outer stamens 4, inner c. 2; filament short, glabrous. *Female flowers* and fruit not seen.

Distr. *Malesia*: West New Guinea (Vogelkop Peninsula; Steenkool Distr.).

Ecol. Primary forest, at 50 m.

Note. The narrowly oblong elliptic, dentate leaves, combined with the small fasciculate inflorescence are distinctive.

16. *Kibara hartleyi* PHILIPSON, *Blumea* 30 (1985) 402.

Tall shrub, glabrous except for unopened buds. *Leaves* up to 8 by 3.8 cm, rigidly coriaceous, base cuneate, apex with a prominent apiculum, margin sharply dentate, reticulation of veins very evident on both surfaces, glabrous; petiole 4–6 mm, channelled above. Monoecious. *Inflorescence* axillary; flowers solitary, pedicels c. 15–20 mm long at anthesis, elongating slightly in fruit. — *Male flower* obovoid, c. 3 mm ϕ ; tepals in c. 3 pairs; stamens in an outer whorl of 5 and an inner whorl of 2–3. — *Female flower* similar but slightly larger, carpels c. 12–16, ovary densely covered with appressed hairs. Ripe *drupes*

not seen, but developing fruits verruculose and pubescent.

Distr. *Malesia*: Papua New Guinea (Eastern Highlands Prov.; Goroka Distr.).

Ecol. Montane forest, c. 2700 m.

Note. This species shows a close but superficial resemblance to *Steganthera ilicifolia*. It approaches *Kibara shungolensis* which differs in having leaves without a prominent apiculum, and with a broader base, the female inflorescence usually bearing a lateral flower, and the ovary being glabrous.

17. *Kibara shungolensis* PHILIPSON, *Blumea* 30 (1985) 402.

Small tree c. 4 m high, glabrous in all its parts. *Leaves* elliptic, up to 7 by 3.5 cm, rigidly coriaceous, base broadly cuneate, apex acute or obtuse, margin shallowly dentate, reticulation of veins very evident on both surfaces, petiole c. 5–8 mm, channelled above. ?Monoecious. *Inflorescence* of compacted dichasia (fascicles); peduncles bracteate at the base, short at anthesis but later elongating (10–12 mm), pedicels c. 8–10 mm long, those of the male flowers more delicate than those of the female. — *Male flowers* obovoid, c. 2 mm \emptyset , ostiole surrounded by 3 pairs of rounded tepals; androecium with 4 outer stamens and fewer smaller inner stamens; filaments glabrous. — *Female flowers* globose, c. 3 mm \emptyset , ostiole surrounded by c. 3 pairs of minute tepals and with swollen glands within; carpels c. 20, ovary and stigma glabrous. Fruits not seen.

Distr. *Malesia*: Papua New Guinea (Morobe Prov.; Mumeng Distr., Mt Shungol).

Ecol. Lower mossy forest, at about 2300 m.

Note. For features distinguishing *K. shungolensis* from *K. hartleyi* see that species.

18. *Kibara moluccana* PERKINS, *Bot. Jahrb.* 45 (1911) 425; *Pfl. R. Hefi* 49 (1911) 36; PHILIPSON, *Blumea* 30 (1985) 403, f. 1b. — *K. vrieseana* PERKINS, *Bot. Jahrb.* 45 (1911) 424. — *K. teijsmanniana* PERKINS, *l.c.* 425. — *K. ledermannii* PERKINS, *Bot. Jahrb.* 52 (1915) 213. — **Fig. 14b.**

A shrub or small tree to 10 m high, glabrous. *Leaves* oblong-elliptic, (10–)15–36 by (4.5–)7–12.5 cm, chartaceous or subcoriaceous, base broadly cuneate to rounded, apex obtuse to subacute or with a short obtuse apiculum, entire, principal veins evident on lower surface, arched and meeting inside the margin, glabrous; petiole 15–22 mm, deeply channelled above. Monoecious. *Inflorescence* axillary, glabrous, with a short peduncle (3–5 mm long) and several short branches bearing slender pedicels (3–4 cm) crowded near their apices, the upper pedicels thicker and bearing female flowers or all the flowers male. — *Male receptacle* obovoid, c. 2 mm long, with bracteoles; tepals 4, minute; stamens 6 (2 inner smaller)

or 4. — *Female receptacle* subglobose, c. 4 mm long, with bracteoles and 4 rounded outer tepals, enclosing irregularly swollen glands; c. 10 carpels, stigma short. In fruit the pedicel becoming stout and woody, the receptacle with several short, very stout stipes. *Drupes* ovoid, 18 by 10 mm.

Distr. *Malesia*: Moluccas (Buru, Ceram, Ambon, Halmahera, Morotai, Obi) and Papua New Guinea (East Sepik Prov.).

Ecol. Rain-forest, to 1000 m.

Uses. The skin of the fruit is rubbed on the hair to dye it black (Halmahera).

Vern. *Ogoroutu masauru mnauru*, Halmahera, Tobaro lang.

Note. The large, glabrous, oblong leaves with the almost fasciculate inflorescences are characteristic. The flowers are yellow. The material I have seen of *K. ledermannii* is fragmentary but the leaves and inflorescence match those of *K. moluccana*.

19. *Kibara microphylla* PERKINS in K. Sch. & Laut., *Nachtr. Deut. Schutzgeb. Südsee* (1905) 268; *Pfl. R. Hefi* 49 (1911) 33; *Bot. Jahrb.* 52 (1915) 210; PHILIPSON, *Blumea* 30 (1985) 403.

A shrub (?) with glabrous branchlets. *Leaves* elliptic to narrowly elliptic, 7.5–11 by 2–3.5 cm, membranous, base cuneate, apex acuminate, margin entire or irregularly dentate, midrib evident, principal veins arched and uniting within the margin, glabrous; petiole to 8 mm, slender, channelled above. Monoecious. *Inflorescences* axillary or terminal, glabrous, c. 2.5–5 cm long, of small simple cymes or panicles with delicate peduncle and branches; pedicels of the male flowers more delicate than of the female. — *Male flowers* c. 1 mm \emptyset , ovoid; tepals 4, minute; stamens 4, subsessile. — *Female flowers* \pm globular with minute tepals with swollen glands within; carpels c. 8, glabrous. Fruits not seen.

Distr. *Malesia*: Papua New Guinea (West Sepik Prov.: Torricelli Mts).

Ecol. Forest at 600 m.

Note. I have not seen the type collection, but a specimen collected at the same locality agrees with the original description in all respects, except that the leaf margins are not entire but irregularly dentate. The small leaves and very delicate inflorescences of this specimen leave no doubt that it represents *K. microphylla*.

20. *Kibara streimannii* PHILIPSON, *Blumea* 30 (1985) 403.

Small tree to 7 m, young shoots softly and densely pubescent. *Leaves* narrowly oblong or oblong, stiffly chartaceous, 8–16 by 2.5–4.7 cm, base truncate to shallowly cordate, apex narrowed into indistinct acute apiculum, margin entire, becoming glabrous above, soft pubescence persisting below, midrib

channelled above, prominent below, lateral veins arched and meeting within the margin, prominent, reticulation well defined; petiole 4–7 mm, densely short pubescent. Monoecious. *Inflorescences* axillary; male and female flowers in separate inflorescences. — *Male inflorescence* consisting of elongated rachises, c. 8 cm long, setulose, bearing many pairs of subulate bracts. — *Female inflorescences* shorter (c. 4.5 cm long), peduncle c. 3.5 cm long, ending in a dichasium. — *Male flowers* in axils of bracts, apparently arising in acropetal sequence and soon caducous, pedicel c. 4 mm long, setulose; receptacle obovoid, c. 3.5 mm long, hairy outside; tepals 6, rounded or mucronate; stamens 4 outer and c. 2 inner, c. 0.75 mm long, anthers triangular with very short narrow filaments. — *Female flowers* globose, c. 4 mm ϕ , densely tomentose. Fruiting receptacle c. 8 mm ϕ , setulose, without stipes. *Drupes* not seen.

Distr. *Malesia*: Papua New Guinea (Morobe Prov., Wau & Menyama Distr.).

Ecol. *Nothofagus* and *Castanopsis* forest at 1700 m.

Note. The softly pubescent foliage is distinctive and the form of the male inflorescence is unique in the genus. The flowers are yellowish white and the ripe fruit deep blue-black.

21. *Kibara macrantha* PHILIPSON, *Blumea* 30 (1985) 404, f. 1c. — Fig. 14c.

Tree up to 20 m, with pubescent branches. *Leaves* ovate or elliptic, 120–240 by 40–80 mm, chartaceous, base rounded to broadly cuneate, apex obtuse or subacute, margin entire or occasionally with few coarse dentations, midrib prominent and reticulation of veins evident, pubescence persisting on the midrib below and to a less extent on the subsidiary veins; petiole 10–15 mm, channelled above, pubescent. Monoecious. *Inflorescence* axillary or supra-axillary, on leafy twigs or clustered on older branches, simple dichasia or open cymose panicles, rachis up to 10 cm with several pairs of lateral branches, or much shorter, pubescent; bracts ovate, c. 4 mm long, at the base the peduncle and lateral branches and usually at the base of each receptacle. — *Male receptacle* obovoid, pubescent outside, c. 5 mm long at anthesis; tepals 6, rounded; stamens 6–8, subsessile, anther broadly triangular with a single horseshoe-shaped opening. — *Female receptacle* similar, 6–8 mm long; tepals in several pairs with swollen glands within, inner surface pubescent; carpels numerous, pubescent, stigma short, obtuse. *Drupes* \pm sessile, ovoid, c. 12 by 9 mm, pubescent; fruiting receptacle c. 10 mm ϕ , woody.

Distr. *Malesia*: Papua New Guinea (Morobe Prov.: Finschhafen & Wau Distr.; Eastern Highlands Prov.: Kainantu Distr.).

Ecol. Lower montane forest (*Nothofagus*, *Castanopsis*, *Lithocarpus*), 1400–2000 m.

Note. The open inflorescences of large flowers distinguish this species.

22. *Kibara carrii* PHILIPSON, *Blumea* 30 (1985) 405.

A shrub, 1.75 m high, glabrous, in all its parts, the nodes dilated. *Leaves* broadly elliptic, up to 27 by 16 cm, coriaceous, base broadly cuneate, apex abruptly apiculate, margin coarsely dentate, midrib and lateral veins prominent below, channelled above; petiole c. 10 mm long, 4 mm wide. ?Monoecious. *Inflorescence* axillary or supra-axillary, cymose panicles, rachis c. 5 cm long, lateral branches c. 2 cm long, sometimes again branched, pedicels 10–12 mm, slender and slightly thickened below the receptacle. — *Male flower* ovoid, c. 2 mm ϕ , ostiole with 3 pairs of tepals, outer whorl of stamens 3–4, inner whorl c. 3, anther with 1 horseshoe-shaped opening; filament pubescent. — *Female flower* ovoid, c. 3 mm ϕ , ostiole surrounded by small obtuse tepals in pairs, the innermost forming thickened pendulous glands; carpels c. 15–20, with a short blunt stigma. Fruiting receptacle c. 12 mm ϕ . *Drupes* subsessile, ovoid (not fully mature).

Distr. *Malesia*: Papua New Guinea (Central Prov.: Goilala Distr.).

Ecol. Secondary forest at 1000 m.

Note. The large broadly elliptical and coarsely serrate leaves are distinctive. Similar dilated nodes are found in a few other species and also in some species of *Steganthera*. The flowers are described as yellow.

23. *Kibara elongata* A.C. SMITH, *J. Arn. Arb.* 22 (1941) 244; PHILIPSON, *Blumea* 30 (1985) 404.

A shrub or small tree, glabrous. *Leaves* elliptic to oblong-elliptic, rarely lanceolate (? juvenile); 17–30 by (3–)5.5–11 cm; coriaceous, sometimes rugose, base broadly cuneate to rounded or cordate, apex with a short blunt or long slender apiculum, margin \pm distantly spinose-dentate, veins prominent, glabrous; petiole 8–20 mm, stout, channelled above. Monoecious. *Inflorescence* axillary or above the foliage leaves, paniculate with slender peduncle, rachis and branches, to 15 cm long and much branched, but often simpler and much shorter, sometimes cauliflorous. Purely female inflorescences sometimes simple pleiochasia. — *Male receptacle* ovoid, c. 3 mm long; tepals 6; stamens 4–6, c. 1 mm long, filamen short. — *Female flowers* globose, c. 2 mm ϕ ; minute tepals surround the ostiole, within which are glandular swellings; carpels c. 30, glabrous, stigma obtuse. Peduncle and pedicel thickened and woody in fruit; receptacle c. 7–12 mm ϕ (without the stipes), stipes stout, c. 3–4 mm. *Drupes* ovoid or narrowly ovoid, 18–27 by 8–12 mm.

Distr. *Malesia*: West New Guinea (Vogelkop

Peninsula to Idenburg R.), Papua New Guinea (Jimi Valley).

Ecol. In primary rain-forest from near sea-level to 2000 m.

Vern. *Kinjoem*, Hattam lang., *talwalye*, Eipomek Valley.

Note. The coriaceous leaves with spiny teeth on the margin are distinctive. The dentations on the leaves from Jimi Valley are less spinose than the collections from Irian Jaya. The inflorescence may be a large diffuse panicle, or may be reduced in size but still with open branching. The flowers are yellow or orange and the ripe drupes are black, borne on an orange receptacle.

24. *Kibara katikii* PHILIPSON, *Blumea* 30 (1985) 406.

Small tree to 16 m, young growth densely covered with buff or fulvous tomentum. *Leaves* variable in size and shape, ovate oblong-elliptic or obovate, 7.5–21 by 3.2–8.3 cm, becoming coriaceous, base broadly cuneate or rounded, apex shortly apiculate, margin entire or (more usually) irregularly dentate in the upper part, dentations either small and obscure or prominent, midrib prominent below, lateral veins evident and meeting within the margin, upper surface becoming ± glabrous above, lower surface softly pubescent; petiole *c.* 10–15 mm, densely pubescent. Monoecious. *Inflorescence* axillary or supra-axillary, usually of simple, 3-flowered cymes, *c.* 30 mm long, densely pubescent, pedicels *c.* 8 mm long, male and female flowers in separate inflorescences. — *Male flowers* scarcely wider than the pedicel (*c.* 1 mm), pubescent on the outer surface and on the lower part inside the receptacle; tepals 4, rounded; stamens 2, attached to the base of the receptacle, *c.* 0.75 mm long, anther kidney-shaped, filament narrow, very short. — *Female flowers* wider than the stout pedicel (to 3 mm), pubescent on both surfaces; tepals 4 (2 tepals or bracts often present on the outer surface), inner rim of ostiole thickened and glandular; carpels *c.* 10–15, *c.* 1.25 mm long, pubescent, stigma obtuse glabrous. *Fruiting receptacle* usually solitary (developing from the terminal flower, side branches occasionally also with fruits), peduncle and pedicel becoming thickened and woody, receptacle enlarging slightly (*c.* 8 mm \emptyset), pubescent, with thick stipes or achenes ± sessile. *Drupes* ovoid to sub-spherical, 13–18 by 9–11 mm, sparsely pubescent.

Distr. Malesia: Papua New Guinea (Southern Highlands, Morobe, Northern, Central & Milne Bay Provinces).

Ecol. Lowland and montane rainforest, 30–2200 m.

Note. The foliage may have very different aspects, sometimes being broadly obovate with an entire margin, at others being ovate and tapering towards the apex. The copious and persistent tomen-

tum on the underside of the leaf is characteristic. This species has a wider distribution than most in the genus and a very considerable altitudinal range. The bark is thickly corky, pale brown and deeply and closely fissured.

25. *Kibara coriacea* (BL.) TULASNE, *Arch. Mus. Hist. Nat. Paris* 7 (1855) 404; *Bl. Mus. Bot. Lugd.-Bat.* 2 (1856) 89; PERKINS, *Bot. Jahrb.* 25 (1898) 576; PERKINS & GILG, *Pfl. R. Heft* 4 (1904) 62, f. 16B; PERKINS, *ibid.* Heft 49 (1911) 35, f. 11; RIDL, *Fl. Mal. Pen.* 3 (1924) 75; BACK. & BAKH, *f. Fl. Java* 1 (1963) 117; PHILIPSON, *Blumea* 30 (1985) 406. — *Brongniartia coriacea* BL. *Bijdr.* (1825) 436. — *K. blumei* STEUD. *Nomencl. Bot.* (1840) 846; *Bl. Mus. Bot. Lugd.-Bat.* 2 (1856) 89. — *Sciadocarpus brongniartii* HASSK. *Flora* 25, ii (1842) Beibl. 1: 20. — *Sarcodiscus chloranthiformis* GRIFF. *Not. Pl. As.* 4 (1854) 380. — *K. chartacea* BL. *Mus. Bot. Lugd.-Bat.* 2 (1856) 89. — *K. cuspidata* BL. *l.c.* 89. — *Mollinedia coriacea* (BL.) BAILL. *Hist. Pl.* 1 (1869) 304. — *K. tomentosa* PERKINS, *Bot. Jahrb.* 25 (1898) 571. — *K. trichantha* PERKINS, *l.c.* 572. — *K. macrophylla* PERKINS, *l.c.* 571. — *K. serrulata* PERKINS, *l.c.* 575; *Pfl. R. Heft* 4 (1901) 60, f. 16A. — *K. angustifolia* PERKINS, *l.c.* 577. — *K. grandifolia* MERR. *Publ. Gov. Lab. Philip. n.* 29 (1905) 15; *En. Philip.* 2 (1923) 185. — *K. ellipsoidea* MERR. *Philip. J. Sc.* 1 (1906) Suppl. 56. — *K. mollis* MERR. *ibid.* 3 (1908) Bot. 225. — *K. clemensiae* PERKINS, *Bot. Jahrb.* 45 (1911) 423; MERR. *En. Philip.* 2 (1923) 184. — *K. vidalii* PERKINS, *Bot. Jahrb.* 45 (1911) 423; MERR. *En. Philip.* 2 (1923) 185. — *K. motleyi* PERKINS, *Bot. Jahrb.* 45 (1911) 424. — *K. merrilliana* PERKINS, *l.c.* 424; MERR. *En. Philip.* 2 (1923) 185. — *K. stapfiana* PERKINS, *Bot. Jahrb.* 45 (1911) 424; MERR. *En. Philip.* 2 (1923) 185. — *K. warburgii* PERKINS, *Bot. Jahrb.* 45 (1911) 424. — *K. macrocarpa* PERKINS, *l.c.* 425. — *K. schlechteri* PERKINS, *Pfl. R. Heft* 49 (1911) 31. — *K. longipes* PERKINS, *l.c.* 31. — *K. inamoena* PERKINS, *l.c.* 34. — *K. dichasialis* SUESSING & HEINE, *Mitt. Bot. Staatssamml. München* 2 (1960) 60.

Tree to 22 m or rarely a scandent shrub, young branches glabrous or pubescent. *Leaves* opposite (rarely subopposite or whorled); broadly ovate to elliptic oblong, 9–35 by 5–24 cm, coriaceous or chartaceous, base cuneate rounded or subcordate, apex shortly to long acuminate, margin entire or minutely to coarsely dentate, glabrous or sparingly to rather densely pubescent beneath, midrib and principal lateral veins prominent beneath, lateral veins arched-ascending and meeting within the margin; petiole 5–25 mm, channelled above, glabrous or pubescent. Monoecious. *Inflorescences* axillary, supra-axillary, terminal, or cauliflorous, pubescent, cymes solitary or several arising at the same node, varying from simple 3-flowered cymes to complex pleiochasia with

lateral branches branching to the third or fourth degree, male flowers on the lower branches; rachis and lateral branches of female part of the inflorescence stout and thickening and becoming woody after anthesis, those of the male parts finer and caducous, up to 20 cm long but often much shorter, pedicels 15–30 mm, gradually widening below the flowers, of the male more delicate than those of the female. — *Male flowers* globose, 1.5–2 mm ϕ , only slightly wider than the pedicel, pubescent; tepals 6–8, apex rounded, usually with 4 outer stamens and up to 4 smaller inner stamens, filaments strap-shaped. — *Female flowers* globose, c. 3–5 mm ϕ ; tepals c. 6, with swollen pendulous glands within the ostiole; carpels usually c. 20, stigma short obtuse. Inflorescence enlarged, woody, receptacle c. 20 mm ϕ . *Drupes* ovoid, 15 mm long, shortly stipitate or sessile.

Distr. Throughout *Malesia*.

Ecol. Lowland rain-forest, including swamp forest and coral limestone, to lower montane forest, from sea-level to 1600 m.

Uses. The fruit is said to be edible, and the leaves are used to flavour meat dishes.

Vern. Malaya: *pako kubang tando*, *p. pakan jantan*, Malacca, *pako srean puteh*, Negri Sembilan, *susu ayam*, Pahang; Sumatra: *alimau dotan*, *kaju mata ole*, *k. ruang-ruang*, *k. singumban paya*, *sangka-sangka batu*, *s.-s. sito*, *sito mèrah*; Java: *bulusan*, *ki bara*, *ki èndog*, *ki kuya*, *ki sauheum*, *pata-tulang*, *ramat daging*, *rimik daging*, S; Banka: *tampui*, M; Sabah: *ambibliw*, Dusun Banggi, *labak*, Dusun; Philippines: *anonias*, Tag., *pototan*, Manila; New Guinea: *keawon*, Sepik, *wardiber*, Biak lang., *pu-ala*, Managalese, *sakunuo*, Muswaar I., *tor*, Bulolo, Biaro dial.

Note. Although this species varies in respect to the size and shape of its foliage and inflorescences, the number of its parts and the degree of its pubescence, it retains a character over its extensive range which ensures its recognition. This is best expressed by the broad, pliant, fresh green leaves and the openly branched inflorescence with strong pedicels to the female flowers which terminate the more distal branches. Specimens with the largest inflorescences occur in Sumatra. The range of variation appears greatest in the Philippines, and, when more complete material becomes available, several species which have been described from there may yet prove to be valid, though here reduced to synonymy. The flowers are yellow, the male being somewhat greener; the drupes are black, borne on a yellow to orange receptacle.

26. *Kibara papuana* A.C. SMITH, J. Arn. Arb. 22 (1941) 242; PHILIPSON, *Blumea* 30 (1985) 407.

— Shrub or medium-sized tree to 22 m; branchlets glabrous or slightly pubescent; buds glabrous or cov-

ered in appressed pubescence. *Leaves* opposite (or subopposite), narrowly to broadly elliptic, or ovate, thinly to firmly chartaceous, (6.5–)10–19 by (2–) 5–6(–9) cm, base broadly to narrowly cuneate or rounded, apex cuspidate obtuse, or narrowly and long-apiculate acute, margin entire or with few to many teeth, midrib prominent below, lateral veins arched-ascending, the reticulation of minor veins evident; petiole narrow, to 15 mm, channelled above. *Inflorescence* axillary, supra-axillary, or terminal, often of 3-flowered cymes, or solitary flowers or pleiochasia, sometimes with secondary or tertiary branching to form panicles; male flowers on lower more slender branches or in separate often paniculate inflorescences. — *Male flowers* ovoid, 1.5–2.5 mm long, glabrous; tepals 6; stamens 4–8, the outer 4 large, the inner smaller or absent, anthers broadly triangular, obtuse, filaments short, as wide as the anthers. — *Female flowers* globose, c. 3 mm long, glabrous and sometimes minutely puberulous on both surfaces; tepals minute with thickened glands within the ostiole; carpels numerous, glabrous or pubescent, stigma short, obtuse. Fruiting receptacle up to 10 mm ϕ , with stout prominent tepals c. 4–6 mm long. *Drupes* ovoid, c. 18 by 12 mm, rugulose.

Distr. *Malesia*: Papua New Guinea (Central, Northern, Milne Bay and Morobe Prov.).

Ecol. Primary lowland rain-forest, montane forest and mossy forest; understory with *Castanopsis* and *Araucaria*. Also in secondary growth, 100–2100 m.

Vern. *Boakeava*, Wagau, *popoia*, Northern Prov., Koiari lang., *siganapa*, Northern Prov., Orokawa lang., *saha*, northern Managalese.

Note. Similar to *K. coriacea* but with smaller foliage, and with smaller, less indurated flowers. The ripe drupes are black on an orange receptacle. In some specimens the achenes are muricate, but this may be due to insect infection. The species, as here treated, includes a considerable range of leaf size, and most specimens do not show the compact inflorescence which SMITH noted on the type. The extreme forms come from the islands to the east of New Guinea (especially Goodenough and Normanby Is.), but a continuous series of intermediate states unite all the forms.

27. *Kibara nitens* PHILIPSON, *Blumea* 30 (1985) 408.

Small sparsely branched shrub usually under 3 m high, glabrous. *Leaves* elliptic, elliptic-oblong or narrowly obovate, 17 by 6.5 cm, coriaceous, base cuneate, apex apiculate, apiculum obtuse or acute, margin obscurely and irregularly dentate, midrib prominent, lateral veins numerous and close-set, at first straight but curved and uniting near the margin, glabrous; petiole 15 by 2.5 mm, channelled above. Monoecious. *Inflorescence* an axillary or terminal

pleiochasium, rachis c. 4 cm, peduncle c. 18 mm long, bracteate at the base, the opposite pairs of pedicels also subtended by bracts; pedicels c. 5 mm, becoming thickened and elongating in female flowers after anthesis. — *Male flowers* ovoid, c. 1 mm \emptyset , ostiole surrounded by 3 pairs of obtuse tepals; stamens 4 inserted halfway up the receptacle, with 2 small central staminodes. — *Female flowers* not seen. Fruiting receptacle woody, c. 8 mm \emptyset . *Drapes* c. 12–15 shortly stipitate, ellipsoid, c. 16 by 11 mm (when dry).

Distr. *Malesia*: West New Guinea (Star Mts), Papua New Guinea (West Sepik Prov.: Telefomin District; Southern Highlands Prov.: Tari Distr.).

Ecol. Undergrowth in primary forest, 750–2150 m.

Vern. *Soinok*, Telefomin.

28. *Kibara fragrans* PHILIPSON, *Blumea* 30 (1985) 408.

Small tree, c. 3 m, young shoots glabrous. *Leaves* elliptic-oblong, to 22 by 8.5 cm, chartaceous, base broadly cuneate, apex shortly apiculate, apiculum obtuse, margin irregularly and indistinctly dentate, midrib prominent, principal lateral veins evident, arched, ascending, glabrous; petiole to 3 cm. *Inflorescences* axillary, c. 50 mm long, glabrous, small few-flowered cymes or rather more complex small paniculate cymes, solitary or clustered at nodes, upper flowers female on stouter pedicels; pedicels c. 20 mm, wider distally. — *Male receptacle* c. 2 mm long, cup-shaped, widely open; tepals 6, rounded; stamens 4 in outer whorl, c. 0.75 mm long, c. 2 in centre, shorter, filament strap-shaped, as wide as the anther. — *Female receptacle* ovoid, c. 2.75 mm long; tepals 6, rounded, ostiole small, with thickened glands within. *Fruit* not seen.

Distr. *Malesia*: NW. New Guinea.

Ecol. Lowland forest and on hilltop at 150 m.

Note. The foliage resembles that of *Steganthera hirsuta*, while the inflorescences are similar to those of *Kibara fugax*. The green flowers are fragrant.

29. *Kibara obtusa* BL. Mus. Bot. Lugd.-Bat. 2 (1856) 89; PERKINS & GILG, Pfl. R. Heft 4 (1901) 61; PERKINS, Bot. Jahrb. 45 (1911) 424; Pfl. R. Heft 49 (1911) 34; MERR. En. Philip. 2 (1923) 185; PHILIPSON, *Blumea* 30 (1985) 409. — *K. depauperata* MERR. Publ. Gov. Lab. Philip. n. 13 (1906) 13.

Shrub or tree to 20 m, bole 36 cm \emptyset dbh, young branches with appressed stiff hairs. *Leaves* narrowly to broadly elliptic, 8–11.5(–15) by 3.5–5(–6.5) cm, base narrowly or broadly cuneate, apex obtuse, margin entire, becoming glabrous or lower surface with sparse stiff pubescence; petiole 10–18 mm, becoming glabrous or hairs \pm persistent. *Inflorescences* axillary or terminal, pubescent, simple or paniculate cymes, up to c. 70 mm long, the rachis, lateral

branches and pedicels slender or stronger with a more compacted inflorescence. — *Male receptacle* obovoid, c. 2 mm long, with a pair of small bracteoles, outside minutely pubescent; tepals 4, minute; stamens 4, sometimes with 2 central staminodes, and with staminodes inside the outer 2 tepals. — *Female receptacle* \pm globose, c. 2.5 mm \emptyset , with bracteoles on the outer surface or on the pedicel, minutely pubescent on outer and inner surfaces; 4 outer tepals, obtuse, with 4 swollen glands within which project among the carpels; carpels c. 13, pubescent, with a blunt stigma. Mature torus swollen and leathery, with 1 to c. 13 short stout stipes, slightly pubescent. *Drapes* ovoid, 17–24 by 10–12 mm.

Distr. *Malesia*: N. Borneo (Sabah: Lahad Datu Distr.), Philippines (Luzon: Benguet Prov.), NE. Celebes (Minahasa), West New Guinea (Biak I.).

Ecol. Primary rain-forest, sea-level to 700 m.

Vern. *Mardieber*, Biak lang.

Note. The flowers are yellow or orange; the ripe drupes are black on an orange receptacle.

30. *Kibara laurifolia* A.C. SMITH, J. Arn. Arb. 22 (1941) 240; PHILIPSON, *Blumea* 30 (1985) 409.

Sprawling shrub or small tree to 7 m, glabrous. *Leaves* elliptic, elliptic-oblong or suborbicular, up to 17 by 8.5 cm, coriaceous, base rounded to broadly cuneate, apex obtuse to slightly apiculate, margin entire or occasionally with obscure dentations, midrib, lateral veins and reticulation evident, glabrous; petiole 5–10 mm, channelled above. Monoecious. *Inflorescences* axillary, supra-axillary, or terminal, flowers solitary or usually in dichasia, or pleiochasia, c. 30 mm long, peduncle c. 10 mm, bracteate at its base, pedicels c. 10–12 mm, subtended by bracts. — *Male flowers* ovoid, c. 3 mm \emptyset , 3 pairs of tepals, 4 stamens with horseshoe-shaped openings, filaments very short. *Female flowers* \pm globose, c. 4 mm \emptyset , ostiole with 4 pairs of tepals and prominent swollen glands within, carpels numerous, ovary glabrous, stigma obtuse. Fruiting peduncle and pedicels elongated up to 8 cm, receptacle woody, c. 10 mm \emptyset . *Drapes* ovoid, c. 16 by 12 mm, or subspherical, \pm sessile or shortly stipitate.

Distr. *Malesia*: throughout New Guinea in the highlands between 139°–148° E.

Ecol. Primary and disturbed lower montane rain-forest, 1800–2800 m.

Vern. *Kamokam*, Enga lang.

Note. The broad, often suborbicular, leathery leaves are distinctive. The ripe drupes are purplish black on an orange to yellow receptacle. A specimen from near Wabag approaches *K. macrantha* in the large pubescent receptacles, but has foliage similar to that of *K. laurifolia*. It may be a hybrid, though it lies west of the known range of *K. macrantha*.

31. *Kibara flagelliformis* PHILIPSON, *Blumea* 30 (1985) 409.

Shrub or small tree; young parts minutely puberulous and soon becoming glabrous. *Leaves* opposite or subopposite, elliptical, chartaceous, c. 19 by 9 cm (all damaged), base broadly cuneate, apex not present, margin entire, midrib prominent below, lateral veins strongly arched-ascending; petiole stout, c. 10–12 mm, channelled above. *Inflorescences* axillary, central rachis c. 8 cm, lateral branches in opposite pairs or 3–4 at the same level, usually again branched about the middle; pedicels slender, elongated (up to 45 mm). — *Male flowers* obovoid, 3 mm long, with 4 rounded tepals surrounding a widely open ostiole (sometimes another pair of tepals (bracts) about the middle of the receptacle), 4 large stamens and c. 3 smaller stamens in the centre; filaments wide, strap-shaped, c. 2 mm long, wider than the small triangular anthers. — *Female flowers* and fruit not seen.

Distr. Malesia: West New Guinea (Napan Distr.). Known only from the type.

Note. The specimen bears only male flowers in strangely branched inflorescences. The stamens are unusual, with long filaments much wider than the small anthers.

32. *Kibara chimbuensis* PHILIPSON, *Blumea* 30 (1985) 410.

Small tree to 7 m, young branches glabrous. *Leaves* glabrous, narrowly elliptic to lanceolate, membranaceous, 9–13 by 2.8–4.8 cm, base narrowed into the petiole, apex narrowed into an indistinct and obtuse apiculum, margin entire or slightly undulate, lateral veins rather indistinct, steeply ascending; petiole to 10 mm. Monoecious. *Inflorescences* axillary, supra-axillary or terminal, glabrous, singly or in groups, either few-flowered cymes or more branched open, cymose, panicles up to 8 cm long; pedicels slender, 20–45 mm; male flowers on lower branches. — *Male flowers* cup-shaped, c. 1.5 mm long, 2 mm \varnothing ; rounded tepals widely open; stamens 4 in outer whorl and 4 smaller stamens at centre, filaments strap-shaped, glabrous. — *Female flowers* subglobose, c. 3 mm long, 2.5 mm \varnothing ; tepals 6, rounded, inner rim of ostiole with pendulous glands; carpels c. 10, glabrous, stigma obtuse. *Infructescence* with somewhat thickened pedicels and a woody receptacle c. 15 mm \varnothing (including short thick stipes). *Drupes* ovoid, c. 15 by 10 mm when dry, shortly stipitate.

Distr. Malesia: Papua New Guinea (Chimbu Prov.: Kerowagi Distr.).

Ecol. A small tree in forest remnant at 1350 m.

Note. The narrowly elliptic to lanceolate leaves have a thin texture and dry to a dull dark green. The inflorescences are similar to those of *K. fugax*.

33. *Kibara fugax* PHILIPSON, *Blumea* 30 (1985) 411. — **Fig. 16.**

Small tree, up to 10 m, all parts glabrous. *Leaves* elliptic to broadly elliptic or obovate, 10–16(–18) by 3.8–7(–8) cm, membranaceous to thinly chartaceous, base cuneate, apex slightly apiculate, apiculum obtuse, entire or occasionally with a few obscure dentations, midrib evident, lateral veins few, strongly arched; petiole 5–8(–10) mm long, channelled above. Monoecious. *Inflorescence* terminal or axillary, simple or paniculate cymes, either all flowers of one sex or with male flowers on the lower branches, to c. 50 mm long; pedicel of male flowers c. 36–60 mm long, very slender, or female flowers stronger and shorter (c. 15–20 mm). — *Male receptacle* subglobose, c. 1.5 mm \varnothing ; 6 rounded tepals around the ostiole; stamens c. 4 (5) outer, 2–5 inner, filament short, broad, anther broad with a single horizontal opening. — *Female receptacle* globose, c. 2–2.5 mm \varnothing ; tepals minute, 4 around the ostiole, another pair inside and with thickened glands within; carpels c. 16–20, glabrous, stigma short, blunt. *Drupes* ovoid, c. 13 by 9 mm, shortly stipitate.

Distr. Malesia: Papua New Guinea (Morobe & Central Prov.).

Ecol. Lower montane forest or secondary forest, between 750 and 1400 m.

Note. A common tree in the Wau District distinguished by its membranous leaves (which usually dry to a blackish colour) and the long delicate pedicels of male flowers. The male receptacles and pedicels wither immediately after anthesis, a feature reflected in the specific epithet. The flowers are yellowish and the ripe drupes purple-black.

34. *Kibara novobritanica* PHILIPSON, *Blumea* 30 (1985) 411.

Small tree up to 16 m high, glabrous. *Leaves* oblong to broadly elliptic, 16–20 by 7.5–10 cm, chartaceous, base broadly cuneate to rounded, apex with a short obtuse (or occasionally acute) apiculum, entire, midrib prominent, principal veins arched ascending and meeting near the margin; petiole c. 10 mm. Monoecious. *Inflorescences* terminal, axillary or supra-axillary, short pleiochasia often densely aggregated together at the nodes, rachis short (up to 30 mm long) with a few pairs of lateral branches which may branch again, pedicels thickened for about 10 mm below the receptacle. — *Male receptacle* subglobose, c. 2 mm \varnothing ; tepals 6, rounded; stamens usually 6 (in 3 pairs, the inner small, the outer inserted well above the base of the cavity); anthers small subsessile. — *Female receptacle* similar but larger, c. 4 pairs of tepals with swollen glands within the ostiole; carpels numerous, glabrous with an obtuse stigma. *Drupes* \pm sessile, ovoid, c. 13 by 18 mm, glabrous; fruiting receptacle c. 8 mm \varnothing , woody.



Fig. 16. *Kibara fugax* PHILIPSON. *a*. Leafy shoot bearing male, female and mixed inflorescences, $\times 1/2$, *b*. male flower, *c*. the same in LS, both $\times 7$, *d*. stamens, $\times 10$, *e*. female flower, *f*. the same in LS, both $\times 7$, *g*. carpel, $\times 10$ (NGF 14583).

Distr. *Malesia*: Papua New Guinea (W. & E. New Britain; New Ireland).

Ecol. Lowland rain-forest to 100 m.

Vern. *Gangnan*, Puh River, Kandrian Distr., *napeewa*, Talasea.

Note. Confined to New Britain and New Ireland, and the only species of *Kibara* known from that region. The thickened pedicels are characteristic. The ripe drupes are black on an orange torus.

35. *Kibara rigidifolia* A.C. SMITH, J. Arn. Arb. 22 (1941) 243; PHILIPSON, *Blumea* 30 (1985) 412.

Small tree to 8 m, sparsely branched; young branches glabrous, flattened or triangular. *Leaves* opposite or in whorls of 3, elliptic-oblong or lanceolate-elliptic, up to 30 by 11.5 cm, base broadly cuneate, apex rounded or obtuse with a glandular mucro, coriaceous, light yellow-green when dry, entire or with acute dentations, midrib prominent beneath,

principal veins numerous, at first straight but arched and uniting within the margin, glabrous; petiole 13–25 mm long, stout, slightly channelled above. Dioecious (according to BRASS). *Inflorescence* axillary, the male flowers in panicles c. 40 mm long, the female pleiochasia up to 60 mm. — *Male receptacle* globose, 4–5 by 3–4 mm, tepals 8, obtuse (the innermost pair \pm resemble staminodes); stamens 3–6, 1.5–1.75 mm long, with broad vertical anthers and a short filament, glabrous. — *Female receptacle* globose, 5 by 3.5 mm; tepals, minute, obtuse, with swollen glands within; carpels c. 30, glabrous, with a cushion-shaped stigma. Peduncle and pedicels becoming thicker and woody in fruit; receptacle leathery, c. 10 mm ϕ , bearing short stipes. *Drupes* ovoid, 12–16 by 8–10 mm.

Distr. Queensland and *Malesia*: Papua New Guinea (Western Prov.: Morehead & Balimo Distr.).

Ecol. In coastal scrub or undergrowth of forest

near sea-level, on sandy soil and on shaded cliff face.

Note. A sparsely branched shrub or small tree with pale, shining, coriaceous leaves which are frequently arranged in whorls of three on triangular stems. Older branches fawn, with soft fissured corky bark. The drupes are black on an orange receptacle. The number of stamens is variable, even on the same plant. They are not arranged irregularly over the receptacle wall (as in *Wilkiea*) but form a central group. When the number of stamens is reduced, the inner tepals may resemble staminodes. The form of the stamens differs from that of most species of *Kibara* as they are held vertically with the two lips of the horseshoe-shaped slit \pm equal (in most species the anther inclines towards the centre with the lower lip smaller than the upper).

36. *Kibara sudestensis* PHILIPSON, Blumea 30 (1985) 412.

Shrub or small tree, c. 4 m, glabrous in all its parts, except that the buds and young foliage are covered in appressed silky hairs. *Leaves* narrowly elliptic, up to 17.5 by 5.8 cm, stiffly coriaceous, narrowed to a truncate base, apex narrowed or slightly apiculate, margin entire or one or a few teeth near the apex, midrib prominent, lateral veins numerous, running straight from the midrib at a slight angle, uniting near the margin; petiole c. 10 mm, channelled above. *Inflorescences* axillary or supra-axillary, one- or few-flowered cymes, c. 25 mm long; pedicels widening into the base of the flower. — *Male receptacle* obovoid, up to c. 6 mm long, glabrous; tepals 6, cavity small, enclosing 4 large and 2 smaller central stamens, anthers kidney-shaped; filaments short, narrower than the anthers. — *Female flowers* and fruits unknown.

Distr. Malesia: Papua New Guinea (Louisiades & Sudest I.).

Ecol. A small undergrowth tree on ridge crest in rain-forest, at 150 m.

Note. The narrowly elliptic, rigid leaves, and the large male flowers with small kidney-shaped anthers are distinctive.

37. *Kibara sleumeri* PHILIPSON, Blumea 30 (1985) 413.

Small tree, 3 m, glabrous. *Leaves* oblong, 14–20 by 6–11 cm, chartaceous, base rounded or broadly cuneate, apex rounded with a short apiculum, entire, principal veins prominent below and meeting inside the margin, glabrous; petiole to 22 mm, channelled above. *Inflorescences* axillary or arising above the foliage leaves, at first setulose becoming glabrous at maturity, one or more few-flowered cymes arising together, peduncles slender, 15–20 mm, with basal bracts and a pair of bracts towards the middle; pedicels c. 5 mm, slightly swollen below the female flow-

ers. — *Male receptacle* obovoid, c. 2.5 mm long, with 6 stamens, the central pair reduced. — *Female receptacle* subglobose, c. 3 mm long; tepals 4, rounded, enclosing swollen glands; c. 10 carpels, very faintly pubescent, stigma short. In fruit the peduncles and pedicels become slightly woody, c. 45 mm long; the receptacle in fruit rather small (c. 10 mm ϕ) with prominent stipes c. 3 mm long. *Drupes* ovoid, 16 by 10 mm.

Distr. Malesia: West New Guinea (Vogelkop Peninsula).

Ecol. Dense shade in *Castanopsis* forest, 450–600 m.

Note. The foliage is similar to that of *K. moluccana*, but the compact subfasciculate inflorescences of that species are distinctive. The flowers are pale yellow and the drupes black on a swollen orange receptacle.

38. *Kibara monticola* PERKINS, Pfl. R. Heft 49 (1911) 32; PHILIPSON, Blumea 30 (1985) 414.

Small tree, with glabrous branchlets. *Leaves* narrowly elliptic, 13–20 by 4–6.5 cm, membranaceous, base cuneate, apex apiculate, entire, midrib prominent, principal veins few, arched and meeting inside the margin, glabrous; petiole 8–10 mm, slightly channelled above. Monoecious. *Inflorescences* axillary or supra-axillary, dichasial or small pleiochasia, glabrous. — *Male flowers* ovoid, 2.5 mm long; tepals 4, rounded; stamens 6, the innermost 2 smaller. — *Female flowers* ovoid, 2.5–3.5 mm ϕ , pedicels 10–15 mm long; tepals with 4 swollen glands within; carpels 10–15, slightly pubescent with a short stigma. *Fruits* not seen.

Distr. Malesia: Papua New Guinea (Sepik region: Ibo Mts). Only known from the type.

Ecol. In forests at 110 m.

39. *Kibara symplocoides* PERKINS, Bot. Jahrb. 52 (1915) 210; PHILIPSON, Blumea 30 (1985) 414.

Small tree to 8 m, glabrous. *Leaves* elliptic to narrowly elliptic, 7–12 by 2.5–4.5 cm, chartaceous, base cuneate, apex narrowly acuminate, entire or with a few small remote dentations in the upper half, the midrib and principal veins deeply immersed above, prominently raised below, the lateral veins arched and uniting within the margin, glabrous; petiole 4–6 mm. ?Monoecious. — *Male inflorescences* axillary or supra-axillary, fasciculate or solitary, cymose, to 10 mm long, with small ovate bracts. — *Male receptacle* ovoid, 1.5–2 mm long; tepals 6; stamens 2, subsessile. — *Female inflorescences* racemose or flowers solitary, axillary or supra-axillary, to 35 mm long, with lanceolate bracts. — *Female receptacle* globose, 4 mm, ostiole with minute tepals and swollen glands within; carpels numerous, pilose. *Fruit* not seen.

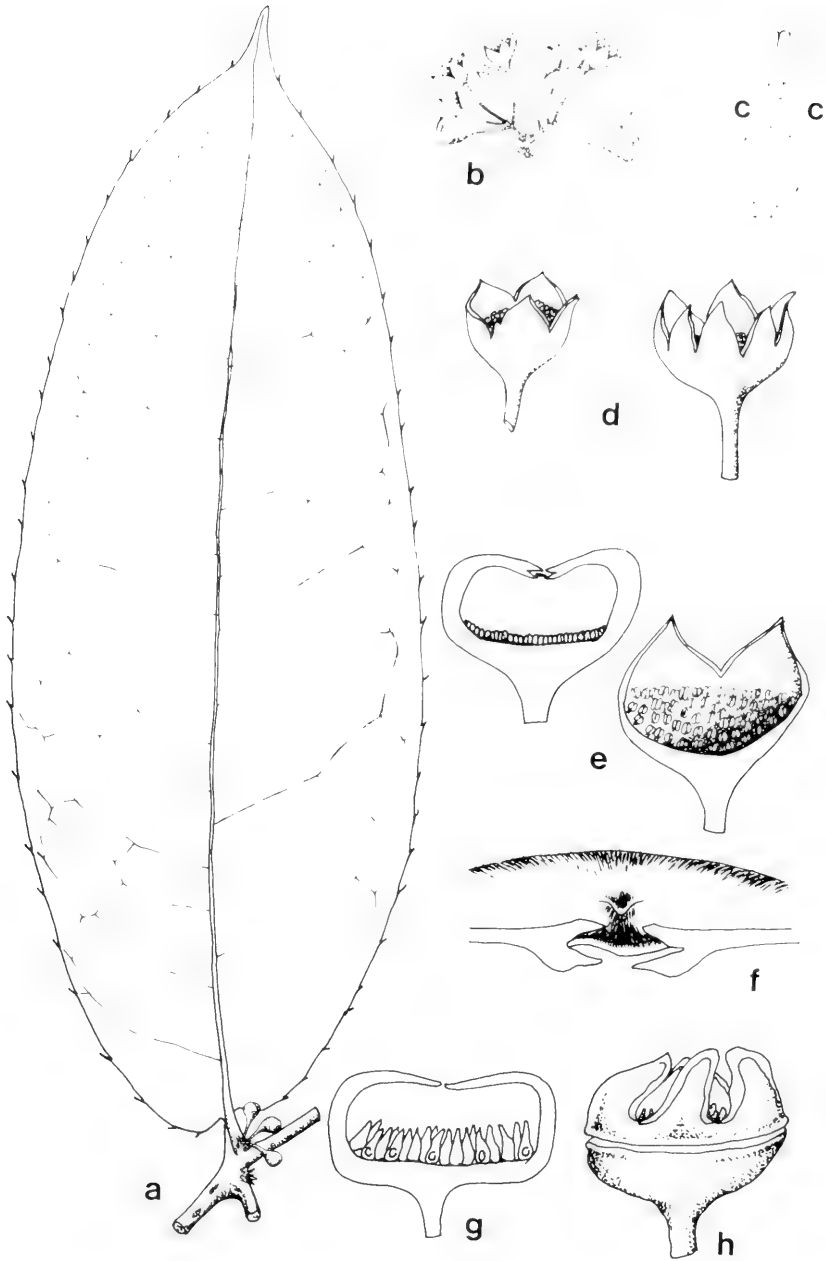


Fig. 17. *Kairoa suberosa* PHILIPSON. *a*. Habit, *b*. male inflorescence, both $\times 1/2$, *c*. stamens, $\times 20$, *d*. two male flowers, nat. size, *e*. male flowers in LS, after splitting of the receptacle, $\times 1 1/2$, *f*. ostiole of male flower, the equal pairs of tepals cut across, one unequal pair visible, $\times 12$, *g*. female flower in LS, $\times 2 1/2$, *h*. female flower after anthesis, the upper part of the receptacle abscising, $\times 1 1/2$ (*a* HARTLEY 12697, *b*, *d* NGF 44173, *c* NGF 14850, *e* PHILIPSON 3681, *f* PHILIPSON 3684, *g* LAE 56322).

Distr. *Malesia*: Papua New Guinea (Sepik region). Only known from the two original collections. Ecol. In open mountain forest, about 20 m high, at 1000 m altitude.

Insufficiently known

The types of the following species have not been seen, and it is not possible to determine from the descriptions whether they correspond to any known species or are distinct:

- K. olivaeformis* BECC. *Malesia* 1 (1877) 187.
K. aruensis BECC. *l.c.* 188.
K. formicarum BECC. *l.c.* 188.
K. perkinsiae K. SCH. & LAUT. *Fl. Deut. Schutzgeb. Südsee* (1900) 330.
K. elmeri PERKINS, *Bot. Jahrb.* 45 (1911) 424.
K. buergersiana PERKINS, *Bot. Jahrb.* 52 (1915) 209.
K. neriifolia PERKINS, *l.c.* 212.

Inadequately represented

The collections listed below appear to represent undescribed species of *Kibara*, but the material is inadequate because no flowers are present.

BARKER LAE 67616, Telefomin Distr.; EYMA 4555, Wissel Lake region; FOREMAN LAE 52220, Ramu Distr.; KOSTERMANS & SOEGENG 853, Baliem Valley; VAN ROYEN & SLEUMER 7773, Vogelkop Peninsula.

Excluded species

Kibara borneensis BOERL. = *Pycnarrhena* (*Menispermaceae*).

Kibara timorensis BOERL. = *Pycnarrhena* (*Menispermaceae*).

8. KAIROA

PHILIPSON, *Blumea* 26 (1980) 368, f. 1–10. — **Fig. 17, 18.**

Small tree or sparsely branched shrub with toothed leaves and flowers in axillary fascicles. *Flowers* monoecious. — *Receptacle of male flower* at first globose with a small ostiole bounded by 8 tepals (in two double pairs), at anthesis splitting to form an open bowl-shaped flower with 4–6 radiating lobes, fleshy. *Stamens* very numerous, inserted over the surface of the receptacle; anthers opening by two longitudinal slits; filament very short. — *Receptacle of female flower* oblate, with an ostiole bounded by 4 tepals, splitting into broad segments; the upper part of the receptacle abscising by a circular split after anthesis. *Carpels* numerous, sessile, with a very short style. *Fruits* numerous, ovoid, sessile on an enlarged fleshy receptacle.

Distr. *Malesia*: Papua New Guinea (Morobe and Northern Provinces, from Finschhafen to Tufi Distr.). Monotypic. Fig. 10.

Ecol. Understorey of rain-forest.

1. *Kairoa suberosa* PHILIPSON, *Blumea* 26 (1980) 368, f. 1–10. — **Fig. 17, 18.**

Shrub or small tree with stout terete branches, bark becoming corky. *Leaves* coriaceous, up to 45 by 17 cm, oblong, elliptic or lanceolate-oblong; base cordate, truncate or cuneate, apex narrowed to an acute apex; lower surface with dense or sparse pubescence or glabrous; margin with few to many sharp teeth; midrib prominent; secondary and tertiary veins forming a distinct reticulation; petiole stout, 5–15 mm. *Inflorescence* of axillary fascicles which continue to appear from successive buds at older nodes; fascicles with a short peduncle bearing crowded minute bracts, the lower sterile, the upper with

flowers in their axils. — *Pedicels of male flowers* fleshy (when fresh), c. 15–20 mm, sometimes with solitary or paired bracteoles, expanded above; receptacle at first globose with a terminal depression and an ostiole with 8 tepals in two double pairs, expanding to c. 18 mm ϕ before opening by 4–6 radial splits to form a star-shaped flower with the stamens fully exposed. *Stamens* numerous (over 100), inserted over the lower half of the receptacle, filament short; anthers to 1 mm long, opening by two longitudinal slits. — *Pedicels of female flowers* shorter (c. 5 mm at anthesis); receptacle globose, smaller (c. 8 mm ϕ), tepals 4, the upper half of the receptacle becoming detached after anthesis by a circular scar. *Carpels* nu-



Fig. 18. *Kairoa suberosa* PHILIPSON. A group of ripe infructescences (the fruits in this cluster were borne on three closely associated receptacles), $\times 3/4$ (PHILIPSON 3626).

merous (c. 50 or more), sessile on the lower half of the receptacle, with a short, blunt style. Receptacle becoming enlarged and fleshy in fruit. *Drupes* sessile, numerous, ovoid, 20–24 by 11–14 mm.

Distr. *Malesia*: Papua New Guinea (Morobe & Northern Prov.). Fig. 10.

Ecol. Locally frequent in the understorey of lowland rain-forest and occasionally ascending into lower montane forest to 1200 m, with *Castanopsis* and *Lithocarpus* dominant.

Note. The specific epithet refers to the thick deeply fissured bark of the older stems, by which feature this species can most readily be detected in the field. The stiff leaves, which are usually sharply toothed, are also distinctive. The male flowers are soft, fleshy, cream-coloured often flecked with violet. They are rather large for the family. The succulent, fleshy fruiting receptacle is orange and the ripe drupes are black and shining.

9. STEGANTHERA

PERKINS, Bot. Jahrb. 25 (1898) 564; Pfl. R. Heft 4 (1901) 52; *ibid.* Heft 49 (1911) 20; Bot. Jahrb. 52 (1915) 197; Übersicht Gattungen Monim. (1925) 33; PHILIPSON, Blumea 29 (1984) 486, f. 1. — *Anthobembix* PERKINS, Bot. Jahrb. 25 (1898) 567. — Fig. 19–23.

Trees or shrubs, resting buds with cataphylls. *Leaves* pubescent at first, sometimes becoming glabrous, entire or dentate, principal secondary veins arched and meeting within the margin. Monoecious or dioecious. *Inflorescences* lateral, cymose or fasciculate. — *Male flowers* globose, turbinate or patelliform, with 4 small tepals, stamens (3–)4(–5), or rarely with a second (inner) whorl of 1–4 smaller stamens; anthers opening by a single horizontal slit. — *Female flowers* similar to male but larger and with a smaller ostiole surrounded by 4 tep-

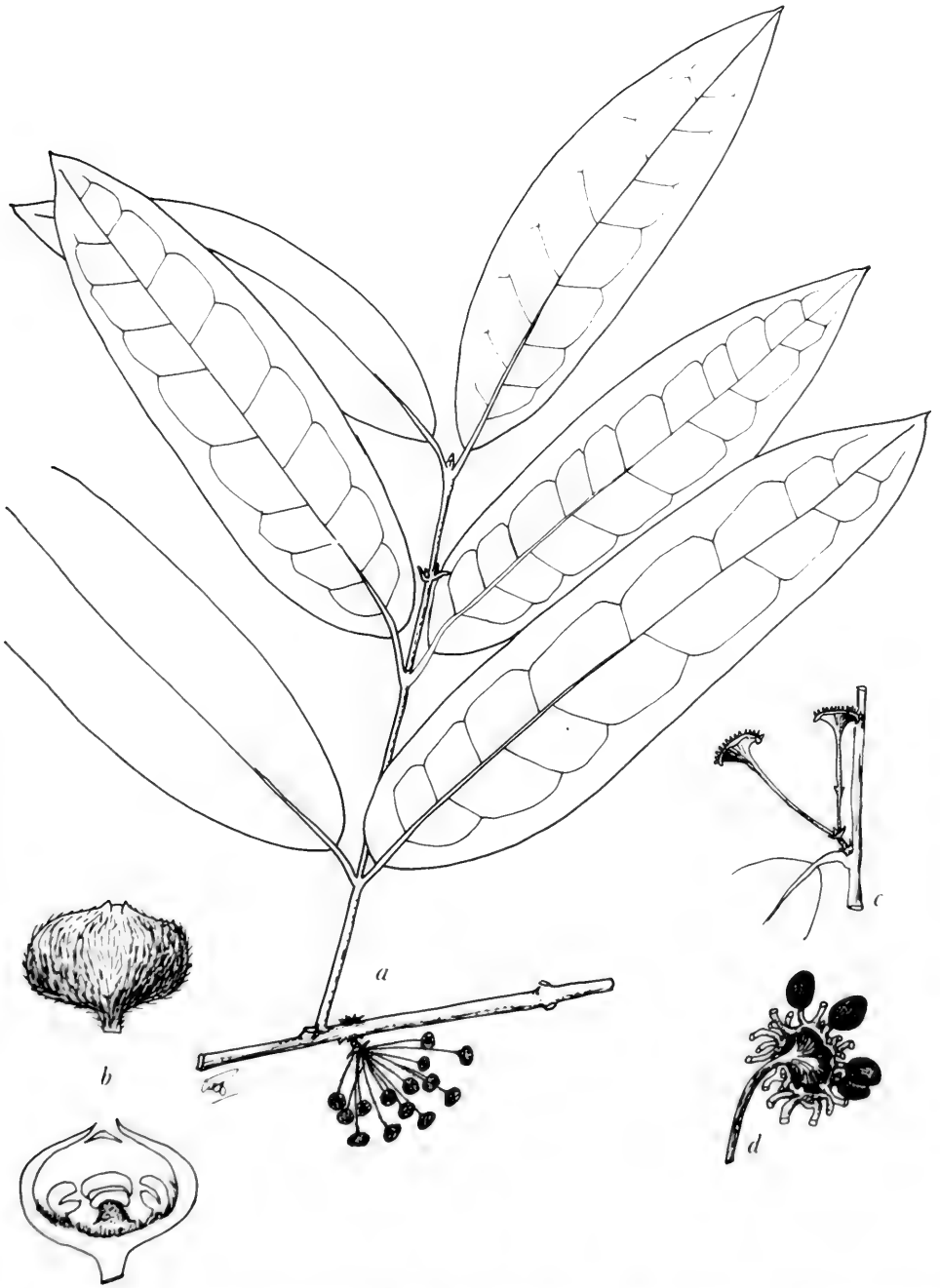


Fig. 19. *Steganthera fasciculata* PHILIPSON. *a*. Habit, with subumbellate male flowers, $\times 1/2$, *b*. male flowers, one in LS, $\times 5$, *c*. female inflorescence, *d*. infructescence with 4 stipitate achenes, both $\times 1/2$ (*a* PHILIPSON & KAIRO 3642, *b* ditto 3643, *c* ditto 3641, *d* PRATT 1082).

als, the upper half abscissing as a calyptra after anthesis to reveal numerous carpels; ovary pubescent; style glabrous awl-shaped. *Drupes* sessile or long-stipitate.

Distr. Queensland, Solomons and *Malesia*: Celebes, Moluccas, New Guinea (incl. Bismarck Archipelago).

Notes. *Steganthera* is frequently confused with *Kibara*, another common and widely distributed genus, because the foliage, fruits and inflorescences are similar. The technical differences between these two genera are not readily observable. They are, firstly, the greater number of tepals in *Kibara*, certain of which are thickened and glandular in the female receptacle, and, secondly, the greater number of stamens in the androecium (but see *S. salomonensis*). However, other features usually allow a generic identification to be made. The most important of these is the appearance of the pedicel: in *Steganthera* the pedicel is relatively slender and is clearly distinct from the receptacle, whereas in *Kibara* the pedicel is thickened distally and has a less clearly defined junction with the receptacle or none at all. Another useful indication is that the leaves usually dry greenish (often yellowish green) in *Kibara*, whereas in *Steganthera* they are mostly brown when dry.

The species of *Steganthera* can be placed in three groups on morphological grounds. One is characterized by the expansion of the female, and to a lesser extent also the male flower, into a turbinate or patelliform receptacle. This group formerly was segregated as the genus *Anthobembix*, but KANEHIRA & HATUSIMA (Bot. Mag. Tokyo 56, 1942, 256) set out valid reasons for uniting the two genera. A second group of species is characterized by their fasciculate inflorescences and by being dioecious. The third group comprises those species lacking both these characters; that is, the species have subglobose receptacles in cymose inflorescences. It includes a number of species which are difficult to separate, including *S. hirsuta* which is very variable in all its characters. The species of the first two groups are well defined morphologically and geographically, whereas those of the third group form a complex which has not yet resolved itself into stable species. These three groups of species are not given formal taxonomic recognition because their limits are not clearly defined. *Steganthera dentata* and *S. cycloensis* combine fasciculate inflorescences with discoid receptacles and therefore fall into both of the first two groups. In some species the expansion of the receptacle is a variable character; for example, in *S. hospitans* and *S. oligantha* the male flower may be globose, but this may be due to hybridity with *S. hirsuta*.

The association of some species with ants is very striking. These species have enlarged nodes with well-defined pores leading into the hollow stems. Scale insects line the pith cavities and small black ants abound over the plant surface and in the hollow stems. The association is most conspicuous in the large-leaved and abundant species *S. hospitans*, but also occurs in *S. moszkowskii*, *S. ledermannii* and *S. royenii*.

Pollination biology has not been studied and the structure of the receptacles poses several problems. The male receptacles have open, if small, ostioles at the time the anthers dehisce, but it is not known what insects visit them. The carpels in the female receptacles are covered by the 'calyptra' at anthesis. The ostiole giving access to the female receptacle is even smaller than that of the male and it is not known how pollen reaches the stigmas. These are awl-shaped and converge towards the ostiole. In *Kibara* and some other genera pollen is received on a hypostigma outside the receptacle (ENDRESS, *Experientia* 35, 1979, 45) but this is not so in *Steganthera*.

KEY TO THE SPECIES

1. Female inflorescence subsessile **16. *S. insculpta***
1. Female inflorescence pedunculate.
 2. Male inflorescence umbellate.
 3. Leaves elliptic to broadly elliptic (mostly under 10 cm long: W. Sepik Prov.) **1. *S. hentyi***
 3. Leaves oblanceolate to narrowly elliptic (mostly longer than 10 cm).
 4. Male receptacle globose (Papua New Guinea, east of 146°30' E) **2. *S. fasciculata***
 4. Male receptacle discoid.
 5. Leaves narrower than 4.5 cm (W. Irian) **3. *S. cycloensis***
 5. Leaves wider than 7 cm (W. Irian) **4. *S. dentata***
 2. Male inflorescence of dichasia, pleiochasia or panicles.
 6. Pedicels of male flowers mostly in irregular clusters.
 7. Nodes dilated, with a pore inhabited by ants (W. Irian).

8. Male receptacle globose 5. *S. royenii*
 8. Male receptacle turbinate with a 4-lobed apical disc 6. *S. moszkowskii*
 7. Nodes not harbouring ants.
 9. Leaves large¹. Inflorescence large with stout pedicels (Solomon Is. and Papua New Guinea east of 48°30' E) 7. *S. salomonensis*
 9. Leaves smaller (to 10 cm long). Inflorescence small, with slender pedicels (Wau, Goilala & Moresby Prov.) 15. *S. australiana*
 6. Pedicels of male flowers mostly solitary.
 10. Receptacles discoid or turbinate.
 11. Leaves 20 cm long or longer (widely distributed) 8. *S. hospitans*
 11. Leaves considerably shorter.
 12. Male inflorescence 1–2-flowered. Leaf 6 cm long or shorter (W. Irian, Idenburg R.) 9. *S. myrtifolia*
 12. Male inflorescence with more flowers. Leaf longer than 6 cm.
 13. Male receptacle turbinate (W. Irian, W. Sepik) 10. *S. parvifolia*
 13. Male receptacle patelliform (Central Prov.) 11. *S. oligantha*
 10. Receptacles globose (or only slightly depressed).
 14. Leaves usually moderate to large (10–32 cm long) and entire (widely distributed, mainly at lower altitudes, but reaching up to 2450 m) 12. *S. hirsuta*
 14. Leaves variable in size (usually under 15 cm long, but up to 21 cm), usually coriaceous, often dentate, but also entire when narrow (widely distributed, usually above 1200 m) 13. *S. ilicifolia*
 14. Leaves 5–10 cm long, coriaceous, ± rugose, entire (Chimbu & Eastern Highlands Prov., above c. 2400 m) 14. *S. chimbuensis*
 14. Leaves 5–10 cm long, chartaceous, usually narrowly elliptic, acuminate, entire or dentate (Wau, Goilala & Moresby Prov.) 15. *S. australiana*

1. *Steganthera hentyi* PHILIPSON, Blumea 29 (1984) 487.

Small tree, to 6 m; young branches densely strigose. *Leaves* elliptic, c. 8–9 by 3–4 cm, base cuneate, apex with a short obtuse apiculum, margin entire or with few obscure teeth, becoming glabrous on the leaf surface but with appressed hairs persisting at least on the principal veins; petiole to 8 mm. ?Dioecious. *Inflorescence* axillary or above the axils, of sessile or shortly pedunculate subumbellate fascicles; peduncle to 10 mm, pedicels 20–30 mm, slender, strigose, subtended by minute subulate bracts. — *Male flowers* unknown. — *Female receptacle* subglobose, c. 3–4 mm ø at anthesis; tepals 4, rounded, outer surface densely strigose except for the upper part, inner surface with long bristles between the carpels; carpels c. 15, ovary covered in dense shaggy hairs, style awl-shaped, glabrous. *Drupe*s ovoid, 12 by 7 mm, with appressed hairs, short stipitate.

Distr. Malesia: Papua New Guinea (West Sepik Prov.).

Ecol. Primary lower montane valley forest, at 500 m.

Note. The small leaves with appressed hairs on the veins of the underside of the leaf, and the fasciculate inflorescences are distinctive. The flowers are described as pink.

2. *Steganthera fasciculata* PHILIPSON, Blumea 29 (1984) 487, f. 3. — Fig. 19.

Small tree, to 12 m; young branches pubescent. *Leaves* oblanceolate to narrowly elliptic, 13–20(–30) by 3.4–7(–9) cm, base rounded to broadly cuneate, apex narrowed to a short obtuse, or long acute apiculum, margin entire or dentate especially in the upper half (leaves of juvenile plants or of suckers more prominently dentate), pubescence may persist on mature leaves or may be lost except along the veins; petiole to 10 mm, pubescent. *Inflorescences* axillary or supra-axillary; male of sessile or shortly pedunculate fascicles with 10–20 flowers, often appearing as sessile umbels, but sometimes seen to consist of dense fascicles of pleiochasia, the principal branches 10–30 mm, tenuous, hairy; female solitary or in pairs, axillary or supra-axillary, pedicel 20–30 mm with subulate bracts at the base and sometimes about the middle, pubescent. — *Male receptacle* globose, outside pubescent, c. 4–5 mm ø; tepals 4, minute; stamens 4, c. 1.5 mm long, filament short, hairy, the anthers 1.5 mm broad. — *Female receptacle* bowl-shaped, c. 12 mm ø at anthesis; tepals 4, carpels numerous, ovary hairy, style awl-shaped glabrous. *Drupe*s not seen. The mature torus with many protuberant pubescent carpophores c. 4–7 mm long.

Distr. Malesia: Papua New Guinea (Morobe,

(1) Rarely (in the Solomon Is.) small leaves occur on stunted individuals.

Northern & Milne Bay Prov.), also in Goodenough I.

Ecol. Primary lower mountain rain-forest, 365–1200 m.

Vern. *Mamkananeh*, Daga lang.

Note. The young flowers are described greenish cream and the mature torus red.

3. *Steganthera cycloensis* PHILIPSON, *Blumea* 29 (1984) 489.

Shrub to 3 m; young branches with strigose appressed hairs. *Leaves* oblanceolate to narrowly elliptic, up to 17 by 4.2 cm, base truncate or rounded, apex shortly apiculate, margin dentate, when dry grey above, brown below, principal veins prominent, pubescence persisting on the lower midrib and main veins; petiole to 5 mm, hairy. ?Dioecious. *Inflorescences* axillary or above the axils, sessile fascicles of c. 12 flowers, pedicels slender, densely strigose, c. 15 mm. — *Male receptacle* discoid or bowl-shaped, the stamens in a small central cavity, c. 8 mm ϕ , pubescent on the outer surface of the disc; tepals 4; stamens 4, c. 1 mm broad, with a very short broad filament, connective expanded as two wings bordering the small narrow anthers. — *Female flowers* not seen, but fewer per inflorescence. *Fruiting receptacle* slightly enlarged, not succulent, on stout pedicel c. 15 mm, upper surface with long hairs between the bases of the apparently sessile achenes. *Drupes* c. 13 by 9 mm with a few persistent appressed hairs.

Distr. *Malesia*: Northern District of West Irian.

Ecol. In primary *Nothofagus* lower montane forest, 1200–1340 m.

Note. Similar to *S. dentata* in many respects, but with smaller usually lanceolate leaves. The flowers are described as carmine and pale orange.

4. *Steganthera dentata* (VALETON) KANEH. & HATUS. *Bot. Mag. Tokyo* 56 (1942) 257; PHILIPSON, *Blumea* 29 (1984) 489. — *Anthobembix dentatus* VALETON, *Bull. Dép. Agric. Ind. Néerl.* 10 (1907) 13.

Shrub to 4 m, with spreading branches; young branches fulvous pubescent, older branches with swollen nodes. *Leaves* c. 5 mm petioled or leaves subsessile, pubescent, oblanceolate or elliptic, 16–30 by 7–11 cm, chartaceous, base \pm auriculate or truncate, apex apiculate, margin with well-spaced, small dentations especially on the distal half; young leaves with pubescence which may persist on the mature leaves or may be lost except along the veins and around the base. Probably dioecious. *Inflorescences* usually inserted well above the nodes (occasionally at the nodes); male sessile or pedunculate fascicles of 10–25 pedicellate flowers, peduncle (if present) up to 15 mm; pedicels 10–20 mm, slender, pubescent; female fascicles few-flowered. — *Male receptacle* bowl-shaped or discoid, outside hirsute, c. 6–10 mm ϕ ; tepals 4, minute; stamens 4, 1.5 mm long, filament

short, hairy, connective broader than the anthers (before dehiscence). — *Female receptacle* similar to male, carpels numerous, hairy, style awl-shaped, glabrous. *Fruit* unknown.

Distr. *Malesia*: West New Guinea (Northern & Southern Distr.).

Ecol. Primary and secondary forest, at low altitudes (to 160 m).

Note. The short-petioled or subsessile leaves and fasciculate male inflorescences are distinctive. The flowers are described as red, orange or yellow. The anthers are considerably narrower than the connective except in one collection where the more widely gaping anthers may be at a stage after anthesis with the lateral lobes of the connective no longer turgid. It has not been possible to determine whether male and female flowers occur on the same or on separate plants.

5. *Steganthera royenii* PHILIPSON, *Blumea* 29 (1984) 489.

Shrub c. 4 m; young branches pubescent; nodes becoming dilated and developing pores. *Leaves* oblong-elliptic, up to 29 by 11 cm, chartaceous, base cuneate, apex acuminate, margin entire or with minute remote dentations, principal veins channelled above, prominent below, arched ascending, becoming glabrous or with a minute puberulence persisting mainly on the veins; petiole 5–10 mm. ?Monoecious. *Inflorescences* supra-axillary or axillary, broadly paniculate, 4–5 cm long, single or grouped, puberulent, rachis and principal branches somewhat thick, ending in irregularly clustered slender pedicels. — *Male receptacle* globose, 2–2.5 mm, sparsely puberulent on the outside; tepals 4, minute, rounded; stamens 4, 1 mm long, filament broad, pubescent. — *Female flowers* not seen. *Fruiting receptacle* 2–3 mm ϕ , leathery. *Drupes* c. 12–20, ovoid, c. 12 by 10 mm, verruculose, stipitate; stipes 2–3 mm long, 2.5 mm ϕ .

Distr. *Malesia*: West New Guinea (a restricted area which includes portions of the Vogelkop, Northern & Southern Distr.).

Ecol. Low-lying primary forest, sometimes periodically flooded, from sea-level to 1200 m.

Vern. *Sirochomenwhah*, Manikiong dialect.

Note. Similar to *S. hospitans* in the appearance of its vegetative parts, but the arrangement of the ultimate branches of the inflorescence is distinctive. The male flowers lack any disk-like extension of the receptacle but female receptacles have not been seen. This species is described as possibly monoecious because one collection bears male inflorescences and also old fruits. However, as these are not on the same branches, the monoecious condition is not certain. All the inflorescences seen consist solely of male flowers, which suggests the possibility of the sexes being on separate plants. The flowers are described

as yellow, the ripe fruit black. The swollen nodes are inhabited by ants.

6. *Steganthera moszkowskii* (PERKINS) KANEH. & HATUS. Bot. Mag. Tokyo 56 (1942) 255; PHILIPSON, Blumea 29 (1984) 490. — *Anthobembix moszkowskii* PERKINS, Pfl. R. Heft 49 (1911) 26.

Shrub or small tree; branches becoming glabrous; nodes swollen. *Leaves* elliptic-ovate to 35 by 12 cm, chartaceous, base broadly cuneate, apex apiculate, margin entire or remotely dentate, glabrous above, minute pubescence persisting below, especially on the veins, the midrib and principal veins prominent below; petiole 5–8 mm long, minutely pubescent. ?Dioecious. *Inflorescences* at or well above the nodes, diffuse paniculate, to 10 cm long; rachis and branches minutely pubescent. — *Male receptacle* turbinate, pubescent, 3 mm high, apex forming a 4-lobed disk; tepals 4, minute; stamens 4, filament broad, hairy, the united anthers small. — *Female flower* and fruit not seen.

Distr. *Malesia*: West New Guinea (Northern Distr.).

Ecol. Understorey in rain-forest at low altitude.

Note. The male receptacle, with 4 rounded lobes radiating from the apex, is distinctive. The swollen nodes are apparently inhabited by ants which gain entrance through pores.

7. *Steganthera salomonensis* (HEMSL.) PHILIPSON, Blumea 29 (1984) 490, f. 2. — *Hedycarya salomonensis* HEMSL. Kew Bull. (1895) 137. — *S. suberoso-alata* KOSTERM. Gard. Bull. Sing. 22 (1968) 445. — Fig. 20.

Shrub or tree, 2–20 m; young branches with a crisp, brownish tomentum or a fine, appressed pubescence which may be quickly lost. *Leaves* ovate or elliptic to narrowly elliptic, rarely suborbicular (Fergusson I.), usually rather large (up to 32 by 11.5 cm), occasionally smaller to much smaller (5 by 2 cm on stunted trees, crater rim New Georgia Group), base cuneate to rounded, apex slightly apiculate; margin entire or rarely a few obscure dentations (even large serrations on saplings, and on flowering branches in Sudest I.), with either a tomentum of crisp brownish hairs which may persist on the undersurface of the leaves especially on the midrib and principal veins, or with a fine pubescence which is soon lost, the mature leaves then becoming glabrous; petiole stout, usually c. 5–18 mm, but occasionally shorter, pubescent or becoming glabrous. Monoecious. *Inflorescences* on leafy shoots or cauliflorous, variable in size and complexity, frequently with several main branches arising from a short peduncle, and with the lateral branches clustered at the nodes, the principal branches often flattened; all parts pubescent when young but the branches may become more or less gla-

brous; the panicles may contain only male flowers when the female flowers are in smaller inflorescences (even solitary) or the female flowers may occur in panicles of mainly male flowers (apparently usually on terminal branches). — *Male flowers* ovoid or subglobose, c. 3 mm ϕ , outside pubescent; tepals 4, rounded; stamen number very variable, usually in two whorls, the outer of larger stamens (3–)4(–5), 2–2.5 mm long, filament hairy, the inner of smaller stamens 1–4 or absent (male receptacles 4 mm ϕ with broad stamens occur in Rennell Is.). — *Female flowers* subglobose or bowl-shaped, pubescent outside, pilose within, c. 3–6 mm ϕ at anthesis but swelling to c. 7–10 mm before the calyptra is shed; ostiole very small with 4 minute tepals; carpels numerous, c. 2 mm long, ovary hairy. Peduncle and receptacle usually becoming enlarged and woody in fruit with numerous drupes borne on long woody stipes, but frequently only few (even only 1) fruits ripen, when the receptacle and peduncle are little enlarged; receptacle up to 3 cm ϕ ; stipes up to 14 mm. *Drupes* ovoid, 12–18 by 10–15 mm, verruculose.

Distr. Throughout the Solomon Is. (incl. Bougainville) to San Cristobal and Rennell I., in *Malesia*: Papua New Guinea (Central Prov.; east of Cape Rodney; Milne Bay Prov.).

Ecol. Primary and secondary lowland rain-forest; in scrub on coral debris and in stunted forest on ridges, from sea-level to 750 m.

Note. Considerable variation occurs, one extreme being a handsome tree with large leaves, \pm brown-pubescent below, diffuse panicles on leafy twigs and also on the older stems, and with clusters of many stipitate achenes (= *S. suberoso-alata*). On the other hand many specimens, including the type, have smaller, greener leaves which become more or less glabrous, and have fruits with few or even a single stipitate achene. The latter form is characteristic of higher altitudes. Specimens from a dry crater rim in the New Georgia Group are so stunted that their inclusion in this species is open to doubt, though intermediate forms occur. A number of local forms are found on the islands off the eastern end of New Guinea (Fergusson I. to Misima I.). The most distinctive of these, with coarsely serrate leaves, occurs on Sudest I. This may represent a distinct species, but serrate leaf-margins occur elsewhere, especially on saplings or suckers, and the flowers and inflorescences are quite typical of *S. salomonensis*.

8. *Steganthera hospitans* (BECC.) KANEH. & HATUS. Bot. Mag. Tokyo 56 (1942) 255, f. 5; PHILIPSON, Blumea 29 (1984) 491. — *Kibara hospitans* BECC. Malesia 1 (1877) 189. — *Anthobembix hospitans* (BECC.) PERKINS, Bot. Jahrb. 25 (1898) 567, t. 6B; K. SCH. & LAUT. Fl. Deut. Schutzgeb. Südsee (1900) 330; PERKINS & GILG, Pfl. R. Heft 4 (1901) 55, f. 12; PERKINS,

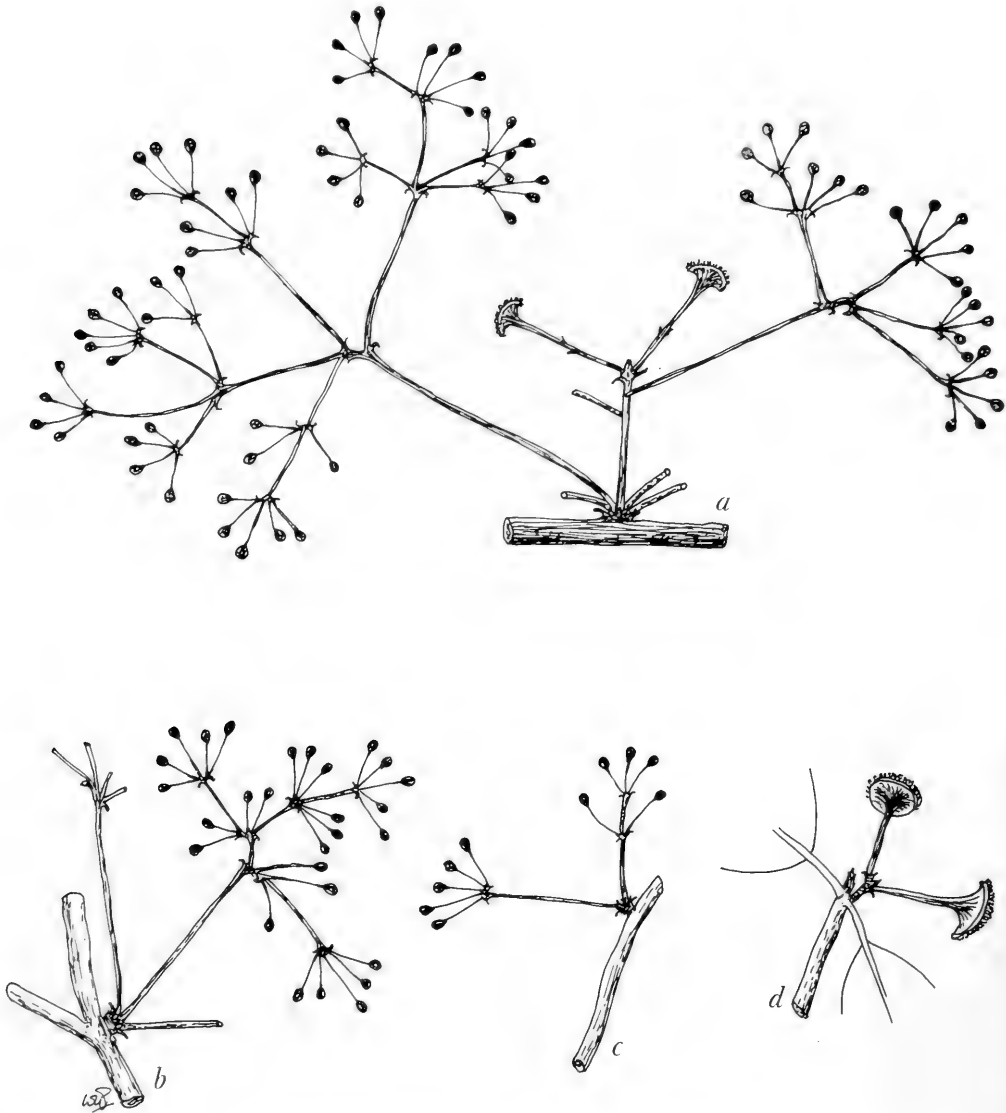


Fig. 20. *Steganthera salomonensis* (HEMSL.) PHILIPSON. *a*. Cauliflorous panicle, with several principal peduncles, central rachis ending with two female flowers, *b*–*c*. two male inflorescences, *d*. purely female inflorescence. All $\times 1/2$ (*a* BSIP 10575, *b* NGF 28733, *c*–*d* SCHODDE 5388).

Pfl. R. Heft 49 (1911) 25, f. 10; Bot. Jahrb. 52 (1915) 205, f. 4. — *S. insignis* PERKINS, Pfl. R. Heft 49 (1911) 24, f. 9. — Fig. 21.

Shrub or small tree to 8 m; young branches more or less glabrous, or pruinose or minutely puberulous;

the nodes soon becoming dilated, and pores developing. *Leaves* oblong-elliptic, or broadly elliptic to obovate, coriaceous, 20–41 by 7–18 cm; base cuneate or rounded, apex apiculate to long acuminate, margin entire or occasionally with well-spaced small den-



Fig. 21. *Steganthera hospitans* (BECC.) KANEH. & HATUS. Panicle of female flowers. Note ants on blade and thickened petiole; one flower attacked by mould (after PHILIPSON & KATIK 3737).

tations, glabrous or minutely pubescent on the midribs and principal veins, veins impressed above, prominent below. Foliage of juvenile plants lanceolate, c. 27 by 4 cm, base narrowly cuneate, apex attenuate, irregularly dentate; petiole to 1 cm. Monoecious. *Inflorescence* axillary or above the nodes, arising successively at the same position, becoming cauliflorous, polychasia or paniculate cymes, minutely pubescent, up to 9 cm long, rachis rather stout, often flattened, with small caducous bracts; pedicels slender, 10–15 mm long. — *Male receptacles* variable in shape, usually turbinate with an expanded flat rim, or this more or less obsolete, 2.5–5 (or more) mm ϕ ; tepals 4, minute, obtuse; stamens 4, 1–1.5 mm high, filament broad, puberulous. — *Female receptacle* turbinate with a broadly expanded flat rim, to c. 12 mm ϕ ; tepals 4, minute, carpels numerous, ovary pilose, style awl-shaped, glabrous above. *Fruit* with large succulent receptacle (c. 3–4 mm ϕ) bearing many drupes on short thick stipes. *Drupes* ovoid to globose, c. 12 by 10 mm, verruculose.

Distr. Solomon Is. and *Malesia*: throughout New Guinea (from Vogelkop to the east).

Ecol. Primary rain-forest and second growth from low altitudes up to 1200 m.

Vern. *Eppareppar*, Adelbert Range, Utu lang., *soreng*, *ibid.*, Rawa lang., *oloni*, *wolonyik*, Ambunti, Waskuk lang., *wasu*, Kutubu lang.

Note. The female receptacles are striking, being broadly expanded into button-like disks of a soft butter-yellow colour. The male receptacles are greener and smaller, with a variable extension of the rim: in some species the male receptacles have a broadly expanded rim, but in others the rim may be obsolete, as in the specimens identified as *S. insignis* by PERKINS (originally placed by her in *Anthobembix hospitans*). It is possible that these are hybrids with *S. hirsuta*. Sterile juvenile plants with lanceolate leaves are frequent, and this type of leaf may be found on the lower parts of more adult shrubs, which have begun to produce flowers. The hollow stems and swollen nodes are inhabited by scale insects (*Adeyrodidae*) and by many small black ants. The receptacle becomes succulent and bright orange in fruit, and the ripe drupes are purple-black.

9. *Steganthera myrtifolia* (A.C. SMITH) PHILIPSON, *Blumea* 29 (1984) 491. — *Anthobembix myrtifolia* A.C. SMITH, *J. Arn. Arb.* 22 (1941) 238.

Small tree to 4 m; young branches with appressed strigose hairs. *Leaves* chartaceous, narrowly elliptic to elliptic, 3–6 by 1–3 cm, base attenuated, apex acute or shortly cuspidate, margin entire, glabrous, midrib well-defined below and with numerous fine lateral veins and reticulations; petiole 4–6 mm, glabrescent. ? Dioecious. — *Male inflorescences* axillary, 10–30 mm long, 2- or often 1-flowered, with



Fig. 22. *Steganthera hirsuta* (WARB.) PERKINS. Branch with axillary pleiochasia; the large flowers are female, the smaller male; terminal bud not yet developed (after PHILIPSON & KAIRO 3657).

dense appressed hairs, slender; receptacle somewhat disk-shaped, 2 mm high, 5 mm ϕ ; tepals 4, minute; stamens 4, the longer *c.* 1 mm longer, filaments densely strigose. — *Female inflorescences* similar to male but apparently always 1-flowered; receptacle turbinate, slightly expanded at the circumference, *c.* 2–2.5 mm high, *c.* 3 mm ϕ , densely strigose within, tepals obsolete; carpels *c.* 6, 1.3–1.5 mm long, ovary densely strigose, style subulate, glabrous. *Fruit* with a stout pedicel *c.* 18 mm; receptacle leathery, only slightly enlarged. *Drupes* subsessile, ovoid, *c.* 13 by 9 mm, verruculose.

Distr. *Malesia*: West New Guinea (Idenburg R.).

Ecol. Mossy forest, 2150 m.

Note. Known only from the original two specimens collected by BRASS. The small, chartaceous, entire leaves are unmistakable among species with a disk-like male receptacle.

10. *Steganthera parvifolia* (PERKINS) KANEH. & HATUS. Bot. Mag. Tokyo 56 (1942) 257; PHILIPSON, Blumea 29 (1984) 491. — *Anthobembix parvifolia* PERKINS, Bot. Jahrb. 52 (1915) 205. — *Anthobembix brassii* A.C. SMITH, J. Arn. Arb. 32 (1941) 239. — *S. brassii* (A.C. SMITH) KANEH. & HATUS. Bot. Mag. Tokyo 56 (1942) 261, f. 9.

Shrub, sometimes scandent, young branches pubescent. *Leaves* oblong-elliptic to narrowly elliptic, to 14 by 6.5 cm, chartaceous, base rounded or broadly cuneate, apex shortly cuspidate to acuminate, margin entire or with obscure or more prominent remote teeth in the upper part, becoming glabrous or with slight pubescence persisting below, the veins and minor reticulations prominent below; petiole 8–22 mm, pubescent or becoming glabrous. Monoecious. *Inflorescences* axillary or at the ends of leafy shoots, of few-flowered cymes or larger paniculate cymes, to 5 cm long, the rachis, branches and pedicels pubescent; female flowers appear to be confined to the ends of the lower branches. — *Male receptacles* obconic with a flat glabrous and black apex (in dried material) to 8 mm ϕ , sides of the receptacle hispid; 4 minute tepals forming a raised ostiole; stamens 4, sessile; anthers *c.* 1 mm wide, connective hairy. — *Female receptacle* similar but larger (*c.* 10 mm ϕ at anthesis), inside with long hispid hairs between the numerous (10–20) carpels; carpels *c.* 2 mm long, ovary pilose, style awl-shaped, glabrous. Receptacle not greatly enlarged in fruit, leathery. Mature *drupes* subsessile or stipitate, ovoid, to 12 by 10 mm, apex mucronate, glabrous, rugose.

Distr. *Malesia*: West New Guinea (Vogelkop, Northern & Southern Distr.), Papua New Guinea (West Sepik Prov.).

Ecol. Understorey of primary lower montane rain-forest, 1900–2800 m.

Vern. *Bobinok*, Telefomin Distr., Bulindup.

Note. The glabrous disk-like upper surface of both male and female receptacles contrasts with the pilose outer surface, especially in dried material in which it takes on a black coloration. The material from the West Sepik Prov. has narrower leaves than the type, but otherwise conforms. The flowers are described as yellow.

11. *Steganthera oligantha* (PERKINS) KANEH. & HATUS. Bot. Mag. Tokyo 56 (1942) 257; PHILIPSON, Blumea 29 (1984) 493. — *Anthobembix oligantha* PERKINS, Bot. Jahrb. 25 (1895) 568.

Small to large tree, young branches slender, finely puberulous. *Leaves* papyraceous, elliptic-oblong to obovate, 6–11 by 2.5–5 cm, base cuneate, apex acuminate, margin entire, midrib and principal veins evident, reticulations rather obscure, when young covered in appressed minute hairs which persist on the midrib and sometimes on the principal veins; petiole 5–10 mm. ? Monoecious. *Inflorescences* axillary or terminal, few flowered pleiochasia, rachis, branches and bracts pubescent, rachis slender, with a long peduncle before the first branches, at flowering 4–6 cm long. — *Male receptacle* turbinate with an expanded rim, 3 mm high, 5–6 mm ϕ , the upper surface glabrous, the sides puberulous; tepals minute. — *Female receptacle* similar to male, carpels numerous, ovary densely pilose, style awl-shaped, glabrous. Fruiting receptacle leathery, *c.* 10 mm ϕ . *Drupes* ovoid, 15 by 10 mm, verruculose, *c.* 4–5 mm stipitate.

Distr. *Malesia*: Papua New Guinea (Central Prov., Moresby Distr., Sogeri region).

Ecol. Forest, 900–1600 m.

Note. A large tree with slender twigs, known with certainty only from the three collections made by FORBES in 1855–56 and one recent collection from Efogi. Other collections from the same region closely match the foliage and fruit, but the male receptacles are globose. These may be hybrids with *S. hirsuta*. The female flowers are described as bright yellow and the fruit as black on orange stipes.

12. *Steganthera hirsuta* (WARB.) PERKINS, Bot. Jahrb. 25 (1898) 567; K. SCH. & LAUT. Fl. Deut. Schutzgeb. Südsee (1900) 329; PERKINS & GILG, Pfl. R. Heft 4 (1901) 54; PERKINS, Bot. Jahrb. 52 (1915) 202; PHILIPSON, Blumea 29 (1984) 493, f. 4. — *Kibara* (?) *hirsuta* WARB. Bot. Jahrb. 13 (1891) 316. — *S. warburgii* PERKINS, Bot. Jahrb. 25 (1898) 564. — *S. schumanniana* PERKINS, l.c. 565. — *S. thyrsoiflora* PERKINS, l.c. 565, t. 6A; PERKINS & GILG, Pfl. R. Heft 4 (1901) 53, f. 11; PERKINS, *ibid.* Heft 49 (1911) 22, f. 8G. — *S. oblongiflora* PERKINS, Bot. Jahrb. 25 (1898) 566; PERKINS & GILG, Pfl. R. Heft 4 (1901) 54 ('*oblongifolia*'); PERKINS, *ibid.* Heft 49 (1911) 22, f. 8A–E. — *S. jengeriana* PERKINS, Bot. Jahrb. 25

(1898) 566; Pfl. R. Heft 49 (1911) 22, f. 8F. — *S. crispula* PERKINS, Pfl. R. Heft 49 (1911) 21. — *S. torricellensis* PERKINS, l.c. 21. — *S. forbesii* PERKINS, l.c. 23. — *S. buergeriana* PERKINS, Bot. Jahrb. 52 (1915) 199, f. 2. — *S. riparia* KANEH. & HATUS. Bot. Mag. Tokyo 56 (1942) 259, f. 8. — **Fig. 22.**

Tree up to 20 m, occasionally a straggling shrub or liane; young branches with a dense tomentum or a fine pubescence which may persist on the leafy branches or these may quickly become glabrous. *Leaves* broadly ovate or elliptic to narrowly elliptic, rarely lanceolate or more or less orbicular, usually of moderate size (10–13 cm long) but frequently up to 32 by 13 cm and occasionally much smaller (7.5 by 2 cm); base rounded or cuneate, apex apiculate, margin entire or occasionally with a few obscure dentations or rarely serrate, either quickly losing all or most of their original pubescence, or the tomentum may persist on both sides of the blade, but more especially below, sometimes as a thick woolly coating over the entire undersurface; principal veins conspicuous below, arching strongly or more gradually towards the apex; petiole 3–14 mm, pubescent or glabrous. Monoecious. *Inflorescences* axillary, supra-axillary or terminal, usually pleiochasia with the lower lateral branches again branched or reduced to simple dichasia, densely pubescent throughout or glabrous. — *Male flowers* ovoid or globose, usually pubescent on the outside, 2.5–4 mm \varnothing ; tepals 4, rounded, the wall thick, leathery, enclosing a cavity either confined to the upper half of the receptacle or extending to near the base; stamens 4, 1–1.5 mm long, filaments pilose. — *Female flowers* globose or somewhat depressed, 3.5–4.5 mm \varnothing , usually pubescent outside, pilose within, sometimes longitudinally furrowed when dry; ostiole small, surrounded by 4 minute or obsolescent tepals; the cavity large; carpels numerous, 1.5–2 mm long, ovary slender, pilose, stigma subulate. *Fruiting receptacle* enlarged to c. 2 cm \varnothing . *Drupes* stipitate or more or less sessile; stipes woody, to 10 mm long; achenes ovoid to c. 13 by 10 mm, verruculose.

Distr. Australia (Queensland, Iron Range); in *Malesia*: SW. Celebes (Mt Bonthain), Moluccas (Buru, Ceram, Ambon, Halmahera, Ternate, Aru Is.), New Guinea (throughout the island from Vogelkop Peninsula to Milne Bay Prov.: Mt Suckling), also on Manus I., New Britain and New Ireland.

Ecol. An understorey tree in rain-forest, mostly at low altitudes, but also in montane forest up to 2450 m. It is recorded from seasonally inundated swamps and from ridge forest. Usually a moderate sized tree with a spreading crown, it may also be a straggling shrub and occasionally is described as a liane.

Uses. The wood is used for clubs (Isago village, Balimo district, Western Prov.). Pipe tobacco rolled

in the leaves (Butemu village, Saidor Distr., Madang Prov.).

Vern. *Gwa*, *Wagu*, *imaitru*, *Jal*, *kamakama*, *kamokam*, *Enga*, *kubal*, *sap*, Madang, *kuraili*, *Koropa*, *kwaffel*, *Bembi*, *mankanane*, *Mt Suckling*, *metjem*, *mey*, *Waskuk*, *namelawe*, *Kainantu*, *napiwa*, *Talasea*, *New Britain*, *ongupinpa*, *S. New Britain*, *sakoboe*, *Moeswaar I.*, *sore*, *Naho*, *tangitang*, *Tomba*, *tonona*, *Kutubu*, *tshoren*, *Rawa*, *tugwambi*, *Wagu*, *tunngacook*, *Wein*, *vingi-vingi*, *Bayer R.*, *waluwali-i*, *Gogodala*.

Notes. The number of different forms included within this species cannot be considered satisfactory, yet they appear to be connected by intermediates so that any segregation of these forms as species would seem, at this stage, to be even less satisfactory. This aggregate has a geographical range extending from Celebes almost to the eastern limit of New Guinea, and reaches from sea-level to 2450 m. It is frequent throughout its range, and the number of separate collections of it approaches that of all the other species combined. Several specific names have been applied to different forms within the complex and some of these certainly appear distinctive until intermediate forms are compared. Variability effects most features of the plant: leaf shape and leaf size and the pattern of the principal veins; the presence or absence of marginal teeth and their prominence; the degree of development and persistence of the indumentum; the degree of branching of the inflorescence; the size and shape of the male and female receptacles; the ratio between the cavity and wall thickness in the male flower; and the presence and length of the stipes bearing the achenes. Some combinations of character states may occur frequently in one region, encouraging the belief that local segregate species may eventually become recognizable. An example is the form named *S. oblongiflora* (with elliptical male receptacles with small cavities and narrowly elliptical \pm glabrous leaves with few, sharply ascending veins) that occurs in the upland parts of the Northern and Central Provinces and adjacent parts of the Manayma District of Morobe Province. Similar to it and occurring sympatrically is the form named *S. thyrsiflora* which is most frequent in the neighbouring Wau, Mumeng and Lae Districts of Morobe Province. This form has broader glabrous leaves with more spreading principal veins, and with globose receptacles with proportionally larger cavities. However, the character states intergrade and occur in different combinations, so that specific distinctions cannot be maintained. A practical difficulty with herbarium material is that specimens rarely display all the significant characters, so that a definitive treatment of this complex must finally rely on extensive fieldwork. Another distinctive form with densely hairy leaves (and often with \pm sessile achenes) has



Fig. 23. *Steganthera ilicifolia* A.C. SMITH. *a*. Habit, $\times 2/3$, *b*. male flowers, one in L.S., *c*. anther from this flower, all $\times 7$ (*a* PHILIPSON & KARINGA 3720, *b-c* CARR 15203).

been collected most frequently east of Wau, but is also found from the Owen Stanley Range to the Western Highlands Province.

The young foliage is pinkish; the flowers are cream coloured; and the black drupes are borne on red, yellow or orange receptacles.

13. *Steganthera ilicifolia* A.C. SMITH, J. Arn. Arb. 22 (1941) 235; PHILIPSON, Blumea 29 (1984) 495. — Fig. 23.

Shrub or small tree to 12 m; young branches with strigose or silky appressed hairs. *Leaves* chartaceous, elliptic, lanceolate to broadly elliptic, 5.5–21 by 2–8.5 cm, base obtuse rounded or truncate, apex with a long or short acute apiculum, margin with

prominent, remote denticulations, or with few minute teeth or entire, at first often covered with silky appressed hairs, becoming glabrous or retaining some indumentum, especially on the midrib below, nerves and reticulations prominent on the lower surface; petiole 5–15 mm, strigose or becoming glabrous. Monoecious. *Inflorescences* axillary, supra-axillary or terminal, 4–6.5 mm long, either solitary few-flowered pleiochasia, or groups of a few pleiochasia, rachis and branches with strigose hairs, minute linear bracts below or on the branches (and also sometimes on the receptacles), rachis slender with a long peduncle before the first branching, branches opposite or subopposite, singly or in clusters and themselves branching. — *Male receptacle* spherical *c*.

2–3 mm ϕ , slightly strigose outside; tepals 4, rounded; stamens 4, *c.* 1.25–2 mm long, with short, glabrous or minutely pubescent filaments. — *Female receptacle* larger and slightly flatter than the male, *c.* 4–5 mm ϕ at anthesis, ostiole minute; tepals 4, minute or obsolete, inner surface pilose; carpels *c.* 10–20, 1.5–2.5 mm long, ovary pilose, style awl-shaped, glabrous. *Fruiting receptacle* only slightly enlarged, with hairs between the sessile or more usually stipitate drupes (stipe occasionally to 5 mm long). *Drupes* ovoid, *c.* 12 by 9 mm when dry, verruculose and slightly pilose.

Distr. Malasia: New Guinea, from Milne Bay Prov. (incl. Fergusson I. at 900 m) westwards as far as the Star and Carstenz Mts in West New Guinea; also in the mountains north of the Huon Gulf in Morobe and Madang Prov.

Ecol. A straggling understorey shrub or small tree in lower mountain forest (often with *Nothofagus* and *Castanopsis*) or in thickets at the forest margin. Frequent along the central mountains usually above 1200 m to as high as 3250 m (but rather lower in Central Prov.).

Uses. Provides stakes for general purposes, *e.g.* for house-building, for digging sticks and firewood.

Vern. *Agubporombigl*, Hagen, *genzphora*, *iganaphore*, Tairua lang., *kamagam*, *kamokam*, *kamokum*, Enga lang., *kamokamp*, Mendi lang., *kamakama*, Ialibu, *kombugump*, *toin bekl*, Togoba, *munne yambo*, Maring, *pundpunda*, Melpa lang., Mt Hagen, *soreng*, Nako lang., *yuri*, Minj.

Note. A common and widespread species, usually a straggling shrub, but sometimes attaining tree stature. In its usual form the harsh dentate leaves vary in size and shape, but the prominent venation below is characteristic as are the delicate, few-flowered inflorescences with small, globose male flowers. Female flowers are less frequent and are either terminal or end the distal branches. In less typical forms the dentations become fewer and less prominent, culminating in forms with quite entire, often lanceolate leaves. A few of the specimens with entire leaf margin cannot be distinguished from forms of *S. hirsuta* with certainty. The young foliage is described as red or pink, the flowers cream, and the ripe receptacle orange bearing purple-black drupes. The flowers are frequently deformed by insect galls.

14. *Steganthera chimbuensis* PHILIPSON, *Blumea* 29 (1984) 495.

Shrub or tree to 20 m; new growth glabrous or sometimes very finely pubescent. *Leaves* glabrous, chartaceous, elliptic, 5–10 by 2.2–4.2 cm, base broadly cuneate, apex apiculate, margin entire (rarely some leaves on a plant may have one or a few dentations), midrib and principal veins usually im-

pressed above (blade more or less rugose) and elevated below; petiole 4–10 mm. Monoecious. *Inflorescences* axillary or supra-axillary, dichasia or with one terminal flower, *c.* 2–3 cm long, with small linear bracts subtending the branches or inserted on them. — *Male receptacles* globose, 2–3 mm ϕ ; tepals 4, rounded, ostiole tending to open widely; stamens 4, *c.* 1.75 mm long, filament hairy. — *Female receptacle* similar to male, slightly larger and often solitary, tepals and ostiole \pm obsolete; carpels *c.* 12–20, 2 mm long, ovary pilose, stigma glabrous, awl-shaped. *Fruiting receptacle* slightly enlarged, leathery. *Drupes* ovoid, *c.* 11 by 8 mm, verruculose, shortly stipitate.

Distr. Malasia: Papua New Guinea (Chimbu & Eastern Highlands Prov.).

Ecol. Primary and secondary lower montane forest, 2400–2850 m.

Vern. *Abangle*, Chimbu, Masul, *ivananottoi*, Mairi, Watabung, *pemle*, Wahgi, Minj, *pogambeg*, Hagen, Togoba.

Note. Similar to the more widely spread *S. ilicifolia*, but the leaves are entire (a dentation very rarely occurs on a leaf of a plant with otherwise entire leaves) and the undersurface dries a warm cinnamon brown in contrast to the buff colour of *S. ilicifolia*. The flowers are described as pale yellow, the drupes purple-black on an orange receptacle.

15. *Steganthera australiana* C.T. WHITE, *Proc. R. Soc. Queensl.* 55 (1944) 78; PHILIPSON, *Blumea* 29 (1984) 496.

Small tree to 10 m; young branches finely pubescent. *Leaves* chartaceous, lanceolate or narrowly to broadly elliptic, *c.* 5–10 by 1.5–5 cm, base attenuate, apex long-acuminate, margin entire or remotely and finely dentate, becoming glabrous or pubescence persisting on midrib and main veins below or occasionally also on the lower surface; petiole 5–10 mm, glabrous or pubescence persistent. Monoecious. *Inflorescences* axillary or supra-axillary, dichasia or few-flowered pleiochasia, rachis, branches, bracts and receptacles pubescent, the rachis slender with a long peduncle below the first branches, branches opposite or subopposite, singly or in clusters. — *Male receptacles* globose, narrowed into the pedicel, 2–2.5 mm ϕ ; tepals 4, rounded, minute; stamens 4, 1.5 mm long, filament pilose. — *Female receptacles* similar but larger, *c.* 4 mm ϕ at anthesis, at and near the ends of inflorescences (when present); tepals 4, minute, inner surface long-pilose, carpels numerous, *c.* 2.2 mm long, ovary pilose, style awl-shaped, glabrous. *Fruiting receptacle* slightly enlarged, leathery. *Drupes* ovoid, 11–14 by 9–11 mm, verrucose, sessile or shortly stipitate.

Distr. Queensland; in *Malasia:* Papua New

Guinea (Morobe Prov.: Wau Distr.; Central Prov.: Goilala & Moresby Distr.).

Ecol. Lower montane forest (*Castanopsis* and *Nothofagus* dominated) and second growth, 1000–2300 m.

Note. A plant of restricted distribution in New Guinea, characterized by the small, usually more or less lanceolate and apiculate leaves and delicate inflorescences, is identified with the species described from Queensland. The few New Guinea specimens show more variation in size, shape, dentation, and indumentum of their leaves than may occur in Australia. A specimen from near Wau has more richly branched inflorescences, the side-branches being clustered, whereas in the other specimens they occur in opposite pairs. CARR collected this species on five occasions, but it has been collected only twice subsequently. A small tree with greenish or cream flowers.

16. *Steganthera insculpta* PERKINS, Bot. Jahrb. 52 (1915) 202; PHILIPSON, Blumea 29 (1984) 496.

Shrub to 1.5 m high; young branches densely brown pilose. *Leaves* chartaceous, elliptic oblong or ovate, 12–21 by 5–10 cm, base rounded, apex apiculate, margin with regular, wide-spaced, small dentations; young leaves uniformly densely brown pilose, in mature leaves the upper surface with remnants of the indumentum especially on the veins, the under-surface remaining densely pilose on the veins, with scattered hairs elsewhere, reticulation impressed above and prominently raised below; petiole 4–6 mm, densely pilose. — *Male flowers* unknown. — *Female flowers* in subsessile axillary or supra-axillary groups. *Fruiting receptacle* densely pilose. *Drupes* numerous, sessile, ovoid or subglobose, 9 by 6 mm, densely pilose.

Distr. *Malesia*: Papua New Guinea (Sepik region & Telefomin). Two collections.

Ecol. In forest at 850–1600 m.

Note. This species is distinguished from densely hairy forms of *S. hirsuta* by the virtually sessile female inflorescences and the regular small dentations on the leaf margins. It may prove to be best regarded as a form of that species because a sterile specimen from much further to the east has leaves identical to those of the type. However, fertile specimens from the same locality with similar (but not so regularly dentate) leaves have long-pedunculate cymose inflorescences and are identified as *S. hirsuta*.

Insufficiently known

1. *Steganthera atepala* PERKINS in K. Sch. & Laut., Fl. Deut. Schutzgeb. Südsee (1900) 329. — RODATZ & KLINK 237, Bismarck Range.

2. *Steganthera odontophylla* PERKINS, Pfl. R. Heft 49 (1911) 23. — SCHLECHTER 17847, Kauli Mts.

3. *Steganthera pycnoneura* PERKINS, l.c. 23. — SCHLECHTER 19517, Maboko.

4. *Steganthera symplocoides* PERKINS, l.c. 23. — SCHLECHTER 19825, Goridjoa.

5. *Steganthera psychotrioides* PERKINS, Bot. Jahrb. 52 (1915) 198. — LEDERMANN 9078, Sepik.

6. *Steganthera alpina* PERKINS, l.c. 201. — LEDERMANN 11968, Sepik.

7. *Steganthera ledermannii* (PERKINS) KANEH. & HATUS. Bot. Mag. Tokyo 56 (1942) 255. — *Anthobembix ledermannii* PERKINS, Bot. Jahrb. 52 (1915) 203, f. 3. — LEDERMANN 11412. Very like *S. hospitans* but leaves with long white hairs, a feature not seen in *S. hospitans*.

10. MATTHAEA

BLUME, Mus. Bot. Lugd.-Bat. 2 (1856) 89; PERKINS, Bot. Jahrb. 25 (1898) 562; Pfl. R. Heft 4 (1901) 51, f. 10; *ibid.* Heft 49 (1911) 15; Übersicht Gattungen Monim. (1925) 62; PHILIPSON, Blumea 28 (1982) 77, f. 1–3. — **Fig. 24–26.**

Shrubs or small trees. *Leaves* pubescent or glabrous at maturity, entire or dentate. Monoecious, with lateral (rarely also terminal) cymose *inflorescences*, much shorter than the leaves. — *Male receptacle* subglobose, the ostiole surrounded by 4 small rounded tepals. *Stamens* 4, free; filaments short; anthers opening by 2 longitudinal slits. — *Female receptacle* more flattened; tepals 4, upper half abscissing as a calyptra at anthesis to reveal very numerous carpels. *Drupes* long-stipitate, verruculose.

Distr. *Malesia*: Malay Peninsula, Sumatra, Anambas Is., Borneo, Celebes, Philippines, N. Moluccas (Talaud Is.).

Ecol. Rain-forest, ascending to 1700 m.



Fig. 24. *Matthaea sancta* Bl. *a*. Habit, developing fruits, *b*. male inflorescence, both $\times 1/2$, *c*. male flower in LS, $\times 7$, *d*. female flowers, on left the calyptra removed, $\times 5$, *e*. carpel with prominent stigma, $\times 12$ (*a* AHMED *s.n.*, *b* VAN BALGOOY 2029, *c* TOXOPEUS 547, *d-e* VAN STEENIS 1171).

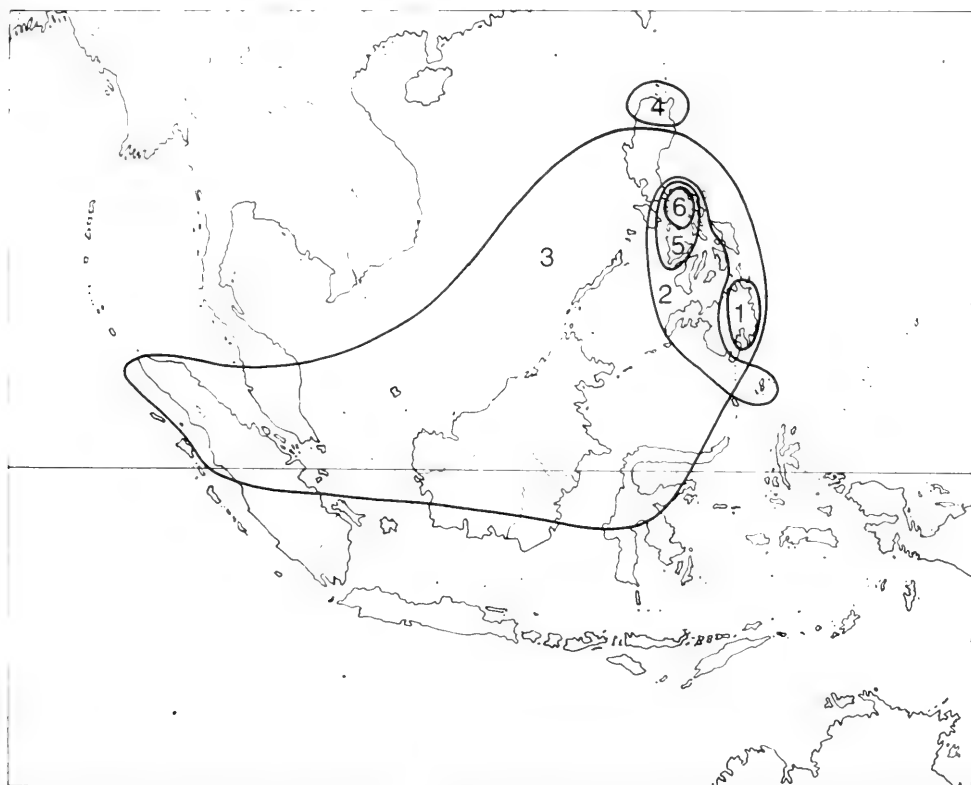


Fig. 25. Range of the species of *Matthaea* Bl. 1. *M. pubescens*, 2. *M. chartacea*, 3. *M. sancta*, 4. *M. heterophylla*, 5. *M. vidalii*, 6. *M. intermedia*.

Note. The distinction between *Matthaea* and *Stegathera* is very slight. The two genera are so alike vegetatively that sterile specimens cannot be allocated to a genus with confidence, and their flowers and fruits are also very similar except for their anthers. In both genera there are four stamens; in *Matthaea* these bear anthers opening by two more or less vertical slits, whereas in *Stegathera* the anthers open by a single horizontal slit. It is useful to maintain the two genera because they are geographically separated (though both may occur in Celebes). *Matthaea* is restricted to western Malesia while *Stegathera*, a considerably larger genus, is centered on New Guinea with outliers in the Moluccas, Celebes and Queensland. Some uncertainties of range remain as male flowers and fruits are not available from several areas.

KEY TO THE SPECIES

- | | |
|--|----------------------------------|
| 1. Undersurface of leaves pubescent | 1. <i>M. pubescens</i> |
| 1. Undersurface of leaves glabrous. | |
| 2. Leaves more than 15 cm long. | |
| 3. Principal lateral veins of undersurface less distinct, scarcely raised above the surface. Leaves usually elliptic to broad-elliptic | 2. <i>M. chartacea</i> |
| 3. Principal veins on undersurface prominent, raised above the surface. Leaves usually oblong-lanceolate to lanceolate. | |
| 4. Leaves oblong-elliptic to narrowly oblong | 3. <i>M. sancta</i> |
| 4. Leaves lanceolate (N. Luzon) | 4. <i>M. heterophylla</i> |
| 2. Leaves less than 15 cm long. | |

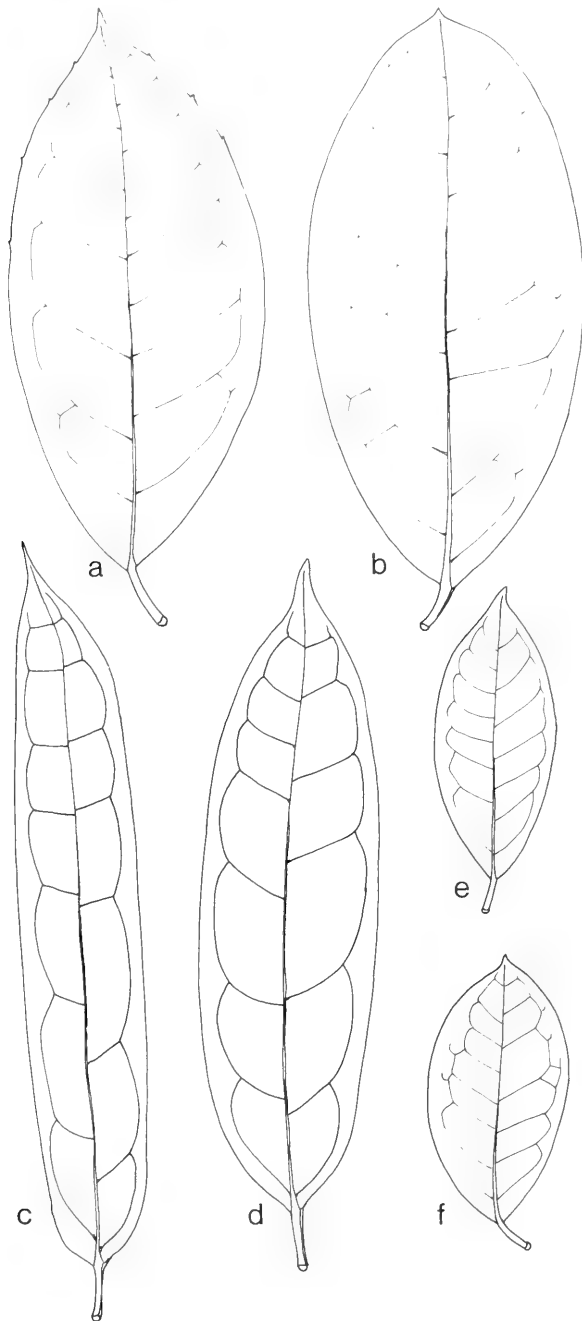


Fig. 26. Leaves of *Matthaea* species, all $\times 1/3$. a. *M. chartacea*, b. *M. pubescens*, c. *M. heterophylla*, d. *M. sancta*, e. *M. vidalii*, f. *M. intermedia* (a BS 40705, b ELMER 10699, c BS 78395, d RIDLEY 10770, e BS 30718, f PNH 4480).

5. Leaves lanceolate-oblong 4. *M. heterophylla*
 5. Leaves elliptic to elliptic-oblong.
 6. Venation on lower surface prominent, raised above the surface. Lamina, petiole, and young branches green 5. *M. vidalii*
 6. Venation on lower surface less distinct, scarcely raised. Lamina, petiole, and young branches olivaceous 6. *M. intermedia*

1. *Matthaea pubescens* MERR. ex PERKINS, Bot. Jahrb. 45 (1911) 422; Pfl. R. Heft 49 (1911) 16; MERR. En. Philip. 3 (1923) 186; PHILIPSON, Blumea 28 (1982) 80, f. 1 & 2. — Fig. 26b.

Shrub or small tree, to 10 m; young branches densely brown pubescent. *Leaves* broadly elliptic to elliptic, 12–27.5 by 5.5–13.7 cm; apex rounded with a short acute apiculum, base broadly cuneate, truncate or rounded, densely brown tomentose (but the upper surface eventually becoming almost glabrous), margin entire or often with dentations on its upper part, lateral veins arched, obscure above; petiole 5–15 mm, densely tomentose. *Inflorescences* axillary, solitary or few in the same axis; male rachis densely brown tomentose, c. 20 mm, bearing a terminal flower, with usually 2 lateral branches subtended by minute bracts; receptacle c. 6 mm ϕ (when dry), tomentose; tepals 4, minute; stamens 4, free. — *Female inflorescences* similar, but apparently only the terminal flower develops fruit (lateral branches frequently bear male flowers) and usually only one inflorescence develops fruit in each axil; rachis becoming stout, elongating to c. 30 mm; receptacle turbinate, 10–15 mm ϕ at anthesis, larger in fruit, inner surface with pilose hairs between the carpels; carpels very numerous, ovary densely strigose; stigmas prominent. *Drupes* numerous, 30 by 15 mm (when dry).

Distr. *Malesia*: Philippines (Mindanao: Agusan, Surigao, Bukidnon & Davao Prov.). Fig. 25.

Ecol. In dense, often mossy forest, 300–1700 m.

Vern. *Kalagau*, *mangilas*, Bukidnon, *baringoras*, *bayung-bayung*, Bag.

Note. The wood is described as white and moderately hard; the bark as yellowish grey, fissured. Ripe fruits are blue-black.

2. *Matthaea chartacea* MERR. Publ. Gov. Lab. Philip. n. 35 (1905) 14; PERKINS, Pfl. R. Heft 49 (1911) 18; MERR. En. Philip. 3 (1923) 186, f. 1–2; PHILIPSON, Blumea 28 (1982) 80. — *M. williamsii* PERKINS, Bot. Jahrb. 45 (1911) 422. — *M. pinchotiana* PERKINS, l.c. 423. — Fig. 26a.

Shrub or small tree to 10 m; young branches becoming glabrous. *Leaves* oblong-ovate, (13–)15–20 (–25) by 6–9.5 (–12) cm, apiculate with an obtuse or acute apex, chartaceous, glabrous when mature (rarely a few hairs retained at the base of the blade); margin with small dentations on the upper part or entire; lateral veins arched, obscure above, veins of a lower order obscure; petiole 15–20 mm, glabrous

(rarely with some persistent hairs). *Inflorescences* axillary, solitary or few in the same axil. — *Male rachis* strigose, to 20 mm, with minute scales at the base, bearing a terminal flower, side branches 1–2 or absent, c. 10 mm long, subtended by minute strigose bracts; receptacle c. 5 mm ϕ (when dry), slightly strigose; tepals 4, minute; stamens 4, free; filaments broad, short; anthers broadly triangular. — *Female inflorescence* similar, but apparently only the terminal flower develops to fruit (lateral branches frequently bear male flowers); rachis becoming stout and dilated distally, elongating to c. 35 mm; receptacle turbinate, c. 10 mm ϕ at anthesis, slightly larger in fruit; carpels very numerous; ovary densely strigose; stigma prominent. Hairs persist on the young fruit, but the numerous ripe *drupes* are glabrous, shining black, wrinkled, c. 20 by 15 mm (dry), long-stipitate (c. 18 mm long).

Distr. *Malesia*: Philippines (Luzon: Laguna & Tayabas Prov.; Mindoro; Leyte; Mindanao: Zamboanga Prov.) and N. Moluccas (Talaud Is.: Karakelong). Fig. 25.

Ecol. Dense forest and second growth, to 700 m.

Uses. The stem is scraped and applied for headaches. The plant is used in hunting rituals.

Vern. *Alukba*, *barau-barau*, Mang., *molikotlang*, Mindoro, *matagusa*, *selimbwang*, Zamboanga; *laba*, Moluccas, Talaud.

Note. This species is similar to *M. pubescens* except for the lack of indumentum. Although both these species occur on Mindanao, their ranges do not overlap, *M. chartacea* being confined to the west and *M. pubescens* to the east.

3. *Matthaea sancta* BLUME, Mus. Bot. Lugd.-Bat. 2 (1856) 90, t. 10; PERKINS, Bot. Jahrb. 25 (1898) 563, t. 5d; Pfl. R. Heft 4 (1901) 52, f. 10; *ibid.* Heft 49 (1911) 18, *incl. var. mindanaoensis* PERKINS *et var. venulosa* PERKINS, l.c.; MERR. En. Philip. 3 (1923) 186; RIDL. Fl. Mal. Pen. 3 (1924) 73; PHILIPSON, Blumea 28 (1982) 82, f. 1–3. — *Ficus pulchra* WALL. Cat. (1831) n. 4518, *nomen*. — *Mollinedia sancta* (BL.) BAILL. Hist. Pl. 1 (1869) 306. — *M. latifolia* PERKINS, Bot. Jahrb. 25 (1898) 563, t. 5d; Pfl. R. Heft 4 (1901) 52, f. 10; *ibid.* Heft 49 (1911) 17, f. 7B–C. — *M. calophylla* PERKINS, Bot. Jahrb. 25 (1898) 563; Pfl. R. Heft 4 (1901) 52; *ibid.* Heft 49 (1911) 17, f. 7A. — Fig. 24, 26d.

Shrub or small tree, rarely to 15 m; young branches becoming glabrous. *Leaves* lanceolate-

oblong to oblong, 15.5–31 by 3.5–9.5 cm, acuminate, base broadly cuneate, truncate or rounded, chartaceous, often somewhat bullate, margin entire or dentate distally, glabrous; lateral veins arched and uniting far from the margins, impressed on upper surface, prominently raised above the lower surface; petiole 2–3 cm, glabrous. *Inflorescences* axillary, solitary or fascicled. — *Male rachis* 2–3 cm, pubescent, bearing a terminal flower and usually 1–2 pairs of lateral flowers on short branches (which occasionally also bear side-branches); receptacle subglobose, c. 3–5 mm ϕ , slightly strigose; tepals 4, minute; stamens 4, free; filaments broad, short; anthers triangular. — *Female inflorescences* similar, some lateral as well as the terminal flower female and developing fruit, or (more usually) the lateral branches bear male flowers which are soon shed; rachis becoming stout and dilated distally; receptacle turbinate, c. 12 mm ϕ at anthesis (dry), inner surface pilose between the carpels; carpels very numerous, ovary densely pilose, stigma prominent. *Drupes* numerous, up to 25 mm stipitate, ovoid, 18 by 11 mm.

Distr. Malesia: Sumatra, Malay Peninsula (Perak & Pahang to Singapore), Anambas Is., Borneo (Sarawak, Sabah, Kalimantan), Philippines (Luzon, Negros, Cebu, Mindanao) and Celebes. Fig. 25.

Ecol. Small tree or shrub, sometimes scandent in forest, from low altitudes to 1200 m.

Uses. The wood is heavy and branches are used in building houses. The leaves are smoked with tobacco to relieve headaches.

Vern. Malacca: *poko churaw*, *p. lumsoo*; Anambas Is.: *kayu sama*; Philippines: *babang di putukan*, *If.*, *colog-colog*, Negros, *bago-bago*, C. Bis.

Note. The only species with a wide geographical range. Leaf size and breadth are variable, as is the degree of toothiness of the margin. Typical leaves are narrowly-oblong, apiculate, and with distant, prominent, strongly arched lateral veins. Broader and more coarsely toothed leaves appear to occur more frequently to the east of the range, but no basis for subspecific taxa can be discerned. The wood is said to be reddish and moderately hard. The ripe fruit is blue-black.

4. *Matthaea heterophylla* QUIS. & MERR. Philip. J. Sc. 37 (1928) 145; PHILIPSON, *Blumea* 28 (1982) 82, f. 1–2. — **Fig. 26c.**

A shrub with appressed whitish hairs on the developing parts but becoming glabrous. *Leaves* oblong-lanceolate to lanceolate, 10–30 by 2.5–6.5 cm, acuminate, base broadly cuneate to rounded, chartaceous, margin entire, glabrous, lateral veins widely spaced, prominent on the lower surface, arched; petiole 13–20 mm, glabrous at maturity. *Flowers* unknown. *Infructescences* terminal or axillary, peduncle becoming woody, c. 6 cm long with a flattened

receptacle c. 20 mm ϕ at maturity, inner surface pilose. *Drupes* c. 15 mm stipitate, ovoid, c. 25 by 18 mm, verruculose (when dry).

Distr. Malesia: Philippines (Luzon: Isabella & Cagayan prov.). Fig. 25.

Ecol. In forests, about 1200–1350 m.

Note. A local species from northern Luzon apparently outside the range of *M. sancta*, characterized by the narrow elongated leaves, with major lateral veins widely spaced and running out straight from the midrib very nearly at right angles.

5. *Matthaea vidalii* PERKINS, Bot. Jahrb. 45 (1911) 422; Pfl. R. Heft 49 (1911) 17; MERR. EN. Philip. 3 (1923) 186; PHILIPSON, *Blumea* 28 (1982) 82, f. 1–2. — **Fig. 26e.**

Shrub, about 2 m; young branches glabrous. *Leaves* elliptic to elliptic-oblong, 11–15 by 3.5–6 cm, acuminate, base broadly cuneate, somewhat coriaceous, margin entire or rarely with a few teeth in the distal part, principal veins prominent on the lower surface and strongly arched; petiole 15–20 mm, glabrous. *Inflorescences* axillary, solitary or fascicled. — *Male rachis* c. 35 mm, sparsely pilose, bearing a terminal flower and a pair of lateral flowers on short branches; receptacle turbinate, c. 5 mm ϕ , sparsely pilose outside; tepals 4; stamens 4, free. — *Female inflorescences* similar, apparently only a single terminal flower producing fruit; receptacle at anthesis not seen; rachis becoming stout and woody at fruiting. *Drupes* numerous, c. 15–18 mm stipitate, ovoid, c. 30 by 20 mm, glabrous, wrinkled, purple-black.

Distr. Malesia: Philippines (Luzon: Camarines Sur & Sorsogon Prov.; Panay: Capiz Prov.). Fig. 25.

Ecol. Forest, from 600 to 1600 m.

Vern. *Salapula*, Bik.

Note. Occurs within the range of *M. sancta*, which it approaches. The smaller, coriaceous and more elliptic leaves appear consistently distinct.

6. *Matthaea intermedia* MERR. Philip. J. Sc. 13 (1928) Bot. 11; PHILIPSON, *Blumea* 28 (1982) 82, f. 1–2. — **Fig. 26f.**

Shrub, about 4 m; young branches glabrous. *Leaves* elliptic to oblong-elliptic, c. 8–13 by 3–6 cm, acuminate, base broadly cuneate, margin entire, glabrous, lateral veins arched, slightly raised below, not impressed above; petiole c. 15 mm, glabrous. *Inflorescences* axillary; rachis c. 15–20 mm, with scattered appressed hairs, bearing a terminal flower and usually one pair of lateral flowers on short branches. — *Male receptacle* turbinate, sparsely pubescent; tepals 4; stamens 4, subsessile. — *Female receptacle* similar, inner surface pilose between the carpels; carpels numerous, ovary densely pilose, stigma prominent. *Drupes* 8–10 mm stipitate, ovoid, c. 20 by 15 mm, verruculate.

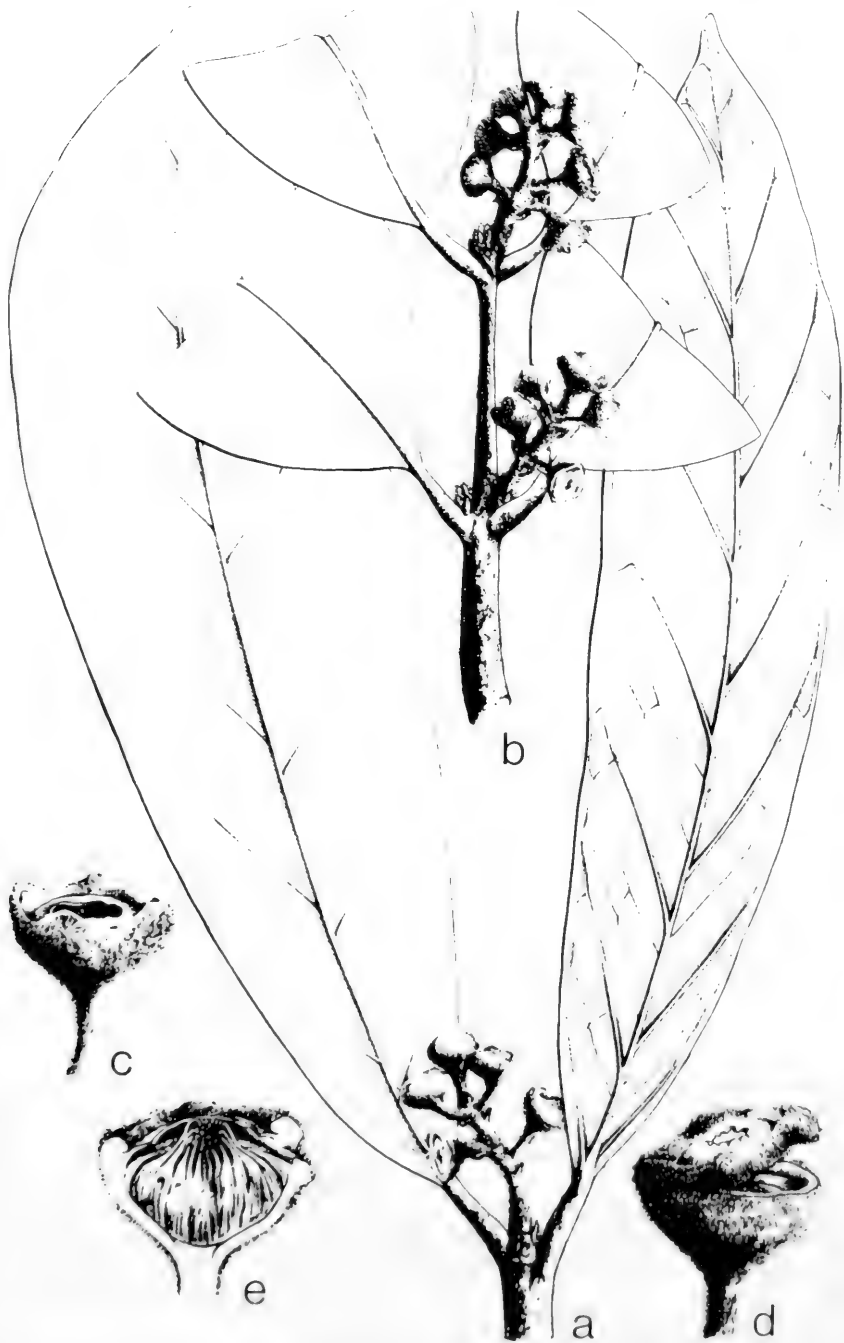


Fig. 27. *Lauterbachia novoguineensis* PERKINS. a - b. Habit, with female flowers, nat. size, c. open flower, d. opening flower, both $\times 3$, e. flower in LS, $\times 4$ (after PERKINS).

Distr. *Malesia*: Philippines (Luzon: Tayabas Prov.). Fig. 25.

Ecol. Forests, about 1000 m.

Note. A local species, from the central Philippines, resembling the neighbouring *M. vidalii* in size and shape of leaf, but differing in the less prominent venation on the lower surface, and particularly in the brown-olivaceous colour of the leaves, petioles and branches.

Insufficiently known

Matthaea philippinensis PERKINS, Bot. Jahrb. 45 (1911) 423; Pfl. R. Heft 49 (1911) 18. Of this species, described from Leyte, no specimens have been seen.

11. LAUTERBACHIA

PERKINS in K. Sch. & Laut., Fl. Deut. Schutzgeb. Südsee (1900) 330, t. 6; PERKINS & GILG, Pfl. R. Heft 4 (1901) 63; PERKINS, Übersicht Gattungen Monim. (1925) 40; HUTCH. Gen. Fl. Pl. 1 (1964) 119. — Fig. 27.

Trees or shrubs with entire leaves. *Inflorescence* axillary or terminal. — *Male flowers* not known. — *Female flowers* with 4 minute tepals and a velum surrounding the ostiole; upper part of the receptacle abscissing as a calyptra. *Carpels* numerous, with a long subulate style.

Distr. *Malesia*: Papua New Guinea (Madang Prov.: Ramu Distr.). Fig. 10.

Ecol. Lower montane rain-forest.

Note. The single species was known only from the type which was destroyed in World War II. No duplicate has been located so the above description and that of the species is based on information published by PERKINS. The presence of a velum in what appears to be a member of the *Mollinedieae* is so exceptional that the interpretation of PERKINS must be considered doubtful until further material can be examined.

1. *Lauterbachia novoguineensis* PERKINS in K. Sch. & Laut., Fl. Deut. Schutzgeb. Südsee (1900) 331; PERKINS & GILG, Pfl. R. Heft 4 (1901) 63. — Fig. 27.

A shrub or tree, the young branches with brown tomentum. *Leaves* elliptic-oblong or oblong, 13–21 by 5–8 cm, base cuneate or rounded, apex broadly acuminate or acute, glabrous above except for sparse hairs on the nerves, below clothed with long greyish hairs chiefly on the nerves, becoming glabrous, entire, margin revolute (when dry); nervation promi-

nent below, nerves arched and meeting within the margin; petiole 10–12 mm, tomentose. *Inflorescence* axillary or terminal, 4–8-flowered pleiochasia, c. 30 mm long, clothed with brown tomentum; pedicels c. 5 mm. — *Female receptacle* turbinate, 8–9 mm \varnothing ; tepals 4, minute, a velamen surrounding the wide ostiole; carpels c. 38, narrowed above into a long subulate style.

Distr. *Malesia*: Papua New Guinea (Madang Prov.: Ramu Distr.; Bismarck Range). Fig. 10.

Excluded

Idenburgia GIBBS = *Sphenostemon* BAILL. (*Sphenostemonaceae*).

Scyphostegia STAPF = *Scyphostegiaceae*.

Tambourissa ficus (TUL.) A.DC. (*Ambora ficus* TUL.) was mentioned by MIQUEL, Fl. Ind. Bat. 1, 2 (1859) 75 and DC. Prod. 16, 2 (1868) 659 to have been collected in Java by LESCHENAULT. PERKINS, Pfl. R. Heft 4 (1901) 70 raised already doubt about this record, which certainly rests on an erroneously localized specimen from Madagascar.

Trimenia SEEM. (*Piptocalyx* OLIV. ex BTH.) = *Trimeniaceae*.

TRIMENIACEAE (W. R. Philipson, Christchurch)

Trimenia was first described by SEEMANN as a genus related to the *Ternstroemiaceae*. BENTHAM & HOOKER *f.* (1880) regarded it as more closely related to the *Monimiaceae* without definitely placing it there. This was done by PERKINS & GILG (1901) who formed the tribe *Trimenieae* of that family. GIBBS (1917) created the family *Trimeniaceae* without stating grounds for the separation. GILG & SCHLECHTER (1923) disagreed, thinking the differences between *Trimenia* and other *Monimiaceae* too slight. However, a more complete study by MONEY, BAILEY & SWAMY (1950) firmly established the family which is now generally accepted. The work of ENDRESS & SAMPSON (1983) strengthened this conclusion and demonstrated the isolated position of the family by drawing attention to a number of features deviating from those generally found in the *Laurales*. These include absence of a floral cup; spiral floral phyllotaxis; caducous tepals; utriculate carpels; polyforate pollen; tectate-columellate exine; capitate stigma with multicellular papillae; vascularized outer integument. Chromosome number $n=8$.

References: BENTHAM & HOOKER *f.*, Gen. Pl. 3 (1880) 143; ENDRESS & SAMPSON, J. Arn. Arb. 64 (1983) 447–473; GIBBS, Fl. Phyl. Arfak Mts (1917) 136; GILG & SCHLECHTER, Bot. Jahrb. 58 (1923) 245; MONEY, BAILEY & SWAMY, J. Arn. Arb. 31 (1950) 372–404; PERKINS & GILG, Pfl. R. Heft 4 (1901) 21.

1. TRIMENIA

SEEMANN, Fl. Vit. (1871) 425, t. 99; B. & H. Gen. Pl. 3 (1880) 143; PAX in E. & P., Nat. Pfl. Fam. 3, 2 (1889) 98; PERKINS & GILG, Pfl. R. Heft 4 (1901) 21, f. 4a–c; RIDL, Trans. Linn. Soc. Bot. II, 9 (1916) 144; GIBBS, Arfak (1917) 135; GILG & SCHLTR, Bot. Jahrb. 55 (1919) 195, f. 1–2; *ibid.* 58 (1923) 245, f. 1; PERKINS, Übersicht Gattungen Monim. (1925) 22; A.C. SMITH, J. Arn. Arb. 23 (1942) 442; RODENBURG, Blumea 19 (1971) 3. — *Piptocalyx* OLIV. ex BTH. Fl. Austr. 5 (1870) 292; PERKINS & GILG, Pfl. R. Heft 4 (1901) 22, f. 4d–f. — **Fig. 1–3.**

Small trees, shrubs or lianes, up to 20 m or more, young parts tomentose or glabrous. *Leaves* opposite, petiolate, exstipulate, ovate to ovate-lanceolate (obovate, *extra-Mal.*), base cuneate, apex acute to long acuminate, entire or serrate, with translucent dots, nerves connected near the margin. *Inflorescence* axillary or terminal, cymose, pleiochasial (racemose) or paniculate. *Flowers* unisexual or bisexual; receptacle continuous with the pedicel, slightly convex, glabrous; tepals caducous before or at anthesis, spirally arranged (outermost sometimes decussate), imbricate, 10–38, the lower ovate to \pm orbicular or reniform, up to 3 mm long, base swollen and sometimes peltate, apex rounded or obtuse, grading upwards into longer, narrower and more membranous tepals, the uppermost spatulate, up to 5 mm long. *Stamens* 7–25, spirally arranged, filament shorter or as long as the anther, connective produced at apex, anthers tetrasporangiate, extrorse or latrorse, opening by two longitudinal slits. *Carpel* solitary (rarely 2), rudimentary or absent in male flowers, superior, barrel-shaped, glabrous or sparsely strigose; stigma sessile tufted-papillose, 1-celled; ovule 1, pendulous, anatropous. *Fruit* a small spherical, succulent berry. *Seed* hard, smooth or ridged; embryo small, apical; endosperm abundant.

DISTR. Eastern Pacific (Marquesas), Polynesia (Samoa, Fiji), New Caledonia, F. Australia (New South



Fig. 1. *Trimenia papuana* RIDL. A. Habit, nat. size, B. bud, $\times 6$, C–E. outer, middle and inner tepals, $\times 8$, F. flower, after removal of tepals, $\times 7$, G. stamen, from inside, $\times 10$, H. ovary, $\times 7$, J. ditto in LS, $\times 10$, K. ditto in CS, $\times 12$, L. fruit, $\times 3$ (after GILG & SCHLECHTER, 1919).

Wales), Solomons (Bougainville) and *Malesia*: New Guinea (incl. New Britain & New Ireland), Moluccas (Ceram, Batjan) and Central Celebes. In all 5 spp. Fig. 2.

Fossils. MULLER (1981) considered that *Cretacaeiporites scabrabut* from West Africa and Brazil, which first appears in the Cretaceous (Albian-Cenomanian) (JARDINÉ & MAGLOIRE, 1963; HERNGREEN, 1973), may represent *Trimenia* pollen.

References: HERNGREEN, Pollen et Spores 15 (1973) 515–555; JARDINÉ *et al.*, Coll. Int. Micropal. Dakar (1963); MULLER, Bot. Rev. 47 (1981) 9.

Ecol. Small trees or climbers in forests, often on ridge crests or other exposed places and usually at moderate to high altitudes.

Floral biology. The flowers of *T. papuana* are scentless, produce no nectar and the pollen is dry. No insect visitors were observed (ENDRESS & SAMPSON, 1983). Presumably wind plays a major role in pollination. The outer tepals fall before flowering and at anthesis all the tepals have been shed. The other species probably have a similar biology. In all species some flowers are male, but the degree of separation of the sexes varies. In *T. papuana* most flowers are hermaphrodite with some male flowers present. In *T. neocaledonica* and *T. moorei* the proportion of male flowers is greater. The sexes are more completely separated in *T. weinmanniifolia* in which species all flowers are functionally either male or female. *Trimenia weinmanniifolia* ssp. *weinmanniifolia* is monoecious but the other two subspecies may be dioecious (RODENBURG, 1971).

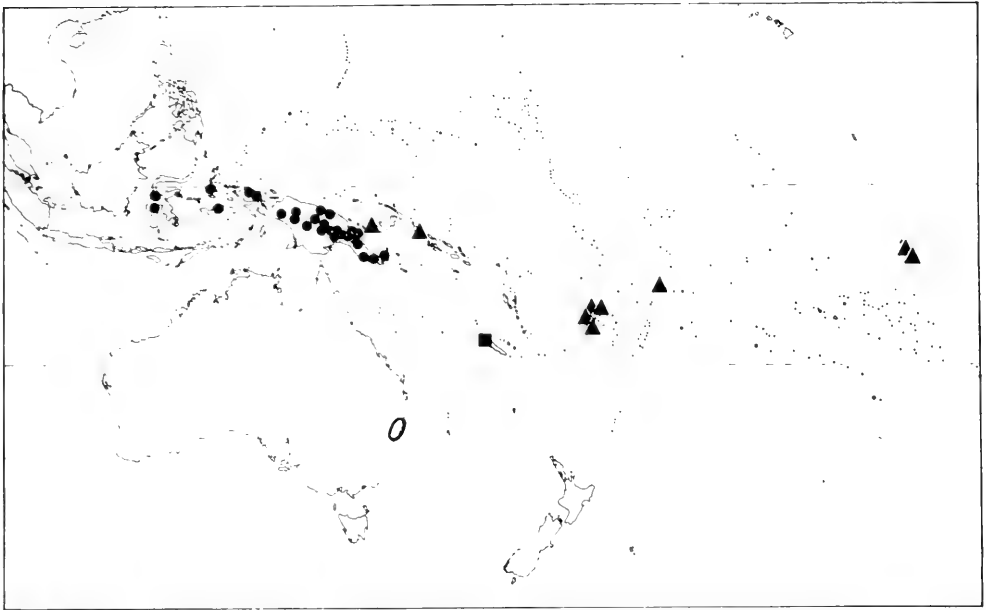


Fig. 2. Range of *Trimenia* SEEMANN: *T. papuana* (dots), *T. neocaledonica* (square), *T. moorei* (oval), *T. weinmanniifolia* (triangles), *T. macrura* (in New Guinea, not indicated).

Dispersal. The one-seeded succulent fruit has dark red to purple juice, and no doubt is distributed by birds.

References: ENDRESS & SAMPSON, *J. Arn. Arb.* 64 (1983) 447; RODENBURG, *Blumea* 19 (1971) 3–15.

Morph. The leaves are in decussate pairs and exstipulate. The lamina is tapered to an acute apex which in *T. macrura* is elongated into a delicate drip-tip. Inflorescences are lateral, or in some species also terminal. The inflorescence axes bear a terminal flower and either pairs of opposite flowers or branches which in turn bear a series of flower pairs, or even branches of a third order, when the inflorescence becomes a diffuse panicle.

Anat. Anatomical features are described by MONEY, BAILEY & SWAMY (1950), METCALFE & CHALK (1950), RODENBURG (1971) and CARLQUIST (1984). Hairs are unicellular or tricellular uniseriate and non-glandular. Stomata are paracytic. Oil cells and mucilage cells occur in the mesophyll of the leaf and in the axis. The leaf blade has no hypodermis and a palisade layer is not clearly defined from the spongy mesophyll. The leaf trace which departs from the single nodal gap comprises 2 or 4 bundles. Young stems develop no hippocrepiform sclereids (or only vestiges of them) in the pericycle opposite the interfascicular sectors. Elongated sclereids develop precociously in the secondary phloem. In the secondary xylem the vessel elements are long with high incidence of scalariform intercellular pitting. There are numerous uniseriate rays in addition to multiseriate rays (5 or 6 cells wide). Gelatinous fibres occur in the tension wood (KUČERA & PHILIPSON, 1977). Phloem plastids are of the S-type (BEHNKE, pers. comm.).

References: CARLQUIST, *Pl. Syst. Evol.* 144 (1984) 103–118; KUČERA & PHILIPSON, *New Zcal. J. Bot.* 15 (1977) 649–654; METCALFE & CHALK, *Anatomy of the Dicotyledons* 2 (1950); MONEY, BAILEY & SWAMY, *J. Arn. Arb.* 31 (1950) 372–404; RODENBURG, *Blumea* 19 (1971) 3–15.

Floral anatomy. The structure and development of the flower have been carefully described and discussed by ENDRESS & SAMPSON (1983). The tepals, stamens and carpel(s) are initiated in a spiral phyllotaxis. The perianth members show a gradation of form from below upwards without differentiation into sepals and petals. The anthers have neither lateral glands nor valvular dehiscence. The middle layer of the anther wall is only 1 or 2 cells thick, and the tapetum is glandular. Cytokinesis is successive and pollen is shed in the 2-celled condition. The mature carpel is markedly utriculate although early developmental stages pass through a chair-like form. The pendent, anatropous ovule is crassinucellar and bitegmic with the micropyle directed upwards. The archesporium is multicellular, but only one megagametophyte reaches maturity forming a long tube growing towards the micropyle. The fruit is a berry, the very juicy carpel wall enclosing a single seed with a very stony

outer coat. The small embryo is embedded in the apical part of the abundant endosperm. The cotyledons are rudimentary in the ripe seed and diverge slightly.

Reference: ENDRESS & SAMPSON, J. Arn. Arb. 64 (1983) 447–473.

Palyn. Earlier accounts of the pollen by MONEY, BAILEY & SWAMY (1950), ERDTMAN (1952) and WALKER (1976) are extended and fully discussed by SAMPSON & ENDRESS (1984). They report that *T. macrura*, *T. moorei* and *T. neocaledonica* have disulcate, globose-elliptic or globose-spherical to globose-elliptic grains, with finely reticulate or rugulose (*T. neocaledonica*) structure. *Trimenia papuana* has dimorphic pollen, with only one type on an individual plant, consisting of either globose-elliptic inaperturate grains, or globose-spherical polyforate grains. Both types have weakly rugulose structure, *T. weinmanniifolia* has globose-spherical polyforate pollen, with similar structure. Exine is tectate-columellate. In *T. papuana* and *T. weinmanniifolia* the innermost tectum, columellae and foot layer have a partly granular form. All taxa have a lamellate endexine in non-apertural regions. SAMPSON & ENDRESS compare the pollen of *Trimenia* with that of other families and conclude that pollen morphology confirms the comparatively isolated position of the family within the *Laurales*.

References: ERDTMAN, Pollen morphology and plant taxonomy (1952) 272–273, f. 157A; MONEY, BAILEY & SWAMY, J. Arn. Arb. 31 (1950) 372–404; SAMPSON & ENDRESS, Grana 23 (1984) 129–137; WALKER in Beck, Origin and early evolution of Angiosperms (1976) 241–299.

Chromosomes. *Trimenia papuana* (GOLDBLATT, 1974) and *T. moorei* (GOLDBLATT & BRIGGS, 1979) both give counts of $n=8$.

References: GOLDBLATT, J. Arn. Arb. 55 (1974) 453–457; GOLDBLATT & BRIGGS, Ann. Mo. Bot. Gard. 66 (1979) 898–899.

Phytochem. The lignans (or neolignans) veraguensin and caloptiptin have been isolated from *Trimenia papuana* and *Piptocalyx* (= *Trimenia*) *moorei* ('bitter vine') respectively. The nature of the bitter principles of bitter vine is still unknown, but a slightly sweet glucoside was isolated from its leaves and called piptoside; its aglucone was shown to be structurally related to the proteaceous metabolite leucodrin. CHENERY reported aluminium accumulation for one species of *Trimenia* (two investigated), but not for *Piptocalyx* (one species tested). The lack of benzyloquinoline alkaloids in *Trimeniaceae* conforms with the exclusion of the taxon from *Monimiaceae*.

References: HEGNAUER, Chemotaxonomie der Pflanzen 5 (1969) 99–107, 457, and *ibid.* 8 (in prep.); family treated together with *Monimiaceae*. — R. HEGNAUER.

Taxon. *Generic limits.* Hitherto a second genus of the *Trimeniaceae*, *Piptocalyx*, has been recognized. First described from Australia (*P. moorei*) a second species (*P. macrurus*) is known from New Guinea. The climbing habit of these two species contrasts with the arboreal or shrubby habit of *Trimenia*, but the floral characters are closely alike. Careful comparisons of *Trimenia* and *Piptocalyx* by ENDRESS & SAMPSON (1983) revealed that some characters thought to separate the genera are indecisive. In particular they showed that the tepals of *Piptocalyx* are spiral, as in *Trimenia*, and not decussate. As *T. neocaledonica*, previously inadequately known, was found to be closer in some respects (e.g. pollen) to *Piptocalyx* than to other species of *Trimenia* they concluded that the only characters which separate the two genera are habit and the number of tepals (more than or fewer than 11). They preferred to leave the genera intact, to avoid name changes, but it is concluded here that the recognition of two genera is unjustifiable and the necessary new combination is made. I should add that also in *Monimiaceae* habit (erect or climbing) is variable within genera and sometimes even within a single species.

Trimenia moorei (OLIV. in BTH.) PHILIPSON, *comb. nov.* — *Piptocalyx moorei* OLIV. in BTH. Fl. Austr. 5 (1870) 292.

Specific delimitation. The treatment of the species adopted here follows that of RODENBURG (1971). A.C. SMITH (1978) was critical of RODENBURG's broad specific concept as regards both the Malesian and Polynesian species. RODENBURG's sinking of *T. arfakensis* and *T. myricoides* into *T. papuana* appears entirely justified. This conclusion has been reached after examination of very ample material. The treatment of RODENBURG's subspecies of *T. weinmanniifolia* does not concern this account except for *ssp. bougainvilleensis* which SMITH elevated to specific rank. In view of the wide geographical range of this complex and the indecisive nature of the characters involved, it appears wise to follow the more conservative treatment of RODENBURG.

References: BENTHAM & HOOKER *f.*, Gen. Pl. 3 (1880) 143; ENDRESS & SAMPSON, J. Arn. Arb. 64 (1983) 447–473; GILG & SCHLECHTER, Bot. Jahrb. 58 (1923) 244–248; GIBBS, Fl. Phyt. Arfak Mts (1917) 317; MONEY, BAILEY & SWAMY, J. Arn. Arb. 31 (1950) 372–404; SAMPSON & ENDRESS, Grana 23 (1984) 129–137; PERKINS & GILG, Pfl. R. Heft 4 (1901) 1–122; RODENBURG, Blumea 19 (1971) 3–15; A.C. SMITH, Allertonia 1 (1978) 311–314.



Fig. 3. *Trimenia papuana* RIDL. In Papua New Guinea (PHILIPSON 3692).

KEY TO THE SPECIES

1. Woody climber. Tepals 10 or fewer 3. *T. macrura*
 1. Trees or shrubs. Tepals 13 or more.
 2. Filaments relatively long and thin; mature anthers once or twice as long as the filaments. Seed smooth 1. *T. papuana*
 2. Filaments relatively short and broad; mature anthers at least 4 times as long as the filaments. Seed with longitudinal or reticulate ridges 2. *T. weinmanniifolia*

1. *Trimenia papuana* RIDL. Trans. Linn. Soc. Bot. II, 9 (1916) 144; GILG & SCHLTR, Bot. Jahrb. 55 (1919) 199, f. 1; A.C. SMITH, J. Arn. Arb. 23 (1942) 442; RODENBURG, Blumea 19 (1971) 9. — *T. arfakensis* GIBBS, Arfak (1917) 136; KANEH. & HATUS. Bot. Mag. Tokyo 56 (1942) 262, f. 10. — *T. myricoides* GILG & SCHLTR, Bot. Jahrb. 58 (1923) 248. — Fig. 1, 3.

Shrub or tree up to 20 m or more high; young

branches reddish brown villous, becoming \pm glabrous. *Leaves* narrowly elliptic to lanceolate, 2–1.25 by 0.7–3.5 cm, base cuneate, apex acuminate or acute, margin serrate or entire, yellowish brown when young, green at maturity becoming reddish, nerves numerous (c. 10–20 pairs), villous when young, becoming \pm glabrous except for the midrib and nerves; petiole c. 6–12 mm, villous. *Inflorescence* axillary and terminal, paniculate, shorter than

the subtending leaf, c. 6.5 by 5.5 cm, peduncle up to 15 mm long, villous at first. Bracts c. 3 mm long, lower ovate-lanceolate, upper broader, caducous. *Flowers* uni- or bisexual, up to 4 by 2 mm, pedicel c. 1 mm long, villous; tepals 11–25(–28), in terminal flowers c. 6 outer decussate, in lateral flowers the outer 2 ± opposite, the remainder spirally arranged, the outer broadly ovate c. 1.5 mm long, peltate, grading into longer narrower tepals, the uppermost spatulate, c. 3 mm long, ciliate on the upper part, dark brown before anthesis, caducous. *Stamens* 9–25, c. 2–3.5 mm long, filament slender, c. 1 mm long, anthers to 2 mm long, white, pinkish white or cream at maturity, connective produced. *Carpel* c. 2 mm long, sparsely strigose, carpelode in male flowers rudimentary or absent. *Berry* to 7.5 by 5 mm, crimson to dark purple-black when ripe. *Seed* ovoid, c. 4 by 3 mm, smooth.

Distr. *Malesia*: Central Celebes, Moluccas (Ceram, Batjan), and throughout New Guinea. Fig. 2.

Ecol. Common on ridge crests and exposed places in primary low to mid-montane forests, 1000–2700 m. Also in regrowth after landslide and fire, and on infertile stony sand in riverside or stream bank vegetation.

Uses. The wood is used for fence posts and building. The leaves provide a treatment against dysentery (Okapa area).

Vern. *Arunan*, *nerch*, *tuna*, Enga, *butulye*, Eipomek, *daloe*, *moble*, Dani, *edigea*, Kapauko, *gial*, Chimu, *guiamak*, Kasanombe, *kiluw*, *kohbig*, Hagen, *kora kiyei*, Wonatabe, *kuje*, *porlyporl*, Mendi, *niebalaa*, Kebar, *pymbug*, Melpa, *paribara*, Gerebi, *sakolo*, Wapi, *taingaa*, *tan-ja*, Huli, *wonnai*, Maring.

Field notes. The bark is smooth and grey-brown, the blaze is pinkish straw to red-brown with few wide rays. The sapwood is pale straw to light reddish brown; the heartwood dark pink to red with conspicuous light brownish to white rays. The bark and crushed leaves have a peppermint-like odour and the leaves are bitter when chewed.

2. *Trimenia weinmanniifolia* SEEMAN ssp. *bougainvilleensis* RODENBURG, *Blumea* 19 (1971) 14. — *T. bougainvilleensis* (RODENBURG) A.C. SMITH, *Allertonia* 1 (1978) 154.

Small tree or shrub, up to 10 m; young branches reddish brown villous becoming ± glabrous. *Leaves* narrowly elliptic to lanceolate, 5–9 by 1.6–3 cm, base cuneate, tapered to an obtuse apex or acuminate, margin serrate, lateral nerves c. 14–20 pairs, glabrous at maturity, at first sparsely villous; petiole c. 10–15 mm, at first villous. *Inflorescence* axillary, paniculate, equal to or somewhat shorter than the subtending leaf, up to c. 85 by 55 mm, peduncle up to 25 mm, villous; lower bracts ovate, c. 2 mm long,

upper broadly ovate, c. 1 mm long, strigose. ? Dioecious. *Flowers* up to 3.5 by 2 mm, pedicel 1 mm long; tepals 12–23, spirally arranged, the outer suborbicular, c. 1.5 mm ø, upper narrower and longer, the uppermost spatulate c. 2.5 mm long, sparsely ciliate. *Stamens* 9–16, c. 3 mm long in male flowers, filaments short, broad, anthers c. 2 mm long, whitish at anthesis, connective produced, staminodes in female flowers c. 2 mm long. *Carpel* c. 2 mm long, sparsely strigose, carpelode in male flowers c. 1 mm long. *Berry* dark crimson to black-purple. *Seed* ovoid, 2.5 by 1.7 mm, with distinct ridges.

Distr. Solomon Is. (Bougainville) and *Malesia*: Papua New Guinea (E. New Britain: Pomio Sub-distr.). The two other subspecies of *T. weinmanniifolia* occur in Fiji and Samoa and the widely distant Marquesas Is. Fig. 2.

Ecol. In lower montane rain-forest and cloud forest, especially on exposed ridges, 1500–1700 m.

Vern. *Naligugu*, *naromalalawe*, New Britain.

NOTE. RODENBURG (1971) reserved judgement on material from New Britain, thinking it might represent another subspecies. Further material now available from New Britain indicates that this subspecies extends outside the island of Bougainville. The identification of collections from New Ireland remains in doubt.

3. *Trimenia macrura* (GILG & SCHLTR) PHILIPSON, comb. nov. — *Piptocalyx macrurus* GILG & SCHLTR, *Bot. Jahrb.* 55 (1919) 200, f. 2; *ibid.* 58 (1923) 246, f. 1.

Woody climber, with terete brown tomentose branches. *Leaves* elliptic-lanceolate, to c. 7–11 by 1.7–3 cm, chartaceous, base broadly cuneate to rounded, apex produced into long delicate acumen (c. 3 cm long), margin entire, nerves numerous, impressed above, reticulations of smaller veins prominent, becoming ± glabrous above, densely rufous-sericeous below; petiole c. 6–10 mm long, tomentose. *Inflorescence* axillary and terminal, shorter than the leaves, pleiochasia on long, brown-tomentose peduncles. *Flowers* evidently uni- and bisexual, c. 5 mm long, subsessile; tepals c. 8–10, ovate to obovate, obtuse, glabrous. *Stamens* c. 10–12, 3.5–4 mm long, filaments slender, the anthers somewhat longer than the filaments, white or pinkish at maturity, connective produced. *Carpel* solitary, c. 2–2.5 mm long, sparsely rigose, carpelode in male flowers rudimentary or absent. *Fruit* a succulent berry c. 7 by 5 mm, deep crimson.

Distr. *Malesia*: Papua New Guinea (West Sepik, Enga, Madang & Morobe Prov.).

Ecol. Climber in dense montane rain-forest and mossy forest, between 2000–3000 m.

Field notes. The tepals are brown and caducous. The stamens are white or pinkish.

Excluded

Idenburgia GIBBS, Fl. Arfak Mts (1917) 136 was reduced by VAN STEENIS, Svensk Bot. Tidskr. 49 (1955) 21 to *Sphenostemon* BAILL. (*Sphenostemonaceae*).

'*Trimenia*' *grandifolia* WARB., Index Kewensis, Suppl. 1 (1906) 439, *sphalm.* for *Trimeria grandifolia* (HOCHST.) WARB. (*Flacourtiaceae*).

ALSEUOSMIACEAE (C.G.G.J. van Steenis, Leyden)

Until recently this small family was only known to occur in New Zealand and New Caledonia, but in 1982 I have shown that it occurs in New Guinea and in 1984 that it is also represented in East Australia.

Its phyto-graphic history is complicated through the former confusion about the systematic affinity. *Wittsteinia* was described by F. VON MUELLER (1861) as probably belonging to *Ericaceae* (or *Pyrolaceae*). *Periomphale* was described by BAILLON (1888) and has been affiliated to *Caprifoliaceae* or *Gesneriaceae*. In the 'Pflanzenfamilien' it was ranged among *incertae sedis* (Nachtr., 1897). GILG & SCHLECHTER (1906) described two other genera from New Caledonia which have appeared not to be different from *Periomphale*.

Recently I could show that *Wittsteinia*, which was by BURTT (1949) relegated to *Epacridaceae*, is the oldest name for *Periomphale* and that, in addition to *Alseuosmia* from New Zealand, there occurs in Queensland a new, peculiar, third genus, *Crispiloba* STEEN., of this family. The assemblage of the three genera is now a coherent, typically Australasian one.

In my mind the affinity is with *Escalloniaceae* *cq.* *Grossulariaceae*, and pending further systematic research in that group, we can maintain it as a family of its own, in agreement with CRONQUIST (1981).

I am particularly satisfied that recent anatomical work on the three genera by Dr. W.C. DICKSON, Chapel Hill (*in litt.*) endorses my opinion.

1. WITTSTEINIA

F. v. M. Fragm. Phytogr. Austr. 2 (1861) 136; *ibid.* 3 (1863) 166; BURTT, Kew Bull. 3 (1949) 493; STEVENS, Bot. J. Linn. Soc. 64 (1971) 45; J.H. WILLIS, Handb. Pl. Vict. 2 (1973) 497; STEEN. Blumea 29 (1984) 391. — *Periomphale* BAILL. Bull. Mens. Soc. Linn. Paris n. 92 (1888) 731; Hist. Pl. 10 (1888) 85; GUILLAUMIN, Fl. Nouv. Caléd. (1948) 318; AIRY SHAW, Kew Bull. 18 (1965) 250; GARDN. Blumea 24 (1978) 141; STEEN. *ibid.* 24 (1978) 480; Fl. Mal. I, 9 (1982) 556; v. ROYEN, Alp. Fl. New Guinea 4 (1983) 2659. — *Memecylanthus* GILG & SCHLTR, Bot. Jahrb. 39 (1906) 269. — *Pachydiscus* GILG & SCHLTR, *l.c.* 270. —

Fig. 1.

Small shrubs. *Leaves* spiral, sometimes some in pairs or in false whorls, entire or dentate, membranous or rather fleshy, exstipulate; axils puberulous. *Flowers* fragrant, actinomorphic, 4–7-merous, usually 5-merous, axillary, solitary or in pauciflorous racemes (up to 5 flowers), sustained by a few bracts, small, often in part cleistogamous. *Calyx* persistent. Disk absent. *Corolla* sympetalous, barrel-shaped, lobes \pm valvate, short, carunculate inside apex. *Stamens* mostly 5, free, alternipetalous; filaments filiform; anthers introrsely, lengthwise dehiscent. *Ovary* inferior, 2–3-celled, with flat apex, style columnar, as long as the corolla, the globular, rugose stigma closely enveloped by the corolla segments. *Ovules* flattened, attached to the septum, (?1–)4–6 in each cell. *Berry* small, globose, crowned by the calyx, few-seeded.

Distr. About 3–4 *spp.*, Australia (Victoria), New Caledonia, in *Malesia*: Papua New Guinea.

Ecol. In forests, the Papuan species epiphytic.

Notes. A clearly Australasian, East Gondwanic genus, in which the Papuan species is manifestly allied with the Australian species, not with the New Caledonian one(s).

The occurrence of cleistogamous flowers is highly peculiar and should be more closely studied in the field.

BAILLON (1888) mentioned the occurrence of an orange disk but in herbarium specimens I cannot distinguish this and assume it is the bulging apex of the ovary.

Whether the flowers are always bisexual is also uncertain; there is probably variability and they may appear to be polygamous. This must be checked in the field.

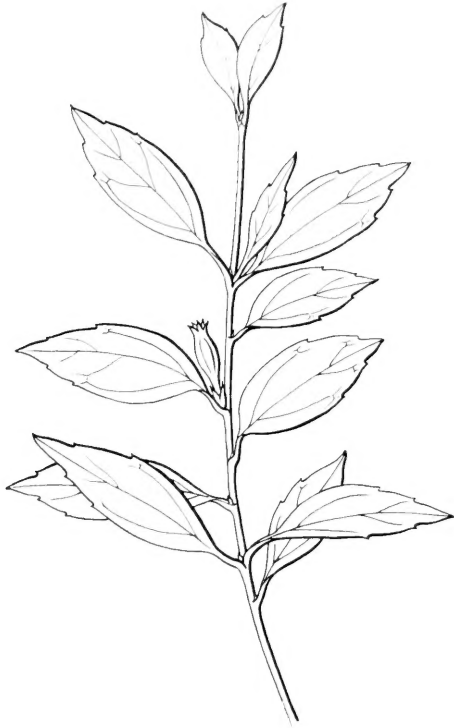


Fig. 1. *Wittsteinia papuana* (STEEN.) STEEN. Small apical part of the very slender habit, nat. size (type, LAE 67068).

1. *Wittsteinia papuana* (STEEN.) STEEN. *Blumea* 29 (1984) 391. — *Periomphale papuana* STEEN. *Blumea* 24 (1978) 481; *Fl. Mal.* I, 9 (1982) 556; v. ROYEN, *Alp. Fl. New Guinea* 4 (1983) 2660, f. 767. — **Fig. 1.**

Branched, very thin and slender, completely glabrous, epiphytic shrublet, c. 75 cm long. *Twigs* angular. *Leaves* scattered and in pseudoverticils, lanceolate-oblong, cuneate at base, acute at apex, margin entire or mostly with 1–2 short gland-tipped teeth; nerves 2–3 pairs, very erect; venation impressed above, indistinct beneath; petiole 3–4 mm, much widened at base. *Flowers* solitary, axillary; pedicel emerging between a few minute bracts, 1–2 mm. *Calyx* lobes 5, thickish, blunt deltoid, 1.25 by 1.5 mm. *Corolla* (in mature bud) narrowly barrel-shaped, 6 mm long; lobes carunculate inside apex, 1 mm. *Stamens* 5, filaments 4 mm, anthers roundish, cordate, 0.75 mm. *Ovary* c. 3 mm, 2-celled; ovules 4(–?5) in each cell.

Distr. *Malesia*: Papua New Guinea (W. Sepik, Telefomin Subdistr., 5°S 141°E). One collection.

Ecol. *Podocarpus-Phyllocladus* woodland with *Gahnia* tussocks undergrowth, 3000 m.

Affinity. The species is differing from the New Caledonian one(s) by having dentate leaves and an ascending habit producing many roots. These characters are also found in the Australian *W. vacciniacea* F. v. M. The latter is a ± creeping or ascending, rooting small shrub with larger, more coarsely and more densely dentate leaves, an attenuate leaf base with a hardly developed petiole, and hairy twigs and lower portion of the leaves.

Field notes. Pedicels pink, gynoecium creamy white, petals pinkish light green, stamens creamy white.



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