

MENISPERMACEAE (L.L. Forman, Kew)^{1 2}

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 ± 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 ± 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 ± 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 THANIKAI-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.), *Tinomis-cium 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. Tuberous 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 racemosely arranged in a pseudopanicle, 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 racemosely arranged. The cymes are umbelliform in *Stephania* spp. and these are sometimes racemosely 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 *Menispermacées*: 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 THANKAIMONI.

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; THANKAIMONI, 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, *Fibraureae* 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 *Fibraureae* 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.

Coscinieae — 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 ± horseshoe-shaped dorsal region usually ornamented with projections or transverse ridges; condyle deeply intrusive, either lamelliform and ± 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. *Fibraureae*) — 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; SRWON, 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 *Polycarpicae* 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 flavonols 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 *Polycarpicae*. A cyanide group is also present in the non-cyanogenic glucoside menisdaurin 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.; SRWON, 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.

Cosciniium 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. I, 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 *Erythrolalum* (*Olacaceae*); both have triplinerved-pinnate 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*, *Tinomisium* (evident in herbarium specimens when any part is broken).

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

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*.

Drupe 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*.

Drupe 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 knobby, 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. Tinomiscium**
 9. Stamens united in a peltate synandrium. Endocarp spiny, the condyle forming a ventral concavity or an enclosed inflated chamber **9. Parabaena**
 8. Petals 0. Endocarp subellipsoidal, smooth with condyle forming a narrow ventral groove **11. Fibraurea**
 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. Tinomisium**
 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 sub-peltate **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 subspiculate 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 dehiscing with longitudinal latrorse slits, the cells parallel and close together. Leaves usually broadly and shallowly crenate 20. *Pericampylus*
22. Anthers dehiscing 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 with in 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, pseudospiculate, 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 \varnothing **13. Anamirta**
8. Leaves without domatia. Drupes over 25 mm \varnothing .
9. Drupes 40–45 mm \varnothing , glabrous. Endocarp covered with branched spines. Leaves glabrous **7. Chlaenandra**
9. Drupes 28–30 mm \varnothing , 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 ruminate **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 ruminate **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 thyrsoid 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. Hyperpa**
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 \varnothing , 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 \varnothing bearing around its margin c. 6 drupes or their scars. *Drupes* red, \pm 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 \varnothing , 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, \pm 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 \varnothing , 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, Leaflet. 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; QUIBILAN & 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, Leaflet. 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. *Drapes* 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 THORNER (Phytochem. 9, 1970, 164, 172).

Vern. Philippines: *ambal*, *mamangal*, Tag., *huluot*, 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. *Drapes* 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, Leaflet. 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. castanopsidifo-*



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. *Drupe* 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: *dulupat*. 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. castanopsidifolia*.

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. *Inflorences* 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 ϕ , 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 (Austr. 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, dehiscent 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 specimen 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*

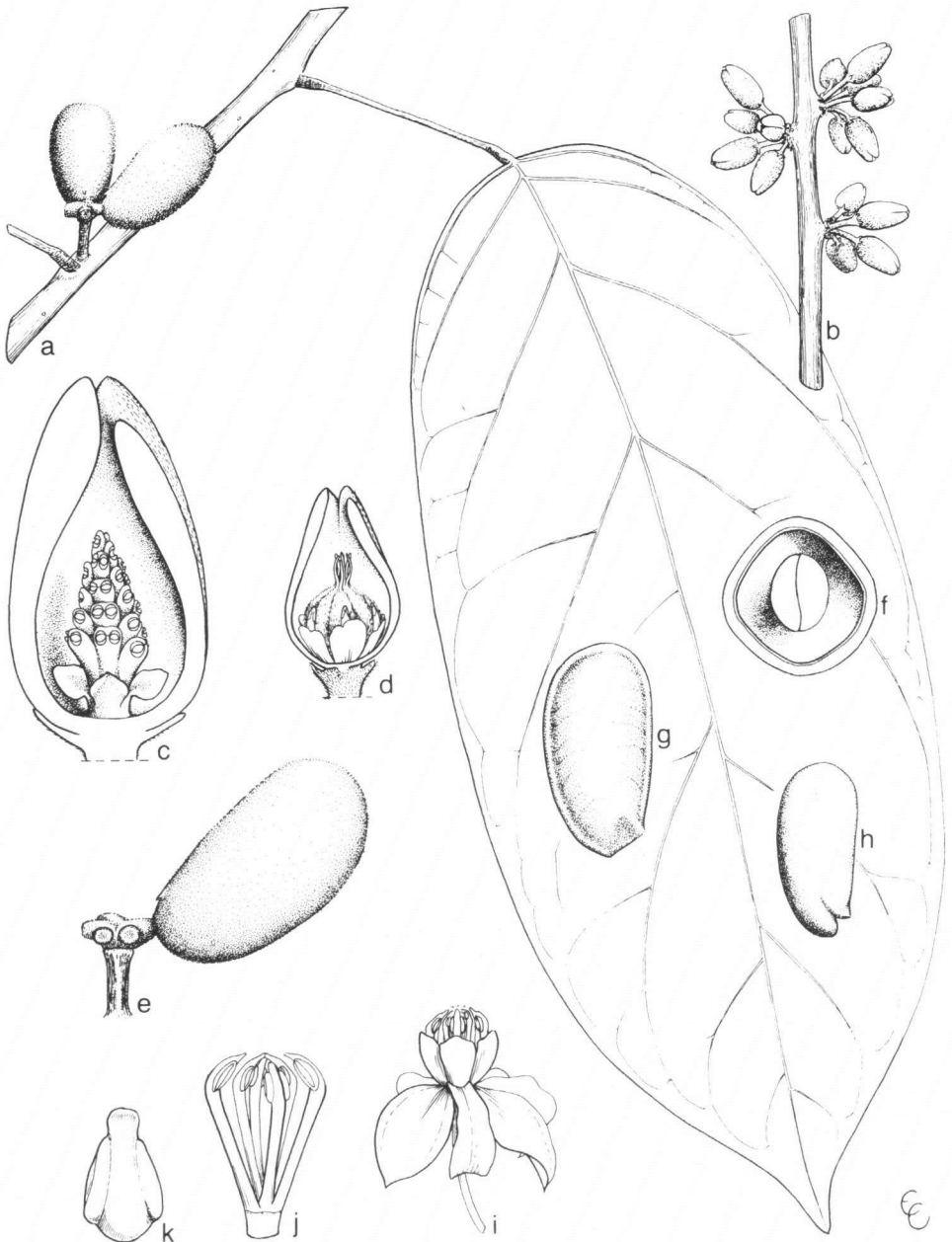


Fig. 2. *Albertisia papuana* BECC. *a.* Habit with infructescence, $\times 2/3$, *b.* male inflorescences, $\times 2/3$, *c.* male flower with half of inner calyx removed, $\times 4$, *d.* female flower with half of inner calyx removed, $\times 4$, *e.* drupe on carpophore, *f.* TS of drupe, *g.* endocarp, *h.* seed, all nat. size. — *Macroccocus 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 \varnothing , 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 \varnothing 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.

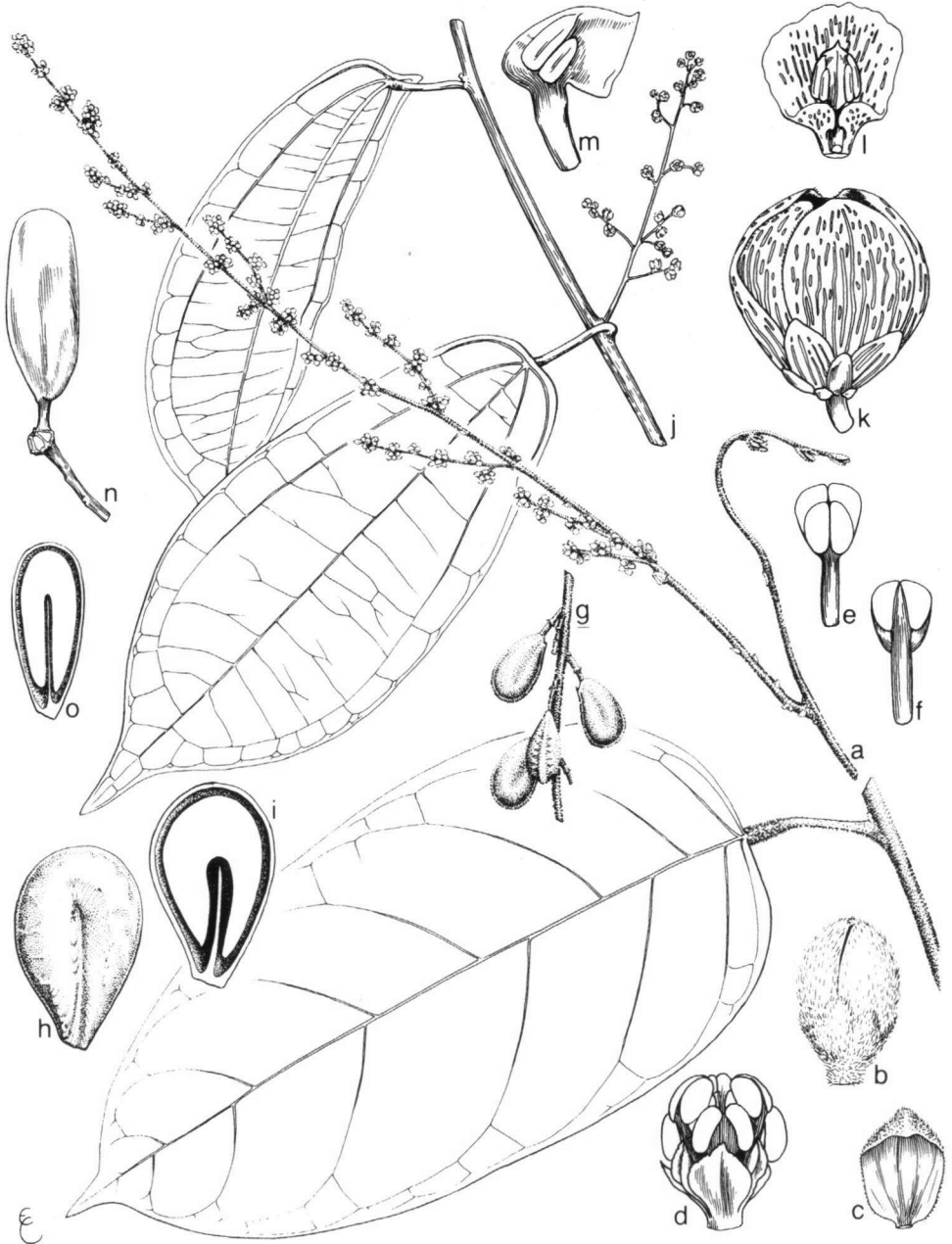


Fig. 3. *Carronia thyrsoflora* (Becc.) Diels. a. Leaf with male inflorescence on young terminal part of shoot, $\times 2/3$, b. male bud with valvate inner sepals, $\times 10$, c. inner sepal, $\times 15$, d. male flower with sepals removed, e. stamen adaxial view, f. *ibid.* abaxial view, all $\times 20$, 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 sessile on gynophore, subobovoid or elongate-obovoid with style-scar near the base; endocarp with or without a dorsal ridge, surface knobby, 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) panicle 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.

Vern. 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 \pm 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 dehiscing 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 ruminant (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. I.-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. I.-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, $\times 1/2$, n. lobed leaf, $\times 1/2$, o. male flower with 2 large sepals removed, $\times 6$, 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. *Drapes* 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 ± 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. *Drapes* 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. *Drapes* reddish with glaucous bloom, ovoid to globose, 5–6 cm \emptyset when fresh, 4–4.5 cm \emptyset when dry; endocarp subglobose, c. 4 cm \emptyset , 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 *Macroccoccus pomiferus* BECC., are avidly eaten by cassowaries. *Fl.* March–April, Sept.; *fr.* July–Jan.

Vern. W. New Guinea: *iebwoneer*, 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* thyrsoid, 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. *Drapes* 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-

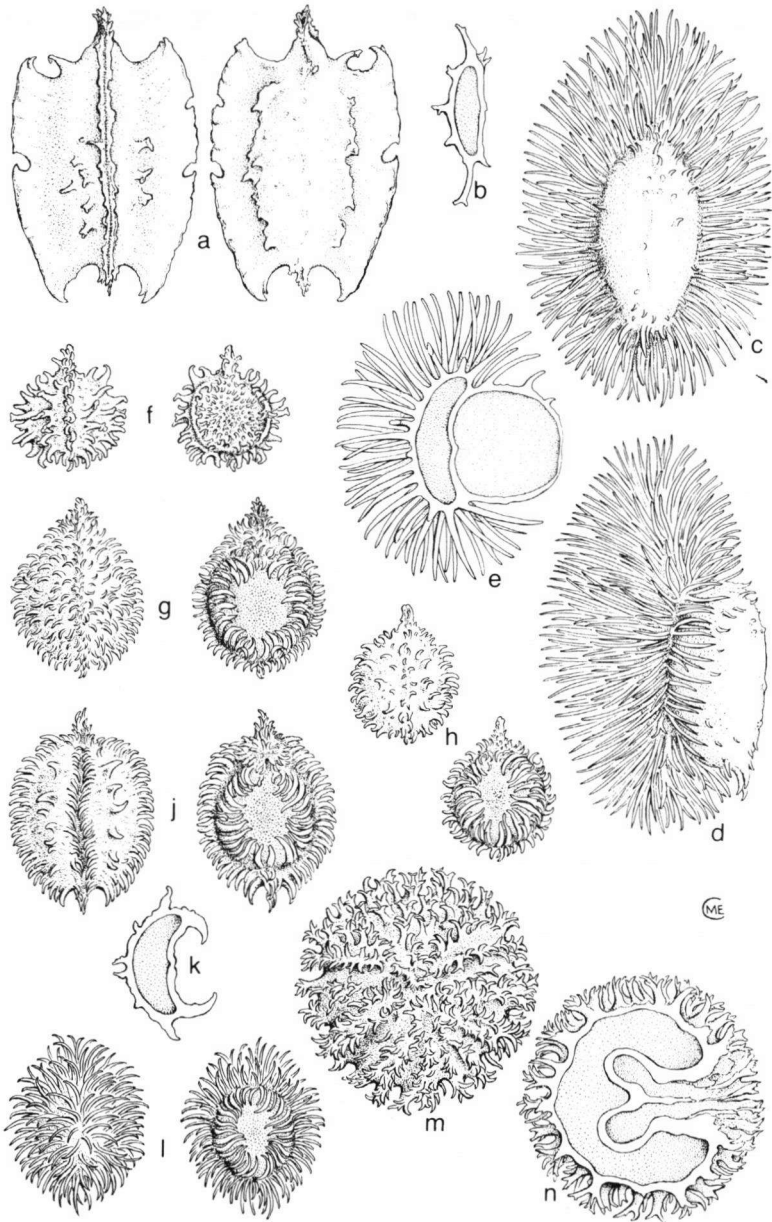


Fig. 5. Endocarps of *Tinosporeae*. *a-b*. *Aspidocarya uvifera* HOOK. f. & TH. *a*. dorsal and ventral views, *b*. in CS; *c-e*. *Parabaena megalocarpa* MERR. *c*. ventral view, *d*. lateral view, *e*. in CS; *f*. *P. sagittata* MIERS ex HOOK. f. & TH. dorsal and ventral views; *g*. *P. elmeri* DIELS, 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 thyrses, 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 ± 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; uncinata hairs absent from main nerves beneath **2. *T. merrilliana***
 7. Fine reticulation raised on both surfaces; some uncinata 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 ± 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. crispata*
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, thin 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 *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

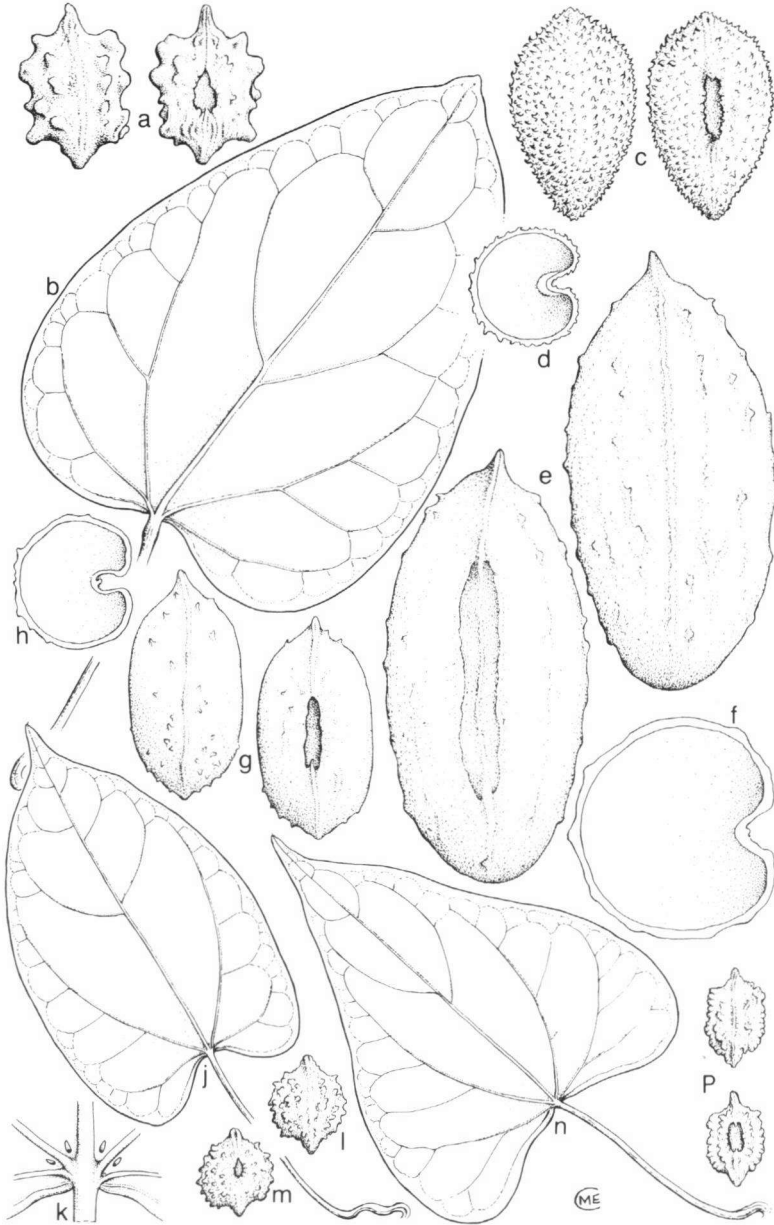


Fig. 6. *Tinospora dissitiflora* (LAUT. & K. SCH.) DIELS. *a*. Endocarp, dorsal and ventral views, $\times 2$. — *T. tinosporoides* (F. v. M.) FORMAN. *b*. Leaf, $\times 2/3$, *c*. endocarp, dorsal and ventral views, *d*. in TS, all $\times 2$. — *T. macrocarpa* DIELS. *e*. Endocarp, dorsal and ventral 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 \varnothing ; young stems 2–3 mm \varnothing drying striate, puberulous or glabrous; older stems covered with raised corky lenticels. *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 \varnothing 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 lenticels. *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 \varnothing ; endocarp cream-whitish, crustaceous, subtrund 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 pseudoracemose 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, subracemose 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. Écon. Indoch. n.s. I-1929, n. 199 (1929) 30 with accompanying plate and figure; MERR. J. Agn. Arg. 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 felleus* 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 about 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 \emptyset , bearing scattered pustular lenticels but

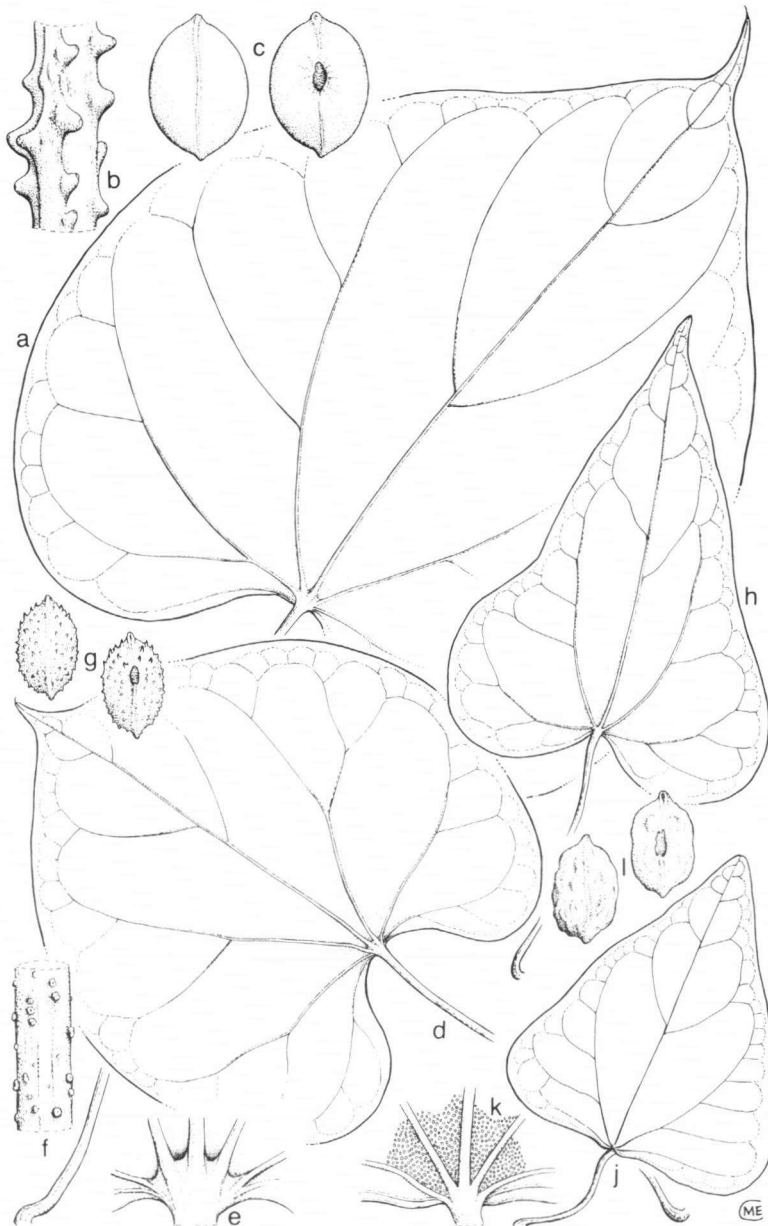


Fig. 7. *Tinospora crispa* (L.) Hook. f. & Th. *a.* Leaf, $\times 2/3$, *b.* stem, nat. size, *c.* endocarp, dorsal and ventral views, $\times 2$. — *T. baenzigeri* FORMAN. *d.* Leaf, $\times 2/3$, *e.* leaf base showing pocket-domatia, $\times 4$, *f.* stem, nat. size, *g.* endocarp, dorsal and ventral 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 *chinha 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. — *Tinomiscium 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 papyraceous, 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, pseudoracemose 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. *Drupe*s 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. Tijds. 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. *Drupe*s 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 ruminant; 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 triangular-ovate, 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. *Drupe*s 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 ruminant 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, Temuan.*

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, Leaf. 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. Kagoshima Un. 5 (1966) 30; PANCH. 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.], *saep. 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-1, 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, subtruncate 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 (Ternimer 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. — *Hyppipodes 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. *Drupes* 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. *Drupes* 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. Infructescences 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. Infructescences with a distinct main axis bearing lateral branches; fruits 7–11 mm long; leaves mostly ovate or cordiform with entire or subentire margins.
3. Infructescences rather densely pubescent. Leaves pubescent below 2. *P. elmeri*
3. Infructescences 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 dorso-ventrally 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, Leaflet. 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 cincinnans* 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. cincinnans* (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 floodbed, 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 1.

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.

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.

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; GAGNEP, Fl. Gén. 1.-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* TEJISM. & 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. Exk. 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. pyrrobotrimum* 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. *Drupes* 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*, *maglabiang*, 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

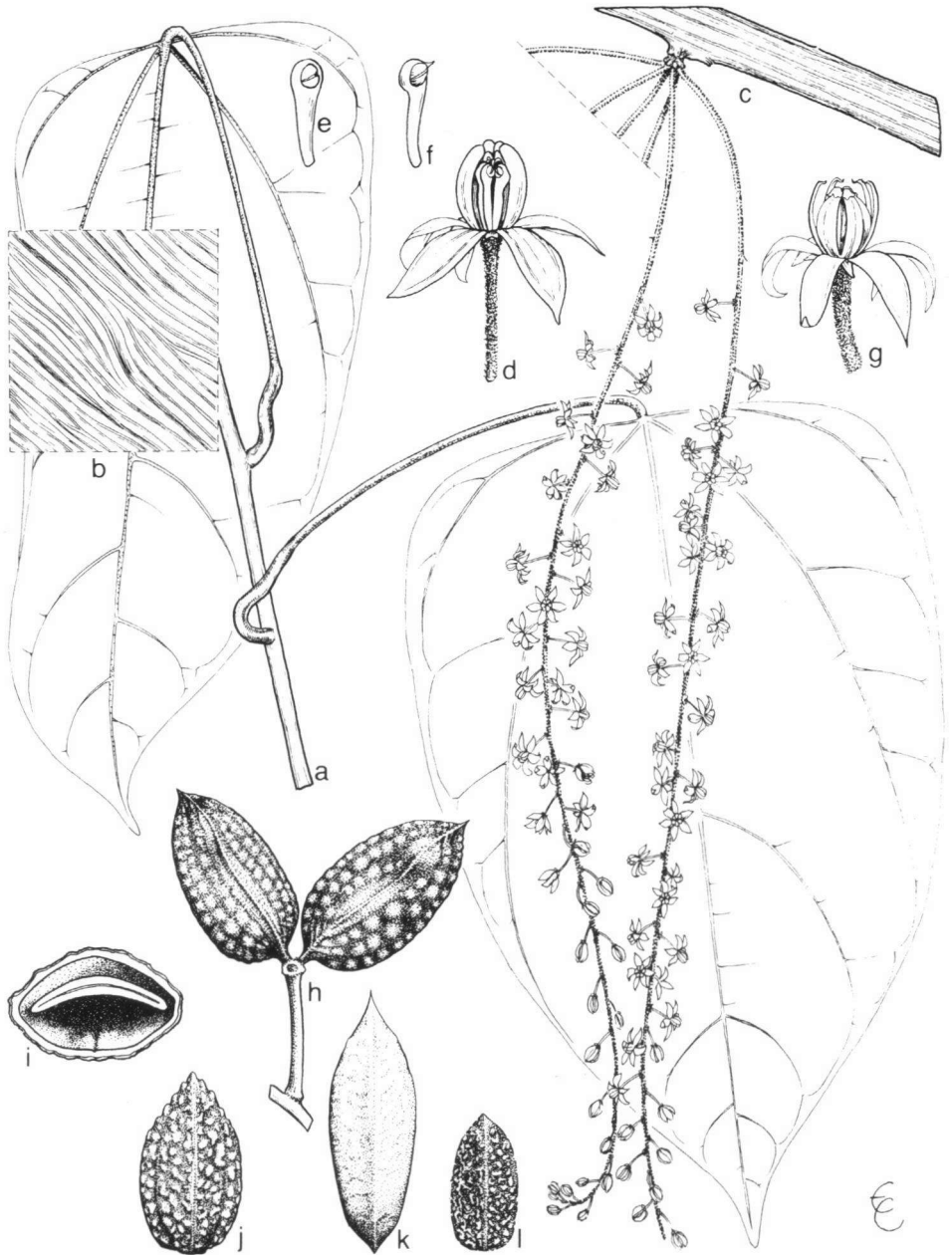


Fig. 8. *Tinomiscium petiolare* Hook. f. & Th. a. Habit, $\times 2/3$, b. detail of lower leaf surface, $\times 20$, c. male inflorescences, $\times 2/3$, d. male flower, front petals removed, $\times 4$, e-f. varying stamens, $\times 15$, g. female flower, all petals and front staminodes removed, $\times 4$, h. drupes, dorsal 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. I.-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

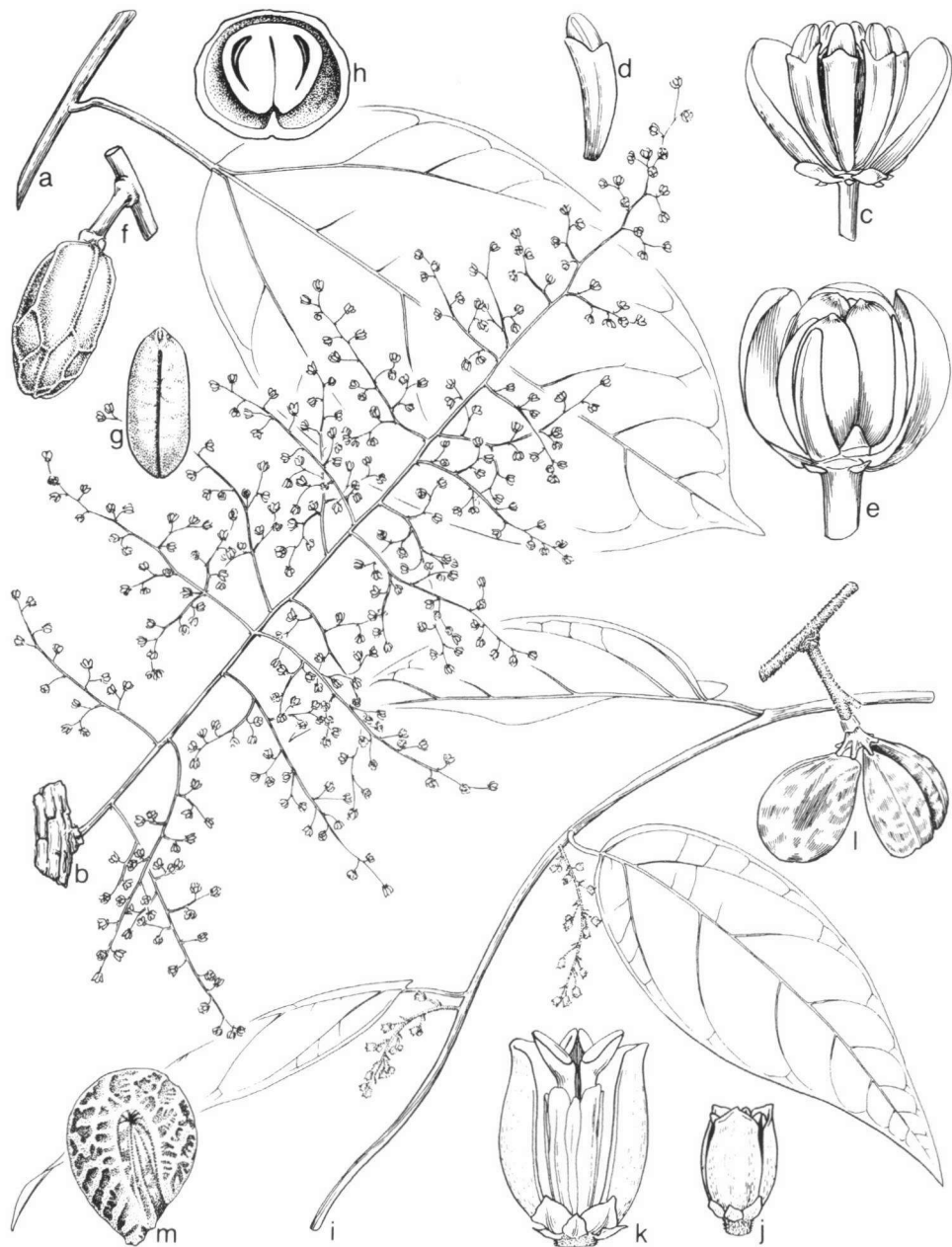


Fig. 9. *Fibraurea tinctoria* LOUR. a. Leaf, b. male inflorescence, both $\times 2/3$, c. male flower, front sepals removed, d. stamen, side view, both $\times 10$, e. female flower, front sepals and staminode removed, $\times 6$ (from spirit material), f. drupe, g. endocarp, both $\times 2/3$, h. TS 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. Schooffl. (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 \emptyset , 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 krua*, *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 ruminate; 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 ϕ ; 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. Schoofl. (1911) 40; DIELS in Elmer, Leafl. 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; staminodes 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 ϕ , 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 tymanopoda* (LAUT. & K. SCH.) DIELS, Pfl. R. Heft 46 (1910) 106, f. 39; FORMAN, Kew Bull. 32 (1978) 337. — *Macrocculus 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 \varnothing , unbranched, terminating in a carpophore, or branched with main axis to 5 mm \varnothing ; carpophore thick, claviform, to 4 cm long, 2 cm \varnothing at apex. *Drupes* yellow, subglobose, slightly laterally compressed with a faint longitudinal dorsal ridge running all round, 4.5-5.5 cm \varnothing , 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.

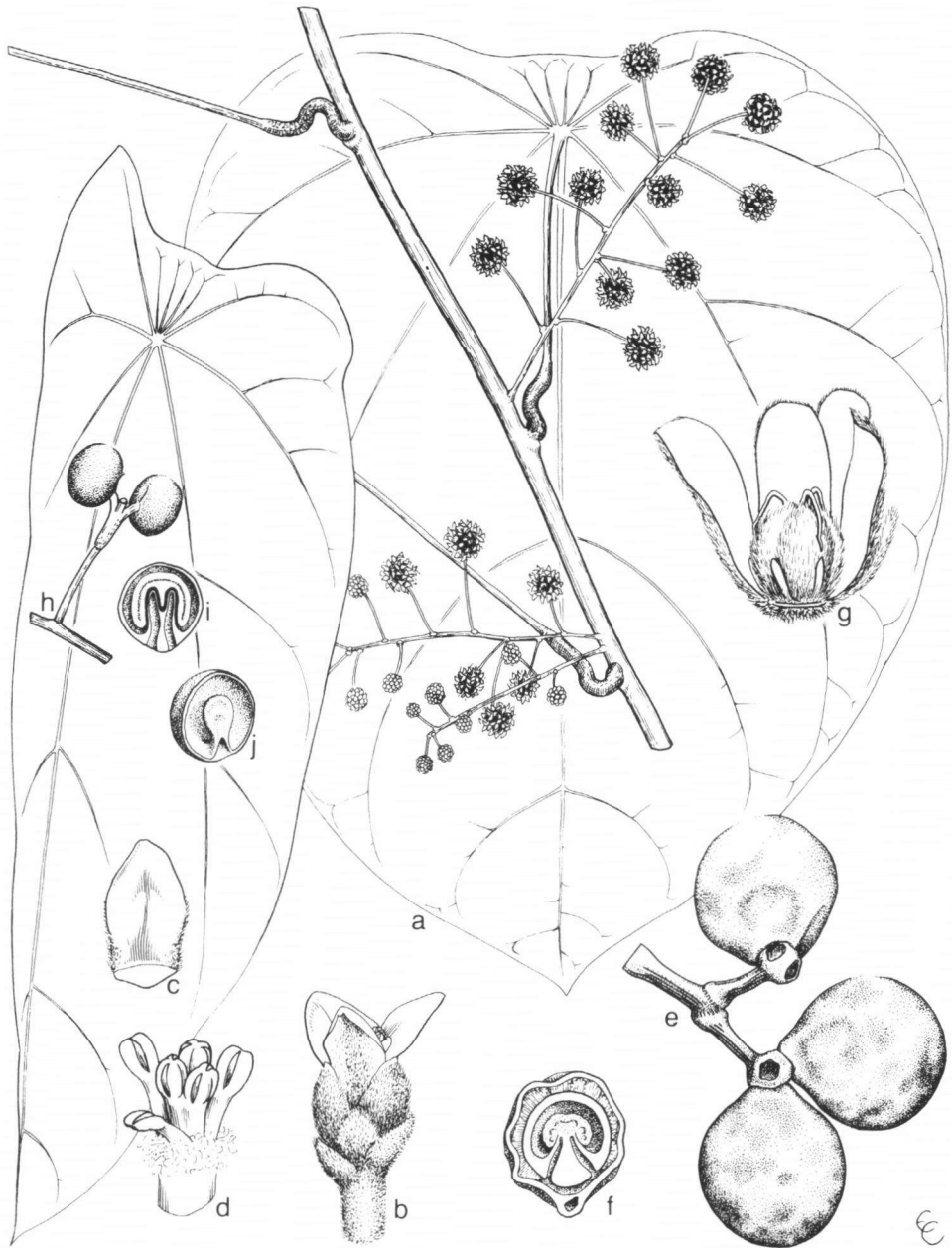


Fig. 10. *Coscinium fenestratum* (GAERTN.) COLEBR. *a.* Habit, male plant, $\times 2/3$, *b.* male flower, $\times 8$, *c.* inner sepal, inner view, $\times 10$, *d.* stamens, $\times 20$, *e.* infructescence, $\times 2/3$, *f.* LS of drupe, $\times 2/3$. — *C. blumeianum* MIERS ex HOOK. *f.* & TH. *g.* 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. Bot. 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; SCHEFF. Nat. Tijd. 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. & HOLLR. 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. Schoolfl. (1911) 41; DIELS in Elmer, Leaf. 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. 1 (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. *Infructescences* 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 numming, 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

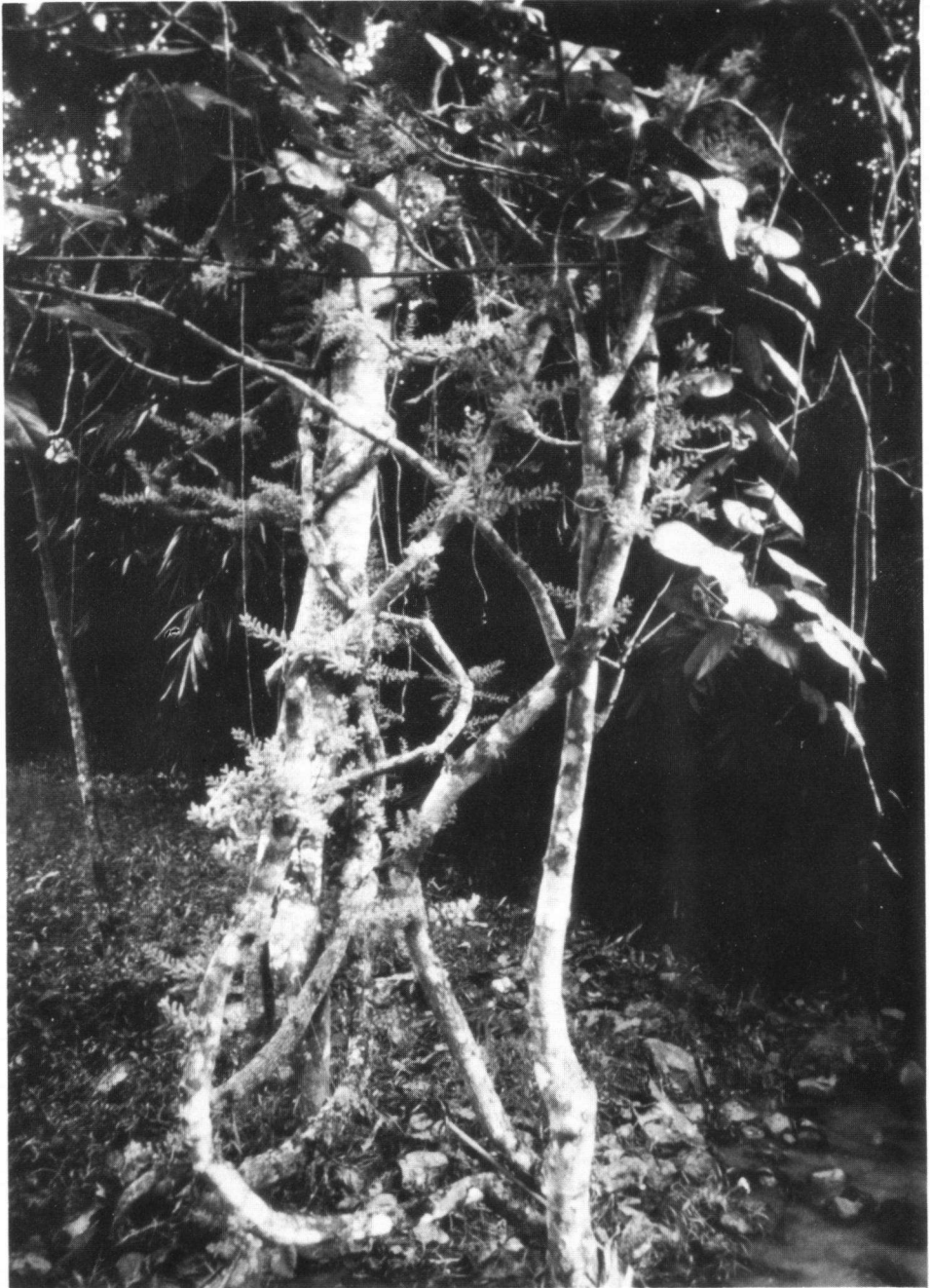


Fig. 11. *Anamirta cocculus* (L.) WIGHT & ARN. in flower (male). Central Thailand, Saraburi (Photogr. H. BÄNZIGER).

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 *Coscinium* 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 \emptyset 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 \emptyset 2. *C. blumeianum*

1. *Coscinium 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. blumeanum* (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. epelatium* 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 \varnothing 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 \varnothing , bearing 1–3 drupes. *Drupe* subglobose, tomentellous, brown to orange or yellowish, 2.8–3 cm \varnothing ; pericarp drying woody, c. 1 mm thick; endocarp bony, 2.2–2.5 cm \varnothing ; 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. blumeanum* 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. blumeanum* probably refers to this species. Further alkaloids were reported by SIWON *et al.* (Planta Medica 38, 1980, 24).

Vern. Malaya: *akar kuning*, (*kunyit-kunyit*) *babbi*, *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 blumeanum* 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 ± 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 ~-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* ± 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. brachystachyua* (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. *Drapes* 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. HYP SERPA

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. *Drapes* 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, Leaf. 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, Leaf. 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. nandinifolia* 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

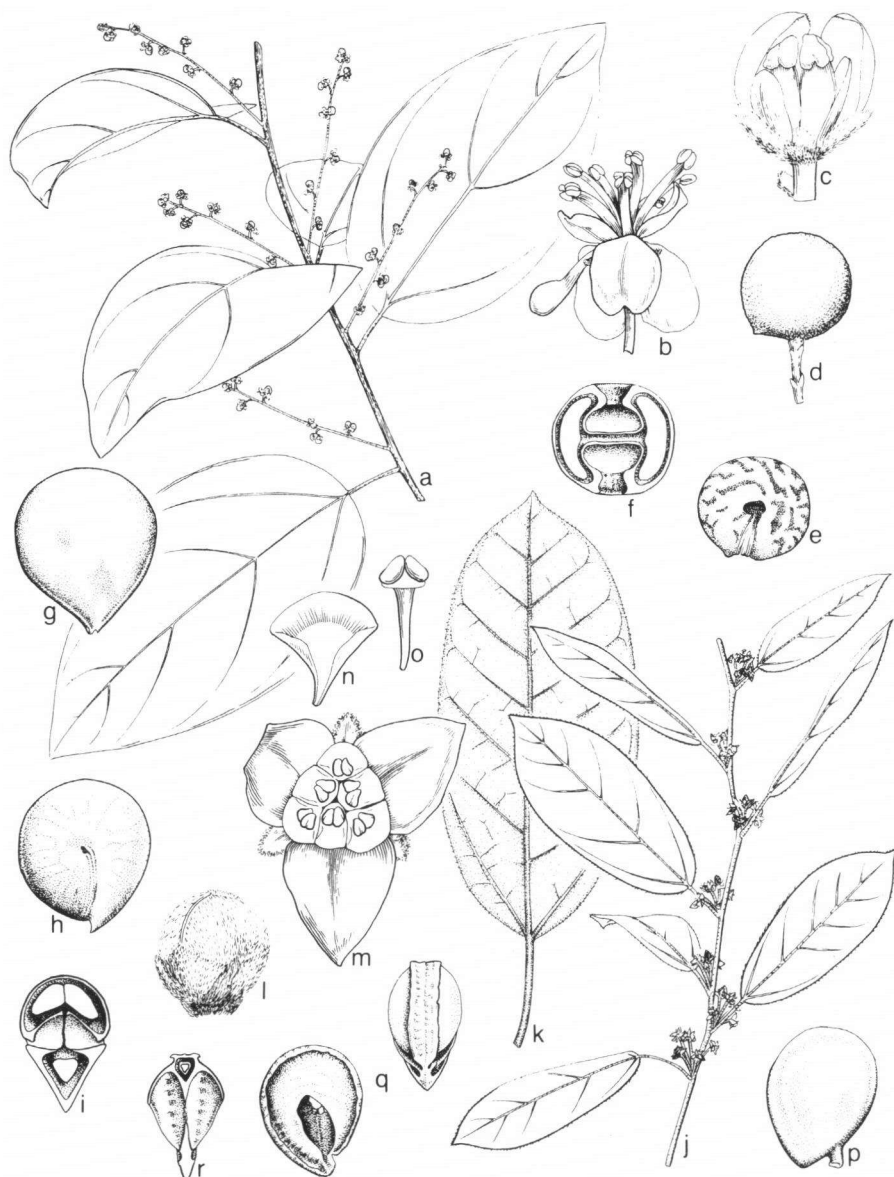


Fig. 12. *Hypserpa nitida* MIERS. a. Habit, male plant, $\times 2/3$, b. male flower, $\times 8$, c. female flower, front sepals and petal removed, $\times 8$, d. drupe, e. endocarp, f. CS of endocarp showing the central 2-chambered condyle and the seed (white) cut through twice, all $\times 3$. — *Pachygone ovata* (POIR.) HOOK. f. & 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 SAN A492, 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 ciliate; 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. *Drupe*s white or red on pedicels up to 2 mm long or subsessile, subtrotund 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. *Drupe*s 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, Schooffl. (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, Leaf. 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 ± as in male, petals clasping linear staminodes; carpels 3, ± obliquely ellipsoidal, 1.5 by 1.25 mm, stigma auriculate. *Drupes* 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, ± 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.

Ecology. 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 spp.

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*

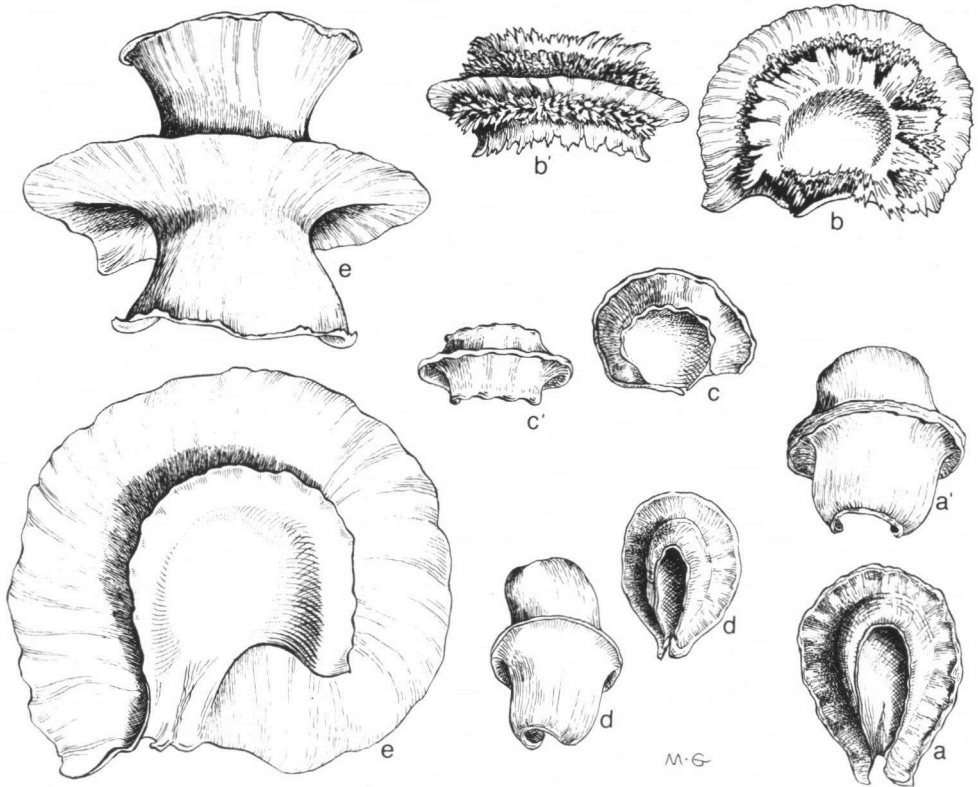


Fig. 14. Endocarps of *Legnephora* MIERS. — *L. acuta* FORMAN, a, side view, a', top view. — *L. moorei* (F. v. M.) MIERS, b, side view, b', top view. — *L. philippinensis* FORMAN, c, side view, c', top view. — *L. microcarpa* FORMAN, d, side view, d', top view. — *L. minutiflora* (K. SCH.) DIELS, e, 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 \varnothing , 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 \varnothing , 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. nycterica* DIELS, Bot. Jahrb. 52 (1915) 189. — *Phytocrene malacothrix* SLEUMER, Notizbl. Berl.-Dahl. 15 (1941) 361; Blumea 17 (1969) 237; Fl. Mal. I, 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 dehiscent 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 \varnothing , 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 dehiscent 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

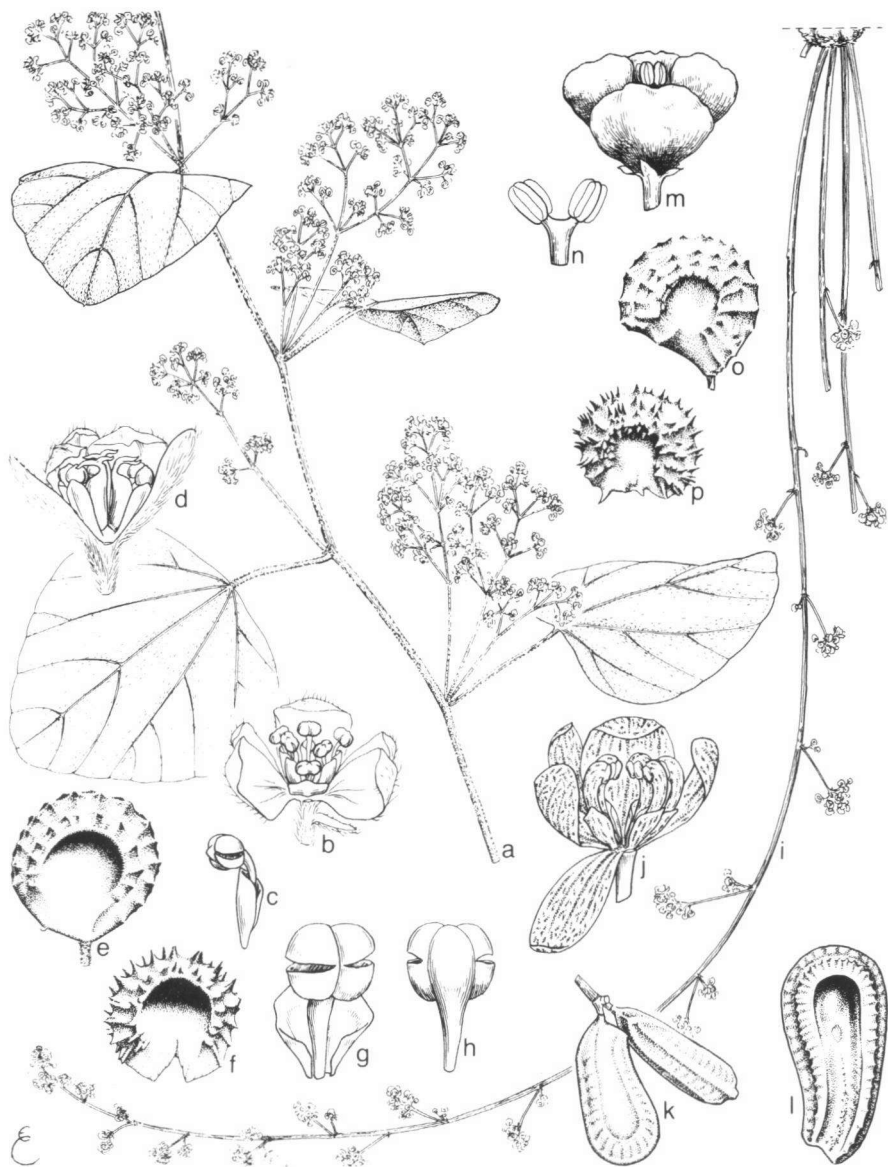


Fig. 15. *Pericampylus glaucus* (LAMK) MERR. a. Habit, male plant, $\times 2/3$, b. male flower, one sepal removed, $\times 14$, c. stamen with petal, $\times 30$, d. female flower, front sepal, petal and staminode removed, $\times 12$, e. drupe, $\times 4$, f. endocarp, $\times 4$. — *Legnephora minutiflora* (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; PANCHO, 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. Tijd. 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. & HOLLR. 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; Voort. Schoolfl. (1908) 9; DIELS, Pfl. R. Heft 46 (1910) 217, f. 74; BACK. Schoolfl. Java (1911) 43; DIELS in Elmer, Leaflet. 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; paperyaceous. *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, obcuneate, 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 ϕ , 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: *sekompalai*; Talaud I.: *talimba-as*; Halmahera: *goumale*, Tidorese; Ternate: *ginato*; Philippines: *bugbug*, Mindoro, *malabawagan*, *silong-pugo*, Luzon; *maripari*, Biliran; *gapus nibid*, Mindanao; further sec. MERRILL (1923): *botang-botang*, C. Bis., *gapisilid*, Sub., *hah-un*, 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. Schoofl. Java (1911) 44; DIELS in Elmer, Leafl. 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. Tijds. 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 emargi-

nate; 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, *slurut*, *tjilurutan*, 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. *Drupe*s 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, t. 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. trilobus* (THUNB.) DC. Syst. 1 (1817) 522; DIELS, Pfl. R. Heft 46 (1910) 232, f. 78A–L; in Elmer, Leaf. 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. ovalifolius* (VAHL ex PERS.) DC. Syst. 1 (1817) 526; BL. Bijdr. (1825) 25; HASSK. Tijd. Nat. Gesch. Physiol. 10 (1843) 132; MAIER, Nat. Tijd. N. I. 3 (1852) 465; MIQ. Fl. Ind. Bat. 1, 2 (1858) 81; Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 84; SCHEFF. Nat. Tijd. 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, Leaflet. 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 ϕ , 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 \pm 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; papery. — *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 thyse 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, \pm 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; stamens 6, minute, 0.3 mm long, glabrous; carpels 6, glabrous, 0.75 mm long; style slender, curved outwards. *Drupes* dark blue, rotund in outline, 4–5 mm ϕ , 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. Tijd. N. I. 32 (1873) 393, t. 12; BOERL. Cat. Hort. Bog. 1 (1899) 39, incl. var. *angustifolius* (HASSK.) BOERL. et var. *triplinervis* 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 \varnothing . 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 thyrse, 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 \pm 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* rotund in outline, c. 4 mm \varnothing , 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 cocculine 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 \pm 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.

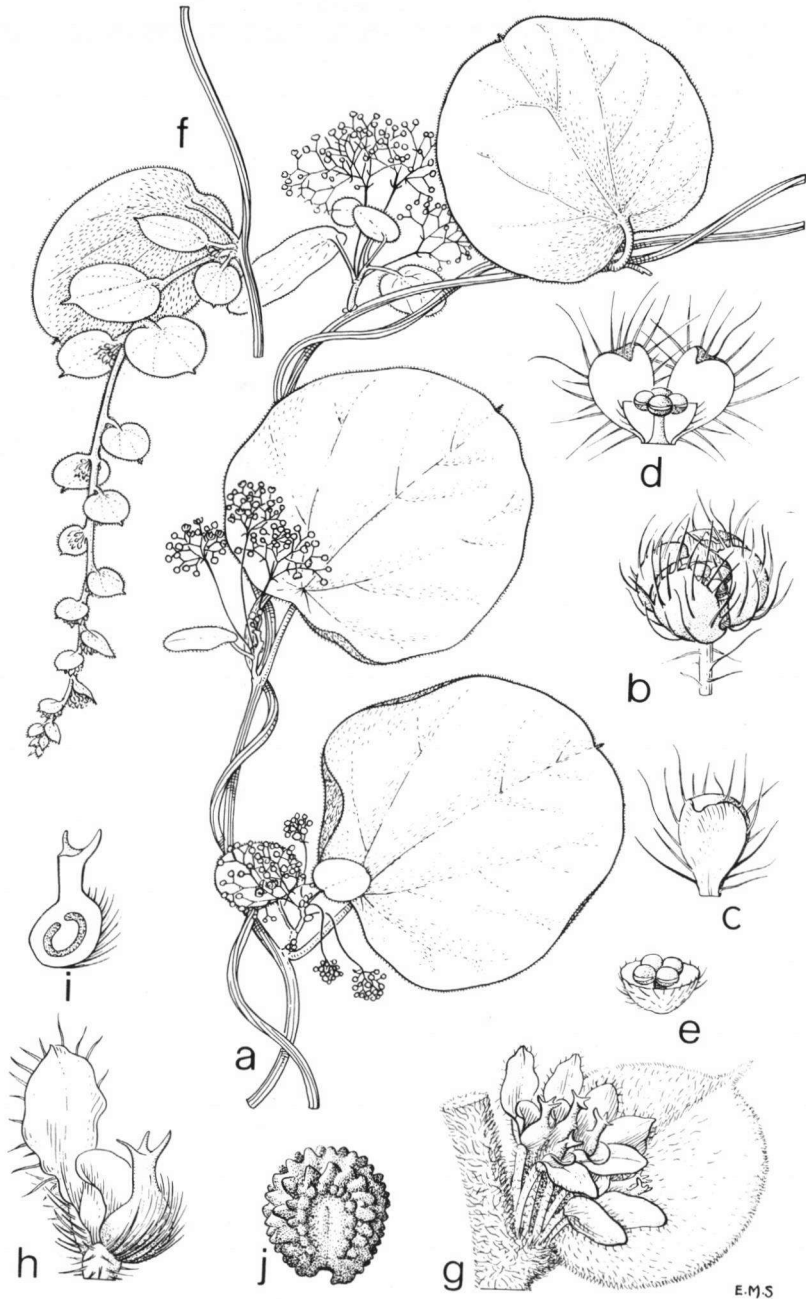


Fig. 17. *Cissampelos pareira* L. var. *hirsuta* (DC.) FORMAN. *a.* Habit, male plant, $\times 2/3$, *b.* male flower, *c.* sepal, *d.* male flower with 2 front sepals and front half of corolla removed, *e.* corolla and stamens, all $\times 13$, *f.* habit, female plant, $\times 2/3$, *g.* part of female 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 Malasia.

1. *Cissampelos pareira* LINNÉ var. *hirsuta* (BUCH. ex DC.) FORMAN, Kew Bull. 22 (1968) 356; PANCHO, Vasc. Fl. Mt. Makiling 1 (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 1 (1872) 103; SCHEFF. Nat. Tijd. N. I. 32 (1873) 401, *incl. var. peltata* SCHEFF.; BECC. Malesia 1 (1877) 156; KING, J. As. Soc. Beng. 58, ii (1889) 386; BOERL. Cat. Hort. Bog. 1 (1899) 43; GAGNEP. Fl. Gén. I.-C. 1 (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. Menisp. 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. *Drupes* 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 Southeast Asia, Australia (Queensland); in *Malasia*: 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, peccatorial and febrifugal; pounded leaves are used for snake-bites and as an antiscabious remedy.

Vern. Philippines: *abobo*, C. Bis., *bangbángau*, *kaláad*, *kalkaláad*, *kuskusipa*, Ilk., *batang-bátang*, *gulagulanán*, *kalakalamáyan*, *makabó-o*, *sansáu*, *sincháw-sincháuan*, *sinsau-sinsáuan*, Tag., *hampapare*, *himpapára*, *sampáre*, Bis., *kauas*, Sub., *malarito*, 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 *sp.*, 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*

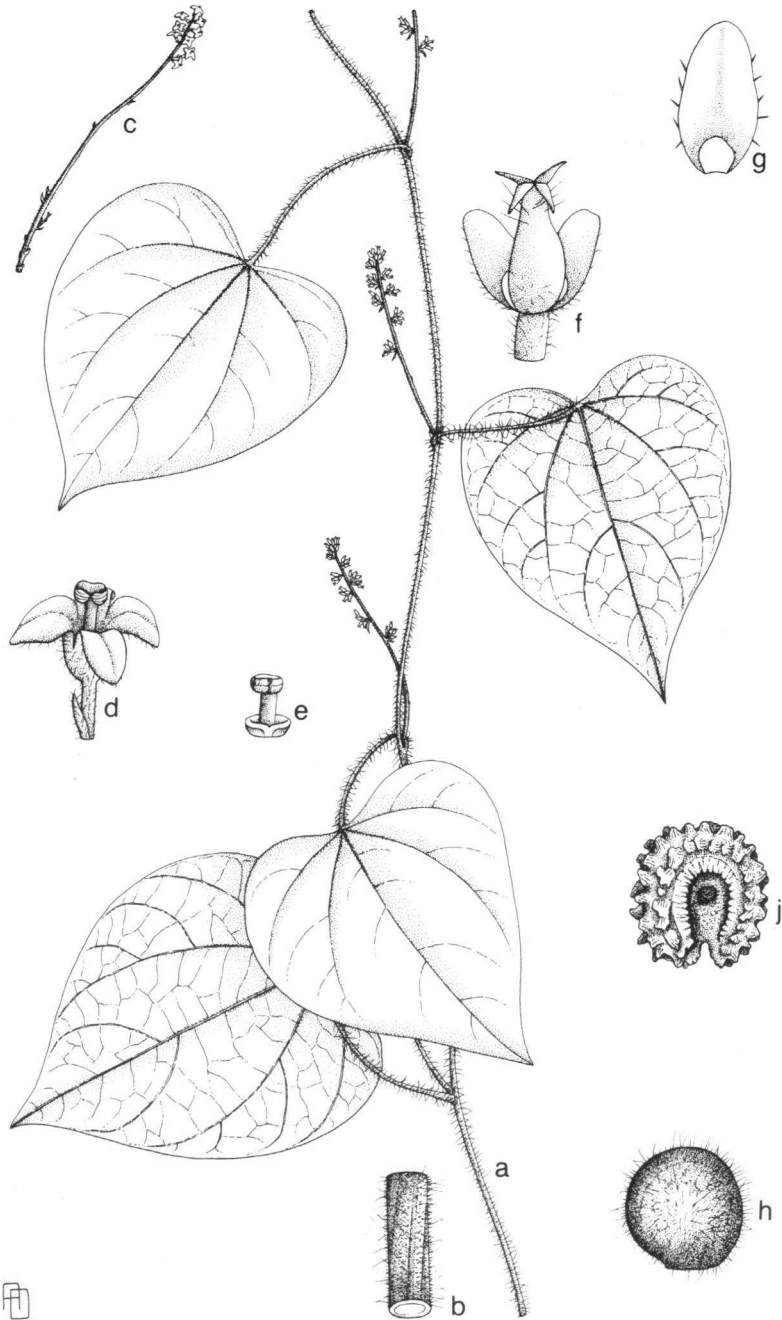


Fig. 18. *Cyclea atjehensis* FORMAN. *a.* Habit with female inflorescences, $\times 1/2$, *b.* portion of stem, $\times 4$, *c.* male inflorescence, $\times 2/3$, *d.* male flower (in spirit), $\times 10$, *e.* corolla and synandrium of male flower, $\times 10$, *f.* female flower, abaxial view, $\times 16$, *g.* sepal and petal of female flower, $\times 20$, *h.* fruit (in spirit), $\times 2 \frac{2}{3}$, *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. *Drupes* 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. hispida* 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. *Drupes* 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. *Drapes* very shortly pedicellate or sessile, covered with both long and short hairs, rotund in outline, 5 mm \varnothing . 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, Leaflet. 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 \varnothing , 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 mucro, 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. *Drapes* 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. *Drapes* 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 \varnothing , 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 mucro, 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. *Drapes* on pedicels 4.5 mm, rotund in outline, 6–7 mm \varnothing , 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, lacinate 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 thyse 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, metimum 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 ø, 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; Voerl. 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, ± 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 telor*, *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 exertum*' 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. *Drupe*s 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 ± 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, Leaf. 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; Voorl. 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;

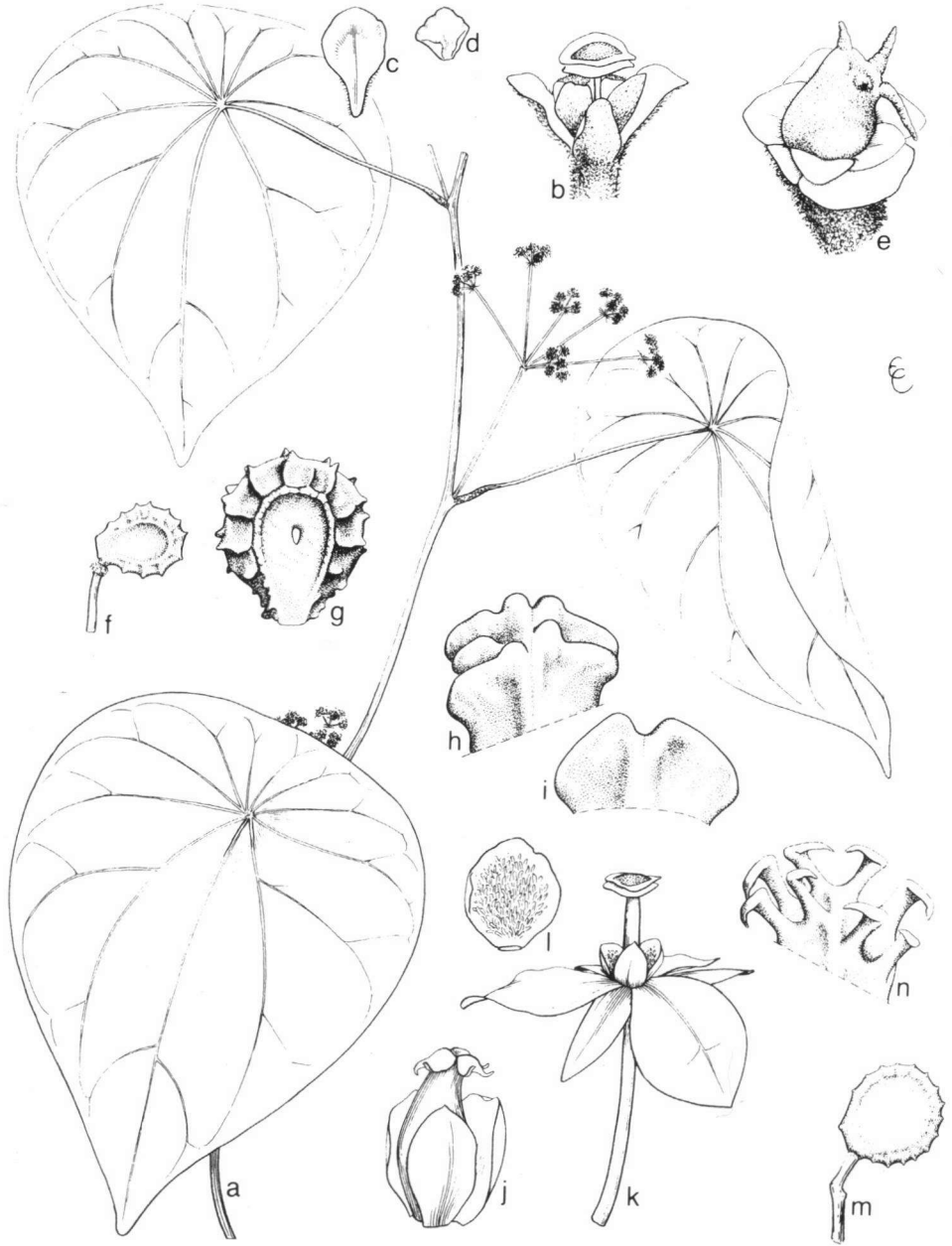


Fig. 19. *Stephania japonica* (THUNB.) MIERS. *a-d, f-h*. var. *timoriensis* (DC.) FORMAN, *e*. var. *discolor* (BL.) FORMAN, *g-i*. var. *japonica*. *a*. Habit, $\times 2/3$, *b*. male flower, $\times 20$, *c*. sepal, $\times 15$, *d*. petal, inner view, $\times 15$, *e*. female flower, $\times 20$, *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–l.

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, ± obdeltoid 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, djadjo, djundju lalakeh, kepleng, ojed minjak, ondjo ondjo, seloro, sluru, tjiluru, tjimtau minjak*; Moluccas: *ginato bobudo, gurnali babudo*, Ternate; New Guinea: *bidililim*, West; *wararugan*, 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 impertorate. 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; syndrium 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. BOEN. (1942) 276; YAMAMOTO, J. Soc. Trop. Agric. 16 (1944) 141; FORMAN, Kew Bull. 11 (1956) 58; BACK. & BAKH. f. Fl. Java 1 (1963) 160 ('*venosa*'); 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 1 (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 oblanceolate, 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; syndrium 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 ± ellipsoidal, 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 scabrid.

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. Btzg 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* 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-Salomons 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).

Infructescences 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 papilliform 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 73, ± broadly obovate, 0.75 mm long, glabrous. — *Female flowers* unknown. *Infructescence* with peduncles of cymes 1–2 cm long. *Drupe* 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 obdeltoid, c. 0.5 mm long; synandrium 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. *Drupe* 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; synandrium 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*

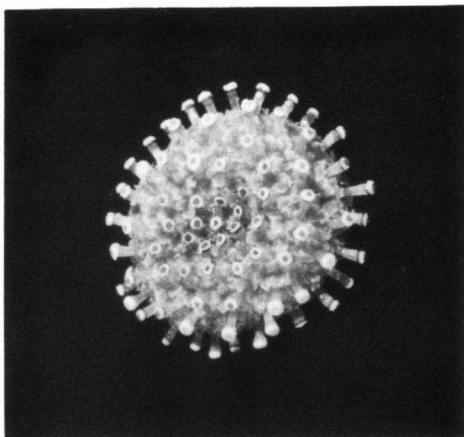


Fig. 20. *Stephania capitata* (BL.) SPRENG. Male inflorescences, side view, $\times 1\ 1/3$; top view of capitulum above, $\times 4$. Trang, Thailand (Photogr. H. BÄNZIGER).

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 curtisii RIDL. J. Bot. 58 (1920) 148 is, according to FORMAN, Kew Bull. 36 (1981) 420 = *Zanonia indica* L. (*Cucurbitaceae*).