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A revision of *Tinospora* (*Menispermaceae*) in Asia to Australia and the Pacific

The Menispermaceae of Malesia and adjacent areas: X*

L. L. FORMAN

Summary. The 23 species of *Tinospora* Miers which occur in Asia to Australia and the Pacific are revised. *Fawcettia* F. Muell. is regarded as a synonym and the resulting new combination *T. tinosporoides* (F. Muell.) Forman is made. Three new species are described: *T. angusta*, *T. baenzigeri* and *T. neocaledonica*. The leaves of *T. arfakiana* Becc. are described for the first time.

Tinospora Miers is the type genus of the tribe *Tinosporeae* established by Hooker fil. and Thomson in Fl. Ind. 1: 179 (1855). The other genera in this tribe which occur in Asia are *Aspidocarya* Hook. f. & Thoms., *Chlaenandra* Miq. and *Parabaena* Miers. Accounts of these genera will follow in further contributions to this series of papers. Apart from the species of *Tinospora* revised in the present account, there are 9 species in Africa of which two occur in Madagascar. The 7 mainland African species were revised by Troupin in his Monogr. Menisperm. afric.: 191–207 (1962).

As discussed by Troupin (*op. cit.* 1962, p. 158), Baillon in his Hist. Pl. 3: 38 (1872) adopted a broad view of the genus *Chasmanthera* Hochst. (1844), under which he included *Tinospora* as a synonym. Troupin himself, while maintaining *Tinospora* as distinct, admitted that the two genera are very close and may eventually have to be reunited. He regarded *Chasmanthera* as an African genus of only two species.

Barneby in Mem. N.Y. Bot. Gard. 20(2): 84–85 (1970) indicated, moreover, that the American genus *Odontocarya* Miers (1851) may be synonymous with *Tinospora* and *Chasmanthera*, in which case the latter name would be the earliest for the resulting circumtropical genus. Before this problem can be settled satisfactorily, generic limits in the *Tinosporeae* must be revised on a world wide basis. Meanwhile, in order to avoid unnecessary confusion, it would be best largely to maintain the generic framework of this tribe as set up by Diels in 1910 and generally followed by other workers over the past 70 years.

The status of the generic name *Campylus* Lour. (1790) must be discussed since its only species, *C. sinensis* Lour. is the basionym of *Tinospora sinensis* (Lour.) Merr. and yet the name *Campylus* is much older than *Tinospora* Miers (1851). As discussed by Merrill in Trans. Amer. Philos. Soc. n. s. 24(2): 41 (1935), in a number of instances Loureiro's descriptions in Flora Cochinchinensis are based on material originating from unrelated plants. The account of *Campylus* with its one species is just such an example consisting of a generic description based on one plant associated with a specific description based on an entirely different plant. From the generic description of *Campylus* on p. 113 of Fl. Cochinchin. it is clear that Loureiro was referring to a plant which cannot possibly belong to *Menispermaceae* since it was stated to have tubular, 2-lipped corollas and 5-celled, many-seeded capsules, amongst other characters. It is apparent that the species *C. sinensis* was

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* Continued from Kew Bull. 32: 338 (1978).

associated with this genus in error since at Paris there is a Loureiro specimen of *C. sinensis* which according to Merrill in *Sunyatsenia* 1: 193 (1934) and in *op. cit.* 158 (1935) was identified by Gagnepain as *Tinospora tomentosa* (Colebr.) Hook. f. & Thoms., and for the latter name Merrill therefore substituted the combination *Tinospora sinensis*. Like Merrill, I have only seen a photograph of the type, which is sterile, but I am indebted to my colleague Dr B. Verdcourt who while visiting the Paris Herbarium compared Loureiro's specimen with material of the species of *Tinospora* formerly called *T. tomentosa*. This comparison has confirmed Gagnepain's identification.

Further confirmation is provided by the Chinese names for this medicinal plant long-established in Chinese medicine. Loureiro gave the Cantonese name 'xeng con than' meaning 'muscle-stretching vine'. This agrees with the Chinese name given by Lien in *Acta Phytotax. Sinica* 13: 37 (1975) for *T. sinensis*: the name he gives means 'muscle-loosening vine'. According to Mr C. Tang from the Canton Botanical Garden (at present visiting Kew) both versions are equivalent, meaning 'muscle-relaxing vine'. I am much indebted to Mr Tang for his help and advice with this matter.

The specific description of *Campylus sinensis* is in agreement, as far as the leaves are concerned, with the sterile Loureiro specimen: 'Folia cordata, acuta, integerrima, utrinque tomentosa, pauca, alterna; petiolis longis, geniculatis'. The reference in the specific description to the flowers being in a long, flexuose raceme agrees with *Tinospora*, although the position of the raceme is not terminal as described but axillary. The reference to 'bracteis 3-lobis' could refer to the 3 outer sepals. The specific name *Campylus sinensis* thus clearly refers to the species of *Tinospora* formerly known as *T. tomentosa* but now called *T. sinensis*.

The question arises as to whether *Campylus sinensis*, the only published species of the genus *Campylus*, is the type of that generic name. According to Article 10.1 of the *Int. Code Bot. Nomencl.* (1978): 'The type of a name of a genus . . . is a species'. The word species here must surely denote a biological entity and not a name of a species, or this would have been stated. From the generic description it follows that the type of the name *Campylus* must be a species—at present unknown—with pentamerous flowers, tubular bilabiate corollas, etc. This clearly cannot be a species of *Tinospora* or, indeed, *Menispermaceae*; yet the name *C. sinensis* has proved to refer to a species of *Tinospora*. The name *Campylus* is therefore not synonymous with *Tinospora* and thus the question of priority does not arise.

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. Three such species occur in Thailand, one being the well-known medicinal plant correctly called *T. crispa*, and another being an undescribed species hitherto undetected amongst a mixture of incomplete material of these species. Only as a result of considerable help from Dr H. Bänziger (Department of Entomology, Chiangmai University) with his extensive field-knowledge of the plants has it been possible to disentangle these species. Dr Bänziger has made numerous collections of the genus over a wide area of Thailand especially for this investigation and in recognition of his invaluable assistance I am pleased to name in his honour the new species which was disclosed as a result of his persistent efforts.

Cited specimens have been seen unless otherwise stated.

MORPHOLOGY

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 thyrse, 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. In *T. tinosporoides* the 'panicle' bears sessile flowers, the branches being spiciform. A pseudoracemose inflorescence, with the flowers in few-flowered fascicles or solitary is the most common type in the genus. A reduction from this is the spiciform inflorescence of *T. macrocarpa* and *T. sumatrana* where each cyme is reduced to a sessile cluster or a single sessile flower. In *T. sagittata* there is a laxly fasciculate inflorescence composed of few-flowered short racemes.

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.

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. Leaf-characters, however, have been used as far as possible in the key on p. 379, sometimes combined with features of the flowers and fruits. Geographical distribution is also indicated so that by combining all the information given it should be possible with nearly every fertile specimen to key it out to its species. The length of the male inflorescences is used in some places and it should be noted that the female inflorescences, which are less frequently collected and unknown in some species, are usually shorter than the males.

PHYTOCHEMISTRY

(by N. G. Bisset, Dept. of Pharmacy, Chelsea College,
University of London)

From the limited phytochemical data available it can be concluded that protoberberine alkaloids (a group of isoquinoline bases) and oxygen-rich heterocyclic bitter substances are common constituents of *Tinospora* species.

The alkaloid palmatine is present in the roots of several Asian species (*T. capillipes* (Chem. Soc. Reports, 1971-), *T. cordifolia* (Beauquesne, 1938), *T. crispa* (*tuberculata*) (Beauquesne, 1938), *T. dentata* (Chen, 1975), *T.*

sagittata (Lien, 1975)) and in an African one (*T. bakis* (Beauquesne, 1938)), while berberine and jatrorrhizine have each been isolated from a single species (*T. crispa* (rumphii) (Thornber, 1970) and *T. dentata* (Chen, 1975) respectively). These alkaloids are present in other genera of the *Tinosporeae* (*Jatrorrhiza*, *Parabaena*) and in genera belonging to the *Coscinieae* (*Anamirta*, *Arcangelisia*), *Fibraureae*, (*Fibraurea*, *Tinomiscium*) and particularly *Cocculae* (*Cocculus*, *Cissampelos*, *Menispermum*, *Stephania*) (Hegnauer, 1969; Thornber, 1970). While in the *Tinosporeae* only these protoberberine alkaloids have been found, in the other tribes mentioned they occur together with a great variety of other isoquinoline alkaloids (Chem. Soc. Reports, 1971–; Hegnauer, 1969; Thornber, 1970). It is not known whether this is a real distinction or whether it is simply a reflection of the limited extent to which the *Tinosporeae* have so far been examined.

The only bitter substance of known constitution so far obtained from *Tinospora* species is the diterpenoid columbin. It is reported to occur in the roots of several species (*T. bakis* (Beauquesne, 1938), *T. cordifolia* (Hegnauer, 1969), *T. crispa* (rumphii) (Acevedo & Santos, 1968; Hegnauer, 1969), *T. dentata* (Chen, 1975), *T. glabra* (crispa) (Hegnauer, 1969), *T. teijsmannii* (Hegnauer, 1969)). Some of these observations are rather old and require confirmation. Many other products have been isolated, especially from other parts of the plants, and given names, but in most cases their chemical individuality is uncertain and their structures have not been ascertained (Acevedo & Santos, 1968; Beauquesne, 1938; Hegnauer, 1969; Khaleque *et al.*, 1971). As with the alkaloids, the presence of bitter substances in the genus is not diagnostic and columbin and related compounds have been found in another genus of the *Tinosporeae* (*Jatrorrhiza*) and in genera of the *Coscinieae* (*Anamirta*, *Coscinium*), *Fibraureae* (*Fibraurea*) and *Cocculae* (*Cocculus*, *Stephania*) (Hegnauer, 1969).

Examination of stem material of *T. crispa* and *T. baenzigeri* from Thailand shows that while the quaternary (and tertiary) alkaloids of the two species are quite similar, the bitter substances present are different: columbin in *T. crispa* and a new compound whose chemical structure is currently under investigation in *T. baenzigeri* (Bisset and Nwaiwu, 1980).

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DESCRIPTION OF GENUS & ENUMERATION OF SPECIES

Tinospora Miers in Ann. Mag. Nat. Hist. ser. II, 7: 35 (1851). Hook. f. & Thoms., Fl. Ind. 182 (1855); Miers in *op. cit.* ser. III: 315 (1864) & Contrib. Bot. 3: 30 (1871); Hook. f. & Thoms. in Hook. f., Fl. Brit. Ind. 1: 96 (1872); Diels in Engler, Pflanzenr. IV. 94: 133 (1910); Troupin, Monogr. Menisperm. afric.: 191 (1962); Backer & Bakh. f., Fl. Java 1: 157 (1963).
Type species: *T. cordifolia* (Willd.) Hook. f. & Thoms. (see Miers l.c. (1864)).

Desmonema Miers in Ann. Mag. Nat. Hist. III, 20: 261 (1867) & Contrib. Bot. 3: 377 (1871); Diels in Engler, Pflanzenr. IV. 94: 153 (1910) non Rafinesque (1833).

Hypsipodes Miq. in Ann. Mus. Lugd.-Batav. 4: 82 (1868).

Fawcettia F. Muell., Fragm. Phyt. Austr. 10: 93 (1877); Bailey, Queensl. Fl. 1: 29 (1899); Diels in Engler, Pflanzenr. IV. 94: 133 (1910); **synon. nov.**

Hyalosepalum Troupin in Bull. Jard. Bot. État Bruxelles 19: 430 (1949).

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(-5)-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. Drupes 3 borne on a short or columnar carpophore; endocarp bony, dorsally convex and often verrucose or tuberculate, ventrally with central aperture leading to a cavity (the condyle); seed with endosperm usually ruminant.

DISTRIBUTION. An Old World genus of 32 species: 7 in Tropical Africa, 2 in Madagascar, 23 in Asia to Australia and the Pacific.

KEY TO THE SPECIES OF TINOSPORA IN ASIA TO AUSTRALIA
AND THE PACIFIC

1. Leaves deeply 3(-5)-lobed (Borneo) **1. trilobata**
1. Leaves not deeply lobed, margin entire, toothed or only slightly lobed
 2. Leaf-margin irregularly toothed (Taiwan) **2. dentata**
 2. Leaf-margin entire or slightly lobed
 3. Leaves very narrow, 0.4-1.6 cm broad (Australia) **3. angusta**
 3. Leaves broader
 4. Leaves hairy (sometimes sparsely) below
 5. Leaves sagittate to hastate (China, Vietnam) **4. sagittata**

5. Leaves \pm ovate
 6. Leaves puberulous above, tomentellous or rather densely puberulous below (Indian subcont., S China, Indochina) **5. sinensis**
6. Leaves glabrous above
 7. Fine reticulation not or scarcely visible on both surfaces, which dry minutely wrinkled; uncinat hairs absent from main nerves on lower surface (C Malesia) **6. merrilliana**
 7. Fine reticulation raised on both surfaces; some uncinat hairs present on main nerves on lower surface (Borneo) **7. hirsuta**
4. Leaves glabrous below
 8. Leaves narrowly elliptic to elliptic
 9. Leaf-base sagittate (Celebes, ?Borneo) **8. celebica**
 9. Leaf-base rounded or subtruncate (Celebes, Borneo) **9. glandulosa**
8. Leaves \pm ovate, rotund or triangular
 10. Inflorescences appearing when plant is leafless
 11. Stems strongly tuberculate (tubercles may be little-developed on young stems); leaves lacking hollow domatia in basal nerve-axils; petals usually 3; endocarp 11–13 mm long (S China, Indochina, Malesia) **10. crispa**
 11. Stems not tuberculate; petals 6
 12. Leaves with a pair of hollow domatia on lower surface in basal nerve-axils; petals usually 6; endocarp 7–9 mm long (Thailand) **11. baenzigeri**
 12. Leaves with glandular patches on lower surface in basal nerve-axils **12. smilacina**
 13. Leaves \pm triangular with sides straight or sometimes concave towards base; endocarp shortly pointed at both ends (Australia) **13. neocaledonica**
 13. Leaves \pm ovate with sides convexly curved **14. cordifolia**
 14. Male inflorescences 1–4 cm long; endocarp 8 mm long, subelliptic in outline, pointed at both ends (New Caledonia) **13. neocaledonica**
 14. Male inflorescences (2–)5–12(–20) cm long; endocarp 6–7 mm long, broadly elliptic to subrotund in outline, rounded at both ends (Indian subcont.) **14. cordifolia**
10. Inflorescences appearing together with leaves
 15. Leaves 18–28 \times 11–23 cm, thinly coriaceous, lacking domatia or glandular patches in basal nerve-axils; endocarp 1.7 to 2.4 cm long, surface very smooth, whitish (New Guinea) **15. arfakiana**
 15. Leaves smaller and thinner, sometimes with domatia or glandular patches in basal nerve-axils; endocarps not as above **16. dissitiflora**
 16. Inflorescences with lateral branches, at least towards base
 17. 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 (New Guinea) **16. dissitiflora**
 17. Leaves with coarse, raised reticulation, lacking glandular patches in basal nerve-axils; flowers sessile; endocarps 16–18 mm long, densely spinulose (Australia) **17. tinosporoides**
16. Inflorescences unbranched

18. Flowers in sessile clusters; inflorescences sometimes zig-zag; endocarps 3.5–4.5 cm long
19. Sepals subequal (Sumatra) **18. sumatrana**
19. Sepals unequal, the outer 3 much smaller than the inner 3 (Malaya) **19. macrocarpa**
18. Flowers pedicellate; inflorescences always straight; endocarps up to 2.5 cm long
20. Leaves with a pair of domatia in basal nerve-axils; endocarp 20–25 mm long, the surface bearing scattered spinules (Sumatra) **20. teijsmannii**
20. Leaves with glandular patches or domatia (rarely neither) in basal nerve-axils; endocarp 6–8 mm long
21. Endocarps rounded at both ends, 6–7 mm long, surface slightly papillose and with weak dorsal ridge; flower-pedicels 3–4 mm; leaves with glandular patches usually present in basal nerve-axils, broadly cordate to cordate with basal sinus often very broad (Indian subcont.). **14. cordifolia**
21. Endocarps \pm pointed at both ends
22. Leaves with domatia usually present in basal nerve-axils (replaced by glandular patches in New Guinea); flower-pedicels 8–12 mm
23. Outer sepals much smaller than inner sepals (Hainan, Malesia to Solomon Is.) **21. glabra**
23. Outer and inner sepals equal (Guam) **22. homosepala**
22. Leaves with glandular patches in basal nerve-axils; flower-pedicels 1–5 mm
24. Male inflorescences 4–7 cm long; male flower-pedicels 1–2.5 mm; drupes borne on \pm subglobose or shortly 3-branched carpophore, 1.5–2 mm long (Australia) **12. smilacina**
24. Male inflorescences (5–)7–15 cm long; male flower-pedicels 4–5 mm; drupes borne on columnar carpophore, 4–5 mm long (Lesser Sunda Is., New Guinea) **23. subcordata**

1. *Tinospora trilobata* Diels in Engler, Pflanzenr. IV. 94: 144 (1910); Winkler in Engler, Bot. Jahrb. 49: 369 (1913); Merrill, Enum. Born. Pl.: 249 (1921); Yamamoto in Journ. Soc. Trop. Agric. 16: 96 (1944). Type: Indonesian Borneo, Sungei Bruni, *Jaheri* in *Exped. Nieuwenhuis* 1312 (holotype BO!).

Slender climber. Stems drying striate, bearing short to long rigid hairs. Leaves with petioles 3–12 cm long, hispid to hispidulous; lamina deeply 3–5-lobed, the lobes subelliptic to subtriangular and acuminate at the apex, base deeply cordate, 9–18 \times 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 long. Male flowers on slender pedicels c. 5 mm long; 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. (Fig. 1A).

HABITAT. Primary forest between 100 and 1000 m; recorded on limestone in Sarawak.

NOTES. This is 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.

The Kew specimen of *Clemens* 26843 from Dallas, Mt Kinabalu, consists of a leaf of *T. trilobata* and loose fruits of *Parabaena megalocarpa* Merr. It may be noted that the latter species has inflorescences which are very similar in general appearance to those of *T. trilobata* and they are also supra-axillary; moreover, the leaves of *P. megalocarpa* are occasionally trilobed.

INDONESIAN BORNEO, Sungei Bruni, (♂), *Jaheri* in *Nieuwenhuis* 1312 (BO). SE Borneo, Uja, July (♂), *Winkler* 2646 (B) & between Bata babi and Lumowia, July (♂), *Winkler* 2837 (L).

SARAWAK. Ist divn., 30 miles S of Kuching, Aug. (♂), *Jacobs* 5161 (B, K, SAR).

SABAH. Mt Kinabalu, Dallas, Oct. (sterile), *Clemens* 26843 in part, excl. fruits (K). Kinabatangan, Tamegang Timber Camp near Kampong Pangkaian, Nov. (♂), *Kokawa* & *Hotta* 1430 (L). Lahad Datu, Kennedy Bay, Takun Quarry Hill, Sept. (♂), *SAN* 26121 (K).

2. *Tinospora dentata* *Diels* in *Engler, Pflanzenr.* IV. 94: 139 (1910); Yamamoto in *Journ. Soc. Trop. Agr.* 12: 243 (1940) and in *Trans. Nat. Hist. Soc. Taiwan* 34: 4 (1944); Li, *Woody Fl. Taiwan*: 186 (1963) and in *Fl. Taiwan* 2: 540 (1976). Type: Taiwan, Bankingsing, *Henry* 152 (holotype K!).

[*'Limacia sp.'*: *Henry* in *Trans. As. Soc. Jap.* 24, Suppl.: 17 (1898).]

Climber with slender woody stems, 2–4 mm diam., drying striate, puberulous when young, later glabrescent. *Leaves* with puberulous petioles 4–5 cm long; lamina subhastate with the basal lobes angular-rounded or bearing a few large triangular teeth, 8–12.5 × 5–7 cm, apex acute and mucronate, margin irregularly repand-dentate or dentate in the middle, entire towards the apex, palmately 5–7-nerved at base with 4–5 pairs of lateral nerves, lower surface puberulous, especially along mid-rib and main nerves, upper surface subglabrous, reticulation fine and prominent on both surfaces, papyraceous. *Male inflorescences* axillary or ramiflorous arising from axils of leaf-scars, pseudopaniculate, 1–3 arising together, 5–17 cm long including peduncle 3–5 cm long, up to 7 cm broad, laxly flowered, puberulous, bracteoles narrowly elliptic, 1.5–2 mm long, sparsely puberulous. *Male flowers* on pedicels 5–10 mm long; sepals subequal, oblanceolate, 6–7 mm long; petals 6, cuneate, fleshy, 1.5–2.5 mm long; stamens 6, 4–5 mm long. *Female inflorescences* similar to male. *Female flowers* incompletely known: carpels 3, curved-ellipsoidal, 1 mm long. *Drupes* unknown. (Fig. 1B).

USES. A note on *Henry* 152 states that the plant has a fibrous root which is used as a 'medicinal simple'.

VERNACULAR NAMES. Taiwan: Chin-shêng.

TAIWAN. Bankinseng, March (♂ & ♀ fl.), *Henry* 152 (K). Between Boryo and Daizurin, March (♂), *Ohwi* 306 (KYO).

3. *Tinospora angusta* *Forman* sp. nov., species foliis angustissimis saepe hastatis vel sagittatis cum inflorescentiis pseudoracemosis utrisque indumento pilorum brevissimorum patentium a congeneribus diversa. Typus: Australia, Northern Territory, *Craven* 2452 (holotypus CANB; isotypus K).

Slender woody climber. Older stems bearing small raised lenticels, young stems puberulous or subglabrous, striate when dried. Indumentum on leaves and inflorescences composed of very short, patent hairs. Leaves with petioles puberulous to glabrous, 0.6–1.7 cm long, lamina very narrow, often hastate or sagittate with narrow and acute basal lobes up to 2 cm long or very narrowly ovate to oblong with base truncate to rounded, apex attenuately and usually bluntly pointed, often with a short mucro, 6–10.5 cm long, 0.4–1.6 cm broad, 3-nerved at the base with the basal nerves often extending half-way up the lamina or beyond, and with 2–3 pairs of less conspicuous distal lateral nerves, main nerves prominent on lower surface, usually drying sunken on upper surface, puberulous on both surfaces or subglabrous, papyraceous, glandular patches present on lower surface in basal nerve axils. Male inflorescences axillary, pseudoracemose, puberulous, 3–5.5 cm long, bracts finely subulate, 1 mm long. Male flowers on puberulous pedicels 2–3 mm long; sepals yellow-green, becoming reflexed, outer sepals narrowly ovate, 1.3 mm long, inner sepals ovate 2.5–3 mm long; petals narrowly obovate, 1–1.3 mm long, fleshy, glandular-papillose externally; stamens 1.7–2 mm long with filaments gradually broadened towards apically dehiscent anthers. Female inflorescences and flowers unknown. Infructescences axillary, racemiform, 3 cm long, puberulous, bearing puberulous pedicels 5–6 mm long surmounted by small knob-like carpophore. Drupes (immature) subellipsoidal, 5 mm long; young endocarp bearing scattered papillae, ventral aperture surrounded by a transversely ridged border. (Fig. 1C).

HABITAT. Low outcrop of sandstone conglomerate; climbing on low shrubs.

NOTES. This very distinctive species is known only from two collections made in February, 1973.

AUSTRALIA. Northern Territory: Central part of Mt Brockman, Feb. (♂), *Craven & Eversons* 2354 (CANB); Nourlangie Creek, Feb. (♂), *Craven* 2452 (holotype CANB; isotype K)—one sheet of Canberra material mixed with fruiting portion from another plant of same species.

4. *Tinospora sagittata* (*Oliv.*) *Gagnep.* in Bull. Soc. Bot. France 55: 45 (1908); Diels in Engler, Pflanzenr. IV. 94: 138 (1910); Sargent, Pl. Wilson. 1: 390 (1913); Yamamoto in Journ. Soc. Trop. Agric. 13: 40 (1941) & in Taiwania 1: 31 (1948). Icon. Cormophyt. Sin. 1: 779, t. 1557 (1972). Lien in Acta Phytotax. Sinica 13: 36, t. 1/6 (1975). Type: China, Hupeh, Ichang, *Henry* 3431 (holotype K!) isotypes B!, BM!, E!).

Limacia sagittata Oliv. in Hook. Icon. 1749 (1888); Dunn & Tutcher in Bull. Misc. Inf. Kew add. ser. 10: 31 (1912).

Tinospora capillipes Gagnep. in Bull. Soc. Bot. France 55: 44 (1908); Gagnep. in Lecomte, Fl. Gén. Indo-Chine 1: 133, t. 14/11–18 (1908); Diels in

- Engler, Pflanzenr. IV. 94: 138 (1910); Chun in Sunyatsenia 4: 176, t. 34 (fruit) (1940). Type: Vietnam (Tonkin), *Balansa* 1469 (holotype P!; isotype K!).
- T. craveniana* S.Y. Hu in Journ. Arn. Arb. 35: 194, t. 1/6 (1954). Types: China: Kiangsi, *Hsiung* 6402 (syntype A!); Szechuan, *Yü* 563 (syntype A!).
- T. imbricata* S.Y. Hu in *op. cit.* 195, t. 1/2 (1954). Type: China, Kwangsi, *Wang* 40521 (holotype A!, isotype P!).
- T. intermedia* S.Y. Hu in *op. cit.* 196, t. 1/5 (1954). Types: China, Szechuan, *Fang* 16320 & 17522 (syntypes A!).
- T. szechuanensis* S.Y. Hu in *op. cit.* 196, t. 1/1 (1954). Type: China, Szechuan, *Wilson* 3528 (holotype A!; isotype K!).
- T. yunnanensis* S.Y. Hu in *op. cit.* 197, t. 1/4 (1954). Type: China, Yunnan, *Tsai* 53100 (holotype A!).

Climber. Roots with small tuberous swellings. *Stems* herbaceous or slender woody, drying striate, puberulous, later glabrescent. *Leaves* with puberulous petioles 1.5–6 cm long; lamina narrowly sagittate, sagittate-ovate to hastate, 7–22 × 2–7.5 cm, the basal lobes rounded to acute, 0.5–3(–5) cm long, apex long-acuminate, palmately 5-nerved at base with 2–4 pairs of lateral nerves, lower surface usually sparsely puberulous, upper surface sparsely puberulous to glabrescent, papyraceous. *Male inflorescences* axillary, or from axils of leaf-scars, pseudoracemose, 1–4 cm long, several arising together in axils from a cluster of ovate puberulous bud-scales, lax, few-flowered with usually long slender peduncles, usually glabrous, the racemes sometimes reduced to single flowers, sometimes pseudopaniculate, 9–12 cm long; bracteoles concave-ovate or sometimes narrower, 1–1.5 mm long, often puberulous. *Male flowers* on slender pedicels 5–13(–20) mm long; sepals green, white or yellow, glabrous or externally puberulous, sometimes subequal, outer 3 ovate to obovate, 1.5–2 mm long, inner 3 ± ovate to elliptic, 2–2.5(–4) mm long; petals 6, rhomboid to subcuneate, fleshy, 1–1.5 mm long; stamens 6, c. 2 mm long. *Female inflorescences* similar to male but racemes solitary, 6–7 cm long, sometimes paniculate, c. 14–15 cm long. *Female flowers*: sepals and petals similar to male but smaller; staminodes 6, oblong, 0.5 mm long; carpels 3, curved-ellipsoidal, 1 mm long. *Drupes* arising from short, squat carpophore 1–2 mm long (occasionally elongate to 7 mm long) on peduncle 10–15 mm long; pericarp drying very thin; endocarp thinly bony, whitish, rotund to oblate in outline, 5–8 mm long, 5–8 mm broad, dorsal ridge usually lacking or weak, surface bearing scattered weak papillae or smooth, with large broadly elliptic ventral aperture leading to deeply intrusive condyle. (Fig. 1D–E).

HABITAT. Recorded at altitudes of 1000 to 2100 m in Szechuan, at 1300 m in Kwangsi, growing by a stream. In SE Tibet it grows in trees in thickets by streams at 2600–3000 m.

USES. A note on the type states that the root is used as a 'medicinal simple'. According to Farges (no. 1027), the roots are tubercular, the tubercles being very bitter, refreshing and used externally for various inflammations.

VERNACULAR NAME. China: ch'ing niu tan (Hupeh), ty-kou-tan (E Szechuan).

NOTES. *Forrest* 21669 from SE Tibet which is without leaves almost certainly belongs to this species. It differs from the other specimens in having pseudo-paniculate male inflorescences, 9–12 cm long bearing narrow subulate

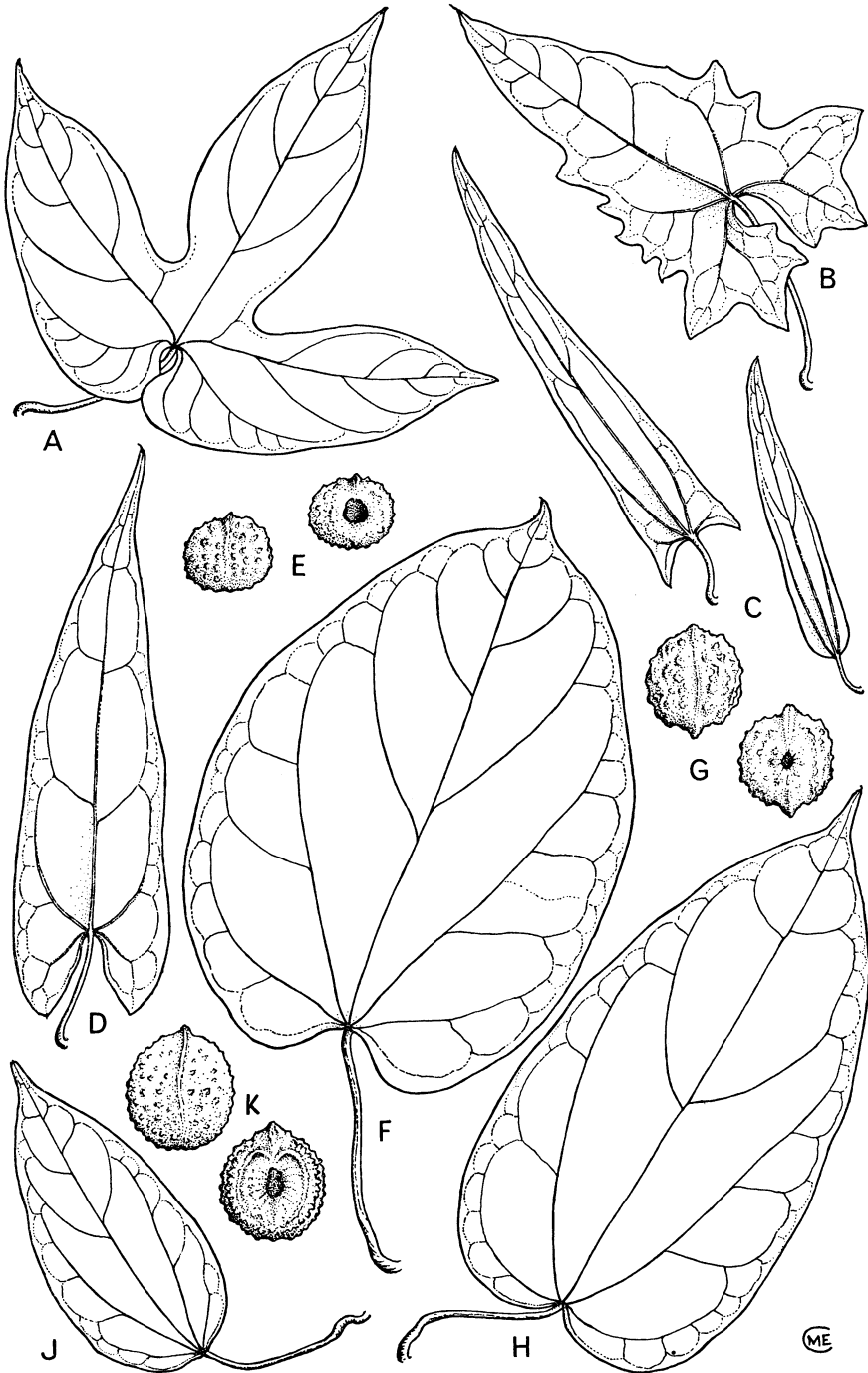


FIG. 1. **A** *Tinospora trilobata* leaf $\times \frac{2}{3}$. **B** *T. dentata* leaf $\times \frac{2}{3}$. **C** *T. angusta* leaves $\times \frac{2}{3}$. **D-E** *T. sagittata*. **D** leaf $\times \frac{2}{3}$; **E** endocarp, dorsal and ventral views $\times 2$. **F-G** *T. sinensis*. **F** leaf $\times \frac{2}{3}$; **G** endocarp, dorsal and ventral views $\times 2$. **H-K** *T. merrilliana*. **H-J** leaves $\times \frac{2}{3}$; **K** endocarp, dorsal and ventral views $\times 2$. **A** from *SAN* 26121; **B** from *Ohwi* 306; **C** from *Craven* 2354; **D** from *Cavalerie* 994; **E** from *Henry* 4137; **F & G** from *Kerr* 8959; **H** from *Clemens* 525; **J-K** from *Clemens* 30379. Drawn by Mrs M. Church.

bracteoles, and male flowers with the larger inner sepals almost 4 mm long. The plant is described as a scandent shrub, 6–10 m high.

The five species described by Dr S. Y. Hu (*op. cit.*) in 1954 were distinguished mainly on leaf-shape, especially the form of the basal lobes and the direction in which they point; also the texture of the leaves was used as well as the presence or absence of indumentum on the sepals and the degree of ornamentation on the endocarp. In the light of all the specimens I have examined, these prove to be variable characters within one species and I do not regard the differences emphasized by Dr Hu as being of taxonomic significance. In a review of Chinese *Menispermaceae* in medicinal use, Lien *op. cit.*: 35–36 (1975) maintains Hu's species in his key (in Chinese) and in Fig. 1/1–7.

CHINA. SE Tibet, Tsanong, Salwin-Kiu Chiang divide N of Si-che, June (♂), *Forrest* 21669 (E). E Szechuan, Tchen-Kéou, April (♂ & fruits), *Farges* 1027 (K, P). Szechuan, Omei-hsien, Mt Omei, April, (♂), *Fang* 16320 (A) & Aug. (fruit), *Fang* 17522 (A). W Szechuan, Hung-ya Hsien, foot of Wa-wu shan, Sept. (fruit), *Wilson* 3528 (A, K). Szechuan, Mt Omei, April (♂), *Yü* 563 (A). Hupeh, Ichang, *Henry* 3431 (B♂, BM ♀ fl., E ♂, K ♂ & ♀ fl.) & (fruits), *Henry* 4137 (BM, K). W Hupeh, Nanto, April (♂), *Wilson* 141 (E, K). Kweichow, near Gan-pin, March (♂), *Martin in Bodinier* 2141 (K, P). Kweichow, near Kweiyang, April (♂), *Chaffanjon in Bodinier* 2178 (E, P). Kweichow, 'Yunnan: Sen District,' Pin-fa, Feb., *Cavalerie* 866 (E♂; K♀ fl.) & April (♂), *Cavalerie* 994 (E, K, P). Kiangsi, Hwang-Kong-shan, Oct. (fruit), *Hsiung* 6402 (A.) Yunnan, Lan ngy tsin near Lou lan, April (♂), *Ducloux* 5516 (P) & Yunnan, (♂), *Tsai* 53100 (A). Kwangsi, Yao Shan, Dec. (fruit), *Wang* 40521 (A, P). Hong Kong, Mt Parker, (sterile), *Tutcher* 1328 (K).

VIETNAM. Tonkin, Dong-Dang, Feb., (♂), *Balansa* 1469 (K, P).

5. *Tinospora sinensis* (Lour.) Merr. in *Sunyatsenia* 1: 193 (1934), & in *Trans. Amer. Philos. Soc. n.s.* 24(2): 158 (1935); Chun, Chang & Chen, *Fl. Hainanica* 1: 318 (1964); Lien in *Acta Phytotax. Sinica* 13: 37 (1975). Type: China, Canton, (holotype P photo!).

Campylus sinensis Lour., *Fl. Cochinch.* 113 (1790); ed. 2, 1: 140 (1793). *Menispermum malabaricum* Lam., *Encycl. Méth. Bot.* 4: 96 (1797). Type: based on *Pee-amerdu* Rheede, *Hort. Malabar.* 7: 37, t.19, 20 (1688).

Cocculus tomentosus Colebr. in *Trans. Linn. Soc.* 13: 59 (1822). Type: Icon. Roxb. no. 1710 (K!).

Menispermum tomentosum [Roxb., *Hort. Bengal.* 72 (1814) nom. nud.] (Colebr.) Roxb., *Fl. Ind.* 3: 813 (1832).

Tinospora malabarica (Lam.) Hook. f. & Thoms., *Fl. Ind.* 1: 183 (1855), & in Hook. f., *Fl. Brit. India* 1: 96 (1872); Kurz in *Journ. As. Soc. Bengal* 43: 60 (1874); Kurz, *For. Fl. Brit. Burma*: 52 (1877); Trimen, *Handb. Fl. Ceylon* 1: 38 (1893); Cooke, *Fl. Pres. Bombay* 1: 18 (1903); Talbot, *For. Fl. Bombay & Sind* 1: 36 (1909); Diels in *Engler, Pflanzenr.* IV 94: 142 (1910); Haines, *Bot. Bihar & Orissa*: 18 (1921); Craib, *Fl. Siam Enum.* 1: 64 (1925); Blatter in *Journ. Bombay Nat. Hist. Soc.* 31: 549 (1926); Kanjilal & Das, *Fl. Assam* 1: 55 (1935); Siddiqi in *Nasir & Ali, Fl. W. Pakistan* 74: 4–5, fig. 2 (1974).

- T. tomentosa* (Colebr.) Hook. f. & Thoms, Fl. Ind. 1: 183 (1855) & in Hook. f., Fl. Brit. India 1: 96 (1872); Thwaites, Enum. Pl. Zeyl.: 12 (1858); Drury, Handb. Ind. Fl. 1: 30j (1864); Kurz in Journ. As. Soc. Bengal 43: 60 (1874); Kurz, For. Fl. Brit. Burma: 52 (1877); Prain, Bengal Pl. 1: 209 (1903); Gagnep. in Lecomte, Fl. Indoch. 1: 130 (1908); Kirtikar & Basu, Indian Med. Pl. 1: 48, t. 33 (1918); Crevost & Pételot in Bull. Écon. Indoch. n.s. I-1929, no. 199: 33 with accompanying plate and figure (1929).
- T. malabarica* (Lam.) Hook. f. & Thoms. var. *scabridula* Miers in Ann. Mag. Nat. Hist. ser. III, 13: 318 (1864). Types: Assam, Khasia, Nunklow, Hook. f. & Thoms. s.n. (syntype, K!) Bangladesh, Chittagong, Sitakund Pass, Hook. f. & Thoms. s.n. (syntype, K!).
- T. malabarica* (Lam.) Hook. f. & Thoms. var. *tomentosa* (Colebr.) Trimen, Handb. Fl. Ceylon 1: 39 (1893).
- T. thorelii* Gagnep. in Bull. Soc. Bot. France 55: 46 (1908) pro parte quoad specimina feminea lectotypo masculo excluso. Gagnep. in Lecomte, Fl. Indoch. 1: 130 (1908) similiter pro parte.
- [*T. nudiflora* (Griff.) Kurz in Journ. As. Soc. Bengal n.s. 41: 292 (1872) pro parte quoad Kurz 1800 tantum, basionymo excl.]
- [*T. crispa* sensu Craib, Fl. Siam. Enum. 1: 64 (1925) pro parte quoad specimina—non (L.) Hook. f. & Thoms.]

Woody climber. Stems puberulous when young, later glabrescent, succulent, drying striate, with scattered lenticels and very prominent leaf-scars, developing a smooth chartaceous bark, producing very long, filiform aerial roots. *Leaves* with petioles 4–9 (–12) cm long, puberulous; lamina ovate to subrotund, margin occasionally with a few broadly pointed lobes or broadly sinuate, base deeply to only slightly cordate, apex acutely acuminate, 7–15 × 4.5–12 cm, 5–7-nerved at the base, tomentellous or subtomentellous below, puberulous above, glandular patches sometimes visible in basal nerve-axils, thinly papyraceous. *Inflorescences* not usually coetaneous with the leaves. *Male inflorescences* solitary or few together arising from axils of protruding leaf-scars on older, leafless stems, pseudoracemose, slender, 3–12 cm long, axis glabrous bearing few-flowered fascicles. *Male flowers* on slender pedicels 2–5 mm long; sepals yellowish or pale green, glabrous, outer 3 ovate, 1–1.5 mm long, inner 3 broadly elliptic, 3–4 mm long; petals 6, broadly spatulate to subrhomboid with lateral margins inflexed, 2–3 mm long, papillose externally towards narrowed base; stamens 6, clavate, 3–4 mm. *Female inflorescences* similar to male, up to 14 cm long with flowers arising singly along the axis. *Female flowers* on pedicels 3–10 mm long; sepals and petals as in male; staminodes 6, subulate scarcely 1 mm long; carpels 3, ellipsoidal 1.5–2 mm long with flat, lobed stigma borne on a lobed, squat gynophore 1 mm or less long. *Drupes* red, radiating from a 3-cornered or shortly 3-branched carpophore 2–3 mm long on a peduncle 8–11 (–15) mm long; pericarp drying thin; endocarp bony, 7–9 × 6 mm, broadly elliptic to subrotund in outline, obtusely pointed at base, broadly keeled at apex, with a low dorsal median ridge, surface with irregular low tubercles or irregular low longitudinal ridges (or very prominent, broken, short longitudinal ridges in *Tsang* 29171 from Vietnam), small elliptic aperture c.1 mm long on ventral face leading to deeply intrusive condyle. (Fig. 1 F–G).

HABITAT. At altitudes up to 800 m from various habitats in Thailand, e.g. evergreen forest by stream; scrub-jungle; mixed deciduous forest; disturbed forest on sandy loam, hedgerows. According to Haines, Bot. Bihar & Orissa: 18 (1921), this species occurs in rocky valleys in Bihar, where it is rare.

USES. In *The Wealth of India* 10: 252 (1976) it is reported that the species is used for the treatment of piles and ulcerated wounds, in the preparation of medicated baths for liver complaints; boiled roots are used to treat fevers and fresh leaves and stems for chronic rheumatism.

The following medicinal uses in Indochina are recorded by Crevost & Pételot in *Bull. Écon. Indoch. n.s.* I-1929, no. 199: 33 (1929). The leaves mixed with rice alcohol are applied as a poultice to treat rheumatism. For internal use for men, small pieces of stem are roasted and then macerated in alcohol then drunk in small quantities; or for women pieces of stem are just boiled in water. The Chinese maintain that the stem is more active than the leaves. The plant has a high reputation and is very popular with the N Vietnamese and Chinese.

Lien (*l.c.* 1975) stated that in China a stem-preparation is used as a muscle-relaxant. The Chinese vernacular names mean 'muscle-relaxing vine'.

VERNACULAR NAMES. Burma: sin ton ma mywe. Thailand: borapet, chung cha ling, ping kaling, salee, tao chali. N Vietnam: dây dau xuong. Chinese: khoan can dang, xeng con than (Cantonese); kuan-jin teng (Mandarin).

NOTES: Roxburgh's comments in *Fl. Ind.* 3: 813 on the filiform aerial roots of this and other species of *Tinospora* are worth quoting: 'Like some other species of this genus, viz. *M. cordifolium* Willd. [= *T. cordifolia* (Willd.) Hook. fil. & Thoms.] and *verrucosum*, *Funis felleus Rumph.* [= *T. crispa* (L.) Hook. f. & Thoms.], tender filaments issue from various parts, which quickly descend into the ground, often from the height of some fathoms. This happens particularly when the lower part of the original plant has been destroyed, the succulent fragments remaining amongst the branches of the trees they run on, send out those fibres abundantly, some one, or more of which soon replaces the former stem and root. A most wonderful economy for the preservation of these plants.'

CHINA, Hainan, Yaichow, (sterile), *F. C. How* 70747 (B, K). Hong Kong, Victoria I., Dragons Back, April (♂), *S.Y. Hu* 9873 (K). Hong Kong, Green I., March (♂), *S.Y. Hu* 11673 (K) & (♀ fl.), *S.Y. Hu* 11674 (K). Lungchow, (♂), *Morse* 511 (K).

NEPAL. Central, Rapti Valley, Hetaura, March (♂), *Stainton* 5232 (BM). East, Chula Chuli, E of Dharan, Feb. (♂), *Stainton* 6398 (BM).

INDIA. Bihar, Santal Parganas, (sterile), Haines 3736 (K). ? S India, 'Sannyashikata', April (fruits), *Hamilton* in *Wall. Cat.* 4969 (K-W) = *Hamilton* 2228 (E). Bombay Presidency, S Maratha & N Canara, March (♂), *A. P. Young* s.n. (BM). Sikkim, July (sterile), *Thomson* s.n. (CAL). Assam, Khasia, Nunklow, (sterile), *Hook. f. & Thoms.* s.n. (K).

BANGLADESH. Chittagong, Sitakund Pass, (sterile), *Hook. f. & Thoms.* s.n. (K).

CEYLON. Anuradhapura distr., E slope of Wannatikanda, (sterile), *Jayasuriya* 1037 (K). No further loc., (♂), *Thwaites* C.P. 2804 (BM, K).

BURMA. Mandalay Town, April (fruits), *Bänziger* 41-30 (K). Pegu, (♀ fl.),

Kurz 1800 (B, CAL). Below Ava on banks of Irawaddy, (sterile), *Wall. Cat.* 4956B (K-W).

THAILAND. NORTH. Fang, March (♂), *Bänziger* 41-27 (K). Chiengmai, Mae Malai, 9 km along road before Pa Pã, March (♀ fl.), *Bänziger* 41-28 (K). Hue Ka, Febr. (♂), *Kerr* 2344 (BM, K). Chiengrai, March (♂), *Kerr* 2499 (BM, E, K). Hue Ka, March (♂), *Kerr* 5025 (BM, K). Muang Fang, April (fruit), *Kerr* 5228 (BM, K). Me Khan, March (♂), *Winit* 71 (BM, E, K). NORTHEASTERN. Loei, Wangsaphung, Pha Daeng, Feb. (♂), *Phloenchit* 1325 (K). EASTERN. Mekong R., Kemarath, (♀ fl.), *Thorel* s.n. (P). Mekong R., Ubon R., (fruits), *Thorel* s.n. (P). CENTRAL. Saraburi, Sam Lann For. Res.: Jan. (♂), *Bänziger* 41-1 (K), Dec. (fruits), *Bänziger* 41-2 (K), Feb. (♂), *Bänziger* 41-20 (K) & Feb. (fruits), *Bänziger* 41-24 (K). Bangkok: May (fruits), *Kerr* 8959 (BM, K), Feb. (♀ fls.), *Kerr* 14350 (BM, K), May (fruits), *Marcan* 1704 (K) & Feb. (♂), *Marcan* 1986 (K). SOUTHWESTERN. Kanburi, Wangka, Feb. (♀ fl.), *Kerr* 10453A (BM, K). Kwae Noi R. Basin, near Neeckey and Wangka, May (fruits), *Kostermans* 257 (K, P). PENINSULAR. Satal, Tapan Lek, March (♂), *Kerr* 14395 (BM, K). Ranawng, Kapor, Jan. (♂), *Kerr* 16713 (BM, K).

VIETNAM. Taai Wong Mo Shan, near Chuk-phai Ha-coi, June (fruits), *Tang* 29171 (E, K).

CAMBODIA. Pursath prov., Kresvanh Mts (sterile), *Pierre* 760 (K).

CULTIVATED. Hort. Bot. Calcutta (sterile), *Roxburgh* in *Wall. Cat.* 4956A (K-W).

6. *Tinospora merrilliana* *Diels* in *Engl., Pflanzenr.* IV 94: 137 (1910) & in *Elmer, Leaflet Philipp. Bot.* 4: 1164 (1911); *Merrill, Enum. Philipp. Fl. Pl.* 2:146 (1923). Type: Philippines, Mindanao, *Clemens* 525 (isotype K!).

T. negrotica *Diels* in *op. cit.* 137 (1910) & in *Elmer, Leaflet Philipp. Bot.* 4: 1164 (1911); *Merrill, Enum. Philipp. Fl. Pl.* 2: 146 (1923). Type: Philippines, Negros, *Elmer* 9468 (holotype B!; isotypes BM!, BO!, E!, Z!).

T. havilandii *Diels* in *op. cit.* 138 (1910); *Merr., Enum. Born. Pl.* 249 (1921); *Yamamoto* in *Journ. Soc. Trop. Agric.* 16: 217 (1944). Type: Sarawak, *Haviland* 1581 *pro parte* quoad infloresc. masc. (**lectotype** K!).

Parabaena amplifolia *Diels* in *op. cit.* 146 (1910); *Merr. loc. cit.* 249 (1921); *Yamamoto op. cit.* 96 (1944). Type: C Borneo, *Hallier* 2794 (isotype K!).

Tinospora hastata *Elmer, Leaflet Philipp. Bot.* 10: 3760 (1939). Type: Philippines, Luzon, *Elmer* 16960 (isotype NY!).

T. negrotica *Diels*, var. *monticola* *Yamamoto* in *Trans. Nat. Hist. Soc. Taiwan* 34: 307 (1944). Type: Philippines, Luzon, *Vanoverbergh* 3955 (not seen, holotype in PNH prob. destroyed).

Fawcettia merrilliana (*Diels*) *Yamamoto* in *op. cit.* 230 (1944).

Slender woody climber. Stems up to 1 cm diam.; young stems 2-3 mm diam. drying striate, puberulous or glabrous; older stems covered with raised corky lenticels. Leaves with petioles 2-9 cm long, 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 × 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 chartaceous, domatia absent. *Male inflorescences* axillary or arising from older leafless stems, pseudoracemose (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 long; 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 \pm oblate 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 long, pendent with long slender peduncle up to 23 cm long, puberulous. *Drupes* pinkish white or white, radiating from subglobose carpophore 1–2 mm diam. on peduncle 4–6 mm long; pericarp glabrous, drying close to endocarp, the endocarp thinly crustaceous, usually pale, broadly ellipsoidal 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. (Fig. 1 H–K).

HABITAT. Growing in forests up to 1800 m and in Luzon in thickets on limestone cliffs, in Palawan on limestone hill.

VERNACULAR NAMES. Philippines: pisok, cangogang (Luzon); balangbatang (Negros); columpangi, kari, laganat (Mindanao).

NOTES. This species varies considerably in leaf-shape. Most specimens from Mt Kinabalu, Sabah have small ovate leaves which are truncate or only moderately cordate at the base (Fig. 1J). 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. The inflorescence is usually a pseudoraceme, but in *PNH* 10013 from Mindanao and *PNH* 80809 from Palawan it is a narrow 'panicle'.

Tinospora havilandii Diels was based on the two sheets at Kew of *Haviland* 1581 from Sarawak. These consist of a mixture of leafy shoots of *Arcangelisia ava* (L.) Merr. and infructescences and male inflorescences of *Tinospora merrilliana* Diels. Since the male flowers are so distinctive in *T. merrilliana*, I designate the male portion of one of the Kew sheets as lectotype of *T. havilandii* Diels. In the duplicate at Kuching, the *Tinospora* element is represented by detached fruits only.

INDONESIAN BORNEO. Central: Liang Gagang, (fruit), Hallier 2794 (K). East: Berau, Tandjung Redeb, Oct. (♂), *Kostermans* 21075 (K, L) & (♂), *Kostermans* 21152 (K, L).

SARAWAK. 3rd Divn., Long Bah, Aug. (fruit), *W. M. A. Brooke* 9001 (L). Saribas, Paku Lakunbong, July (♂, fruits), *Haviland* 1581 *pro parte excl. foliis* (K, SAR).

SABAH. Mt Kinabalu, Tenompok, Oct. (fruit), *Clemens* 26816 (BM, K, L), Jan. (♂), *Clemens* 28091 (BM, K, L) & April (fruit), *Clemens* 30379 (K, L). Mt. Kinabalu, Penibukan, Feb. (young fruit), *Clemens* 31249 (BM). Tenompok, 21 Aug. 1931 (fruit), *Clemens* s.n. (BM), 16 Feb. 1932 (♂), *Clemens* s.n. (BM), 26 April 1932 (fruit), *Clemens* s.n. (BM) & 13 June 1932 (fruit), *Clemens* s.n. (BM). Mt Kinabalu, Ulu Liwagu & Ulu Mesilau, Aug. (fruit),

RSNB (*Chew et al.*) 1985 (K). Kinabalu National Park, Ranau, Feb. (♂), *SAN* 42760 (K). Near Bundu Tulan, March (♂), *Darnton* 521 (BM).

CELEBES. Minahassa: Gunung Kawatak, July (fruit), *Alston* 16255 (BM). Gunung Tetawiran, (sterile), *Alston* 16414 (BM).

PHILIPPINES. PALAWAN. Quezon, Lipuun Point, May (♂), *PNH* 80809 (A). LUZON. Benguet Prov., Baguio, March (young fruit), *Elmer* 8423 (E), Sorsogon Prov., Irosin, Aug. (fruit), *Elmer* 16960 (NY). Sorsogon Prov., Mt Juban, June (fruit), *PNH* 37121 (PNH). Sorsogon Prov., Mt Bulusan, May (♂), *PNH* 38460 (L, PNH). CATANDUANES Nov.–Dec. (♂), *Ramos* 30238 (K). NEGROS. Negros Orientale Prov., Dumaguete, March (fruit), *Elmer* 9468 (B, BM, BO, E, Z). PANAY. Capiz Prov., Jamindan, April–May (young fruit), *BS* 30962 (K). MINDANAO. Lake Lanas, Camp Keithley, May (♂), *Clemens* 525 (K). Davao Distr., Todaya, June (sterile), *Elmer* 10882 (E, K, L), June (fruit), *Elmer* 10895 (E, K, L) & Sept. (sterile), *Elmer* 11639 (E, K, L). Mt Malindang, May (fruit), *Mearns & Hutchinson* 4748 (B). Bukidnon Prov., Mt Katanglad, March (♂), *PNH* 10013 (PNH) & April (fruit), *PNH* 10115 (PNH). Agusan Prov., Mt Hilong-hilong, April (fruit), *PNH* 10639 & 10757 (L). Surigao Prov., April (fruit), *PNH* 34461 (B, BM).

7. *Tinospora hirsuta* (Becc.) Forman comb. nov.

Aspidocarya hirsuta Becc., *Malesia* 1: 136 (1877). Type: Sarawak, Mt Gadin, *Beccari* P. B. 2317 (holotype FI—only fragment seen).

Parabaena hirsuta (Becc.) Diels in Engler, *Pflanzenr.* IV. 94: 147 (1910) *pro parte quoad typum*.

Woody climber. Stems puberulous, sometimes soon glabrescent, drying striate and developing a subnitidous bark with scattered small lenticels. Leaves with petioles 8–10 cm long, puberulous; lamina ovate to broadly ovate, base cordate, apex long-acuminate, 14–18 × 8.5–12 cm, the 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 uncinatate 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 long, puberulous, lateral branches c. 1–1.5 cm long, upper branches reduced to single pedicel 0.5 cm long. Drupes white borne on subglobose carpophore 2 mm diam.; endocarp cream-whitish, crustaceous, subrotund or broadly elliptic in outline, slightly keeled at the apical end, 8–11 × 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. (Fig. 2 A–D).

HABITAT. Alluvial forest in valley floor at c. 60 m (Sarawak, G. Mulu National Park).

NOTES. When Beccari first described this species he had only his collection P.B. 2317 with immature fruits available, and as a result he was uncertain of its generic position, placing it with some doubt in *Aspidocarya*. In *Das Pflanzenreich*, Diels transferred it to *Parabaena* and cited, apart from Beccari's type, three other collections from Borneo: *Hallier* 1532, *Haviland* 2833 and *Jaheri* 1180. I have not been able to check the Jaheri specimen which is in Bogor, but the Hallier and Haviland specimens represent different plants—

indeed, different genera. *Hallier* 1532, which is in fruit, is conspecific with Beccari's plant and the mature fruits indicate that it belongs to *Tinospora*. This is supported by a recent further collection from Sarawak, again in fruit, by my colleague Mr Gwilym Lewis. Beccari's specific epithet must therefore now be transferred to *Tinospora*. The flowers of this species are still unfortunately unknown.

Haviland 2833, which is clearly distinct when the indumentum on the leaves and the reticulation is compared, has male flowers with the fused stamens characteristic of *Parabaena*. It belongs, in fact to *P. megalocarpa* Merr., a species with large ellipsoidal fruits with densely spiny endocarps. Diels's description of *P. hirsuta* is therefore based on two different plants, belonging to distinct genera.

The indumentum on the lower surface of the leaves of *T. hirsuta* is distinctive in including amongst the short stiff patent hairs along the main nerves some hairs which are uncinata at the tip (Fig. 2B); these are more frequent towards the leaf-base. The upper surface is characteristically glabrous, but with a dense raised reticulation (Fig. 2C).

SARAWAK. Sarawak, Mt Gadin, (young fruit), *Beccari* P. B. 2317 (holotype FI). 4th Divn., Gunung Mulu National Park, Melinau gorge, subcamp 5 area, Oct. (fruit), *G. Lewis* 318 (K).

W. INDONESIAN BORNEO. Gunung Kenepai, (fruit), *Hallier* 1532 (K).

8. *Tinospora celebica* *Diels* in Engler, Pflanzenr. IV. 94: 143 (1910). Type: Celebes, Gorontalo, *Riedel* s.n. (isotypes B!, K!).

Slender woody climber, entirely glabrous. *Stems* drying substriate. *Leaves* with petioles 4.5 [-7, teste Diels] cm long, geniculate near base; lamina narrowly elliptic, base sagittate with small acute basal lobes, apex acuminate, 10-12 × 3.5-4.5 cm, reticulation fine, raised on both surfaces, stiffly papyraceous, domatia present on lower surface in basal nerve axils. *Male and female flowers and inflorescences* unknown. *Drupe*s (pericarp unknown) with endocarp bony, rather oblong in outline with squarish corners but shortly pointed at base and apex, 7 × 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. (Fig. 2 E-F).

CELEBES. Gorontalo, (fruit), *Riedel* s.n. (K).

NOTES. The following (unicate) specimen from Sarawak may belong to this species: 1st/2nd Divn. boundary, Ulu Simunjan, Gunung Buri, Sept. (fruit), *Chai et al.* in S 36766 (SAR) at c. 530 m in poor forest with mostly small trees and numerous climbers on igneous derived brownish-yellow sandy soil.

This specimen has leaves with 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 long. The single detached pseudo-racemose infructescence (unknown in *T. celebica*) is 19 cm long; the fruits are borne on slender pedicels 5-8 mm long, each terminating in a narrow clavate carpophore 4 mm long. The drupes have slightly larger endocarps, 10 × 6 mm, and are more prominently ornamented with thin

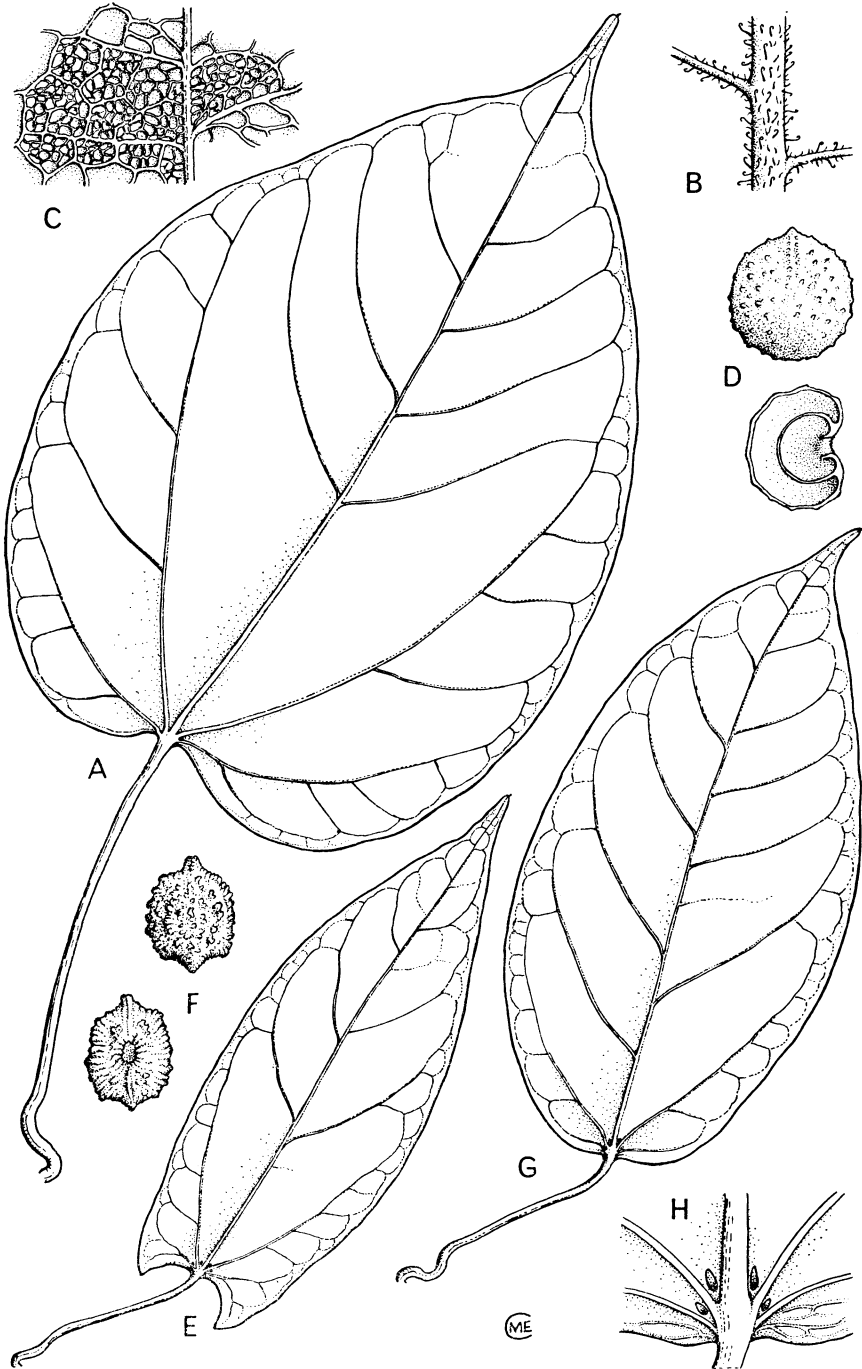


FIG. 2. A-D *Tinospora hirsuta*. A leaf $\times \frac{2}{3}$; B indumentum on mid-rib (lower surface) $\times 4$; C reticulation on upper surface $\times 4$; D endocarp, dorsal and ventral views and in T.S. $\times 2$. E-F *T. celebica*. E leaf $\times \frac{2}{3}$; F endocarp, dorsal and ventral views $\times 2$. G-H *T. glandulosa*. G leaf $\times \frac{2}{3}$; H leaf-base showing domatia $\times 4$. A-D from Lewis 318; E-F from Riedel s.n.; G-H from Wood 939. Drawn by Mrs M. Church.

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.

9. *Tinospora glandulosa* Merr. in Journ. As. Soc. Str. Br. 85: 171 (1922). Yamamoto in Journ. Soc. Trop. Agric. 16: 96 (1944). Type: Sabah, Sandakan, *D. D. Wood* 939 (holotype PNH!).

Woody climber, entirely glabrous. *Stems* drying striate when young, with scattered raised lenticels, developing a papery later subcoriaceous bark. *Leaves* with petioles 4–5 cm long; lamina elliptic, base rounded or subtruncate, apex long-acuminate, 10–13 × 4–6 cm, 3(–5)-nerved at the base and with 4–6 pairs of distal lateral nerves, reticulation raised on both surfaces, stiffly chartaceous, domatia with distinct apertures present on the lower surface in the main nerve-axils. *Flowers* unknown. *Infructescence* arising from older, leafless region of stem, narrowly paniculate 25 to over 60 cm long, the upper part subracemose with one or two pedicels 7–10 mm long arising together in the axil of a 1–2 mm long bract, the lower bracts bearing short lateral branches 2–4 cm long in addition to single pedicels, immature drupes borne on a 2–3 mm long columnar carpophore. Mature *drupes* unknown. (Fig. 2 G–H).

HABITAT. Climbing bamboo forest at low altitude.

NOTES. This species is distinctive in its elliptic leaves and long infructescences with short lateral branches in the lower part. The flowers are unknown and the available fruits are far too young to show any of their mature features. The reticulate venation of the leaves and the domatia each with a distinct aperture (Fig. 2H) are very much as in *T. glabra*, to which *T. glandulosa* appears closely allied.

SABAH. Sandakan, Oct. (young fruit), *D. D. Wood* 939 (PNH!).

NE CELEBES. Minahassa, (very young fruit), *de Vriese & Teijsmann* s.n. 1860 (L).

10. *Tinospora crispa* (L.) Hook. f. & Thoms. Fl. Ind. 1: 183 (1855); Miers, Contrib. Bot. 3: 34 (1871); Trimen, Handb. Fl. Ceylon 1: 39 (1893); Gagnep. in Lecomte, Fl. Gén. Indo-Ch. 1: 132 (1908) & Suppl. 124 (1938) *pro parte*; Kirtikar & Basu, Indian Med. Pl. 1: 48, t. 34 (1918); Crevost & Pételot in Bull. Écon. Indoch. n.s. I–1929, no. 199: 30 with accompanying plate and figure (1929); Backer & Bakh., Fl. Java 1: 158 (1963); Lien in Acta Phytotax. Sinica 13: 37 (1975). Type: *Funis felleus* (non '*Funis quadrangularis*') Rumph., Herb. Amboin. 5: t. 44, f. 1 (1747)—see Merrill in Journ. Arn. Arb. 19: 341 (1938).

Menispermum crispum L., Sp. Pl. ed. 2: 1468 (1763).

M. tuberculatum Lam., Encycl. Méth. Bot. 4: 96 (1797). Type: 'Indes orientales', *Sonnerat* s.n. (P, microfiche!).

M. verrucosum Roxb. ex Fleming in Asiat. Res. 11: 171 (1810); Roxb., Hort. Bengal.: 72 (1814) et Fl. Ind. ed. 2, 3: 808 (1832). Type: Roxb. Icon. 1708 (K!).

- Cocculus crispus* (L.) DC., Syst. Veg. 1: 521 (1817) et Prodr.: 97 (1824).
C. verrucosus (Roxb. ex Fleming) Wall., Cat. 4966 (1830) *pro parte quoad basionymum tantum*.
T. rumphii Boerl., Cat. Hort. Bogor: 116 (1901) *nom. illegit.*; Diels in Engler, Pflanzenr. IV. 94: 135 (1910); Merrill, Interpr. Rumph. Herb. Amb.: 220 (1917), et Sp. Blancoan.: 145 (1918), et Enum. Philipp. Fl. Pl. 2: 146 (1923); Santos in Philipp. Journ. Sci. 35: 187, t. 1 (1928); Quisumbing, Med. Pl. Philipp.: 300 (1951) *pro parte*. Based on *Funis felleus* Rumph. (*vide supra*).
T. thorelii Gagnep. in Bull. Soc. Bot. France 55: 46 (1908) *pro parte quoad specimina mascula*; Gagnep. in Lecomte, Fl. Gén. Indo-Ch. 1: 130 (1908) *pro parte*. Type: NE Thailand, Lakhon, *Thorel* 350 (*planta mascula, excl. fl. f.emin. (lectotype P!)*).
T. mastersii Diels in Engler, Pflanzenr. IV. 94: 140 (1910); Kanjilal & Das, Fl. Assam 1: 55 (1935). Type: Assam, *Masters* s.n. (holotype B!; isotypes ?CAL!, K!).
T. gibbericaulis Hand.-Mazz. in Anz. Akad. Wiss. Wien Math.-Nat. 60: 95 (1923), *e descr.* Type: China, Yunnan, *Handel-Mazzetti* 5816 (holotype in W destroyed).
T. tuberculata (Lam.) Beumée ex K. Heyne, Nutt. Pl. Ned.-Ind. ed. 2, 1: 69 (1927); Burkill, Dict. Econ. Prod. Malay Pen.: 2164 (1935) & ed. 2: 2203 (1966); Backer, Beknopte Fl. Java 3, fam. 34: 14 (1941).
[*Tinospora nudiflora* (Griff.) Kurz in Journ. As. Soc. Bengal n.s. 41: 292 (1872) *pro parte quoad Kurz 1797 tantum, basionymo excl.*].

Woody climber up to c. 15 m. high, 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* with petioles 5–15(–30) cm long; lamina broadly ovate to orbicular, base deeply to shallowly cordate, apex usually long-acuminate, 7–14(–25) × 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 on lower surface. *Inflorescences* not coetaneous with the leaves. *Male inflorescences* arising from the older, leafless stems, often a few together, pseudoracemose, very slender (5–)9–20 cm long, flowers in 1–3-flowered fascicles. *Male flowers* on filiform pedicels 2–4 mm long; 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 long with flowers mostly arising singly along the axis. *Female flowers*: sepals and petals as in male; staminodes 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 long terminating in a subpyramidal 2–3 mm long carpophore below which usually persist reflexed ovate sepals 2 mm long. *Drupe*s orange, ellipsoidal, 2 cm long (when fresh), with whitish endocarp, ± ellipsoidal, 11–13 × 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. (Fig. 3A–C).

HABITAT. 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 & 1966, *ll.cc.*, 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 Dr H. Bänziger.

Merrill in his *Species Blancoanae* (1918, p. 145 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 principal of 'makabuhay' has been investigated by Marañon, in *Philipp. Journ. Sci.* 33: 357 (1927), who found it to be glucosidal; see also above, p. 378. Quisumbing's account of the species (as *T. rumphii*) and its uses in his *Medicinal Pl. Philipp.* 300 (1951) deals in part with *T. glabra*.

According to Thornber in *Phytochem.* 9: 167 (1970), 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 in *Philipp. Journ. Sci.* 35: 187 (1928).

VERNACULAR NAMES. Ceylon: titta kinda. Indochina: *dây than thông*, *bandaul péch*, *dây ki nin*, *thuoc sot rét*. Thailand: *borapet*, *ching cha li*, *chinchá chali*. Java: *andawali*, *brotowali*, *putrowali*, *akar pahat*. Sarawak: *daun akar walli*. Philippines: *makabuhay*, *meliburigan* (Mindanao).

NOTES. 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. It should be remembered that the drawings upon which the published plates were based could not have been checked by Rumphius since they were prepared long after he had lost his sight. Rumphius stated that this climber was brought to Amboina around 1690 and it flowered, when leafless, in November 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 published account of *Funis felleus* in vol. 5 of *Herbarium Amboinense* appeared in 1747, 45 years after the death of Rumphius.

As explained by Merrill in *Journ. Arn. Arb.* 19: 340-1 (1938), when Linnaeus first described this species in 1763 as *Menispermum crispum* in the

second edition of *Species Plantarum* his phrase-name agreed exactly with the illustration in vol. 5 of *Herb. Amboin.* which he correctly cited as t. 44, f. 1, but in error he cited *Funis quadrangularis* on p. 83 instead of *Funis felleus* on p. 82. These two plants are both figured on t. 44 which faces p. 83. This confusion was first pointed out in 1797 by Lamarck when he published the name *Menispermum tuberculatum* Lam. (see synonymy above). *Funis quadrangularis* (t. 44, f. 2) belongs to *Vitaceae*, which Linnaeus later realized since he cited it under *Cissus quadrangularis* ('*quadrangulus*') in his *Mantissa* 1: 39 (1767). Linnaeus had no specimen of *M. crispum* and his reference to its origin in Bengal was clearly copied from Rumphius's statement concerning *Funis quadrangularis*. The type of *Menispermum crispum* L. must therefore be the illustration of *Funis felleus* in *Herb. Amboin.*

The error in citation made by Linnaeus together with the absence of original specimens has led to confusion lasting nearly two centuries over the application of the name *Menispermum crispum* L. and the subsequent combination *Tinospora crispa* (L.) Hook. f. & Thoms. Most authors using the name *T. crispa*, including Diels in Engler, *Pflanzenr.* IV. 94: 142 (1910), have applied it to material of *T. glabra* (Burm. f.) Merr.

Roxburgh's *Menispermum verrucosum* first published in 1810 by Fleming was based on living plants cultivated in the Calcutta Botanic Garden which were said to have been brought from Sumatra. I have not, however, seen any specimens from that island, although it could have been cultivated there as a medicinal plant.

T. gibbericaulis Hand.-Mazz. from Yunnan is placed in the synonymy of this species on the basis of the description—the holotype in Vienna no longer exists and I have not traced an isotype. It is clear from the description that the specimen was without leaves and had stems with prominent tubercles and male flowers with outer sepals thickened at the base, inner sepals unguiculate and 3 petals, features which indicate *T. crispa*. The latter is also recorded from China by Lien in *Acta Phytotax. Sin.* 13: 37, t. 2/2 (1975) in a survey of Menispermaceous medicinal plants of China.

Tinospora thorelii Gagnep. was based on several specimens all cited as 'Thorel 350'. The two leafless female specimens belong to *T. sinensis* (Lour.) Merr.: these are both *Thorel* s.n. from the Me-Kong Expedition, (1) from Kemmarath (♀ flowers) and (2) Ubon River (fruits). Of the remaining specimens, those with tuberculate stems and male flowers belong to *T. crispa*. Two sterile sheets of *Thorel* 350 from 'Cochinchine' with pustulate stems may belong to *T. baenzigeri* Forman. Gagnepain incorrectly described the number of petals in the male flower as 6. As confirmed by Diels *op. cit.* 136 (1910) under *T. rumphii*, *Harmand* 365 from Cambodia has 3 petals. *Thorel* 350 from Me-Kong Expedition, La-Khôn, a male specimen which I choose here as lectotype of *T. thorelii*, also has 3 petals as I have myself confirmed. A combined sketch of male and female flowers attached to the sheet erroneously indicates the number of petals in the male flower as 6, a number which is correct for *T. sinensis*. It is worth noting that there is a solitary female flower of *T. sinensis* in an envelope attached to the sheet; the flower probably comes from the Kemmarath specimen.

The holotype of *T. mastersii*, a Masters collection from Assam, was stated by Diels to be in *Herb. Calcutta*, but this specimen was subsequently presented to the Berlin Herbarium, where it is now preserved. Diels also cited a fruiting specimen from Assam collected in August, 1846 as a Griffith collec-

tion, but since Griffith died in February 1845 he was clearly not the collector. The specimen concerned, which is at Calcutta, does not bear a collector's name and appears most likely to be a duplicate of the Masters collection and is therefore probably an isotype.

In the Wallich Herbarium at Kew there are two sterile collections from Burma under Cat. no. 4966 (Ab and B) which probably belong to this species: 4966Ab from Kalian River, Lower Burma is just a piece of old stem bearing some scattered warts, not all very prominent; 4966B from Amherst consists of lengths of stem, mostly bearing rather crowded prominent warts, and there are also some old, unbranched inflorescences, mostly detached, from which all flowers have fallen.

A further collection from Burma, with male flowers but no leaves, which probably also belongs to *T. crispa* is *McKee* 6115 (K).

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.

Apart from the Assam material, which was formerly regarded as *T. mastersii*, the fruits of *T. crispa* have apparently not been collected until very recently. This is most surprising for a medicinal plant well known over a considerable area and known to Western Science since the time of Rumphius, three centuries ago. As a result of intensive searches in Thailand, Dr H. 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 October, 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 Dr Bänziger, leaves are present during the rainy season April–May to November–December or later if growing in a humid place. Plants flower late January to March; the flowers are scented. Fruits were collected in April and May.

CHINA. Yunnan, *Handel-Mazzetti* 5816 (W†).

INDIA. Bengal, near Sagor, Nov. (fruit), *Pierre* s.n. 1863 (P).

ASSAM. Without further locality: Aug. (fruit), prob. *Masters* s.n. (CAL); (fruit), *Masters* s.n. (B, K).

BURMA. Pegu, (fruit), *Kurz* 1797 (CAL, K). Lower Burma, Sandoway (sterile), *Musgrave* s.n. (K). Myebon, rocky slope near sea, Feb. (♂), *McKee* 6115 (K). Rangoon, Febr. (♂), *Rodger* 18 (CAL). Lower Burma, Kalian R. (sterile), *Wallich Cat.* 4966Ab (K–W). Amherst, (sterile), *Wallich Cat.* 4966B (K–W).

CAMBODIA. Campong-soai, *Harmand* 365 (K, P).

THAILAND. NORTH. Chiangmai: Doi Suthep, Monthatharn Waterfall, Oct. (leaves), *Bänziger* 36–2 (K); Mae Malai, Pa Pä, Oct. and Dec. (leaves), *Bänziger* 36–3 (K) and 36–5 (K) & March (♂), *Bänziger* 36–29 (K); Huan

Kaao, July (♂), *Bänziger* 71-5 (K); Doi Saket, May (♂), *Bänziger* 71-6 (K), March (♂), *Bänziger* 71-15 (K) & May (♂), *Bänziger* 71-16 (K). Fang, Agric. Experim. Statn., March (♀ fls.) & May (fruits), *Bänziger* 86-30 (K). Between Chieng Dao and Fang, Feb. (♂), *Sørensen et al.* 1382 (K). NORTH-EAST. Me Kong, Lakhon (♂), *Thorel* 350 (P). EAST. Ubon, Bung, Jan. (♂), *Kerr* 8361 (BM, K). CENTRAL. Saraburi, Sam Lann, Nov. (♂), *Bänziger* 71-21 (K), Feb. (♂), *Bänziger* 71-22 (K) & 71-25 (K) & Jan. (♂), *Bänziger* 71-31 (K). Bangkok, Feb. (♂), *Kerr* 14352 (BM, K) & Jan. (♂), *Marcan* 1961 (K). SOUTH-WEST. Kanburi, Wangka, Febr. (♂), *Kerr* 10453 (BM, K).

MALAYA. 'Malacca', (♂), *Griffith* s.n. (K). Singapore, Thomson Rd, Jan. (sterile), *Togashi* 6212413 (KYO).

JAVA. No further locality, (♂), *Horsfield* 'Menisp. 4' (K). 'Buitenzorg', Dec. (sterile), *Bakhuizen v.d. Brink* 7255 (L) & April (sterile), *Bakhuizen v.d. Brink* 7418 (L). [Prob. W Java], May (sterile), *Popta* 1093 (L).

LESSER SUNDA Is. Sumbawa, Nov. (sterile), *Colfs* 310 (L).

PHILIPPINES. Mindoro: Mt Yagaw, Oct. (sterile), *PNH* 19135 (L, PNH). LUZON: Central, (♂), *Loher* 1988 (K). Manila, Masabong, March (♂), *Sp. Blancoan*. 903 (K, L) & Oct. (sterile), *Sp. Blancoan*. (BM, K, L). Mindanao: Zamboanga del Norte, (sterile), *PNH* 38402 (PNH).

CULTIVATED. Hort. Bogor, no. XVII.1.53a (♂) (K, L).

11. *Tinospora baenzigeri* *Forman* sp. nov. *T. crispae* (L.) Hook. f. & Thoms. affinis a qua caulibus lenticellas dispersas gerentibus sed tuberculis prominentibus carentibus, foliis infra ad basin laminae pari domatiorum cavorum praeditis, floribus 6-petalis, drupis et endocarpiis minoribus, endocarpiis atrocineris differt. Typus: Thailand, *Kerr* 12345 (holotypus K; isotypus BM).

Characters as in *T. crispae* except:—*Stems* up to c. 6 cm diam. when old, bearing scattered pustular-lenticels but lacking prominent tubercles. *Leaves* with a pair of hollow domatia present in axils of basal nerves on lower surface. *Flowers* with 6 petals. *Drupes* yellow, radiating from subglobose carpophore 1 mm long on peduncle 5-7 mm long; pericarp drying very thin; endocarp thinly bony, blackish-grey, 7-9 × 5-6 mm, broadly elliptic in outline, rounded at base, slightly keeled at apex, with a weak dorsal ridge, surface papillose or almost smooth. (Fig. 3 D-G).

HABITAT. 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 South 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.

VERNACULAR NAMES AND USES. A few specimens from Thailand collected by Kerr and Marcan bear the same vernacular names 'ching cha li' and 'chinchali' as are used for *T. crispae*, 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. crispae* (see above, p. 378).

NOTES. This species is very close to *T. crispae*, with which it shares many

features. Recognition of *T. baenzigeri* as a distinct species is due entirely to Dr H. Bänziger whose valuable collections of both species in Thailand together with his critical field-knowledge of the plants have provided the essential data for separating the two species.

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 (October–November). Flowering begins mid-December and lasts until mid-February, the individual plants remaining in flower for about one month. The flowers have a strong but pleasantly fragrant scent. Fruits appear from mid-January.

?[S VIETNAM. 'Cochinchine', (leaves), *Thorel* 350 (K, P)].

THAILAND. Without further locality, (♂), *Schomburgk* 176 (K). NORTH. Tak Prov., Lan Sang For. Res., Jan. (♀ fls., fruits), *Bänziger* 30–7 (K). Nakawn Sawan, Takli, Nov. (♂), *Put* 2142 (BM, K). CENTRAL. Bangkok, Bangkhien: Feb. (fruits), *Bänziger* 30–2 (K), Dec. (♂), *Bänziger* 30–5 (K), Nov. (♂), *Bänziger* 30–10 (K) & Feb. (fruits), *Bänziger* 30–17 (K). Bangkok Prov., Rangsit, Feb. (♂), *Bänziger* 30–12 (K). Road from Nakhon Sawan to Kamphaeng Phet, July (leaves) & Dec. (♂), *Bänziger* 30–34 (K) & Dec. (♂), *Bänziger* 30–35 (K). Bangkok: Dec. (♂), *Kerr* 3889 (BM, K), Jan. (fruits), *Kerr* 3943 (BM, K), Jan. (♂), *Kerr* 6725 (BM, K), Sept. (leaves), *Kerr* 7855 (BM, K), & Jan. (fruits), *Kerr* 7855A (BM, K), Dec. (♀ fls.), *Kerr* 16223 (BM, K), Jan. (♂), *Marcan* 568 & 1944 (BM, K), Jan. (♀ fls.), *Marcan* 1945 & 1953 (K) & Dec. (♂), *Eryl Smith* 214 (K). SOUTH WEST. Prachuap, Khiri Khan, Huai Yang Waterfall, S of Prachuap, Feb. (♂ & fruits), *van Beusekom* & *Santisuk* 2730 (K, L). PENINSULAR. Surat, Ta Kanawn, March (♂), *Kerr* 12345 (holotype K; isotype BM).

12. *Tinospora smilacina* Benth. in Journ. Linn. Soc. 5, Suppl. 2: 52 (1861), & Fl. Austral. 1: 55 (1863); Miers, Contrib. Bot. 3: 37 (1871); F. Muell., Fragm. Phytogr. Austral. 9: 82 (1875); F. M. Bailey, Queensl. Fl. 1: 28 (1899); Banks, Illustr. Bot. Capt. Cook's Voy. 1: 6, pl. 4 (1905); Specht & Mountford, Rec. Amer.–Austral. Exped. Arnhem Land 3: 229 (1958). Type: Australia, N Territory, Plains of Promise, *D. Moore* s.n. (holotype K!).

T. walcottii F. Muell. ex Benth., Fl. Austral. 1: 56 (1863). Type: W Australia, Nickol Bay, *Walcott* s.n. (holotype? K!).

T. berneyi F. M. Bailey in Queensl. Agric. Journ. 18: 76, 340 (1907) & 20: 241 (1908), & Compreh. Cat. Queensl. Pl. 29, fig. 10 ter. (1913). Type: Queensland, Spring Valley, Hughenden, *Berney* s.n. (isotype K!).

Slender liane, entirely glabrous. *Stems* with smooth pergamentaceous bark, raised lenticles usually sparsely, sometimes densely, scattered. *Leaves* with petioles 1–7(–11) cm long; lamina variable in shape, triangular-ovate, ovate, broadly deltoid or rhomboid, sometimes (on young shoots) lanceolate-elliptic, base cordate, truncate to cuneate, apex acutely acuminate to broadly obtuse, (2–)6.5–15 × (1–)5.5–14 cm, fine reticulation more prominent on lower surface, thinly to stiffly papyraceous, glandular patches present in basal nerve-axils. *Male inflorescences* axillary or arising from the scars of fallen leaves, sometimes appearing when plant is leafless, pseudo-racemose, 4–7 cm long, the flowers in fascicles of usually 3, bracts retrorse,

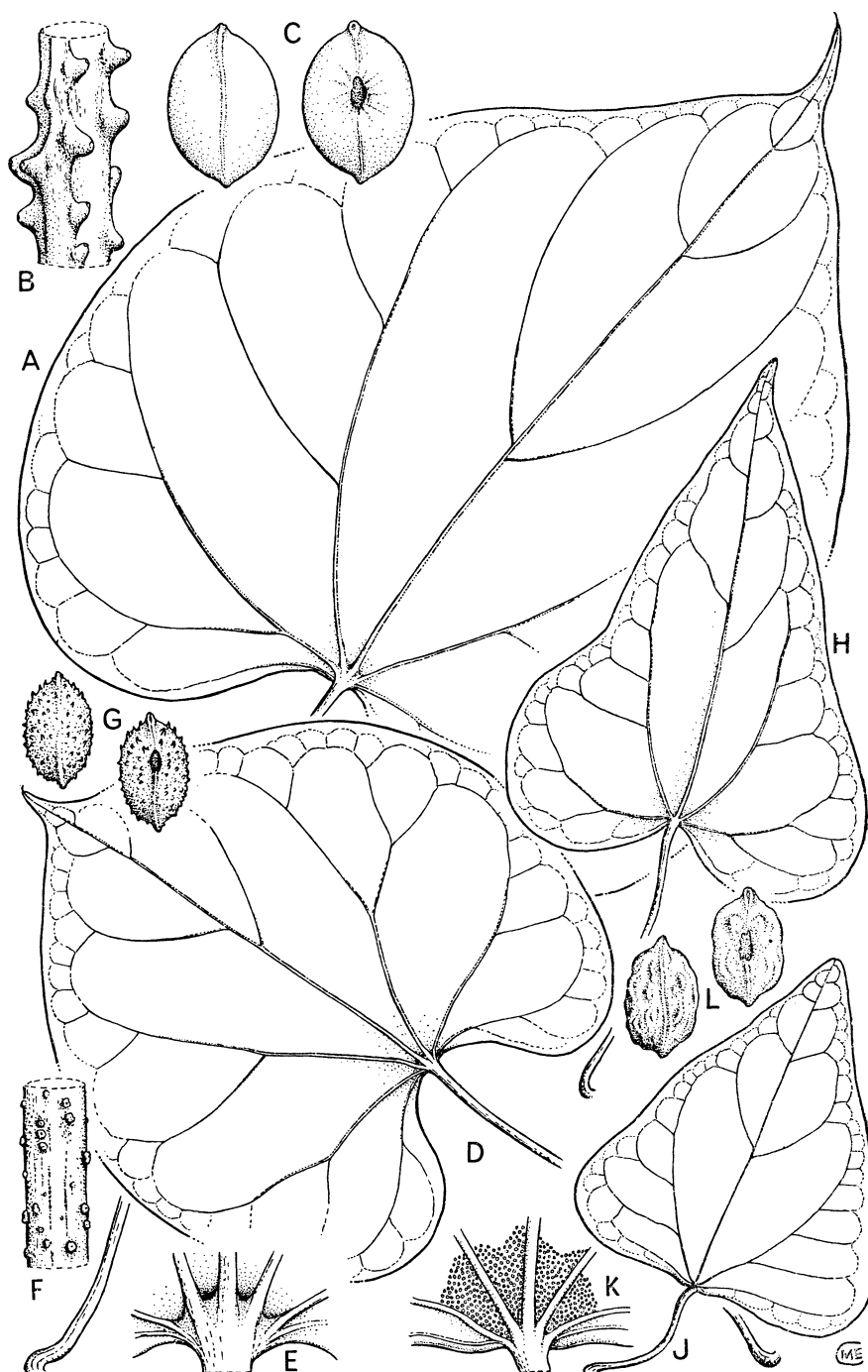


FIG. 3. **A-C** *Tinospora crispa*. **A** leaf $\times \frac{2}{3}$; **B** stem $\times 1$; **C** endocarp, dorsal and ventral views $\times 2$. **D-G** *T. baenzigeri*. **D** leaf $\times \frac{2}{3}$; **E** leaf-base showing pocket-domatia $\times 4$; **F** stem $\times 1$; **G** endocarp, dorsal and ventral views $\times 2$. **H-L** *T. smilacina*. **H-J** leaves $\times \frac{2}{3}$; **K** leaf-base showing glandular patches $\times 4$; **L** endocarp, dorsal and ventral views $\times 2$. **A** from Bänziger 71-6; **B** from Bänziger 71-21; **C** from Bänziger 86; **D-E** from Bänziger 30-10; **F** from Bänziger 30-14; **G** from Bänziger 30-17; **H** from Schultz 711; **J** from Parker 477; **K** from Lazarides 6531; **L** from Must 1289. Drawn by Mrs M. Church.

ovate-acute, 1 mm long. *Male flowers* on pedicels 1–2.5 mm long: sepals pale green, outer 3 ± ovate, 1 mm long, inner 3 broadly elliptic, 3.5 mm long, petals rhomboid-cuneate with the lateral margins incurved, 1.5–2 mm long, glandular externally near base; stamens clavate, 3 mm long. *Female inflorescences* as in male but racemose, from 2 cm long. *Female flowers* on pedicels 2–4 mm long; sepals and petals as in male flowers; staminodes subulate, 0.5 mm long; carpels ellipsoidal, 2 mm long with convoluted-lobed stigma, borne on obpyramido-globose gynophore, 1 mm long. *Drupes* red, radiating from usually unbranched subglobose carpophore 1.5–2 mm long (sometimes very shortly 3-branched) on peduncle 4–9 mm long; pericarp drying thin and close to endocarp; endocarp thinly bony, 7–8 × 4–5 mm, oblong-elliptic in outline, shortly pointed at both ends, lacking a prominent dorsal ridge, surface obscurely rugose, ventral aperture suboblong. (Fig. 3 H–L).

HABITAT. The following habitats up to 50 m altitude are recorded in field-notes: sandy beach, sandstone area, red sandy soil, monsoon forest on coastal dune, dune scrub on river bank, open eucalypt forest on brown loam.

W. AUSTRALIA. Cambridge Gulf, Sept. (sterile), *Cunningham* 469–1819 (K). Careening Bay, Oct. (♂), *Cunningham* 289–1820 (K). Kimberleys, 16 miles N of Noonkanbah Statn., Oct. (♂), *Lazarides* 6531 (K). Ord River, 5 miles E of Kimberley Res. Statn., July (fruits), *Perry* 2563 (K). Lennard R., Aug. 1905 (♂), *Staer* s.n., (E). Nickol Bay, (young fruit), *Walcott* s.n. (K).

N. TERRITORY. W Arnhemland, Canon Hill, July (♂), *van Balgooy & Byrnes* 1323 (K). Black Point, Sept. (♀ fls.), *Byrnes & Maconochie* 1040 (K). Plains of Promise, 29 Aug. 1856 (♀ fls., fruit), *D. Moore* s.n. (holotype K). Douglas Daly Experimental Station, Oct. (fruit), *Must* 1289 (K). 130 km W Timber Creek, Sept. (♂), *Parker* 477 (K). Port Darwin, (♂), *Schultz* 511 (K) & (young buds), *Schultz* 711 (K) & (♀ fls.), *Schultz* 779 (K). Gulf of Carpentaria, Groote Eylandt, April (fruit), *Specht* 273A (K). Yirrkala, July (A–♀ fl., B–♂), *Specht* 789 (K).

QUEENSLAND. Spring Valley, Hughenden, Sept. 1905 (fruit), *Berney* s.n. (K). Thursday I., May (fruit), *Cowley* s.n. (K). Port Douglas, June 1894 (sterile), *Cowley* s.n., (K). Cape York Peninsula, Somerset, June 1897 (fruit), *Bailey* s.n. (K). Sweers I., June 1901 (sterile), *Bailey* s.n., (K). Cooktown, mouth of Endeavour R., May (sterile), *Blake* 23330 (K). Darkam Station, 10 km NE of Cooktown, April (fruits), *McDonald* 1518 (K). Cook Distr., East Hope I., Sept. (sterile), *Stoddart* 4435 (K). Croydon, (♂, ♀ fls.), *Wilson* s.n. 1908 (K).

13. *Tinospora neocaledonica* Forman sp. nov. *T. glabrae* affinis a qua differt floribus cum foliis non coetaneis, pedicellis florum brevissimis, inflorescentiis masculis brevioribus, endocarpio angustiore apertura ventrali majore. Typus: New Caledonia, *McKee* 21361 (holotypus K; isotypi P, Z).

Woody climber, entirely glabrous. *Stems* drying striate when young with scattered lenticels, later developing a smooth coriaceous bark which on old stems becomes detached in flakes. *Leaves* with petioles 2.5–5(–10) cm long; lamina broadly ovate, base broadly cordate to subtruncate, apex acuminate, 6–13 × 5–11 cm reticulation raised on both surfaces especially below, thinly papyraceous, finely glandular-papillose patches present in axils of basal and sometimes main lateral nerves. *Inflorescences* not coetaneous with the leaves.

Male inflorescences axillary to leaf-scars, pseudoracemose, 1–4 cm long, flowers 2–3 in axil of subulate bract 0·8–1 mm long. *Male flowers* on pedicels 1–3 mm long; sepals green, outer 3 ovate 0·8–1 mm long, inner 3 ovate-elliptic to broadly elliptic 3–3·5 mm long; petals 6 rhomboid-obovate with lateral edges incurved, externally papillose at base 1·5–2 mm long; stamens 6, yellow, clavate, latrorse 3 mm long. *Female inflorescences and flowers* unknown. *Drupes* red, borne on carpophore 2 mm long on peduncle 4 mm long arising singly from main axis of infructescence; pericarp drying thin; endocarp bony, 8 × 4·5 mm, subelliptic in outline, pointed at both ends, acutely so at base, dorsal median ridge prominent at ends, surface irregularly tuberculate, flattish ventral face with a broadly elliptic, 2·5 mm long aperture to condyle. (Fig. 4 A–B).

HABITAT. Coastal and degraded forest on limestone or meso-nummulitic schists up to 250 m altitude; climbing on trees or rocks.

NOTES. This species is closely allied to *T. glabra* and *T. smilacina*. On the basis of the limited fertile material so far available, *T. neocaledonica* differs from *T. glabra* by flowering when leafless, having flowers with shorter pedicels, shorter male inflorescences and narrower endocarps with a larger ventral aperture. It differs from *T. smilacina* mainly in leaf-shape: *T. neocaledonica* has ovate leaves, the sides being convexly curved with the basal lobes (when the base is cordate) directed downwards (Fig. 4A). In *T. smilacina* the leaves are more triangular with rather straight sides, sometimes concavely curved below with the basal lobes then directed outwards. The endocarps of *T. smilacina* are very similar to those of *T. neocaledonica* apart from the larger ventral cavity in the latter (Fig. 4B).

NEW CALEDONIA. Koumac, Sept. (♂), *Debray* 2811 (K). Vallée de Koumac, Oct. (♂), *McKee* 19704 (K, P) & Dec. (fruit), *McKee* 21361 (holotype K; isotype P, Z). Koumac, March (sterile), *McKee* 26483 (K). Gomen, March (sterile), *McKee* 26499 (K). Nouméa, Baie Tina, Dec. (sterile), *McKee* 29498 (K). Vallée de Pouembout, April (sterile), *McKee* 30057 (K). Gomen, Oct. (♂), *McKee* 34162 (K). Nouméa, S of Ouen-Toro, Feb. (sterile), *Virot* 1514 (K, P).

14. *Tinospora cordifolia* (Willd.) Hook. f. & Thoms., Fl. Ind. 1: 184 (1855); Thwaites, Enum. Pl. Zeyl.: 12 (1858); Drury, Handb. Ind. Fl. 1: 30j (1864); Miers, Contrib. Bot. 3: 31, pl. 91 (1871); Hook. f. & Thoms. in Hook. f., Fl. Brit. India 1: 97 (1872); Brandis, For. Fl.: 8 (1874); Kurz, For. Fl. Brit. Burma 1: 52 (1877); Trimen, Handb. Fl. Ceylon 1: 39–40 (1893); Cooke, Fl. Pres. Bombay 1: 18–19 (1903); Prain, Bengal Pl. 1: 209 (1903); Duthie, Fl. Upper Gangetic Plain: 26 (1903); Talbot, For. Fl. Bombay & Sind 1: 36 (1909); Gamble, Fl. Madras 1: 26 (1915); Kirtikar & Basu, Indian Med. Pl. 1: 49, t. 35 (1918), & ed. 2, 1: 77, t. 35 (1933); Haines, Bot. Bihar & Orissa: 18 (1925); Blatter in Journ. Bombay Nat. Hist. Soc. 31: 549–550 (1926); Kanjilal & Das, Fl. Assam 1: 54 (1934); Maheshwari, Fl. Delhi: 53 (1963); Ramaswamy & Razi, Fl. Bangalore Distr.: 194, 652 (1973). Types: *Klein* s.n. (syntype B–Herb. Willd., microfiche 18484/1!); *Roxburgh* s.n., ♂ & ♀ (syntypes B–Herb. Willd., microfiches 18484/2–3!); (probably iso-syntypes BM!, K!).

Menispermum cordifolium Willd., Sp. Pl. ed. 4, 4: 826 (1806); Roxb., Fl. Ind. (ed. 2) 3: 811 (1832).

- Cocculus convolvulaceus* DC., Syst. Veg. 1: 518 (1817), Prodr. 1: 97 (1824).
Type: India, collector unknown (holotype G-DC, microfiche!).
- Cocculus cordifolius* (Willd.) DC., Syst. Veg. 1: 518 (1817), Prodr. 1: 97 (1824); Wight & Arn., Prodr. Ind. Or. 12 (1834); Wight Icon. 485-6 (1840-43); Voigt, Cat. Pl. Calcutta: 330 (1845).
- Tinospora crispa* (L.) Hook. f. & Thoms. var. *nitidiuscula* Miers in Ann. Mag. Nat. Hist. III, 13: 320 (1864), Contrib. Bot. 3: 35 (1871). Type: India, Assam, Khasia, Hook. f. & Thoms. s.n. (holotype K).
- T. fosbergii* Kundu in Ceylon Journ. Sci. (Bio. Sci.) 12: 49, tt. I-III (1976).
Type: Ceylon, Kundu 428 (holotype CAL—not seen).
- [*Cocculus verrucosus* (Roxb. ex Fleming) Wall., Cat. 4966 (1830) *pro parte excl. basionymum et 4966A & B sed quoad 4966C, D & E.*]
- T. convolvulacea* (DC.) B. D. Jackson, Index Kew. 2(4): 1083 (1895) nomen in synon.]

Woody climber, entirely glabrous. *Stems* striate when young, sometimes with scattered lenticels, later developing a smooth, thinly pergamentaceous bark which becomes detached, producing long filiform aerial roots. *Leaves* with petioles 2-7 cm long; lamina broadly cordate to cordate, basal sinus often very broad with attachment to petiole sometimes obtuse within the sinus, apex abruptly acuminate, 6-15 (-20) × 6-13 (-20) cm, palmately 5-7-nerved at the base, thinly papyraceous, glandular-papillose patches (domatia) usually occurring on lower surface in basal nerve-axils and sometimes in axils of main lateral nerves, fine reticulation usually more conspicuous on lower surface, reticulation on upper surface laxer. *Inflorescences* sometimes not coetaneous with the leaves. *Male inflorescences* axillary or arising from axils of leaf-scars on older leafless stems, usually solitary, pseudoracemose, (2-) 5-12 (-20) cm long, slender, bearing few-flowered fascicles. *Male flowers* on very slender pedicels 3-4 mm long; 2 (or ?3) minute additional outermost sepals sometimes present, outer 3 sepals ovate, 1-1.5 mm long, inner 3 elliptic, concave, 3-4 mm long; petals 6, rhombic-unguiculate, lateral edges incurved, lower part externally papillose, 2-2.5 mm long, stamens clavate, 3 mm long. *Female inflorescences* similar to male, but flowers arising singly along axis. *Female flowers* on pedicels c. 5 mm long; sepals similar to male; petals broadly spatulate, lower part externally papillose, 2.5 mm long; staminodes subulate, 1.5 mm long; carpels broadly ellipsoidal, 1.75 mm long, stigma capitate. *Drupes* red, radiating from the very shortly 3-branched carpophore c. 2 mm long on peduncles 4-7 mm long; pericarp drying very thin; endocarp very thinly bony, broadly elliptic or subrotund in outline, 6-7 mm long, rounded at both ends, with a weak dorsal ridge, surface slightly papillose, ventrally flattened with small elliptic aperture leading to deeply intrusive condyle. (Fig. 4 C-E).

HABITAT. The specimens examined lack information on habitat other than a solitary mention of an altitude of c. 1000 m (India, Himachal Pradesh), but according to various floras the species is common in hedges and thickets, and also occurs in forests.

USES. The following information is given in Wealth of India 10: 251 (1976): the species was mentioned in Ayurvedic literature as an ingredient in several preparations used for general debility, dyspepsia, fevers and urinary diseases; it is used in Bihar to heal fractures; antiviral properties against Ranikhet

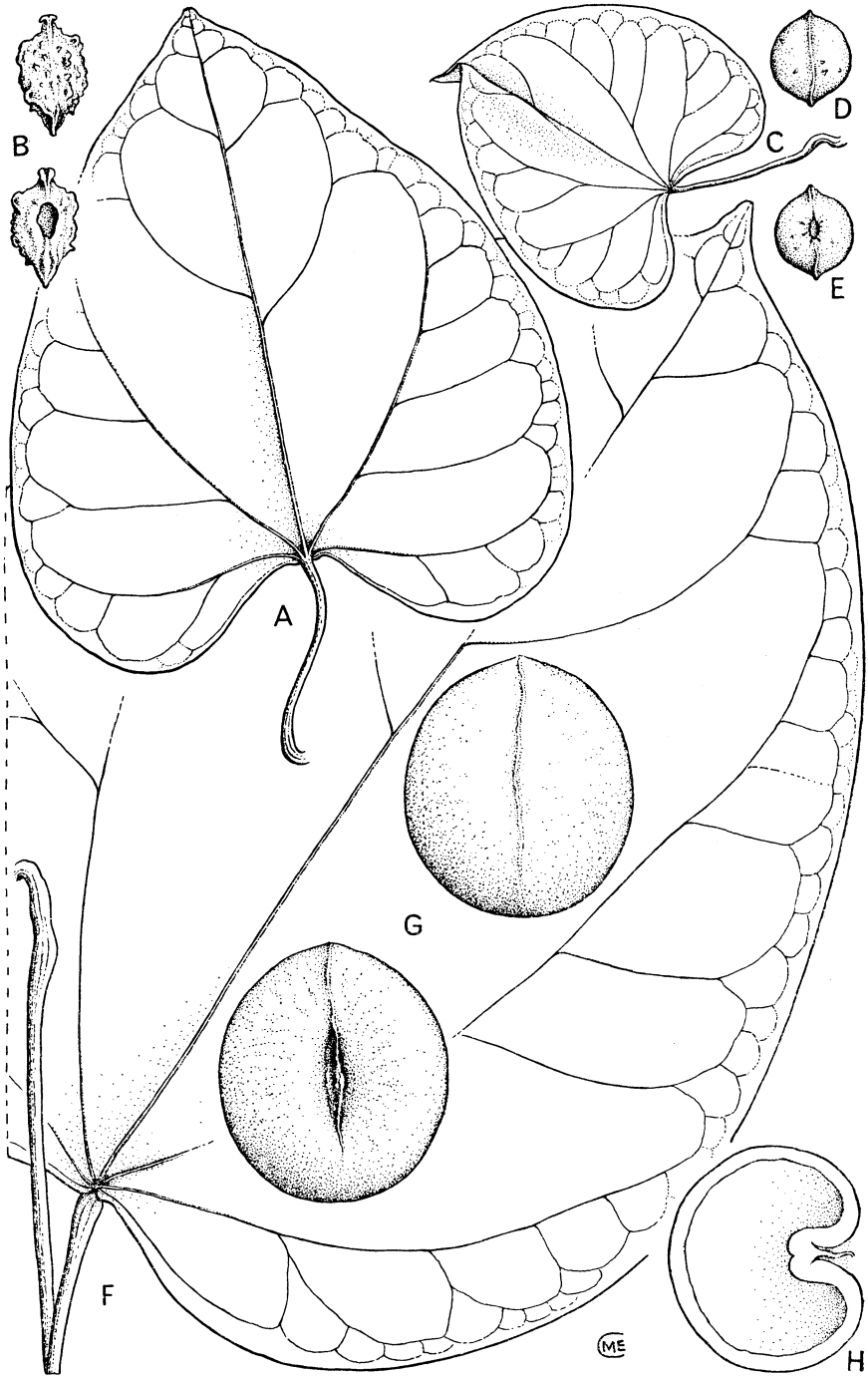


FIG. 4. A-B *Tinospora neocaledonica*. A leaf $\times \frac{2}{3}$; B endocarp, dorsal and ventral views $\times 2$. C-E *T. cordifolia*. C leaf $\times \frac{2}{3}$; D-E endocarp dorsal and ventral views $\times 2$. F-H *T. arfakiana*. F leaf $\times \frac{2}{3}$; G endocarp, dorsal and ventral views and H in T.S. $\times 2$. A from McKee 26483; B from McKee 21361; C from Haines 3733; D-E from Herb. Griffith s.n.; F-H from Jacobs 9100. Drawn by Mrs M. Church.

disease in poultry are reported (references given); various bitter principles occur (references given); the leaves provide good cattle-fodder.

According to Kanjilal & Das *l.c.* (1934), elephants are fond of the aerial roots, which are considered to be a good tonic for them.

A note on an unnumbered Beddome collection from Trichinopoly, Tamil Nadu, India states: 'The porous wood is scraped and mixed with the juice of *Calotrophis* and applied to scorpion-bites with great efficacy.'

According to Malhotra and Moorthy in *Bull. Bot. Surv. India* 15: 13 (1976), the dried stem is powdered, washed with water, mixed with honey and used to treat coughs. Other uses are given by Kirtikar & Basu *l.c.* (1918 & 1933).

VERNACULAR NAMES. India: (Maharashtra State, Chandrapur Distr.) gulvel; (Bengal) gulancha.

NOTES. The type of *T. crispa* (L.) Hook. f. & Thoms. var. *nitidiuscula* Miers, an unnumbered collection by Hooker and Thomson from Khasia Hills, is sterile but almost certainly belongs to this species, which is known to occur in Assam.

Details of embryology of the species are given by Joshi in *Amer. Journ. Bot.* 26: 433-439 (1939).

INDIA. Himachal Pradesh: Sabathu, March (♀ fls.), *Drummond* 1213 (K). Haryana: Hissar, Mt Tosham, July (sterile), *Drummond* 3049 (K). Karnal, Sept. (sterile), *Drummond* 3050 & 3051 (K). Karnal, Ucha Suvana, April (fruits), *Drummond* 6291 (E, K). Bihar: Mongger, April (fruits), *Hamilton* 2229/1 (E & sub. Hb. Wall. 4955A in K-W), Sept. (♀ fl.), *Hamilton* 2229/2 (E & sub Hb. Wall. 4955A in K-W), April (♂), *Hamilton* 2229/3 (E), May (♂), *Hamilton in Hb. Wall.* 4955A (K-W). W Bengal: Darjeeling Tenai, Feb. (♂), *Gamble* 429A (K). Locality uncertain, Banks of the Jelle(-?), Sept. (fruits), *Griffith* s.n. (K). Santal Parganas, Dumka, Dec. (♂), *Haines* 3734 (E, K). 'Bengal', Feb. (♀ fl.), *Watt* 349 (K). Assam: Khasia, Ascent to Mahadeb, June (sterile), *Hooker.f. & Thoms.* s.n. (K). 'Assam', (young buds), *Jenkins* s.n. (K). Cachar, Sept. (♂), *Keenan* s.n. (K). Madhya Pradesh: Between Assirghur and Bogur, (young buds), *Jacquemont* 220 (825) (K). Maharashtra: Bombay, (fruits), *Dalzell* s.n. (K). Nagpur, Nov. (fruits), *Haines* 2883 (K). S Chanda, Oct. (♂), *Haines* 2884 (K). Orissa: Puri Distr., Khurda Hill, Sept. (♀ fl.), *Haines* 3733 (K). Andhra Pradesh: Nellore Distr., Tummalapenta, July (♂), *Gamble* 12209 (K). Ganjam Distr., March (♂), *Gamble* 13914 (K). Godovari Distr., Jan. (fruits), *Gamble* 15889 (K). Kurnool Distr., Pyapali, July (young fruits), *Gamble* 16332 (K). Mysore: Kurg, (♂), *Hooker, f. & Thoms.* s.n. (K). Tamil Nadu: Trichinopoly Distr., (♀ fl.), *Beddome* 134 (BM). Trichinopoly, Banks of Canvery, (♂), *Beddome* s.n. (BM). Madura Distr., Periyakolam, July (♂), *Bourne* 726 (K). Nilghiri Hills, (young buds), *Hooker.f. & Thoms.* s.n. (K). Tranquebar, (old ♀ fl.), *Soc. Unit. Fratr.* s.n. 1775 (BM). Madras, Poonamalla, March (♂), *G. Thomson* s.n. (K). Pulicat, March (♂), *Wight* 31 (E). Madras (former sense), (♂), *Wight* 44 (BM, E, K). Palamcottah, Oct. (young buds), *Hb. Wight*, Kew Distr. no. 38 (K).

BANGLADESH. Dinajpur, May (fruits), *Clarke* [?]6413 (K). Chittagong, Feb. (♀ fl.), *Clarke* 6506 (K). Dacca, April (fruits), *Clarke* 6798 (K) & 16996A (K). Punkabari, Feb. (old ♀ fl.), *Clarke* 13895A (BM). Comilla-Teela, Sept. (sterile), *Clarke* 14218 (BM).

CEYLON: Murunkan, Giants Tank, March (♂), *Simpson* 9354 (BM). No further loc., (sterile), *Thwaites* CPI053 (K). Causeway to Mannar I., Feb. (fruits), *Townsend* 73/107 (K, E).

15. *Tinospora arfakiana* Becc., Malesia 1: 140 (1877) pro parte excl. inflorescentiis. Type: West New Guinea, Arfak Mts, *Beccari* 641 in part, infructescence and fruits only, excluding inflorescences (lectotype FI! chosen here).

Tinomiscium arfakianum (Becc.) Diels in Engler, *Pflanzenr.* IV. 94: 116 (1910) pro parte excl. inflorescentiis.

Woody climber, entirely glabrous. *Stems* rather smooth without conspicuous lenticels when young, bark on old stems with raised elongate lenticels c. 5–10 mm long. *Leaves* with petioles 10–15 cm long; lamina ovate, cordate or slightly so at the base, acuminate to broadly acuminate at the apex, 18–28 × 11–23 cm, palmately 5–7-nerved at the base, with a series of short tertiary nerves running at right angles to the mid-rib, 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 long, pseudoracemose towards apex, 18–70 cm long. *Drupes* red, 1(–3) on peduncles 8–15 mm long, drying smooth, broadly ellipsoidal, ventrally flattened and slightly concave, 17–24 × 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. (Fig. 4 F–H).

HABITAT. In eastern New Guinea occurring in montane rain-forest at 1500 m in primary forest on old, well drained volcanic soil at 600–700 m while in W New Guinea in the Vogelkop Peninsula it has been collected in forest at only 30 m.

NOTES. This species has for long been known only from some fruits and an infructescence which form part of a mixture collected in West New Guinea by Beccari in 1872. The other element in this mixture consists of the female inflorescences of *Tinomiscium*: no leaves were collected. Beccari made it clear that the fruits and inflorescences were collected from different plants on different occasions, but he felt certain that they were conspecific and he consequently described the mixture as *Tinospora ? arfakiana*, the question mark reflecting his uncertainty about the genus. Diels in *Das Pflanzenreich* IV. 94: 116 (1910), recognizing the generic identity of the inflorescences, transferred the species to *Tinomiscium* and published a new combination. His detailed description covering the inflorescences, female flowers and also the fruits implies that he considered all these elements to be conspecific. In an accompanying note, however, he did admit the possibility of a mixture, realizing that the fruits may belong to *Tinospora*. He concluded that the species therefore remained doubtful. It cannot, therefore, be argued that Diels lectotypified the epithet *arfakensis* by the inflorescences.

The leaves, together with fruits, were first collected in 1948 by Dr A Kostermans not far from Beccari's original locality. Similar material has

since been collected in Papua New Guinea. In order to continue the usage of Beccari's name for this species, I have selected the fruiting portion of Beccari's collection at Florence as lectotype, excluding the inflorescences. There still remains some doubt, I feel, as to whether the species is correctly placed in *Tinospora*. As Beccari pointed out, its seeds differ from *Tinospora* in having the endosperm not ruminant. The very smooth whitish endocarp is also remarkable (Fig. 4G). Now that the leaves are available they prove to be so much larger and more robust than is usual in *Tinospora*; also the bark does not flake off in the manner characteristic of that genus. Only when the flowers of this plant are known can its generic position be confirmed.

WEST NEW GUINEA. Arfak Mts, Putat, (fruit), *Beccari* 641 (FI). Vogelkop Penins., Manokwari subdist., Momi, Aug. (fruit), *Kostermans* 2898 (BO, L).

PAPUA. Mt Bosavi, N side, Oct. (fruit), *Jacobs* 9100 (L).

NORTHEAST NEW GUINEA. W Sepik District, Telefomin subdist., valley E of Busilmin airstrip, April (fruit), *LAE* 59375 (L).

16. *Tinospora dissitiflora* (*Laut. et K. Schum.*) *Diels* in Engler, Pflanzenr. IV. 94: 144 (1910). Type: NE New Guinea, *Lauterbach* 2662 (holotype B!)

Aspidocarya dissitiflora *Lauterb. & K. Schum.* Fl. Deutsch. Schutzgeb. Südsee 312 (1900).

A. stenothyrsus *K. Schum.* Nachtr. Fl. Deutsch. Schutzgeb. Südsee 264 (1905).

Type: NE New Guinea, *Weinland* 269 (holotype B!; isotypes BO!, L!).

Tinospora peekelii *Diels* in Engler, Bot. Jahrb. 52: 188 (1915). Type: New Ireland, *Namatani*, *Peekel* 518 (♂ & fruit, syntypes B!).

Slender woody climber, entirely glabrous. *Stems* striate when young, lenticellate, later developing a pergamentaceous subnitidous bark, drying wrinkled. *Leaves* with petioles 6–13 cm long; lamina ovate to broadly ovate, base slightly cordate or truncate, apex abruptly acuminate, 11–16 × 7.5–12 cm, reticulation very fine and raised on both surfaces, stiffly papyraceous, glandular patches present in basal nerve axils on lower surface. *Male inflorescences* axillary or arising from older, leafless stems, pseudopaniculate, 13–20 cm long, the lower lateral branches up to 3.5 cm long. *Male flowers* on very slender pedicels 5–10 mm long; 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* pseudopaniculate 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. *Drupes* red, usually only one developing on each 3 mm long columnar carpophore, on peduncles 1.3–2.5 cm long, very knobbly 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 × 7–8 mm, ventrally flattish with a large elliptic cavity (i.e. the condyle). (Fig. 5A).

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

NOTES. 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.

WEST NEW GUINEA. Nassau Mts, Oct. (fruit), *Docters van Leeuwen* 10708 *pro parte excl. folia* (K).

NORTHEAST NEW GUINEA. Sepik Distr.; (fruit), *Ledermann* 7546 (K); Musu village, July (fruit), *NGF* 19393 (LAE). Morobe Distr.: Wanaru Plantation, Feb. (fruit), *NGF* 9765 (K). Oomsis: April (♂), *Brass* 29199 (K, LAE), May (♂) *NGF* 12270 (K) & March (fruit), *NGF* 12272 (LAE); Bupu R., near Lae, April (fruit), *NGF* 12277 (LAE); Aluki area E of Lae, March (♀ fl. fruit), *NGF* 43907 (K, L); Lae subdistr., Sankwep, March (fruit), *NGF* 44584 (K, L); Matatukam near Finschafen, (sterile), *Weinland* 269 (B, BO, L).

PAPUA. [Central Distr.], Koitaki, June (♂), *Carr* 12634 (BM, K). Gulf Distr., Baimuru subdistr., Purari R. delta area, March (fruit), *LAE* 61099 (K).

NEW BRITAIN. West, Kilenge, Dec. (♂), *NGF* 30427 (LAE). East, Pomio subdistr., Matong, Jan. (♂), *Panoff* 505 (LAE).

NEW IRELAND. Namatanai, Salimun, July (♂, fruit), *Peekel* 518 (B).

17. *Tinospora tinosporoides* (*F. Muell.*) *Forman* comb. nov.

Fawcettia tinosporoides *F. Muell.*, *Fragm. Phyt. Austral.* 10: 93 (1877); *Moore, Handb.* 71. N.S.W.: 20 (1893); *Bailey, Queensl. Fl.* 1: 29 (1899); *Diels in Engler, Pflanzenr.* IV. 94: 130, fig. 47 (1910). Type: Australia, New South Wales, Richmond R., *Fawcett* s.n. (syntypes MEL!).

Woody climber, entirely glabrous. Stem to 12 (–?) mm diam., young stem smooth, drying slightly striate, later with lenticels erupting from the bark as small longitudinal fissures. *Leaves* with petioles (2–) 3–8 cm long, swollen and geniculate at base, less so at apex; lamina triangular to ovate, base truncate with subangled basal corners or slightly cordate, apex acute to obtuse, (6–) 8–13 × (3–) 5.5–10 cm, reticulation prominent on both surfaces, basal nerves not extending beyond half-way up the lamina, 3–4 pairs of lateral nerves anastomosing towards margin, domatia absent, stiffly papyraceous to thinly coriaceous. *Inflorescence* axillary or ramiflorous, a narrow pseudopanicule, 3–11 cm long, apically spiciform, bearing dense spikes below, 0.4–0.7 cm long. *Male flowers* sessile: sepals 8–9 with 2–3 minute outermost sepals 0.3–0.5 mm long, 3 middle sepals narrowly ovate, 1 mm long, 3 inner sepals elliptic, 2 mm long; petals 6, elliptic with lateral edges incurved and clasping opposite stamen; stamens 6, clavate, 1.3 mm long. *Female flowers* (incompletely known): carpels 3, curved-ellipsoidal, 1 mm long, stigma shortly lobed, gynophore small, subglobose. *Infructescence* up to 15 cm long, with lateral branches to 3 cm long. *Drupes* red, borne on carpophore 2 mm long on peduncle 2–3 mm long; pericarp drying thin; endocarp bony, curved-ellipsoidal, more pointed at one end (? basal), 1.6–1.8 × 1 cm, whole surface densely spinulose, lacking a distinct dorsal ridge, with a ventral narrowly elliptic aperture leading to deeply intrusive condyle; endosperm entire, not ruminant. (Fig. 5B–D).

HABITAT. Frequent in dense rain forest.

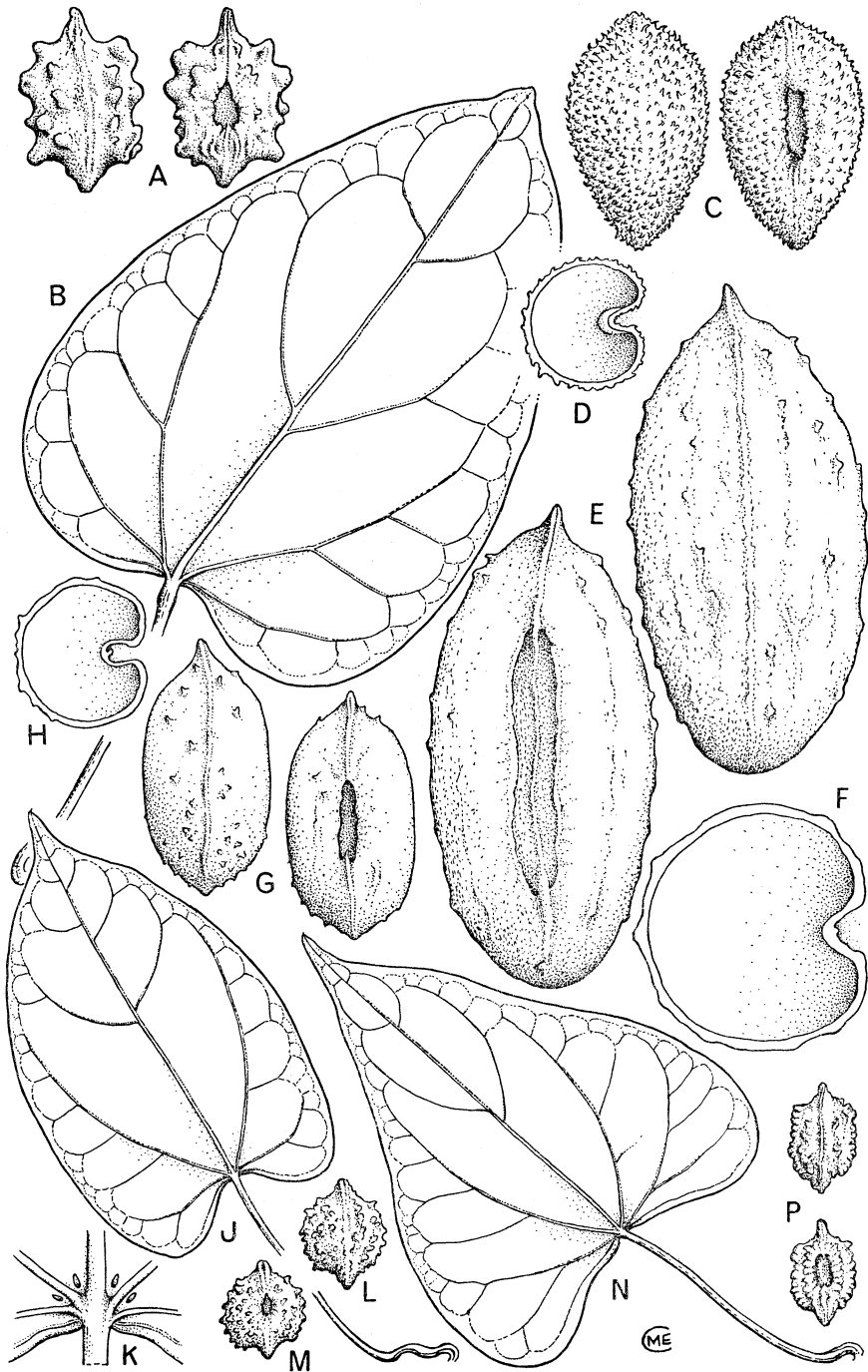


FIG. 5. **A** *Tinospora dissitiflora*, endocarp, dorsal and ventral views $\times 2$. **B-D** *T. tinosporoides*. **B** leaf $\times \frac{2}{3}$; **C** endocarp, dorsal and ventral views and **D** in T.S. $\times 2$. **E-F** *T. macrocarpa*. **E** endocarp, dorsal and ventral views and **F** in T.S. $\times 2$. **G-H** *T. teijsmannii*. **G** endocarp, dorsal and ventral views and **H** in T.S. $\times 2$. **I-M** *T. glabra*. **J** leaf $\times \frac{2}{3}$; **K** leaf-base with domatia $\times 4$; **L-M** endocarp, dorsal and ventral views $\times 2$. **N-P** *T. subcordata*. **N** leaf $\times \frac{2}{3}$; **P** endocarp, dorsal & ventral views $\times 2$. **A** from NGF 44584; **B** from NSW 90151; **C-D** from Fawcett s.n.; **E-F** from KL 2190; **G-H** from Hort. Bogor XI. B.5; **J-K** from Forman 418; **L-M** from Jacobs 4758; **N** from Zippelius s.n.; **P** from Koch s.n. Drawn by Mrs M. Church.

NOTES. The genus *Fawcettia* F. Muell, was retained for this species by Diels in Das Pflanzenreich (*l.c.*) where he distinguished it in his key from *Tinospora* by the presence of a third, outermost whorl of sepals. These sepals are, however, most insignificant and minute, and not all three are always present. Additional outermost sepals are also sometimes found in *T. cordifolia*, *T. merrilliana* and *T. trilobata* and for this reason *T. merrilliana* was transferred to *Fawcettia* by Yamamoto (see p. 389). This small difference does not justify recognition of *Fawcettia*, especially since in all other characters the present species falls within the range found in *Tinospora*, to which it is here transferred. It may be noted that the endosperm of *T. tinosporoides* appears to be entire and not ruminant as is usual in *Tinospora*, but entire endosperm also occurs in *T. arfakiana* Becc.

AUSTRALIA. New South Wales: Richmond River, (♂, ♀ fl. & fruits), *Fawcett* s.n. (MEL). 10 miles W of Wiangeree, Toonumbar State Forest, O'Donnell Creek, May (sterile), *Constable* 4889 in NSW 90151 (K).

18. *Tinospora sumatrana* (*Scheffer*) *Beccari*, *Malesia* 1: 139 (1877). *Boerlage*, *Cat. Pl. Phan. Hort. Bot. Bogor.* 1: 36 (1899) *pro parte* & 2: 118 (1901). *Diels* in *Engler, Pflanzenz.* IV. 94: 144 (1910). Type: *Cult. Hort. Bogor.* (holotype BO!; isotypes FI!, K!, L!).

Limacia sumatrana *Scheffer*, *Obs. Phytogr.* pt. 3: 76, t. 9 (1872) & in *Tijdschr. Ned. Ind.* 32: 398 (1873).

Woody climber, entirely glabrous. *Stems* striate with pustular lenticels, later covered with a smooth pergamentaceous bark. *Leaves* with petioles 3.5–8 cm long; lamina broadly ovate to ovate, base cordate to truncate, apex acuminate, 8–12 × 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, zig-zag 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 long. *Drupes* 3 on stout 1.5 cm long peduncles, subnavicular-ellipsoid, 4.5 × 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 [*teste* *Beccari*: with divaricate broad thinly foliaceous cotyledons, radicle terete, superior].

HABITAT. No data other than altitude ± 200 m (*Iboet* 391).

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.

SUMATRA. Lampong, Estate Wai Lima, Dec. (♂), *Iboet* 391 (BO, L). *Billiton*, (fruit), *Riedel* s.n. (FI).

CULTIVATED. Hort. Bot. Bogor. [originally collected in Sumatra, Lampong by Teijsmann] (♂), no. XVII. I. 68 (K, L) also without cult. no. (FI).

19. *Tinospora macrocarpa* Diels in Engler, Pflanzenr. IV. 94: 141 (1910); Ridley, Fl. Malay Penins. 1: 103 (1922). Type: Malaya, Malacca, *Maingay* Kew Distrib. 111 (holotype K!).

‘? *Tinospora uliginosa*’ sensu Hook. f. & Thoms. in Hook. f., Fl. Brit. India 1: 97 (1872) *non* Miers.

Scandent shrub, entirely glabrous. *Stems* striate with pustular lenticels, later covered with a smooth pergamentaceous bark. *Leaves* with petioles (2–) 5–10(–16) cm long; lamina broadly ovate to ovate (or elliptic-ovate), base cordate to truncate (or rounded), apex acuminate, 6–13(–21) × (3.5–) 6–10(–17) cm, surface drying matt with reticulation rather obscure, papillose patches sometimes present in basal nerve-axils on lower surface, very thinly to stiffly papyraceous. *Male inflorescences*: a few arising together from the older, leafless stems, unbranched, very slender, sometimes slightly zig-zag, 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 long); 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. *Drupes* 3 on stout 1–2 cm long peduncles, orange-yellow, ellipsoidal, 3.5–4.5 × 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 finely lobed margins, radicle cylindrical, superior. (Fig. 5 E–F).

HABITAT. No data other than altitude c. 150 m in Province Wellesley (*Burkill* 9030).

VERNACULAR NAME. Buah pelay tedong, akar kepayang (Temuan).

NOTES. This species is known from only very limited and incomplete specimens which present certain problems. The only material known up to the present has been the type collection, *Maingay* Kew Distrib. no. 111 from Malacca, and this consists of leaves, fruits, infructescences and portions of stem all detached from one another and mounted on two sheets. The leaves are broadly cordate and the fruits are remarkably large for *Tinospora*. There is a further *Maingay* collection (also on two sheets), Kew Distrib. no. 112 from Singapore, involved in this species. In the Flora of British India 1: 97 (1872), Hooker *fil.* and Thomson incorrectly referred this collection, admittedly with a question-mark to *Tinospora uliginosa* Miers, now a synonym of *T. glabra* (Burm. f.) Merr. It is strange that Diels did not account for this collection, especially since its strikingly large fruits are so similar to those of his *T. macrocarpa*, i.e. *Maingay* K.D. 111. The leaves, however, differ mainly in being ovate to elliptic-ovate with a rounded to truncate base. Two of these leaves are attached to a portion of stem which certainly appears

to belong to the remainder of the two Maingay collections. With some hesitation, I am accepting these leaves as conspecific with those of *Maingay* K.D. 111. Apart from the difference in shape, the olivaceous colour on drying and the thinner texture of no. 112 is noticeable, but these features are found in *Burkill* 9030 from Province Wellesley; also the truncate base is approached in *Curtis* 1231 from Penang. A further important point about *Maingay* K.D. 112 is the presence of a few loose inflorescences in a paper capsule with a few buds, mostly detached. The only other collection from Singapore, *Goodenough* s.n., has ovate leaves like those of *Maingay* 112.

Typical of the period when they were collected (1867 and 1868), the Maingay specimens bear no field-data, but the labels do carry references to Maingay's mss. notes, which are preserved in the Kew Library. In vol. 2, p. 143 of the mss. there are notes on *Maingay* 3133 (= Kew Distrib. no. 111) consisting of a detailed description of the fruits, especially of the structure of the seed and embryo, and this is accompanied on the facing page by illustrations of the broadly cordate leaves and the fruits. This information has been invaluable for the present account in drawing up a description of the internal structure of the fruits. On p. 80 of the same mss. volume there are notes on *Maingay* 2594 (= Kew Distrib. no. 112), again with detailed notes and illustrations of the fruits, together with a brief mention of the inflorescences and flowers. Unfortunately, there is nothing concerning the leaves, referred to above.

Concerning the flowers, Maingay added some words of apology: 'I regret to say that from the extreme minuteness of the parts and their softness from being preserved for some time in saline solution, I was unable to make out the exact structure of the flowers from the few at my disposal for dissection'. It is therefore most satisfactory to report that over a century later I have been able to observe clearly the structure of the young buds after soaking them in a solution of detergent. Surprisingly, they prove to be male, which means that the inflorescences must come from a different plant from the fruits. I have no reason, however, to doubt that the inflorescences and fruits belong to the same species: this conclusion is supported by the foliage and inflorescences of the two collections from Province Wellesley and Penang.

Similar inflorescences, flowers and fruits occur in the very closely related *T. sumatrana* (Scheff.) Becc. *Curtis* 1231 shows distinct signs of the zig-zag conformation of the inflorescences resulting from the retrorse direction of the flower-fascicles which is a feature of the type of *T. sumatrana*. Although the flowering material available of both species is very limited, it shows *T. sumatrana* to have subequal sepals, while in *T. macrocarpa* the outer sepals are very much smaller than the inner sepals.

SINGAPORE. Tanah Runto, Feb. (fruit), *Goodenough* s.n. (BM). Sept. (♂ + fruit), *Maingay* Kew Distrib. 112 (K).

MALAYA. Province Wellesley, Oct. (♂), *Burkill* 9030 (K). Selangor, Ulu Langat, Bukit Chemum, Jan. (fruit), *Millard* in KL 1919 (QRS) & Nov. (fruit), *Millard* in KL 2190 (QRS). Penang, Waterfall, Sept. (♂), *Curtis* 1231 (K). Malacca, May (fruit), *Maingay* Kew Distrib. 111 (K).

The following recent collection from Sabah belongs in the affinity of *T. macrocarpa* and *sumatrana*: SABAH. Lahad Datu, Ganduman For. Res., N of Kampung Tegupi, Sept. (fruits), SAN 82333 (K, L, SAN). The field-notes

describe the plant as a climber 10 m long, 30 cm in girth, growing on flat land at about sea-level.

Since this material is in fruit, it does not show the necessary features of the sepals which distinguish these species. The large fruits are on peduncles 4–5 cm long, very much longer than in the limited fruiting material known for *T. macrocarpa* and *sumatrana*. The pale endocarp is very thin, lacking a dorsal carina, and it has an almost smooth surface which is only very obscurely rugose in places. The leaves are submembranous, but their thinness is no doubt due to their immaturity. Further collections of this plant, especially in flower, are required.

20. *Tinospora teijsmannii* Boerl., Cat. Hort. Bogor: 117 (1901); Diels in Engler, Pflanzenr. IV. 94: 141 (1910); Merr., Enum. Bornean Pl.: 249 (1921); Yamamoto in Journ. Soc. Trop. Agric. 16: 96 (1944). Types: Cult. Hort. Bogor. XI. B. 5 (syntypes B!, BO!, K!, L!) & XVI. D. 64 (syntypes BO!, K!, L!).

Slender woody climber, entirely glabrous. Stems drying striate, later developing scattered raised lenticels. Leaves with petioles 4–10 cm long; lamina broadly cordate, often obtuse at insertion of petiole within the broad basal sinus, apex acuminate, 10–13 × 9–12 cm, one pair of domatia present in basal nerve-axils on lower surface, very thinly papyraceous. Male inflorescences and flowers unknown. Female inflorescences a few arising together from older leafless stems, pseudoracemose, lax, 25–30 cm long, the flowers arising 1–2(–3) together. Female flowers with pedicels 9–12 mm long; 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. Drupes 1–3 on peduncles 12–20 mm long arising from main axis of infructescence, ellipsoidal, 20–25 mm long, c. 15 mm broad, pericarp drying thin in loose folds around endocarp; endocarp thinly bony, 16–18 × 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. (Fig. 5 G–H).

CULTIVATED. Cult. Hort. Bogor. XI. B. 5, fruit (B, BO, K, L). XVI. D. 64, ♀ fl. (BO, K, L).

21. *Tinospora glabra* (Burm. f.) Merrill in Journ. Arn. Arb. 19: 340 (1938); Yamamoto in Journ. Soc. Trop. Agric. 16: 95 (1944); Backer & Bakh. f., Fl. Java 1: 157 (1963). Type: ? Java, collector unknown, spm. (♀ fl.) in Herb. Delessert (holotype G!).

Menispermum glabrum Burm. f., Fl. Ind. 216 ('316') 1768 *excl. synonym.* Rheede. *Cocculus coriaceus* Bl., Bijdr. 25 (1825). Type: Java, Mt Salak, Blume 1056 (holotype L!).

C. bantamensis Bl., Bijdr. 26 (1825). Type not traced.

Dioscorea spiculata Bl., Enum. Pl. Java 1: 22 (1827–8) *excl. synonym.* Rumph.; Hallier in Meded. 's Rijks Herb. 1: 41 (1911). Type: Java, Blume s.n. (holotype L!).

- Tinospora uliginosa* Miers in Ann. Mag. Nat. Hist. III, 13: 321 (1864) et Contrib. Bot. 3: 35 (1871); Hook. f. & Thoms. in Hook. f., Fl. Brit. India 1: 97 (1872); Beccari, Malesia 1: 139 (1877); King in Journ. As. Soc. Bengal 58: 378 (1889); Backer, Fl. Batavia 1: 34 (1907) et Voorl. Schoolfl. Java 8 (1908). Types: Java, *Zollinger* 568 (syntypes BM!, K!, L!); S Borneo, Banjermasin, *Motley* 716 (syntype K!).
- T. reticulata* Miers in Ann. Mag. Nat. Hist. III, 13: 321 (1864), et Contrib. Bot. 3: 36 (1871); Diels. in Engler, Pflanzenr. IV. 94: 143 (1910); Diels. in Elmer, Leaflet. Philipp. Bot. 4: 1164 (1911); Merrill, Fl. Manila 204 (1912) et Enum. Philipp. Fl. Pl. 2: 146 (1923) et in Philipp. Journ. Sci. 29: 368 (1926); Santos in Philipp. Journ. Sci. 35: 198, t.5 (1928); Yamamoto in Journ. Soc. Trop. Agric. 16: 95 (1944); Hatusima in Mem. Fac. Agric. Kagoshima Univ. 5: 30 (1966). Type: Philippines, Luzon, *Cuming* 1286 (isotypes BM!, K!).
- T. andamanica* Diels in Engler, Pflanzenr. IV. 94: 141 (1910). Type: S Andaman Is., Port Monat, *Kurz* s.n. (holotype CAL!; isotype B!).
- T. coriacea* (Bl.) Beumée ex K. Heyne, Nutt. Pl. Ned.-Ind. ed. 2. 1: 619 (1927); Backer, Onkruidfl. Jav. Sukkerr.: 248 (1930), t. 259 (1936).
- [*Cocculus crispus* sensu Hassk. Pl. Jav. Rar.: 166 (1848), non (L.) DC.]
- [*T. pseudo-crispa* Boerl. ex Backer, Fl. Bat. 1: 35 (1907) nomen in synonym.]
- [*T. crispa* sensu auctt. saepe pro parte incl. Diels in Engler, Pflanzenr. IV. 94: 143 *pro parte majore*, t. 49, D-O (1910), non (L.) Hook. f. & Thoms.]
- [*Dioscorea aculeata* sensu Zoll. & Mor., Syst. Verz. 92 (1845-6), non L.]

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* with petioles 4-8 (-12) cm long; lamina oblong-ovate or narrowly to broadly ovate, base cordate to truncate, with basal lobes rounded or obtusely pointed, apex acuminate, 7-12 (-15) × 5-9 (-13) cm reticulation raised on both surfaces, papyraceous, domatia with distinct apertures usually present on lower surface 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, pseudoracemose, slender, lax, 10-20 cm long, 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 long; 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 long. *Female flowers*: sepals and petals as in male but inner sepals 3 mm long; staminodes 6, subulate 0.5-1 mm long; carpels 3, ellipsoidal, 1.5 mm long including reflexed lobed stigma, borne on a subglobose gynophore 1-1.5 mm long. *Drupe*s red, radiating from unbranched short to columnar carpophore 2-4 mm long on peduncle 4-10 mm long arising from main axis of infructescence; pericarp drying thin and close to endocarp; endocarp thinly bony, 6-8 × 4-5 mm, subrotund or subelliptic in outline, pointed at base, keeled at apex, dorsally convex with a median ridge and irregularly tuberculate, ventrally flattish with a small elliptic aperture to condyle. (Fig. 5 J-M).

HABITAT. Recorded from a variety of habitats at low altitudes, up to 500 m, the following mentioned in field-notes. Malaya: limestone hill. Sumatra: scrub-forest. Krakatau I.: *Casuarina* secondary growth vegetation. Java: primary forest on calcareous rocks; thin forest on calcareous blackish soil; low hills. Sumbawa: dry ridge in semi-moist forest. Sumba: calcareous rocks. Timor: secondary forest on limestone escarpment. Philippines: mangrove; sandy beach; dense forest on river bank; open woods and shrubberies. New Guinea: disturbed primary forest and secondary forest. New Britain: littoral rain-forest.

USES. In the Philippines this species is used for a variety of medicinal purposes, e.g. burnt leaves used to treat pinworms; ground bark applied to sore breasts of nursing mothers. Together with *T. crispa* (L.) Hook. f. & Thoms., this species is known in the Philippines as 'makabuhay', but apparently *T. crispa* is medicinally more effective. The account of 'makabuhay' in Quisumbing, Med. Pl. Philipp. 300 (1951) 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* (see Thornber in Phytochem. 9: 167 (1970)). The material tested, however, may well have been *T. glabra* since the correctness of its identification is uncertain.

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

NOTES. In his original description of *Menispermum glabrum*, Burmann incorrectly cited as a synonym '*Cit-amerdu*' of Rheede, Hort, Malabar. 7: 39, t. 21 (1688). 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* Lam., 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 Burmann from the herbarium of Pryon. Written on the sheet in distinctive handwriting, presumably that of Pryon, is the phrase-name cited by Burmann followed by 'Malaici Daun Tajonan', an indication of the vernacular name ('daun' is the Malayan and Indonesian word for 'leaf'). Burmann has written '*Menispermum glabrum*' on the sheet as well as the mistaken reference to '*Cit-amerdu*' of Rheede. In his *Flora Indica*, Burmann gave the origin of the species as Java, which from the shape of the leaves is probably correct. The specimen has three leaves and a single female inflorescence. Burmann's reference to the vernacular name gives 'Tayonam' instead of 'Tajonan', as written on the sheet. Pryon himself apparently never visited Java, according to *Fl. Males.*, *Cyclopaedia of Collectors*: 418 (1950).

Cocculus bantamensis Bl. is included in the above synonymy on the basis of Backer's identification of the species with *Tinospora coriacea* in his *Bekn. Fl. Java* 3, fam. 34: 9 (1941). It appears from his remarks that he had examined authentic material of Blume's species, but it has not been found at the Rijksherbarium, Leiden.

The anatomical structure of the stem and leaf of *T. glabra* was investigated by Santos in Philipp. Journ. Sci. 35: 187–208 (1928).

As a rule the outer sepals are much smaller than the inner ones, but exceptionally, as in *PNH* 17161 from Mindoro, Philippines, 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 *PNH* 9142 from Polillo, Philippines, the infructescences have a few lateral branches up to 4 cm long, rather similar to those of *T. glandulosa* Merr. This must, however, be regarded as an anomalous specimen which otherwise agrees with *T. glabra*.

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 long, 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. These features of the endocarp and carpophore are not, however, apparent in *NGF* 4752, a poor specimen with four loose fruits and a fifth attached to a broken off, unbranched carpophore, this being the only portion of the infructescence present. Although New Guinea specimens in part show these distinguishing characters, they are not considered on the basis of the material available to be of taxonomic significance. It remains to be seen from further collections how consistent these differences are.

The holotype of *T. andamanica* Diels at Calcutta has drupes with endocarps no more than 8.3 mm long, not 10–12 mm as stated by Diels in his description. The size of these endocarps thus falls within the range of that of *T. glabra* (= *T. crispa* sensu Diels), and therefore *T. andamanica* cannot be distinguished from *T. glabra* on the size of the endocarps as indicated by Diels.

CHINA. Hainan, near Hoihow, (fruit), *Henry* 8085 (K).

S ANDAMAN Is. Port Monat, (fruit), *Kurz* s.n. (B, CAL). Anikhet, Feb. (♂), *King* s.n. (K).

MALAY PENINSULA. (? State), Jalan Kampong Aji, towards Telok Serna, May (♂), *Phytochem. Survey Malaya* KL3079 (K, L). Perlis, Tebing Tinggi, March (fruit), *Ridley* 15195 (K). Perak: Kampong Gelok, Gua Putri limestone hill, March (♂), *Chin* 960 (K); Ipoh, 26 Jan. 1921 (fruit), *Ridley* s.n. (K) & Sungei Siput, Dec. (♀ fl.), *SFN* 6925 (K). Kelantan, Kota Bahru, 17 Feb. 1917 (♂), *Ridley* s.n. (K).

SUMATRA. Without further locality, (fruit), *Forbes* s.n. (BM). Without further locality, (fruit), *Korthals* s.n. (L). W Coast, Priaman, (♂), *Diepenhorst* s.n. (K). E Coast, Medan, (sterile), *Lörzing* 17375 (L). Jambi, Batang Sungai, (sterile), *Posthumus* 941a (L). Rakata I. (= Krakatau), SE side, Oct. (♂), *van Borssum Waalkes* 849 (BO, L).

JAVA. Without further locality, May 1823 (fruit), *van Hasselt* s.n. (L); (♂), *Zollinger* 568 (K, L). w JAVA. Mt Salak, (fruit), *Blume* 1056 (L). Ujungkulan, near lighthouse, Dec. (♂), *Kostermans* 21858 (L). Amsterdam I., April (young buds), *van Ooststroom* 3579 (L). Near Depok, March (fruit), *Schiffner*

1977 (L). E JAVA. Pasurua, May (♂), *Backer* 7069 (L). Besuki, Puger, Feb. (♂), *Buwalda* 7258 (L). Besuki, Nusa Barung I., S coast W of Teluk Kandangan, May (fruit), *Jacobs* 4758 (K, L) & May (♂), *Jacobs* 4769 (K, L). MADURA. Near Kamal, Jan. (♀ fls.) *Hochreutiner* 2801 (Z).

LESSER SUNDA IS. BALI. SW Bali, Pulukan, April (♂), *van Steenis* 7714 (BO, K). Without further loc., (♀ fl.), *Teijsmann* s.n. (K). LOMBOK. Mt Rindjani, June (fruit), *Elbert* 2097 (L). W SUMBAWA. Mt Batulanteh: road from Semongkat to Batudulang, April (fruit), *Kostermans* 18380 (K, L), Sampar Olet, Batu Burung ridges, April (♂), *Kostermans* 18594 (K) & N of Batudulang, May (♂), *Kostermans* 18680 (K, L). SUMBA. 18 km S of Waikelo, near Waimungura, Feb. (fruit), *Bloembergen* 3198 (L). FLORES. Noa, Sept. (♂), *Schmutz* 326 (L). Nisar, Aug. (♂ + fruit), *Schmutz* 1645 (L). Nisar-Sesok, Oct. (♀ fl.), *Schmutz* 1736 (L). Nisar-Naga, Jan. (♂), *Schmutz* 2053 (L). Golo Mepes, March (fruit), *Verheijen* 3110 (L). TIMOR. E Timor, Muapitine, Plateau of Fuiloro, Dec. (♂), *van Steenis* 18158 (L). TANIMBAR Is., Jamdena I., March (♂), *Buwalda* 4338 (BO, L).

BORNEO. S BORNEO. S Banjarmasin, (♀ fl.), *Motley* 716 (K). SARAWAK, Kuching, Sept. (♂), *Ridley* 12466 (BM). SABAH, Mt Kinabalu, Papar, 16 Dec. 1915 (♂) *Clemens* s.n. (PNH).

PHILIPPINES. BALABAC I. Dalawan Bay, Oct. (♂), *Olsen* 465 (K). PALAWAN. Brooks Point, Feb. (♀ fl.), *Elmer* 12685 (E). Aborlan, Iraan Mts, May (♂), *PNH* 12479 (BM, PNH). CALAMIANES. Culion, Aug. (♂). *Bur. Sci* 21652 (K). MINDORO. Mansalay, Kabalwa, Jan. (♂), *PNH* 17161 (K, PNH). Mt Yagaw, SE slope, July (fruit), *PNH* 18593 (PNH) & Sept. (♀ fl.), *PNH* 18788 (PNH). BATAN I. Mt Iraya, July (fruit), *Bur. Sci.* 80203 (K). LUZON. Tabayas Prov., Casiguran, May–June (♀ fls.), *Bur. Sci.* 45220 (BM). Albay Prov., (♂), *Cuming* 1286 (BM). Sorsogon Prov., Mt Bulusan, Irosin, Dec. (fruit), *Elmer* 15260 (BM, K, L). *Ibidem*, July (fruit), *Elmer* 16606 (BM, K, L). Laguna Prov., Mt Maquiling, Los Baños, July (fruit), *Elmer* 18326 (BM, K, L). San Mateo, July (♂), *Loher* 1990 (K). Montalban, Dec. (♂), *Loher* 5550 (K). Sorsogon Prov., Mt Bulusan, Aug. (fruit), *PNH* 2617 (BO, PNH). Zambales Prov., Mt Pinabuto, Nov. (fruit), *PNH* 4773 (PNH) & July (fruit), *PNH* 4844 (PNH). Sorsogon Prov., Irosin, May (fruit), *PNH* 37756 (L, PNH). POLILLO, Karlagen, Jan. (fruit), *PNH* 9142 (PNH). PANAY. Iloilo Prov., Dingle, Nov. (♂), *PNH* 22368 (PNH). Iloilo Prov., Miagao, (fruit), *Vidal* 2070 (K). SULU ARCHIP., Tawitawi, July–Aug. (fruit), *Bur. Sci.* 44112 (BM, P). MINDANAO. Davao Distr., Mt Apo, June (♂), *Elmer* 11044 (BM, E, K, L) & Todaya, July (fruit), *Elmer* 11189 (BM, E, K, L). Zamboanga, Feb. (fruit), *Hallier* 4624 (L). Davao Prov., Tibanban, Aug. (fruit), *PNH* 11016 (PNH). Zamboanga del Norte, Marupay, Feb. (♂), *PNH* 38352 (L, PNH). Davos Prov., Santa Cruz, April (fruit), *Williams* 2935 (K).

NORTHEAST NEW GUINEA. Morobe District: Sattelberg, Dec. (♂), *Clemens* 1051 (L); Wantoat, Feb. (fruit), *Clemens* 11066 (E); Near Lae, Sankwep Logging area, Nov. (♀ fl.), *LAE* 58002 (K, L. LAE).

PAPUA. Milne Bay Distr: Cape Vogel Penins., Menapi, Apr. (♂), *Brass* 21948 (K); Kwagira R., Peria Creek, Sept. (♂), *Brass* 24278 (K); Normanby I., Sewa Bay, Oct. (fruit), *LAE* 52539 (K). Central Distr.: Kanosia, Feb. (young buds), *Carr* 11269 (BM, K, L) & Veiya, March (young buds), *Carr* 11742 (BM, K, L). Northern Distr., Amboga R., Popondetta, March (fruit), *NGF* 4752 (LAE). Cult. Port Moresby (origin: Sogeri), May 1962 (♀ fl.), *White* s.n., (K, L).

NEW BRITAIN. Talasea subdistr., between Wogonakai and Mt Wangore, Oct. (♂), LAE 66752 (L).

SOLOMON IS. Reef Is., Ngamubulou, Feb. (♂) BSIP 6562 (K, L). Rennell I., Dec. (sterile), Christiansen 32 (K).

22. *Tinospora homosepala* Diels in Philipp. Journ. Sci. Bot. 8: 158 (1913) & 9: 83 (1914). Type: Marianne Is., Guam, McGregor 536 (isotypes K!, US!).

Characters as in *T. glabra*, except that the outer and inner sepals are equal; the fruits are unknown. Domatia with distinct apertures are present in the axils of the basal nerves on the lower surface of the leaf.

HABITAT. Anderson 19 was collected from a steep cliff among *Leucaena* and *Clerodendron* near sea-level.

NOTES. In the original description the number of stamens is given as 3, but this must be an error for 6, which is the number found in the two flowering collections that were examined for the present revision. The two isotypes that were available were both sterile.

The status of this species, apparently endemic to Guam, is uncertain. It differs from *T. glabra* in having equal sepals. In all other features (N.B. fruits unknown) it agrees with *T. glabra*. It should be noted, however, that one specimen of *T. glabra* from Mindoro, Philippines, PNH 17161, was found to have flowers with sepals varying from unequal (outer ones much smaller) to subequal (see p. 417). If fruits of the Guam species prove to be indistinguishable from those of *T. glabra*, it would perhaps be preferable to reduce *T. homosepala* to subspecific status under *T. glabra*.

MARIANNE IS. Guam: Asan Point, Aug. (♂), Anderson 19 (US); without further locality, Oct. [♂ *ex descr.*], McGregor 536 (K, US) & (♂), Thompson 479 (B, K, US).

23. *Tinospora subcordata* (Miq.) Diels in Engler, Pflanzenr. IV. 94: 136 (1910). Types: Timor, Zippelius s.n. (syntype B, K!, L!); Spanoghe s.n. (syntype L!).

Hypsipodes subcordatus Miq., Ann. Mus. Lugd. Bat. 4: 82 (1868). Valetton in Bull. Dép. Agric. Ind. Néerl. 10: 11 (1907).

Tinospora polygonoides Diels in Engler, Pflanzenr. IV. 94: 136 (1910), & in Journ. Arn. Arb. 20: 73 (1939). Types: W New Guinea, Merauke, Koch s.n. (♂) & s.n. (fruit)—'360 & 361' in descr. orig. (syntypes L!).

Small woody climber, entirely glabrous. Stems drying striate when young, later becoming minutely verruculose and bearing scattered raised lenticels. Leaves with petioles 2.5–9 cm long; lamina triangular to broadly triangular, base broadly cordate to truncate with rounded, sometimes subhastate, basal lobes, apex acute, 6–10 × 4–9 cm, reticulation raised on both surfaces, papyraceous, glandular patches present on lower surface in axils of main nerves. Male inflorescences axillary, pseudoracemose, (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 long; 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* pseudoracemose, the flowers arising singly. *Female flowers* on pedicels 4–6 mm long: 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 long. *Drupes* red, radiating from columnar gynophore 4–5 mm long on peduncles 5–8 mm long; pericarp drying thin; endocarp bony, \pm elliptic in outline, shortly pointed at base, strongly keeled (in outline pointed) at apex, 7×4 mm, dorsally with a median ridge, surface coarsely and irregularly tuberculate and also minutely rugulose, ventrally with elliptic aperture to shallow ventral cavity. (Fig. 5 N–P).

HABITAT. Rain forest.

LESSER SUNDA Is. Tanimbar Is., Selaru I., Adaut, March (δ), *van Borssum Waalkes* 3152 (L) & *Pleyte* 113 (K, L). Timor, (δ), *Spanoghe* s.n. (L) & (δ & ♀ fls.), *Zippelius* s.n. (B, K, L).

WEST NEW GUINEA. SW New Guinea, Merauke, (δ & fruit), *Koch* s.n. (L).

PAPUA. Western Distr., Mabaduan, April (δ), *Brass* 6501 (BM) & Wassi Kussa R., Tarara, Dec. (δ), *Brass* 8541 (BM).

EXCLUDED AND DUBIOUS NAMES

Tinospora curtisii Ridley in Journ. Bot. 58: 148 (1920) = **Zanonia indica** L. (*Cucurbitaceae*) **synon. nov.**

T. flavescens (DC.) B. D. Jackson, Index Kew. 2 (4): 1083 (1895) nomen in synonym. = **Arcangelisia flava** (L.) Merr. Although Index Kewensis cites Miers in Ann. Mag. Nat. Hist. ser. II, 7: 38 (1851), the combination in *Tinospora* is not made there.

T. glauca (Lam.) Miers in Ann. Mag. Nat. Hist. ser. 3, 13: 319 (1864), & Contrib. Bot. 3: 33 (1871). Basionym: *Menispermum glaucum* Lam. = **Pericampylus glaucus** (Lam.) Merr.; see Forman in Kew Bull. 22: 366 (1968).

T. hullsii F. Muell., Fragm. 5: 147 (1866) = **Pachygone ovata** (Poir.) Hook. f. & Thoms.; see Forman in Kew Bull. 12: 457 (1957).

T. lacunosus (DC.) B. D. Jackson, Index Kew. 2 (4): 1083 (1895) nomen in synonym. = **Anamirta cocculus** (L.) Wight & Arn. The remark under *T. flavescens* above applies here also.

T. megalobotrys K. Schum. & Lauterb., Fl. Deutsch. Südsee 311 (1900) = **Chlaenandra ovata** Miq.; see Diels in Engler, Pflanzenr. IV. 94: 131 (1910).

T. minutiflora K. Schum. in K. Schum. & Lauterb. Nachtr. Fl. Deutsch. Südsee 262 (1905) = **Legnephora minutiflora** (K. Schum.) Diels; see Forman in Kew Bull. 27: 279 (1972).

T. nudiflora (Griff.) Kurz in Journ. As. Soc. Bengal 41: 292 (1872). Basionym: *Cocculus nudiflorus* Griff., Not. Pl. As. 4: 307 (1854). The type of Griffith's species is not known; he described a plant from Mergui, S Burma without leaves but with female flowers with petals ('squamae') 6, the outer 3 larger than the inner 3, which indicates that *T. crispa* is probably the

species concerned. The description by Kurz with its reference to densely pubescent young leaves appears to refer in part to *T. sinensis*, although the large drupes with a smooth white endocarp point to *T. crispa*.

T. palminervis Miers in Ann. Mag. Nat. Hist. ser. III, 13: 317 (1864), & Contrib. Bot. 3: 31 (1871). The type of this name is a sterile specimen Wall. Cat. 4966Aa (K-W) collected below Yenaungeun, Irawaddi R., Burma. It possibly represents *T. cordifolia*, but I have seen no material of that species from Burma.

T. sumatrana (Scheff.) Becc. var. *hanadae* Yamamoto in Journ. Soc. Trop. Agric. 16: 94 (1944). The type (Sarawak, Kuching, *Hanada* BO15) has not been traced: the status of this varietal name based on a sterile specimen must remain uncertain.