CUPANIOPSIS RADLK. (SAPINDACEAE) A MONOGRAPH

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1. CONTENTS

2. SUMMARY

A monograph of *Cupaniopsis* Radlk. (*Sapindaceae*) is presented. Sixty species (20 new) are recognized. One species, *C. macrocarpa*, is subdivided into two varieties (one new). Several regional keys and a multy-entry key give access to the species. Pollen morphology and leaf anatomy were studied beside macromorphology. This resulted in 40 characters for a cladistic analysis. The result of an initial analysis was rejected for several reasons (chapter 10.5). Van Welzen's enhancement method was used to produce a more acceptable cladogram (chapter 10.6).

A short note on the biogeography is given.

3. INTRODUCTION

The genus *Cupaniopsis* Radlk. (*Sapindaceae*) is the subject of the present monograph. The most recent account on the genus was presented by Radlkofer (1933) in his comprehensive treatment of the whole family.

This revision is part of the Flora Malesiana project. Most species of *Cupaniopsis*, however, occur outside Malesia. They were included in the study as this revision should serve as a Ph.D. thesis.

Phylogenetic or cladistic methods provide the best way to construct a natural classification. For a fruitful cladistic analysis a fairly large number of characters is needed.

Macromorphology provided not enough characters, therefore a pollen morphological study and a leaf anatomical survey were performed. The results of these studies were used in the analysis.

Due to the presence of many homoplasies the initial cladogram contains many steps and has a low consistency index. Also some geographical inconsistencies are present. Van Welzens' method (Van Welzen, 1989) was used to solve this problem. However, the accepted cladogram proved to be only slightly better.

A biogeographical analysis showed that the present distribution is due to dispersal and diffusion rather than to vicariance.

4. HISTORY

In 1879 Radlkofer described the genus *Cupaniopsis*. In this new genus he placed some species originally described in *Cupania* (Richard, 1834; Mueller, 1862, 1863, 1875) and *Harpullia* (Mueller, 1863). He also described several new species.

After this start Radlkofer himself and several others described many new species. In 1933 Radlkofer revised *Cupaniopsis* in his comprehensive monograph of the family *Sapindaceae*. It was probably the last genus he revised completely.

After Radlkofer's death many new species were described, especially by Merrill & Perry (1940) from New Guinea and the Solomon Islands, Guillaumin (1950, 1959) and Guillaumin & Virot (1953) from New Caledonia, and Reynolds (1984) from Australia.

As a first result of the present study four new species from New Caledonia were described (Adema, 1988).

5. CONCEPTS

a rose is a rose is a rose
(Gertrude Stein, 1922)

The revision of *Cupaniopsis* has been based on herbarium specimens only. The criterion on which basis species have been distinguished is the presence of at least two characters in which any two species differ from each other (Van Steenis, 1957; Van Welzen, 1989). Distinguished in this way species will always possess a monothetic set of characters. Whether herbarium technique is sufficient to recognize all species is still an open question.

Species are real objects, that exist in nature. They are natural individuals, having a beginning and an end in time (spatio-temporally restricted), existing in nature as cohesive wholes (interbreeding and descent), and can be described (not defined) by their characters only (Ghiselin, 1974; Geesink & Kornet, 1989).

Infraspecific taxa are recognised in *C. macrocarpa* only, *viz* var. *macrocarpa* and var. *polyphylla*. Both varieties are morphologically rather uniform, and may consist of coherent populations. They may be individuals.

Genera, as historical products of continuing evolution, are also wholes, that exist in nature. They are individuals. They should be monophyletic groups, encompassing an ancestral species and all its descendants (Kornet, 1988).

6. MACROMORPHOLOGICAL CHARACTERS

Leaf anatomical characters are discussed in chapter 7, pollen morphological ones in chapter 8.

Habit

Usually small to medium sized trees or shrubs; rarely large trees. Greatest height mentioned: 35 m. Quite often the smaller trees are palmoid (Schopfbaum) with unbranched stems and a terminal crown of leaves and inflorescences. The stems of these trees are usually deeply furrowed and have a thick pith surrounded by a thin cylinder of wood.

Indumentum

Non-glandular hairs — Usually only simple, solitary hairs are present. On axial parts these are either short and appressed or longer and more or less patent.

In a group of Pacific species (sect. *Mizopetala* of Radlkofer) a curious type of scale hairs occurs on twigs, inflorescences, bracts, and flower parts. These are often accompanied by short patent hairs.

The leaflets are often more or less glabrous, with hairs on midrib and nerves only. Sometimes the leaflets are more or less densely puberulous, with the abaxial surface more densely hairy than the adaxial one. In sect. *Mizopetala* the leaflets are often scaly, in the *C. platycarpa*-group they are abaxially sericeous.

Glandular hairs — In most species either one-celled glands or glandular hairs consisting of few stalk cells and a large, glandular top cell are found. In the *C. platycarpa*-group glandular hairs with many stalk cells and a small glandular top cell occur. In *C. acuticarpa* glandular hairs with several stalk cells and a small top cell occur (see chapter 7.3).

'Varnish' and wax

In sect. *Mizopetala* buds, young axial parts, very young leaves, and inflorescence axes are often 'varnished', *i.e.* covered by a shiny, sticky exudate. Older axes and leaflets are quite often pruinose.

Leaves

The leaves are spirally arranged and always paripinnate. They have one to many (more than 20) pairs of leaflets. The rachis of the leaves end in a short terminal process, only occasionally a larger one imitating a terminal leaflet may be found (fig. 1). Pseudostipulae (= reduced, lowermost pair of leaflets) are found in *C. shirleyana* only (fig. 2).

Leaflets

The leaflets are alternate to opposite. They show a wide range in size and form. The base is usually more or less oblique, but never strongly unequal. The apex is rounded to acute, acuminate, or caudate, rarely, in *C. shirleyana* and *C. wadsworthii*, truncate. The margin is often entire, in several species dentate to serrate, or, rarely, lobed. Midrib and nerves are usually not or only sligthly prominent on the adaxial surface, prominent on the abaxial one. Several types of saccate or pocket-like domatia can be found (fig. 3).

Inflorescences

The inflorescences (fig. 4) are usually axillary and together pseudoterminal, probably quite often pendulous, sometimes flagelliform. They are either not, or short to long branched, laxly to densely flowered. In *C. macropetala* and many specimens of *C. serrata* the inflorescences are very short, unbranched and very densely flowered.

Four New Caledonian species of sect. *Mizopetala* are ramiflorous. Here the inflorescences are found in the axils of fallen leaves. Often a kind of brachyblasts (condensed short shoots) was found, probably indicating that the same axil produces inflorescences in several successive years.

The inflorescences are thyrses, the flowers occur in cymes which are raceme-like arranged along the axis. The cymes are mainly dichasial.

Bracts and bracteoles

Bracts to the axis and the cymes are present. Bracteoles are present at the base of the pedicel. Bracts and bracteoles are deltoid to acicular, outside appressed-hairy, or in sect. *Mizopetala* with scale hairs, inside often glabrous. Bracts and bracteoles may be persistent under the fruits.

Flowers

General — In general the flowers are small, sepals up to 6.5 mm long, petals up to 6.2 mm long. Usually the petals are shorter than to as long as the sepals, in *C. grandiflora* and *C. macropetala* they are longer than the sepals. Presumably the flowers are unisexual, either with well developed stamens and undeveloped pistil, or *vice versa* (fig. 5). Probably, the *Cupaniopsis* species are duodichogamous (see chapter 9.1).

Pedicel — The pedicel is divided into two parts. The abscission zone can be present from just above the base to just below the flower.

Sepals — The 5(–7) sepals are dimorph, sepaloid with a narrow to rather wide scarious rim to almost petaloid. The outer two are smaller than the inner three. The only exception is *C. glomeriflora* were 4 (3–5) almost equal sepals are found.

When more than 5 sepals occur, one (or 2) of them is (are) to be considered bracteole(s).

The outside of the sepals is usually appressed-hairy, or, in sect. *Mizopetala*, scaly; the scarious rim is glabrous, the very margin is usually ciliolate with both non-glandular and glandular hairs.

The sepals are often persistent under the fruit.

Petals — All species show 5 petals, except for *C. glomeriflora* where 4 petals are found. The petals are always caducous in fruit. Only rarely a claw is present. The outside of the petals is often appressed-hairy, in sect. *Mizopetala* scaly, the margin is often ciliate and sometimes provided with short, glandular hairs; the inside is often hairy between the appendages.

Petal appendages are always present at the inside of the petals, either in the form of one large free scale, or two small to large free to adnate scales, or as auricles, *i.e.* inrolled margins of the petals. These appendages are usually woolly. Only rarely the appendages bear glabrous crests (fig. 6).

Disc — The disc is always circular and never interrupted. However, the bases of the staminal filaments may break through the disc, and so the disc may seemingly be interrupted. This condition is very different from the character state 'disc interrupted' as found in *Guioa* (see Van Welzen, 1989). The disc may be glabrous to completely hairy, in several species with 5 tufts of hairs alternating with the petals (fig. 7), rarely (in sect. *Mizopetala*) scales may be found.

Stamens — Usually 8 stamens are present, in *C. glomeriflora* only 6, in *C. glabra* 6–8, and in *C. kajewskii*, *C. leptobotrys*, *C. rhytidocarpa*, and *C. vitiensis* 10–14. The filaments are pilose at least up to halfway. The anthers are sligthly caudate, basifixed in the cleft, glabrous to rather densely hairy, and open latrorsely, lengthwise in the male flowers (fig. 8).

Pistil — The ovary is usually 3-lobed, 3-locular, but 2-lobed, 2-locular in *C. bilocularis*, *C. celebica*, and *C. platycarpa*. The ovary is usually smooth, glabrous to densely hairy, or in sect. *Mizopetala* scaly.

Per locule one axillary ovule is present.

The style and stigma usually form a pyramid, of which the upper surface has 3 lines of small stigmatic papillae. The stigmatic lobes remain united and erect, even in fruit.

Fruit

The fruits are very variable in shape, quite often they are more or less top-shaped. Rarely, the fruits are about obcordate and lobed as in *Guioa*. The fruits open loculicid with 3 valves.

The fruits are often sessile, in several species a short, cuneate stipe is present.

The fruit wall is thin to very thick. The exocarp is smooth to rugose and black or brown when dry, glabrous to densely hairy, or in sect. *Mizopetala* scaly. The endocarp is glabrous to rather densely hairy.

In *C. concolor*, *C. guillauminii*, and *C. samoensis* the septa do not develop and the fruits are seemingly 1-locular, the remnants of the septa are visible as a glabrous line or low ridge on each valve. This is already visible in young buds as the carpel rims are free, and not adnate like in the other species.

Seeds

The seeds (fig. 9) are laterally flattened, obovoid to ellipsoid, to about globose, usually black, smooth and shiny when dry. They are surrounded by an arilloid (Van Welzen, 1990, p. 17), except for *C. platycarpa* where a sarcotesta is found (very thick fleshy and totally or partly adnate to the testa).

In *C. napaensis* the testa is apically hairy (fig. 9b).

The inner testa has a radicular pocket pointing towards the micropyle. From this pocket hardly visible pleurograms (predesigned fracture lines, fig. 9c) are present up to the subapical region of the seed.

The hilum is oval to rounded. One can distinguish the true hilum and the pseudohilum (Van der Pijl, 1957; Van Welzen, 1990). The true hilum is the scar of the funicle, the pseudohilum includes the true hilum surrounded by scartissue of the arilloid.

The cotyledons (fig. 10) are usually either dorsoventrally above each other, with the radicle perpendicular to the slit between the cotyledons (notorrhizal embryo), or laterally besides each other, with the radicle parallel to the slit between the cotyledons (lomatorrhizal embryo). However, quite often the cotyledons are obliquely superposed or obliquely parallel, forms that are intermediate between notorrhizal and lomatorrhizal. Rarely both embryo types were found in the same species.

Fig. 1. Top of leaf, showing a terminal leaflet (× 0.75, *C. macrocarpa* var. *macrocarpa*, *MacKee* 4399).

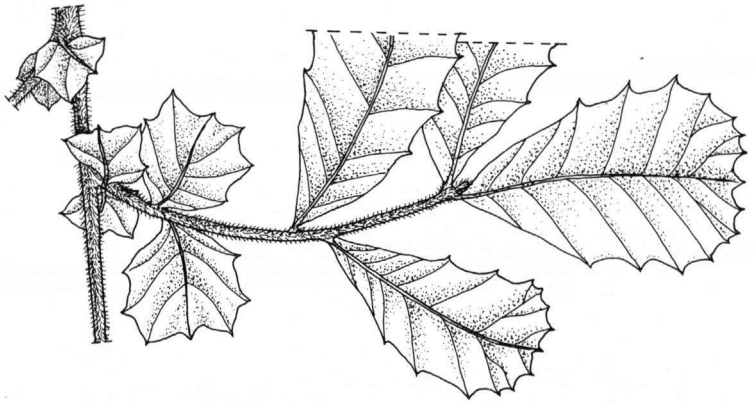


Fig. 2. Pseudostipulae (× 0.75, *C. shirleyana*, *Randall & Young* s.n.).

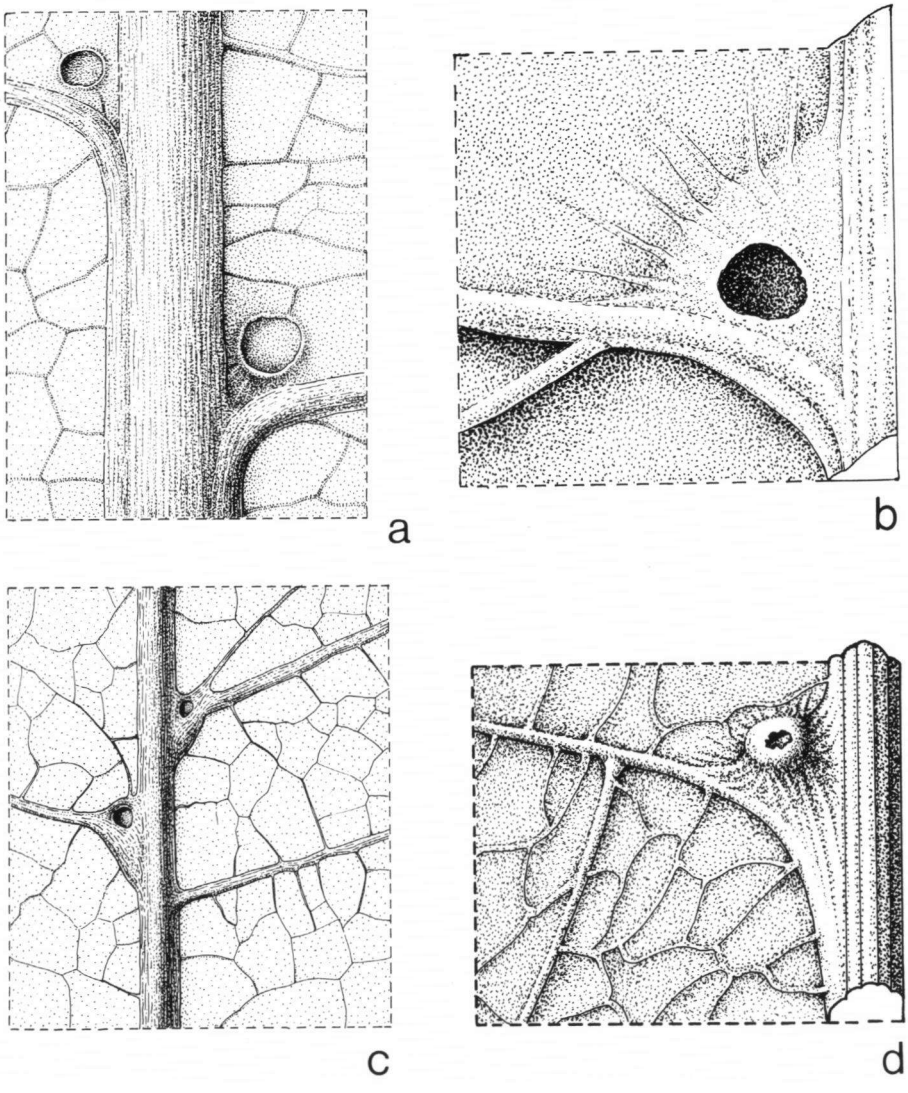


Fig. 3. Domatia. a. Pocket-like (× 20, *C. macrocarpa* var. *polyphylla*, *MacKee* 39490); b, c. dome-shaped (b: × 40, *C. foveolata*, *Clemens* s.n., c: × 5, *C. amoena*, *A.C. Smith* 4083); d. pustulate (× 10, *C. phalacrocarpa*).

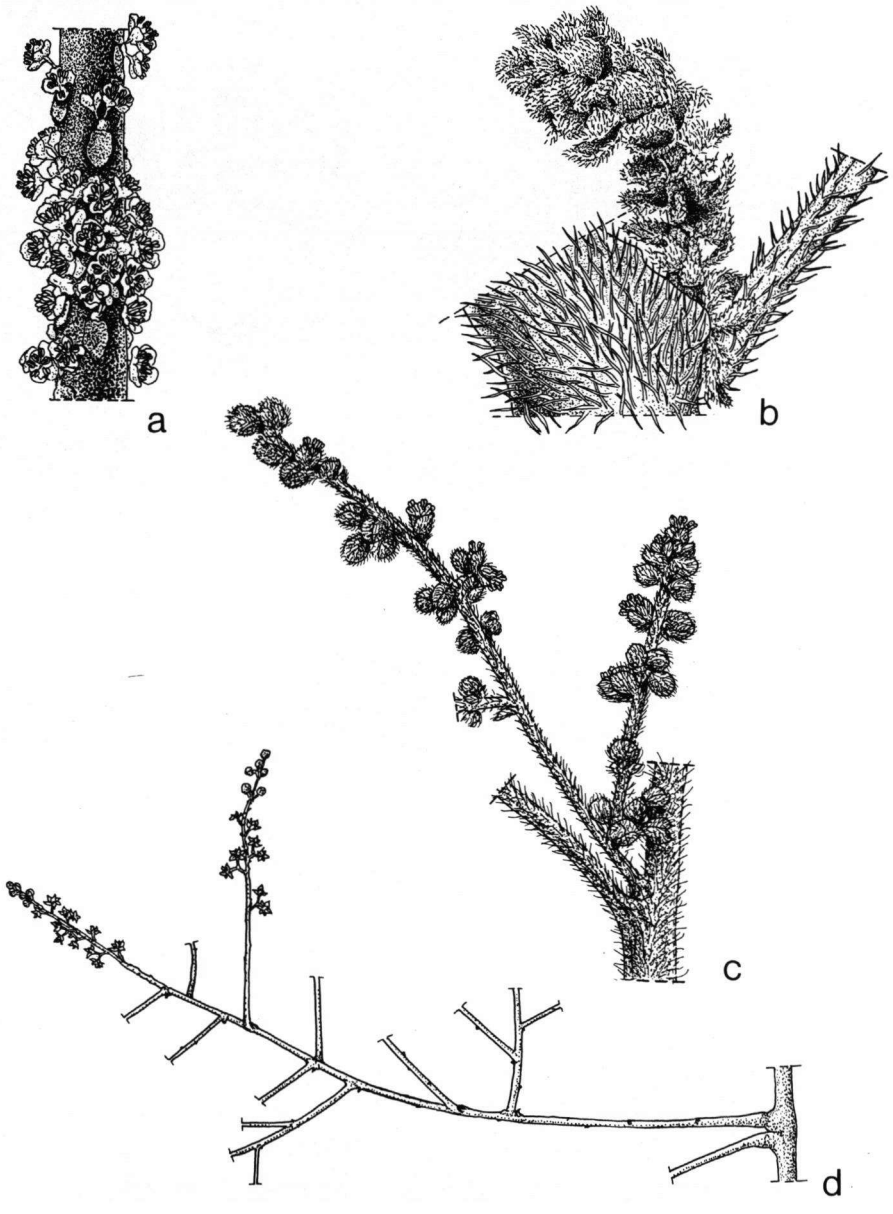


Fig. 4. Inflorescences. a. Cauliflorous (× 1.4, *C. glomeriflora*, *Compton* 139); b. very short, unbranched (× 4, *C. macropetala*, *NGF* 46853); c. short, with few short branches (× 1.4, *C. serrata*, *C.T. White* 11405); d. long, with many long branches (× 0.5, *C. anacardioides*, *McKean* WL 1492).

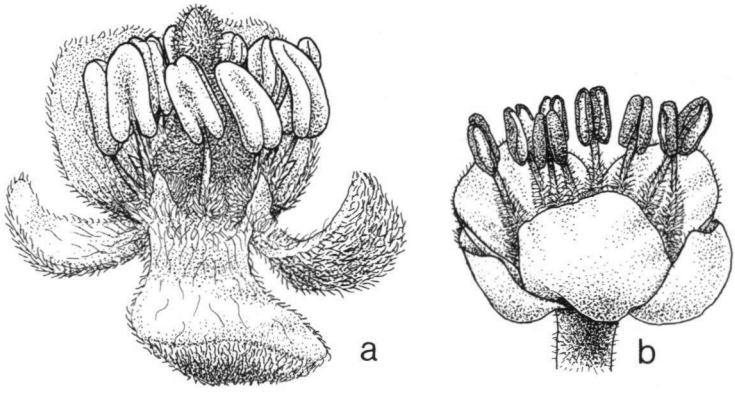


Fig. 5. Flowers. a. Female (× 0.8, *C. macrocarpa* var. *macrocarpa*, *MacKee* 94990); b. male (× 0.8, *C. sylvatica*, *McPherson* 2365).

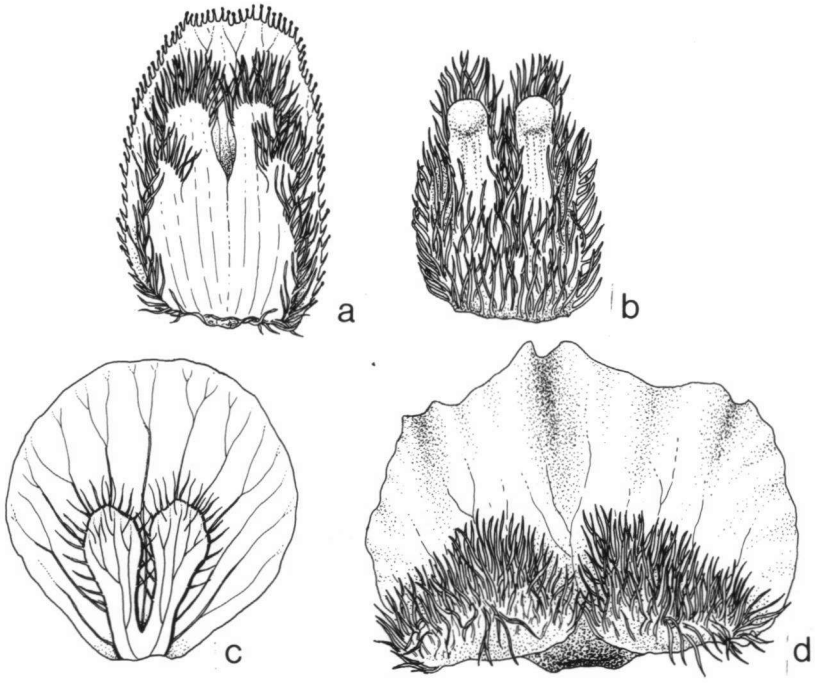


Fig. 6. Petals and petalar appendages. a, b. Petal with one crested scale, a. petal and scale from inside, b. scale from outside, petal removed (× 15, *C platycarpa*, *NGF* 46865); c. petal with two not crested scales (× 2.5, *C. grandiflora*, *McPherson* 3805); d. petal with auricles (× 4, *C. leptobotrys*, *A.C. Smith* 7569).

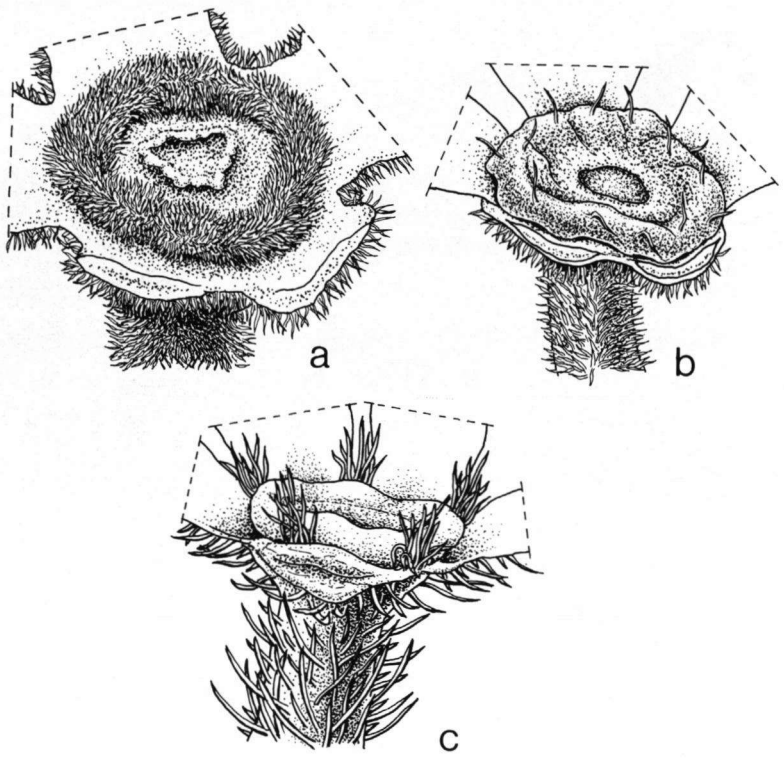


Fig. 7. Disc. a. Totally hairy (× 20, *C. vitiensis*, *DA* 13316); b. sparsely hairy (× 9, *C. kajewskii*, *NGF* 31548); c. hairs in five tufts (× 35, *C. curvidens*, *Forbes* 308).

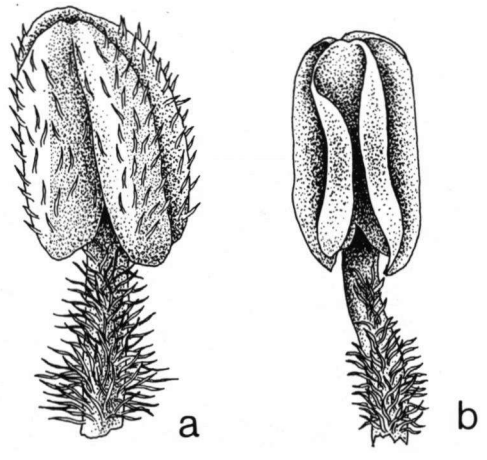


Fig. 8. Stamens. a. Anthers hairy (× 20, *C. tomentella*, *Bailey* s.n.); b. anthers glabrous (× 20, *C. serrata*, *C.T. White* 11405).

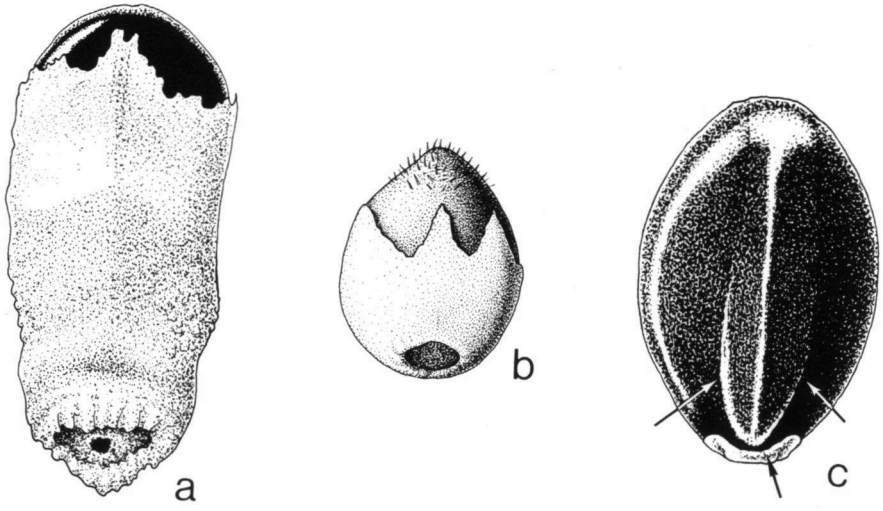


Fig. 9. Seeds. a, b. With arilloid: a. testa glabrous (× 3, *C. petiolulata*, *MacKee* 19933), b. testa hairy (× 4, *C. napaensis*, *UPNG* 4353); c. arilloid removed, visible are (arrows) the radicle pocket and the pleurograms (× 2.5, *C. shirleyana*, *Randall & Young* s.n.).

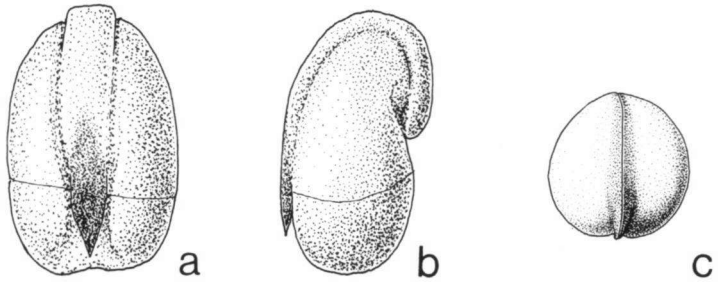


Fig. 10. Embryo types. a, b. Notorrhizal embryo, cotyledons above each other: a. dorsal view, b. lateral view (× 3, *C. anacardioides*, *Kajewski* 78); c. lomatorrhizal embryo, cotyledons laterally beside each other, dorsal view (× 2.5, *C. napaensis*, *UPNG* 4353).

7. LEAF ANATOMY

7.1. Introduction

Radlkofer, the monographer of the family *Sapindaceae*, was also one of the pioneers in systematic plant anatomy. Notes on anatomy can be found throughout his papers (See for instance Radlkofer, 1890, 1895). He even used anatomical characters for the delimitation and naming of species, for instance in *Cupaniopsis*: *C. hypodermatica* (Radlkofer, 1924).

Radlkofer's student Solereder treated the whole family in his survey of the anatomy of the Dicotyledons (Solereder, 1899). In this treatment *Cupaniopsis*, amongst other genera, was mentioned for the possession of certain special traits, for instance: extra horizontal walls in adaxial epidermis cells (in *C. azantha*), hypodermis (in *C. hypodermatica*), idioblasts, undulate anticlinal walls of epidermis cells, crystals and scale-like hairs (see also Metcalfe & Chalk, 1950).

One of the aims of systematic anatomy according to Radlkofer (1883): Clarification of phylogenetic relationship between plant species, is also the purpose of the present study.

7.2. Material and methods

Herbarium material was used for the leaf anatomical study. The material is kept in the Rijksherbarium at Leiden (L), unless stated otherwise (herbarium abbrevations as in Index Herbariorum).

The study is based on 1–3 samples per species, only in some more common or more widely spread species up to 11 samples were studied [*C. anacardioides* (10), *C. curvidens* (11), *C. macropetala* (5), *C. stenopetala* (5)].

Apart from all *Cupaniopsis* species a study was made of *Cupania americana* and *Lepisanthes rubiginosa*, species that serve as possible outgroups in the cladistic analysis, and of *Gloeocarpus patentivalvis* formerly included in *Cupaniopsis*.

Mature, dried leaflets were rehydrated by boiling in water. Transverse sections of the middle part of the lamina, including midrib and margin, were prepared on a sledge microtome and studied unstained. In addition cuticular macerations stained with Sudan IV were studied, these were obtained after incubation of leaflet fragments overnight in a mixture of equal volumes of 30% hydrogen peroxide and glacial acetic acid. All preparations were mounted in glycerin jelly.

Leaflet surfaces were studied with a JEOL JSM-35 scanning electron microscope, after sputter-coating with gold (Polaron SEM coating unit E5100).

The following species and specimens were studied (* = maceration only):

Cupania americana L.: Porto Rico, *Heller* 6355, *Sintenis* 762b; Venezuela, *Breteler* 4178.

Cupaniopsis acuticarpa Adema: New Guinea, *NGF* 22112. — *amoena* A.C. Smith: Fiji, *A.C. Smith* 4083, 4105, 4935. — *anacardioides* (A. Richard) Radlk.:

New Guinea, *Van Royen* 4634; Australia, *Van Balgooy & Byrnes* 1304, *Boorman* s.n. (L 911.121-144), *Brass* 19836, *Forbes & Kenneally* 2453, *Hubbard* 3715, *Lam* 7681, *Martensz* AE 169, *Schodde & Hayes* 3554, *L.S. Smith & Webb* 3124. — *apiocarpa* Radlk.: New Caledonia, *MacKee* 2410, 27726, 40210. — *azantha* Radlk.: New Caledonia, *Bernardi* 12598, *Labillardière* s.n. (P), *MacKee* 16760, *Vieillard* s.n. ('210', P). — *baileyana* Radlk.: Australia, *Bird* s.n. (BRI 349054), *Francis* s.n. (BRI 030622), *McDonald & Whiteman* 2819. — *bilocularis* Adema: New Guinea, *Hoogland & Craven* 10909, *LAE* 51730*, *Soegeng Reksodihardjo* 321. — *bullata* Adema: New Guinea, *LAE* 60052. —*celebica* Adema: Celebes, *Waturandang* 47 (Cel IV-84), 268 (Cel II-369). — *chytradenia* Radlk.: New Caledonia, *MacKee* 24014, 34767. — *concolor* (Gillespie) Ham: Fiji, *A.C. Smith* 5053, 5580, 8171. — *curvidens* Radlk.: New Guinea, *Brass* 21993, *Carr* 14764, 15834, *Darbyshire* 637, *Fallen, Lelean & Akakavara* 276, *Forbes* 308, *Heyligers* 1327, *Hoogland* 4297, *NGF* 19095, 39981, *Pullen* 6702. —*dallachyi* Reynolds: Australia, *Gray* 1037 (BRI). — *diploglottoides* Adema: Australia, *L.S. Smith* 11231A. — *euneura* Adema: New Guinea, *NGF* s.n. (Womersley, L 960.23-075). —*flagelliformis* (Bailey) Radlk.: Australia, *Irvine* 1799, *L.S. Smith* 3328, *Volck* s.n. (L 442709 = AQ 0011605). — *fleckeri* Reynolds: Australia, *Buckley* 6653, *Dockrill* 872, *Smyth* s.n. (BRI 343261). — *foveolata* (F. Muell.) Radlk.: Australia, *Clemens* s.n. (L 959.30-611), *O'Farrell* 22, *L.S. Smith* 11172. — *fruticosa* Radlk.: New Caledonia, *MacKee* 20251, 33249, 34849. —*glabra* Adema: New Caledonia, *MacKee* 40234. — *globosa* Adema: New Caledonia, *Suprin* 2080, *Veillon* 6551. — *glomeriflora* Radlk.: New Caledonia, *MacKee* 33618, 33805, 40163. — *grandiflora* Adema: New Caledonia, *Bernardi* 9592, *MacKee* 12612, 23736. — *grisea* Adema: New Caledonia, *Pennington* 8139. — *guillauminii* (Kanehira) Adema: Truk Tol, *Wong* 277 (A). — *hypodermatica* Radlk.: New Caledonia, *MacKee* 20894, *Schmid* 2889. — *inoplaea* Radlk.: New Caledonia, *MacKee* 16926, 18592, 18639. — *kajewskii* Merr. & Perry: Solomon Islands, *BSIP* 11437, *Craven & Schodde* 445, *Waterhouse* 471B. — *leptobotrys* (A. Gray) Radlk.: New Hebrides, *Bernardi* 13248, *Raynal* 16216; Fiji, *A.C. Smith* 4570, 7457. — *mackeeana* Adema: New Caledonia, *MacKee* 18710, 26592, *McPherson* 6377. — *macrocarpa* Radlk.: New Caledonia, *MacKee* 19511 (var. *macrocarpa*), 23729 (var. *polyphylla* Adema), 39490 (var. *macrocarpa*), *Veillon* 5402 (var. *polyphylla* Adema). — *macropetala* Radlk.: New Guinea, *BW* 3907, 4901, *Jacobs* 9117A, *NGF* 46853, *Van Royen* 5482. — *megalocarpa* Adema: New Caledonia, *MacKee* 17654, *McPherson* 3870. — *mouana* Guillaumin: New Caledonia, *Baas Becking* s.n. (*Baumann-Bodenheim* 6036, P). —*myrmoctona* Radlk.: New Caledonia, *MacKee* 20563, *McPherson* 2427, 2542. — *napaensis* Adema: New Guinea, *UPNG* 4353. — *newmannii* Reynolds: Australia, *Elsol* 50, *Lawson* s.n. (BRI, AQ 398302), *Sharpe & Reynolds* 1995 (BRI). — *oedipoda* Radlk.: New Caledonia, *Guillaumin & Baumann-Bodenheim* 7125, *MacKee* 30948, 39067. —*pennelii* Guillaumin: New Caledonia, *MacKee* 13962, *McPherson* 5584. — *petiolulata* Radlk.: New Caledonia, *Brinon* 641, *MacKee* 22011, *McPherson* 1773. — *phalacrocarpa* Adema: New Caledonia, *MacKee* 20637, 37135, 38361. — *phanerophlebia* Merr. & Perry: New Guinea, *Brass* 7039. — *platycarpa* Radlk.: New Guinea, *BW* 7574,

Forbes 790, *NGF* 43860. — *rhytidocarpa* Adema: New Guinea, *Hoogland & Womersley* 3232, *LAE* 62154. — *rosea* Adema: New Caledonia, *McPherson* 1905. — *rotundifolia* Adema: New Caledonia, *Jaffré* 2531. — *samoensis* Christoph.: Samoa, *Bristol* 2157, *Christophersen* 2670, *Whistler* 1159 (BISH). — *serrata* (F. Muell.) Radlk.: Australia, *Jessup & Sharpe* 201, *Telford* 3443, *C.T. White* s.n. (L 989.202-144). — *shirleyana* (Bailey) Radlk.: Australia, *Randall & Young* s.n. (BRI, AQ 349693), *L.S. Smith* 4119, *C.T. White* 12133 (BRI). — *squamosa* Adema: New Caledonia, *Jaffré* 2374, *MacKee* 20428, *McPherson* 6176. — *stenopetala* Radlk.: Moluccas, *De Vogel* 3494; New Guinea, *Hoogland* 4897, *NGF* 24930, 26764, *Pullen* 3623. — *strigosa* Adema: Celebes, *BB* 5461. — *subfalcata* Adema: New Caledonia, *MacKee* 4297. — *sylvatica* Guillaumin: New Caledonia, *MacKee* 9995, *McPherson* 2789, *Virot* 6182. — *tomentella* (F. Muell.) Reynolds: Australia, *Bailey* s.n. (L 989.202-080), *Elsol* 408. — *tontoutensis* Guillaumin: New Caledonia, *MacKee* 16354. — *trigonocarpa* Radlk.: New Caledonia, *Veillon* 6631, 6657, 7200. — *vitiensis* Radlk.: Fiji, *Setchell & Parks* 15165 (BISH), *A.C. Smith* 4663. — *wadsworthii* (F. Muell.) Radlk.: Australia, *Dietrich* 375, 983, *Webb & Tracey* 10453.

Gloeocarpus patentivalvis (Radlk.) Radlk.: Philippines, *PNH* 11770, 11898, *Ramos* 1321.

Lepisanthes rubiginosa (Roxb.) Leenh.: Lesser Sunda Islands, *Kostermans* 19034, *Meyer & Noerta* 9061, *Schmutz* 3376A.

7.3. Leaf anatomy of Cupaniopsis

A leaf anatomical description of the genus *Cupaniopsis* is given. Details about the characters of the different species can be found in table 1. See figures 11–13.

In surface view — *Non-glandular unicellular hairs* with thick sclerified walls absent to abundantly present on both surfaces, often more densely so on the abaxial side; on (almost) glabrous leaflets usually present on midrib. *Glandular hairs* often present, at least on the abaxial surface, sometimes consisting of a single, large, ellipsoidal cell, but usually with 1–3(–5) small, flat, uniseriate stalk cells and one large top cell (rarely the glandular head consists of up to four smaller cells, fig. 11a); *C. bilocularis*, *C. celebica*, and *C. platycarpa* have a different type: (4–)8–13(–16) small, flat, uniseriate stalk cells and one small top cell (fig. 11b, c); *C. acuticarpa* has also a different type: 4–7 small, flat, uniseriate stalk cells, and one small top cell (fig. 11d); the glandular hairs of *C. bilocularis*, *C. celebica*, and *C. platycarpa* are usualy curved, those of *C. acuticarpa* are straight. *Scale hairs*, consisting of a short stalk cell and a flat, circular head of 6–10 thin-walled cells, are found in a group of Pacific species (Sect. *Mizopetala* of Radlkofer, fig. 11e). *Papillae* usually absent, but in *C. bilocularis*, *C. celebica*, and *C. platycarpa* they may be present abaxially around the stomata as low flattened domes with coronulate thickenings (the shape of a bottle cap), more or less the same form as in *Guioa*. *Cuticle* smooth to striate, not granular, if anticlinal walls are undulate then cuticle often thin in the loops of the undulations. *Unspecialized*

Table 1. Leaf anatomical characters of *Cupaniopsis*, *Cupania americana*, *Gloeocarpus patentivalvis* and *Lepisanthes rubiginosa*.

Legend: () = sometimes present; / = and; ± = slightly present; + = present; – = absent.

Columns:

1. Species name.
2. Number of samples.
3. Type of glandular hairs on adaxial surface. 1 = 1-celled glands; G = 1–3(–5) stalk cells and 1 large glandular top cell; C = 1 or 2 stalk cells and a large glandular top consisting of several cells; L = as C, but arranged with 1–3(–5) around the bases of non-glandular hairs; P = (4–)8–13(–16) stalk cells and 1 small glandular top cell; A = 4–7 stalk cells and 1 small glandular top cell.
4. Type of glandular hairs on abaxial surface. For legend see 3.
5. Papillae on abaxial surface. S = only around stomata.
6. Type of papillae. B = long, slender, warty; C = low, domed.
7. Adaxial cuticle striate.
8. Abaxial cuticle striate.
9. Anticlinal walls of adaxial epidermis undulate.
10. Anticlinal walls of abaxial epidermis undulate.
11. Stomata present in adaxial epidermis.

1	2	3	4	5	6	7	8	9	10	11
Cupania										
americana	3	(C)	C	+	B	()	–	–	–	–
Cupaniopsis										
acuticarpa	1	A	A	–	–	+	+	–	–	+
amoena	3	–/(G)	–/G/1	–	–	–/()	()/+	–/±	–/±	–
anacardioides	10	–/G	G/(1)	–	–	+	+	–	–	+
apiocarpa	3	(G)/1	(G)/1	–	–	+	+	–/+	–/+	+
azantha	4	1	(G)/1	–	–	+	+	–	–	–/+
baileyana	3	(G)	G	–	–	±	–	+	+	+
bilocularis	3	P	P	S	C	+	–/+	–/+	–/+	+
bullata	1	G	G	–	–	+	+	±	±	–
celebica	2	P	P	S	C	+	–/+	–/+	–/±	+
chytradenia	2	1	(G)/1	–	–	–	+	–	–	+
concolor	3	1	1	–	–	–	–/±/+	+	+	–
curvidens	11	G	G	–	–	+	–/±/+	–/()	–/()	+
dallachyi	1	–	–	–	–	+	+	±	±	+
diploglottoides	1	–	G	–	–	–	–	±	+	–
euneura	1	(G)	G	–	–	()	+	±	±	()
flagelliformis	3	(G)	G	–	–	+	–/+	–	–/±	–
fleckeri	3	–	–/G	–	–	+	–/+	–/+	–/+	+
foveolata	3	(G)	G/(1)	–	–	+	+	±	±	+
fruticosa	3	–	–	–	–	–	–	±	±	–
glabra	1	–	–	–	–	–	–	±	±	–
globosa	2	–	–	–	–	–	–	–	–	–

(Table 1 continued)

Legend: () = sometimes present; / = and; ± = slightly present; + = present; – = absent.

Columns:

12. Giant stomata present in abaxial epidermis.
13. Mean lamina thickness in cross section (µm).
14. Hypodermis. L = above midrib and larger veins; G = along entire width.
15. Additional vascular strands in pith.
16. Crystals. R = rhomboidal; D = druses.
17. Crystals around veins.
18. Crystals in pith.
19. Crystals in phloem.
20. Secretory idioblasts in palisade tissue.
21. Secretory idioblasts in spongy tissue directly below palisade.
22. Secretory idioblasts in central part of spongy tissue.
23. Secretory idioblasts in abaxial subepidermal mesophyll layers.
24. Midrib. H = higher than broad; I = as high as broad; J = broader than high.
25. Extra horizontal division walls in abaxial epidermis cells.
26. Attachment of hairs. B = basal; S = subbasal; BS = both basal and subbasal; – = no hairs present.
27. Scale hairs.

12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
–	87.1–118	L	–	–/R	+	()	()	+	+	+	+	H/I/J	–	B	–
–	87.7	L	+	–	–	–	–	+	+	+	+	H	–	B	–
–	138.6–153.4	L	+	R	+	–	–	()	+	+	+	(H)/J	–	S	–
()	81.6–277.2	L	–	–/R	+	()	()	+	+	+	+	J	–	S	–
()	65.4–124.7	L	–	(R)	()	–	–	+	+	+	()	(H)/J	–	S	–
()	152.7–279.2	L	–	R	+	()	–	+	+	+	+	H	+	–/S	–
()	146.5–152.5	L	–	R	+	–	–	()	+	+	+	H	–	S	–
–	116.8–132	–/L	()	R	+	–	–	+	+	+	–	J	–	B	–
–	110.9	(L)	+	–	–	–	–	–	+	+	–	H	–	B	–
()	110.9–122.7	(L)	–	R	+	–	–	+	+	+	+	J	–	BS	–
–	186.3–257.4	L	–	R	+	–	–	+	+	+	+	J	–	–/S	–
+	120.4–162.3	–/L	–	R	+	–	–	+	()	()	()	J	–	–	+
()	39.6–116.3	L	()	R	+	–	()	()	+	+	+	H	–	B	–
()	241.6	L	–	(R)	()	–	–	()	+	()	+	J	–	S	–
–	138.6	L	+	(R)	()	–	–	()	+	+	–	H	–	BS	–
–	172.2	L	+	R	+	+	+	+	+	+	–	H	–	B	–
–	111.1–143.5	(L)	+	R	+	+	+	+	+	+	+	H	–	B	–
–	102.9–196.0	L	–	R	+	–	–	+	+	+	()	J	–	S	–
–	106.9–182.1	L	–	R	+	–	+	+	+	+	()	(H)/J	–	S	–
+	160.4–198	L	–	R	+	()	()	+	+	+	+	H	–	B	+
+	192	L	–	R	+	–	–	+	+	+	+	I	–	–	+
+	178–178.2	L	–	R	+	()	–	+	+	+	–	J	–	–	+

(Table 1 continued)

1	2	3	4	5	6	7	8	9	10	11
glomeriflora	3	–	–	–	–	–	–	+	+	–
grandiflora	3	–	–	–	–	–	–	–	+	–
grisea	1	–	G	–	–	+	+	±	±	–
guillauminii	1	–	–	–	–	–	–	±	–	–
hypodermatica	2	(G/1)	G/(1)	–	–	+	+	–/()	–/()	–/()
inoplaea	3	–	–	–	–	–	–	–/±	±/+	–
kajewskii	3	–/G	G	–	–	–	–/+	–/±	–/±	+
leptobotrys	4	G/(1)	G/1	–	–	+	+	–	–	+
mackeeana	3	–/(1)	G/(1)	–	–	–	+	–	–	+
macrocarpa										
var. *macrocarpa*	2	–/G	–	–	–	±/+	–/±	–	–	–
var. *polyphylla*	2	–/(G)	–	–	–	±/+	–	–	–	+
macropetala	5	(G)	G	–	–	+	()/+	–/±	±	–/±
megalocarpa	2	–	G	–	–	–	+	–	–	–/+
mouana	1	1	–	–	–	–	–	±	+	–
myrmoctona	3	–	–	–	–	–	–	–/±	–/±	+
napaensis	1	G	G	–	–	+	+	–	±	–
newmannii	3	(G)	G	–	–	+	+	–	±	+
oedipoda	3	–	–	–	–	–	–	–/±	–/±/+	–
pennelii	2	–	–	–	–	–	–	–	–/±	–
petiolulata	3	–	(G)	–	–	+	–/+	–	–	+
phalacrocarpa	3	–	–/(G)	–	–	–/+	–/+	–	–	+
phanerophlebia	1	–	G	–	–	–	–	–	–	–
platycarpa	3	P	P	S	C	+	–/+	±	±	–
rhytidocarpa	3	(G)	G	–	–	–	±/+	–/±	±	()
rosea	1	–	–	–	–	–	–	–	–	–
rotundifolia	1	–	–	–	–	–	–	+	+	+
samoensis	3	–	–	–	–	–	–	–/±/+	–/±/+	()
serrata	3	(G)	G	–	–	+	+	–	±	–
shirleyana	3	G/(1)	G	–	–	–/+	–/±/+	–/±	–/±	+
squamosa	3	–	–	–	–	–	–	–	–	–
stenopetala	5	G/1	G/1	–	–	–/±/+	+	–/±	±	–
strigosa	1	–	G	–	–	–	+	±	+	–
subfalcata	1	–	–	–	–	–	–	±	±	–
sylvatica	3	–	(G)	–	–	+	+	±	±	–/+
tomentella	2	–	–	–	–	+	–/+	±	–/±	–
tontoutensis	1	–	–	–	–	–	–	–	–	–
trigonocarpa	3	–	(G)	–	–	–/+	–/+	–	–	+
vitiensis	2	G	G	–	–	+	+	–	±	–
wadsworthii	3	–	–	–	–	–/±/+	+	–	–/±	+
Gloeocarpus										
patentivalvis	3	–/G	G	–	–	–	+	–/±	±	–
Lepisanthes										
rubiginosa	3	L	L	–	–	+	–	–	–	+

(Table 1 continued)

12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
+	99–166.3	L	–	R	+	+	–	+	+	+	+	H/I/J	–	–	+
+	93.1–291.1	L	–	R	+	()	–	+	+	+	+	I	–	–/B	+
+	138.6	G	–	R	+	–	–	+	+	+	+	I	–	–	–
+	93.1	L	–	R	+	+	+	+	+	+	+	I/J	–	–/B	+
+	180.2–183.1	G	–	R	+	–	–	+	+	+	+	H/I	–	–	–
–	207.9–297	L	–	R	+	()	–	+	+	+	+	I/J	–	–	+
–	61.4–124.7	L	+	R	+	()	–	+	+	+	+	H	–	B	–
–	81.1–116.8	L	+	R	+	()	–	+	+	+	+	H/(J)	–	B(S)	–
–	229.7–340.5	L	–	R	+	–	–	+	+	+	+	H	+	–	–
()	233.6–243.5	L	–	R	+	–	–	+	+	+	+	H	+	BS/S	–
+	284.3–390	L	–	R	+	–	–	+	+	+	+	H	+	–	–
–	89.1–158.4	L	+	R	+	()	–	+	+	+	+	H/I/J	–	B	–
()	339.9–346.5	L	–	R	+	()	–	+	+	+	+	H	+	–/B	–
+	158.4	L	–	R	+	–	–	+	+	+	+	J	–	B	+
+	186.1–368.1	L	–	R	+	–	–	+	+	+	+	J	–	–/B	+
+	95	L	+	R	+	–	–	()	+	+	+	J	–	B	–
+	158.4–205.9	L	()	R	+	+	–	+	+	+	+	H	–	B	–
–	111.9–185.6	L	–	R	+	–	–	+	+	+	+	I/J	–	–	+
+	172.2–182.1	L	–	R	+	–	–	()	+	+	–	I/J	–	B	+
+	124.7–202.2	L	–	R	+	()	–	+	+	+	+	J	–	S	–
()	241.5–281.1	L	–	R	+	–	–	+	+	+	+	J	–	–	–
–	107.2	L	–	R	+	–	–	+	+	+	+	H	–	BS	–
()	109–172.2	L	–	R	+	()	()	+	+	+	+	H	–	BS	–
()	84.1–110.4	L	+	–/R	+	()	–	+	+	+	+	H	–	B	–
+	241.5	L	–	R	+	–	–	()	+	+	+	J	–	–	+
+	254.1	L	–	R	+	–	–	+	+	+	+	J	–	–	+
+	74.2–172.2	(G)	–	R	+	()	–	+	+	+	+	J	–	–	+
()	116.8–125.4	L	+	R	+	–	–	+	+	+	+	H	–	B	–
()	133.9–287.1	L	–	R	+	()	–	+	+	+	+	J	–	B	–
+	247.5–388.5	L	–	R	+	()	()	+	+	+	+	J	–	–	+
()	91.1–143.5	L	+	R	+	()	–	+	+	+	+	H(I)	–	B	–
+	120.8	L	–	R	+	–	–	()	+	+	()	J	–	B(S)	–
+	263.3	L	–	R	+	–	–	+	+	+	–	H	–	B	+
+	132–180.1	G/L	–	R	+	–	–	+	+	+	+	J	–	S	–
–	141.1–202.9	L	+	R	+	+	–	+	+	+	()	H/J	–	B	–
–	291	L	–	R	+	–	–	+	+	+	+	J	–	–	+
+	176.2–203.9	G/L	–	R	+	()	–	()	+	+	+	J	–	–/S	–
+	138.6–140.6	L	+	R	+	+	–	+	+	+	–	H	–	B	–
+	130.4–163.3	L	–	R	+	+	–	+	+	+	+	J	–	B	–
+	125.8–160.4	L	–	R	+	()	–	+	+	+	+	H/I/J	–	S	–
()	89.1–163.3	L	–	R/D	+	+	+	+	+	–	+	H	–	B	–

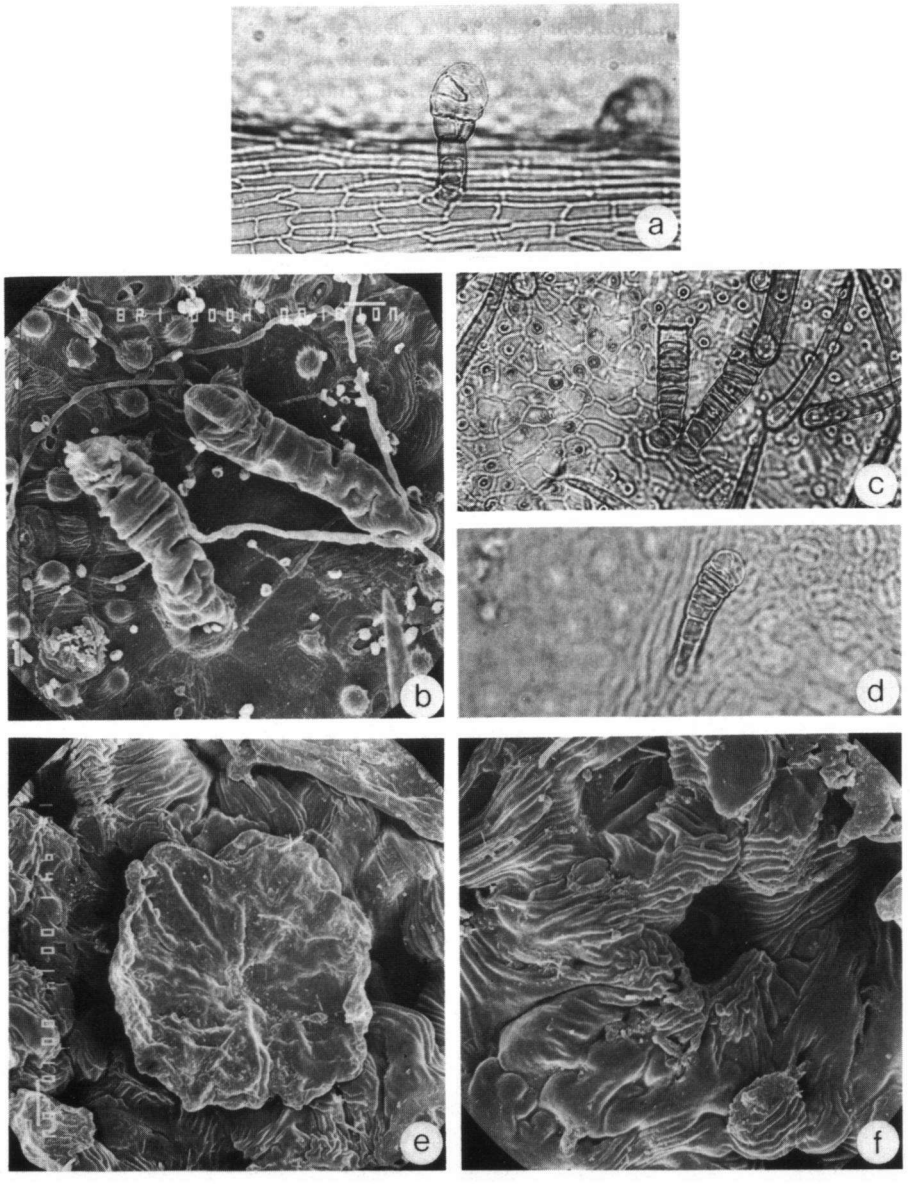


Fig. 11. a. Glandular hairs with few stalk cells and a large glandular head (LM, × 270, *Cupaniopsis napaensis, UPNG* 4353); b, c. glandular hairs with many stalk cells and a small glandular head (b: SEM, scale bar = 10 µm, c: LM, × 300, both *C. platycarpa, NGF* 43860); d. glandular hairs with several stalk cells and a small glandular head (LM, × 300, *C. acuticarpa, NGF* 22112); e. scale hair (SEM, scale bar = 10 µm, *C. squamosa, MacKee* 20428); f. deeply sunken stomata (SEM, × 960, see e).

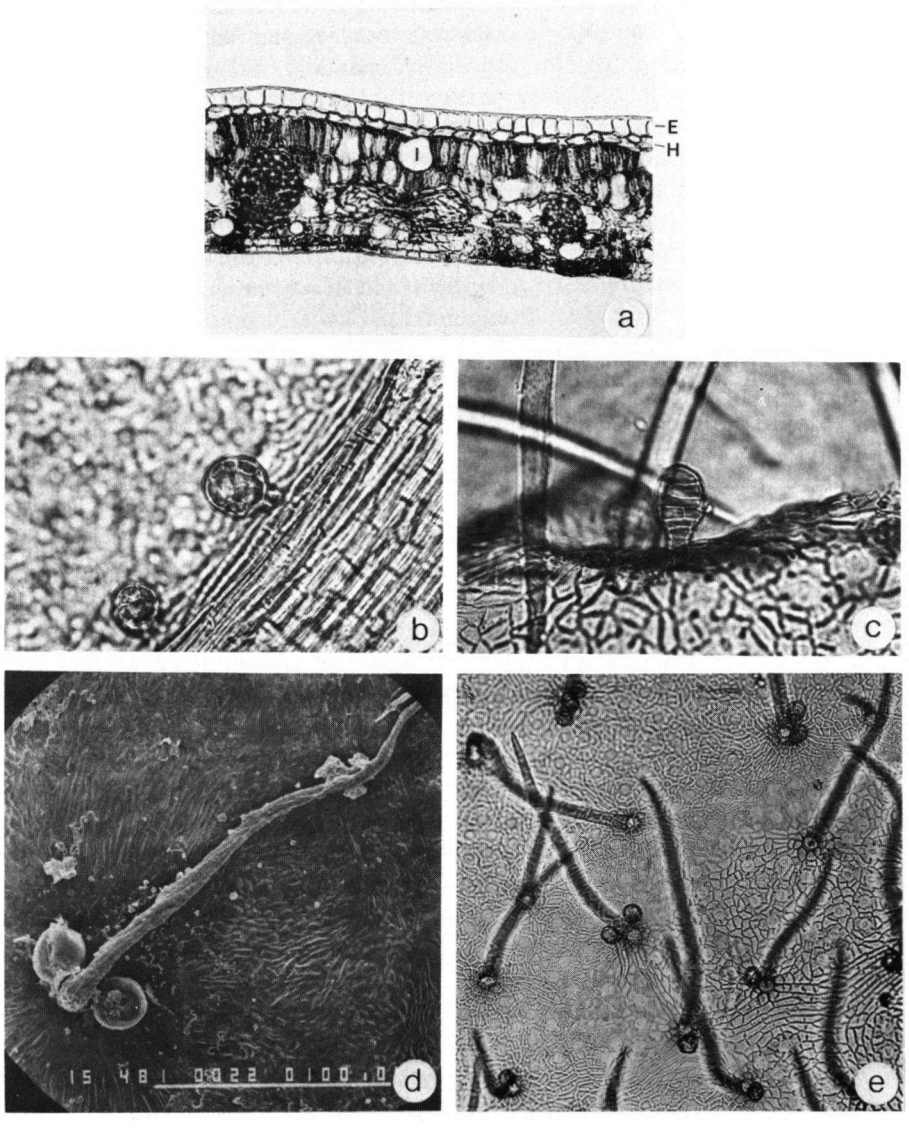


Fig. 12. a. Transverse section of leaflet (LM, × 150, *Cupaniopsis hypodermatica, MacKee* 20894; E = epidermis; H = hypodermis; I = idioblast); b. glandular hairs with few stalk cells and a multicellular head (LM, × 240, *Cupania americana, Sintenis* 762b); c. as b (LM, × 270, *Lepisanthes rubiginosa, Kostermans* 19034); d, e. glandular hairs at the base of non-glandular hairs (d: SEM, scale bar = 10 µm; e: LM, × 150, see c).

epidermal cells polygonal, with straight to undulate anticlinal walls; cells around hairs, glandular hairs and stomata in a radiating pattern; above midrib and veins the epidermis cells tend to be rectangular, in rows parallel to the veins, often showing the venation pattern, especially abaxially. *Stomata* predominantly cyclocytic, usually only slightly sunken, in *C. squamosa* much more deeply sunken (fig. 11f), in many species also present on the adaxial side and then usually along midrib and major veins; giant stomata often abaxially present, usually along midrib and major veins.

In transverse section — *Lamina* dorsiventral. *Unspecialized epidermal cells* square to flatly rectangular, or erect, especialy above midrib and along margin, in *C. azantha*, *C. mackeeana*, *C. macrocarpa*, and *C. megalocarpa* with 1–3 extra, horizontal division walls. *Hypodermis* usually locally present as a uniseriate continuation of the ground tissue above the midrib, sometimes also above major veins, present as a continuous layer of square thin-walled cells in *C. grisea*, *C. hypodermatica* (fig. 12a), *C. samoensis* (in one of the samples only), *C. sylvatica*, and *C. trigonocarpa*. *Mesophyll*: palisade tissue composed of 1 or 2, sometimes up to 4 layers of long, erect cells, rarely the palisade cells isodiametric; spongy tissue rather compact to rather loose. *Midrib* raised abaxially, raised or flat adaxially; ground tissue of round cells, vascular system collateral, with a flat to arc-shaped adaxial strand and an abaxial arc, surrounded by a sclerenchyma sheath, in several species additional vascular strands in the pith are present (fig. 13); pith consisting of large round parenchyma cells, often filled with starch grains. *Margin* with marginal vein and normal mesophyll. *Crystals* absent to abundantly present, rhomboid, usually in the ground tissue around the veins, often also in pith and sometimes in phloem. *Secretory idioblasts* usually abundantly present, small to very large, round to flat rectangular, or erect rectangular in palisade tissue, occurring in palisade tissue, in spongy tissue and in abaxial subepidermis, sometimes also in ground tissue of midrib, rather often in the neighbourhood of veins, contents unknown.

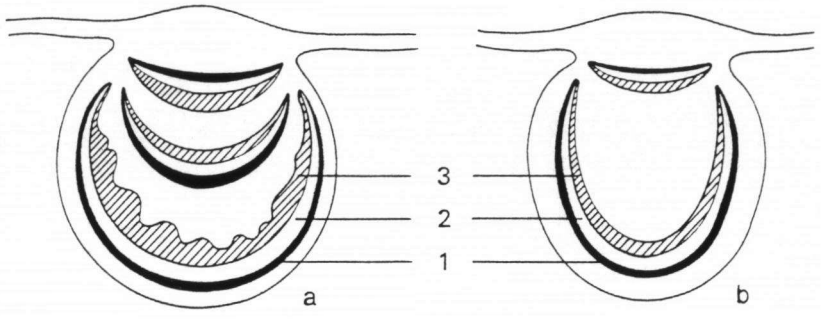


Fig. 13. Schematic drawing of transverse section through midrib. a. Complex, with extra vascular strands in the pith; b. simple. 1 = sclerenchyma sheat; 2 = xylem; 3 = phloem.

Infrageneric variation

Cupaniopsis shows a considerable variation in leaf anatomical characters. Lamina thickness, presence or absence of glands and crystals are especially variable.

Lamina thickness varies between ca. 40 and 390 µm. Glandular hairs and crystals may be absent to abundantly present.

Most species with glandular hairs have either 1-celled glands or glandular hairs with few stalk cells and a large glandular top cell, or any combination between the two. A small group of species, *C. bilocularis*, *C. celebica* and *C. platycarpa*, have glandular hairs consisting of many [(4–)8–13(–16)] stalk cells and a small top cell. *C. acuticarpa* has glandular hairs with 4–7 stalk cells and a rather small top cell.

Crystals occur usually in the ground tissue around the midrib and veins, but in a number of species they may be found in the pith also, and in several cases also in the phloem.

Secretory idioblasts vary only a little. They may be absent or rare in the palisade, almost always present in the spongy tissue, and can be absent from the abaxial subepidermal layer.

A large group of Pacific species possess peculiar scale-like hairs (see also chapter 10.9).

One small group of New Caledonian species, *C. azantha*, *C. mackeeana*, *C. macrocarpa* and *C. megalocarpa*, is characterized by the presence of up to 3 extra horizontal division walls in the adaxial epidermal cells.

Infraspecific variation

Infraspecific variation was studied in a few species only. The samples of these species were chosen to represent a wide range of leaflet thickness, and originated from all over the distributional area.

C. anacardioides: 10 samples were studied. As expected the thickness of the lamina varies greatly: from 80 to 300 µm. Crystals vary from absent to abundantly present. If present, they occur at least around the veins, but they may be found in the pith and the phloem also. Secretory idioblasts vary only little; they seem to be absent or rare in the spongy tissue. Usually glandular hairs with few stalk cells and a large top cell are present, but they may be totally absent or replaced by one-celled glands. Giant stomata may be absent or present.

No geographical trend can be observed in these characters. The only remarkable observation lies in the thickness of the lamina: Australian samples from more northern localities have thinner leaflets than samples from southern localities. However, the one sample from New Guinea has thicker leaflets than the northernmost one from Australia.

C. curvidens: 11 samples were studied. Very little variation was found in this species. The thickness of the lamina lies between 40 µm and 130 µm. Crystals occur rarely in the phloem. Secretory idioblasts may be absent or rare in the palisade, but are always present in spongy tissue, sometimes infrequent in abaxial

subepidermal layers. Giant stomata and stomata on the adaxial surface may be present or absent.

No special pattern of correlation between the varying characters or with geographical distribution is apparent.

C. macrocarpa: Two varieties, var. *macrocarpa* and var. *polyphylla*, were distinguished. Of each two samples were studied. Only very small differences were found, the most prominent in lamina thickness: var. *macrocarpa* 233.6–243.5 μm, var. *polyphylla* 284.3–390 μm.

Generic delimitation

Van Welzen (1989) studied leaf anatomy in a large number of genera of the *Sapindaceae* tribe *Cupanieae* (the number in brackets refers to the number of species studied, not to the total number of species): *Arytera* (1 species), *Atalaya* (1), *Cupaniopsis* (5), *Diploglottis* (3), *Euphorianthus* (1), *Guioa* (65), *Jagera* (1), *Rhysotoechia* (3), *Sarcopteryx* (1), *Sarcotoechia* (1), *Sisyrolepis* (1), *Toechima* (1), and *Zollingeria* (1). To these the present study adds *Cupaniopsis* (60 species), *Cupania* (1), and *Gloeocarpus* (1). From the tribe *Lepisantheae* 3 samples of *Lepisanthes rubiginosa* were studied.

Cupaniopsis has no unique leaf anatomical characters nor has it a unique combination of characters, as is true for *Guioa* (Van Welzen, l.c.).

Compared to *Guioa* several *Cupaniopsis* species (18) have a more complex midrib with extra vascular strands in the pith. The same may be found in *Diploglottis* and *Euphorianthus*.

Cupaniopsis bilocularis, *C. celebica*, and *C. platycarpa* have glandular hairs with many stalk cells and a small top cell, just like *Diploglottis* and *Euphorianthus*; this type is absent in *Guioa*. However, the *Guioa hirsuta* type (Van Welzen, l.c.) is rather similar, it differs only in the number of stalk cells. The type of glandular hairs of *Cupaniopsis acuticarpa* is different from both the *C. platycarpa* type and the *Guioa hirsuta* type.

A large Pacific group of *Cupaniopsis* species has scale hairs, these are absent in *Guioa*. Scale hairs can also be found in the genera *Arytera*, *Lepiderema*, *Rhysotoechia*, and *Sisyrolepis*.

Cupania americana has most characteristics in common with *Cupaniopsis* and *Guioa*. It differs in the glandular hairs and the papillae. The glandular hairs have 1 or 2 stalk cells and a large glandular head consisting of several cells (fig. 12b). Its papillae are slender, 10–30 μm long and warty.

Lepisanthes rubiginosa shows only a few differences to the genera of the tribe *Cupanieae*. The glandular hairs of *L. rubiginosa* look rather similar to those of *Cupania americana*, 1 or 2 stalk cells and a large glandular head consisting of several cells. These glandular hairs are uniquely arranged with 1–3(–5) around the bases of non-glandular hairs (fig. 12c–e). Both rhomboidal crystals and druses can be found. In the *Cupanieae* druses are recorded for *Diploglottis*, *Guioa*, and *Rhysotoechia* (Van Welzen, l.c.).

A quick survey of *Lepisanthes* in the Rijksherbarium proved the type of glands and their arrangement to be characteristic for *L. rubiginosa*. Most other species surveyed do not have glandular hairs. Glandular hairs consisting of few stalk cells and a large glandular top cell were found in *L. dictyophylla* and in *L. tetraphylla* 'siamensis'.

The *Cupania/Lepisanthes* type of glandular hairs with a multicellular head is quite different from the types described for *Cardiospermum halicacabum* (Nair & Joseph, 1960), or *Koelreuteria paniculata* (Rénard, 1913).

8. POLLEN MORPHOLOGY

8.1. Introduction

Radlkofer (1931–1934) was the first to describe *Sapindaceae* pollen in a systematic way. An illustrated survey of pollen types in the *Sapindaceae* was published by Muller & Leenhouts (1976).

Only a few short notes on the pollen of *Cupaniopsis* have been published sofar (Cookson & Pike, 1954; Muller, 1981; Hawkeswood, 1983a, b; Van der Ham & Van Heuven, 1989; Van der Ham, 1990). In the framework of the present monograph an extensive pollen-morphological study of *Cupaniopsis* was undertaken. Out of the 60 species recognized in the genus 53 could be studied. In addition pollen of *Cupania americana* and *C. oblongifolia*, possible outgroups, and of *Gloeocarpus patentivalvis*, originally described in *Cupaniopsis*, was studied. A more detailed report of the pollen morphology of *Cupaniopsis* will be published elsewhere (Adema & Van der Ham, in prep.).

8.2. Material and methods

All samples were obtained from herbarium material. This material is kept in the Rijksherbarium, Leiden (L), unless indicated otherwise (herbarium abbrevations as in Index Herbariorum).

The following species and specimens were studied:

Cupania americana: *Sintenis* 762b. — *C. oblongifolia*: *Martius FL. Bras.* 247.

Cupaniopsis amoena: *A.C. Smith* 4083, 4105. — *C. anacardioides*: *Van Balgooy & Byrnes* 1304, *Lam* 7681, *Van Royen* 4634, *Webb & Tracey* 13132 (BRI). — *C. apiocarpa*: *MacKee* 25023, 40210. — *C. azantha*: *MacKee* 16760. — *C. baileyana*: *Dunn* 63, *McDonald & Whiteman* 2819 (BRI). — *C. bilocularis*: *LAE* 51730, *NGF* 33447. — *C. bullata*: *LAE* 60052. — *C. celebica*: *Cel* IV-84. — *C. chytradenia*: *MacKee* 24014. — *C. concolor*: *Gillespie* 4794 (BISH). — *C. curvidens*: *Brass* 21993, *NGF* 28784. — *C. diploglottoides*: *L.S. Smith* 11231A. — *C. euneura*: *NGF* s.n. (Womersley, L 960.23-075). — *C. flagelliformis*: *Volck* s.n. (L 442709 = AQ 0011605). — *C. fleckeri*: *Smyth* s.n. (BRI 256857). — *C. foveolata*: *Clemens* s.n.

(L 959.30-011), *Dallachy* s.n. (L 908.269-525). — *C. fruticosa*: *MacKee* 14460. — *C. glabra*: *MacKee* 40234. — *C. globosa*: *Suprin* 2080. — *C. glomeriflora*: *MacKee* 21781, *McPherson* 2094. — *C. grandiflora*: *Bernardi* 9592. — *C. grisea*: *Pennington* 8139. — *C. hypodermatica*: *MacKee* 36469. — *C. inoplaea*: *MacKee* 16826. — *C. kajewskii*: *BSIP* 14028. — *C. leptobotrys*: *A.C. Smith* 7569. — *C. mackeeana*: *MacKee* 26607. — *C. macrocarpa*: *MacKee* 29021 (var. *macrocarpa*), *Veillon* 5408 (var. *polyphylla*). — *C. macropetala*: *NGF* 46853, *Warburg* 20539 (A). — *C. megalocarpa*: *Brinon* 1265. — *C. mouana*: *Baas Becking* s.n. (*Baumann-Bodenheim* 6036, P). — *C. myrmoctona*: *MacKee* 37953, *McPherson* 2427. — *C. newmannii*: *Carron* s.n. (MEL 108650). — *C. oedipoda*: *MacKee* 30948, 32734. — *C. pennelii*: *MacKee* 13962. — *C. petiolulata*: *Brinon* 641. — *C. phalacrocarpa*: *MacKee* 37135. — *C. platycarpa*: *Brass* 29225, *NGF* 46865. — *C. rhytidocarpa*: *NGF* 38602. — *C. rosea*: *McPherson* 1905. — *C. samoensis*: *Christophersen & Hume* 2045 (BISH). — *C. serrata*: *C.T. White* 9231 (BRI). — *C. shirleyana*: *Jessup & Guymer* 337 (BRI). — *C. squamosa*: *Jaffré* 1235. — *C. stenopetala*: *Conn & Kairo* 454, *NGF* 46834, *Robbins* 1701. — *C. strigosa*: *BB* 5461. — *C. subfalcata*: *MacKee* 4297. — *C. sylvatica*: *MacKee* 18481. — *C. tomentella*: *Elsol* 408. — *C. tontoutensis*: *MacKee* 16354. — *C. trigonocarpa*: *Vieillard* s.n. (= '2394', P). — *C. vitiensis*: *A.C. Smith* 4663. — *C. wadsworthii*: *Webb & Tracey* 10453.

Gloeocarpus patentivalvis: *PNH* 37058.

All samples were acetolyzed and mounted for light microscopy (LM) and scanning electron microscopy (SEM). LM observation was performed with an Olympus ECBi microscope. SEM observation was performed with a JEOL JSM-35 scanning electron microscope, after coating the pollen grains with gold using a Polaron E 5100 series II sputter-coater. See Van der Ham (1990) for further details, and for the terminology used in the description.

8.3. Pollen morphology of Cupaniopsis

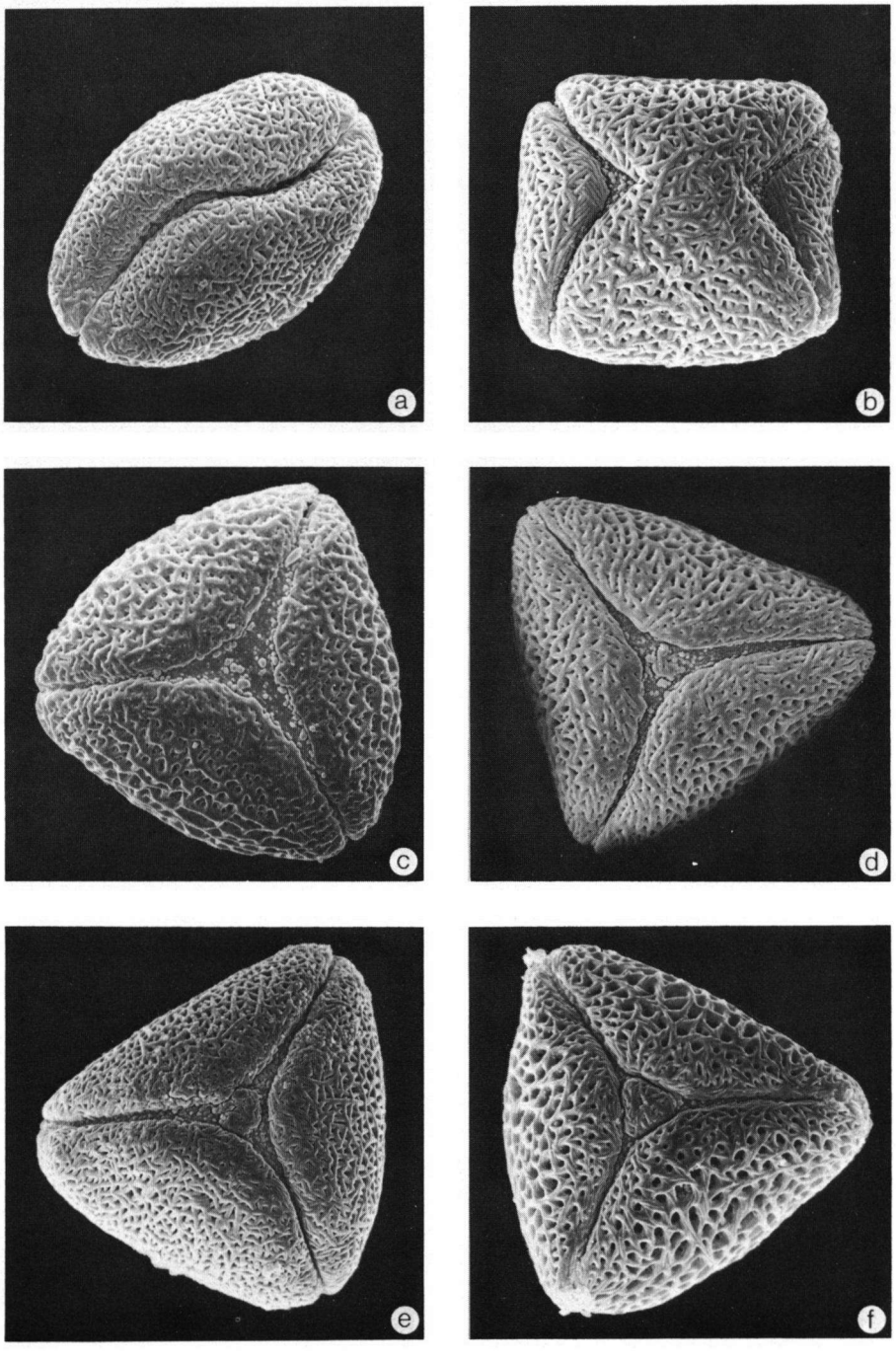
General morphology — *Cupaniopsis* pollen grains are isopolar or subisopolar. Anisopolar grains were rarely found.

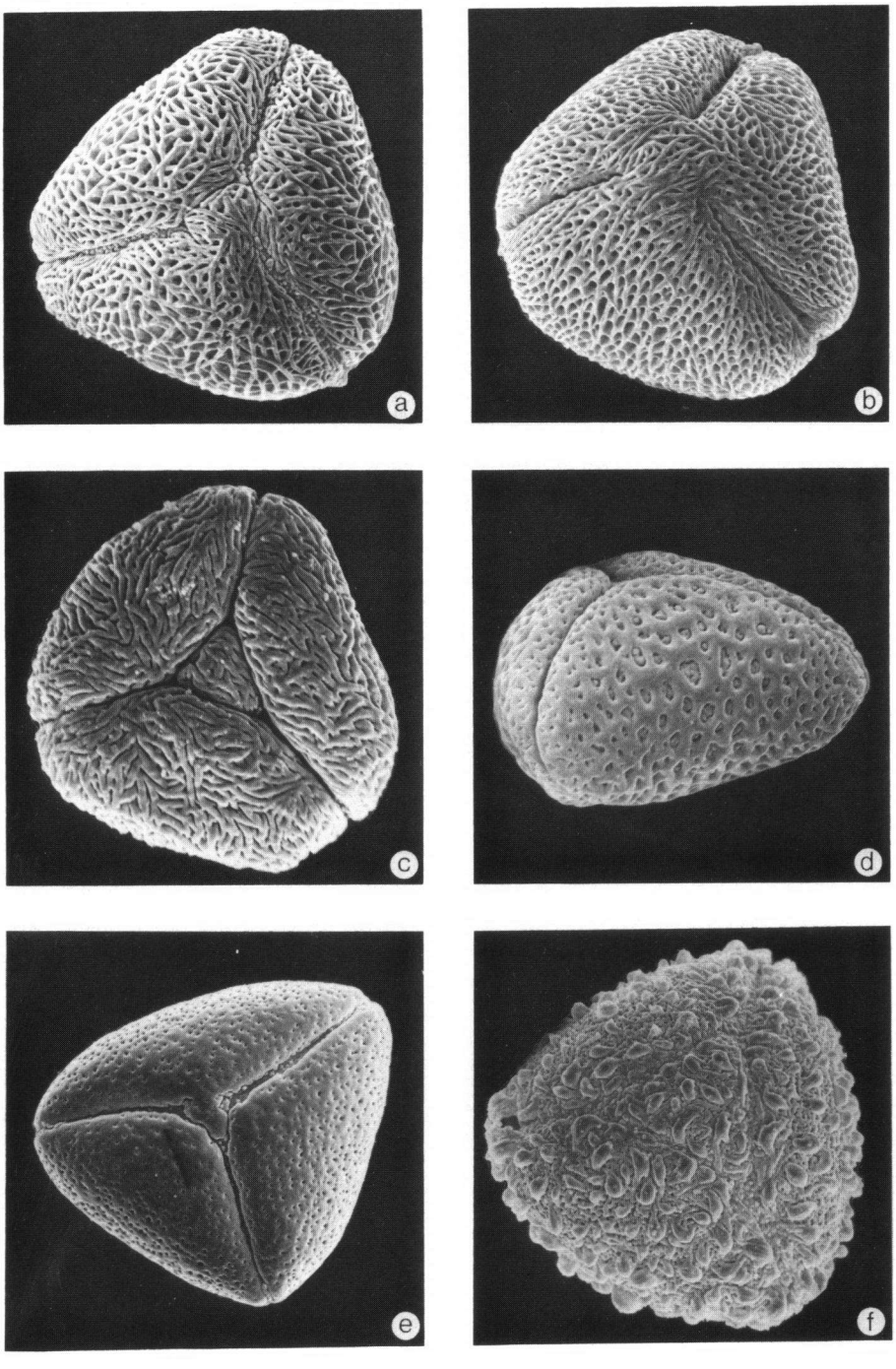
Cupaniopsis pollen generally has three apertures; in several samples grains with two or four apertures occurred in small numbers (fig. 14a, b).

The polar axis (P) measures from 9 to 30 µm (average 12–28 µm); the equatorial diameter (E) measures from 20 to 40 µm (average 24–34 µm).

The equatorial outline in 3-aperturate grains is usually triangular or rounded triangular to almost orbicular, with straight to (sligthly) convex, rarely concave sides.

Fig. 14. Pollen grains of *Cupaniopsis*. a. Two aperture grains; b. four aperture grains, c. syncolporate grain; d, e. syncolporate to parasyncolporate grains; f. parasyncolporate grain (a: × 2400, *C. pennelii*; b: × 2500, *C. myrmoctona*; c: × 2350, *C. mouana*; d: × 2300, *C. macrocarpa* var. *polyphylla*; e: × 1600, *C. pennelii*; f: × 1375, *C. diploglottoides*).


a
b
c
d
e
f


a
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e
f

The shape of the grains as determined by the ratio of the length of the polar axis and the equatorial diameter is mostly oblate (average P/E = 0.48–0.76), rarely peroblate or spheroidal. The lowest P/E values were observed in *C. petiolulata* (0.37–0.68), *C. rosea* (0.37–0.58), *C. strigosa* (0.37–0.68), and *C. sylvatica* (0.39–0.63); the highest in *C. amoena* (0.75–0.96), *C. fleckeri* (0.57–1.00), and *C. foveolata* (0.57–1.00). Most samples show a wide P/E range.

Apertures — *Cupaniopsis* pollen is usually syncolporate (fig. 14c) or parasyncolporate (fig. 14f). *C. amoena*, *C. fleckeri*, *C. foveolata*, *C. kajewskii*, *C. leptobotrys*, *C. tomentella*, and *C. vitiensis* have colporate pollen (fig. 15b). Parasyncolporate pollen intergrades with colporate pollen (fig. 15a).

The apocolpia measure from 2 to 16 µm. The average apocolpium index A/E (= apocolpium size/equatorial diameter) varies from 0.06 to 0.56. Apocolpia smaller than 2 µm consist of granules, those between 2 and 4 µm are irregular to rounded, and almost psilate. Above 4 µm they range from rounded triangular to triangular, the ornamentation being quite similar to that of the mesocolpia. The syncolporate and parasyncolporate conditions intergrade in *Cupaniopsis* pollen (fig.14d, e). Even individual samples may show a range from granules to distinct triangular apocolpia.

The ectoapertures are meridionally oriented. They are usually connected, either at (syncolporate) or near (parasyncolporate) the poles. Their width varies from 0.1 to 2.1 µm (average 0.32–1.84 µm). Usually, they widen towards the poles. The aperture membranes are smooth or more or less densely covered by granules, that increase in size towards the poles.

The endoapertures are always pori. Their width ranges from 1 to 7 µm. They are usually isodiametric, lalongate or lolongate in outline, sometimes meridionally constricted.

Ornamentation — Ornamentation in *Cupaniopsis* pollen varies from rugulate (fig. 15c) to reticulate (fig. 15d). The rugulate ornamentation is rather shallow to prominent. Perforations are always present. The reticulate ornamentation shows rather large lumina that easily can be recognized with light microscopy.

C. grandiflora has a psilate-perforate tectum (fig. 15e); *C. inoplaea* has a psilate-perforate to reticulate tectum.

Towards the ectoapertures the ornamentation is usually less pronounced and the perforations or lumina are smaller (see figs. 14c, 15e).

In several species (*C. euneura*, *C. newmannii*, *C. phalacrocarpa*, *C. shirleyana*, *C. subfalcata*) up to 3 µm large granules were found on top of the existing ornamentation (fig. 15f).

Fig. 15. Pollen grains of *Cupaniopsis*. a. Parasyncolporate to colporate grains; b. colporate grain; c—f. types of ornamentation: c. rugulate, d. reticulate, e. psilate perforate, f. rugulate, with extra material on top of the ornamentation (a: × 2500, *C. foveolata*; b: × 2200, *C. amoena*; c: × 2500, *C. hypodermatica*; d: × 2450, *C. oedipoda*; e: × 1950, *C. grandiflora*; f: × 2150, *C. euneura*).

8.4. A COMPARISON WITH GUIOA

Of the more closely related genera *Guioa* has been studied most comprehensively (Van der Ham & Van Heuven, 1989). In a number of aspects *Cupaniopsis* pollen differs from *Guioa* pollen.

Several *Cupaniopsis* species (7) have colporate pollen, which is only rarely found in *Guioa*.

Ornamentation in *Cupaniopsis* pollen is often much more pronounced than in *Guioa* pollen. Apart from rugulate ornamentation also rugulate to reticulate and reticulate ornamentation were found in *Cupaniopsis*, which types are absent in *Guioa*. Only two *Cupaniopsis* species have psilate-perforate ornamentation, a trait more common in *Guioa*.

Only a few *Cupaniopsis* species can be accommodated in the rugulate *Guioa* pollen groups I or II.

The two species with psilate-perforate ornamentation can be placed in pollen group IV of *Guioa*. They belong to the most derived species of *Cupaniopsis*. Van der Ham & Van Heuven (1989) considered the psilate pollen group in *Guioa* more derived than the rugulate groups I and II.

The pollen of *Cupania americana* and *Cupania oblongifolia* resembles that of several *Cupaniopsis* species (for instance *C. apiocarpa*, *C. petiolulata*, *C. strigosa*). It can be placed in *Guioa* pollen group I.

Gloeocarpus patentivalvis has syncolporate to parasyncolporate pollen with a rugulate ornamentation. The pollen resembles that of several *Cupaniopsis* species (for instance *C. macrocarpa*, *C. trigonocarpa*), and can be placed in *Guioa* pollen group I or II.

9. ECOLOGICAL NOTES

9.1. FLORAL BIOLOGY OF CUPANIOPSIS

Floral biology of *Sapindaceae* is largely unknown. Only a few species have been studied in detail. A comprehensive account of the known floral biology of the family was given by Van Welzen (1989).

Duodichogamy, a special form of monoecy, is prevalent in most *Sapindaceae*, and *Cupaniopsis* is not different in this respect.

In duodichogamy a sequence of three phases is present in the inflorescences: 1) a male phase, with flowers with well developed stamens with dehiscent, fertile pollen producing anthers and a reduced pistil; 2) a female phase, with flowers with a well developed pistil and underdeveloped stamens with indehiscent anthers; 3) a 'bisexual' phase, with flowers with well developed stamens with dehiscent, fertile pollen producing anthers and a pistil that is somewhat better developed than in phase one. This last phase is often functionally male.

In *Cupaniopsis* the first stage may be lacking. Sometimes totally male or female inflorescences were found.

Cupaniopsis anacardioides is the only species of the genus that has been studied in detail sofar (Hawkeswood, 1983a, b). The flowers of this species show traits of both fly and bee pollinated flowers. They are indeed visited by small bees and flies. Common visitors are *Trigona carbonaria* (*Hymenoptera*: *Apidae*) and *Stomorhina discolor* (*Diptera*: *Calliphoridae*). *Trigona carbonaria* proved to be an efficient pollinator. *Trigona* bees are important pollinators in most of the *Sapindaceae* studied sofar (Bawa, 1977; Appanah, 1982; Van Welzen, 1989).

9.2. Germination and seedlings

Seeds of *Cupaniopsis anacardioides* obtained from Mt Coot-tha Botanic Gardens in Brisbane (Australia) were germinated in the Hortus Botanicus at Leiden.

During germination the petioles of the cotyledons and the radicle swell and become terete. The testa pocket breaks open and the seed opens along the pleurograms. Then the petioles, hypocotyl and radicle elongate. The cotyledons stay enclosed in the testa. In De Vogels' seedling classification this type of germination is called Horsfieldia type (Horsfieldia subtype). This type is also found in *Guioa* (Van Welzen, 1989) and other *Sapindaceae* (De Vogel, 1980).

Description of the seedlings of *Cupaniopsis anacardioides*, the only species in which seedlings could be studied:

Epicotyl long and slender, with short patent hairs. First leaves about opposite, 1-jugate, with an acicular to deltoid terminal process; petioles 4–13 mm, very slightly winged, thinly strigose. Leaflets opposite, elliptic to narrowly obovate, 14–32 × 4–15 mm, index 2–3.5, widest about or above the middle, coriaceous, above and below glabrous, base oblique, cuneate, apex rounded to almost truncate, margin with 2–6 teeth near the apex. Later leaves are spiral, bijugate with less-dentate leaflets. From the second or third year onwards the leaflets are entire.

10. PHYLOGENETIC ANALYSIS

10.1. Is Cupaniopsis monophyletic?

A natural classification of *Cupaniopsis* is the purpose of the present study. To achieve this a phylogenetic analysis should be undertaken and the status of the genus as a monophyletic group of species should be established.

A monophyletic group of species includes an ancestral species and all its descendants. It is thought to be recognizable by a set of shared apomorphic character states. Usually, however, the possession of one unique character is sufficient to assume monophyly (Wiley, 1981, chapter 5). Circumstantial evidence for a monophyletic status can be found in the degree of resolution of the cladogram(s), and in arguments concerning the homogeneity of the genus, and the presence of a monothetic set of characters (Van Welzen, 1989).

Several of these arguments were considered to establish the status of *Cupaniopsis*.

1. Most of the cladograms generated in the phylogenetic analysis show a high degree of resolution. The consistency index, however, is low (0.25). Also several species that were ('intuitively') thought to be related were placed by the program widely separated in the cladograms. Moreover, several geographical inconsistencies were present.
   Of course one should keep in mind that paraphyletic groups also can lead to highly resolved cladograms (see Zandee & Geesink, 1987).
2. *Cupaniopsis* is far from homogeneous in its characteristics. Only a few characters are common to all species: dimorphic calyx; complete, annular disc; pyramidal stigma provided with three lines of stigmatic papillae. These characters, with the possible exception of the last, however, are presumably plesiomorphic [as they occur also in closely related genera (*Guioa, Rhysotoechia*) and are widespread throughout the whole family], and thus unsuitable for the recognition of a monophyletic group.

From these two arguments the question whether *Cupaniopsis* is monophyletic or not, cannot be answered in the affirmative. Paraphyly is still possible.

3. A general survey of the possible phylogenetic relationships among the genera of *Sapindaceae* was presented by Muller & Leenhouts (1976).
   They placed *Cupaniopsis* among the most primitive genera of the *Cupanieae* (p. 424, group 0), closely related to *Cupania* and *Rhysotoechia*. Both *Cupaniopsis* and *Rhysotoechia* are thought to have arisen from *Cupania*. *Guioa* (p. 424, group 3), a close relative of *Cupaniopsis*, is thought to be directly derived from the latter genus. If this derivation is from an ancestral species within *Cupaniopsis*, then that genus will be paraphyletic; when, however, *Guioa* shares an ancestral species with *Cupaniopsis* then the latter may be monophyletic.
   Guioa possesses a set of synapomorphies in which it differs from *Cupaniopsis*: fruit shape, pseudofunicle, and an interrupted disc, are the most prominent (see also Van Welzen, 1989). However, *Guioa* differs in the same set of characters from *Cupania*. It can as parsimoniously be derived from the latter genus as well as from *Cupaniopsis*. It seems probable that *Cupaniopsis* and *Cupania* share an ancestor, and that *Guioa*, and *Cupania* and *Cupaniopsis* share an ancestor on a lower level. In this case *Cupania* and *Cupaniopsis* are sistergroups, both possibly monophyletic.

Tentatively the conclusion of the argumentation presented here is, that *Cupaniopsis*, with some caution, can be seen as a monophyletic group. However, apomorphies for *Cupaniopsis*, if present at all, will be rather weak.

10.2. Computer algorithms and outgroup

Van Welzen (1989) discussed three programs used in cladistics: PAUP 2.4 (Swofford, 1985), HENNIG86 1.5 (Farris, 1988) and CAFCA 1.9.6 (Zandee, 1987, 1988).

He concluded that PAUP and HENNIG86 are the better programs for cladistic analysis. PAUP has as a drawback that it cannot handle polytomies. HENNIG86 is not very user friendly.

For several practical reasons, however, the latter program was selected for the cladistic analysis of *Cupaniopsis*

HENNIG86 needs an *a priori* designated outgroup. As such *Guioa*, *Cupania*, and *Lepisanthes* were tried.

Guioa, that has more derived character states than *Cupaniopsis*, did not give very good results, and was disregarded as an outgroup.

Cupania and *Lepisanthes* gave comparable results, both somewhat better than *Guioa*, but still not very good. The cladograms differed mostly in the way they grouped certain species. With *Cupania*, which has entire leaflets, as an outgroup the program finds groups of species with entire leaflets as an apomorphy; with *Lepisanthes*, which has entire leaflets, as outgroup the program finds groups of species with dentate leaflets as an apomorphy.

As *Cupania* is about as primitive or as derived as *Cupaniopsis* (Muller & Leenhouts, 1976), and both are closely related, *Cupania* was selected as the outgroup for the cladistic analysis of *Cupaniopsis*.

10.3. Characters and datamatrix

Multistate coding was used to enter the character states of the different characters in the datamatrix. This coding has to be used, because the program HENNIG86 (Farris, 1988) lacks the possibility to designate which binary columns form one character (Van Welzen, 1989, p. 55).

Many species show polymorphisms in at least some characters. These polymorphisms are regarded as separate character states. For instance crests on petal appendages are absent (character state 1), absent or present (character state 2), or present (character state 3).

Only a few quantitative characters were used. Because of the lack of gaps, it is usually very difficult to design appropriate character states for this kind of characters. If quantitative characters were used, the boundaries of the character states applied to the majority of the species. For instance species with few jugae normally vary between 1 and 3 jugae, while those with several jugae vary between 1 and 6, and those with many jugae vary between 1 and 12(–30) jugae. Exceptional numbers per species were then disregarded.

10.4. Missing values, absence, and question marks

Several species of *Cupaniopsis* have been described on incomplete material. Consequently, some characters will be missing. These unknown character states (or missing values) are entered in the datamatrix as question marks.

Characters may also be absent. The absence may be primary ('primitive') or secondary (through loss). Absence through loss is in *Sapindaceae* illustrated for instance by the number of petals. That may be reduced, and instead of the usual 5 or 6, genera (or species) may have 4, 3, 2 or 0 petals. This is usually seen as a derived character state and coded accordingly. Primitive absence (the character never was there) is a plesiomorphic character state, for instance in *Cupaniopsis* sect. *Mizopetala* scale hairs are present, in all other species they are 'primitively' absent. According to Pimentel & Riggings (1987) this kind of absence is 'neither a character nor a character state' (see also Nelson, 1978; Patterson, 1982), and thus cannot be coded in any way. Question marks should be used in this case. Quite often, however, it is not known whether the absence is primitive or through loss, and the use of question marks is recommended for all cases (Pimentel & Riggings, 1987).

A more complicated form of absence is encountered in those cases where the presence of a character is dependent on the presence of another character. In *Sapindaceae* the presence of petalar appendages (scales or auricles) is dependent on the presence of petals, the presence of crests on petalar appendages is dependent on the presence of those appendages. In this case absence is close to characterstate unknown, and question marks could be used.

In a datamatrix question marks may have at least four different meanings: 1. Unknown character states, through incompleteness of the description; 2. Absence through loss; 3. Primitive absence; 4. Absence because of the absence of another character.

Preferably any entry in a datamatrix should have just one meaning and question marks should be reserved for meaning 1: unknown character states only. From this it may be clear that the use of absence as a character state, and coded according to its supposed plesiomorphic or apomorphic state, is preferred by the present author.

When it is undecided whether absence is through loss or primitive, the character can be used unordered (options in HENNIG86 under 'ccode'). The direction then can be established *a posteriori* from the cladogram.

10.5. Initial analysis

The datamatrix of table 2 was used to obtain an initial cladogram (fig. 16).

This cladogram is just one of several hundred equally (most) parsimonious cladograms produced by the program HENNIG86 (Farris, 1988) using the options mhennig and bb. Although the cladogram looks pretty well solved, there are several reasons to reject it.

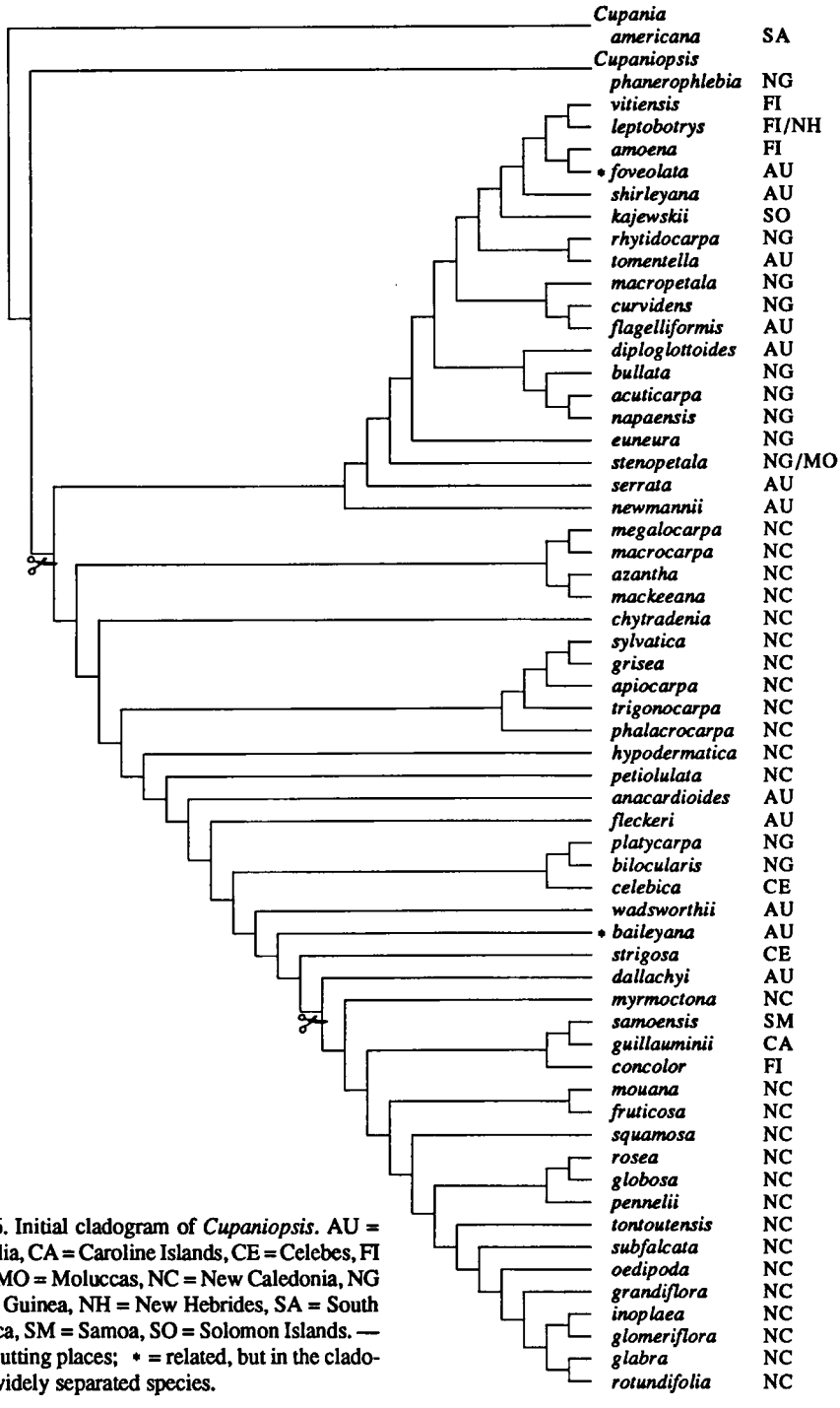


Fig. 16. Initial cladogram of *Cupaniopsis*. AU = Australia, CA = Caroline Islands, CE = Celebes, FI = Fiji, MO = Moluccas, NC = New Caledonia, NG = New Guinea, NH = New Hebrides, SA = South America, SM = Samoa, SO = Solomon Islands. — ✂ = cutting places; * = related, but in the cladogram widely separated species.

1. As stated above it is just one of many equally parsimonious cladograms.
2. The consistency index (ci) is rather low: 0.25.
3. A very large number of homoplasies is present.
4. Changes in the datamatrix, for instance rejecting characters that have a low ci, or need many steps, did not result in cladograms more consistent with the datamatrix.
5. Several geographical inconsistencies are present.
6. Species, that were thought to be related, turned up widely separated in the cladogram. For instance *C. baileyana* and *C. foveolata* (marked with an asterisk in fig. 16) were by Reynolds (1984, 1985) combined in one species. As separate species they are probably closely related.

Table 2. Characters and datamatrix used in the cladistic analysis of *Cupaniopsis*.

Ordered characters

01. Scales
    1. absent
    2. present
02. Ovary
    1. 3-locular
    2. 2-locular
03. Inflorescences
    1. axillary
    2. axillary to ramiflorous
04. Fruits
    1. not lobed
    2. lobed

Unordered characters

05. hairiness axial parts
    1. pilose, puberulous, tomentose, or [villose
    2. strigose
    3. short, patent
    4. glabrous
06. Pseudostipulae
    1. absent
    2. present
07. Number of jugae
    1. 1–3
    2. 1–6
    3. 1–12(–30)
08. Apex of leaflets
    1. obtuse or rounded, usually also [retuse
    2. obtuse or rounded to acuminate
    3. acute to acuminate or caudate
    4. truncate
09. Margin of leaflets
    1. entire to dentate or serrate all around
    2. entire to dentate or serrate apically
    3. spinose dentate
    4. entire to lobed
    5. entire
10. Hairiness abaxial side of leaflets
    1. glabrous to more or less patent
    2. glabrous to (thinly) strigose
    3. sericeous
    4. glabrous to scaly
    5. (almost) glabrous
11. Domatia
    1. absent
    2. absent to pocket-like or [dome-shaped
    3. pocket-like or dome-shaped [to pustulate
    4. absent to pustulate
12. Hairiness outside of petals
    1. appressed
    2. glabrous to appressed
    3. glabrous to scaly
    4. glabrous
13. Petals to sepals
    1. shorter than
    2. as long as
    3. shorter than to as long as
    4. (shorter than to) longer than
14. Petalar appendages
    1. auricles
    2. 2 scales
    3. 1 or 2 scales
    4. 1 scale

15. Crests on petalar appendages
    1. absent
    2. absent or present
    3. present
16. Disc
    1. thinly to densely hairy all over
    2. glabrous to hairs in 5 tufts
    3. glabrous
17. Number of stamens
    1. 8
    2. 6–8
    3. 6
    4. 10–14
18. Stamens in male flowers
    1. exserted
    2. not, or slightly exserted
19. Anthers
    1. glabrous
    2. glabrous or hairy
    3. hairy
20. Carpel rims
    1. adnate
    2. free
21. Stigma
    1. 3-lobed
    2. 3-lined
    3. 2-lined
22. Stipe of fruit
    1. < 1 mm
    2. 1–3 mm
    3. 2–10 mm
23. Exocarp
    1. smooth
    2. smooth to rugose
    3. rugose
24. Hairiness exocarp
    1. villose or velutinous
    2. strigose
    3. glabrous to scaly
    4. glabrous
25. Hairiness endocarp
    1. villose or tomentose
    2. glabrous to appressed hairy
    3. villose to appressed hairy
    4. stiffly hairy
    5. glabrous
26. Septum
    1. complete
    2. incomplete
27. Cotyledons
    1. parallel
    2. parallel to (obliquely) superposed
    3. (obliquely) superposed

Pollen morphological characters

28. Pollentype
    1. syncolporate
    2. syncolporate to parasyncolporate
    3. parasyncolporate
    4. parasyncolporate to colporate
    5. colporate
29. Ornamentation
    1. rugulate
    2. rugulate to reticulate
    3. reticulate
    4. psilate-perforate (to reticulate)

Leaf anatomical characters

30. Glandular hairs
    1. *Cupania* type
    2. *Cupaniopsis* type
    3. *Acuticarpa* type
    4. *Platycarpa* type
    5. absent
31. Papillae on abaxial epidermal cells
    1. long, slender, warty, on most [cells
    2. low, domed, only around stomata
    3. absent
32. Adaxial cuticle
    1. not striate
    2. (slightly) striate
33. Abaxial cuticle
    1. not striate
    2. (slightly) striate
34. Anticlinal walls of adaxial epidermal cells
    1. not undulate
    2. (slightly) undulate
35. Anticlinal walls of abaxial epidermal cells
    1. not undulate
    2. (slightly) undulate
36. Hypodermis
    1. only above midrib and major veins
    2. only above midrib to continuous
    3. continuous
37. Additional vascular strands in pith
    1. absent
    2. present
38. Extra divison walls in adaxial epidermal
    1. absent [cells
    2. present
39. One-celled glands
    1. absent
    2. present

(Table 2 continued)

Taxon / characters	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Cupania																			
americana	1	1	1	1	1	1	2	1	1	1	1	1	2	1	1	1	1	1	3
Cupaniopsis																			
acuticarpa	1	1	1	1	1	1	3	1	2	1	1	1	?	1	1	2	1	?	1
amoena	1	1	1	1	2	1	3	1	5	5	2	1	1	2	1	1	1	2	1
anacardioides	1	1	1	1	2	1	2	1	5	2	1	1	1	2	1	2	1	1	2
apiocarpa	1	1	1	1	2	1	2	1	5	5	4	1	1	3	1	2	1	1	3
azantha	1	1	1	?	1	1	3	3	5	5	2	1	1	2	1	2	1	1	3
baileyana	1	1	1	1	2	1	3	3	2	5	4	1	1	2	1	3	1	2	1
bilocularis	1	2	1	2	1	1	2	3	5	3	1	1	1	4	1	3	1	1	1
bullata	1	1	1	1	1	1	3	3	5	1	1	1	1	2	1	2	1	1	1
celebica	1	2	1	2	2	1	2	3	5	3	1	1	1	2	2	3	1	2	1
chytradenia	1	1	1	1	1	1	2	2	5	5	4	1	1	2	1	2	1	1	2
concolor	2	1	1	1	3	1	1	2	5	5	1	3	1	2	1	3	1	1	3
curvidens	1	1	1	1	1	1	3	2	1	1	2	1	1	2	1	2	1	1	2
dallachyi	1	1	1	1	2	1	3	1	5	5	3	?	?	?	?	3	?	?	?
diploglottoides	1	1	1	1	1	1	2	1	5	1	2	1	1	2	1	3	1	?	1
euneura	1	1	1	1	1	1	1	3	2	1	2	1	1	2	1	3	1	1	1
flagelliformis	1	1	1	1	1	1	3	2	1	1	2	1	1	2	1	2	1	2	3
fleckeri	1	1	1	?	2	1	2	1	5	2	3	1	1	2	1	3	1	2	1
foveolata	1	1	1	1	2	1	3	3	2	5	2	1	1	2	1	1	1	2	3
fruticosa	2	1	1	2	3	1	2	2	5	4	2	3	1	2	1	3	1	1	1
glabra	2	?	1	?	4	1	2	1	2	5	1	3	1	2	1	3	2	1	1
globosa	2	1	1	2	3	1	1	1	5	5	1	4	1	2	1	3	2	1	3
glomeriflora	2	1	2	1	3	1	2	1	4	5	1	3	1	2	1	3	3	1	1
grandiflora	2	1	2	1	3	1	3	2	2	5	1	4	4	2	2	3	1	1	1
grisea	1	1	1	?	2	1	2	2	5	5	2	1	1	2	1	3	1	?	1
guillauminii	2	1	1	1	2	1	2	3	5	4	1	?	?	?	?	?	?	?	?
hypodermatica	1	1	1	1	2	1	2	2	5	5	2	4	1	2	1	3	1	1	1
inoplaea	2	1	2	1	3	1	2	1	1	5	1	3	3	2	1	3	1	1	1
kajewskii	1	1	1	1	1	1	2	3	2	1	2	1	1	1	1	1	4	1	1
leptobotrys	1	1	1	1	2	1	3	3	5	1	2	1	1	1	1	1	4	2	2
mackeeana	1	1	1	1	1	1	3	1	5	5	2	1	1	2	1	3	1	1	3
macrocarpa	1	1	1	1	1	1	3	1	5	1	2	1	1	2	1	3	1	1	3
macropetala	1	1	1	1	1	1	2	3	1	1	2	1	4	2	1	2	1	1	2
megalocarpa	1	1	1	1	1	1	2	1	5	1	2	1	1	2	2	2	1	1	3
mouana	2	1	1	?	3	1	2	2	5	4	1	4	1	2	1	3	1	2	3
myrmoctona	2	1	1	1	4	1	1	2	5	4	1	3	1	2	1	3	1	1	3
napaensis	1	1	1	1	1	1	3	1	1	1	1	?	?	?	?	2	1	?	3
newmannii	1	1	1	1	1	1	3	3	1	5	2	1	1	2	1	2	1	2	1
oedipoda	2	1	2	1	3	1	3	2	5	4	2	4	1	2	1	3	1	1	3
pennelii	2	1	1	1	3	1	1	1	5	5	1	4	1	2	1	3	1	1	3
petiolulata	1	1	1	1	2	1	2	1	5	2	2	1	1	2	1	3	1	1	1
phalacrocarpa	1	1	1	1	2	1	2	1	5	2	4	1	1	2	1	3	1	1	1
phanerophlebia	1	1	1	?	1	1	2	3	5	5	1	1	1	2	1	2	1	?	1
platycarpa	1	2	1	2	1	1	2	3	5	3	2	1	1	4	3	3	1	1	1
rhytidocarpa	1	1	1	1	1	1	2	3	2	1	2	1	?	2	1	2	4	?	3

(Table 2 continued)

Taxon / characters	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
Cupania																				
americana	1	1	2	3	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1
Cupaniopsis																				
acuticarpa	1	2	1	1	1	1	1	?	?	?	3	3	2	2	1	1	1	2	1	1
amoena	1	2	2	3	1	2	1	1	5	2	2	3	1	2	2	2	1	2	1	2
anacardioides	1	2	2	2	1	3	1	3	1	3	2	3	2	2	1	1	1	1	1	1
apiocarpa	1	2	3	1	1	3	1	3	3	1	5	3	2	2	2	2	1	1	1	2
azantha	1	2	?	?	?	?	1	?	3	1	5	3	2	2	1	1	1	1	2	2
baileyana	1	2	3	3	2	1	1	3	3	2	2	3	2	1	2	2	1	1	1	1
bilocularis	1	3	2	2	1	1	1	3	3	2	4	2	2	2	2	2	1	1	1	1
bullata	1	2	1	3	1	1	1	?	3	3	2	3	2	2	2	2	1	2	1	1
celebica	1	3	3	1	1	1	1	?	1	3	4	2	2	2	2	2	1	1	1	1
chytradenia	1	2	2	1	1	1	1	?	3	1	5	3	1	2	1	1	1	1	1	2
concolor	2	2	2	1	4	1	2	3	3	1	5	3	1	2	2	2	1	1	1	1
curvidens	1	2	1	3	1	3	1	2	3	2	2	3	2	2	1	1	1	2	1	1
dallachyi	1	2	2	3	4	2	1	1	?	?	5	3	2	2	2	2	1	1	1	1
diploglottoides	1	2	1	3	1	2	1	?	3	3	2	3	1	1	2	2	1	2	1	1
euneura	1	2	1	3	1	2	1	?	3	1	2	3	1	2	2	2	1	2	1	1
flagelliformis	1	2	1	3	1	2	1	3	4	3	2	3	2	2	1	2	1	2	1	1
fleckeri	1	2	?	?	?	?	1	?	4	1	2	3	2	2	2	2	1	1	1	1
foveolata	1	2	2	3	2	1	1	1	5	1	2	3	2	2	2	2	1	1	1	1
fruticosa	1	2	2	1	3	4	1	3	3	1	5	3	1	1	2	2	1	1	1	1
glabra	1	?	?	?	?	?	1	?	2	2	5	3	1	1	2	2	1	1	1	1
globosa	1	2	1	1	2	5	1	3	1	3	5	3	1	1	1	1	1	1	1	1
glomeriflora	1	2	3	1	4	5	1	3	3	1	5	3	1	1	2	2	1	1	1	1
grandiflora	1	2	1	1	4	5	1	3	2	4	5	3	1	1	1	2	1	1	1	1
grisea	1	2	?	?	?	?	1	?	3	1	2	3	2	2	2	2	3	1	1	1
guillauminii	2	2	3	1	4	5	2	?	?	?	5	3	1	1	2	1	1	1	1	1
hypodermatica	1	2	2	1	1	3	1	3	3	1	2	3	2	2	1	1	3	1	1	1
inoplaea	1	2	2	1	4	5	1	3	2	4	5	3	1	1	2	2	1	1	1	1
kajewskii	1	2	1	2	1	2	1	1	5	1	2	3	1	2	2	2	1	2	1	1
leptobotrys	1	2	3	3	1	1	1	1	5	1	2	3	2	2	1	1	1	2	1	2
mackeeana	1	2	2	1	1	3	1	3	3	1	2	3	1	2	1	1	1	1	2	1
macrocarpa	1	2	3	1	1	2	1	3	3	1	2	3	2	1	1	1	1	1	2	1
macropetala	1	2	1	2	1	2	1	1	3	2	2	3	2	2	2	2	1	2	1	1
megalocarpa	1	2	3	1	1	3	1	?	3	1	2	3	1	2	1	1	1	1	2	1
mouana	1	2	?	?	?	?	1	?	3	1	5	3	1	1	2	2	1	1	1	2
myrmoctona	1	2	2	3	4	4	1	3	3	2	5	3	1	1	2	2	1	1	1	1
napaensis	1	2	1	3	1	1	1	1	?	?	2	3	2	2	1	2	1	2	1	1
newmannii	1	2	2	3	1	2	1	3	3	3	2	1	2	2	1	2	1	1	1	1
oedipoda	1	2	2	1	4	5	1	3	2	3	5	3	1	1	2	2	1	1	1	1
pennelii	1	2	1	1	2	5	1	3	2	1	5	3	1	1	1	2	1	1	1	1
petiolulata	1	2	2	3	4	2	1	3	3	1	5	3	2	2	1	1	1	1	1	1
phalacrocarpa	1	2	3	1	4	2	1	3	3	1	5	3	2	2	1	1	1	1	1	1
phanerophlebia	1	2	?	?	?	?	1	?	?	?	2	3	1	1	1	1	1	1	1	1
platycarpa	1	3	3	1	1	1	1	3	2	1	4	2	2	2	2	2	1	1	1	1
rhytidocarpa	1	2	1	3	1	5	1	1	3	1	2	3	1	2	2	2	1	2	1	1

(Table 2 continued)

Taxon / characters	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
rosea	2	1	1	?	3	1	2	1	5	5	1	2	1	2	1	3	1	1	3
rotundifolia	2	1	1	2	4	1	2	1	2	5	1	3	1	2	1	3	?	?	1
samoensis	2	1	1	1	3	1	1	3	5	4	1	3	1	1	1	1	1	2	1
serrata	1	1	1	1	1	1	2	3	3	5	2	1	1	2	1	3	1	2	2
shirleyana	1	1	1	1	1	2	2	4	3	1	2	1	1	2	1	1	1	1	1
squamosa	2	1	1	1	3	1	1	1	5	4	1	3	1	2	1	2	1	1	2
stenopetala	1	1	1	1	1	1	2	3	2	5	2	1	1	2	1	3	1	1	1
strigosa	1	1	1	1	2	1	1	3	5	5	1	1	3	2	1	3	1	1	1
subfalcata	2	1	1	?	3	1	2	1	5	5	1	3	1	2	1	3	1	1	3
sylvatica	1	1	1	1	2	1	2	1	5	5	2	1	1	2	1	3	1	1	1
tomentella	1	1	1	1	1	1	2	1	2	1	2	1	1	2	1	2	1	2	3
tontoutensis	2	1	1	2	3	1	3	1	5	5	1	4	1	2	1	3	1	1	1
trigonocarpa	1	1	1	1	2	1	1	1	5	5	4	1	1	2	1	3	1	1	1
vitiensis	1	1	1	1	1	1	3	2	5	1	1	1	1	2	1	1	4	2	1
wadsworthii	1	1	1	1	2	1	1	4	2	2	2	1	1	2	1	3	1	1	1

10.6. Further Analysis

Several methods have been proposed to solve problems with homoplasy, low consistency index (ci), etc. They mostly depend on reducing the amount of homoplasy by reducing the number of taxa. In this study the method developed by Van Welzen (1989) was used.

Van Welzen's method depends on cutting the initial cladogram in several parts using appropriate characters as scissors. For each set of taxa a new datamatrix is produced, and outgroups are selected. They are analyzed separately. After they all have been analyzed a complete cladogram has to be constructed.

The initial cladogram of *Cupaniopsis* can be cut in parts using the characters: scales present or absent, the presence of additional vascular strands in the pith, and the form of the apex of the leaflets. This resulted in three groups of species.

1. Lower group

Cupania americana was used as outgroup. *Cupaniopsis anacardioides* represented the middle group. The very incompletely known *Cupaniopsis phanerophlebia* was omitted from the datamatrix (table 3).

The analysis resulted in the cladogram of figuur 17. The ci of this cladogram is 0.44. It is the best result to be obtained with this group.

The uppermost part of this cladogram shows a sequential geographical order starting with New Guinea (*C. euneura, C. stenopetala, C. rhytidocarpa*), next come the Solomon Islands (*C. kajewskii*), then Fiji (*C. vitiensis, C. leptobotrys, C. amoena*), and finally reversing to Australia (*C. baileyana, C. foveolata*).

(Table 2 continued)

Taxon / characters	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
rosea	1	2	?	?	?	?	1	?	1	2	5	3	1	1	1	1	1	1	1	1
rotundifolia	1	2	1	1	3	4	1	?	?	?	5	3	1	1	2	2	1	1	1	1
samoensis	2	2	3	1	4	2	2	3	3	1	5	3	1	1	2	2	2	1	1	1
serrata	1	2	1	3	1	2	1	2	3	2	2	3	1	1	1	2	1	2	1	1
shirleyana	1	2	1	3	1	2	1	2	2	1	2	3	2	2	2	2	1	1	1	1
squamosa	1	2	2	1	3	3	1	3	2	1	5	3	1	1	1	1	1	1	1	1
stenopetala	1	2	1	3	1	1	1	1	2	1	2	3	2	2	2	2	1	2	1	2
strigosa	1	2	?	?	?	?	?	?	2	1	2	3	1	2	2	2	1	1	1	1
subfalcata	1	2	?	?	?	?	1	?	2	2	5	3	1	1	2	2	1	1	1	1
sylvatica	1	2	3	1	1	3	1	3	3	1	5	3	2	2	2	2	2	1	1	1
tomentella	1	2	1	3	1	5	1	3	5	2	5	3	2	2	2	2	1	2	1	1
tontoutensis	1	2	2	1	3	5	1	?	2	2	5	3	1	1	1	1	1	1	1	1
trigonocarpa	1	2	3	1	1	3	1	3	3	1	5	3	2	2	1	1	2	1	1	1
vitiensis	1	2	3	3	1	2	1	1	5	1	2	3	2	2	1	2	1	2	1	1
wadsworthii	1	2	3	1	2	2	1	3	2	3	5	3	2	2	1	2	1	1	1	1

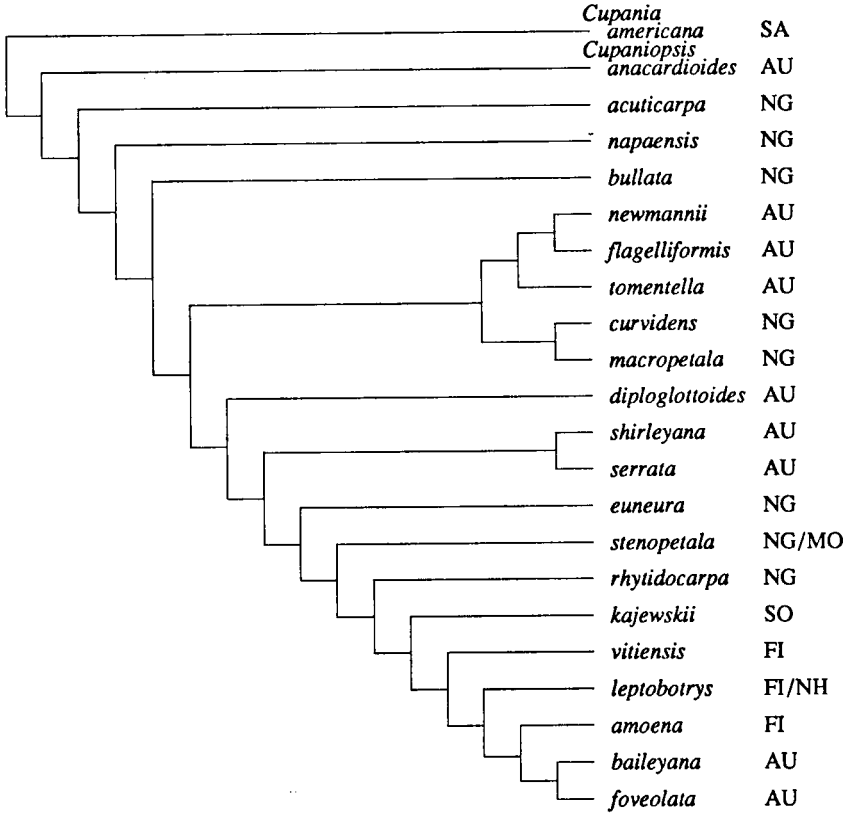


Fig. 17. Cladogram of the lower group. See for the explanation of AU–SO figure 16.

Table 3. Characters and datamatrix for the lower group.

01. Hairiness axes
    1. pilose to tomentose or villose.
    2. strigose
02. Number of jugae
    1. 1–3
    2. 1–6
    3. 1–12(–30)
03. Form of leaflets
    1. obovate
    2. elliptic to obovate
    3. elliptic
    4. elliptic to ovate
    5. ovate
    6. cuneate
04. Apex of leaflets
    1. obtuse or rounded, usually also retuse
    2. obtuse or rounded to acuminate
    3. acute to acuminate or caudate
    4. truncate
05. Margin of leaflets
    1. entire to dentate or serrate all around
    2. entire to dentate or serrate apically
    3. spinose dentate
    4. entire
06. Hairiness abaxial side of leaflets
    1. (thinly) puberulous or villose
    2. glabrous to puberulous or villose
    3. glabrous to thinly strigose
    4. (almost) glabrous
07. Domatia
    1. absent
    2. absent to pocket-like or dome-shaped
    3. pocket-like or dome-shaped to
    4. absent to pustulate [pustulate
08. Petals to sepals
    1. shorter than
    2. as long as
    3. shorter than to as long as
    4. (shorter than) to longer than
09. Petalar appendages
    1. auricles
    2. 2 scales
10. Disc
    1. thinly to densely hairy all over
    2. glabrous to hairs in 5 tufts
    3. glabrous
11. Number of stamens
    1. 8
    2. 10–14
12. Stamens in male flowers
    1. exserted
    2. not, or slightly exserted
13. Anthers
    1. glabrous
    2. glabrous to hairy
    3. hairy
14. Stigma
    1. 3-lobed
    2. 3-lined
15. Stipe of fruit
    1. < 1 mm
    2. 1–3 mm
    3. 2–10 mm
16. Exocarp
    1. smooth
    2. smooth to rugose
    3. rugose
17. Hairiness exocarp
    1. villose or velutinous
    2. strigose
    3. glabrous
18. Hairiness endocarp
    1. villose or tomentose
    2. villose to appressed hairy
    3. glabrous to appressed hairy
    4. glabrous
19. Cotyledons
    1. parallel
    2. parallel to (obliquely) superposed
    3. (obliquely) superposed

Pollen morphological characters

20. Pollentype
    1. syncolporate
    2. syncolporate to parasyncolporate
    3. parasyncolporate
    4. parasyncolporate to colporate
    5. colporate
21. Ornamentation
    1. rugulate
    2. rugulate to reticulate
    3. reticulate

Leaf anatomical characters

22. Glandular hairs
    1. *Cupania*-type
    2. *Cupaniopsis*-type
    3. *Acuticarpa*-type
    4. absent
23. Papillae on abaxial epidermal cells
    1. present
    2. absent
24. Adaxial cuticle
    1. not striate
    2. (slightly) striate

25. Abaxial cuticle
    1. not striate
    2. (slightly) striate
26. Anticlinal walls of adaxial epidermal cells
    1. not undulate
    2. (slightly) undulate
27. Anticlinal walls of abaxial epidermal cells
    1. not undulate
    2. (slightly) undulate
28. Additional vascular strands in pith
    1. absent
    2. present

Taxon/Characters	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Cupania americana	1	2	2	1	1	1	1	2	1	1	1	1	1	1
Cupaniopsis acuticarpa	1	3	3	1	1	1	1	1	2	2	1	1	1	2
amoena	2	3	4	1	4	4	2	1	2	1	1	2	1	2
anacardioides	2	2	1	1	4	3	1	1	2	2	1	1	2	2
baileyana	2	3	4	3	2	4	4	1	2	3	1	2	1	2
bullata	1	3	5	3	4	1	1	1	2	2	1	1	1	2
curvidens	1	3	3	2	1	1	2	1	2	2	1	1	2	2
diploglottoides	1	2	3	1	4	1	2	1	2	3	1	1	1	2
euneura	1	1	3	3	2	1	2	1	2	3	1	1	1	2
flagelliformis	1	3	4	1	1	1	2	1	2	2	1	2	3	2
foveolata	2	3	4	3	2	4	2	1	2	1	1	2	3	2
kajewskii	1	2	4	3	2	2	2	1	1	1	2	1	1	2
leptobotrys	2	3	4	3	4	1	2	1	1	1	2	2	2	2
macropetala	1	2	2	2	1	1	2	3	2	2	1	1	2	2
napaensis	1	3	3	1	4	1	1	1	2	2	1	1	3	2
newmannii	1	3	4	3	1	4	2	1	2	2	1	2	1	2
rhytidocarpa	1	2	2	3	2	1	2	1	2	2	2	1	3	2
serrata	1	2	3	3	3	4	2	1	2	3	1	2	2	2
shirleyana	1	2	6	4	3	1	2	1	2	1	1	1	1	2
stenopetala	1	2	1	3	2	4	2	3	2	3	1	1	1	2
tomentella	1	2	3	1	2	1	2	1	2	2	1	2	3	2
vitiensis	1	3	4	2	4	1	1	1	2	1	2	1	1	2

Taxon / characters	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Cupania americana	2	3	1	1	1	1	1	1	1	2	1	1	1	1
Cupaniopsis acuticarpa	1	1	1	1	?	?	?	3	2	2	2	1	1	2
amoena	2	3	1	3	1	5	2	2	2	2	2	2	2	2
anacardioides	2	2	1	2	3	3	3	2	2	2	2	1	1	1
baileyana	3	3	2	1	3	3	1	2	2	2	1	2	2	1
bullata	1	3	1	1	?	3	3	2	2	2	2	2	2	2
curvidens	1	3	1	3	2	3	3	2	2	2	2	2	2	2
diploglottoides	1	3	1	3	?	3	3	2	2	1	1	2	2	2
euneura	1	3	1	3	?	3	1	2	2	2	2	2	2	2
flagelliformis	1	3	1	3	3	4	3	2	2	2	2	1	2	2
foveolata	2	3	2	1	1	5	1	2	2	2	2	2	2	2
kajewskii	1	2	1	3	1	5	1	2	2	1	2	2	2	2
leptobotrys	3	3	1	1	1	5	1	2	2	2	2	1	1	2
macropetala	1	2	1	3	1	3	1	2	2	2	2	2	2	2
napaensis	1	3	1	1	1	?	?	2	2	2	2	1	2	2
newmannii	2	3	1	3	3	3	3	2	2	2	2	1	2	2
rhytidocarpa	1	3	1	4	1	3	1	2	2	1	2	2	2	2
serrata	1	3	1	3	2	3	2	2	2	2	2	1	2	2
shirleyana	1	3	1	3	2	2	1	2	2	2	2	2	2	1
stenopetala	1	3	1	1	1	2	1	2	2	1	2	2	2	2
tomentella	1	3	1	3	3	5	4	2	2	2	2	2	2	2
vitiensis	3	3	1	3	1	5	1	2	2	2	2	1	2	2

2. *Middle group*

Cupaniopsis serrata from the lower group was used as outgroup. *Cupaniopsis fruticosa* was selected to represent the upper group (table 4).

The analysis resulted in the cladogram of figure 18. This cladogram has a ci of 0.57.

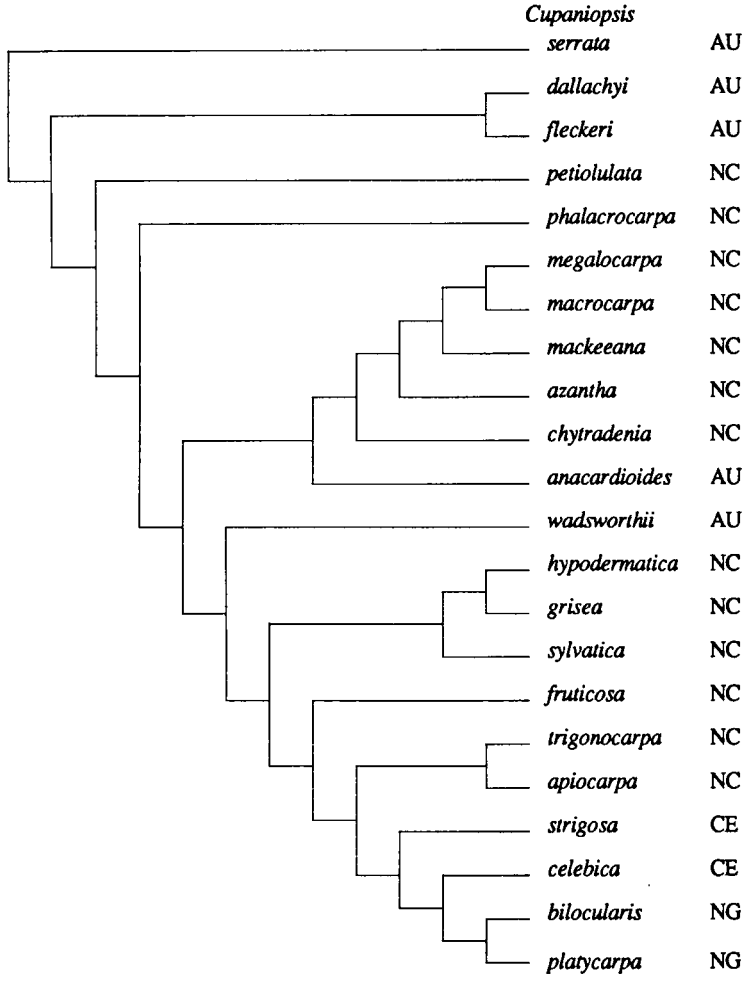


Fig. 18. Cladogram of the middle group. See for the explanation of AU–SO figure 16.

Remarkable in this cladogram is the position of *C. anacardioides* and *C. wadsworthii*. The first as a sister species of a group New Caledonian species, the second as a sister species of a group that includes New Caledonian, Celebian, and New Guinean species.

Table 4. Characters and datamatrix for the middle group.

Ordered characters

01. Scales
    1. absent
    2. present
02. Ovary
    1. 3-locular
    2. 2-locular
03. Hypodermis
    1. only above midrib and veins
    2. continuous or above midrib and
    3. continuous [veins
04. Extra division walls in adaxial epidermal
    1. absent [cells
    2. present

Unordered characters

05. Hairiness axes
    1. pilose or puberulous to villose or
    2. strigose [tomentose
    3. short, patent
06. Number of jugae
    1. 1–2
    2. 1–7
    3. 1–18(–30)
07. Form of leaflets
    1. obovate
    2. elliptic to obovate
    3. elliptic
    4. elliptic to ovate
    5. ovate
08. Apex of leaflets
    1. obtuse or rounded, usually also [retuse
    2. obtuse or rounded to acuminate
    3. acute to acuminate or caudate
09. Margin of leaflets
    1. entire to dentate or serrate all around
    2. entire to dentate in upper part
    3. entire
10. Hairiness abaxial side of leaflets
    1. glabrous to pilose or villose
    2. glabrous to (thinly) strigose
    3. sericeous
    4. (almost) glabrous
11. Domatia
    1. absent
    2. absent to pocket-like or dome- [shaped
    3. pocket-like or dome-shaped to
    4. absent to pustulate [pustulate
12. Hairiness outside of sepals
    1. hairy
    2. glabrous
    3. with scales
13. Petalar appendages
    1. 2 scales
    2. 1 or 2 scales
    3. 1 scale
14. Crests on petalar appendages
    1. absent
    2. absent or present
    3. present
15. Disc
    1. glabrous to hairs in 5 tufts
    2. glabrous
16. Stamens in male flowers
    1. exserted
    2. not exserted
17. Anthers
    1. glabrous
    2. glabrous or hairy
    3. hairy
18. Stigma
    1. 3-lined
    2. 2-lined
19. Stipe of fruit
    1. < 1 mm
    2. 1–2 mm
    3. 1–10 mm
20. Exocarp
    1. smooth
    2. smooth to rugose
    3. rugose
21. Hairiness exocarp
    1. villose or velutinous
    2. strigose
    3. glabrous
    4. scaly
22. Hairiness endocarp
    1. villose to tomentose
    2. villose to appressed
    3. glabrous to appressed
    4. glabrous
    5. stiff
23. cotyledons
    1. parallel
    2. parallel to (obliquely) [superposed
    3. (obliquely) superposed

Pollen morphological characters

24. Pollen type
    1. syncolporate
    2. syncolporate to parasyncolporate
    3. parasyncolporate
    4. colporate

Leaf anatomical characters

25. Glandular hairs
    1. *Cupaniopsis* type
    2. *Platycarpa* type
    3. rarely present to absent
26. Papillae
    1. absent
    2. present
27. Abaxial cuticle
    1. not striate
    2. (slightly) striate
28. Anticlinal walls of adaxial epidermal cells
    1. not undulate
    2. (slightly) undulate
29. Anticlinal walls of abaxial epidermal cells
    1. not undulate
    2. (slightly) undulate

Taxon / characters	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Cupaniopsis serrata	1	1	1	1	1	2	3	3	1	4	2	1	2	1	2
anacardioides	1	1	1	1	2	2	1	1	3	2	1	1	2	1	1
apiocarpa	1	1	1	1	2	2	2	1	3	4	4	1	3	1	1
azantha	1	1	1	2	1	3	4	3	3	4	2	1	2	1	1
bilocularis	1	2	1	1	1	2	4	3	3	3	1	1	1	1	2
celebica	1	2	1	1	2	2	2	3	3	3	1	1	2	2	2
chytradenia	1	1	1	1	1	2	4	2	3	4	4	1	2	1	1
dallachyi	1	1	1	1	2	2	5	1	3	4	3	?	?	?	3
fleckeri	1	1	1	1	2	2	2	1	3	2	3	1	2	1	3
grisea	1	1	3	1	2	2	4	2	3	2	2	1	2	1	2
hypodermatica	1	1	3	1	2	2	3	2	3	4	2	2	2	1	1
mackeeana	1	1	1	2	1	3	4	1	3	4	2	1	2	1	2
macrocarpa	1	1	1	2	1	3	4	1	3	1	2	1	2	1	2
megalocarpa	1	1	1	2	1	2	4	1	3	1	2	1	2	1	1
petiolulata	1	1	1	1	2	2	4	1	3	2	2	1	2	1	2
phalacrocarpa	1	1	1	1	2	2	4	1	3	2	4	1	2	1	2
platycarpa	1	2	1	1	1	2	3	3	3	3	2	1	4	3	2
strigosa	1	1	1	1	2	2	5	3	3	4	1	1	2	1	2
sylvatica	1	1	2	1	2	2	4	1	3	4	2	1	2	1	2
trigonocarpa	1	1	2	1	2	2	2	1	3	4	4	1	2	1	2
wadsworthii	1	1	1	1	2	1	6	4	2	2	2	1	2	1	2
fruticosa	2	1	1	1	3	2	4	2	3	4	1	3	2	1	2

Taxon / characters	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Cupaniopsis serrata	2	2	1	1	3	1	3	2	3	1	1	2	1	2
anacardioides	1	2	1	2	2	1	2	3	3	1	1	2	1	1
apiocarpa	1	1	1	3	1	1	2	3	3	3	1	2	2	2
azantha	1	3	1	?	?	?	?	?	3	3	1	2	1	1
bilocularis	1	1	2	2	2	1	1	3	3	2	2	2	2	2
celebica	2	1	2	3	1	1	1	?	1	2	2	2	2	2
chytradenia	1	2	1	2	1	1	1	?	3	3	1	2	1	1
dallachyi	?	?	1	2	3	3	3	1	?	3	1	2	2	2
fleckeri	2	1	1	?	?	?	?	?	4	3	1	2	2	2
grisea	?	1	1	?	?	?	?	?	3	1	1	2	2	2
hypodermatica	1	1	1	2	1	1	2	3	3	1	1	2	2	2

(Table 4 continued)

Taxon / characters	16	17	18	19	20	21	22	23	24	25	26	27	28	29
mackeeana	1	3	1	2	1	1	2	3	3	1	1	2	1	1
macrocarpa	1	3	1	3	1	1	3	3	3	1	1	2	1	1
megalocarpa	1	3	1	3	1	1	2	?	3	1	1	2	1	1
petiolulata	1	1	1	2	3	3	3	3	3	3	1	2	1	1
phalacrocarpa	1	1	1	3	1	3	3	3	3	3	1	2	1	1
platycarpa	1	1	2	3	1	1	1	3	2	2	2	2	2	2
strigosa	1	1	1	?	?	?	?	?	2	1	1	2	2	2
sylvatica	1	1	1	3	1	1	2	3	3	3	1	2	2	2
trigonocarpa	1	1	1	3	1	1	2	3	3	3	1	2	1	1
wadsworthii	1	1	1	3	1	2	2	3	2	3	1	2	1	2
fruticosa	1	1	1	3	1	4	5	3	3	3	1	1	2	1

3. Upper group

Cupaniopsis anacardioides from the middle group was used as outgroup (table 5).

Table 5. Characters and datamatrix for the upper group.

Ordered characters

01. Scales
    1. absent
    2. present
02. Inflorescences
    1. axillary
    2. axillary to ramiflorous

Unordered characters

03. Hairiness axes
    1. villose
    2. strigose
    3. short, patent
    4. glabrous
04. Number of jugae
    1. 1–3
    2. 1–6
    3. 1–12(–30)
05. Form of leaflets
    1. ovate
    2. elliptic to ovate
    3. elliptic
    4. elliptic to obovate
    5. obovate
    6. broadly ovate to orbicular
06. Apex of leaflets
    1. obtuse or rounded, usually also retuse
    2. obtuse (or rounded) to acuminate
    3. acute to acuminate
07. Margin of leaflets
    1. entire to dentate or serrate all [around
    2. entire to dentate or serrate apically
    3. entire to lobed
    4. entire
08. Hairiness abaxial side of leaflets
    1. glabrous to hairy
    2. glabrous to scaly
    3. (almost) glabrous
09. Outside of sepals
    1. appressed hairy
    2. glabrous to scaly
    3. glabrous
    4. glabrous to appressed hairy
10. Petals to sepals
    1. shorter than
    2. as long as
    3. shorter than to as long as
    4. longer than
11. Crests on petalar appendages
    1. absent
    2. absent or present
    3. present
12. Disc
    1. thinly to densely hairy all over
    2. glabrous to hairs more or less in 5
    3. glabrous [tufts

(Table 5 continued)

13. Number of stamens
    1. 8
    2. 6
    3. 6–8
14. Stamens in male flowers
    1. exserted
    2. not or sligthly exserted
15. Carpels
    1. adnate
    2. free
16. Stipe of fruit
    1. < 1 mm
    2. 1–3 mm
    3. 2–10 mm
17. Exocarp
    1. smooth
    2. smooth to rugose
    3. rugose
18. Hairiness exocarp
    1. villose or velutinous
    2. strigose
    3. glabrous to scaly
    4. glabrous
19. Hairiness endocarp
    1. villose or tomentose
    2. villose to appressed
    3. glabrous to appressed
    4. stiff
    5. glabrous
20. Septum
    1. complete
    2. incomplete

Pollen morphological characters

21. Pollentype
    1. syncolporate
    2. syncolporate to parasyncolporate
    3. parasyncolporate
22. Ornamentation
    1. rugulate
    2. rugulate to reticulate
    3. reticulate
    4. psilate-perforate (to reticulate)

Leaf anatomical characters

23. Glandular hairs
    1. absent
    2. present
24. 1-celled glands
    1. absent
    2. present
25. Abaxial cuticle
    1. not striate
    2. (slightly) striate
26. Anticlinal walls of adaxial epidermal cells
    1. not undulate
    2. (slightly) undulate
27. Anticlinal walls of abaxial epidermal cells
    1. not undulate
    2. (slightly) undulate

Taxon / characters	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Cupaniopsis anacardioides	1	1	2	2	5	1	4	1	1	1	1	2	1	1
concolor	2	1	3	1	2	2	4	3	2	1	1	3	1	1
fruticosa	2	1	3	2	2	2	4	2	2	1	1	3	1	1
glabra	2	1	4	2	1	1	2	2	3	2	1	1	3	3
globosa	2	1	3	1	3	1	4	3	3	1	1	3	1	1
glomeriflora	2	2	3	2	2	1	3	3	2	1	1	3	2	1
grandiflora	2	2	3	3	1	2	2	3	3	4	2	3	1	1
guillauminii	2	1	2	1	2	3	4	3	?	?	?	?	?	?
inoplaea	2	2	3	2	3	1	3	3	2	3	1	3	1	1
mouana	2	1	3	2	2	2	4	2	3	1	1	3	1	2
myrmoctona	2	1	4	1	2	2	4	2	2	1	1	3	1	1
oedipoda	2	2	3	3	1	2	4	2	3	1	1	3	1	1
pennelii	2	1	3	1	2	1	4	3	3	1	1	3	1	1
rosea	2	1	3	2	3	1	4	3	4	1	1	3	1	1
rotundifolia	2	1	4	2	6	1	2	3	2	1	1	3	1	?
samoensis	2	1	3	1	1	3	4	2	2	1	1	1	1	2
squamosa	2	1	3	1	4	1	4	2	2	1	1	2	1	1
subfalcata	2	1	4	2	2	1	4	3	2	1	1	3	1	1
tontoutensis	2	1	4	3	2	1	4	3	3	1	1	3	1	1

Taxon / characters	15	16	17	18	19	20	21	22	23	24	25	26	27
Cupaniopsis anacardioides	1	2	2	1	2	1	3	3	2	2	2	1	1
concolor	2	2	1	4	1	2	3	1	1	1	2	2	2
fruticosa	1	2	1	3	4	1	3	1	1	1	1	2	2
glabra	1	?	?	?	?	?	2	2	1	1	1	2	2
globosa	1	1	1	2	5	1	1	3	1	1	1	1	1
glomeriflora	1	3	1	4	5	1	3	1	1	1	1	2	2
grandiflora	1	3	1	4	5	1	2	4	1	1	1	1	2
guillauminii	2	2	1	4	5	2	?	?	1	1	1	2	1
inoplaea	1	2	1	4	5	1	2	4	1	1	1	2	2
mouana	1	?	?	?	?	1	3	2	1	1	1	2	2
myrmoctona	1	2	3	4	4	1	3	1	1	1	1	2	2
oedipoda	1	2	1	4	5	1	2	3	1	1	1	2	2
pennelii	1	1	1	2	5	1	2	1	1	1	1	1	2
rosea	1	?	?	?	?	1	1	2	1	1	1	1	1
rotundifolia	1	1	1	3	4	1	?	?	1	1	1	2	2
samoensis	2	3	1	4	3	2	3	1	1	1	1	2	2
squamosa	1	2	1	3	2	1	2	1	1	1	1	1	1
subfalcata	1	?	?	?	?	1	2	2	1	1	1	2	2
tontoutensis	1	2	1	3	5	1	2	2	1	1	1	1	1

The analysis resulted in the cladogram of figure 19. This cladogram has a ci of 0.58. Remarkable in this cladogram is the upper group formed by the non-New Caledonian, Pacific species *C. concolor, C. samoensis,* and *C. guillauminii.* This group has a strong synapomorphy in the incomplete septa, by which the fruits of these species become 1-celled.

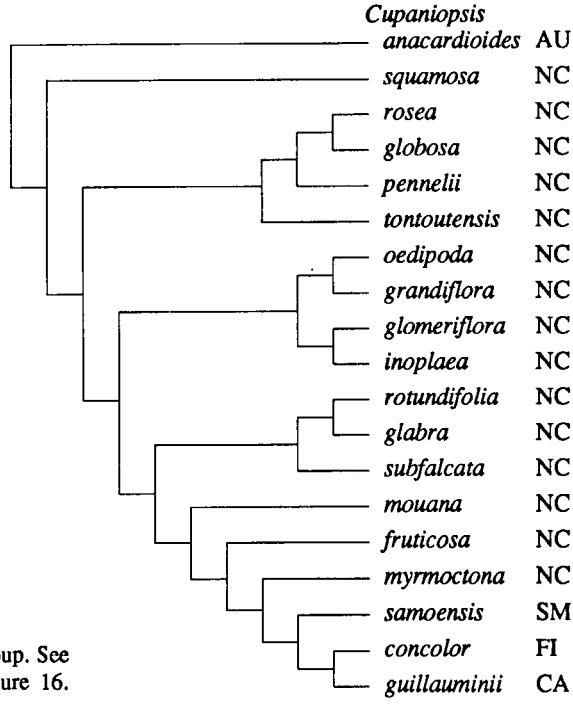
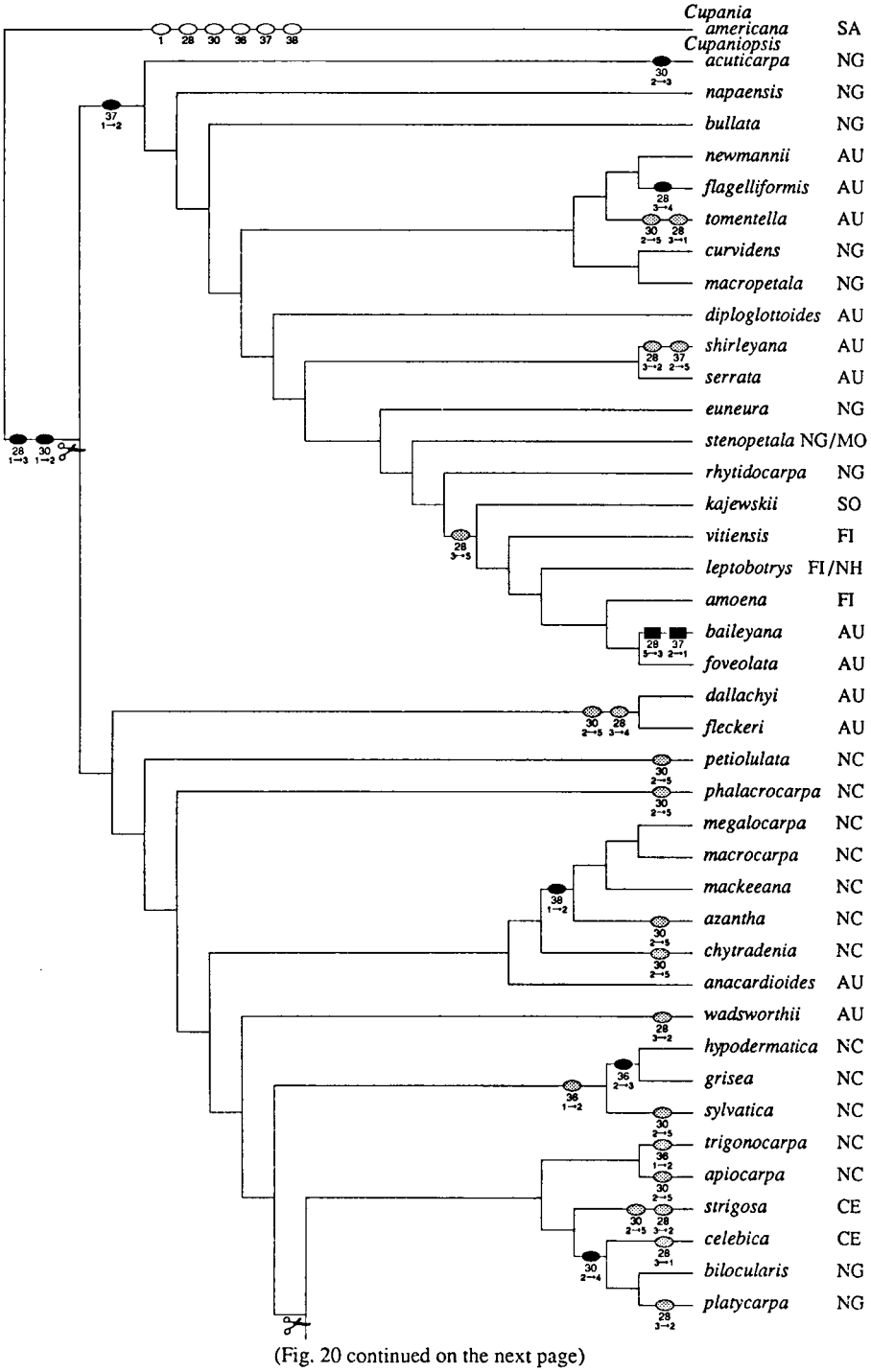


Fig. 19. Cladogram of the upper group. See for the explanation of AU–SO figure 16.



(Fig. 20 continued on the next page)

(Fig. 20 continued)

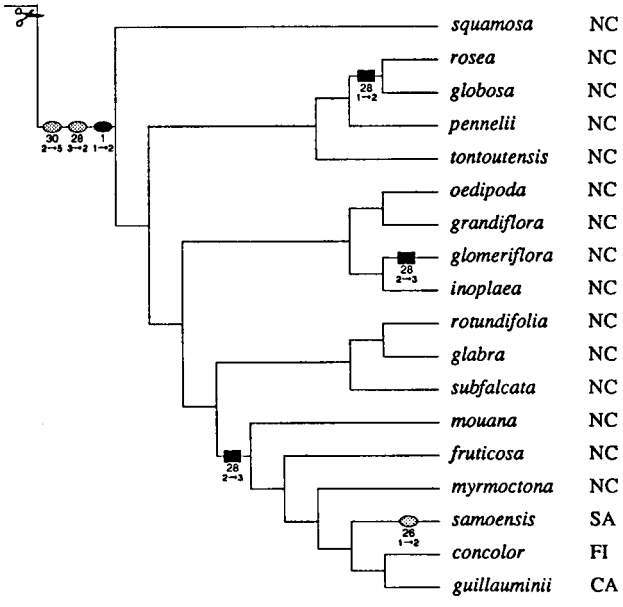


Fig. 20. A complete cladogram of *Cupaniopsis*. ⬭ = plesiomorphy; ⬬ = apomorphy; ⬭ = parallel; ■ = reversal; ✂ = original cutting places. See for explanation of AU–SO figure 16.

10.7. A COMPLETE CLADOGRAM OF CUPANIOPSIS

The three partial cladograms of *Cupaniopsis* added to each other form the complete cladogram of figure 20. Only the very incompletely known *C. crassivalvis* and *C. phanerophlebia* are omitted.

The lower and upper parts of the cladogram each forms a monophyletic group. The middle part is probably paraphyletic. However, this part contains groups that are monophyletic by themselves, for instance the group *C. bilocularis, C. celebica,* and *C. platycarpa.*

A comparison with the initial cladogram shows that the accepted cladogram is better solved. Groups that were expected to exist are mostly recognizable. The relationship between the species in the various groups is rather different from that in the original cladogram. The lower group gives also a better geographical impression. The middle group, however, is still geographically mixed. Also the number of homoplasies is still high.

10.8. Phylogeny and Pollen morphology

1. Pollentype (character 28).

Cupania americana, the outgroup, has syncolporate pollen. According to the outgroup rule this is the plesiomorphic character state. In *Cupaniopsis* this type is found, as a reversal, in *C. celebica*, *C. globosa*, and *C. rosea*.

Parasyncolporate pollen is mostly found in the species of the lower branches in the cladogram. It is also found, as a reversal, in the uppermost part of the cladogram, and in *C. baileyana* and *C. glomeriflora*.

Syncolporate to parasyncolporate pollen is an apomorphy for *C. glabra*, *C. grandiflora*, *C. inoplaea*, *C. oedipoda*, *C. pennelii*, *C. platycarpa*, *C. shirleyana*, *C. squamosa*, *C. stenopetala*, *C. strigosa*, *C. subfalcata*, *C. tontoutensis*, and *C. wadsworthii*.

Parasyncolporate to colporate pollen is an apomorphy for *C. flagelliformis* and *C. fleckeri*.

Colporate pollen is an apomorphy for *C. tomentella*, and a synapomorphy for the group: *C. amoena*, *C. foveolata*, *C. kajewskii*, *C. leptobotrys*, and *C. vitiensis*. This group includes *C. baileyana* where a reversal to parasyncolporate pollen is found.

This character takes 15 steps, it shows several reversals and parallel developments.

2. Ornamentation (character 29).

Rugulate ornamentation is the plesiomorphic character state. It is found in *Cupania americana*, the outgroup, and as a reversal in most species of Cupaniopsis.

Rugulate to reticulate ornamentation is an apomorphy for *Cupaniopsis amoena*, *C. fleckeri*, *C. glabra*, *C. mouana*, *C. rosea*, *C. serrata*, *C. subfalcata*, *C. tomentella*, *C. tontoutensis*, and *C. wadsworthii*.

Reticulate ornamentation is an apomorphy for *Cupaniopsis anacardioides*, *C. bullata*, *C. celebica*, *C. curvidens*, *C. diploglottoides*, *C. flagelliformis*, *C. newmannii*, and *C. oedipoda*.

Psilate-perforate ornamentation is an apomorphy for *C. grandiflora* and *C. inoplaea*.

This character takes 19 steps. It shows many reversals and much parallelism.

10.9. Phylogeny and Leaf anatomy

1. Scale hairs (character 1).

This character is a synapomorphy for all species of sect. Mizopetala, the upper group of the cladogram.

2. Glandular hairs (character 30).

Cupania americana has the *Cupania*-type of glandular hairs. According to the outgroup rule this is the plesiomorphic character state.

Most species of *Cupaniopsis* have the *Cupaniopsis*-type of glandular hairs. In the middle group this character state occurs as a reversal for *C. anacardioides*, *C. grisea*, *C. hypodermatica*, *C. mackeeana*, *C. macrocarpa*, *C. megalocarpa*, and *C. strigosa*.

Cupaniopsis acuticarpa has, as an autapomorphy, its own type of glandular hairs.

The *Platycarpa*-type of glandular hairs is a synapomorphy for the group: *C. bilocularis*, *C. celebica*, and *C. platycarpa*.

Absence of glandular hairs is a synapomorphy for the upper group of the cladogram (sect. *Mizopetala*). As an apomorphy it is also found in *C. apiocarpa*, *C. azantha*, *C. chytradenia*, *C. dallachyi*, *C. fleckeri*, *C. petiolulata*, *C. phalacrocarpa*, *C. strigosa*, *C. sylvatica*, and *C. tomentella*.

This character takes 10 steps. It shows many reversals and also some parallelism.

3. Papillae (character 31).

Cupania americana has long, slender, warty papillae, this will be the plesio morphic character state.

In all *Cupaniopsis* species, except *C. bilocularis*, *C. celebica* and *C. platycarpa*, papillae are absent.

The three species mentioned have as a synapomorphy low, domed, coronulate papillae.

4. Hypoderm (character 36).

A continuous hypodermal layer is a synapomorphy for *Cupaniopsis grisea* and *C. hypodermatica*.

A continuous to local hypodermal layer is an apomorphy for *C. sylvatica* and *C. trigonocarpa*.

5. Additional vascular strand in the pith (character 37).

This character is a synapomorphy for the lower group in the cladogram, with reversals in *Cupaniopsis shirleyana* and *C. baileyana*.

6. Extra division walls in adaxial epidermal cells (character 38).

This character is a synapomorphy for the group: *Cupaniopsis azantha*, *C. mackeeana*, *C. macrocarpa*, and *C. megalocarpa*.

11. BIOGEOGRAPHY

11.1. Introduction

Biogeography tries to explain distribution patterns. Processes like vicariance, dispersal, and diffusion are thought to be the main causes of these patterns. Also extinction and primitive absence may play a role.

Vicariance is the splitting of a larger area in two or more smaller ones, usually through geological processes such as plate tectonics. Since the discovery of plate tectonics, and the rise to importance of cladistics in phylogeny, vicariance has

become the state of the art in biogeography. This form of biogeography is usually called Historical Biogeography (see Nelson & Platnick, 1981, amongst others).

Diffusion is the slow spreading of a (newly formed) species over an area without barriers. Dispersal is the active crossing of a barrier.

As in phylogeny absence causes problems. Extinction (= absence through loss) and primitive absence (= the species never was there) are commonly used as *ad hoc* explanations for otherwise unexplainable gaps in distribution patterns.

11.2. Vicariance

If a large landmass breaks into smaller ones barriers arise between parts of a former larger ('ancestral') distributional area. The breakaway parts and their biota will follow their own history. Species may react to these events by speciation; and the phylogenetic relationship between the new species is thought to reflect this reaction. As different plant and animal groups may react in the same way to the same event, congruence between their phylogenies will reflect a common history. Historical biogeography (Nelson & Platnick, 1981; Van Welzen, 1989) tries to explain distribution patterns through this common history.

For an analysis along these ideas a cladogram of a group is needed. In this cladogram terminal taxa are substituted by their areas. Then the areas of the ancestors (= sum of the areas of descendants) are added to the datamatrix. With CAFCA (Zandee, 1988), according to Van Welzen (1989) the best program for vicariance analysis, an areagram is made. Areagrams of different groups, distributed over the same area, are combined in a generalized areagram. This generalized areagram is then used to discuss the relations between the areas, and to explain the various distribution patterns.

A more comprehensive account on historical biogeography, and its methods can be found in Van Welzen (1989: 95–130).

11.3. Cupaniopsis and biogeography

The accepted cladogram of *Cupaniopsis* is not very well resolved. The partial cladograms, used to construct the complete cladogram, show a better resolution. They were used in the biogeographical analysis to find out whether the distribution patterns in *Cupaniopsis* reflect any vicariance event.

1. The lower group

This group covers almost the same area as Van Welzen's Pacific group (l.c.: 99–102). However, it occurs also in Australia and the Moluccas, and is absent from the Santa Cruz group and Tonga. Van Welzen, however, omitted from his outgroup *Cupaniopsis anacardioides* the main part of its distribution: Australia! After adding Australia to his datamatrix the generalized areagram of fig. 21 was produced. It differs from the one given by Van Welzen (l.c.: 101, fig. 48d) only in the presence of Australia as a sisterarea of New Guinea. The consistency index is a bit lower (.964) and the redundancy index is a bit higher (.482).

Table 6. Datamatrix for biogeographical analysis of: *Guioa* Pacific group, *Aceropyga*, and *Cupaniopsis* lower group. – Columns: 1–16: *Guioa*, 17–28: *Aceropyga*, 29–69: *Cupaniopsis*. – Rows: 1. Australia, 2. New Guinea, 3. Solomon Islands, 4. Santa Cruz group, 5. New Hebrides, 6. Fiji, 7. Tonga, 8. Moluccas.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0
3	0	1	1	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	1	0	0	0	0
4	0	0	0	1	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0
5	0	0	0	0	1	0	0	0	0	0	0	0	1	1	1	1	0	0	0	1	0	0	0
6	0	0	0	0	0	1	1	1	0	1	1	1	1	1	1	1	0	0	0	0	1	1	0
7	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	1
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46
1	0	0	0	0	0	1	0	0	0	1	1	1	0	0	1	1	1	0	0	0	0	0	0
2	0	0	0	0	1	1	1	1	1	0	0	0	1	1	0	0	0	1	1	1	0	0	0
3	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
6	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
7	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0

	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69
1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1
2	0	0	0	0	0	0	0	0	1	1	1	0	1	1	0	0	1	1	1	1	1	1	1
3	0	0	0	0	0	0	0	1	1	1	1	0	1	1	0	0	0	0	1	1	1	1	1
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	1	1	1	1	1	1	0	1	1	0	0	0	0	1	1	1	1	1
6	1	0	0	0	1	1	1	1	1	1	1	0	1	1	0	0	0	0	1	1	1	1	1
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	1	1	0	1	1	0	0	0	0	1	1	1	1	1

The *Cupaniopsis* data were added to those of *Guioa* and *Aceropyga* used by Van Welzen (table 6), and a new generalized areagram was produced. This generalized areagram contains 84 steps, the consistency index = .821, the redundancy index = .406. According to Van Welzen (l.c.) the data on *Aceropyga* are rather incomplete and its cladogram is poorly solved. Removing the *Aceropyga* data, and using only *Guioa* and *Cupaniopsis* resulted in exactly the same generalized areagram (fig. 22). It now contains 68 steps, the consistency index = .838, and the redundancy index = .428. Compared to the cladogram produced by the *Guioa/Aceropyga* data (fig. 21) the consistency and redundancy indexes are considerably lower. It also offers a quite different solution. New Guinea is now a sisterarea of the Moluccas,

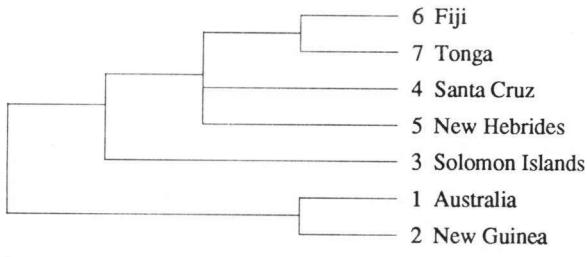


Fig. 21. Generalized areagram for *Aceropyga* and *Guioa* Pacific group. After Van Welzen (1989: fig 48d), added: Australia.

and Australia is a sisterarea of Fiji and the New Hebrides. The basal polytomy formed by Tonga, Santa Cruz and the rest of the cladogram is caused by the absence of *Cupaniopsis* from the former two areas.

The generalized areagram shows a large amount of homoplasy, probably due to the incongruence of the data on *Cupaniopsis* and *Guioa*. This incongruence leads to the conclusion that the pattern of distribution is not caused by vicariance, but by dispersal followed by speciation. The dispersal centres either in New Guinea or in Australia.

2. The middle group

The species of this group are mostly distributed in Australia and New Caledonia. The same area is covered by the groups discussed in chapter 12.5 of Van Welzen (l.c.: 113–120). Four of the *Cupaniopsis* species occur outside this area: two in Celebes, and two in New Guinea.

After adding the *Cupaniopsis* data to the original datamatrix an analysis with CAFCA was started. This analysis, however, resulted in so many cladograms, that it had to be discontinued. No cladogram was chosen to be discussed.

The distribution pattern is most likely produced by dispersal with Australia as centre. From the original cladogram (fig. 20) it seems possible that New Caledonia was provided with species at least twice.

3. The upper group

This group occurs only in New Caledonia, Samoa, Fiji, and Truk Tol. Samoa, Fiji and Truk Tol were reached by dispersal.

11.4. Conclusions

1. Distribution patterns of the *Cupaniopsis* species are produced by dispersal.
2. Australia has been the main centre of dispersal. Secondary centres are New Guinea and New Caledonia.
3. New Caledonia was provided with species several times. Probably mostly from Australia, but it may be possible that at least once New Guinea was involved. Both Australia and New Guinea have a strong floristic relationship with New Caledonia (Morat, Veillon & MacKee, 1986).

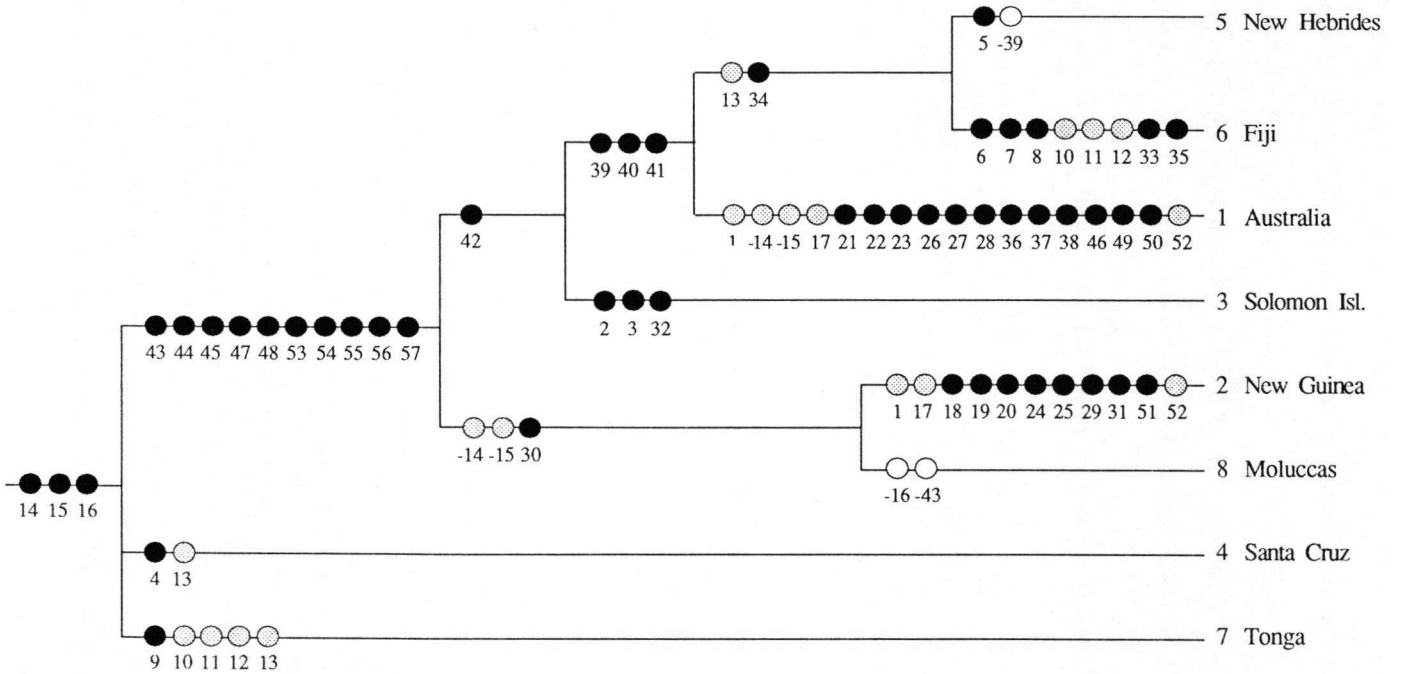


Fig. 22. Generalized areagram for *Guioa* Pacific group and *Cupaniopsis* lower group. Species numbers: 1–16 = *Guioa*; 17–57 = *Cupaniopsis* (= 29–69 from table 6). ● = apomorphy; ◍ = homoplasy; ○ = reversal.

12. REFERENCES

ADEMA, F. 1988. Notes on Cupaniopsis (Sapindaceae). 1. New species from New Caledonia. Adansonia 10: 263–270.

APPANAH, S. 1982. Pollination of androdioecious Xerospermum intermedium Radlk. (Sapindaceae) in a rain forest. Biol. J. Linn. Soc. 18: 11–34.

BAWA, K.S. 1977. The reproductive biology of Cupania guatemalensis Radlk. (Sapindaceae). Evolution 31: 52–63.

COOKSON, I.C., & K.M. PIKE. 1954. Some dicotyledonous pollen types from Cainozoic deposits in the Australian region. Aust. J. Bot. 2: 197–219.

FARRIS, J.S. 1988. Hennig86 reference, version 1.5. University of Stony Brook, New York.

GEESINK, R., & D.J. KORNET. 1989. Speciation and Malesian Leguminosae. In: L.B. Holm-Nielsen, I.C. Nielsen & H. Balslev, Tropical Forests: botanical dynamics, speciation and diversity: 135–151. London

GHISELIN, M.T. 1974. A radical solution to the species problem. Syst. Zool. 23: 536–544.

GUILLAUMIN, A. 1959. Contributions à la flore de la Nouvelle- Calédonie. 116 Plantes receuillies par MacKee (suite) 4e liste (1). Mém. Mus. Nat. Hist. Nat. Sér. Bot. 8: 121–191.

GUILLAUMIN, A., & R. VIROT. 1953. Contributions à la flore de la Nouvelle-Calédonie. 102. – Plantes récoltées par M.R. Virot. Mém. Mus. Nat. Hist. Nat. Paris Sér. Bot. 4: 1- 82.

HAM, R.W.J.M. VAN DER. 1990. Nephelieae pollen (Sapindaceae): Form, function, and evolution. Leiden Botanical Series 13. Leiden.

HAM, R.W.J.M. VAN DER, & B.J. VAN HEUVEN. 1989. Evolutionary trends in the morphology and harmomegathy of the pollen of the genus Guioa (Sapindaceae-Cupanieae). Blumea 34: 21–60.

HAWKESWOOD, T.J. 1983a. Pollination and fruitproduction of Cupaniopsis anacardioides (A. Rich.) Radlkf. (Sapindaceae) at Townsville, North Queensland. I. Pollination and floral biology. Victorian Naturalist 100: 12–20.

HAWKESWOOD, T.J. 1983b. Pollination and fruitproduction of Cupaniopsis anacardioides (A. Rich.) Radlkf. (Sapindaceae) at Townsville, North Queensland. II. Fruit and seed production. Victorian Naturalist 100: 121–123.

KLIKSPAAN (J. Kneppelhout). 1839–1841. Studenten-typen. Bewerkt door J. van Nieuwenhuizen. Den Haag.

KORNET, D.J. 1988. Conventional and fundamental problems in the delimitation of genera from a phylogenetic point of view. Acta Bot. Neerl. 37: 527–529.

MERRILL, E.D., & L.M. PERRY. 1940. Plantae papuanae archboldianae V. J. Arn. Arbor. 21: 511–527.

METCALFE, C.R., & L. CHALK. 1950. Anatomy of the Dicotyledons 1. Oxford.

MORAT, PH., J.-M. VEILLON, & H.S. MACKEE. 1986. Floristic relationship of New Caledonian rainforest phanerogams. Telopea 2: 631-679.

MUELLER, F. 1862. Fragmenta Phytographiae Australiae 3. Melbourne.

MUELLER, F. 1863. Fragmenta Phytographiae Australiae 4. Melbourne.

MUELLER, F. 1875. Fragmenta Phytographiae Australiae 9. Melbourne.

MULLER, J. 1981. Fossil pollen records of extant angiosperms. Bot. Review 47: 1–142.

MULLER, J., & P.W. LEENHOUTS. 1976. A general survey of pollen types of Sapindaceae in relation to taxonomy. In: I.K. Ferguson & J. Muller (eds), The evolutionary significance of the exine. Linn. Soc. Symp. Ser. 1: 407–445.

NAIR, N.C., & T. JOSEPH. 1960. Morphology and embryology of Cardiospermum halicacabum Linn. J. Ind. Bot. Soc. 39: 178–194.

NELSON, G. 1978. Ontogeny, phylogeny, paleontology, and the biogenetic law. Syst. Zool. 27: 324–345.

NELSON, G., & N.I. PLATNICK. 1981. Systematics and biogeography. Oxford.

PATTERSON, C. 1982. Morphological characters and homology. In: K.A. Joysey & A.E. Friday (eds), Problems of phylogenetic reconstruction. London: 20–74.
PIMENTEL, R.A., & R. RIGGINS 1987. The nature of cladistic data. Cladistics 3: 201–209.
PIJL, L. VAN DER. 1957. On the arilloid of Nephelium, Euphoria, Litchi, and Aesculus, and the seeds of Sapindaceae in general. Acta Bot. Neerl. 6: 618–641.
RADLKOFER, L. 1879. Ueber Cupania und damit verwandte Pflanzen. Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. Münch. 9: 457–678.
RADLKOFER, L. 1883. Ueber die Methoden in der botanischen Systematik, insbesondere die anatomische Methode. Festrede zur Vorfeier des Allerhöchsten Geburts- und Namensfestes Seiner Majestät des Königs Ludwig II. München.
RADLKOFER, L. 1890. Ueber die Gliederung der Familie der Sapindaceen. Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. Münch. 20: 105–379.
RADLKOFER, L. 1895. Sapindaceae. In: A. Engler & K. Prantl, Natürlichen Pflanzenfamilien III, 5: 277–366. Leipzig.
RADLKOFER, L. 1924. Sapindaceae oceanicae novae vel emendatae. Fedde Rep. 20: 27–42.
RADLKOFER, L. 1931–1934. Sapindaceae. In: A. Engler, Das Pflanzenreich 98: 1–1539. Leipzig.
RÉNARD, A.L.E. 1913. Rapports anatomiques du genre Arfeuillea. Ann Sc. Nat. Bot. 9e Sér., 17: 353–389.
REYNOLDS, S.T. 1984. Notes on Sapindaceae, III. Austrobaileya 2: 29–64.
REYNOLDS, S.T. 1985. Sapindaceae. Flora of Australia 25: 4–163. Canberra.
RICHARD, A. 1832–1834. Sertum Astrolabium.
SOLEREDER, H. 1899. Systematische Anatomie der Dicotyledonen. Stuttgart.
STEENIS, C.G.G.J. VAN. 1957. Specific and infraspecific delimitation. In: C.G.G.J. van Steenis (ed.), Flora Malesiana ser. I. 5: CLXVII–CCXXXIV. Djakarta.
STEIN, GERTRUDE. 1922. Geography and plays. Reprint 1968. New York.
SWOFFORD, D.L. 1985. PAUP. Phylogenetic analysis using parsimony, version 2.4. Champaign, Illinois.
VOGEL, E.F. DE. 1980. Seedlings of dicotyledons. Wageningen.
WELZEN, P.C. VAN. 1989. Guioa Cav. (Sapindaceae): Taxonomy, Phylogeny, and Historical biogeography. Leiden Bot. Ser. 12. Leiden.
WILEY, C.O. 1981. Phylogenetics. New York.
ZANDEE, M. 1987. A computing environment for cladistic analysis. In P. Hovenkamp (ed.), Systematics and evolution: a matter of diversity: 111–140. Utrecht.
ZANDEE, M. 1988. A user manual for CAFCA/PC (version 1.9.6). Institute of Theoretical Biology, University of Leiden.
ZANDEE, M., & R. GEESINK. 1987. Phylogenetics and legumes: A desire for the impossible? In: C.H. Stirton (ed.), Advances in legume systematics, part 3: 131–167. Royal Botanic Gardens, Kew.

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CUPANIOPSIS

Cupaniopsis Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. Münch. 9 (1879) 483, 498, 584; 20 (1890) 291, 357; in Engler & Prantl, Nat. Pflanzenfam. III, 5 (1895) 346; Guillaumin, Bull. Soc. Bot. Fr. 79 (1932) 338; Radlk., Bot. Jahrb. 56 (1920) 283; in Engler, Pflanzenr. 98 (1933) 1177; Guillaumin, Fl. Nouv. Caléd. (1948) 199; Reynolds, Austrobaileya 2 (1984) 44; Fl. Austr. 25 (1985) 55; A.C. Smith, Fl. Vitiensis Nova 3 (1985) 603. — *Cupaniopsis* Sect. *Elattopetalum* Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. Münch. 9 (1879) 584; in Engler & Prantl, Nat. Pflanzenf. III, 5 (1895) 346; in Engler, Pflanzenr. 98 (1933) 1183. — Lectotype species (Reynolds, 1984): *Cupania anacardioides* A. Richard [= *Cupaniopsis anacardioides* (A. Richard) Radlk.].

Cupaniopsis Sect. *Mizopetalum* Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. Münch. 9 (1879) 588; in Engler & Prantl, Nat. Pflanzenf. III, 5 (1895) 346; in Engler, Pflanzenr. 98 (1933) 1202. — Lectotype species (present author): *Cupaniopsis fruticosa* Radlk.

Cupaniopsis Sect. *Macropetalum* Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. Münch. 20 (1890) 357; in Engler & Prantl, Nat. Pflanzenf. III, 5 (1895) 346; in Engler, Pflanzenr. 98 (1933) 1182. — Type species: *Cupaniopsis macropetala* Radlk.

Cupania auct. non L. pp.: Bentham, Fl. Austr. 1 (1863) 457; Bailey, Queensl. Fl. 1 (1899) 289.

Shrubs or small to medium sized, often unbranched palmoid *trees* ('Schopfbäume'). *Twigs* terete, smooth to striate or grooved. *Indumentum* consisting of simple solitary hairs, sometimes mixed with red clavate glands, in many Pacific species consisting of scale hairs. *Leaves* spirally arranged, paripinnate, 1–28-jugate, without stipules, pseudostipules present in *C. shirleyana*; petiole pulvinate, semiterete or at least upwards terete; rachis terete or semiterete. *Leaflets* opposite to alternate, lower ones usually smaller than the upper ones, slightly to distinctly asymmetric or rarely symmetric, thinly papyraceous to coriaceous, often punctate, base rounded to attenuate, apex rounded to acuminate, often retuse, rarely caudate, very apex often mucronate, margin entire to serrate or dentate, rarely lobed, upper surface often darker and shinier than the lower, smooth, glabrous or with a puberulous midrib to more or less puberulous, sometimes with scale hairs, lower surface usually dull, smooth, rarely papillate, usually more densely hairy than the upper side, domatia absent or few to many pocket-like, dome-shaped, or pustulate, venation open or closed, laxly to densely reticulate, prominent usually on lower surface only, nerves alternating with smaller ones; petiolules pulvinate, usually distinct. *Inflorescences* thyrsoid, ramiflorous or axillary and then often pseudoterminal, without or with short to long branches, laxly to densely flowered; cymules dichasial, 1- to several-flowered. *Bracts* and *bracteoles* acicular to deltoid, usually not persistent in fruit, outside hairy or with scale hairs, inside glabrous or hairy, especially at the base, rarely with scale hairs. *Buds* (flattened) globose to obovoid. *Flowers* regular, with a zygomorphic calyx, unisexual, rarely hermaphrodite, male flowers with a minute pistillode, female ones with rather large staminodes. Perianth of female flowers usually not much different from that of the male ones. *Sepals* 5, rarely 4, 6, or 7, outer 2 distinctly smaller than inner 3 (in *C. glomeriflora* mostly 4, rarely 3 or 5, and almost equal), free, im-

bricate, often concave, especially the inner sepals with a narrow to wide petaloid rim to almost totally petaloid, usually persistent in fruit, outside glabrous to appressed-hairy or with scale hairs, the petaloid rim glabrous, margin usualy ciliate and often also with small glandular hairs, inside glabrous to appressed-hairy. *Petals* 5, or 4 (*C. glomeriflora*), elliptic to orbicular or spathulate, rhomboid or obovate, rarely clawed, often dentate at apex, both sides glabrous to hairy, margin ciliate, often also with glandular hairs; petalar scales 1 or 2, rarely crested, free or up to 3/4 connate with the margin of the petals, rarely with auricles instead of scales. *Disc* complete, lobed, smooth, glabrous or with 5 distinct tufts of hairs alternating with the petals, rarely entirely short hairy. *Stamens* (7–)8–14, *C. glomeriflora* 6, usually exserted in male flowers; filaments patently hairy, usually up to halfway, exceptionally glabrous; anthers shorter to longer than the filaments, basifixed in cleft, latrorsely lengthwise opening, glabrous to rather densely hairy. *Pistil*: ovary 2- or 3-locular, smooth, glabrous to densely hirsute, sometimes with few to many scale hairs, sessile or with a short gynophore; ovule one per loculus, ascending, apotropous, campylotropous; style apical, shorter than the ovary, with 2 or 3 stigmatic lines, rarely stigma lobed. *Fruit* a loculicidal capsule, rarely distinctly lobed, 2- or 3-, rarely 1-celled (septa not developed in *C. concolor*, *guillauminii*, *samoensis*), sessile or with a short stipe, usually rounded in cross section, rarely keeled, never winged, pericarp coriaceous to woody, thin to rather thick, exocarp smooth to rugose, glabrous to hirsute, sometimes with scale hairs, endocarp glabrous to tomentose or appressed-hairy. *Seeds* ellipsoid or globose to obovoid, often dorso-ventrally, exceptionally laterally flattened, arilloid half to completely covering the seed, in *C. platycarpa* instead of a arilloid a sarcotesta, hilum oval, (sub)basal, micropylar wart indistinct; sclerotesta woody, thin, usually black, endotesta membraneous, brownish. *Embryo* noto- or lomatorrhizal, cotyledons thick, superposed or parallel, often inequal, rootlet dorsoventrally flattened, inserted in a pocket formed by the endotesta; plumule inconspicuous.

Distribution — 60 species. E. Malesia (very rare on Celebes and in the Moluccas), N. and E. Australia, from northern West Australia to northern New South Wales, the Caroline Islands (Truk Tol), Pacific from the Solomon Islands to Samoa and New Caledonia (fig. 23).

Habitat — Found in secondary or primary forests, often in forest margins, road- and riversides, on floodplains and beaches. Rather indifferent to soiltype, on New Caledonia several species are found on ultrabasic (serpentine). Alt.: sealevel to lower montane zones. Usually rare.

Notes — *Cupaniopsis* is rather variable in many characters. Typical are the dimorph sepals, the usually not crested petalar scales and the complete, often hairy disc; a pseudo-funicle is absent.

Gongrodiscus according to Van der Ham (1977, p. 290) a genus worth to be remembered when revising *Cupaniopsis*, is not as he wrote much alike *C. concolor* or other *Cupaniopsis*-species. It differs greatly in calyx, corolla, fruits, and other characters.

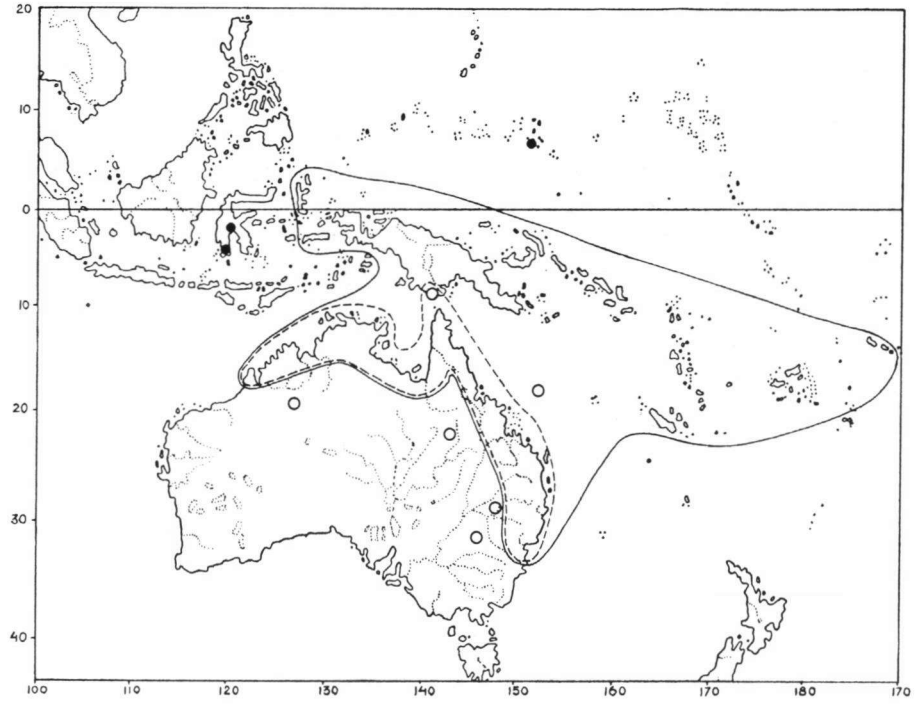

Fig. 23. Distribution of *Cupaniopsis* Radlk. ——, ●, ○ = all species; - - - -, ○ = *Cupaniopsis anacardioides* (A. Richard) Radlk.

KEYS TO THE SPECIES OF CUPANIOPSIS

A. Species from Celebes, the Moluccas, New Guinea, and the Solomon

1 a. At least young parts with red glands. Lower side of leaflets sericeous. Pistillode, ovary, and fruits 2-celled; stigma 2-lined 2
b. Red glands absent. Lower side of leaflets glabrous to puberulous, if appressed-hairy than not sericeous. Pistillode, ovary, and fruits 3-celled; stigma 3-lined 4

2 a. Axial parts villose to tomentose. Petals outside glabrous, petalar scale 1. Stamens exserted. (*New Guinea*) 3
b. Axial parts strigose. Petals outside hairy, petalar scales 2. Stamens not exserted. (*Celebes*) . . . . . **9. C. celebica**

3 a. Leaflets usually with small pocket-like domatia. Petalar scales crested. Fruits ellipsoid, lenticular or obcordate, 4–8 × 4–6 cm, stipe ca. 10 mm. Seeds 3.5–4 × 2–3 cm, with a sarcotesta . . . . . **44. C. platycarpa**
b. Leaflets without domatia. Petalar scales not crested. Fruits transversely ellipsoid to obreniform, 2 × 3 cm, stipe 1 mm. Seeds 1 × 0.5 cm, with an arilloid . . . . . **7. C. bilocularis**

4 (1) a. Stamens (or staminodes) 10–14 5
b. Stamens (or staminodes) 8 6
5 a. Petals with 2 scales. Pericarp 2.4–3.6 mm thick, endocarp glabrous. (*New Guinea*) . . . . . **45. C. rhytidocarpa**
b. Petals with auricles. Pericarp 0.4–0.5 mm thick, endocarp appressed-hairy. (*Solomon Islands*) . . . . . **29. C. kajewskii**
6 (4) a. Leaflets entire, exceptionally obscurely crenate 7
b. Leaflets dentate to serrate, rarely crenate or entire (but never all entire) 11
7 a. Axial parts strigose. Flowering twigs 1–5 mm in diameter. Leaves (1–)2–6(–7)-jugate 8
b. Axial parts villose to tomentose. Flowering twigs 10–15 mm in diameter. Leaves 6–11-jugate 9
8 a. Leaflets (narrowly) obovate or rarely elliptic, apex obtuse to rounded, often retuse, rarely shortly and broadly acuminate. Petals in male flowers elliptic to broad-obovate, sometimes semicircular, 0.5–3.5 × 0.6–3.6 mm. (*New Guinea, Australia*) . . . . . **3. C. anacardioides**
b. Leaflets ovate, apex acuminate. Petals in male flowers lingulate, 1.8–2.3 × 0.5–0.7 mm. (*Celebes*) . . . . . **53. C. strigosa**
9 (7) a. Upper leaflets 25.5–32.5 × 6–7 cm, apex acuminate; petiolules 2–5 mm long. Anthers glabrous 10
b. Upper leaflets 21.5 × 7 cm, apex rounded; petiolules 15–17 mm long. Anthers hairy. (*Testa of seeds hairy at apex*) . . . . . **37. C. napaensis**
10 a. Leaves 6-jugate. Upper leaflets narrowly elliptic, 32.5 × 6 cm; petiolules 2–3 mm long. Inflorescences 10.5 cm long. Bracts about elliptic to acicular, 1.9–3.0 × 0.5–1.2 mm . . . . . **43. C. phanerophlebia**
b. Leaves ca. 10-jugate. Upper leaflets ovate, 25.5 × 7.3 cm; petiolules 3–5 mm long. Inflorescences 19.5–35 cm long. Bracts narrowly triangular, 0.6–1.0 × 0.2–0.4 mm . . . . . **8. C. bullata**
11 (6) a. Inflorescences longer than 3 cm, with long or short branches, laxly flowered. Petals shorter than, exceptionally as long as, or longer than the sepals 12
b. Inflorescences up to 3 cm long, without, rarely with short branches, densely flowered. Petals longer than, rarely as long as or shorter than the sepals . . . . . **32. C. macropetala**
12 a. Leaves (3–)4–18(–28)-jugate. Leaflets thinly papyraceous to coriaceous 13
b. Leaves 2–3-jugate. Leaflets coriaceous . . . . . **16. C. euneura**
13 a. Leaflets usually dentate in upper part, rarely entire. Endocarp villose. . 14
b. Leaflets dentate to serrate all around, rarely crenate or entire. Endocarp thinly to densely appressed-hairy to slightly villose . . . . **13. C. curvidens**
14 a. Leaflets (narrowly) obovate, rarely elliptic, apex acuminate, the domatia pocket-like. Disc glabrous. Fruits more or less circular in cross section, apex rounded . . . . . **52. C. stenopetala**
b. Leaflets elliptic, apex obtuse, domatia absent. Disc with 5 tufts of hairs. Fruits triangular in cross section, apex acute . . . . . **1. C. acuticarpa**

B. SPECIES FROM AUSTRALIA:

1 a. Most of the leaflets cuneate, widest at or near the truncate apex 2
b. Leaflets elliptic to ovate or obovate, widest below the obtuse to rounded, acuminate or retuse, exceptionally truncate apex 3

2 a. Leaves 2–6(–8)-jugate, with pseudostipules. Leaflets spinose-dentate **50. C. shirleyana**
b. Leaves 1–2(–3)-jugate, without pseudostipules. Leaflets apically with 2–4 obtuse teeth, rarely entire ..... **60. C. wadsworthii**

3 (1) a. Axial parts villose to tomentose, often also with longer hairs 4
b. Axial parts strigose 8

4 a. Sepals inside usually with scattered appressed hairs, rarely glabrous. Fruits 12–20 × 15–18 mm, wall 0.5–2.4 mm thick, inside appressed-hairy 5
b. Inside of sepals glabrous. Fruits 20 × 28 mm, wall 3.0–3.6 mm thick, inside glabrous ..... **56. C. tomentella**

5 a. Margin of leaflets ± dentate. Pericarp 0.5–1.8 mm thick 6
b. Margin of leaflets entire. Pericarp 2.4 mm thick or more **15. C. diploglottoides**

6 a. Teeth of leaflets soft, not sharp. Inflorescences (6.5–)11–60 cm long, with long, rarely short branches. Disc with few to many hairs, more or less in 5 tufts 7
b. Teeth of leaflets hard and sharp. Inflorescences 1.5–6.5 cm long, without or with 1 or 2 short branches. Disc glabrous ..... **49. C. serrata**

7 a. Leaves 4–10-jugate. Anthers hairy ..... **17. C. flagelliformis**
b. Leaves (7–)10–12-jugate. Anthers glabrous ..... **38. C. newmannii**

8 (3) a. Leaves (4–)6–10(–15)-jugate. Leaflets crenate-dentate 9
b. Leaves (1–)2–7-jugate. Leaflets entire 10

9 a. Trees or treelets, 12–25 m high. Leaflets with dome-shaped to pocket-like domatia. Fruits 15 × 13–14 mm, stipe 1–2 mm long, wall 0.5–0.8 mm thick. Seeds 8–8.5 × 6.5–7 mm ..... **19. C. foveolata**
b. Shrubs or treelets, 2–12 m high. Leaflets without or with pustulate domatia. Fruits 22 × 18 mm, stipe 5 mm long, wall 1.1–1.2 mm thick. Seeds 17–18 × 9 mm ..... **6. C. baileyana**

10 (8) a. Leaflets usually with domatia. Disc glabrous or short-hairy all over .. 11
b. Leaflets without domatia. Disc glabrous or with hairs more or less in 5 tufts ..... **3. C. anacardioides**

11 a. Leaves (2–)4–6-jugate. Leaflets obovate, rarely elliptic. Inflorescences 4–20 cm long ..... **18. C. fleckeri**
b. Leaves 6–7-jugate. Leaflets ovate to narrowly ovate. Inflorescences 25 cm long ..... **14. C. dallachyi**

C. Species from the Caroline Islands, the New Hebrides, Fiji and Samoa:

1 a. Axial parts with small scale hairs at least when young, often also with short patent or appressed hairs. Leaves 1–3-jugate. Fruits 1-celled, septa not developed, visible as a glabrous line or a low ridge on each valve, outside glabrous 2
b. Scale hairs absent, axial parts strigose to tomentose. Leaves 4–10-jugate. Fruits 3-celled, septa complete, outside hairy 4
2 a. Inflorescences 6–13.5 cm long, with long branches. Inside of fruits glabrous or tomentose. 3
b. Inflorescences 1.5–8.5 cm long, without, rarely with short branches. Inside of fruits appressed-hairy. (*Samoa*) . . . . . **48. C. samoensis**
3 a. Axial parts with patent hairs. Upper leaflets 8–17 × 3–9 cm, index 1–3. Inside of fruits tomentose. (*Fiji*) . . . . . **11. C. concolor**
b. Axial parts at least when young with appressed hairs. Upper leaflets 13.5–18.5 × 4.5–6.5 cm, index 3–3.2. Inside of fruits glabrous. (*Caroline Islands*) . . . . . **26. C. guillauminii**
4 (1) a. Apex of leaflets obtuse to rounded, retuse, sometimes short acuminate. Petals with 2 scales. Inside of fruits more or less appressed-hairy. . . . 5
b. Apex of leaflets short to long acuminate, rarely obtuse. Petals with auricles. Inside of fruits tomentose . . . . . **30. C. leptobotrys**
5 a. Axial parts villose. Domatia absent. Stamens 10 . . . . **22. C. vitiensis**
b. Axial parts strigose. Domatia dome-shaped. Stamens 8. . **2. C. amoena**

D. Species from New Caledonia:

1 a. Axial parts at least when young with small scale hairs, usually also with short patent hairs. Twigs when young, sometimes also buds and inflorescences, 'varnished', often pruinose when older. Sepals outside glabrous or with scale hairs (rarely in *C. rosea* short appressed-hairy) 2
b. Axial parts strigose to puberulous or villose, never 'varnished', exceptionally pruinose. Sepals outside hairy or rarely glabrous 16
2 a. Flowers with 5 sepals, 5 petals and 8 stamens or staminodes 3
b. Flowers with 4 sepals, 4 petals and 6 stamens or staminodes **23. C. glomeriflora**
3 a. Ramiflorous, or, rarely, also with axillary inflorescences. Inflorescences usually in bundles 4
b. All inflorescences axillary, never in bundles 6
4 a. Leaflets (narrowly) ovate, widest below, exceptionally about the middle, apex obtuse to rounded or acuminate, exceptionally retuse, acumen (2–) 5–15 mm long 5
b. Leaflets (narrowly) elliptic, rarely narrowly ovate or narrowly obovate, widest about, rarely above or below the middle, apex obtuse to rounded, retuse, exceptionally acuminate, acumen 3–4 mm long **28. C. inoplaea**

5 a. Upper leaflets 10–31 × 2.5–10.5 cm, margin entire, exceptionally dentate or crenate. Petals 0.5–3.2 × 0.3–1.9 mm, usually shorter than the sepals. Anthers mostly hairy ..... **39. C. oedipoda**

b. Upper leaflets 8.5–17 × 1.5–5.5 cm, margin obscurely to grossly dentate, rarely entire. Petals 4.0–6.7 × 4.0–6.5 mm, longer than the sepals. Anthers glabrous ..... **24. C. grandiflora**

6 (3) a. Leaflets ovate to obovate, upper 2.5–13.5 × 0.5–4.5 cm 7

b. Leaflets broadly ovate to almost orbicular, upper 6–8 × 4–6 cm **47. C. rotundifolia**

7 a. Stamens in the male flowers exserted, the anthers shorter than the filaments 8

b. Stamens in the male flowers not exserted, anthers as long as or longer than the filaments. (*Leaves 3–5-jugate; sepals outside glabrous; anthers hairy*) **35. C. mouana**

8 a. Leaves 1–4-jugate. Anthers mostly hairy 9

b. Leaves 2–8-jugate. Anthers glabrous or rarely with some hairs 13

9 a. Largest sepals 1.8–3.1 × 1.6–2.9 mm, outside with scale hairs. Filaments of stamens 1.6–2.4 mm long, anthers 0.7–1.1 mm long 10

b. Largest sepals 2.9–4.2 × 2.5–3.7 mm, outside glabrous or rarely short appressed-hairy in lower part. Filaments of stamens 2.0–3.4 mm long, anthers 1.1– 1.7 mm long 11

10 a. Upper leaflets 4–10 × 1.5–4 cm, apex obtuse to acuminate, lateral nerves 7–12(–14) per side. Inflorescences 4–17 cm long. Fruits almost globular, 13–17 × 9–15 mm, stipe 2–3 mm long, outside glabrous, inside with stiff hairs ..... **36. C. myrmoctona**

b. Upper leaflets 2.5–6.5 × 0.5–2.5 cm, apex obtuse to rounded, lateral nerves 4–8 per side. Inflorescences 3.5–8 cm long. Fruits obovoid to obpyramidal, 10–13 × 6–9 mm, stipe 1–1.5 mm long, outside with scale or rarely also with short hairs, outside appressed-hairy to tomentose **51. C. squamosa**

11 (9) a. Leaves 1–3-, rarely 4-jugate. Leaflets elliptic to ovate, index 1.6–3.4. Largest sepals broadly elliptic to orbicular, 2.9–4.0 × 2.9–3.7 mm, outside glabrous. Anthers 1.1–1.4 mm long 12

b. Leaves 4-jugate. Leaflets narrowly elliptic, index 3.4–4.4. Largest sepals obovate, 3.8–4.2 × 2.5–3.0 mm, outside glabrous or short appressed-hairy in lower part. Anthers 1.3–1.7 mm ..... **46. C. rosea**

12 a. Petioles 2–7.5 cm long. Upper leaflets 5.5–12.5 × 2.5–4.5 cm, above glabrous, or rarely with short hairs on basal part of midrib and margin. Fruits 20 × 18 mm ..... **40. C. pennelii**

b. Petioles 1–4 cm long. Upper leaflets 3.5–7.5 × 1.5–3.5 cm, above with short hairs at the base, sometimes also with scattered scales. Fruits 9–17 × 7–13 mm ..... **22. C. globosa**

13 (8) a. Leaves (2–)3–8-jugate, petioles 2–9 cm long. Stamens 8, filaments 1.9–3.2 mm long, anthers (0.8-)1.0–1.4 mm long. Pistillode 3-celled ... 14

b. Leaves 2–4-jugate, petioles 1.1–1.8 cm long. Stamens 6–8, filaments 1.2–1.7 mm long, anthers 0.7–0.8 mm long. Pistillode 2-celled **21. C. glabra**

14 a. Angle of lateral nerves of leaflets to midrib 50°–70° (–80°). Sepals outside with scale hairs 15

b. Angle of lateral nerves of leaflets to midrib 45°–55°. Sepals outside glabrous. (*Fruits inside glabrous*) ..... **57. C. tontoutensis**

15 a. Pedicels 1.8–2.4 mm long. Anthers glabrous. (*Fruits inside with long stiff hairs*) ..... **20. C. fruticosa**

b. Pedicels 2.6–4.2 mm long. Anthers with some hairs **54. C. subfalcata**

16 (1) a. Axial parts puberulous to villose, rarely ± appressed-hairy. Flowering twigs 3–14 mm in diameter 17

b. Axial parts strigose. Flowering twigs 1–3(–5) mm in diameter 22

17 a. Disc glabrous 18

b. Disc hairy, hairs more or less in 5 tufts or, rarely, in female flowers, glabrous 20

18 a. Fruits obovoid to globular, 22–27 × 20–24 mm. Seeds 15–22 × 9–11 mm 19

b. Fruits more or less ellipsoid to cylindrical, 20–30 × 13–20 mm. Seeds 12–16 × 6–9 mm. [*Flowering twigs 3–7(–10) mm in diameter. Stipe of fruits 2–5(–8) mm long. Hypocotyl glabrous*] .. **32. C. macrocarpa**

19 a. Flowering twigs 7–14 mm in diameter. Fruits 22–25 × 20–24 mm, stipe 1–2 mm long, pericarp 0.8–1.8 mm thick. Seeds 15–18 × 9–10 mm, hypocotyl hairy on the sides ..... **31. C. mackeeana**

b. Flowering twigs 5–6 mm in diameter. Fruits 27 × 20 mm, stipe 6 mm long, pericarp 2.4 mm thick. Seeds 19–22 × 10–11 mm, hypocotyl glabrous ..... **12. C. crassivalvis**

20 (17) a. Flowering twigs 4–10 mm in diameter. Petioles (3–)7–15.5(–28) cm long, rachis 6.5–27(–46) cm long. Leaflets widest about, rarely below the middle; domatia pocket-like to dome-shaped 21

b. Flowering twigs 3–5 mm in diameter. Petioles 4.5–8 cm long, rachis 6.5–17.5 cm long. Leaflets widest below, rarely about the middle, domatia pustulate ..... **10. C. chytradenia**

21 a. Flowering twigs 8–10 mm in diameter. Leaves 8–11-jugate **5. C. azantha**

b. Flowering twigs 4–7 mm in diameter. Leaves 3–5-jugate **34. C. megalocarpa**

22 (16) a. Domatia pustulate 23

b. Domatia pocket-like, rarely dome-shaped 25

23 a. Inflorescences 3–10 cm long. Buds globular, 1.6–3.0 × 1.8–3.0 mm. Fruits outside hairy 24

b. Inflorescences 7.5–19 cm long. Buds flattened globular, 2.4–2.8 × 3.0–3.6 mm. Fruits outside glabrous or rarely with few scattered hairs **42. C. phalacrocarpa**

24 a. Leaves 2–5(–6)-jugate. Disc with 5 tufts of hairs. Anthers of stamens 0.7–1.0 mm long, of staminodes 0.8 mm long. Style 0.8–1.2 mm long. Fruits obovoid, more or less elliptic to orbicular in cross section, wall 1.4 mm thick ..... **4. C. apiocarpa**

b. Leaves 2–3-jugate. Disc glabrous or exceptionally with 5 tufts of hairs. Anthers of stamens 0.6–0.8 mm long, of staminodes 1.2 mm long. Style 0.6–0.8 mm long. Fruits obpyramidal, triangular in cross section, wall 0.8–1.2 mm thick ..... **58. C. trigonocarpa**

25 (22) a. Inflorescences 2.5–14.5(–21) cm long. Fruits more or less cylindrical to obovoid, 19–30 × 15–20 mm, wall 0.8–1.8 mm thick 26

b. Inflorescences 1.5–2.0 cm long. Fruits globular, 20 × 20 mm, wall 1.0–1.2 mm thick ..... **27. C. hypodermatica**

26 a. Inflorescences 2.5–9 cm long. Bracts 0.7–2.6 × 0.5–1.3 mm. Largest sepals in female flowers 3.0–3.6 × 3.0–4.2 mm 27

b. Inflorescences (3–)5–14.5(–21) cm long. Bracts 0.4–0.6 × 0.2–0.6 mm. Buds 1.8–2.2 × 1.8–2.4 mm. Largest sepals in female flowers 2.2–2.9 × 1.9–2.9 mm. [*Stipe of fruits 2(–3) mm long, exocarp glabrous, rarely hairy in basal part or on the stipe*] ... **41. C. petiolulata**

27 a. Pedicels 1.8–4.2 mm long. Buds 2.4 × 2.5 mm. Petals in female flowers 1.4–1.7 × 1.4–1.7 mm, scales 1.0–1.3 mm long. Anthers of staminodes hairy. (*Stipe of fruit 3–4 mm long, exocarp hairy*) **55. C. sylvatica**

b. Pedicels 0.7 mm long. Buds 1.7 × 1.9 mm. Petals in female flowers 1.2–1.4 × 1.2–1.3 mm, scales 1.3-1.6 mm long. Anthers of staminodes glabrous ..... **25. C. grisea**

E. MULTI-ENTRY KEY:

List of species:

1 *acuticarpa*
2. *amoena*
3. *anacardioides*
4. *apiocarpa*
5. *azantha*
6. *baileyana*
7. *bilocularis*
8. *bullata*
9. *celebica*
10. *chytradenia*
11. *concolor*
12. *crassivalvis*
13. *curvidens*
14. *dallachyi*
15. *diploglottoides*
16. *euneura*
17. *flagelliformis*
18. *fleckeri*
19. *foveolata*
20. *fruticosa*
21. *glabra*
22. *globosa*
23. *glomeriflora*
24. *grandiflora*
25. *grisea*
26. *guillauminii*
27. *hypodermatica*
28. *inoplaea*
29. *kajewskii*
30. *leptobotrys*
31. *mackeeana*
32. *macrocarpa*
33. *macropetala*
34. *megalocarpa*
35. *mouana*
36. *myrmoctona*
37. *napaensis*
38. *newmanii*
39. *oedipoda*
40. *pennelii*
41. *petiolulata*
42. *phalacrocarpa*
43. *phanerophlebia*
44. *platycarpa*
45. *rhytidocarpa*
46. *rosea*
47. *rotundifolia*
48. *samoensis*
49. *serrata*
50. *shirleyana*
51. *squamosa*
52. *stenopetala*
53. *strigosa*
54. *subfalcata*
55. *sylvatica*
56. *tomentella*
57. *tontoutensis*
58. *trigonocarpa*
59. *vitiensis*
60. *wadsworthii*

Numbers printed in **bold** = the species shows more than one character state. Numbers printed in **bold** and between brackets = the species shows more than one character state, of which the bracketed ones are rare. Numbers with a question mark = character state unknown.

1. Habit
   a. Trees or treelets: **1 2 3 4 5 6 7 8 9** 10 11 12 **13** 14 15 16? **17** 18 19 20 21 22 **23** 24 25 26 27 **28** 29 **30** 31 **32 33 34** 35? **36 38 39** 40 41 **42** 43 44 45 46 47 48 **49 50 51** 52 53? 55 56 **57** 58 59 **60.**
   b. shrubs: **1 3 6 13** 16? **(17) 23 28 30 32 33 34** 35? **36 38 39 49 50 51** 53? 54 **57 60.**
   c. palmoid trees: **13** 16? **(23) 30** 32 35? 37 **(39) 42** 53?

2. Indumentum (especially on young axial parts)
   a. strigose: 2 3 4 6 9 14 18 19 25 27 **30** 41 42 53 55 58 60.
   b. pilose, puberulous, tomentose, or villose: 1 5 7 8 10 12 13 15 16 17 29 (30) 31 32 33 34 37 38 43 44 45 49 50 51 52 56 59.
   c. small scale hairs: **11 20** 21 **22 23 24 26 28 35 36 39 40 46** 47 **48** 51 **54** 57.
   d. short patent hairs: **11 (20) 22 23 24 28 (35) 36 39 40 46 (48) (49) 54 (56).**
   e. short apressed hairs: **26.**

3. Red glands at least on young parts
   a. present: 7, 9, 44. (b.: absent).

4. Pseudostipules
   a. present: 50. (b.: absent).

5. Number of jugae per leaf
   a. 1: **(3) (11) 22 (28) 36 48 51 60.**
   b. 2–3: **3 4 7 11** 16 **(18) 20** 21 **22 23** 24 26 **27** 17 **28 (29)** 32 **33 34 35 36** 40 **41 42 (44) 47 48 49 50 51 (52)** 53 **55 56** 58 **60.**
   c. 4–6: **2 3 4 6 7 9** 10 **12 13 14** 15 **17 18 19 20** 21 **(22) 23 24** 25 **27 28 29 30 31 32 33 34 35 (36) 39 41 42** 43 **44** 45 46 **47 49 50** 52 53 54 **55 56 57 59.**
   d. 7–12: **1 2 (3) 5 6 (7) 8 9 13 14 17 19 (20) (23) 24 (28) (29) 30 31 32 (33)** 37 **38 39 (41) (49) (50) (52) (55) 57 59.**
   e. 13 or more: **13 (19).**

6. Form of leaflets
   a. narrowly elliptic: **6 13 19 23 28 29 32 33 35 37 41** 43 46 **49 51.**
   b. elliptic: **1 2 4 5 6 7 9 10 11 12 13** 15 **16 17 18** 20 22 **23** 25 **26 27 28** 30 **31 32 33 34 35 36** 37 **38** 40 **41 42** 44 **45 49 51 (52) 54 55 56 (57) 58 59.**
   c. narrowly ovate: **14 19 20 21 23 24 (28) 30 36 37 39 (41).**
   d. ovate: **(2) 4 5 6 7 8 10 11 14 17 18** 21 **23 24 25 26 (27) 29 30 31 32 34 35 36 38 39 40 (41) 42** 48 **(49)** 53 **54 55 (56) 57 58 59.**
   e. narrowly obovate: **3 (28) 33 (41) 51 52.**
   f. obovate: **3 4 9 12 (16) (17) 33 45 51 52.**
   g. cuneate: 50 60.
   h. broadly ovate to orbicular: 47.

7. Thickness of leaflets
   a. (thinly) chartaceous (papyraceous): 1 2 4 7 8 9 **13** 20 21 **22** 25 27 29 30 33 35 36 37 **40** 41 43 44 45 46 52 53 **55** 59.
   b. coriaceous: 3 5 6 10 11 12 **13** 14 15 16 17 18 19 20 **22** 23 24 26 27 28 31 32 34 38 39 **40** 42 47 48 49 50 51 54 **55** 56 57 58 60.

8. Upper side of leaflets
   a. glabrous: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 49 50 51 52 53 54 55 57 58 59 60.
   b. thinly pilose, puberulous or villose: 13 17 22 (32) 33 50 56.
   c. thinly appressed-hairy: 41 42.
   d. with scales:20 (22) (24) 26 (28) 36 39 48 51 (57).

9. Lower side of leaflets
   a. glabrous: 2 3 4 5 6 10 11 13 14 (17) 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 34 36 38 39 40 41 42 43 45 46 47 49 50 52 53 54 55 57 58 60.
   b. sericeous: 7 9 44.
   c. (thinly) pilose, puberulous, or villose: 1 8 12 13 14 15 16 17 28 29 30 32 33 34 37 45 50 56 59.
   d. (thinly) appressed-hairy: 3 18 (26) (37) 41 42 60.
   e. with scales: 20 (24) 26 (28) 35 36 (39) 48 51 (56) (57).

10. Apex of leaflets
   a. obtuse: 1 2 3 4 10 11 13 14 15 17 18 (19) 20 21 23 24 25 27 28 (30) 31 32 (33) 34 35 36 (37) 39 40 41 42 46 51 54 55 56 57 59.
   b. rounded: 2 3 4 12 17 18 (19) 20 22 23 24 27 28 31 32 (33) 34 37 (38) 39 41 42 47 50 51 55 56 57 58 59.
   c. truncate: (17) 50 60.
   d. acute: 9 10 17 20 25 26 33 36.
   e. acuminate: 2 (3) (4) 5 6 7 8 9 10 11 13 16 17 (18) 19 (20) 24 25 26 27 (28) 29 30 (32) 33 (34) 35 36 38 39 (40) (41) 43 44 45 48 49 52 53 59.
   f. caudate: 29.
   g. mucronate: (17) 56.
   h. retuse: 2 3 4 (17) 18 23 28 31 32 34 (39) 40 41 42 (55) (56) 58.
   i. broadly 2-lobed: 60.

11. Margin of leaflets
   a. entire: 1 2 3 4 5 7 8 9 10 11 12 (13) 14 15 18 20 21 22 (23) (24) 25 26 27 28 (29) 30 31 32 34 35 36 37 39 40 41 42 43 44 45 46 47 48 51 (52) 53 54 55 56 57 58 59 60.
   b. serrate: 13 33.
   c. dentate: 1 (13) 16 17 24 28 29 (30) (33) 38 (39) 47 49 50 52 56.
   d. crenate: 6 (13) 19 29 (30) 37 (39) 45.
   e. lobed: 23 (28).
   f. apically with 2 - 4 obtuse teeth: 21 47 60.

12. Domatia:
   a. absent: 1 3 6 7 8 9 11 (13) 18 20 21 22 23 24 26 28 (29) 31 33 35 36 37 39 40 43 (44) 46 47 48 51 53 54 57 59.
   b. pocket-like: 5 12 13 15 16 17 18 19 (20) 25 27 29 30 31 32 33 34 38 (39) 41 44 45 49 50 52 55 56 60.
   c. dome-shaped: 2 5 14 18 19 (27) 30 32 34 45.
   d. pustulate: 4 6 10 14 18 42 58.

13. Position of inflorescences
   a. ramiflorous: 23 24 28 39 [b.: (supra) axillary or pseudoterminal].

14. Length of inflorescences
    a. up to 3 cm: **3 4** 12? **20 22 (23) 24** 27 **28** 33 **39 40 48 49 55 56 60** (b.: longer than 3 cm).

15. Branching of inflorescences
    a. without branches: **4** 12? **22 23 24** 27 **28 33 34 39 47 48 49** 50 **55 56 57 (58) 60.**
    b. with long branches: 1 2 **3 4** 5 6 7 8 9 **10** 11 12? **13** 14 15 16 **17 18** 19 **20 (22) 24 25** 26 **28** 29 **30 31 32 34 35** 36 37 **38 39 40** 41 42 43 **44 45 46 47 51 52** 53 54 **55 56 57 58** 59 **60.**
    c. with short branches: **(3) 4 10** 12? **(13) (17) 18 (20)** 21 **22 (23) 24 25 28 (30) (31) 32 (33) 34 35 (38) 40 44 45 46 (48) 49 51 52 55 56 (58) 60.**

16. Flowers in inflorescences
    a. crowded (inflorescences densely flowered): 12? 14? **23 27 28 31 32** 33 **34** 39 43 49 **56** [b.: spaced (inflorescences laxly flowered)].

17. Number of sepals and petals
    a. 4, rarely 3 or 5: 12? 14? 23 (b.: 5, rarely 4, 6 or 7).

18. Sepals outside
    a. glabrous: 12? 14? **21** 22 **23** 24 26? 27 **28** 35 37? 39 40 **46** 57.
    b. hairy: 1 2 3 4 5 6 7 8 9 10 11 12? 13 14? 15 16 17 18 19 25 26? 29 30 31 32 33 34 37? 38 41 42 43 44 45 **46** 49 50 52 53 55 56 57 58 59 60.
    c. with scales: 11 12? 14? 20 **21 23** 26? 28 36 37? 47 48 51 54.

19. Sepals inside
    a. glabrous: 3 12? 14? **15** 18 **20** 21 **23** 24 26? **28** 33 35 37? 39 40 43 47 **49** 50 51 54 56 **57 60.**
    b. hairy (especially in lower part): 1 2 4 5 6 7 8 9 10 12? 13 14? **15** 16 17 19 22 25 26? 27 29 30 31 32 34 36 37? 38 41 42 44 45 46 **49** 52 53 55 **57** 58 59 **60.**
    c. with scales: 11 12? 14? **20 23** 26? **28** 37? 48.

20. Petals in relation to sepals
    a. longer: 1? 12? 14? **(23)** 24 26? **28 33** 37? 45? **(53).**
    b. equal: 1? 12? 14? **(20) (23)** 26? **28 (33)** 37? 45? **(52) 53.**
    c. shorter: 1? 2 3 4 5 6 7 8 9 10 11 12? 13 14? 15 16 17 18 19 **20** 21 22 **23** 25 26? 27 **28** 29 30 31 32 **(33)** 34 35 36 37? 38 39 40 41 42 43 44 45? 46 47 48 49 50 51 **52 53** 54 55 56 57 58 59 60.

21. Petals outside
    a. glabrous: 1? **3 (6)** 7 **10** 12? **13** 14? 20 **21** 22 23 24 26? 28 **33** 36 37? **39** 40 41 44 47 **52** 54 **57 58.**
    b. hairy: 1? 2 **3** 4 5 **6** 8 9 **10** 11 12? **(13)** 14? 15 16 17 18 19 **21** 25 26? 27 29 30 31 32 **33** 34 35 37? 38 **39** 42 43 45 46 48 49 50 51 **52** 53 55 56 **(57) (58)** 59 60.
    c. with scales: 1? 12? 14? 26? 37?

22. Petals inside
    a. glabrous: 1? 2 **3 (6)** 7 8 9 12? **13** 14? **15 17** 18 **20 23** 24 26? 30 **33** 37? 38 39 43 44 47 49 50 **56 59** 60.
    b. (thinly) hairy: 1? **3** 4 5 **6** 10 11 12? **13** 14? **15** 16 **17** 19 **20** 21 22 **(23)** 25 26? 27 28 29 31 32 **33** 34 35 36 37? **(39)** 40 41 42 45 46 48 51 **52** 53 54 55 **56** 57 58 **59.**
    c. with scales: 1? 12? 14? 26? 38?

23. Appendages of petals
    a. 1 scale: **4** 7 12? 14? 26? 37? 44.
    b. 2 scales: 1 2 3 **4** 5 6 8 9 10 11 12? 13 14? 15 16 **17** 18 19 20 21 22 23 24 25 26? 27 28 31 32 33 34 35 36 37? 38 39 40 41 42 43 45 46 47 49 50 51 52 53 54 55 56 57 58 59 60.
    c. auricles: 12? 14? (**17**) 26? 29 30 37? 48.

24. Petalar scales or auricles
    a. crested: **9** 12? 14? (**23**) **24** 26? **34** 37? 44 (b.: not crested).

25. Disc
    a. glabrous: **3 6** 7 9 **10 11** 12? **13** 14 15 16 **18 20** 21 22 23 24 25 26? 27 28 31 32 **33** 35 36 39 40 41 42 44 **45** 46 47 49 **51** 52 53 54 55 **57 58** 60.
    b. with 5 tufts of hairs: 1 **3** 4 5 8 **10** 12? **13** 17 26? **33** 34 37 38 43 **45 51** 56 (**58**).
    c. with some hairs: (**6**) 12? 26? **29** 50.
    d. (short) hairy all over: 2 12? **18** 19 26? **29** 30 48 59.
    e. with scales: **11** 12? **20** 26? **56**.

26. Number of stamens and staminodes
    a. 6: 12? 14? **21** 23 26? 47?
    b. 8 or 9 (rarely 5, 6, 7 or 10): 1 2 3 4 5 6 7 8 9 10 11 12? 13 14? 15 16 17 18 19 20 **21** 22 24 25 26? 27 28 31 32 33 34 35 36 37 38 39 40 41 42 43 44 46 47? 48 49 50 51 52 53 54 55 56 57 58 60.
    c. 10–14: 12? 14? 26? 29 30 45 47? 59.

27. Stamens in male flowers
    a. exserted: 1? 3 4 5 7 8 10 11 12? 13 14? 15? 16 20 21 22 23 24 25? 26? 27 28 29 31 32 33 34 36 37? 39 40 41 42 43? 44 45? 46 47? 50 51 52 53 54 55 57 58 60.
    b. not or slightly exserted: 1? 2 6 9 12? 14? 15? 17 18 19 25? 26? 30 35 37? 38 43? 45? 47? 48 49 56 59.

28. Filaments
    a. glabrous: 1 12? (**13**) 14? 26? (b.: hairy).

29. Anthers
    a. glabrous: 1 2 **3** 4 6 7 8 9 **10** 12? **13** 14? 15 16 **18** (**19**) 20 21 23 24 25 26? 27 **28** 29 **30 33** 38 (**39**) 41 **42** 43 44 47 48 **49** 50 **51** 52 53 55 57 58 59 60.
    b. hairy: **3** 5 **10** 11 12? **13** 14? 17 (**18**) **19** 22 26? (**28**) **30** 31 32 **33** 34 35 36 37 **39** 40 (**42**) 45 46 **49 51** 54 56.

30. Anthers in relation to filaments
    a. longer: 1? 2 **5** 8 9 12? **13** 14? 15? **17** (**18**) **19** 25? 26? 30 37? 43? 45? 47? **49 50** (**52**) 56 59 (**60**).
    b. equal: 1? **5** 12? **13** 14? 15? (**17**) **19** 25? 26? **35** 37? 43? 45? 47? **49 50** (**52**) (**60**).
    c. shorter than: 1? 3 4 **5** 6 7 10 11 12? **13** 14? 15? 16 (**17**) 20 21 22 23 24 25? 26? 27 28 29 30 31 32 33 34 **35** 36 37? 38 39 40 41 42 43? 44 45? 46 47? 48 **49** 51 **52** 53 54 55 57 58 **60**.

31. Pistillode
    a. 2-celled: 7 9 21 44 (b.: 3-celled).

32. Outside of pistillode
    a. glabrous: 1? 8? 11 12? 14? 15? **20** 21 **23** 25? 26? **28** 36 37? 43? 47? 48 54 **57**.
    b. hairy: 1? 2 3 4 5 6 7 8? 9 10 12? 13 14? 15? 16 17 18 19 22 24 25? 26? 27 **28** 29 30 31 32 33 34 (**35**) 37? 38 39 40 41 42 43? 44 45 46 47? 49 50 51 52 53 55 56 (**57**) 58 59 60.
    c. with scales: 1? 8? 12? 14? 15? **20 23** 25? 26? **35** 37? 43? 47?

33. Ovary
    a. 2-celled: 7 9 21? 44 53? (b.: 3-celled).

34. Outside of ovary
    a. glabrous: 1? 8? 11 12? 14? 16? 21? **23** 26? 27? **28** 36 37? 40 48 51? 53?
    b. hairy: 1? 2 3 4 5 6 7 8? 9 10 12? 13 14? 15 16? 17 18 19 21? 22 **23** 24 25 26? 27? **28** 29 30 31 32 33 34 **35** 37? 38 39 41 42 43 44 45 46 49 50 51? 52 53? 55 56 58 59 60.
    c. with scales: 1? 8? 12? 14? 16? 20 21? 26? 27? **35** 37? 47 51? 53? 54 57.

35. Stigma
    a. 2-lined (or -grooved): 1? 7 8? 9 12? 16? 21? 27? 37? 44 52? 53?
    b. 2-lobed: 1? 7 8? 12? 16? 21? 27? 37? 52? 53?
    c. 3-lined (or -grooved): 1? 2 3 4 5 6 8? 10 11 12? 13 14 15 16? 17 18 19 20 21? 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37? 38 39 40 **41** 42 43 45 46 47 48 49 **50** 51 52? 53? 54 **55** 56 57 58 59 **60**.
    d. 3-lobed:1? 8? 12? 16? 21? 27? 37? (**41**) (**50**) 52? 54 53? (**55**) (**60**).

36. Fruits
    a. 1-celled: 5? 11 18? 21? 25? 26 35? 43? 48 53? 54?
    b. 2-celled: 5? 7 9 18? 21? 25? 35? 43? 44 53? 54?
    c. 3-celled: 1 2 3 4 5? 6 8 10 12 13 14 15 16 17 18? 19 20 21? 22 23 24 25? 27 28 29 30 31 32 33 34 35? 36 37 38 39 40 41 42 43? 45 46 47 49 50 51 52 53? 54? 55 56 57 58 59 60.

37. Fruits
    a. with a stipe 1 mm or more: 1? 2 3 4 5? 6 7 8? 9 10 11 12 14 15? 18? 19 20 21? 23 24 25? 26 27 28 30 31 32 34 35? 36 38 39 41 42 43? 44 45? 46? 48 51 53? 54? 55 57 58 59 60 (b.: stipe absent or < 1 mm).

38. Fruits outside
    a. glabrous: 5? 11 14 18? 21? 23 24 25? 26 **28** 35? **36 39 41 42** 43? 46? 48 53? 54?
    b. with few, scattered hairs: 5? 18? 21? 25? 35? **41** (**42**) 43? 46? 53? 54?
    c. thinly to densely hairy: 1 2 3 4 5? 6 7 8 9 10 12 13 15 16 17 18? 19 21? 22 25? 27 29 30 31 32 33 34 35? 37 38 40 43? 44 45 46? 49 50 (**51**) 52 53? 54? 55 56 58 59 60.
    d. with some hairs at the base and on the stipe: 5? 18? 21? 25? (**28**) 35? **36** (**41**) **42** 43? 46? 53? 54?
    e. with scales: 5? 18? 20 21? 25? (**28**) 35? (**39**) 43? 46? 47 **51** 53? 54? 57.

39. Fruits inside
    a. glabrous: 5? 18? 21? 22 23 24 25? 26 **28 33** 35? **39** 40 43? 45 46? 53? 54? 56 57 (b.: thinly to densely hairy).

40. Septa of fruits
    a. not developed: 5? 11 18? 21? 25? 26 35? 43? 46? 48 53? 54? (b.: fully developed).

41. Seeds
    a. with a sarcotesta: 5? 8? 10? 18? 21? 25? 35? 43? 44 46? 53? 54? 57? (b.: with an arilloid).

42. Testa
    a. hairy at apex: 1? 5? 8? 10? 18? 21? 25? 34? 35? 37 43? 46? 53? 54? 57? (b.: glabrous).

43. Cotyledons
    a. superposed: 1? **3** 4 5? **6** 7 8? 9? 10? 11 12 **13** 15? 16? **17** 18? 20 21? 22 23 24 25? 26? 27 28 31 32 34? 35? 36 38 **39** 40 41 42 43? 44 46? 47? 48 **49** **50** 51 53? 54? 55 56 57? 58 60.
    b. parallel: 1? 2 (**3**) 5? 8? 9? 10? **13** 14 15? 16? (**17**) 18? 19 21? 25? 26? 29 30 33 34? 35? 37 (**39**) 43? 45 46? 47? **49** **50** 52 53? 54? 57? 59.

44. Hypocotyl
    a. hairy on the sides: 1? 5? 8? 9? 10? 16? 18? 21? 25? 26? 31 34? 35? 43? 46? 47? 53? 54? 57? (b.: glabrous).

45. Geography
    a. Celebes: 9 53
    b. Moluccas: **52**
    c. New Guinea: 1 **3** 7 8 13 16 33 37 43 44 45 **52**
    d. Admiralty Islands: **52**
    e. Solomon Islands: 29
    f. Caroline Islands: 26
    g. Australia: **3** 6 14 15 17 18 19 38 49 50 56 60
    h. New Hebrides: **30**
    i. Fiji: 2 11 **30** 59
    j. Samoa: 48
    k. New Caledonia: 4 5 10 12 20 21 22 23 24 25 27 28 31 32 34 35 36 39 40 41 42 46 47 51 54 55 57 58.

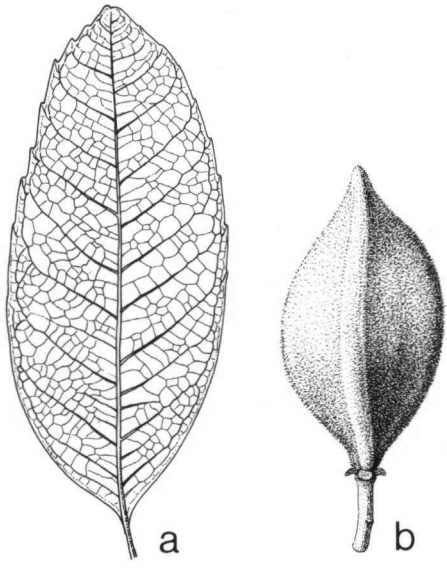

Fig. 24. *Cupaniopsis acuticarpa* Adema. a. Leaflet, × 0.75; b. fruit, × 1.5 (*NGF* 22112, L).

1. Cupaniopsis acuticarpa Adema, *spec. nov.* — Fig. 24.

Arbuscula fruticosa. Folia 7–8-jugata, foliolis ellipticis, integerrimis vel dentatis apicem versus, apice obtuso. Discus pilis quinquefasciculatis obsitus. Capsulae juveniles in sectione transversali triangulari, apice et basi acuto. — Typus: *NGF* 22112, Papua New Guinea, Central Province, Tavai Creek, alt. 30 m, 16.12.1964 (L!, holo, iso in CANB!, K!).

Shrubby *treelet*, 1.5 m high, several stems together. *Flowering twigs* ca. 5 mm in diameter, grooved, puberulous. *Leaves* 7–8-jugate; petiole 14–15 cm, semiterete, upwards terete, striate, puberulous; rachis 27.7–30.5 cm, terete, striate, puberulous. *Leaflets* alternate to opposite, elliptic, slightly asymmetric, upper 14 × 4 cm, index ca. 3.5, chartaceous, above almost glabrous, midrib and nerves puberulous, below very thinly puberulous, midrib more densely so, base cuneate, apex obtuse, margin dentate in upper part, rarely entire, midrib slightly sunken above, nerves 19–21 per side, 4–10 mm apart, angle to midrib 70°–80°; petiolule 4–6 cm, grooved above, puberulous. *Inflorescences* axillary, 13–16.5 cm, laxly flowered, with long branches. Flowers known from young buds only. *Sepals* inside and outside hairy. *Petals* with scales. *Disc* with 5 tufts of hairs. *Stamens* 8, glabrous. Young *fruits* 3-celled, triangular in cross section, acute at both apex and base, outside villose, inside villose, septa complete. Young *seeds* basally attached, with an arilloid.

Distribution — Papua New Guinea (Central Province).

Field notes — a. Ecological notes: Monsoon pocket fringe with grassland. Alt. 30 m. Fruiting: December.

b. Additional descriptive notes: Wood soft. Leaves more or less converted, evenly green. Fruit bright orange, yellowish hairy.

Notes — This species resembles in some aspects *C. curvidens*, but differs greatly in hairiness and in the peculiar, acute fruits.

Specimen examined:
PAPUA NEW GUINEA. Central Province: *NGF* 22112, Tavai Creek.

2. Cupaniopsis amoena A.C. Smith — Fig. 25.

Cupaniopsis amoena A.C. Smith, J. Am. Arbor. 31 (1950) 295; Parham, Plants Fiji Is. (1964) 173; ed. 2 (1972) 246; A.C. Smith, Fl. Viti. 3 (1985) 606, fig. 147B–D. — Type: *A.C. Smith* 4083, Fiji, Viti Levu, Mba, slopes of Mt. Nairosa, eastern flank of Mt. Evans Range, 28.4.1947 (A!, holo, iso in BISH!, K!, L!, NY!).

Trees 5–10(–25) m high. *Flowering twigs* 2–4 mm in diameter, striate, strigose, soon glabrescent. *Leaves* (4–)5–7-jugate; petiole 3–10 cm, rachis 5–18 cm, both semiterete, striate, strigose to almost glabrous. *Leaflets* alternate or rarely subopposite, elliptic (to ovate), slightly asymmetric, upper 5.5–10.5 × 2–4 cm, index 2.3–3.3, lower 3.5–7.5 × 1.5–4 cm, index 1.5–2.5, chartaceous, above and below glabrous, base cuneate to rounded, apex obtuse to rounded, retuse or shortly acuminate, acumen 1–5 mm, margin entire, midrib above slightly sunken to some what prominent, nerves 5–10(–12) per side, 7–13(–17) mm apart, angle to midrib (55°–)70°–80°, dome-shaped domatia present; petiolule 5–21 mm, grooved, strigose. *Inflorescences* axillary, (4–)8–19.5 cm, laxly flowered, with long patent branches,

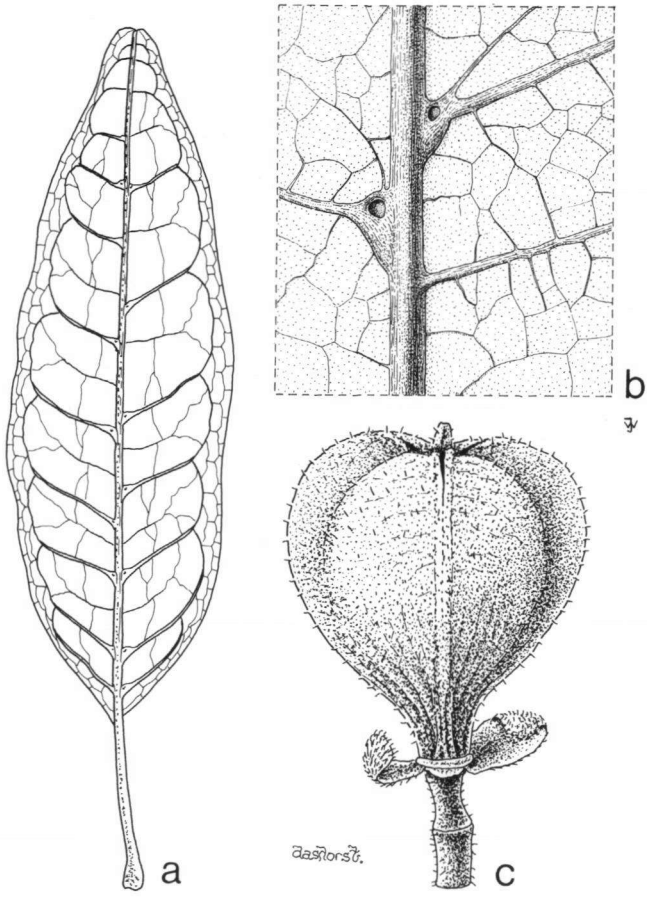

Fig. 25. *Cupaniopsis amoena* A.C. Smith. a. Leaflet, × 0.7; b. idem, detail, × 4.5; c. fruit, × 3.5 (a, b: *A.C. Smith* 4083, L; c: *A.C. Smith* 4935, L).

strigose; cymules dichasial, 1–several-flowered. *Bracts* and *bracteoles* triangular to deltoid, or transversely elliptic, 0.5–1.4 × 0.7–1.1 mm, not persistent under the fruits, outside very shortly appressed-hairy, margin ciliate and with small glands, inside with some appressed hairs at the base. *Pedicels* 2.0 mm, articulate at 1/5 above the base. *Buds* 3.4 × 4.8 mm. Male flowers: *Sepals* orbicular, outside and inside very shortly appressed-hairy except rim, rim ciliate and with glands, outer 3.4–4.4 × 3.6–4.2 mm, scarious rim rather wide, inner 4.6 × 5.0 mm, scarious rim wide. *Petals* ± orbicular, dentate, 1.8–1.9 × 1.7–2.0 mm, outside very shortly appressed-hairy in basal part, inside glabrous, scales 2, not crested, 0.6 mm, curved, short hairy. *Disc* short hairy. *Stamens* 8, not exserted, filaments 1.2–1.4 mm, patently short hairy except apex, anthers 2.0–2.3 mm, glabrous. *Pistillode* 3-celled, outside hairy, 0.6 × 0.7 mm. Female flowers: *Sepals* persistent under the fruits, outer 2.8–3.6 × 3.0–3.6 mm, inner 4.6–4.8 × 4.6–5.4 mm. *Petals* 2.2 × 2.6

mm, scales 1.2 mm. *Ovary* 3-celled, outside hairy, style 1.2 mm, stigma 1.2 mm, 3-lined. *Fruits* obpyramidal, rounded triangular in cross section, 14 × 14 mm, stipe 2.4 mm, wall 0.2 mm thick, outside rugose, velutinous, inside appressed hairy, septa complete. *Seeds* 11 × 7 mm, testa shiny black, arilloid covering over 2/3, cotyledons unequal, parallel.

Distribution — Fiji (Viti Levu).

Field notes — a. Ecological notes: Dense forests. Alt. (115–)700–1100 m. Flowering: April to May, fruiting: April to July.

b. Additional descriptive notes: Petals white. Disc white. Filaments white, anthers yellow or orange. Fruit green.

c. Vernacular name: Ndrengandrenga (Viti Levu, Mba).

Specimens examined:
Fiji: Viti Levu: 7 specimens.

3. Cupaniopsis anacardioides (A. Richard) Radlk. — Figs. 23, 26, 27.

Cupaniopsis anacardioides (A. Richard) Radlk., Sitzber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. Münch. 9 (1879) 530; Domin, Bibl. Bot. 22 (1927) 904; Radlk. in Engl., Pflanzenr. 98 (1933) 1186; Anderson, Trees N.S.W., ed. 2 (1947) 244; Francis, Austr. Rain-For. Trees, ed. 2 (1951) 249; Blake, Aust. J. Bot. 2 (1954) 135; Webb, J. Ecol. 47 (1959) 551–570; Beadle, Evans & Carolin, Handb. Vasc. Pl. Sydney Distr. and Blue Mountains (1962) 325; McKee, Contr. N.S.W. Nat. Herb. 3 (1963) 233; Neal, Gardens of Hawaii (1965) 536; Beadle, Evans, Carolin & Tindale, Fl. Sydney Reg. (1972) 236; ed. 2 (1982) 308; Beadle, Stud. Fl. NE. N.S.W. 4 (1980) 571, fig. 251A; Reynolds, Austrobaileya 1 (1982) 481; in Stanley & Ross, Fl. SE Queensl. 1 (1983) 512, fig. 80G; Hawkeswood, Victorian Naturalist 100 (1983) 12–20, 121–123; Reynolds, Austrobaileya 2 (1984) 48, fig. 4F–G; Webb, Tracey, & Williams, Aust. J. Ecol. 9 (1984) 169–198; Reynolds, Fl. Austr. 25 (1985) 58, map 71. — *Cupania anacardioides* A. Richard, Sert. Astrol. (1834) 33, t. 13; Walpers, Rep. 1 (1842) 420; Gray, US Expl. Exp. Botany. Phanerogamia 1 (1854) 258; Bentham, Fl. Austr. 1 (1863) 458; F. Muell., Fragm. 9 (1875) 91; F.M. Bailey, Queensl. Fl. 1 (1899) 290; Compr. Cat. Queensl. Pl. (1913) 113; Audas, Native trees Austr. ed. 2 (undated) 179. — *Alectryon anacardioides* (A. Richard) Schwarz, Fedde Rep. 24 (1927) 87 (invalid comb., no basionym mentioned). — *Cupaniopsis anacardioides* (A. Richard) Radlk. f. *genuina* Radlk. in Engl., Pflanzenr. 98 (1933) 1187 (nom. illeg., I.C.B.N. art. 26i). — Type: *Fraser* s.n., Australia, Moreton Bay (P!, holo).

Cupania anacardioides A. Richard var. *parvifolia* F.M. Bailey, Queensl. Fl. 1 (1899) 290; Compr. Cat. Queensl. Pl. (1913) 113. — *Cupaniopsis anacardioides* (A. Richard) Radlk. var. *parvifolia* (F.M. Bailey) Domin, Bibl. Bot. 22 (1927) 904. — *Cupaniopsis anacardioides* (A. Richard) Radlk. f. parvifolia (F.M. Bailey) Radlk. in Engl., Pflanzenr. 98 (1933) 1187. — *Cupaniopsis parvifolia* (F.M. Bailey) Johnson, Contr. N.S.W. Nat. Herb. 3 (1962) 98; Beadle, Stud. Fl. NE. N.S.W. 4 (1980) 571; Reynolds in Stanley & Ross, Fl. SE Queensl. 1 (1983) 512; Reynolds, Austrobaileya 2 (1984) 48; Fl. Austr. 25 (1985) 59, map 72. — Syntypes: *F.M. Bailey* s.n., Australia, several localities in southern Queensland (BRI?, M!); *Keys* s.n., Australia, Mt. Perry (BRI!).

Alectryon bleeseri O. Schwarz, Fedde Rep. 24 (1927) 87. — Type: *Bleeser* 332, Australia, Northern Territory, Darwin, 11.1927 (B, holo, lost, iso in MEL!, NSW!).

Trees, treelets or *shrubs*, (0.5–)2.5–20 m high, d.b.h up to 45 cm, usually much and widely branched. *Flowering twigs* 1–4(–5) mm in diameter, striate, rarely grooved, strigose, glabrescent. *Leaves* (1–)2–6(–7)-jugate; petiole 1–6(–10.5) cm, semiterete, upwards usually terete, strigose; rachis 0.5–16.5 cm, semiterete, or

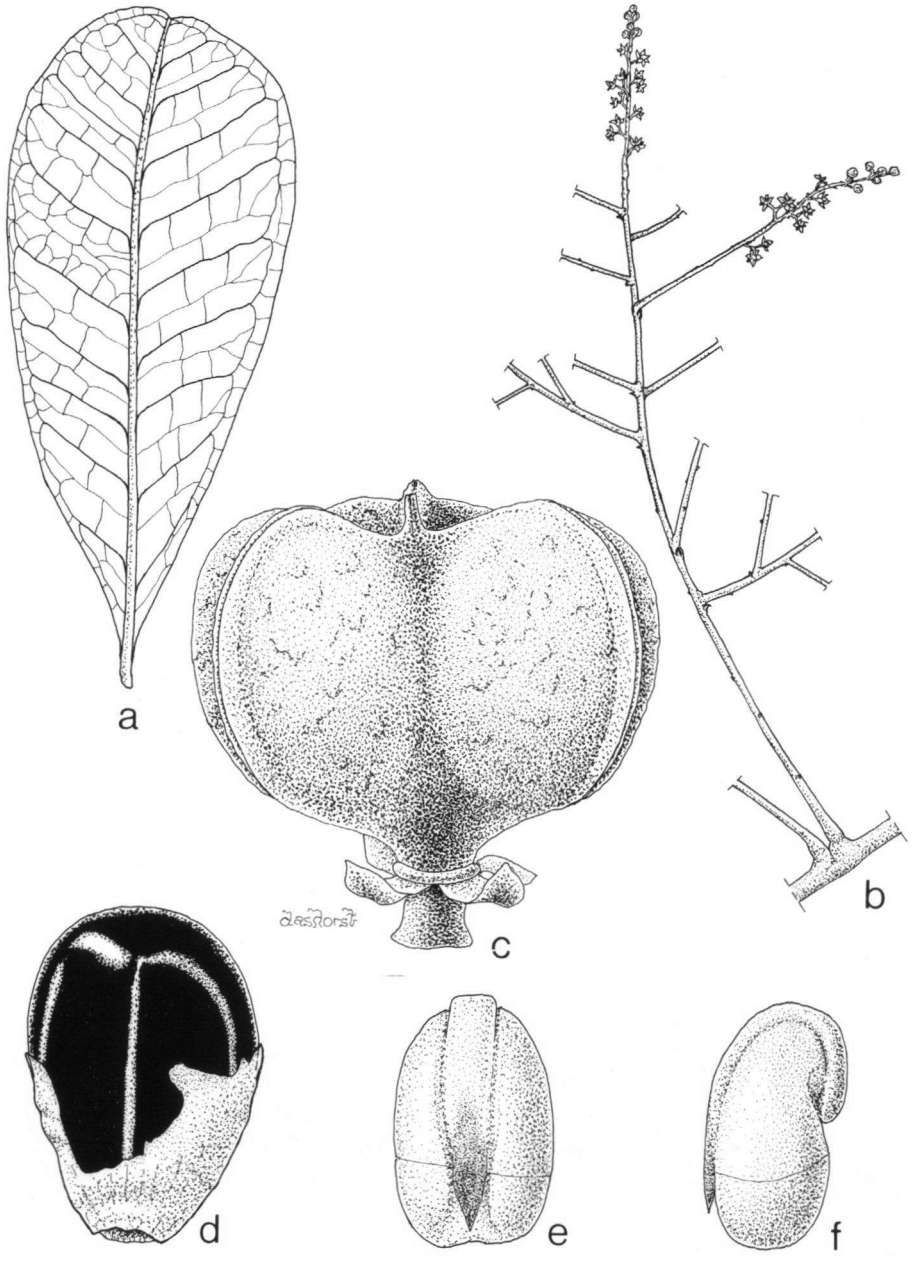

Fig. 26. *Cupaniopsis anacardioides* (A. Richard) Radlk. a. Leaflet, × 1; b. inflorescence, × 0.5; c fruit, × 3.3; d. seed, × 3.3; e, f. embryo, × 3 (e: dorsal view, f: side view) (a: *Clemens* s.n., L; b *McKean* W/L 1492, CANB; c–f: *Kajewski* 78, BRI).

more or less terete in lower part and semiterete upwards, striate, often grooved above, strigose, glabrescent. *Leaflets* opposite to alternate, (narrowly) obovate, rarely elliptic, symmetric to slightly asymmetric, upper (2–)5–16(–19) × 1–7.5 cm, index 1.5–3.8(–4.2), lower 1.5–10(–12.5) × 0.5–6.5 cm, index 1.2–3, (thinly) coriaceous, above glabrous, below glabrous to thinly shortly appressed-hairy, midrib usually a bit more densely so, base (broad-)cuneate, rarely rounded, apex obtuse to rounded, exceptionally shortly and broadly acuminate, often retuse, rarely emarginate, margin entire, midrib above rarely slightly prominent, exceptionally slightly sunken, nerves (5–)7–16(–20) per side, (2–)5–15(–22) mm apart, angle to midrib 50°–70°; petiolule (0.5–)1–6(–13) mm, grooved above, shortly appressed-hairy to (sometimes) almost glabrous. *Inflorescences* axillary to pseudoterminal, often pendulous, 2–36 cm, laxly flowered, with (very) long, rarely short branches, exceptionally unbranched; cymules dichasial, 1–several-flowered. *Bracts* and *bracteoles* lanceolate to deltoid, sometimes semicircular, 0.4–1.0 × 0.4–1.1 mm, not persistent under the fruits, outside shortly appressed-hairy, margin short ciliate and rarely also with short glandular hairs, inside glabrous. *Pedicels* 1.3–6.0 mm, articulated at the base or up to halfway. *Buds* more or less globular, 1.8–4.2 × 2.0–4.8 mm. Male flowers: *Sepals* irregularly dentate, outside shortly appressed-hairy except rim, rim ciliolate and with glandular hairs, inside glabrous, outer elliptic to almost orbicular, sometimes triangular, 0.8–3.6 × 1.1–3.0 mm, scarious rim narrow, inner more or less orbicular, 1.8–5.4 × 2.4–5.2 mm, scarious rim wide. *Petals* elliptic to broad ovate, sometimes semicircular, 0.5–3.5 × 0.6–3.6 mm, out- and inside glabrous or with some appressed hairs in basal part, scales 2, not crested, 0.5–1.7 mm, long-ciliate. *Disc* glabrous or with few hairs to 5 tufts of hairs. *Stamens* 8, rarely 6 or 7, exserted, filaments 1.2–4.2 mm, patently hairy in lower half, anthers 1.2–2.9 mm, glabrous or hairy. *Pistillode* 3-celled, outside shortly appressed-hairy, sometimes also with longer hairs, 0.7–1.8 × 0.6–1.4 mm. Female flowers: *Sepals* persistent under the fruits, outer 1.2–3.8 × 0.8–4.2 mm, inner 3.6–5.6 × 2.4–6.0 mm. *Petals* 1.1–3.7 × 0.6–3.6 mm. Filaments of *staminodes* 1.3–3.6 mm, anthers 1.2–3.0 mm. *Ovary* 3-celled, outside shortly appressed-hairy, style 0.8–3.5 mm, stigma 0.4–1.5 mm, 3-lined. *Fruits* obpyramidal to ellipsoid, obscurely 3-lobed, 3-keeled or -ribbed at least when young, 9–20 × 10–21(–29) mm, stipe 1–2(–4) mm, wall 0.6–2.2 mm thick, outside almost smooth to rugose, velutinous, inside villose to appressed hairy, septa complete. *Seeds* flattened ellipsoid, 5–14 × 4–9 mm, testa shiny black, arilloid covering half to whole of the seed (sometimes oblique), lacerate or grossly dentate to lobed at apex, cotyledons unequal or equal, (sometimes oblique) superposed, exceptionally (*Gulliver* 32) parallel.

Distribution — Irian Jaya (Merauke Distr.), Papua New Guinea (Western Prov.), Australia (chiefly along the coast in Western Australia, the Northern Territory, Queensland and New South Wales) (fig. 23).

Field notes — a. Ecological notes: Various types of (dry) rain forest, evergreen to deciduous, noto-, sclero- or microphyll vine thickets or scrubs, in margins of mangrove, in grassland or heath vegetation. Very often along the coast on sanddunes or beaches, often on the banks of rivers or creeks, sometimes more

inland in mountains. Usually on a sandy substrate, but also on (lateritic) clay, loam, black soil, vulcanic soil etc. Alt. 0–825 m. Flowering (March to) May to October (to December), fruiting: August to January (to May). The species seems to be attractive to (green) ants.

b. Additional descriptive notes: Trunk fluted. Bark green or gray to brown, smooth to finely rough, inner bark pink to brownish. Wood white to (pinkish) brown, heartwood usually darker. Leaflets above dull or glossy, light to dark green, below paler so, sometimes grayish. Buds green or greenish yellow. Flowers greenish to white or cream, sweet or faintly scented or male flowers with a strong unpleasant smell (*Gray* 1421). Calyx green. Corolla white to cream. Filaments cream, anthers yellow to light brown. Fruits green or yellow to orange brown, endocarp covered with pink hairs. Seeds shiny black, rarely brown, arilloid red or orange.

c. Vernacular names: New Guinea: Tag (Bian dialect, Irian Jaya); Australia: Tamaan (Woowoonga, Queensland), Tuckeroo (Brisbane River, Queensland), Waket (Richmond River, New South Wales).

d. Uses: Planted as a street or park tree.

Notes — The present species is in most characters very variable, notably so in the form and size of the leaflets, the number of nerves, the length of the inflorescences, and the size of the fruits.

Several times these characters have been used to distinguish within *C. anacardioides* a var. or f. *parvifolia* (Bailey, 1899; Domin, 1927; Radlkofer, 1933), or even a species *C. parvifolia* apart from *C. anacardioides* (Johnson, 1962; Reynolds, 1984, 1985). The latter delimits both taxa in 1985 as follows:

Lateral nerves 6–20 mm apart; leaflets and panicles usually more than 7 cm long
C. anacardioides

Lateral nerves 2–5 mm apart; leaflets and panicles less than 7 cm long
C. parvifolia

Specimens with the characteristics of *C. parvifolia*, i.e. with small, densely nerved leaflets and short inflorescences, have been collected in southern Queensland and New South Wales.

When the cited characters are plotted as scatter or blockdiagrams only small differences are found (fig. 26). In the diagrams five facts become clearly visible: 1. *C. anacardioides* covers a much wider range; 2. There is a large overlap in the character states of the characters used; 3. Only the means are different; 4. Almost no specimen can be placed with certainty; 5. No clear break in any diagram occurs. This means that in the characters used no gap was found pointing to the occurrence of different taxa. Using the characters separately gives no discrimination between the taxa and even a combination of leafletlength, number of nerves per side and length of inflorescences is discriminative for only a very small number of specimens of '*parvifolia*'. Using the same set of characters it is even possible to split off a group of specimens with very large leaflets and a group with rather narrow leaflets. As this process is not very helpful in clarifying the systematics of

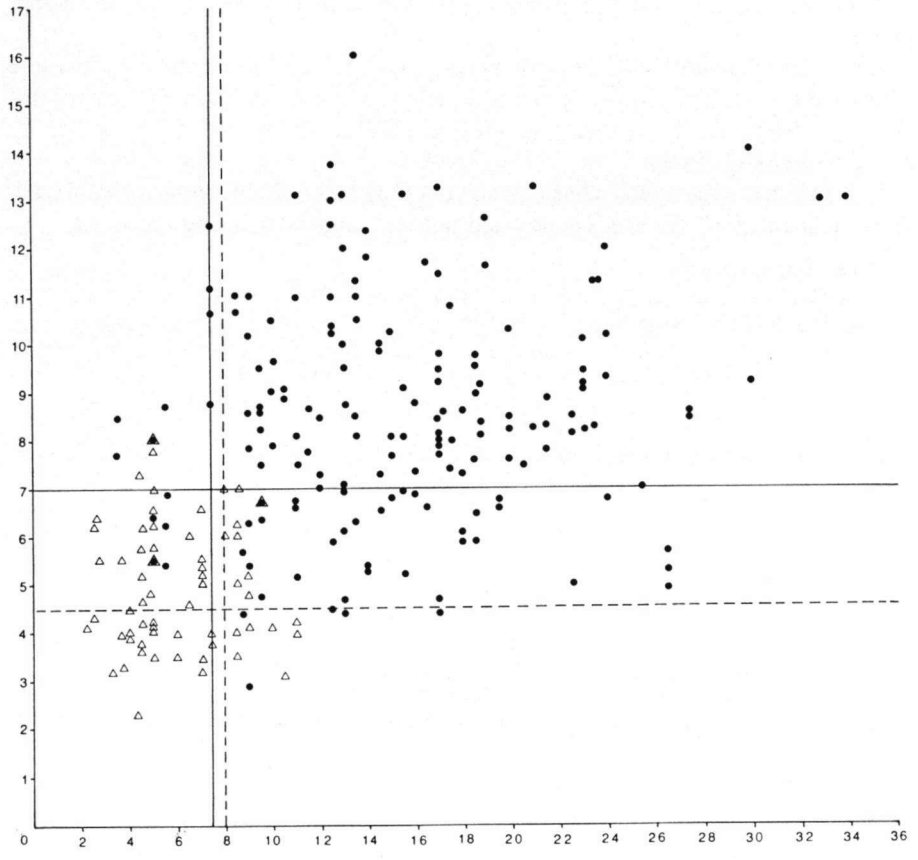

Fig. 27. Relation between the inflorescence length (X-axis, cm) and the length of the upper leaflets (Y-axis, cm) in *Cupaniopsis anacardioides*. ● = *C. anacardioides* sensu stricto; △ = *'C. parvifolia'* (as named by L. Johnson, see Johnson, 1962) (▲ = ● + △ at the same place); —— = upper limit of *'C. parvifolia'*; – – – – = lower limit of *C. anacardioides* (both after Reynolds, 1985).

Cupaniopsis I have refrained from doing so. And in the case of *anacardioides* and *parvifolia* I combine both 'taxa' into one species, because of the missing of gaps in the character states.

On labels it has been noted that the species was grazed by horses (*Durrington* 189) and in another case it was thought to be the cause of the death of a 10 days old calf (*Murray* s.n., NSW 17944).

The account of the ecology in 'Field notes' was compiled from a bewildering amount of names for forest, scrub, or thicket types. The localities of the present species fall well within the area of the tropical and subtropical rain forest (Webb, 1949). Webb *et al.* (1984) cited *C. anacardioides* from their types A1, Complex notophyll vineforest and B3, Deciduous vinethicket, both belonging to the tropical rain forest.

Pollination by small flies and bees was observed in Townsville (Hawkeswood, 1983).

The sheet *Michael* 3082 bears 4 twigs two of which have entire leaflets, the others have in part obscurely spinose dentate leaflets. In that aspect they resemble *C. shirleyana*, but otherwise they are not different from the other *C. anacardioides* specimens.

Several times the species has been erroneously recorded from Lord Howe Isl. The real identity of the specimens cited in these studies is *Guioa coriacea.*

Specimens examined:

New Guinea. Irian Jaya: Merauke Distr.: *Van Royen* 4634, South of Senayo; Papua New Guinea: Western Prov.: 6 specimens.

Australia. Western Australia: 6 specimens; Northern Territory: 36 specimens; Queensland: 196 specimens; New South Wales: 78 specimens.

4. Cupaniopsis apiocarpa Radlk. — Fig. 28.

Cupaniopsis apiocarpa Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. Münch. 9 (1879) 386; Guillaumin, Bull. Soc. Bot. Fr. 79 (1932) 339; Radlk. in Engl., Pflanzenr. 98 (1933) 1200; Däniker, Mitt. Bot. Mus. Univ. Zürich 142 (1933) 246; Guillaumin, Fl. Nouv.-Caléd. (1948) 200; Sarlin, Bois et forêts de la Nouvelle-Calédonie (1954) 187, pl. 81. — Lectotype (present author): *Balansa* 145, New Caledonia, près de Nouméa, au dessus de la ferme modèle, 11.1868 (P!, holo, iso in G!, M!, P!). Paratypes: *Baudouin* 761 (P!), *Pancher* s.n. (= *Mus. Néocal.* 221, *Vieillard* 2394, M!), *Vieillard* 216 (P!).

Cupaniopsis psilocarpa Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. Münch. 9 (1879) 386; Guillaumin, Bull. Soc. Bot. Fr. 79 (1932) 339; Radlk. in Engl., Pflanzenr. 98 (1933) 1199; Guillaumin, Fl. Nouv.-Caléd. (1948) 199. — Type: *Balansa* 1443, New Caledonia, Bourail, 3.1869 (P!, holo).

Trees (4–)6–10(–15) m high, d.b.h. 20 cm. *Flowering twigs* terete, 1–3(–4) mm in diameter, striate, rarely grooved, strigose. *Leaves* 2–5(–6)-jugate; petiole 2–8(–10) cm, semiterete, striate, rarely grooved above, strigose; rachis (1–) 5–14 cm, semiterete, striate, grooved above, strigose. *Leaflets* opposite to alternate, ovate to obovate, asymmetric, upper 5–12 × 2–4.5 cm, index 2–4, lower 3–9.5 × 1.5–4.5 cm, index 1.3–2.7, chartaceous, above and below (almost) glabrous, midrib and nerves (sometimes) with few short hairs, base (broadly) cuneate, apex rounded or obtuse, often retuse, rarely short- and broad-acuminate, acumen 1–3(–6) mm, rounded, retuse, margin entire, midrib above slightly prominent nerves 4–9(–16) per side, (2–)5–18(–23) mm apart, angle to midrib 45°–70°, pustulate domatia present; petiolule 2–5 mm, grooved above, glabrous or with short hairs. *Inflorescences* axillary or pseudoterminal, 3–8 cm, laxly flowered, without or with long and short branches, strigose; cymules dichasial, 1–several-flowered. *Bracts* and *bracteoles* broad-elliptic to deltoid, 0.2–1.0(–2.5) × 0.2–1.0 mm, not persistent under the fruits, outside and inside appressed-hairy. *Pedicels* 1.7–3.0 mm, articulated up to 2/3 above the base. *Buds* globular, 1.6–3.0 × 1.8–3.0 mm. Male flowers: *Sepals* out- and inside shortly appressed-hairy except rim, rim ciliate and with glands, outer elliptic to orbicular, 1.4–2.8 × 1.2–1.9 mm, scarious rim narrow to wide, inner orbicular, 2.0–2.8 × 1.6–2.5 mm, scarious rim wide. *Petals*

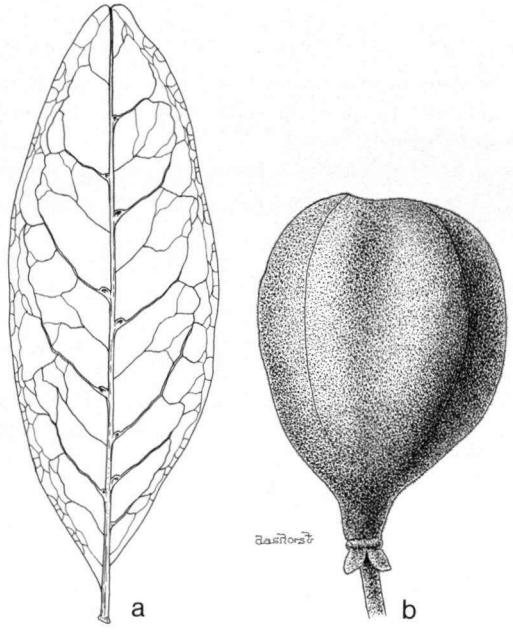

Fig. 28. *Cupaniopsis apiocarpa* Radlk. a. Leaflet, × 1.5; b. fruit, × 2.5 (a: *MacKee* 40210, L; b: *Balansa* 145, P).

elliptic to semicircular, 0.6–1.2 × 0.6–1.3 mm, out- and inside shortly appressed-hairy in lower part, rarely glabrous, scales 1 or 2, not crested, 0.4–1.1 mm, short-woolly. *Disc* with few hairs, more or less in 5 tufts. *Stamens* 8, exserted, filaments 1.1–2.6 mm, patently hairy in lower part, anthers 0.7–1.0 mm, glabrous. *Pistillode* 3-celled, outside hairy, 0.8–1.2 × 0.6–1.0 mm. Female flowers: *Sepals* not persistent under the fruits, outer 1.2–2.4 × 0.8–1.9 mm, inner 2.3–2.9 × 1.8–2.9 mm. *Petals* 0.7–1.4 × 0.7–1.2 mm, scales 0.7–1.1 mm. Filaments of *staminodes* 1.4–2.0 mm, anthers 0.8 mm. *Ovary* 3-celled, outside hairy, style 0.8–1.2 mm, stigma 0.5–0.6 mm, straight or hooked, 3-lined. *Fruits* obovoid, more or less elliptic to orbicular in cross section, 23 × 15–18 mm, stipe 3–5 mm, wall 1.4 mm thick, outside smooth, velutinous, inside appressed-hairy to villose, septa complete. *Seeds* ovoid, 15 × 8 mm, testa black, arilloid covering almost whole of the seed, lacerate, cotyledons unequal, superposed.

Distribution — New Caledonia.

Field notes — a. Ecological notes: Dense forests or forest remnants, often along streams, on serpentine, schists or basalt. Alt. 30–700 m. Flowering: January to April (to August), fruiting: (January to) June to November.

b. Additional descriptive notes: Bark grayish or brown, almost smooth. Leaflets shiny dark green above, shiny light green below, rarely both sides dark or light

green. Flowers pale green or pale yellow. Petals white. Filaments white. Fruits green or brown. Seeds shiny dark brown, arilloid orange-yellow.

Notes — *Balansa* 1443, the type of *C. psilocarpa*, was described with glabrous fruits. However, the sheets seen by me bear clearly hairy fruits, that are otherwise not different from those in the type collection of *C. apiocarpa*. See also the notes sub *C. phalacrocarpa*.

Specimens examined:
NEW CALEDONIA. 34 specimens.

5. Cupaniopsis azantha Radlk. — Fig. 29.

Cupaniopsis azantha Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München. 9 (1879) 587; Guillaumin, Bull. Soc. Bot. Fr. 79 (1932) 340; Radlk. in Engl., Pflanzenr. 98 (1933) 1202; Däniker, Mitt. Bot. Mus. Univ. Zürich 142 (1933) 246; Guillaumin, Fl. Nouv.-Caléd. (1948) 200. — Lectotype (present author): *Labillardière* s.n., New Caledonia (P!, holo). Paratypes: *Vieillard* 218 (P!), 220 (n.v.).

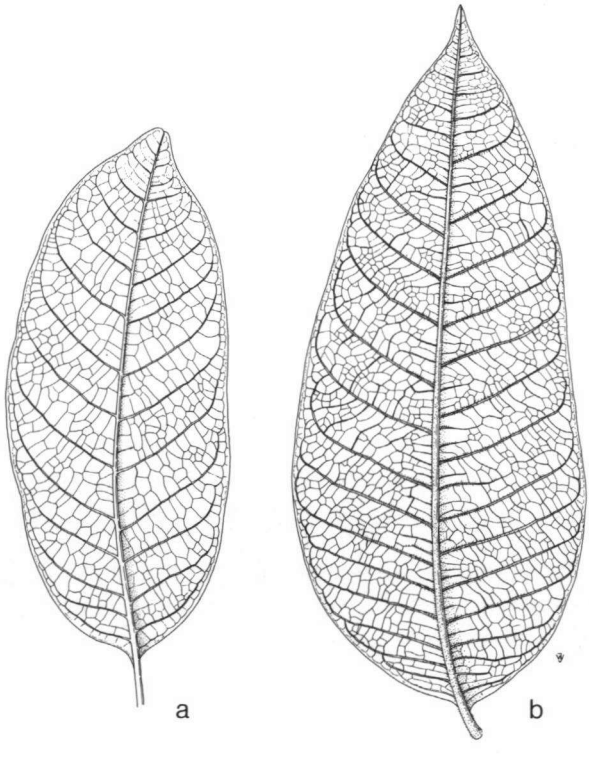

Fig. 29. *Cupaniopsis azantha* Radlk. a. Leaflet, × 0.5 (*MacKee* 16760, L). — Fig. 30. *Cupaniopsis bullata* Adema. b. Leaflet, × 0.5 (*LAE* 60057, L).

Trees 4 m high. *Flowering twigs* terete, 8–10 mm in diameter, grooved, villose. *Leaves* 8–11-jugate; petiole 8–15.5(–28) cm, semiterete, ± terete upwards, rachis 17–27(–46) cm, more or less terete, both striate, villose to glabrous. *Leaflets* alternate, rarely opposite or subopposite, elliptic to ovate, slightly asymmetric, upper 9.5–18.5 × 3.5–7 cm, index 2.6–3.0, lower 4–10.5 × 2–5 cm, index 1.9–2.1, coriaceous, above glabrous, below almost glabrous, midrib with very few to many, short hairs, base broadly cuneate to rounded, apex short acuminate, acumen 1–4 mm, rounded, margin entire, midrib above not or slightly prominent, nerves 6–9(–15) per side, 7–17 mm apart, angle to midrib 60°, small pocket-like to ± dome-shaped domatia present; petiolule (7–)15–30 mm, grooved above, short villose to glabrous. *Inflorescences* axillary, 11–13(–28) cm, laxly flowered, with long branches, villose; cymules dichasial, 1–several-flowered *Bracts* and *bracteoles* lanceolate to narrowly triangular, thick, 1.7–3.1 × 0.8–1.1 mm, outside appressed-hairy, inside glabrous or at the base appressed-hairy. *Buds* 1.7–2.4 × 2.6–4.2 mm. Male flowers: *Sepals* outside appressed-hairy except rim, rim ciliate, inside appressed-hairy in lower part, outer elliptic to orbicular, 1.8–3.6 × 1.2–3.0 mm, scarious rim 0 to narrow, inner orbicular, 3.0–4.7 × 3.0–4.2 mm, scarious rim wide. *Petals* broad ovate to orbicular, 0.8–2.5 × 0.8–1.8 mm, out- and inside in lower part appressed-hairy, scales 2, not crested, 0.4–1.8 mm, woolly. *Disc* with 5 tufts of hairs. *Stamens* 8, exserted, filaments 1.1–6.0 mm, patently hairy except apex, anthers 1.2–2.0 mm, hairy *Pistillode* 3-celled, 0.8–1.3 × 0.8–1.2 mm, outside hairy. Female flowers: Outer *sepals* 2.4–4.0 × 2.0–3.5 mm, inner 3.8–4.8 × 2.5–4.6 mm. *Petals* 1.4–3.2 × 1.1–1.8 mm, scales 1.1–2.0 mm. Filaments of *staminodes* 1.4–4.2 mm, anthers 1.4–2.0 mm. *Ovary* 3-celled, outside hairy, style 0.8–1.0 mm, stigma 0.8–1.0 mm, 3-lined.

Distribution — New Caledonia.

Field notes — a. Ecological notes: Humid forests on micaschists. Alt. 300–600 m. Flowering: April to May, December.

b. Additional descriptive notes: Leaflets shiny dark green above, light green below. Flowerbuds pale green. Flowers greenish white or yellow.

Notes — Closely related to *C. macrocarpa* and *C. mackeeana*. From *C. macrocarpa* it differs in the longer petioles and rachises, the often more numerous leaflets with shorter acumens and longer petiolules, the hairy discs, and the shorter styles. From *C. mackeeana* it differs in the smaller leaflets with usually more dense nerves, the shorter inflorescences, the hairy discs, and the shorter styles.

MacKee 16760 has much larger leaflets and flowers than the other specimens.

Specimens examined:
New Caledonia. *Bernardi* 129858, *Labillardière* s.n., *MacKee* 16760, 21317, *Vieillard* 218.

6. Cupaniopsis baileyana Radlk. — Fig. 31.

Cupaniopsis baileyana Radlk., Fedde Rep. 20 (1924) 32; in Engl. Pflanzenr. 98 (1933) 1185. — Type: *Bailey* 5, Australia, Queensland, Mount Mistake, SW of the railway line, about 20 miles from Laidley (BRI!, holo).

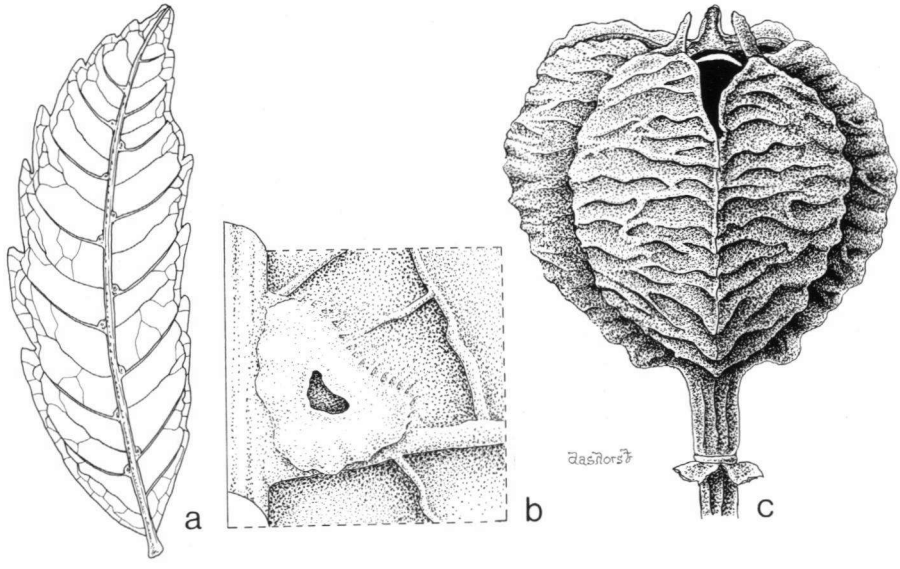

Fig. 31. *Cupaniopsis baileyana* Radlk. a. Leaflet, × 0.9; b. idem, detail, × 15; c. fruit, × 3 (a, b: *Bird* s.n., BRI; c: *Dunn* s.n., NSW).

Cupaniopsis foveolata auct. non (F. Muell.) Radlk. pp. (only the specimens from southern Queensland and New South Wales): Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. Münch. 9 (1879) 530; Maiden & Betche, Proc. Linn. Soc. N.S.W. 31 (1906) 732; Domin, Bibl. Bot. 22 (1927) 904; Radlk., in Engl. Pflanzenr. 98 (1933) 1186; Francis, Austr. Rain-For. Trees ed. 2 (1951) 252; Beadle, Stud. Fl. NE. N.S.W. 4 (1980) 571; Reynolds, Austrobaileya 2 (1984) 47; Fl. Austr. 25 (1986) 58, map 69 (southern part).

Cupania foveolata auct. non F. Muell. (as to *Carron* s.n.): F. Muell., Fragm. 9 (1875) 95; F.M. Bailey, Queensl. Fl. 1 (1899) 292.

Shrubs or *treelets*, 2–12 m high. *Flowering twigs* terete, 2–4 mm in diameter, striate, rarely grooved, strigose. *Leaves* (4–)6–10-jugate; petiole 2–8.5 cm, semiterete, rarely upwards terete, striate, thinly strigose; rachis 7–24 cm, semiterete, rarely ± terete, striate, sometime bisulcate, almost glabrous to thinly strigose. *Leaflets* alternate, sometimes subopposite, ovate to narrowly elliptic, slightly asymmetric, upper 6–10.5 × 2–2.5 cm, index 3–4.6, lower 4–8 × 1.5–3 cm, index 2.1–3.2, coriaceous, above glabrous, below almost glabrous, midrib with few hairs to thinly strigose, base (broad-)cuneate, apex acuminate, acumen 2–6(–9) mm, rounded, rarely retuse, margin obscurely to obviously crenate-dentate at least upwards, midrib above slightly prominent, nerves 7–15 per side, mostly ending in the sinuses between the teeth, 4–12 mm apart, angle to midrib 55°–70°, none to several small pustulate domatia, usually with a narrow opening; petiolule 1–4(–8) mm, grooved, glabrous to thinly strigose. *Inflorescences* axillary, usually pendulous, 4.5–11 cm, laxly flowered, with long branches, strigose; cymules 1-flowered. *Bracts* and *bracteoles* more or less deltoid, 0.4–0.7 × 0.6–0.8 mm, not

persistent under the fruits, outside shortly appressed-hairy, ciliolate, inside shortly appressed-hairy at the base. *Buds* 2.4–3.0 × 2.9–3.2 mm. Male flowers: *Sepals* more or less orbicular, outside shortly appressed-hairy except rim, rim ciliolate and with glands, inside shortly appressed-hairy in lower part, outer 2.9 × 2.2 mm, scarious rim narrow, inner 3.5 × 2.4 mm, scarious rim wide. *Petals* broadly ovate to almost orbicular, 1.4–1.9 × 1.3 mm, out- and inside with some short appressed hairs in basal part, scales 2, not crested, 0.7–0.8 mm, long-ciliate. *Disc* glabrous. *Stamens* 8, not exserted, filaments 1.9 mm, patently hairy in lower half, anthers 1.6 mm, glabrous. *Pistillode* 3-celled, outside hairy, 1.1 × 1.0 mm. Female flowers: *Sepals* persistent under the fruits, outer broadly to transversely elliptic, 1.6–3.4 × 2.4–2.7 mm, inner broadly elliptic to almost orbicular, 4.6 × 3.5–4.2 mm. *Petals* lanceolate to rather broad-ovate or 'squarish', 1.6–2.4 × 1.1–1.9 mm, outside and inside glabrous to shortly appressed-hairy in basal part, ciliolate, scales 1.0–1.3 mm. *Disc* glabrous or with some hairs. Filaments of *staminodes* 1.4 mm, anthers 1.8–1.9 mm. *Ovary* 3-celled, outside hairy (long and short), style 1.4–1.7 mm, stigma 0.8–1,0 mm, 3-lined. *Fruits* 22 × 18 mm, stipe 5 mm, wall 1.1–1.2 mm thick, outside rugose, more or less strigose, inside villose, septa complete, glabrous. *Seeds* 17–18 × 9 mm, testa brownish black, arilloid oblique, covering 2/3 of seed, lobed, lacerate, cotyledons about equal, obliquely superposed.

Distribution — Australia (Queensland, New South Wales).

Field notes — Ecological notes: Mixed notophyll vine forest on red basaltic loam. Alt. 1000–1100 m. Flowering: March, fruiting: (June to) November to December.

Notes — In all literature about *C. foveolata* the present species is included in the latter. Even Radlkofer (1924) when describing *C. baileyana* cited several specimens that belong to that species under *C. foveolata*. However, there is a rather large set of small differences between the two. The most important are given in table 7.

Table 7. Differences between *Cupaniopsis foveolata* and *C. baileyana*.

Character	*C. foveolata*	*C. baileyana*
Habit	tree or treelet, 12–25 m	treelet or shrub, 2–12 m
Domatia	dome-shaped to pocket-like	pustulate or absent
Disc	short hairy	glabrous
Pollentype	colporate	parasyncolporate
Fruits (mm)	15 × 13–14	22 × 18
stipe (mm)	1–2	5
thickness pericarp (mm)	0.5–0.8	1.1–1.2
Seeds (mm)	8–8.5 × 6.5–7	17–18 × 9
Cotyledons	parallel	obliquely superposed

In my opinion these differences justify the separation of *C. baileyana* from *C. foveolata*. *C. baileyana* occurs in southern Queensland and New South Wales, *C. foveolata* in northern Queensland.

Specimens examined:
AUSTRALIA. SE Queensland: 7 specimens, New South Wales: 7 specimens.

7. **Cupaniopsis bilocularis** Adema, *spec. nov.* — **Fig. 32.**

Arbor 3–15 m alta, partibus juvenilibus densissime pubescentibus. Folia 3–5(–8)-jugata, foliolis integerrimis, longe acuminatis. Inflorescentiae axillares. Petala squama una ecristata. Capsulae biloculares transverse ellipticae emarginatae, exocarpio velutinoso, endocarpio villoso. Semina arilloidiis fere tote obtegentia. — Typus: *LAE* 51730, Papua New Guinea, Western Province, Kiunga, alt. 100 ft, 6.8.1971 (L!, holo, iso in A!, CANB!, K!, LAE!, US!).

Trees 3–15 m high, d.b.h. 7–8 cm, young parts and inflorescences with a dense golden-brown indumentum. *Flowering twigs* terete, 3–4 mm in diameter, striate, villose, with reddish glands. *Leaves* 3–6(–8)-jugate; petiole 2–6.5 cm, semiterete in lower part, upwards terete, rachis 2–8.5(–16) cm, terete, both striate, villose, with reddish glands. *Leaflets* alternate to opposite, elliptic to ovate, (slightly) asymmetric, upper 4–11 × 1.5–3.5 cm, index 2.8–4, lower 2–6.5 × 1–2.5 cm, index 2–3, chartaceous, above almost glabrous, midrib villose, nerves more thinly so, below thinly to rather densely sericeous, midrib more densely so, reddish glands especially along midrib, base cuneate or rounded, apex long acuminate, acumen (5–)9–17 mm, mucronate, margin entire, midrib above rather prominent, nerves 10–19 per side, 2–7 mm apart, angle to midrib 55°–70°(–75°); petiolule 2–5(–8) mm, velutinous. *Inflorescences* axillary, 1–2 in an axil, 7–23 cm, laxly flowered, with long patent branches; cymules dichasial, several-flowered. *Bracts* and *bracteoles* acicular, 0.8–3.2 × 0.1–0.6 mm, not persistent under the fruits, outside appressed-hairy, with reddish glands, inside glabrous. *Buds* globular, 2 × 2 mm. Male flowers: *Sepals* outside appressed-hairy, rim ciliate, inside with some hairs at the base to almost glabrous, outer ± elliptic, 1.3–2.4 × 1.0–1.4 mm, with a narrow scarious rim, inner broadly elliptic to orbicular, 2.0–2.4 × 1.3–1.6 mm, with a rather wide scarious rim. *Petals* broad elliptic, 0.5–0.8 × 0.4–0.8 mm, out- and inside glabrous, rim long-ciliate, scale 1, V-shaped to squarish, 0.6–0.8 mm, not crested, apically with long patent hairs. *Disc* glabrous. *Stamens* 8, exserted, filaments filiform, 1.2–1.8 mm, hairy in basal part, anthers elliptic, 0.8–1.2 mm, glabrous. *Pistillode* 2-celled, densely hairy, 0.4–1.0 × 0.4–1.0 mm. Female flowers only known in fruit. *Sepals* persistent under the fruits, outer 1.8–2.3 × 1.1–1.4 mm, inner 2.6 × 2.0 mm. *Ovary* 2-celled, outside hairy, with reddish glands, style 1.8–2.4 mm, stigma 1.2–1.8 mm, 2-lined to 2-lobed. *Fruits* transversely ellipsoid to obreniform, emarginate, dorso-ventrally flattened, 2-celled, 20 × 30 mm, stipe c. 1 mm, wall 0.2–0.4 mm thick, outside smooth to rugose, velutinous, with reddish glands, inside villose, septum complete. *Seeds* ellipsoid, 10 × 6 mm, basally attached, testa shiny black, almost totally covered by the arilloid, cotyledons unequal, superposed.

Distribution — Papua New Guinea (East Sepik Province, Western Province).

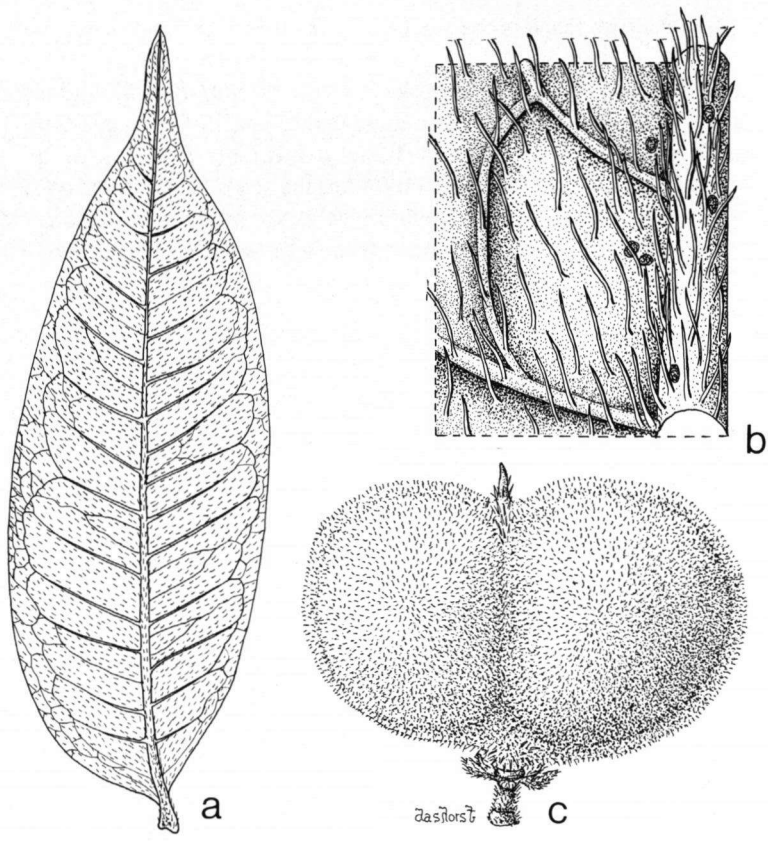

Fig. 32. *Cupaniopsis bilocularis* Adema. a. Leaflet, × 1.5; b. idem, detail, × 35; c. fruit, × 2 (a–c *LAE* 51730, L).

Field notes — a. Ecological notes: Lowland ridge forest, garden regrowth, edge of swamp forest, lower montane rain forest. Alt. 30–120(–1300) m. Flowering: June to August, fruiting: June to August.

b. Additional descriptive notes: Bark smooth, light to reddish brown. Leaves dull or glossy, dark to mid green above, paler below. Buds olivaceous. Flowers white or cream. Fruits brown or crimson.

c. Vernacular names: Milom (Waskuk), Bureau (Wagu).

Notes — In several flowers of *NGF* 31983, 33447 only 5 or 6 stamens were found. Close study revealed that in those cases several stamen pairs grew together to form 1 stamen.

Hoogland & Craven 10909 probably belongs to this species, although it was collected on a much higher altitude (1300 m). It has rather large leaves (petiole 4–6 cm, rachis 14–16 cm) with many (8) leaflets. *NGF* 33447 has leaves with long

petioles (4–6 cm); its leaflets are the largest for this species (7.5–11.5 × 2.5–3.5 cm).

With Radlkofer (1933) this taxon keys out to *C. platycarpa*, which species it resembles in the red glands, the 2-locular fruits, and in the petals with 1 scale. However, the fruits and seeds are strikingly different. The fruit of the present species is smaller, thin-walled and much flatter; the seeds have almost no sarcotesta, but are covered by an arilloid; the petalar scales are not crested. *C. bilocularis* is also generally a smaller, more slender tree, with smaller leaves and narrower leaflets. See table 8.

Table 8. Differences between *Cupaniopsis platycarpa* and *C. bilocularis*.

Character	*C. platycarpa*	*C. bilocularis*
Height of tree (m)	12–33	3–15
Inflorescence (cm)	10–40	7–23
Sepals (mm)	1.9–5.0 × 2.0–5.0	1.3–2.4 × 1.0–1.6
Petals (mm)	2.5–4.0 × 1.3–2.5	0.5–0.8 × 0.4–0.8
Petalar scales (mm)	2.0–3.5, crested	0.6–0.8, not crested
Fruits (cm)	4–8 × 4–6	2 × 3
Thickness pericarp (mm)	0.7–1.7	0.2–0.4
Seeds (cm)	3.5–4.0 × 2.0–3.0, sarcotesta up to at least half of the seed	1.0 × 0.6, arilloid covering the whole seed, sarcotestal only around the hilum

Specimens examined:

Papua New Guinea. East Sepik Prov.: *Hoogland & Craven* 10909; Western Prov.: *LAE* 51730; *NGF* 31983, 33447; *Soegeng Reksodihardjo* 321.

8. Cupaniopsis bullata Adema, *spec. nov.* — Fig. 30.

Foliolis ovatis, bullatis, acuminatis. Sepala late ovata ad orbiculata. Petala elliptica. Discus pilis quinquefasciculatis obsitus. Capsulae 3-loculares, exocarpio velutinosa, endocarpio villoso. — Typus: *Lae* 60052, Papua New Guinea, Central Province, Port Moresby Subdistrict, Boridi Village, 1250 m, 27.9.1973 (L!, holo, iso in A!, BRI!, E!, K!, M!).

Small *tree*. *Flowering twigs* ca. 10 mm in diameter, grooved, villose with shorter and longer hairs. *Leaves* ca. 10-jugate; petiole semiterete, upwards terete, rachis semiterete to terete, both striate to grooved, villose with shorter and longer hairs. *Leaflets* alternate to opposite, ovate, bullate, slightly asymmetric, upper 25.5 × 7.5 cm, index 3.5, lower 19 × 7.5, index 2.5, chartaceous, above almost glabrous, midrib and nerves puberulous, below thinly puberulous, midrib and nerves puberulous, base rounded, apex acuminate, acumen 5–10 mm, acute, margin

entire, midrib above scarcely prominent, nerves 19–29 per side, 10–14 mm apart, angle to midrib 70°–75°; petiolule 3–5 mm, grooved above. *Inflorescences* axillary, 1 or 2 per axil, 19.5–35 cm, laxly flowered, with long patent branches; cymules several-flowered *Bracts* and *bracteoles* narrowly triangular, 0.6–1.0 × 0.2–0.4 mm, outside appressed-hairy, inside glabrous. *Pedicels* 1.4 mm, articulated near the apex. Male flowers: *Sepals* reflexed at anthesis, outside appressed-hairy, inside with scattered hairs, outer broad-ovate, 2.4 × 1.9 mm, scarious rim narrow, inner orbicular, 3.6 × 2.6 mm, scarious rim wide. *Petals* elliptic, 1.9–2.4 × 1.0–1.1 mm, outside with a tuft of appressed hairs at the base, rim with few glands, inside glabrous, scales 2, not crested, 0.7 mm, long-woolly. *Disc* with 5 tufts of hairs. *Stamens* 8, exserted, filaments 1.2 mm, patently hairy except at base, anthers 2.6 mm, glabrous. *Fruits* 3-celled, wall thick, outside rugose, velutinous, inside villose, septa complete.

Distribution — Papua New Guinea (Central Province).

Field notes — a. Ecological notes: secondary growth on ridge. Alt. 1250 m. Flowering: September.

b. Additional descriptive notes: Leaves dark shiny green above, lighter and duller below. Flowers pink. Fruit orange-brown.

Notes — In indumentum resembling *C. curvidens* and allied species, but different in several characters, especially in the large, bullate, entire leaflets.

Specimens examined:
PAPUA NEW GUINEA. Central Province: *Lae* 60052.

9. Cupaniopsis celebica Adema, *spec. nov.* — Fig. 33.

Arbor 15–20 m alta, partibus juvenilibus densissime adpresse pilosis. Folia 4–7-jugata, foliolis integerrimis acutis ad acuminatis. Inflorescentiae axillares. Petala squamis duabus cristatis vel ecristatis. Capsulae cordatae biloculares stipitatae, exocarpio velutinoso, endocarpio villoso. Semina arillodiis obtegentia. — Typus: *Waturandang* 47 (Cel/IV-84), Indonesia, Sulawesi, Malili, alt. 30 m, 31.5.1932 (L!, holo, iso in BO!).

Trees 15–20 m high, d.b.h. 20–38 cm, young parts and inflorescences with dense yellowish indumentum mixed with very small reddish glands. *Flowering twigs* terete, 2 mm in diameter, striate, strigose, when young also with reddish glands. *Leaves* 4–7-jugate; petiole 3–6 cm, semiterete, upwards terete, rachis 5–16 cm, terete, both striate, strigose. *Leaflets* alternate, elliptic to obovate, asymmetric, acroscopic side broader, upper 6.5–11.5 × 2–3 cm, index 3.2–4, lower 3.5–8.5 × 1.5–3.5 cm, index 2–3.3, chartaceous, above almost glabrous, midrib and nerves puberulous, below thinly to densely sericeous, especially when young with reddish glands, base cuneate to rounded, apex acute to acuminate, acumen 6–13 mm, rounded or mucronate, margin entire, midrib above prominent, nerves 7–13 per side, 4–13 mm apart, angle to midrib 45°–60°; petiolule 2–5 mm, strigose. *Inflorescences* axillary or pseudoterminal, 5–19.5 cm, laxly flowered, with long patent branches; cymules dichasial, several-flowered. *Bracts* and *bracteoles* not persistent in fruit. *Pedicels* 3.0–3.6 mm. Male flowers: *Sepals* about orbicular, outside appressed-hairy except rim, rim ciliate and with reddish

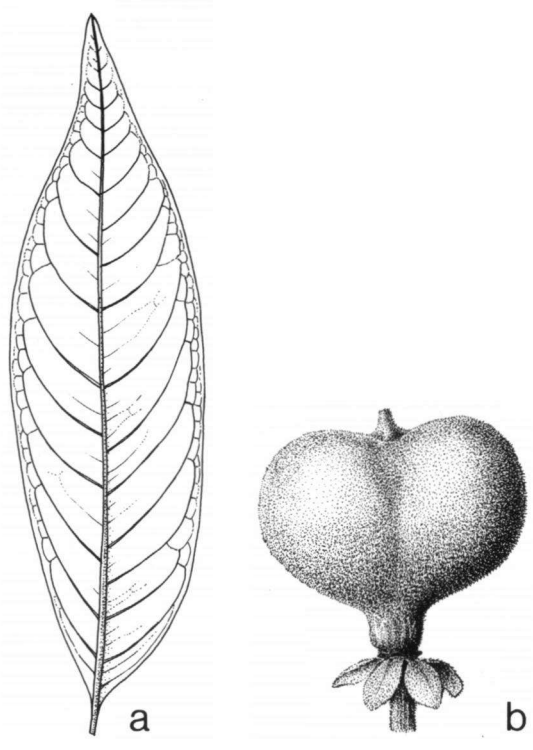

Fig. 33. *Cupaniopsis celebica* Adema. a. Leaflet, × 0.75; b. young fruit, × 2 [a, b: *Waturandang* 47 (Cel IV-84)].

glands, inside with few hairs at the base, outer 2.2 × 2.4 mm, scarious rim narrow, inner 3.0 × 2.0 mm, scarious rim wide. *Petals* irregular ovate to almost orbicular, dentate, 1.1–1.7 × 1.1 mm, outside appressed-hairy, inside glabrous, scales 2, not crested or with fingerlike crests, 0.7–1.0 mm, long-woolly at recurved apex. *Disc* glabrous. *Stamens* 9, not exserted, filaments 1.2 mm, patently hairy, anthers 1.4 mm, glabrous. *Pistillode* 2-celled, outside hairy. Female flowers: Outer *sepals* 2.3 × 1.3 mm, inner 2.6 × 2.4 mm. *Petals* 1.7 × 1.2 mm. *Ovary* 2-celled, outside hairy, style 2.0–2.4 mm, stigma 0.8–1.0 mm, 2-lined. Young *fruits* cordate, with a 3.5 mm long stipe, outside smooth, velutinous, inside villose, septum complete. Arilloid covering young *seed* completely.

Distribution — Celebes (Malili).

Field notes — a. Ecological notes: Old forest on sloping clay. Alt. 30–200 m. Flowering: April to May.

b. Additional descriptive notes: Floral buds dark red. Fruits reddish yellow.

c. Vernacular names: Solompé maeto (Tobela), Raroensoe awoe (Tobela, To Padoe, To Koronsie).

Notes — The present species resembles both *C. platycarpa* and *C. bilocularis* especially in the shape and the hairiness of the leaflets, the occurrence of reddish glands, and in the bilocular fruits. It is sufficiently different from both.

Specimens examined:
CELEBES. Malili: *Waturandang* 47 (CEL/IV-86), 268 (CEL/IV-369).

10. Cupaniopsis chytradenia Radlk. — Fig. 34.

Cupaniopsis chytradenia Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. Münch. 9 (1879) 587; Guillaumin, Not. Syst. 1 (1911) 330; Bull. Soc. Bot. Fr. 79 (1932) 339; Radlk. in Engl., Pflanzenr. 98 (1933) 1201; Guillaumin, Fl. Nouv.-Caléd. (1948) 200. — Lectotype (present author): *Vieillard* 217, New Caledonia, Port de France, 1855–1860 (P!, holo, iso in P!). Paratypes: *Deplanche* s.n. (P!), *Pancher* s.n. (P!).
Cupania glandulosa Pancher & Sebert, in Sebert, Not. Bois Nouv. Caléd. (1874) 270 (nom. nud.).

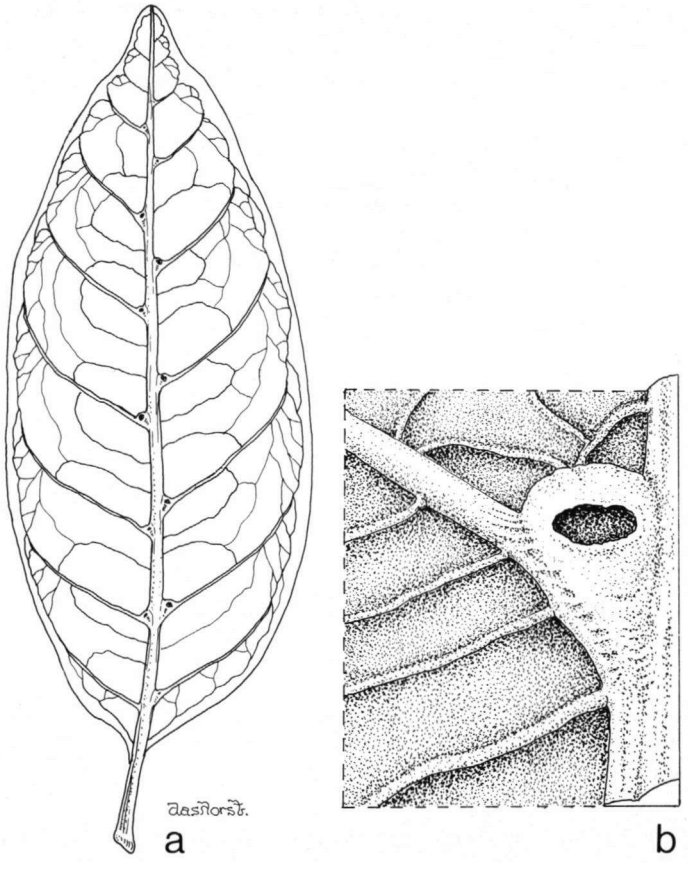

Fig. 34. *Cupaniopsis chytradenia* Radlk. a. Leaflet, × 0.9; b. idem, detail, × 15 (a, b: *Vieillard* 217, P).

Trees or *treelets*, 4–10 m high, d.b.h. 25 cm. *Flowering twigs* terete, 3–5 mm in diameter, striate, villose. *Leaves* 4–6-jugate; petiole 4.5–8 cm, semiterete, usually terete upwards, rachis 6.5–17.5 cm, semiterete or more or less terete, both striate, villose. *Leaflets* opposite or subopposite, sometimes alternate, elliptic to ovate, slightly asymmetric, upper 7–11.5 × 2.5–3.5 cm, index 2.5–3.5, lower 3–6 × 2–3.5 cm, index 1.6–2.7, coriaceous, above and below glabrous, midrib glabrous to villose, base cuneate to rounded, apex obtuse to acuminate, acumen 1–7 mm, rounded, margin entire, midrib above not or slightly prominent, nerves 5–9 per side, 5–12(–17) mm apart, angle to midrib 45°–55°, pustulate domatia present; petiolule 6–15 mm, grooved above, glabrous to villose. *Inflorescences* axillary, 5–11.5 cm, laxly flowered, with long or short branches, villose; cymules 1-flowered. *Bracts* and *bracteoles* lanceolate to deltoid, 0.6–1.2 × 0.6 mm, thick, outside appressed-hairy, inside appressed-hairy except apex. *Pedicels* 1.2 mm, articulated at the base. *Buds* 2.4 × 3.6 mm. Male flowers: *Sepals* elliptic to orbicular, out- and inside appressed-hairy except rim, rim ciliate, outer 1.8–2.8 × 2.3–2.4 mm, without scarious rim, inner 3.6 × 3.6 mm, scarious rim wide. *Petals* elliptic to almost orbicular, 1.3–1.7 × 0.8 mm, claw if present 0.2 mm, outside glabrous or appressed-hairy in lower half, rim ciliate in lower half, inside appressed-hairy in lower part, scales 2, not crested, 0.8–1.3 mm, woolly. *Disc* with 5 tufts of hairs. *Stamens* 8, exserted, filaments 2.9–4.2 mm, patently hairy in lower half, anthers 1.3–1.4 mm, hairy or glabrous. *Pistillode* 3-celled, outside hairy, 0.6 × 0.8 mm. Female flowers: Outer *sepals* 2.8–3.6 × 2.8–3.4 mm, inner 3.5–4.7 × 3.0–4.3 mm. *Petals* 1.6–1.8 × 1.2–1.6 mm. *Disc* glabrous. Filaments of *staminodes* 1.0 mm, anthers 1.6 mm, glabrous. *Ovary* 3-celled, outside hairy, style 1.1–1.8 mm, stigma 1.0–1.1 mm, 3-lined. Young *fruits* stiped, outside smooth, velutinous, inside villose, septa complete.

Distribution — New Caledonia.

Field notes — a. Ecological notes: Humid forests on schists or greywacke. Alt. 200–800 m. Flowering: February, July.

b. Additional descriptive notes: Bark brown, rather rough. Leaflets shiny dark green above, shiny light green below. Flowers whitish to yellowish or brown.

Specimens examined:
NEW CALEDONIA. 10 specimens.

11. Cupaniopsis concolor (Gillespie) Ham — Fig. 35.

Cupaniopsis concolor (Gillespie) Ham, Blumea 23 (1977) 287, 290; A.C. Smith, Fl. Viti. 3 (1985) 604, fig. 145B–D, 146C, D. — *Guioa concolor* Gillespie, Bull. Bish. Mus. 83 (1931) 17, fig. 19; Radlk. in Engl., Pflanzenr. 98 (1933) 1503. — *Arytera concolor* (Gillespie) A.C. Smith, J. Arn. Arbor. 31 (1950) 298; Parham, Plants Fiji Is. (1964) 173; ed. 2 (1972) 245. — Type: *Gillespie* 4794, Fiji, Taveuni, vicinity of Waiyevo, banks of streams in coconut plantations, 3.3.1928 (BISH, holo, n.v., iso in A!, B!, K!,NY!).

Trees 3–18.25 m high, young parts with minute scale, often also with short patent hairs, 'varnished'. *Flowering twigs* terete, 1–3 mm in diameter, striate, glabrous. *Leaves* (1–)2–3-jugate; petiole 2–8.5 cm, semiterete, upwards terete, rachis 1–8.5 cm, terete, rarely semiterete, both striate, glabrous. *Leaflets* alternate

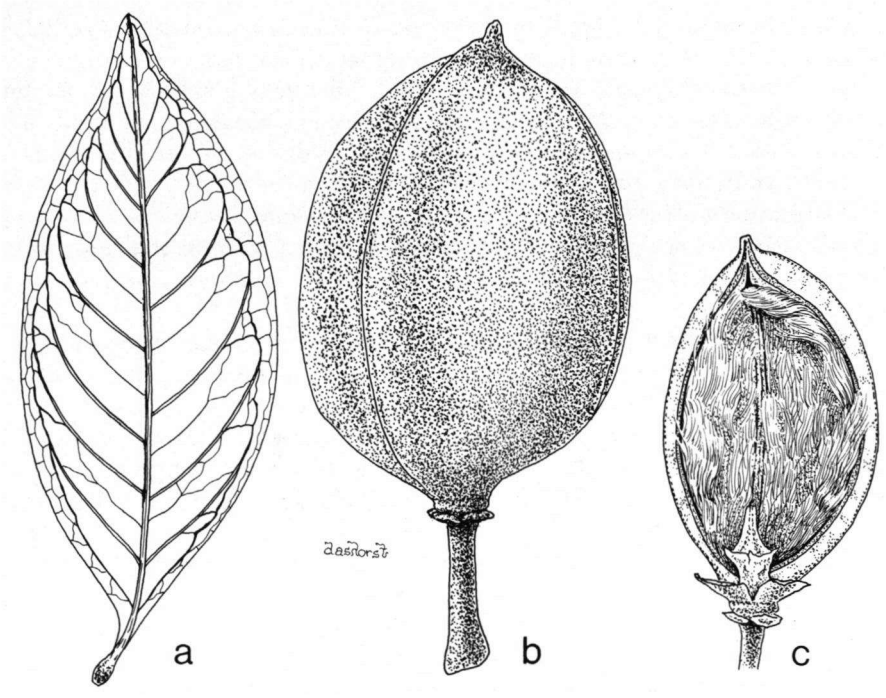

Fig. 35. *Cupaniopsis concolor* (Gillespie) Ham. a. Leaflet, × 0.75; b. fruit, × 3.5; c. fruitvalve from inside, × 3 (a–c: *A.C. Smith* 8171, L).

to opposite, elliptic to ovate, symmetric, upper 8–17 × 3–9 cm, index 1–3, lower 3–14 × 2–6.5 cm, index 1–3, coriaceous, above and below glabrous, base cuneate to rounded, apex obtuse to acuminate, acumen 6–12 mm, rounded, margin entire, midrib above slightly prominent, nerves 7–13 per side, (4–)6–17 mm apart, angle to midrib 45°–80°; petiolule 3–13 mm, semiterete, grooved, glabrous. *Inflorescences* axillary, 6–10 cm, laxly flowered, with long patent branches; cymules 1-flowered. *Bracts* and *bracteoles* deltoid, 0.2–0.6 × 0.2–0.6 mm, not persistent under the fruits, outside with few scale hairs, inside glabrous. *Buds* globular, 1.2–1.8 × 1.2–1.8 mm. *Pedicels* in bud 1.2–3.0 mm, articulated at 1/3 above the base, after anthesis c. 3.6 mm, articulated at 1/10 above the base. Male flowers: *Sepals* with narrow to wide scarious rims, out- and inside with scale hairs, rim shortly glandular-ciliate, outer broad-ovate, 0.8–1.8 × 1.1–1.8 mm, inner orbicular, 1.9–2.4 × 1.8–2.2 mm. *Petals* ovate to deltoid, 1.4–1.9 × 1.0–1.7 mm, out- and inside more or less patently hairy in lower part, scales 2, not crested, 0.4–0.5 mm, woolly. *Disc* glabrous or with scale hairs. *Stamens* 8, exserted, filaments 3.0 mm, patently hairy in lower half, anthers 0.7–0.8 mm, with an apical wart, hairy *Pistillode* very small, outside glabrous. Female flowers: *Sepals* not persistent under the fruits, outer 1.9–2.4 × 1.7–1.9 mm, inner transversely elliptic, 2.4 × 2.8 mm. *Petals* 1.3–1.4 × 1.2–1.6 mm. *Staminodes* 10, filaments 1.2 mm, anthers 0.8–1.0 mm. *Ovary* 3-celled,

outside glabrous, style 0.6 m, stigma 0.6 mm, 3-lined. *Fruits* ovoid, 1-celled, 3-valved, 12–20 × 10–16 mm, stipe 1 mm, rather broad, pericarp 0.6–1.1 mm thick, outside smooth, glabrous, inside tomentose, sometimes glabrous at apex and margins of valves, septa not developed, visible as a glabrous line on each valve. *Seeds* 10–16 × 7–11 mm, basally attached, testa shiny black, arilloid covering 2/3 to the whole seed, cotyledons superposed.

Distribution — Fiji (Viti Levu, Vanua Levu, Taveuni).

Field notes — a. Ecological notes: Dense forests or forestremnants, often along streams. Alt. 200–1150 m. Flowering: February to March, fruiting: May to August.

b. Additional descriptive notes: Flowers white. Fruit green.

c. Vernacular names: Marasa, Nduvunduvu, Sauva, Sorovula, Tombilito (all Viti Levu, Mba), Saulangitua, Vatudamu (both Viti Levu, Ra).

Notes — Only the very young parts bear a visible, dense cover of minute scale hairs. When the parts become older these hairs disappear, and finally they are widely scattered and even with large magnifications (about 50 diameters) scarcely visible.

In young ovaries free carpelrims can be seen. They do not grow into septa, and in ripe fruits they are visible as a glabrous line in the middle of each valve.

DA 15625, with only very young buds, differs in the hairiness of the inflorescence axis, but probably belongs to the present species.

Gillespie 4765 cited by A.C. Smith (1985: 605) as *C. concolor* belongs to *Antidesma gillespiana* A.C. Smith (*Euphorbiaceae*).

Specimens examined:

Fiji. Viti Levu: 10 specimens, Vanua Levu: *DA* 15091, Thakandrove, Navonu, Taveuni: 6 specimens.

12. Cupaniopsis crassivalvis Radlk. — Fig. 36.

Cupaniopsis crassivalvis Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. Münch. 9 (1879) 567; Guillaumin, Bull. Soc. Bot. Fr. 79 (1932) 339; Radlk. in Engl., Pflanzenr. 98 (1933) 1201; Guillaumin, Fl. Nouv.-Caléd. (1948) 200. — Type: *Balansa* 1455, New Caledonia, NE de la Conception, alt. c. 700 m, 24.1.1869 [P!, holo, iso in M! (fragments)].

Tree 10 m high. *Flowering twigs* terete, 5–6 mm in diameter, striate, villose. *Leaves* 4–5-jugate; petiole 4.5–5.5 cm, semiterete, upwards more or less terete, rachis 9–11 cm, ± terete or semiterete, both striate, villose. *Leaflets* subopposite to alternate, elliptic to obovate, slightly asymmetric, upper 9–10.5 × 3.5–4 cm, index ca. 2.5, lower 6–7 × 3–3.5 cm, index ca. 2, coriaceous, above almost glabrous, midrib glabrous or villose, below thinly puberulous, midrib and nerves villose, base cuneate to rounded, apex rounded, margin entire, midrib above slightly prominent, nerves 7–11 per side, 8–10 mm apart, angle to midrib 55°, small pocket-like domatia present; petiolule 6–8 mm, grooved, villose. *Inflorescences* axillary. *Sepals* outside appressed-hairy. *Disc* glabrous. *Fruits* 3-celled, obovoid to almost globular, 27 × 20 mm, stipe 6 mm, wall 2.4 mm thick, outside smooth, velutinous, inside villose, septa complete. *Seeds* ellipsoid to obovoid, 19–22 ×

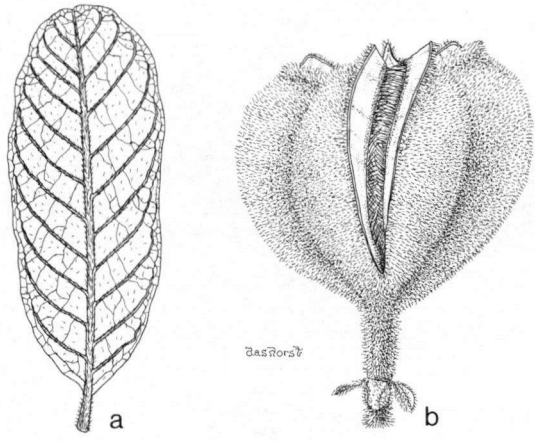

Fig. 36. *Cupaniopsis crassivalvis* Radlk. a. Leaflet, × 0.5; b. fruit, × 1.7 (a, b: *Balansa* 1455, P).

10–11 mm, testa dark brown to black, arilloid covering almost the whole seed, cotyledons unequal, superposed.

Distribution — New Caledonia.

Field notes — Ecological notes: Forest. Alt. 700 m. Fruiting: January.

Notes — The present species strongly resembles *C. macrocarpa* and *C. megalocarpa*. From the former it differs in the thick pericarp, the villose endocarp and the larger seeds, from the latter in the smaller obovate to almost globular fruits.

Specimens examined:
NEW CALEDONIA. Northeast of Conception: *Balansa* 1455.

13. Cupaniopsis curvidens Radlk. — Fig. 37.

Cupaniopsis curvidens Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. Münch. 20 (1890) 359; in Engl., Pflanzenr. 98 (1933) 1191. — *Guioa curvidens* (Radlk. ex Dur. & Jacks., Ind. Kew., Suppl. 1 (1906) 190 (in errore). — Lectotype (present author): *Forbes* 308, Papua New Guinea, Central Prov., Sogeri, 30.10.1885 (M!, holo, iso in BM!, E!, FI!, K!, L!, LAE!, MEL!). Paratype: *Armit* s.n. (M!).

Cupaniopsis serrata (F. Muell.) Radlk. f. *vestita* Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. Münch. 9 (1879) 674; in Engl., Pflanzenr. 98 (193) 1184. — Type: *Beccari* PP273 (FI 2880, 2880A), Irian Jaya, Ramoi, 1872 (FI!, holo).

Cupaniopsis subserrata Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. Münch. 20 (1890) 358; in Engl., Pflanzenr. 98 (1933) 1189. — Type: *Anon.* s.n., Papua New Guinea, base of Mt. Obree, 1887 (M!, holo).

Cupaniopsis multidens Radlk., Bot. Jahrb. 56 (1920) 285; in Engl., Pflanzenr. 98 (1933) 1190. — Type: *Fitzgerald* 11, Papua New Guinea, Central Prov., Ameiana (M!, holo, iso in M!).

Cupaniopsis gigantophylla Radlk., Bot. Jahrb. 56 (1920) 289; in Engl., Pflanzenr. 98 (1933) 1195. — Type: *Ledermann* 8389, Papua New Guinea, East Sepik Prov., Mt. Hunstein, 'Quellenlager', 8.1912 (B, holo, lost, fragments of iso in K!).

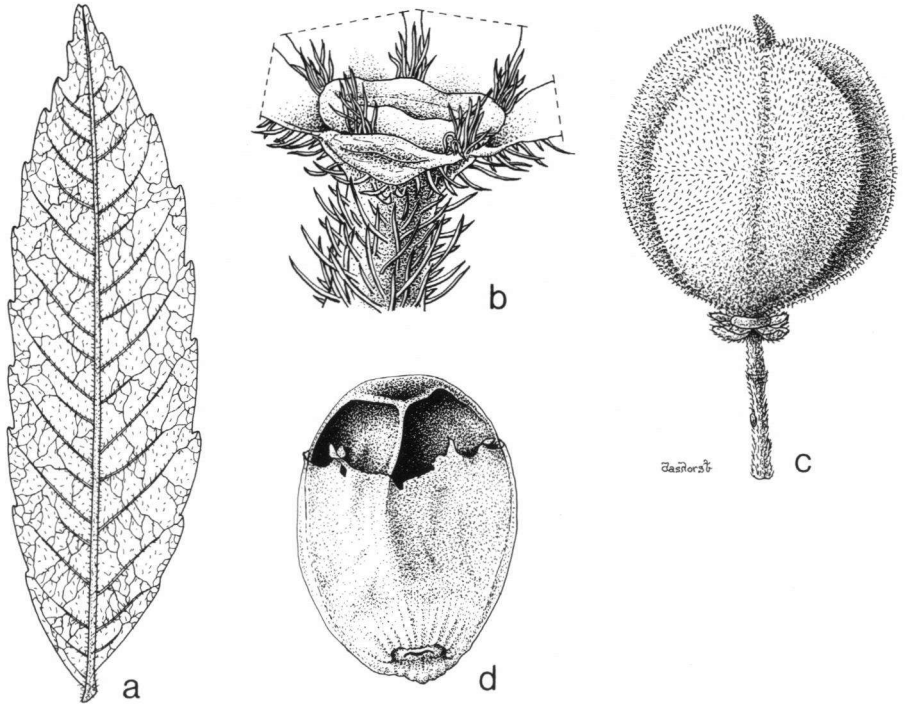

Fig. 37. *Cupaniopsis curvidens* Radlk. a. Leaflet, × 1; b. disc, × 30; c. fruit, × 2; d. seed, × 2.5 (a, b: *Forbes* 308, L; c, d: *Schoaae* 5701, L).

Cupaniopsis flaccida Radlk., Bot. Jahrb. 56 (1920) 290; in Engl., Pflanzenr. 98 (1933) 1195. — Syntypes: *Ledermann* 11377, Papua New Guinea, East Sepik River, Hunsteinspitze, 3.1913 (B, lost, fragments in M!); 12411a, Papua New Guinea, Felsspitze, 8.1913 (B, lost, fragments in M!).

Cupaniopsis angustifolia Radlk., Fedde Rep. 20 (1924) 33. — Type: *Djibda* 707, culta in Hort. Bogoriensis, no. III, J, 8 (BO, holo?, n.v., iso in M!).

Cupaniopsis insularis Radlk. in Engl. Pflanzenr. 98 (1933) 1190. — Syntypes: *C.T. White* 748 (BRI!, fragments in M!), 748A (BRI!), Papua New Guinea, Central Prov., Yule Island, 8.1918.

Cupaniopsis papuana Radlk. in Engl., Pflanzenr. 98 (1933) 1190. — Type: *C.T. White* 278 (BRI!, holo, fragments of iso in M!).

Cupaniopsis subdentata Radlk. in Engl., Pflanzenr. 98 (1933) 1180 (nom. inval.). — *Cupaniopsis denticulata* Radlk. in Engl., Pflanzenr. 98 (1933) 1191 (*'subdentata'* in key). — Type: *Turner* s.n., Papua New Guinea, Central Prov., Rigo, 1925 (BRI!, holo, iso in M!, fragments in both only).

Cupaniopsis multijuga Merr. & Perry, J. Arn. Arbor. 21 (1940) 515. — Type: *Brass* 5660, Papua New Guinea, Central Prov., Kubuna 11.1938 (A!, holo, iso in NY!).

Cupaniopsis remotidens Merr. & Perry, J. Arn. Arbor. 21 (1940) 516. — Type: *Brass* 706, Papua New Guinea, Central Prov., Iawarere, 11.1925 (A!, holo).

Cupaniopsis reticulata Merr. & Perry, J. Arn. Arbor. 21 (1940) 517. — Type: *Brass* 4134, Papua New Guinea, Central Prov., Mt. Tafa, 2100 m, 5.9.1933 (A!, holo, iso in UC!, NY!).

Cupaniopsis longifoliata Kan. & Hat., Bot. Mag. Tokyo 57 (1943) 74, fig. 10. — Syntypes: *Kanehira & Hatusima* 12940, Irian Jaya, Waren, 60 miles south of Manokwari, 21.3.1940 (FU, non vidi); 14135, Irian Jaya, Momi, 11.3.1940 (FU, non vidi, A!, BO!).

Shrubs or small unbranched or sparsely branched, often palmoid *trees*, 1.5–15.5 m high, d.b.h. 4–10(–60) cm, young parts and inflorescences with dense brown indumentum. *Flowering twigs* terete, 4–18 mm in diameter, grooved, pilose to villose, usually mixed with longer hairs. *Leaves* (4–)5–18(–28)-jugate; petiole (2–)5–39 cm, upper side grooved at base, semiterete, usually upwards terete, rachis (9.5–)11–78 cm, terete, sometimes semiterete in lower part and terete upwards, both striate, pilose to villose, sometimes also with longer hairs. *Leaflets* opposite to alternate, usually (narrowly) elliptic, slightly asymmetric, upper 6.5–32 × 2–10.5 cm, index 2.4–6.3, lower 3–18.5 × 1–10 cm, index 1.8–4.2, thinly papyraceous to coriaceous, above and below almost glabrous to (thinly) pilose, midrib (thinly) pilose, base cuneate to rounded, apex obtuse to acuminate, acumen 2–24 mm, rounded, emarginate or mucronate, margin usually serrate, sometimes dentate or more or less crenate, exceptionally entire, midrib above slightly prominent to slightly sunken, nerves (6–)9–28 per side, most ending in a tooth, 4–22 mm apart, angle to midrib 45°–80°, usually with small, pocket-like domatia; petiolule 0–10(–15) mm, pilose to villose, sometimes also with longer hairs. *Inflorescences* (supra)axillary, 4.5–44 cm, rarely 2 per axil, with long, rarely short patent branches, laxly flowered; cymules dichasial. 1–few-flowered. *Bracts* and *bracteoles* acicular to deltoid, 0.4–5(–10) × 0.1–1.8 mm, not persistent under the fruits, outside appressed-hairy, inside glabrous or with some appressed hairs at the base. *Pedicels* 0.5–4.2 mm, articulated up to 2/3 above the base. *Buds* globular to obovate, 1.4–4.8 × 1.6–4.6 mm. Male flowers: *Sepals* elliptic to orbicular, usually deflexed, concave, dentate at apex, outside appressed-hairy except rim, rim ciliate and with short glandular hairs, inside with some appressed hairs at the base, outer 1.2–3.0 × 0.8–2.8 mm, without or with a narrow scarious rim, inner 1.8–4.1 × 1.1–4.0 mm, scarious rim wide. *Petals* about elliptic to almost orbicular, 0.4–4.6 × 0.2–2.6 mm, out- and inside glabrous or with few appressed hairs, scales 2, not crested, 0.6–1.8 mm, long-woolly. *Disc* glabrous or with some scattered hairs to 5 tufts of hairs. *Stamens* (5–)8(–10), exserted, filaments 0.8–3.2 mm, patently hairy, exceptionally glabrous, anthers 0.8–2.8 mm, filaments, glabrous or with few hairs. *Pistillode* 3-celled, outside hairy, 0.5–1.7 × 0.4–1.6 mm. Female flowers: *Sepals* persistent or not persistent under the fruits, outer 1.4–4.6 × 1.4–3.0 mm, inner 2.0–4.2 × 1.3–5.0 mm. *Petals* 1.1–5.0 × 0.7–3.2 mm, shorter to longer than the sepals, scales 0.7–3.0 mm. Filaments of *staminodes* 1.0–2.4 mm, anthers 1.1–2.4 mm. *Ovary* 3-celled, outside hairy, style 1.0–4.6 mm, stigma 0.8–2.0 mm, 3-lined. *Fruits* obpyramidal, 3-angled in cross section, 3-ribbed, 14–24 × 9–20 mm, wall 0.7–1.8 mm thick, outside rugose, villose, inside thinly to rather densely appressed-hairy to more or less villose, septa complete, usually less densely hairy. *Seeds* basally attached, ellipsoid, 8–19 × 6–12 mm, arilloid covering 1/2 to almost the whole seed, oblique, lacerate to fimbriate, cotyledons equal, parallel, exceptionally unequal and superposed.

Distribution — Irian Jaya; Papua New Guinea.

Field notes — a. Ecological notes: Primary or secondary rain forest, dense to open forest or low scrub patches in savannah; often along rivers, sometimes in swamp forest. Alt. 0–2700 m. Flowering: February to May (to December); fruiting: (February to) August to November.

b. Additional descriptive notes: Stem hollow or pithy. Bark more or less smooth, brown to mottled gray, inner bark cream or white to brown, under bark green to red brown, blaze straw or orange to purple brown. Wood cream or white. Young leaves red, later on dull to shiny, light to dark green, often darker or more grayish above; old leaves can become over 1 m long (*Brass* 22174). Peduncles dark pink. Buds green or dark pink. Flowers scented. Calyx greenish white to green, inside pinkish. Corolla white or cream, sometimes pinkish to deep rose-red. Anthers yellow. Fruits usually orange, brown when old. Seeds black, arilloid white or yellowish.

c. Vernacular names: Fonanitur (Wanigela, Onjob language), Gari (Usino), Gunini (Madang), Kainotnotwea (Tapio, Gaboboraa language), Kiyinge (Manim Valley), Madala (Oksapmin), NiuNiu (Matapali language), Patere (Kutubu), Sapaha (Kalau), Simeka (Baruga), Simpunpumpurugwan (Kaigorin), Sisimana (Iawarere), Wanoauw (Wandammen language), Wata Kum (Veiya).

d. Uses: Wood for making bows (Manim Valley).

Notes — A group of specimens from several, mostly northern, localities (*Beccari* PP273, *BW* 13786, *Fallen* c.s. 276, *Hoogland* 5055, *Ledermann* 8389, *NGF* 39981, 41549, 46743, *Schodde* 2412, *Veldkamp* 6758) differs from most specimens of the present species in the large to very large wide leaflets. In this aspect they resemble *Cupaniopsis gigantophylla* Radlk. However, as no other differences could be found I included this material in *C. curvidens*.

The inclusion of the *gigantophylla*-group in the latter species does not change its circumscription in any important aspect. It merely adds some percents to the variability of various characters. Moreover, it does not even make the delimitation of *C. curvidens* from its relatives more troublesome. Although it is always possible that the ideas about this taxon may change when new material becomes available, I will keep for the moment *C. curvidens* as a large, variable species, including the *gigantophylla*-like specimens.

BW 13796 and *NGF* 4673 are large trees. *Schodde* 3061 has long petioles and rachises. *Carr* 16082 has larger flowerparts than the other specimens. *NGF* 39981 and *Veldkamp* 6758 have rather small petals. *Carr* 13210 has only 1 seed per fruit. *EKN* s.n. has unequal, superposed cotyledons.

The type of *C. angustifolia* should originate from G. Alkmaar, Irian Jaya, according to the label.

Cupaniopsis subserrata Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. Münch. 20 (1890) 358; Bot. Jahrb. 56 (1920) 285; in Engl., Pflanzenr. 98 (1933) 1189. — Type: *Anon.* s.n., Papua New Guinea, base of Mount Obree, 1887 (M!, holo).

This species was described on rather fragmentary material: a part of a leaf, a part of an inflorescence and several loose fruits and seeds. It is not clear whether all these parts were collected from the same tree.

Comparing Radlkofer's description with those of several *Cupaniopsis*-species from New Guinea, and determination with some keys to those species, leads to the conclusion that *C. subserrata* is very close to *C. curvidens*. Both species may even be identical. However, the fragmentary character of the *subserrata*-material prevents that conclusion.

C. papuana clearly belongs here. The only difference with *C. curvidens* can be found in the young fruits, that seem to have a short and wide stipe.

Specimens examined:
NEW GUINEA. Irian Jaya: 7 specimens; Papua New Guinea: 64 specimens.

14. Cupaniopsis dallachyi Reynolds — Fig. 38.

Cupaniopsis dallachyi Reynolds, Fl. Austr. 25 (1985) 199, 58, map 70. — Type: *Stocker* 1773, Australia, Queensland, Jaggan, near Malanda, 30.9.1980 (BRI, holo, iso in QRS, n.v.).

Small *tree*. *Flowering twigs* ca. 3 mm in diameter, striate, strigose, soon glabrescent. *Leaves* 6–7-jugate; petiole 4.5–4.8 cm, rachis 17–18 cm, both

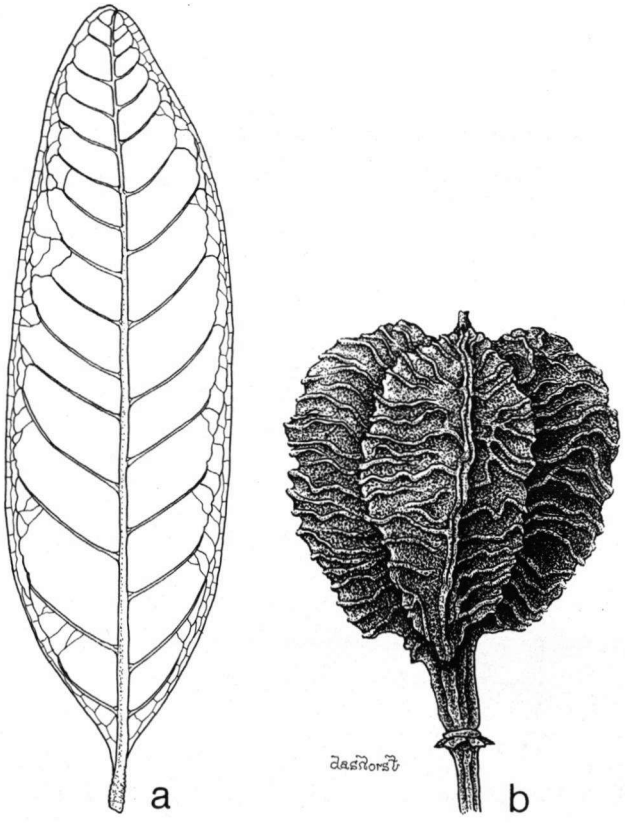

Fig. 38. *Cupaniopsis dallachyi* Reynolds. a. Leaflet, × 0.75; b. fruit, × 2 (a, b: *Gray* 1037, BRI).

semiterete, striate, thinly strigose. *Leaflets* alternate, (narrowly) ovate, slightly asymmetric, upper 11–13.5 × 3–4 cm, index 3–4, lower 7.5 × 3.5 cm, index ca. 2, coriaceous, above and below glabrous, base broadly cuneate, apex obtuse, margin entire, midrib above slightly sunken, nerves 11 or 12 per side, 10–16 mm apart, angle to midrib 60°, small dome-shaped to pustulate domatia present; petiolule 9–10 mm, grooved above, almost glabrous. *Inflorescences* axillary, 25 cm, with long branches. *Disc* glabrous. Young *fruits* 3-celled, stiped, wall 1.2 mm thick, outside rugose, glabrous, inside appressed-hairy, septa complete. Arilloid covering young *seed* for 3/4, lacerate, cotyledons about equal, parallel.

Distribution — Australia (NE Queensland).

Field notes — a. Ecological notes: Rain forest. Alt. 840 m. Fruiting: October.

b. Additional descriptive notes: Young fruit green with purplish tinge.

Notes — Of the specimens cited by Reynolds I have seen material of *Gray* 1037, and photographs of *Hyland* 3485 and *Stocker* 1773.

The indumentum and the leaves of the present species are similar to those of *C. fleckeri*. The latter is known from flowering material only, while *C. dallachyi* is described from fruiting material, which makes a good comparison of both taxa very difficult.

Specimen examined:

AUSTRALIA. NE Queensland: *Gray* 1037.

15. Cupaniopsis diploglottoides Adema, *spec. nov.* — Fig. 39.

Arbor parva. Folia 6-jugata; foliolis ellipticis, bullatis, integerrimis. Sepala squamis duabus ecristatis. Discus glaber. Capsulae juveniles exocarpio rugoso, villoso, endocarpio adpresse piloso. — Typus: *L.S. Smith* 11231A, Australia, Queensland, Cook District, Gap Creek, 38 km S by E of Cooktown, in rain forest, 10.11.1960 (BRI!, holo, iso in L!).

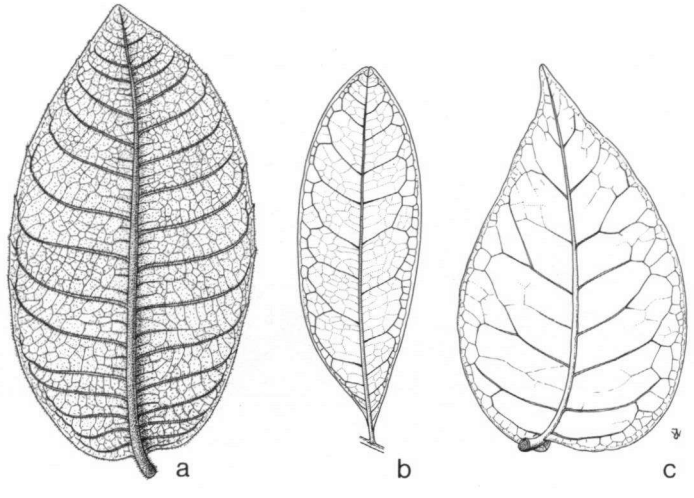

Fig. 39. *Cupaniopsis diploglottoides* Adema. a. Leaflet, × 0.5 (*L.S. Smith* 11231A, L). — Fig. 40. *Cupaniopsis fleckeri* Reynolds. b. Leaflet, × 0.5 (*Dockrill* 872, L). — Fig. 41. *Cupaniopsis glabra* Adema. c. Leaflet, × 1.5 (*MacKee* 40234, L).

Small *tree*. *Flowering twigs* 13 mm in diameter, grooved, villose, also with longer hairs. *Leaves* 6-jugate; petiole 22.5 cm, rachis 35.5 cm, both more or less semiterete, striate, villose, also with longer hairs. *Leaflets* subopposite to alternate, elliptic, bullate, slightly asymmetric, upper 18.4 × 6 cm, index 3.1, lower 11.5 × 6.3 cm, index 1.8, coriaceous, above almost glabrous, midrib puberulous, nerves thinly puberulous, below rather densely puberulous, midrib very densely so, base rounded, apex obtuse, margin entire, midrib above slightly sunken, nerves 16–19 per side, 9–12 mm apart, angle to midrib 75°–80°, very small, pocket-like domatia present; petiolule 2–3 mm, grooved above, pilose, also with longer hairs. *Inflorescences* axillary, 17 cm, with long branches, laxly flowered. *Bracts* and *bracteoles* deltoid to rhomboid, 2.3–2.8 × 2.0–2.6 mm, outside appressed-hairy, rim ciliate, with glands, inside appressed-hairy at the base. Female flowers (from young fruits): *Sepals* outside appressed-hairy, rim with few ciliae and some glands, inside glabrous or with few scattered appressed hairs, outer more or less elliptic to broadly ovate, 5.0–5.6 × 4.2–4.4 mm, scarious rim narrow, inner more or less broadly elliptic, 6.2 × 4.8 mm, scarious rim wide. *Petals* broadly ovate to elliptic, 2.9–3.1 × 1.8–2.5 mm, outside appressed-hairy in lower part, rim ciliate in lower half, inside glabrous or with few appressed hairs, scales 2, not crested, 1.7–2.4 mm, ciliate. *Disc* glabrous. *Staminodes* 8, filaments 2.9–3.2 mm, patently hairy, anthers 2.3–2.4 mm, glabrous. Young *fruits* 3-celled, wall 2.4 mm thick, outside rugose, villose, inside appressed-hairy, septa complete. Arilloid covering young *seed* totally.

Distribution — Australia (Queensland, Cook District).

Field notes — Ecological notes: Rain forest. Fruiting: September.

Notes — This new species is rather different from all other *Cupaniopsis*-species from Australia. Vegetatively it strongly resembles *Diploglottis australis* and *D. macrantha*.

Cupaniopsis diploglottoides has a typical *Cupaniopsis*-calyx, petalar scales without crests, a complete disc, its seeds are not lenticular and the arilloid is not bilobed. All these characters are pointing towards *Cupaniopsis* and not to *Diploglottis*.

Webb & Tracey 12163, Australia, Queensland, Cook District, Mt. Finnegan, S of Cooktown, 15.47 S/145.17 E, alt. 700 m, understory of notophyll vine forest on soils derived from granite. This specimen consisting of a damaged part of a leaf, shows a great resemblance to the present species.

Specimens examined:
AUSTRALIA. Queensland, Cook District: *L.S. Smith* 11231A, *Webb & Tracey* 12163.

16. Cupaniopsis euneura Adema, *spec. nov.* — Fig. 42.

Folia 2–3-jugata; foliolis ellipticis, raro obovatis, acuminatis, dentatis apicem versus. Discus glaber. Capsulae globosae, exocarpio velutinoso, endocarpio sparse adpresse piloso. — Typus: *NGF* s.n. (J. Womersley), Papua New Guinea, Western Highlands Province, Porget logging area, 12 miles North of Wabag, alt. 2100–2400 m, 7.1959 [L (960.23.075)!, holo, iso in BRI (393925, 393626)!, K!].

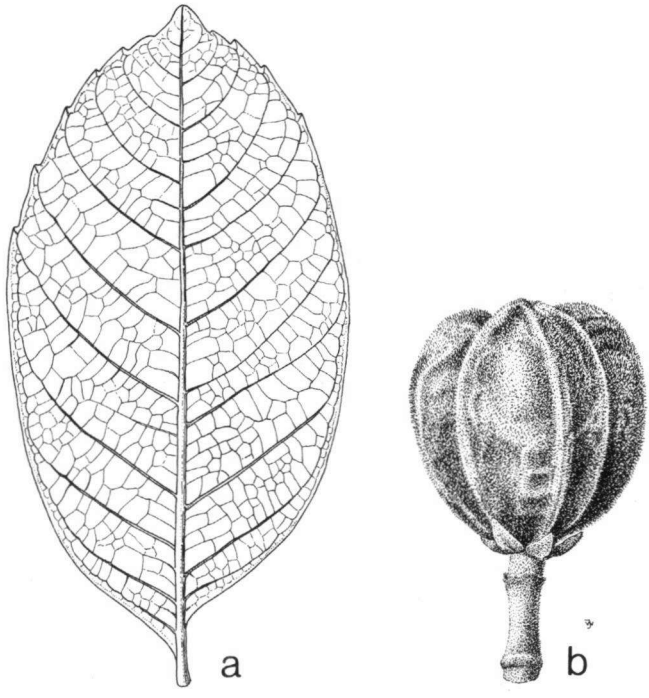

Fig. 42. *Cupaniopsis euneura* Adema. a. Leaflet, × 0.75; b. fruit, × 2 (a, b: *NGF* s.n., L).

Flowering twigs 3–5 mm in diameter, grooved, tomentose. *Leaves* 2–3-jugate; petiole 6.5–7.5 cm, semiterete, upwards terete, rachis 5.5–8 cm, semiterete or terete, both striate, tomentose. *Leaflets* alternate to subopposite, elliptic, rarely obovate, slightly asymmetric, upper 12.5–15 × 5.5–7 cm, index ca. 2, lower 8.5–12 × 4.5–6 cm, index ca. 2, coriaceous, above almost glabrous, midrib appressed-hairy, nerves with some appressed hairs, below rather thinly puberulous, especially on midrib and nerves, base cuneate to rounded, apex acuminate, acumen acute to obtuse, margin dentate in upper half, midrib slightly prominent above, nerves 9–13 per side, upper ones ending in a tooth, (5–)10–17 mm apart, angle to midrib 60°–65°, small pocket-like domatia present; petiolule 4–6 mm, grooved above, tomentose. *Inflorescences* axillary, 12–16 cm, with long patent branches, laxly flowered: cymules several-flowered. *Bracts* and *bracteoles* 0.6–1.2 × 0.2–0.6 mm, thick, out- and inside appressed-hairy. *Pedicels* 3.5–4.2 mm, articulated at 1/3 above the base. Male flowers: *Sepals* rather thick, outside appressed-hairy, rim ciliate, inside appressed-hairy, the innermost only in the lower part, outer about deltoid, 1.0–1.4 × 1.3–1.4 mm, without scarious rim, inner triangular to obovate, 2.4 × 1.7–1.8 mm, without or with a narrow scarious rim. *Petals* elliptic to obovate, clawed, 1.7–2.3 × 1.1–1.2 mm, outside appressed-hairy at the base, rim ciliate, inside appressed-hairy in lower part, scales 2, not crested, 1.1–1.2 mm, adnate to

the side of the petals, long woolly. *Disc* glabrous. *Stamens* 8, exserted, filaments filiform, 1.8–2.6 mm, patently hairy except base and apex, anthers 1.1–1.3 mm, glabrous. *Pistillode* 3-celled, 1.2 × 1.2 mm, outside hairy. Female flowers: Outer *sepals* 1.1–1.2 × 1.2 mm, inner 1.8 × 1.2 mm. *Petals* 2.2 × 1.1 mm, scales 1.4 mm. *Fruits* 3-celled, globular, 14 × 14 mm, wall 0.7–1.0 mm thick, outside rugose, velutinous, inside sparingly appressed-hairy, septa complete. *Seeds* 10 × 16 mm, testa shiny brown, arilloid covering about 2/3, lacerate, embryo not (yet?) developed.

Distribution — Papua New Guinea (Western Highlands Province).

Field notes — Ecological notes: Alt. 2100–2400 m. Flowering: July, fruiting: July.

Specimens examined:
PAPUA NEW GUINEA. Western Highlands Prov.: *NGF* s.n., Wabag, Porget logging area.

17. Cupaniopsis flagelliformis (Bailey) Radlk. — Fig. 43.

Cupaniopsis flagelliformis (Bailey) Radlk., Fedde Rep. 20 (1924) 31; Domin, Bibl. Bot. 22 (1927) 904; Radlk. in Engl., Pflanzenr. 98 (1933) 1185; Reynolds in Stanley & Ross, Fl. SE Queensl. 1 (1983) 61; Austrobaileya 2 (1984) 50, fig. 4R, S, T; Fl. Austr. 25 (1985) 60, map 76, 77. — *Cupania flagelliformis* Bailey, Dep. Agric. Bot. Bull. 8 (1893) 73; Queensl .Fl. 1 (1899) 291; Compr. Cat. Queensl. Pl. (1913) 113. — *Cupaniopsis flagelliformis* (Bailey) Radlk. var. *flagelliformis;* Reynolds, Austrobaileya 2 (1984) 50; Fl. Austr. 25 (1985) 62, map 76. — Type: *Cowley* s.n., Australia, Queensland, scrub about the Barron River (MEL!, holo, iso in K!, M!).

Cupania curvidentata Bailey, Queensl. Agric. J. 5 (1899) 483; Queensl. Fl. 1 (1899) 292. — *Cupaniopsis curvidentata* (Bailey) Radlk., Fedde Rep. 20 (1924) 31; in Engl., Pflanzenr. 98 (1933) 1185. — Type: *Nugent* s.n., Australia, Queensland, Stoney Creek near Cairns (BRI!, holo).

Cupaniopsis flagelliformis (Bailey) Radlk. var. *australis* Reynolds, Austrobaileya 2 (1984) 51; Fl. Austr. 25 (1985) 62, map 77. — Type: *Bird* s.n., Australia, New South Wales, Wiangaree State Forest, 8.1.1981 (BRI!, holo).

Cupaniopsis serrata (F. Muell.) Radlk. var. *tomentella* auct. non (F. Muell.) Radlk.: C.T. White, Contr. Arn. Arbor. 4 (1933) 61.

Trees, rarely *shrubs*, (2–)3–25 m high, d.b.h. 10–30 cm. *Flowering twigs* terete, 2–4(–5) mm in diameter, grooved, more or less villose, with longer hairs. *Leaves* 4–10-jugate; petiole 2–8(–11) cm, semiterete, usually upwards more or less terete, rachis 6.5–29.5 cm, more or less semiterete or terete, both striate to grooved, ± villose, also with longer hairs. *Leaflets* alternate, rarely subopposite, elliptic to ovate, rarely obovate, slightly asymmetric, upper 6.5–17 × 2–6 cm, index 2.1–3.8, lower 3–10.5 × 2–5 cm, index 1.4–2.3, coriaceous, above and below glabrous to thinly pilose, midrib and (sometimes) nerves more densely so, base cuneate to rounded, apex acute to rounded, sometimes truncate, retuse or mucronate, often acuminate, acumen 1–6(–15) mm, acute to rounded, margin (grossly) or rarely obscurely dentate, midrib above slightly prominent to somewhat sunken, nerves 6–16(–22) per side, most ending in a tooth, 4–17 mm apart, angle to midrib 50°–70°, small pocket-like domatia present; petiolule 1–10(–15) mm, grooved, more or less velutinous. *Inflorescences* axillary, often flagelliform, sometimes pendulous, (6.5–)11–60 cm, laxly flowered, with long or rarely short

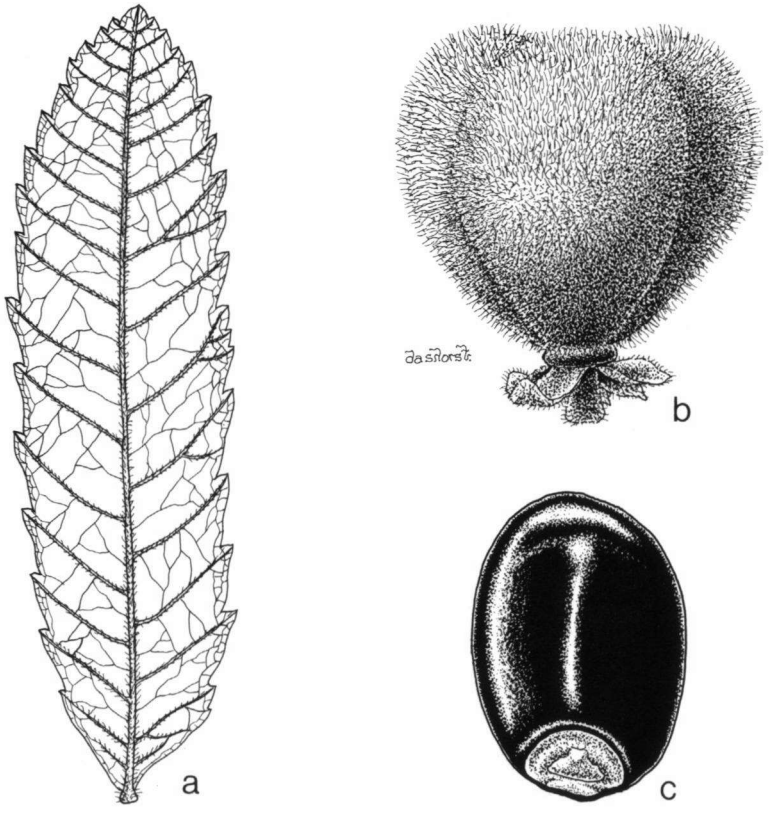

Fig. 43. *Cupaniopsis flagelliformis* (Bailey) Radlk. a. Leaflet, × 0.65; b. fruit, × 3.5; c. seed, arilloid removed, × 3.5 (a–c: *Jessup* 510, BRI).

branches, these sometimes flagelliform, (1–)3.5–52 cm, secondary branches if present 6.5–10 cm long, villose, usually also with longer hairs; cymules dichasial, 1–several-flowered. *Bracts* and *bracteoles* elliptic to orbicular, obovate, or 'squarish', 0.7–4.2 × 0.7–3.3 mm, persistent or not persistent under the fruits, outside appressed-hairy, usually long-ciliate, inside glabrous to appressed-hairy at the base. *Pedicels* ca. 0.2 mm, articulate at the base. *Buds* 3.0–3.7 × 2.6–4.7 mm. Male flowers: *Sepals* broadly elliptic to orbicular, apically irregular dentate, outside appressed-hairy except rim, rim ciliate in lower part, also with some glands, inside with scattered appressed hairs, especially in lower part, outer 2.5–4.6 × 2.4–3.6 mm, scarious rim narrow, inner 4.0–5.2 × 3.6–4.1 mm, scarious rim (very) wide. *Petals* more or less orbicular to 'squarish', 1.1–3.0 × 0.7–2.0 mm, claws 0.2–0.5 mm, outside in lower half more or less appressed-hairy, rim ciliate at least in lower part, inside glabrous or at least in lower part with scattered appressed hairs, scales 2, not crested, 0.4–1.4 mm, ciliate, sometimes petals with auricles instead

of scales. *Disc* with few to many hairs, usually more or less in 5 tufts. *Stamens* 8, not exserted, filaments 1.1–1.9(–2.5) mm, patently hairy except apex, anthers 1.6–2.0 mm, hairy. *Pistillode* 3-celled, outside hairy, 1.0–1.7 × 0.8–1.2 mm. Female flowers: *Sepals* persistent under the fruits, outer more or less elliptic, 2.4–5.2 × 2.6–4.8 mm, inner about orbicular, 4.2–5.8 × 3.2–6.0 mm. *Petals* broadly ovate to rhomboid, 1.7–3.4 × 1.3–2.8 mm, scales 1.2–2.4 mm. Filaments of *staminodes* 1.4–4.2 mm, anthers 1.4–2.2 mm. *Ovary* 3-celled, outside hairy, style 0.8–2.3 mm, stigma 0.8–1.4 mm, 3-lined. *Fruits* 15–20 × 15–17 mm, wall 0.5–1.8 mm thick, outside rugose, villose, inside appressed hairy, septa complete. *Seeds* 11.5–17 × 5.5–10 mm, testa shiny black, arilloid covering 1/2–2/3 of seed, lacerate, cotyledons equal or unequal, obliquely superposed or rarely parallel.

Distribution — Australia (Queensland; NE New South Wales).

Field notes — a. Ecological notes: Rain forest (complex meso- or notophyll vine forest, semideciduous or evergreen notophyll vine forest) on sand or soils derived from basalt, sometimes on the beach. Alt. 10–800 m. Flowering: January, February, August to October, fruiting: November to March (to July).

b. Additional descriptive notes: Bark medium gray to reddish brown, wrinkled, finely and obscurely tessellated, with a faint watermelon smell when cut, inner bark creamy. Leaves light green. Pedicels light pink. Buds pinkish tinged. Calyx red. Petals pink. Anthers cream. Fruit red or brown. Seeds black, arilloid yellow.

c. Vernacular name: Maraguigi (Barron River).

Notes — Specimens from southern Queensland and New South Wales tend to have inflorescences with short branches and without secondary ones. On that basis Reynolds (1984, 1985) recognised a var *australis* apart from the typical variety from northern Queensland. As many of the plants from the latter region show the same traits as the southern ones I find it impossible to retain that variety.

The present species is very close to *C. tomentella*. The latter differs in the number of leaflets that are never acuminate, the length of the branches of the inflorescence, the colour of the flowers: white in *C. tomentella*, pink in *C. flagelliformis*, the much larger fruits with very thick pericarps. Although some of the differences are slight, and there even may be some overlap, I think it is best to retain both taxa as distinct species.

Specimens examined:
AUSTRALIA. Queensland: 32 specimens; NE New South Wales: 12 specimens.

18. Cupaniopsis fleckeri Reynolds — Fig. 40.

Cupaniopsis fleckeri Reynolds, Austrobaileya 2 (1984) 47, fig. 4Q; Fl. Austr. 25 (1985) 59, map 73. — Type: Flecker NQNC 13240, Australia, Queensland, Cook District, Coen, Mt. White, 19.7.1949 (BRI!, holo).

Small *trees* (2–)5–10(–25) m high, d.b.h. 2–50 cm. *Flowering twigs* terete, 1–3 cm in diameter, striate, rarely grooved, strigose, glabrescent, hairs with reddish bases or sometimes totally red. *Leaves* (2–)4–6-jugate; petiole 1–8.5 cm, semiterete or upwards rarely more or less terete, rachis 3–21.5 cm, semiterete or rarely ±

terete, usually bisulcate above, both striate, thinly strigose, glabrescent. *Leaflets* alternate to opposite, obovate, sometimes elliptic, slightly asymmetric, upper 3.5–10(–13.5) × 1.5–3.5(–6) cm, index 1.9–3.5, lower 2–4(–10) × 1.5–5 cm, index 1.3–2.3, (thinly) coriaceous, above glabrous, below glabrous, or with few, widely spaced, short appressed hairs, midrib with few appressed hairs, base cuneate, apex obtuse to rounded, retuse, rarely short and broadly acuminate, acumen 4–6 mm, rounded, margin entire, midrib above slightly prominent, nerves 4–11 per side, 3–10(–20) mm apart, angle to midrib (45°–)60°–70°, 0–6 small, pocket-like or dome-shaped to pustulate domatia present; petiolule 0–3(–10) mm, grooved above, thinly strigose. *Inflorescences* axillary, 4–20 cm, laxly flowered, with long or short branches, strigose; cymules dichasial, 1–several-flowered. *Bracts* and *bracteoles* ovate to deltoid, 0.5–2.8 × 0.4–1.8 mm, outside shortly appressed-hairy, inside glabrous. *Pedicels* 2.9 mm, articulated at the base. *Buds* globular, 2.8–3.2 × 3.5–3.6 mm. Male flowers: *Sepals* outside thinly shortly appressed-hairy except rim, rim ciliolate at the base, inside glabrous, outer about elliptic, 2.4–2.6 × 1.7–1.8 mm, scarious rim narrow to rather wide, inner orbicular, 3.5 × 3.5 mm, scarious rim wide. *Petals* more or less ovate, 1.3–1.8 × 1.0–2.3 mm, outside appressed-hairy in lower part, inside glabrous, scales 2, not crested, 0.8–1.2 mm, ciliate. *Disc* glabrous. *Stamens* 8, not exserted, filaments 1.1–1.3 mm, patently hairy in lower part, anthers 1.4–1.9 mm, glabrous, rarely hairy. *Pistillode* 3-celled, outside hairy, 0.7 × 0.8 mm. Female flowers: *Sepals* orbicular, outer 3.2–3.6 × 2.9–3.6 mm, inner 3.7–4.8 × 3.8–4.8 mm. *Petals* broadly ovate to almost orbicular, 2.4–2.5 × 1.7–2.0 mm, scales 1.7–1.8 mm. *Disc* glabrous to shortly appressed-hairy. Filaments of *staminodes* 1.6–1.9 mm, anthers 1.7–2.0 mm, glabrous or hairy. *Ovary* 3-celled, outside hairy, style 1.1–1.6 mm, stigma 1.1–1.6 mm, 3-lined.

Distribution — Australia (NE Queensland).

Field notes — a. Ecological notes: Rain forest on sand, sandstone or laterite. Alt. 5–400 m. Flowering: July to August (to November).

b. Additional descriptive notes: Flowers fragrant. Sepals green. Petals white.

Notes — The present species resembles *C. foveolata* in the presence of domatia. The latter has usually more, thicker, dentate leaflets. Because of the entire leaflets *C. fleckeri* seems close to *C. anacardioides* which has thicker leaflets without domatia.

See also the notes under *C. dallachyi*.

Most specimens of the present species show small differences between each other. *Dockrill* 872, *Flecker* NQNC 13240, *Hyland* 10721, *Smyth* s.n. (BRI 343261/256857) have pustulate domatia, *Gray* 4668 pustulate to dome-shaped domatia, *Webb & Tracey* 13793 dome-shaped domatia, *Buckley* 6653 dome-shaped to pocket-like domatia, and *Hyland* 10735 and *Tracey* 14480 pocket-like domatia. *Dockrill* 872 and *Webb & Tracey* 13793 have larger leaflets than the seven other specimens.

Specimens examined:
AUSTRALIA. NE Queensland: 9 specimens.

19. Cupaniopsis foveolata (F. Muell.) Radlk. — Fig. 44.

Cupaniopsis foveolata (F. Muell.) Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München. 9 (1879) 530; Maiden & Betche, Proc. Linn. Soc. N.S.W. 31 (1906) 732; Domin, Bibl. Bot. 22 (1927) 904; Radlk. in Engl., Pflanzenr. 98 (1933) 1186; Francis, Austr. Rain-For. Trees, ed. 2 (1951) 252; Reynolds in Stanley & Ross, Fl. SE Queensl. 1 (1983) 513; Austrobaileya 2 (1984) 47, fig. 4E; Fl. Austr. 25 (1985) 58, map 69 (all references pp, excluding the specimens from southeastern Queensland and New South Wales). — *Cupania foveolata* F. Muell., Fragm. 9 (1875) 95; Bailey, Queensl. Fl. 1 (1899) 292 (excluding Carron s.n. from New South Wales). — Lectotype (present author): *Dallachy* s.n., Australia, Queensland, Rockingham Bay [MEL!, holo (MEL 108619), iso in M!, NSW!, in both only fragments]. Paratype: *Hill* s.n. (n.v.).

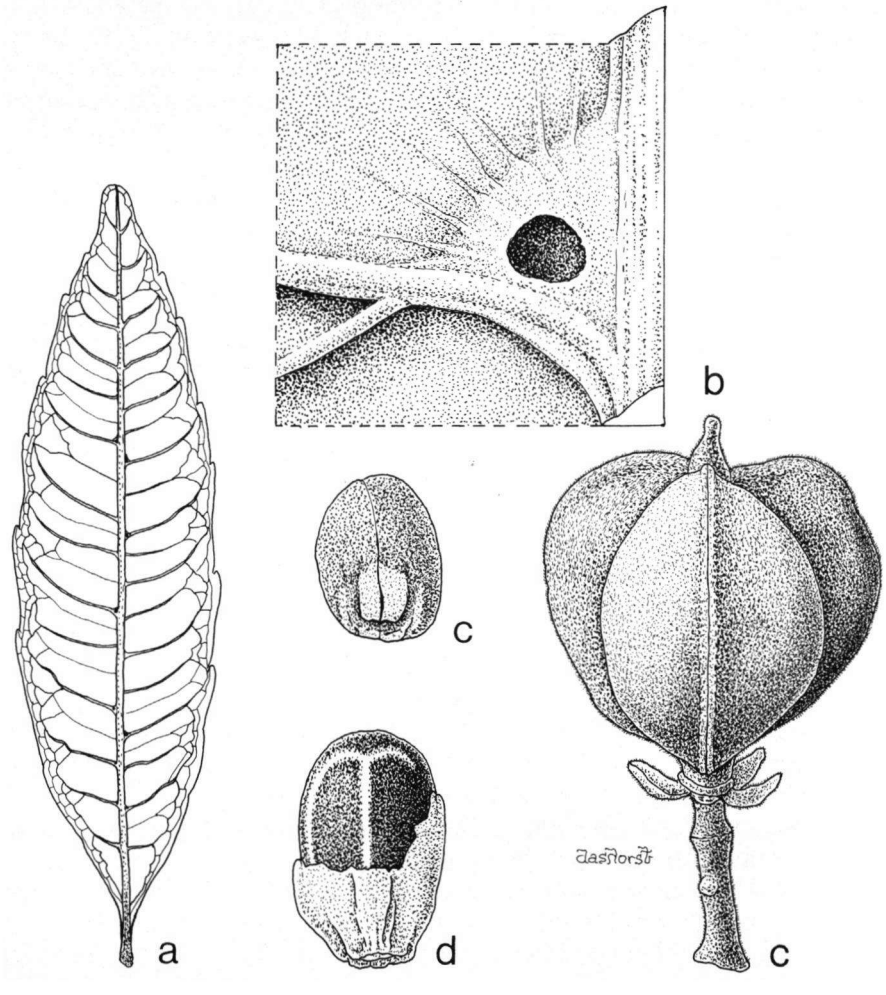

Fig. 44. *Cupaniopsis foveolata* (F. Muell.) Radlk. a. Leaflet, × 1; b. idem, detail, × 35; c. fruit, × 3.5; d. seed, × 3.5; e. embryo, × 3.5 (a, b: *Clemens* s.n., BRI; c–e: *Webb & Tracey* 5721, L).

Trees or *treelets* 12–25 m high, d.b.h. 30–45 cm. *Flowering twigs* terete, 2–3 mm in diameter, striate, strigose. *Leaves* (5–)6–8(–15)-jugate; petiole 2.5–5.5 cm, rachis 6.5–11.5 cm, usually bisulcate, both semiterete, striate, glabrous to strigose. *Leaflets* alternate, (sub)opposite, narrowly ovate to narrowly elliptic, slightly asymmetric, upper 6.5–14.5 × 1.5–3.5 cm, index 3.3–5.3, lower 4–9.5 × 1–3 cm, index 2.3–4.4, coriaceous, above glabrous, below almost glabrous, midrib with very few short appressed hairs, domatia with some hairs, base cuneate to broadly cuneate, apex acuminate, rarely obtuse or rounded, acumen (2–)6–13 mm, rounded, rarely retuse, margin dentate at least upwards (in juvenile leaves more or less lobed), midrib above slightly prominent, nerves 7–16 per side, most ending in a sinus between the teeth, 4–14 mm apart, angle to midrib 65°–70°, few to many dome-shaped to pocket-like domatia with wide openings present; petiolule 0–5(–10) mm, grooved, glabrous to thinly strigose. *Inflorescences* axillary, 4.5–18 cm, laxly flowered, with long branches, strigose; cymules dichasial, 1–several-flowered. *Bracts* and *bracteoles* ovate to semicircular, 0.4–0.6 × 0.2–1.0 mm, not persistent under the fruits, outside shortly appressed-hairy, ciliolate, inside glabrous. *Pedicels* 1.3–3.0 mm, articulated up to 1/4 above the base. Male flowers: *Sepals* outside shortly appressed-hairy except rim, rim ciliolate and with glands, inside shortly appressed-hairy in lower part, outer elliptic to more or less orbicular, 2.3–3.1 × 1.8–2.2 mm, scarious rim narrow to rather wide, inner orbicular, 3.0–3.6 × 2.6–3.6 mm, scarious rim wide. *Petals* elliptic to almost orbicular, 1.2–1.7 × 0.8–1.6 mm, out- and inside shortly appressed-hairy in lower part, rim ciliolate in lower part, scales 2, not crested, 0.6–1.1 mm, ciliate. *Disc* short hairy. *Stamens* 8, not exserted, filaments 0.7–1.6 mm, patently hairy in lower 1/2–2/3, anthers 1.4–1.6 mm, with few hairs, rarely glabrous. *Pistillode* 3-celled, outside hairy, 1.2–1.8 × 0.6–1.2 mm. Female flowers: *Sepals* persistent under the fruits, outer 2.4–3.4 × 1.8–2.8 mm, inner 3.6–4.2 × 3.0–3.8 mm. *Petals* 1.0–1.7 × 0.7–1.0 mm. Filaments of *staminodes* 1.2–1.4 mm, anthers 1.3–1.4 mm. *Ovary* 3-celled, outside short and longer hairy, style 1.0–1.7 mm, stigma 1.0–1.4 mm, 3-lined. *Fruits* 15 × 13–14 mm, 3-ribbed when young, stipe 1–2 mm, wall 0.5–0.8 mm thick, outside rugose, strigose, inside villose, septa complete. *Seeds* 8–8.5 × 6.5–7 mm, testa brown, arilloid covering 2/3 of the seed, more or less lacerate, cotyledons about equal, parallel.

Distribution — Australia (Queensland).

Field notes — a. Ecological notes: Simple, mixed or complex meso- to notophyll vine forest on soils derived from granite or mesomorphics. Alt. 200–760 m. Flowering: September; fruiting: January.

b. Additional descriptive notes: Underbark pink, outer blaze pink, granular, inner blaze pink, fibrous. Fruits orange yellow.

Notes — *Cupania foveolata* was described by Mueller on specimens collected by Carron, Dallachy and Hill. The material of Carron belongs to *C. baileyana*. Of the other specimens only Dallachy material was seen by Radlkofer. Therefore this material was examined in order to choose a lectotype. The Dallachy collection consist of flowering and fruiting material gathered at different times, at least in part from the same tree. The fruiting specimen MEL 108619 is a good example of

the species as described by Mueller and has been chosen as the lectotype; fragments of this specimen can be found in M and NSW.

See also the note under *C. baileyana.*

Specimens examined:
AUSTRALIA. Queensland: 16 specimens.

20. Cupaniopsis fruticosa Radlk. — Fig. 45.

Cupaniopsis fruticosa Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. Münch. 9 (1879) 588; Guillaumin, Bull. Mus. Nat. Hist. Nat. 17 (1911) 356; Bull. Soc. Bot. Fr. 79 (1932) 335; Radlk. in Engl., Pflanzenr. 98 (1933) 1203; Däniker, Mitt. Bot. Mus. Univ. Zürich 142 (1933) 246; Guillaumin, Fl. Nouv.-Caléd. (1948) 200. — Lectotype (present author): *Pancher* 142, New Caledonia (M!, holo, iso? in MEL!, P!). Paratypes: *Baudouin* 142 (P!), *Pancher* 162 (P!).

Cupaniopsis dictyophora Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. Münch. 9 (1879) 589; Guillaumin, Bull. Soc. Bot. Fr. 79 (1932) 340; Radlk. in Engl., Pflanzenr. 98 (1933) 1204; Guillaumin, Fl. Nouv.-Caléd. (1948) 200. — Type: *Balansa* 1449, New Caledonia, Mt. Mi, 25.3.1869 (P!, holo).

Cupaniopsis subcuneata Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. Münch. 9 (1879) 589; Guillaumin, Bull. Soc. Bot. Fr. 79 (1932) 340; Radlk. in Engl., Pflanzenr. 98 (1933) 1203; Guillaumin, Fl. Nouv.-Caléd. (1948) 200. — Type: *Balansa* 2267, New Caledonia, Baie Duperré, rade de Canala, 6.1869 (P!, holo).

Cupaniopsis sebertii Guillaumin, Bull. Soc. Bot. Fr. 79 (1932) 339; Radlk. in Engl., Pflanzenr. 98 (1933) 1207; Guillaumin, Fl. Nouv.-Caléd. (1948) 199. — Lectotype (present author): *Sebert & Fournier* 69, New Caledonia (P!, holo).

Cupania glauca auct. non Camb.: F. Muell., Fragm. 9 (1875) 93.

Treelets 2–7 m high, d.b.h. 10 cm, very young parts usually 'varnished'. *Flowering twigs* terete, 1–3 mm in diameter, usually striate, pruinose, with scale, sometimes also with short patent hairs. *Leaves* (2–)3–6(–7)-jugate; petiole 2–9 cm, semiterete, rarely upwards terete, rachis 1.5–15.5 cm, semiterete, rarely more or less terete, both grooved above, striate, pruinose, with scale, above with short hairs. *Leaflets* opposite to alternate, elliptic to narrowly ovate, asymmetric, upper 3–11(–13.5) × 0.5–4.5 cm, index 2–4.9, lower 2–10 × 0.5–4 cm, index 2–4.8, chartaceous-coriaceous, above and below glabrous or with scattered scale hairs, midrib and margin usually with short hairs in lower part, usually pruinose, base cuneate to rounded, sometimes more or less tapering into petiolule, apex acute, obtuse or rounded, sometimes shortly and broadly acuminate, acumen 2–9 mm, rounded, margin entire, exceptionally apically with few teeth, midrib above slightly prominent, nerves 6–9(–12) per side, 3–15 mm apart, angle to midrib 50°–70°(–80°), small pocket-like domatia sometimes present (*Franc* 1584A, *MacKee* 20251, *McPherson* 4815, *Vieillard* 2409); petiolule 0–6(–10) mm, grooved above, pruinose, with scale hairs, above with short hairs. *Inflorescences* axillary or pseudoterminal, 2.5–16.5(–27) cm, laxly flowered, with long or rarely short branches, with scale, sometimes also with short patent hairs; cymules dichasial, 1–several-flowered. *Bracts* and *bracteoles* lanceolate to ovate or triangular, 0.2–0.8 × 0.1–0.5 mm, not persistent under the fruits, outside with scale hairs, inside glabrous or with some

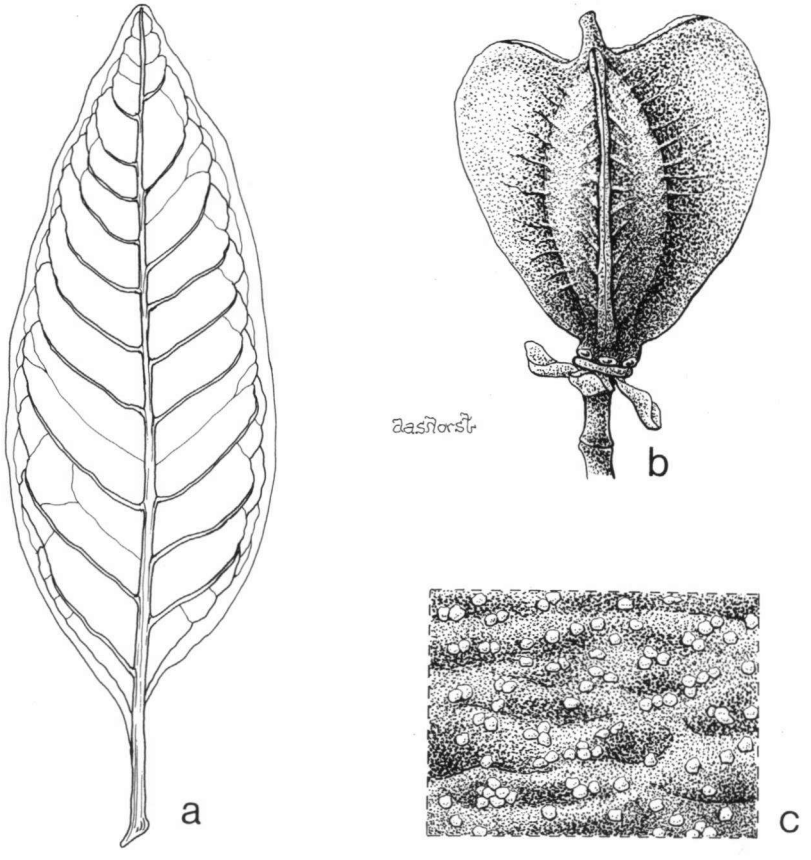

Fig. 45. *Cupaniopsis fruticosa* Radlk. a. Leaflet, × 2; b. fruit, × 2; c. idem, detail, × (50) (a–c: *McPherson* 4815, L).

scale hairs. *Pedicels* 1.8–2.4 mm, articulated at base to halfway. *Buds* 1.7–2.4 × 1.8–3.0 mm. Male flowers: *Sepals* outside with scale hairs, rim ciliolate in lower part and with few glands, inside glabrous or with few scale hairs, outer elliptic to orbicular, 1.2–2.2 × 1.0–2.3 mm, scarious rim rather wide, inner obovate to orbicular, 2.2–3.2 × 1.6–3.0 mm, scarious rim very wide. *Petals* elliptic to orbicular, rounded to emarginate, 1.2–2.6 × 1.0–1.7 mm, outside glabrous, rim ciliolate in basal part, inside glabrous or with some hairs in lower part, scales 2, not crested, 0.7–1.3 mm, short or long hairy. *Disc* glabrous or with few scale hairs. *Stamens* 8, exserted, filaments 1.9–3.2 mm, patently hairy in lower part, anthers (0.8–)1.0–1.2 mm, glabrous. *Pistillode* 3-celled, 0.5–1.0 × 0.4–0.7 mm, outside glabrous or with scale hairs. Female flowers: *Sepals* persistent under the fruits, outer 1.3–2.4 × 0.8–1.8 mm, inner 2.3–3.4 × 1.8–2.4 mm. *Petals* 2.0–2.5 × 1.1–2.3 mm, scales 0.8–1.6 mm. Filaments of *staminodes* 1.1–1.4 mm, anthers 0.8–

1.2 mm. *Ovary* 3-celled, outside with scales, style 1.0–1.7 mm, stigma 0.6–0.8 mm, 3-lined, exceptionally slightly 3-lobed (*Franc* 1584A). *Fruits* obcordate, 3-lobed at apex, usualy only 2 cells, rarely only 1 or all 3 cells developed, 15–21 × 15–20 mm, stipe 1–3 mm, wall 0.3–0.6 mm thick, outside smooth, with scale hairs, inside with long stiff hairs except apex, later on only near the seed attachment, septa complete. *Seeds* obovoid, rarely lenticular (young?, *Balansa* 2267), 8 × 6 mm, testa shiny black, arilloid covering almost the whole seed, cotyledons thick, equal or unequal, superposed.

Distribution — SW New Caledonia.

Field notes — a. Ecological notes: Humid forests in the mountains, usually on serpentine, sometimes on schists or laterites. Alt. 5–300(–900) m. Flowering: (November to) February to March (to May), fruiting: (February to) June to August (to October).

b. Additional descriptive notes: Bark brown or gray, almost smooth. Wood reddish. Leaflets shiny dark green above, often lighter green below. Flowers white. Fruits green or yellow.

Notes — *Franc* 1584A has ovaries with 3-lined and slightly 3-lobed stigmas. In one flower of this specimen a transition between sepals and petals could be observed as one sepal had at one side a small scale and on the other side a small auricle.

Morat 8018, New Caledonia,'exploitation forestière Guirard, piste en direction de Me Adeo, en lisière forestière sur peridotite', 23.3.1988, probably belongs here. This specimen differs from the present species in several characters: nerves at 45° to midrib, pedicels 4.2–5.0 mm, flowers larger in most parts. Another possibility could be *C. tontoutensis* from which *Morat* 8018 differs in number of leaflets, length of pedicels and size of the flowerparts.

Specimens examined:
NEW CALEDONIA. 33 specimens.

21. Cupaniopsis glabra Adema, *spec. nov.* — Fig. 41.

Arbuscula 1 m alta, partibus juvenilibus lepidotis obsita. Folia 1–4-jugata; foliolis ovatis, glabris, obtusis, integerrimis vel sparse dentatis apicem versus. Petala squamis duabus ecristatis. Discus glaber. Stamina 6–8. Pistillodium biloculare. — Typus: *MacKee* 40234, New Caledonia, Basse Tontouta, rive gauche, terrain serpentineux, alt. 50 m, 10.2.1962 (L!, holo, iso in P!).

Treelet 1 m high, young parts and inflorescences, varnished. *Flowering twigs* terete, 1.5–2.0 mm in diameter, striate, with scale hairs. *Leaves* 2–4-jugate; petiole 1.1–1.8 cm, rachis 1.5–3.2 cm, both semiterete, striate, grooved (to bisulcate) above, glabrous. *Leaflets* subopposite to alternate, (narrowly) ovate, symmetric, upper 3–4 × 0.5–2 cm, index 2.2–4.1, lower 2–3 × 0.5–1.5 cm, index 2.1–4.3, chartaceous, above and below glabrous, base rounded, apex obtuse, margin entire or apically with a few obtuse teeth, midrib above slightly prominent, nerves 6–8 per side, 2–7 mm apart, angle to midrib ca. 60°; petiolule 1–2 mm, grooved above, glabrous. *Inflorescences* axillary, 3.5–8.0 cm, with short branches, laxly flowered, with scale hairs; cymules 1–3-flowered, dichasial *Bracts* and *bracteoles*

lanceolate to ovate, 0.2–0.6 × 0.1–0.3 mm, out- and inside with some scale hairs. *Pedicels* 3.0–6.0 mm, articulate at the base to halfway. Male flowers: *Sepals* almost orbicular, outside glabrous or at least the outer ones with scale hairs, rim with short glands, inside glabrous, outer 1.2–1.6 × 1.4–1.6 mm, scarious rim narrow, inner 2.2–2.3 × 2.2–2.3 mm, almost totally petaloid. *Petals* about orbicular, 1.4–2.2 × 1.2–1.9 mm, outside glabrous or with few appressed hairs, rim ciliate in lower part, inside hairy in lower part, scales 2, not crested, 1.0–1.4 mm, ciliate. *Disc* glabrous. *Stamens* 6–8, exserted, filaments 1.2–1.7 mm, patently hairy except apex, anthers 0.7–0.8 mm, glabrous. *Pistillode* 2-celled, outside glabrous, 0.4–0.5 × 0.3–0.4 mm.

Distribution — New Caledonia (Tontouta River).

Field notes — a. Ecological notes: High maquis, on serpentine or peridotite. Alt. 50 m. Flowering: February.

b. Additional descriptive notes: Leaves shining dark green on both sides. Branches of the inflorescences reddish, viscose. Petals white. Anthers pale yellow.

Notes — Quite different from all other species with scale hairs. These never have a 2-celled pistillode!

Specimens examined:
NEW CALEDONIA. Tontouta River: *MacKee* 40234; *Suprin* 1648.

22. **Cupaniopsis globosa** Adema, *spec. nov.* — **Fig. 46.**

Arbuscula, partibus juvenilibus lepidotis pilis brevis patentiter obsita. Folia 1–3-jugata; foliolis integerrimis ellipticis. Discus glaber. Stamina 8 exserta, filamentis pubescentibus, antheris pilosus. Fructus globosus. Semina arilloidiis ad dimidia obtegentia. — Typus: *Suprin* 2080, New Caledonia, Bourail, Les Montagnes Blanches, 12.10.1982 (P!, holo, iso in L!).

Treelets 10–11 m high. *Flowering twigs* terete, 1.5–2.5 mm in diameter, striate, with minute scale hairs, also shortly patently hairy. *Leaves* 1–3(–4)-jugate; petiole 1–4 cm, rachis 1.5–6 cm, semiterete, striate, shortly patently hairy, especially above, sometimes with some scattered scale hairs. *Leaflets* opposite to alternate, elliptic, slightly asymmetric, upper 3.5–7.5 × 1.5–3.5 cm, index 1.7–2.4, lower 2.5–6 × 1.5–3, index 1.6–2.7, chartaceous to coriaceous, above with short patent hairs at the base, sometimes also with scattered scale hairs, below glabrous, base (broadly) cuneate, apex rounded, margin entire, midrib above not or slightly prominent, nerves 6–9 per side, 4–17 mm apart, angle to midrib 45°(–50°); petiolule 1–4 mm, grooved above, short, patently hairy on upperside. *Inflorescences* axillary, 3–8 cm, laxly flowered, without or with short, rarely long branches, shortly patently hairy; cymules dichasial, 1–several-flowered. *Bracts* and *bracteoles* lanceolate to more or less semicircular, 0.5–1.1 × 0.5–0.6 mm, not persistent under the fruits, outside with some short hairs and few glands, especially near the apex, margin short ciliate with glands, inside glabrous. *Pedicels* 1.8–5.4 mm, articulated at the base to halfway. *Buds* 3.0 × 2.6 mm. Male flowers: *Sepals* more or less orbicular, almost totally petaloid, outside glabrous, rim ciliate and with glands, inside appressed-hairy in lower part, outer 2.5–3.0 × 2.5–3.0 mm, inner 3.7 × 3.7 mm. *Petals* (broadly) elliptic, 3.2–3.4 × 2.3–2.8 mm, outside glabrous,

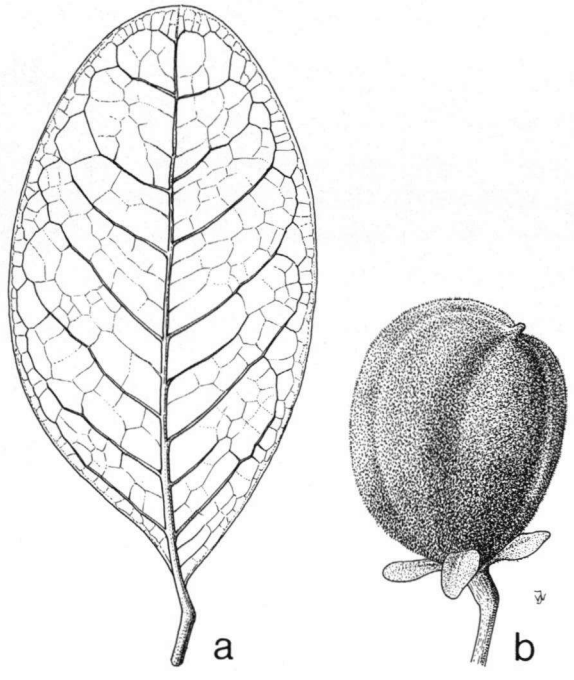

Fig. 46. *Cupaniopsis globosa* Adema. a. Leaflet, × 1; b. fruit, × 2 (a: *Suprin* 2080, L; b: *Veillon* 6551, L).

rim ciliate, inside thinly appressed-hairy in lower part, scales 2, not crested, 1.2–1.3 mm, woolly. *Disc* glabrous. *Stamens* 8, exserted, filaments 2.5–2.8 mm, patently hairy except apex, anthers 1.2–1.3 mm, hairy. *Pistillode* 3-celled, outside appressed-hairy, 1.4 × 1.1 mm. Female flowers incompletely known. *Sepals* not persistent under the fruits, outer 2.8 × 2.5 mm, inner 4.0 × 3.5 mm. *Ovary* 3-celled, outside more or less tomentose, style 1.1 mm, stigma 0.7 mm, 3-lined. *Fruits* about globular, 9–17 × 7–13 mm, wall 1.0–1.8 mm thick, outside smooth, thinly shortly appressed-hairy, inside glabrous, septa complete. *Seeds* more or less ellipsoid, 6–9 × 4–6 mm, testa shiny black, arilloid covering about half of the seed, long lacerate, cotyledons unequal, superposed.

Distribution — New Caledonia.

Field notes — Ecological notes: Low sclerophyll forest on calcareous soils. Alt. 70–100 m. Flowering: October, fruiting: October to November.

Notes — Resembling *C. fruticosa*, *C. myrmoctona*, and *C. pennelii*, but different in the size of the flowerparts, the indumentum of most parts and the size and form of the fruits, which are thick-walled.

Specimens examined:
New Caledonia. *Hoff* 943; *Jaffré* 2901; *Suprin* 2080; *Veillon* 6551, 6606.

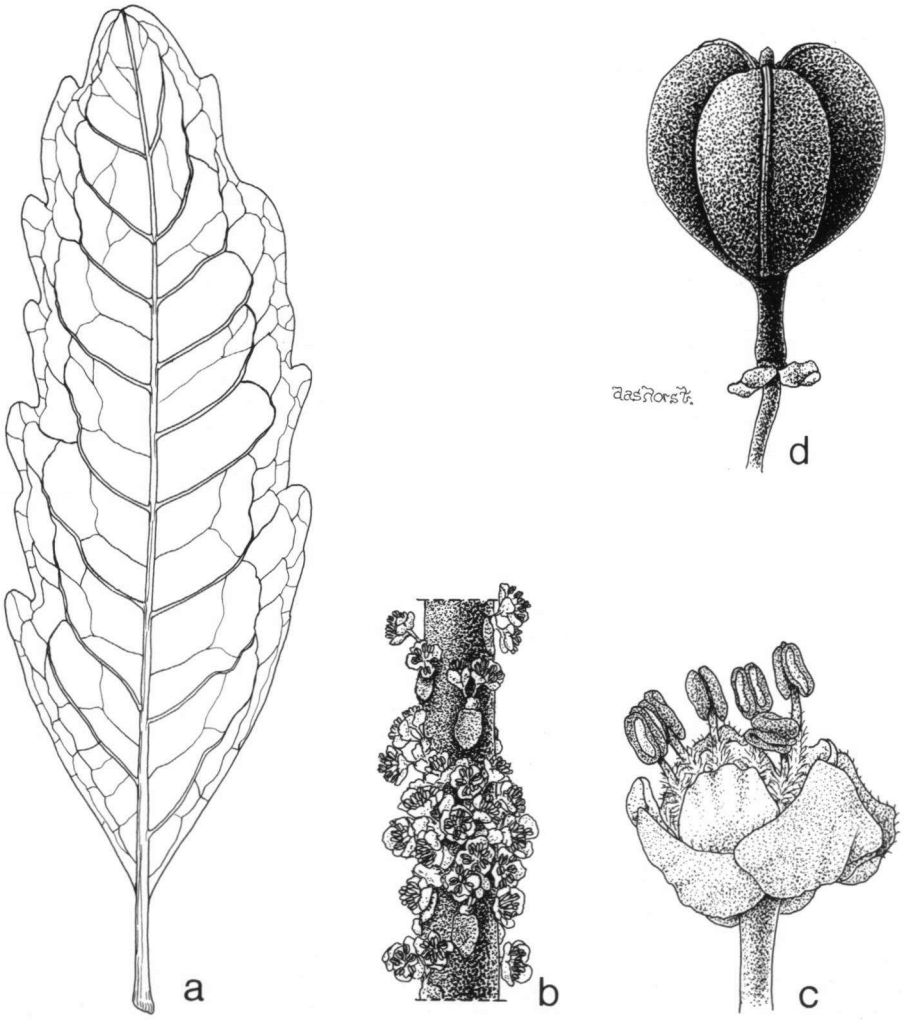

Fig. 47. *Cupaniopsis glomeriflora* Radlk. a. Leaflet, × 1.5; b. inflorescence, × 0.75; c. flower, × 20; d. fruit, × 3.5 (a, b: *Compton* 139, P; c: *McPherson* 2094, L; d: *Virot* 913, A).

23. Cupaniopsis glomeriflora Radlk. — Fig. 47.

Cupaniopsis glomeriflora Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. Münch. 9 (1879) 589; Guillaumin, Bull. Soc. Bot. Fr. 79 (1932) 340; Radlk., in Engl. Pflanzenr. 98 (1933) 1204; Däniker, Mitt. Bot. Mus. Univ. Zürich 142 (1933) 247; Guillaumin, Fl. Nouv.-Calléd. (1948) 200. — Lectotype (present author): *Balansa* 1447, New Caledonia, Bourail, dans les bois, 3.1869 (P!, holo, iso in P!). Paratypes: *Balansa* 153pp (P!), *Baudouin* 354pp (P!), *Deplanche* 83 (P!), *Labillardière* 169 (n.v.), *Pancher* 782 (P!), *Vieillard* 228 (P!), 233 (P!).

Slender, sometimes palmoid, not or little branched *trees* or *shrubs*, 1–5 m high. *Flowering twigs* terete, 1–3(–4) mm in diameter, striate, glabrous or with scale hairs, often also short patent hairs. *Leaves* 3–6(–9)-jugate; petiole 1.5–11 cm, semiterete, usually upwards terete, rachis 2.5–14.5(–21.5) cm, usually semiterete, rarely terete, both (usually) grooved above, glabrous or with scale hairs and short hairs. *Leaflets* opposite to alternate, (narrowly) elliptic to (narrowly) ovate, (slightly) asymmetric, upper 2.5–12(–17) × 0.5–5 cm, index (1.6–)2–4.9, lower 1.5–7.5 × 0.5–4.5 cm, index 1.6–3.7, coriaceous, above and below glabrous, midrib sometimes with short hairs, base cuneate to rounded, apex retuse or obtuse to rounded, margin entire or, usually, lobed at least in upper part, midrib above slightly prominent, nerves 4–10(–13) per side, usually some of the upper ones ending in a tooth, 4–16(–22) mm apart, angle to midrib 45°–60°; petiolule 1–17 mm, grooved above, glabrous or with scale hairs and short hairs. *Inflorescences* ramiflorous, rarely axillary, 3–30(–50) mm, laxly to densely flowered, clustered, small wartlike brachyblasts usually present, without or rarely with short branches, with scale hairs; cymules 1-flowered. *Bracts* and *bracteoles* subulate to deltoid, 0.2–0.7 × 0.1–0.4 mm, not persistent under the fruits, outside with scale hairs, inside glabrous. *Pedicels* 1.8–4.8 mm, articulated at the base to halfway. *Buds* flattened globular, 0.8–1.3 × 1.0–1.7 mm. Male flowers: *Sepals* (3–)4(–5), orbicular, irregular dentate, almost totally petaloid, out- and inside glabrous or with scale hairs, rim ciliolate and with glands, outer 0.7–2.4 × 0.7–2.5 mm, inner 1.3–3.0 × 1.1–2.8 mm. *Petals* (3–)4(–5), ovate to reniform or rhomboid, irregular dentate, 1.0–3.1 × 0.5–2.2 mm, outside glabrous, rim ciliolate and with glands, in lower part long-ciliate, inside glabrous or with some appressed hairs (*Vieillard* 2402bis), scales 2, usually not crested, exceptionally crested, 0.6–2.6 mm, woolly. *Disc* glabrous. *Stamens* (5–)6(–8), exserted, filaments 1.1–4.6 mm, patently hairy in lower part to almost totally, anthers 0.5–1.0 mm, glabrous. *Pistillode* 3-celled, outside glabrous or with scales, 0.2–0.8 × 0.2–0.6 mm. Female flowers: *Sepals* not persistent under the fruits, outer 1.1–1.9 × 1.1–1.8 mm, inner 1.2–2.9 × 1.4–2.3 mm. *Petals* 1.0–2.4 × 0.7–1.9 mm, scales 0.4–1.4 mm. Filaments of *staminodes* 0.6–1.2(–1.9) mm, anthers 0.5–0.7 mm. *Ovary* 3-celled, outside glabrous or with some hairs, style (0.6–)1.1–1.7 mm, stigma 0.6–1.4 mm, 3-lined. *Fruits* obovoid or almost globular, rounded triangular in cross section, 7–17 × 7–11.5 mm, stipe 1.8–3.4 mm, wall 0.5 mm thick, outside smooth, glabrous, inside glabrous, septa complete. *Seeds* ellipsoid to obovoid, 6.5–7.5 × 4–5.5 mm, testa blackish, arilloid covering the whole seed, lacerate, shortly enlarged past hilum, cotyledons equal or unequal, superposed.

Distribution — New Caledonia (also on Pine Isl.), Loyalty Isl. (Lifu, Maré).

Field notes — a. Ecological notes: Maquis, dry to humid forests, or forest remnants, along the coast, on hill- or mountainsides, often along rivers, on calcareous soils, serpentine and schists. Alt. 10–500 m. Flowering: January to May, August to November, fruiting: December to April, August to October.

b. Additional descriptive notes: Leaflets shiny dark green on both sides, rarely light green. Sepals white or greenish white. Petals white. Filaments white, anthers yellow. Fruits green or orange. Seeds black, arilloid orange-yellow to orange.

Notes — Rather variable in size, form, and indentation of the leaflets. *Virot* 797 and *Mackee* 2004 are much more densely covered with short patent hairs than the other specimens. The stigma of *Bergeret* 56 is sessile. *Vieillard* 2402bis has some appressed hairs on the inside of the petals. *Mackee* 12538 differs in several aspects: 9-jugate leaves, very long rachises, long inflorescences and large female flowers. The male flowers of *Mackee* 23618 are the largest of the species. One damaged leaflet of *Däniker* 3509 measures more than 18.5 × 5 cm.

Specimens examined:
NEW CALEDONIA. 52 specimens; Loyalty Islands: 8 specimens.

24. Cupaniopsis grandiflora Adema — Fig. 48.

Cupaniopsis grandiflora Adema, Adansonia 10 (1988) 263. — Type: *McPherson* 3805, New Caledonia, Mont Do, alt. 950 m, 6.6.1981 (MO!, holo, iso in NOU!).

Treelets 2–3 m high, very young parts 'varnished'. *Flowering twigs* terete, 1.5–5 mm in diameter, smooth, with minute scale and short patent hairs, soon glabrous. *Leaves* 3–9-jugate; petiole 4.5–16.5 cm, more or less terete, semiterete in lower or upper part, glabrous or with scattered scale, sometimes also with short patent hairs; rachis 6–28 cm, more or less terete or semiterete, glabrous or with short, patent hairs at the attachment of the petiolules, rarely also with scattered scale hairs. *Leaflets* opposite to alternate, (narrowly) ovate, (slightly) asymmetric, upper 8.5–17 × 1.5–5.5 cm, index 3.1–5.6, lower 4.5–14 × 1.5–5 cm, index 2.3–4.2, coriaceous, above and below glabrous, rarely with few scattered scale hairs, base cuneate to rounded, apex obtuse to rounded or acuminate, acumen (2–)5–12 mm, rounded, margin obscurely to grossly dentate in apical part, rarely entire, midrib above slightly prominent, nerves (5–)7–12(–15) per side, several of the upper ones ending in a tooth, (3–)10–22 mm apart, angle to midrib 45°–55°; petiolule 1–10(–19) mm, grooved above, glabrous or with short patent hairs at the pulvinus, sometimes with scattered scale hairs. *Inflorescences* ramiflorous, 2–16 cm, laxly flowered, without or with short to long branches, with scattered scale hairs; cymules 1-flowered *Bracts* and *bracteoles* lanceolate to deltoid, 0.4–0.7 × 0.2–0.5 mm, not persistent under the fruits, outside with scales and short hairs, inside glabrous. *Pedicels* 7–10 mm, articulated at 1/2–3/4 above the base. *Buds* globular, 2.8–4.6 × 2.8–4.2 mm. Male flowers: *Sepals* broad-ovate to orbicular, out- and inside glabrous, rim ciliolate, also with glands, outer 1.0–3.2 × 1.4–2.5 mm, scarious rim rather wide, inner 4.0–4.8 × 3.1–5.3 mm, scarious rim very wide. *Petals* more or less orbicular, irregularly dentate, 4.0–6.7 × 4.0–6.5 mm, out- and inside glabrous, rim ciliolate at base, scales 2, often 2-lobed at apex, with or without crests, 2.4–4.2 mm, ciliate. *Disc* glabrous. *Stamens* 8 (9), exserted, filaments 3.2–5.2 mm, patently hairy in middle part, anthers 1.2–1.6 mm, glabrous. *Pistillode* 3-celled, 0.5–2.4 × 0.5–1.1 mm, outside with some hairs in upper part. Female flowers: *Sepals* persistent or not under the fruits, outer 2.4–2.6 × 1.9–2.0 mm, inner 5.4 × 4.1 mm. *Petals* 5.9–6.2 × 4.6–5.8 mm, scales 3.2–3.6 mm. Filaments of *staminodes* 2.2–2.4 mm, anthers 1.6–1.8 mm, with few hairs. *Ovary* 3-

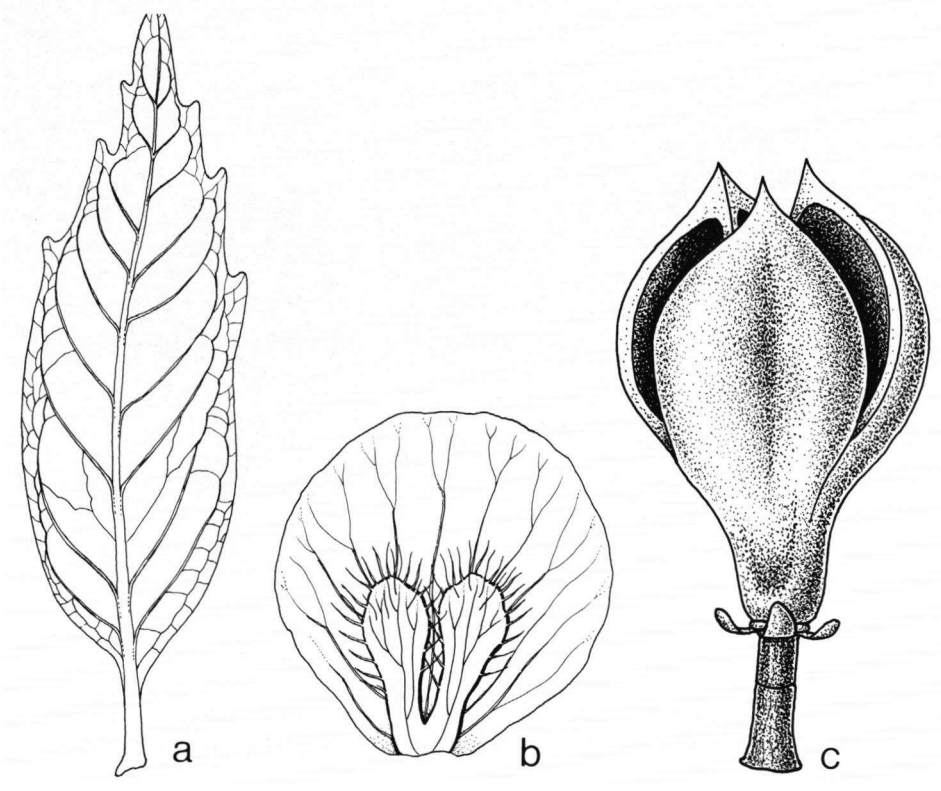

Fig. 48. *Cupaniopsis grandiflora* Adema. a. Leaflet, × 1; b. petal from inside, × 3; c. fruit, × 2 (a b: *McPherson* 3805, L; c: *Guillaumin & Baumann-Bodenheim* 8683, P).

celled, outside with few hairs, inside glabrous, style 3.6 mm, stigma 1.8 mm, 3-lined. *Fruits* ellipsoid, 3-angular in cross section, 26–32 × 16 mm, stipe 3–6 mm, wall 1.1–2.0 mm thick, outside smooth, glabrous, inside glabrous, septa complete. *Seeds* 17 × 9 mm, almost totally covered by the lacerate arilloid, cotyledons unequal, superposed.

Distribution — New Caledonia.

Field notes — a. Ecological notes: Undergrowth of wet forests and maquis. Alt. 400–1000 m. Flowering: May (to July), fruiting: November to December.

b. Additional descriptive notes: Leaves shiny green, usually darker below. Inflorescence axes red or green. Pedicels, flowers and stamens white. Fruit green.

Notes — Strongly resembling *C. oedipoda* in vegetative parts, especially the leaves. However, these are usually dentate in the present species. Furthermore the present species has larger flowers, and in the male flowers glabrous anthers.

Specimens examined:
NEW CALEDONIA: 13 specimens.

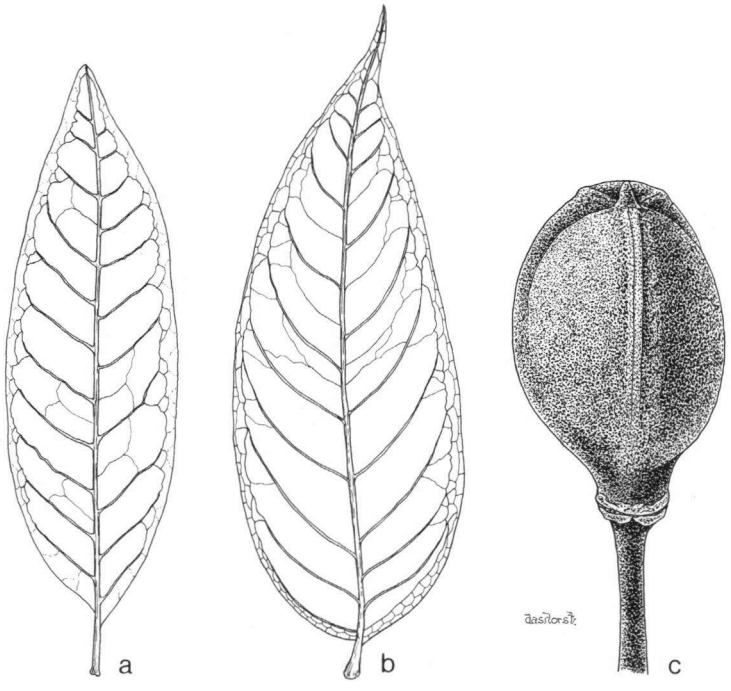

Fig. 49. *Cupaniopsis grisea* Adema. a. Leaflet, × 0.75 (*Pennington* 8139, L). — Fig. 50. *Cupaniopsis guillauminii* (Kanehira) Adema. b. Leaflet, × 0.5; c. fruit, × 2.5 (b: *Kanehira* 1268, A; c: *Hosokawa* 8323, USN).

25. Cupaniopsis grisea Adema, *spec. nov.* — Fig. 49.

Arbor 8–13.5 m alta, axibus strigosis. Folia 5-jugata; foliolis ellipticis ad ovatis, obtusis ad acuminatis, integerrimis. Inflorescentiae axillares. Ovarium triloculare, exocarpio piloso. — Typus: *Pennington* 8139, New Caledonia, Thi Valley, disturbed forest, 21.2.1964 (L!, holo).

Trees 8–13.5 m high, d.b.h. ca. 8 cm. *Flowering twigs* terete, 1.5–4 mm in diameter, striate to grooved, strigose. *Leaves* 5-jugate; petiole 6–10 cm, rachis 10.5–16 cm, both semiterete, striate, grooved above, strigose to glabrous. *Leaflets* opposite to alternate, elliptic to ovate, slightly asymmetric, upper 8.5–13.5 × 2.5–4.5 cm, index ca. 3, lower 10 × 4 cm, index 2.5, thick chartaceous, above and below glabrous or midrib with few, short hairs, base (broad) cuneate, apex obtuse to acuminate, acumen (2–)5–7 mm, rounded, retuse, margin entire, midrib above slightly prominent, nerves 9–11 per side, 8–18 mm apart, angle to midrib 65°, small pocket-like domatia present; petiolule 6–15 mm, grooved above, glabrous. *Inflorescences* axillary, 4.5–6 cm, laxly flowered, with long and short branches. *Bracts* and *bracteoles* about semicircular, 0.8–1.3 × 0.8–1.3 mm, outside short appressed-hairy, rim ciliate, with glands, inside glabrous. *Pedicels* 0.7 mm, articulated at the base. *Buds* 1.7 × 1.9 mm. Female flowers: *Sepals* more or less orbicular, out- and inside short appressedhairy in lower part, rim ciliate, outer 2.6–2.8 × 2.0–2.2 mm, scarious rim rather wide, inner 3.0 × 3.0 mm, scarious rim

very wide. *Petals* broad-ovate to orbicular, 1.2–1.4 × 1.2–1.3 mm, out- and inside shortly appressed-hairy in lower part, rim ciliate, scales 2, not crested, 1.3–1.6 mm, woolly. *Disc* glabrous. *Staminodes* 8, filaments 1.2 mm, patently hairy, anthers 1.1–1.2 mm, glabrous. *Ovary* 3-celled, outside hairy, style 1.0 mm, stigma 0.6 mm, 3-lined.

Distribution — New Caledonia.

Field notes — a. Ecological notes: Gallery forest, disturbed forest. Alt. 100 m. Flowering: February.

b. Additional descriptive notes: Branches spreading widely. Crown dense. Bark brown to dark greenish black, smooth or finely cracked, inner bark mid brown. Sapwood pale straw. Leaflets dark green above, paler below. Sepals green. Petals white. Anthers yellow. Ovary pale orange.

Notes — Closely resembling and probably closely related to *C. sylvatica*. From that species the present one differs in the very short pedicels, the small buds, the larger outer and smaller inner sepals, the smaller petals with larger scales, the short filaments, and the longer style.

Specimens examined:
NEW CALEDONIA. *MacKee* 20026; *Pennington* 8139.

26. Cupaniopsis guillauminii (Kanehira) Adema, *comb. nov.* — Fig. 50.

Basionym: *Mischocarpus guillauminii* Kanehira, Bot. Mag. Tokyo 46 (1932) 672; Fl. Micronesica (1933) 203, fig. 88; Hosokawa, Bull. Biogeogr. Soc. Japan 7 (1937) 194. — *Lepidopetalum triloculare* Kanehira, Bot. Mag. Tokyo 47 (1933) 400 (nom. nud.). — Type: *Kanehira* 1268 (1368?), Caroline Islands, Truk Tol, 6.1931 (FU, holo, n.v., iso in A!, P!).

Mischocarpus paradoxa auct. non Radlk.: Kanehira & Hatusima, Bot. Mag. Tokyo 57 (1943) 79.

Cupaniopsis concolor auct. non (Gillespie) Ham: Ham, Blumea 23 (197) 271, 287, 289 (pro specimens from Truk Tol).

Trees 7.5 m high, d.b.h. 25 cm, 'varnished'. *Flowering twigs* terete, 2(–3.5) mm in diameter, with scale and short appressed hairs when young. *Leaves* 2–3-jugate; petiole 3–12 cm, semiterete, usually upwards terete, striate, glabrous or with scale and some short appressed hairs at least in lower part; rachis 2.5–6 cm, more or less semiterete, striate, glabrous. *Leaflets* (sub)opposite, elliptic to ovate, slightly asymmetric, upper 13.5–18.5 × 4.5–6.5 cm, index ca. 3, lower 9–15.5 × 3.5–5.5 cm, index 2.3–2.8, coriaceous, above and below with scattered scale hairs at least on the midrib, below sometimes with few, appressed hairs, base cuneate to rounded, apex acute to acuminate, acumen 8–15 mm, acute to rounded, margin entire, midrib above not or scarcely prominent, nerves 9–13 per side, 8–25 mm apart, angle to midrib 55°–65°; petiolule 3–9 mm, glabrous. *Inflorescences* axillary, 7.5–13.5 cm, laxly flowered, with long branches, with minute scale and short appressed hairs; cymules 1-flowered. *Bracts* and *bracteoles* not persistent under the fruits. *Sepals* persistent or not under the fruits. *Fruits* (most rather young) 1-celled, 3-valved, 16–27 × 13–14 mm, stipe 2–5 mm, wall ca. 1 mm thick, outside smooth, glabrous, inside glabrous, septa incomplete, forming a low, glabrous ridge on each valve. *Seeds* 1 per fruit, ca. 18 mm long, testa shiny black, arilloid covering 2/3 to the whole seed, lobed or lacerate.

Distribution — Caroline Islands (Truk Tol).

Field notes — a. Ecological notes: Primary forest on volcanic soil and humus. Alt. 400–450 m. Fruiting: June to November.

b. Vernacular names: Ääppo, Tyammis (Hosokawa, 1937).

c. Uses: Bark as medicine for general debility.

Notes — All specimens are rather incomplete. The species resembles both *C. concolor* and *C. samoensis*. However, several differences in hairiness and in the fruits seem to indicate that it is discrete from both.

In the original description the type was indicated as *Kanehira* 1368. This is a typing error, the right number is 1268.

Specimens examined:
CAROLINE ISLANDS. Truk Tol: *Hosokawa* 8323, *Kanehira* 1368 (1268?), *Wong* 277.

27. Cupaniopsis hypodermatica Radlk. — Fig. 51.

Cupaniopsis hypodermatica Radlk., Fedde Rep. 20 (1924) 35; Guillaumin, Bull. Soc. Bot. Fr. 79 (1932) 340; Radlk. in Engl., Pflanzenr. 98 (1933) 1200; Guillaumin, Fl. Nouv.-Caléd. (1948) 200. — Type: *Vieillard 2405*, New Caledonia, Lifu (P!, holo, iso in K!, P?).

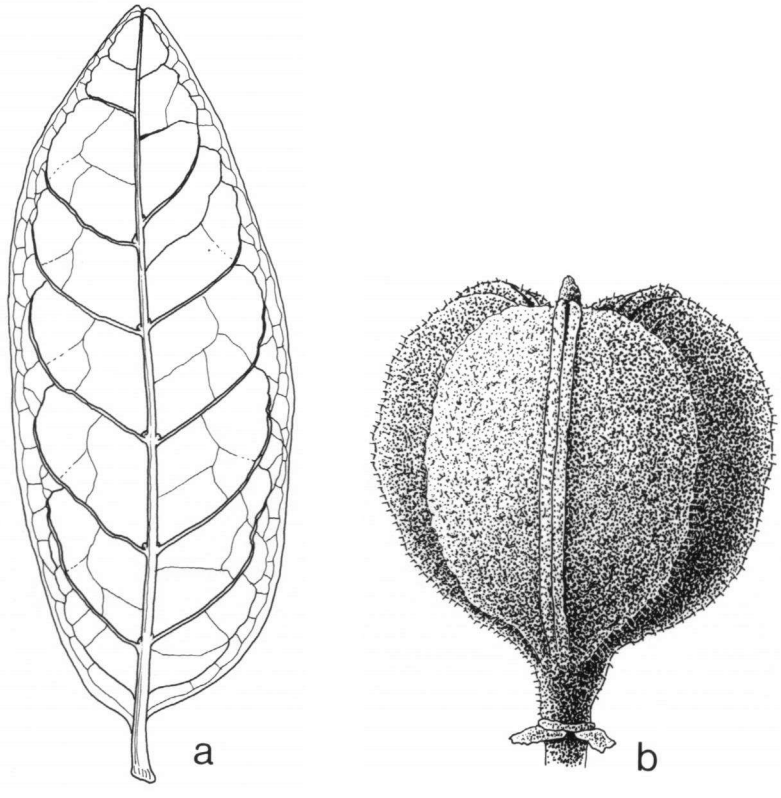

Fig. 51. *Cupaniopsis hypodermatica* Radlk. a. Leaflet, × 1; b. fruit, × 3 (a, b: *MacKee* 20894, L).

Trees 8–12 m high, d.b.h. 30 cm. *Flowering twigs* terete, 2–3 mm in diameter, striate, glabrous to strigose. *Leaves* 2–4(–5)-jugate; petiole 2.5–6.5 cm, rachis 1–9.5 cm, rarely grooved above, both semiterete, striate, rarely grooved above, glabrous to strigose. *Leaflets* opposite to alternate, elliptic, rarely ovate, slightly asymmetric, upper 5–10 × 2–4 cm, index 2.0–3.5, lower 4.5–8 × 2–4 cm, index 1.8–2.7, chartaceous to coriaceous, above and below glabrous, base cuneate to rounded, apex obtuse to rounded, or short and broad acuminate, acumen 2–5 mm, obtuse to rounded, retuse, margin entire, midrib above slightly prominent, nerves (5–)7–9 per side, (5–)6–16 mm apart, angle to midrib 55°–60°, small pocket-like, rarely dome-shaped domatia present; petiolule (2–)5–7(–11) mm, grooved above, glabrous. *Inflorescences* axillary, 1.5–2 cm, without branches, laxly or densely flowered, strigose; cymules 1-flowered. *Bracts* and *bracteoles* not persistent under the fruits, deltoid, 1.1 × 1.0 mm, outside with scattered appressed hairs, inside glabrous. *Pedicels* 2.9 mm, articulated at 1/3 above the base. Male flowers: *Sepals* about orbicular, outside glabrous, rim ciliolate, inside appressed-hairy in lower part, almost totally petaloid, outer 2.0 × 2.1 mm, inner 2.5 × 2.8 mm. *Petals* more or less orbicular, 1.1–1.3 × 0.8–1.3 mm, out- and inside at the base appressed-hairy at the base, rim ciliate, scales 2, not crested, 1.2–1.3 mm, densely woolly. *Disc* glabrous. *Stamens* 8, exserted, filaments 2.2–2.4 mm, patently hairy in lower half, anthers 1.0–1.2 mm, glabrous *Pistillode* 3-celled, outside hairy, 1.9 × 1.8 mm. Female flowers not known. *Sepals* not persistent under the fruits. *Fruits* about globular, 3-celled, 20 × 20 mm, stipe 3 mm, wall 1.0–1.2 mm thick, outside smooth, more or less velutinous, inside appressed-hairy to villose, septa complete. *Seeds* more or less ellipsoid, 15–18 × 8–10.5 mm, testa shiny black, arilloid covering almost the whole seed, cotyledons equal, superposed.

Distribution — New Caledonia, Loyalty Islands (Lifu).

Field notes — a. Ecological notes: Humid forests on greywacke. Alt. 150–600 m. Flowering: January, fruiting: July to September.

b. Additional descriptive notes: Bark light brown, almost smooth. Leaflets shiny dark green above, dark or light green below. Flowers yellow. Fruits brown.

c. Vernacular name: The vernacular name *Imoinri* has been noted for this and other species of *Cupaniopsis* and also for other *Sapindaceae* (*MacKee* 20894).

Notes — Very similar to *C. sylvatica*. The present species differs especially in the acuminate leaflets, the very short inflorescences, and the smaller fruits and seeds.

Specimens examined:
New Caledonia. 5 specimens; Loyalty Islands: Lifu: 1 specimen.

28. Cupaniopsis inoplaea Radlk. — Fig. 52.

Cupaniopsis inoplaea Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. Münch. 9 (1879) 589; Guillaumin, Bull. Soc. Bot. Fr. 79 (1932) 340; Radlk. in Engl., Pflanzenr. 98 (1933) 1204; Däniker, Mitt. Bot. Mus. Univ. Zürich 142 (1933) 247; Guillaumin, Fl. Nouv.-Caléd. (1948) 200. — Type: *Balansa* 3307, New Caledonia, Mt. Poum, dans les terrains éruptifs, 5.1871 (P!, holo).

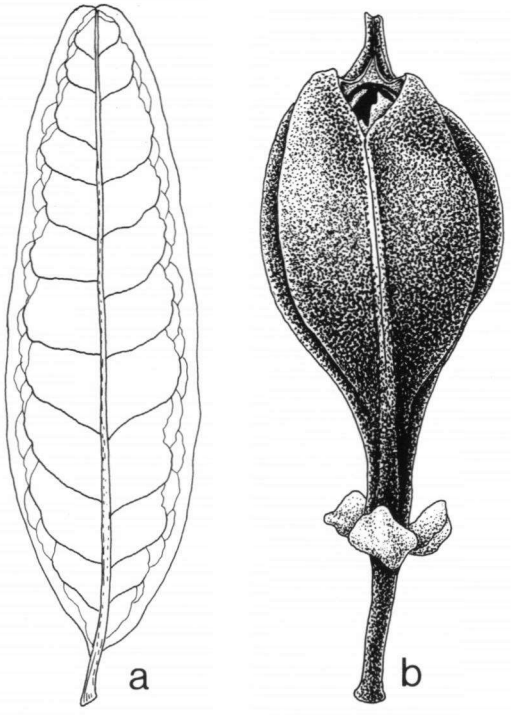

Fig. 52. *Cupaniopsis inoplaea* Radlk. a. Leaflet, × 1.5; b. fruit, × 3.5 (a: *MacKee* 33182, L; b: *MacKee* 22404, L).

Slender *shrubs* or *treelets* 0.5–4 m high. *Flowering twigs* terete, 1–6 mm in diameter, smooth or striate, glabrous or with scattered scale hairs, sometimes also with short patent hairs, pruinose. *Leaves* (1–)3–6(–10)-jugate; petiole 2–8.5 (–11) cm, rachis (1.5–)3–13(–23.5) cm, more or less terete, or at least upwards semiterete, often grooved above, striate, usually pruinose, glabrous or with scattered scale hairs, sometimes also with short patent hairs. *Leaflets* opposite to alternate, (narrowly) elliptic, rarely narrowly ovate or narrowly obovate, slightly asymmetric, upper 3–20 × 1–6.5 cm, index 1.9–5.3, lower 2–15 × 1–6 cm, index 1.6–3.7, coriaceous, above and below glabrous, rarely with scattered scale hairs or short patent hairs, midrib sometimes pruinose, base cuneate to rounded, apex obtuse to rounded, retuse, exceptionally acuminate, acumen 3–4 mm, rounded, margin entire to grossly obtusely dentate, rarely lobed, midrib above not or slightly prominent, nerves 4–13 per side, at least some of the upper ones ending in a tooth, 3–20(–30) mm apart, angle to midrib 45°–70°; petiolule 1–12(–17) mm, grooved, sometimes pruinose, glabrous, rarely with scattered scale hairs. *Inflorescences* ramiflorous, exceptionally axillary, 0.5–6(–11,5) cm, often on wart-like, small to rather big brachyblasts, clustered, laxly to rather densely flowered, without or with short or long branches, with scattered scale hairs and short patent

hairs; cymules dichasial, 1–several-flowered. *Bracts* and *bracteoles* lanceolate to deltoid, 0.1–0.8 × 0.1–0.6 mm, not persistent under the fruits, outside with 1 or 2 hairs at the apex, margin with scale hairs, inside glabrous. *Pedicels* 2.4–4.8 mm, articulated up to 1/3 above the base. *Buds* flattened globular, 1.3–2.4 × 1.8–3.5 mm. Male flowers: *Sepals* orbicular, scarious rim wide, out- and inside glabrous or with few scale hairs, rim with very few ciliae, outer 1.2–2.6 × 1.1–3.6 mm, inner 2.3–3.7 × 1.7–3.7 mm. *Petals* orbicular to rhomboid or obovate, 1.9–3.8 × 1.2–2.9 mm, claws if present 0.2–1.2 mm, outside glabrous, inside (thinly) appressed-hairy in lower part, rim ciliate in lower part, scales 2, not crested, 1.2–3.2 mm, free or adnate for 1/2–2/3 with sides of petals, patently hairy at least in upper part. *Disc* glabrous. *Stamens* 8, exserted, filaments 2.4–4.3 mm, patently hairy except apex, anthers 0.6–1.2 mm, glabrous or rarely with few hairs. *Pistillode* 3-celled, outside glabrous or with few hairs at apex, 0.3–1.6 × 0.3–0.8 mm. Female flowers: *Sepals* persistent or not persistent under the fruits, outer (0.7–)1.4–2.5 × (0.8–)1.3–2.3 mm, inner (1.1–)3.0–3.8 × (1.0–)2.6–3.6 mm. *Petals* 3.2–5.3 × 1.7–2.8 mm, scales 2.3–3.7 mm. Filaments of *staminodes* 3.0–3.8 mm, anthers 1.0–1.1 mm. *Ovary* 3-celled, triangular in cross section, outside glabrous or with few hairs, style 3.1–6.0 mm, stigma 1.4–2.4 mm, 3-lined. *Fruits* more or less obovoid, triangular in cross section, 12–23 × 9–15 mm, stipe 1–3(–7) mm, exceptionally with some scale or some short hairs, wall 0.6–1.1 mm thick, outside smooth, exceptionally rough, glabrous, rarely with some scale hairs in lower part, inside glabrous, exceptionally (thinly) tomentose when young, septa complete. *Seeds* ellipsoid, 10–11 × 5.5–6.0 mm, testa shiny black, arilloid covering 1/3 to almost the whole seed, long lacerate, cotyledons equal or unequal, superposed.

Distribution — NW New Caledonia; Loyalty Islands (Lifu, Maré).

Field notes — a. Ecological notes: Maquis or gallery forests on serpentine, sometimes on schists. Alt. 0–700 m. Flowering: April to July, fruiting: (March to) July to August (to November).

b. Additional descriptive notes: Leaflets shiny dark green on both sides, sometimes lighter green above and/or below. Flowers white or rarely pale yellow. Calyx yellowish green. Fruits green when young, brown, orange or purple when ripe. Seeds shiny black, arilloid yellow, orange or red.

Notes — *MacKee* 26890 has acuminate leaflets. *MacKee* 14538 has rather small sepals under the fruit and some hairs on the stipe. *MacKee* 14538, 20374, 26890 have smaller fruits on shorter stipes than *MacKee* 22404. *Mackee* 43477 and *Schmid* 677 from the Loyalty Islands probably belong here. They differ in the endocarps, that are hairy at least when young.

Specimens examined:
New Caledonia. 34 specimens; Loyalty Islands: 2 specimens.

29. Cupaniopsis kajewskii Merr. & Perry — Fig. 53.

Cupaniopsis kajewskii Merr. & Perry, J. Arn. Arbor. 21 (1940) 519; Foreman, Check List Bougainville (1971) 58. — Type: *Kajewski* 1781, Papua New Guinea, North Solomon Province, Bougainville, Kugimaru, Buin, 28.5.1930 (A!, holo, iso in A!, BISH!, BM!, BO!).

Cupaniopsis caudata Merr. & Perry, J. Arn. Arbor. 21 (1940) 519. — Type: *Brass* 3454, Solomon Islands, Santa Isabel, Sigana, 11.1.1933 (A!, holo, iso in BISH!, BM!, BO!, L!).

Trees 4.5–15 m high, d.b.h. 6–60 cm. *Flowering twigs* 3–8(–13) mm in diameter, striate to grooved, shortly tomentose. *Leaves* (3–)4–6(–7)-jugate; petiole 6–22.5 cm, semiterete, upwards usually terete, rachis 15.5–33 cm, semiterete or usually terete, both striate, shortly tomentose. *Leaflets* alternate, ovate to narrowly elliptic, slightly asymmetric, upper 15–36 × 4–12 cm, index 2.6–4, lower 7–18.5 × 2.5–8 cm, index 1.5–3, chartaceous, above (almost) glabrous, midrib and nerves glabrous to thinly pilose, below glabrous to thinly pilose, midrib and

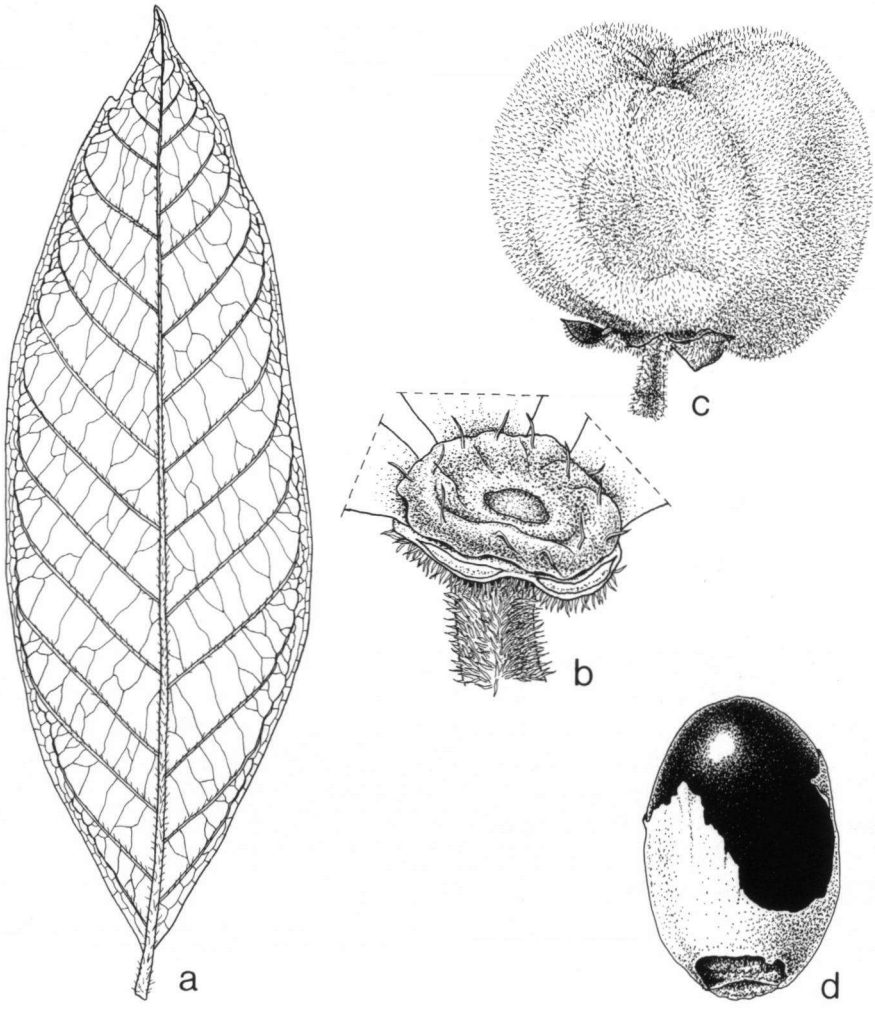

Fig. 53. *Cupaniopsis kajewskii* Merr. & Perry. a. Leaflet, × 0.7; b. disc, × 8.5; c. fruit, × 2; d. seed × 2 (a, b: *NGF* 31458, L; c, d: *Craven & Schodde* 231, L).

nerves with few hairs to pilose, base cuneate to rounded, apex long-acuminate to caudate, acumen 5–50 mm, rounded to acute, margin obscurely dentate to crenate in upper part, sometimes entire, midrib above slightly prominent, nerves 7–18 per side, 8–26 mm apart, angle to midrib 45°–70°, small pocket-like domatia usually present; petiolule 4–10(–14) mm, grooved, thinly shortly tomentose. *Inflorescences* axillary, 8–28 cm, laxly flowered, with long patent branches, shortly tomentose; cymules dichasial, several-flowered *Bracts* and *bracteoles* elliptic to deltoid, 0.6–2.4 × 0.5–1.2 mm, thick, outside appressed-hairy, inside glabrous or with some hairs at the base, not persistent under the fruits. *Pedicels* 2.6–4.8 mm, articulated up to 1/4 above the base. *Buds* globular, 4.2–4.8 × 3.6–5.2 mm. Male flowers: *Sepals* orbicular, outside shortly appressed-hairy except rim, rim ciliate, inside appressed-hairy in lower part, outer 2.8–3.6 × 2.8 mm, scarious rim narrow, inner 4.3 × 4.4 mm, scarious rim wide. *Petals* ovate to obovate, irregular dentate, 2.0–2.4 × 1.3–1.4 mm, outside rather long appressed-hairy, rim ciliate, inside appressed-hairy in lower part, auriculate, auricles long patent-hairy. *Disc* with few to many, more or less scattered hairs. *Stamens* 10–14, exserted, filaments 2.6–2.9 mm, patently hairy, anthers 1.8–1.9 mm, glabrous. *Pistillode* very small, 3-celled, outside hairy. Female flowers: *Sepals* persistent under the fruits, outer 2.4–5.4 × 2.4–4.6 mm, inner 4.8–6.0 × 4.2–6.0 mm, inside appressed-hairy except rim. *Petals* elliptic to almost orbicular, 2.4–4.4 × 1.2–2.6 mm, claw 0.6–1.2 mm. Filaments of *staminodes* 2.2–3.8 mm, anthers 1.7–2.7 mm, glabrous or hairy. *Ovary* 3-celled, outside hairy, style 1.3–2.3 mm, rather thick, almost totally stigmatic, 3-lined, straight or hooked. *Fruits* about cylindrical, rounded triangular in cross section, 19–23 × 14–24 mm, 1, 2, or 3 cells developed, wall 0.4–0.5 mm thick, outside rugose or smooth, velutinous, inside appressed-hairy, septa complete. *Seeds* about ellipsoid, 16–22 × 9–17 mm, testa brownish black, arilloid covering most of the seed, lacerate, cotyledons slightly unequal, parallel.

Distribution — Papua New Guinea (North Solomon Province, Bougainville), Solomon Islands (Fauro Island, Choiseul, Vella Lavella, Kolombangara, Santa Isabel, Guadalcanal).

Field notes — a. Ecological notes: Usually in well drained primary rain forests on hillsides or ridgetops, rarely in secondary forest. Alt. 5–1000 m. Flowering: December to April (to September), fruiting: May to August (to November).

b. Additional descriptive notes: Bole straight or crooked. Bark smooth, mid to dark brown, slash pale brown to midbrown. Wood hard, white to yellow or brownish. Leaves glossy mid to dark green above, duller and paler below. Flower buds whitish green. Calyx green. Corolla white to yellow, with a (faint) sweet smell. Fruits yellow to red or brown. Seeds glossy dark red to brown black, arilloid yellow or orange.

c. Vernacular names: Ao-kai (Bougainville, Buin), Buriakolo (Kwara'ae), Piranga (Bougainville, Siwai).

Notes — *C. caudata* (*Brass* 3454, *BSIP* 5406, 11256) has larger leaflets with strikingly longer acumens: 30–50 mm in upper, 15–20 mm in lower leaflets (in *C. kajewskii* s.s. 10–25, resp. 5–10 mm). However, in no other character a real difference could be found. Therefore I combine both species into one.

Specimens examined:

PAPUA NEW GUINEA. North Solomon Province: Bougainville: 6 specimens.

SOLOMON ISLANDS. Fauro Island: 2 specimens, Choiseul: 1 specimen, Vella Lavella: 1 specimen, Kolombangara: 1 specimen, Santa Isabel: 2 specimens, Guadalcanal: 2 specimens.

30. Cupaniopsis leptobotrys (A. Gray) Radlk. — Fig. 54.

Cupaniopsis leptobotrys (A. Gray) Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. Münch. 9 (1879) 519, 530, 585; in Engl., Pflanzenr. 98 (1933) 1197; A.C. Smith, J. Arn. Arbor. 31 (1950) 294; Parham, Plants Fiji Is. (1964) 173; ed. 2 (1972) 246; A.C. Smith, Fl. Viti. 3 (1984) 605, fig. 147A. — *Cupania leptobotrys* A. Gray, U.S. Exploring Expedition, Botany, Phan. 1 (1854) 255; Walpers, Ann. 4 (1857) 380; Seemann, Viti (1862) 434; Fl. Viti (1865) 46; Drake, Ill. Fl. Ins. Mar. Pac. (1890) 143. — Type: *U. S. South Pacific Exploring Expedition* s.n., Fiji, Ovalau, 1840 (US 17731/17732, holo, n.v., iso in A!, K!).

Ratonia storckii Seemann, Fl. Viti (1865) 47. — *Cupaniopsis storckii* (Seemann) Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Akad. Wiss. Münch. 9 (1879) 530, 487; in Engl., Pflanzenr. 98 (1933) 1197; Parham, Plants Fiji Is. (1964) 173; ed. 2 (1972) 246. — *Matabya storckii* (Seemann) Drake, Ill. Fl. Ins. Mar. Pac. (1890) 144. — Type: *Seemann* 67, Fiji (K!, holo, iso in A!).

Cupania apetala auct. non Labill.: Seemann, Bonplandia 9 (1861) 254; Viti (1862) 434; A. Gray, Bonplandia 10 (1862) 35; Proc. Amer. Acad. Arts. 5 (1862) 316.

Shrubs or small, often *palmoid* trees, 2–10(–15) m high. *Flowering twigs* terete, 2–10 mm in diameter, striate to grooved, glabrous or strigose (to short-tomentose). *Leaves* 4–10-jugate; petiole (5.5–)8–20(–37) cm, semiterete, upwards terete, rachis (8–)16.5–42 cm, terete or semiterete, both striate, glabrous or strigose (to short-tomentose). *Leaflets* alternate to subopposite, elliptic to (narrowly) ovate, slightly asymmetric, upper 9–26(–30.5) × 2.5–9.5 cm, index 2.5–4(–4.5), lower 6–15 × 2.5–8 cm, index 1.6–3, chartaceous, above almost always glabrous, sometimes midrib and nerves thinly puberulous, below glabrous to thinly puberulous, midrib and nerves glabrous to more or less puberulous, base cuneate to rounded, apex usually short to long-acuminate, rarely obtuse, acumen 3–15(–25) mm, obtuse or retuse to mucronate, margin entire, rarely obscurely crenate or dentate, midrib above slightly prominent, nerves 7–18 per side, (4–)7–18(–23) mm apart, angle to midrib 50°–70°(–80°), small pocket-like to dome-shaped domatia present; petiolule 5–30(–35) mm, grooved, glabrous to strigose or short-tomentose. *Inflorescences* axillary, often pendulous, 9–82.5(–120) cm, laxly flowered, with long branches, not rarely the whole inflorescence or the branches flagelliform, very rarely (*Seemann* 67, *A.C. Smith* 120) short with short branches, strigose (to short-tomentose); cymules dichasial, 1–several-flowered. *Bracts* and *bracteoles* ovate to deltoid, 0.6–2.4 × 0.5–1.4 mm, not persistent under the fruits, outside appressed-hairy, inside appressed-hairy at the base. *Pedicels* 1.4–4.2 mm, articulated at 1/5–1/2 above the base. *Buds* more or less flattened globular, 2.2–4.4 × 2.8–4.7 mm. Male flowers: *Sepals* ± orbicular, dentate, out- and inside appressed-hairy except rim, rim ciliate and with glands, outer 1.8–5.2 × 2.8–5.2 mm, scarious rim 0 to rather wide, inner 3.4–5.9 × 3.6–5.4 mm, scarious rim wide. *Petals* elliptic to obovate or transversely elliptic, dentate, 1.3–2.5 × 1.3–2.6 mm, outside appressed-hairy in lower part, inside glabrous, auriculate, auricles woolly.

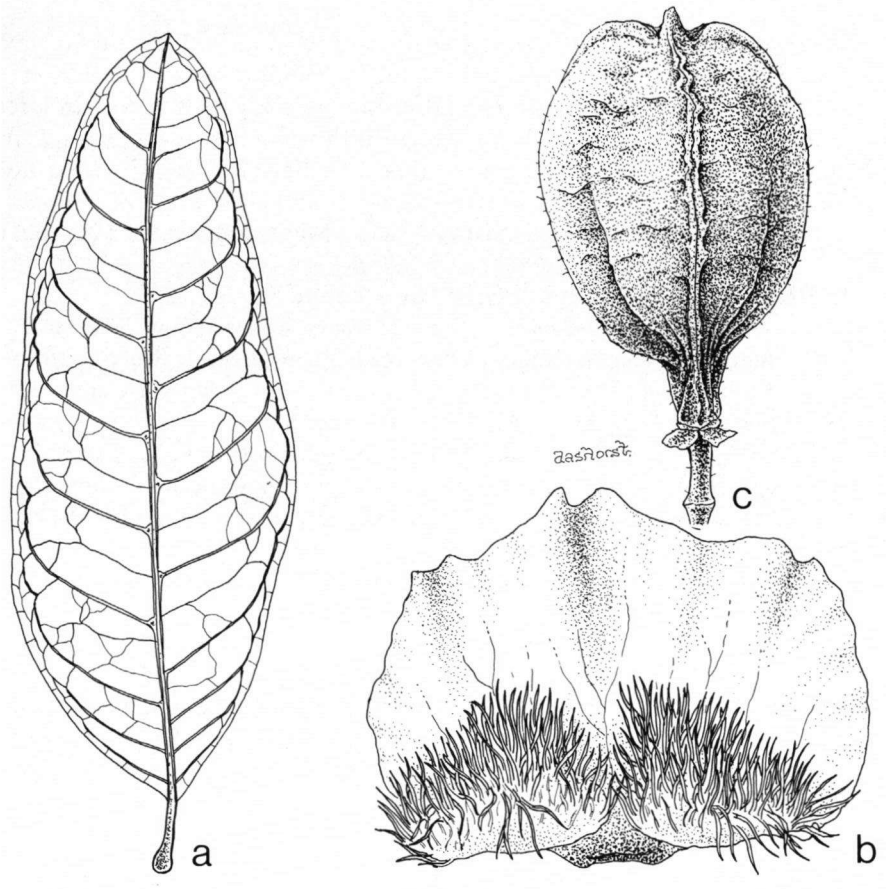

Fig. 54. *Cupaniopsis leptobotrys* (A. Gray) Radlk. a. Leaflet, × 0.75; b. petal from inside, × 2; c. fruit, × 3.5 (a, c: *A.C. Smith* 8426, L; b: *A.C. Smith* 7569, L).

Disc hairy. *Stamens* 10, not exserted, filaments 1.3–2.5 mm, short or rarely also long patent-hairy except apex, anthers 1.8–3.0 mm, glabrous to hairy on the inner side. *Pistillode* 3-celled, outside hairy, 0.8–1.2 × 0.7–1.2 mm. Female flowers: *Sepals* persistent under the fruits, outer 2.5–4.2 × 2.4–4.2 mm, inner 4.1–5.4 × 4.2–5.6 mm. *Petals* 1.8–1.9 × 1.9–2.0 mm. Filaments of *staminodes* 2.4 mm, anthers 2.2 mm, with few hairs. *Ovary* 3-celled, outside hairy, style 1.3–2.4 mm, with 3 stigmatic lines. *Fruits* obovoid, apically lobed, rounded triangular in cross section, 14–30 × 14–23 mm, stipe 2–6 mm, pericarp 0.1–0.6 mm thick, outside rugose, velutinous, inside tomentose, septa complete, rather thin. *Seeds* 13–22 × 8–12 mm, testa brownish, arilloid covering half to the whole seed, shortly elongate basally, cotyledons unequal, parallel.

Distribution — New Hebrides, Fiji.

Field notes — a. Ecological notes: Dense forests or crest thickets. Alt. 150–1215 m. Flowering: January to June (to October), fruiting: May to December.

b. Additional descriptive notes: Leaflets above clear dark green. Inflorescence blue green. Buds brownish. Sepals greenish white to brown. Petals white. Filaments white, anthers pale yellow to orange. Fruits yellow to brown. Arilloid pale orange.

c. Vernacular names: Malatawa (Viti Levu, Mba), Malawathe (Viti Levu, Ra).

d. Uses: An infusion of the bark for stomach trouble.

Notes — This is a very variable species. Many specimens show differences in various characters, most strikingly in size and shape of the leaflets and in the length of the inflorescences. *Seemann* 67 has very short, short branched inflorescences, whereas *A.C. Smith* 7457 has very long, long branched, flagelliform ones. *DA* 14798, 15533 have leaflets that are more hairy below. *Seemann* 67 has also the largest fruits. *A.C. Smith* 1954 has stamens that are much longer than those of other specimens. *Degener* 15371 has extremely short petiolules. Probably the non-flowering specimen *Gillespie* 3659 with very large leaflets (ca. 31 × 11.5 cm) also belongs to the present species. *Gillespie* 2029 has bisexual flowers.

Smith (1985: 606) included *C. storckii* in *C. leptobotrys* saying: 'I am unable to find any significant differences between the two [type] collections'. In comparing *U. S. South Pacific Exploring Expedition* s.n. (isotypes of *C. leptobotrys*) and *Seemann* 67 (type of *C. storckii*) they seem to be rather different, as the former has long, long branched, flagelliform inflorescences, and the latter has very short, short branched ones. As this is the only difference, and *C. leptobotrys* proved to be very variable, it may be best indeed to include *C. storckii* in that species.

Specimens examined:

New Hebrides. Erromanga: 5 specimens, Efate: 1 specimen, Anatom Sud: 1 specimen.

Fiji. Viti Levu: 11 specimens, Vanua Levu: 4 specimens, Kandavu: 2 specimens, Ovalau: 4 specimens, Cakaudrove: 1 specimen.

31. Cupaniopsis mackeeana Adema — Fig. 55.

Cupaniopsis mackeeana Adema, Adansonia 10 (1988) 26. — Type: *MacKee* 18710, New Caledonia, Haute vallée de l'Amoa, alt. 300 m, 28.4.1968 (P!, holo, iso in L!, P!).

Trees or (palmoid?) *treelets* 3.5–12 m high. *Flowering twigs* terete, 7–14 mm in diameter, striate to grooved, shortly villose mixed with longer hairs. *Leaves* 4–12-jugate; petiole 10–34 cm, semiterete, upwards terete, rachis 18–44 cm, more or less terete, both striate, glabrous to short villose, also with longer hairs. *Leaflets* opposite to alternate, elliptic to ovate, asymmetric, upper 15–21 × 4–8 cm, index 2.2–3.3, lower 9–14.5 × 3.5–6.5 cm, index 1.7–2.5, coriaceous, above and below glabrous, rarely with some scattered hairs and midrib and nerves villose, base cuneate to rounded, apex obtuse to rounded, retuse, margin entire, midrib above not or slightly prominent, nerves 7–20 per side, 10–22 mm apart, angle to midrib 45°–70°, without or with small pocket-like domatia; petiolule (8–)15–30 mm, grooved above, glabrous to shortly villose. *Inflorescences* axillary, rarely

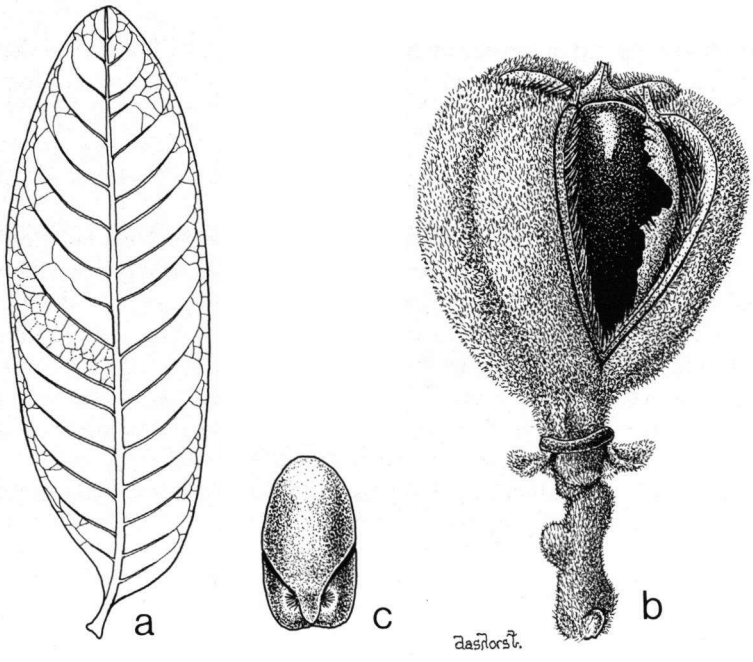

Fig. 55. *Cupaniopsis mackeeana* Adema. a. Leaflet, × 0.3; b. fruit, × 2; c. embryo, × 1.5 (a: *MacKee* 1871, L; b, c: *Schmid* 2888, P).

pseudoterminal, (6.5–)13.5–53 cm, laxly to rather densely flowered, with long or rarely short branches, shortly villose, also with longer hairs; cymules dichasial, 1–several-flowered. *Bracts* and *bracteoles* lanceolate to deltoid, 0.5–3.0 × 0.5–1.6 mm, persistent or not under the fruits, thick, concave, outside appressed-hairy to more or less villose, inside appressed-hairy at the base. *Pedicels* 1.2–1.4 mm, articulated at the base. *Buds* 1.8–4.2 × 2.3–4.8 mm. Male flowers: *Sepals* out- and inside appressed-hairy except rim, inside sometimes only up to halfway, rim ciliate in lower part, outer elliptic to almost orbicular, 2.8–4.2 × 1.7–3.0 mm, without or with a narrow scarious rim, inner obovate to orbicular, 3.6–5.4 × 3.1–4.4 mm, scarious rim wide. *Petals* oblique, elliptic to orbicular, or lingulate (*MacKee* 26592), (1.1–)1.8–2.4 × (0.3–)1.2–2.2 mm, out- and inside appressed-hairy in lower part, rim ciliate in lower part, scales 2, not crested, 0.8–2.0 mm, woolly. *Disc* glabrous. *Stamens* 8, exserted, filaments 2.3–4.6 mm, patently hairy in lower half, anthers 1.4–2.3 mm, hairy. *Pistillode* 3-celled, outside hairy, 1.0–1.6 × 0.6–1.2 mm. Female flowers: *Sepals* persistent under the fruits, outer 3.6–4.8 × 3.0–3.6 mm, inner 4.0–6.0 × 4.2–4.8 mm. *Petals* 2.2–3.6 × 0.8–2.0 mm, scales 1.2–2.5 mm. Filaments of *staminodes* 1.7–2.9 mm, anthers 1.4–2.0 mm. *Ovary* 3-celled, outside hairy, style 1.4–2.5 mm, stigma 1.1–1.6 mm, 3-lined. *Fruits* globular to obovoid, 22–25 × 20–24 mm, stipe 1–2 mm, wall 0.8–1.8 mm thick, outside smooth, short villose, inside villose to appressed-hairy, septa complete. *Seeds*

ellipsoid, 15–18 × 9–10 mm, testa shiny black, arilloid covering almost the whole seed, lacerate, cotyledons equal or unequal, (obliquely) superposed, hypocotyl hairy on the sides.

Distribution — New Caledonia.

Field notes — a. Ecological notes: Humid forests on greywacke. Alt. 30–700 m. Flowering: March to July, fruiting: June, December.

b. Additional descriptive notes: Bark brown, a bit rough. Leaflets glossy dark green above, clear to dark green below. Inflorescence axes pale green with bronze-silver pubescence. Sepals pale green to greenish white. Petals white to pale yellow. Filaments white, anthers yellow or red, pollen bright light yellow. Pistil greenish white to grayish green.

Notes — Strongly resembling *C. macrocarpa* and *C. azantha*, but usually larger in most parts. The leaflets are never acuminate in the present species. Hairy hypocotyls are a rare phenomenon in *Cupaniopsis*.

MacKee 26592 has rather small sepals and petals, the latter being linguiate instead of more or less elliptic to orbicular.

Specimens examined:
NEW CALEDONIA. 10 specimens.

32. Cupaniopsis macrocarpa Radlk. — Fig. 56.

Cupaniopsis macrocarpa Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. Münch. 9 (1879) 587; Guillaumin, Bull. Soc. Bot. Fr. 79 (1932) 340; Radlk. in Engl., Pflanzenr. 98 (1933) 1202; Guillaumin, Fl. Nouv.-Caléd. (1948) 200. — Type: *Balansa* 2262, New Caledonia. Canala (P!, holo, iso in M!).

Cupaniopsis tramitis Guillaumin, Mém. Mus. Nat. Hist. Nat. B, 8 (1959) 135. — Type: *MacKee* 4399, New Caledonia, Dzumac, track above valley of Couvelée River, 400–500 m, 15.4.1956 (P!, holo, iso in K!, L!).

Cupaniopsis azantha auct. non Radlk.: Baker in Rendle, J. Linn. Soc. 45 (1921) 290; Däniker, Mitt. Bot. Mus. Univ. Zürich 142 (1933) 246.

Small, sometimes palmoid, *trees* or *shrubs*, (0.6–)2–8(–15) m high, d.b.h. 20–35 cm. *Flowering twigs* terete, 3–7(–10) mm in diameter, striate or grooved, villose. *Leaves* (2–)3–8(–10)-jugate; petiole 4–13.5(–19) cm, semiterete, upwards more or less terete, rachis (2.5–)8.5–17(-35) cm, more or less terete or semiterete, both striate, villose to glabrescent. *Leaflets* opposite to alternate, (narrowly) elliptic to ovate, slightly asymmetric, upper 7.5–18.5 × 3–7.5 cm, index 1.8–3.8, lower 3.5–12 × 2–6.5 cm, index 1.5–2.8, coriaceous, above and below glabrous to thinly villose, midrib usually more densely so, base cuneate to rounded, apex obtuse to rounded, retuse, rarely short acuminate, acumen 4–5 mm, obtuse to retuse, margin entire, midrib above not to slightly prominent, nerves 4–14 per side, 8–26 mm apart, angle to midrib 45°–70°, small pocket-like or more or less dome-shaped, usually hairy domatia present; petiolule 5–17(–25) mm, grooved above, shortly villose to glabrous. *Inflorescences* axillary, usually pseudoterminal, 3.5–18.5(–27) cm, laxly to rather densely flowered, with short or long branches, villose or rarely ± appressed-hairy; cymules dischasial, 1–several-flowered. *Bracts*

and *bracteoles* lanceolate to deltoid, 0.7–2.5 × 0.5–1.6 mm, not persistent under the fruits, thick, outside long appressed-hairy, inside rather short appressed-hairy at the base. *Pedicels* 1.8 mm, articulated at 1/3 above the base. *Buds* globular, more or less triangular in cross section, 2.6–3.4 × 3.1–4.7 mm. Male flowers: *Sepals* about orbicular, outside appressed-hairy except rim, rim ciliate, inside rather long appressed-hairy in the middle part, outer 2.3–2.4 × 1.9–2.0 mm, scarious rim absent or very narrow, inner 3.4 × 3.5 mm, scarious rim wide. *Petals* obovate to almost orbicular, 1.1–1.3 × 1.0–1.2 mm, out- and inside appressed-hairy in lower part, scales 2, not crested, 0.7–1.0 mm, long-woolly. *Disc* glabrous. *Stamens* 8, exserted, filaments 2.6–3.0 mm, patently hairy in lower half, anthers 1.2–1.7 mm, with few hairs. *Pistillode* 3-celled, outside hairy, 1.1–1.3 × 1.0–1.3 mm. Female flowers: *Sepals* persistent under the fruits, outer elliptic, 1.9–4.4 × 1.2–4.3 mm, inner 3.6–5.0 × 2.6–5.4 mm. *Petals* elliptic to almost orbicular, 1.3–3.7 × 1.0–1.9 mm, scales 1.2–2.4 mm. Filaments of *staminodes* 1.6–4.0 mm, anthers 1.4–1.9 mm, glabrous or with few hairs. *Ovary* 3-celled, outside hairy, style 1.3–1.8 mm, stigma 1.1–1.4 mm, 3-lined. *Fruits* more or less ellipsoid to cylindrical, 20–30 × 13–20 mm, stipe 2–5(–8) mm, 1, 2 or 3 cells developed, wall 1.1–1.8 mm thick, outside smooth, velutinous, inside more or less (thinly) appressed-hairy, septa complete. *Seeds* ellipsoid, 12–16 × 6–9 mm, testa brownish, arilloid covering most of the seed, lacerate, cotyledons equal or unequal, superposed.

Distribution — New Caledonia.

Notes — In this species two groups of plants can be recognized, *viz* a group with few rather large leaflets, often ± villose below, and a group with many slightly smaller leaflets, usually glabrous below. Except for two specimens (*Compton* 1795, *Hürlimann* 1837), the first group occurs in the middle and southern parts of the island; the other group occurs mainly in the northern part. Probably there are also small ecological differences. I have described both groups as varieties.

Most specimens of the present species have more leaflets than *C. macrocarpa* should have according to Radlkofer (1879, 1934). In fact many specimens can be identified as *C. azantha*, or fall between *C. macrocarpa* and *C. azantha*, with Radlkofer's (1934) and Guillaumin's (1948) keys. The differences between *C. azantha* and the present species are discussed under *C. azantha*.

KEY TO THE VARIETIES

1a. Leaves (2–)3–4(–7)-jugate; the leaflets glabrous to more or less villose below **a.** var. **macrocarpa**

b. Leaves 7–8(–10)-jugate; the leaflets usually glabrous, rarely thinly villose below **b.** var. **polyphylla**

a. var. macrocarpa — Fig. 56a–d.

Leaves (2–)3–4(–7)-jugate; petiole 4–12 cm; rachis (2.5–)8.5–17(–31) cm. Upper *leaflets* (8.5–)10.5–18.5 × 3–7.5 cm, index 1.8–3.1, below glabrous to more or less villose.

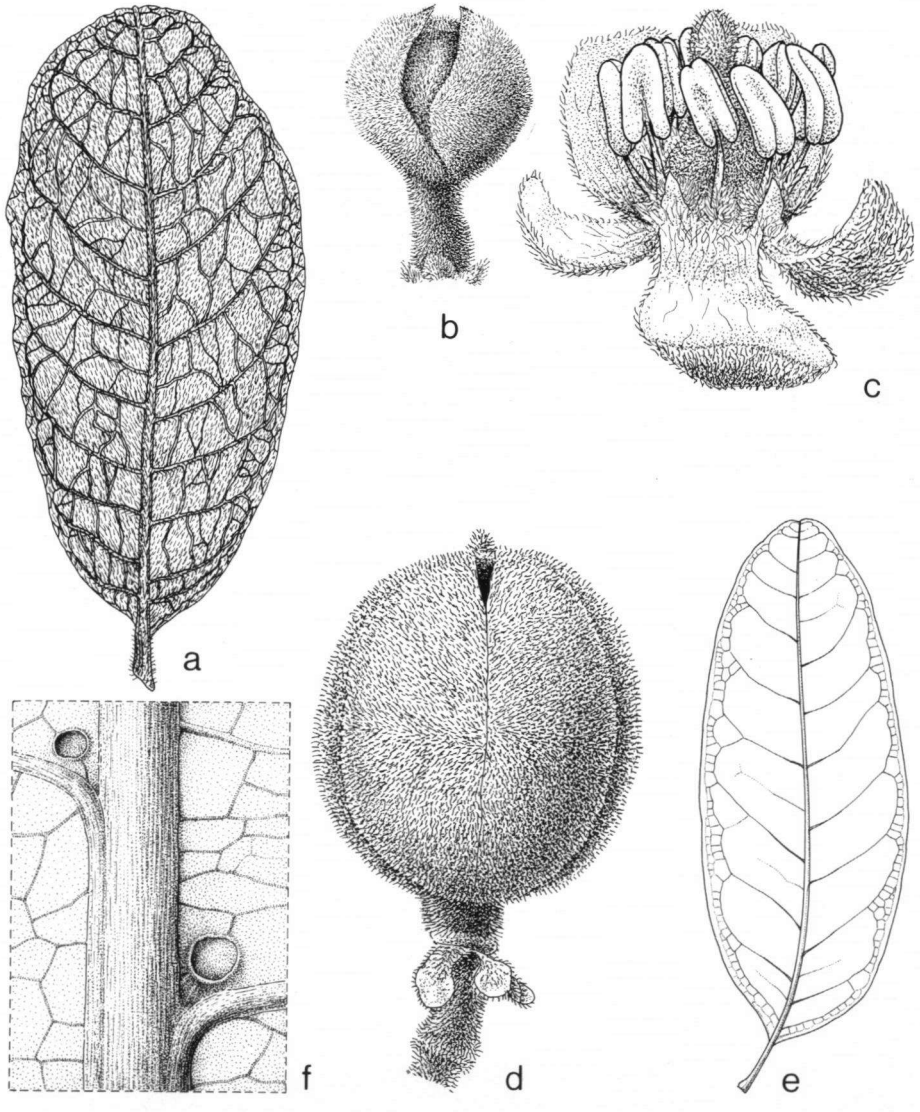

Fig. 56. *Cupaniopsis macrocarpa* Radlk. a–d: var. *macrocarpa*. a. Leaflet, × 0.65; b. flowerbud, × 8; c. female flower, × 8; d. fruit, × 2.5. e, f: var. *polyphylla* Adema. e. Leaflet, × 0.65; f. idem, detail, × 15 (a: *MacKee* 39490, L; b, c: *MacKee* 29021, L; d: *Balansa* 2262, P; e, f: *MacKee* 23729, L).

Distribution — New Caledonia (usually in the middle and southern parts; *Hürlimann* 1837, from Mt. Ignambi, and *Compton* 1795, from Mt. Panié, in the northern part).

Field notes — a. Ecological notes: Humid forests, usually in the mountains, on greywacke, serpentine or gneiss. Alt. (100–)400–1200 m. Flowering: April to July, fruiting: September to October.

b. Additional descriptive notes: Bark brown or gray, a bit rough. Leaflets shiny dark green above, dark or light green, usually brown hairy below. Buds grayish green. Flowers white or green. Stamens yellow. Fruits green with brown hairs.

c. Vernacular name: See *C. hypodermatica.*

Notes — *Ingle* 20 and *Compton* 1795 both have clearly bisexual flowers, but are otherwise not different from var. *macrocarpa. MacKee* 4399 has several leaves with a terminal leaflet (fig. 1).

Specimens examined:
NEW CALEDONIA. 22 specimens.

b. var. **polyphylla** Adema, *var. nov.* — **Fig. 56e, f.**

Differt a var. *macrocarpa* foliis plurifoliolis infra plerumque glabris. — Typus: *Bernardi* 12780, New Caledonia, Mt. Colnett, in mountainforest, 500–950 m, 19.4.1968 (G!, holo, iso in K!, P?).

Leaves 7–8(–10)-jugate; petiole (6.5–)10–13.5(–19) cm; rachis 13.5–28.5(–35) cm. Upper *leaflets* 7.5–14 × 3–5 cm, index 2.3–3.8, below usually glabrous, rarely thinly villose.

Distribution — New Caledonia (usually in the northern part; *Le Rat* 2417 and *Brinon* 738 from more southern, coastal localities).

Field notes — a. Ecological notes: Humid forests usually in the mountains, on gneiss or schists. Alt. (300–)500–950 m. Flowering: April, fruiting: (March to) July to October.

b. Additional descriptive notes: Bark pale, smooth. Leaflets shiny dark green above. Buds green. Corolla white. Anthers yellow. Fruit brown-green, brown hairy.

Specimens examined:
NEW CALEDONIA. 20 specimens.

33. **Cupaniopsis macropetala** Radlk. — **Fig. 57.**

Cupaniopsis macropetala Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. Münch. 20 (1890) 357; in Engl., Pflanzenr. 98 (1933) 1182. — *Guioa macropetala* Radlk. ex Dur. & Jacks., Ind. Kew., Suppl. 1 (1906) 190 (in errore). — Type: *Warburg* 20539, Papua New Guinea, Bussum, 3.4.1889 (B, holo, lost; iso in A!, BM!, M!, WRSL!, only fragments in the last two).

Cupaniopsis grosseserrata Radlk., Bot. Jahrb. 56 (1920) 284; in Engl., Pflanzenr. 98 (1933) 1182. — Type: *Ledermann* 7223, Papua New Guinea, East Sepik Province, May River, 9.5.1912 (B, holo, lost; iso in K!, M!, only fragments in both).

Cupaniopsis brachythyrsa Radlk., Bot. Jahrb. 56 (1920) 285; in Engl., Pflanzenr. 98 (1933) 1183. — Type: *Ledermann* 10698, Papua New Guinea, East Sepik Province, Ambunti, 1.1913 (B, holo, lost; iso in M!, fragments only).

Shrubs or *treelets* 1–6 m high, d.b.h. 1.5–8 cm, young parts and inflorescences with a dense, brownish indumentum. *Flowering twigs* terete, 3–9 mm in

diameter, striate to grooved, thinly pilose to villose. *Leaves* 2–6(–10)-jugate; petiole 4.5–16.5(–21.5) cm, semiterete, upwards terete, rachis 10–35.5(–45) cm, terete, both striate, pilose to more or less villose. *Leaflets* opposite to alternate, (narrowly) obovate or (narrowly) elliptic, slightly asymmetric, upper 12–35.5 × 3–12 cm, index 2–4.3, lower 6.5–27 × 2.5–10 cm, index 1.6–3.5, thin to thickly papyraceous, above almost glabrous to thinly pilose, midrib and nerves more

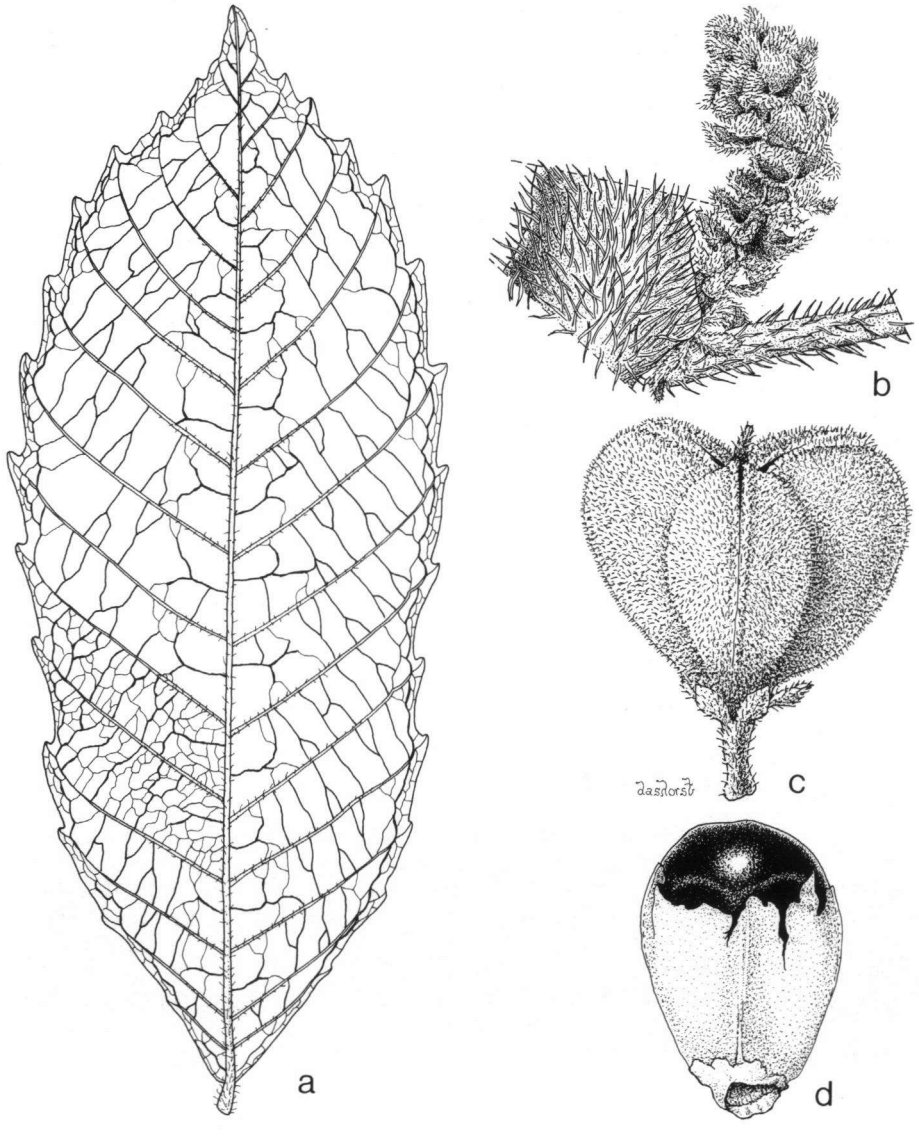

Fig. 57. *Cupaniopsis macropetala* Radlk. a. Leaflet, × 0.65; b. inflorescence, × 4; c. fruit, × 2; d seed, × 2.5 (a, b: *NGF* 46853, L; c, d: *Clemens* 121, L).

densely so, below (thinly) pilose, midrib and nerves usually more densely so, base cuneate to rounded, apex acuminate, sometimes acute, obtuse, or rounded, acumen 2–8(–15) mm, usually mucronate, margin serrate, often only obscurely so in the lower part, rarely more or less dentate, midrib above slightly prominent to somewhat sunken, nerves 8–20 per side, at least the higher ones ending in a tooth, 4–27 mm apart, angle to midrib 50°–80°, domatia, if present, obscure pocket-like; petiolule (0–)1–10(–20) mm, ± terete, rarely grooved above, more or less velutinous. *Inflorescences* axillary, 1–3 cm, in fruit up to 4.5 cm, without or rarely with short branches, densely flowered, thinly pilose to ± villose; cymules 1-flowered *Bracts* and *bracteoles* triangular to deltoid, 1.2–3.0 × 0.7–1.8 mm, acute, thick, persistent under the fruits, outside appressed-hairy, inside glabrous or with few hairs at the base. *Pedicels* ca. 1 mm, articulated at the base. *Buds* globular, 2.4–3.0 × 2.4–3.0 mm. Male flowers: *Sepals* broadly ovate to orbicular, concave, outside appressed-hairy except rim, rim ciliate, inside glabrous, outer 2.3–3.2 × 1.4–2.3 mm, scarious rim narrow, inner 2.9–3.6 × 1.8–3.0 mm, scarious rim narrow to wide. *Petals* more or less elliptic to obovate, rarely (*Kanis* 1135, *LAE* 61135) with a distinct claw, irregular dentate, 3.0–4.2 × 1.1–1.8 mm, outside glabrous or appressed-hairy in lower part, rim ciliate in lower part, inside glabrous or with few hairs in lower part, scales 2, not crested, 1.9–2.8 mm, up to ca. 2/3 adnate to the sides of the petal, woolly. *Disc* glabrous or with few scattered hairs to hairs in 5 tufts. *Stamens* 8, exserted, filaments 3.0–4.4 mm, patently hairy, anthers 1.1–2.0 mm, glabrous to hairy *Pistillode* 3-celled, 1.0–1.2 × 1.0 mm, outside hairy. Female flowers: *Sepals* persistent under the fruits, outer 1.9–2.9 × 2.0–3.6 mm, inner 2.5–4.9 × 2.4–4.3 mm. *Petals* 3.2–4.9 × 1.6–2.4 mm, scales 2.2–3.0 mm. Filaments of *staminodes* 1.8–2.4 mm, anthers 0.8–1.1 mm. *Ovary* 3-celled, outside hairy, style 2.4 mm, stigma 1.4 mm, 3-lined. *Fruits* ellipsoid to obpyramidal, rounded triangular in cross section, 13–18 × 10–18 mm, wall 0.2–0.7 mm thick, outside smooth or rugose, villose, inside glabrous to thinly appressed-hairy, septa complete, membranous. *Seeds* ellipsoid to globular, 10–14 × 6–10 mm, testa shiny black, arilloid covering half to almost the whole seed, lacerate, cotyledons equal or unequal, parallel.

Distribution — Irian Jaya; Papua New Guinea.

Field notes — a. Ecological notes: Primary or secondary forests, often on slopes, on limestone or old volcanic soil, along rivers or lakes. Alt. 50–1550 m. Flowering: (March to) October (to December), fruiting: February to October (to December).

b. Additional descriptive notes: Bark smooth, finely striate, dark brown or black, under bark red, inner bark brown. Wood reddish brown. Leaves bright to dull, mid- to grayish or dark green above, paler green below. Flowers green, yellowish, or cream. Fruits red to orange, inside yellowish. Seeds black, arilloid red to orange or golden brown.

c. Vernacular names: Dolo (Sentani), Teman (Eipomek), Tewal (Sepik, Ossima).

Notes — In this species I have combined the three species of section *Macropetalum* Radlk. In thoroughly comparing these species only differences in the hairiness of the disc and the anthers could be found.

Cupaniopsis	Disc	Anthers
brachythyrsa	5 tufts of hairs	hairy
grosseserrata	5 tufts of hairs	glabrous
macropetala	glabrous	glabrous

However, in *brachythyrsa* specimens with almost glabrous discs, and specimens with far less hairy anthers were found. In *macropetala* hairy instead of glabrous anthers were found.

The differences as given in the table above are in my opinion too slight to maintain these taxa as separate species.

C. macropetala s.l. is a rather variable species, especially in leafshape and -texture.

The specimen *NGF* 46853 shows a tendency towards a more appressed hairiness. *Clemens* 121, *NGF* 33021, and *Van Royen* 5482 have longer petioles. The last one has also more leaflets than all other specimens. *Clemens* 670, 1104 have longer petiolules. *Kanis* 1135 and *LAE* 61135 have larger flowers with petals with a 2.4 mm long claw.

Specimens examined:
NEW GUINEA. Irian Jaya: 6 specimens; Papua New Guinea: 22 specimens.

34. Cupaniopsis megalocarpa Adema, *spec. nov.* — Fig. 58.

Arbuscula vel frutex 2.5–6 m alta, partibus juvenilibus villosis. Differt a *C. macrocarpa*: discus pilosus, capsula maior. — Typus: *MacKee* 17654, New Caledonia, Route de Dzumac, audessus de la Couvelée, alt. 200–500 m, 11.10.1967 (P!, holo, iso in L!).

Treelets or *shrubs*, 2.5–8 m high. *Flowering twigs* terete, 4–7 mm in diameter, striate to grooved, more or less villose. *Leaves* 3–5-jugate, exceptionally with a terminal leaflet; petiole (3–)7–14.5 cm, semiterete, rarely upwards terete, rachis 6.5–21 cm, more or less semiterete or terete, both striate, ± villose to glabrous. *Leaflets* opposite to alternate, elliptic to ovate, symmetric to slightly asymmetric, upper 7–17 × 3–7 cm, index 2.2–3.4, lower 5–13 × 3–7 cm, index 1.7–2.9, coriaceous, above glabrous, rarely with some hairs, below glabrous to thinly puberulous, midrib with few short hairs to more or less villose, base cuneate to rounded, apex obtuse to rounded, retuse, rarely acuminate, acumen 6–7 mm, retuse, margin entire, midrib above slightly prominent to slightly sunken, nerves 6–9(–14) per side, 8–24 mm apart, angle to midrib 45°–65°, small pocket-like to dome-shaped domatia present; petiolule (4–)10–15(–21) mm, grooved above, glabrous. *Inflorescences* axillary, 5.5–13.5 cm, laxly to rather densely flowered, without or with short or long branches, ± villose; cymules 1-flowered. *Bracts* and *bracteoles* lanceolate to triangular, 1.1–2.9 × 0.7–1.9 mm, not persistent under the fruits, outside appressed-hairy, inside with some hairs at the base. *Buds* about globular, 3.6 × 4.4 mm. Male flowers: *Sepals* broadly elliptic to orbicular, thick, irregular dentate, out- and inside appressed-hairy except rim, rim ciliate, outer 3.0–3.4 × 2.4–3.0 mm, without scarious rims, inner 4.6 × 3.6 mm, scarious rim

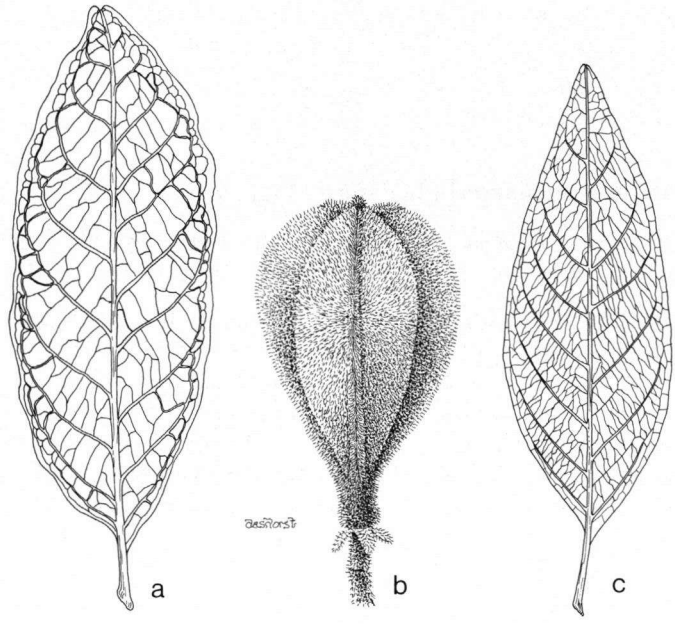

Fig. 58. *Cupaniopsis megalocarpa* Adema. a. Leaflet, × 0.5; b. fruit, × 1.25 (a, b: *MacKee* 17654, L). — Fig. 59. *Cupaniopsis mouana* Guillaumin. c. Leaflet, × 0.75 [*Baas Becking* s.n. (*Baumann-Bodenheim* 6036), P].

narrow to wide. *Petals* more or less elliptic, 1.2–1.8 × 0.8–1.1 mm, out- and inside appressed-hairy in lower half, scales 2, without or with crests, 1.0–1.2 mm, woolly. *Disc* with 5 tufts of hairs. *Stamens* 8, exserted, filaments 2.0–2.4 mm, hairy in lower half, anthers 1.8–1.9 mm, with few hairs. *Pistillode* 3-celled, outside hairy, 1.2 × 1.0 mm. Female flowers: Outer *sepals* 3.4–4.3 × 2.2–3.6 mm, inner 4.1–5.4 × 3.6–4.6 mm. *Petals* 1.8–2.5 × 1.1–1.7 mm, scales 1.2–1.7 mm. Filaments of *staminodes* 1.8–2.9 mm, patently hairy in lower half, anthers 1.2–1.6 mm, glabrous to hairy. *Ovary* 3-celled, outside hairy, style 1.8–2.0 mm, stigma 1.1–1.4 mm, 3-lined. Young *fruits* 29–35 × 22–25 mm, stipe 3–5 mm, wall 1.8–2.4 mm thick, outside smooth, shortly velutinous, inside villose to more or less appressed-hairy, septa complete. Young *seeds* covered for 2/3 to wholly by the lacerate arilloid.

Distribution — New Caledonia.

Field notes — a. Ecological notes: Forests on serpentine. Alt. 110–700 m. Flowering: June to August, fruiting: October.

b. Additional descriptive notes: Indumentum bronze coloured. Leaflets dark glossy green above, light green below. Calyx silvery with little green bronze colour. Corolla white. Filaments white, pollen yellow. Fruits brown to grayish or pale green.

Notes — This new species seems closely related to *C. macrocarpa* var. *macrocarpa*. The latter has glabrous discs and smaller fruits, however.

Specimens examined:
NEW CALEDONIA. 7 specimens.

35. Cupaniopsis mouana Guillaumin — Fig. 59.

Cupaniopsis mouana Guillaumin, Mém. Mus. Nat. Hist. Nat. B, 15 (1967) 109. — Type: *Baas Becking* s.n. (*Baumann-Bodenheim* 6036), New Caledonia, Mt. Mou, 8.2.1950 (P!, holo).

Flowering twigs terete, ca. 1 mm in diameter, striate, young parts with small scale hairs, varnished. *Leaves* 3–5-jugate; petiole 3–5 cm, rachis 4–8.5 cm, both semiterete, striate, glabrous or with short patent hairs (especially above). *Leaflets* subopposite to alternate, narrowly elliptic to ovate, slightly asymmetric, upper 6–8.5 × 1.5–3 cm, index 3.1–4.4, lower 4.5–8 × 1.5–3 cm, index 2.9–3.4, chartaceous, above almost glabrous, midrib with few, short hairs, below with some scattered scales, base (broadly) cuneate, apex obtuse to acuminate, acumen 3–4 mm, rounded, margin entire, midrib above slightly prominent, nerves 7–9 per side, 4–14 mm apart, angle to midrib 55°; petiolule 5–10 mm, grooved above, above with short patent hairs. *Inflorescences* axillary, 4–7.5 cm, laxly flowered, with long and short branches. *Bracts* and *bracteoles* lanceolate, 0.7–0.8 × 0.4 mm, outside with scale hairs, inside glabrous. *Pedicels* 3.2–4.8 mm, articulated at 1/3 above the base. Male flowers: *Sepals* with wide scarious rims, out- and inside glabrous, rim ciliate at the base, outer ± elliptic, 1.9–2.4 × 1.4–1.6 mm, inner more or less obovate, 3.1 × 2.0 mm. *Petals* 6, ± elliptic, 2.6–3.0 × 1.3–1.8 mm, out- and inside with some appressed hairs at the base, rim ciliate at base, scales 2, not crested, 0.7–1.1 mm, woolly. *Disc* glabrous. *Stamens* 8, not exserted, filaments 1.1–1.2 mm, patently hairy except apex, anthers 1.2 mm, hairy. *Pistillode* 3-celled, outside with scale hairs and few hairs, 1.2 × 0.7 mm. Female flowers: Outer *sepals* 2.3–3.0 × 1.8–1.9 mm, inner 3.6 × 2.2 mm. Filaments of *staminodes* 1.3 mm, anthers 1.2 mm. *Ovary* 3-celled, outside with scale and some short hairs, style 1.7 mm, stigma 1.1 mm, 3-lined.

Distribution — New Caledonia (Mt. Mou).

Specimens examined:
NEW CALEDONIA. Mt. Mou: *Baas Becking* s.n. (*Baumann-Bodenheim* 6036).

36. Cupaniopsis myrmoctona Radlk. — Fig. 60.

Cupaniopsis myrmoctona Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. Münch. 9 (1879) 588; Guillaumin, Bull. Soc. Bot. Fr. 79 (1932) 340; Radlk. in Engl., Pflanzenr. 98 (1933) 1202; Guillaumin, Fl. Nouv.-Caléd. (1948) 200. — Lectotype (present author): *Labillardière* s.n., New Caledonia (G!, holo).

Shrubs or *trees* 2–9(–14) m high, d.b.h. 5–20 cm, very young parts sometimes 'varnished'. *Flowering twigs* terete, 1–2 mm in diameter, striate, with minute scale hairs, usually pruinose. *Leaves* 1–3(–4)-jugate; petiole 1.5–10 cm, rachis

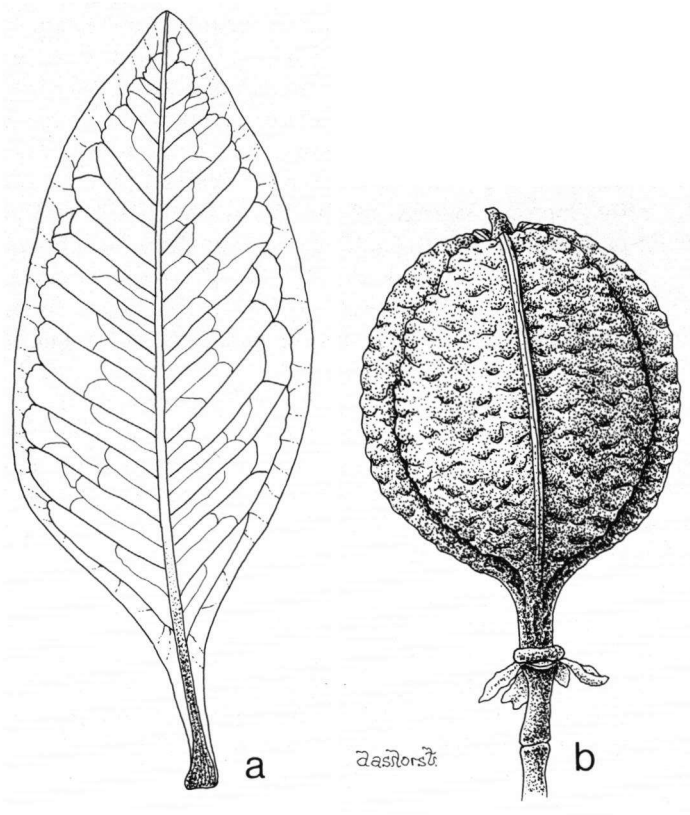

Fig. 60. *Cupaniopsis myrmoctona* Radlk. a. Leaflet, × 1.5; b. fruit, × 3.5 (a: *McPherson* 2542, L b: *McPherson* 2981, L).

1–10.5 cm, both semiterete, grooved above, striate, with scale hairs, exceptionally (*McPherson* 2616) above with short hairs or glabrous, usually pruinose. *Leaflets* opposite to alternate, elliptic to (narrowly) ovate, slightly asymmetric, upper 4–10 × 1.5–4 cm, index 2.3–3.8, lower 3–7.5 × 1–3.5 cm, index 1.5–4, thick chartaceous, above and below glabrous or with scattered scale hairs, midrib usually pruinose, below with more scale hairs than above, base (broadly) cuneate, tapering into petiolules, apex obtuse to acuminate, acumen 2–14 mm, rounded, margin entire, midrib above slightly prominent, nerves 7–12(–14) per side, 1–13 mm apart, angle to midrib 45°–65°; petiolule 0–6(–9) mm, grooved above, with scale hairs, exceptionally (*McPherson* 2616) also with short hairs, pruinose. *Inflorescences* axillary or pseudoterminal, 4–17 cm, laxly flowered, with long branches, with scale hairs; cymules dichasial, 1–several-flowered. *Bracts* and *bracteoles* lanceolate to deltoid, 0.4–0.8 × 0.2–0.4 mm, not persistent under the fruits, outside with scale hairs, inside glabrous. *Pedicels* 1.4–1.9 mm, articulated at 1/7–1/3 above the base, with scale hairs. *Buds* about globular, 1.6–2.4 × 1.7–2.4

mm. Male flowers: *Sepals* outside with some scale hairs in lower part, rim ciliolate and with glands, inside shortly appressed-hairy in lower part, outer transversely elliptic to almost orbicular, 0.8–1.3 × 1.1–1.3 mm, scarious rim narrow, inner about orbicular, 2.4–2.5 × 2.3–2.6 mm, scarious rim wide. *Petals* elliptic, irregular dentate at apex, 1.6–2.6 × 0.8–1.4 mm, outside glabrous, rim ciliolate in basal part, inside appressed-hairy in lower part, scales 2, not crested, 0.8–1.6 mm, woolly. *Disc* glabrous. *Stamens* 8, exserted, filaments 1.8–2.4 mm, patently hairy in lower part, anthers 0.8–1.1 mm, hairy. *Pistillode* 3-celled, outside glabrous, 0.8–1.6 × 0.6–0.8 mm. Female flowers: *Sepals* persistent or not under the fruits, outer 0.8–1.8 × 1.0–1.6 mm, inner 2.4–3.0 × 2.5–2.9 mm. *Petals* 1.7–2.3 × 1.3–1.8 mm, scales 1.1–1.7 mm. Filaments of *staminodes* 1.1–1.7 mm, anthers 1.0–1.2 mm. *Ovary* 3-celled, outside glabrous, style 0.7–1.4 mm, stigma 0.7–0.8 mm, 3-lined. *Fruits* almost globular, obscurely triangular in cross section, 13–17 × 9–15 mm, stipe 2–3 mm, glabrous or with few appressed hairs, wall 0.6–0.7 mm thick, outside rugose, glabrous, inside with long stiff hairs, rarely almost glabrous, septa complete. *Seeds* more or less ellipsoid, 8–9 × 5–6 mm, testa brownish, arilloid oblique, lobed and long-lacerate, covering 2/3 to most of the seed, cotyledons unequal, superposed.

Distribution — New Caledonia.

Field notes — a. Ecological notes: Humid forests, rarely in maquis, in the mountains, on schists or serpentine. Alt. (50–)300–1100 m. Flowering: February to April, fruiting: May to October.

b. Additional descriptive notes: Bark brown or gray, smooth or a bit rough. Leaflets light or dark green above, light green below. Flowers scented. Calyx green-white. Corolla white. Filaments white, anthers pale yellow. Fruits green, black when old.

Notes — As the bases of the leaflets taper into the petiolules it is often difficult to give a proper measurement for the petiolule.

McPherson 2427 has larger flowers.

Godefroy s.n. (herb. d'Alleizette 179, L) probably belongs here, it differs especially in the larger number of leaflets with a more rounded apex.

The occurrence of short patent hairs is in *C. myrmoctona* very rare.

Specimens examined:
NEW CALEDONIA. 32 specimens.

37. **Cupaniopsis napaensis** Adema, *spec. nov.* — **Fig. 61.**

Ramunculis florentibus sulcatis, tomentosis. Folia 11-jugata. Discus pilis quinquefasciculatis obsitus. Testa pilis brevis apicem versus obsita. — Typus: *UPNG* 4353, Papua New Guinea, Central Province, Port Moresby Subdistrict, 1–2 km along Napa-Napa road, west of Barune Junction, alt. 10 m, 24.8.1974 (BISH!, holo, iso in K!, L!, LAE!).

Palmoid *tree*, 7 m high. *Flowering twigs* 15 mm in diameter, grooved, more or less tomentose, also with longer hairs. *Leaves* 11-jugate; petiole 11.5 cm, semiterete, upwards terete, rachis 47.5 cm, terete, but semiterete near petiolules, both striate, ± tomentose, also with longer hairs. *Leaflets* (sub)opposite, elliptic,

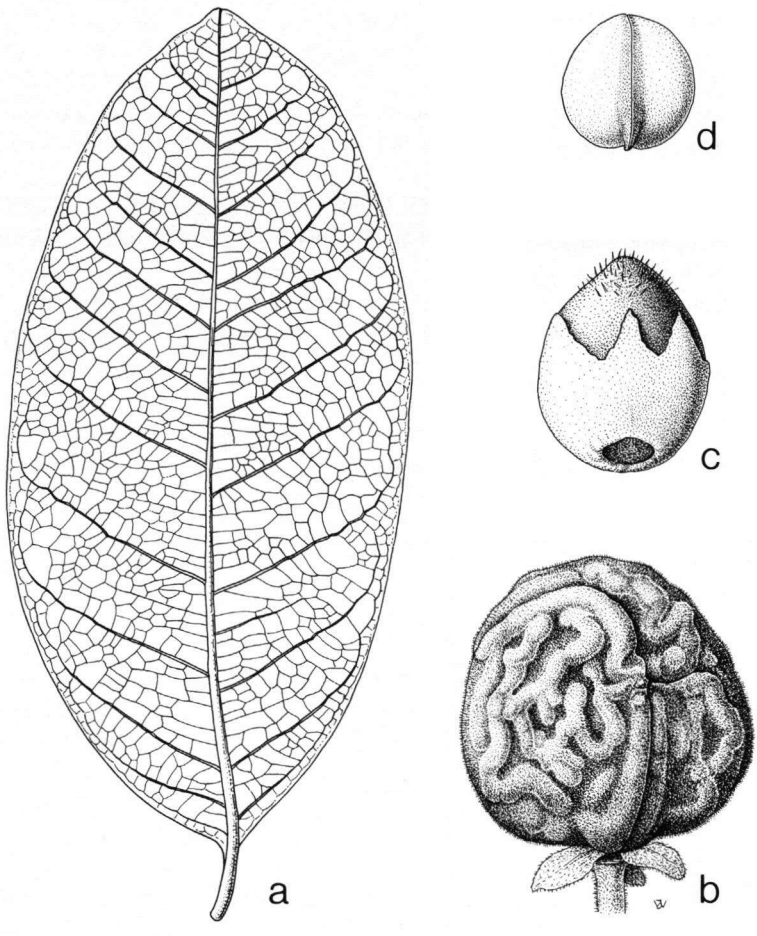

Fig. 61. *Cupaniopsis napaensis* Adema. a. Leaflet, × 0.75; b. fruit, × 2; c. seed, × 2; d. embryo, × 2 (a–d: *UPNG* 4353, L).

slightly asymmetric, upper 21.5 × 7.1 cm, index 3, chartaceous, above almost glabrous, midrib puberulous, nerves puberulous in lower part, thinning upwards, below thinly puberulous especially on midrib and nerves, base cuneate, apex rounded, margin entire to obscurely crenate, midrib above slightly sunken, nerves 10–18 per side, 12–17 mm apart, angle to midrib 60°–70°; petiolule 15–17 mm, grooved above, more or less tomentose. *Inflorescences* supra-axillary, 31.5 cm, laxly flowered, with long branches, ± tomentose. Female flowers: *Disc* with 5 tufts of hairs. *Staminodes* 8, filaments and anthers hairy. *Fruits* 3-celled, wall 3.6 mm thick, outside rugose, tomentose, inside villose, septa complete. *Seeds* 1.4 × 0.9 mm, basally attached, testa with short hairs at the apex, arilloid lacerate, cotyledons equal, parallel.

Distribution — Papua New Guinea (Central Province).

Field notes — a. Ecological notes: Gallery scrub along edge of dry creek. Alt. 10 m. Fruiting: August.

b. Additional descriptive notes: Several stemmed tree with rosette crowns. Leaflets olive-green above, paler beneath. Flowers cream orange. Fruits orange. Seeds black purple, with orange aril.

Notes — The present species is in indumentum quite similar to *C. anacardioides* and *C. stenopetala*, but rather different in the leaves. The leaflets have much longer petiolules than those of the latter two species.

This new species is the only one in *Cupaniopsis* with seeds with a hairy testa.

Specimen examined:
PAPUA NEW GUINEA. Central Province, Port Moresby Subdistrict: *UPGN* 4353.

38. Cupaniopsis newmannii Reynolds — Fig. 62.

Cupaniopsis newmannii Reynolds, Austrobaileya 2 (1984) 49, fig. 4H–N; Fl. Austr. 25 (1985) 60, map 75. — Type: *Jessup & Reynolds* 158, Australia, Queensland, Moreton District, Lower Beechmont Road, near Numinbah Valley Road intersection, 12.1978 (BRI!, holo).

Shrubs or palmoid, little branched or unbranched *trees* 2–6(–12) m high. *Flowering twigs* terete, 3–7 mm in diameter, grooved, rarely striate, more or less tomentose. *Leaves* (7–)10–12-jugate; petiole 5–14 cm, semiterete, usually upwards terete, rachis 22–46.5 cm, semiterete or more or less terete, sometimes semiterete only upwards, both striate, ± tomentose. *Leaflets* alternate, sometimes subopposite, (narrowly) elliptic to (narrowly) ovate, slightly asymmetric, upper 11–22 × 2–6 cm, index 3.2–5.3, lower 6–12.5 × 2.5–6 cm, index 1.8–3, coriaceous, above and below (almost) glabrous, midrib glabrous to thinly appressed-hairy, base cuneate to rounded, apex acuminate, rarely obtuse to rounded, acumen 2–17 mm, acute or mucronate, rarely rounded, margin dentate, rarely obscurely so, midrib slightly sunken above, nerves 7–21 per side, most ending in a tooth, 5–15 mm apart, angle to midrib 50°–70°, small pocket-like domatia present; petiolule 2–20 mm, grooved, glabrous to thinly appressed-hairy. *Inflorescences* axillary or pseudoterminal, 14–27 cm, laxly flowered, with long or sometimes short branches, ± tomentose; cymules 1-flowered. *Bracts* and *bracteoles* 'squarish', 1.2–3.2 × 0.7–1.8 mm, not persistent under the fruits, outside appressed-hairy, margin ciliate, sometimes also with some glands, inside appressed-hairy at base. *Pedicels* 0.6–0.8 mm, articulated at the base. *Buds* 3.6–4.2 × 2.4–3.1 mm. Male flowers: *Sepals* outside appressed-hairy except rim, rim ciliate and with glands, inside with scattered appressed hairs, outer (broad-)elliptic, 2.9–3.8 × 2.0–2.9 mm, scarious rim narrow, inner about orbicular, 4.2–4.7 × 2.6–3.6 mm, scarious rim wide. *Petals* transversely elliptic, crenate to lobed, 1.2–1.8 × 1.8–2.2 mm, outside appressed-hairy in lower part, rim rarely with few hairs, inside glabrous, scales 2, not crested, 0.5–1.2 mm, ciliate. *Disc* with few to many hairs, more or less in 5 tufts. *Stamens* 8, not exserted, filaments 1.8–2.4 mm, patently hairy in lower half, anthers 2.2–2.3 mm, glabrous *Pistillode* 3-celled, outside hairy,

1.0–1.2 × 1.0 mm. Female flowers: *Sepals* persistent under the fruits, outer 2.6–5.0 × 2.0–3.8 mm, inner obovate to orbicular, 4.2–5.2 × 3.0–5.0 mm. *Petals* 1.9–2.2 × 1.8–2.2 mm, rarely with a claw of 0.2 mm, scales 1.3–1.4 mm. Filaments of *staminodes* 2.4–2.8 mm, anthers 1.8–2.5 mm. *Ovary* 3-celled, outside hairy, style 1.4–1.9 mm, stigma 1.1–1.3 mm, 3-lined. *Fruits* ca. 15 × 17 mm, stipe 1–1.5 mm,

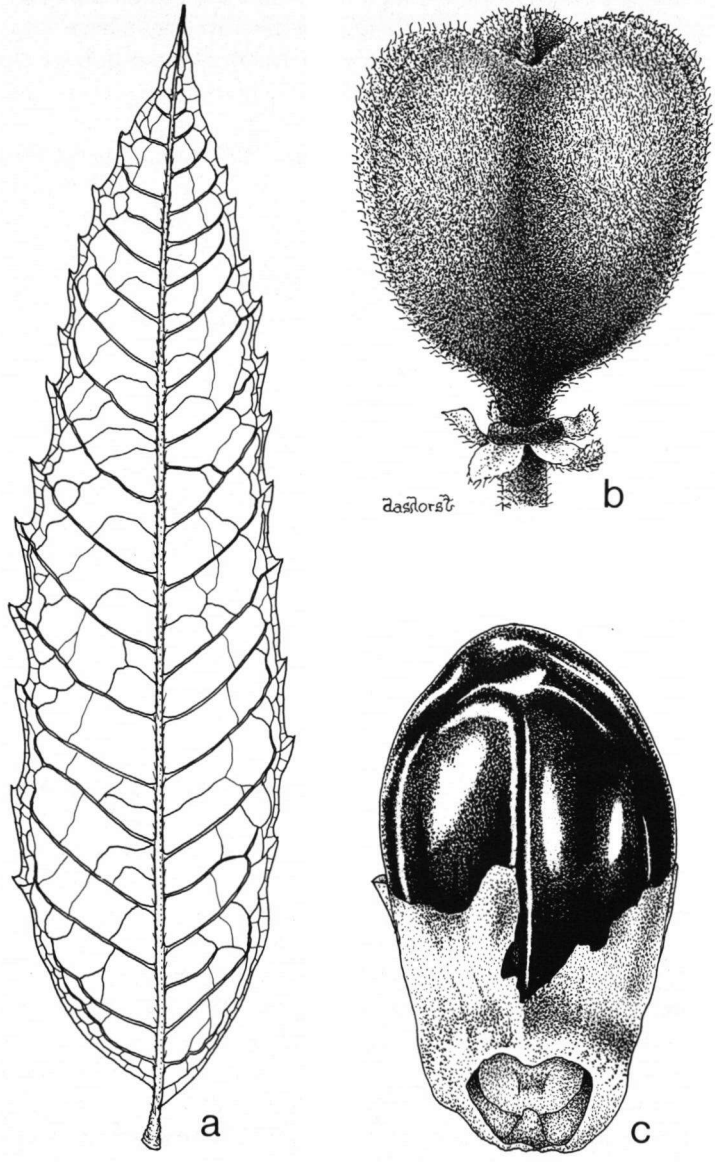

Fig. 62. *Cupaniopsis newmannii* Reynolds. a. Leaflet, × 0.75; b. fruit, × 4; c. seed, × 3.5 (a: *Jessup & Reynolds* 555, BRI; b, c: *Lemaire* s.n., NSW 179438).

wall 0.7–1.2 mm thick, outside rugose, villose, inside appressed hairy, septa complete. *Seeds* 14–17 × 9–10 mm, testa shiny black, arilloid covering about half of seed, lacerate, cotyledons more or less equal, obliquely superposed.

Distribution — Australia (SE Queensland; NE New South Wales).

Field notes — a. Ecological notes: More or less open rain forest with closed forest understorey on hill tops and mountainsides, sometimes along a dry creek. Flowering: August to October, fruiting: September to December.

b. Additional descriptive notes: Trees in small clumps; bole straight, trunk smooth. Buds pinkish. Sepals dull red. Petals white or deep pink, scales white. Filaments white, anthers yellow. Fruits rusty brown, pink flushed.

Notes — Very similar to *C. flagelliformis*. The present species is usually a smaller tree, with leaves with longer petioles and rachises, and more leaflets on longer petiolules, the petals are wider than long, the stamens have larger anthers on longer filaments.

Specimens examined:
AUSTRALIA. SE Queensland: 14 specimens; NE New South Wales: 7 specimens.

39. Cupaniopsis oedipoda Radlk. — Fig. 63.

Cupaniopsisis oedipoda Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. Münch. 9 (1879) 390; Guillaumin, Bull. Soc. Bot. Fr. 79 (1932) 339, 340; Radlk. in Engl., Pflanzenr. 98 (1933) 1205; Däniker, Mitt. Bot. Mus. Univ. Zürich 142 (1933) 248; Guillaumin, Fl. Nouv.-Caléd. (1948) 200. — Lectotype (present author): *Pancher* s.n., New Caledonia, escarpment of Mt. Koghi (Congui), 11.1962 (P!, holo, iso in M!). Paratypes: *Balansa* 153pp, 1441, 2257, *Baudouin* 354pp (all in P!).

Cupaniopsis ganophloea Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. Münch. 9 (1879) 390; Guillaumin, Bull. Soc. Bot. Fr. 79 (1932) 340; Radlk. in Engl., Pflanzenr. 98 (1933) 1205; Däniker, Mitt. Bot. Mus. Univ. Zürich 142 (1933) 247; Guillaumin, Fl. Nouv.-Caléd. (1948) 200. — Syntypes: *Labillardière* s.n., New Caledonia (n.v.); *Vieillard* 227, New Caledonia, Balade (P!); *Vieillard* 230, New Caledonia, Balade (P!); *Pancher* 77 (777), New Caledonia (P!).

Slender, sometimes unbranched *shrubs* or small, sometimes palmoid *trees*, 1.5–10 m high. *Flowering twigs* terete, 2–8 mm in diameter, smooth or striate, glabrous or when young with scale and short patent hairs. *Leaves* (4–)5–12-jugate; petiole (5.5–)7–24 cm, semiterete, upwards terete, rachis 16–48.5 cm, more or less terete, sometimes upwards semiterete, both smooth or striate, glabrous or with scale and short patent hairs, rarely densely short hairy throughout, exceptionally with a 17–45 mm long process at the apex. *Leaflets* opposite to alternate, (narrowly) ovate, ± asymmetric, upper 10–31 × 2.5–10.5 cm, index 2.2–5.4, lower (5.5–)7–20(–26) × 2–7.5(–9.5) cm, index 1.8–4, coriaceous, above and below glabrous or with few, scattered scale hairs, sometimes midrib with few short hairs, base cuneate to rounded, apex obtuse to rounded, rarely retuse, often acuminate, acumen (3–)6–15 mm, acute to rounded or retuse, margin entire, exceptionally (*Bernardi* 12790, *Vieillard* 227) dentate to crenate in upper part, midrib above more or less prominent, nerves (6–)9–18 per side, strongly curved upwards, 6–25(–34) mm apart, angle to midrib 45°–60°, sometimes with small pocket-like

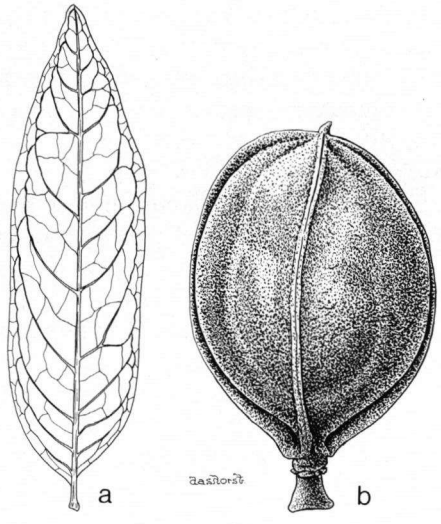

Fig. 63. *Cupaniopsis oedipoda* Radlk. a. Leaflet, × 0.5; b. fruit, × 2.5 (a, b: *C.T. White* 2042, A).

domatia; petiolule (3–)7–25 mm, grooved above, glabrous, or at base and above with short hairs. *Inflorescences* axillary or ramiflorous, usually in bundles, 2–32 cm, laxly to rather densely flowered, usually with long branches at least basally, wart-like small to rather big brachyblasts may be present, with minute scale and short patent hairs; cymules dichasial, 1–3-flowered. *Bracts* and *bracteoles* subulate to ovate or deltoid, 0.2–1.0 × 0.1–0.4 mm, not persistent under the fruits, outside with scale and short appressed hairs, especially towards apex and margins, inside glabrous or with scale hairs at the base. *Pedicels* 0.7–2.4 mm, articulated at 1/6–1/2 above the base. *Buds* globular, 1.1–2.0 × 1.1–2.4 mm. Male flowers: *Sepals* out- and inside glabrous, rim ciliolate and with glands, outer elliptic to orbicular, 1.0–2.4 × 0.8–1.7 mm, scarious rim narrow to rather wide, inner more or less orbicular, 1.8–3.1 × 1.7–3.1 mm, scarious rim wide. *Petals* elliptic to ovate, deltoid or 5-angled, 0.5–3.2 × 0.3–1.9 mm, irregular dentate, outside glabrous or appressed-hairy in lower half, rim long-ciliate in lower half, inside glabrous or with some appressed hairs, scales 2, not crested, 0.2–1.8 mm, long-woolly. *Disc* glabrous. *Stamens* 8, rarely 7, exserted, filaments 2.0–3.0 mm, patently hairy except apex, anthers 0.6–1.1 mm, hairy, rarely glabrous. *Pistillode* 3-celled, outside appressed-hairy at apex and ribs, 0.6–1.1 × 0.4–0.6 mm. Female flowers: *Sepals* not persistent under the fruits, outer 1.7–2.2 × 1.2–2.0 mm, inner 3.2 × 3.6 mm. *Ovary* 3-celled, 3-ribbed, outside hairy at apex and on ribs, style 1.1–1.2 mm, stigma 1.1–1.2 mm, 3-lined. *Fruits* more or less cylindrical, ovoid or almost globular, 16–27 × 9–18 mm, stipe 1–2 mm, 1, 2, or 3 cells developed, wall 0.6–1.1 mm thick, outside smooth, glabrous, exceptionally with some scattered scale hairs in lower part (*Jaffré* 20), inside glabrous or rarely hairy when young, septa

complete. *Seeds* ovoid, 11–19 × 5–13 mm, testa blackish, arilloid covering half to most of the seed, split almost to the base at hilar side, with a small lobe at the base of the split, this lobe sometimes fingerlike enlarged to apex of seed, marginally and apically lacerate, cotyledons equal or unequal, superposed, exceptionally parallel (*McPherson* 2510).

Distribution — New Caledonia.

Field notes — a. Ecological notes: Maquis, humid forests, gallery forests or forest remnants, often along streams, usually on hill- or mountainsides, on serpentine, greywacke and schists. Alt. 0–850 m. Flowering: January to August (to November), fruiting: (January to) August to December.

b. Additional descriptive notes: Leaflets usually shiny dark green on both sides, sometimes duller and lighter green below, midrib reddish. Buds greenish white. Petals white. Fruits green to brown or dark red. Arilloid orange.

c. Vernacular name: Koré (Monéo).

Notes — This species is rather variable, especially in the size and shape of the leaflets. *Bernardi* 12790 and *Vieillard* 227 have dentate to crenate leaflets. *McPherson* 2510 has large leaflets, a short arilloid with a long middle lobe, and sometimes parallel cotyledons. *Webster & Hildreth* 14842 has leaves with many leaflets with many nerves, and long inflorescences. *Mackee* 32734 has rather densely hairy petioles and rachises, a terminal reticulate veined process of 4.5 cm long at the rachis, and narrow sepals. *Mackee* 30948 has narrow leaflets and rather long inflorescences.

Specimens examined:
NEW CALEDONIA. 104 specimens.

40. Cupaniopsis pennelii Guillaumin — Fig. 64.

Cupaniopsis pennelii Guillaumin, Bull. Soc. Bot. Fr. 79 (1932) 338; Radlk. in Engl., Pflanzenr. 98 (1933) 1206; Guillaumin, Fl. Nouv. Caléd. (1948) 200. — Type: *Pennel* 403, New Caledonia, Bourail (P!, holo).

Trees or *treelets* 2–10 m high, d.b.h. 20 cm, young parts with few minute scale and short patent hairs, later on only with hairs. *Flowering twigs* terete, 1–2 mm in diameter, striate, pruinose, glabrous or at least young parts with short patent hairs, 'varnished'. *Leaves* 2–3-jugate; petiole 2–7.5 cm, semiterete, usually upwards more or less terete, rachis 2–8 cm, ± terete or semiterete, both striate, pruinose, glabrous or above with short patent hairs. *Leaflets* opposite to alternate, elliptic to ovate, slightly asymmetric, upper 5.5–12.5 × 2.5–4.5 cm, index 2.2–3.3, lower 5.5–7.5 × 2–5 cm, index 1.9–3.4, chartaceous to coriaceous, above and below glabrous, midrib and margin with or without short hairs in lower part, midrib usually pruinose, base cuneate to rounded, apex obtuse to rounded, rarely retuse, margin entire, midrib (ending before apex) above slightly prominent, nerves 6–9 per side, 5–18 mm apart, angle to midrib 45°(–60°); petiolule 2–3(–10) mm, grooved above, pruinose, glabrous or above with short hairs. *Inflorescences* axillary, 2–8(–14.5) cm, laxly flowered, with long or short branches;

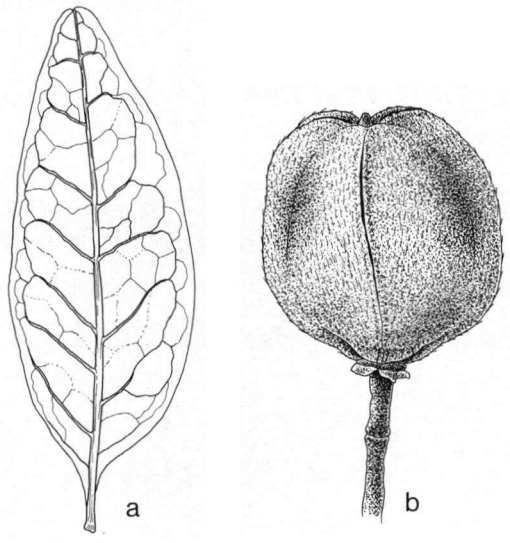

Fig. 64. *Cupaniopsis pennelii* Guillaimin. a. Leaflet, × 0.75; b. fruit, 2 (a, b: *McPherson* 5584, L).

cymules dichasial, 1–several-flowered. *Bracts* and *bracteoles* anceolate to subulate, 0.2–1.1 × 0.1–0.4 mm, not persistent under the fruits, outside rather long appressed-hairy, inside glabrous. *Pedicels* 4.2 mm, articulated at 1/8–1/5 above the base, glabrous or with short patent hairs. *Buds* globular, 2.4 × 2.4 mm. Male flowers: *Sepals* broadly elliptic to orbicular, out- and inside glabrous, rim ciliate, outer 2.2–3.0 × 1.9–2.4 mm, scarious rim rather wide, inner 2.9–3.6 × 2.9 mm, scarious rim wide. *Petals* elliptic to ovate (oblique), 2.2–3.4 × 1.3–2.0 mm, outside glabrous, rim ciliate, inside with some appressed hairs, scales 2, not crested, 0.8–1.4 mm, ciliate. *Disc* glabrous. *Stamens* 8, exserted, filaments 2.0–3.4 mm, patently hairy except apex, anthers 1.1–1.4 mm, patently hairy *Pistillode* 3-celled, 0.8–1.0 × 0.4–0.6 mm, outside hairy. Female flowers: *Sepals* not persistent under the fruits, outer 2.4–2.6 × 2.0–2.4 mm, inner 3.4–3.6 × 3.0 mm, inside sometimes with some appressed hairs in lower part. *Petals* 2.5–2.8 × 1.7–1.8 mm, scales 1.1–1.8 mm. Filaments of *staminodes* 1.4–1.6 mm, anthers 1.1 mm. *Ovary* 3-celled, outside glabrous, style 1.2 mm, stigma 0.7 mm, 3-lined. *Fruits* more or less cylindrical, 20 × 18 mm, wall 1.8–1.9 mm thick, outside smooth, thinly shortly appressed-hairy, inside glabrous, septa complete. Young *seeds* almost totally covered by the long-fimbriate arilloid, cotyledons superposed.

Distribution — New Caledonia.

Field notes — a. Ecological notes: Forests on limestone. Alt. 20–100 m. Flowering: October to December, fruiting: March, December.

b. Additional descriptive notes: Leaflets shiny dark green above, duller below. Sepals pinkish. Petals white. Anthers light green. Fruit green.

Specimens examined.

NEW CALEDONIA. 6 specimens.

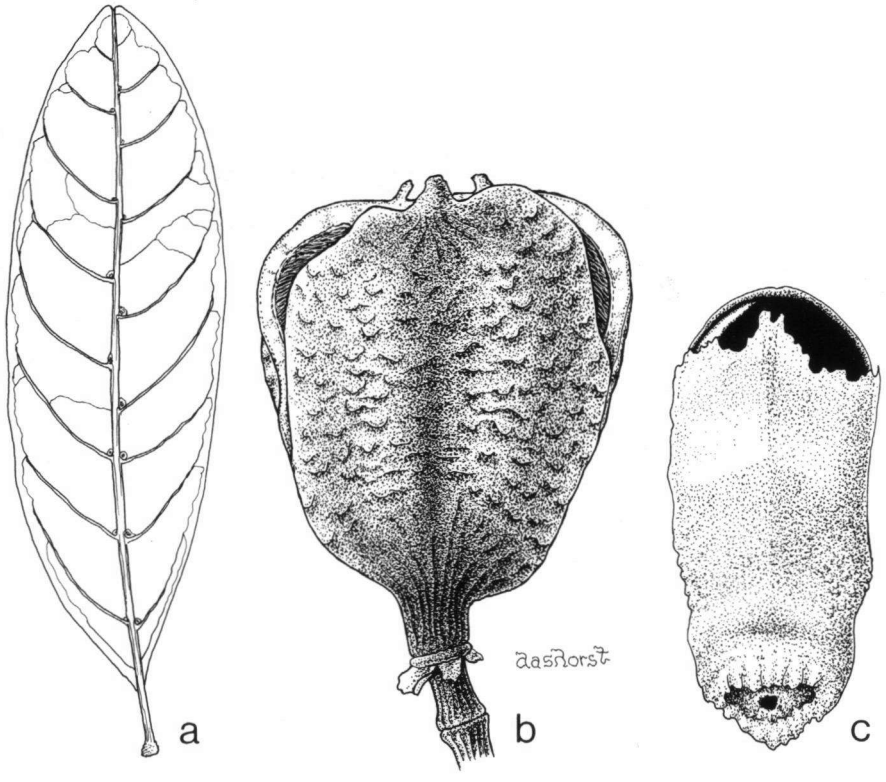

Fig. 65. *Cupaniopsis petiolulata* Radlk. a. Leaflet, × 1; b. fruit, × 2; c. seed, × 2.5 (a: *Mus. Neocal.* 223, MEL; b, c: *McKee* 19933, L).

41. Cupaniopsis petiolulata Radlk. — Fig. 65.

Cupaniopsis petiolulata Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. Münch. 9 (1879) 386; Guillaumin, Bull. Soc. Bot. Fr. 79 (1932) 586; Radlk. in Engl., Pflanzenr. 98 (1933) 1194; Guillaumin, Fl. Nouv.-Caléd. (1948) 199. — Lectotype (present author): *Vieillard* 2293, New Caledonia, vallées humides (M!, holo, iso in K!, P!). Paratype: *Vieillard* 209 (M!).

Small *trees* 5–8(–15) m high, d.b.h. 9–35 cm. *Flowering twigs* terete, 1–2(–3) mm in diameter, striate, strigose. *Leaves* 2–6(–7)-jugate; petiole (2–)4–9(–11) cm, semiterete, usually upwards more or less terete, rachis 1.5–15.5(–21.5) cm, ± terete or at least in upper part semiterete, both striate, glabrous to strigose. *Leaflets* opposite to alternate, (narrowly) elliptic, rarely narrowly ovate or narrowly obovate, slightly asymmetric, upper (4–)5.5–11.5(–17) × 1.5–5.5 cm, index 1.9–5, lower 3.5–9(–13.5) × 1–5.5 cm, index 1.7–3.2, chartaceous, above and below glabrous or with widely scattered very short appressed hairs, base cuneate to rounded, apex obtuse to rounded, retuse, rarely acuminate, acumen 2–5 mm, rounded or retuse, margin entire, midrib above not prominent, nerves 5–12 per side, 5–17

mm apart, angle to midrib 45°–65°, small pocket-like domatia present; petiolule 3–16 mm, grooved above, glabrous to thinly shortly appressed-hairy. *Inflorescences* axillary, (3–)5–14.5(–21) cm, laxly flowered, with long branches; cymules 1-flowered. *Bracts* and *bracteoles* lanceolate to triangular, 0.4–0.6 × 0.2–0.6 mm, not persistent under the fruits, outside very shortly appressed-hairy, inside glabrous. *Pedicels* 1.2–3.0 mm, articulated at the base to halfway. *Buds* globular, 1.8–2.2 × 1.8–2.4 mm. Male flowers: *Sepals* outside shortly appressed-hairy, rim ciliate and with glands, inside rather long appressed-hairy except rim, outer elliptic to orbicular, 1.2–2.4 × 1.2–1.8 mm, scarious rim very narrow to rather wide, inner orbicular, 2.3–3.1 × 2.2–3.0 mm, scarious rim wide. *Petals* elliptic or obovate to orbicular, 0.6–1.8 × 0.5–1.2 mm, outside glabrous, inside with some long appressed hairs at the base, scales 2, not crested, 0.6–1.2 mm, woolly. *Disc* glabrous. *Stamens* (7–)8, exserted, filaments 1.7–3.8 mm, patently hairy in lower part, anthers 0.8–1.2 mm, glabrous. *Pistillode* 3-celled, outside very shortly appressed-hairy, 0.5–1.3 × 0.5–1.1 mm. Female flowers: *Sepals* persistent or not under the fruits, outer 0.8–2.4 × 1.0–1.8 mm, inner 2.2–2.9 × 1.9–2.9 mm. *Petals* 0.7–1.4 × 0.6–1.8 mm, scales 0.5–1.1 mm. Filaments of *staminodes* 0.7–1.2 mm, anthers 0.8–1.1 mm. *Ovary* 3-celled, outside very shortly appressed-hairy, style 0.6–1.3 mm, stigma 0.4–0.7 mm, 3-lined (exceptionally also 3-lobed). *Fruits* about cylindrical to obovoid, shallowly lobed at apex, 19–30 × 17–20 mm, stipe 2(–3) mm, wall 0.8–1.8 mm thick, outside rugose, glabrous, basal part and stipe sometimes with short appressed hairs, inside appressed-hairy, septa complete. *Seeds* ovoid to ellipsoid, 15–21 × 7–10.5 mm, testa brown or black, arilloid covering half to almost the whole seed, lobed, more or less obvious enlarged downwards at base, cotyledons unequal, obliquely superposed.

Distribution — New Caledonia.

Field notes — a. Ecological notes: Humid forests, usually in the mountains, often along rivers, on schists. Alt. (40–)100–600 m. Flowering: March to June, fruiting: (July to) September to November.

b. Additional descriptive notes: Bark gray to brown, slightly rough. Leaflets shiny dark green above, ligther and usually duller below. Inflorescences pendulous. Flowers with a slight buttery smell. Sepals green to greenish white. Petals white to yellow. Filaments white, anthers cream to yellow, after anthesis yellow-ochre to brown, pollen yellow. Fruits green to brown. Seeds shiny brown to black, arilloid orange.

Specimens examined:
NEW CALEDONIA. 39 specimens.

42. Cupaniopsis phalacrocarpa Adema — Fig. 66.

Cupaniopsis phalacrocarpa Adema, Adansonia 10 (1988) 266. — Type: *MacKee* 38361, New Caledonia, Canala, Chiamoué, 29.12.1980 (P!, holo, iso in L!).

Trees or *treelets* 3–8 m high, d.b.h. 15–20 cm. *Flowering twigs* terete, 1.5–3 (–5) mm in diam., striate, glabrous to strigose. *Leaves* 3–5-jugate; petiole 3–8.5

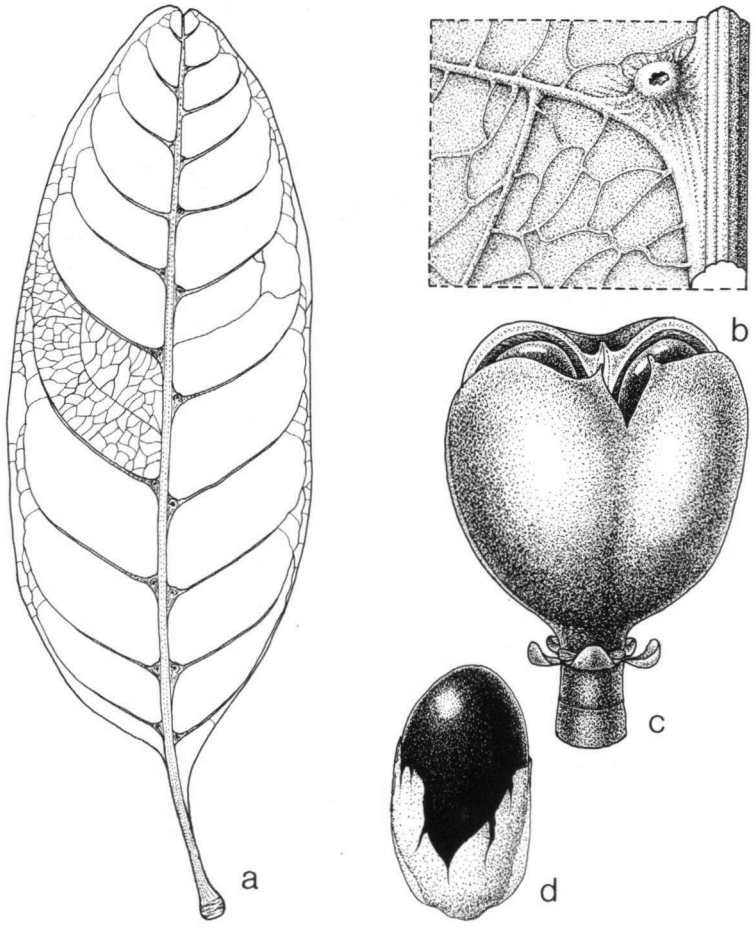

Fig. 66. *Cupaniopsis phalacrocarpa* Adema. a. Leaflet, × 1.5; b. idem, detail, × 9; c. fruit, × 2; d. seed, × 2 (a–d: *McPherson* 4540, L).

cm, semiterete, usually upwards more or less terete, rachis 5–14.5 cm, terete, or at least upwards semiterete, both striate, glabrous to strigose. *Leaflets* alternate, rarely opposite, elliptic to ovate, slightly asymmetric, upper 5.5–12.5 × 2–6.5 cm, index 1.7–3.2, lower 3–10.5 × 1.5–6 cm, index 1.4–2.4, coriaceous, above glabrous or with few scattered short appressed hairs, below glabrous to very thinly shortly appressed-hairy, midrib slightly more densely so, base cuneate to rounded, apex obtuse to rounded, retuse, margin entire, midrib above not prominent, nerves 4–10 per side, 5–22 mm apart, angle to midrib (50°–)60°, pustulate domatia present; petiolule (5–)7–20 mm, grooved above, glabrous to strigose. *Inflorescences* axillary, 7.5–19 cm, laxly flowered, with long branches; cymules dichasial, 1-, rarely several-flowered. *Bracts* and *bracteoles* deltoid to semicircular, 0.2–0.6 × 0.3–1.0 mm, not persistent under the fruits, outside shortly appressed-hairy, inside the

same or glabrous. *Pedicels* 1.1–2.4 mm, articulated at the base. *Buds* flattened globular, 2.4–2.8 × 3.0–3.6 mm. Male flowers: *Sepals* more or less orbicular, out- and inside appressed-hairy except rim, rim ciliate and with glands, outer 1.3–3.1 × 1.9–2.9 mm, scarious rim absent or very narrow, inner 2.4–3.6 × 2.9–3.6 mm, scarious rim rather narrow to wide. *Petals* ovate to orbicular, 0.8–2.2 × 0.7–1.6 mm, outside with some short hairs at the base, rim ciliate in lower half, inside with long appressed hairs in lower half, scales 2, not crested, 0.6–1.2 mm, woolly. *Disc* glabrous. *Stamens* (7) 8, exserted, filaments 2.8–4.2 mm, patently hairy in lower half, anthers 1.1–1.7 mm, glabrous, rarely with few hairs. *Pistillode* 3-celled, outside hairy, 1.1–1.6 × 1.0–1.3 mm. Female flowers: *Sepals* not persistent under the fruits, outer 1.7–3.4 × 1.9–3.4 mm, inner 2.9–4.1 × 3.1–5.0 mm. *Petals* 0.8–1.6 × 0.6–0.8 mm, scales 0.5–0.7 mm. Filaments of *staminodes* 1.7–2.4 mm, anthers 1.3–1.7 mm. *Ovary* 3-celled, outside hairy, style 0.8–1.6 mm, stigma 0.5–0.8 mm, 3-lined. *Fruits* about globular to ellipsoid, 22–30 × 17–20 mm, stipe 2–4 mm, rather wide, 1, 2, or 3 cells developed, wall 0.7 mm thick, outside smooth, glabrous or with few scattered short hairs, stipe with some short hairs, inside appressed-hairy, septa complete. *Seeds* ovoid or ellipsoid, 17–18 × 8–10 mm, testa brownish, arilloid thick, covering most of the seed, lacerate, cotyledons about equal, superposed.

Distribution — New Caledonia.

Field notes — a. Ecological notes: Wet forests on mica schist, basalt, and greywacke. Alt. 400–700 m. Flowering: (June to) August; fruiting: (May to) November to December.

b. Additional descriptive notes: Bark brown with gray spots, almost smooth. Leaflets shiny green, often darker above. Sepals and petals white to green. Disc pink. Filaments white to pink. Anthers yellow. Fruits green. Arilloid yellow.

Notes — This species resembles in several aspects *C. apiocarpa* Radlk. The latter differs from the present species in being a usually larger tree with thinner leaflets on shorter petiolules, shorter inflorescences, usually smaller flower parts, a hairy disc, and hairy, more slender-stiped fruits with smaller seeds.

Because of the glabrous fruits fruiting specimens of this species key out as *C. psilocarpa* Radlk. both with Radlkofer's (1934) and Guillaumin's (1948) key. However, contrary to both keys and descriptions, the type specimen of *C. psilocarpa* has rather hairy fruits with slender stipes and belongs to *C. apiocarpa*.

Specimens examined:
NEW CALEDONIA. 14 specimens.

43. Cupaniopsis phanerophlebia Merr. & Perry — Fig. 67.

Cupaniopisis phanerophlebia Merr. & Perry, J. Arn. Arbor. 21 (1940) 518. — Type: *Brass* 7039, Papua New Guinea, Palmer River, 2 mi. below junction Black River, alt. 100 m, 6.1936 (A!, holo, iso in L!).

Tree 2 m high, unbranched, more or less palmoid. *Flowering twigs* 10 mm in diameter, grooved, villose. *Leaves* 6-jugate; petiole 24 cm, semiterete, upwards

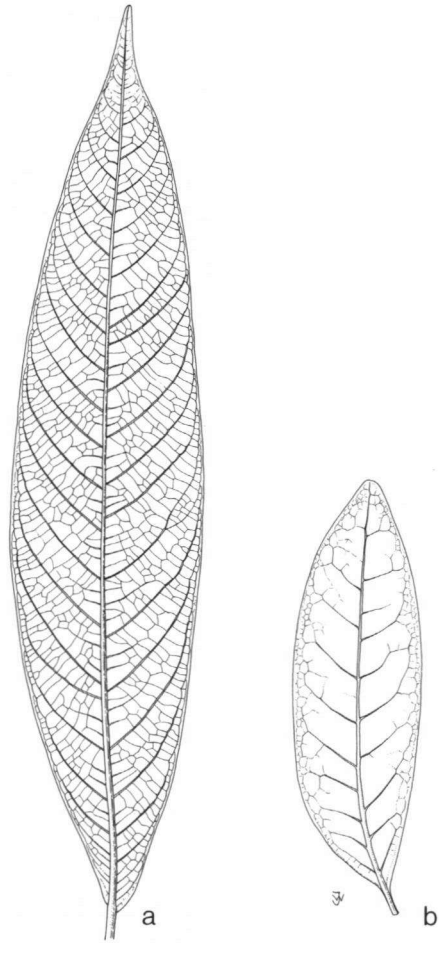

Fig. 67. *Cupaniopsis phanerophlebia* Merr. & Perry. a. Leaflet, × 0.5 (*Brass* 7029, L). — Fig. 68. *Cupaniopsis rosea* Adema. b. Leaflet, × 0.5 (*McPherson* 1905, L).

terete, rachis 32 cm, terete, both striate, villose with shorter and longer hairs. *Leaflets* alternate, narrowly elliptic, slightly asymmetric, upper 32.5 × 5.8 cm, index 5.6, lower 19.5 × 4.4 cm, index 4.4, chartaceous, above almost glabrous, midrib thinly short hairy, towards the base also with longer hairs, below almost glabrous, midrib and (larger) nerves thinly short and rather long hairy, base cuneate, apex long-acuminate, acumen 10–18 mm, acute, margin entire, midrib above slightly sunken, nerves 19–28 per side, 9–15 mm apart, angle to midrib 55°; petiolule 2–3 mm, villose with shorter and longer hairs. *Inflorescences* axillary, 10.5 cm, with long patent branches, rather densely flowered; cymules dichasial, several-flowered. *Bracts* and *bracteoles* about elliptic to acicular, acute, 1.9–3.0 × 0.5–1.2 mm, outside

long appressed-hairy, apically with a tuft of hairs, inside glabrous. *Pedicels* ca. 1 mm. Female flowers: *Sepals* about rhomboid, scarious rim wide, especialy at apex and angles, outside appressed-hairy except rim, rim ciliate, inside glabrous, outer 2.4 × 2.3 mm, inner 2.8 × 2.4 mm. *Petals* about rhomboid, 2.5–2.6 × 1.4 mm, outside appressed-hairy, rim ciliate in lower part, inside glabrous, scales 2, not crested, 1.4–1.6 mm, hairy. *Disc* with 5 tufts of hairs. *Staminodes* 3, filaments 1.8 mm, hairy throughout, anthers 1.3 mm, glabrous. *Ovary* 3-celled, outside tomentose, inside glabrous, stigma 3-lined.

Distribution — Papua New Guinea (Western Province).

Field notes — Ecological notes: Ridge forest undergrowth. Alt. 100 m. Flowering: June.

Notes — The present species shows in hairiness some resemblance to *C. curvidens*, but is otherwise very different.

Specimens examined:
PAPUA NEW GUINEA. Western Province: *Brass* 7039.

44. Cupaniopsis platycarpa Radlk. — Fig. 69.

Cupaniopsis platycarpa Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. Münch. 20 (1890) 359; in Engl., Pflanzenr. 98 (1933) 1196; Merr. & Perry, J. Arn. Arbor. 21 (1940) 520. — *Guioa platycarpa* Radlk. ex Dur. & Jacks., Ind. Kew., Suppl. 1 (1906) 190 (in errore). — Type: *Forbes* 790, Papua New Guinea, Central District, Sogeri, 3.1886 (M!, holo, iso in FI!, L!, MEL!).

Erioglossum edule auct. non Bl.: Baker in Rendle, J. Bot. 61, suppl. (1923) 11.

Trees 12–33 m high, d.b.h. 15–55 cm, young parts and inflorescences with a dense golden to rusty brown indumentum, also with small red more or less clavate glands. *Flowering twigs* terete, 3–8(–9) mm in diameter, striate to grooved, tomentose, glabrescent. *Leaves* (3–)4–6-jugate; petiole (2.5–)3–8(–11) cm, rachis (5–)6.5–17 cm, both terete, striate, tomentose. *Leaflets* (sub)opposite, rarely alternate, elliptic, slightly asymmetric, upper 7–15 × 2–5 cm, index 2.5–3.6, lower 7–9.5 × 1.5–4.5 cm, index 2–2.5(–3), chartaceous, above almost glabrous, with reddish glands along the midrib and nerves, midrib puberulous, below thinly sericeous, usually with many reddish glands, midrib more densely hairy, base cuneate to rounded, apex acuminate, acumen 4–14 mm, acute, sometimes mucronate, margin entire, midrib above slightly prominent, nerves 10–22 per side, (2–)5–12 mm apart, angle to midrib ca. 60°, usually with small pocket-like domatia; petiolule (2–)3–7 mm, puberulous. *Inflorescences* axillary, 10–40 cm, laxly flowered, with long and short, or only short patent branches; cymules dichasial, many-flowered. *Bracts* and *bracteoles* acicular, 0.7–4.0 × 0.2–1.1 mm, not persistent under the fruits, outside appressed-hairy, inside glabrous or with some short hairs at the base, margin with red glands. *Pedicels* 0.8–1.1 mm, articulated at the base, tomentose. *Buds* globular, 2.6–4.0 × 2.9–4.0 mm. Male flowers: *Sepals* outside appressed-hairy except rim, rim ciliolate and with small red glands, inside with some hairs at the base, outer about elliptic, 1.9–4.0 × 2.0–2.5 mm, scarious rim narrow, inner orbicular, 3.4–5.0 × 3.0–5.0 mm, scarious rim wide. *Petals* elliptic

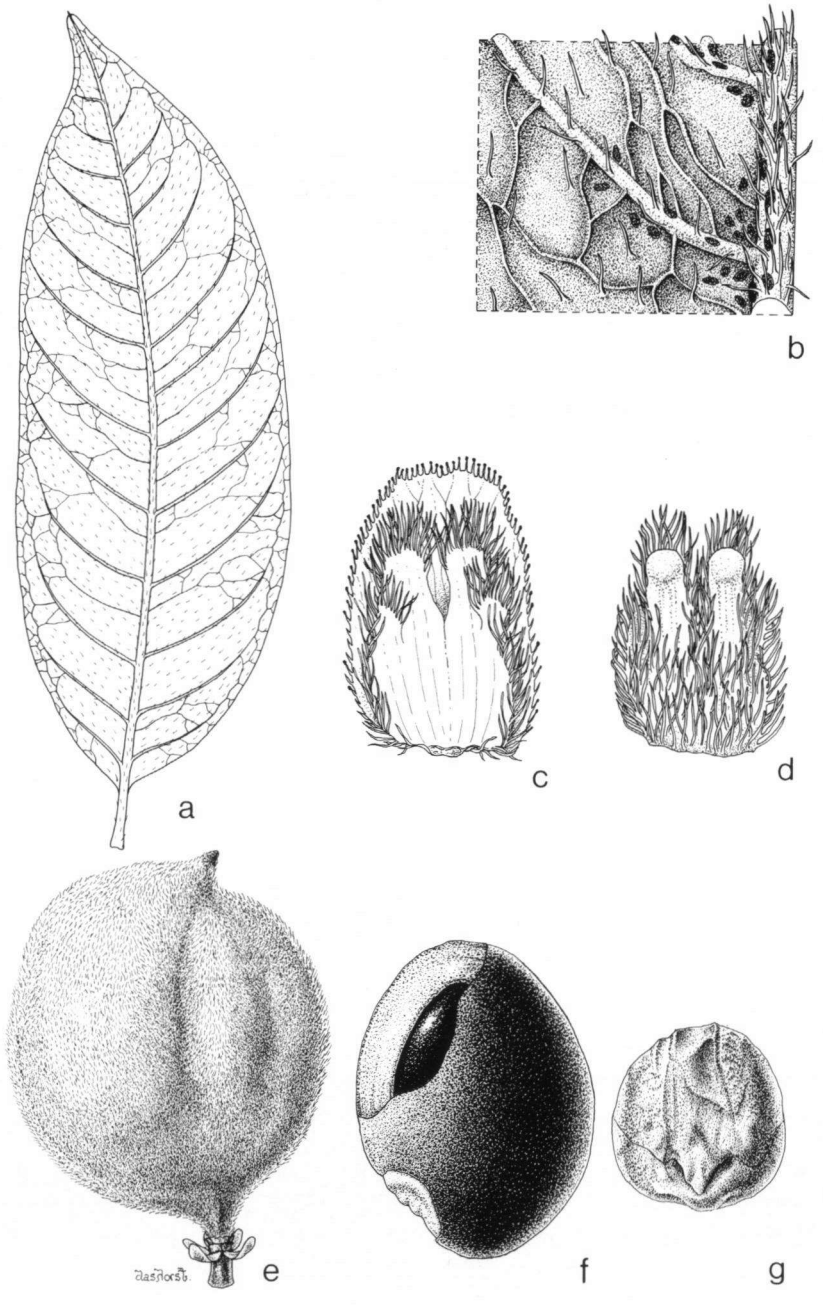

Fig. 69. *Cupaniopsis platycarpa* Radlk. a. Leaflet, × 0.9; b. idem, detail, × 15; c. petal and petalar scale from inside, × 15; d. petalar scale with crests from outside, × 15; e. fruit, × 0.9; f. seed, sarcotesta partly removed, × 1.2; g. embryo, × 1.2 (a, b, e, f: *NGF* 43860, L; c, d: *NGF* 46865, L; g: *Brass* 13698, L).

or spatulate, not clawed, apically with few teeth to almost crenate, 2.5–4.0 × 1.3–2.5 mm, rim ciliate, but otherwise glabrous, scale 1, 2-crested, basifixed, 2.0–3.5 mm, densely woolly, crests glabrous. *Disc* glabrous. *Stamens* 8, exserted, filaments filiform, 2.0–6.0 mm, pilose in basal third, anthers ellipsoid, 0.5–1.5 mm, glabrous. *Pistillode* 2-celled, outside velutinous, 0.8–2.0 × 0.8–2.0 mm. Female flowers: *Sepals* not persistent under the fruit, outer 2.8–4.5 × 1.8–2.0 mm, inner 4.4–6.5 × 3.4–5.0 mm. *Petals* 3.4 × 1.8 mm, scales 2.4 mm. Filaments of *staminodes* thick, ca. 2 mm, pilose in lower half, anthers ca. 1.5 mm. *Ovary* 2-celled, outside velutinous; style 2.0 mm, stigma 0.5–1.0 mm, 2-lined. *Fruits* usually compressed, ellipsoid or more or less lensshaped to obcordate, 4–8 × 4–6 cm, 2-celled, acuminate, stipe 10 mm, wall 0.7–1.7 mm thick, outside smooth, velutinous, inside whitish villose, septa complete. *Seeds* ellipsoid, 3.5–4 × 2–3 cm, attached at 1/3 from the base of the cell, totally covered by a sarcotesta or sarcotesta up to halfway the seed and the rest of the seed covered by an arilloid, hilum large, about 1/3 above the base, cotyledons more or less oblique superposed, unequal.

Distribution — Irian Jaya (Vogelkop, Jayapura Distr.); Papua New Guinea (Morobe, Central Prov.).

Field notes — a. Ecological notes: Rain forest on floodplain or lower slopes, young secondary forest on clay. Alt. 100–850 m. Flowering: March to May; fruiting: March to August.

b. Additional descriptive notes: Bole slightly crooked, flanged to ca. 5 m. Bark smooth, gray to grayish-green or medium brown; blaze straw; underbark light brown or green; inner bark yellowish brown to brown. Wood dark straw or cream. Leaves light to dark green, shiny above, dull below. Buds whitish with brown pubescence. Calyx white to yellow. Corolla white or cream. Fruits dark yellow to golden brown. Seeds black; sarcotesta yellow or bright orange.

Notes — Occasionally a vegetative bud is found terminating the inflorescence. The petalar scales in *Brass* 29225 are divided to halfway. In *Brass* 13698 most inflorescences bear galls instead of flowers. The fruits of *BW* 7574 are empty.

Specimens examined:

New Guinea. Irian Jaya: *Brass* 13698, Idenburg River, *BW* 7574, Manokwari, Maripi; Papua New Guinea: 12 specimens.

45. Cupaniopsis rhytidocarpa Adema, *spec. nov.* — Fig. 70.

Arbor 15–21.5 m alta, partibus juvenilibus tomentosis. Folia 4–6-jugata, foliola integerrima vel obscure crenata apicem versus. Inflorescentiae axillares. Stamina 10. Capsulae triloculares, exocarpio rugoso, velutinoso, endocarpio glabro. — Typus: *Hoogland & Womersley* 3232, Papua New Guinea, Northern Province, ca. 2 km NE of Sangara homestead, 10 km W of Popondetta, alt. 200 m, 8.7.1953 (L!, holo, iso in A!, BM!, BRI!, K!, LAE!).

Trees 15–21.5 m high, d.b.h. 25–45 cm, young parts with a dense, straw coloured indumentum. *Flowering twigs* terete, 4–5 mm in diameter, grooved, tomentose. *Leaves* 4–6-jugate; petiole 5– 2.5 cm, semiterete, rachis 12–19 cm, semiterete, usually upwards terete, striate, both tomentose. *Leaflets* alternate, elliptic to obovate, slightly asymmetric, upper 12–15 × 4–5.5 cm, index 2.8–3.2,

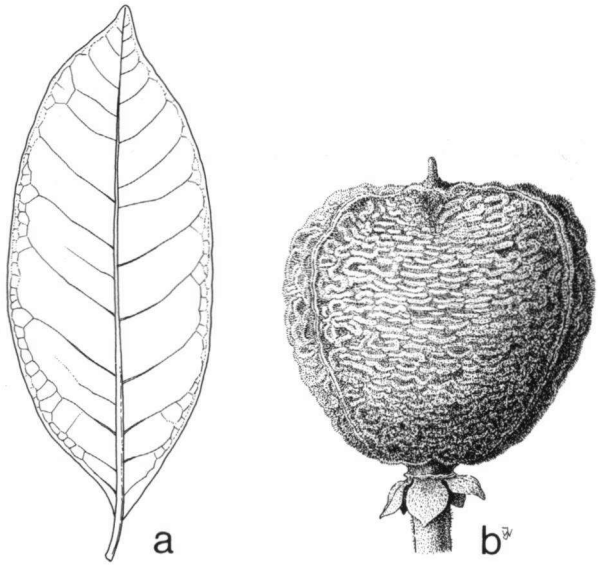

Fig. 70. *Cupaniopsis rhytidocarpa* Adema. a. Leaflet, × 0.75; b. vrucht, × 1.5 (a, b: *Hoogland & Womersley* 3232, L).

lower 8–11.5 × 3–5 cm, index 2.1–2.5, chartaceous, above almost glabrous, midrib and nerves puberulous at least in basal part of leaflet, below almost glabrous to very thinly puberulous, midrib and nerves more or less puberulous, base cuneate, apex acuminate, acumen 4–28 mm, rounded, margin entire or obscurely crenate towards the apex, midrib above slightly sunken, nerves 11–19 per side, 6–13 mm apart, angle to midrib (50°–)70°–80°, small pocket-like to more or less dome-shaped domatia present; petiolule (2–)5–8 mm, grooved above, tomentose. *Inflorescences* axillary, 13–17 cm, laxly flowered, with short or long branches; cymules 1-flowered. *Bracts* and *bracteoles* lanceolate to deltoid, 0.6–2.5 × 0.4–1.0 mm, not persistent under the fruits, outside appressed-hairy, inside glabrous. *Buds* globular, 4.0 × 4.0 mm. *Pedicels* 2.0 mm, articulated at the base. Male flowers known in bud only. *Sepals* more or less orbicular, concave, with a narrow to wide scarious rim, outside appressed-hairy except rim, rim ciliate in basal part, and with sessile glands, inside shortly appressed-hairy in basal part. *Petals* about 5-angular, 3-dentate at apex, out- and inside appressed-hairy at the base, scales 2, not crested, woolly. *Disc* glabrous or with 5 tufts of hairs. *Stamens* 10, filaments and anthers hairy. *Pistillode* 3-celled, outside hairy. Female flowers known only under the young fruits. *Sepals* persistent under the fruits. Young *fruits* more or less globular, wall 2.4–3.6 mm thick, outside rugose, velutinous, inside glabrous, septa complete. Young *seeds* almost totally covered by the lacerate arilloid, this with a large sarcotestal part, cotyledons parallel.

Distribution — Papua New Guinea (Northern Province, Central Province).

Field notes — a. Ecological notes: Primary or secondary forest. Alt. 60–200 m. Fruiting: July.

b. Additional descriptive notes: Tree buttressed to ca. 1 m, flanged, bole bent and fluted, crown narrow, compact. Bark pale gray to dark brown, smooth, underbark greenish or yellowish brown, inner bark light brown. Wood white to red-brown. Leaves dark, glossy green above. Flowers white. Young fruits yellowish or pale orange.

c. Vernacular name: Umbupu (Orokaiva language, Mumuni).

Notes — The present species is known from 3 specimens, of which 2 bear young fruits and 1 male flowers in bud, only. The fruits are strikingly different from those of all other species of *Cupaniopsis* from New Guinea. The male flowers also seem to be different, especially in the shape of the young petals and the number of stamens. The leaflets look rather similar to those of *C. stenopetala*.

Although knowledge about quite some characters is missing and the description therefore rather incomplete, there is no doubt that this material represents a new *Cupaniopsis*-species.

Specimens examined:

Papua New Guinea. Northern Province: *Hoogland & Womersley* 3232; Central Province: *Lae* 62154, *NGF* 38602.

46. Cupaniopsis rosea Adema, *spec. nov.* — Fig. 68.

Arbor gracilis 4 m alta, partibus juvenilibus lepidotis pilis brevis patentiter obsitis. Folia 4-jugata, foliolis integerrimis. Discus glaber. Stamina 8, exserta. — Typus: *McPherson* 1905, New Caledonia, 5 km east of Col de Crèvecoeur on road between Canala and Thio, alt. ca. 350 m, 27.9.1979 (L!, holo, iso in MO?).

Slender *tree*, 4 m high. *Flowering twigs* terete, 4 mm in diameter, striate, very young parts with minute scale and short patent hairs, soon glabrous. *Leaves* 4-jugate; petiole 4–5.5 cm, semiterete, upwards more or less terete, rachis 7.5–10 cm, semiterete, both striate, above with short, patent hairs. *Leaflets* opposite, narrowly elliptic, slightly asymmetric, upper 9.5–12 × 2.5–3.5 cm, index 3.4–3.5, thick chartaceous, above and below glabrous, base cuneate to rounded, more or less tapering into the petiolules, apex obtuse, margin entire, midrib above slightly prominent, nerves 8–10 per side, 5–12 mm apart, angle to midrib 55°; petiolule 0–5 mm, grooved above, glabrous. *Inflorescences* axillary, 7–10 cm, laxly flowered, with short to long branches. Male flowers: *Sepals* almost totally petaloid, outside glabrous or shortly appressed-hairy in lower part, rim ciliate, inside shortly appressed-hairy in lower part, outer broadly ovate, 2.8–3.4 × 2.0–2.6 mm, inner obovate, 3.8–4.2 × 2.5–2.9 mm. *Petals* elliptic to broadly ovate, 2.0–3.0 × 1.6–1.8 mm, outside with few hairs in lower part, rim ciliate, inside appressed-hairy except apex, scales 2, not crested, 1.1–1.2 mm, woolly. *Disc* glabrous. *Stamens* 8, exserted, filaments 2.8–3.4 mm, patently hairy except apex, anthers 1.3–1.7 mm, patently hairy. *Pistillode* 3-celled, outside hairy, 0.7 × 0.5 mm. Female flowers: Outer *sepals* elliptic to ovate, 3.5 × 2.2 mm, inner about elliptic, 4.2 × 3.0 mm. *Petals* about elliptic, 2.6–3.6 × 2.2–2.3 mm, scales 1.1–1.3 mm. Filaments of *staminodes*

2.2 mm, anthers 1.4 mm. *Ovary* 3-celled, outside hairy, style 1.8 mm, stigma 1.2 mm, 3-lined.

Distribution — New Caledonia (between Canala and Thio).

Field notes — a. Ecological notes: Forest. Alt. ca. 350 m. Flowering: November.

b. Additional descriptive notes: Sepals pink-red. Petals white to pinkish-white. Stamens yellow-green.

Specimens examined:
NEW CALEDONIA. Between Canala and Thio: *McPherson* 1905.

47. Cupaniopsis rotundifolia Adema, *spec. nov.* — Fig. 71.

Arbuscula 2 m alta, partibus juvenilibus lepidotis. Folia 3–4-jugata, foliolis late ovatis ad fere orbicularibus, integerrimis. Inflorescentiae axillares. Discus glaber. — Typus: *Jaffré* 2531, New Caledonia, colline surplombant la Tontouta, 25.8.1984 (NOU!, holo, iso in P!).

Treelet 2 m high. *Flowering twigs* terete, 2 mm in diameter, striate, pruinose, with scale hairs when young. *Leaves* 3–4-jugate; petiole 3–4.5 cm, rachis 7–11 cm, both semiterete, striate or grooved, pruinose, glabrous. *Leaflets* opposite to alternate, broadly ovate to almost orbicular, slightly asymmetric, upper 6–8 × 4–6 cm, index 1.4–1.5, lower 4.5–7 × 3.5–5 cm, index 1.2–1.3, coriaceous, above and below glabrous, base rounded, apex rounded, margin entire or with 2–4, obtuse teeth near the apex, midrib above not prominent, nerves 5 per side, 6–24 mm apart, angle to midrib 55°–65°; petiolule 5–7 mm, pruinose. *Inflorescences* axillary, 7–12.5 cm, laxly flowered, without or with long branches; cymules 1-flowered. Female flowers (under the fruits): *Sepals* 5, more or less orbicular, outside with some scale hairs, inside glabrous, outer 1.6–2.3 × 1.9–2.4 mm, scarious

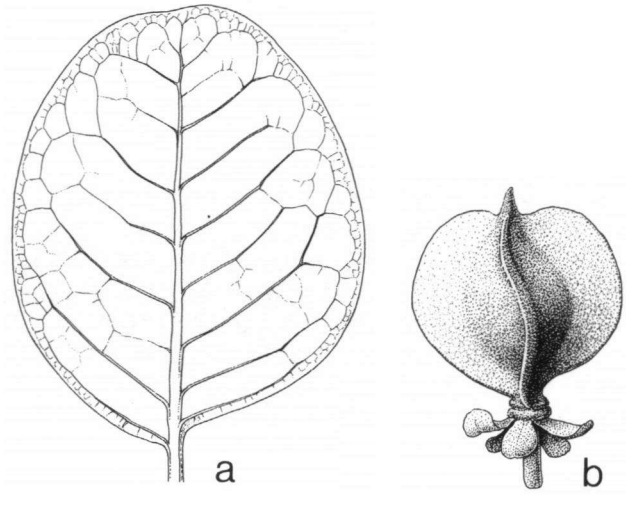

Fig. 71. *Cupaniopsis rotundifolia* Adema. a. Leaflet, × 0.75; b. young fruit, × 2 (a, b: *Jaffré* 2531, NOU).

rim narrow, inner 3.7 × 3.7 mm, scarious rim wide. *Petals* 5, more or less orbicular, 3.4–3.6 × 3.5–3.6 mm, out- and inside glabrous, scales 2, not crested, hairy. *Disc* glabrous. Filaments of *staminodes* hairy, anthers glabrous. Young *fruits* 3-celled, very shortly stiped, 3-lobed, outside smooth, with scale hairs, inside with stiff hairs near the attachment of the seeds and along the rims of the carpels up to 2/3. Young *seeds* with an arilloid.

Distribution — New Caledonia (Tontouta River).

Field notes — Ecological notes: Fruiting: July.

Notes — Probably closely related to *C. fruticosa* and *C. tontoutensis*. The present species differs from the former in the wider leaflets with fewer nerves and the larger sepals, from the latter in the fewer wider leaflets with nerves at a wider angle to the midrib and the stiff hairs on the endocarp.

Specimens examined:
NEW CALEDONIA. Tontouta River: *Jaffré* 2531.

48. Cupaniopsis samoensis Christoph. — Fig. 72.

Cupaniopsis samoensis Christoph., Bull. Bish. Mus. 154 (1938) 14, fig. 4, 5; Parham, Plants of Samoa (1972) 123. — Type: *Christophersen & Hume* 2045, Western Samoa, Savai'i, above Matavanu, 14.8.1931 (BISH!, holo, iso in A!, BISH!, K!, UC!).

Trees 4–8(–10) m high. *Flowering twigs* terete, 1–2(–3) mm in diameter, striate, with scale hairs when young, later on glabrous. *Leaves* 1–3-jugate; petiole 2.5–7 cm, semiterete, upwards terete, rachis 1–5.5 cm, more or less semiterete or terete, both striate, with scale hairs when young, later on glabrous. *Leaflets* (sub)opposite, ovate, slightly asymmetric, upper 9.5–16.5 × 3–6 cm, index 2–3.4, lower 5.5–11.5 × 2.5–4 cm, index 2.3–3, coriaceous, above and below with scattered scale hairs, base cuneate to rounded, apex acuminate, acumen 6–15 mm, rounded, margin entire, midrib above scarcely prominent, nerves 8–13 per side, 5–15 mm apart, angle to midrib (45°–)60°(–65°); petiolule 2–10 mm, semiterete, with scale hairs when young, later on glabrous. *Inflorescences* axillary, 1.5–8.5 cm, laxly flowered, without or rarely with short branches, with scale hairs, sometimes also with short patent hairs; cymules 1-flowered. *Bracts* and *bracteoles* deltoid, 0.4 × 0.6 mm, not persistent under the fruits, out- and inside with scale hairs. *Pedicels* 4.8–6 mm, articulated at the base. Male flowers: *Sepals* out- and inside with some scale hairs, rim ciliolate and with glands, outer broadly elliptic, 1.6 × 1.8 mm, scarious rim rather narrow, inner transversely elliptic, 2.4 × 3.1 mm, scarious rim wide. *Petals* about elliptic, 1.7–2.0 × 1.3–1.4 mm, outside appressed-hairy in lower part, rim long-ciliate in lower half, inside woolly in lower half, auricled, auricles woolly. *Disc* hairy. *Stamens* 8, not exserted, filaments 1.8–2.0 mm, patently hairy in lower half, anthers 1.0–1.1 mm, glabrous. *Pistillode* 3-celled, 0.7–0.6 mm, outside glabrous. Female flowers: *Sepals* not persistent under the fruits, outer elliptic to rounded deltoid, 1.9–2.5 × 2.0–2.4 mm, inner 3.0–3.2 × 3.6–4.2 mm. *Petals* about orbicular, 1.8–2.2 × 1.4–2.0 mm. Filaments of *staminodes* 1.2–1.4 mm, anthers 1.2–1.3 mm. *Ovary* 3 (4)-celled, carpelrims free, outside glabrous, style thick, 0.8–1.8 mm, with 3 stigmatic lines.

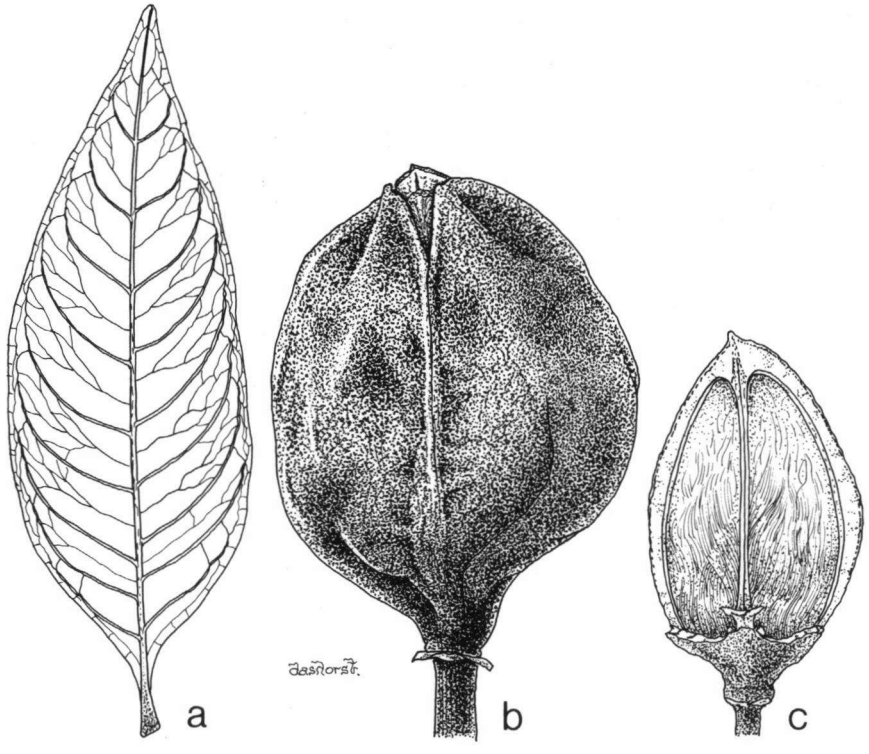

Fig. 72. *Cupaniopsis samoensis* Christoph. a. Leaflet, × 0.75; b. fruit, × 1.5; c. fruitvalve from inside, × 1 (a–c: *Christophersen* 3111, K).

Fruits obovoid, rounded triangular in cross section, 3.5–5.5 × 2.5–4 cm, stipe (4–) 5 mm, wall 1.4–4.8 mm thick, outside smooth, glabrous, inside thinly appressed-hairy, septa incomplete, visible as a thin glabrous line on each valve. Young *seeds* 25 × 19 mm, covered for 2/3 by an arilloid, cotyledons obliquely superposed.

Distribution — Western Samoa (Savai'i, Upolu).

Field notes — a. Ecological notes: Primary forests. Alt. 650–1350 m. Flowering: June to July (to November), fruiting: September to November.

b. Additional descriptive notes: Wood very hard. Buds red. Petals white. Style trigonous, red.

c. Vernacular name: Taputo'i (Savai'i).

Notes — Rather close to *C. concolor* of Fiji which differs in the usually longer petiole and rachis, in the leaflets that show a wider range in size and are often alternate, in the acumen that is much shorter and broader, in the inflorescence that is longer and always branched, and finaly in the fruits that are smaller and tomentose inside.

Specimens examined:

Western Samoa. Savui'i: 4 specimens, Upolu: 2 specimens.

49. Cupaniopsis serrata (F. Muell.) Radlk. — Fig. 73.

Cupaniopsis serrata (F. Muell.) Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. Münch. 9 (1879) 523, 585; Domin, Bibl. Bot. 22 (1927) 903; Radlk. in Engl., Pflanzenr. 98 (1933) 1183; Francis, Australian Rain-for. trees (1951) 252; Beadle, Stud. Fl. NE. N.S.W. 4 (1980) 571; Reynolds, in Stanley & Ross, Fl. SE. Queensland 1 (1983) 513; Austrobaileya 2 (1984) 50, fig. 4c, d; Fl. Austr. 25 (1985) 60, map 74. — *Cupania serrata* F. Muell., Fragm. 3 (1862) 43; Benth., Fl. Aust. 1 (1863) 458; F. Muell., Fragm. 9 (1875) 94; Bailey, Queensland Fl. 1 (1899) 291; Compr. Cat. Queensl. Pl. (1913) 113. — *Cupaniopsis serrata* (F. Muell.) Radlk. f. *genuina* Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. Münch. 9 (1879) 585, nom. illeg. (I.C.B.N. art. 26i). — *Cupaniopsis serrata* (F. Muell.) Radlk. var. *genuina* (Radlk.) Domin, Bibl. Bot. 22 (1927) 903, nom. illeg. — *Cupaniopsis serrata* (F. Muell.) Radlk. var. *serrata*, Domin, Bibl. Bot. 22 (1927) 903; Reynolds, in Stanley & Ross, Fl. SE. Queensland 1 (1983) 513. —Type: *Hill* s.n. (MEL 84181), Australia, Queensland, Moreton Bay, Pine River (MEL!, holo, iso in K?).

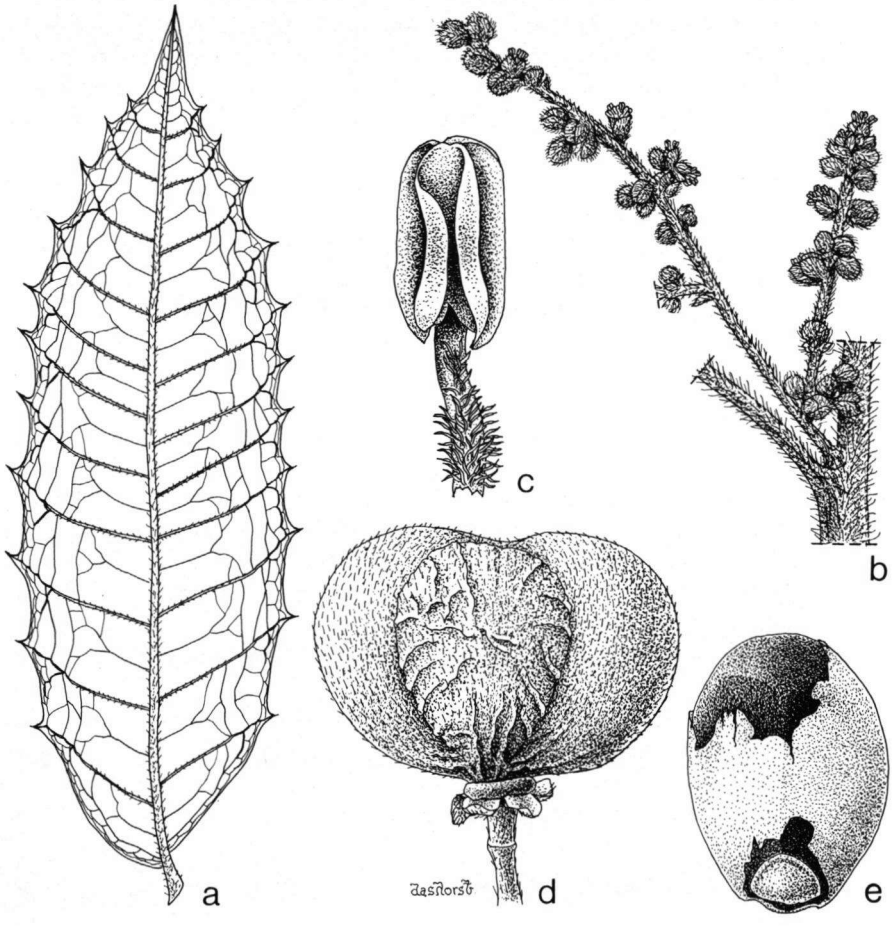

Fig. 73. *Cupaniopsis serrata* (F. Muell.) Radlk. a. Leaflet, × 1; b. inflorescence, × 1.5; c. stamen, × 15; d. fruit, × 4; e. seed, × 3.5 (a–c: *C.T. White* 11405, BRI; d, e: *Webb & Tracey* 13206, BRI).

Shrubs or small *trees* 1–3(–15) m high, young parts and inflorescences with a dense, brown indumentum. *Flowering twigs* 2–4 mm in diameter, striate to grooved, tomentose, usually also with longer, patent hairs. *Leaves* 3–6(–7)-jugate; petiole 3–7.5 cm, semiterete, sometimes upwards terete, rachis 7–23 cm, semiterete to terete, both striate, tomentose, usually also with longer, patent hairs. *Leaflets* subopposite to alternate, (narrowly) elliptic, rarely ovate, slightly asymmetric, upper 7–16 × 2–5 cm, index 2.2–4.5, lower 4.5–14 × 1.5–4.5 cm, index 1.8–3.3, coriaceous, above and below almost (totally) glabrous, midrib glabrous to thinly pilose, base broadly cuneate to rounded, apex acuminate, acumen 3–25 mm, acute, rarely obtuse, margin coarsely dentate, with hard sharp teeth, midrib above slightly prominent, nerves 8–16 per side, almost all ending in a tooth, 3–15 mm apart, angle to midrib 65°–75°(–80°), small pocket-like domatia present; petiolule (0–)1–6 mm, grooved, tomentose to glabrous. *Inflorescences* axillary, 1.5–6.5 cm, densely or rarely laxly flowered, without or with 1 or 2 short branches in basal part; cymules 1-flowered. *Bracts* and *bracteoles* lanceolate to deltoid, 0.7–2.4 × 0.4–1.2 mm, thick, acute, outside appressed-hairy, inside with some hairs at the base, usually not persistent under the fruits. *Pedicels* up to 0.2 mm, articulated at base. *Buds* globular, 3.0–3.6 × 3.1–3.8 mm. Male flowers: *Sepals* rather thick, outside appressed-hairy except rim, rim glandular ciliate, inside glabrous or with some appressed hairs, outer elliptic, 2.6–3.4 × 2.2–2.5 mm, without scarious rim, inner orbicular, 3.8–4.0 × 3.6–4.0 mm, scarious rim narrow. *Petals* broadly or transversely elliptic to orbicular, 1.2–2.0 × 1.6–2.6 mm, outside appressed-hairy, rim glandular ciliate, inside glabrous, scales 2, not crested, 1.0–1.6 mm, long to short patently hairy. *Disc* glabrous. *Stamens* 8, not or slightly exserted, filaments 1.8–2.8 mm, patently hairy in lower half, anthers 1.6–1.9 mm, glabrous or with some hairs on the back. *Pistillode* 3-celled, 0.8–1.2 × 0.7–1.3 mm, outside hairy. Female flowers: *Sepals* persistent in fruit, outer 2.4–4.2 × 1.3–3.2 mm, inner 3.8–4.8 × 3.1–4.0 mm. *Petals* 1.7–2.4 × 1.7–2.2 mm, scales 1.2–1.4 mm. Filaments of *staminodes* 1.8–2.4 mm, anthers 1.8 mm, glabrous. *Ovary* 3-celled, outside hairy, stigma sessile, 0.7–0.8 mm, thick, 3-lined. *Fruits* topshaped, rounded triangular in cross section, 12–16 × 15–18 mm, wall 0.5–0.6 mm thick, outside rugose, (thinly) velutinous, inside thinly appressed-hairy, septa complete. *Seeds* ellipsoid, 10–14 × 7–9 mm, testa shiny black, arilloid covering seed totally, cotyledons unequal, obliquely parallel or superposed.

Distribution — Australia [SE Queensland; New South Wales: Tweed River, Reynolds (1985) 60].

Field notes — a. Ecological notes: Rain forest, or notophyll or mesophyll vine forest. Alt. 300 m. Flowering: August to September, fruiting: (October to) November (to December).

b. Additional descriptive notes: Flowers white.

Specimens examined:
AUSTRALIA. SE Queensland: 22 specimens.

50. Cupaniosis shirleyana (Bailey) Radlk. — Fig. 74.

Cupaniopsis shirleyana (Bailey) Radlk., Fedde Rep. 20 (1924) 32; Domin, Bibl. Bot. 22 (1927) 904; Radlk. in Engl., Pflanzenr. 98 (1933) 1188; Francis, Australian Rain-for. trees ed. 2 (1951) 249; Reynolds in Stanley & Ross, Fl. SE Queensl. 1 (1983) 512, fig. 80H; Austrobaileya 2 (1984) 46, fig. 4P; Fl. Austr. 25 (1985) 56, map 67. — *Cupania shirleyana* Bailey, Syn. Queensl. Fl. Suppl. 2 (1888) 15; Queensl. Fl. 1 (1899) 290; Compr. Cat. Queensl. Pl. (1913) 113, fig. 92. — Type: *Bailey* s.n., Australia, Queensland, Brisbane, Sankey's scrub off Logan Road (BRI!, holo).

Shrubs or small *trees*, 1–4 m high. *Flowering twigs* terete, 1–2.5 mm in diameter, striate, more or less short tomentose, rarely glabrescent. *Leaves* 2–6(–8)-jugate, with pseudostipulae; petiole 0.4–1.4 cm, semiterete, rarely ± terete, rachis 1–9.5 cm, semiterete or sometimes in lower part more or less terete and upwards semiterete, both grooved to bisulcate, striate, ± short tomentose. *Leaflets* opposite to alternate, cuneate, symmetric or slightly asymmetric, upper 2–9.5 × 1–5.5 cm, index 1.5–3.4, lower 0.5–4.5 × 0.5–3 cm, index 1–1.9, coriaceous, above and below glabrous to (very thinly) puberulous, midrib usually more densely so, base (broadly) cuneate, rarely rounded, apex truncate, rarely rounded, usually mucronate, margin spinose-dentate at least in upper part, midrib above somewhat sunken to slightly prominent, nerves 2–8 per side, upper ones ending in a tooth, 2–17 mm apart, angle to midrib 45°(–60°), small pocket-like domatia present; petiolule 0; pseudostipulae as the leaflets but much smaller and with very oblique bases. *Inflorescences* axillary, 3.5–16 cm, laxly flowered, without branches, pendulous?, ± short tomentose; cymules usually 1-flowered. *Bracts* and *bracteoles* angular to oblong, 1.4 × 0.8–1.0 mm, persistent or not under the fruits, rather thick, outside shortly appressed-hairy, ciliate, inside glabrous. *Pedicels* 0.4 mm, articulated just below the flower. *Buds* about globular, 3.0–3.6 × 3.6 mm. Male flowers: *Sepals* broadly elliptic to more or less orbicular, outside shortly appressed-hairy except rim, rim ciliolate and with glands, inside glabrous, outer 3.0–4.0 × 2.4–3.4 mm, scarious rim absent to rather wide, inner 3.6–4.2 × 3.6–3.7 mm, scarious rim wide. *Petals* broadly elliptic to orbicular, 1.8–2.0 × 1.3–2.0 mm, outside shortly appressed-hairy in lower part, inside glabrous, scales 2, not crested, 1.4–1.8 mm, woolly. *Disc* with some hairs. *Stamens* 8, 9, exserted, filaments 1.6–1.8 mm, patently hairy in lower half to 2/3, bases usually enclosed by the disc, anthers 1.8 mm, glabrous. *Pistillode* 3-celled, outside hairy, 1.0 × 0.7 mm. Female flowers: *Sepals* persistent under the fruits, outer elliptic to broadly elliptic, 2.8–3.4 × 2.2–3.4 mm, inner about orbicular, 4.0–4.8 × 3.8–4.8 mm, inside glabrous or thinly shortly appressed-hairy. *Petals* elliptic to orbicular or rhomboid, 1.9–3.6 × 1.3–2.3 mm, scales 1.7–2.5 mm. Filaments of *staminodes* 1.4–2.5 mm, anthers 1.3–1.8 mm, glabrous to hairy. *Ovary* 3-celled, outside hairy, style 1.2–1.8 mm, stigma 0.6–1.0 mm, 3-lined, exceptionally 3-lobed. *Fruits* ± topshaped, rounded triangular in cross section, 15 × 7–20 mm, 2 or 3 cells developed, wall 0.2–1.0 mm thick, outside rugose, velutinous, inside thinly appressed-hairy, septa

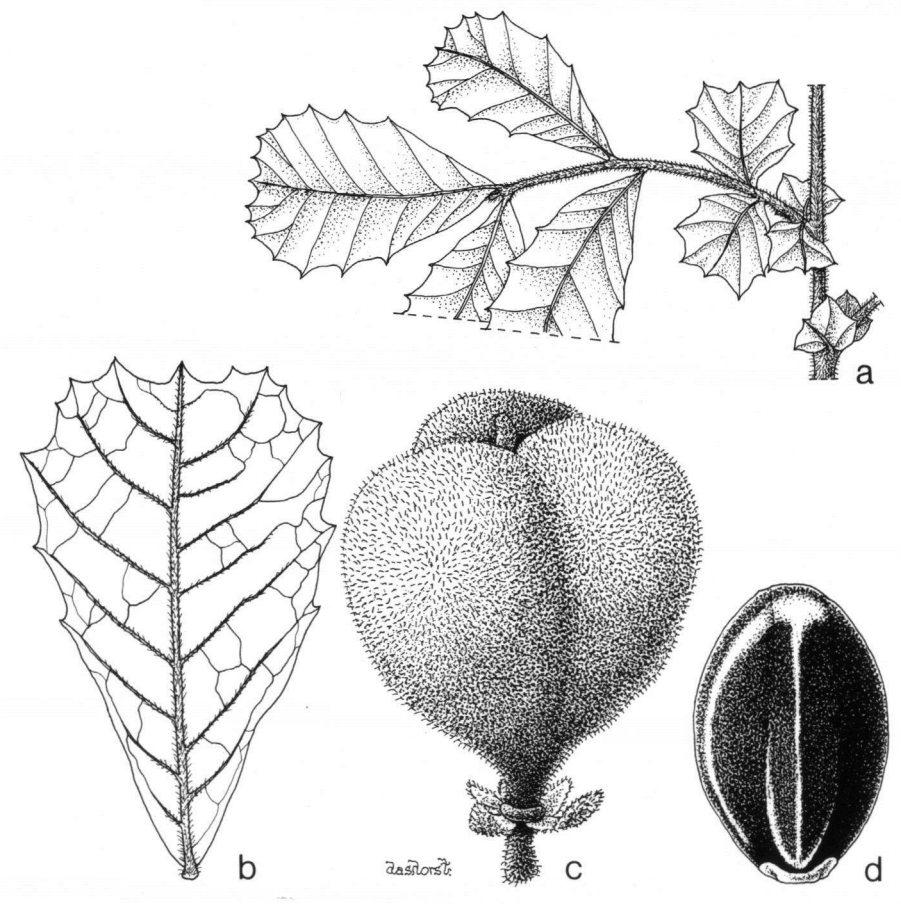

Fig. 74. *Cupaniopsis shirleyana* (Bailey) Radlk. a. Leaf, × 0.6; b. leaflet, × 1.3; c. fruit, × 3.5; d. seed without arilloid, × 3.5 (a, b: *Randall & Young* s.n., BRI; c, d: *Simmonds* s.n., BRI).

complete. *Seeds* 9–14 × 7–9 mm, testa brownish black, arilloid covering 2/3 to the whole seed, crenate to lobed, cotyledons equal or unequal, parallel to obliquely superposed.

Distribution — Australia (Queensland).

Field notes — a. Ecological notes: Dry rain forest, micro-notophyll vine forest, complex notophyll vine forest, scrubs or bushes, on sandy or stony soil, rarely on loam, often along creeks. Flowering: May to August; fruiting: September to December.

b. Additional descriptive notes: Bark smooth, gray. Flowers cream.

c. Vernacular name: Kooraloo [Bundaberg, Bailey (1899) 290].

Notes — *Webb & Tracey* 3306 and *Stanton* s.n. (BRI 317256) have ± appressed-hairy vegetative parts, few rather obscure sometimes obtuse teeth, and sometimes rather obvious petiolules. In these characters they resemble *C. wadsworthii*, in other characters, especially sharp teeth and the presence of pseudostipulae, they resemble *C. shirleyana*.

Specimens examined:
AUSTRALIA. Queensland: 27 specimens.

51. Cupaniopsis squamosa Adema — Fig. 75.

Cupaniopsis squamosa Adema, Adansonia 10 (1988) 264. — Type: *McPherson* 6176, New Caledonia, Massif de Tiébaghi, north of Koumac, alt. c. 550 m, 21.12.1983 (MO!, holo, iso in L!, NOU!).

Treelets or *shrubs* 0.30–2 m high, very young parts often 'varnished'. *Flowering twigs* terete, 1–2 mm in diameter, smooth to striate, with minute scale hairs. *Leaves* 1–2(–3)-jugate; petiole 0.5–2.5 cm, rachis 0.5–2.5(–4.5) cm, both semiterete, smooth, sometimes striate, grooved above, with scale hairs. *Leaflets* opposite to alternate, (narrowly) elliptic to (narrowly) obovate, slightly asymmetric, upper 2.5–6.5 × 0.5–2.5 cm, index 2.4–4.6, lower 2–5.5 × 1–2.5 cm, index 2.1–4, coriaceous, above glabrous to rather densely scaly, below densely scaly, base cuneate, usually tapering in the petiolules, apex obtuse to rounded, margin entire,

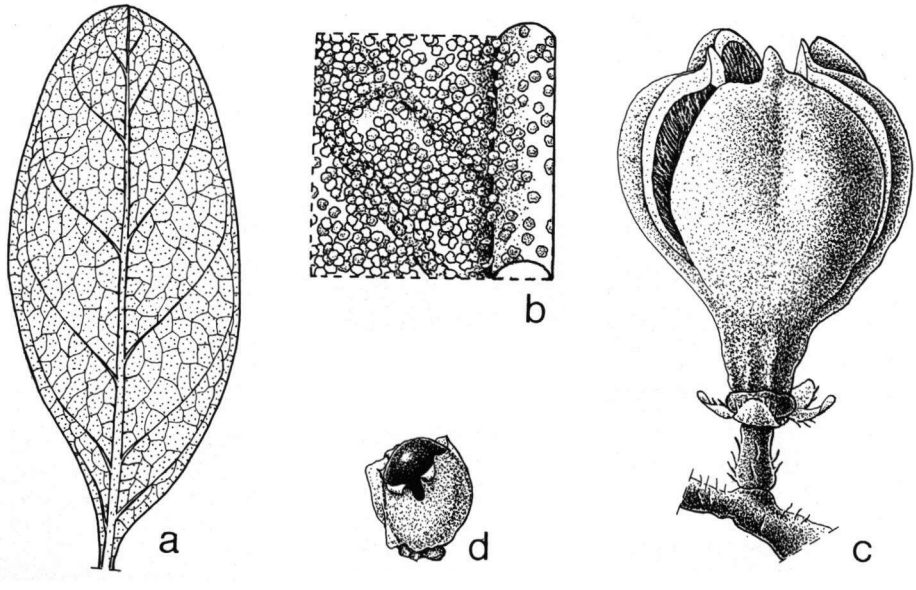

Fig. 75. *Cupaniopsis squamosa* Adema. a. Leaflet, × 1.5; b. idem, detail, × 35; c. fruit, × 3; d. seed, × 4.5 (a–d: *MacKee* 20428, L).

midrib above slightly prominent, nerves 4–8 per side, 4–15 mm apart, angle to midrib 45°(–60°); petiolule 0–4 mm, grooved above, with scale hairs. *Inflorescences* axillary or pseudoterminal, 3.5–8.5 cm, laxly flowered, with long or short branches, axes densely scaly, without or with few to many short patent hairs; cymules dichasial, 1–several-flowered. *Bracts* and *bracteoles* lanceolate to deltoid, 0.4–0.7 × 0.4–0.6 mm, not persistent under the fruits, outside with scale hairs, inside glabrous. *Pedicels* 0.8–1.2 mm, articulated up to halfway above the base, with scale hairs. *Buds* globular, 1.8 × 1.6–1.8 mm. Male flowers: *Sepals* outside with scale hairs except rim, rim ciliolate at least at the base, inside glabrous, outer ovate to elliptic, 1.2–2.5 × 0.8–1.3 mm, scarious rim narrow to rather wide, inner elliptic to obovate or orbicular, 1.8–3.1 × 1.6–2.2 mm, scarious rim very wide. *Petals* elliptic to orbicular, irregularly dentate, 1.2–2.0 × 0.7–1.6 mm, out- and inside appressed-hairy in lower half, rim ciliate in lower part, scales 2, not crested, 0.6–1.2 mm, woolly. *Disc* glabrous or with some hairs more or less in 5 tufts. *Stamens* 8 (9), exserted, filaments 1.6–2.4 mm, patently hairy in lower half to 2/3, anthers 0.7–1.1 mm, glabrous or hairy. *Pistillode* 3-celled, outside hairy, 0.4–0.8 × 0.4–0.6 mm. Female flowers not known. *Sepals* persistent under the fruits. *Fruits* obovoid to obpyramidal, slightly 3-lobed at apex, 10–13 × 6–9 mm, stipe 1–1.5 mm, wall 0.5 mm thick, outside smooth, with scale hairs, sometimes also with short hairs at the apex, inside villose to appressed-hairy, septa complete. *Seeds* obovoid, 6–8.5 × 3.5–6 mm, testa shiny dark brown or black, arilloid covering 2/3 to almost the whole seed, lobed to fimbriate, cotyledons superposed.

Distribution — New Caledonia.

Field notes — a. Ecological notes: Dense maquis-like scrubs on serpentine Alt. 380–600 m. Flowering: December to February, fruiting: May to August.

b. Additional descriptive notes: Leaves shiny green above, paler or grayish green below, brown below when young. Buds green. Corolla white. Filaments white. Fruits brown.

Notes — In one seed of *MacKee* 20428 an embryo with three cotyledons was found.

Specimens examined:
New Caledonia. 9 specimens.

52. Cupaniopsis stenopetala Radlk. — Fig. 76.

Cupaniopsis stenopetala Radlk. in K. Sch. & Lauterb., Nachtr. (1905) 309; in Engl., Pflanzenr. 98 (1933) 1192. — *C. stenopetala* Radlk. f. genuina Radlk., Bot. Jahrb. 56 (1920) 286, nom. illeg. (I.C.B.N. art. 26i). — Type: *Schlechter* 14436, Papua New Guinea, East Sepik Province, Torricelli Mts., 4.1902 (M!, holo, iso in BM!, BO!, K!, WRSL!).

Cupaniopsis oxypetala Radlk., Bot Jahrb. 56 (1920) 287, fig. 1; in Engl., Pflanzenr. 98 (1934) 1193, fig. 35. — Syntypes: *Ledermann* 7252 (B, lost, K!, M!), 7296 (B, lost, K!, M!), Papua New Guinea, East Sepik Province, 'Primarlager' on the Sepik, 5. 1912; 18533, Papua New Guinea, East Sepik Province, Ambunti, 1. 1913 (non vidi).

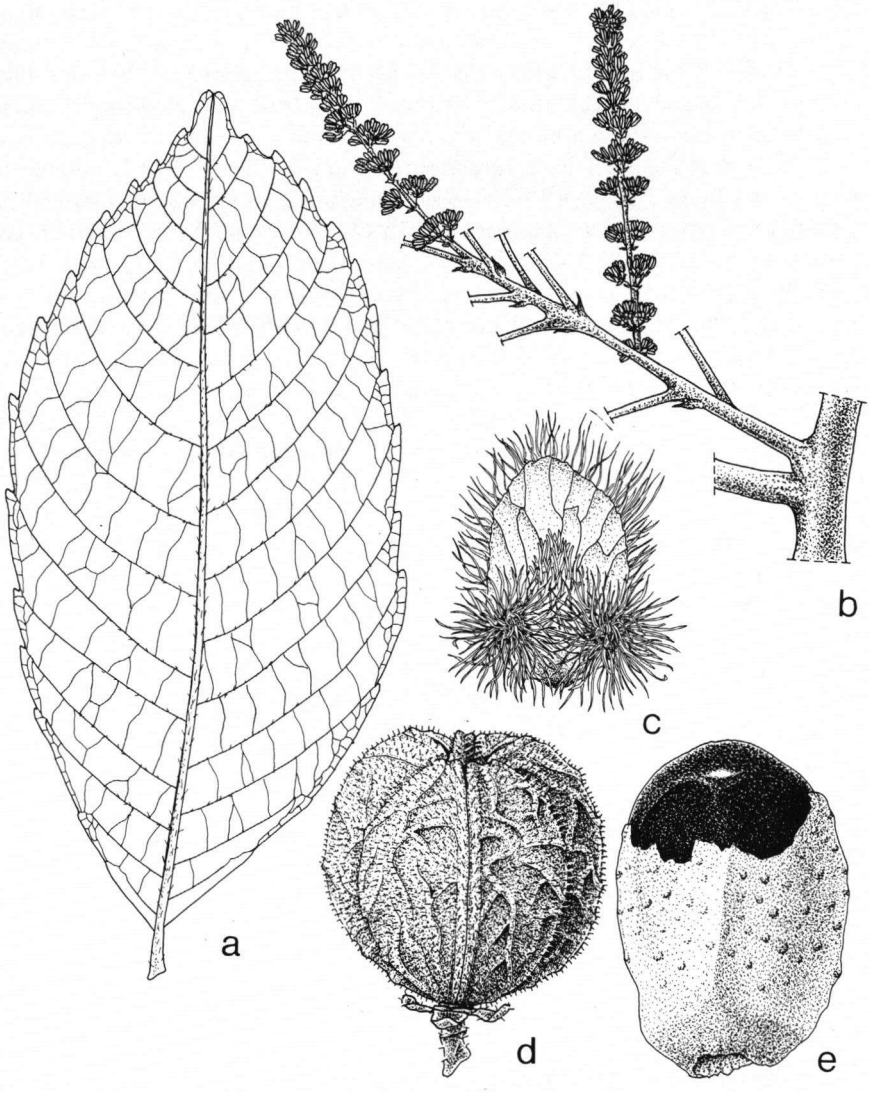

Fig. 76. *Cupaniopsis stenopetala* Radlk. a. Leaflet, × 1; b. inflorescence, × 0.7; c. petal from inside, × 35; d. fruit, × 4; e. seed, × 7 (a–c: *NGF* 46834, L; d, e: *Hoogland* 4897, L).

Trees 3.5–25 m high, d.b.h. 10–35 cm. *Flowering twigs* terete, 2–6(–12) mm in diameter, dark brown, striate to grooved, tomentose, glabrescent, exceptionally (*Hartley* 13129, *De Vogel* 3494) villose. *Leaves* (3–)4–6(–8)-jugate; petiole (3–)7–13 cm, semiterete, rarely upwards terete, rachis 9–26(–38) cm, semiterete

or terete, striate, more or less tomentose. *Leaflets* alternate to opposite, (narrowly) obovate, rarely elliptic, slightly asymmetric, upper 8–22 × 3–8 cm, index 2.2–4, lower 7–15 × 2.5–6 cm, index 1.8–3.4, chartaceous, above and below almost glabrous, midrib and nerves almost glabrous to shortly appressed-hairy, base cuneate to rounded, apex acuminate, acumen 1–20 mm, acute to rounded, margin (obtusely) dentate in upper part, rarely entire, midrib above slightly sunken to somewhat prominent, nerves (9–)10–19 per side, some of the upper ones ending in a tooth, 8–22 mm apart, angle to midrib (45°–)55°–80°, small pocket-like domatia present; petiolule 2–10 mm, grooved above, tomentose. *Inflorescences* axillary, 5–20(–34.5) cm, laxly flowered, with long or short, patent branches, tomentose, glabrescent; cymules dichasial, several flowered *Bracts* and *bracteoles* ovate to triangular, 0.6–5.0 × 0.4–2.0 mm, outside appressed-hairy, inside glabrous or with some hairs at the base, not persistent under the fruits. *Buds* obovate to globular, 1.4–2.6 × 1.0–2.6 mm. *Pedicels* 0.6–3.6 mm, articulated up to 2/3 above the base. Male flowers: *Sepals* outside appressed-hairy except rim, rim ciliate and with glands, inside appressed-hairy, outer elliptic to triangular, 1.0–2.9 × 0.8–2.2 mm, scarious rim narrow, inner elliptic to orbicular, 1.6–3.5 × 0.8–2.9 mm, scarious rim wide, irregularly dentate at apex. *Petals* elliptic to obovate, 0.8–2.9 × 0.5–2.2 mm, out- and inside glabrous or appressed-hairy in basal part, rim ciliate, sometimes (*Schlechter* 14436) with an apical tuft of hairs, scales 2, not crested, 0.6–1.3 mm, long-woolly. *Disc* glabrous. *Stamens* 8, exserted, filaments 1.4–2.6 mm, patently hairy except apical part, anthers 0.8–2.6 mm, glabrous, exceptionally hairy (*Conn & Kairo* 454, *NGF* 49156). *Pistillode* 0.4–1.3 × 0.4–1.3 mm, 3-celled, outside hairy. Female flowers: *Sepals* persistent under the fruits, outer 1.8 × 1.7–1.8 mm, inner 2.2 × 2.6 mm. *Ovary* 3-celled, outside hairy, style 2.3 mm, stigma 1.1 mm, 3-lined. *Fruits* globular, 9–15 × 10–15 mm, wall 0.4–1.1 mm thick, outside rugose, villose, inside villose, exceptionally (*Brass* 7769) thinly appressed-hairy, septa complete, in *Brass* 7769 almost glabrous. *Seeds* 9–10 × 6–8 mm, basally attached, testa shiny black, arilloid covering most of the seed, lacerate, cotyledons parallel.

Distribution — Moluccas; Papua New Guinea.

Field notes — a. Ecological notes: Primary or secondary rain forest, often along rivers. Alt.: 15–1900 m. Flowering: April to October; fruiting: May to October.

b. Adittional descriptive notes: Bole flanged all the way up. Bark pale gray or greenish to dark brown, smooth except for longitudinal cracks, underbark red, inner bark straw yellow to brown. Wood straw or white. Young leaves red-brown, leaflets glossy pale to dark green above, pale to medium green below. Calyx white to brown. Corolla cream to pink. Filaments pink, anthers yellow. Style sometimes orange tipped. Fruit yellow to reddish brown. Seeds glossy black, arilloid pale orange.

c. Vernacular names: Gai (Kaigorin), Garigor (Mawan), Nomai (Waskuk), Poiepoweh (Rawa), Taubasima (Kutubu).

Notes — Plants from lower altitude are more appressed-hairy and have wider leaflets than those from higher altitudes.

Schlechter 14436, 19201 have elliptic leaflets and small flowers. *Conn & Kairo* 454 has (in part) entire leaflets, large flower buds and flowers. The septum of the fruits of *Hoogland & Craven* 10,129 is sparsely hairy, the arilloid of its seeds is lobed and lacerate. In *Brass* 7769 the inside of the fruitwall is thinly appressed-hairy, the septa are almost glabrous.

Brass 32366 with (in part) entire leaflets, petals with a claw of 0.4–0.6 mm, and a reticulate instead of a rugulate ornamentation of the pollen grains, probably belongs to the present species. As does *UPNG* 8098 which is larger in most parts than all other specimens.

Specimens examined:
Moluccas. Morotai, Subdistr. Tobelo: *Tangkilisan* 215.
Papua New Guinea. 23 specimens; Admiralty Islands: *Moxley* s.n.

53. Cupaniopsis strigosa Adema, *spec. nov.* — Fig. 77.

Ramunculis strigosis. Folia 3-jugata, foliolis ovatis, integerrimis, acuminatis. Inflorescentiae axillares. Discus glaber. Stamina 8, exserta. Pistillodium 3-loculare. — Typus: *BB* 5461, Indonesia, Sulawesi, Bonthain, Paringtalasa, alt. ca. 2000 m, 18.4.1923 (L!, holo).

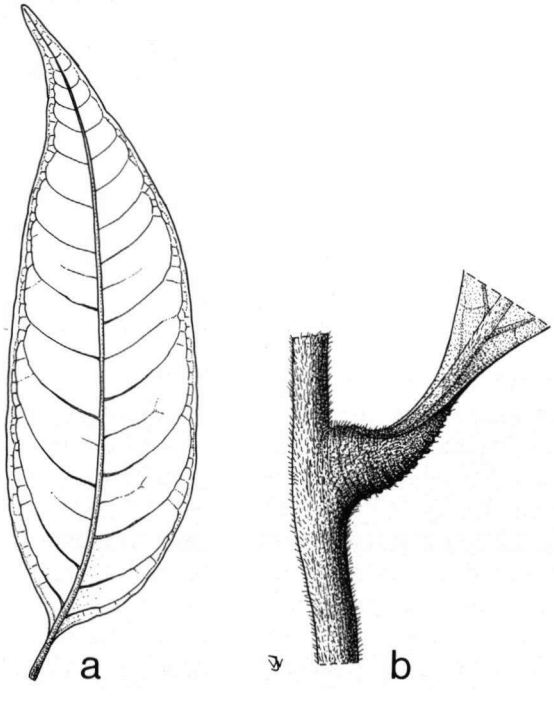

Fig. 77. *Cupaniopsis strigosa* Adema. a. Leaflet, × 0.75; b. part of petiole, × 4.5 (a, b: *BB* 5461, L).

Flowering twigs 2 mm in diameter, strigose. *Leaves* 3-jugate; petiole 5.5–6.0 cm, semiterete, upwards terete, rachis 7.0–7.5 cm, terete, both striate, strigose. *Leaflets* alternate to opposite, ovate, slightly asymmetric, upper 9–11.2 × 3.0–3.2 cm, index 3–3.7, lower 8 × 2.4 cm, index 3.3, chartaceous, above and below almost totally glabrous, midrib with some very short appressed hairs, base cuneate, apex acuminate, acumen 8–16 mm, rounded, margin entire, midrib above slightly prominent, nerves 12–16 per side, 5–7 mm apart; petiolule 5–7 mm, grooved above, with some short appressed hairs. *Inflorescences* axillary, 2 per axil, 11 cm, laxly flowered, with long branches. Male flowers: *Sepals* 6, outside shortly appressed-hairy in basal part, rim ciliate, also with dark coloured glands, inside with very few, appressed hairs, outer about elliptic, 1.6–1.9 × 1.2 mm, scarious rim rather wide, inner broadly elliptic, 2.2 × 1.9 mm, scarious rim wide. *Petals* 5, lingulate, 1.8–2.3 × 0.5–0.7 mm, out- and inside with some appressed hairs, rim ciliate, scales 2, not crested, 0.6–0.7 mm, woolly at the apex. *Disc* glabrous. *Stamens* 8, exserted, filaments 3.6 mm, patently hairy except upper quarter, anthers 0.6 mm, glabrous. *Pistillode* 3-celled, outside hairy.

Distribution — Celebes (Bonthain).

Notes — Only known from the type, a male flowering specimen. The present species is quite different from the other species from Celebes, *C. celebica*. The latter species belongs to the *Platycarpa*-group and has a 2-celled pistil. The new species is also rather different from the other species of *Cupaniopsis* with a strigose indumentum.

Specimens examined:
CELEBES. Bonthain. Paringtalasa: *BB* 5461.

54. Cupaniopsis subfalcata Adema, *spec. nov.* — Fig. 78.

Frutex 3 m alta, partibus juvenilibus lepidotis pilis brevis patentiter obsita. Folia 5-jugata, foliolis ellipticis ad ovatis, obtusis, integerrimis. Inflorescentiae axillares. Discus glaber. Stamina 8, exserta. Ovarium 3-loculare. — Typus: *MacKee* 4297, New Caledonia, summit plateau Mt. Koniambo, alt. 800–900 m, 31. 3.1956 (L!, holo, iso in A!, K!).

Shrub 3 m high. *Flowering twigs* terete, 2 mm in diameter, striate, young parts with scale and short patent hairs, varnished and pruinose. *Leaves* 5-jugate; petiole 4.5–5.5 cm, rachis 7–8 cm, both semiterete, striate, with scale and short patent hairs. *Leaflets* opposite to alternate, elliptic to ovate, asymmetric, upper 6–8 × 2–2.5 cm, index 2.8–3.2, lower 4.5–6.5 × 2–2.5 cm, index 2.1–2.6, coriaceous, above and below almost glabrous, midrib with scale and short hairs, base cuneate to rounded, apex obtuse, margin entire, midrib above slightly prominent, nerves 6–10 per side, 5–11 mm apart, angle to midrib 65°–70°; petiolule 3–8 mm, grooved above, with scale and short hairs. *Inflorescences* axillary or pseudoterminal, 11–13.5 cm, laxly flowered, with long branches. *Bracts* and *bracteoles* linear-lanceolate to triangular, 0.4–0.7 × 0.1–0.5 mm, outside with scale and very short hairs, inside with some scale hairs. *Pedicels* 2.6–4.2 mm, articulated halfway above the base. *Buds* 2.4 × 3.0 mm. Male flowers: *Sepals* outside with scale hairs except

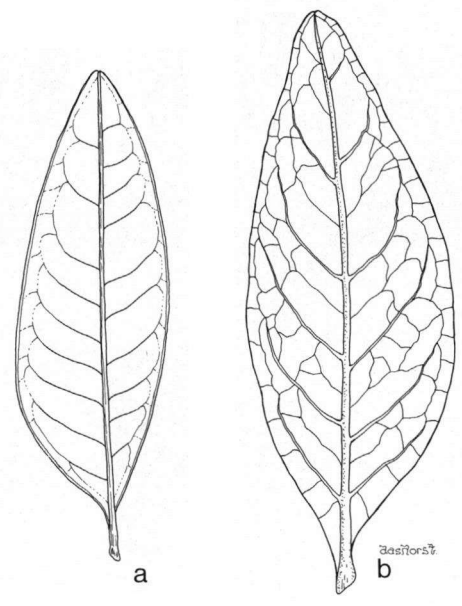

Fig. 78. *Cupaniopsis subfalcata* Adema. a. Leaflet, × 0.75 (*MacKee* 4297, L). — Fig. 79. *Cupaniopsis tontoutensis* Guillaumin. b. Leaflet, × 1.25 (*Webster* 19354, L).

rim, rim sometimes ciliate at the base, inside glabrous or rarely with some appressed hairs, outer about orbicular, 1.8–2.2 × 1.7–2.0 mm, scarious rim narrow to rather wide, inner obovate to almost orbicular, 2.9 × 2.4–2.6 mm, scarious rim wide. *Petals* almost elliptic, 1.9–2.3 × 1.2–1.3 mm, outside glabrous, rim ciliate at base, inside appressed-hairy in lower part, scales 2, not crested, 1.3–1.4 mm, woolly. *Disc* glabrous. *Stamens* 8, exserted, filaments 2.3–2.6 mm, patently hairy in lower half, anthers 1.0–1.1 mm, with some hairs. *Pistillode* 3-celled, outside glabrous, 0.6 × 0.5 mm. Female flowers: Outer *sepals* 2.2–2.5 × 2.0–2.3 mm, inner broadly ovate, 3.7 × 3.0 m. *Petals* 2.4–2.6 × 1.6–1.8 mm, scales 1.8–2.2 mm. Filaments of *staminodes* 1.8–2.0 mm, anthers 1.0–1.1 mm. *Ovary* 3-celled, outside with scale hairs, style 1.8 mm, stigma 0.6 mm, 3-lined.

Distribution — New Caledonia (Mt. Koniambo).

Field notes — a. Ecological notes: Alt. 800–900 m. Flowering: March.

b. Additional descriptive notes: Leaves light green above and below. Flowers white.

Notes — The present species resembles in some aspects *C. myrmoctona*. It differs from that species mainly in the number of leaflets, the length of the pedicels, the size of the buds, and the size of most flower parts.

Specimens examined:

New Caledonia. Mt. Koniambo: *MacKee* 4297.

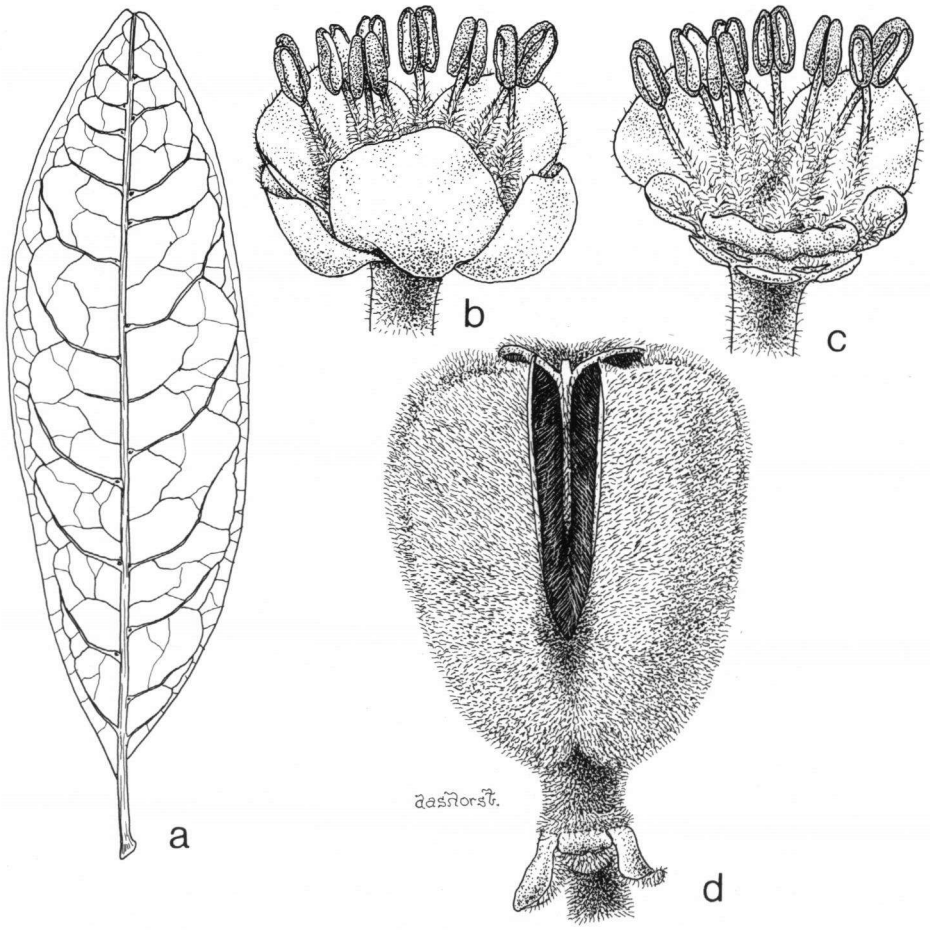

Fig. 80. *Cupaniopsis sylvatica* Guillaumin. a. Leaflet, × 0.75; b. male flower, × 9; c. idem, 3 sepals and 2 petals removed, × 9; d. fruit, × 3.5 (a–c: *McPherson* 2365, L; d: *MacKee* 20807, L).

55. Cupaniopsis sylvatica Guillaumin — Fig. 80.

Cupaniopsis sylvatica Guillaumin in Guillaumin & Virot, Mém. Mus. Nat. Hist. Nat. B 4 (1953) 18, fig. 5. — Type: *Virot* 1682, New Caledonia, Massif des Grosses Gouttes, Haute rivière de Saint-Louis, 25. 1.1947 (P!, holo, iso in L!).

Trees or *treelets* (2–)6–15 m high, d.b.h. 15–35 cm. *Flowering twigs* terete, 1.5–4 mm in diameter, striate, glabrous to strigose. *Leaves* (2–)3–6(–8)-jugate; petiole (2–)3.5–12 cm, rachis (2.5–)4–16.5 cm, both semiterete, striate, grooved above, thinly strigose to glabrous. *Leaflets* opposite to alternate, elliptic to ovate, asymmetric, upper 5–14.5 × 2–5 cm, index 2.4–3.3, lower 3.5–11 × 1.5–6 cm, index

1.7–2.8, chartaceous to more or less coriaceous, above and below almost glabrous, midrib and nerves with or without very few scattered short hairs, base cuneate to rounded, apex obtuse to rounded, sometimes retuse, margin entire, midrib above slightly prominent, nerves 5–11 per side, 5–18(–23) mm apart, angle to midrib 45°–70°, small pocket-like domatia present; petiolule 3–14 mm, grooved above, strigose to glabrous. *Inflorescences* axillary, exceptionally ramiflorous, 2.5–9 cm, laxly flowered, without or with long or short branches, strigose; cymules dichasial, 1–several-flowered. *Bracts* and *bracteoles* to semicircular, obtuse to rounded, 0.7–2.6 × 0.5–1.2 mm, not persistent under the fruits, outside thinly shortly appressed-hairy, margin ciliolate, inside shortly appressed-hairy at the base. *Pedicels* 1.8–4.2 mm, articulated at the base. *Buds* 2.4 × 2.5 mm. Male flowers: *Sepals* out- and inside shortly appressed-hairy except rim, rim ciliate and with glands, outer elliptic to orbicular, 1.4–2.6 × 1.3–2.6 mm, scarious rim narrow to rather wide, inner orbicular, 2.3–3.5 × 2.0–3.6 mm, scarious rim very wide. *Petals* obovate to orbicular, 1.1–1.7 × 0.8–1.4 mm, out- and inside appressed-hairy in lower part, scales 2, not crested, 0.8–1.8 mm, woolly. *Disc* glabrous. *Stamens* (5) 8, exserted, filaments 1.2–3.5 mm, patently hairy at least in lower half, anthers 1.0–1.2 mm, glabrous. *Pistillode* 3-celled, outside hairy, 0.8–1.1 × 0.6–0.8 mm. Female flowers: *Sepals* not persistent under the fruits, outer 1.7–2.0 × 1.9–2.4 mm, inner 3.6 × 4.2 mm. *Petals* 1.4–1.7 × 1.4–1.7 mm, scales 1.0–1.3 mm. Filaments of *staminodes* 1.4 mm, anthers 1.2 mm, hairy. *Ovary* 3-celled, outside short-velutinous, style 0.7 mm, stigma 0.6 mm, 3-lined or occasionally short 3-lobed (*MacKee* 23827). *Fruits* cylindrical, 20–26 × 15–20 mm, stipe 3–4 mm, wall 0.8–1.4 mm thick, outside smooth, more or less velutinous, inside appressed-hairy to more or less villose, septum complete. *Seeds* 14–19 × 8–10 mm, testa brownish to black, arilloid lacerate, covering 2/3 to almost the whole seed, cotyledons about equal, obliquely superposed.

Distribution — New Caledonia, Ile des Pins.

Field notes — a. Ecological notes: Forests on hill- or mountainsides, often along rivers, sometimes along the coast, rarely in maquis, on schists and serpentine. Alt. 10–900 m. Flowering: January to June, fruiting: June to November (to April).

b. Additional descriptive notes: Bark reddish brown, a bit rough. Leaflets shiny dark green above, light green below. Sepals green. Petals greenish white to white. Filaments white. Fruits brown or greenish brown. Seeds black, arilloid orange or red.

Notes — *Virot* 1682 (type) has thin leaflets and small flowers with rather short stamens. *McKee* 23827 has shortly lobed stigmas.

Specimens examined:
NEW CALEDONIA. 29 specimens; Ile des Pins: 1 specimen.

56. Cupaniopsis tomentella (F. Muell. ex Benth.) Reynolds — Fig. 81.

Cupaniopsis tomentella (F. Muell. ex Benth.) Reynolds, Austrobaileya 2 (1984) 51, fig. 4A, B; Fl. Austr. 25 (1985) 62, map 78. — *Cupania tomentella* F. Muell. ex Benth., Fl. Austr. 1 (1863) 458; Bailey, Queensland Fl. 1 (1899) 292; Audas, Native trees Austr. ed. 2 (1947) 179

('*tomentilla*'). — *Cupania serrata* F. Muell. var. *tomentella* (F. Muell. ex Benth.) F. Muell., Fragm. 9 (1875) 95. — *Cupaniopsis serrata* (F. Muell.) Radlk. var. *tomentella* (F. Muell. ex Benth.) Domin, Bibl. Bot. 22 (1927) 903; Reynolds in Stanley & Ross, Fl. SE Queensl. 1 (1983) 513, fig. 80I. — *Cupaniopsis serrata* (F. Muell.) Radlk. f. *tomentella* (F. Muell. ex Benth.) Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. Münch. 9 (1879) 585; in Engl., Pflanzenr. 98 (1933) 1184. — Type: *Hill* s.n., Australia, Queensland, Moreton Bay (K!, holo).

Trees 6–10 m high, young parts and inflorescences with a dense, brown indumentum. *Flowering twigs* terete, 2–4 mm in diameter, grooved, villose. *Leaves* 3–6-jugate; petiole 2.5–5.5 cm, semiterete, sometimes upwards terete, rachis 3–13 cm, semiterete, sometimes more or less terete in lower part, both striate to grooved, villose. *Leaflets* alternate or rarely subopposite, elliptic or rarely ovate, slightly asymmetric, upper 5–9.5 × 2–4 cm, index 2–3.4, lower 4–7 × 1.5–3 cm,

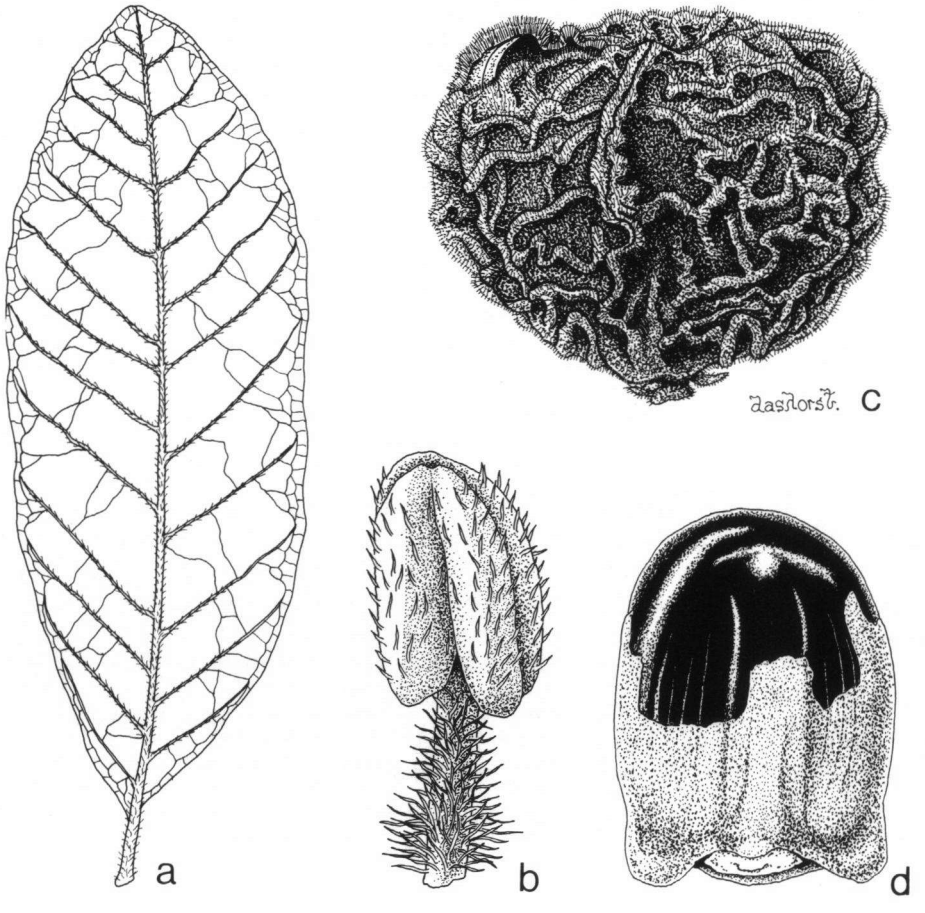

Fig. 81. *Cupaniopsis tomentella* (F. Muell. ex Benth.) Reynolds. a. Leaflet, × 1; b. stamen, × 15; c. fruit, × 3; d. seed, × 3.5 (a, b:*Bailey* s.n., BRI; c, d: *Bird* s.n., BRI).

index 1.9–2.7, coriaceous, above and below (very) thinly pilose, midrib more densely so, base cuneate to rounded, apex obtuse to rounded, often mucronate, rarely retuse, margin entire or obscurely dentate to dentate at least in upper part, midrib above somewhat sunken to slightly prominent, nerves 5–13(–18) per side, upper ones often ending in a tooth, other nerves often also reaching the margin of the leaflets, 4–14(–18) mm apart, angle to midrib 45°(–60°), small pocket-like domatia present; petiolule 2–10 mm, grooved, short velutinous. *Inflorescences* axillary, 3–12 cm, laxly to rather densely flowered, without or with short or long branches: cymules dichasial. 1–several-flowered. *Bracts* and *bracteoles* ovate to orbicular or rhomboid, 1.0–2.5 × 1.1–2.4 mm, not persistent under the fruits, outside appressed-hairy, margin ciliate, inside scattered appressed-hairy. *Pedicels* 0–1.2 mm, articulated at the base. *Buds* 2.9–3.6 × 3.1–3.9 mm. Male flowers: *Sepals* outside appressed-hairy, rim ciliate, inside glabrous, outer orbicular to transversely elliptic, 2.6–3.2 × 2.3–3.5 mm, scarious rim rather wide, inner orbicular, 3.6–4.0 × 3.0–3.5 mm, scarious rim wide. *Petals* broadly ovate to 'squarish', 1.0–1.6 × 1.1–1.7 mm, outside appressed-hairy in lower half, rim ciliate, inside glabrous or with few hairs, scales 2, not crested, 0.7–1.2 mm, long ciliate. *Disc* with 5 tufts of hairs. *Stamens* 8, not exserted, filaments 1.3–1.7 mm, patently hairy in lower 2/3, anthers 1.8–2.0 mm, hairy. *Pistillode* 3-celled, outside hairy, 0.7–1.2 × 0.6–0.8 mm. Female flowers: *Sepals* persistent under the fruits, broadly elliptic to orbicular, outer 3.2–4.3 × 3.2–4.3 mm, inner 4.8 × 4.1–4.6 mm. *Petals* 1.8–2.5 × 1.2–1.6 mm, scales 1.6–2.3 mm. Filaments of *staminodes* 2.2–2.8 mm, anthers 1.8–2.0 mm. *Ovary* 3-celled, outside hairy, style 1.0–1.3 mm, stigma 1.0–1.3 mm, 3-lined. *Fruits* ± globular, 20 × 28 mm, wall 3.0–3.6 mm thick, outside rugose, villose, inside glabrous, septa complete. *Seeds* 11.5–15 × 10–12 mm, testa shiny black, arilloid covering the whole seed, crenate?, cotyledons unequal, obliquely superposed.

Distribution — Australia (SE Queensland).

Field notes — a. Ecological notes: Rain forest, remnants of vine forest or vine scrub on sandstone or stony soils. Alt. 0–150 m. Flowering: November to January (to June), fruiting: December to January.

b. Additional descriptive notes: Flowers white. Fruits yellow. Seeds black.

Notes — Usually the venation is open with the nerves reaching the margin of the leaflets even when not ending in a tooth.

Specimens examined:
AUSTRALIA. SE Queensland: 11 specimens.

57. Cupaniopsis tontoutensis Guillaumin — Fig. 79.

Cupaniopsis tontoutensis Guillaumin in Guillaumin & Virot, Mém. Mus. Nat. Hist. Nat. B. 4 (1953) 18, fig. 6. — Type: *Virot* 1448, New Caledonia, cours moyen de la Tontouta, rive droite, alt. ca. 50 m, 14.1.1945 (P!, holo).

Treelets or *shrubs* 1–3 m high, young parts with minute scale hairs, pruinose later on, buds 'varnished'. *Flowering twigs* terete, 2–5 mm in diameter, striate, glabrous. *Leaves* 5–8-jugate; petiole 2.5–6.5 cm, semiterete, upwards ± terete,

pruinose, rachis 7.5–15.5 cm, more or less terete, both striate, above grooved, glabrous or with scale hairs, or above with short patent hairs. *Leaflets* opposite to alternate, (elliptic to) ovate, asymmetric, upper 3.5–9 × 1.5–3.5 cm, index 2.2–2.8, lower 2.5–6 × 1–2.5 cm, index 2–2.4, coriaceous, above and below glabrous, rarely with scattered scale hairs, midrib sometimes with short hairs, base cuneate to rounded, apex obtuse to rounded, margin entire, midrib above slightly prominent, nerves 4–8 per side, 5–12(–15) mm apart, angle to midrib 45°–55°; petiolule 0–5 mm, grooved above, pruinose, glabrous. *Inflorescences* axillary or pseudoterminal, 7–13.5 cm, laxly flowered, without or with long branches; cymules 1-flowered *Bracts* and *bracteoles* with scale hairs, inside glabrous. *Pedicels* 2.4–3.8 mm, articulated at the base. *Buds* globular, 2.0–2.9 × 2.2–2.9 mm. Male flowers: *Sepals* outside glabrous, rim shortly glandular ciliate, inside glabrous to appressed-hairy in basal part, outer elliptic to orbicular, 2.3–3.6 × 1.7–3.0 mm, scarious rim rather wide, inner orbicular, 3.2–3.7 × 3.0–3.2 mm, scarious rim wide. *Petals* irregularly elliptic to orbicular, crenate to lobed at apex, 2.3–3.0 × 1.4–2.8 mm, outside glabrous or with few appressed hairs at the base, rim ciliate at base, inside more or less appressed-hairy in basal part, scales 2, not crested, 1.2–1.3 mm, woolly. *Disc* glabrous or with scale hairs. *Stamens* 8, exserted, filaments 2.3–2.9 mm, patently hairy except apex, anthers 1.3–1.4 mm, glabrous. *Pistillode* 3-celled, 0.5–0.6 × 0.4–0.5 mm, glabrous or with few hairs at the apex. Female flowers known under young fruits only. *Style* 1.1 mm, stigma 1.1 mm, 3-lined. Young *fruits* 3-celled, stiped, lobed at apex, outside smooth, with scale hairs, inside glabrous, septa complete.

Distribution — New Caledonia (Tontouta River).

Field notes — a. Ecological notes: Maquis on serpentine. Alt. 20–100 m. Flowering: December to January, fruiting: October.

b. Additional descriptive notes: Leaflets dark green above, light green below. Flowers white, not or little scented.

Notes — Only known from 3 male flowering collections, and 1 fruiting collection. The present species seems to be rather distinct, however.

Specimens examined:
NEW CALEDONIA. Tontouta River: 4 specimens.

58. Cupaniopsis trigonocarpa Radlk. — Fig. 82.

Cupaniopsis trigonocarpa Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. Münch. 9 (1879) 586; Guillaumin, Bull. Soc. Bot. Fr. 79 (1932) 339; Bull. Mus. Nat. Hist. Nat. 2e sér., 4, B (1932) 694; Radlk. in Engl., Pflanzenr. 98 (1933) 1200; Guillaumin, Fl. Nouv.-Caléd. (1948) 200. — Type: *Balansa* 144, New Caledonia, bords de la rivière du Port-des-Francais, près de Nouméa, 11.1868 (P!, holo, iso in BM!, M!, NY!).

Trees 4–10 m high, d.b.h. 15–35 cm. *Flowering twigs* terete, 1.5–3 mm in diameter, striate, strigose. *Leaves* 2–3-jugate; petiole 2–6.5 cm, semiterete, rarely upwards more or less terete, rachis 1–9.5 cm, semiterete or sometimes ± terete, often grooved above, both striate, strigose, glabrescent. *Leaflets* opposite to al-

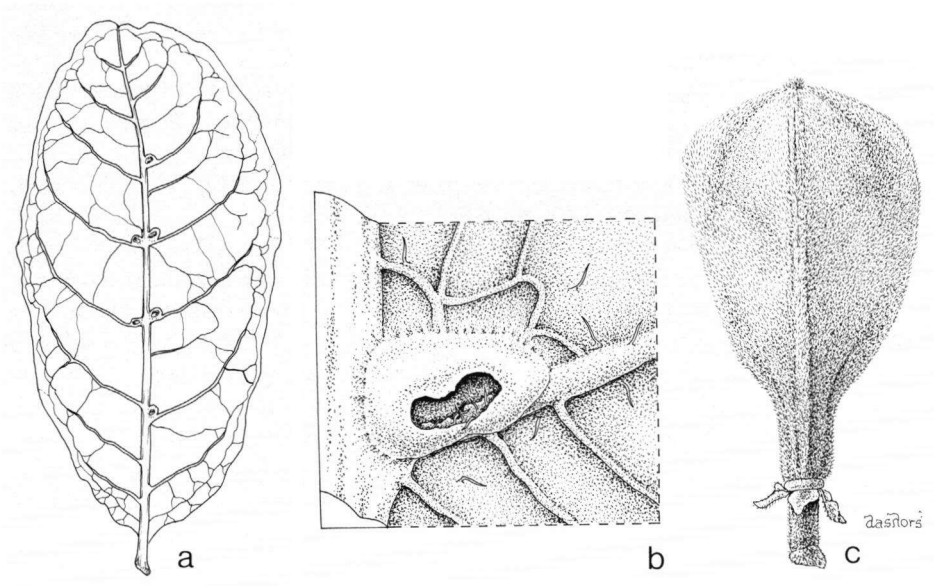

Fig. 82. *Cupaniopsis trigonocarpa* Radlk. a. Leaflet, × 0.9; b. idem, detail, × 15; c. young fruit, × 2.5 (a, b: *Le Rat* 2055, P; c: *MacKee* 40843, L).

ternate, elliptic to obovate, slightly asymmetric, upper 5–12 × 2–6.5 cm, index 1.6–2.7, lower 3.5–10.5 × 2–6.5 cm, index 1.3–2.8, coriaceous, above and below (almost) glabrous, midrib (and sometimes also nerves) glabrous or with short hairs, especially in lower part, base cuneate to rounded, apex rounded, retuse, margin entire, midrib above slightly prominent, usually ending before apex, nerves (4–)5–9 per side, 6–22 mm apart, angle to midrib 45°–70°, small pustulate domatia present; petiolule 2–11 mm, grooved, strigose glabrescent. *Inflorescences* (supra) axillary, 3.5–10 cm, laxly flowered, usually with rather long, rarely with short or without branches; cymules 1-flowered. *Bracts* and *bracteoles* triangular to deltoid, 0.2–0.6 × 0.2–0.7 mm, not persistent under the fruits, outside shortly appressed-hairy, inside glabrous or shortly appressed-hairy at base. *Pedicels* 2.2–2.4 mm, articulated at the base. *Buds* globular, 1.6–2.6 × 1.8–2.6 mm. Male flowers: *Sepals* broadly elliptic to orbicular, out- and inside shortly appressed-hairy except rim, rim ciliate and with glands, outer 0.8–2.4 × 1.0–1.8 mm, scarious rim narrow to rather wide, inner 2.0–2.8 × 1.8–2.8 mm, scarious rim wide. *Petals* more or less semicircular to obovate or orbicular, usually irregularly dentate, 0.6–1.8 × 0.4–1.8 mm, outside glabrous or with very few short hairs at the base, inside appressed-hairy in lower half, rim usually ciliate in lower half, scales 2, not crested, 0.6–1.2 mm, woolly. *Disc* glabrous, exceptionally with 5 tufts of hairs (*Veillon* 7200). *Stamens* 8, exserted, filaments 1.6–3.0 mm, patently hairy in lower half, anthers 0.6–0.8 mm, glabrous. *Pistillode* 3-celled, outside hairy, 0.6–1.0 × 0.6–0.8 mm. Female flowers: *Sepals* not persistent under the fruits, outer 1.4–1.8 × 1.4–1.8 mm,

inner 1.9–3.4 × 1.4–3.0 mm. *Petals* 0.8–1.3 × 0.8–1.3 mm, scales 1.0–1.2 mm. Filaments of *staminodes* 1.8 mm, anthers 1.2 mm. *Ovary* 3-celled, outside hairy, style 0.6–0.8 mm, stigma 0.5–0.6 mm, 3-lined. *Fruits* obpyramidal, trigonal in cross section, 22–26 × 15–19 mm, stipe 4–5 mm, wall 0.8–1.2 mm thick, outside smooth, velutinous, inside appressed-hairy to more or less villose, septa complete. *Seeds* 13 × 8 mm, testa brownish, arilloid lobed to crenate, covering 2/3 of the seed, cotyledons slightly unequal, superposed.

Distribution — SW New Caledonia.

Field notes — a. Ecological notes: Forests along rivers and the coast on schists. Alt. 0–50 m. Flowering: June to July (to October), fruiting: October to December.

b. Additional descriptive notes: Bark brown or pale gray, smooth to rough. Leaflets shiny dark green above, light green below. Flowers white, greenish white, or pinkish, scentless. Anthers yellow. Fruits green or brown.

Specimens examined:
NEW CALEDONIA. 24 specimens.

59. Cupaniopsis vitiensis Radlk. — Fig. 83.

Cupaniopsis vitiensis Radlk., Fedde Rep. 20 (1924) 34; in Engl., Pflanzenr. 98 (1933) 1198; Parham, Plants Fiji Is. (1964) 173; ed. 2 (1972) 246; A.C. Smith, Fl. Viti. 3 (1985) 608, fig. 147E. — Type: *Horne* 982, Fiji, Viti Levu, Korosuli on the Wainimala, 8.1878 (K!, holo).

Cupaniopsis induta A.C. Smith, J. Arn. Arbor. 31 (1950) 296; Parham, Plants Fiji Is. (1964) 173; ed. 2 (1972) 246. — Type: *A.C. Smith* 4663, Fiji, Viti Levu, Mba, upper slopes of Mt. Koromba, 3.6.1947 (A!, holo, iso in BISH!, K!, L!, NY!).

Trees 2–15 m high, d.b.h. 5–6(–20) cm. *Flowering twigs* terete, 3–10 mm in diameter, striate, villose. *Leaves* 5–8-jugate; petiole 8.5–27.5 cm, semiterete, upwards terete, rachis 17–38.5 cm, terete, both striate, (shortly) villose. *Leaflets* alternate to opposite, elliptic to ovate, slightly asymmetric, upper 9–21.5(–25.5) × 3–8 cm, index 2.5–3.7, lower 5.5–12 × 2.5–6 cm, index 2–2.3, chartaceous, above almost glabrous, midrib and nerves glabrous or more or less pilose, below thinly pilose to villose, midrib and nerves more densely so, base cuneate to rounded, apex rounded, obtuse or short acuminate, acumen 2–8 mm, obtuse, margin entire, midrib above scarcely prominent, nerves 7–17 per side, (4–)6–19 mm apart, angle to midrib 45°–70°(–90°); petiolule 5–20 mm, grooved, glabrous to villose. *Inflorescences* axillary, 13–34 cm, laxly flowered, with long patent branches, villose; cymules dichasial, 1–several-flowered. *Bracts* and *bracteoles* elliptic to deltoid, 1.0–3.4 × 0.8–2.2 mm, not persistent under the fruits, thick, outside appressed-hairy, inside appressed-hairy at the base or glabrous. *Pedicels* 1.2–3.0 mm, articulated up to 1/4 above the base. *Buds* flattened globular, 3.8–4.8 × 3.4–6.0 mm. Male flowers: *Sepals* orbicular, irregularly dentate, out- and inside appressed-hairy except rim, rim ciliate and with some glands, outer 3.0–4.8 × 2.4–4.2 mm, scarious rim narrow to rather wide, inner 4.8–5.4 × 4.4–5.4 mm, scarious rim wide. *Petals* mostly irregular, obliquely or transversely elliptic to orbicular, irregularly dentate, 1.2–3.1 × 1.2–2.4 mm, outside appressed-hairy up

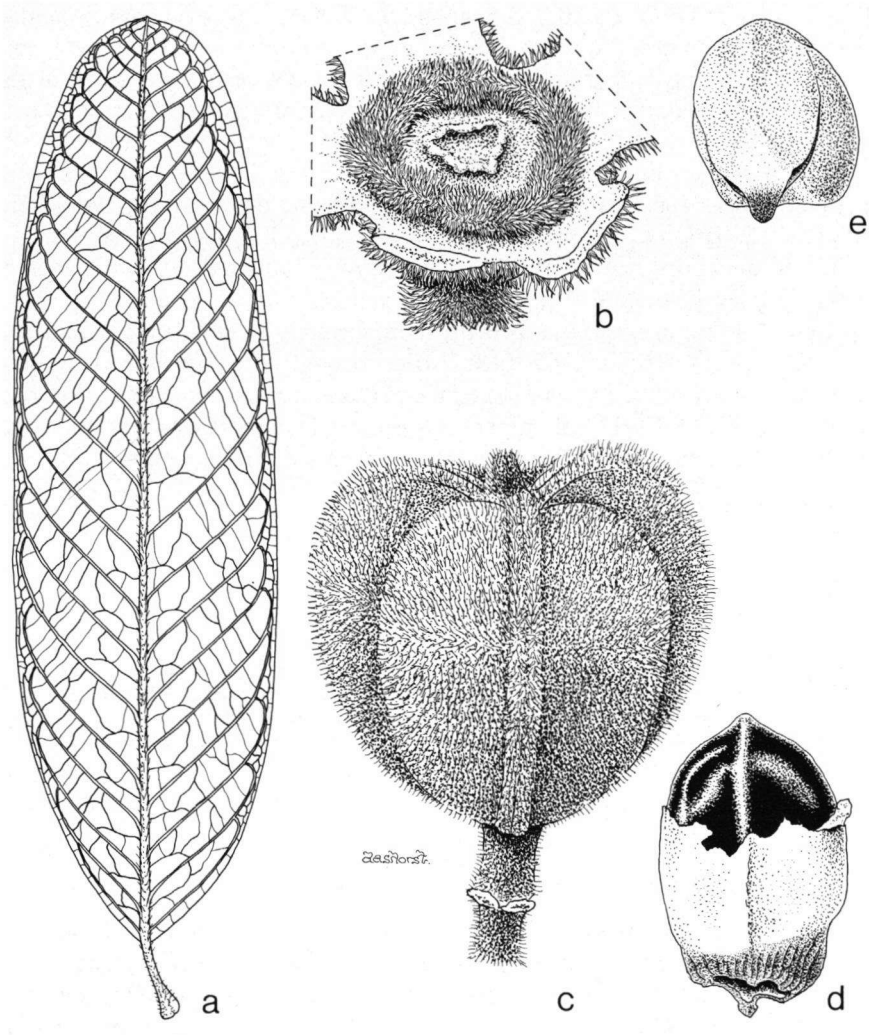

Fig. 83. *Cupaniopsis vitiensis* A.C. Smith. a. Leaflet, × 0.4; b. disc, × 15; c. fruit, × 3.5; d. seed, × 3.5; e. embryo, × 3.5 (a, d, e: *DA* 12911, K; b: *DA* 13316, BISH; c: *A.C. Smith* 5854, L).

to 2/3, inside glabrous or appressed-hairy between the scales, scales 2, not crested, 0.6–1.2 mm, curved, woolly. *Disc* hairy. *Stamens* 10, not exserted, filaments 1.1–1.8 mm, patently hairy, anthers 1.9–2.9 mm, glabrous. *Pistillode* 3-celled, outside hairy, 1.2–2.2 × 1.2–1.8 mm. Female flowers: *Sepals* persistent under the fruits, outer 3.4–5.2 × 2.5–4.6 mm, inner 4.8–6.0 × 4.0–5.4 mm. *Petals* 2.0–2.4 × 1.3–2.0 mm, scales 1.1–1.3 mm. Filaments of *staminodes* 1.8 mm, anthers 2.2 mm. *Ovary* 3-celled, outside hairy, style 1.2–2.8 mm, thick, with 3 stigmatic lines. *Fruits* obovoid or obpyramidal, rounded triangular in cross section, 15–22 × 11–

20 mm, stipe 2–4 mm, wall 0.2–0.5 mm thick, outside rugose, villose, sometimes also with longer hairs, inside more or less appressed-hairy, septa complete, membranous, mostly easily tearing. *Seeds* 11–18 × 8–12 mm, testa shiny black, arilloid covering half to almost the whole seed, lacerate, cotyledons equal or unequal, parallel.

Distribution — Fiji (Viti Levu, Vanua Levu).

Field notes — a. Ecological notes: Dense forests or forest-grassland transition. Alt. 150–1075 m. Flowering: April to July, fruiting: July to October.

b. Additional descriptive notes: Sepals yellow or brown. Petals white or cream. Anthers yellow or orange. Fruits brownish yellow.

Notes — Many specimens, especially those formerly included in *C. induta*, show small differences. *Meebold* 16721 has leaflets strongly alternate with very oblique bases. *Smith* 1742, 4663, the type collection of *C. induta*, and *Smith* 5854 have rather small leaflets. *DA* 12911 has rather long elliptic leaflets. However, all seem to belong to the same species. See also the comments of Smith (1985: 608).

Specimens examined:
Fiji. Viti Levu: 9 specimens, Vanua Levu: 3 specimens, Navatu Levu: 1 specimen.

60. Cupaniopsis wadsworthii (F. Muell.) Radlk. — Fig. 84.

Cupaniopsis wadsworthii (F. Muell.) Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München. 9 (1879) 483, 534, 585; Maiden & Betche, Census N.S.W. Pl. (1916) 128; Domin, Bibl. Bot. 22 (1927) 904; Radlk. in Engl., Pflanzenr 98 (1933) 1188; Francis, Austr. Rain-for. trees ed. 2, (1951) 249; Reynolds, Austrobailey 2 (1984) 46, fig. 4O; Fl. Austr. 25 (1985) 56, map 68. — *Harpullia wadsworthii* F. Muell., Fragm. 4 (1863) 1, pl. 26; Walpers, Ann. 7 (1869) 632 ('wodsworthii'); F. Mueller, Fragm. 9 (1875) 89, 197. — *Cupania wadsworthii* (F. Muell.) F. Muell., Census Austr. Pl. (1882) 24; ed. 2 (1889) 41; Moore, Fl. N.S.W. (1893) 91; Bailey, Queensl. Fl. 1 (1899) 290; Compr. Cat. Queensl. Pl. (1913) 114, fig. 91ter. — Lectotype (present author): *Dallachy* s.n., Australia, Queensland, Rockhampton (M!, holo).

Slender *trees* or *shrubs*, 1–3 m high. *Flowering twigs* terete, 1–2 mm in diameter, striate, strigose to glabrous. *Leaves* 1–2, exceptionally 3-jugate; petiole 2–20 mm, semiterete, rarely more or less terete, rachis (1–)5–24 mm, semiterete, usually grooved above, both striate, strigose to almost glabrous. *Leaflets* (sub)opposite or rarely alternate, cuneate, slightly asymmetric, upper 2–10.5 × 1–6 cm, index 1.2–2.3, lower 1–7 × 0.5–4.5 cm, index 1.2–2.5, coriaceous, above (almost) glabrous, midrib glabrous or sometimes with few short appressed hairs, below glabrous or with scattered short appressed hairs, midrib with more hairs, base (broadly) cuneate, apex truncate or broadly 2-lobed, often with a median tooth, margin entire, or with 2–4 obtuse teeth in apical part, midrib above slightly prominent, nerves 2–8 per side, 2–22 mm apart, angle to midrib 45°–65°, small pocket-like domatia present at least in upper nerf axils; petiolule 0–1(–2) mm, strigose to glabrous. *Inflorescences* axillary, 1–16.5 cm, laxly flowered, without or with short or long, often pendulous branches; cymules dischasial, 1–several-flowered. *Bracts* and *bracteoles* lanceolate to ovate or triangular, 0.6–1.6 × 0.2–0.8 mm, not persistent under the fruits, outside shortly appressed-hairy, margin

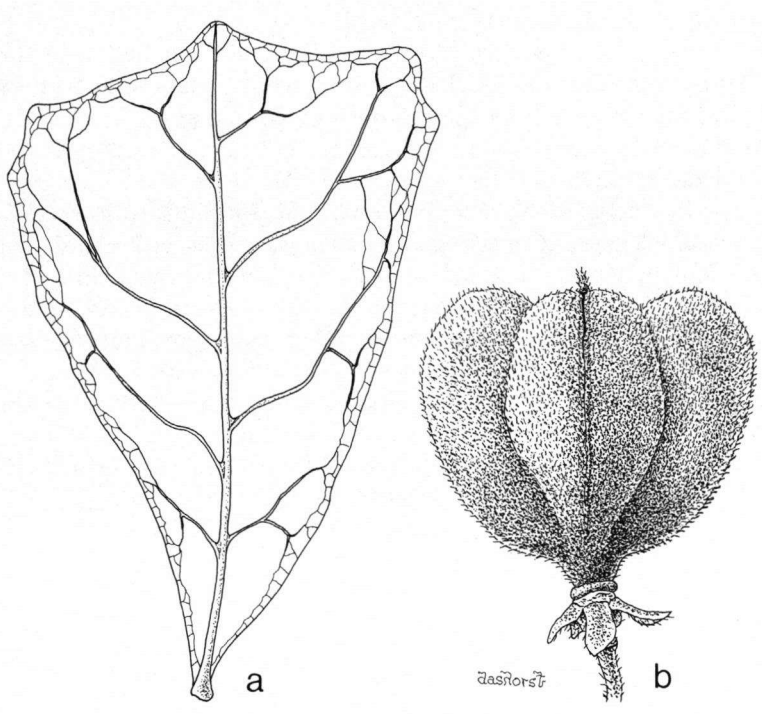

Fig. 84. *Cupaniopsis wadsworthii* (F. Muell.) Radlk. a. Leaflet, × 1; b. fruit, × 3.5 (a: *Batianoff & McDonald* 554, BRI; b: *Brown* 6355, K).

with some glands, inside glabrous. *Pedicels* 1.8–3.0 mm, articulate at 1/3–2/3 above the base. *Buds* 2.4–2.9 × 2.4–3.4 mm. Male flowers: *Sepals* more or less orbicular, outside shortly appressed-hairy except rim, rim ciliolate and with glands, inside glabrous or shortly appressed-hairy in lower part, outer 2.4–3.5 × 2.2–2.9 mm, scarious rim narrow to rather wide, inner 3.7–4.4 × 2.6–4.1 mm, scarious rim wide to very wide. *Petals* elliptic to more or less orbicular or squarish, 1.1–2.6 × 0.7–1.9 mm, outside shortly appressed-hairy in lower part, rim ciliate in lower half, inside glabrous, scales 2, not crested, 1.2–1.9 mm, rather long appressed-hairy, long-ciliate. *Disc* glabrous. *Stamens* 8, exserted, filaments 1.7–3.6 mm, patently hairy except apex, anthers 1.4–1.9 mm, glabrous *Pistillode* 3-celled, outside hairy, 1.1–2.0 × 0.7–1.7 mm. Female flowers: *Sepals* persistent under the fruits, outer 2.3–4.2 × 2.2–3.8 mm, largest 4.2–4.8 × 3.5–4.4 mm. *Petals* 2.4–4.6 × 1.7–3.1 mm, scales 1.3–3.2 mm. Filaments of *staminodes* 1.8–3.1 mm, anthers 1.3–2.3 mm. *Ovary* 3-celled, outside hairy, style 1.2–3.1 mm, stigma 0.7–1.3 mm, 3-lined, exceptionally 3-lobed. *Fruits* ± globular, 20 × 17 mm, stipe 5 mm, wall 0.1 mm thick, outside smooth, strigose, inside thinly, shortly appressed-hairy, septa complete. *Seeds* obovate, 13 × 9 mm, arilloid covering 2/3 to the whole seed, cotyledons superposed.

Distribution — Australia (Queensland).

Field notes — a. Ecological notes: Rain forest (notophyll vine forest) or scrubs (semi-evergreen vine thicket) on stony soils, often on hills. Flowering: (January to) May to June (to August); fruiting: November.

b. Additional descriptive notes: Bark smooth, gray. Leaflets dark green. Flowers greenish white or greenish cream.

Notes — F. Mueller send original material of his *Harpullia wadsworthii* to Kew and München. The specimen send to München, said to be collected by Dallachy at Rockhampton, shows the greatest resemblance to the figure in F. Mueller's description and therefore has been chosen as the lectotype specimen. Other specimens collected at Rockhampton by either Thozet or Dallachy should be viewed as syntypes. They are now incorporated in K and MEL.

The present species has several times erroneously been recorded from New South Wales.

Dietrich 371 shows a strong tendency towards bisexual flowers. *Guymer* 1531 has 3-lobed instead of 3-lined stigmas.

Specimens examined:
AUSTRALIA. Queensland: 36 specimens.

EXCLUDED SPECIES

1. *Cupaniopsis aneityensis* Guillaumin, J. Arn. Arbor. 14 (1933) 56. — Type: *Kajewski* 827 pp. (A!, holo), New Hebrides, Aneityum, Anelgauhat bay = **Arytera brackenridgei** (A. Gray) Radlk.
   See A.C. Smith, Fl. Viti. 3 (1985) 602.

2. *Cupaniopsis arcuata* (Radlk.) Guillaumin, Bull. Mus. Nat. Hist. Nat. 18 (1917) 171.
   Unintended new combination, meant is **Arytera arcuata** Radlk.

3. *Cupaniopsis atrotheca* Radlk., Bot. Jahrb. 56 (1920) 288; in Engl., Pflanzenr. 98 (1933) 1194. — Type: *Ledermann* 12952 (B, lost, fragments in M!), Papua New Guinea, Sepik, 'Felzspitze'.
   Not *Cupaniopsis*! The type-specimen, consisting of fragments of leaves and flowers, does not belong to any *Cupaniopsis* species.

4. *Cupaniopsis dictyophylla* Radlk., Sitzb. Math.-Phys. Cl. Kön. Bayer. Akad. Wiss. Münch. 20 (1890) 359. — *Aphania dictyophylla* Radlk., Bot. Jahrb. 56 (1920) 268; in Engl., Pflanzenr. 98 (1933) 713. — Type: *Sayer* s.n. (M!, holo), Papua New Guinea, Base of Mount Obree = **Lepisanthes dictyophylla** (Radlk.) Leenh.
   See P.W. Leenhouts, Blumea 17 (1969) 83.

5. *Cupania dunnii* Maiden & Betche, Proc. Linn. Soc. N.S.W. 33 (1908) 305. — *Cupaniopsis dunnii* Maiden & Betche, Census N.S.W. Pl. (1916) 128. — Type: *Dunn* s.n. (BRI, n.v.), Australia, Macpherson Range, Acacia Creek = **Rhysotoechia bifoliata** Radlk.
See L. Radlkofer in Engl., Pflanzenr. 98 (1933) 1211.

6. *Cupaniopsis godefroyi* Guillaumin, Bull. Soc. Bot. Fr. 79 (1932) 338. — Type: *Godefroy* s.n. (P!, holo), New Caledonia, Nouméa = **Lepisanthes rubiginosa** (Roxb.) Leenh.
See F. Adema (in prep.).

7. *Cupaniopsis guioides* Guillaumin, Bull. Mus. Nat. Hist. Nat. sér. 2, 15 (1943) 218. — Type: *Vieillard* s.n. (P!, holo), New Caledonia, Mt. Canala = **Guioa microsepala** Radlk.
See P.C. van Welzen, Leiden Botanical Series 12 (1989) 234.

8. *Cupaniopsis neoebudensis* Guillaumin, J. Arn. Arbor. 12 (1931) 241. — Type: *Kajewski* 381 pp. (A!, holo, iso in BISH!, BRI!, NY!), New Hebrides, Eromanga, Dillon Bay = **Arytera** cf. **collina** Radlk.
Described with few scale hairs, none could be found, however. The short strigose indumentum of most parts agrees very well with that of *A. collina*.

9. *Cupaniopsis patentivalvis* Radlk., Elmer Leafl. Philip. Bot. 5 (1913) 1612. — Type: *Elmer* 9319 (PNH, lost, iso in BM!, FI, L!), Philippines, Luzon, Tayabas, Lucban = **Gloeocarpus patentivalvis** (Radlk.) Radlk.
See L. Radlkofer in Engl., Pflanzenr. 98 (1933) 1208.

15. IDENTIFICATION LIST

3 — Meebold 16721: 39 — Melville 335913: 7 — Melville, Melville & Parham 7024: 30; 7025: 30 — Michael 477: 3; 1816: 56; 1817: 3; 3046: 3; 3082A: 3; 3082B: 3; 3112: 3 — C. Moore 55: 3 — W.E. Moore 255: 49 — Morat 6179: 39; 6235: 39; 6250: 32b; 6529: 41; 6542: 36; 6565: 28; 7810: 32b; 8018: 20 — Musselman, Delzell & Rich 5416: 29.

NGF 3769: 52; 3794: 13; 4146: 13; 5098: 13; 10552: 13; 12271: 44; 13104: 13; 13297: 33; 14595: 33; 14803: 44; 19095: 13; 22112: 1; 22207: 13; 22314: 13; 24930: 52; 26764: 15; 28784: 13; 31158: 29; 31548: 29; 31983: 7; 33021: 33; 33447: 7; 33707: 3; 35622: 13; 38602: 45; 39981: 13; 41549: 13; 43860: 44; 46367: 13; 46743: 13; 46834: 52; 46853: 33; 46865: 44; 49156: 52; 49362: 3 — Nicholson 59: 23 — Nothis 58: 39; 106: 39; 139: 20; 276: 20; 414: 39.

O'Farrell 22: 19 — O'Shanesy 70: 60; 85: 3; 142: 60; 173: 3; 1120: 3.

Pancher 75: 10; 77: 39; 135A: 58; 136: 10; 142: 20; 162: 20; 782: 23; 221: 4 — Parker 157: 3; 488: 3; 638: 3; 668: 3 — Parks 20755: 59 — Parks & Setchell 15165: 59 — Pedley 949: 3 — Pennel 403: 40 — Pennington 8139: 25 — Petit 69: 20 — Pratt 78-1139: 52 — Pullen 3488: 13; 3489: 13; 3623: 52; 6702: 13; 7020: 3; 7056: 3; 7071: 3; 7608: 13 — Pussot 67: 20.

Robbins 1701: 52 — Royen 4634: 3; 5482: 33 — RSNH 1119: 30; 16216: 30.

Salasoo 2736: 3 — Sarlin 222: 4 — Saunders 1097: 44 — Scanlan 4C: 3; 7C: 3 — Schlechter 14436: 52; 19201: 52 — Schmid 538: 23; 677: 28; 727: 41; 968: 4; 1185: 39; 1186: 39; 1241: 41; 1565: 32a; 1566: 32; 1903: 31; 2008: 39; 2887: 39; 2888: 31; 2889: 27; 4000: 30; 4119: 39; 4190: 41; 5263: 55; 5278: 24 — Schodde 2412: 13; 2432: 52; 2533: 13; 3061: 13; 5585: 3; 5701: 13 — Schodde & Craven 5076: 33 — Schodde & Hayes 3554: 3 — Schultz 495: 3 — Scortechini 298: 50 — Sébert & Fournier 69: 20 — Seemann 67: 30 — Setchell & Parks 15140: 30 — Sharpe & Durrington 866: 3 — Sharpe & Reynolds 1995: 38 —Simmonds 75: 50; 76: 3 — A.C. Smith 120: 30; 154: 30; 1639: 30; 1742: 59; 1954: 30; 4066: 30; 4083: 2; 4105: 2; 4149: 2; 4490: 11; 4570: 30; 4663: 59; 4857: 11; 4935: 2; 5053: 11; 5287: 11; 5580: 11; 5854: 59; 7457: 30; 7569: 30; 8135: 11; 8171: 11; 8426: 30; 8749: 30 — L.S. Smith 393: 3; 3328: 17; 3901: 3; 4119: 50; 11172: 19; 11231A: 15; 11477A: 6; 11866: 3; 11959: 3; 12530: 17; 12608: 3; 14532: 60; 14611: 60 — L.S. Smith & Webb 3124: 3 — Soegeng Reksodihardjo 321: 7 — Specht 855: 3; 1152: 3 — Specht & Specht 166: 3 — Speck 1702: 60; 1769: 3 — Stocker 1405: 3 — Stocker & Son 116: 3 — Story 7747: 3; 7791: 3 —Suprin 574: 39; 685: 55; 830: 32a; 1017: 55; 1194: 39; 1271: 39; 1359: 42; 1648: 21; 2061: 58; 2080: 22; 2089: 40 — Suprin & Berger 2356: 55 — Swain 318: 49.

Tangkilisan 215: 52 — Telford 2628: 6; 3443: 49; 3479: 3 — Telford & Butler 9081: 56 — Thorne 28165: 55 — Tirel 1290: 39; 1413: 39 — Tracey 14328: 3; 14383: 17; 14469: 3; 14480: 18; 15019: 3.

Uhe 930: 36 — UPNG 841: 13; 4353: 37; 8098: 52.

Veillon 7: 23; 51: 39; 946: 24; 1149: 23; 1360: 39; 1515: 32; 1910: 39; 1992: 36; 2921: 30; 2964: 32b; 3064: 28; 3074: 51; 3580: 36; 3830: 39; 3939: 36; 4181: 23; 4680: 55; 4681: 41; 4880: 23; 5408: 32b; 5697: 41; 5936: 32a; 6034: 57; 6291: 32b; 6551: 22; 6606: 22; 6631: 58; 6657: 58; 7200: 58 — Veldkamp 6758: 13 — Verreaux 507: 3 — Virot 797: 23; 827: 23; 913: 23; 1448: 57; 1680: 39; 1682: 55 — De Vogel 3494: 52 — Volck 988: 19.

Walter 2347: 3; 3002: 3 — Warburg 20539: 33 — Waterhouse 471-B: 29 — Waturandang 47: 9; 268: 9 — Webb & Tracey 3306: 50; 5721: 19; 6576: 17; 6958: 17; 7117: 17; 7568: 60; 7605: 3; 7675: 19; 7776: 3; 7893: 3; 8409: 19; 8816: 3; 8912: 19; 9017: 17; 9174: 19; 9511: 3; 9842: 3; 9916: 3; 10351: 3; 10358: 50; 10391: 50; 10453: 60; 10684: 19; 10708: 3; 12163: 15; 12676: 3; 12677: 3; 12678: 3; 12679: 3; 12680: 3; 12889 ; 3; 13067: 3; 13131: 3; 13132: 3; 13206: 49; 13216: 17; 13266: 17; 13267: 17; 13791: 3; 13792: 3; 13793: 18 — Webster 19354: 57 — Webster & Hildreth 14842: 39; 14928: 41 — Webster, Hildreth & Kuruvoli 14138: 2; 14259: 11 — Webster & Jaffré 19225: 32 — Whistler W1159: 48; W3509: 48 — C.T. White 278: 13; 748: 13; 748A: 13; 956: 49; 1848: 3; 2042: 39; 8234: 38; 9078: 3; 9231: 49; 10074: 3; 11405: 49; 12133: 50; 12203: 3 — K.A. Williams 82221: 17; 84016: 56 — Winkworth 855: 3; 1152: 3 — Wong 277: 26 — Woods 21: 3 — WooWoonya & Simon 38: 3; Wyatt 3: 3.

16. INDEX

References are only made to the species descriptions and to the synonyms. Accepted names are printed in Roman type, new names and combinations in **bold**, and synonyms in *italics*. The numbers refer to the numbers of the accepted species names and to those of the excluded species (E).