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A REVISION OF THE GENUS CEPHALOMAPPA (EUPHORBIACEAE) IN MALESIA

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ABSTRACT

The Malesian genus *Ceplialomappa* Baillon has been revised. Five species have been recognized based on morphological and anatomical characters, e.g. *C. beccariana, C. lepidotula, C. rnalloticarpa, C. paludicola, C. penangensis,* and four varieties within *C. beccariana.*

The genus *Muricococcum* has been reinstated, the single species *M. sinense* is considered to differ significantly from the species of *Cephalomappa* to warrant generic recognition.

A phylogenetic analysis of the genus, with *Koilodepas* as outgroup, shows the species to branch off sequentially, the first is *C. paludicola,* followed by *C. rnalloticarpa, C. lepidotula,* and finally *C. penangensis* and *C. beccariana.* All varieties of *C. beccariana* group together as a single terminal polytomy.

ABSTRAK

Marga *Cephalornappa* Baillon di Malesia telah direvisi. Lima jenis telah diakui berdasarkan ciri morfologi dan anatominya, yaitu *C. beccariana, C. lepidotula, C. rnalloticarpa, C. paludicola, C. penangensis* dan 4 varietas dalam *C. beccariana.*

Marga *Muricoccum* telah dikembalikan pada kedudukannya semula, karena jenis tunggalnya *M. sinense* dianggap berbeda nyata dari jenis-jenis *Cephalornappa* sehingga mengukuhkan pengakuannya sebagai marga tersendiri.

Analisis filogenetik marga ini, dengan *Koilodepas* sebagai kelompok **luar,** memperlihatkan bahan jenis-jenisnya memisah secara berurutan, pertama C. *paludicola,* diikuti oleh *C. mallolicarpa, C. lepidotula,* dan akhirnya C. *penangensis* dan *C. beccariana.* Semua varietas *C. beccariana* mengelompok bersama sebagai suatu politomi ujung manunggal.

INTRODUCTION

Webster (1994) placed the genus *Cephalomappa* in the tribe Epiprineae of the subfamily Acalyphoideae. The Epiprineae have been divided into two subtribes, the Epiprineae and the monotypic Cephalomappinae, containing *Cephalomappa.* The characteristics of the latter subtribe and of the genus are monoecy, staminate flowers in terminal capitula on axillary inflorescences, the pistillate flowers single on the same iniflorescences, but placed lower; staminate flowers with a (2-5-lobed) calyx, 3-5 stamens of which the filaments are basally united; pistillate flowers with a caducous calyx in fruit and acuminate or bifid stigmas.

Baillon (1874) established *Cephalomappa* with the single species *C. beccariana* based on the specimen *Beccari PB 425,* from Sarawak. His delimitation of the genus mainly depended on the small flowers arranged in heads, which is why the genus has been named *Cephalomappa.* Fifty years later Ridley (1923), described the second species, C. *penangensis,* based on a Curtis collection made in Kuala Trengganu (Malaysia). *C. malloticarpa* was described by Smith (1924) based on four living collections in Bogor Botanical Gardens, all originally from Borneo. Airy Shaw (1960) described *Cephalomappa paludicola,* based on a specimen collected by Sanusi bin Taher in Sarawak, and *Cepfialomappa lepidotula* based on Beccari specimens from Sumatra. In the same year, Airy Shaw (1960) also described three varieties under the type species, *C. beccariana* based on differences in indumentum, e.g. var. *beccariana, havilandii,* and *hosei.* A few years later Airy Shaw (1975) added a fourth variety, also characterized by indumentum characters, called var. *tenuifolia.*

A complete account of *Cephalomappa* has never been undertaken before, while the leaf anatomy of the genus was still unknown. The latter is very useful to fully understand the varieties in *C. beccariana.* A phylogenetic analysis of this small genus will also be presented, which will clearly demonstrate the relationships within the genus.

Kostermans (1961) considered the monotypic genus *Muricococcum,* with the species *M. sinense* Chun & How (1956) to be synonymous with *Cephalomappa,* a view followed by Airy Shaw (1963). Neither Kostermans, nor Airy Shaw and ourself could study the original specimens, but judging from the description and illustration *Muricococcum* can be kept separate from *Cephalomappa* and should be reinstated, because *Muricococcum* shows stipules which are less caducous, petioles which are basally and apically not pulvinate, staminate inflorescences which are terminal, a pistillode anthers which consist of 2 large parts are basally inserted.

MACROMORPHOLOGY

The characters like leaf shape, glands, hairs on the lower leaf surface, and flower characters are the main characters used for delimiting the species and for identifying the relationships in *Cephalomappa.*

Branches

All species of a *Cephalomappa* have terete branches. The surface of the branches of *C. malloticarpa* and *C. paludicola* is smooth, whereas the surface is rough in *C. beccariana, C. penangensis* and *C. lepidotula.*

Leaves - Fig. 1

The leaves are simple and alternate. Most species have elliptic! leaves except in *C. malloticarpa* with obovate leaves and *C. beccariana* var. *beccariana* with ovate leaves. *C. beccariana, C. penangensis,* and *C. lepidotula* have hairy leaves, but *C malloticarpa* and *C. paludicola* have glabrous leaves.

The leaf margin of *C. beccariana* is entire, whereas it is serrate in G *malloticarpa,* dentate in *C. lepidotula,* crenate in C. *paludicola,* sinuate in *C. penangensis,* and denticulate in *C. beccariana* var. *tenuifolia.* Small glands are found on the lower side of the leaves in every tooth of the margin. Larger, circular glands, are also found at the lower surface, but near the base of the leaves. Usually 2-4 of these glands are present, only *C. beccariana* has a single gland at the one side. The texture of the lamina is coriaceous except in *C. beccariana* var. *tenuifolia,* which has papery leaves. The tertiary venation is scalariform.

Inflorescences - Fig. 2

The inflorescences are axillary racemes. The peduncle is hairy except in *C. malloticarpa* and *C. paludicola.* The staminate flowers are arranged in glomerate heads. The bracteoles are obovate with a fimbriate margin except in *C. paludicola* where the bracteoles are ovate with an entire margin and acute apex. The lobes of the calyx are rounded and densely papillate except in *C. paludicola* which has acute lobes and which are hardly papillate. The number of stamens is somewhat different per species, *C. beccariana* has 3, *C. malloticarpa* 3 (or 4), C. *lepidotula* and C. *paludicola* each 4, and *C. penangensis* has 4 (or 5). The filaments are basally united into an androphore, which is hairy in *C. beccariana* and *C. penangensis,* but glabrous in the other species. The anther is subapically dorsifixed.

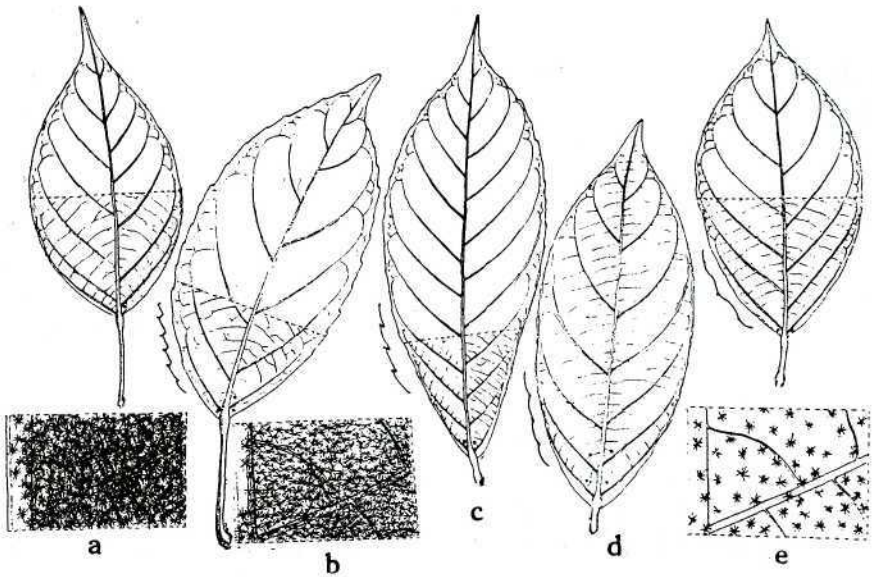


Fig. 1. Leaf shape, margin dentation and indumentum of *Cephalomappa* Baill. a. *C. beccariana,* b. *C. lepidotula,* c. *C. malloticarpa,* d. *C. paludicola,* e. *C. penangensis.*

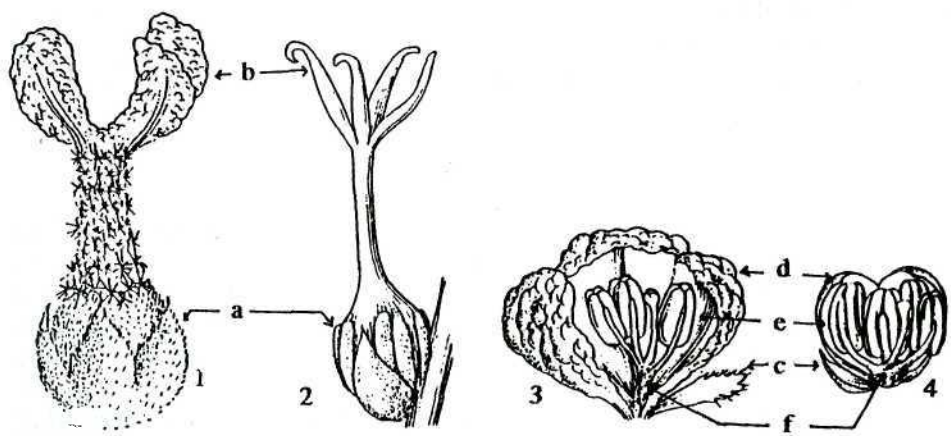


Fig. 2. Pistillate and staminate flower types of *Cephalomappa* species.1 = pistillate flower; 2 = pistillate flower of *C paludicola;* 3 = staminate flower; 4 = staminate flower of *C. paludicola;* a = lobes of calyx, b = stigmas; c = bracteoles; d = surface of calyx lobes; e = anther; f = androphore.

The solitary pistillate flower is found on the same inflorescences as the staminate flowers. The sepals are connate and form a calyx except in *C. paludicola* which has free sepals. The basal angle between the lobes is acute in *C. beccariana* and *C. lepidotula,* but obtuse in C. *malloticarpa* and *C. penangensis.* The apex of the lobes is acute except in *C. paludicola* which has obtuse lobes. The apex of the lobes is entire, but bifid in *C. malloticarpa.* The stigma surface is papillate except in C. *paludicola.*

LEAF ANATOMY

The results of the present study indicate that anatomical characters such as epidermal cells, indumentum, and stomata may support the identification of the species and varieties of *Cephalomappa.*

Materials and Methods

Twenty herbarium specimens have been used to make anatomical slides: *Anderson 25557, Arizi bin Arshid 10298; Beccari 975; Culta Bogor Botanical Garden VIII. F. 50; Bojang bin Sitam 13139; Corner 28951; FRI 10741; Haviland 2184; Haviland & Hose 3211; Hose 303; S series 18041; 18470; 23613; 25985; 43702; 45211; SAN 75067; Sinanggul 57297; Sanusi bin Tahir 9713; Sinclair & Kiah bin Saleh 40866.*

To study the paradermal anatomy of herbarium material, pieces of leaves (about 5 mm) were soaked in water overnight or boiled in water and then dried at room temperature by using filter papers. After that the leaves were soaked in 30 % nitrit acid overnight. The following day, the epidermis of the leaves was peeled off by using tweezers and then washed in running water. After that the epidermis was dyed with 1 % safranin and mounted in 10 % glycerin to get semi-permanent slides.

Epidermis

The adaxial and abaxial epidermis consists of long and short epidermal cells with (slightly) sinuous to deeply sinuous anticlinal walls. The undulation of anticlinal walls is also slightly different in the varieties of C. *beccariana.* Deeply sinuous walls are found in C. *beccariana* var. *beccariana, C. beccariana* var. *tenuifolia,* and *C. penangensis,* sinuous walls in *C. beccariana* var. *hosei* and C. *malloticarpa,* slightly wavy anticlinal walls are found in *C. beccariana* **var.** *havilandii* and *C. lepidotula,* and almost straight anticlinal walls are present in *C. paludicola.*

Hairs

Two types of hairs are found in *Cephalomappa,* stellate and lepidote. The lepidote hairs are more or less intermediate between real lepidote and stellate hairs, but in comparison to the real stellate hairs their spines are in a single plain and not 3-dimensional. The stellate hairs can be subdivided into short and long ones. *C. beccariana* var. *beccariana* has long and short stellate hairs, whereas.*C. beccariana* var. *hosei* only has short ones. *C. penangensis* and C. *beccariana* var. *tenuifolia* have long stellate hairs. The stellate hairs are single except in *C beccariana* var. *tenuifolia* where they occur in tufts. Lepidote hairs are found in C. *beccariana* var. *havilandii* and C. *lepidotula,* but the length of the hairs in *C. lepidotula* is longer than those of *C. beccariana* var. *havilandii.*

Stomata

Stomata are found on the lower leaf surface only; *C. beccariana* var. *tenuifolia* also has a few on the upper surface. The stomata of *Cephalomappa* are paracytic and mostly elliptic.

DISTRIBUTION

Cephalomappa is found in West Malesia (Malay Peninsula, Sumatra, and Borneo). *C. lepidotula* and *C. malloticarpa* are widespread in W Malesia, *C. beccariana* and *C. paludicola* are endemic in Sarawak, and *C. penangensis* is only found in the Malay Peninsula. All species mainly occur in the humid tropics and they are absent from areas with a dry monsoon.

PHYLOGENETrC ANALYSIS OF CEPHALOMAPPA

The phylogenetic analysis of *Cephalomappa* was performed with the genus *Koilodepas* as outgroup. The latter was selected because it is classified in the sister subtribe of the Cephalomappinae, the Epiprininae. Within this subtribe it seems to be the SE Asian genus with probably most primitive characters, e.g. staminate flowers in racemes, pistillate calyx not accrescent nor involucrate, styles free, stamens 3-6, filaments not inflexed in bud (Webster, 1994). *Koilodepas* could have been used as outgroup together with *Muricococcum sinense,* but because not **all** characters could be interpreted from the drawing nor description, **the latter could not** be added as outgroup.

The characters and character states used are shown in Table 1. The data matrix can be found in Table 2. Character 7 contains a question mark for *C malloticarpa* and *C. penangensis,* because these two species are polytypic for the number of stamens, they possess 3-4 or 4-5 respectively. The analysis is performed with the program PAUP 3.0 (Swofford, 1993) with all characters unordered and the exhaustive search in operation.

Character 1: Leaf shape
1 = elliptic
2 = ovate
3 = obovate

Character 2: Number of glands abaxially
1 = 1
2 = 2
3 = 3
4 = 4

Character 3 : Hairs on leaves
1 = glabrous
2 = hairy

Character 4: Staminate flower
1 = sessile
2 = not sessile

Character 5: Margin of bracteoles of staminate flowers
1 = entire
2 = fimbriate

Character 6 : Surface of staminate calyx lobes
1 = smooth
2 = thinly papillate
3 = densely papillate

Character 7: Number of stamens
1 = 2
3 = 4

Character 8: Anther attachment
1 = basally
2 = dorsally

Character 9: Hairs on androphore
1 = glabrous
2 = hairy

Character 10: Carpel type
1 = astylocarpellous
2 = stylocarpellous

Character 11: Pistillate perianth
1 = free
2 = connate

Character 12: Apex of pistillate calyx lobes
1 = acute
2 = obtuse

Character 13: Glands on pistillate calyx
1 = at base of lobes
2 = at apex of lobes

Character 14: Stigma surface
1 = smooth
2 = papillate

Table 1. Characters and character states used in the phylogenetic analysis of ***Cephalomappa.***

Characters	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Koilodepas	;	*2*	*1*	7	*1*	*1*	*2*	i	*1*	*1*	*1*	*1*	*1*	/
Cephalomappa														
C. beccariana var. *becariana*	2	1	2	2	2	3	1	2	2	*2*	2	1	2	2
C. beccariana var. *havilandii*	1	1	2	2	2	3	1	2	2	2	2	1	2	2
C. beccariana var. *hosei*	1	1	2	2	2	3	1	2	2	2	2	1	2	2
C. beccariana var. *tenuifolia*	1	1	2	2	2	3	1	2	2	2	2	1	2	2
C. lepidotula	1	3	2	2	2	3	2	2	1	2	2	1	2	2
C. mallolicarpa	3	2	1	2	2	3	9	2	1	2	2	1	2	2
C. paludicola	1	4	1	2	1	2	2	2	1	2	1	2	2	1
C. penangensis	1	1	1	1	1	2	9	1	1	1	1	0	1	1

Table 2. Datamatrix used for the phylogenetic analysis of *Cephalomappa*

The resulting cladogram (Fig. 3) is 18 steps long and does not show any homoplasy (consistency and retention index = 1). All species branch of sequentially, starting with *C. paludicola* and ending with the sister species *C. penangensis* and the variable *C. beccariana.*

Characters 6 and 7 may have a different optimisation. The few papillae on the staminate calyx lobes (character 6) are now considered to be an apomorphy for *Cephalomappa* with a further development on the next node after *C. paludicola* splits off. However, they may also be an autapomorphy for *C. paludicola* and dense papillate may be the apomorphy for *Cephalomappa.* Character 7, due to the question mark for C. *penangensis* can change from 4 to 3 stamens below *C. beccariana* or below *C. penangensis.* However, *C. penangensis* has 4 (or 5) stamens, therefore the character change in character 7 occured in *C. beccariana.*

The polytomy for the varieties *C. beccariana* could not be resolved, partly because the species show autapomorphies (lepidote hairs in var. *havilandii,* ovate leaves in var. *beccariana)* and partiy because the character differences (undulation of anticlinal epidermal walls, density of stellate hairs) were too slight to distinguish different character states.

The character at the base of the cladogram are considered to be apomorphies for *Cephalomappa* and not for *Koilodepas.* However, this interpretation is uncertain for character 4 (pedicel of staminate flower) and 13 (gland on the calyx lobes of the pistillate flower). The other characters also seem to be present in *Muricococcum,* which still has basally attached anthers.

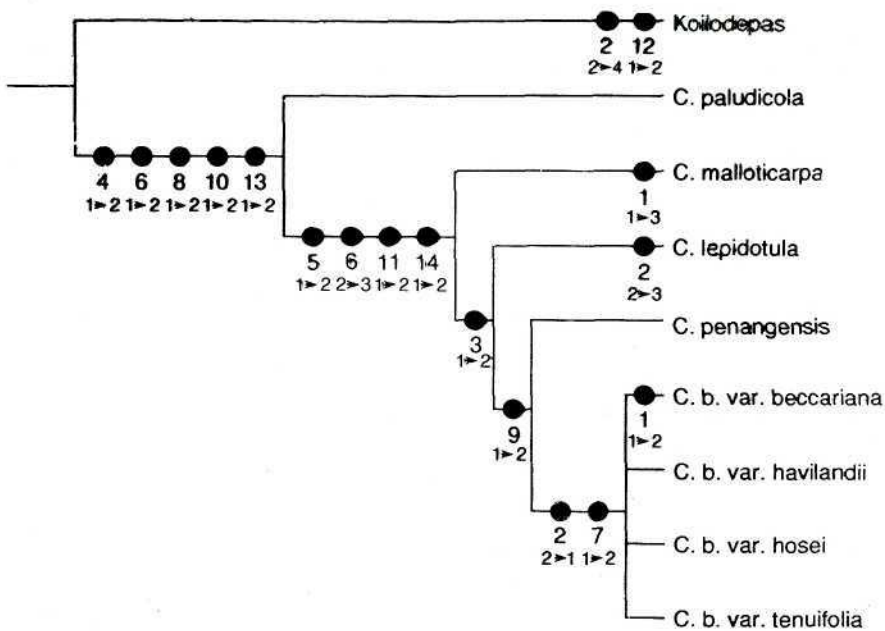


Fig. 3. Cladogram *of Cephalomappa* Baill.

TAXONOMY

CEPHALOMAPPA **Baill.**

Cephalomappa Baill., Adansonia 2 (1874) 131; Pax in Engl., Pflanzenr. IV. 147 ii (1910) 16; Pax & K.Hoffm. in Engl. & Harms, Nat. Pflanzenfam. 2 ed., 19c (1931) 123; Airy Shaw, Kew Bull. 14 (1960) 380; Kew Bull. 16 (1963) 353; Whitmore, Tree Fl. Malaya 2 (1973) 76; Airy Shaw, Kew Bull. Add. Ser. 4 (1975) 66; Airy Shaw, Kew Bull. 36 (1981) 274; Webster, Ann. Missouri Bot. Garden 81 (1994) 79. -Type species: *Cephalomappa beccariana* Baill.

Tree, monoecious. *Indumentum:* next to simple hairs usually with lepidote and stellate hairs. *Brandies* smooth to rough. *Leaves* alternate, simple; stipules small, linear, very early caducous, petioles terete, basally and apically pulvinate, usually hairy; lamina ovate to elliptic or obovate, symmetric, coriaceous; base rounded-obtuse or acute; margin entire to crenate to dentate, flat or recurved; with glands on the lower surface, apex acuminate to cuspidate, very apex obtuse to acute; upper surface glabrous, sometimes with stellate hairs on the basal part of the

midrib; lower surface hairy or glabrous; venation pinnate, raised on both sides, especially below, nerves 4-11 pairs, submarginally looped, united, veins scalariform; 1-4 glands at the lower part of leaf base. *Inflorescences* axillary, reduced thyrses, receme-like, branching, with the staminate flowers in glomerules and the pistillate flowers solitary. Peduncles and pedicels hairy or glabrous. *Bracts* ovate, with stellate hairs, apex (obtusely) acute; bracteoles ovate or obovate. *Flowers* actinomorphic, sessile or pedicellate. *Staminate flowers:* calyx 3-merous, campanulate, valvate, lobes rounded or acute, thinly to densely papillate; petals and disc absent; staments 3-5; filaments basally united into a glabrous to hairy androphore; anther subapically dorsifixed, opening latrors, lengthwise, smooth; pistillode 1, small. *Pistillate flowers:* calyx either connate and 5-merous, or free and 8 sepals, basal angle between lobes obtuse or acute, apex entire or bifid, acute or obtuse, with a gland; ovary superior, echinate to densely echinate, hairy, 3-locular; ovules 1 per locule, subapically attached, descending, apotropous; style short to long, terete, glabrous or with stellate hairs; stigmas 3 or 4, apically entire or bifid, smooth below, papillate above. *Fruit* a rhegma, ellipsoid in lateral view, 3-lobed, all lobes developed, echinate to densely echinate, with stellate hairs or glabrous; wall thick, woody, smooth ana glabrous inside; peduncle hairy or galbrous. *Seed* subglobular, smooth, glabrous, apex 2-lobed; hilum ovate. *Leaf anatomy:* abaxial surface of leaf hairy or glabrous; epidermis consiting of cells with sinuous to deeply sinuous anticlinal walls or almost straight to sligtly wavy; stomata paracytic, elliptic.

DISTRIBUTION. Five species are recognized, all in *Malesia* : Malay Peninsula, Sumatra, and Borneo.

KEY TO THE SPECIES

1. a. Branches rough. Lower leaf sufaee hairy 2
   b. Braches smooth. Lower leaf surface glabrous 4

2. a. Androphore subglabrous, Stigma apically entire. Fruit echinate 3
   b. Androphore glabrous. Stigma apically bifid. Fruit densely echinate ..... *2. C. lepidotula*

3. a. Leaves ovate or elliptic. Stamens 3 ..... *1. C. beccariana*
   b. Leaves elliptic. Stamens 4 (or 5) ..... *5. C. penangensis*

4. a. Leaves obovate, margin serrate. Staminate bracteoles with fimbriate apex. Sepals of pistillate flowers connate; stigmas 3 ..... *3. C. malloticarpa*
   b. Leaves elliptic, margin crenate. Staminate bracteoles with an acute apex. Sepals of pistillate free; stigma 4 ..... *4. C. paludicola*

1. CEPHALOMAPPA BECCARIANA Baill. - Fig. 4-8, Map 1

Cephalomappa beccariana Baill., Adansonia 2 (1874) 131; Pax in Engl., Pflanzenr. IV.147.ii (1910)17; Airy Shaw, Kew Bull. 14 (1960) 380; Kew Bull. Add. Ser. 4 (1975) 66. - Type : *Beccari PB 425* (holo FI, *n.v.;* iso in K), Sarawak.

Tree. *Branches* rough, flowering branches c. 3.5 mm thick. *Leaves:* petiole 1.1-3.5 cm long, covered by dense long and short stellate hairs; lamina ovate to elliptic, 4-20.2 by 2-9.3 cm, base obtuse to rounded, with a single gland at the lower surface close to the midrib, mar.gin entire to subentire to shallowly denticulate, flat, apex acuminate to cuspidate, very apex acute, upper surface glabrous except for basal part of midrib, lower surface covered with dense short lepidote to sparse (tuffed) short to dense long and short stellate hairs, nerves 5-7 pairs. *Peduncle* 2-3.5 cm long, densely hairy; peduncle to glomerules 0.1-2.7 cm long, densely hairy; glomerules 2-5 by 2.6 mm. *Staminate flowers* 24-28 together, 1.6-3.4 by 0.1-1.2 mm; bracts 0.8-1.2 by 0.2-0.4 mm; bracteoles 1.2-1.4 by 0.2-0.4 mm, margin fimbriate; calyx tube 1.2-2.4 by 0.8-1.6 mm; lobes 0.5-0.8 by 0.3-0.5 mm, subglabrous, densely papillate; stamens 3, androphore 0.3-0.5 by 0.15-0.3 mm, subglabrous to with few stellate hairs, filaments 1.6-2.4 mm long, anther 0.6-0.8 by 0.3-0.4 mm; pistillode 1-2.2 mm long. *Pistillate flowers:* pedicels 0.2-3.1 mm long, with short lepidote hairs or long and short stellate hairs; bracts 1-1.4 by 0.2-0.4 mm, apex obtuse, with stellate hairs, calyx 5-lobed, with dense long and short stellate hairs; tube 0.3-1.7 by 0.9-1.8 mm; lobe 0.8-1.3 by 0.4-1.2 mm; ovary 0.9-2.3 by 0.6-2.0 mm, style 0.6-1.6 mm long; stigmas 3, 0.7-1.5 mm long, apically entire, surface papillate. *Fruits* 1.2-1.9 by 1.3-2.6 cm, echinate, with long and short stellate hairs, peduncle 2-4.5 cm, 1.4-2.5 mm; wall 2.7-3 mm thick. *Seeds* 0.7-1.3 by 0.7-1.3 cm. *Leaf anatomy:* leaf abaxially with dense short (75-90 um long) lepidote hairs, or sparse to dense long (125-163 µm) and short (63-94 µm) stellate hairs; epidermis cells with slightly wavy to (deeply) sinuous anticlinal walls, 36-44 by 18-29 um wide. Stomata 21-24 by 16-18 µm.

DISTRIBUTION. *Malesia* : Borneo (Sarawak).

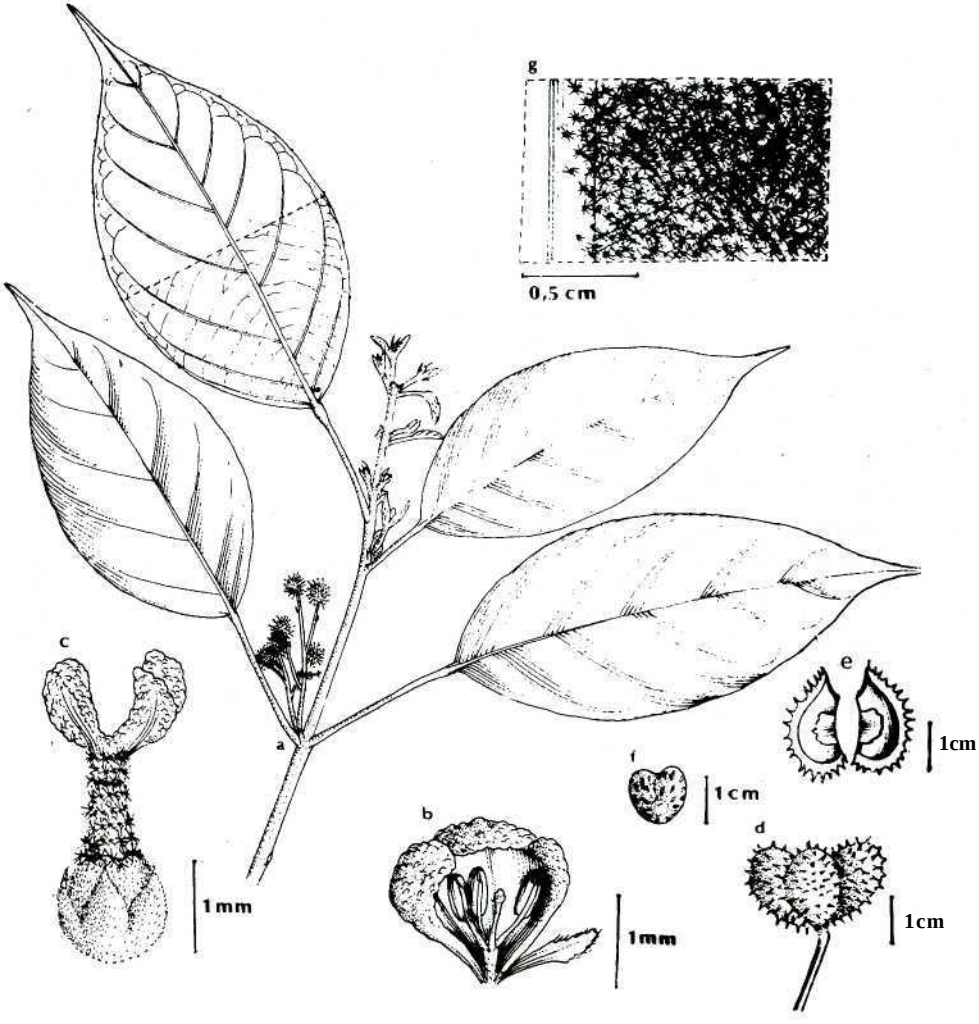
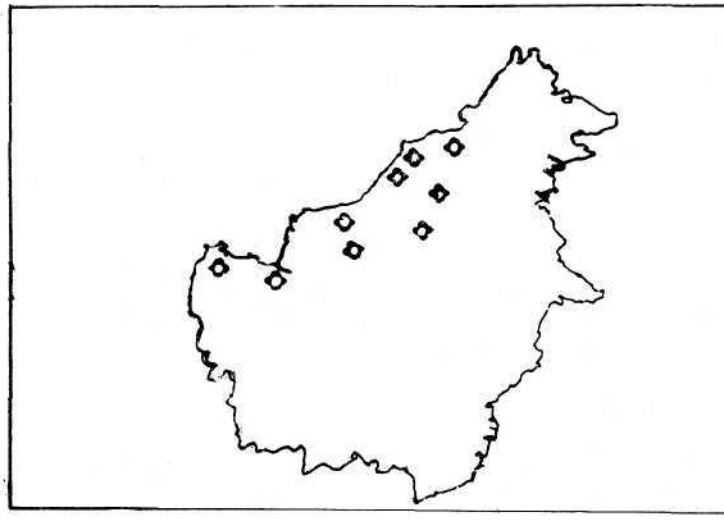


Fig. 4. *Cephalomappa beccariana* Baill, a. Habit; b. Staminate flower; c. Pistillate flower; d. Fruit; e. Fruit valves; f. Seed; g. Indumentum of lower leaf surface (a-c, g: *S. 25985,* L; e-f: *Arizi bin Arshid 10298,* BO).



Map 1. Distribution of *Cephalomappa beccariana* Baill. and its varieties

KEY TO THE VARIETIES OF C. BECCARIANA

1. a. **Lower leaf surface with** stellate hairs, epidermis cells with sinuous **anticlinal walls**.....2
   b. **Lower leaf surface with** lepidote hairs, epidermis cells with slightly wavy **anticlinal walls**.....var. *havilandii*

2. a. **Blade coriaceous, margin entire**.....3
   b. **Blade papery, margin subentire** to shallowly denticulate .... var. *lenuifolia*

3. a. **Leaves elliptic, lower surface** with sparse stellate hairs, epidermis cells **with sinuous anticlinal walls**.....var. *hosei*
   b. **Leaves ovate, lower surface with** dense stellate hairs, epidermis cells with **deeply sinuous anticlinal walls**.....**var. *beccariana***

var. BECCARIANA - Fig. 5

***Cephalomappa beccariana* Baill. var. *beccariana* : Airy Shaw, Kew Bull. 14 (1960) 380; Kew Bull. Add. Ser. 4 (1975) 66. -Type : as the species.**

Leaves: petioles 1.2-3.5 cm long; lamina ovate, 6-12 by 4-5.8 cm, coriaceous, base rounded, margin entire, lower surface covered with dense long and short stellate hairs. *Peduncle to staminate glomerules* 1.1-1.7 cm long, densely hairy; glomerules 4.5-5 by 2.6-3.1 mm. *Staminate flowers* 2.9-3.4 by 0.8-1.2 mm; calyx: tube 2.2-2.4 by 0.8-1.2 mm, lobes 0.7

0.7-0.8 by 0.3-0.5 mm, subglabrous; stamens: androphore 0.3-0.5 by 0.2-0.3 mm, filaments 1.8-2.4 mm long; pistillode 1.6-2 mm long. *Pistillate flowers:* pedicels 1-3.1 cm long, covered with long and short stellate hairs; calyx: tube 0.3-0.5 by 1.4-1.8 mm, lobes 1.1-1.3 by 0.6-1.2 mm; ovary 1.9-2.3 by 1.6-2 mm, style 1.2-1.6 mm long, stigmas 1.3-1.5 mm long. *Fruits* 1.5-1.9 by 2.4-2.6 cm. *Seeds* 1.2-1.3 by 1.1-1.3 cm. *Leaf anatomy:* abaxial epidermis with dense long (125-163 µm) and short (63-94 µm) stellate hairs; epidermis cells with deeply sinuous anticlinal walls, 41-43 by 24-26 urn; stomata c. 24 by 18 µm.

DISTRIBUTION. *Malesia :* Borneo (Sarawak).

HABITAT & ECOLOGY. Tree in primary lowland forest, on hill slopes with yellow sandy soil. Alt: sea level up to 275 m.

VERNACULAR NAMES. Sarawak : mahu hutan (Malay).,

USES. The fruit is locally eaten.

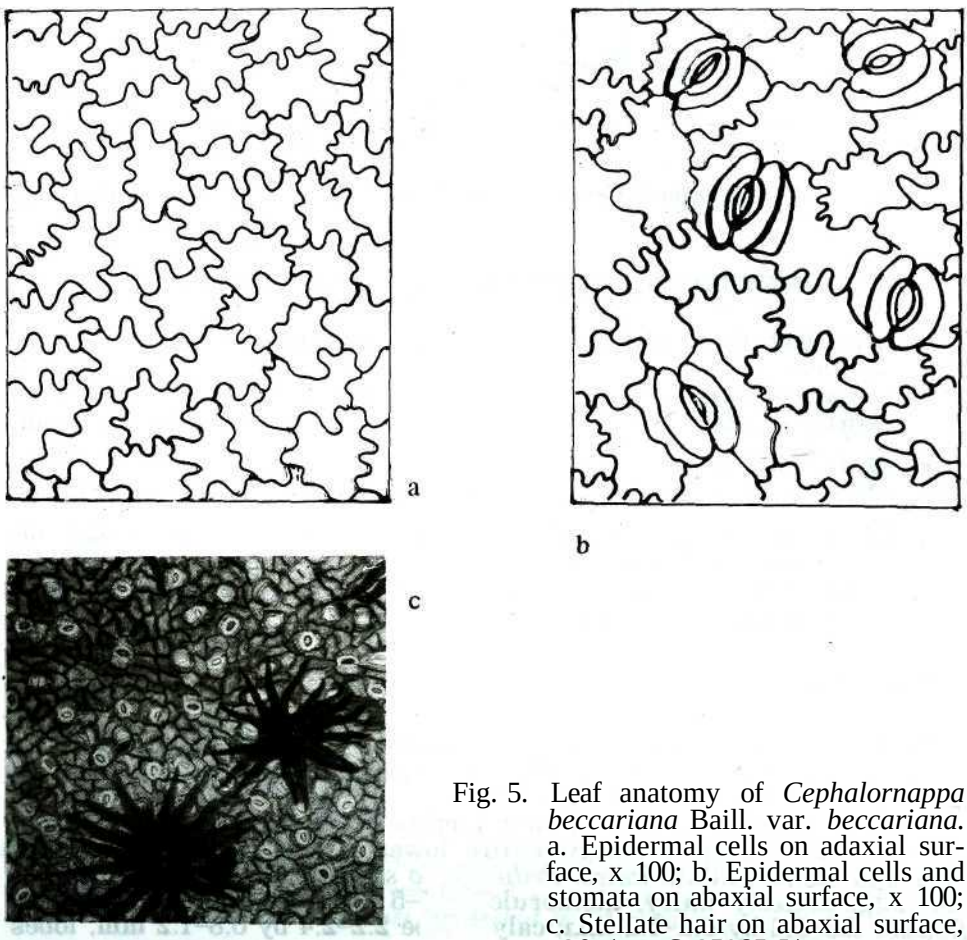


Fig. 5. Leaf anatomy of *Cephalornappa beccariana* Baill. var. *beccariana.* a. Epidermal cells on adaxial surface, x 100; b. Epidermal cells and stomata on abaxial surface, x 100; c. Stellate hair on abaxial surface, x20. (a-c: *S. 25985,* L).

NOTES. Baillon (1874) described the apex of the stigmas as bifid. We found those to be entire.

var. HAVILANDII Airy Shaw - Fig. 6.

Cephalomappa beccariana Baill. var *havilandii* Airy Shaw , Kew BuD. 14 (1960) **380; Kew Bull.** 16 (1963) 353; Kew Bull. Add. Ser. 4 (1975) 66. - Type: *Haviland £184* **(K, holo, *n.v.;* iso** BM, **L,** BO), Sarawak, near Kuching.

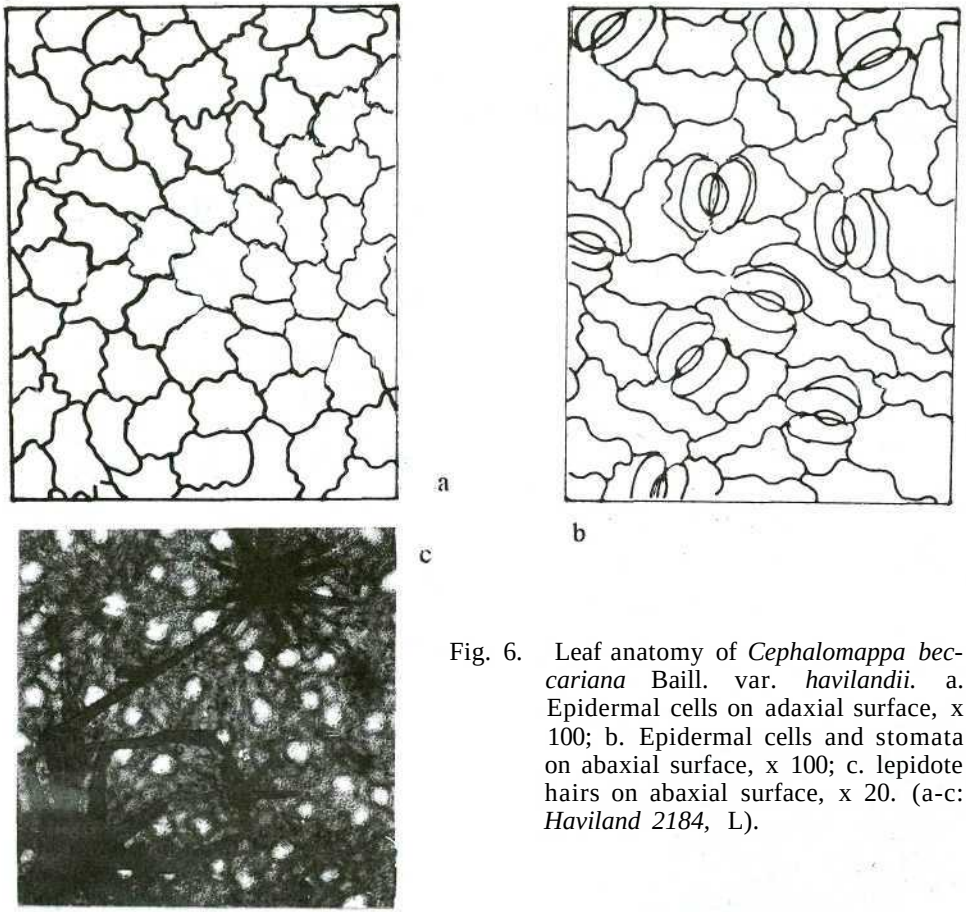


Fig. 6. Leaf anatomy of *Cephalomappa beccariana* Baill. var. *havilandii.* a. Epidermal cells on adaxial surface, x 100; b. Epidermal cells and stomata on abaxial surface, x 100; c. lepidote hairs on abaxial surface, x 20. (a-c: *Haviland 2184,* L).

Leaves: petioles 1,4-2.3 cm long ; lamina elliptic, 4-8 by 2-4.3 cm, coriaceous, base obtuse; margin entire, lower surface with dense short lepidote hairs. *Peduncle to staminate glomerules* 2-5 mm long with short lepidote hairs; glomerules 2-4 by 4-6 mm. *Staminate flowers* 1.6-1.8 by 0.8-1 mm; calyx tube 1.2-1 by 1.2-16 mm, lobes 0,5-0.7 by 0.3-0.5 mm, subglabrous; stamens: androphore 0.3-0.5 by 0.2-0.3 mm, subglabrous,

filaments 1.6-2 mm long; pistillode 1.8-2.2 mm long. *Pistillate flowers:* sessile or with pedicels, latter with short lepidote hairs; calyx: tube 0.3-0.5 by 1.3-1.5 mm, lobes 0.8-1.2 by 0.4-0.6 mm; ovary 1.9-2.1 by 1.6-1.8 mm, style 1.2-1.3 mm long, stigmas 0.9-1.3 mm long. *Fruits* 1.5-1.7 by 1.3-1.5 cm. *Seeds* 0.8-1 by 7-0.9 cm. *Leaf anatomy:* abaxial epidermis with dense short (75-90 *µm* long) lepidote hairs; epidermis cells with slightly wavy anticlinal walls, 36-42 by 18-22 µm; stomata c. 22 by 16 urn.

DISTRIBUTION. *Malesia:* Borneo (Sarawak).

var. HOSEI Airy Shaw - Fig.7

Cephalomappa beccariana Baill. var. *hosei* Airy Shaw, Kew Bull. 14 (1960) 380; Kew Bull. Add. Ser. 4 (1975) 66. - Type: *Hose 303* (K, holo, *n.v.*; iso in L), Sarawak, Baram

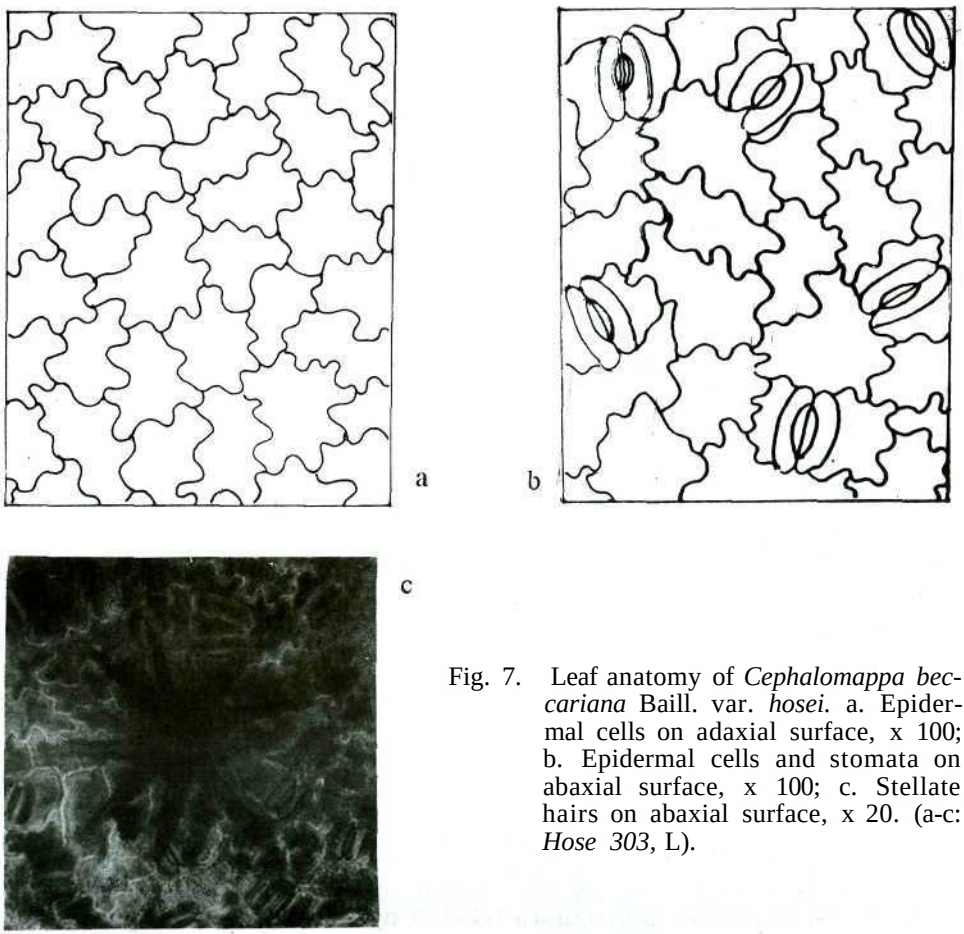


Fig. 7. Leaf anatomy of *Cephalomappa beccariana* Baill. var. *hosei.* a. Epidermal cells on adaxial surface, x 100; b. Epidermal cells and stomata on abaxial surface, x 100; c. Stellate hairs on abaxial surface, x 20. (a-c: *Hose 303,* L).

Leaves: petioles 1.1-3.2 cm long; lamina elliptic, 6-18 by 4-7.4 cm, coriaceous, lbase rounded, margin entire, lower surface with sparse short stellate hairs. *Peduncle to staminate glomerules* 1-3.1 mm long, sometime absent, covered with dense short stellate hairs; glomerules c. 4 by 3.75 mm. *Staminate flowers* c. 1.9 by 0.9 mm; calyx tube c. 1.2 by 0.9 mm, lobes 0.7 by 0.4 mm; stamens: androphore c. 0.3 by 0.15 mm subglabrous, filaments c. 1.8 mm long; pistillode 1-2 mm long; *Pistillate flowers* sessile or with 1-3.1 mm long pedicels, the latter covered with dense short stellate hairs; calyx tube 1.5-1.7 by 1.4-1.6 mm, lobes 0.9-1.2 by 0.5-0.7 mm; ovary 1.8-2 by 1.7-1.9 mm, style 1.2-1.4 mm long, stigma 0.9-1.1 mm long. *Fruits* 1.4 -1.6 by 1.9-2.3 cm. *Seeds* 0.7- 0.9 by 0.8-0.9 cm. *Leaf anatomy:* abaxial epidermis with sparse short (60-94 µm long) stellate hairs. Epidermis cells with sinuous anticlinal walls, 42-44 by 25-29 µm; stomata c. 23 by 16 µm.

DISTRIBUTION. *Malesia:* Borneo (Sarawak).

var. TENUIFOLIA Airy Shaw - Fig. 8

Cephalomappa beccariana Baill. var. *tenuifolia* Airy Shaw, Kew Bull. Add. Ser. 4(1975) 66 - Type: *S. 18041* (K, holo; iso in BM, BO), Sarawak, First Division, Lundu District, Gunong Gading.

Leaves: petioles 1,2-3.5 cm long; lamina elliptic, 8-20.2 by 5-9.3 cm, papery, base rounded, margin subentire to shallowly denticulate, lower surface covered with sparse stellate hairs in tufts. *Penduncle to staminate glomerules* 2-2.7 cm long, covered with dense short stellate hairs; glomerules c. 3 by 4 mm. Staminate flowers 1.8-2.2 by 1-1.1 mm; calyx tube 1.2-1.4 by 0.9-1.1 mm, lobes 0.6-0.8 by 0.3-0.5 mm; stamens: androphore 0.3-0.5 by 0.2-0.3 mm, subglabrous, filaments 1.8-2.2 mm long; pistillode 1.3-1.5 mm long. *Pistillate flowers:* pedicels 0.2-0.3 mm, covered with dense stellate hairs; calyx tube 0.3-0.5 by 0.9-1.1 mm, lobes 0.8-1 by 0.7-0.9 mm; ovary 0.9-1.2 by 0.6-0.8 mm, style 0.6-0.8 mm lone, stigma 0.7-0.9 mm long. *Fruits* 1.2-1.4 by 2.4-2.6 cm. *Seeds* 0.9-1.1 by 1-1.2 cm. Leaf anatomy: abaxial epidermis covered with sparse stellate hairs 69-125 µm long; epidermis cells with sinuous: anticlinal walls, 41-43 by 21-24 µm; Somata c. 21 by 16 µm.

DISTRIBUTION. *Malesia:* Borneo (Sarawak).

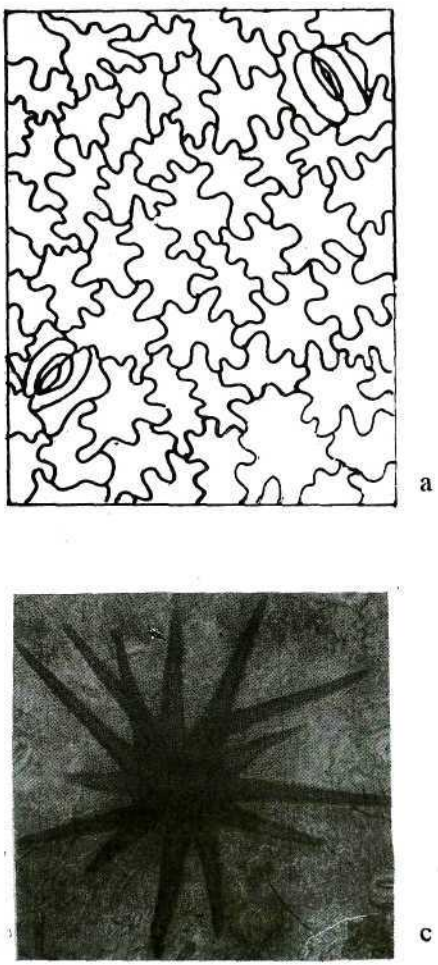


Fig. 8. Leaf anatomy of *Cephalomappa beccariana* Baill. var. *tenuifolia*. a. Epidermal cells on adaxial surface, x 100; b. Epidermal cells and stomata on abaxial surface, x 100; c. lepidote hairs on abaxial surface, x 20. (a-c: *S. 18041*, BO).

2. CEPHALOMAPPA LEPIDOTULA Airy Shaw - Fig. 9,10; Map 2

Cephalomappa lepidotula Airy **Shaw,** Kew **Bull. 14** (1960) 379; Whitmore, Tree Fl. **Malaya** 2 (1973) 76; Airy Shaw, Kew Bull. Add. Ser. 4 (1975) 67; Kew Bull. 36 **(1981)** 275. -- **Type:** *Beccari 975* (K, holo, *n.v.* iso in BM, L), Sumatra, Padang **Prov., Sungai Bulu.**

Tree. *Branches* rough, flowering branches c.3.5 mm thick. *Leaves* : petioles 3.2-5.2 cm long covered with dense lepidote hairs; lamina elliptic, 6.5-20.2 by 3.4-5.2 cm, base obtuse, with 2 glands at the lower surface

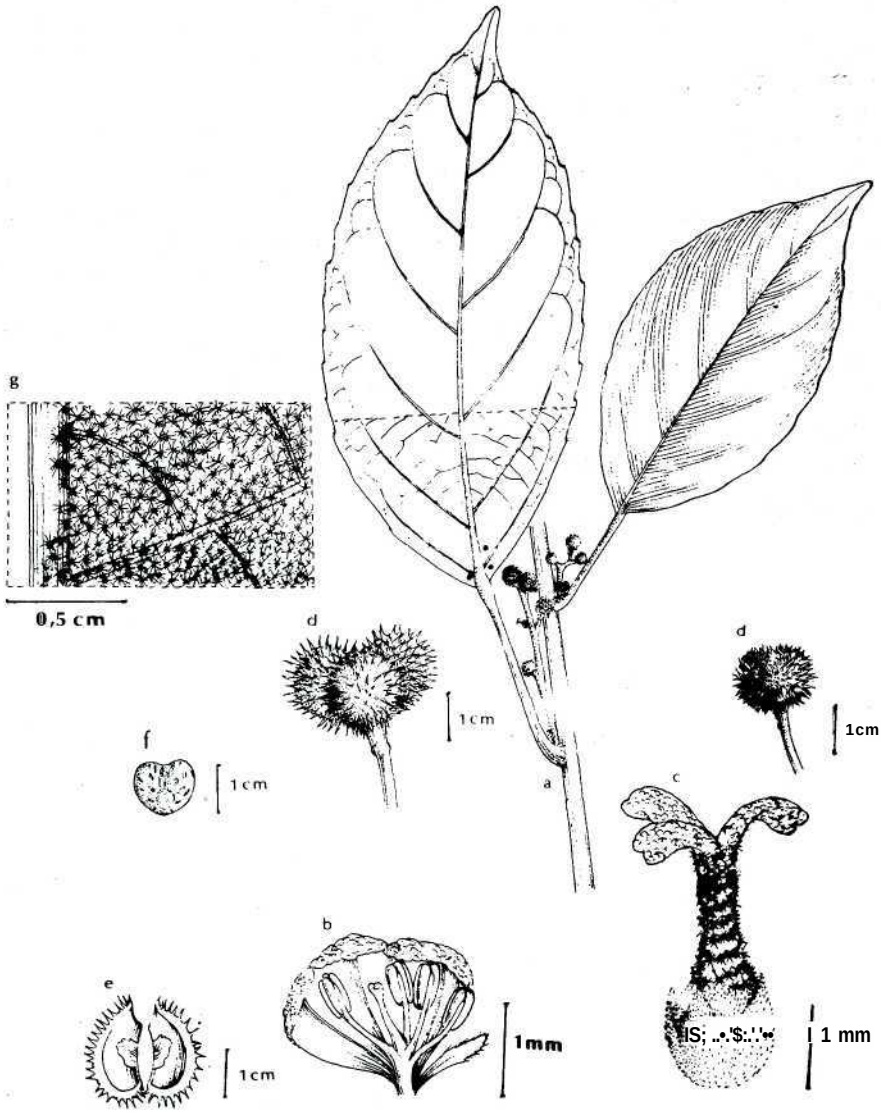
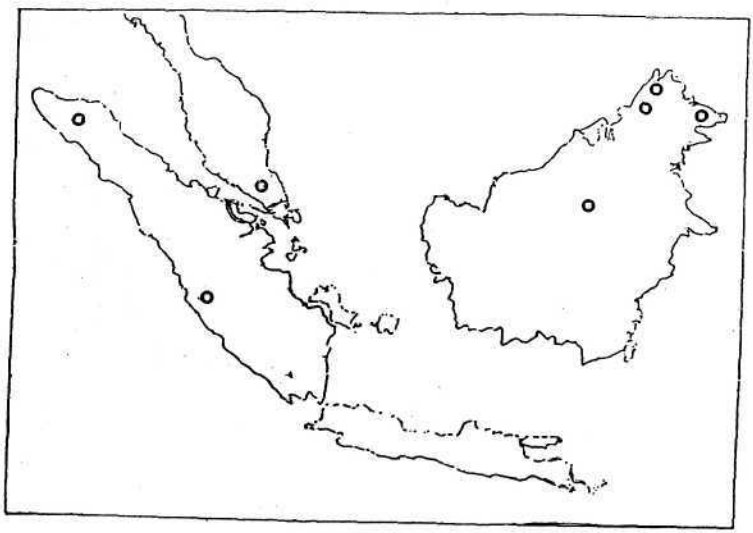


Fig. 9. *Cephalomappa lepidotula* Airy Shaw. a. Habit; b. Staminate flower; c. Pistillate flower; d. Fruit; e. Fruit valves; f. Seed; g Indumentum of lower leaf surface (a-g: *Beccari 975,* L). .

near the midrib, margin dentate, flat, apex acuminate, very apex acute, upper surface glabrous, lower surface with closely set lepidote hairs.nerves 5-9 pairs. *Peduncle* 2-3.5 cm long, densely hairy; peduncle to glomerules 0.7-1 cm long, densely hairy; glomerules 3.8-4.2 by 3.6-3.8 mm. *Staminate flowers* 27-35 together, 1.6-1.8 by 0.9-1.1 mm; bracts c. 1.1 by 0.9 mm; bracteoles 0.8-1 by 0.2-0.3 mm, margin fimbriate; calyx tube 1.1-1.3 by 0.9-1.1 mm, lobes 0.4-0.6 by 0.3-0.5 mm, densely papillate; stamens 4, androphore 0.3-0.5 by 0.2-0.3 mm, glabrous, filaments 1.1-1.3 mm long; anthers 0.6-0.8 by 0.4-0.6 mm; pistillode 0.9-1.1 mm long. *Pistillate flowers:* pedicels 1.4-1.6 mm long, covered with dense lepidote hairs; bracts ovate, 0.9-1.1 by 0.8-2.2 mm, apex acute, with lepidote hairs; calyx 5-lobed, with lepidote hairs, tube 0.3-0.5 by 1.4-1.6 mm; lobes 1-1.2 by 0.7-0.9 mm; ovary 0.9-1.1 by 1.1-1.4 mm; style 1.6-1.8 mm long; stigmas 3, 1.3-1.5 mm long, apically bifid, surface papillate. *Fruits* c. 3 by 4.2 cm, densely echinate with 2.5-3.7 mm long spines, lepidote hairs present; peduncle 1-2.9 by 1.9-2.9 mm; wall c. 2.4 mm thick, woody, inside smooth and glabrous. *Seeds* 1-1.2 by 0.9-1.1 cm, smooth, glabrous, apex 2-lobed. *Leaf anatomy:* leaf abaxially covered with lepidote hairs 87-113 µm long; epidermis cells with wavy anticlinal walls, 34-36 by 20-22 µm; stomata c. 24 by 17 µm.

DISTRIBUTION. *Malesia:* Malay Peninsula, Sumatra, Borneo.

ECOLOGY. Tree in swampy forest and on hill slopes, Alt: c. 195 m.



Map 2. Distribution of *Cephalomappa lepidotula* Airy Shaw

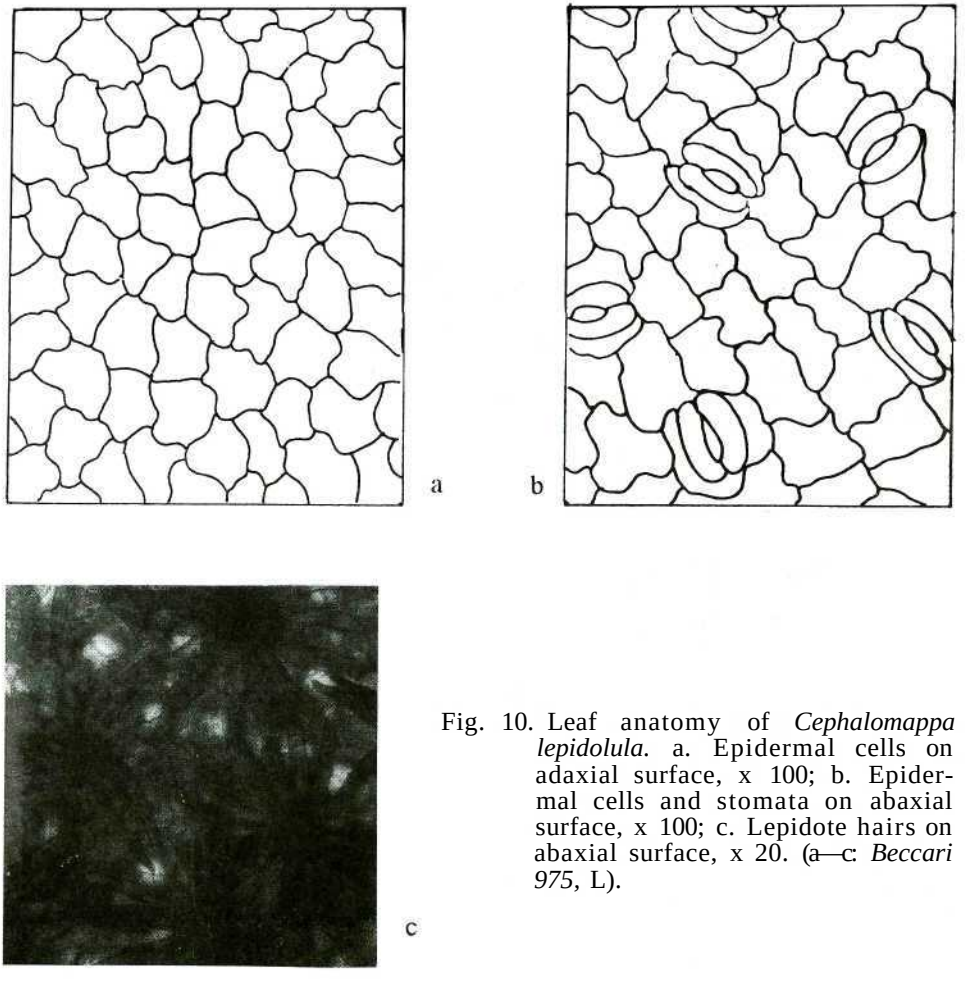


Fig. 10. Leaf anatomy of *Cephalomappa lepidolula.* a. Epidermal cells on adaxial surface, x 100; b. Epidermal cells and stomata on abaxial surface, x 100; c. Lepidote hairs on abaxial surface, x 20. (a—c: *Beccari 975,* L).

3. CEPHALOMAPPA MALLOTICARPA J.J. Sm. -Fig. 11, 12; Map 3

Cephalomappa mallolicarpa J .J. Sm., Bull. Jard. Bot. Buitenz. Ser. Ill, 6 (1924) 95; Merr., PI. Elmer. (1929) 160; Airy Shaw, Kew Bull. 14 (1960) 380; Whitmore Tree Fl. Malaya 2 (1973) 76, Fig. 4; Airy Shaw, Kew Bull Add Ser 4 (1975) 67- Kew Bull. 36 (1981) 275 - Type: *VIII F. 50* (BO, hololecto), Culta Bogor Botanical Gardens.

Tree. *Brandies* smooth, glabrous, flowering branches c. 4.3 mm thick. *Leaves:* petiole 0.6-1.2 cm long, glabrous; lamina obovate, 10-28.2 by 2.5-6.2 cm, base acute with 2 glands at the lower surface near the midrib, margin serrate, flat, apex cuspidate, very apex obtuse, both surfaces smooth, glabrous, nerves 8-11 pairs. *Peduncle* 2-3 cm long, glabrous;

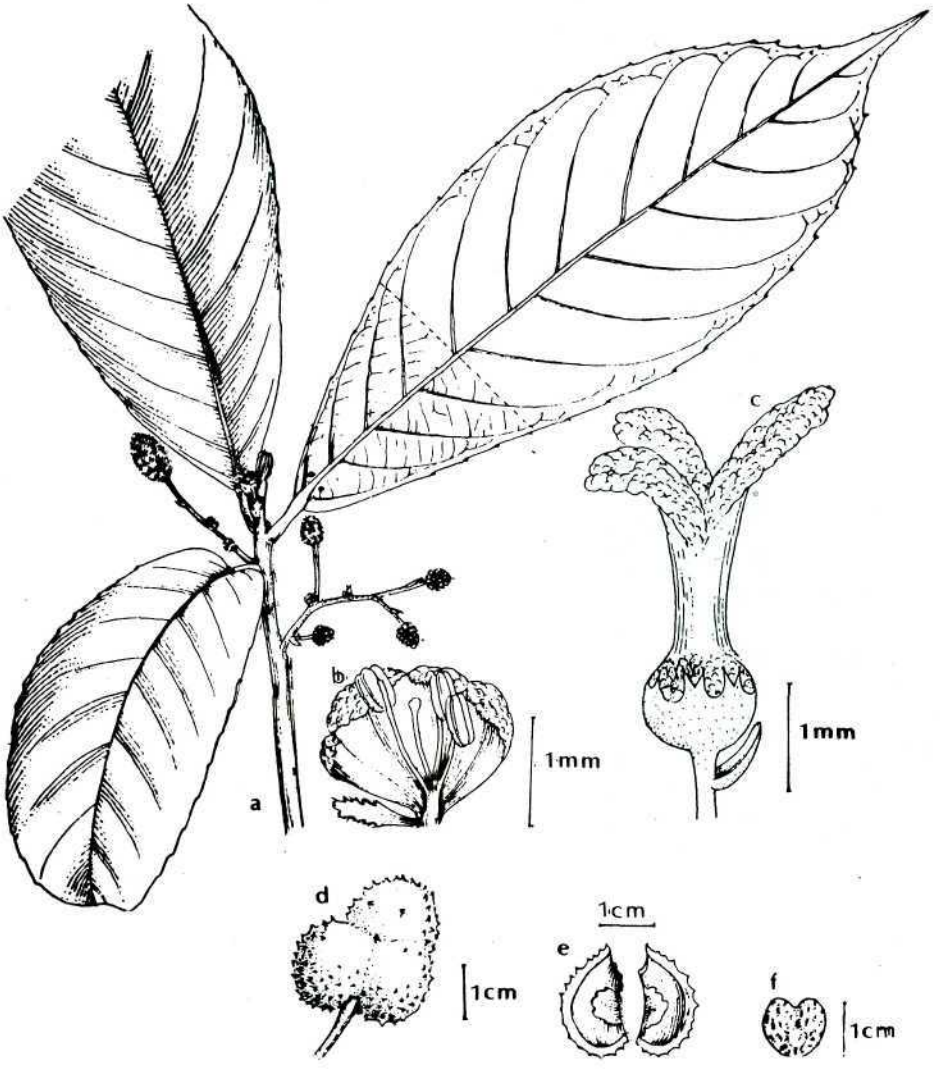


Fig. 11. *Cephalomappa mallolicarpa* J.J. Sm. a. Habit; b. Staminate flower; c. Pistillate flower; d. Fruit; e. Fruit valves; f. Seed (a—f: *Culta Bogor Botanical Gardens VIII F 50,* BO).

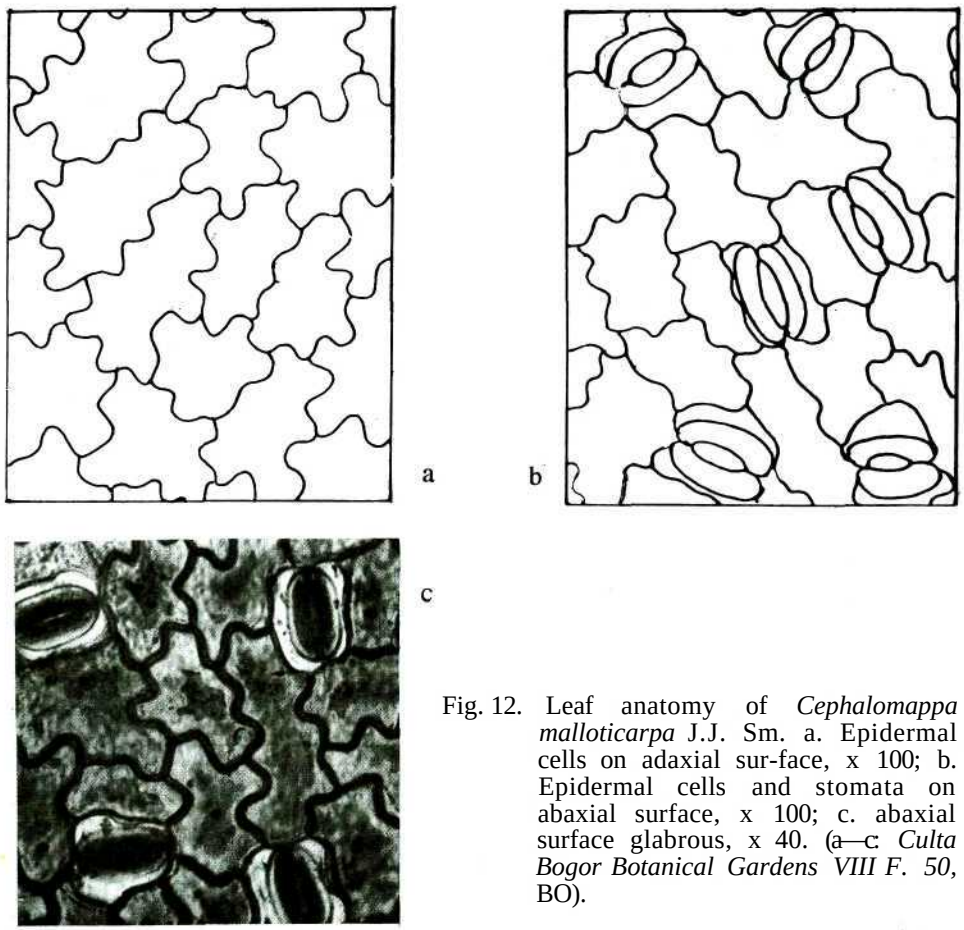


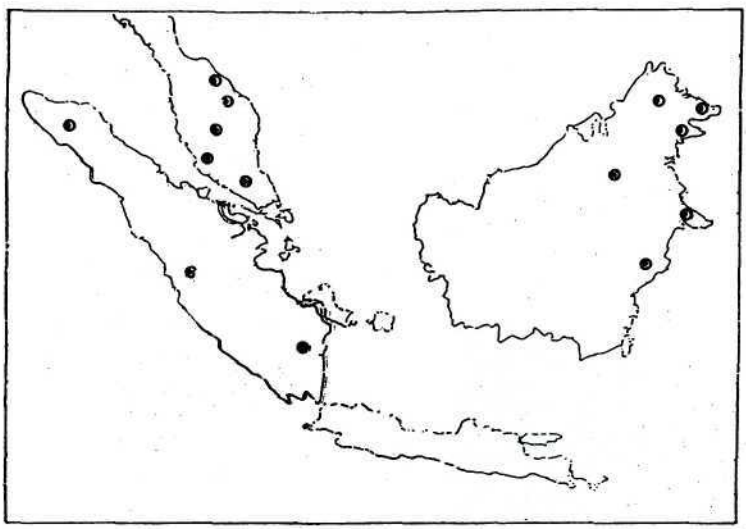
Fig. 12. Leaf anatomy of *Cephalomappa malloticarpa* J.J. Sm. a. Epidermal cells on adaxial sur-face, x 100; b. Epidermal cells and stomata on abaxial surface, x 100; c. abaxial surface glabrous, x 40. (a—c: *Culta Bogor Botanical Gardens VIII F. 50,* BO).

peduncle to glomerules 0.5-1.8 cm long, glabrous, glomerules 0.5-0.7 by 0.4-0.6 cm. *Staminate flowers* 29-36 together, 1.8-2.2 by 0.9-1.1 mm; bracts 0.9-1.1 by 0.2-0.4 mm; bracteoles 1.4-1.6 by 0.5-0.7 mm, margin fimbriate; calyx tube 1.4-1.7 by 0.9-1.1 mm; lobes 0.4-0.5 by 0.4-0.6 mm, glabrous, densely papillate; stamens 3 (or 4), androphore 0.3-0.4 by c. 0.2 mm, glabrous, filaments 1.1-1.3 mm long; pistillode 0.8-1 mm long. *Pistillate flowers:* pedicels 0-2 cm long, glabrous; bracts 0.9-1.1 by 0.3-0.5 mm, apex obtuse, subglabrous; calyx 5-lobed, subglabrous, tube 0.3-0.5 by 1.5-1.7 mm, lobes 1-1.2 by 0.5-0.7 mm; ovary 1.5-1.7 by 2.5-2.7 mm, style c. 1.5 mm long, stigmas 3, 1.8-2 mm, apex of stigmas usually bifid, surface papillate. *Fruits* 1.1-1.3 by 2.2-2.4 cm, echinate; peduncle 3-6.5 cm, 2-2.4 mm; wall 2.8- 3 mm thick, woody, inside smooth and glabrous. *Seeds* 1.1-1.3 by 0.9-1.1 cm. *Leaf anatomy:* leaf abaxially glabrous; epidermis cells with sinuous anticlinal walls, 44-46 by 26-30 µm; stomata c. 26 by 16 µm.

DISTRIBUTION. *Malesia:* Malay Peninsula, Sumatra, Borneo (not known from Brunei and Sarawak yet).

ECOLOGY. Tree in primary forest, on hillside with a sandy-loam soil with lime. Alt: 80-600 m.

USES. The wood is of low quality, its durability class is V. Nevertheless, local people use it for the contruction of their house.



Map 3. Distribution of *Cephalomappa mallolicarpa* J.J. Sm.

NOTES.'The original syntypes, cultivated in Bogor Botanical Garden, were said to have been originally from Mt. Salak in Java, but this species has never been found on this mountain. Up to now the species is not known from Java, therefore, J. J. Smith's suspicion of the Mt. Salak origin of the trees seems justified.

4. CEPHALOMAPPA PALUDICOLA Airy Shaw - Fig. 13, 14; Map 4

Cephalomappa paludicola Airy Shaw, Kew Bull. 14 (1960) 380; Kew Bull. 16 (1963) 353; Whitmore, Tree Fl. Malaya 2 (1973) 76; Airy Shaw, Kew Bull. Add. Ser. 4 **(1975)** 67. — Type: *S. 9713* (K, holo, *n.v.;* iso in L), Sarawak, Binatang Distr., **Surong** trib., Daro Forest Reserve.

Tree. *Branches* smooth, flowering branches c. 3.2 mm thick. *Leaves:* petiole 0.5-0.7 cm long, glabrous; lamina elliptic, 6.5-13 by 2-5 cm, base acute, with 4 glands at the lower surface near the midrib, margin

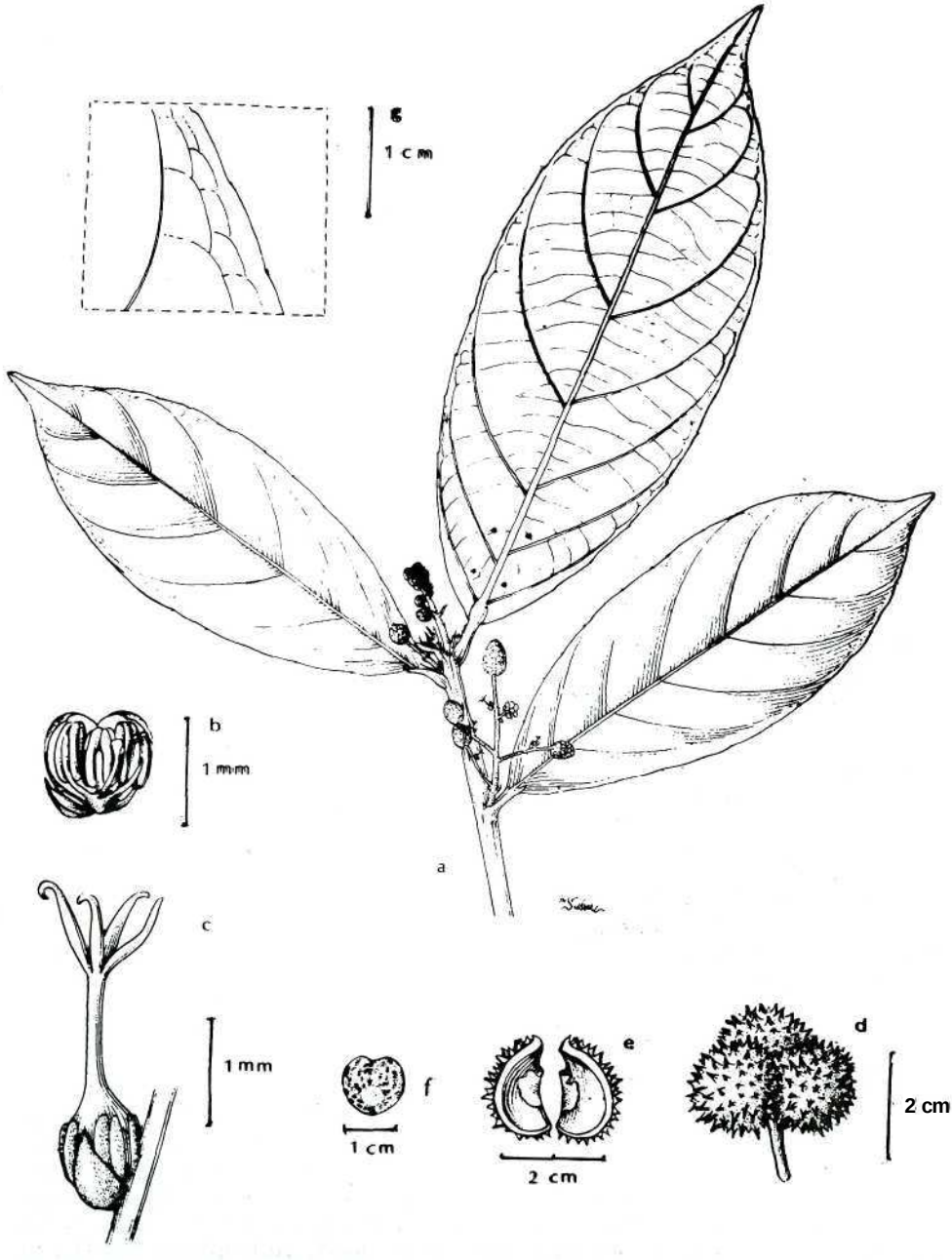


Fig. 13. *Cephalomappa paludicola* Airy Shaw. a. Habit; b. Staminate flower; c. Pistillate flower; d. Fruit; e. Fruit valves; f. Seed; g. Indumentum of lower leaf surface (a & g S. 9713, L; b-f : Anderson 25557,L)

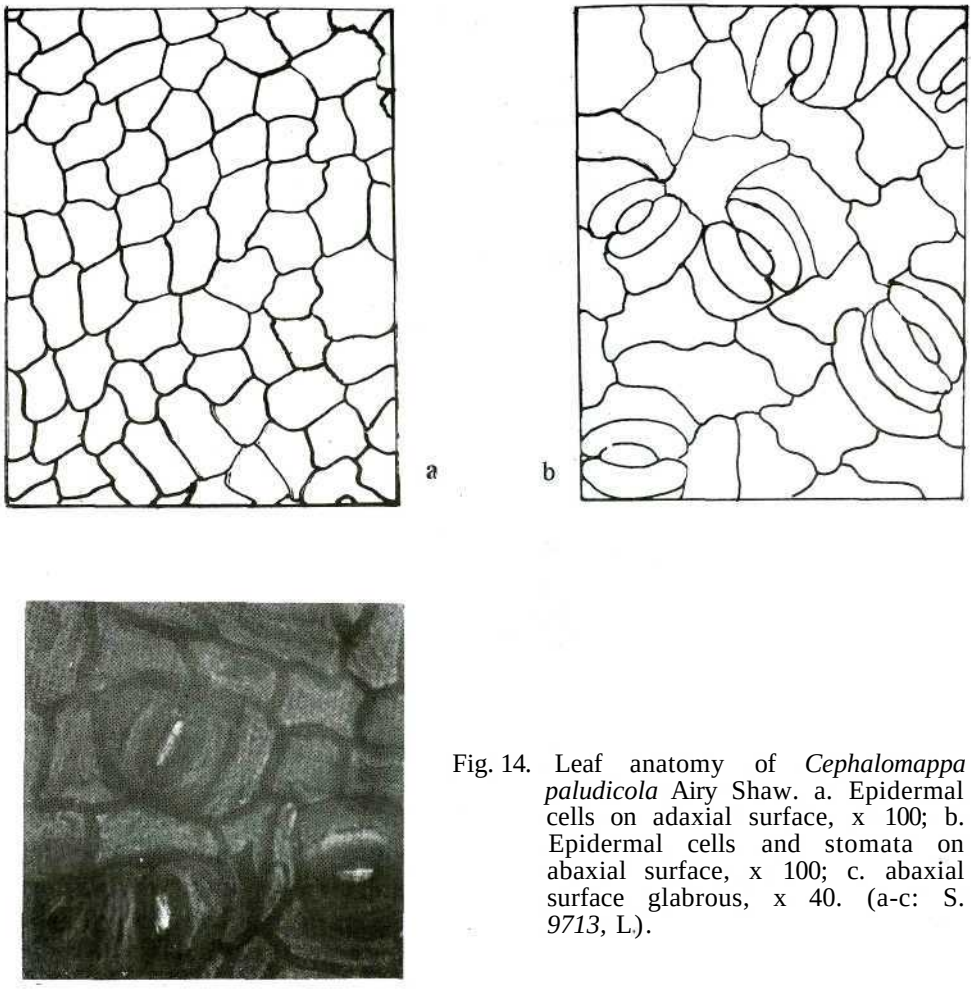


Fig. 14. Leaf anatomy of *Cephalomappa paludicola* Airy Shaw. a. Epidermal cells on adaxial surface, x 100; b. Epidermal cells and stomata on abaxial surface, x 100; c. abaxial surface glabrous, x 40. (a-c: S. *9713,* L).

crenate, recurved, apex acuminate-cuspidate, apex obtuse, upper and lower surface glabrous, nerves 4-6 pairs. *Peduncle:* 1.6-2 cm long, glabrous; peduncle to glomerules 0.3-1.8 mm long, glabrous; glomerules 6-9 by 4-7 mm. *Staminate flowers* 25-33 together, 1.8-2.2 by 1.3-1.5 mm; bracts 0.8-1 by 0.4-0.6 mm; bracteoles 0.7-0.9 by 0.3-0.5 mm, margin entire, apex acute; calyx tube 1.2-1.5 by 1.3-1.5 mm, lobes 0.8-0.7 by 1-1.2 mm, thinly papillate; stamens 4, androphore 0.3-0.4 by 0.15-0,2 mm, glabrous, filaments 1.7-1.9 mm long; anthers 0.6-0.8 by 0.4-0.5 mm; pistillode 1, 1.4-1.6 mm long. *Pistillate flowers:* pedicel 0-2.2 cm, glabrous; bracts 1-1.2 by 0.9-1.1 mm, apex acute, subglabrous;

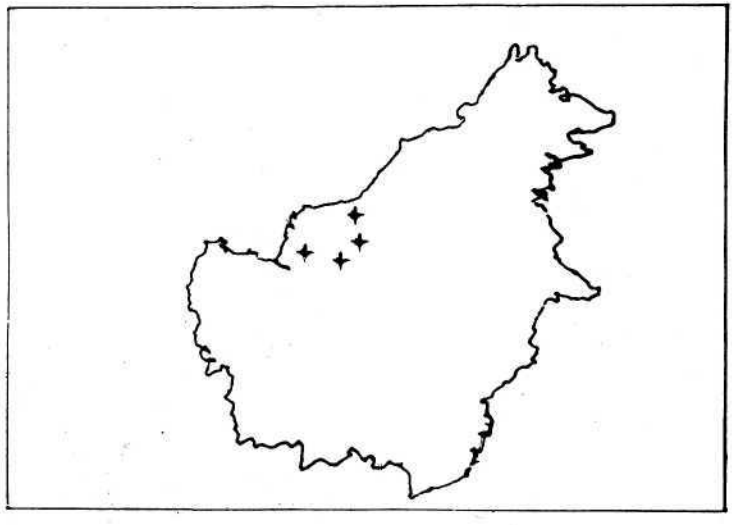
sepals 8, free, elliptic, 1.2-1.3 by 0.3-0.5 mm, apex obtuse and entire, glabrous; ovary 1.2-1.3 by 0.9-1.1 mm, style 1.1-1.3 mm long; stigmas 4, 2-2.5 mm long. *Fruits* 1.4-1.6 by 2.3-2.5 cm, echinate glabrous; peduncle 1.5-1.7 cm by 1-3 mm; wall 2.6-2.8 mm thick. *Seeds* 0.9-1.1 by 0.8-1 cm. *Leaf anatomy:* Leaf abaxially glabrous; epidermis cells with almost straight anticlinal walls, 38-42 by 1.9-2.2 µm. Stomata c. 26 by 24 µm.

DISTRIBUTION. *Malesia:* Borneo (Sarawak).

ECOLOGY. Mainly found in freshwater peat swamp forest, also in primary forest. Alt.: sea level up to 300 m.

VERNACULAR NAME. Sarawak; Arau, ahrau, pela

USES, wood is used as firewood.



Map 4. Distribution of *Cephalomappa paludicola* Airy Shaw

NOTES: Distinguishable from the other species by its crenate leaf margin, staminate flowers with ovate bracteoles, and the 8 sepals of the pistillate flower with their obtuse apex.

5. CEPHALOMAPPA PENANGENSIS Ridl. — Fig. 15, 16; Map 5

Cephalomappa penangensis Ridl., Fl. Malay Pen. 3 (1924) 279; Airy Shaw, Kew Bull. Misc. Inf. (1923) 368; Kew Bull. 14 (1960) 379; Kew Bull. 16 (1963) 353; Whitmore, Tree Fl. Malaya 2 (1972) 76. - Type: *Curtis 3584* (SING, Iso), Malay Peninsula.

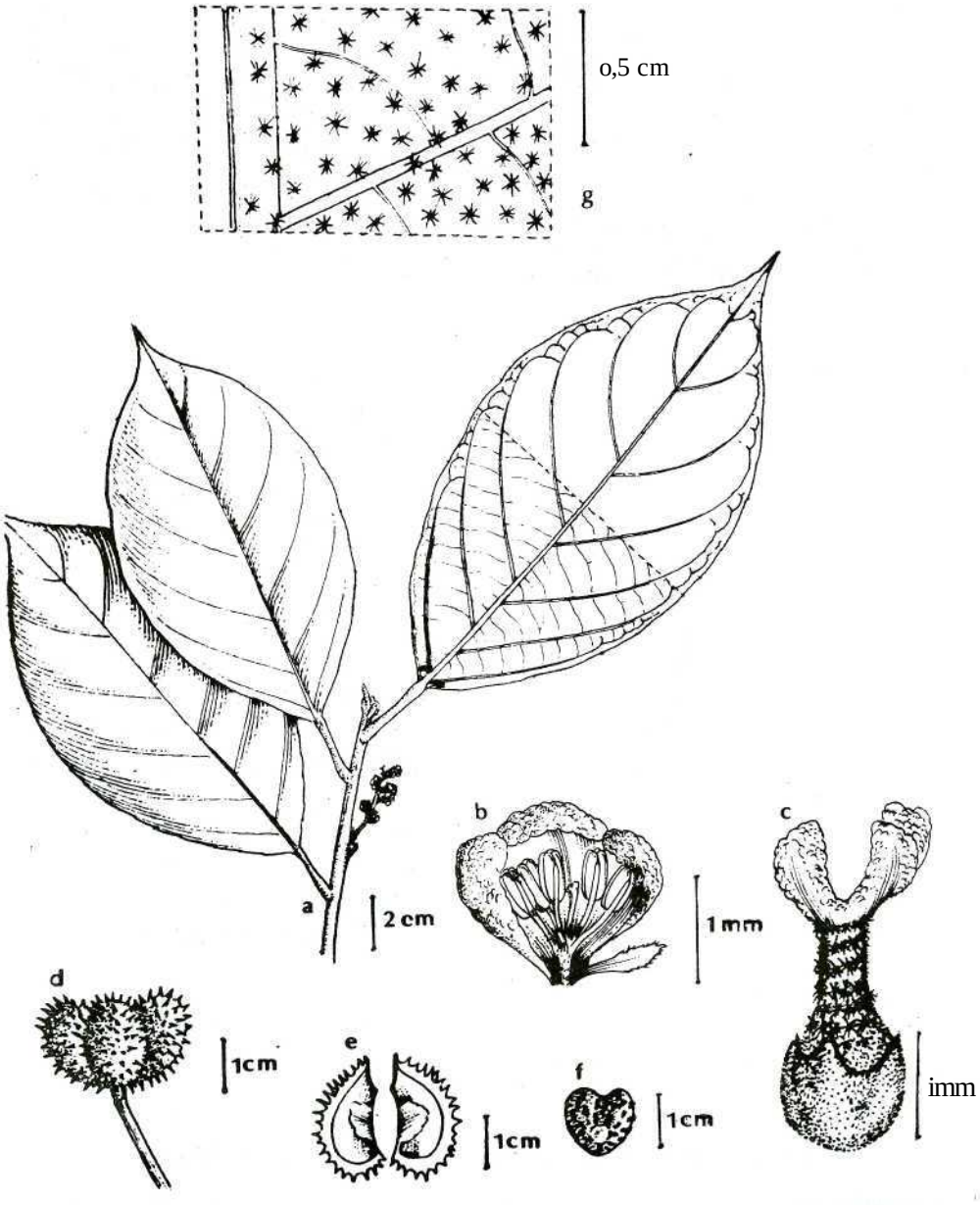


Fig. 15. *Cephalomappa penangensis* Ridl. a. Habit; b. Staminate flower; c. Pistillate flower; d. Fruit; e. Fruit valves; f. Seed; g. Indumentum of lower leaf surface (a-f: *Curtis 3854*,,SING).

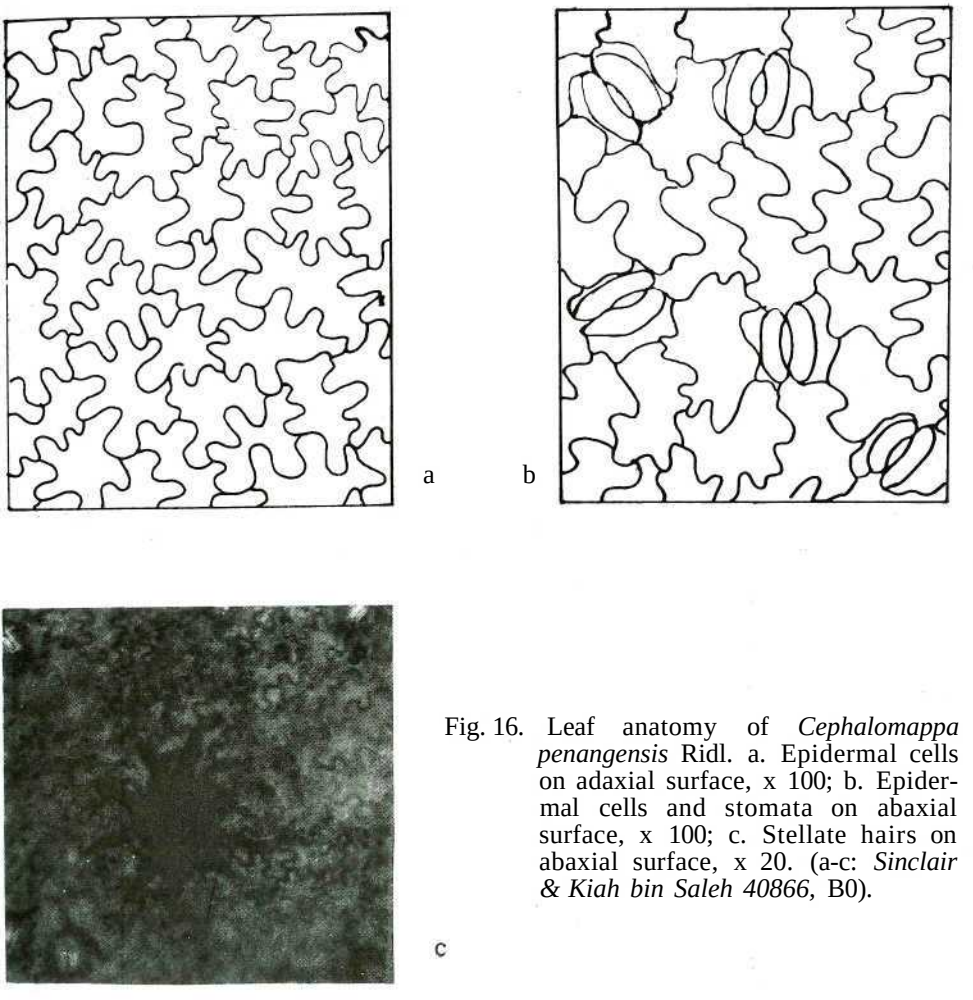


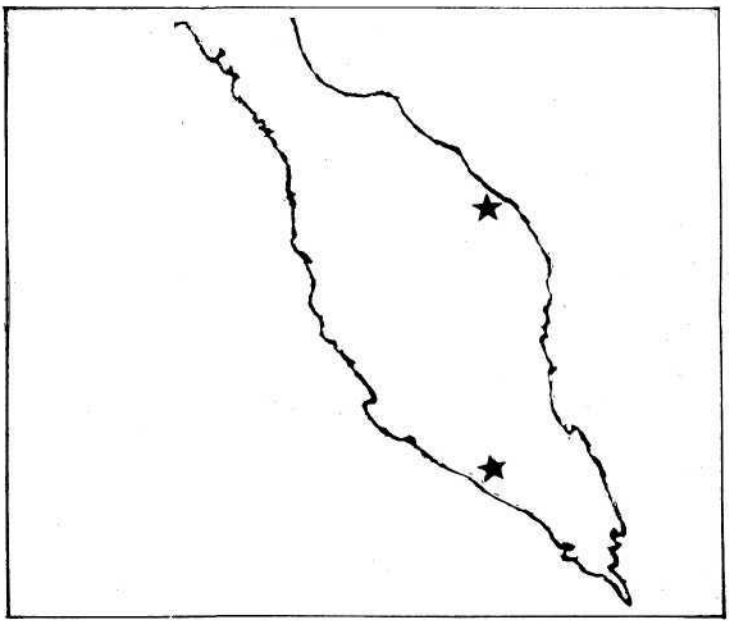
Fig. 16. Leaf anatomy of *Cephalomappa penangensis* Ridl. a. Epidermal cells on adaxial surface, x 100; b. Epidermal cells and stomata on abaxial surface, x 100; c. Stellate hairs on abaxial surface, x 20. (a-c: *Sinclair & Kiah bin Saleh 40866,* B0).

Tree. *Branches* rough, strong, flowering branches c. 4 mm thick. *Leaves:* petiole 1.8-3.2 cm long, covered with densely stellate hairs; lamina elliptic, 14.5-23.5 by 7.4-10.4 cm, base obtuse, with 2 glands at the lower surface close to the midrib, margin sinuate, recurved, apex acuminate to cuspidate, apex acute; upper surface glabrous, glossy; lower surface covered with sparse long stellate hairs, nerves 7-9 pairs. *Peduncle* 2-2.5 cm long, hairy; peduncle to glomerules 0.4-1.2 mm long, densely hairy; glomerules 6-8 by 4-6 mm. *Staminate flowers* 27-34 together, 2.2-2.3 by 1.7-2.3 mm; bracts 1.2-1.4 by 0.6-0.9 mm; bracteoles 1.5-1.7 by 0.3-0.4 mm, margin fimbriate; calyx tube 1.4-1.6 by 1.7-2.3 mm, lobes 0.7-0.8 by 0.6-1.2 mm, densely papillate; stamens 4 (or 5),

androphore 0.3-0.5 by 0.2-0.3, subglabrous, filaments 1.9-2.1 mm long, anthers 0.7-0.9 by 0.3-0.5 mm; pistillode 0.2-0.4 mm long. *Pistillate flowers:* pedicels c. 0.8 cm long, with stellate hairs; bracts 1.2-1.3 by 0.6-0.8 mm, apex acute, with stellate hairs; calyx 5-lobed, with dense stellate hairs, tube 1.4-1.6 by 1.8-1 mm; lobes 0.3-0.4 by 0.3-0.5 mm; ovary c. 2.3 by 2.5, style 1.6-1.8, stigmas 3, 1-1.2 mm long, apically entire, surface papillate. *Fruits* 1.4-1.8 by 2.2-2.4 cm, echinate, suglabrous; peduncle 1-3 cm 1.3-2 mm; wall 2.7-3.1 mm thick. *Seeds* 1-1.2 by 1.1-1.3 cm. *Leaf anatomy:* leaf abaxially covered with long stellate hairs, 125-225 µm long; epidermis cells with deeply sinuous anticlinal walls, 42-44 by 26-28 µm. Stomata c. 23 by 17 µm.

DISTRIBUTION. *Malesia:* Malay Peninsula.

ECOLOGY. Tree in lowland forest. Alt.: c. 90 m



Map 5. Distribution of *Cephalomappa penangensis* Ridl.

NOTES. *C. penangensis* resembles *C. beccariana* var *tenuifolia,* but the latter has thin leaves with a flat denticulate margin. *C. penangensis,* unlike the other species has much stouter petioles, and stiff recurved leaves with a sinuate margin.

EXCLUDED NAMES

Cephalomappa sinensis (Chun & How) Kosterm., Reinwardtia 5 (1961) 413; Airy Shaw, Kew Bull. 16 (1963) 354. = *Muricococcum sinense* Chun & How, Acta Phytotax. Sinica 5 (1956) 14, t. VI.

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IDENTIFICATION LIST

Material of Cephalomappa studied :

1 = *C. beccariana* var. *beccariana*
2 = *C. beccariana* var. *havilandii*
3 = *C. beccariana* var. *hosei*
4 = *C. beccariana* var. *tenuifolia*
5 = *C. lepidotula*
6 = *C. malloticarpa*
7 = *C. paludicola*
8 = *C. penangensis*

Ahmad Talip 54991: 5 - Anderson 12: 7; 5123: 7; 5235: 7;8540: 7; 12886: 7; 25557: 7; 25985: 1 - Arizi bin Arshid 10298:1

bb series 13554: 6; 13921: 6; 18464: 6; 19828: 6; 19829: 6; 32077: 6; 32154: 6- Beccari 975: 5 -Bogor Botanical Garden VIII. F. 32: 6; 32 a: 6; 50: 6; 50 a: 6- Bojangbin Sitam 13139: 7; 13803: 7.

Chew Wee Lek 570: 4; 586: 4 - Clemens *et al.* 20197: 6 - Corner 28951: 5 - Curtis 1571:8; 3584:8.

DorstT 1032: 6.

Elmer 21695: 6.

Forman 604: 6; FRI 6675: 6; 10741:6; 7546:6.

Haviland 2184: 2 - Haviland & Hose 3211: 2 - Hose 303: 3.

Jugah ak Kurdi 23709: 1 - Josep Au 23931: 6.

KEP series 10453: 6 - Kostermans 5376: 6; 12540: 6; 21587: 6.

S series 8290: 3; 13006: 7; 14909: 1; 15143: 3; 18041: 4; 18470: 4; 23613: 3; 23669: 2; 24567: 3; 24601: 2; 31559: 1; 31721: 3; 42501: 5; 43648: 6; 43702: 6; 45211: 4 - SAN series 64775: 6; 68492: 6; 75068: 5; 82236: 6; 99721: 5; 100006: 5; - Sanusi bin Tahir 8953: 7; 9713: 7; - Shea 75087: 5 - Sinanggul 57297: 3 - Sinclair & Kiah bin Saleh 40866: 8.

Thorenaar 126 T3P 359: 6.

Wilde & de Wilde-Duyfjes 12681: 5; 14384: 6; 14826: 6; 19714: 6; 20821: 6.

Zehnder 5767: 7.

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CONTENTS

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