THESIS

TAXONOMIC STUDIES OF THE GENUS *CALOPHYLLUM* L. (GUTTIFERAE) IN THAILAND

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GRADUATE SCHOOL, KASETSART UNIVERSITY
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Master of Science (Forestry)

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เรื่อง TAXONOMIC STUDIES OF THE GENUS CALOPHYLLUM L. (GUTTIFERAE) IN THAILAND

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THESIS

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the Requirements for the Degree of
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สราวุธ สังข์แก้ว 2542 : การศึกษาทางอนุกรมวิธานของพรรณไม้สกุลตังหน ในประเทศไทย ปริญญาวิทยาศาสตรมหาบัณฑิต (วนศาสตร์) สาขาวิชาชีววิทยาป่าไม้ ภาควิชาชีววิทยาป่าไม้ ประธานกรรมการที่ปรึกษา : อาจารย์ ดวงใจ ศุขเฉลิม, D.Sc. 144 หน้า

การศึกษาทางอนุกรมวิธานของพรรณไม้สกุลตังหนในประเทศไทย ดำเนินการโดยการศึกษาลักษณะทางสัณฐานวิทยาจากตัวอย่างพรรณไม้ที่เก็บรวบรวมจากป่าธรรมชาติตามภาคต่าง ๆ ประกอบกับการศึกษาจากตัวอย่างพรรณไม้แห้งซึ่งเก็บรวบรวมไว้แล้วในหอพรรณไม้ต่าง ๆ ของประเทศไทย

จัดทำรูปวิธานจำแนกชนิดโดยอาศัยดอกและผลเป็นหลัก ประกอบกับคำบรรยายลักษณะของแต่ละชนิดโดยละเอียดพร้อมทั้งมีภาพวาดลายเส้นประกอบ

จากการศึกษา พบพรรณไม้สกุลตังหนในประเทศไทยจำนวน 17 ชนิด ดังนี้ *C. thorelii* Pierre, *C. touranense* Gagnep. ex P. F. Stevens, *C. polyanthum* Wall. ex Choisy, *C. dryobalanoides* Pierre, *C. symingtonianum* M. R. Henderson & Wyatt-Smith, *C. macrocarpum* Hook. f., *C. sclerophyllum* Vesque, *C. teysmannii* Miq., *C. inophyllum* L., *C. tetrapterum* Miq., *C. molle* King, *C. canum* Hook. f., *C. calaba* L., *C. rupicolum* Ridl., *C. pisiferum* Planchon & Triana, *C. depressinervosum* M. R. Henderson & Wyatt-Smith และ *C. soulattri* Burman f.

โดย *C. sclerophyllum* Vesque, *C. teysmannii* Miq. และ *C. canum* Hook. f. เป็นชนิดที่รายงานใหม่ในประเทศไทย

ลายมือชื่อนิสิต ลายมือชื่อประธานกรรมการ 22 / ตค. / 42

Saravut Sangkaew 1999 : Taxonomic Studies of the Genus *Calophyllum* L. (Guttiferae) in Thailand. Master of Science (Forestry), Major Field Forest Biology, Department of Forest Biology. Thesis Advisor : Mrs. Duangchai Sookchaloem, D.Sc. 144 pages.

Taxonomic studies of the genus *Calophyllum* L. (Guttiferae) in Thailand was conducted by comparative morphological study. Many specimens collected from field work in several regions and herbarium specimens deposited in several herbaria in Thailand have been examined.

Keys to species based on flowering and fruiting materials have been constructed. Full descriptions supported by line drawing are provided.

Seventeen species are reported as follows: *C. thorelii* Pierre, *C. touranense* Gagnep. ex P. F. Stevens, *C. polyanthum* Wall. ex Choisy, *C. dryobalanoides* Pierre, *C. symingtonianum* M. R. Henderson & Wyatt-Smith, *C. macrocarpum* Hook. f., *C. sclerophyllum* Vesque, *C. teysmannii* Miq., *C. inophyllum* L., *C. tetrapterum* Miq., *C. molle* King, *C. canum* Hook. f., *C. calaba* L., *C. rupicolum* Ridl., *C. pisiferum* Planchon & Triana, *C. depressinervosum* M. R. Henderson & Wyatt-Smith and *C. soulattri* Burman f.

C. sclerophyllum Vesque, *C. teysmannii* Miq. and *C. canum* Hook. f. are new records for Thailand.

S. Sangkaew
Student's signature

Duangchai Sookchaloem 22 / 09 / 99
Thesis Advisor's signature

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Mr. Saravut Sangkaew

August, 1999

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INTRODUCTION

Tropical forests have the highest plant species diversity. Ten thousand species of vascular plants have been recorded in Thailand (Santisuk *et al.*, 1991), but, only about 40% have been revised.

The genus *Calophyllum* is one of the large genera with many identification problems. Earlier studies of this genus reported taxonomic confusion in the number and delimitations of species. The genus is economically important, in particular for timber, as it is used for housing, shipbuilding, furniture etc., its non-timber products are also important eg. for medicinal uses. Many species proliferate in tropical rain forests both in lowland and montane zones. Therefore taxonomic studies of this genus, *Calophyllum*, are strongly needed in Thailand.

PURPOSES

1. To study the morphological characters of each species of the genus *Calophyllum* in Thailand.
2. To construct keys to the species of the genus *Calophyllum* in Thailand.
3. To record the geographical and ecological distributions of each species of the genus *Calophyllum* in Thailand.

LITERATURE REVIEW

The characters of the genus *Calophyllum* L.

Habit

Small to large evergreen trees (Kanjilal *et al.*, 1934; Parkinson, 1983; Whitmore, 1972); occassionally shrubs, such as *C. rupicolum* (Henderson and Wyatt-Smith, 1956).

Trunk

The trees are usually clear and straight, some posses stilt roots and pneumatophores, especially species growing in swamps (Stevens, 1980). The outer bark of immature trees is usually smooth with diamond-shaped or boat-shaped lenticellate fissures, these change to longitudinal fissures in mature trees, gray or yellowish-brown in color. The inner bark is pink or reddish, laminated; with clear or yellow or opaque whitish colored exudate, sticky or not. The youngest twigs are characteristically quadrangular (Henderson and Wyatt-Smith, 1956; Whitmore, 1972)

Leaves

The leaves are simple, opposite, margin entire or repand, often coriaceous in texture and shining; lateral nerves slender and numerous, close together and paralleled from the midrib to the margin (Li, 1963; Brandis, 1978); exstipulate (Rendle, 1952; Robson, 1976; Kostermans, 1980).

Inflorescence

The inflorescences are axillary or terminal paniculate or racemose (Gamble, 1915; Grierson and Long, 1984), or cymose (Rendle, 1952; Stevens, 1980), rarely

umbellate (Whitmore, 1972). Flower bisexual, usually numerous and fragrant, (Robson, 1976; Kostermans, 1980; Grierson and Long, 1984), sometimes with few flowers per inflorescence, such as *C. gracillimum, C. biflorum* (Henderson and Wyatt-Smith, 1956). Polygamous flower may be present (Kurz, 1877; Gamble, 1915; Grisebach, 1963; Li, 1963). The number of sepals is 4, imbricate (Gamble, 1915; Robson, 1976; Grierson and Long, 1984) or decussate (Whitmore, 1972; Kostermans, 1980). Inner pair sepals are often petaloid (Robson, 1976; Kostermans, 1980; Grierson and Long, 1984). The number of petals is 2-8, usually 4 in 1 or 2 whorls, imbricate or decussate (Gamble, 1915; Grisebach, 1963; Whitmore, 1972), sometimes absent (Whitmore, 1972; Robson, 1976; Kostermans, 1980). Stamens are numerous; filaments slender, basifixed, free or joined at base; anther 2-celled, dehiscence vertically (Kurz, 1877; Gamble, 1915; Li, 1963). Ovary is superior with slender style, stigma peltate, 1-locular and 1 basal ovule, anatropous (Kurz, 1877; Gamble, 1915; Henderson and Wyatt-Smith, 1956; Stone, 1970; Robson, 1976; Stevens, 1980).

Fruit

The fruit is a drupe, ovoid to subglobose, with a single erect seed, usually with pale yellow green or dark green spots, crustose endocarp. The seed is not arillate; embryo slender, straight; distinct large cotyledons (Li, 1963; Stone, 1970; Brandis, 1978); without endosperm (Keng, 1969).

Pollen morphology

Pollen morphology of *Calophyllum* species are suboblate-prolate spheroidal; 3 colporate; sexine reticulate. Pollen grains of *C. inophyllum* are (2-)3 colporate, suboblate-prolate spheroidal, diameter about 38 μm. (Erdtman, 1971). Huang, (1972) found that pollen grains of *C. inophyllum* are 3 colporate, suboblate-spheroidal, 33-38x36-45 μm., amb. circular or semi-angular, ora transversely elliptic or transversely parallel, sexine reticulate. The pollen grains of *C. apetalum* are 3 colporate, polar axis 34 μm., equatorial axis 42 μm., sexine reticulate; *C.*

austroindicum are 3 colporate, polar axis 40 μm., equatorial axis 38 μm., sexine reticulate; *C. polyanthum* are 3 colporate, polar axis 31 μm., equatorial axis 35 μm., sexine reticulate (Tissot *et al.*, 1994).

Chromosome number

Darlington and Wylie (1955) reported that chromosome number of *C. inophyllum* was 2n=32 (n=16).

Utilization

Timber: Several species such as *C. thorelii, C. polyanthum, C. symingtonianum, C. calaba* var. *bracteatum* and *C. depressinervosum* provide good timber for general construction, for example, for houses, parts of ship, spars, furniture, implement handles etc. (Stevens, 1980).

Bark: In Vietnam, the bark of *C. dryobalanoides* is used for pails, baskets and partitions. In Cambodia, the bark of *C. pisiferum* is used for curing diarrhea (Stevens, 1980). Processing the aromatic gum from the bark of *C. inophyllum* can produce a perfume (Dasture, 1964). In the Philippines the bark of *C. inophyllum* is produces satisfactory leather, because the bark contains a lot of tannins (Brown, 1921). The bark of *C. soulattri* has been employed as a tonic for horses (Perry, 1980).

Exudate: In Cambodia, the exudate of *C. dryobalanoides* is used as shampoo. The exudate of *C. calaba* var. *bracteatum* in Malesia is used as a fish poison in fresh water (Stevens, 1980). The powdered resin of *C. inophyllum* is used as a tonic for ulcers and infected wounds. The exudate of *C. lowii* or *C. palustre* when heated with coconut milk can be applied to itches and other skin affections (Perry, 1980).

Leaves: The water derived from soaking slashed leaves of *C. inophyllum* can be used as a wash for inflamed eyes and to treat hemorrhoids (Perry, 1980).

Flowers: The stamens from fallen flowers of *C. inophyllum* are used as medicines applied at childbirth (Perry, 1980).

Fruits: Seeds of *C. inophyllum* are antiparasitic and can treat scabies, ringworm and dermatosis in general, it can also heal all kinds of ulcer and embrocation for rheumatism (Perry, 1980).

The early taxonomic treatments of the genus *Calophyllum* L. in Thailand

Craib (1931) recorded 5 species and 2 varieties they were *C. inophyllum, C. polyanthum, C. smilesianum, C. smilesianum* var. *lutea, C. thorelii* and *C. williamsianum.*

Smitinand (1980) reported additional species of *Calophyllum* namely *C. depressinervosum* (Figure 1), *C. macrocarpum* (Figure 2), *C. molle, C. pisiferum, C. siamense, C.soulattri, C. symingtonianum* (Figure 3) and *C. tetrapterum.*

Stevens (1980) reported more species of *Calophyllum*: they were *C. calaba* var. *bracteatum, C. calaba* var. *cuneatum, C. dryobalanoides* (Figure 4), *C. rupicolum* and *C. touranense.*

No endemic species of *Calophyllum* has been reported from Thailand. All native *Calophyllum* species are also found in neighbouring countries: Indo-China (Gagnepain, 1944), Malesia (Henderson and Wyatt-Smith, 1956), Burma (Kurz, 1877), India (Anderson, 1973) and Java (Baker and Brink, 1963).

Figure 1 **Type photograph of *C. depressinervosum* M. R. Henderson & Wyatt-Smith** (Ilford Cibacopy, donated by Royal Botanic Gardens, Kew, UK.)


ISOTYPE
of Calophyllum depressinervosum
Hend. & Wyatt-Smith
Determinavit
FLORA OF PENANG.
No. 130
Local Name
Botanical Name Calophyllum sp.
Where collected Moniet Rd.
Elevation 1000 ft Date May 1886
Rec'd VIII. 1886.
Collector
ILFORD CIBACOPY
ROYAL BOTANIC GARDENS KEW

Figure 2 **Type photograph of *C. macrocarpum* Hook. f.**
(Ilford Cibacopy, donated by Royal Botanic Gardens, Kew, UK.)


ROYAL BOTANIC GARDENS KEW
ILFORD CIBACOPY
cm 0 1 2 3 4 5 6 7 8 9 10
TYPE
Calophyllum macrocarpum Hook. f.
Fl. Brit. India 1: 272 1875
DET. P.F. Stevens 10. 1975
LECTOTYPE
of Calophyllum macrocarpum
selected by Hooker
in
Calophyllum
Malacca
1867
SHEET 1/2 Herbarium of the late A. C. MAINGAY, M. D.
No. 174
Calophyllum
MALAYA.
Distributed at the Royal Gardens, Kew. 1871.
Malacca
no. 1728

Figure 3 Type photograph of *C. symingtonianum* M. R. Henderson & Wyatt-Smith (Ilford Cibacopy, donated by Royal Botanic Gardens, Kew, UK.)


ISOTYPE
of Calophyllum pyrmingtonianum
Hend. & Wyatt - Smith
cm 0 1 2 3 4 5 6 7 8 9 10
ILFORD CIBACOPY
ROYAL BOTANIC GARDENS KEW
Arn. Arb. collection
Gardens 40
Singapore Field No. 32633
DISTRIBUTED FROM
THE BOTANIC GARDENS, SINGAPORE
MALAY PENINSULA
Name Calophyllum pulcherrimum Wall.
Locality Boh Plantations, Cameron Highlands, PAHANG.
Altitude c.4000 ft.
Date 12 April 1937.
Det. M.R.Henderson
Coll. Md. Nur.
50-60 ft. tall, in valley.
Calophyllum pyrmingtonianum Hend. & W.-S. Smith
Determinavit Exam. Hend. & Wyatt-Smith (1956)

Figure 4 Type photograph of *C. dryobalanoides* Pierre
(Ilford Cibacopy, donated by Royal Botanic Gardens, Kew, UK.)


ROYAL BOTANIC GARDENS KEW
ILFORD CIBACOPY
cm
0 1 2 3 4 5 6 7 8 9 10
LECTOTYPE
of Calophyllum dryobalanoides
selected by
in
HERB. L. PIERRE.
Comm. M. PIERRE, 1880.

MATERIALS AND METHODS

MATERIALS

1. Plant presses 30 by 45 cm., used newspapers, cardboards, pruning knife, plastic bags and field books. Material for mounting herbarium specimens:
   - herbarium sheet 300 gram, 26.5 by 42 cm.
   - White paper covers, 27 by 42 cm.
   - Needles and thread.
   - Labels 10 by 13.5 cm.
2. Handlens and dissecting microscope.
3. 70% ethylalcohol.
4. Altimeter.
5. Tree climbing spurs.
6. SLR 35 mm. camera, negative films and colors slides.

METHODS

1. Surveying and collection of specimens were carried out. The geographical and ecological distribution of individual plants was systematically recorded.

2. The herbarium specimens were prepared and deposited at the Forest Herbarium, Royal Forest Department (BKF). Material from the following herbaria: Bangkok Herbarium, Department of Agriculture (BK), Prince of Songkla University Herbarium (PSU) and Department of Forest Biology were also consulted.

3. The genus *Calophyllum* revision was based on comparative morphological studies. A taxonomic key to the species of *Calophyllum* was constructed.

4. Some data of vernacular were based on Smitinand (1980) and the distributions in neighbouring countries were based on Stevens (1980).

RESULTS

Field and morphological characters

Habit

All plants in the genus *Calophyllum* in Thailand are usually medium to large evergreen large trees. *C. rupicolum* is occassionally a small tree. The boles are often straight and cylindrical, but occasionally slanting in *C. inophyllum*. Some species such as, *C. tetrapterum* and *C. teysmannii*, sometimes have small butresses or spurs. The species growing in peat swamp forest, such as *C. sclerophyllum* have a profusion of stilt roots and pneumatophores. *C. rupicolum* also possesses pneumatophores.

Branching mode is mostly monopodial in immature trees and thereafter sympodial branching.

Habitat

Ecological amplitude of plants in this genus have a wide range from Beach Forest, Mangrove Forest, Peat Swamp Forest, Evergreen Forest, Semi-Evergreen Forest, Dry Dipterocarps Forest to Hill Evergreen Forest. Some species are restricted to certain habitats, *C. sclerophyllum* is found only in peat swamp forest. *C. touranense* is usually restricted in hill evergreen forest, but occassionally found in semi-evergreen forest at 700 m. altitude. *C. soulattri*, *C. rupicolum*, *C. pisiferum* and *C. tetrapterum* are often confined stream in the evergreen forests. *C. calaba* can be found from beach forest to dry dipterocarps forest. *C. inophyllum* usually belongs to coastal vegetation (beach forest) and is now widely cultivated in tropical countries.

Bark

The bark of *Callophyllum* is usually characteristically fissured, yellowish-brown to grayish-brown (Figure 5). But the bark of *C. canum* is a smooth, grayish-brown, sometimes with hoop-marked. Pink to red slash-marked bark with clear honey or opaque whitish colored exudate is occassionally found.

The exudate from a mature trunk of Thai *Calophyllum* can be characteristically classified into 2 groups:

1. Clear honey exudate: *C. thorelii, C. touranese, C. polyanthum, C. dryobanoides, C. symingtonianum, C. macrocarpum, C. sclerophyllum, C. teysmannii, C. inophyllum, C. tetrapterum, C. molle, C. calaba* and *C. depressinervosum.*

2. Opaque whitish exudate: *C. canum, C. rupicolum, C. pisiferum,* and *C. soulattri.*

Leaves

The leaves are simple, petiolate, opposite and decussate, coriaceous in texture and usually shining. The name of the genus *Calophyllum* is derived from the Greek word for beautiful leaves. These leaves have fine and closed parallel lateral veins from the midrib towards the margin. In *C. teysmannii*, the paralleled lateral veins start from the midrib towards distinct intra-marginal veins or sub-marginal veins before margin. Usually venations are distinct on both surfaces, except in *C. depressinervosum*, have the veins on the under surface are obscure or absent and the midrib is usually depressed.

Figure 5 The barks of Thai *Calophyllum* species.

A *C. canum* Hook. f.

B *C. rupicolum* Ridl.

C *C. soulattri* Burman f.

D *C. pisiferum* Planchon & Triana

E *C. macrocarpum* Hook. f.

F *C. depressinervosum* M. R. Henderson & Wyatt-Smith

G *C. symingtonianum* M. R. Henderson & Wyatt-Smith

H *C. molle* King

I *C. thorelii* Pierre

J *C. calaba* L.

K *C. touranense* Gagnep. ex P. F. Stevens

L *C. polyanthum* Wall. ex Choisy

M *C. teysmannii* Miq.

N *C. tetrapterum* Miq.

O *C. inophyllum* L.

P *C. dryobalanoides* Pierre

Q *C. sclerophyllum* Vesque


A
B
C
D
E
F
G
H
Q
I
J
K
L
M
N
O
P

Node and internode

Nodes and internodes are used as additional characters. Most Thai *Calophyllum* have no transverse lines at nodes, except *C. teysmannii, C. soulattri* and often *C. molle*. *C. macrocarpum* and *C. rupicolum* have slightly small alated at angle of youngest twigs. Axillary buds of the latter species are usually supra-axils.

Inflorescences

The inflorescences of Thai *Calophyllum* are cymose, from terminal and/or upper leaf axils or from leaf axils.

Teminal and/or upper leaf axils inflorescence are encountered in the following species: *C. thorelii, C. touranense, C. polyanthum, C. dryobalanoides* and *C. symingtonianum.*

Axillary inflorescence are found in: *C. macrocarpum, C. sclerophyllum, C. teysmannii, C. inophyllum, C. tetrapterum, C. molle, C. canum, C. calaba, C. rupicolum, C. pisiferum, C. depressinervosum* and *C. soulattri.*

Flowers and Floral parts

Flowers of the genus *Calophyllum* are apparently all alike. They are about the same size, usually 1-2 cm. in diameter. Tepals are whitish, and anthers are yellowish. Bracts and bracteoles are ovate, caducous. The flowers are usually actinomorphic and pedicellate.

The genus can be classified into 2 groups based on the number of tepals. Eight tepals are found in *C. thorelii, C. touranense, C. polyanthum, C. dryobalanoides, C. symingtonianum, C. macrocarpum, C. sclerophyllum, C. teysmannii* and *C.*

inophyllum. Four tepals are found in *C. molle, C. canum, C. calaba, C. pisiferum, C. rupicolum, C. depressinervosum* (Stevens, 1980) and *C. soulattri. C. tetrapterum* has a varying number of tepals from 4 to 8.

The stamens are numerous and varied from 30 to 600 per flower. In most species the stamens are glabrous, except *C. molle* which has puberulent stamens. The anthers are oblong or oblique, but sometimes in *C. pisiferum* and *C. rupicolum*, the anthers are obovate. The anthers are basifixed and 2-celled, usually retuse, sometimes apiculate, vertically dehiscence. In almost all species the filaments are slender and joined at base into 4-6 bundles.

Ovary is superior, 1-celled, with 1 ovule and basal placentation, stigma is peltate. Ovaries almost are glabrous, except *C. molle* with pubescent ovary.

Fruit

The fruit of *Calophyllum* species are drupe, the fruit shape varies from ovoid to globose. Color of the ripening fruit is yellowish-green, pale brown, orange or blackish. The pericarp can be divided into three parts: exocarp, mesocarp and stone or crustose endocarp. The mesocarp of *C. thorelii* can be a good diagnostic character to distinguish this species from *C. touranense* and *C. polyanthum*. In most the seed is distinct large cotyledons and without endosperm.

Taxonomic history of the genus *Calophyllum* L.

Calophyllum **L.** Sp. Pl. **1**: 513. 1753, Gen. Pl. ed. 5. 229. 1754; Lam. Encycl. Meth. Bot. **1**: 552. 1785; Juss. Gen. Pl. 286. 1791; Willd. Sitz-ber. Ges. Naturf. Fr. Berlin Mag. **5**: 78. 1811; Choisy, Mem. Soc. Hist. Nat. Paris **1**: 228. 1823, in DC. Prodr. **1**: 562. 1824; Endl. Gen. Pl. 1028. 1840; Choisy, Descr. Guttif. Inde, 41. 1849; Mig. Fl. Nederl. Indie **1**(2): 509. 1859; Planchon & Triana, Ann. Sci. Nat. Bot. IV. **15**: 241. 1862; Bentham in Bentham & Hook. f. Gen. Pl. **1**: 175. 1862; T. Anderson in Hook. f. Fl. Brit. India **1**: 271. 1874; Vesque, Epharmosis **2**: 6. 1889; King, Jour. Asiatic Soc. Bengal, II. **59**: 172. 1890; Vesque in C. DC. Monogr. Phanerog. **8**: 529. 1893; Trimen, Handb. Fl. Ceylon **1**: 98. 1893; Engler in Engler & Prantl, Nat. Pflanzenfam. **3**(6): 220. 1895; Pitard in Lecomte, Fl. Gen. Indo-Chine **1** (4): 316. 1910; Ridl., Fl. Malay Penin. **1**: 181. 1922; Engler in Engler & Prantl, Nat. Pflanzenfam. ed. 2. **21**: 192. 1925; Gagnep. Fl. Gen. Indo-Chine Suppl. **1**(3): 268. 1943; Perrier de la Bathie, Fl. Madagascar Comores, Fam. **136**: 3. 1951; M. R. Henderson & Wyatt-Smith, Gard. Bull. Singapore **15**: 285. 1956; Maheshwari, Bull. Bot. Survey India **2**: 139. 1960; Backer & Bakh. f. Fl. Java **1**: 384. 1963; A. C. Sm. & Darwin, Jour. Arnold Arb. **55**: 216. 1974; P. F. Stevens, Austral. Jour. Bot. **22**: 349. 1974, Jour. Arnold Arb. **61**: 167. 1980. Type: *Calophyllum inophyllum* L.

- *Ponna* Rheede ex Ludwig, Defin. Gen. ed. 3. 239. 1760. *Nomen superfluum.*
- *Calaba* Plum. ex Adanson, Familles **2**: 446. 1763. *Nomen superfluum.*
- *Augia* Lour. Fl. Cochinch. 337. 1790, *pro minore parte.*
- *Balsamaria* Lour. *Ibid.* 467. Type: *Balsamaria inophyllum* Lour.
- *Apoterium* Blume, Bijd. Nerderl. Indie **1**(5): 218. 1825. Type: *Apoterium sulatri* Blume.

Small to large evergreen trees. *Trunk* usually without buttresses, occassionally with stilt roots and pneumatophores (*C. sclerophyllum*). *Bark* yellowish-brown to grayish-brown; usually smooth with diamond or boat-shaped lenticellate fissures in immature trees thereafter changed into longitudinally fissured in mature trees, occassionally hoop-marked present (*C. canum*); pink to redish slash-marked bark, laminated; exudate clear honey or opaque whitish, sticky or not. *Youngest twigs* characteristically quadrangular, and with terminal buds. *Leaves* simple with petiolate,

opposite and decussate; lamina coriaceous, usually glabrous and shining, occassionally dorsally pubescent (*C. molle*); lateral nerves numerous, slender, close together and paralleled from midrib towards margin, occassionally sub-marginal vein distinct (*C. teysmannii*); exstipulate. *Inflorescences* cymose, rarery pseudo-umbellate (*C. soulattri*); axillary or terminal and/or upper leaf axils; flowers usually numerous, bisexual; *tepals* 4-8, imbricate or decussate; *stamens* numerous, usually glabrous, occasionally puberulent (*C. molle*); filaments slender, basifixed, more or less joined at base into 4-6 bundles; anther oblong or oblique, 2-celled, apex retuse or apiculate, dehiscence vertically. *Ovary* superior, ocassionally pubescent (*C. molle*), 1-locular, 1 ovule, anatropous, basal placentation; style slender, stigma peltate. *Fruit* a drupe, ovoid to globose with crustose endocarp; yellowish-green, pale brown, orange or blackish when ripen; seed exalbuminous, single, erect; ovoid to globose; not arillate; testa thin or thick and spongy; embryo slender, straight, distinct large cotyledons.

Keys to the species of the genus *Calophyllum* L. in Thailand

1. Inflorescences terminals and/or from upper leafs axils.
   2. Outer pair of tepals dorsally pubescent.
      3. Mesocarp usually fiber-like.----------**1. C. thorelii**
      3. Mesocarp sclereid.
         4. Outer pair of tepals equalling the next one. Terminal bud usually 0.5-0.7 cm long. Fruit subglobose to globose, apex rounded.-------- **2. C. touranense**
         4. Outer pair of tepals shorter than or equalling 1/2 of the next one. Terminal bud usually 1-2 cm long. Fruit ovoid to subglobose, more or less pointed at apex.---------- **3. C. polyanthum**
   2. Outer pair of tepals dorsally glabrous or slightly pubescent towards base.
      5. Stamens more than 140. Fruit broadly ovoid, 1-1.5 x 0.7-1; acute to acuminate at apex. Ratio of leaf length/width is 2/1.----**4. C. dryobalanoides**
      5. Stamens less than 80. Fruit ellipsoid or ovoid, 1.7-2 x 1.5-1.7; acute to round at apex. Ratio of leaf length/width is 3/1.------**5. C. symingtonianum**
1. Inflorescences axillary.
   6. Tepals 8 [except *C. tetrapterum*, tepals (4)-8].
      7. Outer pair of tepals dorsally pubescent.
         8. Lamina coriaceous; apex acute to acuminate. Fruit ellipsoid, 6.5-8 x 4.5-5.5 cm. Tree without stilt roots.----------**6. C. macrocarpum**
         8. Lamina strongly coriaceous; apex retuse to round. Fruit ovoid, ellipsoid to subglobose, 2.5-3.5 x 2-3 cm. Tree with stilt roots.-- **7. C. sclerophyllum**
      7. Outer pair of tepals dorsally glabrous.
         9. Leaf with intra-marinal veins. Youngest twigs with transvers lines at nodes. ----------**8. C. teysmannii**
         9. Leaf without intra-marinal veins. Youngest twigs without transvers lines at nodes.
            10. Leaf apex round to retuse (rarely acute). Stamens 120-260. Fruit more than 1.5 cm across. Tree without still roots.-------- **9. C. inophyllum**
            10. Leaf apex acute to acuminate. Stamens 20-100. Fruit less than 1.5 cm across. Tree occassionally with short still roots or spurs. ---------- **10. C. tetrapterum**

6. Tepals 4.

11. Outer pair of tepals dorsally pubescent.

12. Lower surface of leaf pubescent, base obtuse or cucullate. Ovary and fruit pubescent.---------- **11. C. molle**

12. Lower surface of leaf glabrous, or slightly pubescent only along midrib. Ovary and fruit glabrous.

13. Outer pair of tepals dorsally generally pubescent.

14. Stamens usually more than 300. Exudate opaque whitish. ---------- **12. C. canum**

14. Stamens usually less than 200. Exudate clear honey.--- **13. C. calaba**

13. Outer pair of tepals with dorsally pubescent along midrib.

15. Youngest twigs glabrous. Buds and inflorescences usually supra-axillary.---------- **14. C. rupicolum**

15. Youngest twigs pubescent. Buds and inflorescence axillary. ---------- **15. C. pisiferum**

11. Outer pair of tepals dorsally glabrous.

16. Venation on lower surface of leaf obscure. Midrib on lower surface depressed or flattened. Ripening fruit pale brown.-**16. C. depressinervosum**

16. Venation on lower surface of leaf distinct. Midrib on lower surface raised. Ripening fruit blackish.----------**17. C. soulattri**

1. Calophyllum thorelii Pierre, Fl. Forest. Cochinch. **1**: *pl. 103*. 1885; Vesque in C. DC. Monogr. Phanerog. **8**: 601. 1893; Pitard in Lecomte, Fl. Gen. Indo-Chine **1**(4): 322. 1910; Craib, Fl. Siam. Enum. **1**: 122. 1931; Gagnep. in Humbert, Fl. Gen. Indo-Chine Suppl. **1**: 269. 1943; P. F. Stevens, Jour. Arnold Arb. **61**: 218. 1980. Type: Cochinchine [Vietnam], in montibus Dinh ad Baria Galliae, 300 m., March? 1867, *Pierre 34* (lectotype, P; isolectotypes, BM, K).

- *C. thorelii* Pierre var. *oxycarpum* Gagnep. in Humbert, Fl. Gen. Indo-Chine Suppl. **1**: 270. 1943. *Nomen invalidum.*

Large tree about 25-30 m tall; trunk bole and straight, without buttresses. Outer bark brownish-yellow, deeply fissured. Slash-marked pink to reddish-brown; exudate clear honey. *Youngest twigs* flattened, grayish-brown pubescent; internode 1-6 cm long. Uppermost pair of axillary bud 1-2 mm long. Terminal buds 0.7-1.0 cm long, with grayish-brown pubescent. *Leaves* petiolate, 1.5-3 cm long, shallowly concave above and convex below, waxy or slightly pubescent to glabrous. Lamina oblong to oblong-elliptic, 7-15 by 3-5 cm; apex acute, rarely round, base cuneate, margin entire; coriaceous, drying grayish or greenish-gray above and light brown below; midrib on upper surface depressed in channel about 1/5-1/2 of lamina length, under one raised, lateral veins on the both surface distinct, 7-12 veins/0.5 cm. *Inflorescences* terminal and from upper leaf axils, covered by grayish brown pubescent, 8-15 cm long, 7-31 flowers/inflorescence, pedicels 0.7-1.5 cm long. *Tepals* 8, the outer pair ovate, oval to suborbicular, 4-5 by 3.5-5 mm, dorsally grayish brown pubescent; inner one ovate, ovate-elliptic to obovate-oblong, 9-10 by 4-5 mm, dorsally pubescent in band about 1/2 of total length towards base; the next two ones with same shape and size, obovate to elliptic-oblong, 5-7 by 2-3 mm, dorsally slightly pubescent towards base. *Stamens* about 124-178 per flower, filament 4-6 mm long, anther 0.5-1 mm long. *Ovary* 2-2.5 mm long, style 5-6 mm, long. *Fruits* ellipsoid to ellipsoid-globose 2-3 by 1-2 cm; acute or round at apex; yellowish-green when ripen. Exocarp plus mesocarp 0.3-0.4 cm thick. Endocarp 1-2 mm thick, ovoid, ellipsoid 1.5-2.5 by 0.8-1.3 cm.

T h a i l a n d.- NORTH-EASTERN: Mukdahan; SOUTH-EASTERN: Chon Buri, Chanthaburi, Trat.

D i s t r i b u t i o n.- Vietnam.

E c o l o g y.- In semi-evergreen forest, at ca. 50-300 m. altitude. Flowering November-January. Fruiting December-May.

V e r n a c u l a r.- Kathanghan (กะทังหัน), Kanghan (กังหัน) (Chanthaburi).

U s e s.- The wood is generally useful in construction, including that of boats and masts, apparently being resistant to the attacks of borers. The flowers are very fragrant. Fruit is edible.

Figure 6 ***C. thorelii*** **Pierre**

A Fruiting branch.

B Terminal bud.

C Fruit with some exocarp plus mesocarp removed.

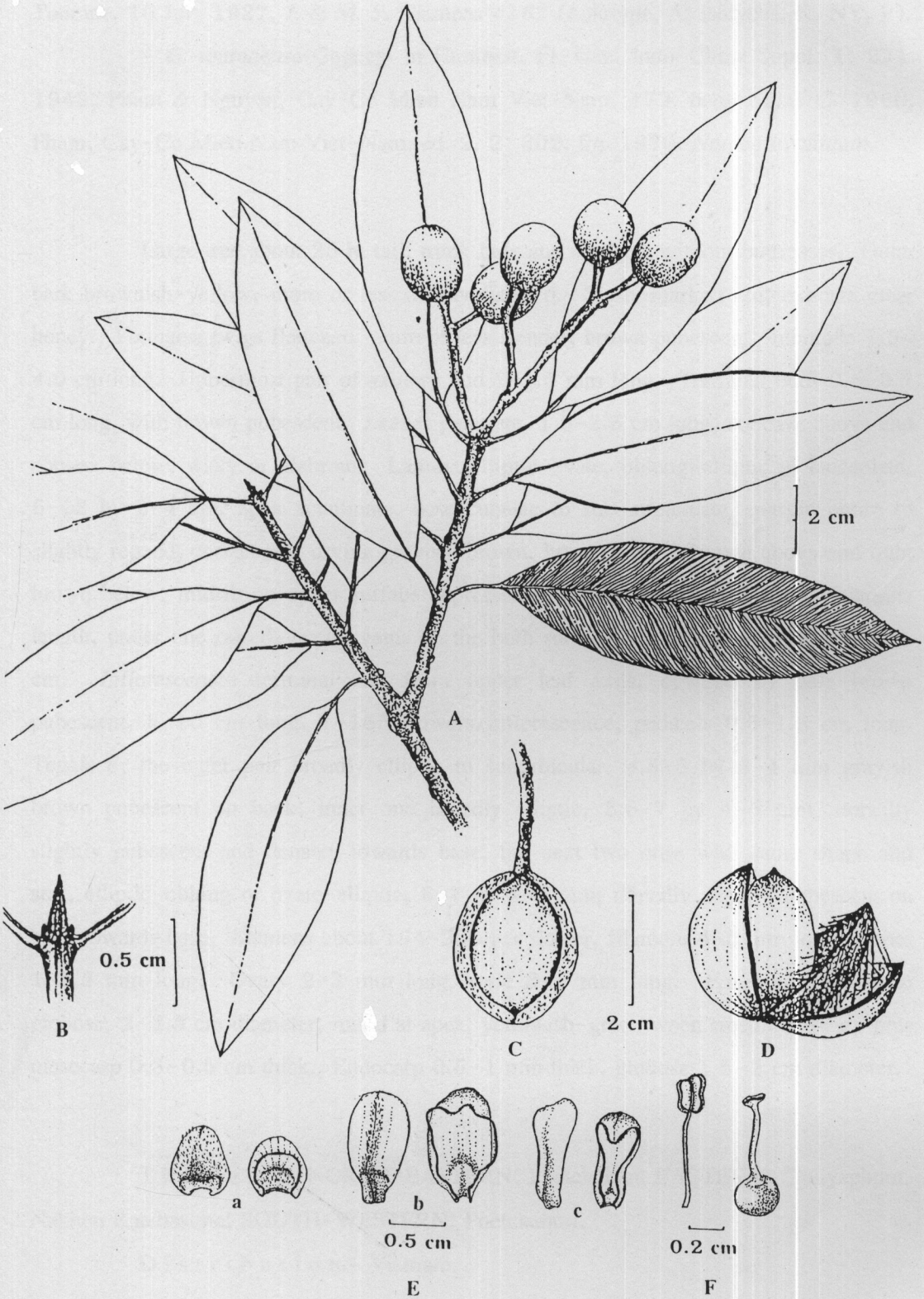
D Fruit showing fibre-like mesocarp.

E Tepals: a The outer pair of tepals.

b The next pair of tepals.

c The third and the fourth pair of tepals.

F Stamen and pistil.


2 cm
A
0.5 cm
B
C
2 cm
D
a
b
c
0.5 cm
0.2 cm
E
F

2. Calophyllum touranense Gagnep. ex P. F. Stevens, Jour. Arnold Arb. **61**: 226. *fig.8, b-d.* 1980. Type: Indochina [Vietnam], Annam, Hoi Mit, 40 km. N. of Tourane, 10 July 1927, *J. & M. S. Clemens 4162* (holotype, A; isotypes, K, NY, P).

- *C. touranense* Gagnep. in Humbert, Fl. Gen. Indo-Chine Suppl. **1**: 271. 1943; Pham & Nguyen, Cay-Co Mien Nam Viet-Nam, 179. *bang 62bis C.* 1960; Pham, Cay-Co Mien Nam Viet-Nam. ed. 2. **2**: 302. *fig.* 1970. *Nomen invalidum.*

Large tree about 25 m tall; trunk bole and straight, without buttresses. Outer bark brownish-yellow, more or less deeply fissured. Slash-marked red; exudate clear honey. *Youngest twigs* flattened, more or less slender, brown pubescent; internode 1.5-4.0 cm long. Uppermost pair of axillary bud 1-1.5 mm long. Terminal buds 0.5-0.7 cm long, with brown pubescent. *Leaves* petiolate, 1.5-2.5 cm long, concave above and convex below, waxy or glabrous. Lamina elliptic-ovate, oblong-elliptic to lanceolate, 6-12 by 2-4 cm; apex acuminate, base cuneate to sub-attennuate, margin entire to slightly repand; coriaceous, drying grayish-brown, brown to dark brown above and light brown below; midrib on upper surface depressed in channel about 2/3-4/5 of lamina length, under one raised, lateral veins on the both surface distinct, 6-9(10) veins/0.5 cm. *Inflorescences* terminal and from upper leaf axils, covered by pale brown pubescent, 5-10 cm long, 7-165 flowers/inflorescence, pedicels 0.5-1.3 cm long. *Tepals* 8, the outer pair broadly elliptic to suborbicular, 4.5-5 by 3-4 mm grayish brown pubescent on back; inner one broadly elliptic, 5.5-7 by 4-5 mm, dorsally slightly pubescent and densely towards base; the next two ones with same shape and size, elliptic-oblong or ovate-elliptic, 6-7 by 4-5 mm, dorsally slightly pubescent on back towards base. *Stamens* about 154-200 per flower, filament 4-5 mm long, anther 1-1.5 mm long. *Ovary* 2-3 mm long, style 3-5 mm long. *Fruits* subglobose to globose, 2-2.5 cm diameter; round at apex; yellowish-green when ripen. Exocarp plus mesocarp 0.3-0.5 cm thick. Endocarp 0.5-1 mm thick, globose 1.5-2 cm diameter.

T h a i l a n d.- NORTH-EASTERN: Phetchabun; EASTERN: Chaiyaphum, Nakhon Ratchasima; SOUTH-WESTERN: Phetchaburi.

D i s t r i b u t i o n.- Vietnam.

E c o l o g y.- Usually present in hill evergreen forest, at ca. 700-1200 m. altitude. Flowering January-March. Fruiting February-June and September-October.

V e r n a c u l a r.- Tanghon khao (ตังหนเขา) (Author).

U s e s.- The wood is used in house construction.

Figure 7 ***C. touranense*** **Gagnep. ex P. F. Stevens**

A Flowering branch.

B Fruiting branch.

C Terminal bud.

D Fruit longitudinal section.

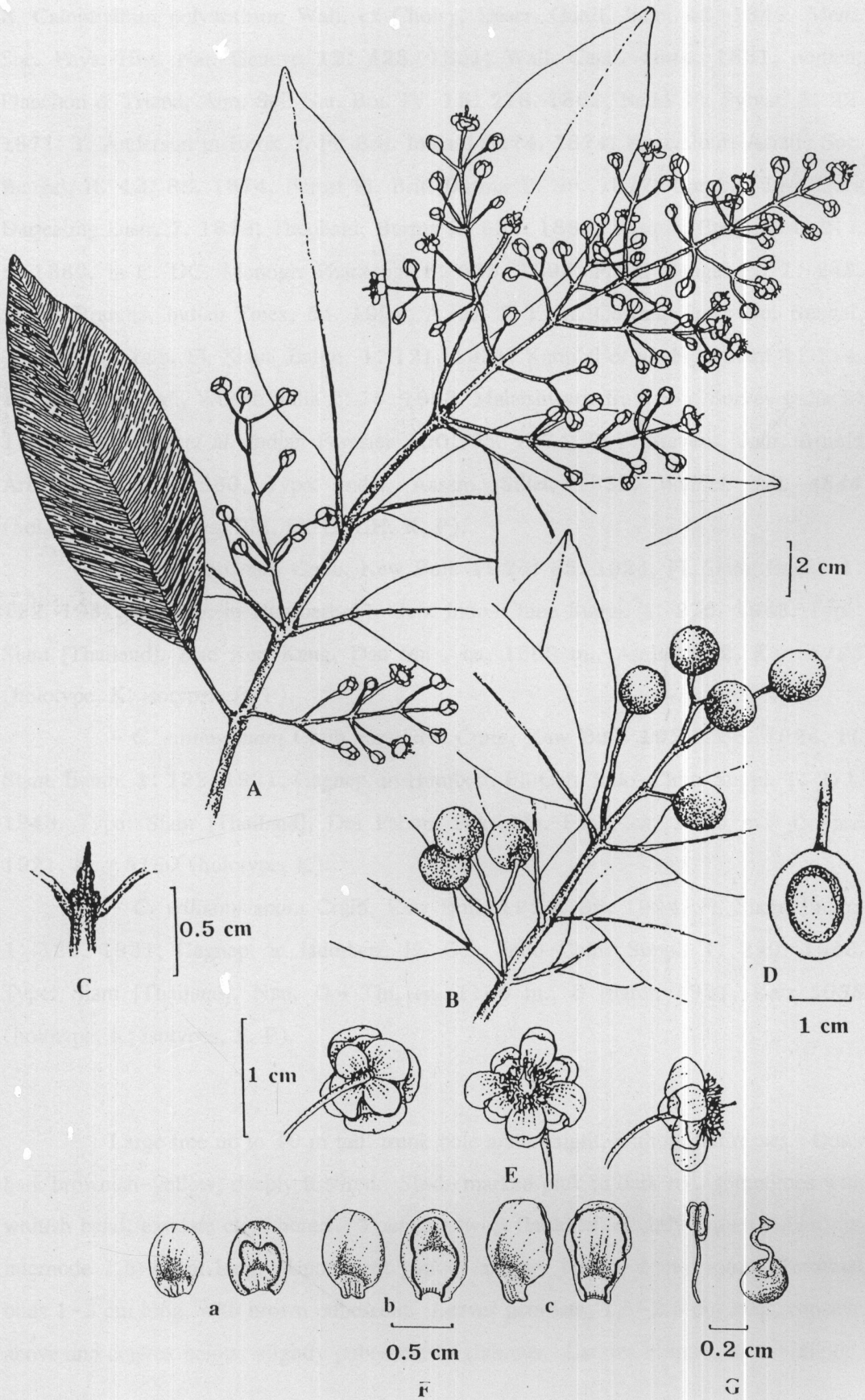
E Flowers.

F Tepals: a The outer pair of tepals.

b The next pair of tepals.

c The third and the fourth pair of tepals.

G Stamen and pistil.


2 cm
A
0.5 cm
C
B
D
1 cm
1 cm
E
a
b
c
0.5 cm
F
0.2 cm
G

3. Calophyllum polyanthum Wall. ex Choisy, Descr. Guttif. Inde, 43. 1849, Mem. Soc. Phys. Hist. Nat. Geneve **12**: 423. 1851; Wall. Catal. *4844*. 1831, *nomen;* Planchon & Triana, Ann. Sci. Nat. Bot. IV. **15**: 278. 1862; Bedd. Fl. Sylvat. 3: 22. 1871; T. Anderson in Hook. f. Fl. Brit. India **1**: 274. 1874; Kurz, Jour. Asiatic Soc. Bengal, II. **43**: 88. 1874, Forest Fl. Brit. Burma **1**: 95. 1877; Gamble, List Trees Darjeeling Distr. 7. 1878; Theobald, Burma **2**: 636. 1883; Vesque, Epharmosis **2**: *t. 6.* 1889, in C. DC. Monogr. Phanerog. **8**: 555. 1893; Prain, Bengal Pl. **1**: 246. 1903; Brandis, Indian Trees, 54. 1907; A. M. & T. M. Cowan, Trees No. Bengal, 17. 1929; Craib, Fl. Siam. Enum. **1**: 121. 1931; Kanjilal *et al.* Fl. Assam **1**: 114. 1934; Sastri *et al.*, Wealth India **2**: 19. 1950; Maheshwari, Bull. Bot. Survey India **2**: 144. 1960; Dutt *et al.* Indian Forester **100**: 65. 1974; P. F. Stevens, Jour. Arnold Arb. **61**: 220. 1980. Type: India, Assam, Sillet, 1832, *Wallich dist. 4844* (holotype, G; isotypes, BM, FI, G, GH, K, P).

- *C. smilesianum* Craib, Kew Bull. **1924**: 85. 1924, Fl. Siam. Enum. **1**: 122. 1931; Gagnep. in Humbert, Fl. Gen. Indo-Chine Suppl. **1**: 270. 1943. Type: Siam [Thailand], Kao Keo Kang, Dan Sui , ca. 1300 m., April 1922, *Kerr 5792* (holotype, K; isotypes, E, P).

- *C. smilesianum* Craib var. *lutea* Craib, Kew Bull. **1924**: 86. 1924, Fl. Siam. Enum. **1**: 122. 1931; Gagnep. in Humbert, Fl. Gen. Indo-Chine Suppl. **1**: 271. 1943. Type: Siam [Thailand], Doi Pahom Pok, Mg. Fang, ca. 1600 m., 1 April 1921, *Kerr 5180* (holotype, K).

- *C. williamsianum* Craib, Kew Bull. **1924**: 86. 1924, Fl. Siam. Enum. **1**: 122. 1931; Gagnep. in Humbert, Fl. Gen. Indo-Chine Suppl. **1**: 270. 1943. Type: Siam [Thailand], Nan, Doi Tiu, ca. 1100 m., 8 March 1921, *Kerr 5038* (holotype, K; isotypes, E, P).

Large tree up to 40 m tall; trunk bole and straight, without buttresses. Outer bark brownish-yellow, deeply fissured. Slash-marked pink to dark red, sometimes with whitish band; exudate clear honey. *Youngest twigs* flattened, slightly brown pubescent; internode 1.5-4 cm long. Uppermost pair of axillary bud 1-4 mm long. Terminal buds 1-2 cm long, with brown pubescent. *Leaves* petiolate, 1.5-2.5 cm long, concave above and convex below, slightly pubescent to glabrous. Lamina elliptic, ovate-elliptic,

oblong-elliptic to lanceolate, 6-15 by 3-5 cm; apex acuminate, base attenuate, margin entire to slightly repand; coriaceous, drying brown to greenish-brown above and light brown below; midrib on upper surface depressed in channel about 1/3-2/3 of lamina length, under one raised, lateral veins on the both surface distinct, 7-15(20) veins/0.5 cm. *Inflorescences* terminal and from upper leaf axils, covered by brown pubescent, 6.5-17.5 cm long, 21-187 flowers/inflorescence, pedicels 1-1.8 cm long. *Tepals* 8, the outer pair oval to suborbicular, 3-4 by 3-3.5 mm, dorsally grayish brown pubescent; inner one ovate, 5-8 by 4.5-5.5 mm, dorsally slightly pubescent and densely towards base; the next two ones with same shape and size, ovate, 6-6.5 by 5-5.5 mm, slightly pubescent along margin towards base. *Stamens* about 200-277 per flower, filament 2.5-4.5 mm long, anther 1-1.7 mm long. *Ovary* 2-2.2 mm long, style 3.5-4 mm long. *Fruits* ovoid to ellipsoid, occassionally subglobose, 3-4 by 2-3 cm, acute to more or less pointed at apex; blackish when ripen. Exocarp plus mesocarp 0.2-0.3 cm thick. Endocarp 0.5-0.7 mm thick, ovoid to subglobose, 2-2.6 by 1.6-2 cm.

T h a i l a n d.- NORTH: Mae Hong Son, Chiang Mai, Nan; NORTH-EASTERN: Loei; SOUTH-WESTERN: Uthai Thani, Prachuap Khiri Khan; PENINSULAR: Nakhon Si Thammarat, Trang.

D i s t r i b u t i o n.- India(Western Ghats and northeastern India) to southwestern China.

E c o l o g y.- Evergreen forest in Peninsular, at ca. 100-200 m. altitude and in hill evergreen forest in North and North-Eastern, at ca. 950-1500 m. altitude. Flowering March-May. Fruiting May-November and October-February.

V e r n a c u l a r.- Pha ong (พะอง) (Loei); Kho-mai-do (คอไหม้ดอ) (Karen-Kamphaeng Phet); Saa-chum-mun (ซ้าจุ้มมุ่น) (Karen-Mae Hong Son); Tanghon (ตังหน) (Nakhon Si Thammarat; Ma haen doi (มะแหนดอย) (Chiang Mai).

U s e s.- The wood is used for general construction and furniture.

Figure 8 ***C. polyanthum*** **Wall. ex Choisy**

A Flowering branch.

B Fruiting branch.

C Terminal bud.

D Fruit longitudinal section.

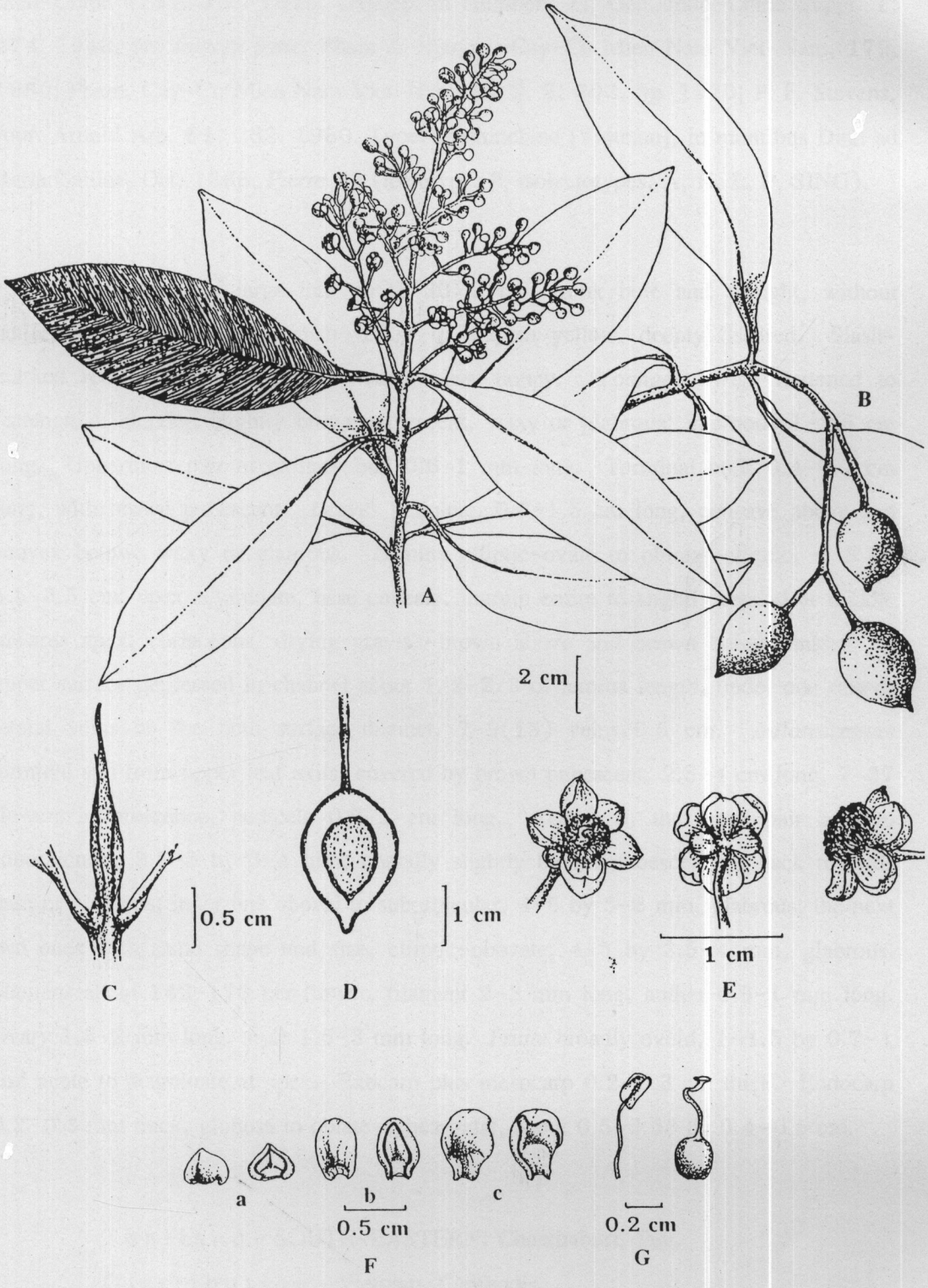
E Flowers.

F Tepals: a The outer pair of tepals.

b The next pair of tepals.

c The third and the fourth pair of tepals.

G Stamen and pistil.


A
B
2 cm
0.5 cm
1 cm
1 cm
C
D
E
a
b
c
0.5 cm
0.2 cm
F
G

4. Calophyllum dryobalanoides Pierre, Fl. Forest. Cochinch. **1**: *pl. 106.* 1885; Vesque, in C. DC. Monogr. Phanerog. **8**: 601. 1893; Pitard in Lecomte, Fl. Gen. Indo-Chine **1**(4): 319. 1910; Gagnep. in Humbert, Fl. Gen. Indo-Chine Suppl. **1**: 274. 1943, *pro minore parte;* Pham & Nguyen, Cay-Co Mien Nam Viet-Nam, 179. 1960; Pham, Cay-Co Mien Nam Viet-Nam. ed. 2. **2**: 302. *fig.* 1970; P. F. Stevens, Jour. Arnold Arb. **61**: 232. 1980. Type: Cochinchine [Vietnam], in montibus Dinh ad Baria Galliae, Oct. 1866, *Pierre 83* (lectotype, P; isolectotypes, A, K, L, P, SING).

Medium to large tree up to 30 m tall; trunk bole and straight, without buttresses. Outer bark brownish-yellow or grayish-yellow, deeply fissured. Slash-marked red to reddish brown; exudate clear honey. *Youngest twigs* flattened to rectangular, slender, slightly brown pubescent, waxy or glabrous; internode 1-2.5 cm long. Uppermost pair of axillary bud 0.6-1 mm long. Terminal buds 0.4-0.7 cm long, with brown pubescent. *Leaves* petiolate, 0.6-1.5 cm long, concave above and convex below, waxy or glabrous. Lamina elliptic-ovate to oblong-elliptic, 4-8 by 1.5-3.5 cm; apex acuminate, base cuneate, margin entire to slightly repand at middle towards apex; coriaceous, drying grayish-brown above and brown below; midrib on upper surface depressed in channel about 1/2-2/3 of lamina length, under one raised, lateral veins on the both surface distinct, 7-9(15) veins/0.5 cm. *Inflorescences* terminal and from upper leaf axils, covered by brown pubescent, 2.5-4 cm long, 7-37 flowers/inflorescence, pedicels 0.6-1 cm long. *Tepals* 8, the outer pair oval to suborbicular, 3.5-5 by 3-4 mm, dorsally slightly brown pubescent on back towards base or glabrous; inner one oboval to suborbicular, 4-6 by 5-6 mm, glabrous; the next two ones with same shape and size, elliptic-obovate, 4-5 by 3.5-4 mm, glabrous. *Stamens* about 142-170 per flower, filament 2-3 mm long, anther 0.6-1 mm long. *Ovary* 1.5-2 mm long, style 1.5-3 mm long. *Fruits* broadly ovoid, 1-1.5 by 0.7-1 cm; acute to acuminate at apex. Exocarp plus mesocarp 0.2-0.3 cm thick. Endocarp 0.2-0.3 mm thick, globose to oblate-sphearoidal, about 0.5-0.53 by 0.4-0.5 cm.

T h a i l a n d.- SOUTH-EASTERN: Chanthaburi, Trat.

D i s t r i b u t i o n.- Vietnam, Cambodia.

E c o l o g y.- In semi-evergreen forest, at ca. 900-1000 m. altitude. Flowering November-December. Fruiting January-March.

V e r n a c u l a r.- Pha ong (ผะอง) (Chaiyaphum).

U s e s.- The wood is used for general construction. Fragrant oil used in hair dressing.

Figure 9 ***C. dryobalanoides*** **Pierre**

A Fruiting branch.

B Terminal bud.

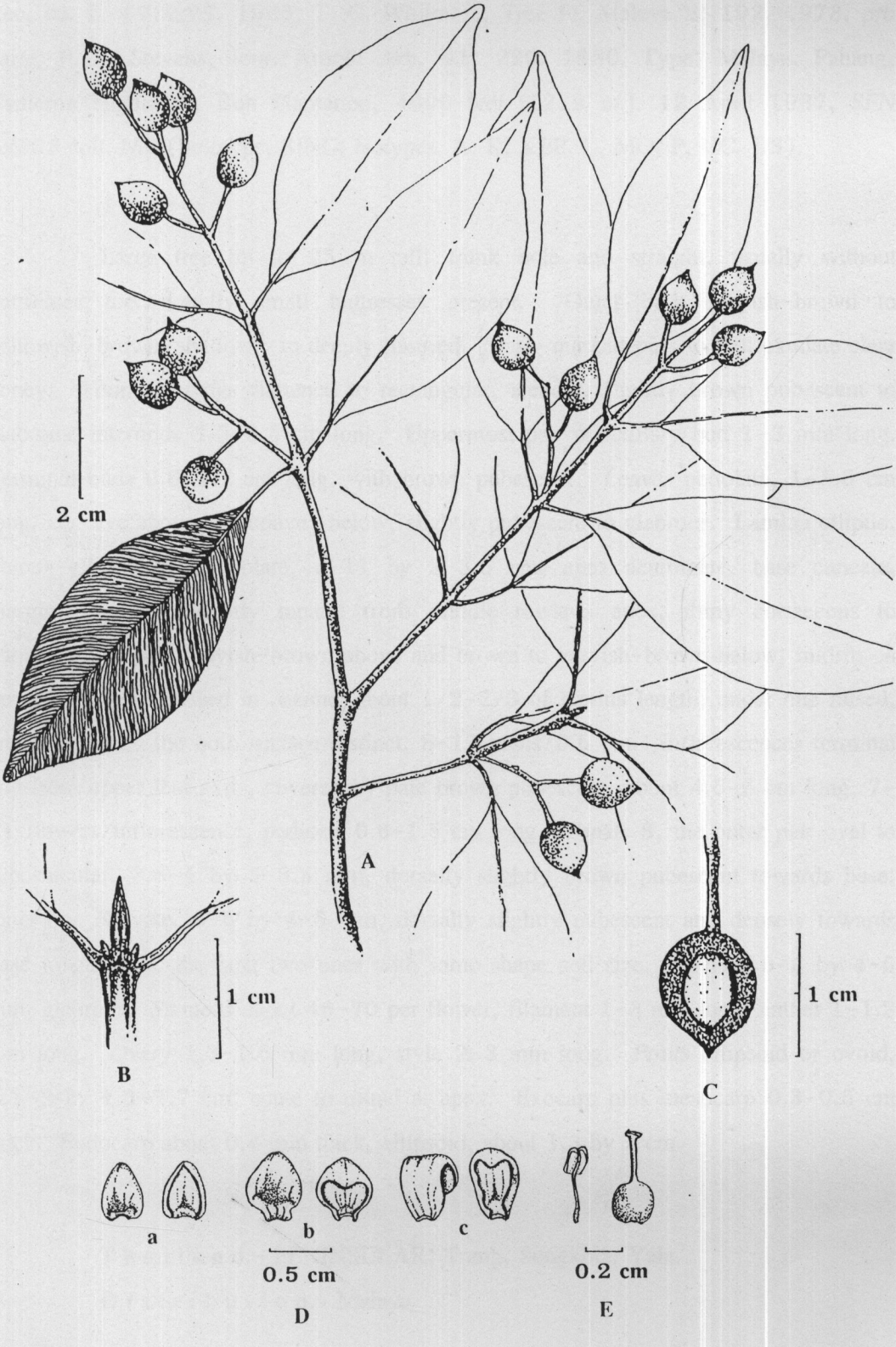
C Fruit longitudinal section.

D Tepals: a The outer pair of tepals.

b The next pair of tepals.

c The third and the fourth pair of tepals.

E Stamen and pistil.


2 cm
A
1 cm
B
1 cm
C
a
b
c
0.5 cm
D
0.2 cm
E

5. Calophyllum symingtonianum M. R. Henderson & Wyatt-Smith, Gard. Bull. Singapore **15**: 338. *pl. 18.* 1956, *pro majore parte;* Kochummen, Malayan Forest Rec. ed. 2. **17**: 222. 1965; T. C. Whitmore, Tree Fl. Malaya **2**: 192. 1973, *pro parte;* P. F. Stevens, Jour. Arnold Arb. **61**: 229. 1980. Type: Malaya, Pahang, Cameron Highlands, Boh Plantation, 4000 feet [1219 m.], 12 April 1937, *SFN 32633* coll. *Nur* (holotype, SING; isotypes, A, K, KEP, L, MO, P, UC, US).

Large tree up to 25 m tall; trunk bole and straight, usually without buttresses, occasionally small buttresses present. Outer bark grayish-brown to yellowish-brown, shallowly to deeply fissured. Slash-marked pink to red; exudate clear honey. *Youngest twigs* flattened to rectangular, slender, slightly brown pubescent to glabrous; internode 1.5-3.5 cm long. Uppermost pair of axillary bud 1-3 mm long. Terminal buds 0.6-1.1 cm long, with brown pubescent. *Leaves* petiolate, 1-1.5 cm long, concave above and convex below, slightly pubescent to glabrous. Lamina elliptic, oblong-elliptic to lanceolate, 6-11 by 2-3.5 cm; apex acuminate, base cuneate, margin entire to slightly repand from middle towards apex; thiny coriaceous to coriaceous, drying grayish-brown above and brown to grayish-brown below; midrib on upper surface depressed in channel about 1/2-2/3 of lamina length, under one raised, lateral veins on the both surface distinct, 8-17 veins/0.5 cm. *Inflorescences* terminal and from upper leaf axils, covered by pale brown pubescent, about 4.5-6 cm long, 7-11 flowers/inflorescence, pedicels 0.6-1.5 cm long. *Tepals* 8, the outer pair oval to suborbicular, 3.5-4 by 3-3.5 mm, dorsally slightly brown pubescent towards base; inner one obovate, 5-6 by 4-5 mm, dorsally slightly pubescent and densely towards base to glabrous; the next two ones with same shape and size, obovate, 5-6 by 4-5 mm, glabrous. *Stamens* about 46-70 per flower, filament 1-3 mm long, anther 1-1.2 mm long. *Ovary* 1.3-1.5 mm long, style 2-3 mm long. *Fruits* ellipsoid or ovoid, 1.7-2 by 1.5-1.7 cm; acute to round at apex. Exocarp plus mesocarp 0.3-0.5 cm thick. Endocarp about 0.4 mm thick, ellipsoid, about 1.3 by 1 cm.

T h a i l a n d.- PENINSULAR: Trang, Songkhla, Yala.

D i s t r i b u t i o n.- Malaya.

E c o l o g y.- In evergreen Forest, at ca. 100-150 m. altitude. Flowering unknown. Fruiting February-Apri.

V e r n a c u l a r.- Tanghon (ตังหน) (Trang).

U s e s.- The wood is used for house construction.

Figure 10 ***C. symingtonianum*** **M. R. Henderson & Wyatt-Smith**

A Fruiting branch.

B Terminal bud.

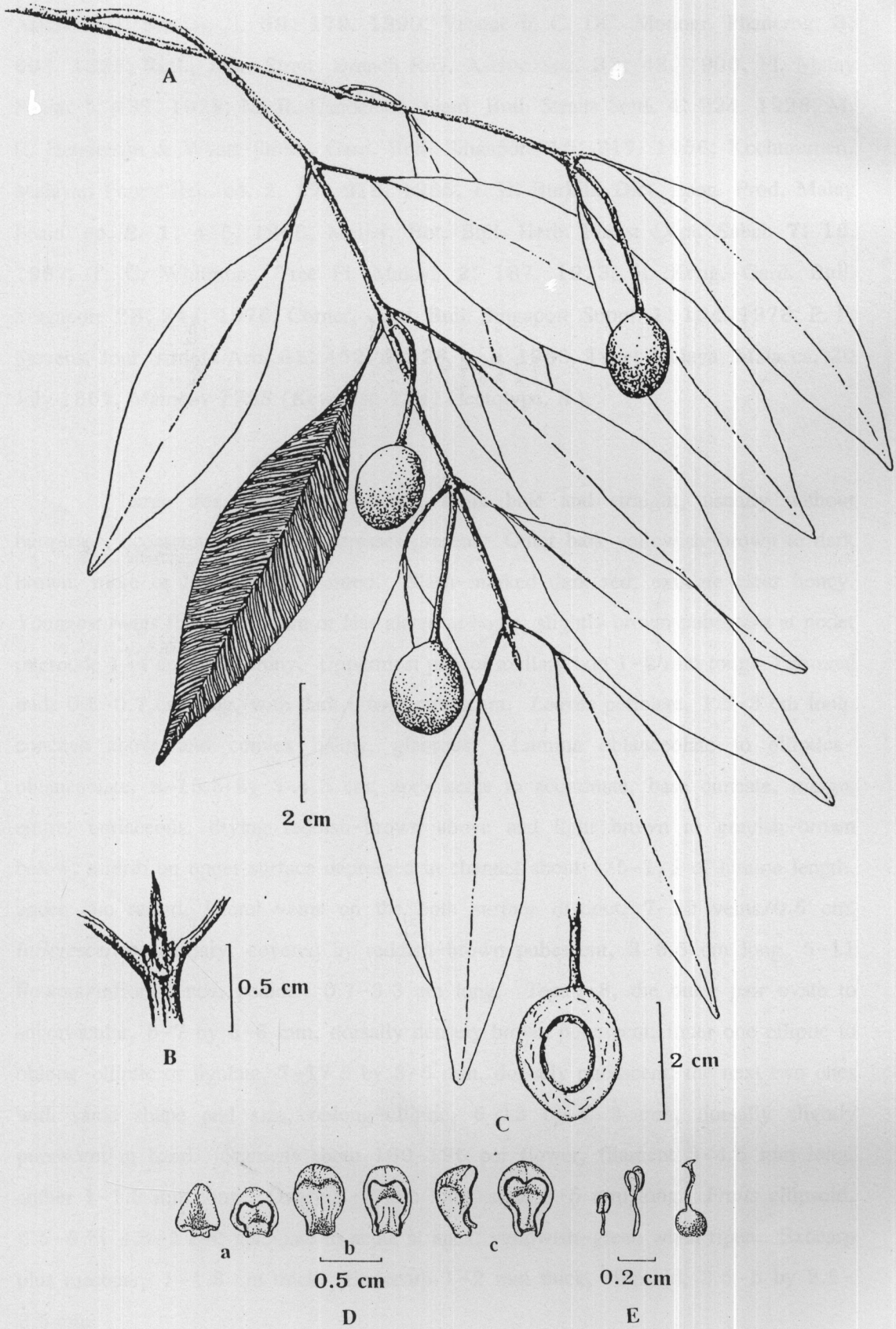
C Fruit longitudinal section.

D Tepals: a The outer pair of tepals.

b The next pair of tepals.

c The third and the fourth pair of tepals.

E Stamen and pistil.


A
2 cm
0.5 cm
B
2 cm
C
a
b
c
0.5 cm
D
0.2 cm
E

6. Calophyllum macrocarpum Hook. f., Fl. Brit. India **1**: 273. 1874; King, Jour. Asiatic Soc. Bengal, II. **59**: 179. 1890; Vesque in C. DC. Monogr. Phanerog. **8**: 603. 1893; Ridl., Jour. Straits Branch Roy. Asiatic Soc. **33**: 48. 1900, Fl. Malay Penin. **1**: 187. 1922; M. R. Henderson, Gard. Bull. Straits Settl. **4**: 224. 1928; M. R. Henderson & Wyatt-Smith, Gard. Bull. Singapore **15**: 317. 1956; Kochummen, Malayan Forest Rec. ed. 2. **17**: 218. 1965; I. H. Burkill, Dict. Econ. Prod. Malay Penin. ed. 2. **1**: 416. 1966; Meijer, Bot. Bull. Herb. Forest Dept. Sabah **7**: 16. 1967; T. C. Whitmore, Tree Fl. Malaya **2**: 187. 1973; H. Keng, Gard. Bull. Singapore **28**: 244. 1976; Corner, Gard. Bull. Singapore Suppl. **1**: 104. 1978; P. F. Stevens, Jour. Arnold Arb. **61**: 452. *fig. 28, g, h.* 1980. Type: Malaya, Malacca, 30 July 1867, *Maingay 1728 (Kew dist. 174)* (lectotype, K).

Large tree up to 40 m tall; trunk bole and straight, usually without buttresses, occassionally small buttresses present. Outer bark yellowish-brown to dark brown, more or less deeply fissured. Slash-marked dark red; exudate clear honey. *Youngest twigs* flattened, more or less alated at angle, slightly brown pubescent at node; internode 1-4 cm long, shiny. Uppermost pair of axillary bud 1-2 mm long. Terminal buds 0.5-0.7 cm long, with dark brown pubescent. *Leaves* petiolate, 1.5-3 cm long, concave above and convex below, glabrous. Lamina oblanceolate to elliptica-oblanceolate, 8-15.5 by 3-4.5 cm; apex acute to acuminate, base cuneate, margin entire; coriaceous, drying reddish-brown above and light brown to grayish-brown below; midrib on upper surface depressed in channel about 1/5-1/2 of lamina length, under one raised, lateral veins on the both surface distinct, 7-12 veins/0.5 cm. *Inflorescences* axillary, covered by reddish-brown pubescent, 3-6.5 cm long, 5-11 flowers/inflorescence, pedicels 0.7-3.3 cm long. *Tepals* 8, the outer pair ovate to suborbicular, 6-7 by 5-6 mm, dorsally densely brown pubescent; inner one elliptic to oblong-elliptic or ligulate, 7-17.5 by 3-5 mm, dorsally pubescent; the next two ones with same shape and size, oblong-elliptic, 6-13 by 2-3 mm, dorsally slightly pubescent in band. *Stamens* about 160-196 per flower, filament 3-4.5 mm long, anther 1-1.3 mm long. *Ovary* 2-3 mm long, style 3-5 mm long. *Fruits* ellipsoid, 6.5-8 by 4.5-5 cm; apiculate to acute at apex; yellowish-green when ripen. Exocarp plus mesocarp 1-1.3 cm thick. Endocarp 1-2 mm thick, ellipsoid, 3.5-5 by 2.5-3.5 cm.

T h a i l a n d.- PENINSULAR: Chumphon, Ranong, Krabi, Nakhon Si Thammarat, Trang, Songkhla, Narathiwat.

D i s t r i b u t i o n.- Malaya to Borneo. Excluding Java.

E c o l o g y.- In evergreen forest, at ca. 100-220 m. altitude. Flowering May-July. Fruiting August-April.

V e r n a c u l a r.- Chuat (ชวด), Tanghon (ตังหน) (Trang).

U s e s.- The wood is used for construction and furniture.

Figure 11 ***C. macrocarpum*** **Hook. f.**

A Flowering branch.

B Fruit.

C Terminal bud.

D Fruit longitudinal section.

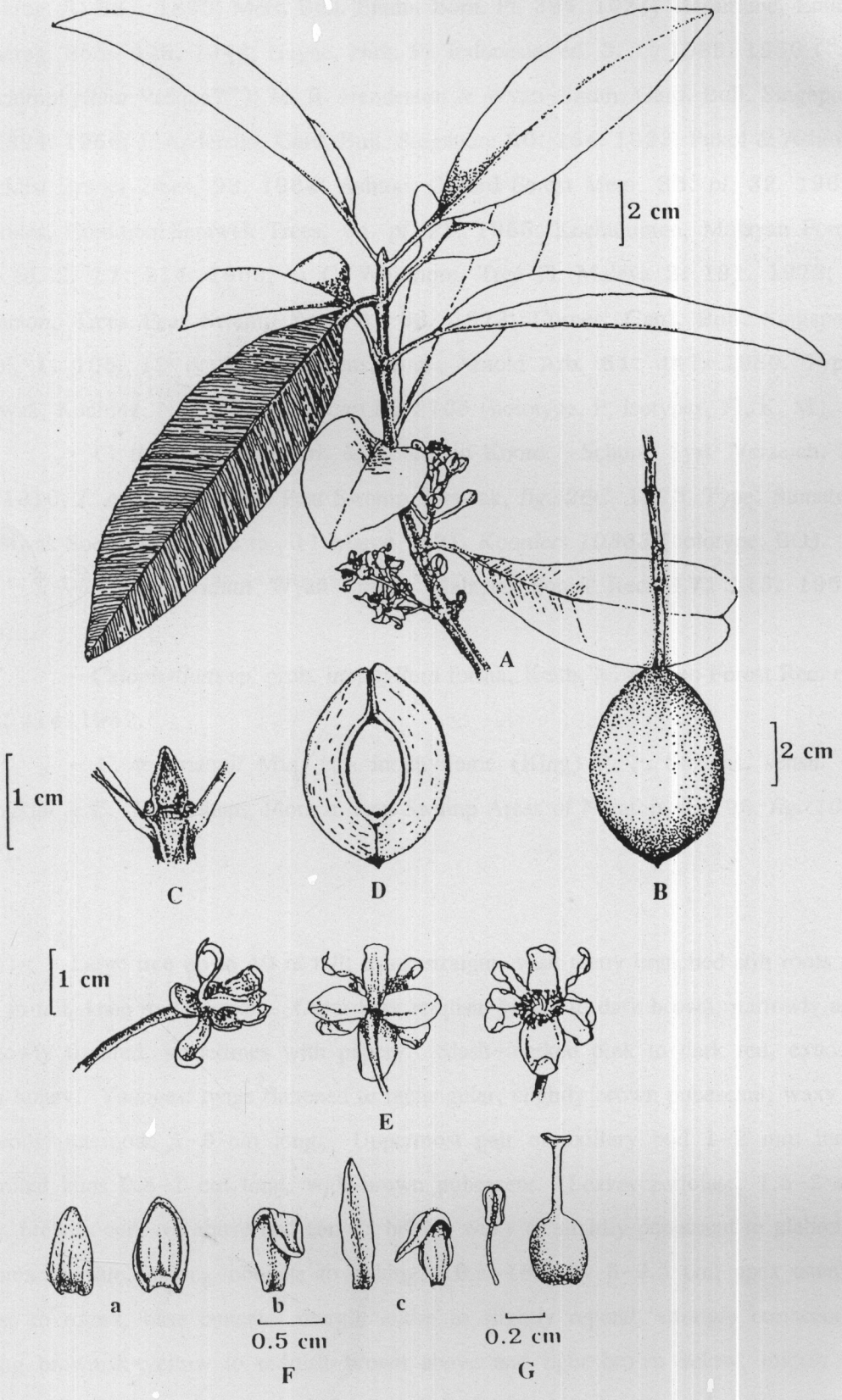
E Flowers.

F Tepals: a The outer pair of tepals.

b The next pair of tepals.

c The third and the fourth pair of tepals.

G Stamen and pistil.


2 cm
A
2 cm
1 cm
C
D
B
1 cm
E
a
b
c
0.5 cm
0.2 cm
F
G

7. Calophyllum sclerophyllum Vesque, Epharmosis **2**: *t. 33.* 1889, in C. DC. Monogr. Phanerog. **8**: 587. 1893; Merr. Bibl. Enum. Born. Pl. 394. 1921; Masamune, Enum. Phanerog. Born. 476. 1942; Heyne, Nutt. Pl. Indonesie. ed. 3. **1**: 1085. 1950 ("an *C. sclerophyllum* Vesque?"); M. R. Henderson & Wyatt-Smith, Gard. Bull. Singapore **15**: 324. 1956; J. Anderson, Gard. Bull. Singapore **20**: 154. 1963; Pukol & Ashton, Checklist Brunei Trees, 93. 1964; Ashton, Oxford Forest Mem. **25**: *pl. 32.* 1964; Smythies, Common Sarawak Trees, 64. *pl. 22.* 1965; Kochummen, Malayan Forest Rec. ed. 2. **17**: 214. 1965; T. C. Whitmore, Tree Fl. Malaya **2**: 191. 1973; J. Anderson, Trees Peat Swamp Sarawak, 88. 1973; Corner, Gard. Bull. Singapore Suppl. **1**: 105. 1978; P. F. Stevens, Jour. Arnold Arb. **61**: 447. 1980. Type: Sarawak, Kuching, Nov. 1886, *Beccari PB 2705* (holotype, P; isotypes, FI, K, M).

- *C. rhizophorum* Boerl. & Koord. in Koord. -Schum. Syst. Verzeich. **2**: 39. 1910; J. Anderson, Trees Peat Swamp Sarawak, *fig. 26C.* 1973. Type: Sumatra, bei Biwak Soengei Gati, 25 m., 11 March 1891, *Koorders 10333* (holotype, BO).

- *C. subluridum* Wyatt-Smith, Malayan Forest Rec. **17**: 113. 1952. *Nomen.*

- *Calophyllum* sp. prob. *inophyllum* forma, Keith, N. Borneo Forest Rec. ed. 2. **2**: 314. 1952.

- *C. teysmannii* Miq. var. inophylloide (King) P. F. Stevens, *sensu.* C. Phengklai & C. Niyomdham, Flora in Peat Swamp Areas of Narathiwat, 196. *fig. 108.* 1991.

Large tree up to 40 m tall; trunk straight, with many branched stilt roots up to 5 m tall, knee roots present. Outer bark reddish-brown to dark brown, narrowly and shallowly fissured, sometimes with papery. Slash-marked pink to dark red, exudate clear honey. *Youngest twigs* flattened to rectangular, slightly brown pubescent, waxy or glabrous; internode 1-3 cm long. Uppermost pair of axillary bud 1-2 mm long. Terminal buds 0.8-1 cm long, with brown pubescent. *Leaves* petiolate, 1.5-2 cm long, broadly concave above and convex below, waxy or slightly pubescent to glabrous. Lamina obovate, oblong-obovate to oblong, 10.5-18.5 by 6-9.5 cm; apex usually retuse to round, base cuneate, margin entire to slightly repand; strongly coriaceous, drying brownish-yellow to reddish-brown above and light brown below; midrib on upper surface depressed in channel about 1/3-2/3 of lamina length, under one strongly

raised, lateral veins on the both surface distinct, 5-9 veins/0.5 cm. *Inflorescences* axillary, covered by brown pubescent, 3.5-15 cm long, 9-11 flowers/inflorescence, pedicels 1-4 cm long. *Tepals* 8, the outer pair ovate to suborbicular, 6.5-7.5 by 6.5-7 mm, dorsally densely brown pubescent; inner one ovate to suborbicular, 10-13 by 9-9.5 mm, dorsally pubescent in band; the next two ones with same shape and size, obovate, 10-14 by 5-7(10) mm, slightly pubescent only margin. *Stamens* about 199-356 per flower, filament 4-6 mm long, anther 1.3-1.8 mm long. *Ovary* 4-4.5 mm long, style 4.5-6.5 mm long. *Fruits* ovoid, ellipsoid to subglobose, 2.5-3.5 by 2-3 cm; apiculate, acute to round at apex; yellowish-green when ripen. Exocarp plus mesocarp 0.3-0.5 cm thick. Endocarp 1-2 mm thick, ovoid, ellipsoid to subglobse, 2.3-2.8 by 1.8-2.5 cm.

T h a i l a n d.- PENINSULAR: Narathiwat.

D i s t r i b u t i o n.- Malay Peninsular(mostly on the eastern coast) to Borneo excluding Java.

E c o l o g y.- In Peat Swamp Forest, at ca. sea level-10 m. altitude. Flowering July-August. Fruiting August-December.

V e r n a c u l a r.- Ya-Kang (ยะกัง) (Malay-Narathiwaat); Kra thing phru (กระทิงพรุ) (Author).

U s e s.- The wood is hard and heavy and used in general construction; since it is not attacked by insects, it is durable.

Figure 12 ***C. sclerophyllum*** **Vesque**

A Flowering branch.

B Fruiting branch.

C Terminal bud.

D Fruit longitudinal section.

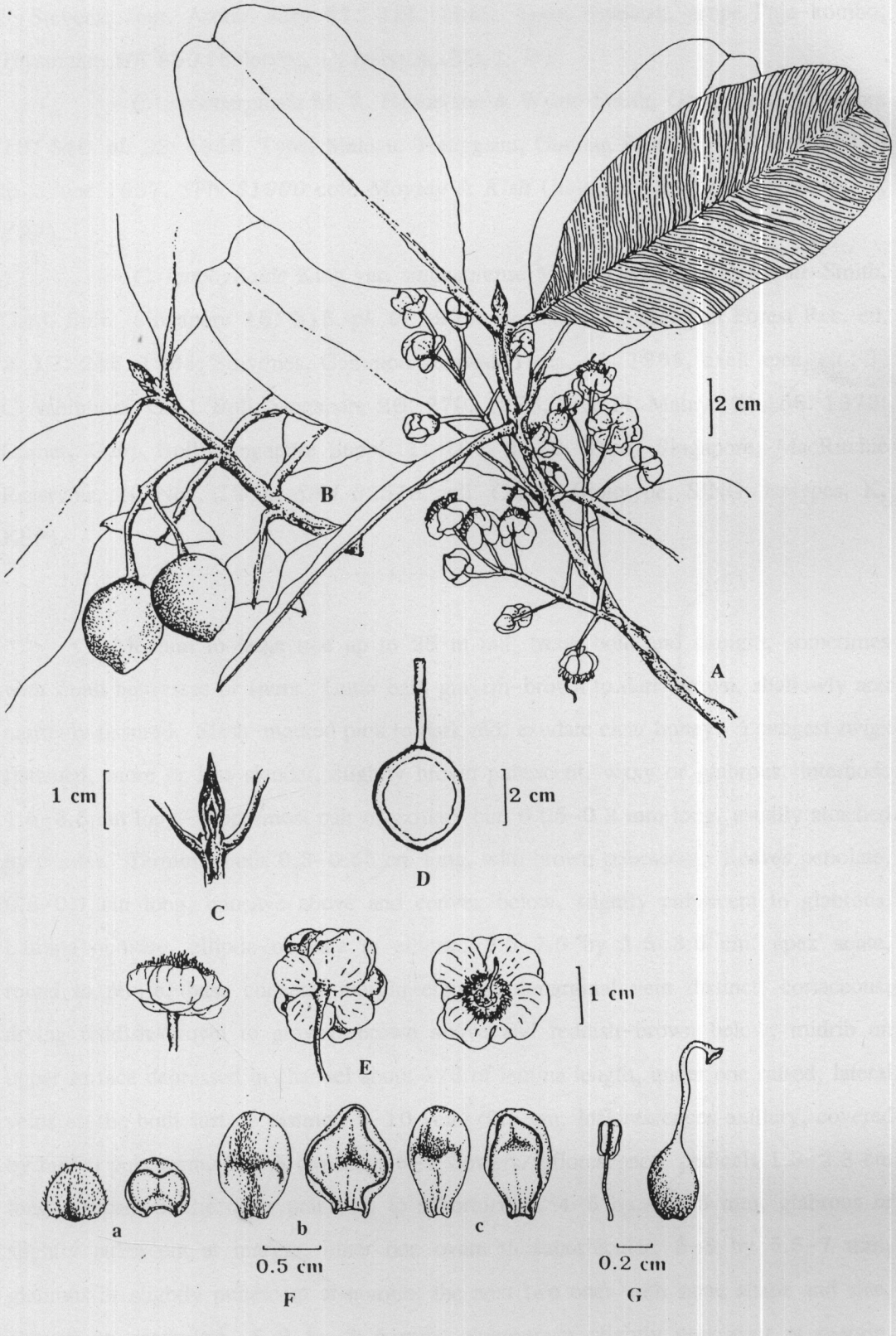
E Flowers.

F Tepals: a The outer pair of tepals.

b The next pair of tepals.

c The third and the fourth pair of tepals.

G Stamen and pistil.


2 cm
B
A
1 cm
2 cm
C
D
E
1 cm
a
b
c
0.5 cm
0.2 cm
F
G

8. Calophyllum teysmannii Miq., Fl. Indiae Batavae Suppl. **1**(3): 499. Dec. 1861; P. F. Stevens, Jour. Arnold Arb. **61**: 431. 1980. Type: Sumatra, prope Paja-kombo, *Teysmann, HB 650* (holotype, U; isotypes, BO, L, P).

- *C. intramarginale* M. R. Henderson & Wyatt-Smith, Gard. Bull. Singapore **15**: 342. *pl. 22.* 1956. Type: Malaya, Trengganu, Gunong Padang, 4000 feet [1218 m.], June 1937, *SFN 31900* coll. *Moysey & Kiah* (holotype, SING; isotypes, A, K, KEP).

- *C. inophylloide* King var. *singapurense* M. R. Henderson & Wyatt-Smith, Gard. Bull. Singapore **15**: 316. *pl. 9.* 1956; Kochummen, Malayan Forest Rec. ed. 2. **17**: 215. 1965; Smythies, Common Sarawak Trees, 61. 1965, excl. spec. cit.; T. C. Whitmore, Gard. Bull. Singapore **26**: 270. 1973, Tree Fl. Malaya **2**: 186. 1973; Corner, Gard. Bull. Singapore Suppl. **1**: 104. 1978. Type: Singapore, MacRitchie Reservoir, 10 Nov. 1936, *SFN 32518* coll. *Corner* (holotype, SING; isotypes, K, KEP).

Medium to large tree up to 25 m tall; trunk bole and straight, sometimes with small buttresses or spurs. Outer bark grayish-brown to dark brown, shallowly and narrowly fissured. Slash-marked pink to dark red; exudate clear honey. *Youngest twigs* flattened, more or less slender, slightly brown pubescent, waxy or glabrous; internode 1.5-3.5 cm long. Uppermost pair of axillary bud 0.05-0.2 mm long, usually attached by petoles. Terminal buds 0.3-0.45 cm long, with brown pubescent. *Leaves* petiolate, 0.3-0.7 cm long, concave above and convex below, slightly pubescent to glabrous. Lamina obovate, elliptic-obovate to elliptic, 3.5-7.5 by 1.5-3.5 cm; apex acute, round to retuse, base cuneate, margin entire, submarginal vein distinct; coriaceous, drying reddish-brown to grayish-brown above and reddish-brown below; midrib on upper surface depressed in channel about 1/3 of lamina length, under one raised, lateral veins on the both surface distinct, 6-10 veins/0.5 cm. *Inflorescences* axillary, covered by brown pubescent, 2.5-5 cm long, 3-7 flowers/inflorescence, pedicels 1.3-2.3 cm long. *Tepals* 8, the outer pair oval to suborbicular, 4-5 by 4-4.5 mm, glabrous or slightly pubescent at margin; inner one ovate to suborbicular, 5-8 by 5.5-7 mm, glabrous or slightly pubescent at margin; the next two ones with same shape and size, obovate to spathulate, 6-9 by 2-5 mm, glabrous or slightly pubescent at margin. *Stamens* about 81-212 per flower, filament 3-3.5(5) mm long, anther 1-1.5 mm

long. *Ovary* 2-2.5 mm long, style 4.5-5 mm long. *Fruits* ellipsoid to subglobose, 2-2.5 by 1.8-2 cm; acute to round at apex; yellowish-green to pale brown when ripen. Exocarp plus mesocarp 0.2-0.3 cm thick. Endocarp 0.5-0.8 mm thick, ellipsoid to subglobose, 1.8-2 by 1.4-1.7 cm.

T h a i l a n d.- PENINSULAR: Narathiwat.

D i s t r i b u t i o n.- Northeastern and southeastern Malay Peninsular to Borneo.

E c o l o g y.- In evergreen forest, at ca. 230-315 m. altitude. Flowering May-June. Fruiting July-August.

V e r n a c u l a r.-Tanghon bai neep (ตังหนใบหนีบ) (Author).

Figure 13 ***C. teysmannii*** **Miq.**

A Flowering branch.

B Fruiting branch.

C Terminal bud.

D Fruit longitudinal section.

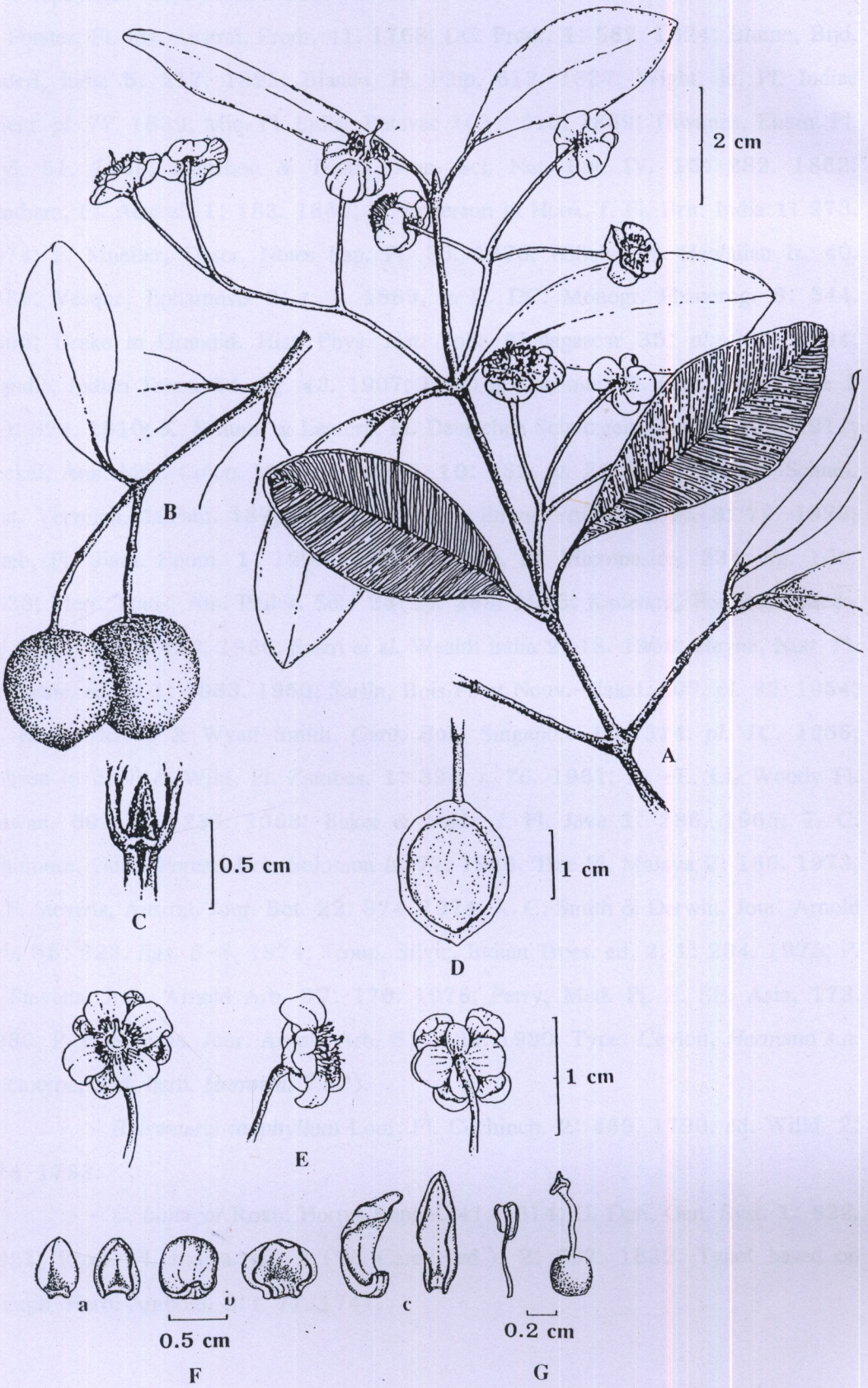
E Flowers.

F Tepals: a The outer pair of tepals.

b The next pair of tepals.

c The third and the fourth pair of tepals.

G Stamen and pistil.


2 cm
B
A
0.5 cm
C
1 cm
D
1 cm
E
a
b
c
0.5 cm
F
0.2 cm
G

9. Calophyllum inophyllum L., Sp. Pl. 513. 1753; Burman f. Fl. Indica, 120. 1768; G. Forster, Fl. Ins. Austral. Prodr. 41. 1768; DC. Prodr. **1**: 562. 1824; Blume, Bijd. Nederl. Indie **5**: 217. 1825; Blanco, Fl. Filip. 612. 1837; Wight, Ic. Pl. Indiae Orient. *pl.* 77. 1839; Miq. Fl. Indiae Batavae **1**(2): 510. 1859; Thwaites, Enum. Pl. Zeyl. 51. 1858; Planchon & Triana, Ann. Sci. Nat. Bot. IV. **15**: 282. 1862; Bentham, Fl. Austral. **1**: 183. 1863; T. Anderson in Hook. f. Fl. Brit. India **1**: 273. 1874; F. Mueller, Descr. Notes Pap. Pl. 36. 1875; Hillebr. Fl. Hawaiian Is. 40. 1888; Vesque, Ephamosis **2**: *t. 1.* 1889, in C. DC. Monogr. Phanerog. **8**: 544. 1893; Drake in Grandid. Hist. Phys. Nat. Polit. Madagascar **35**: *pl. 355.* 1894; Brandis, Indian Trees, 54. *fig. 43.* 1907; Pitard in Lecomte, Fl. Gen. Indo-Chine **1** (4): 324. 1910; K. Schum. & Lauterb. Fl. Deutschen Schutzgeb. Sudsee, 499. 1911; Heckel, Ann. Mus. Colon. Marseille, ser. 2. **10**: 262. *pl. 25.* 1912; Koord.-Schum. Syst. Verzeich. **1**(Fam. 187): 4. 1912; Merr. Enum. Philip. Fl. Pl. **3**: 79. 1923; Craib, Fl. Siam. Enum. **1**: 120. 1931; Kanehira, Fl. Micronesica, 234. *fig. 106.* 1933; Merr. Trans. Am. Philos. Soc. **24**(2): 269. 1935; Kanehira, Formosan Trees. rev. ed. 473. *fig. 433.* 1936; Sastri *et al.* Wealth India **2**: 18. 1950; Heyne, Nutt. Pl. Indonesie. ed. 3. **1**: 1083. 1950; Sarlin, Bois Foret Nouv.-Caled. 207. *pl. 92.* 1954; M. R. Henderson & Wyatt-Smith, Gard. Bull. Singapore **15**: 314. *pl. 1C.* 1956; Robson in Exell & Wild, Fl. Zambes. **1**: 394. *t. 76.* 1961; H. -L. Li, Woody Fl. Taiwan, 601. *fig. 235.* 1963; Baker & Bakh. f. Fl. Java **1**: 386. 1965; T. C. Whitmore, Guide Forests Brit. Solomon Is. 77. 1966, Tree Fl. Malaya **2**: 186. 1973; P. F. Stevens, Austral. Jour. Bot. **22**: 374. 1974; A. C. Smith & Darwin, Jour. Arnold Arb. **55**: 223. *figs. 6-8.* 1974; Troup, Silvic. Indian Trees. ed. 2. **1**: 234. 1975; P. F. Stevens, Jour. Arnold Arb. **57**: 170. 1976; Perry, Med. Pl. E. SE. Asia, 173. 1980; P. F. Stevens, Jour. Arnold Arb. **61**: 324. 1980. Type: Ceylon, *Hermann s.n.* (lectotype, BM, *herb. Hermann 2.82*).

- *Balsamaria inophyllum* Lour. Fl. Cochinch. **2**: 469. 1790. ed. Willd. **2**: 574. 1793.

- *C. bintagor* Roxb. Hortus Bengal. 41. 1814; G. Don, Gen. Syst. **1**: 622. 1831; Roxb. Fl. Indica. ed. 2 (W. Carey, ed.). **2**: 607. 1832. Type: based on Rumph. Herb. Amboin. **2**: *t. 71.* 1741.

- *C. blumei* Wight, Illus. Indian Bot. **1**: 128. 1840 ("*C. blumii*"); Walp. Rep. Bot. Syst. **1**: 397. 1842; *C. inophyllum* L. β [var.] *blumei* (Wight) Hassk. Pl. Jav. Rar. 276. 1848. Type: based on Bl. Bijd. Nederl. Indie **5**: 217. 1825.

- *C. inophyllum* L. β [forma] *obovata* Miq. Pl. Jungh. 291. 1854. Type: Java, ad sinum maris Wijnkoopersbaai, [*Junghuhn s.n.*] (lectotype, L, sheet no. 903,343-103).

- *C. inophyllum* L. γ [forma] *oblongata* Miq. Pl. Jungh. 291. 1854. Type: Java, sine loco, *Junghuhn s.n.* (lectotype, L, sheet no. 903,343-55).

- *C. wakamatsui* Kanehira, Bot. Mag. Tokyo **48**: 401. 1934, Jour. Dept. Agr. Kyushu Imp. Univ. **4**: 371. 1935. Type: Palau, Amiriik, ca. 200 m., 1 Aug. 1933, *Kanehira 2343* (isotype, NY)

- *C. inophyllum* L. var. *takamaka* Fosberg, Kew Bull. **29**: 255. 1974. Type: Aldabra Atoll, South Island, Takamaka Grove, 9 Feb. 1968, *Fosberg 49272* (holotype, US; isotype, K).

- *C. ovatifolium* Norona, Verh. Batav. Genootsch. **5**(4): 13. 1790. *Nomen.*

Medium tree up to 15 m tall; trunk bole and straight or not, usually slanting and low branched, without buttresses. Outer bark grayish-yellow to brownish-black, shallowly fissured. Slash-marked pink to red; exudate clear honey. *Youngest twigs* flattened, slightly brown pubescent to glabrous; internode 2-3 cm long. Uppermost pair of axillary bud 1-1.5 mm long. Terminal buds 0.5-1 cm long, with brown pubescent. *Leaves* petiolate, 2-3 cm long, flattened to broadly concave above and convex below, glabrous. Lamina ovate, elliptic, oblong-elliptic to obovate, 10-15 by 5-8 cm; apex round to retuse, rarely acute, base cuneate to attenuate, margin entire to slightly revolute; coriaceous, drying grayish-brown to brown above and yellowish-brown to brown below; midrib on upper surface depressed in channel about 3/4 of lamina length, under one raised, lateral veins on both surface distinct, 6-8 veins/0.5 cm. *Inflorescences* axillary, covered by slightly pale brown pubescent to glabrous, 4.5-8.5 cm long, 9-13 flowers/inflorescence, pedicels 0.6-3.7 cm long. *Tepals* 8, the outer pair oval to suborbicular, 6-7 by 5.5-8 mm, glabrous or slighltly pubescent at margin; inner one elliptic, 12-15 by 4-8 mm, glabrous or slighltly pubescent at margin; the next two ones with same shape and size, elliptic or obovate, 11-14 by 5.5-7 mm,

glabrous. *Stamens* about 132-251 per flower, filament 4-5 mm long, anther 1-1.5 mm long. *Ovary* 1.5-3.5 mm long, style 4-9 mm long. *Fruits* subglobose to globose, 3-3.2 by 3 cm; mucronate to round at apex; pale brown when ripen. Exocarp plus mesocarp 0.2-0.25 cm thick. Endocarp 0.7-1.2 mm thick, globose, 2-2.6 cm diameter.

T h a i l a n d.- SOUTH-EASTERN: Chon Buri, Trat; SOUTH-WESTERN: Prachuap Khiri Khan; PENINSULAR: Chumphon, Ranong, Surat Thani, Phatthalung, Trang, Satun, Songkhla, Narathiwat.

D i s t r i b u t i o n.- Eastern Africa to Taiwan, the Ryukyu and Line islands and New Caledonia; often planted both within its range and in West Africa and the tropics of the New World.

E c o l o g y.- Usually in beach forest or coastal area and commonly planted for ornamental trees. Flowering and fruiting all year.

V e r n a c u l a r.- Kra thing (กระทิง) (Central); Thing (ทิง) (Krabi); Saaraphee thale (สารภีทะเล) (Prachuap Khiri Khan).

U s e s.- The wood is moderately heavy and fairly strong and has a closely grain; it is especially durable under water and used in various other aspects of construction. Oil can be extracted from seeds by heating them either cut and with water or finely crushed. It is used in soap making. It is also used against rheumatism and skin infection when applied externally. The round stones are used as marbles. *C. inophyllum* contains saponins, hydrocyanic acid and also poisonous coumarin derivatives. There are numerous other medicinal and quasi-medicinal uses of the plant. *C. inophyllum* is widely planted as an ornamental tree and is known as "Alexandrian Laurel" (Stevens, 1980).

Figure 14 ***C. inophyllum*** **L.**

A Flowering branch.

B Fruiting branch.

C Terminal bud.

D Fruit longitudinal section.

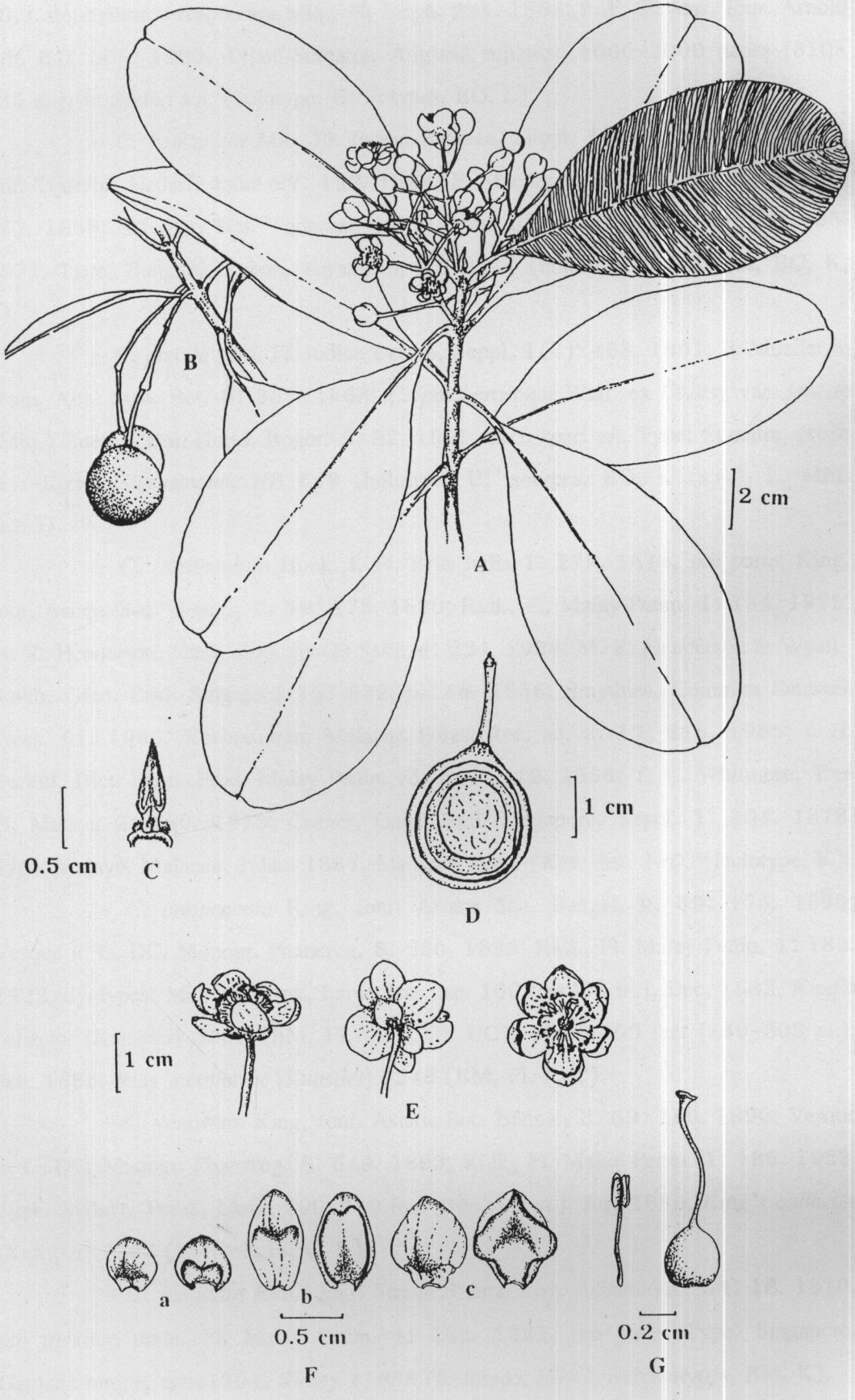
E Flowers.

F Tepals: a The outer pair of tepals.

b The next pair of tepals.

c The third and the fourth oair of tepals.

G Stamen and pistil.


B
2 cm
A
1 cm
0.5 cm
C
D
1 cm
E
a
b
c
0.5 cm
F
0.2 cm
G

10. Calophyllum tetrapterum Miq., Pl. Jungh. 291. 1854; P. F. Stevens, Jour. Arnold Arb. **61**: 505. 1980. Type: Sumatra, Angkola superior, 1000-3000 pedes [310-925 m.], *Junghuhn s.n.* (holotype, U; isotypes, BO, L).

- *C. bancanum* Miq. Fl. Indiae Batavae, Suppl. **1**(3): 499. 1861; Kurz, Nat. Tijdschr. Nederl.-Indie **27**: 192. 1864; F. Mueller in Walp. Ann. Syst. Bot. **7**: 357. 1868; Scheffer, Nat. Tijdschr. Nederl.-Indie **31**: 354. 1870, *ibid.* **32**: 405. 1873. Type: Bangka, Djebus, *Teysmann, HB 3214* (holotype, U; isotypes, BO, K, L).

- *C. gracile* Miq. Fl. Indiae Batave, Suppl. **1**(3): 498. 1861; F. Mueller in Walp. Ann. Syst. Bot. **7**: 357. 1868; *C. pulcherrimum* Wall. ex Choisy var. *gracile* (Miq.) Boerl. Catal. Horto. Bogor. **2**: 82. 1901, *excl. spec. cit.* Type: Sumatra, prope Paja-Kombo, *Teysmann, HB 649* (holotype, U; isotypes, BO, K (*s.n.*), L, MEL (*s.n.*)).

- *C. floribundum* Hook. f. Fl. Brit. India **1**: 272. 1874, *pro parte*; King, Jour. Asiatic Soc. Bengal, II. **59**: 175. 1890; Ridl., Fl. Malay Penin. **1**: 184. 1922; M. R. Henderson, Gard. Bull. Straits Settl. **4**: 224. 1928; M. R. Henderson & Wyatt-Smith, Gard. Bull. Singapore **15**: 332. *pl. 16.* 1956; Smythies, Common Sarawak Trees, 61. 1965; Kochummen, Malayan Forest Rec. ed. 2. **17**: 215. 1965; I. H. Burkill, Dict. Econ. Prod. Malay Penin. ed. 2. **1**: 412. 1966; T. C. Whitmore, Tree Fl. Malaya **2**: 180. 1973; Corner, Gard. Bull. Singapore, Suppl. **1**: 104. 1878. Type: Malaya, Malacca, 1 Jan. 1867, *Maingay 1660 (Kew dist. 170)* (lectotype, K).

- *C. praineanum* King, Jour. Asiatic Soc. Bengal, II. **59**: 175. 1890; Vesque in C. DC. Monogr. Phanerog. **8**: 550. 1893; Ridl., Fl. Malay Penin. **1**: 183. 1922. Syntypes: Malaya, Perak, Larut, less than 100 feet [30 m.], Dec. 1883, *King's collector* [*Kunstler*] *5366* (BM, FI, G, K, P, UC), 800-1000 feet [240-305 m.], Feb. 1885, *King's collector* [*Kunstler*] *7243* (BM, FI, K, P).

- *C. venustum* King, Jour. Asiatic Soc. Bengal, II. **59**: 180. 1890; Vesque in C. DC. Monogr. Phanerog. **8**: 549. 1893; Ridl., Fl. Malay Penin. **1**: 186. 1922. Type: Malaya, Perak, Larut, 300-350 feet [90-105 m.], July 1885, *King's collector* [*Kunstler*] *7763* (isotypes, FI, G, K).

- *C. foetidum* Ridl., Jour. Straits Branch Roy. Asiatic Soc. **54**: 18. 1910, *pro maxime parte,* Fl. Malay Penin. **1**: 186. 1922, *pro parte.* Type: Singapore, Gardens Jungle, anno1904, *Ridley 11958* (lectotype, SING; isolectotypes, BM, K).

- *C. lanceola* Ridl., Jour. Straits Branch Roy. Asiatic Soc. **82**: 170. 1920, Fl. Malay Penin. **1**: 182. 1922. Type: Malaya, Kedah, Kedah Peak, 4000 feet [1219 m.], *Ridley 5751* (holotype, SING).

- *C. rupicolum* Ridl. var. *elatum* T. C. Whitmore, Gard. Bull. Singapore **26**: 270. 1970, *pro minore parte*, Tree Fl. Malaya **2**: 169. 1973, *pro minore parte*. Type: Malaya, Kelantan, Ulu Sat F. R., 180 m., 2 Feb. 1970, *FRI 2538* coll. *Kochummen* (holotype, KEP; isotypes, K, L, SING).

- *C. pulcherrimum* auct., non Wall. ex Choisy; T. Anderson in Hook. f. Fl. Brit. India **1**: 271. 1874, *pro parte;* Pierre, Fl. Forest. Cochinch. **1**: *pl. 104A*. 1885, *pro parte;* Vesque, Epharmosis **2**: *t. 21*. 1889, in C. DC. Monogr. Phanerog. **8**: 570. 1893, *pro parte;* Curtis, Jour. Straits Branch Roy. Asiatic Soc. **25**: 78. 1894; Pitard in Lecomte, Fl. Gen. Indo-Chine **1(4)**: 321. 1910; Ridl., Fl. Malay Penin. **1**: 182. 1922, *pro parte;* I. H. Burkill & M. R. Henderson, Gard. Bull. Straits Settl. **3**: 347. 1925; Craib, Fl. Siam. Enum. **1**: 121. 1931; Gagnep. in Humbert, Fl. Gen. Indo-Chine, Suppl. **1**: 274. 1943; Pham & Nguyen, Cay-Co Mien Nam Viet-Nam, 179. 1960; Pham, Cay-Co Mien Nam Viet-Nam. ed. 2. **2**: 301. *fig.* 1970, *pro parte*.

- *C. dryobalanoides* auct., non Pierre; Craib, Fl. Siam. Enum. **1**: 120. 1931; Gagnep. in Humbert, Fl. Gen. Indo-Chine, Suppl. **1**: 274. 1943, *pro parte*.

- *C. globuliferum* Ridl., Kew Bull. **1938**: 121. 1938, *typo excluso*.

- *Calophyllum* sp. Craib in Schmidt, Bot. Tidsskr. **32**: 328. 1915.

Medium to large tree up to 25 m tall; trunk bole and straight, sometimes with small buttresses or spurs. Outer bark grayish-brown to dark grayish-black, shallowly and narrowly fissured. Slash-marked pink to reddish-brown; exudate clear honey. *Youngest twigs* flattened, more or less slender, glabrous; internode 1-3 cm long. Uppermost pair of axillary bud 0.5-1 mm long. Terminal buds 0.2-0.5 cm long, with brown pubescent. *Leaves* petiolate, 0.5-1.5 cm long, narrowly and deeply concave above and convex below, glabrous; lamina vary in shape and size, oblong-elliptic, elipptic to obovate, 3.5-8(10) by 2-3.5 cm, apex acute to acuminate, base cuneate to attenuate, margin entire and pale brown when dry, coriaceous, drying brown to reddish-brown above and light brown below; midrib on upper surface depressed in channel about 1/2-2/3 of lamina length, under one raised, lateral veins on the both surface distinct, 6-15(17) veins/0.5 cm. *Inflorescences* axillary, 1.5-4.5 cm long,

3-11 flowers/inflorescence, covered by slightly brown pubescent; pedicels 0.5-2.5 cm long. *Tepals* (4)-8, sometimes 5,6 or 7, the outer pair ovate, oval to suborbicular, 3-5 by 3-4 mm, glabrous to slighly pubescent along margin and apex; inner one obovate or ligulate, 4-8 by 3-5 mm, glabrous; the next two ones with same shape and size, obovate to spathulate, 5-7 by 2-3 mm, or the inner most ones oblong-oblanceolate, 5-6 by 1-1.5 mm, glabrous. *Stamens* about 36-86 per flower, filament 2-5 mm long, anther oblong or elliptic-oblong, 1-1.3 mm long. *Ovary* 1-2 mm long, style 2-4.5 mm long. *Fruits* broadly ovoid to globose, 0.6-1 by 0.5-0.8 cm; acute to round at apex; dark green when ripen. Exocarp plus mesocarp 0.05-0.1 cm thick. Endocarp 0.5-0.7 mm thick, ellipsoid-globose to globose, 0.55-0.85 by 0.45-0.75 cm.

T h a i l a n d.- SOUTH-EASTERN: Trat; PENINSULAR: Chumphon, Ranong, Krabi, Trang, Satun, Songkhla, Narathiwat.

D i s t r i b u t i o n.- Cambodia to Borneo, excluding mainland Java.

E c o l o g y.- Usually found along stream in evergreen or peat swamp forest, at ca. sea level to 150 m. altitude. Flowering September-January. Fruiting January-April.

V e r n a c u l a r.- Tanghon (ตังหน) (Surat Thani, Trang, Narathiwat)

U s e s.- Young leaves are edible as vegetation.

Figure 15 ***C. tetrapterum*** **Miq.**

A Flowering branch.

B Fruiting branch.

C Terminal bud.

D 4 tepals flowers.

E 8 tepals flowers.

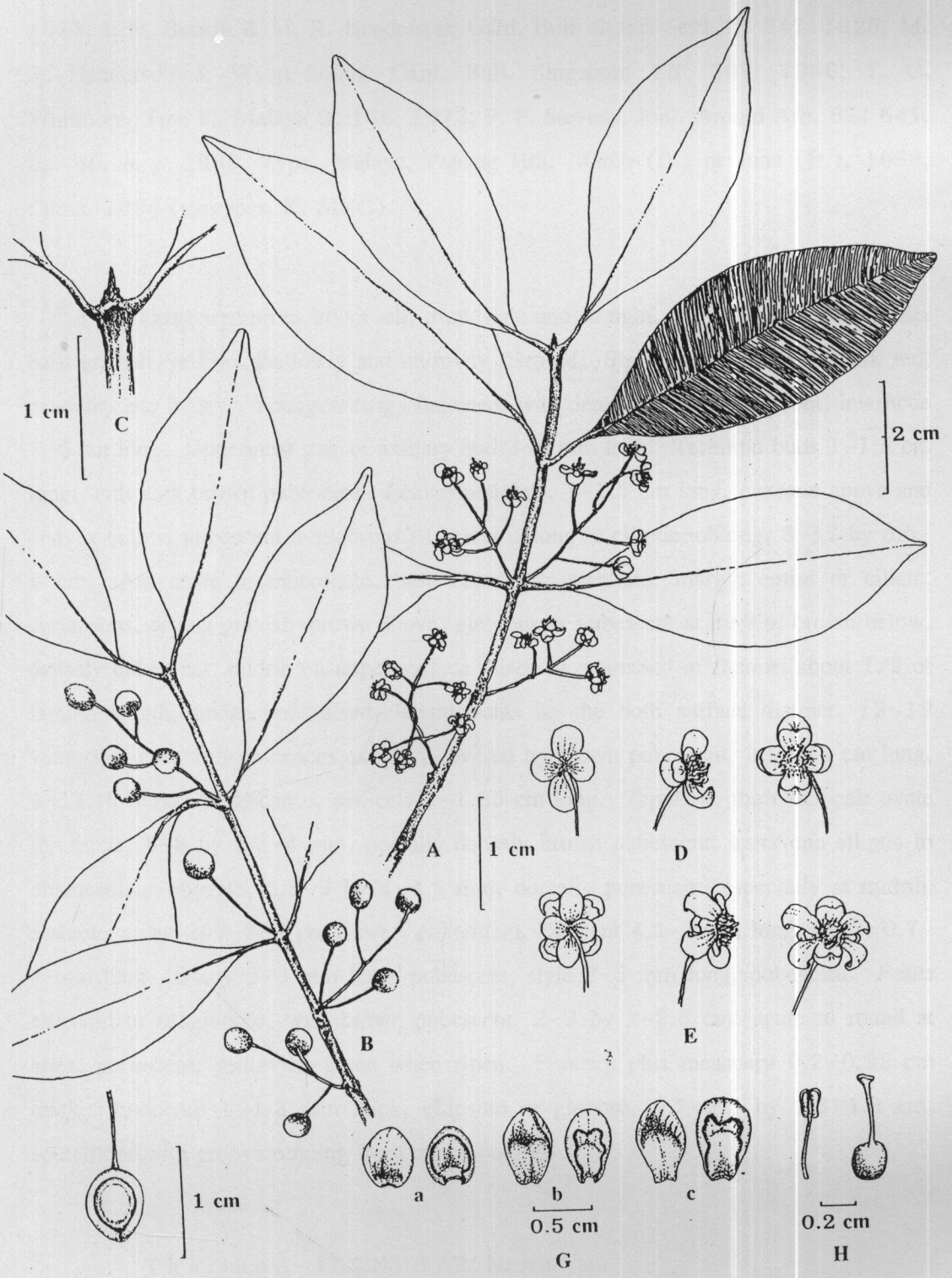
F Fruit longitudinal section.

G Tepals: a The outer pair of tepals.

b The next pair of tepals.

c The third and the fourth pair of tepals.

H Stamen and pistil.


1 cm
C
2 cm
A
1 cm
D
E
B
1 cm
a
b
0.5 cm
G
c
0.2 cm
H

11. Calophyllum molle King, Jour. Asiatic Soc. Bengal, II. **59**: 177. 1890; Curtis, Jour. Straits Branch Roy. Asiatic Soc. **25**: 78. 1894; Ridl., Fl. Malay Penin. **1**: 185. 1922; I. H. Burkill & M. R. Henderson, Gard. Bull. Straits Settl. **3**: 347. 1925; M. R. Henderson & Wyatt-Smith, Gard. Bull. Singapore **15**: 307. 1956; T. C. Whitmore, Tree Fl. Malaya **2**: 188. 1973; P. F. Stevens, Jour. Arnold Arb. **61**: 641. *fig. 40, h, j.* 1980. Type: Malaya, Penang Hill, March (fl.) or June (fr.), 1888, *Curtis, 1426* (syntypes, K, SING).

Large tree up to 25 m tall; trunk bole and straight, without buttresses. Outer bark grayish-yellow, shallowly and narrowly fissured. Slash-marked pink to dark red; exudate clear honey. *Youngest twigs* flattened, with densely brown pubescent; internode 3-6 cm long. Uppermost pair of axillary bud 3-5 mm long. Terminal buds 1-1.5 cm long, with dark brown pubescent. *Leaves* petiolate, 1-1.5 cm long, concave above and convex below, pubescent to glabrous. Lamina oblong to elliptic-oblong, 8-17 by 3.5-6 cm; apex acute to mucronate, base obtuse or cucullate, margin entire or ciliate; coriaceous, drying grayish-brown above, glabrous or pubescent at midrib, brown below, densely pubescent; midrib on upper surface raised or depressed in channel about 1/2 of lamina length, under one raised, lateral veins on the both surface distinct, 12-19 veins/0.5 cm. *Inflorescences* axillary, covered by brown pubescent, 3.5-5.5 cm long, 5-11 flowers/inflorescence, pedicels 1-1.85 cm long. *Tepals* 4, the outer pair ovate to elliptic, 6-8 by 2.5-4 mm, dorsally densely brown pubescent; inner one elliptic to oblanceolate-obovate, 6.5-9 by 4-4.5 mm, dorsally pubescent, especially at midrib. *Stamens* about 207-289 per flower, puberulent, filament 4.5-5 mm long, anther 0.7-1 mm long. *Ovary* 2-3 mm long, pubescent, style 2-3 mm long, pubescent. *Fruits* ellipsoid to subglobose, with brown pubescent, 2-3 by 2-2.3 cm; acute to round at apex, pubescent; yellowish-green when ripen. Exocarp plus mesocarp 0.2-0.35 cm thick. Endocarp 1-1.3 mm thick, ellipsoid or globose, 1.7-2.5 by 1.3-1.8 cm, sometimes with groove running from top to bottom.

T h a i l a n d.- PENINSULAR: Narathiwat.

D i s t r i b u t i o n.- Malay Peninsular, possibility also western Borneo.

E c o l o g y.- In evergreen forest, at ca. 200-300 m. altitude.

V e r n a c u l a r.- . Tanghon bai khon (ตังหนใบขน) (Author)

Figure 16 ***C. molle*** **King**

A Fruiting branch.

B Terminal bud.

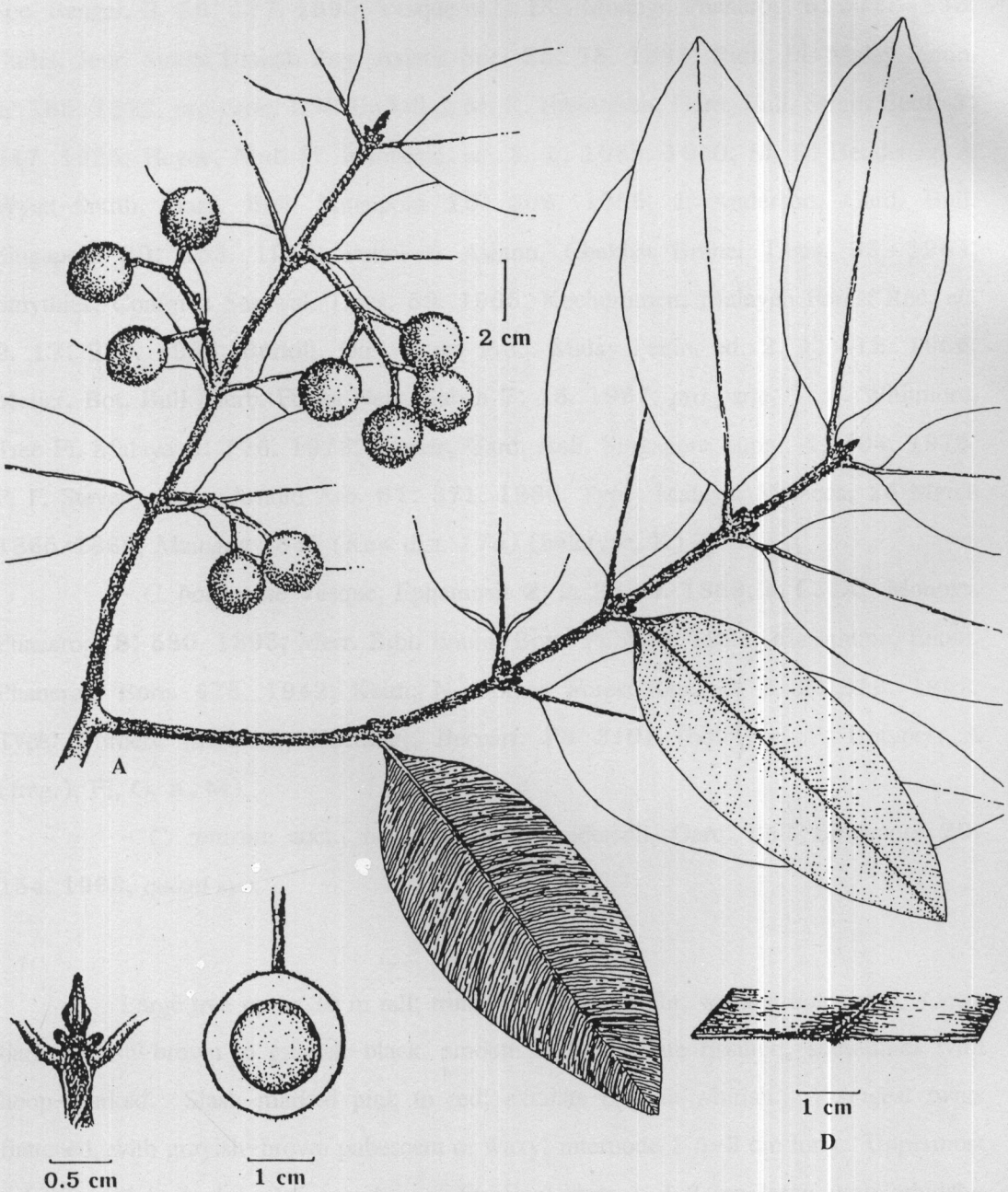
C Fruit longitudinal section.

D Leaf blade cross section.

E Tepals: a The outer pair of tepals.

b The inner pair of tepals.

F Stamen and pistil.


2 cm
A
0.5 cm
B
1 cm
C
1 cm
D
a
b
0.5 cm
E
0.2 cm
F

12. Calophyllum canum Hook. f., Fl. Brit. India **1**: 271. 1874; King, Jour. Asiatic Soc. Bengal, II. **59**: 177. 1890; Vesque in C. DC. Monogr. Phanerog. **8**: 573. 1893; Curtis, Jour. Straits Branch Roy. Asiatic Soc. **25**: 78. 1894; Ridl., Fl. Malay Penin. **1**: 185. 1922, *pro parte;* I. H. Burkill & M. R. Henderson, Gard. Bull. Straits Settl. **3**: 347. 1925; Heyne, Nutt. Pl. Indonesie. ed. 3. **1**: 1082. 1950; M. R. Henderson & Wyatt-Smith, Gard. Bull. Singapore **15**: 306. 1956; J. Anderson, Gard. Bull. Singapore **20**: 153. 1963; Pukol & Ashton, Cheklist Brunei Trees, 93. 1964; Smythies, Common Sarawak Trees, 59. 1965; Kochummen, Malayan Forest Rec. ed. 2. **17**: 219. 1965; Burkill, Dict. Econ. Prod. Malay Penin. ed. 2. **1**: 412. 1966; Meijer, Bot. Bull. Herb. Forest Dept. Sabah **7**: 16. 1967, *pro parte;* T. C. Whitmore, Tree Fl. Malaya **2**: 176. 1973; Corner, Gard. Bull. Singapore Suppl. **1**: 104. 1978; P. F. Stevens, Jour. Arnold Arb. **61**: 371. 1980. Type: Malaya, Malacca, 26 March 1865/1866, *Maingay 1645 (Kew dist. 175)* (holotype, K)

- *C. borneense* Vesque, Ephamosis **2**: *tt. 28,29.* 1889, in C. DC. Monogr. Phanerog. **8**: 580. 1893; Merr. Bibl. Enum. Born. Pl. 393. 1921; Masamune, Enum. Phanerog. Born. 475. 1942; Keith, N. Borneo Forest Rec. ed. 2. **2**: 313. 1952. Type: Borneo, [Sarawak, Kuching], *Beccari, PB 2101* (holotype, P; isotypes, A (frag.), FI, G, K, M).

- *C. retusum* auct., non Choisy; J. Anderson, Gard. Bull. Singapore **20**: 154. 1963, *quoad syn.*

Large tree up to 30 m tall; trunk bole and straight, without buttresses. Outer bark grayish-brown to grayish-black, smooth to lenticellate fissured, sometimes with hoop-marked. Slash-marked pink to red; exudate opaque whitish. *Youngest twigs* flattened, with grayish-brown pubescent or waxy; internode 1.5-3 cm long. Uppermost pair of axillary bud 1-2.5 mm long. Terminal buds 1-1.2 cm long, with grayish-brown pubescent. *Leaves* petiolate, 1.5-2 cm long, broadly concave above and convex below, waxy or grayish-brown pubescent to glabrous. Lamina oblong to elliptic-oblong, 8-15 by 3.5-6 cm; apex acute to acuminate, base cuneate, occassionally sub-attenuate, margin entire; coriaceous, drying grayish-brown to reddish above and reddish-brown below; midrib on upper surface depressed in channel about 2/3-4/5 of lamina length, under one raised, lateral veins on the both surface distinct, 12-18 veins/0.5 cm. *Inflorescences* axillary, covered by grayish-brown pubescent, 3-5 cm

long, about 13 flowers/inflorescence, pedicels 0.3–0.6 cm long. *Tepals* 4, the outer pair elliptic to oval, 5-6.5 by 4-6 mm, dorsally grayish-brown pubescent; inner one obovate, 5.5–7 by 5–6 mm, dorsally pubescent in band. *Stamens* about 564-665 per flower, filament 3.5-4 mm long, anther 0.5-1 mm long. *Ovary* 1.5-2 mm long, style 3-4 mm long. *Fruits* unknown.

T h a i l a n d.- PENINSULAR: Narathiwat.

D i s t r i b u t i o n.- Malaya, Sumatra and northwestern Borneo.

E c o l o g y.- In Evergreen Forest, at ca. 200-300 m. altitude.

V e r n a c u l a r.-Tanghon khaao (ตังหนขาว) (Author).

Figure 17 ***C. canum*** **Hook. f.**

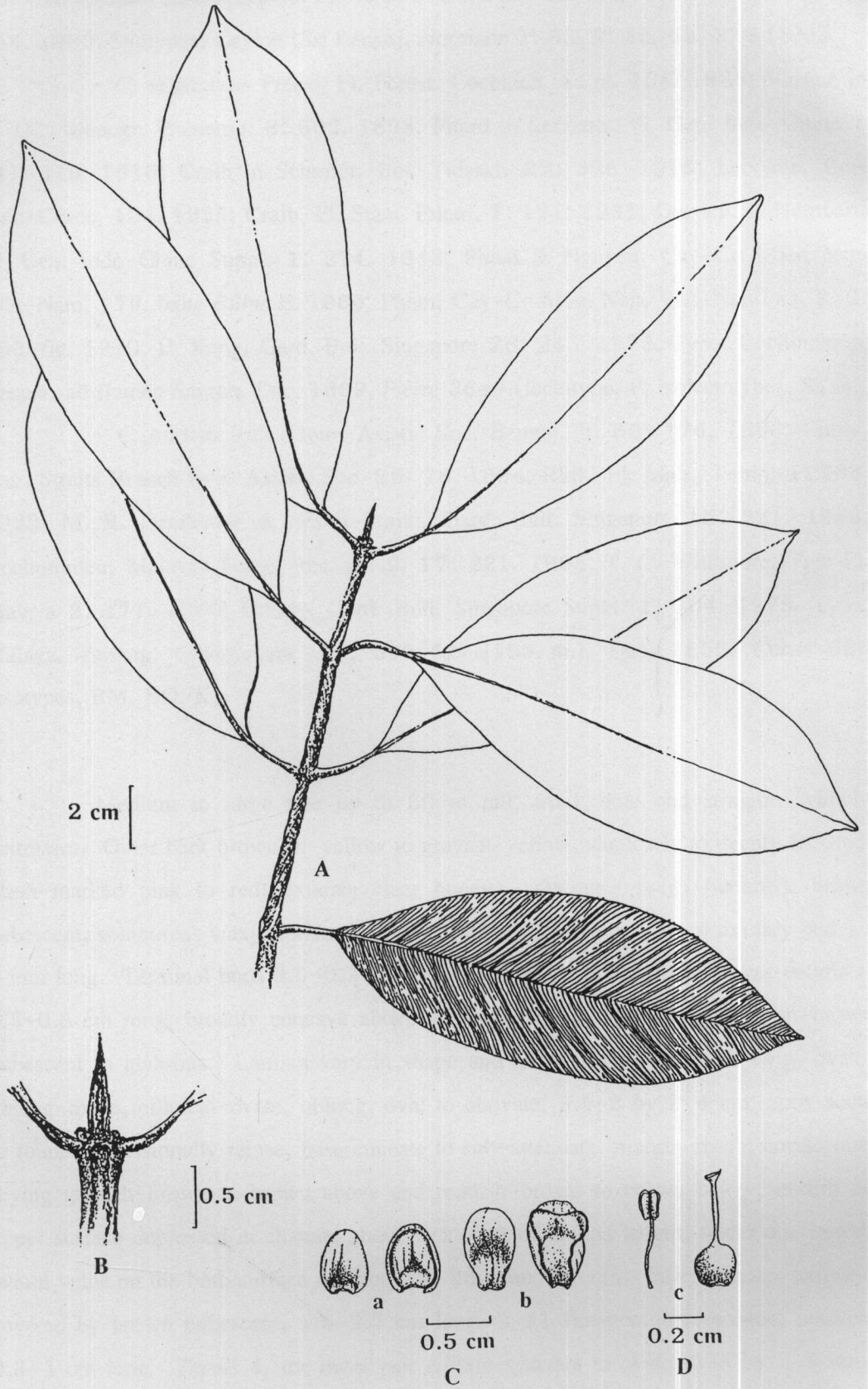
A Branch sterile.

B Terminal bud.

C Tepals: a The outer pair of tepals.

b The inner pair of tepals.

D Stamen and pistil.


2 cm
A
0.5 cm
B
a
b
0.5 cm
C
c
0.2 cm
D

13. Calophyllum calaba L., Sp. Pl. 732. 1753; P. F. Stevens, Jour. Arnold Arb. **61**: 256. 1980. Syntypes: Ceylon [Sri Lanka], *Hermann* 1: 65, 2: 42, 52, 3: 3 (BM).

- *C. saigonense* Pierre, Fl. Forest. Cochinch. **1**: *pl. 105.* 1885; Vesque in C. DC. Monogr. Phanerog. **8**: 602. 1893; Pitard in Lecomte, Fl. Gen. Indo-Chine **1** (4): 318. 1910; Craib in Schmidt, Bot. Tidsskr. **32**: 328. 1915; Lecomte, Bois Indo-Chine, 124. 1925; Craib, Fl. Siam. Enum. **1**: 121. 1931; Gagnep. in Humbert, Fl. Gen. Indo-Chine Suppl. **1**: 274. 1943; Pham & Nguyen, Cay-Co Mien Nam Viet-Nam, 179. *bang 62bis E.* 1960; Pham, Cay-Co Mien Nam Viet-Nam. ed. 2. **2**: 303. *fig.* 1970; H. Keng, Gard. Bull. Singapore **28**: 245. 1976. Type: Cochinchine, Beucar, ad flumen Saigon, Dec. 1869, *Pierre 3649* (lectotype, P; isolectotypes, K, P).

- *C. curtisii* Ridl., Jour. Asiatic Soc. Bengal, II. **59**: 176. 1890; Curtis, Jour. Straits Branch Roy. Asiatic Soc. **25**: 78. 1894; Ridl., Fl. Malay Penin. **1**: 185. 1922; M. R. Henderson & Wyatt-Smith, Gard. Bull. Singapore **15**: 321. 1956; Kochummen, Malayan Forest Rec. ed. 2. **17**: 221. 1965; T. C. Whitmore, Tree Fl. Malaya **2**: 177. 1973; Corner, Gard. Bull. Singapore Suppl. **1**: 104. 1978. Type: Malaya, Penang, Government Hill, 500 feet [150 m.], Dec. 1855, *Curtis 523* (isotypes, BM, BO, K).

Medium to large tree up to 30 m tall; trunk bole and straight, without buttresses. Outer bark brownish-yellow to grayish-yellow, shallowly to deeply fissured. Slash-marked pink to red; exudate clear honey. *Youngest twigs* flattened, brown pubescent, sometimes waxy; internode 1-3 cm long. Uppermost pair of axillary bud 1-2 mm long. Terminal buds 0.5-0.7 cm long, with brown pubescent. *Leaves* petiolate, 0.3-0.8 cm long, broadly concave above and convex below, waxy or grayish-brown pubescent to glabrous. Lamina vary in shape and size, also in the same twig, ovate, oblong-ovate, ellipical-ovate, oblong, oval to obovate, 3.5-8 by 2-4 cm; apex acute to round, occassionally retuse, base cuneate to sub-attenuate, margin entire; coriaceous, drying grayish-brown to brown above and reddish-brown to brown below; midrib on upper surface depressed in channel about 1/2-4/5 of lamina length, under one raised, lateral veins on the both surface distinct, 12-26 veins/0.5 cm. *Inflorescences* axillary, covered by brown pubescent, 1.5-2.5 cm long, 3-11 flowers/inflorescence, pedicels 0.3-1 cm long. *Tepals* 4, the outer pair elliptic-obovate to ovate, 3-5 by 2-3 mm, dorsally brown pubescent; inner one elliptic-oblong to oblong, 4.5-7 by 1.5-3 mm,

dorsally pubescent in band. *Stamens* about 43-95 per flower, filament 2-7 mm long, anther 1-1.2 mm long. *Ovary* 1.5-2 mm long, style 2-4 mm long. *Fruits* ellipsoid to globose, 0.5-1 by 0.5-0.8 cm; mucronate to round at apex; yellowish-green to pale brown when ripen. Exocarp plus mesocarp 0.1-0.15 cm thick. Endocarp 2-3 mm thick, ellipsoid to globose, 0.4-0.85 by 0.35-0.55 cm.

T h a i l a n d.- NORTH-EASTERN: Udon Thani, Nong Khai; EASTERN: Buri Ram, Surin, Roi Et, Yasothon, Si Sa Ket, Ubon Ratchathani; SOUTH-EASTERN: Chon Buri, Chanthaburi, Trat; PENINSULAR: Ranong, Chumphon, Surat Thani, Phangnga, Phuket, Nakhon Si Thammarat, Trang, Songkhla, Pattani, Yala, Narathiwat.

D i s t r i b u t i o n.- Vietnam to Borneo, perhaps also the Sunda Islands and Timor.

E c o l o g y.- In peat swamp forest, beach forest to and evergreen forest in the Peninsular. Semi-evergreen forest to dry dipterocarps forest with pine in other part of our country, at ca. 800-1000, except the Northern. Flowering August-December. Fruiting October-April.

V e r n a c u l a r.- Pha uung (พะอูง) (Nong Khai); Pa-ong (ปะอง) (Khmer-Surin); Pa-ung (ปะอุ้ง) (Suai-Surin); Phanghan klet raet (พังหันเกล็ดแรต) (Chanthaburi).

U s e s.- The wood is used for construction such as house, furniture. The fruit is edible.

Figure 18 ***C. calaba*** **L.**

A Flowering branch.

B Fruiting branch.

C Terminal bud.

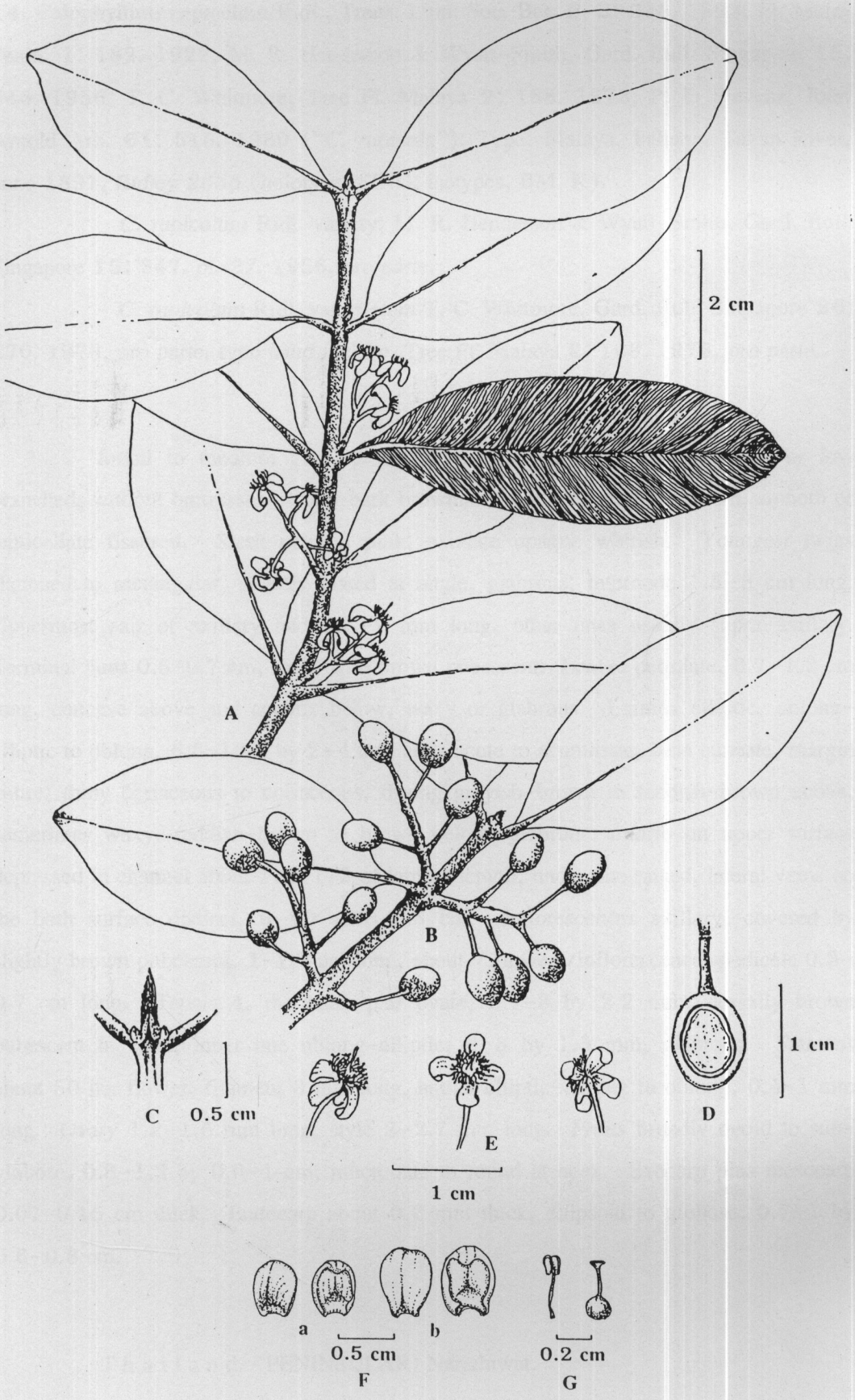
D Fruit longitudinal section.

E Flowers.

F Tepals: a The outer pair of tepals.

b The inner pair of tepals.

G Stamen and pistil.


2 cm
A
B
C
0.5 cm
D
1 cm
E
1 cm
a
b
0.5 cm
F
0.2 cm
G

14. Calophyllum rupicolum Ridl., Trans. Linn. Soc. Bot. II. **3**: 278. 1893, Fl. Malay Penin. **1**: 182. 1922; M. R. Henderson & Wyatt-Smith, Gard. Bull. Singapore **15**: 346. 1956; T. C. Whitmore, Tree Fl. Malaya **2**: 168. 1973; P. F. Stevens, Jour. Arnold Arb. **61**: 515. 1980 ("*C. rupicola*"). Type: Malaya, Pahang, Tahan River, anno 1891, *Ridley 2636* (holotype, SING; isotypes, BM, K).

- *C. rupicolum* Ridl. variety; M. R. Henderson & Wyatt-Smith, Gard. Bull. Singapore **15**: 347. *pl. 27*. 1956, *pro parte*.

- *C. rupicolum* Ridl. var. *elatum* T. C. Whitmore, Gard. Bull. Singapore **26**: 270. 1973, *pro parte, typo haud incluso*, Tree Fl. Malaya **2**: 168. 1973, *pro parte*.

Small to medium tree up to 15 m tall; trunk bole and straight or low branched, without buttresses. Outer bark brownish-yellow to grayish-brown, smooth or lenticellate fissured. Slash-marked pink; exudate opaque whitish. *Youngest twigs* flattened to rectangular, slightly alated at angle, glabrous; internode 1.5-3 cm long. Uppermost pair of axillary bud 0.5-2 mm long, other ones usually supra-axillary. Terminal buds 0.5-0.7 cm, long, with brown pubescent. *Leaves* petiolate, 0.7-1.2 cm long, concave above and convex below, waxy or glabrous. Lamina elliptic, oblong-elliptic to oblong, 6.5-13.5 by 2-4 cm; apex acute to acuminate, base cuneate, margin entire; thiny coriaceous to coriaceous, drying grayish-brown to reddish-brown above, sometimes waxy, reddish-brown to brown below, glabrous; midrib on upper surface depressed in channel about 1/3-1/2 of lamina length, under one raised, lateral veins on the both surface distinct, 6-10 veins/0.5 cm. *Inflorescences* axillary, covered by slightly brown pubescent, 1-1.7 cm long, about 7 flowers/inflorescence, pedicels 0.3-0.7 cm long. *Tepals* 4, the outer pair ovate, 2.7-3 by 2.2 mm, dorsally brown pubescent in band; inner one oblong-elliptic, 4-5 by 1.5 mm, glabrous. *Stamens* about 50 per flower, filament 3 mm long, anther elliptic-oblong to oblong, 0.4-1 mm long. *Ovary* 1.2-1.6 mm long, style 2-2.7 mm long. *Fruits* broadly ovoid to sub-globose, 0.8-1.2 by 0.6-1 cm; mucronate to round at apex. Exocarp plus mesocarp 0.07-0.15 cm thick. Endocarp about 0.3 mm thick, ellipsoid to globose, 0.7-1 by 0.6-0.8 cm.

T h a i l a n d.- PENINSULAR: Narathiwat.

D i s t r i b u t i o n.- Northeastern Malaya and scattered in Sumatra.

E c o l o g y.- Peat swamp forest and along stream on granite bedrock in evergreen forest, at ca. 200-270 m. altitude. Flowering October-November. Fruiting December-April.

V e r n a c ul a r.- Tanghon nam (ตังหนน้ำ) (Author)

Figure 19 ***C. rupicolum*** **Ridl.**

A Flowering branch

B Fruiting branch

C Terminal bud

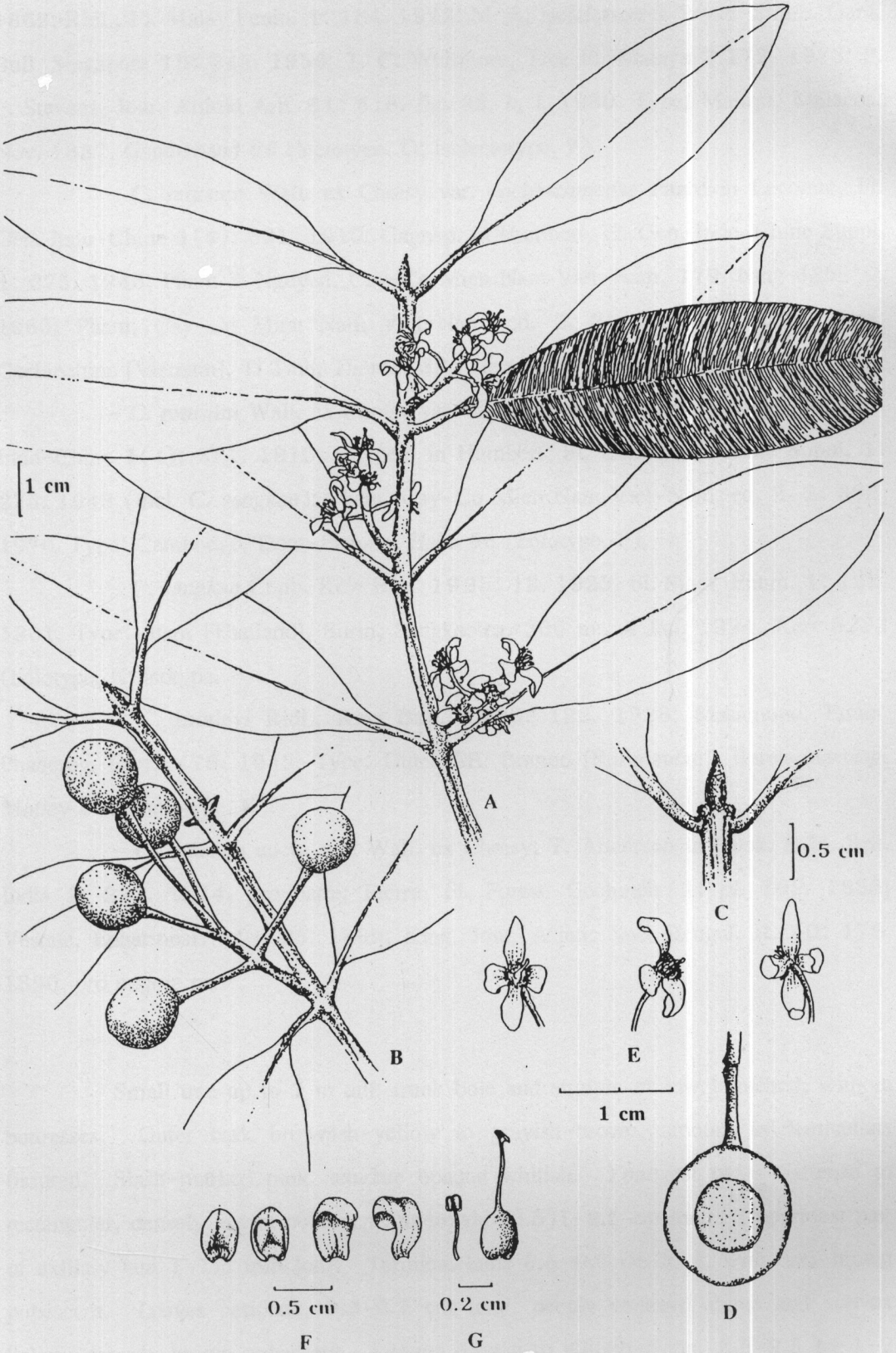
D Fruit longitudinal section

E Flowers

F Tepals: a The outer pair of tepals

b The inner pair of tepals

G Stamen and pistil


1 cm
A
B
0.5 cm
C
E
1 cm
D
0.5 cm
0.2 cm
F
G

15. Calophyllum pisiferum Planchon & Triana, Ann. Sci. Nat. Bot. IV. **15**: 294. 1862; Ridl., Fl. Malay Penin. **1**: 184. 1922; M. R. Henderson & Wyatt-Smith, Gard. Bull. Singapore **15**: 345. 1956; T. C. Whitmore, Tree Fl. Malaya **2**:172. 1973; P. F. Stevens, Jour. Arnold Arb. **61**: 518. *fig. 32, k, l.* 1980. Type: Malaya, Malacca, Nov. 1837, *Gaudichaud 86* (lectotype, G; isolectotype, P).

- *C. retusum* Wall. ex Choisy var. *cochinchinense* Pitard in Lecomte, Fl. Gen. Indo-Chine **1**(4): 321. 1910; Gagnep. in Humbert, Fl. Gen. Indo-Chine Suppl. **1**: 275. 1943; Pham & Nguyen, Cay-Co Mien Nam Viet-Nam, 179. *bang 62bis D.* 1960; Pham, Cay-Co Mien Nam Viet-Nam. ed. 2. **2**: 303. *fig.* 1970. Type: Cochinchine [Vietnam], Ti Tinh, *Thorel 1395* (lectotype, P; isolectotypes, B, K).

- *C. retusum* Wall. ex Choisy var. *cambodgense* Pitard in Lecomte, Fl. Gen. Indo-Chine **1**(4): 321. 1910; Gagnep. in Humbert, Fl. Gen. Indo-Chine Suppl. **1**: 275. 1943 (incl. *C. sangkae*); Pham, Cay-Co Mien Nam Viet-Nam. ed. 2. **2**: 303. 1970. Type: Cambodge, Dom-Phaong, *Hahn 86* (holotype, P).

- *C. sangkae* Craib, Kew Bull. **1925**: 18. 1925, Fl. Siam. Enum. **1**: 122. 1931. Type: Siam [Thailand], Surin, Sangka, ca. 300 m., 4 Jan. 1924, *Kerr 8283* (holotype, K; isotype, P).

- *C. motleyi* Ridl., Kew Bull. **1938**: 122. 1938; Masamune, Enum. Phanerog. Born. 476. 1942. Type: Dutch SE. Borneo [Kalimantan], Bangarmassing, *Motley 865* (holotype, K).

- *C. retusum* auct., non Wall. ex Choisy; T. Anderson in Hook. f. Fl. Brit. India **1**: 272. 1874, *pro parte;* Pierre, Fl. Forest. Cochinch. **1**: *pl. 102.* 1885; Vesque, Epharmosis **2**: *t. 25.* 1889; King, Jour. Asiatic Soc. Bengal, II. **50**: 176. 1890, *pro majore parte.*

Small tree up to 7 m tall; trunk bole and straight or low branched, without buttresses. Outer bark brownish-yellow to grayish-brown, smooth or lenticellate fissured. Slash-marked pink; exudate opaque whitish. *Youngest twigs* flattened to rectangular, densely brown pubescent; internode (0.5)1-2.5 cm long. Uppermost pair of axillary bud 1-1.5 mm long. Terminal buds 0.5-0.6 cm long, with dark brown pubescent. *Leaves* petiolate, 0.3-0.7 cm long, deeply concave above and convex below, densely brown pubescent. Lamina oblong to elliptic-ovate, 3.5-9.5 by 1-2 cm; apex acute to round, base round, acute to cuneate, margin entire; coriaceous, drying

reddish-brown to dark brown above and reddish-brown below, glabrous to slightly pubescent at midrib; midrib on upper surface depressed in channel about 1/3-1/2 of lamina length, under one raised, lateral veins on the both surface distinct, 7-13 veins/0.5 cm. *Inflorescences* axillary, covered by brown pubescent, 1-1.5 cm long, 7-11 flowers/inflorescence, pedicels 0.5-1.5 cm long. *Tepals* 4, the outer pair ovate, 4-5 by 2-3 mm, dorsally brown pubescent in band; inner one elliptic to obovate-elliptic, 5-7 by 3-5 mm, slightly dorsally pubescent in band to glabrous. *Stamens* about 30-70 per flower, filament 3-3.5 mm long, anther oblong, oblique, elliptic to obovate, 0.4-0.6 mm long. *Ovary* 1.5-3 mm long, style 4-5 mm long. *Fruits* ellipsoid to globose, 0.8-1.3 by 0.7-1 cm; acute to round at apex; orange when ripen. Exocarp plus mesocarp 0.1-0.12 cm thick. Endocarp about 0.5 mm thick, ellipsoid-globose to globose, 0.7-0.9 by 0.6-0.75 cm.

T h a i l a n d.- SOUTH-EASTERN: Prachin Buri, Chanthaburi, Trat.

D i s t r i b u t i o n.- Southern Vietnam to Borneo, scattered, excluding Java.

E c o l o g y.- Along stream in semi-evergreen forest, at ca. sea level-730 m. altitude. Flowering October-November. Fruiting November-January.

V e r n a c u l a r.- Kathanghan bailek (กะทังหันใบเล็ก) (Chanthaburi, Trat); Pa-ong (ปะอง) (Suai-Surin).

U s e s.- The branches are used for house and boat poles.

Figure 20 ***C. pisiferum*** **Planchon & Triana**

A Flowering branch.

B Fruiting branch.

C Terminal bud.

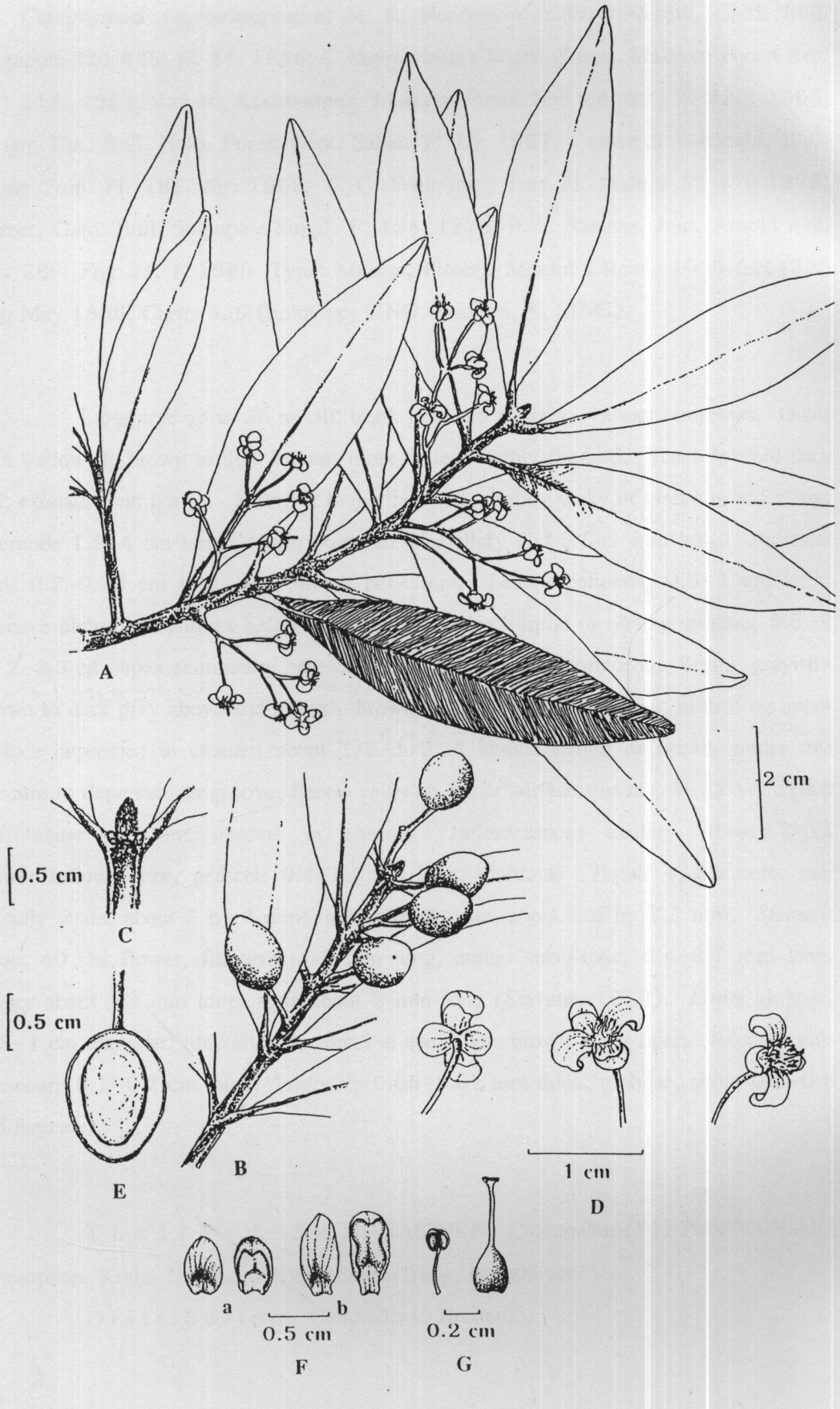
D Flowers.

E Fruit longitudinal section.

F Tepals: a The outer pair of tepals.

b The next pair of tepals.

G Stamen and pistil.


A
2 cm
0.5 cm
C
0.5 cm
E
B
1 cm
D
a
b
0.5 cm
F
0.2 cm
G

16. Calophyllum depressinervosum M. R. Henderson & Wyatt-Smith, Gard. Bull. Singapore **15**: 335. *pl. 17.* 1956; *C. depressinerve* Wyatt-Smith, Malayan Forest Rec. **17**: 113. 1952, *nomen;* Kochummen, Malayan Forest Rec. ed. 2. **17**: 220. 1965; Meijer, Bot. Bull. Herb. Forest Dept. Sabah **7**: 15. 1967; Corner & Watanabi, Illus. Guide Trop. Pl. 181. *fig.* 1969; T. C. Whitmore, Tree Fl. Malaya **2**: 179.1973; Corner, Gard. Bull. Singapore Suppl. **1**: 104. 1978; P. F. Stevens, Jour. Arnold Arb. **61**: 389. *Fig. 21, f.* 1980. Type: Malaya, Pinang, Moniot's Road, 1000 feet [305 m.], May 1886, *Curtis 830* (holotype, SING; isotypes, K, SING).

Large tree up to 35 m tall; trunk bole and straight, without buttresses. Outer bark yellowish-brown to dark brown, more or less deeply fissured. Slash-marked dark red; exudate clear honey. *Youngest twigs* flattened, slightly waxy or glabrous and shiny; internode 1.5-4 cm long. Uppermost pair of axillary bud 0.5-1 mm long. Terminal buds 0.2-0.35 cm long, with brown pubescent. *Leaves* petiolate, 0.5-1 cm long, concave above and convex below, glabrous. Lamina elliptic to oblong-elliptic, 5.5-9 by 2-3.5 cm; apex acuminate, base cuneate, margin entire; coriaceous, drying grayish-brown to dark gray above and grayish-brown to yellowish-gray below; midrib on upper surface depressed in channel about 1/3-1/2 of lamina length or raised, under one obscure to depressed in groove, lateral veins on upper surface distinct, 7-12 veins/0.5 cm, under one one obscure or absent. *Inflorescences* axillary, about 7-13 flower/inflorescence, pedicels 0.4-1.3 cm long, glabrous. *Tepals* 4, the outer pair broadly ovate, about 3 by 3 mm; inner one obovate, about 5.5 by 2.5 mm. *Stamens* about 40 per flower, filament to 3 mm long, anther subelliptic, 0.4-0.7 mm long. *Ovary* about 1.2 mm long, style about 2 mm long (Stevens, 1980). *Fruits* globose, 0.8-1 cm diameter; mucronate to round at apex; pale brown when ripen. Exocarp plus mesocarp 0.1-0.2 cm thick. Endocarp 0.05-0.07 mm thick, globose, about 0.6-0.8 cm diameter.

T h a i l a n d.- SOUTH-EASTERN: Chanthaburi(?); PENINSULAR: Chumphon, Krabi, Nakhon Si Thammarat, Trang, Narathiwat.

D i s t r i b u t i o n.- Cambodia to Borneo.

Ecology.- Usually in evergreen forest in the Peninsular, at ca. 100-200 m. altitude. Flowering unknown. Fruiting January-April.

Vernacular.- Phanghan bailek (พังหันใบเล็ก) (Chanthaburi)(?).

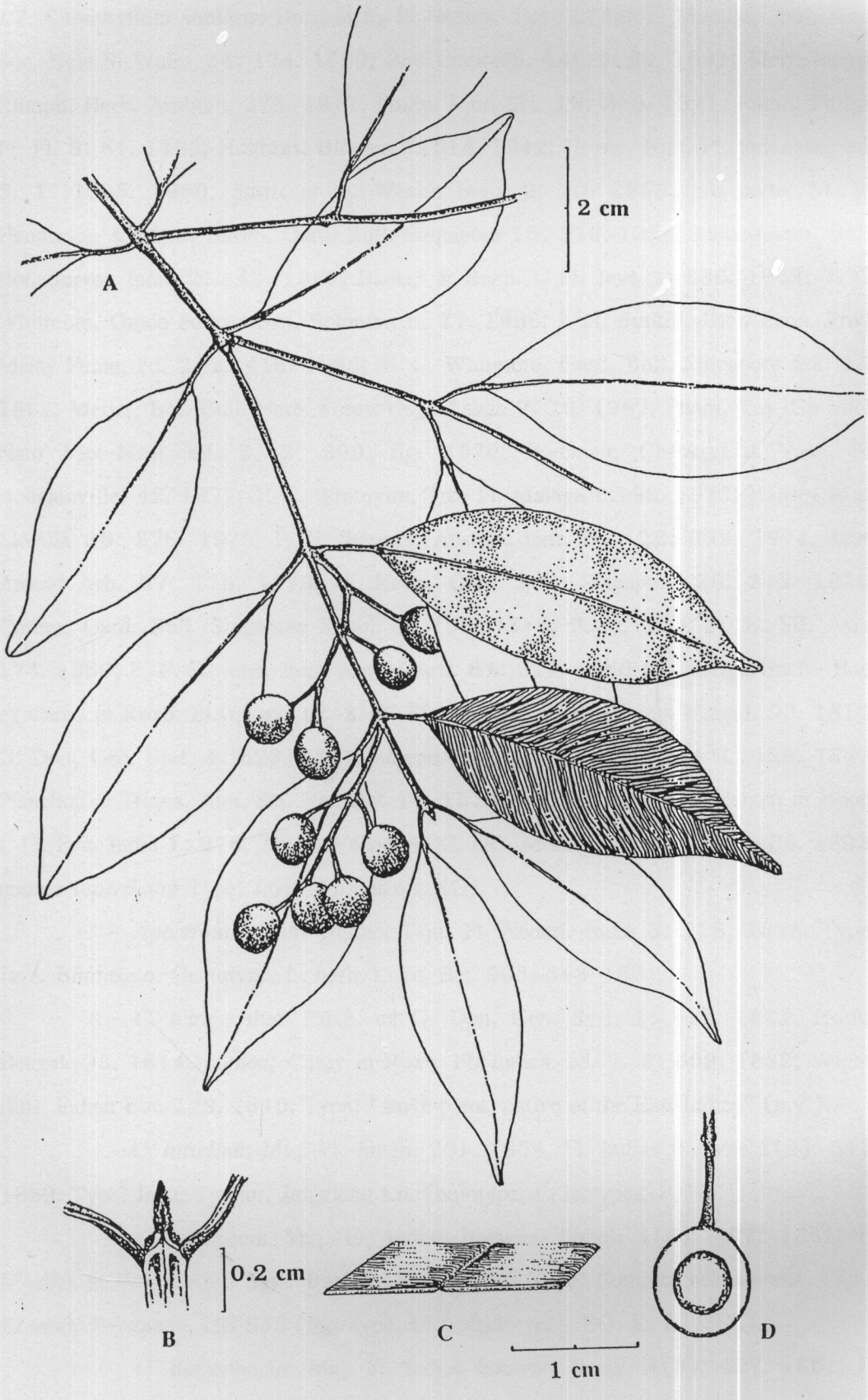
Figure 21 ***C. depressinervosum*** **M. R. Henderson & Wyatt-Smith**

A Fruiting branch.

B Terminal bud.

C Leaf blade cross section.

D Fruit longitudinal section.


2 cm
A
0.2 cm
B
C
D
1 cm

17. Calophyllum soulattri Burman f., Fl. Indica, 121. 1768; F. Mueller, Jour. Roy. Soc. New S. Wales **24**: 174. 1890, Bot. Centralbl. **44**(1): 29. 1891; Merr. Interp. Rumph. Herb. Amboin. 371. 1917, Philip. Jour. Sci. **19**: 366. 1921, Enum. *Philip.* Fl. Pl. **3**: 81. 1923; Holthuis, Blumea **5**: 214. 1942; Heyne, Nutt. Pl. Indonesie. ed. 3. **1**: 1085. 1950; Sastri *et al.* Wealth India **2**: 20. 1950, *pro parte;* M. R. Henderson & Wyatt-Smith, Gard. Bull. Singapore **15**: 319. 1956; Maheshwari, Bull. Bot. Survey India **2**: 142. 1960; Backer & Bakh. f. Fl. Java **1**: 386. 1963; T. C. Whitmore, Guide Forests Brit. Solomon Is. 77. 1966; I. H. Burkill, Dict. Econ. Prod. Malay Penin. ed. 2. **1**: 416. 1966; T. C. Whitmore, Gard. Bull. Singapore **22**: 15. 1967; Meijer, Bot. Bull. Herb. Forest Dept. Sabah **7**: 16. 1967; Pham, Cay-Co Mien Nam Viet-Nam. ed. 2. **2**: 300. *fig.* 1970; Foreman, Check List Vasc. Pl. Bougainville, 42. 1971; T. C. Whitmore, Tree Fl. Malaya **2**:192. 1973; Hartley *et al.* Lloydia **36**: 276. 1973; P. F. Stevens, Austral. Jour. Bot. **22**: 399. 1974, Jour. Arnold Arb. **57**: 175. 1976; H. Keng, Gard. Bull. Singapore **28**: 245. 1976; Corner, Gard. Bull. Singapore Suppl. **1**: 105. 1978; Perry, Med. Pl. E. SE. Asia, 174. 1980; P. F. Stevens, Jour. Arnold Arb. **61**: 277. 1980 ; *C. suriga* Buch.-Ham ex Carey in Roxb. Fl. Indica. ed. 2. **2**: 608. 1832; Roxb. Hortus Bengal. 93. 1814; G. Don, Gen. Syst. **1**: 623. 1831, *nomen;* Wight, Illus. Indian Bot. **1**: 129. 1840; Planchon & Triana, Ann. Sci. Nat. Bot. IV. **15**: 292. 1862 [?]; T. Anderson in Hook. f. Fl. Brit. India **1**: 276. 1874; Vesque in C. DC. Monogr. Phanerog. **8**: 609. 1893, *nomen superfluum* Type: Java, *Burman s.n.* (G).

- *Apoterium sulatri* Blume, Bijd. Fl. Nederl. Indie **5**: 218. 1825. Type: Java, *Blume s.n.* (lectotype, L, herb. Lugd. Bat. 903, 343-183).

- *C. tetrapetalum* Roxb. ex G. Don, Gen. Syst. **1**: 622. 1831, Hortus Bengal. 93. 1814, *nomen;* Carey in Roxb. Fl. Indica. ed. 2. **2**: 608. 1832; Wight, Illus. Indian Bot. 129. 1840. Type: "stove plant, native of the East Indies" (n.v.).

- *C. hirtellum* Miq. Pl. Jungh. 201. 1854, Fl. Indiae Batavae **1**(2): 511. 1859. Type: Java, Tjanjor, *Junghuhn s.n.* (holotype, L; isotypes, P, U).

- *C. cymosum* Miq. Fl. Indiae Batavae, Suppl. **1**(3): 497. 1861; F. Mueller in Walp. Ann. Syst. Bot. **7**: 357. 1868. Type: Sumatra occidentalis, Paja-Kombo, *Teysmann, HB 653* (lectotype, U; isolectotypes, BO, K, L, MEL).

- *C. diepenhorstii* Miq. Fl. Indiae Batavae, Suppl. **1**(3): 497. 1861; F. Mueller in Walp. Ann. Syst. Bot. **7**: 357. 1868; Vesque in C. DC. Monogr. Phanerog.

8: 605. 1893; *C. spectabile* Willd. var. *diepenhorstii* (Miq.) Boerl. Catal. Pl. Phanerog. Horto Bot. Bogor. 2: 81. 1901. Type: Sumatra, in prov. Priaman, *Diepenhorst, HB 2236* (holotype, U; isotypes, BO, L, MEL).

- *C. lanceolatum* Warb. Bot. Jahrb. 13: 381. 1891, non Blume, 1825, nec Teijsm. & Binn. 1853; *C. warburgii* Engler in Engler & Prantl, Nat. Pflanzenfam. 3 (6): 222. 1893, *nomen novum*; Lauterb. Nova Guinea Bot. 8: 843. 1912, Bot. Jahrb. 58: 13. 1922; A. C. Smith, Jour. Arnold Arb. 22: 345. 1941, *pro majore parte*. Type: Kei Inseln, anno 1889, *Warburg 20048* (isotypes, A, LAE (frag.), US).

- *C. spectabile* Willd. var. *ceramicum* Boerl. Catal. Pl. Phanerog. Horto Bot. Bogor. 2: 80. 1901. Type: Cult. hort. Bogor. (semina ex Ceram) sub numero *VI C 46* (holotype, BO; isotypes, BO, US).

- *C. kiong* Lauterb. & K. Schum. in K. Schum. & Lauterb. Fl. Deutschen Schutzgeb. Sudsee, 450. 1901; Lauterb. Bot. Jahrb. 58: 11. 1922; O. Schwarz, Repert. Sp. Nov. 24: 89. 1927. Syntypes: Deutsch Neu Guinea [Papua New Guinea, Morobe Province], Sattelberg, Nuselang, 850 m., 8 Dec. 1893; *Karnbach 74* (frag., WRSL); bei Laleca, 300 m., 12 April 1889, *Hellwig 657* (WRSL); Sattelberg, 2 Dec. 1898 and 10 Jan. 1899, *Bammler 6* (WRSL).

- *C. hibbardii* Elmer, Leafl. Philip. Bot. 2: 503. 1908. Type: Philippine Islands, Negros Island, prov. Negros Oriental, Cuernos Mountains, Dumaguete, 3500 feet [1067 m.], April 1908, *Elmer 9837* (isotypes, A, BM, BO, E, F, FI, G, K, L, LY, MO, NY, US, W).

- *C. lancifolium* Elmer, Leafl. Philip. Bot. 7: 2683. 1915 ("*C. lancifolia*"); Merr. Enum. Philip. Fl. Pl. 3: 80. 1923. Type: Philippine Islands, Mindanao, Agusan Province, Cabadbaran (Mt. Urdaneta), 1000 feet [305 m.], July 1912, *Elmer 13266* (lectotype, A; isolectotypes, BM, BO, E, F, FI, G, GH, K, L, MO, NY, U, UC, US, W).

- *C. zschokkei* Elmer, Leafl. Philip. Bot. 7: 2686. 1915; Merr. Enum. Philip. Fl. Pl. 3: 81. 1923. Type: Philippine Islands, Sibuyan Island, Magellanes (Mt. Giting-Giting), Paula River, 750 feet [225 m.], March 1910, *Elmer 12129* (lectotype, GH; isolectotypes, A, BM, BO, E, F, FI, G, K, LY, MO, NY, P, W).

- *C. versteegii* Lauterb. Bot. Jahrb. 58: 12. 1922. Type: Sud Neu Guinea, Noord Fluss, Nepenthes-Hugel, 25 Sept. 1907, *Versteeg 1748* (isotypes, BO, K, L, U).

- *C. cholobtaches* Lauterb. *ibid.* **59**: 20. 1924, *pro majore parte*. Type: Palau Inseln, Korror, 10-100 m., 13 Feb. 1914, *Ledermann 14251* (lectotype, WRSL).

- *C. solomonense* A. C. Smith, Jour. Arnold Arb. **22**: 346. 1941, *paratypo excepto;* Whitmore, Guide Forests Brit. Solomon Is. 78. 1966, *pro parte*, Gard. Bull. Singapore **22**: 9. 1967, *pro parte;* P. F. Stevens, Austral. Jour. Bot. **22**: 398. 1974, *pro parte*. Type: Solomon Islands, Guadalcanal, Ma-Massa, Konga, 500 m., 8 Feb. 1931, *Kajewski 2469* (holotype, A; isotypes, BM, BO, BRI, G, L, P, SING).

- *C. paludosum* C. T. White, Jour. Arnold Arb. **31**: 98. 1950; T. C. Whitmore, Guide Forests Brit. Solomon Is. 77. 1966, Gard. Bull. Singapore **22**: 14. 1967. Type: Solomon Islands, New Georgia, Bupara River, 16 Oct. 1945, *BSIP 192* coll. *Walker & White* (holotype, BRI; isotypes, A, CANB, K, LAE, MEL).

- *C. spectabile* auct., non Willd.; Choisy in DC. Prodr. **1**: 562. 1824; G. Don, Gen. Syst. **1**: 622. 1831, *pro parte;* Moritzi, Syst. Verzeich. Zoll. Java, 25. 1845-46; Choisy, Descr. Guttif. Inde, 43. 1849, Mem. Soc. Phys. Hist. Nat. Geneve **12**: 423. 1851, *pro parte*, in Zoll. Syst. Verzeich. **2**: 149. 1854, Pl. Javan. 10. 1858; Miq. Fl. Indiae Batavae **1**(2): 511. 1859; Planchon & Triana, Ann. Sci. Nat. Bot. IV. **15**: 266. 1862, *pro parte;* T. Anderson in Hook. f. Fl. Brit. India **1**: 271. 1874, *pro parte;* Kurz, Jour. Asiatic Soc. Bengal, II. **43**: 88. 1874, *ibid.* **45**: 119. 1876, Forest Fl. Burma **1**: 94. 1877; Naves in Blanco, Fl. Filip. ed. 3. *t. 241*. 1879; Fernand.-Vill. Novis. App. 17. 1880; Theobald, Burma **2**: 636. 1883; Pierre, Fl. Forest. Cochinch. **1**: *pl. 107*. 1885; Vidal, Rev. Vasc. Pl. Filip. 54. 1886; Vesque, Epharmosis **2**: *tt. 26, 27*. 1889; King, Jour. Asiatic Soc. Bengal, II. **59**: 175. 1890; Vesque in C. DC. Monogr. Phanerog. **8**: 583. 1893; Drake in Grandid. Hist. Nat. Polit. Madagascar **35**: *pl. 356*. 1896; Gamble, Pl. Andaman Is. 6. 1903; Koord. & Valeton, Meded. s'Lands Plant. **61**(Bijd. Booms. Java 9): 386. 1903; Merr. Philip Is. Bur. Gov. Lab. Publ. **27**: 20. 1905; Brandis, Indian Trees, 55. 1907; Pitard in Lecomte, Fl. Gen. Indo-Chine **1**(4): 323. 1910; Koord.-Schum. Syst. Verzeich. **1** (Fam. 187): 5. 1912; Koord. Exkursionsfl. Java **2**: 617. 1912; Koord.-Schum. Syst. Verzeich. **3**(1): 87. 1914; Ridl., Fl. Malay Penin. **1**: 185. 1922, *pro parte;* C. E. Parkinson, Forest Fl. Andaman Is. **1**: 87. 1922; Gagnep. in Humbert, Fl. Gen. Indo-Chine, Suppl. **1**: 274. 1943; H. Perr. Mem. Mus. Nat. Hist. Nat. Paris, n.s. **24**: 77.

1948, in Humbert, Fl. Madagascar Comores, Fam. **136**: 5. 1951, *pro parte;* Pham & Nguyen, Cay-Co Mien Nam Viet-Nam, 179. 1960.

- *C. wallichianum* auct. non Planchon & Triana; Kurz, Jour. Asiatic Soc. Bengal, II. **45**: 119. 1876; Theobald, Burma **2**: 637. 1883; Maheshwari, Bull. Bot. Survey India **2**: 146. 1960, *pro parte.*

- *C. treubii* Koord. ex Koord.-Schum. Syst. Verzeich. (Fl. N. O. Celebes) **3**: 87. 1914, Fl. N. O. Celebes, Suppl. **2**: *pl. 88.* 1922. *nomen.*

- *C. oblongum* Koord. ex Koord.-Schum. Syst. Verzeich. (Fl. N. O. Celebes) **3**: 87. 1914, Fl. N. O. Celebes, Suppl. **2**: *pl. 89.* 1922. *nomen.*

- *C. celebicum* Koord. (*pro majore parte*), *C. minahassae* Koord., et *C. wigmannii* Koord. ex Koord.-Schum. Syst. Verzeich. (Fl. N. O. Celebes) **3**: 87,88. 1914. *Nomina.*

- *C. sorsogonense* Elmer ex Merr. Enum. Philip. Fl. Pl. **3**: 81. 1923, in synon. sub *C. zschokkei, nomen;* Elmer, Leafl. Philip. Bot. **10**: 3744. 1939. *Nomen invalidum*

- *C. inophyllum* auct. non L.; Holthuis, Blumea **5**: 214. 1942.

- *Calophyllum* sp. Walker, Forests Brit. Solomon Is. Prot. 124. 1948.

Large tree up to 25 m tall; trunk bole and straight or low branched, without buttresses, occassional small buttresses present. Outer bark brownish-yellow, more or less deeply fissured. Slash-marked pink to red; exudate whitish. *Youngest twigs* flattened, reddish-brown pubescent; internode 3-7(10) cm long. Uppermost pair of axillary bud 2-5 mm long. Terminal buds 1-2 cm long, with reddish-brown pubescent. *Leaves* petiolate, 1-2 cm long, broadly concave above and convex below, slightly pubescent to glabrous. Lamina oblong-ovate to elliptic-ovate, 6-15 by 3-6.5 cm; apex acute to acuminate, base cuneate, margin entire; coriaceous, drying yellowish-brown to greenish-brown above and brownish-yellow to greenish-brown below, glabrous; midrib on upper surface depressed in channel about 1/4-1/2 of lamina length, under one raised, lateral veins on the both surface distinct, 15-24 veins/0.5 cm. *Inflorescences* axillary, paniculate or pseudo-umbellate cyme, covered by brown pubescent, 2-4 cm long, 11-29 flowers/inflorescence, pedicels 1-3 cm long. *Tepals* 4, the outer pair oval to suborbicular, 3-4.5 by 4.5-5 mm, glabrous or slightly pubescent at margin; inner ones obovate, 5-6.5 by 5-6 mm glabrous or slightly

pubescent at margin. *Stamens* about 59-97 per flower, filament 3-5 mm long, anther 1-2.6 mm long. *Ovary* 2-2.5 mm long, style 3-5 mm long. *Fruits* broadly ovoid to depressed globose, 0.8-1 by 0.7-1 cm; round at apex; blackish, occassionally acute; blackish when ripen. Exocarp plus mesocarp 0.1-0.15 cm thick. Endocarp 0.3-0.7 mm thick, depressed globose, 0.6-0.7 by 0.65-0.7 cm.

T h a i l a n d.- SOUTH-WESTERN: Kanchanaburi PENINSULAR: Chumphon, Ranong, Surat Thani, Krabi, Nakhon Si Thammarat, Phatthalung, Trang, Songkhla.

D i s t r i b u t i o n.- Vietnam to Australia(Northern Territory), the Solomon Islands, and Palau Island; more or less naturalized in the Mascarenes.

E c o l o g y.- Usually found along stream in evergreen forest or in peat swamp area, at ca. 50-300 m. altitude. Flowering and fruiting all year.

V e r n a c u l a r.- Tanghon baiyai (ตังหนใบใหญ่) (Surat Thani).

U s e s.- The wood is not very durable, it is used for masts and spars and in house construction throughout it range (Stevens, 1980)

Figure 22 ***C. soulattri*** **Burman f.**

A Flowering branch.

B Fruiting branch.

C Terminal bud.

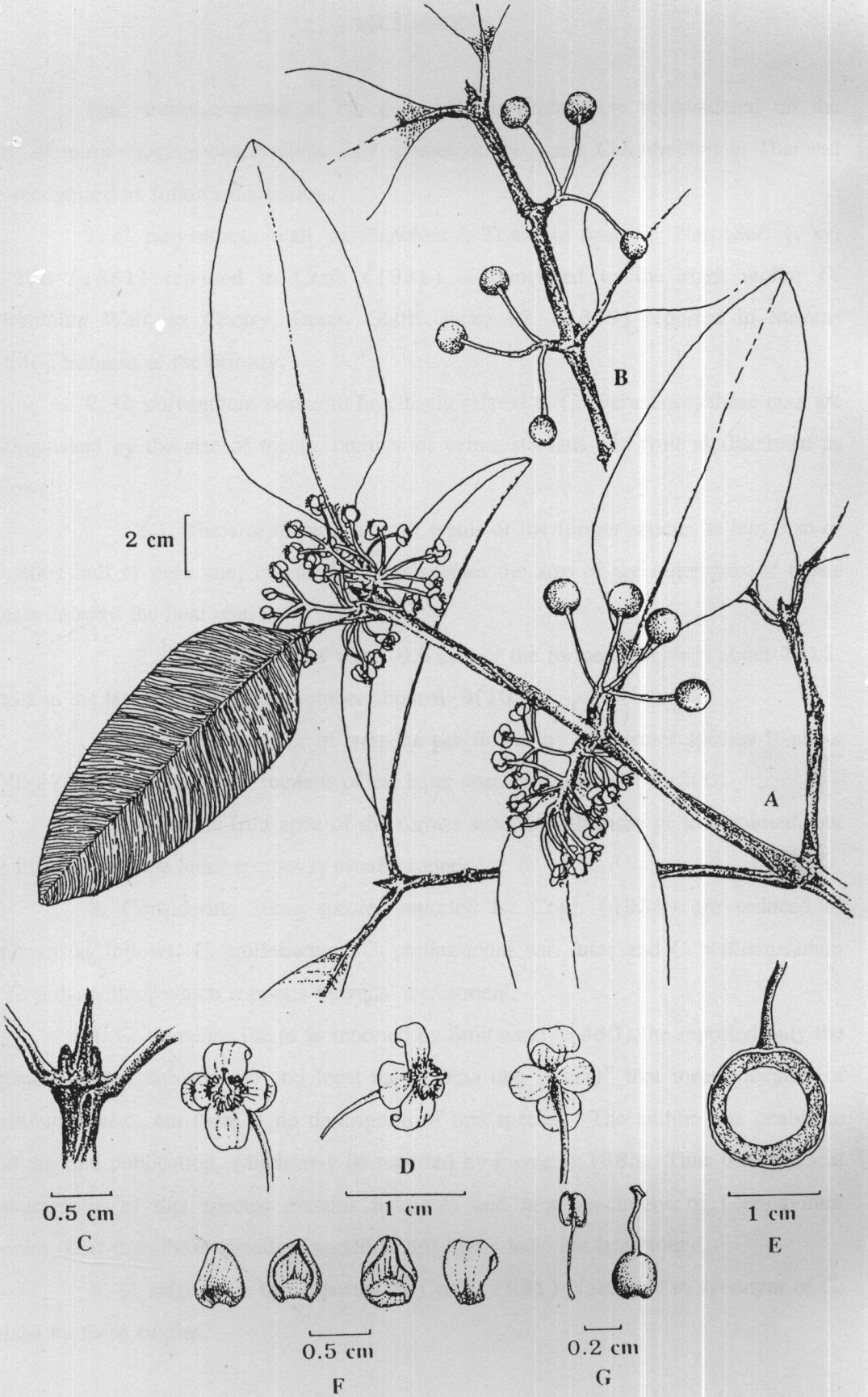
D Flowers.

E Fruit longitudinal section.

F Tepals: a The outer pair of tepals.

b The inner pair of tepals.

G Stamen and pistil.


B
2 cm
A
0.5 cm
C
D
1 cm
1 cm
E
0.5 cm
F
0.2 cm
G

DISCUSSION

The circumscriptions of the genus *Calophyllum* were reconsidered on the basis of morphological observations. 17 species of the genus *Calophyllum* in Thailand are recognized as follows discussion:

1. *C. polyanthum* Wall. ex Planchon & Triana in Ann. Sc. Nat., Ser. 4, xv. p. 278 (1861) reported in Craib (1931) is transfered to the right author *C. polyanthum* Wall. ex Choisy, Descr. Guttif. Inde, 43. (1849) reported in Stevens (1980) because of the priority.

2. *C. polyanthum* seems to be closely related to *C. touranense*; these taxa are distinguished by the size of tepals, number of veins, stamens and fruit as discussed as follows:

2.1. The size of outer pair of tepals of the former species is less than or equalling half of next one, but in the latter species the size of the outer pair of tepals equals those of the next one.

2.2. The number of veins/0.5 cm. of the former species is about 7-15, whilst in the latter species these number about 6-9(10).

2.3. The number of stamens per flower of the former species is about 200-277, while number of stamens of the latter species is about 154-200.

2.4. The fruit apex of the former species with more or less pointed, but the fruit apex of the latter species is usually rounded.

3. Considering some species reported by Craib (1931) are reduced to synonym as follows: *C. smilesianum, C. smilesianum* var. *lutea* and *C. williamsianum* to *C. polyanthum,* which supports Stevens' s treatment.

4. *C. siamense* Pierre as reported by Smitinand (1980), he reported only the botanical name, habit (tree) and local name "Pha ong (Loei)" that means locality of distribution also, but there is no description of this species. The author was unable to find the first publication, which may be reported by Pierre in 1885. Thus the botanical characteristic of this species remains unknown and new specimens of *Calophyllum* species other than those already reported in this thesis have not been found.

5. *C. saigonense* that reported by Craib (1931) is reduced to synonym of *C. calaba* by these studies.

6. These studies can not divided *C. calaba* into 2 varieties, which reported by Stevens (1980). Because the different characters of the 2 varieties are not clear.

7. *C. sclerophyllum*, *C. teysmannii* and *C. canum* are new records for Thailand. These have been recorded in Malesia by Henderson and Wyatt-Smith (1965).

8. For the species *C. depressinervosum*, that the herbarium sheet number "BKF 2484 (SN 027933)" which was collected by "Put" (Collector number: *Put No. 427*) from Chanthaburi, Southeastern Thailand, but the author has not found this species in Southeastern forest complex in these studies. The distribution range of this species is from Chumphon to Narathiwat, in Southern Thailand only.

9. The herbarium sheet for *C. pisiferum* in which "T. Smitinand" (*Collector no. 5723*) reported " tree up to 30 m. tall." may be mistaken, because the several trees of this species were found and these were small trees up to 7 m. tall.

10. The color of exudate from the mature trunk when slash-marked bark as an important character when used with other characters for field identification.

SUMMARY

The following is could be summarizing for this studies:

1. Seventeen species were recorded namely: *C. thorelii, C. touranese, C. polyanthum, C. dryobalanoides, C. symingtonianum, C. macrocarpum, C. sclerophyllum, C. teysmannii, C. inophyllum, C. tetrapterum, C. molle, C. canum, C. calaba, C. rupicolum, C. pisiferum, C. depressinervosum* and *C. soulattri.*

2. Thirteen species were found in the Peninsular as follows; *C. polyanthum, C. symingtonianum, C. macrocarpum, C. sclerophyllum, C. teysmannii, C. inophyllum, C. tetrapterum, C. molle, C. canum, C. calaba, C. rupicolum, C. depressinervosum* and *C. soulattri.*

3. Six species were found in the South-Eastern as follows; *C. thorelii, C. dryobalanoides, C. inophyllum, C. tetrapterum, C. calaba* and *C. pisiferum.*

4. Four species were found in the South-Western as follows; *C. touranese, C. polyanthum, C. inophyllum* and *C. soulattri.*

5. Four species were found in the North-Eastern as follows; *C. thorelii, C. polyanthum, C. touranese* and *C. calaba.*

6. Two species were found in the Eastern as follows; *C. touranese* and *C. calaba.*

7. Only one species found in the North is *C. polyanthum.*

8. *C. symingtonianum, C. macrocarpum, C. sclerophyllum, C. teysmannii, C. molle, C. canum, C. rupicolum* and *C. depressinervosum* were found in evergreen forest, the Peninsular only.

9. Phetchaburi Province, South-Western is the new locality of *C. touranense*; Uthai Thani and Prachuap Khiri Khan Province, South-Western is the new locality of *C. polyanthum*, and Mukdahan, North-Eastern is the new locality of *C. thorelii.*

10. The geographical distribution of *C. calaba* is over all regions of Thailand, except the Northern. An also the ecological distribution of this species is wide range from beach forest to dry dipterocarps forest.

11. The new record to Thailand from this thesis were *C. sclerophyllum, C. teysmannii* and *C. canum.*

Figure 23 ***C. thorelii*** **Pierre**

A Fruiting branch with fruit showing some exocarp plus mesocarp removed and fruit cross section.

B Fruit showing fiber-like mesocarp.

B
A
1CM

Figure 24 ***C. touranense*** **Gagnep. ex P. F. Stevens**

A Flowering branch.

B Fruiting branch with sections of fruits.


1 CM
A
1 CM
B

Figure 25 ***C. polyanthum*** **Wall. ex Choisy**

A Flowering branch.

B Fruiting branch with sections of fruits.


B
1 CM
A
1 CM

Figure 26 ***C. dryobalanoides*** **Pierre**

A Fruiting branch.

B Fruit and sections of fruits.


A
1CM
B
1CM

Figure 27 ***C. symingtonianum*** **M. R. Henderson & Wyatt-Smith**

A Fruiting branch.

B Fruiting branch with sections of fruits.


B
1CM
A

Figure 28 ***C. macrocarpum*** **Hook. f.**

A Flowering branch.

B Fruit and longitudinal sections of fruit.

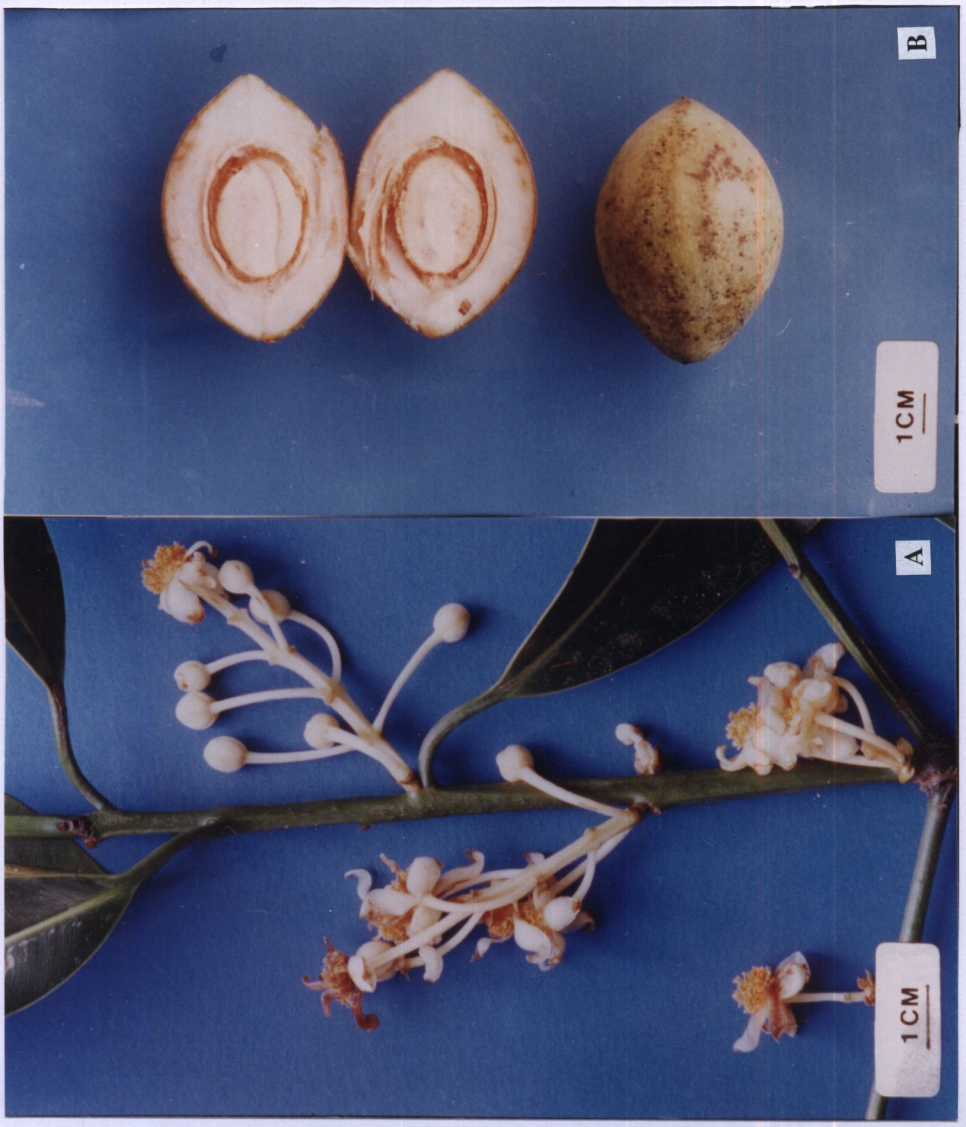

A
1CM
B
1CM

Figure 29 ***C. sclerophyllum*** **Vesque**

A Flowering branch.

B Fruiting branch with sections of fruits.

A
1CM
B
1CM

Figure 30 ***C. teysmannii*** **Miq.**

A Flowering branch.

B Fruiting branch with sections of fruits.

A
1CM
B
1CM

Figure 31 *C. inophyllum* L.

A Flowering branch.

B Fruiting branch.

A
1CM
B
1 CM

Figure 32 ***C. tetrapterum*** **Miq.**

A Flowering branch.

B Fruiting branch.


A
1CM
B
1CM

Figure 33 ***C. molle*** **King**

A Fruiting branch.

B Fruit and seeds with crustose endocarps.

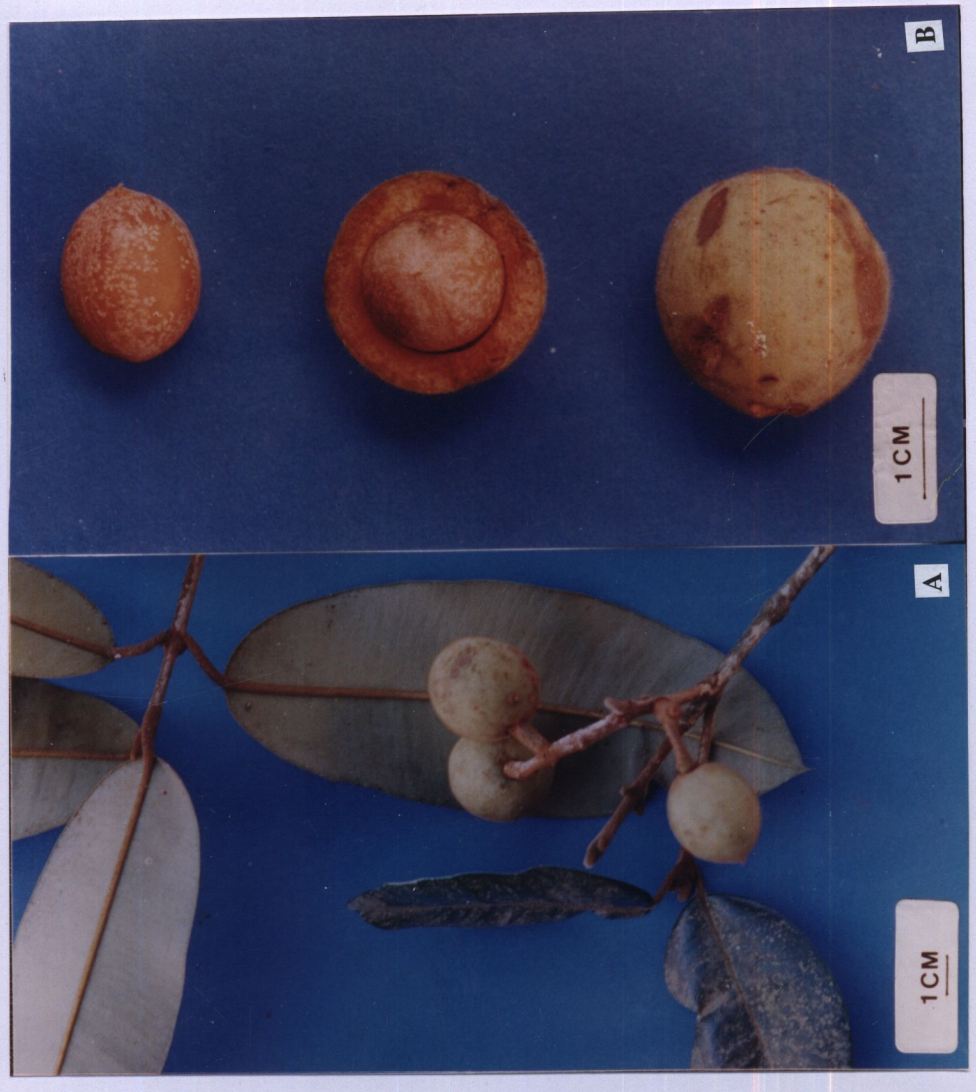

A
1CM
B
1CM

Figure 34 ***C. canum*** **Hook. f.**

A Branch sterile.

B Inflorescence and flowers.

A
B
1 CM

Figure 35 ***C. calaba*** **L.**

A Flowering branch.

B Fruiting branch with sections of fruits.


1 CM
A
1 CM
B

Figure 36 ***C. rupicolum*** **Ridl.**

A Flowering branch.

B Fruiting branch with sections of fruits.

A
1CM
B
1CM

Figure 37 ***C. pisiferum*** **Planchon & Triana**

A Flowering branch.

B Fruiting branch with sections of fruits.

A
1CM
B
1CM

Figure 38 ***C. depressinervosum*** **M. R. Henderson & Wyatt-Smith**

A Branch sterile.

B Fruiting branch with sections of fruits.

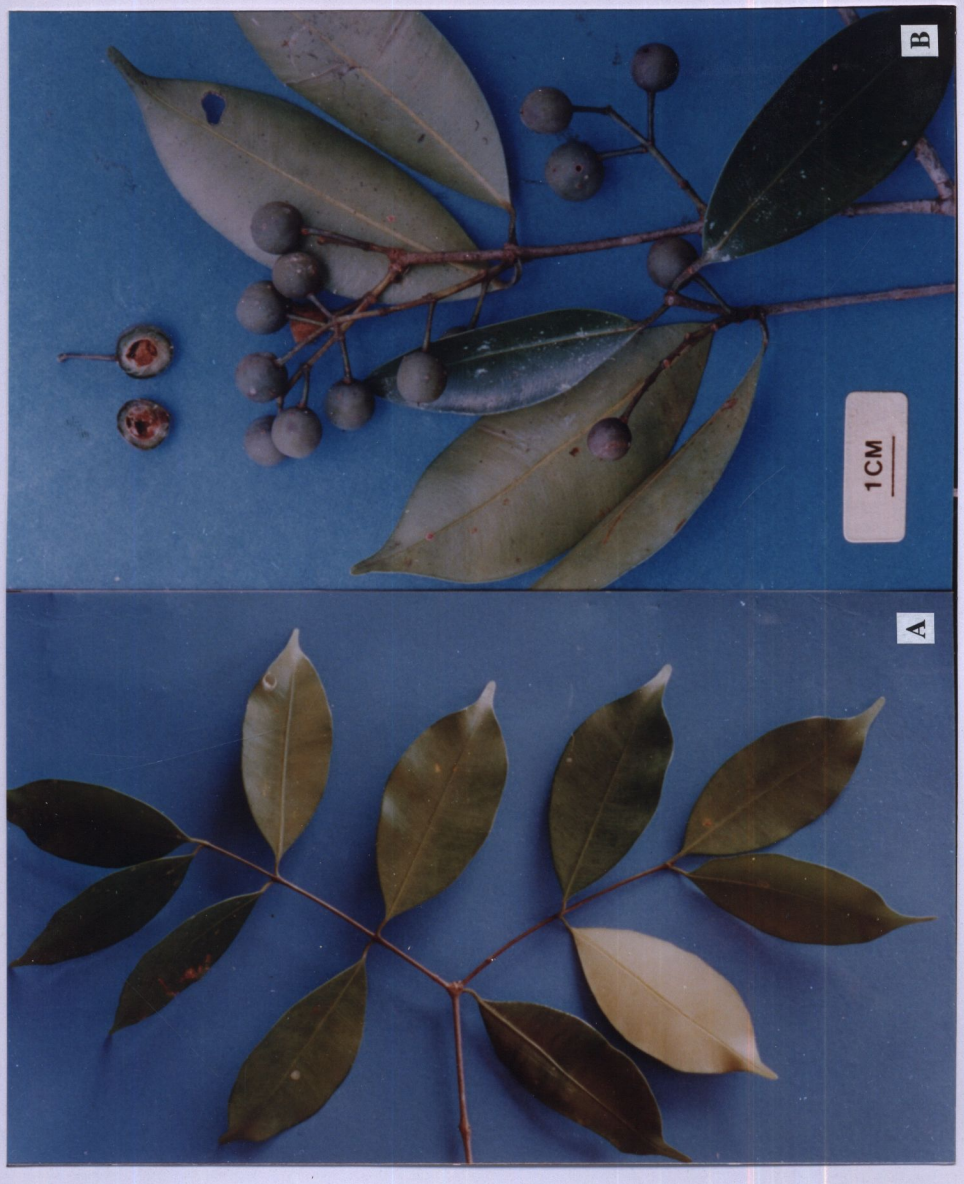

B
1CM
A

Figure 39 ***C. soulattri*** **Burman f.**

A Flowering branch.

B Fruiting branch with sections of fruits and showing seeds.

A
1CM
B
1CM

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APPENDIX

Appendix 1 Some quantitative characters distinguishing in Thai *Calophyllum* species.

	Internode l.	Terminal bud l.	Petiole l.	Leaves s.	No. veins/0.5 cm.	No. fl./infl.	Pedicel l.	No. tepals	The outer pair of tepals s.	The next pair of tepals s.	No. stamens/fl.	Fruit s.	Altitude (m.)
C. thorelii	1-6	0.7-1	1.5-3	7-15 x 3-5	7-12	7-31	0.7-1.5	8	4-5 x 3.5-5	9-10 x 4-5	124-178	2-3 x 1-2	50-300
C. touranense	1.5-4	0.5-0.7	1.5-2.5	6-12 x 2-4	6-9(10)	7-165	0.5-1.3	8	4.5-5 x 3-4	5.5-7 x 4-5	154-200	2-3.5 x 1.5-2.5	700-1200
C. polyanthum	1.5-4	1-2	1.5-2.5	6-15 x 3-5	7-15(20)	21-187	1-1.8	8	3-4 x 3-3.5	5-8 x 4.5-5.5	200-277	3-4 x 2-3	100-200 and 950-1500
C. dryobalanoides	1-2.5	0.4-0.7	0.6-1.5	4-8 x 1.5-3.5	7-9(15)	7-37	0.6-1	8	3.5-5 x 3-4	4-6 x 5-6	142-170	1-1.5 x 0.7-1	900-1000
C. symingtonianum	1.5-3.5	0.6-1.1	1-1.5	6-11 x 2-3.5	8-17	7-11	0.6-1.5	8	3.5-4 x 3-3.5	5-6 x 4-5	46-70	1.7-2 x 1.5-1.7	100-200
C. macrocarpum	1-4	0.5-0.7	1.5-3	8-15.5 x 3-4.5	7-12	5-11	0.7-3.3	8	6-7 x 5-6	7-17.5 x 3-5	160-196	6.5-8 x 4.5-5	100-220
C. sclerophyllum	1-3	0.8-1	1.5-2	10.5-18.5 x 6-9.5	5-9	9-11	1-4	8	6.5-7.5 x 6.5-7	10-13 x 9-9.5	199-356	2.5-3.5 x 2-3	Sea level-10
C. teysmannii	1.5-3.5	0.3-0.45	0.3-0.7	3.5-7.5 x 1.5-3.5	6-10	3-7	1.3-2.3	8	4-5 x 4-4.5	5-8 x 5.5-7	81-212	2-2.5 x 1.8-2	230-315
C. inophyllum	2-3	0.5-1	2-3	10-15 x 5-8	6-8	9-13	0.6-3.7	8	6-7 x 5.5-8	12-15 x 4-8	132-251	3-3.2 x 2.8-3	Sea level
C. tetrapterum	1-3	0.2-0.5	0.5-1.5	3.5-8(10) x 2-3.5	6-15(17)	3-11	0.5-2.5	(4)-8	3-5 x 3-4	4-8 x 3-5	36-86	0.6-1 x 0.5-0.8	sea level-150
C. molle	3-6	1-1.5	1-1.5	8-17 x 3.5-6	12-19	5-11	1-1.85	4	6-8 x 2.5-4	6.5-9 x 4-4.5	207-289	2-3 x 2-2.3	200-300
C. canum	1.5-3	1-1.2	1.5-2	8-15 x 3.5-6	12-18	ca. 13	0.3-0.6	4	5-6.5 x 4-6	5.5-7 x 5-6	564-665	-	200-300
C. calaba	1-3	0.5-0.7	0.3-0.8	3.5-8 x 2-4	12-26	3-11	0.3-1	4	3-5 x 2-3	4.5-7 x 1.5-3	43-95	0.5-1 x 0.5-0.8	sea level-1000
C. rupicolum	1.5-3	0.5-0.7	0.7-1.2	6.5-13.5 x 2-4	6-10	ca. 7	0.3-0.7	4	2.7-3 x 2.2	4-5 x 1.5	ca. 50	0.8-1.2 x 0.6-1	sea level-270
C. pisiferum	(0.5)1-2.5	0.5-0.6	0.3-0.7	3.5-9.5 x 1-2	7-13	7-11	0.5-1.5	4	4-5 x 2-3	5-7 x 3-5	30-70	0.8-1.3 x 0.7-1	sea level-730
C. depressinervosum	1.5-4	0.2-0.35	0.5-1	5.5-9 x 2-3.5	7-12	7-13	0.4-1.3	4	3 x 3	5.5 x 2.5	40	0.8-1 dia.	100-200
C. soulattri	3-7(10)	1-2	1-2	6-15 x 3-6.5	15-24	11-29	1-3	4	3-4.5 x 4.5-5	5-6.5 x 5-6	59-97	0.8-1 x 0.7-1	50-300

Remark: l. = length (cm)

s. = size (cm), except The outer pair of tepals s. and The next pair of tepals s.; s. = size (mm)

- = unknown

Appendix 2 **Index to collector numbers.**

Kerr, A. F. G. ***s.n.***: 9 (BK); ***s.n.***: 13 (BK); **5180**: 3 (BK); **6930**: 10 (BK); **8271**: 13 (BK); **8283**: 15 (BK); **8526**: 13 (BK); **8752**: 3 (BK); **9175**: 10 (BK); **9368a,b**: 1 (BK); **9435**: 15 (BK); **9462**: 4 (BK); **9556**: 1 (BK); **11217**: 9 (BK); **11318**: 13 (BK); **11733**: 13 (BK); **13853**: 13 (BK); **14213**: 10 (BK); **16065**: 13 (BK); **17291**: 13 (BK); **17771**: 10 (BK); **17774**: 15 (BK); **17993**: 13 (BK); **18419**: 13 (BK); **18567**: 10 (BK); **19035**: 17 (BK)

Kid 216: 3 (BKF)

Lakshnakara, M. C. 946: 9 (BK)

Manee, S. 28: 9 (BKF)

Mauric, A. 15: 13 (BKF)

Maxwell, J. F. ***s.n.***: 1 (BK); **74-404**: 1 (BK); **75-430**: 9 (BK); **76-205**: 13 (BK); **76-592**: 13 (BK); **85-65**: 13 (BKF, PSU); **85-417**: 10 (BKF, PSU); **85-766**: 17(BKF); **85-1181**: 13 (BKF); **86-261**: 13 (BKF); **86-546**: 17 (BKF, PSU); **87-194**: 17 (BKF, PSU)

Nitrasirirak, P. 206: 10 (BKF)

Niyomdham, C. 1952: 14 (BKF); **4836a,b**: 8 (BKF)

Niyomdham, C. & D. Sriboonma 1623: 14 (BKF)

Niyomdham, C. & P. Puudjaa 4717: 8 (BKF)

Niyomdham, C. & W. Ueachirakan 1815: 7 (BKF); **1916**: 14 (BKF); **1935**: 14 (BKF)

Niyomdham, C. *et al.* 654: 7 (BKF); **1136**: 13 (BKF); **1225a,b**: 13 (BKF); **2250**: 6 (BKF)

Paisooksantivatana, Y. & S. Sutheesorn 1065-82: 13 (BK); **1070-82**: 13 (BK)

Phengklai, C. & T. Smitinand 6105: 13 (BKF)

Phengklai, C. *et al. s.n.*: 3 (BKF); **3331**: 13 (BKF); **3624**: 13 (BKF); **7049**: 3 (BKF); **7089**: 3 (BKF); **7105**: 3 (BKF)

Phloenchit 624: 6 (BKF)

Phusomsaeng, S. & T. Smitinand 240: 6 (BKF)

Pooma, R. 728: 2 (BKF)

Pooma, R. *et al.* 1446: 3 (BKF)

Premrasami, T. *s.n.*: 13 (BKF)

Put 183: 5 (BKF); **427**: 16 (BKF)(?); **566**: 13 (BK); **567**: 10 (BK); **1155**: 13 (BK); **1156**: 13 (BK); **1562**: 17 (BK); **3668**: 13 (BK); **3670**: 13 (BK); **3785**: 3 (BK); **362/359**: 13 (BK);

Sangkaew, S. 1: 4; **2**: 4; **3**: 3; **4**: 9; **5**: 13; **6**: 13; **7**: 2; **8**: 15; **9**: 10; **10**: 1; **11**: 13; **12**: 1; **13**: 13; **14**: 17; **15**: 6; **16**: 6; **17**: 16; **18**: 16; **19**: 10; **20**: 10; **21**: 6; **22**: 15; **23**: 13; **24**: 16; **25**: 13; **26**: 6; **27**: 6; **28**: 10; **29**: 1; **30**: 15; **31**: 13; **32**: 1; **33**: 3; **34**: 17; **35**: 17; **36**: 17; **37**: 16; **38**: 13; **39**: 13; **40**: 17; **41**: 5; **42**: 10; **43**: 13; **44**: 11; **45**: 16; **46**: 11; **47**: 14; **48**: 12; **49**: 13; **50**: 3; **51**: 6; **52**: 10; **53**: 7; **54**: 11; **55**: 12; **56**: 8; **57**: 8; **58**: 10; **59**: 10; **60**: 1; **61**: 9; **62**: 10; **63**: 7; **64**: 14; **65**: 8; **66**: 3; **67**: 1; **68**: 10; **69**: 13; **70**: 15; **71**:

14; **72**: 7; **73**: 10; **74**: 10; **75**: 13; **76**: 14; **77**: 10; **78**: 10; **79**: 13; **80**: 13; **81**: 10; **82**: 10; **83**: 15; **84**: 15; **85**: 1; **86**: 1; **87**: 101; **88**: 10; **89**: 14; **90**: 16; **91**: 10; **92**: 2; **93**: 5.

Sangkhachan, B. 317: 1 (BKF); **1185**: 13 (BKF)

Sangkhachan, B. ***et al.*** **1067**: 14 (BKF)

Sangkhachan, P. 201: 13 (BK)

Santisuk, T. ***s.n.***: 2 (BKF); ***s.n.***: 3 (BKF); ***s.n.***: 13 (BKF); **797**: 13 (BKF); **1148**: 3 (BKF); **6821**: 3 (BKF)

Santisuk, T. ***et al. s.n.***: 17 (BKF); **5**: 3 (BKF)

Shimizu, T. ***et al.*** **T-20574**: 3 (BKF)

Sirirugsa, P. 592: 10 (PSU); **835**: 13 (BKF)

Siwanna, W. ***s.n.***: 13 (BKF)

Smitinand, T. ***s.n.***: 13 (BKF); **4106**: 3 (BKF); **4157**: 13 (BKF); **5722**: 15 (BKF); **8079**: 13 (BKF); **90-38**: 3 (BKF); **11780**: 3 (BKF); **11960**: 7 (BKF)

Smitinand, T. & J. Turbang 10504: 13 (BKF)

Smitinand, T. & R. G. Robbins 7913: 2 (BKF)

Smitinand, T. ***et al.*** **7708**: 3 (BKF); **7787**: 3 (BKF)

Somkid 535: 9 (BKF)

Sutheesorn, S. 109: 15 (BK); **1070**: 13 (BK); **2204**: 17 (BK); **2227**: 10 (BK); **5342-82**: 13 (BK); **5358**: 13 (BK)

Taengsuwan, J. ***s.n.***: 9 (BKF)

Thaew 77a,b: 9 (BK)

Vacharapong 064: 9 (BK)

Vanpruk, T. S. 268a,b: 9 (BKF); **772**: 9 (BKF)

Wanarak, A. 62: 13 (BK)

Winit 1375a: 3 (BKF); **1375b**: 3 (BK)