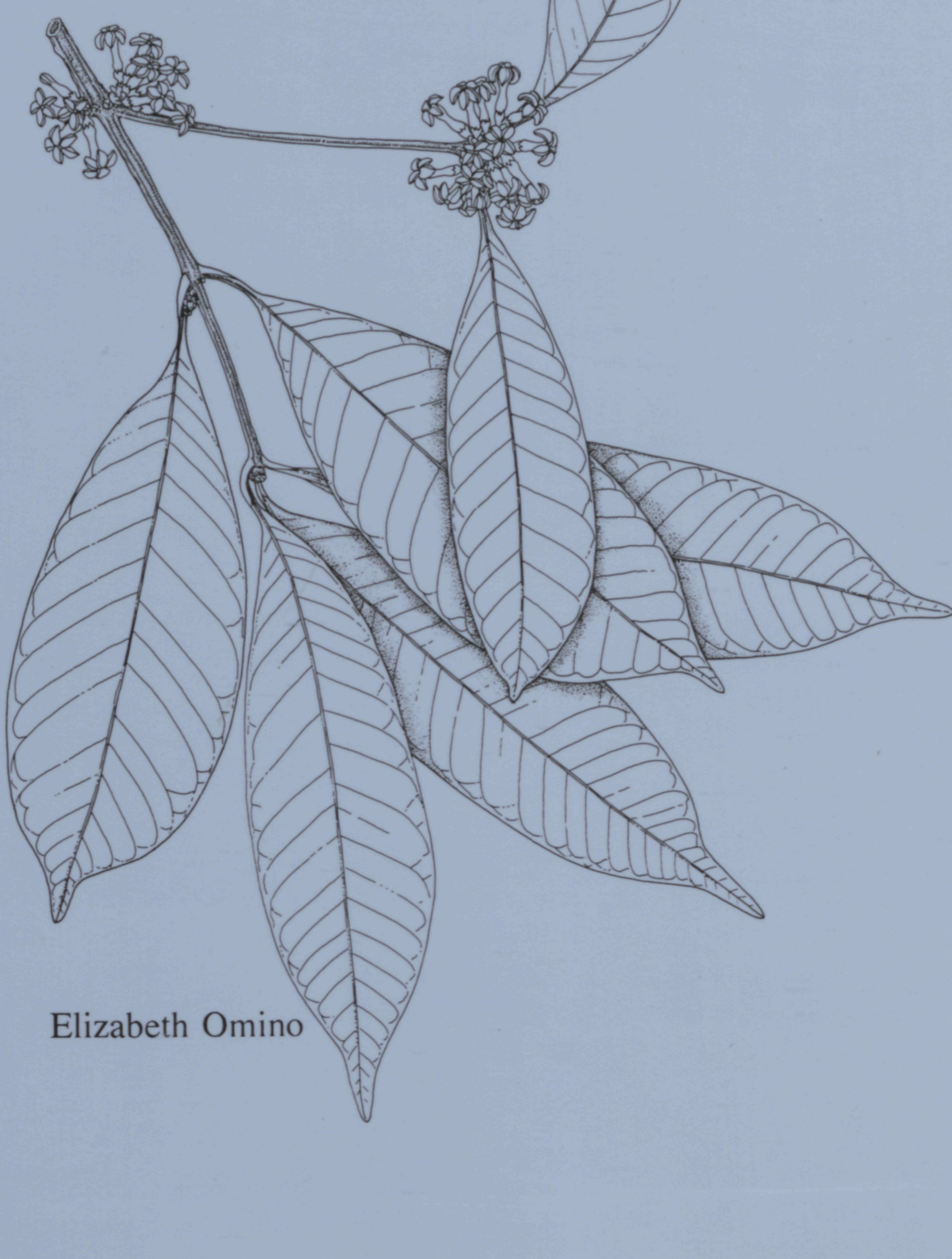
A CONTRIBUTION TO THE LEAF ANATOMY AND TAXONOMY OF APOCYNACEAE IN AFRICA

- The leaf anatomy of Apocynaceae in East Africa
- A monograph of Pleiocarpinae



Elizabeth Omino

Propositions (Stellingen)

1. We come to know our own minds only by explaining ourselves to others. Until we have to defend our opinions in public, they remain half-formed convictions based on random impressions.
   Jean Bethke Elshtain, Democracy on Trial.

2. Apocynaceae leaves exhibit a wide range of variability in anatomical characters, some of which can be confidently used to distinguish the genera and the species.
   This thesis.

3. The genus Pleiocarpa has proved to be extremely variable as a whole, and one cannot merely unravel this mystery based on morphology alone.
   This thesis.

4. Pairs of related genera occurring in different continents will often prove to be congeneric.
   F.J. Breteler, The boundary between Amherstieae and Detarieae (Caesalpinioideae). In: Adv. in Legume Syst. 7: 53-61, 1995.

5. Although the species may be defined as a group of similar organisms that interbreed or share a common lineage of descent, there is no universal agreement on how to define a species.
   V.H. Heywood. In: Global Biodiversity assessment, UNEP 1995.

6. The measure of a truly great man is the courtesy with which he treats a little man.

7. After all the outcry on human rights and equality for women leading to the Beijing conference, the British High Commission cannot, surely, in this time and age equate the Kenyan women with children.
   Recent requirement for all Kenyan women travelling to Britain to obtain written permission from their husbands when applying for a visa.

8. No matter how carefully we may strive to classify various entities of life, there will always be the odd man out.

9. Nothing is as easy as it looks, everything takes longer than you expect. And if anything can go wrong it will, at the worst possible moment.
   Adapted from Murphy's Law.

Propositions belonging to the thesis entitled "A contribution to the leaf anatomy and taxonomy of Apocynaceae in Africa" by E. Omino.

Wageningen, April 22, 1996.

A contribution to the leaf anatomy and taxonomy of Apocynaceae in Africa

- The leaf anatomy of Apocynaceae in East Africa
- A monograph of Pleiocarpinae

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A contribution to the leaf anatomy and taxonomy of Apocynaceae in Africa

- The leaf anatomy of Apocynaceae in East Africa
- A monograph of Pleiocarpinae

(Series of revisions of Apocynaceae XLI)

Elizabeth Omino

PROEFSCHRIFT

ter verkrijging van de graad van doctor in de landbouw- en milieuwetenschappen op gezag van de rector magnificus, Dr C.M. Karssen, in het openbaar te verdedigen op maandag 22 april 1996 des namiddags te vier uur in de Aula van de Landbouwuniversiteit te Wageningen

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TABLE OF CONTENTS

GENERAL SUMMARY

This publication comprises two main parts.

Part one (Chapter 1) deals with the leaf anatomy of Apocynaceae in East Africa, where this family is represented by 77 species in 30 genera. Out of these, 37 species in 26 genera are examined and these exhibit a wide range of anatomical variations. Many species can be separated on the basis of their leaf anatomy and many genera are confirmed to be closely related. The most outstanding anatomical characters include the dorsiventral leaves, presence of laticifers, and bicollateral vascular bundles with intraxylary phloem.

Part two (Chapter 2) is a monograph of the apocynaceous subtribe Pleiocarpinae-Plumeriodeae-Carisseae, which comprises of three genera, *Hunteria* (12 spp.); *Pleiocarpa* (5 spp.) and *Picralima* (1 sp.). The subtribe Pleiocarpinae is restricted to Africa, although one species, *Hunteria zeylanica*, extends to Asia. It is easily distinguished from the other members of the tribe Carisseae by the presence of completely apocarpous ovaries, with 2-5 carpels, which are a great exception in the family Apocynaceae.

The genus *Picralima* was first described by Pierre in 1896 and has since remained monotypic. Its only species, *Picralima nitida*, is not only exploited for its wood, but also used medicinally in its present distribution area and employed as well as an arrow and a fish poison.

In this publication, three new species are described in the genus *Hunteria* (Roxburgh, 1814, 1824) and one new combination is made.

The genus *Pleiocarpa* (Bentham, 1876) has proved to be a very difficult subject due to insufficient collections and lack of sufficient information from the field. At present it has 5 species and one doubtful species of which the collections are all either sterile or only bearing fruits. One new species is described.

Parallel to the investigations reported here a taxonomic treatment was prepared for the Flora of Tropical East Africa. This contribution, covering all the mentioned 30 genera and 77 species, will be submitted to the editors in Kew shortly.

SAMENVATTING

Deze publicatie bestaat voornamelijk uit twee delen.

Hoofdstuk 1 behandelt de bladanatomie van vertegenwoordigers van de in Oost Afrika voorkomende Apocynaceae, een familie die daar 77 soorten in 30 genera telt. Hiervan werden 37 soorten van 36 genera bestudeerd en deze vertonen een grote variatie aan anatomische kenmerkstaten. Veel soorten kunnen worden onderscheiden aan de hand van de kenmerken van de bladanatomie, en de nauwe verwantschappen tussen vele genera kunnen er mee worden bevestigd. De meest opvallende anatomische kenmerken zijn de dorsiventrale bladeren, de aanwezigheid van melksapvaten, en bicollaterale vaatbundels met intraxylair floeem.

Hoofdstuk 2 is een monografie van de subtribus Pleiocarpinae, welke uit drie genera bestaat: *Hunteria* (met 12 soorten); *Pleiocarpa* (5 soorten) en *Picralima* (1 soort). De subtribus Pleiocarpinae van de onderfamilie Plumerioideae, tribus Carisseae, is voornamelijk beperkt tot Afrika, maar één soort, *Hunteria zeylanica*, komt ook in Azië voor. De subtribus verschilt duidelijk van andere in de tribus Carisseae door de aanwezigheid van geheel apocarpe vruchtbeginsels met 2 tot 5 vruchtbladen, hetgeen een grote uitzondering is in de familie Apocynaceae.

Het genus *Picralima* werd door Pierre in 1896 beschreven en is sindsdien monotypisch gebleven. De enige soort, *Picralima nitida*, wordt niet alleen vanwege het hout geexploiteerd, maar ook medicinaal benut en bovendien zowel voor pijlgif als voor visvergift.

In *Hunteria* (Roxburgh, 1814, 1824) worden drie nieuwe soorten beschreven, en er is een nieuwe combinatie gemaakt.

Het genus *Pleiocarpa* (Bentham, 1876) bleek een zeer lastig onderwerp, doordat er weinig materiaal verzameld is en veldgegevens nauwelijks beschikbaar waren. Er worden nu vijf soorten onderscheiden en er is een probleemgeval waarvan de belegexemplaren óf steriel waren óf alleen vruchten dragen. Er is één nieuwe soort beschreven.

Tijdens het onderzoek dat hier wordt gepubliceerd werd ook een taxonomische bewerking voorbereid voor de Flora van Tropisch Oost Afrika. Deze bijdrage die de genoemde 30 genera en 77 soorten omvat, zal binnenkort aan de redactie van de Flora of Tropical East Africa in Kew worden aangeboden.

1 LEAF ANATOMY OF APOCYNACEAE IN EAST AFRICA

1.1 SUMMARY

A study has been made of 37 species in 26 genera of the Apocynaceae in East Africa. The anatomical characters found to be useful in distinguishing taxa are: presence and absence of hairs/domatia, hair types and position on the leaf, cuticular architecture (SEM), stomatal outline, and occasionally density, their leaf venation; in transverse section: petiole/midrib outline, shape of vascular bundle, phloem arrangement, presence or absence of fibres in the petiole, and occasionally spongy mesophyll arrangement and presence or absence of foliar sclerids, arrangement of laticifers at the midrib, sclerenchymatous marginal veins and presence of papillose cells at the margin. The present study confirms a close relationship between the Pleiocarpinae (*Hunteria*, *Picralima* and *Pleiocarpa*); *Motandra* and *Oncinotis*; *Mascarenhasia* and *Funtumia*; *Carissa*, and *Acokanthera* and *Tabernaemontana*, *Voacanga Schizozygia* and *Carvalhoa*.

The most outstanding anatomical characters are the dorsiventral leaves; presence of lalicifers; typically bicollateral vascular bundle in petiole and leaf and presence of intraxylary phloem.

1.2 INTRODUCTION

In East Africa, the plant family *Apocynaceae* is represented by 77 species in 30 general (Table 3). The family is usually subdivided into two subfamilies, Plumerioideae and Apocynoideae. The subfamilies are further subdivided into tribes and subtribes (Table 3). The earliest work on the general leaf anatomy was by Solereder (1899, 1908) followed by Poulsen (1917) and Metcalfe & Chalk (1950). Other work on leaf anatomy includes Sayeed-ud-Din (1941) on *Lochnera pusilla* (now *Catharanthus pusilla*); Holm (1910) on *Apocynum cannabinum*; Ballard (1926), on trichomes in *Apocynum*, Ngan (1965) on the genus *Wrightia*; Newcombe & Patel (1966) on *Voacanga schweinfurthii* (now *V. africana*); Fjell (1983) on *Allamanda neriifolia* (now *A. schottii*), *Thevetia peruviana* and *Vinca minor*; Araujo etal., (1984) on *Plumeria rubra*. Epidermal and venation studies have been carried out by Chandra et al., (1969, 1972); Kapoor et al., (1969); Sharma et al., (1970); Kapoor & Mitra (1979). Extensive stomatal studies in West African species have been carried out by Nyawuame & Gill (1991), other work on stomata include Karatela & Gill (1983). Apart from the stomatal studies in West African species of Apocynaceae and a few remarks on some African genera by Metcalfe & Chalk (1950), leaf anatomy especially of the East African species is hitherto unknown.

In the present paper leaf anatomical characters are described in detail for 26 of the

30 genera in East Africa and their effect on the current taxonomic relationships in the family is discussed at the end of the chapter.

All scientific authorities of the species names have been omitted, these are given in the final index.

1.3 Material and methods

All living material was obtained from the field in Kenya, fixed in FAA and stored in 70% alcohol. Material from Uganda and Tanzania was obtained from Kew and East African herbaria (see appendix 1).

Dried leaves were boiled for several minutes and stored in 70% alcohol. Petiole and leaves were sectioned at the approximate midpoint using a Reichert sliding microtome, cleared with parazone, and mounted in euparol after dehydration through an alcohol series. Technical methods for cuticular preparations, clearing leaves, stomatal counts and measurements for lamina thickness are adapted from Wilkinson (1989).

1.4 Observations

Characteristics of the family Apocynaceae as a whole:

Leaves: opposite, rarely alternate or bunches set close together as in *Adenium obesum*, or whorled as in *Rauvolfia*, *Pleiocarpa* and *Alstonia*; petiolate, rarely sessile as in *Voacanga africana*, entire; texture varies from membranaceous as in *Carvalhoa campanulata* to coriaceous as in *Carissa* and *Acokanthera*, to succulent as in *Adenium obesum*; size ranges from 0.8-3.6 × 0.3-1.4 cm in *Strophanthus mirabilis* to 1.8-50(-70) × 0.8-19 cm in *Rauvolfia caffra*; petiole with colletors and axils of secondary veins with domatia as in *Motandra*, *Baissea* and *Oncinotis*; blade obovate to linear as in *Adenium obesum* to elliptic as in *Clitandra cymulosa*; completely glabrous as in *Hunteria* to densely short-pubescent as in *Strophanthus hypoleucos*.

Leaf venation: According to the terminology proposed by Hickey (1979) for the architecture of dicotyledonous leaves, all the species studied have camptodromous leaves, as the secondary veins do not terminate at the margin. The venation is either brochidodromous with secondaries joined together in a series of prominent arches (Figs:22A, B) or eucamptodromous with secondaries connected to superadjacent veins by a series of cross-veins without forming prominent marginal loop (Fig 22c).

Leaf surface

Hairs: present on the petiole as in *Dictyophleba*, *Ancylobotrys* and *Carissa* (Fig. 1C, F); on both surfaces of midrib as in *Baissea myrtifolia* and *Holarrhena pubescens* (Fig. 1I, B); on adaxial midrib as in *Carissa tetramera* or on abaxial leaf surface as in *H. pubescens* and *Stephanostema stenocarpum*. Hairs simple, uniseriate, 1-20-

celled; thin-walled, short as in *Mascarenhasia arborescens* (Fig. 1E); thick walled, long and straight as in *Holarrhena pubescens* (Fig. 1B); thick-walled, curved, with very short cells as in *Dictyophleba lucida* (Fig. 1F); thick-walled, hooked, but with longer basal cells and shorter terminal cells as in *Baissea myrtifolia* (Fig. 1I). Glandular hairs with three basal cells have been observed in the petiole of *Motandra guineensis* (Fig. 1D). Tufts of hairs (domatia) are present in the axils of secondary veins e.g. in *Baissea myrtifolia*, with long curled hairs (Fig. 3E) and in *Oncinotis tenuiloba* with short straight hairs (Fig. 3F).

Cuticular surface: smooth as in *Diplorhynchus condylocarpon* (Fig. 2A) and *Carissa tetramera* (Fig. 5C); with wings of striae across subsidiary cells as in *T. stapfiana* (Fig. 5B); with concentric rings of striae over subsidiary cells as in *Strophanthus courmontii* (Fig. 4C); with ridges extending from the stomatal poles as in *Stephanostema stenocarpum* (Fig. 5A); with striations confined to each cell as in *Schizozygia coffaeiodes* (Fig. 2D) or striate over the whole surface as in *Tabernaemontana stapfiana* (Fig. 2C).

Stomata: distribution hypostomatic in almost all species examined except in *Strophanthus courmontii* (Fig. 6A), *Schizozygia coffaeiodes*, *Voacanga africana* and *V. thouarsii* where it is amphistomatic and in *Carissa edulis* where a few stomata overly the adaxial midrib. In this case the stomata found on the adaxial surface are very few and larger than the ones on the abaxial surface (Fig. 6A, B).

Stomata outline: broadly elliptic as in *Carissa tetramera* (Fig. 5C); narrowly elliptic as in *Rauvolfia mannii* (Fig. 7G); circular as in *Ancylobotrys tayloris* (Fig. 5E).

Density per mm²: (Table 2): lowest in *Tabernaemontana pachysiphon* (31-56-69) and highest in *Dictyophleba lucida* (700-825-925).

Stomatal size: (Table 2): ranging from 14.6-16.6 μm long in *Landolphia watsoniana* to 26.4-36.5 μm long in *Tabernaemontana stapfiana*.

Subsidiary cells: in most cases the subsidiary cells were readily distinguished from adjacent epidermal cells by their specially thin cuticle; paracytic (Fig. 7D, F, G), sometimes extending over one or both poles (laterocytic) as in *Carvalhoa campanulata*, *Holarrhena pubescens* (Fig. 6D) and *Stephanostema stenocarpum*; usually with one or two pairs of subsidiary cells, rarely 3 pairs as in *Acokanthera oppositifolia* (Fig. 6F); occasionally paracytic cells subdivided by radiating walls on one or both sides as in *Strophanthus courmontii* (Fig. 6B); anomocytic and anisocytic as in *Hunteria congolana*; anomocytic with 5-8 cells around the stoma as in *Clitandra cymulosa* and 3-6 cells as in *Dictyophleba lucida* (Fig. 6H); cyclocytic or cyclocytic-tetracytic with 3-4 subsidiary cells as in *Pleiocarpa* (fig 7B), with 7-8 subsidiary cells as in *Carissa edulis*; tetracytic with 4 subsidiary cells as in *A. oppositifolia* (Fig. 6F); occasionally complex as in *A. oppositifolia*. Primary stomata observed in several species of most genera (Fig. 4C); double stomata present in several species (Fig. 6B); single guard cell observed in *Holarrhena pubescens.*

Anticlinal walls: (Table 2), ± straight on both sides as in *Acokanthera oppositifolia* (Fig. 6E, F); very undulate on both sides as in *Baissea myrtifolia* (Fig. 7C, D); slightly undulate on both sides as in *Rauvolfia mannii* (Fig. 6E, F); adaxial straight, abaxial undulate as in *Oncinotis tenuiloba* and *Rauvolfia mombasiana* (Fig. 7G, H).

T.S. (Transverse Section) of leaf lamina (Figs. 13, 14)

Thickness: (Table 1), ranging from 82-110 μm in *Baissea myrifolia* to 384-458 μm *Acokanthera oppositifolia.*

Cuticle and outer periclinal walls: (Fig. 8, 9,) the outer cuticle is of even thickness along the lamina (Fig. 8A, K, W) and of even thickness to crenate at the midrib and margin (Fig. 9H, I, J, K, L, T); generally thicker at the midrib and margin in all species examined (Fig. 9A, B, G, M, P, T); ranging from 1 μm in *Carvalhoa campanulata* to 9.4-48 μm in *Acokanthera oppositifolia.*

Epidermal cells: (Fig 8, 9), more or less rectangular in most of the species examined (Fig. 8 A, B, O, S, T); Table 1, to almost square or taller than wide as in *Adenium obesum* which has the largest epidermal cells (up to 68.4 × 61.8 μm) (fig. 8C); adaxial epidermal cells generally larger than abaxial (Fig. 8C, D), occasionally of ± the same size as in *Diplorhynchus condylocarpon*; usually smaller, taller than wide and with an obtuse apex at the midrib in *Adenium obesum* (Figs. 9C, D) and *Oncinotis tenuiloba*; with an acute apex as in *Mascarenhasia arborescens* (Figs. 9I, J). Adaxial epidermal cells 1-layered in most species; 2-layered at the midrib and margin as in *Mascarenhasia arboresens* (Fig. 9S); intermittently 2-layered with larger cells in the second layer in *Ancylobotrys tayloris* (Fig. 8E); irregularly 2-3-layered, sometimes with tangential divisions in *Funtumia elastica* and *Tabernaemontana pachysiphon* (Figs. 8M, U, W 18F); abaxial mostly 1-layered; 1-2-layered as in *F. elastica* and *T. stapfiana* (Figs. 8N, X).

Stomata T.S.: (Figs. 10 & 11), Stomata level with the cuticular surface as in *Oncinotis tenuiloba* (Fig. 11D), *Adenium obesum* or *Alafia microstylis*; raised on abaxial surface as in *Strophanthus courmontii* and *Tabernaemontana pachysiphon* (Figs. 11F, H); sunken on adaxial surface as in *Strophanthus courmontii* and abaxial surface *Voacanga thouarsii* (Figs. 11E, J); with a very thick cuticular ledge as in *Acokanthera oppositifolia* and *Picralima nitida* (Figs. 10A, 11A); with smaller cuticular ledges in several other species (Figs. 11B, C, I, 10B, C, F, H, I).

Mesophyll: (Table 2; Fig. 12), bifacial in all the species examined except in *Saba comorensis* (Fig. 12A) and where it is homogenous (the palisade and spongy tissue cannot be distinguished). In some species like *Acokanthera oppositifolia* there are 2-3 layers of poorly developed palisade-like cells above the lower epidermis (Fig.

12E), 3-rows in *Carissa edulis*, 2-rows in *Clitandra cymulosa* (tendency to be isobilateral).

Palisade tissue: (Table 1), the palisade tissue consists of 1-4 layers of regularly arranged cells elongated at right angles to the adaxial epidermis; it may extend to the midrib as in *Tabernaemontana elegans* (Fig. 15F) or leave a gap as in *Saba comorensis* (Fig 15D); it is 1-layered in *Holarrhena pubescens* (Fig. 12B), *Baissea myrtifolia* and *Carvalhoa campanulata*; 2-layered as in *Clitandra cymulosa* and 3-4-layered as in *Strophanthus courmontii*, *Tabernaemontana elegans* (Fig. 12D) and *T. stapfiana*. In the multiseriate palisade tissue the outermost cells are the longest, the innermost the shortest; palisade cells are characteristically short in *Strophanthus courmontii* and several times longer than wide as in *Carissa tetramera* (Fig. 16B), *Rauvolfia caffra*, *Landolphia buchananii* and *Funtumia elastica* (Fig. 17E).

Spongy mesophyll cells: (Fig. 12), appear less regular; transversely elongated and compact as in *Hunteria congolana* and *H. pubescens* (Fig. 12B), or less compact as in *Tabernaemontana elegans* (Fig. 12D) except in *Saba comorensis* where all the cells are vertically elongated and very compact (homogenous) (Fig. 12 A) and in *Ancylobotrys tayloris* where they are also more or less elongated perpendicular to the leaf surface, but very lacunate (Fig. 12C), and in *Diplorhychus condylocarpon* where they are less lacunate (Fig. 12F) and in *Adenium obesum* where they are more or less irregularly arranged.

Minor veins: embedded in most of the species examined, collateral, with xylem on adaxial and phloem on abaxial side; xylem vessels usually surrounded by thick-walled fibres as in *Pleiocarpa bicarpellata* (Fig. 16F), the larger veins of *Acokanthera oppositifolia* are bicollateral; transcurrent as in *Diplorhynchus condylocarpon* (Fig. 12F), *Ancylobotrys petersiana* and *Saba comorenis* (Fig. 12A) with girders towards one or both epidermis (Figs. 12A, F). Girders and bundle sheath cells composed of thin- to thick-walled parenchyma cells (Fig. 16F).

Midrib: (outlines illustrated in Figs. 13 & 14).

Thickness: thickest in *Tabernaemontana stapfiana* (2013-2141 µm) and thinnest in *Baissea myrtifolia* (201-238 µm); adaxial outline ± straight as in *Motandra guineensis* (Fig. 14B) and *Baissea myrtifolia* (Fig. 13F); prominent as in *Holarrhena pubescens* and *Tabernaemontana pachysiphon* (Figs. 13N, 14N, 15B); abaxial ± straight as in *Ancylobotrys tayloris* and *Pleiocarpa pycnantha* (Figs. 13E, 14E, 15E), very prominent as in *Tabernaemontana elegans* (Fig. 15F); outline ± straight on both sides as in *Diplorhynchus condylocarpon* and *Landolphia watsoniana* (Figs. 13L, R).

Vascular bundle bicollateral, usually consisting of one median crescentic bundle (Figs. 13, 14) but may have small accessory bundles as in *Pleiocarpa pycnantha* (14E); usually in the form of a shallow arc as in *Carissa edulis* (Fig. 13G) although it may rarely be crenate as in *Pleiocarpa bicarpellata* (Fig. 14D), comparatively deep as in *Mascarenhasia arborescens* (Fig. 14A) and v-shaped as in *Tabernaemontana* (Figs. 14M, N, O); ends of bundle in contact with one another, forming a cylindrical bundle as in *Landolphia* and *Clitandra* (Figs. 13J, Q), in this case the top part of the bundle is predominantly composed of fibres (Fig. 15C); with a lower crescentic bundle and five smaller ones at the top as in *Saba comorensis* (Fig. 15D); in *Clitandra cymulosa* the outer phloem is surrounded by lignified tissue.

Phloem: generally surrounds the xylem as in (Figs. 13, 14), but may extend across the bundle as in *Ancylobotrys*, *Tabernaemontana* and *Landolphia* (Figs. 13D, E, 14N, O); may also form islands of phloem in the middle of the bundle as in *Dictyophleba lucida* and *Tabernaemontana elegans* (Figs. 13K, 14M, 15F); the islands of phloem may alternate with thick-walled mucilaginous fibres as in *Oncinotis tenuiloba* (Fig. 16A) and *Motandra guineensis*.

Fibres: mucilaginous fibres usually present in groups of 1-20 immediately below the vascular bundle (Fig. 16F), may extend to the abaxial side which usually has less fibres. Lignified, thick-walled fibres present on the adaxial side of the bundle in *Carissa tetramera*.

Laticifers: (Fig. 17) The laticifers are typically branching tubes with thin, smooth walls and no dividing transverse walls (Fig. 17B, C, E). The degree of branching varies from species to species and may be very branched as in *Funtumia elastica*, (Fig. 17E) to less branched as in *Landolphia*. The laticifers are mostly narrower than the surrounding cells (6-13 μm diam.) but may be very wide as in *Carissa* and *Acokanthera* (32 μm diam.) and become increasingly narrower towards the epidermis (Fig. 17B). They ramify throughout the mesophyll, commonly following the veins (Fig. 17A, D) and ramify outwards towards the epidermis as in *Adenium obesum* (Fig. 17B) or towards the palisade as in *Holarrhena pubescens*. Also observed adjacent to the inner periclinal walls of the adaxial epidermis, above the palisade tissue as in *Strophanthus courmontii* and *Hunteria zeylanica*; present in the ground tissue of the petiole ramifying towards the epidermis as in *H. pubescens* and *Ancylobotrys petersiana* (Fig 17C).

Crystals: (Fig. 18), clustered, solitary, small prismatic or rhomboidal crystals of calcium oxalate recorded. Clustered crystals occur in large idioblasts as in *Hunteria zeylanica*, mainly in the palisade tissue (Fig. 17E, 18A); in enlarged cells in the first layer of the spongy mesophyll as in *Holarrhena pubescens* or in the entire mesophyll as in *Funtumia elastica* and *Oncinotis tenuiloba* (Fig. 18B); in layers of 2-4 crystals above the minor veins as in *Rauvolfia caffra* and *R. mombasiana* (Fig. 18E); in the ground tissue of the midrib especially in *Schizozygia coffaeoides* and *Funtumia elastica*. Smaller crystals common in the layer above the lower epidermis in most species. Solitary crystals occasional in both epidermis of *Pleiocarpa bicarpellata* and *Hunteria*; solitary and crystals of irregular shape frequently abundant in the in the phloem of most of the species investigated and in the ground tissue of the midrib of *Motandra guineensis* alternating with clustered crystals; along the veins in *Dictyophleba lucida* (Fig. 18D).

Margin: (Fig. 19) usually straight as in *Acokanthera oppositifolia* (Fig. 19A) to revolute as in *Schizozygia coffaeoides* (19B); slightly revolute (downcurved) at the tip with a rounded apex as in *Carissa tetramera* (Fig. 19C). Epidermal cells may be small as in *Diplorhynchus condylocarpon* and *Baissea myrtifolia* (Fig. 9Q); extremely large and with an obtuse apex as in *Adenium obesum* (Fig. 9N, 19D), acute as in *Carissa edulis* to long, pointed and papillose as in *Acokanthera oppositifolia* (Fig. 9M, 19A). Marginal vein with a well developed sclerenchymatous bundle sheath of several layers in *Carissa tetramera* (Fig. 19C) and *A. oppositifolia*, and *Dictyophleba lucida* (Fig. 19C).

Petiole: (Figs. 20 & 21), Outline varies from ridged on the abaxial and canaliculate on adaxial as in *Funtumia elastica* (Fig. 20G) or straight on adaxial as in *Adenium obesum* (Fig. 20B) to subglobose as in *Schizozygia coffaeoides* (Fig. 21D) to circular as in *Dictyophleba lucida* (Fig. 20F). Vascular bundle bicollateral, of one crescentic median bundle which may be shallow as in *Adenium* (Fig. 20B); deep and with incurved edges as in *Hunteria* and *Pleiocarpa* (Figs. 20H, 21C) to almost cylindrical as in *Ancylobotrys*, *Dictyophleba* or *Motandra* (Fig. 20C, F, 21A); to cylindrical but flattened on the adaxial side to form a semi-circle as in *Clitandra cymulosa* and *Saba comorensis* (Fig. 20D, 21B). Vascular strand strongly supported in the pericyclic region by thick-walled mucilaginous fibres in *Hunteria*, *Pleiocarpa* (Fig. 16C) and *Picralima*. Cluster crystals present in the ground tissue of the petiole in *Funtumia elastica*, *Mascarenhasia arborescens* (Fig. 18C), *Schizozygia coffaeoides* and in *Motandra guineensis*, styloids also present.

YOUNG STEM (Transverse section):
The stem of 20 species of Apocynaceae was examined. All had the similar type of arrangement in cross section (Figs. 22E, F), with the epidermis outermost; followed by the cortex, sometimes with solitary or grouped stone cells; then the pericycle with white, sometimes mucilaginous, unlignified fibres, mostly in groups; followed by the phloem; then the xylem which forms a continous cylinder traversed by narrow rays; all the species have an intraxylary phloem at the margin af the pith; pith frequently containing sclerosed elements as in *Acokanthera*, *Carissa*, *Hunteria*, *Landolphia*, *Picralima*, *Pleiocarpa* and *Tabernaemontana* (Figs. 22 D, F). According to Mecalfe and Chalk (1950), no pericyclic fibres were seen *Rhazya orientalis* (Dcne.) A. DC. *Amsonia orientalis* Dcne.Latifers are present in all the species examined and is generally situated in the primary cortex, pericycle, phloem and pith (Fig. 17F).

1.5 CHARACTERISTICS OF THE GENERA

1.5.1 **Acokanthera** G. Don

(Figs. 3D, 6E, F, 8A, B, 9A, B, M, 10A, M, 12E, 13A, 17A, 19A, 20A; Tables 1, 2, 3; Appendix 1)

A genus of 5 species, mainly trees or shrubs from Yemen to South Africa. It is represented by three species in East Africa. *A. oppositifolia* is examined here.

Leaf surface
HAIRS: absent. CUTICULAR SURFACE (SEM): more or less smooth but very uneven on both surfaces. STOMATA (Table 2): hypostomatic; paracytic, with 2-3 pairs of subsidiary cells and cyclocytic-teracytic, sometimes with very complex subsidiary cells Figs. 6E, F). outline broadly elliptic to circular and rounded at the poles, with wide rims and a round aperture; subsidiary cells obscured by thick peristomatal rims; size 15-22 × 11.5-16 μm; density per mm² 650-719. EPIDERMAL CELL OUTLINE: indistinctly visible as grooves. ANTICLINAL WALLS (LM): straight to slightly curved on both sides (Figs. 6E, F).

T.S. lamina
THICKNESS (Table 2) 384-458 μm thick. CUTICLE: adaxial 19-26.6 μm thick, abaxial 9.4-15 μm thick, very thick at the midrib, even thicker at the margin at 22-48 μm. ADAXIAL EPIDERMAL CELLS: 1-layered, rectangular, 11-19 × 19-40 μm, much smaller at the midrib. ABAXIAL EPIDERMAL CELLS: 1-layered, 11.4-19 × 5.7-28.5 μm, much smaller than adaxial, even smaller at the midrib, triangular and acute at the apex. STOMATA (T.S.) (Fig. 10A): with a very thick cuticular ledge and wide aperture. MESOPHYLL: bifacial; palisade extends to the midrib, in 2(-3) rows, with 1-2 layers of poorly developed palisade on the abaxial side (Fig. 12E); spongy mesophyll with somewhat horizontally elongated cells, with ample air spaces. MINOR VEINS: small veins collateral with xylem on the adaxial and phloem on the abaxial side; larger veins bicollateral, with a lot of fibres on the lateral and abaxial side of the xylem tissue. MIDRIB (Fig. 13A; Table 1): 677-732 μm thick; abaxial outline almost flat to slightly curved; abaxial with a slight ridge. Vascular bundle bicollateral, forming a shallow arc, with 6-10 mucilaginous fibres on the adaxial side, xylem tissue with a lot of thick-walled, xylem fibres on the adaxial and lateral sides (Fig. 17A). Collenchyma on the adaxial periphery of the midrib. MARGIN: straight, with a marginal vein surrounded with several layers of sclerenchymatous tissue; cuticle very thick; epidermal cells papillose, pointed (Fig. 19A) CRYSTALS: cluster crystals (druses) present in the palisade layer, especially in the 2nd row and the layer immediately above the lower epidermis. LATICIFERS: always accompany the veins, quite prominent at the midrib (Fig. 17A), branching throughout the mesophyll towards the adaxial or abaxial epidermis, becoming increasingly narrower at the point of branching.

T.S. petiole
Vascular bundle bicollateral, forms a relatively deep arc with incurved edges (Fig. 20A), with small accessory bundles predominantly surrounded with thick-walled fibres; Laticifers observed along the veins as in the midrib; ground tissue predominantly parenchymatous, lignified, with pits.

Comments:
This species exibits various xeromorphic characters such as coriaceous leaves, thick cuticle and outer epidermal cell walls as well as a tendency towards being isobilateral. The stomata has a very thick cuticular ledge.

1.5.2 **Adenium** Roem. & Schult.

(Figs. 8C, D, 9C, D, N, 10B, 13B, 17B, 19B, 20B; Tables 1 & 2, 3; Appendix 1)

A genus of 6 species, mainly succulent shrubs or trees up to 5 m tall in Africa from Senegal in the West to South Africa. Represented by *Adenium obesum* in East Africa which extends to Socotra and the extreme southern part of Arabia, and is examined here.

Leaf surface
HAIRS: absent. CUTICULAR SURFACE (SEM): adaxial surface smooth, abaxial striate over the whole surface. STOMATA: hypostomatic and paracytic, occasionally subsidiary cells subdivided by radiating walls on one or both sides or sometimes cyclocytic-staurocytic with 3-4 cells around the stomata; outline elliptic; size 23-33.5 × 19-22.5 μm; density per mm² 150-188. EPIDERMAL CELL OUTLINE (SEM): adaxial with cuticular ridges over anticlinal walls, smooth within the cells. ANTICLINAL WALLS (LM): adaxial straight angular, abaxial straight to very slightly curved.

T.S. Lamina
THICKNESS (Table 1, Fig. 13B): 403-439 μm. CUTICLE: thickest on adaxial epidermis and leaf margin, thinnest on lower epidermis. ADAXIAL EPIDERMAL CELLS (Fig. 8C): regular, 1-layered, very large, 43.7-68.4 × 28.5-61.8 μm, taller than wide, smaller at the midrib. ABAXIAL EPIDERMAL CELLS (Fig. 8D): irregular, 1-layered, 19-28.5 × 15.2-57 μm, wider than tall. STOMATA (T.S.) (Fig. 10B): slightly raised and with a wide aperture. MESOPHYLL: bifacial; palisade layers 1-2, does not extend to the midrib; spongy mesophyll cells more or less irregularly arranged and quite compact. MINOR VEINS: collateral, with a parenchymatous sheath. MIDRIB (Fig. 13B; Table 1): 1245-1263 μm thick, with a prominent abaxial ridge and a slight adaxial projection. Vascular bundle crescent-shaped, bicollateral; ground tissue of midrib collenchymatous towards the periphery, especially on the abaxial side. MARGIN: slightly revolute at the tip, with collenchyma at the acute tip; epidermal cells taller than wide with a rounded apex (Figs. 9N, 19D). CRYSTALS: none seen. LATICIFERS (Fig. 17B): many, branched throughout the mesophyll;

along the veins; branching below the palisade and epidermis; between the palisade and epidermal cells and towards the abaxial or adaxial epidermis.

T.S. petiole
Vascular bundle bicollateral, forming a shallow arc, with accessory bundles at the wings (20 B); collenchyma cells at the periphery; epidermal cells very small.

Comments: the leaves examined have no hairs, but the leaves of this genus are usually glabrous to hairy. Nyawuame & Gill (1991) recorded anomocytic stomata in *Adenium obesum* with straight anticlinal walls on both leaf surfaces and the agenous type of stomatal development.

1.5.3 **Alafia** Thouars

(Fig. 90, 13C; Table 1, 2; Appendix 1)

A genus of 23 lianescent species in Africa. Represented by 5 species in East Africa. *A. microstylis* is examined here.

Leaf surface
HAIRS: absent. CUTICULAR SURFACE (SEM): smooth. STOMATA: hypostomatic; paracytic; outline elliptic, size 18-25 × 19-20 µm; density per mm² 140-150. EPIDERMAL CELL OUTLINE (SEM): undulate ANTICLINAL WALLS (LM): both undulate.

T.S. lamina
THICKNESS (Table 1) 256-302 µm. CUTICLE: 1.9-2.9 µm thick on both sides, 3.8-4.8 µm thick around the midrib. ADAXIAL EPIDERMAL CELLS: 1-layered, 13.3-18 × 13.3-34.2 µm, rectangular, 2-layered at the midrib and leaf margin, thick-walled. ABAXIAL EPIDERMAL CELLS: 1-layered, 8.6-12.4 × 13.3-32.3 µm, narrower. STOMATA (T.S.): more or less level with the surface. MESOPHYLL: bifacial; palisade 15-36 × 4-13 µm, in 1-2(-3) rows, extends to the midrib; spongy mesophyll with somewhat horizontally elongated cells, not compact. MINOR VEINS: embedded, collateral, with xylem surrounded with thick-walled fibres, phloem abaxial, with an outer parenchyma sheath; larger minor veins bicollateral. MIDRIB (Table 1; Fig. 13C): 402-439 µm thick; adaxial outline with a slight depression, abaxial slightly projecting. Vascular bundle bicollateral forming a shallow crescentic arc with islands of mucilaginous fibres below. Collenchyma present only on the adaxial periphery. MARGIN: straight, epidermal cells smaller (Fig. 90); cutin thick. CRYSTALS: a few large clustered crystals in the mesophyll, smaller ones on the row above lower epidermis; a few rhombohedra and many small clustered crystals in the phloem. LATICIFERS: accompany the veins; branching below the palisade; between epidermal cells towards both epidermis.

T.S. petiole
Vascular bundle bicollateral.

Comments: Nyawuame & Gill (1991) reported paracytic stomata, with sinuous anticlinal walls on both surfaces and the eumesogenous ontogenetic type of development in *Alafia barteri*, *A. multiflora* and *A. landolphioides* (as *A. scandens*). Stomatal sizes ranged from 23.2-25.8 × 13.6-19.8 μm.

1.5.4 **Ancylobotrys** Pierre

(Figs. 1C, 4D, 5E, 8E, F, 9E, F, 10C, D, 12C, 13 D, E, 15E, 20C; Tables 1 & 2, 3; Appendix 1)

A genus of 7 species, mainly lianas or sarmentose shrubs restricted to Africa, with *A. petersiana* spreading to the Comoro Islands and Madagascar. It is represented by three species in E. Africa, *A. petersiana* and *A. tayloris* are observed here.

Leaf surface
HAIRS: present on the petiole of both species, 2-7-celled, thin-walled in both. CUTICULAR SURFACE (SEM): adaxial of *A. tayloris* with small bumps, abaxial smooth but with thick cuticular ridges over subsidiary cells (Fig. 5 E). STOMATA (Fig. 4D, 5E): hypostomatic, anomocytic in *A. petersiana*, outline circular in *A. tayloris* and with a round aperture. EPIDERMAL CELL OUTLINE (SEM): not visible on adaxial surface in *A. tayloris*. ANTICLINAL WALLS (LM): very undulate on both sides in *A. petersiana*, undulate on both sides in *A. tayloris*.

T.S. Lamina
THICKNESS (Table 1): 229-300 μm in *A. tayloris*, 293-320 μm in *A. petersiana*. CUTICLE: thicker in *A. tayloris*, thickest on adaxial midrib in both. ADAXIAL EPIDERMAL CELLS (Figs. 8E, 9E): intermittently 2-layered in *A. tayloris*, second layer larger, thick-walled; 1-layered in *A. petersiana*, 2-3-layered towards the margin and the midrib; outer periclinal wall of the first layer very thick in both. ABAXIAL EPIDERMAL CELLS (Figs. 8F, 9F): 1-layered in both but with 1-2 layers of short, compact cells above the lower epidermis. STOMATA (T.S.) (Figs. 10C, D): with a wider aperture in *A. tayloris*. MESOPHYLL: bifacial in both, but with a tendency towards being isobilateral in both; palisade 2(-3)-layered in both, does not extend to the midrib; spongy mesophyll composed of more or less vertically elongated cells with a lot of air spaces (Fig. 12C). MINOR VEINS: embedded or transcurrent and bicollateral in the larger veins in both species. MIDRIB (Figs. 13 D, E; Table 1) 549-586 μm in *A. tayloris*, 714-750 μm in *A. petersiana*; outline almost straight on both sides in *A. tayloris*; adaxial gently curved, abaxial prominently ridged in *A. petersiana*. Vascular bundle bicollateral, forms a shallow arc in *A. tayloris* and a deeper one in *A. petersiana*; phloem extends across the vascular bundle and forms a semi-circle above it in both species (Figs. 13D, E, 15E) MARGIN: slightly revolute in both, with an acute tip in *A. tayloris*. CRYSTALS: solitary crystals in the

phloem and a few in the ground tissue below vascular bundle in *A. petersiana*. LATICIFERS: along veins; branching in the palisade towards both epidermis; below palisade tissue and epidermis in both species.

T.S. petiole
Ends of vascular bundle almost in contact with one another forming an almost cylindrical strand with accessory bundle in both (Fig. 20 C); laticifers branching between cells in the ground tissue.
Comments:
Both species have a very thick cuticle and outer epidermal cells and both have a tendency towards being isobilateral. *A. tayloris* can be distinguished from *A. petersiana* by its larger stomata with a wider, circular aperture; 2-layered epidermis and a midrib which is almost straight on both sides.

1.5.5 **Baissea** A. DC.

(Figs. 1I, 3E, 7C, D, 8G, H, 9Q, 13 F; Tables 1, 2, 3; Appendix 1)

A genus of 18 mainly lianescent species, mainly climbers or scandent shrubs restricted to Africa. Represented by five species in East Africa. *B. myrtifolia* is examined here.

Leaf surface
HAIRS: occur on adaxial surface of midrib and on petiole; multicellular, uniseriate, sometimes hooked with longer basal and shorter apical cells (Fig. 1I); domatia present in the axils of secondary veins (Fig. 3E). CUTICULAR SURFACE (SEM): more or less smooth but with uneven surface on both sides. STOMATA (Table 2; Figs. 7C, D): hypostomatic and paracytic; outline elliptic; size 15-19.5 × 8-13 µm; density per mm^2 150-200. EPIDERMAL CELL OUTLINE (SEM): not visible. ANTICLINAL WALLS (LM): very undulate on both surfaces (Figs. 7C, D).

T.S. lamina
THICKNESS (Table 1): 82-110 µm. CUTICLE: 1-3 µm thick, thickest at the midrib. ADAXIAL EPIDERMAL CELLS (Fig. 8G): 1-layered, rectangular, with an irregular in outline. ABAXIAL EPIDERMAL CELLS (Fig. 8H): 1-layered, rectangular, with an irregular outline. STOMATA (T.S.): slightly raised. MESOPHYLL: bifacial; palisade 1-layered, extends to the midrib; spongy mesophyll with more or less transversely elongated cells. MINOR VEINS: with a parenchyma sheath. MIDRIB (Fig. 13F): 201-238 µm thick; outline almost flat on adaxial surface; abaxial prominently ridged. Vascular bundle bicollateral, forming a shallow arc. Ground tissue of midrib collenchymatous towards the periphery. MARGIN: slightly revolute. CRYSTALS: cluster crystals present in the palisade layer; cluster and solitary crystals in the spongy mesophyll. LATICIFERS: along the veins; below the palisade; branching in the mesophyll towards both epidermises.

T.S. petiole
Vascular bundle u-shaped, bicollateral.

1.5.6 Carissa L.

(Figs. 4F, 5C, 9G, H, 10E, F, 13G, H, P, 16B, 17D; Tables 1 & 2, 3; Appendix 1)

A genus of about 20 species mainly shrubs or small trees in Africa, Asia and Madagascar. Represented by three species in East Africa, *C. edulis* and *C. tetramera* are investigated here.

Leaf surface

HAIRS: very few on adaxial midrib of *C. tetramera* and on petiole of both species; unicellular, simple and thin-walled. CUTICULAR SURFACE (SEM): smooth on both sides in *C. tetramera* and on abaxial surface of *C. edulis*. STOMATA: hypostomatic but in *C. edulis* a few stomata found on abaxial surface overlying the midrib and on adaxial surface of petiole; cyclocytic in *C. edulis*, paracytic in *C. tetramera*; outline broadly elliptic in both, and with a truncate pole in *C. tetramera* (Fig. 5C); size larger in *C. edulis* at 29-36 x 23-32 μm, sunken with a narrow aperture (Fig. 4F); density per mm^2 500-572 in *C. tetramera*, 66-176 mm^2 in *C. edulis*. EPIDERMAL CELL OUTLINE (SEM): outline obscurely visible on both sides. ANTICLINAL WALLS (LM) adaxial ± straight, angular in *C. tetramera*, abaxial straight to slightly curved; straight to slightly curved on both surfaces in *C. edulis*.

T.S. lamina
THICKNESS (Table 1): 247-302 μm in *C. edulis*; 366-412 μm in *C. tetramera*. CUTICLE: thicker in *C. tetramera* on the adaxial midrib at 9-20 μm. ADAXIAL EPIDERMAL CELLS (9G): 1-layered in both, larger in *C. tetramera*, triangular and acute at the apex in *C. edulis*. ABAXIAL EPIDERMAL CELLS (Fig. 9H): 1-layered in both, rectangular in *C. tetramera*, smaller and triangular in *C. edulis*. STOMATA (T.S.) (Figs. 10E, F): raised, with a smaller aperture in *C. edulis*. MESOPHYLL: bifacial in both species, *C. edulis* with a tendency towards being isobilateral; palisade cells 2(-3)-layered, characteristically long, extends up to the midrib in both species; spongy mesophyll with transversely elongated cells in *C. edulis; C. tetramera* with shorter cells with arms; many transversely elongated thick-walled sclerids in the palisade and mesophyll of *C. tetramera* (Fig. 16 B). MINOR VEINS: smaller ones collateral with a parenchyma sheath; larger ones in *C. tetramera* with an outer parenchyma sheath and an inner sclerenchymatous sheath. MIDRIB (Fig. 13 G, H): almost flat on adaxial surface in both species, more ridged on abaxial surface in both. Vascular bundle bicollateral and forming a shallow arc in both species, with thick-walled lignified fibres above and below the bundle in *C. tetramera*. Collenchyma only on abaxial periphery of midrib. CRYSTALS: cluster crystals in the mesophyll of both; solitary crystals in the phloem and mesophyll of *C. tetramera*. LATICIFERS: along veins in the midrib (Fig. 17D) and mesophyll; be-

tween epidermal cells; below palisade; towards the upper and lower epidermis in both species; width decreasing at the point of branching. MARGIN: revolute in both species, apex bluntly obtuse in *C. edulis* and rounded in *C. tetramera* (Fig. 19C); epidermal cells triangular with acute apex in *C. edulis* (Fig. 9P); marginal bundle surrounded by a large amount of sclerenchyma in *C. tetramera* (Fig. 19C).

T.S. petiole
Vascular bundle forming a deeper and slightly incurved bundle in *C. tetramera*; epidermal cells small, triangular; laticifers observed along the veins in the midrib.

Comments: *C. tetramera* is easily distinguished by the foliar sclerids in the mesophyll of the leaves (Fig. 16B) and its venation with a strong marginal vein (Fig. 22 A). The stomata are smaller in *C. tetramera* which also has a higher density. Nyawuame & Gill (1991) reported the paracytic type of stomata with straight anticlinal walls on both sides and eumesogenous type of stomatal development in *C. edulis* and size of 30.1 × 17.4 µm.

1.5.7 **Carvalhoa** K. Schum.

(Figs. 2E, 5F, 8I, J, 10G, 13I; Tables 1, 2, 3; Appendix 1)

A monotypic genus restricted to Eastern and South Eastern Africa. In East Africa it is restricted to Kenya and Tanzania. The only species, *C. campanulata*, is examined in the present study.

Leaf surface
HAIRS: absent. CUTICULAR SURFACE (SEM): adaxial with striations over the whole surface, striations crossing cell outlines (Fig. 2E); abaxial with concentric rings striae over subsidiary cells and with cuticular ridges on the rest of the surface (Fig. 5F). STOMATA (Fig. 5F; Table 2): hypostomatic; paracytic with one subsidiary cell on either side, subsidiary cells extending over one or both poles; outline elliptic; size 20-25 × 13-19 µm; density per mm² 81-106-150. EPIDERMAL CELL OUTLINE (SEM): adaxial with cuticular ridges over anticlinal walls (Fig. 2E), abaxial with irregular cuticular ridges. ANTICLINAL WALLS (LM): adaxial straight to slightly curved, abaxial undulate.

T.S. lamina
THICKNESS (Table 1; Fig 8I, J): 156-220 µm. CUTICLE: very thin, c. 1 µm. ADAXIAL EPIDERMAL CELLS (Fig. 8I): regular, 1-layered, wider than tall, collenchymatous at the midrib. ABAXIAL (Fig. 8J): 1-layered. STOMATA (T.S.) (Fig. 10G): slightly raised. MESOPHYLL: bifacial; palisade, 1-layered, extends to the midrib; spongy mesophyll with short transversely elongated cells. MINOR VEINS: collateral, with xylem on adaxial side. MIDRIB (Fig. 13I; Table 1): 1409-1446 µm thick; adaxial ridge small, less prominent, abaxial more prominent, u-shaped. Vascular bundle bicollateral, forming a deep arc; collenchyma in 2-3 layers

on both surfaces. MARGIN: revolute, with 2-3 layers of collenchymatous cells; epidermal cells subglobose. CRYSTALS: cluster crystals in the palisade layer. LATICIFERS: along the veins; in the mesophyll and among parenchyma cells of ground tissue.

T.S. petiole
Vascular bundle bicollateral, u-shaped, with accessory bundles on the wings.

NOTES: The petioles and leaves of *C. campanulata* sometimes have some pubescence.

1.5.8 Clitandra Benth.

(Figs. 8K, L, 9R, 13J, 20D; Tables 1 & 2, 3; Appendix 1)

A monotypic genus restricted in Africa from Guinea to Tanzania. *C. cymulosa*, a large liana, is examined.

Leaf surface
HAIRS: absent. CUTICULAR SURFACE (SEM): STOMATA: hypostomatic; anomocytic with 5-8 cells around the stomata; outline broadly elliptic to rounded; size 17-23 × 15-19 μm; density per mm^2 288-340. EPIDERMAL CELL OUTLINE: not visible. ANTICLINAL WALLS (LM): more or less straight to very slightly curved on both sides.

T.S. lamina
THICKNESS (Table 1): 192-247 μm. CUTICLE: thickest at the margin. ADAXIAL EPIDERMAL CELLS (Fig. 8K): ± square, smaller at the midrib. ABAXIAL EPIDERMAL CELLS (Fig. 8L): rectangular in shape, much smaller at the midrib. STOMATA (T.S.): slightly sunken stop. MESOPHYLL: bifacial, but with two layers of vertically elongate short palisade-like cells above abaxial epidermis; palisade layer in 2 rows, does not extend to the midrib; spongy mesophyll with horizontally elongated cells, not compact. MINOR VEINS: smaller ones embedded, with a parenchyma sheath; larger ones transcurrent towards the adaxial side. MIDRIB: 640-659 μm thick; outline more or less straight on adaxial side, prominent on abaxial side, acute. Vascular bundle bicollateral, forming an oval shape. MARGIN: straight. CRYSTALS: none seen. LATICIFERS: branching in the mesophyll and palisade layers towards both epidermis.

T.S. petiole
Vascular bundle bicollateral, cylindrical and flattened on adaxial side forming a semi-circle (Fig. 20D).

1.5.9 **Dictyophleba** Pierre

(Figs. 1F, 4A, 6G, H, 13K, 18 D, 19C, 20F; Tables 1, 2, 3; Appendix 1)

A genus of 5 species in Africa, all lianas with tendrils. Only one species, *D. lucida,* extends to East Africa: Tanzania and Kenya.

Leaf surface
HAIRS (Fig. 1F): present on the petiole, up to 25-celled, cells short. CUTICULAR SURFACE (SEM) (Fig. 4A): smooth. STOMATA (Fig. 6 G, H; Table 2): hypostomatic and anomocytic with 3-6 cells around the guard cells; outline almost circular; size 14.6-16.6 × 14.6-16.6 µm; density per mm^2 700-825-925. EPIDERMAL CELL OUTLINE (SEM). cell outlines obscurely visible as wide grooves (Fig. 4A). ANTICLINAL WALLS (LM): undulate on both surfaces.

T.S. lamina
THICKNESS (Table 1): 183-311 µm. CUTICLE: very thin, 1-3 µm. ADAXIAL EPIDERMAL CELLS: 1-layered, much larger than abaxial ones. ABAXIAL EPIDERMAL CELLS: 1-layered, rectangular in outline. STOMATA (T.S.): raised. MESOPHYLL: bifacial; palisade layer in 2-rows, extends to the midrib; spongy mesophyll with vertically elongated, lacunate cells. MINOR VEINS: transcurrent, with outer parenchyma sheath and inner sclerenchymatous sheath; bundle sheath extensions towards both epidermis. MIDRIB (Fig. 13K): 714-787 µm thick; slightly concave on adaxial surface; abaxial ridge prominent, with an irregular outline. Vascular bundle forming a wide u-shape, bicollateral, with islands of phloem within the u-shape (Fig. 13K). Collenchyma in 3-4 layers on both sides of the midrib. MARGIN (Fig. 19C): revolute with an obtuse tip, marginal vein with sclerenchyma. CRYSTALS: solitary crystals arranged in a neat row along the veins in the mesophyll. LATICIFERS: many laticifers seen especially branching from the mesophyll to the palisade and to the upper epidermis and margin.

T.S. petiole
Outline of petiole circular; ends of vascular bundle almost in contact with one another forming an almost cylindrical strand with accessory bundles at the wings of the petiole (Fig. 20F).

1.5.10 **Diplorhynchus** Welw. ex Fic. & Hiern

(Figs. 2A, 5D, 9K, L, 12F, 13L; Tables 1, 2, 3; Appendix 1)

A monotypic genus with its only species, *D. condylocarpon,* restricted to Africa, which has been examined.

Leaf surface
HAIRS: absent. CUTICULAR SURFACE (SEM): adaxial smooth with very fine

striations, abaxial smooth (Figs. 2A, 5D). STOMATA (Table 2): hypostomatic; type; outline broadly elliptic with peristomatal rims (Fig. 5D); size 16-18 × 14-16 mm; density per mm² 260-340; EPIDERMAL CELL OUTLINE (SEM): not visible. ANTICLINAL WALLS (LM): slightly undulate.

T.S. lamina
THICKNESS (Table 1): 256-275 μm. CUTICLE: 2.9-5.7 μm on the upper epidermis; 1.9-5.7 μm in the lower epidermis; thickest at the margin. ADAXIAL EPIDERMAL CELLS: 1-layered, rectangular in shape, 7.6-15.2 × 7.6-28.5 μm, smallest at the midrib, triangular. MESOPHYLL (Fig. 12F): bifacial; palisade in 2 (-3) rows, very narrow; mesophyll vertically elongated. MINOR VEINS: transcurrent with bundle sheath extensions reaching towards both epidermises. MIDRIB: 439-458 μm thick; outline more or less straight on both sides. Vascular bundle bicollateral, forming a wide arc with phloem across the arc and many fibres below the vascular bundle. MARGIN: more or less straight with much collenchyma at the tip; epidermal cells narrow, small, acute at the apex.

T.S. petiole
Vascular bundle bicollateral.

Comments: the leaves are normally glabrous to pubescent; petioles are glabrescent to puberulent.

1.5.11 **Funtumia** Stapf

(Figs. 8M, N, 13M, 17E, 20G; Tables 1, 2, 3; Appendix 1)

A genus of two tree species restricted to Africa. *F. elastica* was available for study.

Leaf surface
HAIRS: absent. CUTICULAR SURFACE (SEM): rough. STOMATA: hypostomatic; paracytic; outline narrowly elliptic; size 19-25 × 10-15 μm; density per mm² 300-320. EPIDERMAL CELL OUTLINE: completely obscured. ANTICLINAL WALLS: straight to slightly undulate on both sides.

T.S. Lamina
THICKNESS (Table 1): 311-366 μm. CUTICLE: thickest on adaxial midrib. ADAXIAL EPIDERMAL CELLS (Fig. 8M, 9I): irregularly 2-3-layered, sometimes with periclinal divisions, thick-walled, 7.6-24.7 × 13.3-24.7 μm. ABAXIAL EPIDERMAL CELLS (Fig. 8 N): 1-2-layered, thick-walled, smaller, 7-11.4 × 10-20 μm, even smaller around midrib, acute at the apex. STOMATA (T.S.): level with the surface. MESOPHYLL: bifacial; palisade extends to the midrib, in 2-3-rows, characteristically long; spongy mesophyll with transversely elongated cells with air spaces. MINOR VEINS: embedded, larger ones bicollateral, smaller ones collateral, with a parenchyma sheath. MIDRIB (Fig. 13M): 586-768 μm thick; adaxial outline

almost flat, abaxial ridged; Vascular bundle bicollateral, forming a wide shallow arc; pockets of phloem interspersed with mucilaginous fibres above the arc, few fibres below it. Ground tissue collenchymatous towards the periphery. MARGIN revolute with two layers of epidermal cells and collenchymatous cells. CRYSTALS: many cluster crystals present in the mesophyll and lower cortex of midrib and larger minor veins. LATICIFERS(Fig. 17E): branching freely in the mesophyll and along the veins; branching just below the epidermis and palisade tissue into the epidermal cells.

T.S. petiole
The vascular bundle forms a deep arc with adaxial phloem extending across the bundle and has three accessory bundles on each side of the wings; numerous clustered crystals in the ground tissue of the petiole; outline deeply canaliculate on adaxial side (Fig. 20G).

Comments: Leaf may have a few hairs on midrib.

1.5.12 **Holarrhena** R.Br.

(Figs. 1B, 2F, 4E, 6C, D, 12B, 13N, 15B)

A genus of 4 species in Africa, Southern Continental Asia and Sri Lanka. Represented by only one species, *H. pubescens*, confined to Kenya and Tanzania, which is examined here.

Leaf surface
HAIRS (Figs. 1B, 4E): present on petiole, abaxial leaf surface and on both surfaces of the midrib and at the margin; 1-2 (-7)-celled, the basal cells are shorter and terminal cells longer and may be hooked. CUTICULAR SURFACE (SEM) (Fig. 2F): abaxial striate; abaxial smooth. STOMATA (Figs. 6C, D; Table 2): hypostomatic; paracytic with subsidiary cells extending over the poles, a few anisocytic stomata also seen; double stomata and stomata with single guard cell seen; outline rounded to elliptic, slightly raised; with double rims; aperture wide, elliptic; size 17-31 × 14-19 μm; density per mm^2 250-289-312. EPIDERMAL CELL OUT LINE (SEM): with cuticular ridges over anticlinal walls (Fig. 2F). ANTICLINAL WALLS (LM): ± straight, angular on both surfaces.

T.S. lamina
THICKNESS: 201-220 μm. CUTICLE: 1-3 μm thick. ADAXIAL EPIDERMAL CELLS: 1-layered, at some points seen dividing periclinally, taller than wide or more or less square. ABAXIAL EPIDERMAL CELLS: 1-layered, rectangular, taller than wide at the midrib. STOMATA (T.S.): slightly raised. MESOPHYLL (12B): bifacial; palisade layer 1-layered, extends to the midrib, but leaves a gap; spongy mesophyll cells transversely elongated, very compact. MINOR VEINS: embedded, with a thin-walled parenchyma sheath; older ones transcurrent towards adaxial epi-

dermis. MIDRIB (Figs. 13N, 15B; Table 1): 970-1025 μm thick; adaxial outline with a small ridge, abaxial more prominent, u-shaped. Vascular bundle forming a shallow arc. Collenchyma on the periphery of both ridges. MARGIN: revolute at the extreme tip or more or less straight. CRYSTALS: cluster crystals in large subglobose cells immediately below the palisade layer. LATICIFERS: in the mesophyll along veins; below the palisade eventually ending in the upper or lower epidermis.

T.S. petiole:
Vascular bundle forms a very wide and a shallow u-shape, with small accessory bundles; many laticifers seen between cortical parenchyma cells of the petiole eventually ending in the epidermis.

Comments: the stomata are also reported to be paracytic in *H. pubescens* by Nyawuame & Gill (1991) and in *H. antidysenterica* (= *H. pubescens*) by Chandra et al., (1969), with eumesogenous type of stomatal development (Nyawuame & Gill 1991).

1.5.13 **Hunteria** Roxb.

(Figs. 3A, 18A, 10 H, I, 13O, P, 20H, 22A; Table 1, 2, 3; Appendix 1)

A genus of 12 species restricted to Africa, only *H. zeylanica* extends to South and South East Asia up to Sumatra. Represented by two species in East Africa, *H. congolana* and *H. zeylanica*, both examined here.

Leaf surface:
HAIRS: absent. CUTICULAR SURFACE (SEM): smooth on both sides in *H. congolana*, smooth with fine striations in *H. zeylanica*. STOMATA: hypostomatic; anomocytic and anisocytic in *H. congolana*, complex-cyclocytic with sunk subsidiary cells in *H. zeylanica* (Fig. 3 A); outline broadly elliptic to circular; larger in *H. zeylanica*; density per mm^2 greater in *H. zeylanica* at 294-350. EPIDERMAL CELL OUTLINE: not visible in both. ANTICLINAL WALLS (LM): both walls straight to very slightly curved in both species.

T.S. lamina
Width 183-220 in *H. congolana*, and 266-348 μm in *H. zeylanica*. CUTICLE: thickest at the midrib and margin in both species. ADAXIAL EPIDERMAL CELLS: 1-layered in both species, more or less rectangular in *H. congolana*, taller than wide in *H. zeylanica*. ABAXIAL EPIDERMAL CELLS: 1-layered in both, rectangular, larger in *H. zeylanica*; epidermal cells papillose with acute apex around midrib in *H. congolana*. STOMATA (T.S.) (10H, I): raised in both species. MESOPHYLL: bifacial, *H. zeylanica* with two layers of short palisade-like cells above the lower epidermis; palisade 1-2-layered in *H. congolana*, extends to the midrib; 2-3(-4)-layered in *H. zeylanica*; spongy mesophyll with short horizontally elongated cells, very compact in both species. MINOR VEINS: embedded, with a parenchyma sheath, xylem

surrounded by fibres. MIDRIB (13O, P; Table 1): 915-951 μm thick in *H. zeylanica*, 403-439 μm thick in *H. congolana*; adaxial outline more or less straight, abaxial ridged in both. Vascular bundle bicollateral, forming a wide shallow arc in both species; mucilaginous fibres present on lower side in *H. congolana*. Ground tissue collenchymatous especially on the abaxial side. MARGIN: slightly revolute in both, epidermal cells taller than wide, with acute apex in *H. congolana*. CRYSTALS: cluster crystals in the palisade layer in large subglobose idioblasts in both species, idioblasts extremely large in *H. zeylanica* (Fig. 18A); mesophyll with cluster crystals in enlarged cells in *H. zeylanica*; *H. congolana* with numerous druses in the ground tissue of midrib and mesophyll and many solitary crystals in the phloem (Fig. 18F); solitary crystals in both epidermis. LATICIFERS: common adjacent to the lower periclinal walls of the adaxial epidermis, and between palisade cells in *H. zeylanica*; along veins of midrib in *H. congolana*.

T.S. petiole

Vascular bundle bicollateral; forms a deep u-shape with incurved margins, in both species; strongly supported in the pericyclic region by thick-walled mucilaginous fibres in groups of 2-35 scattered sclerosed elements in the ground tissue of *H. zeylanica* (Fig.16E).

Comments: anisocytic stomata with straight anticlinal walls on both surfaces and hemimesogenous type of stomatal development have been reported in *H. umbellata* by Nyawuame & Gill (1991), size 18.7 × 14.6 μm.

1.5.14 **Landolphia** P. Beauv.

(Figs. 13 Q, R, 15C, 20 E; Table 1, 2, 3; Appendix 1)

A genus of 51 species in Africa and ca. 8 species are endemic to Madagascar. Represented by 7 species in East Africa and two are examined here.

Leaf surface

HAIRS: absent. CUTICULAR SURFACE (SEM): smooth on abaxial epidermis in *L. watsoniana*. STOMATA: hypostomatic and anomocytic in *L. watsoniana*; outline circular in *L. watsoniana*, elliptic in *L. buchananii*; size 15-18 × 15-16 μm; density per mm² 500-625 in *L. watsoniana*. EPIDERMAL CELL OUTLINE: obscurely visible as groves. ANTICLINAL WALLS (LM): undulate on both surfaces in both species.

T.S. lamina

THICKNESS: 256-311 μm in *L. buchananii*, 201-256 μm thick in *L. watsoniana*. CUTICLE: thickest at the margin in both species. ADAXIAL EPIDERMAL CELLS: 1-layered on both species, rectangular, larger in *L. buchananii*. ABAXIAL EPIDERMAL CELLS: 1-layered, rectangular, smaller in *L. watsoniana*. STOMATA

(T.S.): slightly raised in *L. buchananii*; slightly sunk in *L. watsoniana*. MESOPHYLL: bifacial; palisade 1-2-layered in *L. watsoniana*, extends to the midrib; 2(-3)-layered with much longer cells in *L. buchananii*, does not extend to midrib; spongy mesophyll cells horizontally elongated in both. MINOR VEINS: embedded, with outer parenchyma sheath and inner sclerenchyma sheath; larger ones transcurrent towards both epidermis. MIDRIB (Figs. 13Q, R): adaxial slightly prominent in *L. watsoniana*, more or less straight in *L. buchananii*; abaxial more or less straight in *L. watsoniana*, ridged in *L. buchananii*. Vascular bundle forming a cylindrical strand in *L. buchananii*, flattened on the adaxial side (Figs. 13Q, 15C) and an almost cylindrical strand in *L. watsoniana* (Fig. 13R). MARGIN: straight in both. CRYSTALS: *L. watsoniana* with a few cluster crystals above minor veins and solitary crystals in the parenchyma sheath and along the veins; *L. buchananii* with solitary crystals in the ground tissue of midrib and in the 2nd layer of palisade, small cluster crystals in the palisade. LATICIFERS: towards upper and lower epidermis; along veins; between palisade cells and in the mesophyll.

T.S. petiole
Vascular bundle cylindrical, forming an oval shape in *L. watsoniana* (13E), flattened adaxially in *L. buchananii*; ground tissue with solitary crystals in *L. buchananii*.

Comments: anomocytic stomata with sinuous anticlinal walls on abaxial surface and agenous type of stomatal development reported in *L. calabrica* and *L. dulcis* var. *barteri* (= *L. dulcis*) and paracytic stomata in *L. owariensis* with sinuous anticlinal walls on both surfaces and eumesogenous type of stomatal development by Nyawuame & Gill (1991). *Landolphia buchananii* may sometimes have leaves with pubescence.

1.5.15 **Mascarenhasia** A. DC.

Figs. 1E, 9I, J, S, 14A, 18C; Table 1, 2, 3; Appendix 1)

A genus of 8 species, all distributed in Madagascar, one of which also occurs in East Africa: *M. arborescens*.

Leaf surface
HAIRS (Fig. 1E): simple, unicellular hairs on abaxial petiole. CUTICULAR SURFACE (SEM): rough. STOMATA: hypostomatic, elliptic, outline; size 21-31 × 10-18 μm; density per mm² 200-213; EPIDERMAL CELL OUTLINE (SEM): obscured. ANTICLINAL WALLS: abaxial straight, adaxial undulate.

T.S. lamina
THICKNESS (Table 1): 211-256 μm. CUTICLE: thickest at the midrib at the midrib and margin. ADAXIAL EPIDERMAL CELLS: irregularly 1-2-layered, almost square to rectangular; smaller at the midrib, taller than wide with an acute apex (Fig. 9I). ABAXIAL EPIDERMAL CELLS: 1-layered, rectangular; smaller around the

midrib and with a pointed apex (Fig. 9J). MESOPHYLL: bifacial; palisade 1-2-layered, extends to the midrib; spongy mesophyll with transversely elongated cells, compact. MINOR VEINS: embedded, collateral with an outer parenchyma and an inner sclerenchymatous sheath. MIDRIB (Fig. 14A): 750-787 μm thick; adaxial outline almost straight, abaxial prominently ridged. Vascular bundle bicollateral, forming a deep arc, with islands of phloem above the u-shape; mucilaginous fibres below the bundle, a few above it. Collenchyma in 3-4 layers on the periphery. MARGIN: revolute, epidermis 2-layered, collenchymatous. CRYSTALS: cluster crystals in the mesophyll and ground tissue of midrib; solitary crystals in the phloem. LATICIFERS: branched freely in the mesophyll; along the veins; below the palisade and epidermal cells towards both epidermis.

T.S. petiole:

Vascular bundle bicollateral, forms a u-shape, with numerous cluster crystals dispersed in the cortex.

1.5.16 **Motandra** A. DC.

(Figs. 1D, H, 14B; Table 1, 2, 3; Appendix 1)

A genus of 3 species confined to Africa. *M. guineensis* is examined here.

Leaf surface

HAIRS: present on the petiole and midrib; simple, thick-walled, 1-5-celled, with an acute apex (Fig. 1H); few glandular hairs also observed on the petiole, with three short basal cell (Fig. 1D). CUTICULAR SURFACE (SEM): smooth on both surfaces. STOMATA: hypostomatic anomocytic; type; outline elliptic, raised; size 15-19 × 9-15 μm; density per mm^2 70-160. EPIDERMAL CELL OUTLINE: featureless on both sides. ANTICLINAL WALLS: adaxial straight to slightly curved, abaxial undulate.

T.S. lamina

THICKNESS (Table 1): 99-110 μm thick. CUTICLE: adaxial 1.9-3.8 μm thick; abaxial 1.9-2.9 μm, thickest at the midrib. ADAXIAL EPIDERMAL CELLS: 1-layered, 9.5-13.3 × 8.6-25.7 μm. ABAXIAL EPIDERMAL CELLS: 1-layered, smaller, 6.7-9.5 × 7.6-22.8 μm. MESOPHYLL: palisade 1(-2)-layered; transversely elongated, compact. MINOR VEINS: embedded MIDRIB (14B): 513-549 μm thick; adaxial outline straight, abaxial prominently ridged. Vascular bundle bicollateral, forming a deep arc with mucilaginous fibres interspersed with phloem within the arc and many pockets of mucilaginous fibres below the vascular bundle. CRYSTALS: numerous solitary crystals in the ground tissue below the vascular bundle and in enlarged cells in the palisade layer; many solitary crystals in the phloem.

T.S. petiole:
Vascular bundle bicollateral, oval shaped, ends of vascular bundle almost in contact with one another; phloem in the middle of the oval shape; numerous solitary and clustered crystals in the cortical region.

Comments: anomocytic stomata with sinuous anticlinal walls on both surfaces and the agenous type of stomatal development have been reported in *M. guineensis* by Nyawuame & Gill (1991).

1.5.17 **Oncinotis** Benth.

(Figs. 1G, 3C, 3F, 4C, 11D, 14C, 16A, 18A; Table 1, 2, 3; Appendix 1)

A genus of 7 lianescent species confined to Africa. *O. tenuiloba* has been inspected here.

Leaf surface
HAIRS: present on adaxial surface of petiole; with short, thick-walled basal cells, terminal cell longer with an acute apex (Fig. 1G) and in the axils of secondary veins as domatia (Fig. 3F). CUTICULAR SURFACE (SEM) (Fig. 3C): smooth on both surfaces. STOMATA: hypostomatic and paracytic; outline elliptic, slightly sunken; rim very narrow; aperture elliptic, wide; size 15-22.5 × 10-14 µm; density per mm² 369-439; primary stomata observed. EPIDERMAL CELL OUTLINE (SEM): cuticular ridges over anticlinal walls on both surfaces. ANTICLINAL WALLS (LM): adaxial straight to slightly curved, angular; abaxial undulate.

T.S. lamina
THICKNESS (Table 2) 147-183 µm. CUTICLE: very thin. ADAXIAL EPIDERMAL CELLS: 1-layered, 2-layered towards the midrib, rectangular in outline. ABAXIAL EPIDERMAL CELLS: smaller, rectangular to square. STOMATA (T.S.) (Fig. 11D): more or less level with the surface. MESOPHYLL: bifacial; palisade in 1-2 rows; spongy mesophyll cells compact, transversely elongated. MINOR VEINS: embedded, collateral, with a parenchyma sheath. MIDRIB: abaxial prominently ridged, adaxial almost flat. Vascular bundle bicollateral, forming a deep arc with many fibres below and above interspersed with phloem tissue (Fig. 16A). Ground tissue collenchymatous at the periphery. CRYSTALS: numerous cluster crystals in the ground tissue of midrib and spongy mesophyll; solitary crystals and small cluster crystals in the phloem. LATICIFERS: occur along veins; branching below the epidermis and palisade towards both epidermis. MARGIN: slightly revolute.

T.S. petiole
Vascular bundle bicollateral, deeply curved with phloem in the middle of the arc; numerous crystals in the ground tissue (Fig. 18A).

Comments: paracytic stomata have also been reported in *O. gracilis* and *O. nitida*, with the eumesogenous type of stomatal development and anomocytic stomata with the agenous type of development in *O. glabrata* by Nyawuame & Gill (1991).

1.5.18 **Picralima** Pierre

(Fig. 11A; Table 1, 3; Appendix 1)
A monotypic genus restricted to Africa. The only species *P. nitida* is examined.

Leaf surface
HAIRS: absent. CUTICULAR SURFACE (SEM): rough. STOMATA: hypostomatic; anisocytic. Outline elliptic; size ; density per mm². EPIDERMAL CELL OUTLINE: not visible. ANTICLINAL WALLS: more or less straight.

T.S. lamina
THICKNESS: 366-403 μm. CUTICLE: thickest at the upper midrib region. ADAXIAL EPIDERMAL CELLS: 1-layered, rectangular in shape, 13.3-19 × 13.3-25.7 μm. ABAXIAL EPIDERMAL CELLS: rectangular, 10.5-13.3 × 11.4-28.5 μm, 1-layered, smallest around the midrib and with an acute apex. STOMATA (T.S.) (Fig. 11 A). MESOPHYLL: bifacial; palisade does not extend to the midrib, (1-)2-3-layered; spongy mesophyll with horizontally elongated cells with ample air spaces. MINOR VEINS: with a parenchyma sheath. MIDRIB: 1208-1190 μm; adaxial outline slightly concave, abaxial prominently ridged, acute; vascular bundle bicollateral, forming a deep arc, incurved at the edges, with many islands of fibres below the bundle. Ground tissue collenchymatous towards the periphery. MARGIN: revolute, epidermal cells smaller with a little collenchyma. CRYSTALS: druses in large idioblasts in palisade layer; numerous druses in the mesophyll especially in the layer above the lower epidermis; a few in the cortex below the vascular bundle, fewer above.

T.S. petiole
Vascular bundle bicollateral, forms a u-shape, with many fibres below the vascular bundle.

Comments: anomocytic stomata, with straight anticlinal walls on both sides and agenous type of stomata have been reported in *P. nitida* by Nyawuame & Gill (1991).

1.5.19 **Pleiocarpa** Benth.

(Figs. 7A, B, 9T, 11B, C, 14D, E, 16C, E, F, 21B, 21C; Table 1, 2, 3; Appendix 1)

A genus of 5 species restricted to Africa, mainly trees or shrubs. Represented in East Africa by two species, *P. bicarpellata* and *P. pycnantha*, and both are examined here.

Leaf surface
HAIRS: absent. CUTICULAR SURFACE (SEM): adaxial rough in *P. bicarpellata*, smooth in *P. pycnantha*; abaxial smooth in both. STOMATA: hypostomatic in both species; cyclocytic with 3-4 cells around the stomata (Fig. 7A); outline broadly elliptic; slightly raised with sunken subsidiary cells in both; aperture slit like with narrow rims in both; of ± the same size 16-23 × 14-20 µm; density per mm² 133-153 in *P. bicarpellata*, 200-238 in *P. pycnantha*. EPIDERMAL CELL OUTLINE: vaguely visible as wide ridges in *P. bicarpellata* and as round mounds in *P. pycnantha*. ANTICLINAL WALLS (LM): both walls more or less straight to very slightly curved in *P. pycnantha* (Fig. 7A), abaxial slightly undulate in *P. bicarpellata*.

T.S. lamina
THICKNESS (Table 1): 293-348 µm in *P. pycnantha* and 275-329µm in *P. bicarpellata*. CUTICLE: thickest at the margin and midrib in both species. ADAXIAL EPIDERMAL CELLS: 1-layered, rectangular in both species, smaller and taller than wide at the midrib. ABAXIAL EPIDERMAL CELLS: 1-layered, rectangular in both species, smaller and taller than wide at the midrib. STOMATA (T.S.) (Fig. 11B, C): slightly raised. MESOPHYLL (Table 1): bifacial; palisade layer in 2 (-3) rows, extends to the midrib in both species; mesophyll with transversely elongated cells in both species. MINOR VEINS (Fig. 16F): embedded and with a parenchyma sheath in both species. MIDRIB: 622-641 µm thick in *P. bicarpellata*, 750-767 µm thick in *P. pycnantha*, adaxial outline almost flat in *P. bicarpellata*, prominent in *P. pycnantha*, abaxial outline slightly prominent in both species. Vascular bundle bicollateral, forming an almost straight arc with accessory bundles in *P. pycnantha* and a crenate one in *P. bicarpellata*; abaxial side of vascular bundle with a few pockets of mucilaginous fibres and very few or none on the adaxial side. MARGIN: more or less straight to slightly revolute at the tip; epidermal cells taller than wide and papillose in *P. pycnantha*; marginal vein with a well developed sclerenchymatous bundle sheath in *P. pycnantha*. CRYSTALS: abaxial and adaxial epidermis with solitary crystals in both; phloem with solitary crystals and mesophyll with clustered crystals in *P. pycnantha*; palisade with clustered crystals in enlarged cells in both. LATICIFERS: branching in the mesophyll and also along the veins in both; immediately below the palisade tissue.

T.S. petiole
Vascular bundle bicollateral, forming a deep u-shape with incurved ends of bundles (Fig. 21C); strongly supported by thick-walled islands of mucilaginous fibres in groups of 2-35 in both (Fig. 16C); *P. bicarpellata* with accessory bundles in the wings of petiole also supported with mucilaginous fibres adaxially; *P. pycnantha* with thick-walled, sclerosed elements scattered in the ground tissue (Fig. 16E).

Comments: in my study of stomata of 3 species of *Pleiocarpa*, all were found to have cyclocytic-staurocytic type of stomata (Fig. 7B). On the contrary, Nyawuame

& Gill (1991) record anomocytic stomata in *P. mutica, P. pycnantha* var. *tubicina* (now *P. pycnantha*) and *P. talbotii* (now *P. rostrata*).

1.5.20 Rauvolfia L.

(Figs. 7E, F, G, H, 8 O, P, 14F, G, H, 15A, 18E, Tables 1, 2, 3; Appendix 1)

A pantropical genus of about 60 species, 7 restricted to Africa and 3 to Madagascar. Represented by 5 species in East Africa and 3 of them are examined here: *R. caffra, R. mannii*, and *R. mombasiana*.

Leaf surface
HAIRS: absent. CUTICULAR SURFACE (SEM): with fine striae across subsidiary cells and over the whole surface on both sides in *R. mannii*. STOMATA (Figs. 7F, G): hypostomatic and paracytic in all, sometimes with subsidiary cells subdivided by radiating walls on one or both sides; outline elliptic; aperture long, slit-like; size ranges from 19-32 × 10-18 μm; density per mm² 125-138-175 in *Rauvolfia mombasiana*. EPIDERMAL CELL OUTLINE (SEM): cuticular ridges over anticlinal walls on both surfaces in *R. mannii*. ANTICLINAL WALLS (LM) (Figs. 7E, H): adaxial straight in *R. mombasiana*, undulate on both sides in the other two species and on abaxial side of *R. mombasiana*.

T.S. lamina
THICKNESS (Table 1): 165-183 μm thick in *R. mannii*, 201-275 μm thick in *R. mombasiana* and 183-238 μm thick in *R. caffra*. CUTICLE: thickest at the margin *R. manii*. ADAXIAL EPIDERMAL CELLS (Fig. 8O): larger than abaxial, rectangular, 1-layered, 2-layered at the margin with periclinal divisions at some points in *R. caffra*, much smaller around at the midrib area. ABAXIAL EPIDERMAL CELLS (Fig. 8P): 1-layered in all species, smaller. MESOPHYLL: bifacial in all species; palisade layer in a single row in *R. mannii* and *R. caffra*; in 1 (-2) rows in *R. mombasiana*, extends to the midrib in all but leaves a small gap; spongy mesophyll with somewhat horizontally elongated cells, not so compact. MINOR VEINS: embedded, with a parenchyma sheath. MIDRIB (Figs. 14F, G, H): 567-604 μm thick in *R. caffra*; 695-714 μm thick in *R. mannii*, 714-732 μm thick in *R. mombasiana*; outline more or less straight in *R. mombasiana* on both sides, with a small abaxial ridge and a prominent adaxial ridge in *R. mannii*, with ridges on both sides in *R. caffra*. (Fig. 14F). Vascular bundle bicollateral, forms a shallow arc in all species but widest in *R. mombasiana* (Fig. 15A). Ground tissue collenchymatous for 3-4 layers on both sides. MARGIN: more or less straight to very slightly curved in *R. mannii* and revolute in the other two; epidermal cells 2-layered in *R. caffra*, thick-walled. CRYSTALS: in subglobose idioblasts in the palisade in *R. mannii* and *R. mombasiana*; 2-4 druses present above minor veins in a single or double file in the palisade tissue in *R. caffra* and *R. mombasiana* (Fig. 18E); clustered crystals in the ground tissue of midrib in *R. mombasiana*. LATICIFERS: along veins; in the mesophyll and towards both epidermis.

T.S. petiole
Vascular bundle bicollateral and forms a shallow arc in both but wider in *R. mombasiana*; with accessory bundles in *R. mannii* and *R. mombasiana*. Clustered crystals present in ground tissue and solitary crystals in the phloem parenchyma of *R. mombasiana*. Ground tissue collenchymatous towards the periphery.

Comments: paracytic stomata are characteristic of the genus. Also reported in *R. vomitoria*, by Nyawuame & Gill (1991). Eumesogenous and eumesoperigenous type of stomatal ontogeny have been reported in *R. caffra* and *R. mannii* respectively by Karatela (1983) and Gill (1988).

1.5.21 Saba (Pichon) Pichon

(Figs. 4B, 8B, 8Q, R, 10J, 12A, 14I, 15D, 21B; Tables 1, 2; Appendix 1)

A genus of three species restricted to Africa. Only one species, *Saba comorensis* is represented in East Africa and is examined here.

Leaf surface
HAIRS: absent. CUTICULAR SURFACE (SEM): smooth. STOMATA (Fig. 4B): hypostomatic and anomocytic; outline broadly elliptic to circular, sunken; rims very narrow, aperture short, circular; size 13-18 × 11-16 µm; density per mm^2 850-856. EPIDERMAL CELL OUTLINE (SEM): cell outlines visible as round mounds. ANTICLINAL WALLS: straight to slightly curved on both sides.

T.S. lamina
THICKNESS (Table 1): 165-183 µm. CUTICLE: thickest on adaxial midrib at 10-15 µm. ADAXIAL EPIDERMAL CELLS (Fig. 8Q): 1-layered, taller than wide. ABAXIAL EPIDERMAL CELLS: 1-layered, rectangular. STOMATA (T.S.) (Fig. 10J): slightly sunken: MESOPHYLL (Fig. 12A): homogenous with 5-6 (-7) layers of vertically elongated cells, taller than wide, longest in the first row. MINOR VEINS: smaller veins collateral, embedded, larger ones transcurrent towards the adaxial epidermis; girders with lignified parenchyma cells. MIDRIB (Fig. 14I; Table 1): 878-924 µm thick; adaxial outline ridged, more prominently ridged on abaxial surface. Vascular bundle bicollateral and forms an oval shape with a shallow abaxial bundle and 5-6 adaxial bundles (Figs. 15D, 14I). Ground tissue with 3-4 layers of collenchyma on the periphery. MARGIN: more or less straight, with an acute apex; epidermal cells taller than wide but with a rounded apex. CRYSTALS: a few styloids present in the mesophyll. LATICIFERS: a few noted, branching between palisade cells.

T.S. petiole
Vascular bundle bicollateral, circular, but flattened at the top.

1.5.22 **Schizozygia** Baill.

(Figs. 2D, 14J, 19B, 21D; Tables 1, 2, 3; Appendix 1)

A genus in Central and East Africa and Comoro Islands. The only species *S. coffaeoides* is investigated here.

Leaf surface
HAIRS: absent. CUTICULAR SURFACE (SEM) (Fig. 2D): adaxial with striations confined to antepericlinal wall of each cell; abaxial more or less smooth. STOMATA: hypostomatic; paracytic; outline elliptic; rim narrow, aperture slit like, sometimes closed; size 27-31 × 16.6-20.3 µm; density per mm² 63-106. EPIDERMAL CELL OUTLINE: adaxial surface with thick, wide ridges of cuticle over anticlinal walls (Fig. 2D). ANTICLINAL WALLS (SEM): adaxial straight, abaxial straight to slightly curved.

T.S. lamina
THICKNESS (Table 1): 256-275 µm thick. CUTICLE: not very thick. ADAXIAL EPIDERMAL CELLS: 1-layered, 2-3-layered towards the midrib, larger than abaxial. ABAXIAL EPIDERMAL CELLS: 1-layered, wider than tall. MESOPHYLL: bifacial; palisade in 1-2 rows, extends to the midrib; spongy mesophyll with somewhat transversely elongated cells but with many air spaces. MINOR VEINS: with a parenchymatous sheath. MIDRIB (Fig. 14J): 1437-1473 µm thick; adaxial outline very slight, abaxial very prominent. Vascular bundle bicollateral, forming a u-shape with a few pockets of fibres on the lower side, fewer above. Collenchyma, adaxial ridge with 5-6 layers, abaxial with 3-4 layers. MARGIN: revolute. CRYSTALS: present in enlarged cells in the palisade layer and in the cortex of the midrib. LATICIFERS: along veins; branching in the mesophyll towards both epidermis.

T.S. petiole
Vascular bundle bicollateral, forms a wide u-shaped arc (Fig. 21D); with crystals in the ground tissue and collenchyma on the periphery.

Comments: Can be distinguished from Tabernaemontana by cuticular ornamentation

1.5.23 **Stephanostema** K. Schum.

(Figs. 1A, 5A, 8S, T 14K; Table 1, 2,3; Appendix 1)

A monotypic genus known from only one locality in Tanzania. The only species *S. stenocarpum* is examined here.

Leaf surface
HAIRS: present on abaxial epidermis near the midrib and on the petiole; simple, uniseriate, with 1-5 cells, thick-walled (Fig. 1A) CUTICULAR SURFACE (SEM):

abaxial with thick ridges extending from the pole, across subsidiary cells and on the rest of the surface (Fig. 5A). STOMATA: hypostomatic; paracytic, with subsidiary cells over the poles; outline elliptic; size 15-21 × 9-13 μm; density per mm² 132-264. EPIDERMAL CELL OUTLINE: with wide ridges over anticlinal walls on both surfaces. ANTICLINAL WALLS (LM): adaxial slightly undulate, abaxial more undulate.

T.S. lamina
THICKNESS: 229-256 μm. CUTICLE: thickest at the midrib. ADAXIAL EPIDERMAL CELLS (Fig. 8S): rectangular, 1-layered, 19-28.5 × 32.3-72 μm. ABAXIAL EPIDERMAL CELLS (Fig. 8T): 1-layered, smaller, 15.2-20.9 × 24.7-49.4 μm. MESOPHYLL: bifacial; palisade extends to the midrib, 1-3-layered; spongy mesophyll with transversely elongated cells, not compact. MINOR VEINS: embedded, with a parenchyma sheath. MIDRIB (Fig. 14K): 787-823.5 μm thick; adaxial outline with a slight projection, abaxial prominently ridged. Vascular bundle bicollateral, with a shallow arc. Collenchyma with 5-6 layers on adaxial ridge and 2-3 layers on abaxial side. MARGIN: straight. CRYSTALS: none observed.

T.S. petiole
Vascular bundle bicollateral, forms a u-shape. Ground tissue collenchymatous.

1.5.24 **Strophanthus** DC.

(Figs. 4C, 6A, B, 11E, F, 14L; Tables 1, 2, 3; Appendix 1)

Strophanthus is a genus of 38 species occurring in Africa including Madagascar and South Asia. It is represented by 11 species in East Africa. *S. courmontii* is examined here.

Leaf surface
HAIRS: absent. CUTICULAR SURFACE (SEM) (Fig. 4C): abaxial surface with concentric rings of striae around subsidiary cells, finer striae on the rest of the surface; adaxial surface with wide ridges. STOMATA: amphistomatic (Fig. 6A); paracytic with a few anomocytic-actinocytic stomata (Fig. 6B); outline elliptic, slightly raised; rim wide; aperture narrow, slit-like; size 24-33 × 17-29 μm; density per mm² 63-144. EPIDERMAL CELL OUTLINE: with wide ridges over anticlinal walls. ANTICLINAL WALLS (LM): adaxial straight to slightly curved, abaxial undulate.

T.S. lamina
THICKNESS: 192-238 μm thick. CUTICLE: 1-2 μm. ADAXIAL EPIDERMAL CELLS: 1-layered, taller than wide. ABAXIAL EPIDERMAL CELLS: 1-layered rectangular to square smaller at the midrib. STOMATA (T.S.) (Figs. 11E, F): abaxial epidermis raised, adaxial sunk, larger. MESOPHYLL: bifacial; palisade layer in 3 (-4) rows, extends to the midrib but leaves a very small gap; spongy mesophyll

with somewhat horizontally elongated cells, but not compact.
MINOR VEINS: embedded, with a parenchyma sheath; larger ones transcurrent towards adaxial side. MIDRIB; 970-988 μm thick, abaxial outline with a slight ridge, adaxial prominently ridged (Fig. 14L). Vascular bundle bicollateral, forms a shallow median crescentic arc, with thin-walled mucilaginous fibres above and below the bundle. Collenchyma 3-4 layers on both sides. MARGIN: slightly revolute at the tip. CRYSTALS: clustered and solitary crystals in the ground tissue of the abaxial ridge. LATICIFERS: common adjacent to the inner periclinal walls of the epidermis; between the palisade cells and along the veins.

T.S. petiole
Vascular bundle bicollateral, forms a curved arc; numerous crystals in the ground tissue especially below the vascular bundle; thin-walled mucilaginous fibres above and below the bundle. Collenchyma on the periphery.

Comments: stomata reported to be paracytic in *S. barteri* and *S. gracilis*, with eumesogenous development and anomocytic in *S. hispidus* (also amphistomatic) and *S. preussii*, with agenous type of development by Nyawuame & Gill (1991).

1.5.25 Tabernaemontana L.

(Figs. 2B, C, 3B, 5B, 8U, V, W, X, 11G, H, I, 12D, 14M, N, O, P, 15F, 16D, 17F, 18F, 21E, F; Table 1, 2, 3; Appendix 1)

Tabernaemontana is a genus of about 99 species, 18 in Africa, 15 in Madagascar, 1 on the Mascarene Islands, 21 in Asia, Oceania and Australia and 44 in Tropical America. In East Africa it is represented by 5 species, four of which are examined here: *T. elegans*, *T. pachysiphon*, *T. stapfiana* and *T. ventricosa*.

Leaf surface
HAIRS: absent. CUTICULAR SURFACE (SEM) (Fig. 3B, 5B): abaxial surface with wings of striae across slightly sunken subsidiary cells in *T. stapfiana*, otherwise with thick ridges on the rest of the surface; a few striae across subsidiary cells of *T. elegans*, thicker ones from the poles and the rest of surface striate; striate over the whole surface and across the poles in *T. pachysiphon*; adaxial surface with very fine striae in *T. elegans*, striate in *T. stapfiana* and *T. pachysiphon* (Figs. 2B, C). STOMATA: hypostomatic and paracytic with 1 or 2 pairs on both sides in all species examined; outline elliptic in all, slightly raised; rims very narrow in *T. elegans* and *T. pachysiphon*; narrow in the others; aperture very wide in *T. elegans*; size largest in *T. stapfiana*; density per mm^2 highest in *T. stapfiana* at 99-123, lowest in *T. pachysiphon* at 31-69. EPIDERMAL CELL OUTLINE (SEM): adaxial indistinct as very shallow grooves in *T. elegans*, abaxial obscure in all. ANTICLINAL WALLS: adaxial straight, angular in all; abaxial straight to slightly curved; slightly undulate in *T. elegans*.

T.S. lamina

THICKNESS: 165-384 μm, thickest in *T. stapfiana* at 329-384 μm. CUTICLE:thickest at the upper midrib in almost all. ADAXIAL EPIDERMAL CELLS (Figs. 8U, W): 1-layered in *T. elegans* and *T. ventricosa*, towards the margin or midrib, 2-layered; irregularly 2(-3)-layered in *T. stapfiana* and *T. pachysiphon*. ABAXIAL EPIDERMAL CELLS (Figs. 8V, X): 1-layered in *T. ventricosa*; 1-layered in *T. elegans* except at some points near the margin, 2-layered; irregularly 2-layered in *T. pachysiphon* and *T. stapfiana*. STOMATA (T.S.) (Figs. 11G, H, I): with a wide aperture in *T. elegans*, a narrow one in *T. pachysiphon* and with a cuticular ridge in *T. stapfiana*. MESOPHYLL: bifacial in all species; palisade 2-3(-4)-layered in *T. stapfiana* and *T. elegans* (Fig. 12D); 1-2(-3)-layered in *T. pachysiphon* and *T. ventricosa*, extends to the midrib in all species; spongy mesophyll cells transversely elongated with numerous air spaces in all species. MINOR VEINS: collateral, embedded and with a parenchyma sheath in all; each supported by one large sclerid in *T. pachysiphon* (Fig. 16D). MIDRIB (Figs. 14M, N, O,P): 604-2141 μm thick, thickest in *T. pachysiphon* at 2013-2141 μm; midrib outline forms a slight adaxial ridge and a prominent abaxial ridge in all species. Vascular bundle deep v-shaped in all species; islands of phloem in the middle of the vascular bundle in *T. elegans* (Figs. 14M, 15F): phloem extending across the bundle on the adaxial side in the rest of the species (Figs. 14N, O, P). Ground tissue of midrib collenchymatous towards the periphery. MARGIN: revolute in *T. ventricosa* and *T. pachysiphon*; slightly revolute in *T. elegans*. CRYSTALS: *T. pachysiphon* with many single crystals in lower epidermis and with star-like crystals in the palisade layer and in large cells in the layer immediately below it, few in spongy mesophyll; *T. stapfiana* with many small star-like crystals in palisade layer and phloem parenchyma, very large star-like crystals in the layer above the lower epidermis and in the ground tissue of midrib; *T. ventricosa* with clustered crystals in enlarged cells of the mesophyll, in the ground tissue of midrib and in both epidermis. LATICIFERS: in the spongy mesophyll; below the palisade and epidermis; between palisade and epidermal cells and towards both epidermis.

T.S. petiole

Vascular bundle deep u-shaped in *T. elegans* and *T. stapfiana*, numerous crystals in the u-shape and some in the cortical region.

Comments: paracytic stomata are characteristic of this genus. Stomata are also reported to be paracytic in *T. eglandulosa*, *T. pachysiphon* and *T. penduliflora*, and with eumesogenous type of stomatal development by Nyawuame & Gill (1991). Hairs are sometimes present on *T. elegans* leaves.

1.5.26 Voacanga Thouars.

(Figs. 11J, 14Q, R, 22C; Tables 1, 2, 3; Appendix 1)

A genus of 12 species, 7 of which occur in Africa, and 5 in Asia. Two species are examined here: *V. africana* and *V. thouarsii.*

Leaf surface

HAIRS: absent. CUTICULAR SURFACE (SEM): with striae across subsidiary cells. STOMATA: amphistomatic; outline elliptic; size larger in *V. thouarsii*; density per mm^2; EPIDERMAL CELL OUTLINE (SEM): not visible. ANTICLINAL WALLS (LM): adaxial straight, abaxial undulate.

T.S. lamina

THICKNESS: CUTICLE: thickest in *V. africana* ADAXIAL EPIDERMAL CELLS: 1-layered, 2-layered at the margin in *V. thouarsii.* ABAXIAL EPIDERMAL CELLS: 1-layered, smaller. STOMATA (T.S.) (Fig. 11J): sunken in the abaxial epidermis of *V. thouarsii* MESOPHYLL: bifacial; palisade in 1-2-layered in *V. africana*, 2-3(-4)-layered in *V. thouarsii*, extends to the midrib; spongy mesophyll with somewhat horizontally elongated cells. MINOR VEINS: embedded. MIDRIB (Figs. 14Q, R): thicker in *V. thouarsii* at 476-550 µm thick; outline curved on abaxial, ridged on adaxial side. Vascular bundle bicollateral, v-shaped in *V. africana*, wider in *V. thouarsii*. Ground tissue collenchymatous towards adaxial side. MARGIN: revolute on both sides.

T.S. petiole

Vascular bundle bicollateral, forms a shallow v in *V. thouarsii* and a deeper one in *V. africana.*

Comments: paracytic stomata have been reported by Nyawuame & Gill (1991) in *V. africana*, with hemimesogenous type of development.

1.6 General discussion

Leaves

The results of the present study and the information from previous studies carried out by various authors on the leaf anatomy of *Apocynaceae* species clearly indicate that the leaves are dorsiventral (bifacial) except in a few cases where they have been described as isobilateral such as in *Wrightia saligna* (Ngan 1965), *Aspidosperma quebracho* and *Nerium oleander* (Metcalfe and Chalk 1950). The leaves of *Nerium oleander* are not always isobilateral as shown by Esau (1965) in Fig. 16.2, a fact which could be controlled by the environment. Some leaves have a tendency towards being isobilateral e.g. in the genera *Carissa, Acokanthera* and *Ancylobotrys*. All the species examined in these genera show xeromorphic characteristics such as thick cuticle (Figs. 8A, 12C), papillose marginal cells (Fig. 19A) and marginal veins strongly supported by sclerenchymatous cells (Fig. 19C). *Saba comorensis* has been shown to have homogenous leaves in the present study (Fig. 12A).

Hairs

Five basic types are recognised:

(i) Unicellular: may be only 10 μm long as in *Carissa* to 247 μm long in *Holarrhena pubescens*, or even up to 850 μm long as reported in *Allamanda violacea* (now *A. blanchetii*) by Chandra et al. (1972). (ii) Multicellular: vary from 57 μm in *Ancylobotrys* to 304 μm in *Dictyophleba* but longer lengths of 800 μm have been recorded in *Ichnocarpus frutescens* by Chandra et al. (1972). (iii) Multicellular hairs with compressed basal cells embedded in the epidermis: reported in *Echites peltata* (now *Peltastes peltata*) by Metcalfe and Chalk (1950) (iv) Variously branched hairs, shaped like antlers: recorded in *Oncinotis hirta* by Solereder (1908) and de Kruif (1985), also recorded in *O. gracilis* and *O. tomentella* (de Kruif 1985) (v): Glandular hairs: present in *Motandra guineensis* (Fig. 1C) and *Clitandra cymulosa* (Leeuwenberg & Berndsen 1988).

Cuticular ornamentation

Apocynaceae leaves show a wide range of variation of the cuticular surface which can be smooth as in *Carissa tetramera* to striate over the whole surface as in *Holarrhena pubescens*. *Tabernaemontana stapfiana* can be distinguished from *T. pachysiphon* by its wholly striate cuticle (Compare Figs 2B & 2C). Kurer (1917), as seen in Wilkinson (1979), was able to distinguish adulterants from official leaves of certain compounds based on presence, absence or positon of striae and granules on the leaf. According to Paganelli Cappelletti (1975), after his study of *Atropa belladona* under the s.e.m, cuticular striations are of great usefulness for diagnostic purposes and enable one to distinguish even small samples of species from adulterants.

Stomata

Stomata are recorded on both surfaces in only 5 of the 37 species studied. Stomata on both leaf surfaces have also been reported in *Lochnera pusilla* (now *Catharanthus pusillus* by Sayeed-ud-Din (1941) and Chandra et al. (1972); *Ervatamia coronaria* (now *Tabernaemontana divaricata*) by Kapoor et al. (1969); *Plumeria rubra*, *Wrightia tinctoria*, *Wrightia tomentosa* (now *W. arborea*) by Chandra et al. (1969); *Wrightia saligna* and *Wrightia laevis* by Ngan (1965); *Carissa hirsuta* (now *C. spinarum*), by Kapoor & Mitra (1979); *Landolphia owariensis*, *L. dulcis* var. *barteri* (now *L. dulcis*), *Strophanthus hispidus* and *Isonema bulcholzii* by Nyawuame and Gill (1991).

Subsidiary cells

May not always fit exactly in the types described by Wilkinson (1979) and I have indeed experienced some difficulty in describing some arrangements in *Acokanthera oppositifolia*, *Hunteria zeylanica* and *Carissa tetramera*. Jansen and Baas (1973), Baas (1975) and Hartog and Baas (1979) have used the term "complex" for several intermediate types like complex-anisocytic and complex-laterocytic. It is also sometimes difficult to decide whether surrounding cells are truly anomocytic or somewhat anisocytic (Wilkinson 1979) and this problem is experienced in *Strophanthus cormontii*.

Stomatal size

Ranges from 13 µm-36.5 µm long (Table 2). An extensive survey of stomata of West African *Apocynaceae* by Nyawuame and Gill (1991), resulted in stomatal sizes between 16-35.5 µm long. On the contray Chandra et al. (1972) recorded unusually large sizes in *Allamanda violacea* (now *A. macrocarpa*) (15-45 µm long), *Carissa grandiflora* (now *A. blanchetii*) (25-45 µm long) and *Catharanthus pusillus* (25-68 µm long). Sizes are dependent on position of stomata on the leaf surface and whether the sizes of primary stomata are recorded or not.

Anticlinal walls

Differences in waviness between sun and shade leaves were first reported by Areshong (1897) and confirmed by Anheisser (1900). They found that undulations are consistently more pronounced in shade leaves and this fact is confirmed by numerous other investigators. According to Haberlandt (1934) and Watson (1942) the epidermal cell wall undulation is affected by light intensity which inhibits the genes for waviness. *Baissea myrtifolia* has very undulate walls on both sides, a fact explained by its habitat in the forest understorey which lacks light. On the contrary, *Ancylobotrys petersiana* also has very undulate walls, although the specimen analysed was from a very dry forest and not in a shaded area. On the contrary, Sharma and Dunn (1968) found that undulations were always markedly reduced in xeric habitats in *Kalanchoë fedschenkoi.*

Stomatal abnormalities

Single guard cells are observed in Holarrhena pubescens and were also reported in *Trachelospermum jasminoides* by Chandra et al. (1972). Aborted stomata and stomata with single guard cells are reported in *Allamanda cathartica*, *Vinca rosea* (now *Catharanthus roseus*) and *Thevetia peruviana* by Nyawuame & Gill (1991). Single guard cells and giant stomata with aborted guard cells are reported in *Rauvolfia mannii* and *R. caffra* (Karatella and Gill 1983). Giant stomata were recorded in many species, as in *Strophanthus courmontii*, *Carvalhoa campanulata* etc, also frequent in *Rauvolfia mannii* (Karatella and Gill 1983).

Lamina thickness

The lamina is thickest in *Adenium obesum*, *Acokanthera oppositifolia*, *Carissa tetramera*, *Picralima nitida* and *Tabernaemontana pachysiphon*. *T. pachysiphon* has a thick lamina because it has very large leaves. *Adenium obesum* has a very thick lamina because of the succulent nature of the leaves and the other three species always have thick coriaceous leaves due to the nature of the environment in *Carissa tetramera*, but the habitat of *A. oppositifolia* and *P. nitida* are quite diversified. *Baissea myrtifolia* has a very thin lamina (82-110 µm) because it is usually found growing in the forest understorey where light is minimal. The rest of the species have a lamina thickness below 350 µm and cannot be separated on the basis of this character.

1.7 Conclusions

The present study carried out on the leaf anatomy of *Apocynaceae* is not very conclusive as only 37 of the 77 species in East Africa were examined. The results, however, show that the leaves exhibit a wide range of variability in anatomical characters, some of which can be confidently used to distinguish the genera or species. The present conclusions are based on limited material available for examination and in situations where I felt more material of the same species should be examined, I have indicated so and intend to do so in future. Listed below are some of the leaf anatomical characters which are either characteristic to the family or genera or useful in distinguishing the taxa. Conclusions about close relationships are also mentioned and the most outstanding anatomical characters are listed.

Leaves
are typically dorsiventral (bifacial) except in very few instances where they may be isobilateral depending on their environment as observed in *Nerium oleander* (Metcalfe & Chalk 1950; Esau 1965) or have a tendency towards being isobilateral as observed in some xeric species. Truly isobilateral leaves in *Apocynaceae* have been recorded by Ngan (1965), in *Wrightia saligna.*

Hairs
are simple, rarely glandular and uniseriate, rarely branched. May be uni- or muticellular, sometimes with compressed basal cells. The number of cells and the size is variable. The hairs of both *Baissea myrtifolia* and *Oncinotis tenuiloba* are terete (Figs. 3E, F), whereas those of *Holarrhena pubescens* are flattened with a widened base (Fig. 4E). More specimens should be examined under s.e.m. to find out whether the hairs are always terete or not.

Cuticular surface
highly variable and in many instances diagnostic. More material need to be examined as striations may be of great taxonomic value in some groups. (Stace (1965): genus *Macropteranthes* (Combretaceae); Wilkinson (1971): Anacardiaceae; van Staveren & Baas (1973): Icacinaceae) or may show considerable variation in degree of development in some groups as seen in the genus *Combretum* (Stace 1965), or in *Pistacia terebinthus*, which shows a wide range of cuticular ornamentation from coarsely striate to smooth (Wilkinson 1971).

Stomata
have been reported on adaxial surface in only 10 genera of *Apocynaceae*. In this case they are usually larger and scattered (Figs. 6A, B; Chandra et al. 1969) and appear to be of no taxonomic value. Only *Wrightia saligna* which is endemic to Australia can be said to be truly amphistomatic as stomata are reported to occur in equal numbers on both surfaces by Ngan (1965).

Outline
variable from narrowly to broadly elliptic to circular. Can be used to distinguish most species, especially if the width of the rim and type of aperture are also taken into consideration, e.g. the narrow rim and wide, elliptic aperture of *Tabernaemontana elegans* compared to the wider rim and circular aperture of *Ancylobotrys tayloris* (Figs. 3B, 5E).

Density per mm
This is inversely proportional to size and is only useful in extreme cases. Generally higher in the lianas and not useful in the intermediate cases.

Stomatal size
rarely exceeds 45 µm. Those species considered to have large stomata show measurements between 30-36 µm.

Subsidiary cells
four basic types of subsidiary cells are recognised in the family *Apocynaceae*: (i) paracytic, sometimes laterocytic: very common. Characteristic of the genera *Rauvolfia*, *Tabernaemontana* and *Voacanga*. (ii) anomocytic, fairly common and may sometimes occur together with anisocytic type in the same species; anisocytic type of stomata was never recorded on its own in the present study. (iii) Cyclocytic: rather uncommon except in *Pleiocarpa*, *Carissa* and *Acokanthera*. (iv) Actinocytic: very rare but seen in *Strophanthus courmontii* in the present study and recorded in *Catharanthus pusillus* by Chandra et al. (1972). According to Poulsen (1917) stomata are surrounded by several rings of radially arranged subsidiary cells in *Acokanthera spectabilis* (now *A. oblongifolia*).

Anticlinal walls
a situation was never found where the abaxial walls are straight and the adaxial undulate, it was always vice versa: abaxial walls undulate, adaxial straight or both walls straight or both undulate (see Table 2). Only useful in extreme cases and more specimens should be examined as some variaton in wall undulation of different leaves of the same species is to be expected, according to Wilkinson (1979) and this fact was not investigated in the present paper.

Lamina thickness
has not proved to be reliable in distinguishing the species as it is also dependent on the environment, texture and size of the leaves. Thirty-one of the 37 examined species have a lamina thickness below 350 µm and cannot be easily separated.

Cuticle and outer periclinal walls
only useful in extreme cases and quite dependent on the environment and age of the leaf. More specimens from different localities need to be examined.

Epidermal cells
size and shape useful in distinguishing species e.g. the large more or less square cells of *Adenium obesum* from the small rectangular shaped ones of *Baissea myrtifolia*. 1-2 layered species also easily distinguished from the 1 layered species.

Stomata t.s.
useful in distinguishing species with thick cuticular ledges (*Acokanthera* and *Picralima*), or in distingushing those with wide apertures (*Tabernaemomtana elegans*) and sunken (*Voacanga thouarsii*) or raised stomata.

Palisade cells
continuity or discontinuity of chlorenchyma across the adaxial side of the midrib vascular tissue is too variable to be useful.

Spongy mesophyll
very compact in *Hunteria*, *Saba* and *Holarrhena* and very lacunate in *Ancylobotrys* and *Dictyophleba*, not markedly different in the rest. More specimens need to be examined.

Minor veins
embedded or transcurrent, not very useful in distinguishing species, except in *Dictyophleba*, *Diplorhynchus*, *Ancylobotrys* and *Saba* where they are transcurrent and easily distinguishable.

Midrib outline and thickness
can be substantially used to distinguish taxa (see Figs. 13, 14)

Vascular bundle
typically bicollateral in petiole and leaves of all specimens examined. The shape of the bundle is of some diagnostic value, i.e. the v-shaped bundles of the tribe Tabernaemontaneae from the cylindrical bundles of *Landolphia* and *Clitandra*.

Phloem
arrangement in the midrib and petiole can be used in distinguishing some species.

Laticifers
recorded in all the species examined. Variable in diameter, position and degree of branching.

Crystals
calcium oxalate, abundant in all parts of the leaf and petiole; druses are the most common, followed by solitary crystals in the phloem. No crystals were observed in *Adenium obesum*, *Clitandra cymulosa* and *Stephanostema stenocarpum*.

Leaf margin
has not proved to be a useful character in distinguishing most of the species, except in extreme cases. The leaf margin in *Apocynaceae* is usually entire, although it may be straight to revolute on section, with an obtuse to almost rounded apex (Figs. 19 A-D). The rest of the species did not show very marked differences.

Petiole
outline, size and shape of vascular bundle can be used to distinguish species (see Figs. 20, 21)

A. The following species can be easily distinguished from all the others:

1. Acokanthera oppositifolia: by its thickly coriaceous leaves with a very thick cuticle and outer periclinal walls; leaf margin with papillose cells (Fig. 16A); stomata in transverse section with a very thick cuticular ledge (Fig. 10A)

2. *Baissea myrtifolia* and *Ancylobotrys petersiana:* by the presence of very undulate anticlinal walls on both leaf surfaces and from each other by paracytic stomata in the former and anomocytic in the latter. More specimens from different localities need to be exmined to ascertain that the anticlinal walls are always undulate.

3. Carissa tetramera: by the leaf mesophyll which has numerous sclerids; the marginal vein which is surrounded by a large amount of schlerenchymatous tissue and the leaves which have one strong marginal vein (Fig. 22A) as opposed to all the other species studied, which are eucamptodromous or have a submarginal vein (Fig. 22 A, D).

4. Dictyophleba lucida: by its hairs with numerous, short cells; leaf margin acutely obtuse with schlerenchymatous marginal vein and solitary crystals neatly arranged along the vascular bundle in the mesophyll.

5. Oncinotis hirta: sterile specimens can be easily distinguished from all other East African *Apocynaceae* species by presence of many branched hairs in the leaf and petiole.

6. Tabernaemontana pachysiphon: can be distinguished from others species by its minor veins that are supported with one large sclerid. More specimens from different localities need to be examined.

B. The present survey confirms a close relationship between the following:

(i) The genera *Carissa* and *Acokanthera*
Both comprise the subtribe Carissinae (Table 3) and have coriaceous leaves with laticifers prominently following the midrib vascular bundle, a situation never

occuring so clearly in all the other species (Figs. 14 A & D). Both genera have leaves with a tendency towards being isobilateral.

(ii) *Motandra* and *Oncinotis*
Both have phloem above the midrib bundle, clearly interspersed with mucilaginous fibres (Fig. 16A)

(iii) *Dictyophleba* and *Ancylobotrys*
Although the three species studied from the above genera were from three different localities in the Kenyan coast, they all exhibited the same type of spongy mesophyll arrangement which is highly lacunate (Fig. 12C).

(iv) *Mascarenhasia* and *Funtumia*
Both have characteristically long palisade cells; similar types of vascular bundle arrangement; repeatedly branched laticifers and similar type of vascular bundle in the petiole with many druses in the ground tissue.

(v) *Hunteria, Picralima* and *Pleiocarpa*
These three genera comprise the subtribe Pleiocarpinae and have 2-5 completely apocarpous carpels; the petiolar vascular bundle is strongly supported in the pericyclic region by mucilaginous fibres with very thick walls (fig. 16C). This is very evident in my present study of the Pleiocarpinae where all the ten species examined exhibited this character. The palisade layer also has large subglobose idioblasts with druses.

(vi) *Clitandra* and *Landolphia*
Both have a cylindrical vascular bundle in the petiole and midrib and a spongy mesophyll with horizontally elongated cells.

C. The most outstanding anatomical characters include:

The dorsiventral leaves, presence of laticifers, bicollateral vascular bundle and intraxylary phloem.

The present investigation was carried out as a preliminary survey of the leaf anatomy of *Apocynaceae* in East Africa. The results show more diversity in anatomical characters in the leaves than in the stem. The results also confirm that many species can be identified using leaf venation, surface characters or leaf transverse section. It is hoped that all the information gathered will stimulate further research.

1.8 FIGURES AND TABLES

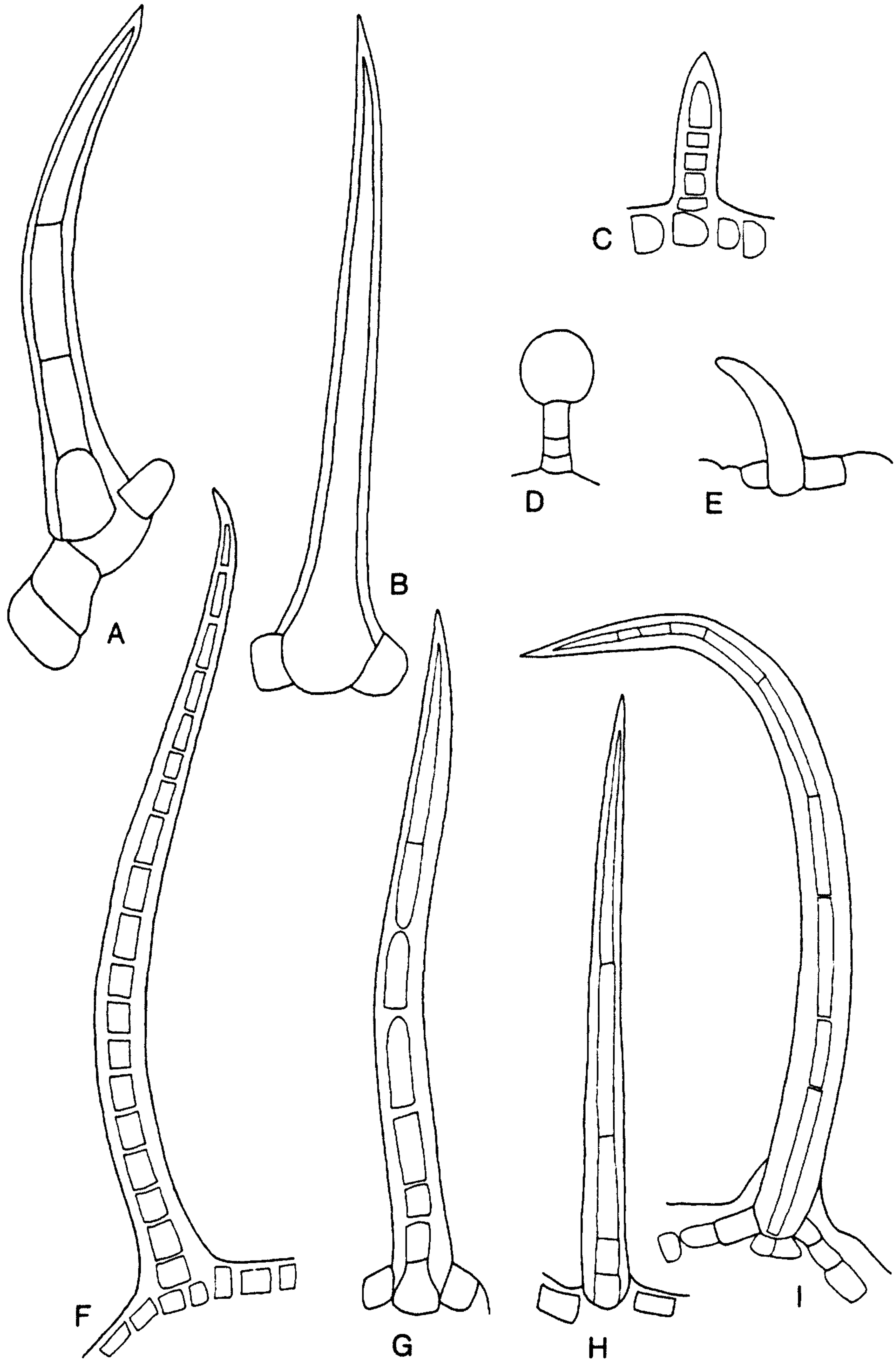

Figure 1. A-I. Hairs. A. *Stephanostema stenocarpum*; adaxial epidermis, curved 5-celled. B. *Holarrhena pubescens*; adaxial epidermis, unicellular, straight. C. *Ancylobotrys petersiana*; petiole, short hairs. D. *Motandra guineensis*; petiole, glandular hairs. E. *Mascarenhasia arborescens*; petiole, unicellular, thin walled. F. *Dictyophleba lucida*; petiole, cells small, numerous. G. *Oncinotis tenuiloba*; petiole, short basal cells, terminal cells longer. H. *Motandra guineensis*; midrib, straight hair, short basal cells and long terminal cells. I. *Baissea myrtifolia*; adaxial midrib, basal cells long, terminal cells short, hooked at the apex. A-I = mag. × 25.

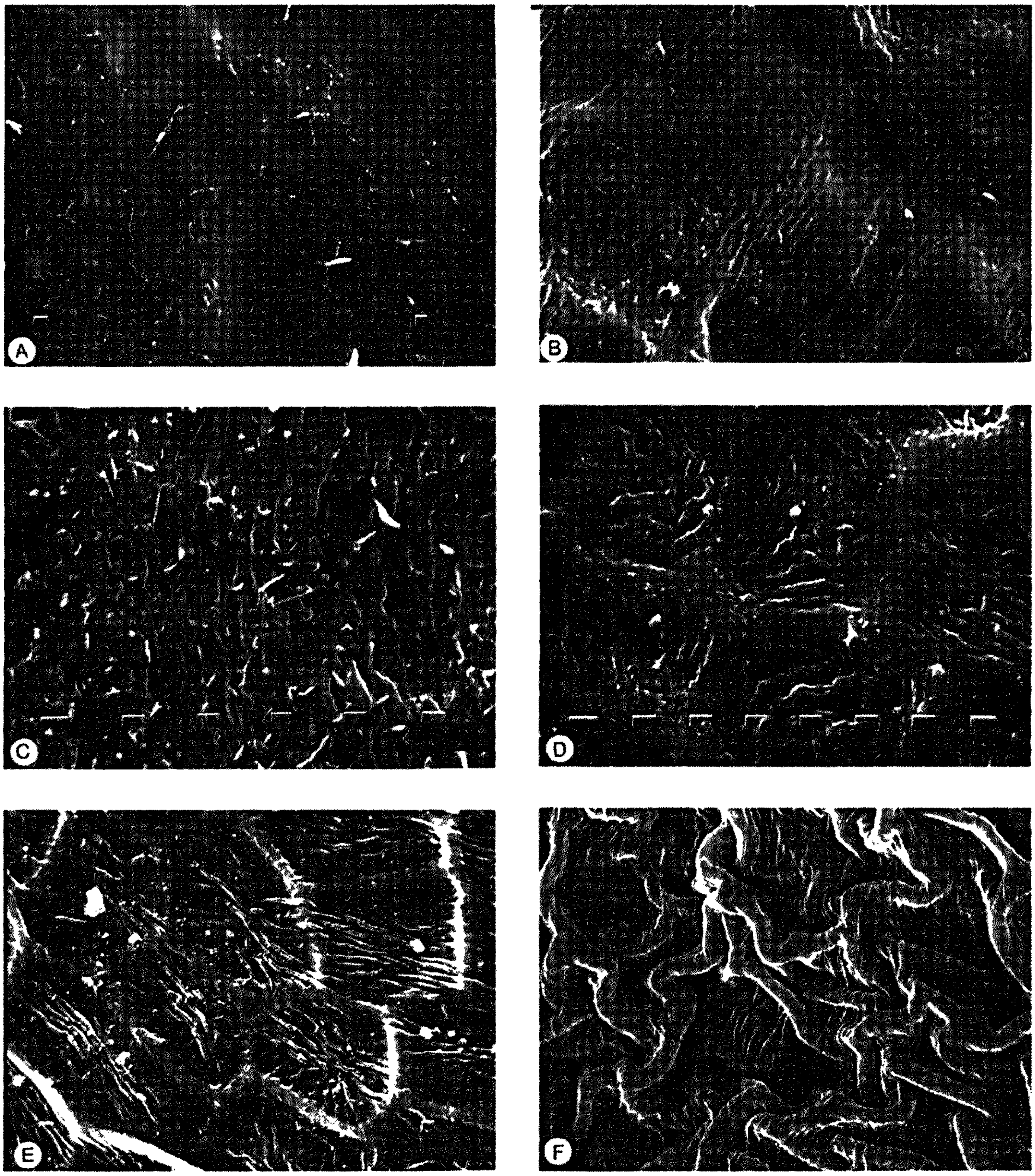

Figure 2. A-F. Adaxial leaf surfaces. A. *Diplorhynchus condylocarpon*; smooth surface with very fine striae. B. *Tabernaemontana elegans*; surface with fine striae, cell outline indistinct as shallow groves. C. *T. stapfiana*; whole cuticle striate, obscuring cell outlines. D. *Schizozygia coffaeiodes*; ridges of cuticle over anticlinal walls; striations confined to antepericlinal wall of each cell. E. *Carvalhoa campanulata*; cuticular ridges over anticlinal walls, striations over cell outlines. F. *Holarrhena pubescens*; cuticular ridges over undulate, anticlinal walls, striations crossing cell outlines. The cells exhibit some inward collapse of the outer periclinal walls, due to drying. A, E = mag. × 1000; B = mag. × 1250; C = mag. × 2000; D = mag. × 1500; F = mag. × 2060.

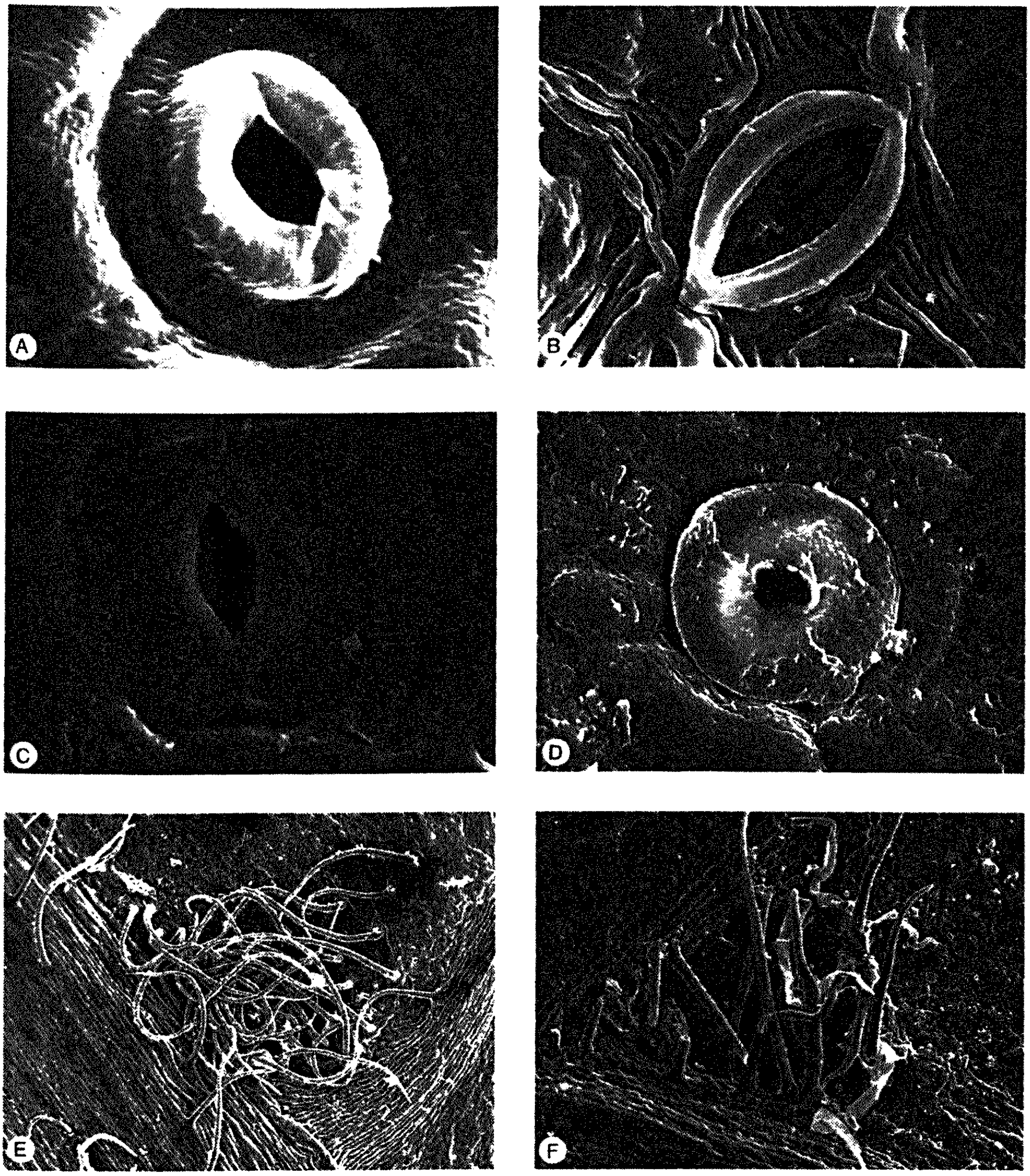

Figure 3. A-F. Abaxial leaf surfaces. A. *Hunteria zeylanica*; surface smooth, stoma circular, slightly raised with sunken subsidiary cells. B. *Tabernaemontana elegans*; wide, elliptic aperture and narrow rims, pore closed, striations across subsidiary cells and ridges extending at polar ends. C. *Oncinotis tenuiloba*; stoma with paracytic subsidiary cells, surface smooth. D. *Acokanthera oppositifolia*; circular stoma, round aperture and wide rims. E. *Baissea myrtifolia*; domatia in the axils of secondary veins, hairs long, curled, extending to the midrib. F. *Oncinotis tenuiloba*; domatia in the axils of secondary veins, hairs straight erect. A = mag. x 3080; B = mag. x 1640; C = mag. x 2730; D = mag. x 2800; E = mag. x 101; F = mag. x 185.

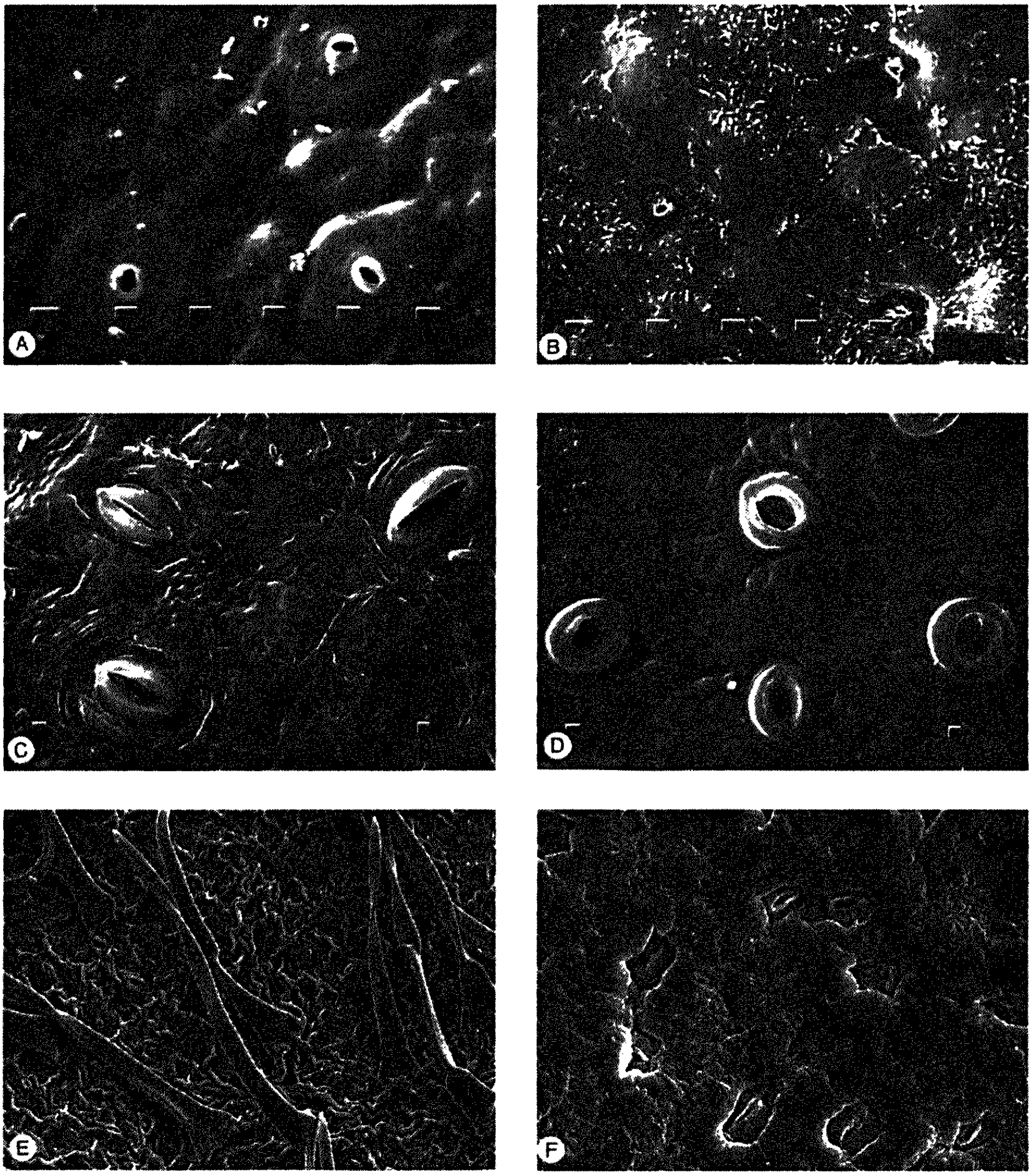

Figure 4. A-F. Abaxial leaf surfaces. A. *Dictyophleba lucida*; stomata and subsidiary cells raised, surface smooth, with shallow grooves over cell outlines. B. *Saba comorensis*; sunken stomata; cells outlines visible as tiny mounds. C. *Strophanthus courmontii*; primary stoma at top right, concentric rings of striae around subsidiary cells. D. *Ancylobotrys petersiana*; circular stoma, pore narrow, slit, cuticular surface ornamented. E. *Holarrhena pubescens*; flattened multicellular hairs with a wide base, tapering at the apex; whole cuticle striate. F. *Carissa edulis*; broadly elliptic stomata, sunken; ridges over subsidiary cells and partly obscuring stomata. A, B = mag. × 2000; C, D = mag. × 1000; E = mag. × 366; F = mag. × 1520.

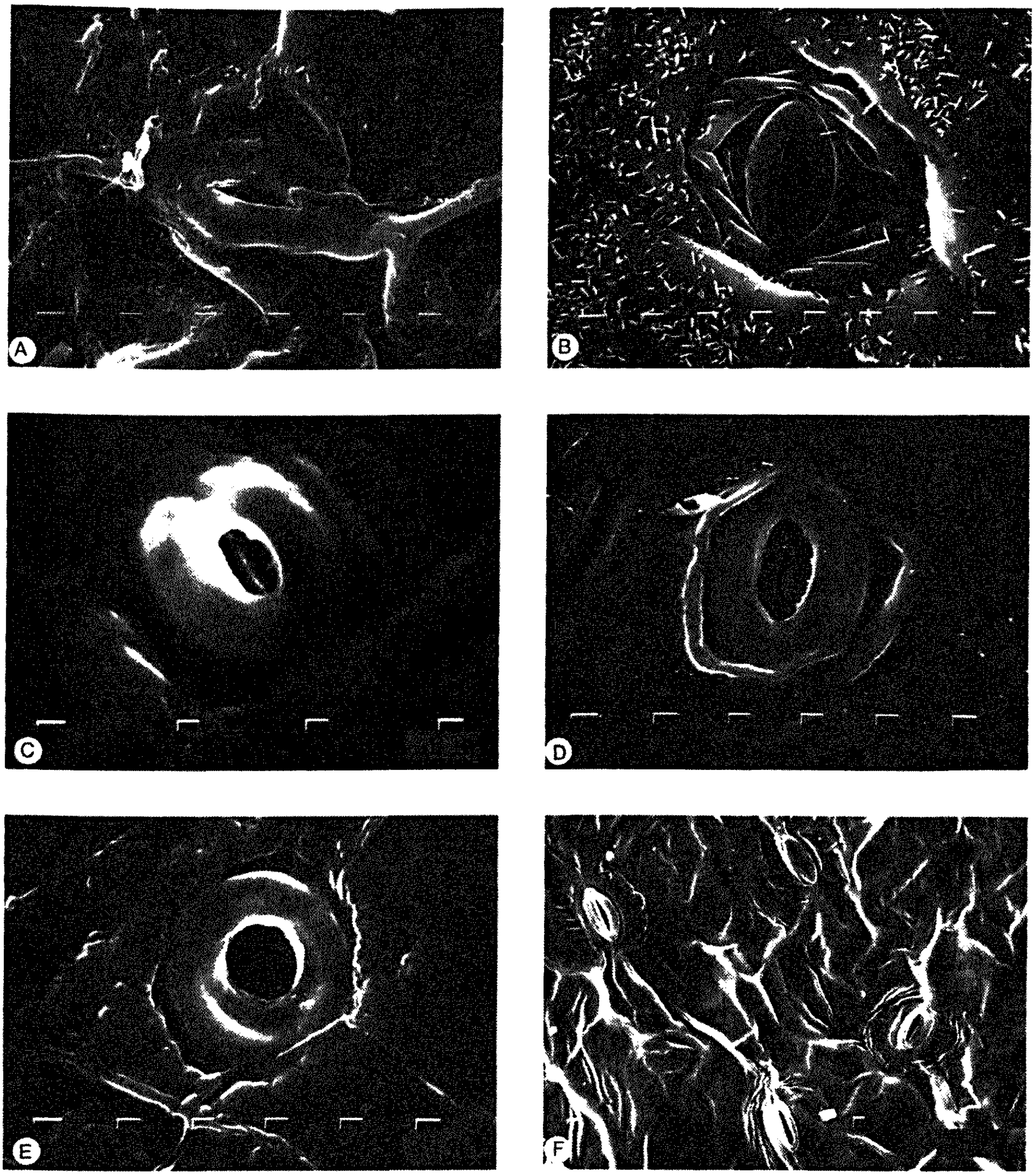

Fig 5. A-F. Abaxial leaf surfaces and stomata. A. *Stephanostema stenocarpum*; thick cuticular ridges extend from the poles and across subsidiary cells. B. *Tabernaemontana stapfiana*; wings of striae across slightly sunken subsidiary cells; C. *Carissa tetramera*; broadly elliptic stoma with wide rims, truncate at the poles, surface smooth. D. *Diplorhynchus condylocarpon*; broadly elliptic stoma with narrow pore and peristomatal rims. E. *Ancylobotrys tayloris*; circular stoma with a circular aperture, ridges over sunken subsidiary cells. F. *Carvalhoa campanulata*; concentric rings of striae around subsidiary cells, stomata narrowly elliptic, cuticular surface ridged, otherwise smooth. A, B, D, E = mag. × 2000; C = mag. × 3500; F = mag. × 1000.

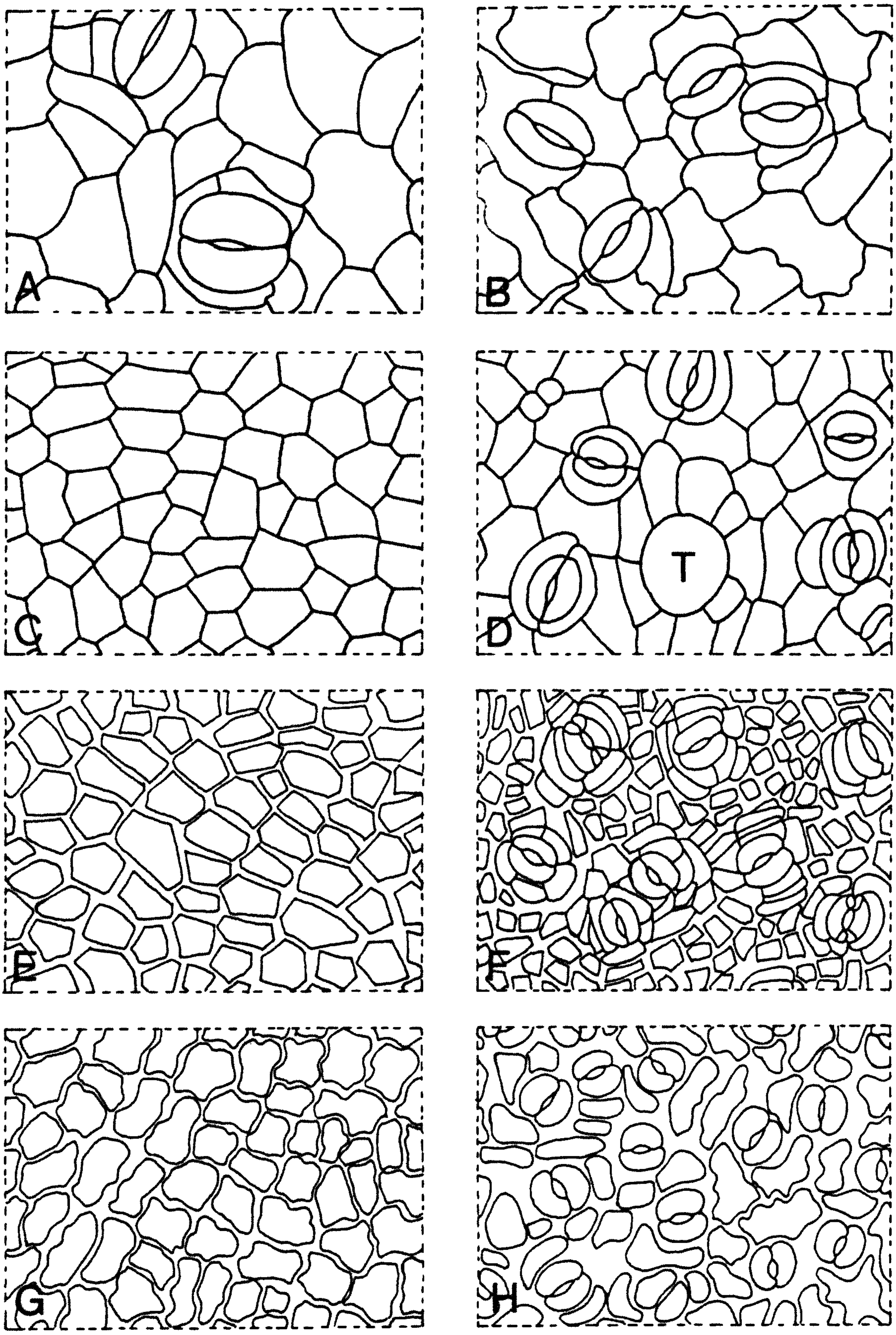

Figure 6 A-H. Adaxial and Abaxial leaf surfaces showing stomata and anticlinal walls. A,C,E,G, adaxial; B,D,F,H, abaxial. A,B. *Strophanthus courmontii*; amphistomatic. C,D. *Holarrhena pubescens*; with paracytic cells extending over the poles (laterocytic). E,F. *Acokanthera oppositifolia*; paracytic and cyclocytic-tetracytic. G,H. *Dictyophleba lucida*. anomocytic stomata. T = trichome, A-H = mag. × 200.

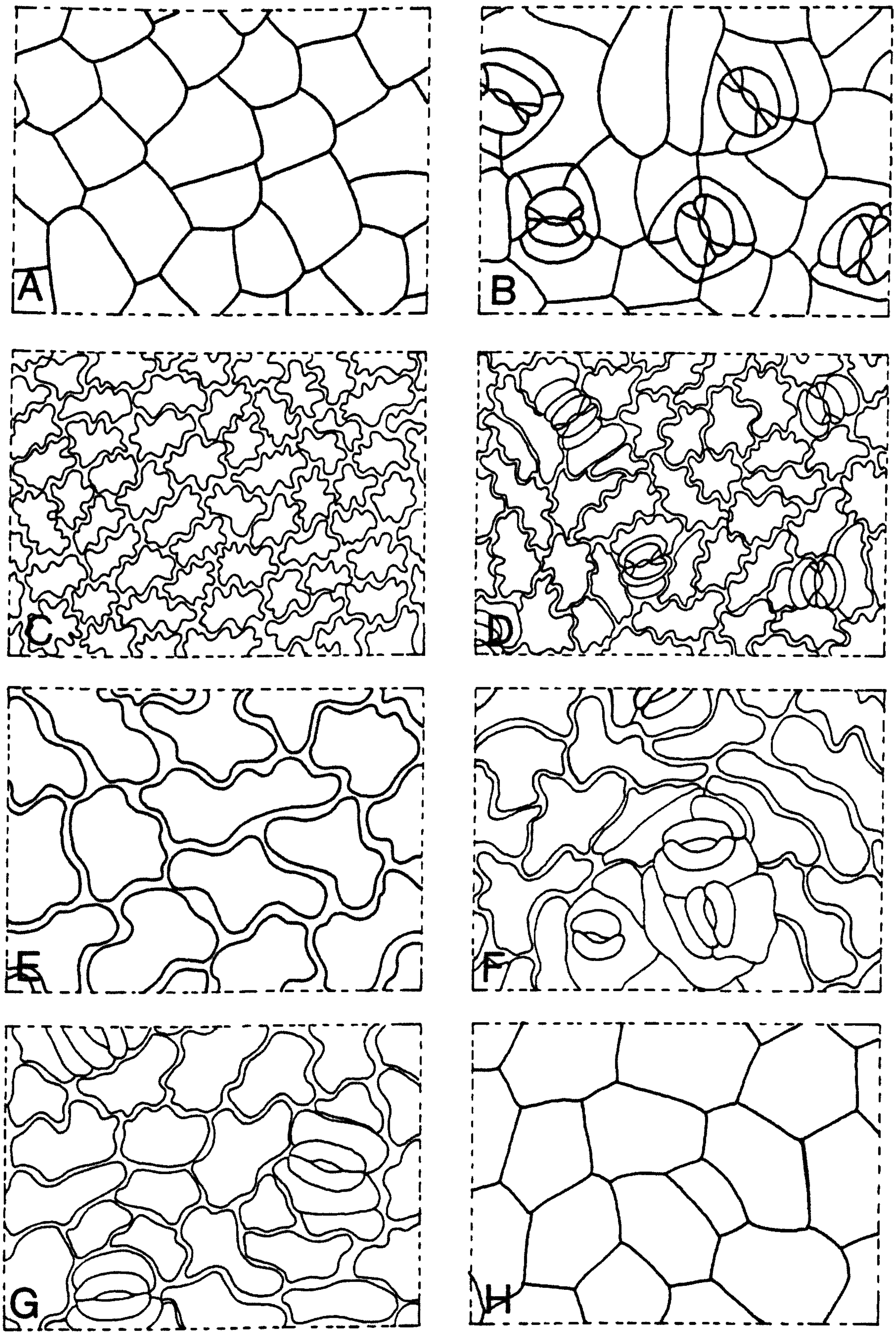

Figure 7 A-H. Adaxial and Abaxial leaf surfaces showing stomata and anticlinal walls. A,C,E,H, adaxial; B,D,F,G, abaxial. A,B. *Pleiocarpa pycnantha*; cylocytic and tetracytic. C,D. *Baissea myrtifolia*; paracytic stomata, anticlinal walls very undulate on both sides. E,F. *Rauvolfia mannii*; paracytic, anticlinal walls undulate on both sides. G,H. *R. mombasiana*; abaxial undulate, adaxial straight. A-H = mag. × 200.

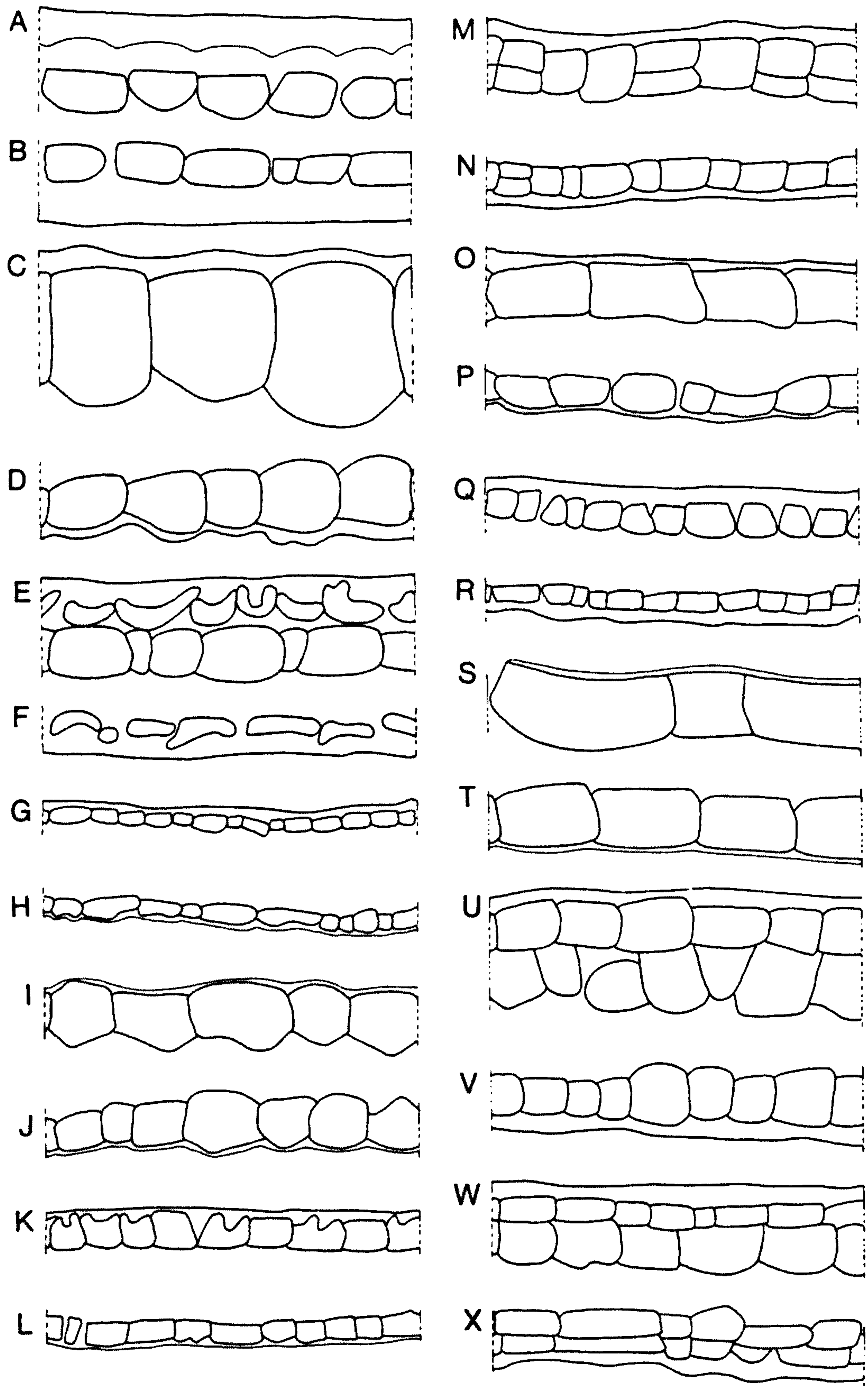

Figure 8 A-X. Adaxial and abaxial epidermis of various Apocynaceae. A,C,E,G,I,K,M,O,Q,S,U,W, adaxial. B,D,F,H,J,L,N,P,R,T,V,X, abaxial. A,B. *Acokanthera oppositifolia.* C,D. *Adenium obesum.* E,F. *Ancylobotrys tayloris.* G,H. *Baissea myrtifolia.* I,J. *Carvalhoa campanulata.* K,L. *Clitandra cymulosa.* M,N. *Funtumia elastica.* O,P. *Rauvolfia caffra.* Q,R. *Saba comorensis.* S,T. *Stephanostema stenocarpum.* U,V. *Tabernaemontana pachysiphon.* W,X. *T. stapfiana.* A-X = mag. × 25.

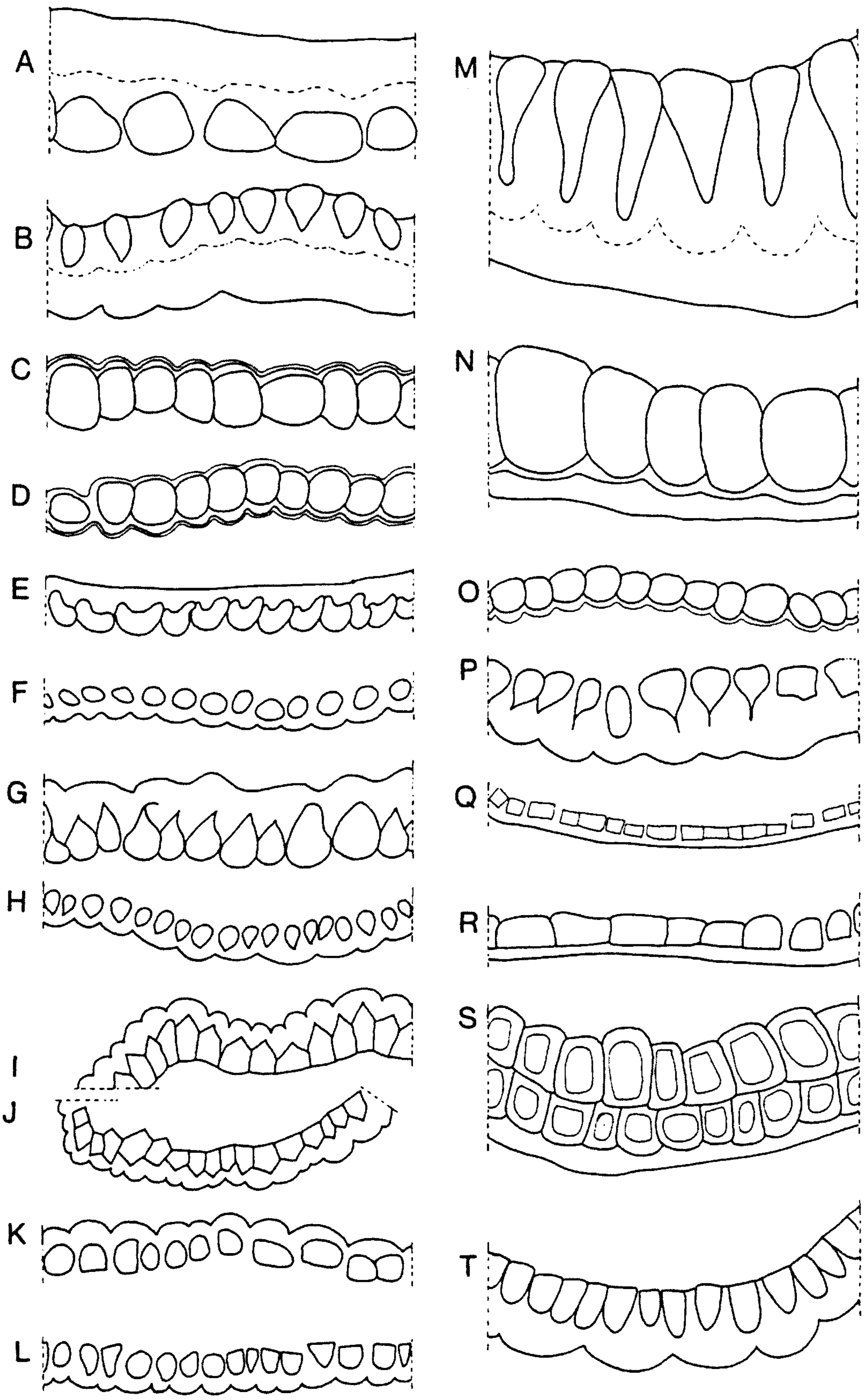

Figure 9 A-T. Adaxial and abaxial epidermis. A, C, E, G, I, K, adaxial midrib. B, D, F, H, J, L, abaxial midrib. M-T, margin. A,B. *Acokanthera oppositifolia.* C,D. *Adenium obesum.* E,F. *Ancylobotrys petersiana.* G,H. *Carissa edulis.* I,J. *Mascarenhasia arborescens.* K,L. *Diplorhynchus condylocarpon.* M. *Acokanthera oppositifolia.* N. *Adenium obesum.* O. *Alafia microstylis.* P. *Carissa edulis* Q. *Baissea myrtifolia.* R. *Clitandra cymulosa.* S. *Mascarenhasia arborescens.* T. *Pleiocarpa pycnantha.* A-T = mag. × 25.

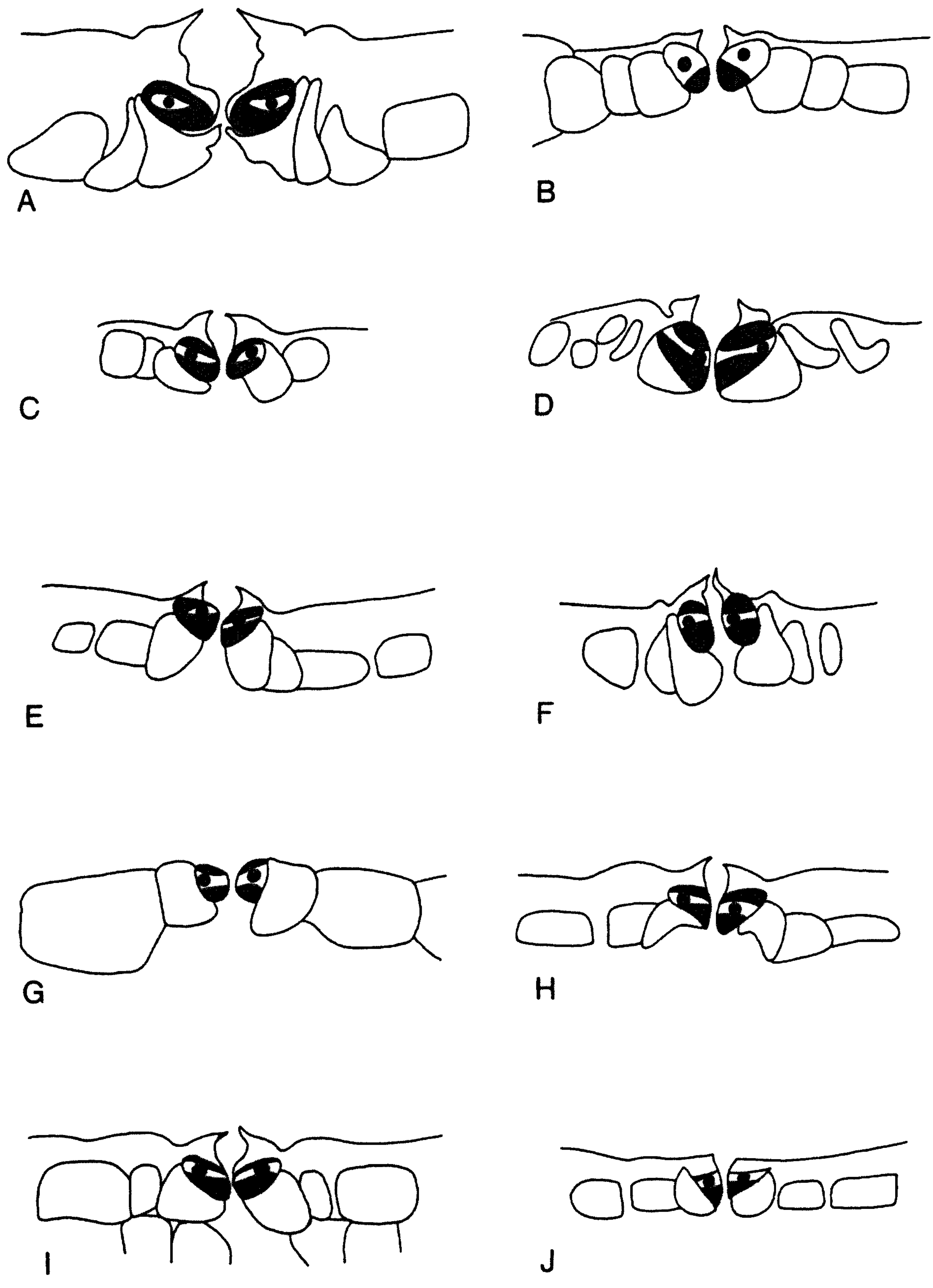

Figure 10. A-J. Stomata in transverse section. A. *Acokanthera oppositifolia*; thick cuticular ledge. B. *Adenium obesum*; slightly raised. C. *Ancylobotrys petersiana*; narrower aperture. D. *A. tayloris*; wider aperture. E. *Carrisa tetramera*: wider aperture. F. *C. edulis*; very narrow aperture. G. *Carvalhoa campanulata*; more or less level with the surface. H. *Hunteria congolana*; stoma raised. I. *H. zeylanica*. J. *Saba comorensis*; stoma sunken. A-J= mag. × 400.

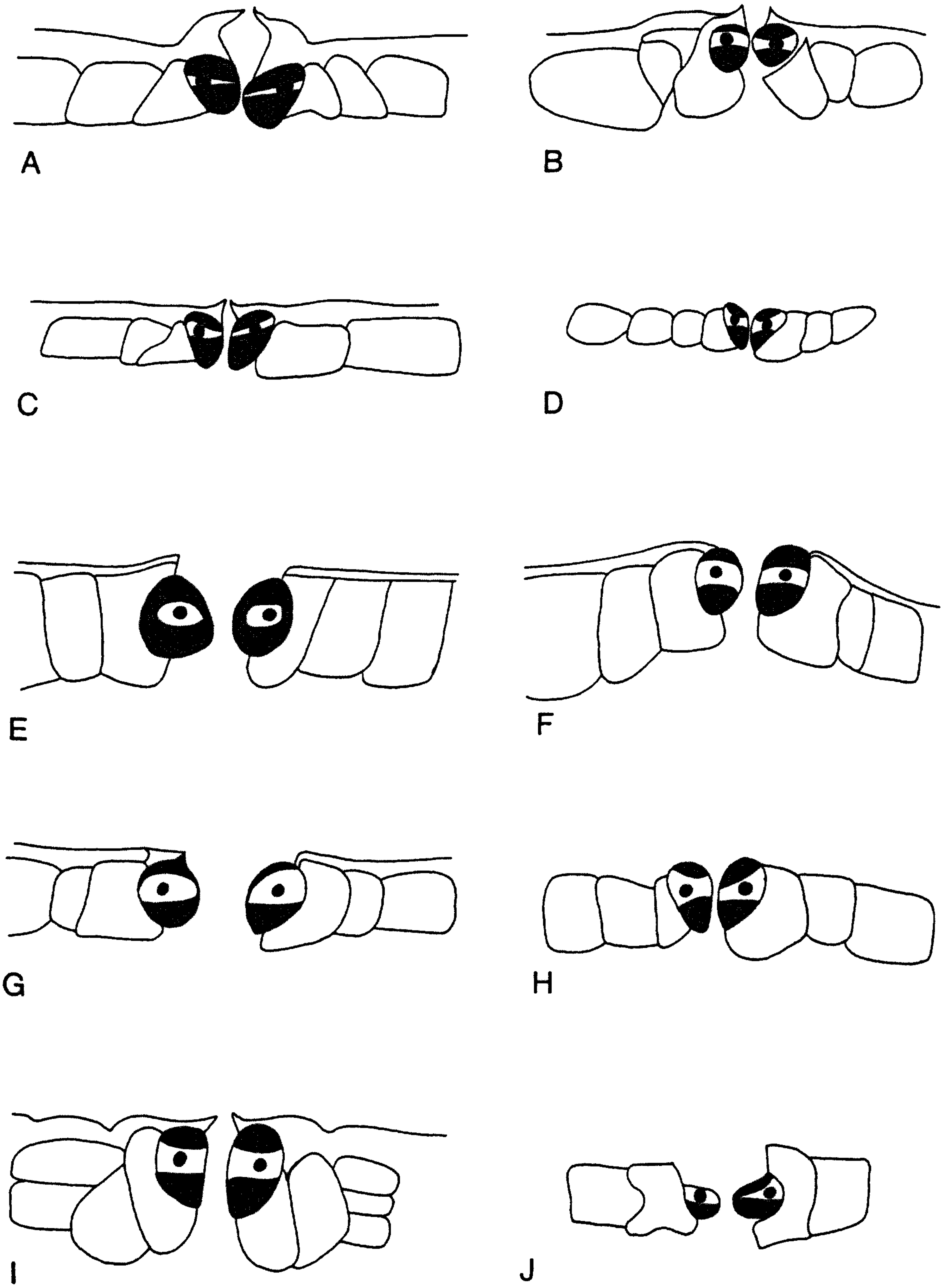

Figure 11. Stomata in transverse section. A. *Picralima nitida*; thick cuticular ledge. B. *Pleiocarpa pycnantha*; C. *P. bicarpellata* D. *Oncinotis tenuiloba*; more or less level with the surface. E, F. *Strophanthus courmontii*; E. adaxial, very wide aperture; F. abaxial raised. G. *Tabernaemontana elegans*; very wide aperture. H. *T. pachysiphon*; narrow aperture. I. *T. stapfiana*; J. *Voacanga thouarsii*; abaxial, sunken stomata. A-J = mag. × 400.

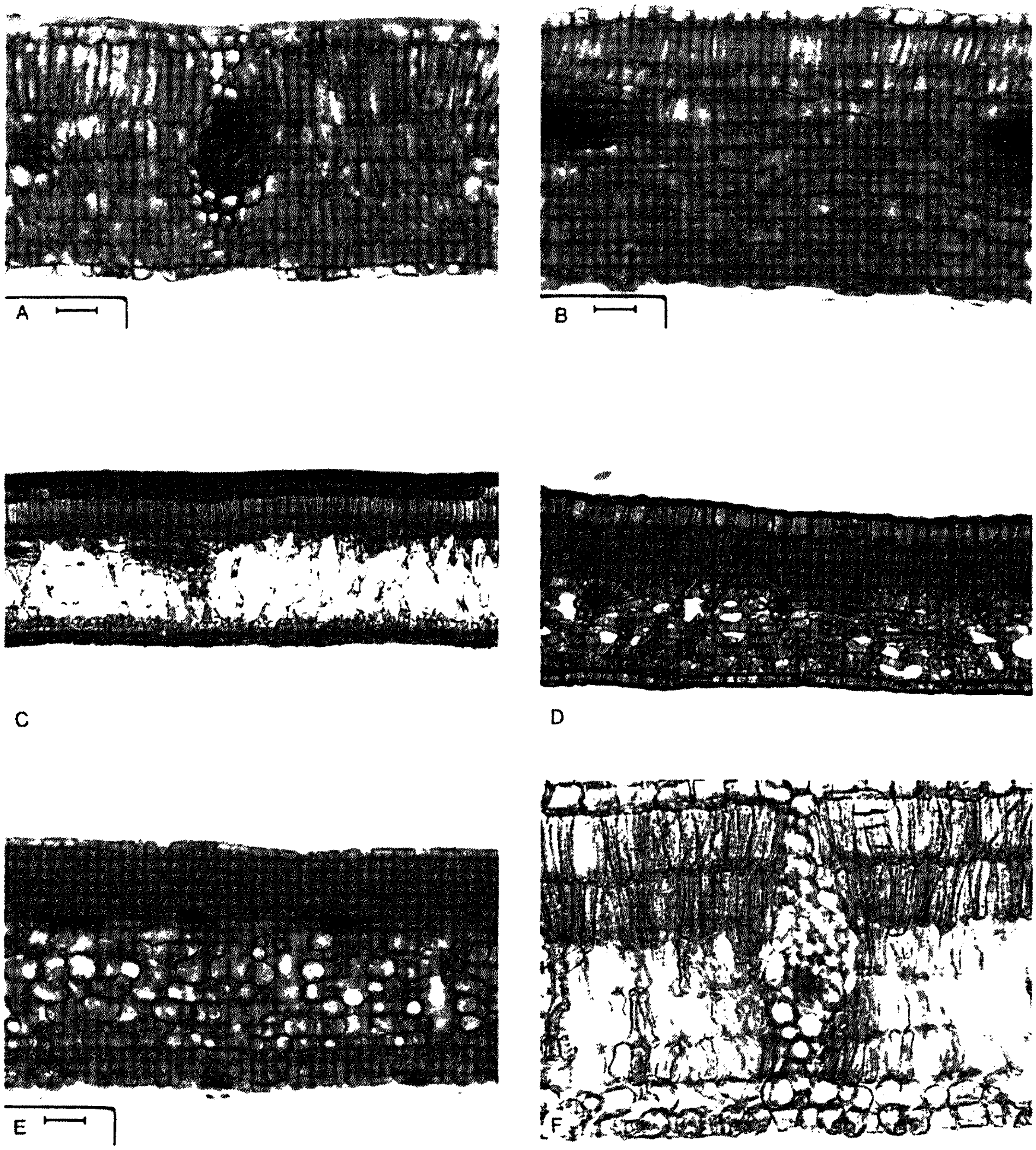

Figure 12. A-F. Mesophyll. A. *Saba comorensis*; homogenous. B. *Holarrhena pubescens*; 1-layered palisade, transversely elongated spongy mesophyll cells, compact. C. *Ancylobotrys tayloris*; vertically elongated spongy mesophyll cells, lacunate, note thick cuticle and outer periclinal walls. D. *Tabernaemontana elegans*; 3-4 layered palisade, transversely elongated spongy mesophyll cells, less compact. E. *Acokanthera oppositifolia*; mesophyll with tendency towards being isobilateral. F. *Diplorhynchus condylocarpon*; vertically elongated spongy mesophyll cells, less lacunate with transcurrent veins towards both epidermis. A, B = mag. × 200; C = mag. × 312; D = mag. × 125; E = mag. × 160; F = mag. × 312.

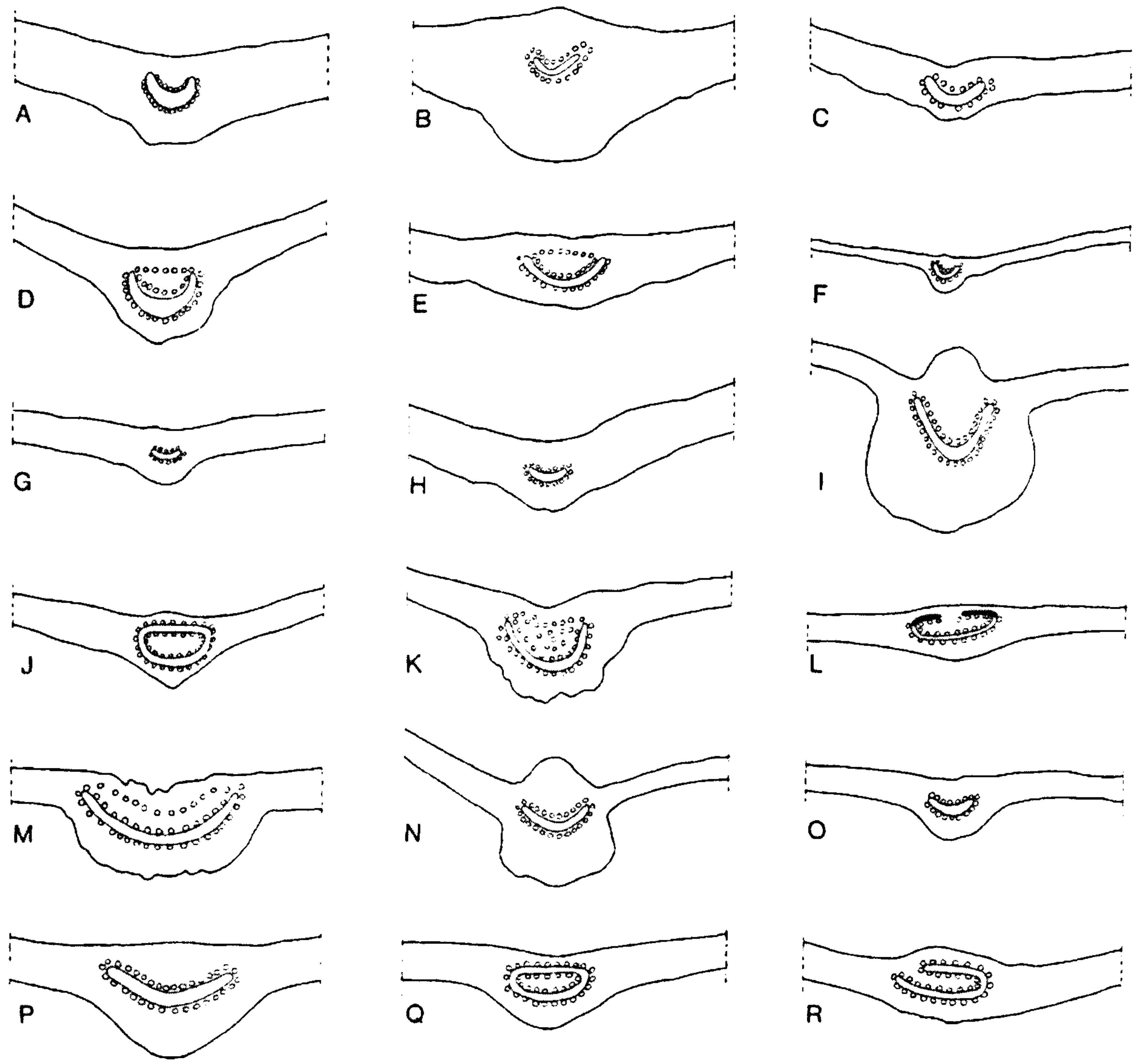

Figure 13. A-S. Midrib outline: A. *Acokanthera oppositifolia*. B. *Adenium obesum*. C. *Alafia microstylis*. D. *Ancylobotrys petersiana*. E. *A. tayloris*. F. *Baissea myrtifolia*. G. *Carissa edulis*. H. *C. tetramera*. I. *Carvalhoa campanulata*. J. *Clitandra cymulosa*. K. *Dictyophleba lucida*. L. *Diplorhynchus condylocarpon*. M. *Funtumia elastica*. N. *Holarrhena pubescens*. O. *Hunteria congolana*. P. *H. zeylanica*. Q. *Landolphia buchananii*. R. *L. watsoniana*. A-R = mag. × 25.

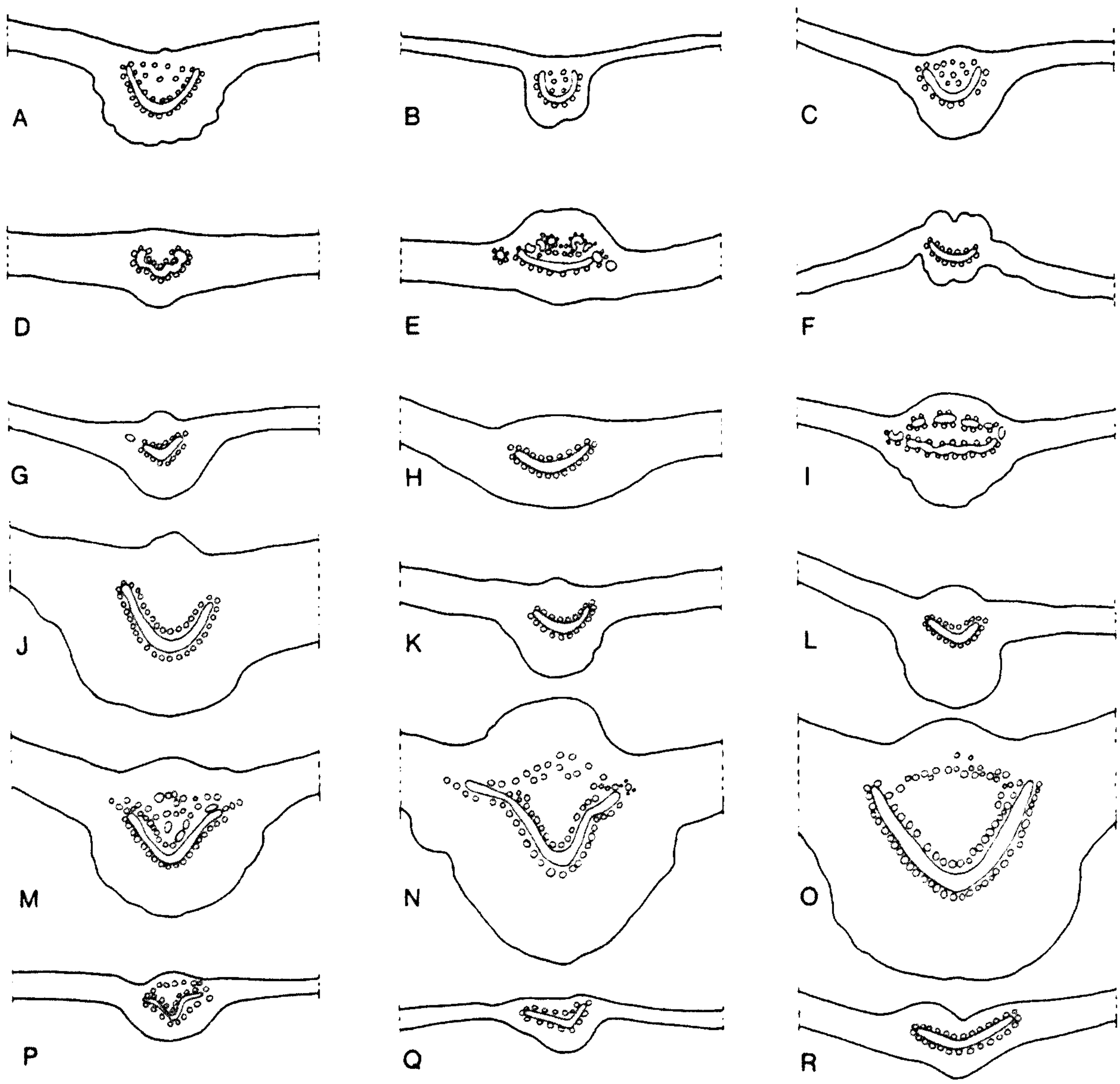

Figure 14. A-S. Midrib outline. A. *Mascarenhasia arborescens*. B. *Motandra guineensis*. C. *Oncinotis tenuiloba*. D. *Pleiocarpa bicarpellata*. E. *P. pycnantha*. F. *Rauvolfia caffra*. G. *R. mannii*. H. *R. mombasiana*. I. *Saba comorensis*. J. *Schizozygia coffaeiodes*. K. *Stephanostema stenocarpum*. L. *Strophanthus courmontii*. M. *Tabernaemontana elegans*. N. *T. pachysiphon*. O. *T. stapfiana*. P. *T. ventricosa*. Q. *Voacanga africana*. R. *V. thouarsii*. A-R = mag. × 25.

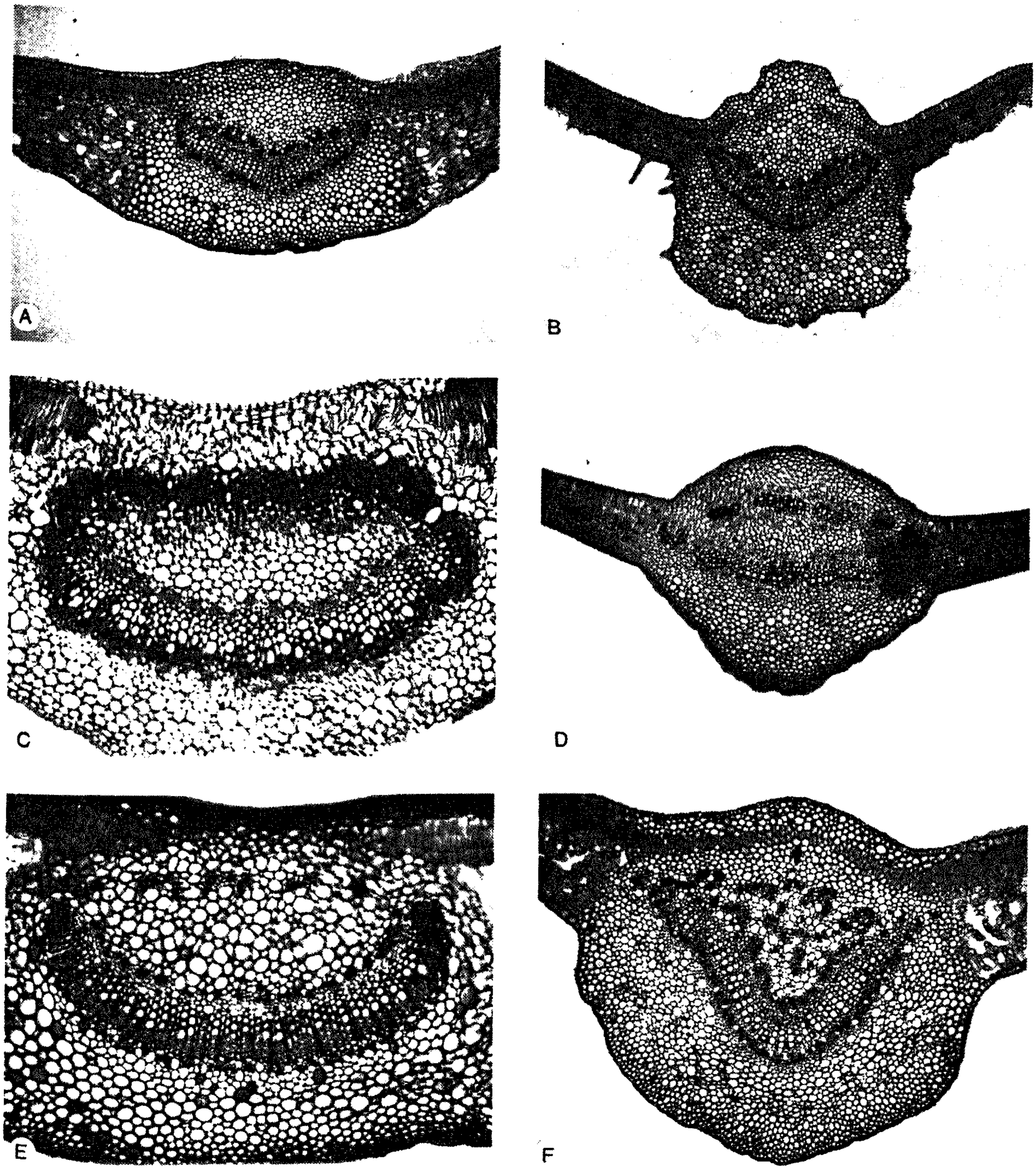

Figure 15. A-F. Midrib. A. *Rauvolfia mombasiana*; midrib outline straight on both sides, vascular bundle shallow arc. B. *Holarrhena pubescens*; midrib outline, 1-layered palisade. C. *Landolphia buchananii*; vascular bundle with schrenchymatous tissue on adaxial side. D. *Saba comorensis*. E. *Ancylobotrys tayloris*; phloem extends across the top of bundle. F. *Tabernaemontana elegans*; phloem forms islands in the middle of the bundle, palisade extends to the midrib (arrow). A, B, D, F = mag. × 50; C, E = mag. × 125.

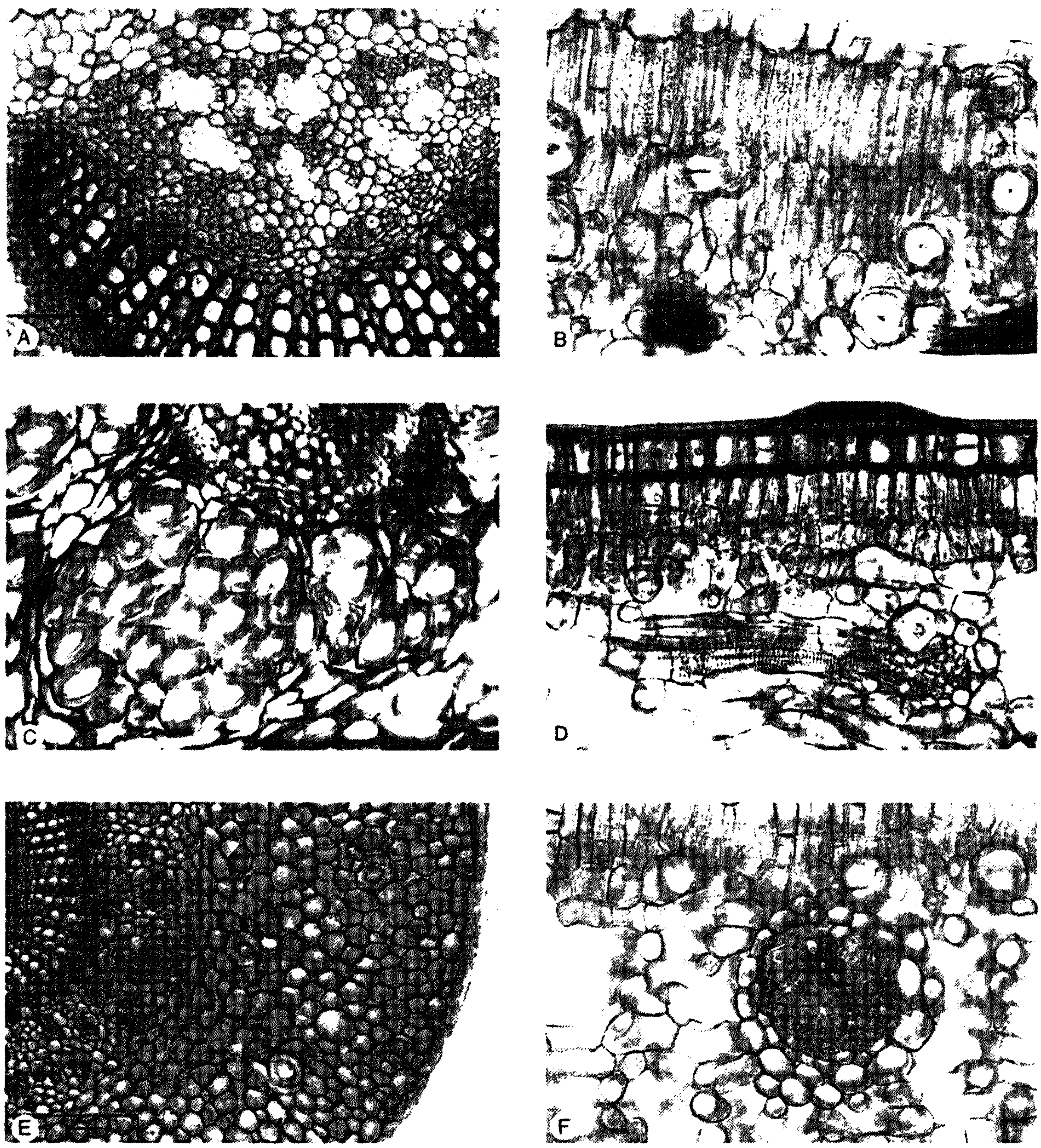

Figure 16. A-F. Fibres. A. *Oncinotis tenuiloba*; Mucilaginous fibres above vascular bundle interspersed with phloem. B. *Carissa tetramera*; sclerids among palisade and spongy palisade tissue. C. *Pleiocarpa bicarpellata*; petiolar vascular bundle strongly supported by mucilaginous fibres. D. *Tabernaemontana pachysiphon*; sclerid supporting each minor bundle; cork wart. E. *Pleiocarpa pycnantha*; sclerosed elements in ground tissue of petiole; mucilaginous fibres along petiolar vascular bundle. F. *Pleiocarpa bicarpellata*; embedded and collateral minor bundle with outer parenchyma sheath and xylem vessels surrounded with fibres. A, E = mag. × 125; B, C, D, F = mag. × 312.

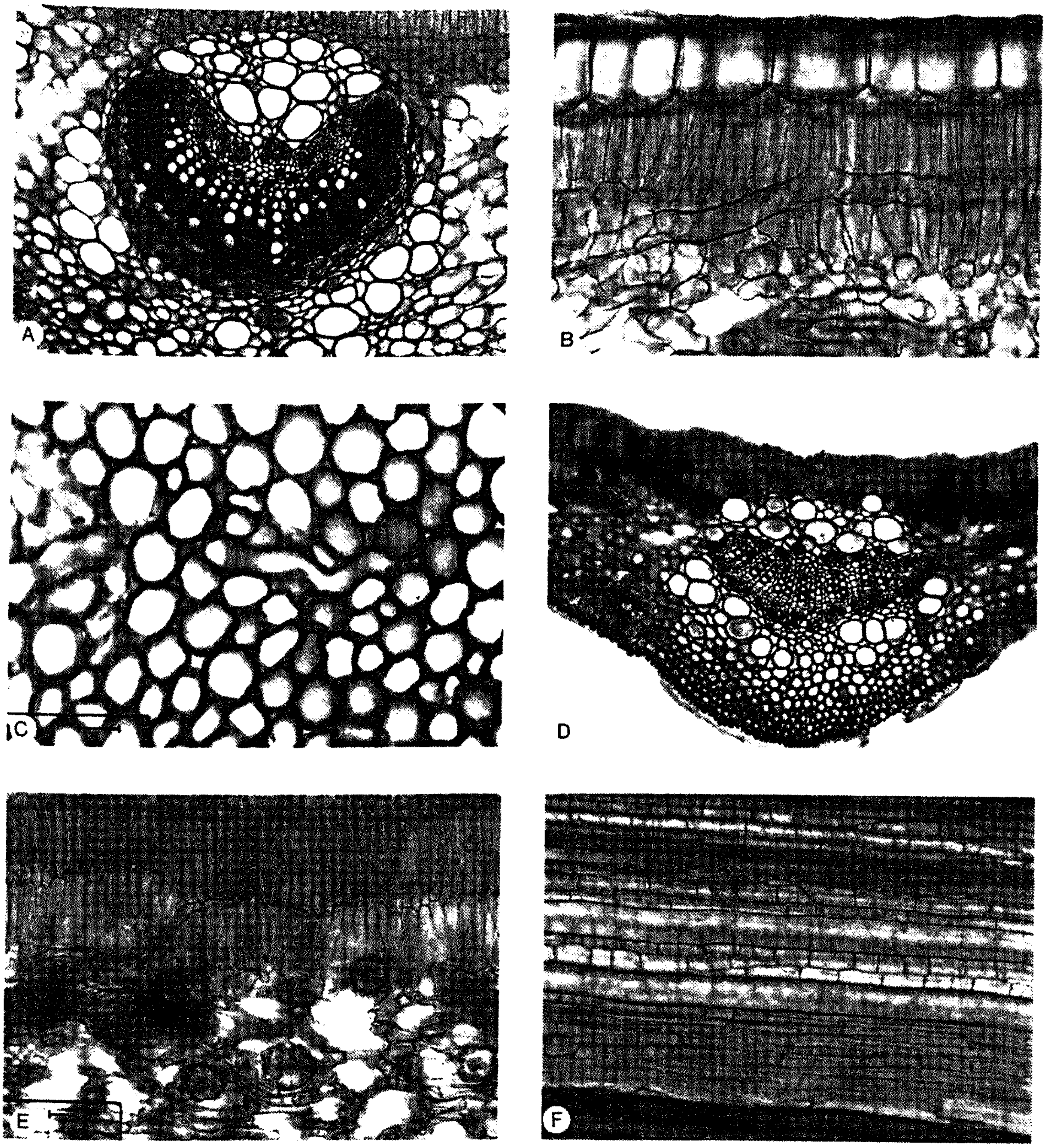

Figure 17. A-E. Laticifers. A. *Acokanthera oppositifolia*; Laticifers along the midrib veins. B. *Adenium obesum*; laticifer branching below epidermis. C. *Ancylobotrys petersiana*; laticifers in ground tissue of petiole. D. *Carissa edulis*; laticifers along midrib veins. E. *Funtumia elastica*; laticifer branching in the palisade; crystals in mesophyll. F. *Tabernaemontana elegans*, two laticifers along the stem. A, D= mag. × 125; B = mag. × 312; C = mag. × 500; E = mag. × 200; F = mag. × 160.

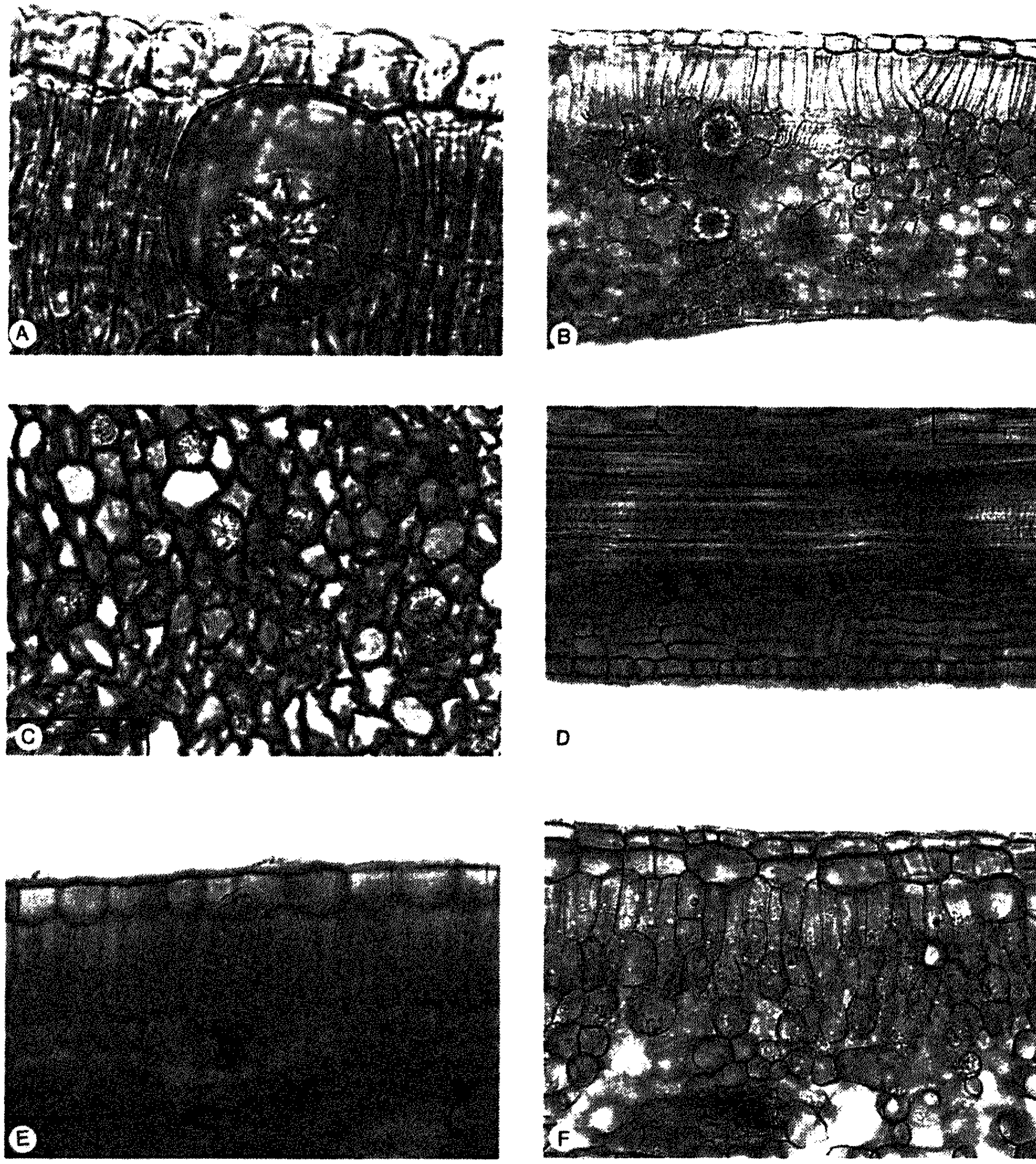

Figure 18. A-D. Crystals. A. *Hunteria zeylanica*; idioblast with cluster crystal (druse) in palisade. B. *Oncinotis tenuiloba*; cluster crystals in spongy mesophyll. C. *Mascarenhasia arborescens*; cluster crystals in the ground tissue petiole. D. *Dictyophleba lucida*; solitary cystals along veins in the mesophyll E. *Rauvolfia mombasiana*. cluster crystals (druses) in two layers above minor vein. F. *Tabernaemontana stapfiana*; crystals in palisade; 2-layered epidermis. A = mag. × 787; B, F = mag. × 312; C = mag. × 320; D, E = mag. × 400.

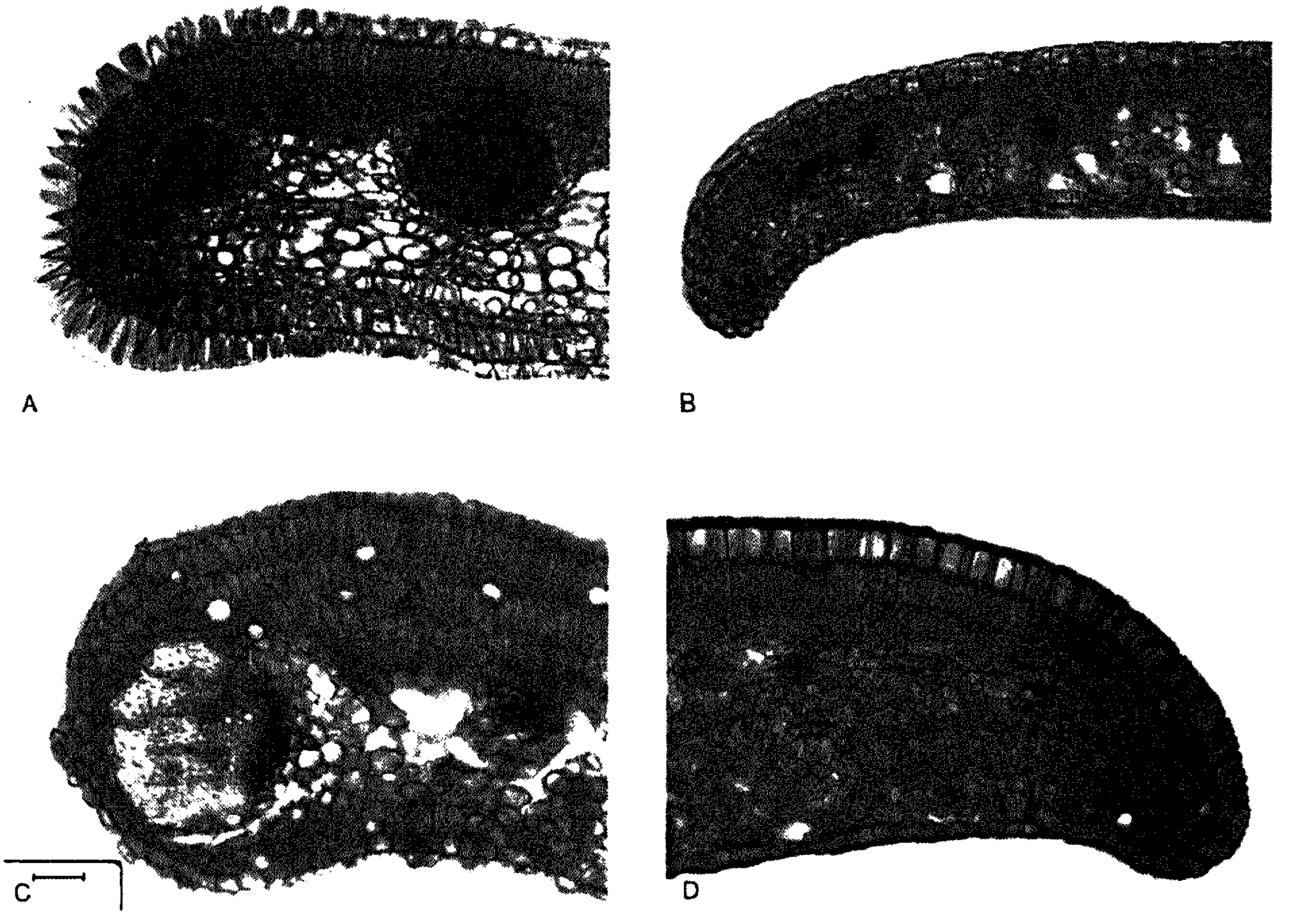

Figure 19. A-D. Leaf margin: A. *Acokanthera oppositifolia*; straight margin with papillose epidermal cells. B. *Schizozygia coffaeiodes*; revolute leaf margin. C. *Carissa tetramera*; marginal vein with layers of schlerenchymatous tissue. D. *Adenium obesum*; obtusely acute margin, slightly revolute at the tip. A, B, C = mag. × 125; D = mag. × 250.

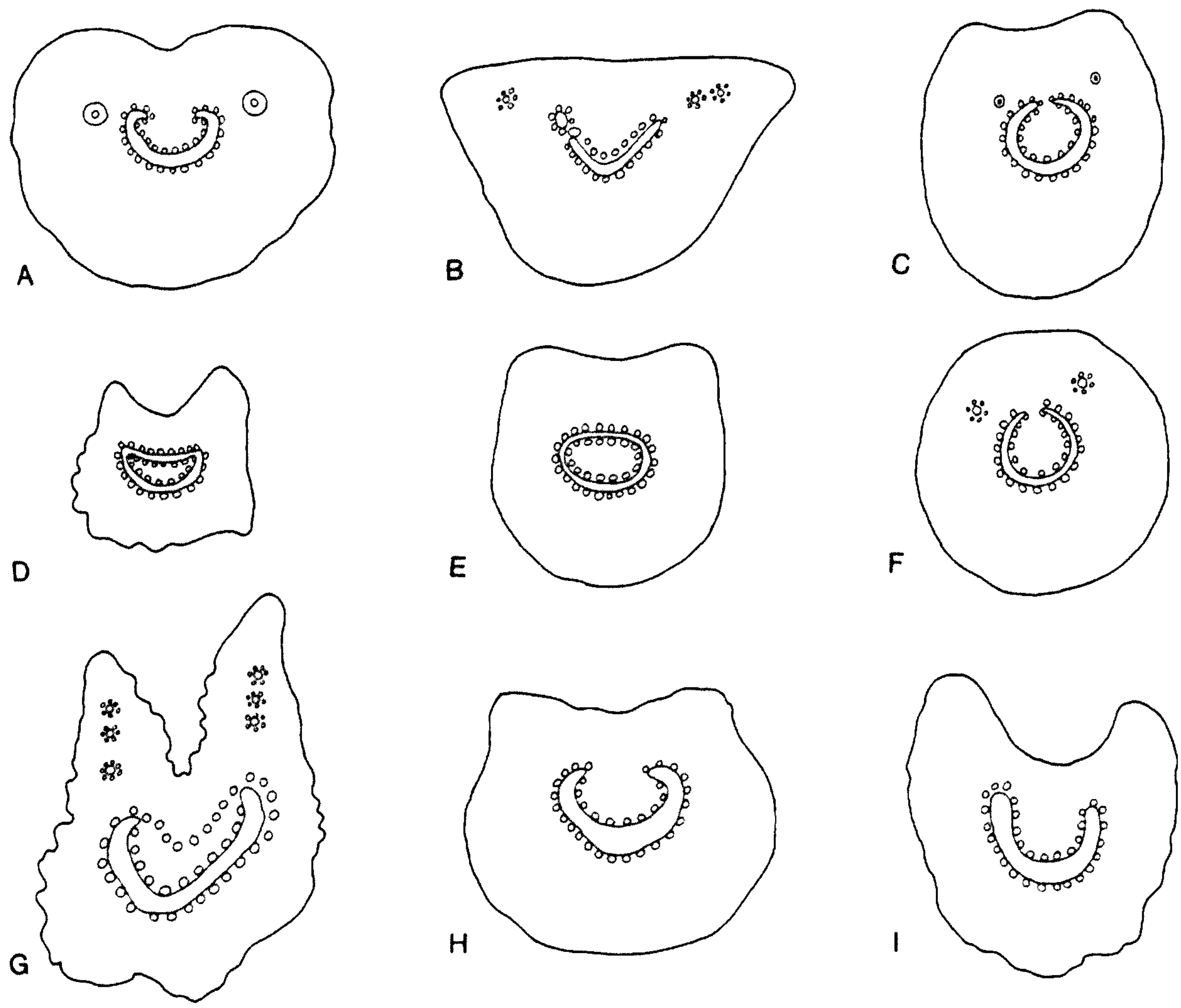

Figure 20. A-I. Petiole outline. A. *Acokanthera oppositifolia*. B. *Adenium obesum*. C. *Ancylobotrys petersiana*. D. *Clitandra cymulosa*. E. *Landolphia watsoniana*. F. *Dictyophleba lucida*. G. *Funtumia elastica*. H. *Hunteria zeylanica*. I. *Mascarenhasia arboresens*. A-D = mag. × 25.

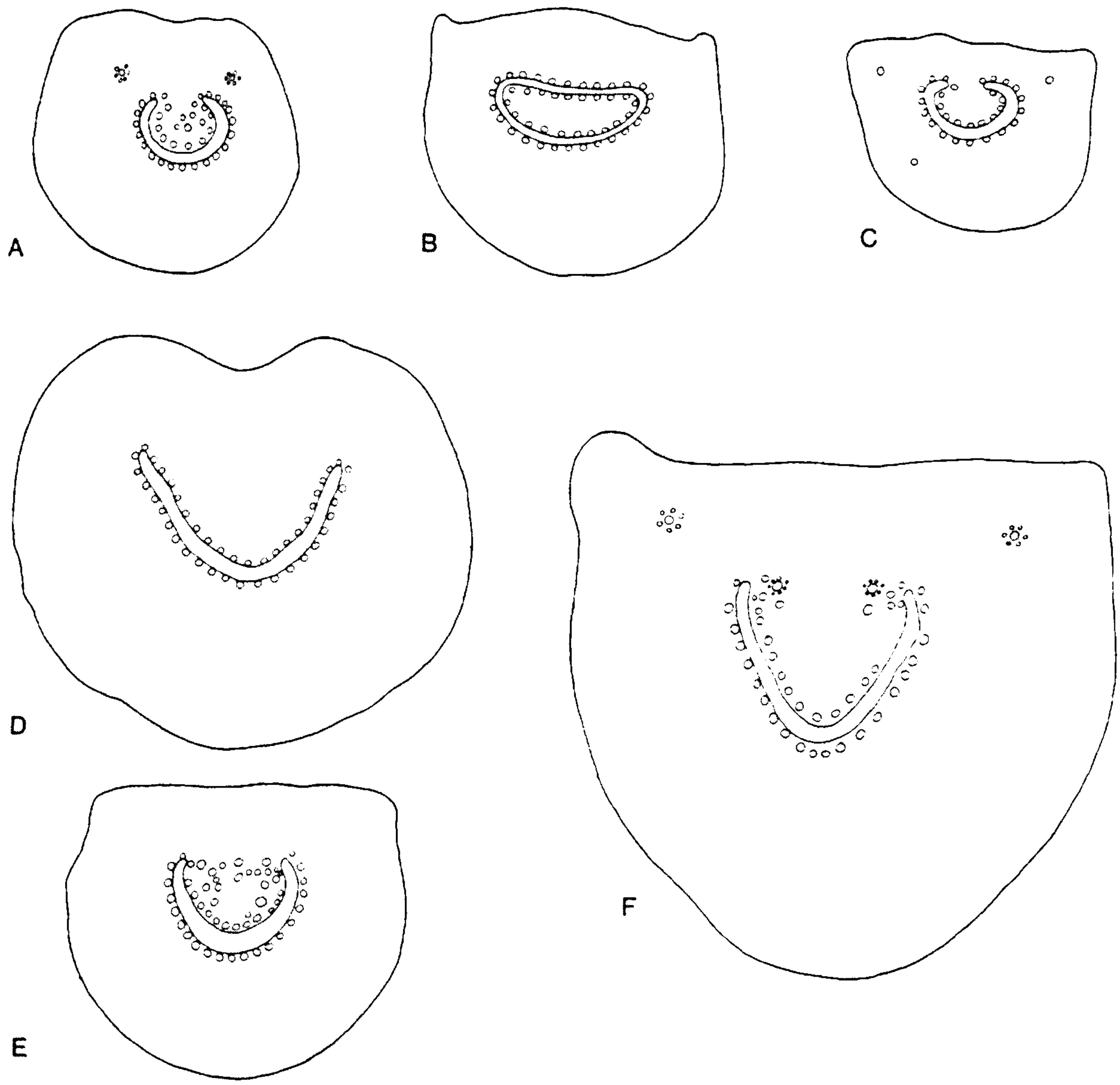

Figure 21. A-F. Petiole outlines. A. *Oncinotis tenuiloba*. B. *Saba comorensis*. C. *Pleiocarpa pycnantha*. D. *Schizozygia coffaeiodes*. E. *Tabernaemontana elegans*. F. *T. pachysiphon*. A-F = mag. × 25.

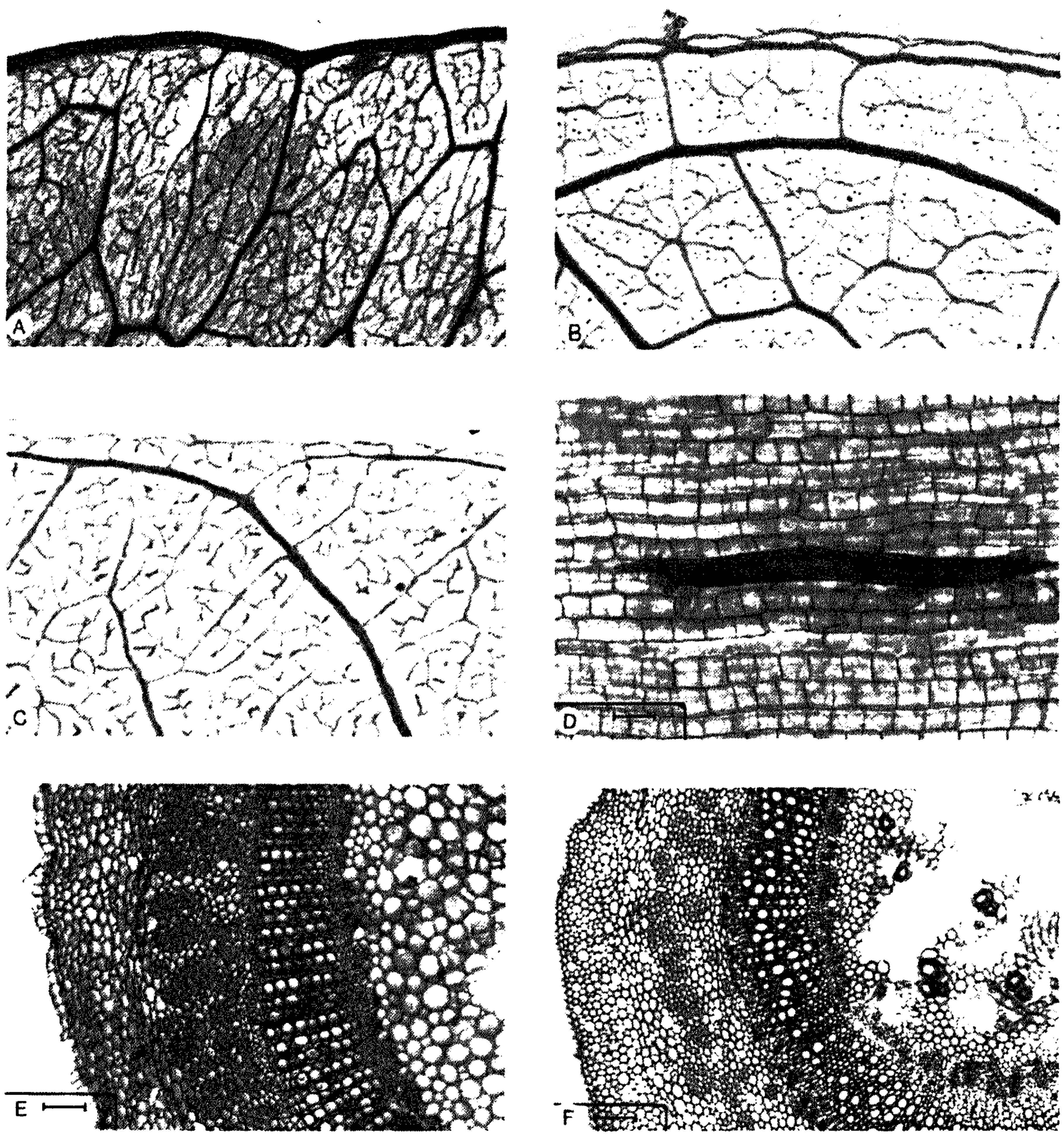

Figure 22. A-F. A. *Carissa tetramera*; leaf venation with a very strong marginal vein. B. *Pleiocarpa pycnantha*; leaf venation with a submarginal vein. C. *Voacanga africana*; leaf venation without prominent marginal loops (eucamptodromous). D. *Tabernaemontana elegans*; stem (L.S.), sclerosed element in pith. E. *Carvalhoa campanulata*; stem, (T.S.), to show arrangement of cells. F. *Hunteria zeylanica*; stem, (T.S.), to show arrangement of cells, note the sclerosed elements in the pith. A, B, C, D = mag. × 160; E = mag. × 125; F = mag. × 100.

Table 1. Leaf anatomical characters of some East African Apocynaceae species.

Species	Cuticle size in µm	Epidermal cells, size in µm.	Palisade, number of rows and sizes of 1/2 row	Midrib thickness (µm)	Lamina thickness (µm)
1. Acokanthera oppositifolia	19-26.6[a] 9.4-15[b] 21-28.5[x] 21-23.8[y] 22-48[z]	11-19 × 19-40[a] 11.4-19 × 5.7-28.5[b] 12.4-22.8 × 11.4-27[x] 11.4-17 × 2.9-15.2[y] 30.4-40 × 5.7-11.4[z]	2-3 rows 32.3-59 × 8-13[1] 30-44 × 6-12[2]	677-732	384-458
2. Adenium obesum	1.9-9.5[a] 1.9-3.8[b] 1.9-5.7[x] 1.9-5.7[y] 5.7-9.5[z]	43.7-68.4 × 28.5-61.8[a] 19-28.5 × 15-57[b] 12.4-20.9 × 7.6-17[x] 13.3-19 × 9.5-18[y] 22.8-36.6 × 9.5-26.6[z]	1-2 rows 51-67 × 6-13[1] 32-38 × 10-15[2]	1245-1263	403-439
3. Alafia microstylis	1.9-2.9[a] 1.9-2.9[b] 3.8-4.8[x] 1.9-2.9[y] 2.9-4.8[z]	13.3-18 × 13.3-34.2[a] 8.6-12.4 × 13.3-34.2[b] 9.5-11.4 × 9.5-17[x] 5.7-9.5 × 3.8-7.6[y] 7.6-13 × 7.6-9.5[z]	1-2 (-3) rows 15-29 × 4-13[1] 27-36 × 6-13[2]	402-439	256-302
4. Ancylobotrys petersiana	3-7.5[a] 3-6[b] 5-8[x] 3-6.5[y]	5-10 × 7-33[a] 3.5-5 × 9-19[b] 6-8 × 5-9[x] 4-6 × 5-9[y] 7-9 × 4-8[z]	1-2 (-3) rows 29-45 × 7-15[1] 28-42 × 8-15[2]	714-750	293-320
5. Ancylobotrys tayloris	6-11[a] 3-9[b] 2-6[x] 4-4.5[y] 3.5-5.5[z]	4-8 × 8-24[a] 3-5 × 9-23[b] 5-7 × 5-8.5[x] 3-6 × 4-7[y] 7-11 × 4-7[z]	2-(3) rows 30-92 × 6-13[1] 19-27 × 6-13[2]	549-586	229-300
6. Baissea myrtifolia	1[a] 1[b] 3[x] 3[y] 2[z]	4.5-8 × 5-20[a] 4-6 × 5-28[b] 13-19 × 5-16[x] 6-12 × 4-13[y] 3.8-7.6 × 7.6-9.5[z]	1 row 15-28 × 4-7[1]	201-238	82-110
7. Carissa edulis	8-13[a] 4-5[b] 8-17[x] 3-5[y] 3-8[z]	9-12 × 13-27[a] 7-11 × 5-12[b] 10-18 × 6-17[x] 8-11 × 5-9[y] 9-15 × 5-10[z]	2 (-3) rows 40-86 × 6-15[1] 25-35 × 6-10[2]	439-458	247-302

Species	Cuticle size in µm	Epidermal cells, size in µm.	Palisade, number of rows and sizes of 1/2 row	Midrib thickness (µm)	Lamina thickness (µm)
8. Carissa tetrameta	12-16[a] 3-6[b] 9-20[x] 3-9[y] 13-15[z]	13-17 × 13-25[a] 5-12 × 7-24[b] 13-19 × 14-27[x] 4-6 × 4-8[y] 8-11 × 7-20[z]	2 (-3) rows 45-65 × 7-15[1] 30-50 × 5-15[2]	494-549	366-412
9. Carvalhoa campanulata	1[a] 1[b] 1[x] 1[y] 1[z]	14-21 × 16-38[a] 10-20 × 11-29[b] 12-14 × 10-16[x] 10-12 × 8-14[y] 10-13 × 7-16[z]	1 row 25-35 × 8-14[1]	1409-1446	156-220
10. Clitandra cymulosa	1-2[a] 1.9[b] 1-2.8[x] 1-3.8[y]	8-13 × 8-15[a] 5.7-9.5 × 11.5-22.8[b] 7.6-11.5 × 3.8-15.2[x] 5.7-9.5 × 3.8-9.5[y] 7.6-11.5 × 3.8-11.4[z]	2 rows 25-32 × 8-12[1] 17-23 × 8-12[2]	640-659	192-247
11. Dictyophleba lucida	1-2[a] 2-2.5[b] 2-3[x] 2-3[y]	10-12 × 7-20[a] 4-6 × 7-14[b] 8-12 × 3-11[x] 4-7 × 3-7[y] 3-10 × 3-5[z]	2 rows 32-42 × 6-13.5[1] 23-31 × 10-21[2]	714-787	183-311
12. Diplorhynchus condylocarpon	2.9-5.7[a] 1.9-5.7[b] 3.8-7.6[x] 3.8-7.6[y] 7.6-10.5[z]	8.6-17 × 9.5-32.3[a] 7.6-15.2 × 7.6-28.5[b] 7.6-9.5 × 2.9-15.2[x] 7.6-12.4 × 3.8-7.6[y] 12-14 × 4-5[z]	2-3 rows 34-42 × 6-7.5[1] 21-36 × 38.7[2]	439-458	256-275
13. Funtumia elastica	3.8-5.7[a] 1.9-3.8[b] 4.5-7[x] 3.8-5.7[y] 3.8-6[z]	7.6-24.7 × 13.3-24.7[a] 7-11.4 × 10-20[b] 7-12 × 5-10[x] 8-12 × 8-13[y] 9.5-19 × 3.8-13[z]	2-3 rows 55-80 × 6-10[1] 44-67 × 8-15[2]	586-768	311-366
14. Holarrhena pubescens	1-2[a] 1-2[b] 1-2[x] 1[y] 2-3[z]	12-26 × 7-26[a] 10-24 × 11-30[b] 16-21 × 8-17[x] 12-20 × 10-17[y] 18-22 × 9-18[z]	1 row 30-37 × 5-9[1]	970-1025	201-220

Species	Cuticle size in µm	Epidermal cells, size in µm.	Palisade, number of rows and sizes of 1/2 row	Midrib thickness (µm)	Lamina thickness (µm)
15. Hunteria congolana	$8\text{-}9^{a}$ $4\text{-}7^{b}$ $10\text{-}14^{y}$ $13\text{-}15^{z}$	$8\text{-}12 \times 7\text{-}20^{a}$ $5\text{-}8 \times 8\text{-}18^{b}$ $10\text{-}15 \times 10\text{-}20^{x}$ $7\text{-}12 \times 5\text{-}9^{y}$ $7\text{-}11 \times 4\text{-}11^{z}$	1-2 rows $14\text{-}26 \times 5\text{-}9^{1}$ $8\text{-}13 \times 6\text{-}8^{2}$	403-439	183-220
16. Hunteria zeylanica	$9\text{-}10^{a}$ $5\text{-}7^{b}$ $10\text{-}13.5^{x}$ $10\text{-}12.5^{y}$ $9\text{-}13^{z}$	$12\text{-}19 \times 6\text{-}20^{a}$ $10\text{-}12.8 \times 9\text{-}29^{b}$ $16\text{-}17 \times 15\text{-}16^{x}$ $14\text{-}16 \times 11\text{-}15^{y}$ $10\text{-}15 \times 9\text{-}12^{z}$	2-3 rows $16\text{-}31 \times 5\text{-}9^{1}$ $14\text{-}30 \times 5\text{-}10^{2}$	915-951	266-348
17. Landolphia buchananii	$2\text{-}3.5^{a}$ $1\text{-}3^{b}$ $2.5\text{-}5.5^{x}$ $3\text{-}5.5^{y}$ $5.5\text{-}9^{z}$	$6\text{-}9 \times 4.8\text{-}18^{a}$ $6\text{-}8 \times 9\text{-}25^{b}$ $7\text{-}10 \times 4.5\text{-}14.5^{x}$ $4\text{-}9 \times 2\text{-}8^{y}$ $6\text{-}9 \times 3.5\text{-}11^{z}$	1-2 (-3) rows $57\text{-}90 \times 7\text{-}10^{1}$	586-622	256-311
18. Landolphia watsoniana	$4\text{-}5.8^{a}$ $2.5\text{-}3^{b}$ $4\text{-}5.5^{x}$ $3\text{-}5.5^{y}$ $5\text{-}7.5^{z}$	$3.5\text{-}5 \times 8.5\text{-}18^{a}$ $3\text{-}5 \times 6\text{-}15^{b}$ $5\text{-}7.5 \times 12\text{-}15^{x}$ $4\text{-}5 \times 6\text{-}8^{y}$ $6\text{-}8.5 \times 6\text{-}10^{z}$	1-2 rows $25\text{-}30 \times 6\text{-}12^{1}$ $24\text{-}27 \times 11\text{-}19^{2}$	586-604	201-256
19. Mascarenhasia arborescens	$1.9\text{-}3.8^{a}$ $1.9\text{-}3.8^{b}$ $3.8\text{-}5.7^{x}$ $1.9\text{-}5.7^{y}$ $3.8\text{-}5.7^{z}$	$17\text{-}24.7 \times 13.3\text{-}34.2^{a}$ $19\text{-}24.7 \times 20.9\text{-}38^{b}$ $13.3\text{-}19 \times 5.7\text{-}9.5^{x}$ $7.6\text{-}13.3 \times 3.8\text{-}10.5^{y}$ $13\text{-}21 \times 9.5\text{-}13.3^{z}$	1-2 rows $50\text{-}60 \times 9.5\text{-}15^{1}$ $29\text{-}38 \times 9.5\text{-}19^{2}$	750-787	211-256
20. Motandra guinensis	$1.9\text{-}3.8^{a}$ $1.9\text{-}2.9^{b}$ $1.9\text{-}3.8^{x}$ $1.9\text{-}2.9^{y}$ $1.9\text{-}3.8^{z}$	$9.5\text{-}13.3 \times 8.6\text{-}25.7^{a}$ $6.7\text{-}9.5 \times 7.6\text{-}22.8^{b}$ $3.8\text{-}11.4 \times 2.9\text{-}8.6^{x}$ $4\text{-}10.5 \times 2.6\text{-}7^{y}$ $4\text{-}5 \times 6\text{-}10^{z}$	1-2 rows $20\text{-}30 \times 7\text{-}12^{1}$ $15\text{-}20 \times 8\text{-}13^{2}$	513-549	99-110
21. Oncinotis tenuiloba	$1\text{-}2^{a}$ $1\text{-}2^{b}$ $1\text{-}2^{x}$ $1\text{-}2^{y}$ $1\text{-}2.5^{z}$	$11\text{-}17 \times 13\text{-}22^{a}$ $4\text{-}7 \times 7\text{-}16^{b}$ $4\text{-}9 \times 3\text{-}9^{x}$ $6\text{-}8 \times 6\text{-}10^{y}$ $5\text{-}8 \times 5\text{-}9^{z}$	1-2 rows $25\text{-}40 \times 5\text{-}9^{1}$ $24\text{-}35 \times 5\text{-}12^{2}$	723-732	147-183
22. Picralima nitida	$5.7\text{-}9.5^{a}$ $3.8\text{-}6.7^{b}$ $7\text{-}11.4^{x}$ $3.8\text{-}7.6^{y}$ $9\text{-}24.6^{z}$	$13.3\text{-}19 \times 13.3\text{-}25.7^{a}$ $10.5\text{-}13.3 \times 11.4\text{-}28.5^{b}$ $13.3\text{-}29 \times 9.5\text{-}20.9^{x}$ $9.5\text{-}17.1 \times 5.7\text{-}13.3^{y}$ $8\text{-}25 \times 4\text{-}16.5^{z}$	1-2 (-3) rows $15\text{-}45 \times 8\text{-}14^{1}$ $15\text{-}30 \times 8\text{-}15^{2}$	1190-1208	366-403

Species	Cuticle size in µm	Epidermal cells, size in µm.	Palisade, number of rows and sizes of 1/2 row	Midrib thickness (µm)	Lamina thickness (µm)
23. Pleiocarpa bicarpellata	3-5.5[a] 3-4[b] 8-10[x] 5-6[y] 6-10[z]	20.9-30.4 × 19-51.3[a] 17-24.7 × 19-57[b] 15.2-28.5 × 13.3-30.4[x] 19-36 × 13.3-30.4[y] 19-30.4 × 9.5-19[z]	2 (-3) rows 15-27 × 9-15[1] 15-20 × 9-15[2]	622-641	275-329
24. Pleiocarpa pycnantha	3-5.6[a] 3-4[b] 8-10[x] 10-13[y] 10-11[z]	15.2-28.5 × 26.6-58.9[a] 15.2-24.7 × 19-55[b] 26.6-36 × 19-30.4[x] 19-34 × 15.2-28.5[y] 19-28.5 × 7.6-19[z]	2 (-3) rows 10-31 × 8-15[1] 10-15 × 9-14[2]	768-787	293-348
25. Rauvolfia caffra	1.9-3.8[a] 0.9-3.8[b] 1.9-2.9[x] 1-1.9[y] 1.9-3.8[z]	11.4-20.9 × 19-41[a] 3.3-15.2 × 7.6-34.2[b] 11.4-17.1 × 7.6-11.4[x] 7.6-11.4 × 3.8-7.6[y] 9.5-13.3 × 5.7-11.4[z]	1 row 67-93 × 9.5-25[1]	567-604	183-238
26. Rauvolfia mannii	1-2[a] 1[b] 1.8-3[x] 1.5-3[y] 1.9-4[z]	16-21 × 3.5-38[a] 6-13 × 5-26[b] 9-12 × 5-7.5[x] 6.5-12.5 × 6-11.8[y] 11.3-14 × 15.5-19[z]	1 row 30-40 × 11.5-17[1]	695-714	165-183
27. Rauvolfia mombasiana	1-1.5[a] 1[b] 1-3[x] 1-2[y] 1-3[z]	23-30 × 17.5-38[a] 5.5-9.8 × 4-20[b] 10-15.5 × 6.5-15[x] 4-9.5 × 3-6.9[y] 5-10 × 5.5-13.3[z]	1-2 rows 58-67 × 8.5-14[1]	714-732	201-275
28. Saba comorensis	4-6[a] 2-4[b] 10-15[x] 3-4[y] 4-6.5[z]	15.2-20.9 × 8.6-24.7[a] 9.5-19 × 13.3-34[b] 19-26.5 × 6.5-23[x] 17-28.5 × 9.5-15.2[y] 17-24.7 × 9.5-19[z]	homogenous 38-42 × 7-10[1] 14-20 × 6-8[2]	878-924	165-183
29. Schizozygia coffaeiodes	2-3[a] 1-1.5[b] 1-1.8[x] 2.6-4[y] 1-2[z]	22-29 × 18-40[a] 15-19 × 16-40[b] 6-13 × 6-12[x] 5-11.8 × 3-12[y] 7.6-17.1 × 11.4-28.5[z]	1-2 rows 31-38 × 6-15[1] 17-31 × 7-9[2]	1437-1473	256-275
30. Stephanostema stenocarpum	1-2[a] 1[b] 1-3[x] 1-3[y] 1-2.5[z]	19-28.5 × 32.3-72[a] 15.2-20.9 × 24.7-49.4[b] 4.5-10 × 2-9[x] 7.5-10 × 6-8[y] 7.6-17 × 11-28[z]	1-3 rows 40-67 × 8-13.5[1] 23-38 × 9.5-15[2]	787-824	229-256

Species	Cuticle size in µm	Epidermal cells, size in µm.	Palisade, number of rows and sizes of 1/2 row	Midrib thickness (µm)	Lamina thickness (µm)
31. Strophanthus courmotii	1[a] 1[b] 1[x] 2[y]	20-33 × 11-33[a] 19-28 × 15-35[b] 15.2-26.6 × 7.6-24.7[x] 15.2-20.9 × 13.3-24.7[y] 15.2-24.7 × 9.5-20.9[z]	3 (-4) rows 9-26 × 8-10[1] 10-15 × 5-10[2]	970-988	192-238
32. Tabernaemontana elegans	2.5-4.5[a] 2.5-3.2[b] 2.5-3.5[x] 2.5-3.5[y] 2.5-4.5[z]	14-34 × 23-41[a] 6-36 × 24-43[b] 9-11 × 6.5-13[x] 4.5-11 × 2.5-8.5[y] 7-11 × 5.5-10[z]	2-3 (-4) rows 14-44 × 6.5-11[1] 10-35 × 6-12[2]	1281- 1318	266-311
33. Tabernaemontana pachysiphon	3-5[a] 1-2[b] 7.2-8[x] 3-5[y] 7-8[z]	15-26 × 11-29[a] 12-23 × 9-25[b] 11-14 × 8-11[x] 8-13 × 6-9.5[y] 7-11 × 5.5-10[z]	1-2 (-3) rows 25-39 × 8-12[1] 19-26 × 8-11[2]	2031- 2105	329-403
34. Tabernaemontana stapfiana	3-7[a] 3-4.5[b] 5-6.5[x] 5-6[y] 7.5-9[z]	6-25 × 9-35[a] 8-18 × 16-27[b] 11.5-14.5 × 5-11.5[x] 5-10 × 3-13[y] 9-10 × 7-13.5[z]	2-3 (-4) rows 31-40 × 9-14[1] 22-28 × 10-13[2]	2013- 2141	329-384
35. Tabernaemontana ventricosa	1.9-3.8[a] 1.9[b] 3.8-7.6[x] 3.8-5.7[y] 3.8-5.7[z]	19.5-2.8 × 11.4-32[a] 11.4-15 × 15 × 26.6[b] 9.5-19 × 7.6-17[x] 7.6-13.3 × 5.7-9.5[y] 13.3-20.9 × 7.6-15.2[z]	1-2 (-3) rows 25-35 × 9-14[1] 22-30 × 20-14[2]	604-641	165-220
36. Voacanga africana	1.9-3.8[a] 1.9-4.3[b] 3.8-6.5[x] 1.9-3.8[y] 3.8-5.7	11.4-13.3 × 15-44[a] 5-18 × 9-36[b] 11-17 × 10-20[x] 7-13 × 4-8[y] 11-22 × 9-18[z]	2-3 (-4) rows 21-25 × 8-13[1]	439-476	146-220
37. Voacanga thouarsii	1.9-3.8[a] 1.9[b] 1.9-3.8[x] 1.9-3.8[y] 2.5-3.8[z]	13.3-19 × 11.4-30.5[a] 5.7-19 × 9.5-36[b] 11.4-17 × 11.4-22.8[x] 7.6-13.3 × 3.8-9.5[y] 11.4-22.8 × 9.5-19[z]	2-3 (-4) rows 29-44 × 9.5-19[1]	476-550	238-293

[a]= upper epdermis; [b] = lower epidermis; [x] = upper epidermis, midrib; [y] = lower epidermis, midrib; [z] = margin; [1] = first row of palisade; [2] = second row of palisade.

Table 2. Stomatal size, density and type of some East African Apocynaceae.

Species	Stomatal length in µm	Stomatal width in µm	Density per mm	Subsidiary cells, surface	Anticlinal walls adaxial	Anticlinal walls abaxial
1. Acokanthera oppositifolia	15-19-22	11.5-13-16	650-663-719	Hypostomatic cyclocytic and paracytic	± straight angular	± straight angular
2. Adenium obesum	23-30-33.5	19-20-22.5	150-169-188	hypostomatic cyclocytic and staurocytic	straight, angular	slightly curved
3. Alafia microstylis	18-20-25	19-20-20	140-150	hypostomatic paracytic	undulate	undulate
4. Ancylobotrys petersiana	21-23-25	20-21-23.5	400-500	hypostomatic amomocytic	very undulate	very undulate
5. Ancylobotrys tayloris	27-29-31	24-27-29	200-300	anomocytic	undulate	undulate
6. Baissea myrtifolia	15-16-19.5	8-11-13	150-172-200	hypostomatic paracytic	very undulate	very undulate
7. Carissa edulis	29-30-36	23-28-32	66-132-176	hypostomatic cyclocytic	straight to slightiy curved	straight to slightly curved
8. Carissa tetramera	17-19.5-22	14-17-19.5	418-534-572	hypostomatic paracytic	straight angular	straight to slightly curved
9. Carvalhoa campanulata	20-21-25	13-15-19	81-150-220	hypostomatic paracytic	straight to slightly curved	undulate
10. Clitandra cymulosa	17-20-23	15-16-19	288-340	hypostomatic anomocytic	± straight to slightly curved	straight to slightly curved
11. Dictyophleba lucida	14.6-16.6	14.6-16.6	700-825-925	hypostomatic anomocytic	slightly undulate	slightly undulate

Species	Stomatal length in µm	Stomatal width in µm	Density per mm	Subsidiary cells, surface	Anticlinal walls adaxial	Anticlinal walls abaxial
12. Diplorhynchus condylocarpon	16-18	14-16	260-340	hypostomatic paracytic	straight	straight
13. Funtumia elastica	19-22-25	10-13-15	300-320	hypostomatic paracytic	straight to slightly undulate	slightly undulate
14. Holarrhena pubescens	17-26-31	14-16-19	250-289-312	hypostomatic paracytic anomocytic	straight angular	slightly curved angular
15. Hunteria congolana	17-19-22	16-17-19	266-280	hypostomatic anomocytic anisocytic	straight to very slightly curved	slightly curved
16. Hunteria zeylanica	21-24-25.7	22-24.7	294-338-350	hypostomatic anomocytic anisocytic	straight to slightly curved	slightly curved
17. Landolphia buchananii	15-18	13-15-16	400-450	hypostomatic anomocytic	undulate	undulate
18. Landolphia watsoniana	15-16	13-15-16	500-525-625	hypostomatic anomocytic	undulate	undulate
19. Mascarenhasia arborescens	21-25-31	10-15-18	200-219-213	hypostomatic paracytic	slightly undulate	slightly undulate
20. Motandra guineensis	15-18-19	9-10-15	168-200-370	hypostomatic anomocytic	slightly curved	undulate
21. Oncinotis tenuiloba	15-21-22.5	10-12.5-14	369-406-439	hypostomatic paracytic	slightly curved angular	undulate
22. Pleiocarpa bicarpellata	16-20-22	14-15-20	133-148-153	hypostomatic cyclocytic	slightly curved	angular slightly undulate

Species	Stomatal length in µm	Stomatal width in µm	Density per mm	Subsidiary cells, surface	Anticlinal walls adaxial	Anticlinal walls abaxial
23. Pleiocarpa pycnantha	16-20.8-23	15-16.6-19	200-219-238	hypostomatic cyclocytic	slightly curved	slightly curved
24. Rauvolfia caffra	21-25-31	10-15-18	100-130-160	hypostomatic paracytic	undulate	undulate
25. Rauvolfia mannii	19-20.9-32	11-16-18	63-81-125	hypostomatic paracytic	undulate	undulate
26 Rauvolfia mombasiana	20.8-27-29	11.5-14-17	125-138-175	hypostomatic paracytic	straight	undulate
27. Saba comorensis	13-15-18	11-16	850-856	hypostomatic anomocytic	slightly curved	slightly curved
28. Schizozygia coffaeiodes	27-28.5-31	16-18-20.3	63-88-106	amphistomatic paracytic	straight angular	slightly curved
29. Stephanostma stenocarpum	15-18-21	9-10-13	132-220-264	hypostomatic paracytic	slightly undulate	undulate
30. Strophanthus courmontii	24-27-33	17-19-29	63-100-144	amphistomatic paracytic anomocytic-actinocytic	slightly curved angular	undulate
31. Tabernaemon-tana elegans	30.6-34.8	25-27.8	31-56-81	hypostomatic paracytic	straight angular	slightly curved angular
32. Tabernaemon-tana pachysiphon	29-32-33.4	21-22-23.6	31-56-69	hypostomatic paracytic	straight angular	± straight angular
33. Tabernaemon-tana stapfiana	26-28-36.5	19.5-21-25	99-109-123	hypostomatic paracytic	straight angular	± straight angular

Species	Stomatal length in µm	Stomatal width in µm	Density per mm	Subsidiary cells, surface	Anticlinal walls adaxial	Anticlinal walls abaxial
34. Tabernaemon-tana ventricosa	26-29-32	20-23-25	30-60-88	hypostomatic paracytic	± straight angular	± straight angular
35. Voacanga africana	26-28	18-20	60-80-120	amphistomatic paracytic	± straight angular	± straight angular
36. Voacanga thouarsii	25-28-30	20-23-25	80-90-140	amphistomatic paracytic	± straight angular	± straight angular

Table 3. A summary of Apocynaceae species in East Africa, including their sub-division into tribes and subtribes. Tribes are in bold face, subtribes in italics, * = species examined, Afr= Africa, As = Asia.

Subfamily Plumeriodeae

1.Carisseae

1.1 Carissinae

- 1. Carissa 20 Afr + As
  - 1. C. bispinosa
  - 2. C. edulis*
  - 3. C. tetramera*
- 2. Acokanthera 5 Afr
  - 4. A. laevigata
  - 5. A. oppositifolia
  - 6. A. schimperi

1.2 *Landolphiinae*

- 3. Landolphia 60 Afr
  - 7. L. buchananii*
  - 8. L. eminiana
  - 9. L. kirkii
  - 10. L. landolphiodes
  - 11. L. owariensis
  - 12. L. parvifolia
  - 13. L. watsoniana*
- 4. Clitandra 1 Afr
  - 14. C. cymulosa*
- 5. Dictyophleba 5 Afr
  - 15. D. lucida*
- 6. Ancylobotrys 7 Afr
  - 16. A. amoena
  - 17. A. petersiana*
  - 18. A. tayloris*
- 7. Saba 3 Afr
  - 19. Saba comorensis*

1.3 *Pleiocarpinae*

- 8. Picralima 1 Afr
  - 20. P. nitida*
- 9. Hunteria 12 Afr + As
  - 21. H. congolana*
  - 22. H. zeylanica*
- 10. Pleiocarpa 5 Afr
  - 23. P. bicarpellata*
  - 24. P. pycnantha*

2. Tabernaemontaneae

- 11. Voacanga 12 Afr + As
  - 25. V. africana*
  - 26. V. thouarsii*
- 12. Tabernaemontana 99 tro
  - 27. T. elegans*
  - 28. T. odoratissima
  - 29. T. pachysiphon*
  - 30. T. stapfiana*
  - 31. T. ventricosa*
- 13. Carvalhoa 1 Afr
  - 32. C. campanulata*
- 14. Schizozygia 1 Afr
  - 33. S. coffaeiodes*

3. Plumerieae

3.1 *Aspidospermatinae*

- 15. Diplorhynchus 1 Afr
  - 34. D. condylocarpon*

3.2 *Alstoniinae*

- 16. Alstonia 40 trop
  - 35. A. boonei

4. Alyxieae

4.1 *Rauvolfiinae*

- 17. Rauvolfia 60 trop
  - 36. R. caffra*
  - 37. R. mannii*
  - 38. R. mombasiana*
  - 39. R. volkensii
  - 40. R. vormitoria

5. Cerbereae

- 18. Cerbera 7 Seych-Oc
  - 41. C. manghas

Subfamily Apocynoideae

6. Wrighteae

6.1 *Neriinae*

- 19. Adenium 5 Afr
  - 42. A. obesum*

6.2 *Wrightiinae*

20. Wrightia 23 Afr + As
    43. W. demartiniana
21. Pleioceras 5 Afr
    44. P. orientale
22. Stephanostema 1 Afr
    45. S. stenocarpum*
23. Strophanthus 38 Afr + As
    46. S. courmontii*
    47. S. eminii
    48. S. hispidus
    49. S. hypoleucus
    50. S. kombe
    51. S. mirabilis
    52. S. petersianus
    53. S. preusii
    54. S. sarmentosus
    55. S. welwitschii
    56. S. zimmermannianus

6.3 *Malouetiinae*

24. Funtumia 2 Afr
    57. F. africana*
    58. F. elastica*
25. Mascarenhasia 8 Afr
    59. M. arborescens*

6.4 *Alafiinae*

26. Holarrhena 4 Afr + As
    60. H. pubescens*
27. Alafia 23 Afr
    61. A. erythrophthalma
    62. A. caudata
    63. A. lucida
    64. A. microstylis*
    65. A. orientalis
    66. A. schumanii
    67. A. zambesiaca

7. Apocyneae

7.1 *Ichnocarpinae*

28. Motandra 3 Afr
    68. M. guinensis*
29. Baissea 18 Afr
    69. B. leonensis
    70. B. leontonori
    71. B. major
    72. B. myrtifolia*
    73. B. viridifolia
30. Oncinotis 7 Afr
    74. O. glabrata
    75. O. hirta
    76. O. pontyi
    77. O. tenuiloba*

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APPENDIX 1

List of Material examined:

1. *Acokanthera oppositifolia* (Lam.) Codd, Kenya, Sagalla Mts., *E.A. Omino 133*, (EA, WAG).
2. *Adenium obesum* (Forssk.) Roem. & Schult., Kenya, Silaloi, *E.A. Omino 123*, (EA, WAG).
3. *Alafia microstylis* K.Schum, Kenya, *Luke & Robertson 2298*, (K).
4. *Ancylobotrys petersiana* (Kl.) Pierre, Kenya, Arabuko Sokoke Forest, *E.A. Omino 213* (EA, WAG).
5. *A. tayloris* (Stapf) Pichon, Kenya, Buda mafisini, *E.A. Omino 199*, (EA, WAG).
6. *Baissea myrtifolia* A.DC., Kenya, Makadara Forest, *E.A. Omino 174*, (EA, WAG).
7. *Carissa edulis* (Forssk.) Vahl, Kenya, Sagalla mts, *E.A. Omino 131*, (EA, WAG).
8. *C. tetramera* (Sacl.) Stapf, Kenya, Arabuko Sokoke Forest, *E.A. Omino 212*, (EA, WAG); Kenya, Galana Ranch, *Bally 16743* (K).
9. *Carvalhoa campanulata* K. Schum., Kenya, Makadara Forest, *E.A. Omino 175* (EA, WAG).
10. *Clitandra cymulosa* Benth., Uganda, Sese Islands, *Maitland 339* (K).
11. *Dictyophleba lucida* (K. Schum) Pierre, Kenya, Shimba Lodge, *E.A. Omino 166*, (EA, WAG); Kenya, Makadara Forest, *E.A. Omino 181* (EA, WAG).
12. *Diplorhynchus condylocarpon* (Muell. Arg.) Pichon, Tanzania, *Lovett & Congdon 1933*, (EA, WAG).
13. *Funtumia elastica* (Preuss) Stapf, Uganda, Mengo, *B. styles 228* (K).
14. *Holarrhena pubescens* (Buch.-Ham) Wall. ex G.Don, Kenya, Musau-Ronge Rd., *E.A. Omino 124*, (EA, WAG).
15. *Hunteria congolana* Kenya, Mt. Kulal, *Bally 3960* (K).
16. *H. zeylanica* Kenya, Shimba Lodge, *E.A. Omino 163*, (EA, WAG).
17. *Landolphia buchananii* (Hall.f.) Stapf, Kenya, Ngangao Forest, *Beentje 2192* (K).
18. *L. watsoniana* Romburgh, Kenya, *E.A. Omino 173 B*, *E.A. Omino 211 B*, (EA, WAG).
19. *Mascarenhasia arborescens* A.DC., Kenya, Marere Waterworks, *Perdue & Kibuwa 10220* (K).
20. *Motandra guineensis* (Schum. & Thonn.) A.DC., Uganda, *Synnot 725*, (EA).
21. *Oncinotis tenuiloba* Stapf, Kenya, Mkomba River, *E.A. Omino 192*, (EA, WAG).
22. *Picralima nitida* Cultivated, Wageningen Bot. Garden, The Netherlands.
23. *Pleiocarpa bicarpellata* Stapf, Kenya, Chawia forest, *E.A. Omino 157, 158*, (EA, WAG).
24. *P. pycnantha* (K.Schum.) Stapf, Kenya, Mwele Mdogo Forest, *E.A. Omino 187*, (EA, WAG); Kenya, Meru Nat. Park, *Ament & Magogo 169* (EA).

25. *Rauvolfia caffra* Sond., Kenya, Meru National Park, *Gillet 20801* (K).
26. *R. mannii* Stapf, Kenya Chawia Forest, *E.A. Omino 154*, (EA, WAG).
27. *R. mombasiana* Stapf, Kenya, *E.A. Omino 162 B*, (EA, WAG); Kenya, Marere, *E.A. Omino 170*, (EA, WAG).
28. *Saba comorensis* (Bojer) Pichon, Kenya, Ukunda, *E.A. Omino 161 B* (EA, WAG).
29. *Schizozygia coffaeoides* Baill., Kenya, Marere, *E.A. Omino 168*, (EA, WAG).
30. *Stephanostema steonocarpum* Tanzania, *J & J Lovett 500*, (K); Tanzania *Luke et al 3754* (EA).
31. *Strophanthus courmontii* Kenya, Ramisi Mrima Rd, *E.A. Omino 211* (EA, WAG).
32. *Tabernaemontana elegans* Kenya, Shimba Lodge, *E.A. Omino 167* (EA, WAG).
33. *T. pachysiphon* Kenya, Buda Mafisini *E.A. Omino 107* (EA, WAG),.
34. *T. stapfiana* Kenya, *E.A. Omino 127*. (EA, WAG).
35. *T. ventricosa* Tanzania, Lumi Forest, *Gardner 2956* (K).
36. *Voacanga africana* Tanzania, *P. Cribb & G. Wilson 10693* (K); Tanzania, *Pocs* 6277/B (EA).
37. *V. thouarsii*, Tanzania, TG, *Ruffo 1533*.

2 A MONOGRAPH OF THE SUBTRIBE PLEIOCARPINAE

(APOCYNACEAE-PLUMERIOIDEAE-CARISSEAE)

Series of revisions of Apocynaceae XLI

2.1 SUMMARY

The subtribe Pleiocarpinae, belonging in the tribe Carisseae of the subfamily Plumerioideae has been revised and comprises three genera: *Pleiocarpa*, *Hunteria* and *Picralima*, with 5, 12 and 1 species respectively. All species are restricted to continental Africa, but for *Hunteria zeylanica*.

Pleiocarpa has five species, including a newly described one: *P. brevistyla*. A new combination for a probable sixth species, *P. picralimoides*, was made for *Carpodinopsis (?) picralimoides*, but due to a scarcity of material this species remains doubtful.

Three new *Hunteria* species were described: *H. macrosiphon*, *H. myriantha* and *H. oxyantha*, while a new combination *H. hexaloba* was made, as the genus name *Tetradoa* falls into synonymy with *Hunteria*.

The monotypic genus *Picralima* remained as such.

Of all Pleiocarpinae typification, full synonymy and literature references are given, and a key provides the means to identify the species. Detailed descriptions are accompanied with illustrations, and the distributions are mapped. Notes present further information where relevant.

2.2 INTRODUCTION

The present chapter is a monographic revision of the subtribe Pleiocarpinae of the Plumeriodeae-Carisseae (Apocynaceae), represented by 3 genera and 18 species in continental Africa. This monograph is mainly based on study of herbarium specimens, in addition the author has had the opportunity of studying 6 species in the field and in cultivation at Wageningen. The subtribe Pleiocarpinae comprises 3 genera, *Pleiocarpa* Benth (5 spp.); *Hunteria* Roxb. (12 spp.) and *Picralima* Pierre (1 sp.). One of the species, *Hunteria zeylanica*, extends to Asia.

Most of the type material could be traced, a few lectotypes were designated here, while only one neotype was chosen.

All measurements are from dried material. The uses of the plants were compiled from herbarium sheets and the available literature. Local names were not recorded, as most of them proved to be unreliable. The source on information from herbarium sheets is arranged systematically, e.g (*Scott Elliot* 5690, K, 1892, Sierra Leone), where Scott Elliot is the collector, 5690 the collection number, K, the herbarium Kew lodging the specimen, 1892 the year of collection and Sierra Leone the country of collection.

2.3 General part

2.3.1 History of the subtribe

The subtribe *Pleiocarpinae* was first described by K. Schumann in 1895 as a tribe based on three genera *Notonerium*, *Lepinia* and *Pleiocarpa*. *Lepinia* currently belongs to the subtribe *Alyxiinae* although it has multicarpellate fruits, but these are drupaceous and not baccate. Pichon (1948) first described it as a subtribe basing it on 5 genera, *Polyadoa*, reduced to synonymy by him in 1953 under *Hunteria*; *Tetradoa*, reduced to synonymy by Huber (1963) under *Hunteria*; *Pleiocarpa*, *Picralima* and *Hunteria*. In the last complete revision of the subtribe *Pleiocarpinae* in 1953 Pichon recognised 18 species in 7 genera, *Pleuranthemum* (1 sp.), *Comularia* (2 sp.) and *Tetradoa* (2 sp.) (all currently synonyms of *Hunteria*); *Hunteria* (6 sp.), *Carpodinopsis* (3 sp.), currently a synonym of *Pleiocarpa* (3 sp.) and *Picralima* (1 sp.).

2.3.2 History of the genera *Hunteria* Roxb., *Pleiocarpa* Benth. and *Picralima* Pierre

The genus *Hunteria* was first proposed as *Apocyno-Nerium* by Linnaeus in 1747 based on one species *H. zeylanica*. The name was later rejected by Roxburgh in 1814 when he merely listed it as *Hunteria*. He later described the genus in 1824 basing it on *Hunteria corymbosa*, a synonym of *H. zeylanica*, which had already been described by Retzius in *Cameraria* in 1786. The genus is named after Dr. William Hunter of the Bengal Medical Establishment, an eminent botanist and author of various Asiatic Researches of the history of Pegu. G. Don (1837) enumerated 5 species, 4 later attributed to the genera *Wrightia*, *Alyxia* and *Chilocarpus* and A. De Candolle (1844) included 7 species in the genus, 3 later attributed to the genus *Alyxia* and 2 to *Melodinus* and *Chilocarpus*. F. Miquel (1856) enumerated 4 species, 2 later attributed to the genera *Rauvolfia* and *Alyxia*. Pichon (1948) enumerated 7 species which he placed under two sections, section *Euhunteria* with five species, 3 later attributed to the genera *Alyxia*, *Wrightia* and *Rauvolfia* and section *Pleuranthemum* with two species from Africa. In the most recent revision of *Hunteria* in West Africa by Huber (1963), 5 species were recognised.

The genus *Pleiocarpa* was first described by Bentham in 1876, based on *P. mutica* (the lectotype of the genus) and *P. rostrata*. The name comes from the Greek words Pleios, more and carpos, fruits, referring to the fruits with more than two carpels. *P. bicarpellata* was first described by Stapf in 1894. K. Schumann (1895) enumerated 3 species, and Stapf (1902) distinguished 9 species, 4 were later reduced to synonymy under *P. pycnantha* and 1 reduced to synonymy under *P. mutica*. Pichon (1953) recognised 3 species, *P. pycnantha* with two varieties and Huber (1963) recognised 4 species, *P. pycnantha* with two varieties.

Pierre (1896) first described the genus *Picralima* basing it on *P. klaineana*, a synonym of *P. nitida*, the only species of the genus which had already been described by Stapf (1895) in *Tabernaemontana*. The name *Picralima* comes from the Greek word pikros which means bitter, probably referring to the bitter seeds. The genus has since remained monotypic.

2.3.3 Geographical distribution

Hunteria zeylanica is the most widely distributed species which extends to Asia, from Sri-Lanka, India to S. China (Hainan) including Malaysia and Indonesia. In Africa, its distribution is restricted to Somalia, Kenya, Tanzania (including Pemba and Zanzibar) and Mozambique, mainly along the Zanzibar-Inhambane regional mosaic (sensu White 1979). It also extends to Zambezian and Somalia-Masai regional centres of endemism in Kenya and Somalia.

Four species are found West to East of the Dahomey gap and these include *Pleiocarpa pycnantha*, the most widely distributed of the African species, which covers 8 phytochoria sensu White (1979). *H. umbellata* is also widely distributed from Senegal to Zaire and Angola but restricted to only two phytochoria. *Pleiocarpa mutica* extends from Sierra Leone to Gabon and *Picralima nitida* from Ivory Coast to Congo and Zaire, including Uganda.

Two species of *Hunteria, H. ghanensis* and *H. simii* are restricted to the Western centre of Endemism, West of the Dahomey gap. *H. ghanensis* is found only in Ghana and Ivory Coast, whereas the later extends from Guinea to Ivory Coast.

The rest of the species is restricted to the Eastern centre of endemism, East of the Dahomey gap. *H. camerunensis* in Cameroun and Gabon; *H. congolana* in Zaire and Kenya, in two phytochoria; *H. macrosiphon* in Gabon and Congo; *H. oxyantha* in Gabon, Congo and Zaire; *Pleiocarpa bicarpellata* extends further East to Kenya from Cameroun. *P. rostrata* is restricted to Nigeria, Cameroun and Gabon.

The remaining four species are endemic. *Hunteria hexaloba* and *Pleiocarpa brevistyla* are locally endemic to Gabon and *H. myriantha* and *H. densiflora* is found only in Zaire.

Two species, *Pleiocarpa bicarpellata* and *Hunteria congolana*, show disjunctions in their current distribution areas.

2.3.4 Morphology

Habit

The members of the subtribe Pleiocarpinae are usually small trees or shrubs, rarely lianescent. They are completely glabrous in all parts except inside the corolla tube, below or above the stamens. Predominantly shrubby species up to 5 m high include *Pleiocarpa rostrata* and *P. brevistyla*; *Hunteria ballayi, H. camerunensis, H. hexaloba* and *H. macrosiphon*. The rest of the species rarely exceed a height of 20m. *Pleiocarpa pycnantha* may attain a height of 30 m and *Picralima nitida*, a height of 35 m.

Bark
The bark of most species is thin, smooth and pale to dark grey or brown. In some species like *Picralima nitida* and *Hunteria oxyantha* the bark may be rough, hard and brittle or it may be longitudinally fissured with straight horizontal cracks in *Pleiocarpa pycnantha*. The inner bark is usually cream, pale yellowish-brown or orange.

Wood
The wood of the species attaining exploitable height is very hard, dense and durable, shiny dark brown or pale yellow to orange, and is used to make small sundry objects or sometimes used for local construction.

Leaves
The leaves are opposite and decussate, rarely in whorls of 3-5 as in *Pleiocarpa pycnantha* and sometimes ternate as in *P. mutica*. The blade is papery to coriaceous when fresh, elliptic to oblong with an acuminate apex except in *Hunteria zeylanica* where the apex is variable especially in specimens from Asia. The smallest leaves are found in *Hunteria oxyantha* and *H. ghanensis* (up to 13.5 × 4.6 cm) and the largest in *Pleiocarpa mutica* (up to 29.5 × 11.4 cm long). According to the terminology proposed by Hickey (1979) for the architecture of dicotyledonous leaves, all the leaves in Pleiocarpinae are camptodromous as the secondary veins do not terminate at the margin. The venation is either brachidodromous with secondaries joined together in a series of prominent arches or eucamptodromous with secondaries connected to superadjacent veins by a series of cross-veins without forming prominent marginal loops. All the species have the brachidodromous type of venation except *Hunteria myriantha* which is eucamptodromous. *H. simii*, *H. hexaloba*, *H. camerunensis* and *Pleiocarpa rostrata* have leaves which are entirely brachidodromous or brachidodromous in the upper 0.5-0.75 and eucamptodromous in the lower part.

Inflorescence
The inflorescence in *Pleiocarpa* is predominantly axillary and sometimes also terminal, sessile, ramiflorous, and when many-flowered, fasciculate. In *Hunteria* and *Picralima* the inflorescences are predominantly terminal, sometimes at the same time axillary, few- to many-flowered cymes except in *H. ballayi* where inflorescences are axillary, sessile and ramiflorous. The bracts are usually sepal-to scale-like. The peduncle size is highly variable in most species and ranges from 0 to 6 mm long in *H. camerunensis* to 15 to 40 mm long in *Hunteria densiflora*. The peduncle and pedicel base and inflorescence axes in *Hunteria umbellata* may appear swollen due to exudation of resin from the colleters and young buds. The inflorescences in *H. zeylanica*, *H. ghanensis* and *H. myriantha* are lax and many flowered. The number of flowers is also very variable and may be as low as 1 (-4) in *Pleiocarpa rostrata* and *P. brevistyla* to as high as 160 in *Hunteria myriantha*.

Flowers
The subtribe Pleiocarpinae is distinguished from the rest of the members of the Carisseae by the ovary which is completely apocarpous with 2-5 carpels and the flowers which are completely glabrous except inside below or above the insertion of the stamens.

Calyx
The calyx consists of five (sub)equal sepals which are almost free, completely glabrous on both sides in *Pleiocarpa*, with colleters inside up to 0.75 of their length in *Hunteria* (except in *H. myriantha*) and in 1-4 rows at the extreme base in *Picralima*. The sepals are tightly clasped to the base of the corolla tube in *Hunteria* and *Picralima* due to the exudation of resin from the colleters and is persistent in fruit in all genera. The size varies from 0.6-4.5 × 0.3-3 mm in *Hunteria* and *Pleiocarpa* to 5.5-7.5 × 3.5-5 mm long in *Picralima*. The texture is variable and may be membranaceous as in *Hunteria myriantha*, to thick and coriaceous as in *Picralima*. The calyx lobes are always imbricate in bud, but are strongly imbricate even at anthesis in *Picralima* and rarely also in *Pleiocarpa rostrata*.

Corolla
Salverform, sympetalous, with five lobes, contorted in bud. The colour is pure white in *Pleiocarpa* except in *P. pycnantha* where it may vary from white via yellow to orange; white to lime-yellow in *Picralima* and white, cream, to yellow or even red in *Hunteria*. The corolla head is usually oblong with an obtuse apex in mature bud in *Pleiocarpa* and *Picralima* and mostly ovoid with an acute apex in *Hunteria* except *H. ghanensis* where it is globose and with a rounded apex. The tube is more or less cylindrical, widened at the base and at the insertion of the stamens. The tube is always thick and fleshy in *Picralima*, sometimes thick in *Pleiocarpa rostrata* and in some species of *Hunteria* as in *H. zeylanica*; it is very constricted at the orifice in *H. camerunensis*. The length varies from 3-4 mm in *H. camerunensis* to 12-32 mm long in *Pleiocarpa rostrata*. There is a belt of pubescence below the insertion of the stamens which may continue up to the mouth of the tube as in *H. congolana*, or may be reduced to minute tufts of hairs at the base of each filament as in *H. camerunensis*. The corolla lobes overlap to the left in bud, are twisted in bud in some species of *Hunteria* and are always shorter than the tube in *Pleiocarpa* and shorter or longer than the tube in *Hunteria* and *Picralima*. The shape is ovate in *Picralima*, ovate to oblong in *Hunteria* and variable in *Pleiocarpa* where it is obovate in *P. rostrata*. The apex is acute to obtuse in all species except in *H. ghanensis* and *P. rostrata* where it is rounded and is spreading to recurved at anthesis.

Fruits
The fruits are composed of two to five separate, indehiscent mericarps. The mericarps are generally smooth except in *H. ballayi* (slightly rough and warty) and in some specimens of *P. rostrata* (partly or wholly rugose). They are mostly subglobose to obovoid except in *Hunteria simii* where they are oblong. The fruits are divergent at an angle of 180° except in *H. ghanensis*, 90° and usually turn yellow

and finally orange when ripe. The smallest fruits are those of *H. ghanensis*, 10-15 × 9-12 mm followed by those of *H. macrosiphon*, *H. zeylanica*, *H. densiflora*, *H. ballayi*, *H. congolana*, and *H. hexaloba* which are 15-28 × 20-21 mm, while those of *H. oxyantha* measure 28-35 × 20-26 mm. The largest fruits are those of *H. umbellata*: 31-60 × 40-50 mm. The fruits of *H. simii* measure 37-60.5 × 10-18 mm but are usually clearly longer than wide.

The seeds of *Hunteria ballayi* are swallowed together with the sweet mesocarp to act as a fertility drug in Central African Republic, and the pulp and seeds of *Picralima nitida* are used as an arrow and fish poison.

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2.4.1 The subtribe Pleiocarpinae

Subtribe **Pleiocarpinae** (K. Schum.) Pichon in Mém. Mus. Natn. Hist. Nat. sér. 2, 24: 158 (1948), Leeuwenberg in Wageningen Agr. Univ. Pap. 94, 3: 53 (1994). – Type genus: *Pleiocarpa* Benth.

Basionym: *Pleiocarpeae* K. Schum. in Engler & Prantl, Nat. Pflanzenf. 4, 2: 133 (1895), partly as for *Pleiocarpa*.

Unarmed trees or shrubs, sometimes lianescent; branchlets glabrous. *Leaves* opposite, or less often in whorls of 3-5, petiolate; petiole glabrous; blade mostly elliptic, entire and glabrous on both sides. *Inflorescence* in dense fascicles or in lax to dense cymes, terminal and/or axillary, sometimes ramiflorous, glabrous. Bracts small. *Flowers* actinomorphic, 5-merous. *Sepals* subequal, free or connate at the extreme base, persistent in fruit, glabrous or with colleters inside on the inner side, not ciliate. *Corolla* salverform, white to yellow, rarely also red; tube nearly cylindrical, widened at the insertion of the stamens, not twisted; lobes overlapping to the left in bud, spreading and often recurved later. *Stamens* free from each other, included, inserted at or above the middle of the corolla tube; anthers introrse, ovate or oblong, cordate or saggitate at the base, of two parallel cells, entirely fertile or with a small sterile acumen, glabrous. *Pistil* glabrous; ovary superior, of 2-5 separate carpels, united at the extreme base by a disk-like thickening; pistil head subglobose to oblong and with a pronounced stigmoid apex in *Hunteria* and *Pleiocarpa*; ovules 1-30 (-150) in each carpel. Fruit of 2-5 fleshy, indehiscent mericarps; mericarps globose to oblong, 1-100 seeded; wall thin to thick, fleshy or fibrous. *Seeds* variously shaped, hilum basal, endosperm rather hard, starchy, leaving a cavity around the radicle base; embryo straight, spathulate; testa thin to thick, membranaceous to coriaceous.

Three genera in tropical Africa. One species, *Hunteria zeylanica*, extends into Asia.

2.4.2 Key to the genera of the subtribe Pleiocarpinae

1. Sepals completely glabrous on both sides; pistil head subglobose to oblong; inflorescence sessile, predominantly axillary and ramiflorous; bracts less than 0.4 mm long .... 3. **Pleiocarpa**
   Sepals glabrous outside, with colleters inside; pistil head with a stigmatic oblong to subglobose basal part and a stigmoid apex up to 1.5 mm long; inflorescence predominantly terminal and sometimes axillary (except in *H. ballayi*); bracts at least 0.5 mm long 2
2. Sepals imbricate even at anthesis, (3.5-)5.5-7.5 mm long, with colleters up to 0.18 of their length; testa coriaceous; cotyledons with secondary nerves; fruits 11-20 x 8-15 cm, wall very hard and very fibrous .... 2. **Picralima**

Sepals imbricate in bud, 0.7-2.5 mm long, with colleters covering at least 0.4 of the sepal length; testa membranaceous; cotyledons without visible secondary nerves; fruits 2-5 × 1-5 cm, wall mostly fleshy .... 1. **Hunteria**

2.5 HUNTERIA ROXB.

Hunteria Roxb. in Fl. Ind. Seramp. ed. Carey & Wall. 2: 531 (1824) & ed. 2, 1: 695 (1832); G. Don in Gen. Syst. 4: 105 (1837); Thwaites in Enum. Pl. Zeyl. 191 (1860); Bentham in Bentham & Hooker f., Gen. Pl. 2: 698 (1876); Hooker, J.D. in Fl. Brit. Ind. 3: 637 (1882); K. Schumann in Engler Pflanzenw. Ost.-Afr. C: 317 (1895); Stapf in Fl. Trop. Afr. 4, 1: 104 (1902); O. Kuntze in Post & O. Kuntze, Lexicon 288 (1904); Pichon in Mém. Mus. Natn. Hist. Nat. 24: 160 (1948) & in Bol. Soc. Brot. sér. 2, 27: 88 (1953); H. Huber in Fl. W. Trop. Afr. ed. 2, 2: 62 (1963); Huber in Rev. Handb. Fl. Ceylon 1: 10 (1973); Tsiang Ying in Fl. Rep. Pop. Sin. 63: 15 (1977); Markgraf in Blumea 30: 169 (1984); Kupicha in Fl. Zamb. 7, 2: 430 (1985). – Type species: *Hunteria corymbosa* Roxb. (= *H. zeylanica* (Retz) Gardn. ex Thw.).

Heterotypic synonyms:

Polyadoa Stapf in op. cit: 103; Pichon in Mem. Mus. Natn. Hist. Nat. 24: 159 (1948). Lectotype species: *P. umbellata* (K. Schum.) Stapf (= *H. umbellata* (K. Schum.) Hall. f.), designated here.
Tetradoa Pichon in Bull. Soc. Bot. France 93, 7-8: 251 (1946) & in Mém. Mus. Natn. Hist. Nat. 24: 160 (1948) & in Bull. Soc. Brot. sér. 2, 27: 119 (1953). – Type species: *Tetradoa hexaloba* Pichon, designated by Pichon in 1953 (= *H. hexaloba* (Pichon) Omino.
Hunteria sect. *Euhunteria* Pichon in Mém. Mus. Nat. Hist. Nat. 24: 161 (1948), partly. – Type species: *Hunteria zeylanica* (Retz.) Gard. ex Thw., designated here.
Hunteria sect. *Pleuranthemum* Pichon, l.c. – Lectotype species: *H. ballayi*, designated here.
Pleuranthemum Pichon in Bol. Soc. Brot. sér. 2, 27: 112 (1953). – Type species: *P. ballayi* (Hua) Pichon (= *H. ballayi* Hua), designated by Pichon in 1953.
Comularia Pichon op. cit. 114 (1953). – Type species: *C. camerunensis* (K. Schum. ex Hall. f.) Pichon (= *Hunteria camerunensis* K. Schum. ex Hall. f.).

Shrubs or trees, rarely lianescent with white latex or occasionally colourless (in *H. zeylanica*) in all parts; branchlets glabrous. *Leaves* opposite, petiolate, those of a pair equal or subequal; blade mostly elliptic, entire and glabrous on both sides. *Inflorescence* mostly terminal, sometimes also axillary, few-to many-flowered, dense to lax, pedunculate; peduncle 2-45 mm long, glabrous. *Flowers* fragrant, actinomorphic except for the subequal sepals. *Sepals* light green, thin to thick and coriaceous, free or connate at the extreme base, membranaceous at the edge, glabrous outside, and with colleters inside up to 0.9 of their length. *Corolla* white to yellow to red, tube greenish in bud, with a belt of pubescence up to 3 mm wide inside just below the insertion of the stamens, sometimes extending to the mouth or reduced to minute tufts of hairs below each filament; tube much longer than the calyx, almost cylindrical, narrowed below the insertion of the stamens; lobes overlapping to the left in bud, sometimes twisted, shorter or longer than the tube, spreading and often recurved later. *Stamens* included, inserted at or above the middle of the corolla tube; anthers ovate, obtuse to acuminate at the apex, cordate at the base, glabrous, of two parallel cells longitudinally dehiscent. *Pistil* glabrous; ovary subglobose to oblong, composed of 2 separate carpels, united at the extreme base by a disk-like thickening; pistil head composed of a stigmatic subglobose basal part and a stigmoid apex up to 1 mm long; ovules 1-6(-30) in each carpel. *Fruits* yellow to orange, smooth or warty, composed of two separate mericarps divergent at 90-180°; mericarps subglobose to obovoid, with a rounded to beaked apex, 1-9 (-26)-seeded; wall 2-12 mm thick, fleshy to fibrous. *Seeds* brown, variously shaped, somewhat angular, smooth. Embryo straight, spathulate, surrounded by thick rather starchy and hard endosperm, leaving a hole around the radicle base; cotyledons thin, leafy; radicle almost cylindrical, flattened and narrowed at the apex, widened towards the base.

DISTRIBUTION. All 12 species occur in Africa. One species, *Hunteria zeylanica*, is also widely spread in S and SE Asia.

Key to the species of *Hunteria*

1. Corolla lobes wider than long, 1.3-2 × 1.7-2.8 mm, broadly ovate with a rounded apex; corolla head globose in mature bud, 0.22-0.24 of the bud length . . . . 5. **H. ghanensis**
   Corolla lobes longer than wide, 2.6-12 × 0.5-3.9 mm, ovate, elliptic to oblong with an acute to obtuse apex; corolla head ovoid in mature bud, 0.25-0.68 of the bud length 2
2. Corolla tube 1.3-2.1 × as long as the calyx, 3-4 mm long, inside with or without minute tufts of hairs below each filament; stamens inserted 1.7-2 mm from the base of the corolla tube . . . . 2. **H. camerunenis**
   Corolla tube 2.9-18 × as long as the calyx, 4-18.5 mm long, inside with a belt of pubescence 0.8-2.0 (-3.5) mm below the stamens and sometimes up to the mouth of the tube; stamens inserted 2.6-9.8 mm from the base 3
3. Stamens with apex 2.5-3.7 mm below the mouth of the corolla tube 4
   Stamens with apex 0.2-1.2 mm below the mouth of the corolla tube 5
4. Corolla tube 13-18 × as long as the calyx, 12.5-18.5 mm long; stamens with apex 3.2-3.7 mm below the mouth of the corolla tube, inserted 6-8 mm from the base of the tube; mericarps oblong with a long slender beak; Sierra Leone to Ivory Coast . . . . 10. **H. simii**
   Corolla tube 4.6 × as long as the calyx, 6.5-7 mm long; stamens with apex 2.5 mm below the mouth of the corolla tube, inserted 2.6-2.8 mm from the base of the tube; mericarps ellipsoid with an acuminate beak; . . . .
   Gabon . . . . 6. **H. hexaloba**

5. Inflorescence predominantly axillary, sessile, ramiflorus, 1-1.2 × 1-1.5 cm; fruit warted, beaked .... 1. **H. ballayi**
Inflorescence terminal and sometimes at the same time axillary, 1.5-7.5 × 1-8.5 cm, fruits smooth, rounded to obtuse at the apex 6
6. Secondary veins oblique, in 7-12 pairs, reaching the margin without looping to join their neighbours, forming an angle of 50-60° with the midrib; inflorescence, lax, in dense, umbellate cymes up to 160-flowered .... 8. **H. myriantha**
Secondary veins more or less straight, in 9-30 pairs, forming a submarginal vein and an angle of (55-) 65-80° with the midrib; inflorescence, contracted or lax, up to 150-flowered 7
7. Leaf acumen indistinct; inflorescence lax, up to 96-flowered, Eastern Coast from Somalia to Mozambique .... 12. **H. zeylanica**
Leaf acumen distinct; Inflorescence few-flowered or contracted, Western Coast from Senegal to Zaire and Mt. Kulal in Northern Kenya 8
8. Corolla tube 9-13 mm long; stamens inserted at 7-9.8 mm from the corolla base 9
Corolla tube 4-8.2 mm long; stamens inserted at 2.5-6.2 mm from the corolla base 10
9. Secondary veins in 9-14 pairs, 8-13 mm apart at the cental part of the leaf; sepals membranaceous, colleters sparsely distributed within; ovary with 1 ovule per carpel .... 7. **H. macrosiphon**
Secondary veins in 20-25 pairs, 3-6 mm apart at the central part of the leaf; sepals thick towards the middle, coriaceous with colleters up to 0.75 of their length; ovary with 6-7 ovules per carpel .... 9. **H. oxyantha**
10. Corolla lobes 0.4-0.5 × as long as the tube, 2.6-3 mm long; ovules 2 per carpel .... 4. **H. densiflora**
Corolla lobes 0.8-2.7 × as long as the tube, 4-12 mm long; ovules 6-30 per carpel 11
11. Ovary gradually narrowed into style, 1.5-2 mm long, with 5-6 ovules per carpel; fruit 20-26 × 11-18 cm; Zaire and Kenya .... 3. **H. congolana**
Ovary abruptly narrowed into style, 0.6-1.1 mm long, with 14-30 ovules per carpel; fruit 31-60 × 40-50 cm; Senegal to Zaire ...... 11. **H. umbellata**

2.5.1 Hunteria ballayi Hua

in Bull. Mus. Hist. Paris 7: 281 (1902). – Type: Cultivated in greenhouse at Paris from seeds collected in Gabon by *Ballay* in May 1906 (holotype P).

Fig. 23, p. 91; map 1, p. 92

Homotypic synonym:

Pleuranthemum ballayi (Hua) Pichon in Bull. Soc. Brot. sér 2, 27: 113, plate II, fig 7-10, map A, p. 85 (1953).

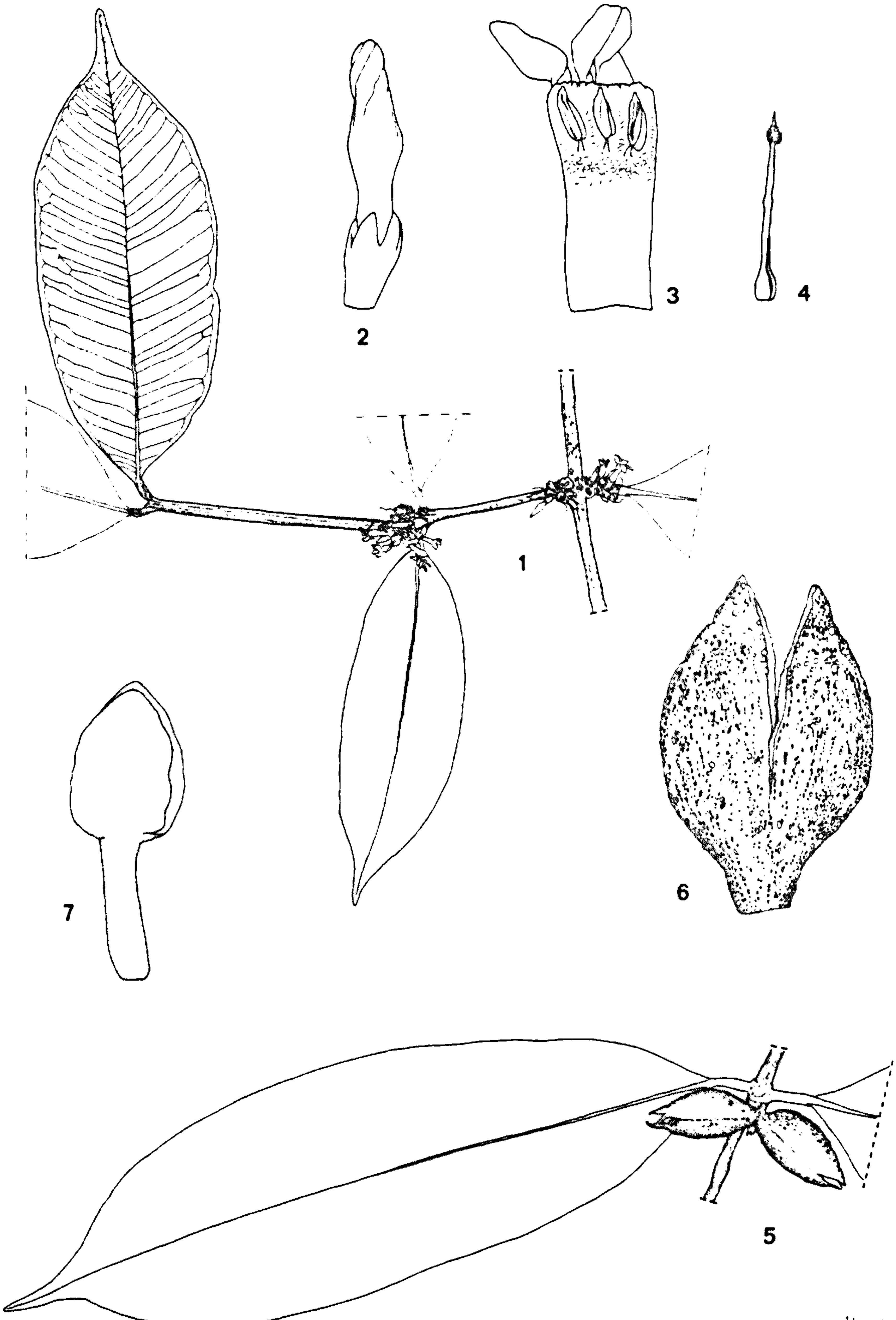
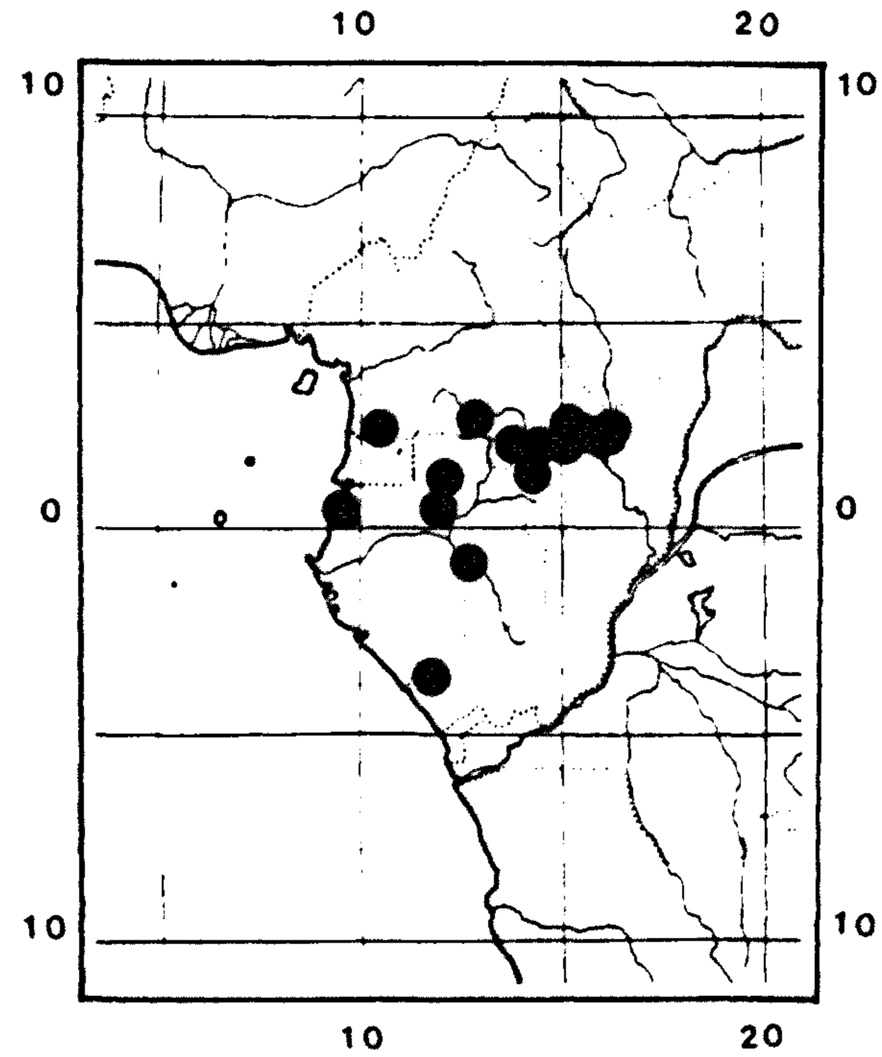


Figure 23. *Hunteria ballayi*. **1**, habit (× 2/3); **2**, flower bud (× 4); **3**, opened corolla (× 4); **4**, pistil (× 4); **5**, fruiting branch (× 2/3); **6**, fruit (× 2); **7**, embryo (× 4). 1 from Le Testu 8558; 2-4 from van der Maesen et al. 5579; 5 from Wilks 1453; 6-7 from Schlott 11.



Map 1. *Hunteria ballayi*.

Shrub 1-3 m high, sometimes lianescent and up to 5 m high with white latex. Trunk slender; inner bark yellowish; wood very hard. Branchlets drying greyish green. *Leaves* opposite; petiole 3-7 mm; blade papery when dried, elliptic to slightly obovate, 2.2-3.1 × as long as wide, 6.7-20.3 × 2.2-8.1 cm, acuminate at the apex, acumen obtuse, 7-14 × 2 mm, acute at the base; midrib prominent beneath in dried leaves, drying brownish orange; secondary veins straight, in 20-30 pairs, forming a submarginal vein and an angle of 65-70° with the costa, 5-6 mm apart at the approximate centre of the leaf. *Inflorescence* predominantly axillary and terminal, fasciculate, ramiflorous, 1-1.2 × 1-1.5 cm, about 10-flowered; peduncle 0-2 mm. Pedicels 0.5-2 mm. Bracts 0.5-0.7 × 0.4-0.5 mm, acuminate. *Flowers: Sepals* light green, free, membranaceous at the edge, thicker towards the middle and at the base, erect, ovate, 1.3-3 × as long as wide, 1-1.5 × 0.5-0.8 mm, obtuse to acute at the apex, with rows of colleters inside up to 0.4 of their length, colleters very small. *Corolla* dirty white, pale yellow in bud, 7.1-11.2 mm long in mature bud and forming a comparatively small ovoid head 0.36-0.39 of the bud length, 2.8-4 × 0.9-1.6 mm, with an obtuse to rounded apex, with a belt of pubescence 1 mm wide inside just below the insertion of the stamens, with a few hairs around the stamens, tube 3.3-6 × as long as the calyx, 1.7-2.4 × as long as the lobes, 5-7.2 mm long, almost cylindrical, 0.9-2 mm wide above the base, narrowed below the insertion of the stamens to 0.8-1.6 mm wide, again widened around the anthers to 1.3-1.8 mm wide; lobes not twisted in bud, ovate, 0.4-0.6 × as long as the tube, 1.9-2.3 × as long as wide, 2.7-3.5 × 1.3-1.5 mm, obtuse at the apex, entire, spreading or erect. *Stamens* with apex 0.2-0.3 mm below the mouth of the corolla tube, inserted 0.69-0.79 of the length of the corolla tube at 3.5-5.5 mm from the base; filaments short, filiform, 0.3-0.6 mm long; anthers narrowly ovate, 3.5-4.5 × as long as wide, 0.9-1.4 × 0.3-0.4 mm, acuminate at the apex, acumen 0.2-0.3 mm, cordate at the base. *Pistil* 4.6-5.6 mm long; ovary narrowly oblong, 1-1.2 × 0.4-0.8 × 0.3-0.6 mm, abruptly narrowed into the style, with a disk-like thickening uniting the carpels at the base, about 0.2 of the length, 0.2 mm high, of two separate carpels; style 2.8-3.7 mm long; pistil head composed of a globose stigmatic basal part 0.4-0.5 × 0.15-0.3 mm and a filiform stigmoid apex 0.2-0.6 × 0.1-0.15 mm. Ovules 2 in each carpel. *Fruits* pale yellow, rough, warty to smooth, of two separate mericarps, mericarps obovoid or ellipsoid, 15-28 × 9-15 × 6-11 mm, with a short beak at the apex, beak 2-6 mm, 2-seeded, wall about 1-2 mm; pulp smooth or slightly fibrous. *Seeds* ellipsoid or subglobose, 8-13 × 5-9 × 3-7 mm. Embryo 4.3-9 mm long; cotyledons ovate, 1.2-2 × as long as wide 2.3-5 × 1.8-4 mm, obtuse at the apex, rounded at the base; radicle 0.7-1 × as long as cotyledons, 2-4 × 0.5-2 mm.

DISTRIBUTION. Cameroun, Central African Republic, Gabon and Congo.

ECOLOGY. Old secondary forest, flood plain forest and drier forest with scattered trees and numerous gaps dominated by *Marantaceae*. Alt. 350-500 m. Flowering in April in Central African Republic, April and November in Gabon, and fruiting around July to September in all countries.

USES. Used as a fertility drug, women swallow the seed together with the sweet mesocarp; chimps suck the sweet mesocarp (*Fay* 8127, MO, 1987, RCA); used as a fertility drug and also found in gorilla droppings, but never in high density (*Harris & Fay* 63, MO, 1988, RCA).

Specimens examined:

CAMEROUN. Est: 65 km NNE of Moloundou, *Letouzey & Villiers* 10568 (P); 85 Km N of Molundou, *Letouzey & Villiers* 10383 (P); Ndankan, *D. W. Thomas* 7202 (WAG); Moloundou, *Mildbraed* 4038 (HBG). Ngongondje Hill, *Koufani* 143 (P); Nyabessan, *Mezili* 120 (P).

CENTRAL AFRICAN REPUBLIC. Sangha: Ndankan Gorilla Study area, Harris & Fay 63 (MO), *Harris & Fay* 547 (WAG), *Fay* 8127 (MO), *Fay & Harris* 8782 (MO), 8835 (MO); 45 km S of Lidjombo, *Schlott* 11 (WAG).

GABON. Haut Ogoué: Ngounie, *Le Testu* 8558 (BM, BR, P). Ogooué-Ivindo: 40 km N of Koumameyong, *Wilks* 1453 (WAG). Ogooué-Lolo: 10 km from Lastoursville, *Van der Maesen* et al. 5579 (WAG). Estuaire: Libreville, *Klaine* 3077 (P); *Ballay* May 1906 (P, type).

CONGO: Ngoko, *Bouquet* 1629 (P); Sembe Forest, *Sita* 3373 (WAG); near N'gbal, *Sita* 3451 (BR).

2.5.2 Hunteria camerunensis K. Schum. ex Hall f.

in Jahrb. Hamb. Wiss. Anst., 17 Beih. 3: 187 (1899); Pichon in Mém. Mus. Natn. Hist. Nat. 24: 161, 179 t. 3 fig. 20 (1948). – Type: Cameroun, Bipindi, *Zenker* 1620 (lectotype P, designated by Pichon in 1953, isolectotypes B, BP, BR, E, G, HBG, L, M, NY S, W, WAG, WU, Z).

Fig. 24, p. 94; map 2, p. 95

Homotypic synonyms:

Pleiocarpa camerunensis (K. Schum. ex Hall. f.) Stapf in Fl. Trop. Afr. 4, 1: 102 (1902). *Polyadoa camerunensis* (K. Schum. ex Hall. f.) Brenan in Kew Bull.

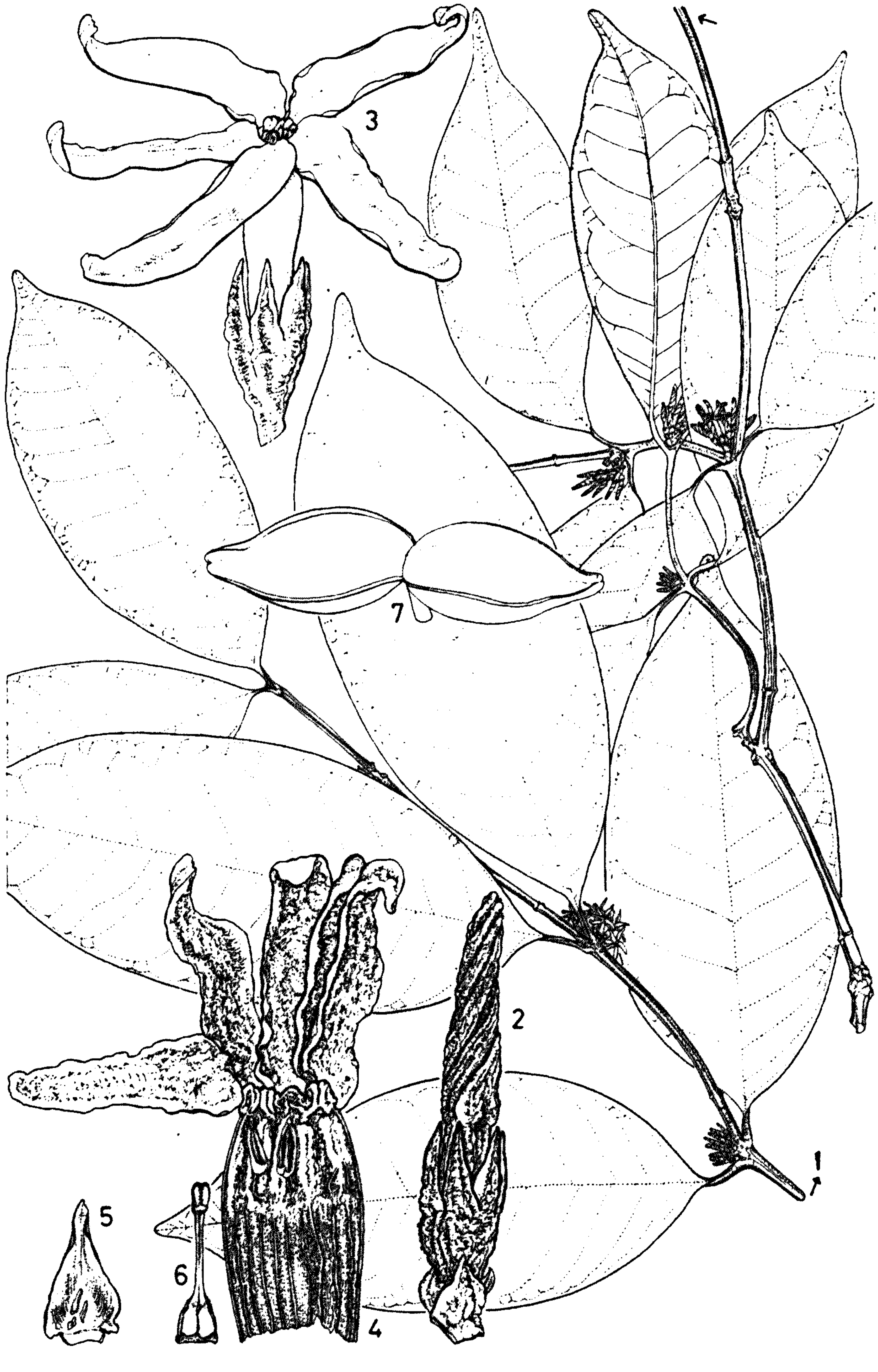
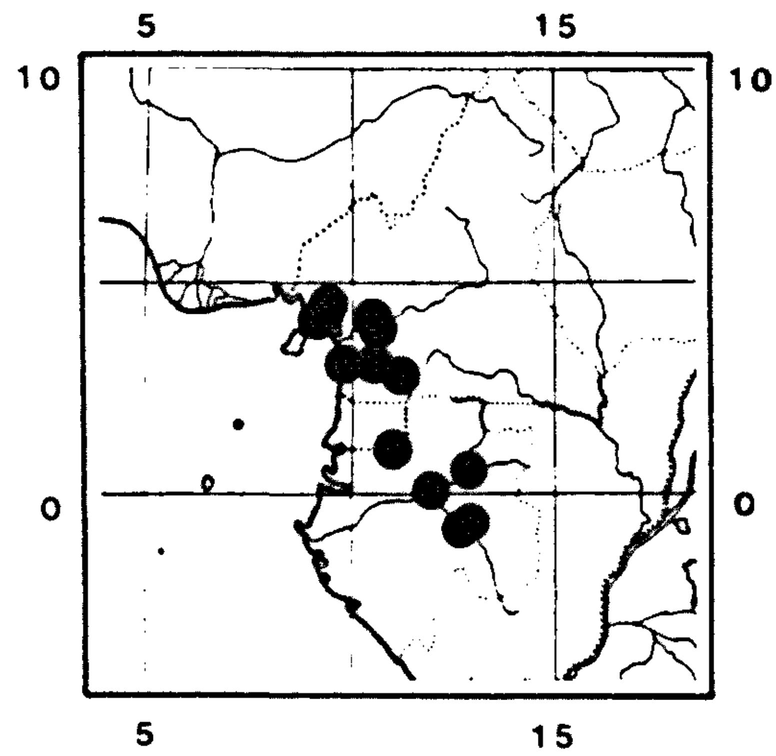


Figure 24. *Hunteria camerunensis*. **1**, habit (× 2/3); **2**, flower bud (× 1.4); **3**, flower (× 10); **4**, opened corolla (× 10); **5**, sepal inside (× 1.4); **6**, pistil (× 1.4). 1-6 from Zenker 1211. 7. Fruit is *Tabernaemontana letestui*.



Map 2. *Hunteria camerunensis.*

1952: 451 (1952). *Comularia camerunensis* (K. Schum. ex Hall. f.) Pichon in Bol. Soc. Brot. sér. 2, 27: 116, 117 t. 3, fig 1-3, map A, p. 85 (1953).

Shrub 1-3 m high. Trunk slender, green up to 1.5 cm in diameter. Branches dark green, drying grey to black; branchlets quadrangular to slightly four-ribbed, green, even when dried. *Leaves* opposite; petiole 4-10 mm; blade thinly leathery when fresh, elliptic, oblong to obovate, 2-3.3(-5) × as long as wide, 6-18.8(-24.7) × 1.4-8 cm, acuminate at the apex, acumen obtuse, 5-20 × 2-4 mm, acute, obtuse to cuneate at the base, smooth, glossy above; midrib prominent beneath and drying light orange; secondary veins more or less straight to slightly curved, in 11-13 pairs, forming an angle of 60-75° with the midrib, 6-18 mm apart at the approximate centre of the leaf. *Inflorescence* terminal, rarely axillary, in compact clusters, 0.5-1.5 × 0.5-2.3 cm, about 5-12-flowered, sessile or with a peduncle 1-6 mm long. Pedicels 0.5-2 mm. Bracteoles, three at the base of each pedicel, 0.5-1.5 × 0.2-1 mm, acuminate at the apex. *Flowers*: *Sepals* pale green, free, erect, covered by a little resin on the inner side, membranaceous for about 0.2 mm of their edge, ovate, 1.9-3.6 × as long as wide, 1.5-2.5 × 0.6-1.2 mm, acuminate to acute at the apex, acumen 0.5-1 mm, with rows of colleters up to one 0.4 of their length inside, colleters very small 0.2 × 0.05 mm. *Corolla* creamy to white, light green in bud, 4.3-8 mm long in mature bud and forming a comparatively large ovoid or triangular head 0.44-0.63 of the bud length, 2.3-3.7 × 0.5-0.9 mm, with an acute apex, with minute tufts of hairs at the base of each filament inside, tube 1.3-2.1 × as long as the calyx, 0.6-0.9 (-1.2) × as long as the lobes, 3-4 mm long, almost cylindrical, 0.7-1.8 mm wide above the base, narrowed below the insertion of the stamens to 0.6-1.2 mm wide, again widened around the anthers to 0.8-1.5 mm wide, thickened and very constricted at the throat; lobes pale pink, twisted in bud, narrowly oblong to ovate, (0.9-) 1.1-1.6 × as long as the tube, 2.4-5.9 (-10) × as long as wide, 2.8-5.5 × 0.5-2 mm, obtuse at the apex, entire, spreading to erect. *Stamens* with apex 0.2-0.8 mm below the mouth of the corolla tube, inserted 0.43-0.67 of the length of the corolla tube, at 1.7-2 mm from the base; filaments 0.2-0.5 mm long; anthers narrowly ovate to oblong, 4-6 × as long as wide, 0.8-1.2 × 0.2-0.3 mm, obtuse at the apex, subcordate at the base. *Pistil* 1.9-

3.1 mm long, ovary subglobose, 0.6-1.0 × 0.4-0.7 × 0.2-0.5 mm, distinctly narrowed into the style, with a disk-like thickening uniting the carpels at the base, about 0.25-0.33 of the length, 0.2 mm high, of two separate carpels; style 0.5-0.8 mm long; pistil head composed of a subglobose to oblong stigmatic basal part 0.3-0.8 × 0.15 × 0.2 mm and a cylindrical stigmoid apex 0.3-0.9 × 0.1 mm. Ovules 6-8 in each carpel. *Fruits* orange, smooth, of two separate mericarps, mericarps divergent at an angle of 180°, ovoid to subglobose, 28-47 × 15-25 × 10-18 mm, bluntly acuminate at the apex, 6-8-seeded; wall about 2 mm; pulp smooth or slightly fibrous. *Seeds* subglobose to ellipsoid, 7-14 × 5.5-10 × 3-4 mm. Embryo 5.5-9 mm long; cotyledons ovate, 1.2-2.5 × as long as wide 3-4.2 × 2-2.5 mm, obtuse at the apex, rounded at the base; radicle 0.75-0.83(-1.2) × as long as cotyledons, 2.5-4.8 × 0.5-0.9 mm.

DISTRIBUTION. Cameroun and Gabon.

ECOLOGY. Primary or secondary forest along small creeks, or stream gullies on forest border or in rain forest. Alt. 50-650 m. Flowering and fruiting all the year round.

Geographical selection of the approximately 40 specimens examined:

CAMEROUN. Sud-Ouest: Limbe, *Mildbraed* 10716 (A); S Bakundu Forest Reserve, *Beentje* 1450 (WAG), *Brenan* 9401 (FHO, K, P), *Binuyo & Daramola* FHI 35090 (K, P). Centre-Sud: 8 km N of Kribi, *De Wilde & De Wilde-Duyfjes* 2901 (WAG); 60 km NNW of Eseka, *De Wilde & De Wilde-Duyfjes* 2195 (WAG); Bipindi, *Zenker* 1211 (E, G, HBG, L, M, P, S, W, Z), 1620 (B, BP, BR, E, G, HBG, L, M, NY, P, W, WAG, WU, Z, type of *H. camerunensis*), 2311 (BR, E, HBG, L, M, P, S, W, WU, Z), 3163 (BP, BR, E, G, HBG, K, L, M, P, S, W, WAG, WU), 3611 (BP, BR, E, G, HBG, K, L, M, MA, P, S, US, W, Z), 4113 (BP, BR, E, G, HBG, K, L, M, MA, P, S, W, Z); Mimfia, *Zenker* II 163 (B, C, FT, G, UC, US, U, WAG); 25 km NW of Eseka, *De Wilde & De Wilde-Duyfjes* 1442 (BR, K, P, WAG); Nkoemvone, *Raynal* 9606 (P); 15 km S of Ebolowa, *De Wilde & De Wilde-Duyfjes* 1974 (BR, K, P, WAG).

GABON. Woleu-Ntem: 29 km ESE of Medouneu, *Reitsma* 1858 (NY, WAG). Ogooué-Ivindo: ca. 20-40 km NNE of Koumémayong, *Breteler* et al. 8654 (WAG); 10 km S of Makokou, *Florence* 154 (P), 566 (P, WAG). Ogooué-Lolo: 16 km on Lastoursville-Moanda Rd., *Breteler & de Wilde* 748/78 (WAG); 28 km NE of Lastoursville, *Wieringa & Van der Poll* 1479 (WAG).

2.5.3 **Hunteria congolana** Pichon

in Bol. Soc. Brot. sér 2, 27: 101, t.1 fig. 9-13; map A p.85 (1953). – Type: Zaire, Haut-Zaire, 10 km East of Yangambi, *J. Louis* 1083 (holotype BR; isotypes K, P, S).

Fig. 25, p. 97; map 3, p. 98

Shrub or small tree 1.7-20 m high with white to yellow latex in all parts. Trunk 5-30 cm in diameter; wood yellow and hard. Bark of branches thin, smooth, finely fissured. *Leaves* opposite; petiole 8-18 mm long; blade thin, papery when dried, elliptic to oblong, 2.4-4 × as long as wide, 6.3-18.4 × 1.5-5.9 cm, acuminate at the apex, acumen obtuse, 10-18 × 2-4 mm, acute to obtuse at the base; midrib pale yellow, prominent beneath; secondary veins slightly prominent beneath, in 11-16 pairs, more or less straight, forming an angle of 70-80° with the midrib, 6-14 mm apart at the approximate centre of the leaf. *Inflorescence* terminal or axillary, 3-3.5 × 3-5 cm, 1-

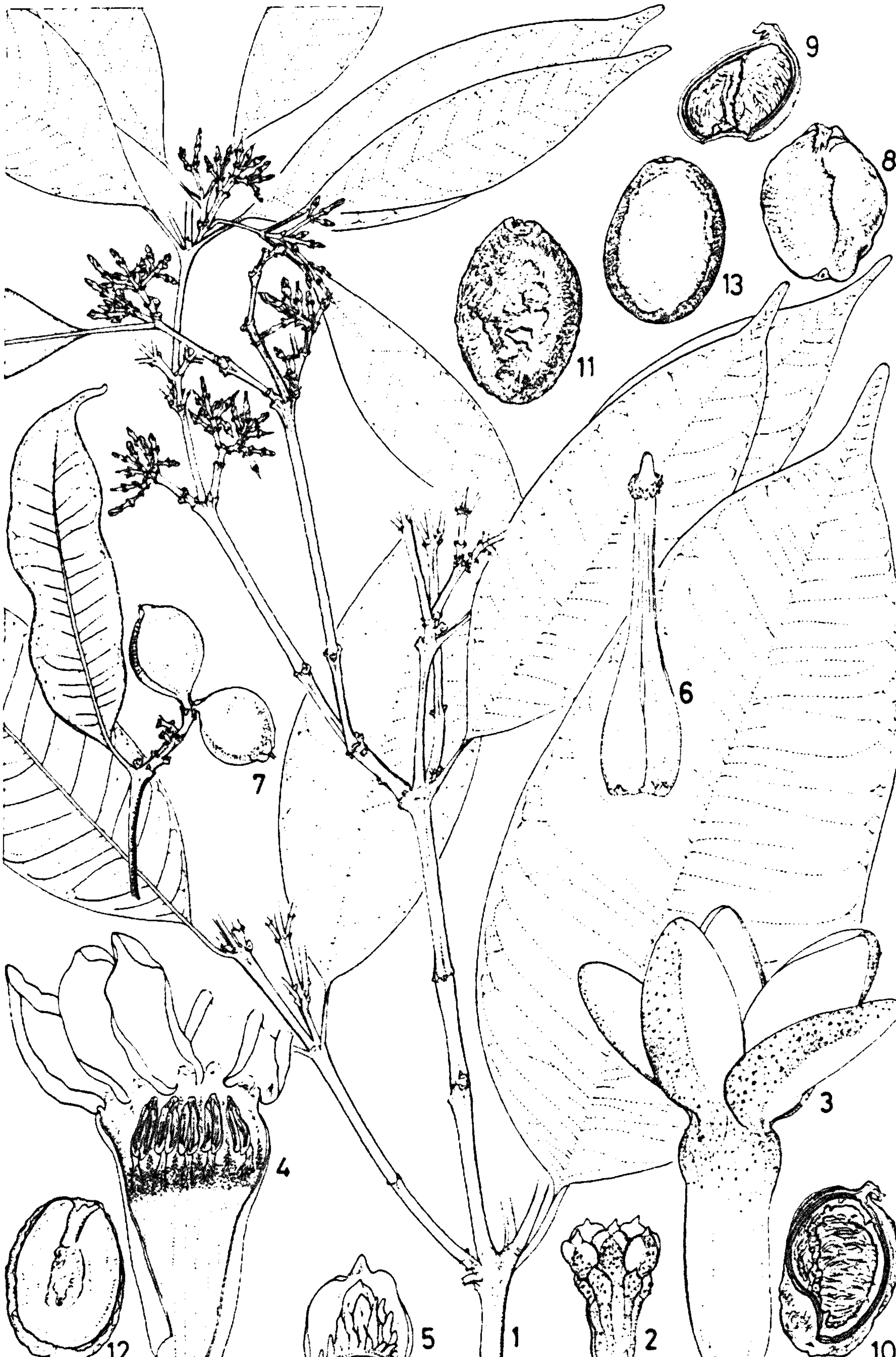
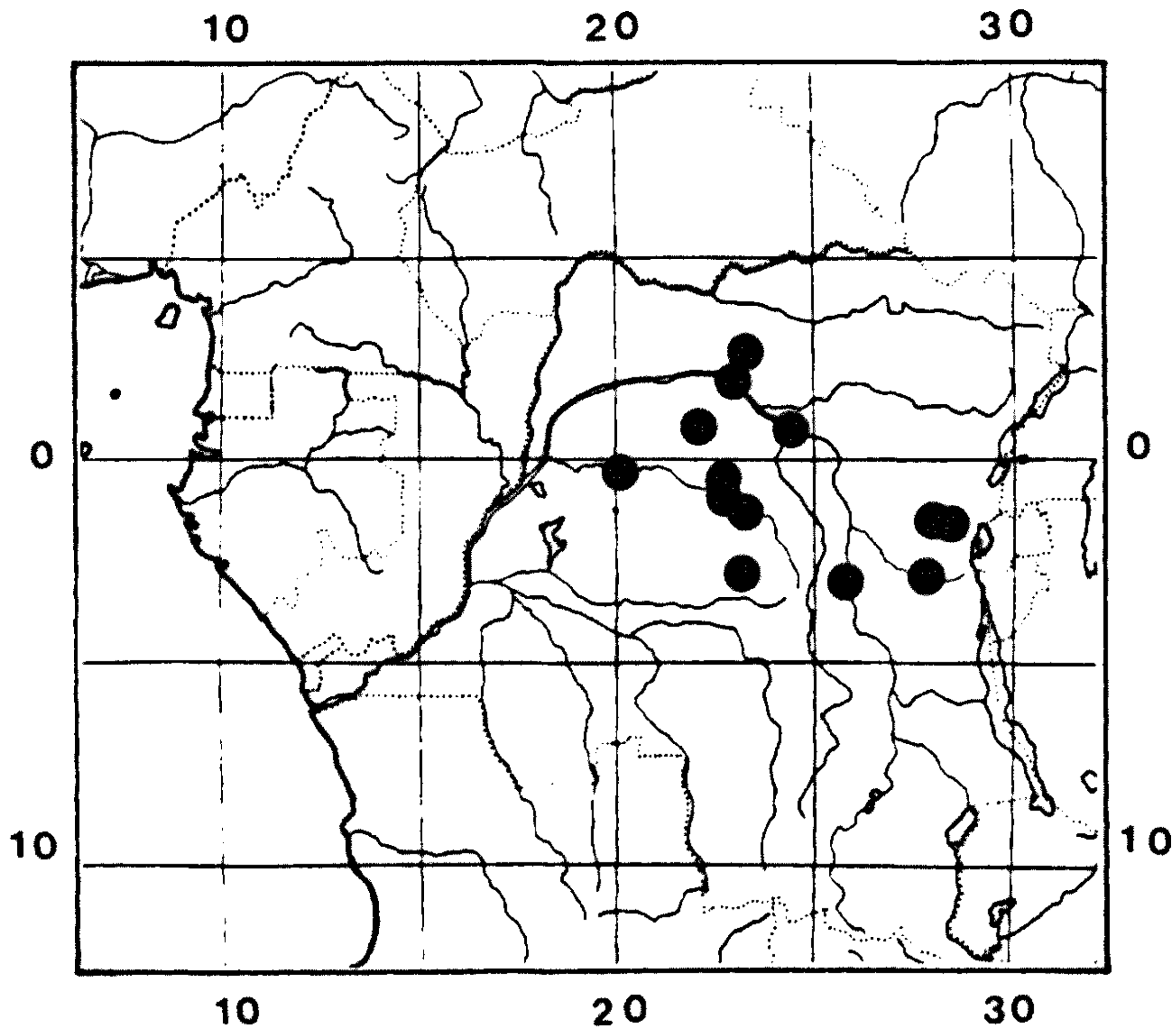


Figure 25. *Hunteria congolana*. **1**, habit (× 2/3); **2**, calyx (× 6); **3**, corolla (× 6); **4**, opened corolla (× 6); **5**, sepal inside (× 14); **6**, pistil (× 10); **7**, dried immature fruit (× 2/3); **8**, dried fruit (× 2/3); **9**, dried part of fruit wall (× 1); **10**, opened dried fruit (× 1); **11**, seed (× 2); **12**, longitudinal section of seed (× 2); seed (× 2). 1 from J. Louis 6489; 2-6 from J. Léonard 1445; 7 from Nsola 1261; 8-13 from J. Louis 6328.



Map 3. *Hunteria congolana.*

2 × branched, about 7-18 (-45)-flowered; peduncle 2-14 mm long, primary branches 3-10 mm long, secondary branches 2-4 mm long; pedicels 2-5 mm long. Bracts sepal-like, 1-1.5 × 0.5-0.7 mm, with colleters inside. *Flowers*: *Sepals* pale green, coriaceous, almost free, erect, membranaceous at the edge and the apex, thicker towards the middle and at the base, with much white to clear resin within, broadly to narrowly ovate, 1.1-2.7 × as long as wide, 0.8-1.5 × 0.3-0.8 mm, acuminate to acute at the apex, with rows of colleters inside up to 0.9 of their length, colleters very small 0.2 × 0.05 mm. *Corolla* white or yellow, creamy-pink in bud, 6.6-11.6 mm long in mature bud and forming a comparatively wide ovoid head 0.38-0.55 of the bud length 2.2-6 × 0.9-1.7 mm, with an obtuse apex; with a belt of pubescence 1-1.5 mm wide inside just below the insertion of the stamens and up to the mouth of the tube, tube 3.7-6.3 × as long as the calyx, 0.7-1.3 × as long as the lobes, 4.8-5.5 mm long, almost cylindrical, 1-1.8 mm wide above the base, narrowed below the insertion of the stamens to 0.8-1.3 mm wide, again widened around the anthers to 1-2 mm wide; lobes narrowly ovate to oblong, 0.8-1.5 × as long as the tube, 1.7-4 × as long as wide, 4-8 × 1.5-2.8 mm, obtuse at the apex, spreading. *Stamens* with apex 0.2-1 mm below the mouth of the corolla tube, inserted 0.63-0.73 of the length of the corolla tube, at 3-4.7 mm from the base; filaments 0.2-0.5 mm long; anthers narrowly ovate 3.7-7.5 × as long as wide, 1.1-1.5 × 0.2-0.3 mm, obtusely acuminate at the apex, acumen up to 0.4 mm, cordate at the base. *Pistil* 3.4-4.8 mm long; ovary oblong, 1.5-2 × 0.6-1 × 0.3-0.8 mm, gradually narrowed into the style, with a disk-like thickening uniting the carpels at the base, about 0.1-0.2 of the length, 0.2 mm high, of two separate carpels; style 0.8-2.1 × 0.2-0.4 mm; pistil head composed of a subglobose stigmatic basal part 0.2-0.8 × 0.2-0.5 mm and an conical stigmoid apex 0.4-1.0 × 1-0.2 mm. Ovules 5-6 in each carpel at the extreme base. *Fruits* yellow to bright orange, smooth, dull; mericarps ellipsoid to subglobose, somewhat flattened,

20-26 × 11-18 × 11-16 mm, rounded to obtuse at the apex; 1-3-seeded; wall about 1-3 mm thick, slightly fibrous within. *Seeds* ovoid to ellipsoid, 7-13 × 5-7.5 × 3-4 mm. Embryo 6.3-8.7 mm long; cotyledons ovate to elliptic, 1.5-2.6 (-5.7) × as long as wide, 2.3-4.2 × 0.7-2 mm, obtuse at the apex and the base; radicle 0.7-1.7 × as long as cotyledons, 3-4.7 × 0.5-0.8 mm.

DISTRIBUTION. Zaire and Kenya.

ECOLOGY. Dense understorey of primary, rarely secondary forest or gallery forest on plateau. Alt. 470-1700 m. Flowering and fruiting all the year round.

Geographical selection of the approximately 48 specimens examined:

ZAIRE. Equateur: Boende, *L. Dubois* 651 (BR); Yalifake, *Evrard* 6270 (BR); between Yokolo and Mondombe, *Evrard* 4354 (BR). Haut-Zaire: Mobwasa, *Reygaert* 884 (BR); Esabo Island, *Germain* 4957 (BR, M); near Yangambi, *J. Léonard* 1445 (BR); ibid., *J. Louis* 1083 (BR, K, P, S, type), 3809 (B, BR, FT, K, NY), 6328 (BR), 6489 (BR, C, NY); ibid., *Menavanza* 143 (BR, K, WAG). Kasai-Oriental: Mukumari, *Germain* 7998 (BR, K, P). Kivu: Kampala, *Pierlot* 950 (BR); Kabunga, *A. Léonard* 1831 (BR, MO, P, WAG); near Irangi, *Troupin* 12151 (BR); Masanga, *A. Léonard* 5879 (BR, MO, WAG); km 89 Shabunda-Kasese Road, *Michelson* 914 (BR).

KENYA. K1: Northern Frontier Distr., Mt. Kulal, *Adamson* 115 (EA, K); North of Gatab, sin. coll. 178 (EA, K).

Note. The corolla of this species always falls off leaving only the pistil, therefore it probably flowers during the night. It can be clearly distinguished from the other *Hunteria* species by the ovary which gradually narrows into the style. Collected twice in Kenya, in Mt. Kulal where lobes are much longer and leaves much smaller. Fruits not known from Kenya.

2.5.4 **Hunteria densiflora** Pichon

in Bull. Jard. Bot. Brux. 23: 392, fig 38 (1953), partly excluding of *Michelson* 85.– Type: Zaire, Maniema, 22 km on Elila-Kailo road, *Michelson* 921 (holotype BR; isotype P).

Fig. 26, p. 100; map 4, p. 101

Tree up to 18 m high; trunk up to 55 cm in diameter; bark smooth, dark greenish-brown; inner bark brown; wood not differentiated, hard, yellowish-orange. *Leaves* opposite, occasionally ternate, petiolate; petiole 12-20 mm long; blade coriaceous, elliptic, 2.8-2.9 × as long as wide, 6.5-15.3 × 3.5-6.5 cm, acuminate at the apex, acumen acute, 10-22 × 3-4 mm, acute to obtuse at the base; midrib prominent beneath; secondary veins prominent above and beneath, in 22-30 pairs, forming an angle of 70-80° with the midrib and a neat submarginal vein, 4-6 mm apart at the approximate centre of the leaf, tertiary veins more or less parallel. *Inflorescence* terminal, dense, 2 × branched, in umbellate cymes, 60-120-flowered; peduncle 15-40 mm, branches 2-8 mm long; pedicels 2-3 mm long. *Flowers* very fragrant. *Sepals* pale green, free, erect, membranaceous at the edge, thick towards the middle and the base, ovate 1.4-1.7 × as long as wide, 1-1.2 × 0.7 mm, acuminate at the apex, with

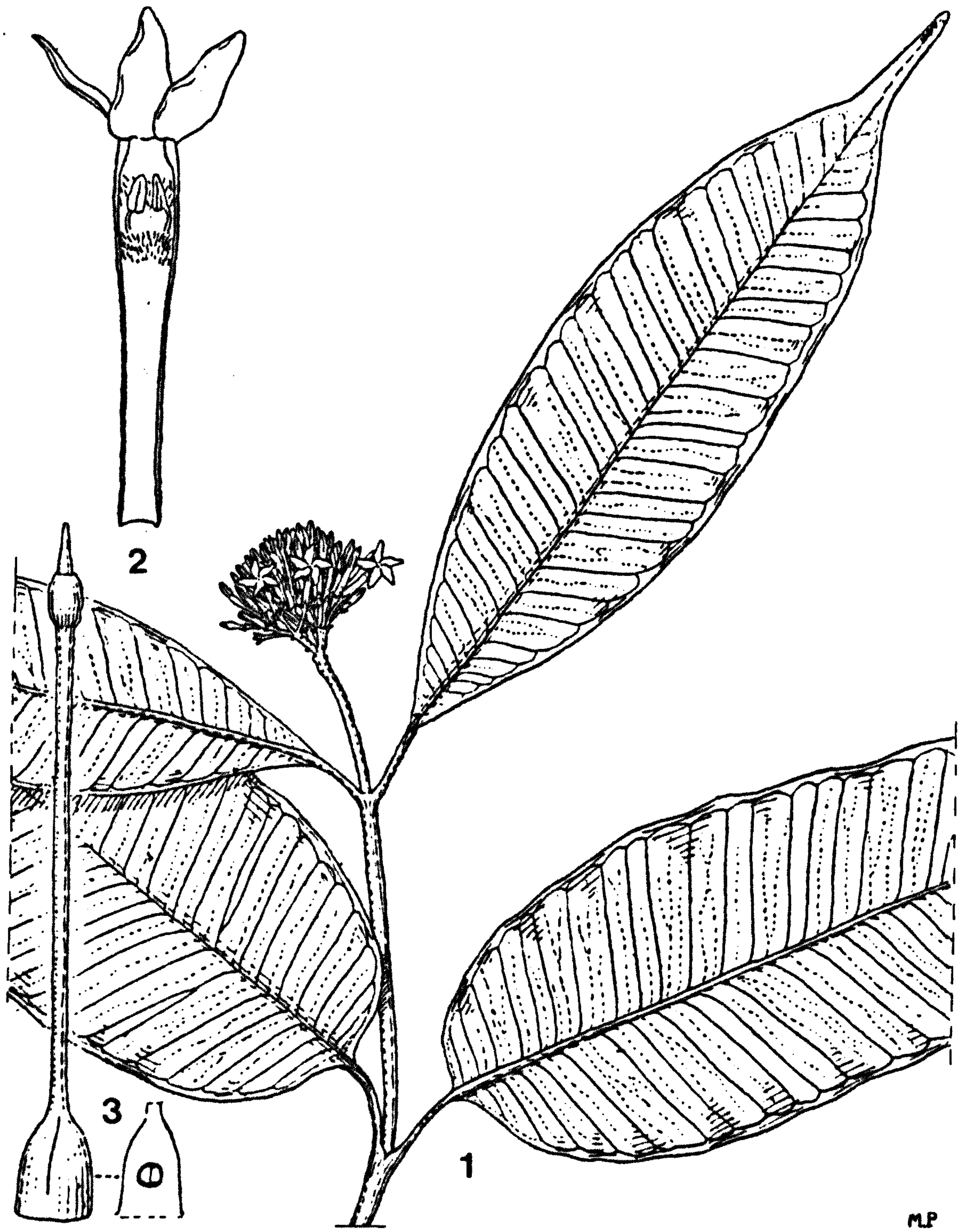
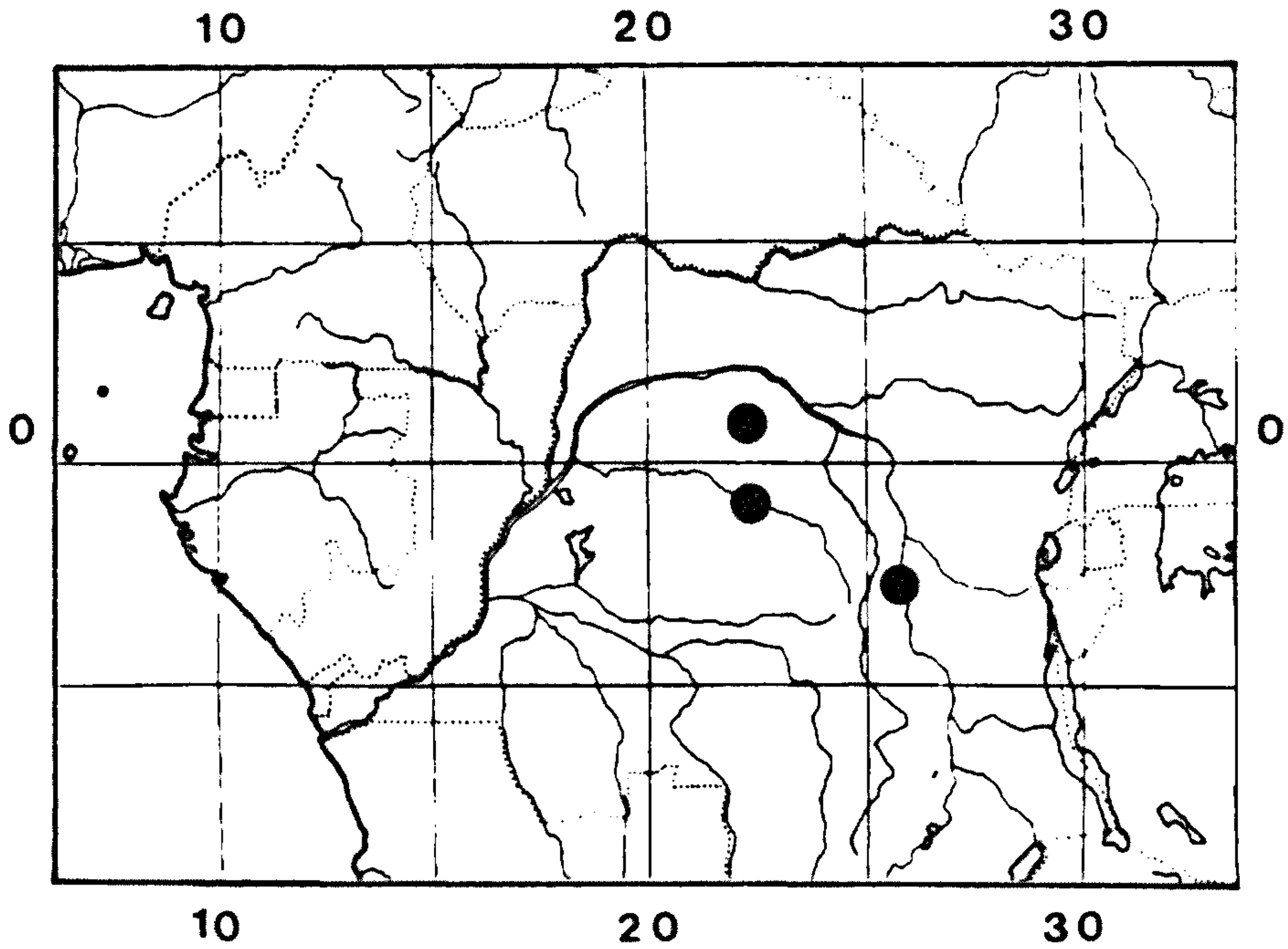


Figure 26. *Hunteria densiflora.* **1**, habit (× 2/3); **2**, section of corolla (× 5); **3**, pistil (× 10). 1-3 from Michelson 941. adapted from Pichon, 1953.



Map 4. *Hunteria densiflora.*

resin within and colleters inside up to 0.5 of the length. *Corolla* white, 10 mm long in mature bud and forming a comparatively small ovoid head 0.35 of the bud length, 3.2 × 1 mm, with an obtuse apex, with a belt of pubescence 1-1.3 m wide inside, just below the insertion of the stamens and up to the mouth of the corolla tube; tube 5-5.5 × as long as the calyx, 1.8-2.3 × as long as the lobes, 5.5-6 mm long, almost cylindrical, 0.8-1.5 mm wide above the base, narrowed below the insertion of the stamens to 0.6-0.8 mm wide, again widened around the anthers to 1.2-1.3 mm wide; lobes ovate, 0.4-0.5 × as long as the tube, 1.3-1.4 × as long as wide; 2.6-3 mm long, obtuse at the apex, entire, spreading. *Stamens* with apex 0.4 mm below the mouth of the corolla tube, inserted 0.87 of the length of the corolla tube at 4.8 m from the base; filaments 0.5 mm long; anthers ovate, 3.5-4 × as long as wide, 0.6-0.7 × 0.15-0.2 mm, obtuse at the apex and sterile for 0.2 mm, cordate at the base. *Pistil* 5.5-6.2 mm long; ovary subglobose, 0.7-1 × 0.6-0.7 × 0.4-0.5 mm, abruptly narrowed into the style, with a disk-like thickening uniting the carpels at the base, about 0.3 of the length, 0.2-0.3 mm high, of two separate carpels; style 3.8-4.3 mm long; pistil head with a stigmatic ellipsoid basal part 0.3-0.5 × 0.3 and a conical stigmoid apex 0.5 × 0.15-0.2 mm. Ovules two in each carpel. *Fruits* immature, green, of two separate mericarps; mericarps subglobose with an obtuse apex, 2-seeded.

DISTRIBUTION. Zaire.

ECOLOGY. Semi-deciduous forest. Alt. 500 m. Flowering in February and fruiting in March-April.

Specimens examined:

ZAIRE. Equateur: Bokata, Territory Bokungu *Evrard*, 5675 (BR, WAG); Maniema, 22 km on Elila-Kailo Road, *Michelson* 921 (BR, P, type).

Notes. Mature fruits unknown. The immature fruits of *Michelson* 85 cited by Pichon (1953), were analyzed and found to have 7 seeds, meaning that the ovaries have at least 7 ovules. *H. densiflora* has only two ovules per carpel and immature fruits of *Michelson* 921 have 2 seeds only. *Michelson* 85 matches the new species, *Hunteria oxyantha* Omino, from Gabon.

2.5.5 Hunteria ghanensis Hall & Leeuwenberg

in Bull. Jard. Bot. Nat. Belg. 49: 422, 423, fig. 1 (1979). – Type: Ghana, Apam junction, *J. B. Hall* GC 47044 (holotype WAG; isotypes B, BR, K, P).

Fig. 27, p. 103; map 5, p. 104

Tree 1-12 m high. Trunk 20-25 cm in diameter; bark pale grey, shallowly fissured, dark brown on section; wood ochraceous. Branches pale grey, with small lenticels; branchlets thin, smooth. *Leaves* opposite; petiole 5-10 mm long; blade subcoriaceous when fresh, narrowly elliptic (2-) 2.7-5.1 × as long as wide, 3.5-13.5 × 0.8-3.4 cm, abruptly acuminate at the apex, acumen 12-15 × 2-4 mm, acute, cuneate at the base; midrib prominent beneath; secondary veins straight, inconspicuous above, slightly prominent beneath, in 15-20 pairs, forming a submarginal vein and an angle of 60-72° with the costa, 6-10 mm apart at the approximate centre of the leaf; tertiary venation parallel to the secondary veins. *Inflorescence* terminal, almost compound umbellate, 2 × branched, 2-4 × 2.5-4 cm, 30-150-flowered; peduncle 3-18 mm long, branches 5-18 mm long; pedicels 2-4 mm long. Bracts very small. *Flowers*: *Sepals* almost free, erect, with a little resin within, ovate to narrowly triangular, acute to acuminate at the apex, 1.7-3.4 × as long as wide, 1-1.2 × 0.35-0.6 mm, with rows of colleters inside up to 0.5 of their length, colleters very small, scale-like. *Corolla* cream to pale yellow, 5.5-8.5 mm long in mature bud and forming a comparatively small, globose head 0.22-0.24 of the bud length, 1.2-2 × 1 mm, with a rounded apex, with a belt of pubescence 2.5-3.5 mm wide inside just below the insertion of the stamens, and around the stamens; tube 3.6-6.2 × as long as the calyx, 2.7-4.8 × as long as the lobes, 4.3-6.2 mm long, almost cylindrical, 0.6-1.5 mm wide above the base, narrowed below the insertion of the stamens to 0.5-0.8 mm wide, again widened around the anthers to 0.7-1.5 mm wide; lobes broadly ovate, 0.2-0.35 × as long as the tube, 0.7-0.9 × as long as wide, 1.3-2 × 1.7-2.8 mm, rounded at the apex, entire, spreading to slightly recurved. *Stamens* with apex 0.3-0.5 mm below the mouth of the corolla tube, inserted 0.77-0.93 of the length of the corolla tube, at 4-5.2 mm from the base; filaments 0.3-0.5 mm long; anthers ovate to oblong, 2.6-3.5 × as long as wide, 0.6-0.8 × 0.2-0.3 mm, obtuse at the apex, subcordate at the base. *Pistil* 4.6-6.0 mm long, with apex approximately halfway along the anthers; ovary subglobose, 0.6-0.9 × 0.5-0.6 × 0.3-0.5 mm, abruptly narrowed into the style, with a disk-like thickening uniting the carpels at the base, about 0.22-0.25 of the length, 0.1-0.2 mm high, of two separate carpels; style 3-4.5 × 0.15-0.2 mm; pistil head composed of a subglobose, stigmatic basal part, 0.2-0.4 × 0.2 × 0.25 mm and a conical stigmoid apex 0.3-0.5 × 0.1 mm, sometimes with a bilobed apex. Ovules 1(-2) in each carpel. *Fruits* orange, smooth; mericarps diverging at an angle of 90°, ob-

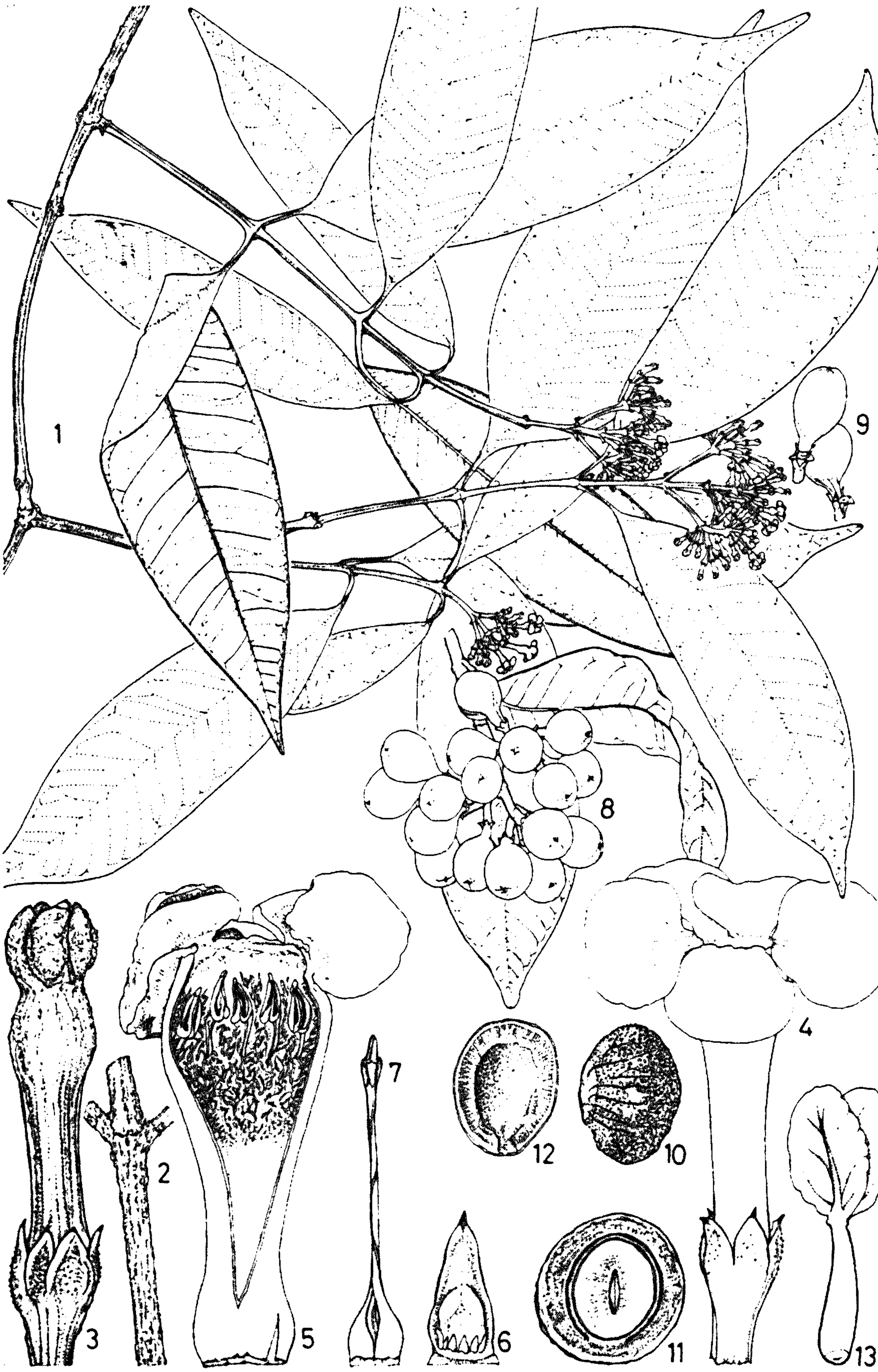
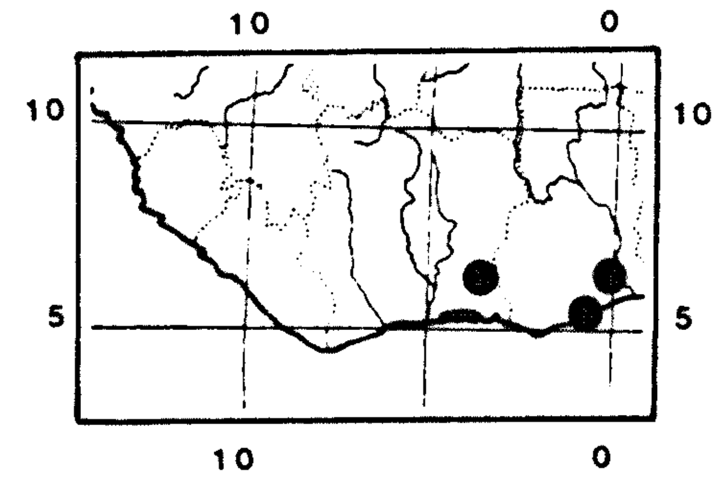


Figure 27. *Hunteria ghanensis*. **1**, habit (× 2/3); **2**, branch (× 2/3); **3**, flower bud (× 8); **4**, flower (× 8); **5**, opened corolla (× 8); **6**, sepal inside (× 16); **7**, pistil (× 8); **8-9**, fruits (× 2/3); **10**, seed (× 2); **11**, transverse section of seed (× 2); **12**, longitudinal section of seed (× 2); **13**, embryo (× 6). 1-3 from Leeuwenberg et al. 11208; 4-7 from Hall & Swain 43741; 8-13 from Hall GC 47044.



Map 5. *Hunteria ghanensis.*

ovoid, 10-15 × 10-12 × 9-11 mm, rounded at the apex, stipitate; 1-2-seeded; wall about 1-2 mm thick, slightly fibrous within. *Seeds* bean-shaped or ellipsoid, coated with a sticky mucilage when fresh, olive green and tinged with brown, pale-veined, smooth, 7-10 × 5-8 × 3-5 mm, testa smooth orange. Embryo 6-6.4 mm long; cotyledons ovate, 2-2.3 × as long as wide, 2.8-3 × 1.2-1.5 mm, obtuse at the apex, rounded at the base; radicle 0.8-1 × as long as cotyledons, 2.5-3 × 0.5-0.6 mm.

DISTRIBUTION. Ivory Coast and Ghana.

ECOLOGY. Dry forest or light secondary forest with an annual rainfall of 1000-1200 mm. Alt. 50-100 m. Flowering and fruiting between December and July in both countries.

USES. Bark together with that of *Croton zambesicus* Muell. Arg. and *Nauclea latifolia* Sm. taken as a medicine for stomach ache and difficult urination (Leeuwenberg 1979).

Specimens examined:

IVORY COAST. Abongoua Forest, *Aké Assi* 11222 (WAG).

GHANA. Central: Apam Junction, *Hall* GC 47044 (BR, K, MO, P, WAG, type); *Hall* GC 47045 (B, BR, K, MO, P, WAG); 2 km E of Apam Junction, *Leeuwenberg* 11164 (BR, MO, P, WAG); 1.7 km E of Apam Junction, *Hall & Swain* 43741 (K, MO, WAG). Eastern: near harbour of Akosombo, *Leeuwenberg* et al., 11208 (B, BR, MO, P, WAG).

CULTIVATED. Ivory Coast: Adiopodoume Bot. Garden, *Aké Assi* 7478 (WAG), 13763 (WAG).

2.5.6 **Hunteria hexaloba** (Pichon) Omino, **comb. nov.**

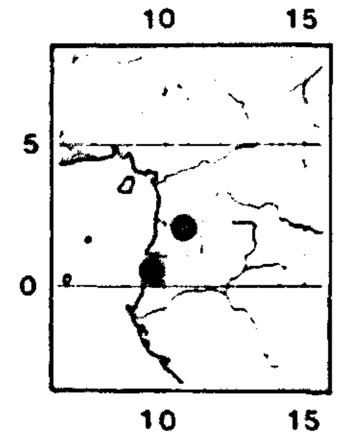
Fig. 28, p. 105; map 6, p. 106

Basionym:

Tetradoa hexaloba Pichon in Bull. Soc. Bot. France 93, 7-8: 252 (1946) & in Bull. Soc. Brot. sér. 2, 27: 122, t. III fig. 7, p.117; map C, p. 121 (1953). – Type: Gabon, *Klaine* 3158 (holotype P; isotype BR).

Shrub 1.6 m high. Trunk slender. Branchlets drying dark brown to greyish-black. *Leaves*: petiole 7-10 mm long; blade elliptic, 1.8-2.5 × as long as wide, 10.3-21 × 4.5-11.3 cm, acuminate at the apex, acumen acute or obtuse, 6-13 × 4-6 mm, acute to obtuse at the base; midrib prominent beneath; secondary veins very prominent

Figure 28. *Hunteria hexaloba*. **1**, habit (× 2/3); **2**, flower bud (× 4); **3**, sepal inside (× 30); **4**, opened corolla (× 4); **5**, pistil (× 4); **6**, pistil with opened ovary (× 30); **7**, infructescence (× 2/3). 1-6 from Klaine 3158; 7 from Trilles 118.



Map 6. *Hunteria hexaloba.*

beneath in dried leaves, curved, in 7-10 pairs, the lower veins reaching the margin without looping to join their neighbours, forming an angle of 55-65° with the costa, 13-30 mm apart at the approximate centre of the leaf. *Inflorescence* terminal, rarely axillary, 1.5-2 × 3-3.5 cm, about 10-20-flowered; peduncle 2-3 mm long; pedicels 3-6 mm long. Bracts very small. *Flowers*: *Sepals* pale green, free or connate at the base for about 0.2 of their length, membranaceous at the edge and the tip, thicker towards the middle and the base, erect and with resin within, ovate, 2.3 × as long as wide, 1.3-1.5 × 0.6-0.7 mm, acute at the apex, with rows of colleters inside up to 0.75 of their length; colleters small. *Corolla* reddish, 16-16.4 mm long in mature bud and forming a comparatively big ovoid head 0.56-0.57 of the bud length, 9-9.4 × 1-2 mm, with an obtuse apex, with a belt of pubescence 1-1.5 mm wide inside just below the insertion of the stamens and up to the mouth of the corolla tube, tube 4.6 × as long as the calyx, 0.9 × as long as the lobes, 6.5-7 mm long, almost cylindrical, 1 mm wide above the base, narrowed below the insertion of the stamens to 0.8 mm wide, again widened around the anthers to 1 mm wide; lobes narrowly oblong, twisted in mature bud, 1.2 × as long as the tube, 4.2 × as long as wide, 7.5 × 1.8 mm, obtuse at the apex, spreading and recurved later. *Stamens* with apex 2.5 mm below the mouth of the corolla tube, inserted 0.45 of the length of the corolla tube at 2.6-2.8 mm from the base; filaments 0.3-0.5 mm long; anthers narrowly ovate to oblong, 5.6 × as long as wide, 1.4-1.5 × 0.25-0.5 mm, obtuse at the apex, cordate at the base. *Pistil* 2.5-2.8 mm long; ovary subglobose, 0.3-0.5 × 0.3-0.5 × 0.2 mm, abruptly narrowed into the style, with a disk-like thickening uniting the carpels at the base, about 0.2 of the length, 0.1 mm high, of two separate carpels; style 1.7-1.8 mm long; pistil head composed of a subglobose stigmatic basal part 0.4 × 0.2 mm and conical stigmoid apex 0.2 × 0.1 mm. Ovules 6 in each carpel. *Fruits* red, smooth, of two separate mericarps; mericarps ellipsoid, 25-27 × 18-20 × 8-10 mm, acuminate at the apex, acumen 6 × 4 mm, about 4-seeded; wall about 4 mm thick; pulp fibrous. *Seeds* obovate to oblong, 16-17 × 11-12 × 6-7 mm, testa smooth, orange. Embryo 9.5 mm long; cotyledons obovate, 1.4-1.7 × as long as wide, 3.5-5 × 2.5-3 mm, rounded at the apex, rounded to obtuse at the base; radicle 0.8-0.9 × as long as cotyledons, 3-4 × 0.8 mm.

DISTRIBUTION. Gabon.
ECOLOGY. Forest. Alt. 0-100 m. Flowering in November.

Specimens examined:

GABON. Estuaire: near Libreville, *Klaine* 3158 (holotype P, isotype BR), Trilles *118* (P, paratype).

2.5.7 Hunteria macrosiphon Omino, sp. nov.

Arbuscula gracilis foliis laminis anguste ellipticis papyraceis apice caudatis venis submarginalis. Inflorescentia terminalis vel rariter axillaris. Flores odorantes. Sepala libera erecta ovata vel triangularia. Corolla laete lutea extus glabra intus pro parte pubescens tubo angusto lobis patentibus. Stamina inclusa filamentis brevisbus filiformis glabris antheris ovatis vel oblongis apice obtusis basi subcordatis glabris. Ovarium ovoideum carpellis duabis separatis. Fructus luteus laevis mericarpiis duabus obovatus divaricatus. Semina ellipsoidea. – Type: Gabon, near Lastoursville, *Le Testu* 7085 (holotype BR, isotypes B, M, P, LISC).

Fig. 29, p. 108; map. 7 p. 109

Etymology: μακρός= long, σίφων= siphon, referring to the long corolla tube.

Slender erect shrub 1-4 m high, with a little white latex. Trunk slender. Branchlets quadrangular, green. *Leaves* opposite; petiole 5-8 mm long; blade papery when fresh, elliptic to oblong, 2.4-3.2 × as long as wide, 5.6-19.5 × 1.8-6.4 mm, caudate at the apex, acumen obtuse, 13-25 × 2-3 mm, acute to obtuse at the base; midrib prominent beneath; secondary veins prominent beneath in dried leaves, slightly curved, in 9-14 pairs, forming a submarginal vein and an angle of 65-75° with the midrib, 8-13 mm apart at the approximate centre of the leaf. *Inflorescence* in 1(-3) terminal, umbellate cymes, 1.5-3 × 1-3.5 mm, each 6-15-flowered; sessile or with a peduncle 2-9 mm long; pedicels 1-4 mm long. Bracts very small, sepal-like. *Flowers* fragrant. *Sepals* free, erect, membranaceous, ovate to triangular, 1-2.5 × as long as wide, 0.7-1.1 × 0.3-0.7 mm, acute at the apex, with colleters sparsely distributed inside on the side; colleters small. *Corolla* bright yellow, 11.7-14.3 mm long in mature bud and forming a comparatively small ovoid head 0.25-0.36 mm of the bud length, 2.9-6 × 0.7-1.8 mm, with an acute apex, with a belt of pubescence 1.2-3.5 mm wide inside just below the insertion of the stamens and up to the mouth of the tube; tube 10-13 × as long as the calyx, 1.8-3.9 × as long as the lobes, 9-13 mm long, almost cylindrical, 0.7-1.1 mm wide above the base, narrowed below the insertion of the stamens to 0.7-1.5 mm wide, again widened around the anthers to 1-2 mm wide; lobes ovate, not twisted in bud, 0.3-0.6 × as long as the tube, 1.6-2.5 × as long as wide, 2.8-6.5 × 1.8-3 mm, obtuse at the apex, entire, spreading and recurved later. *Stamens* with apex 0.5-1.2 mm below the mouth of the corolla tube, inserted 0.75-0.85 mm of the length of the corolla tube, at 7-9.8 mm from the base; filaments 0.4-0.6 mm long; anthers ovate 4-5.7 × as long as wide, 1-1.9 × 0.2-0.3 mm, obtuse, cordate at the base. *Pistil* 8.8-10.8 mm long; ovary ovoid, 0.8-1.4 × 0.5-1 × 0.3-0.7 mm, abruptly narrowed into the style, with a disk-like thickening uniting the carpels at the base, about 0.2-0.3 of the length, 0.2 mm high, of two separate carpels; style 5.5-8 × 0.2 mm; pistil head composed of a subglobose stigmatic basal part, 0.2-0.5 × 0.2-0.3 mm and a conical stigmoid apex 0.3-0.7 × 0.1-0.2 mm. Ovule 1 in each

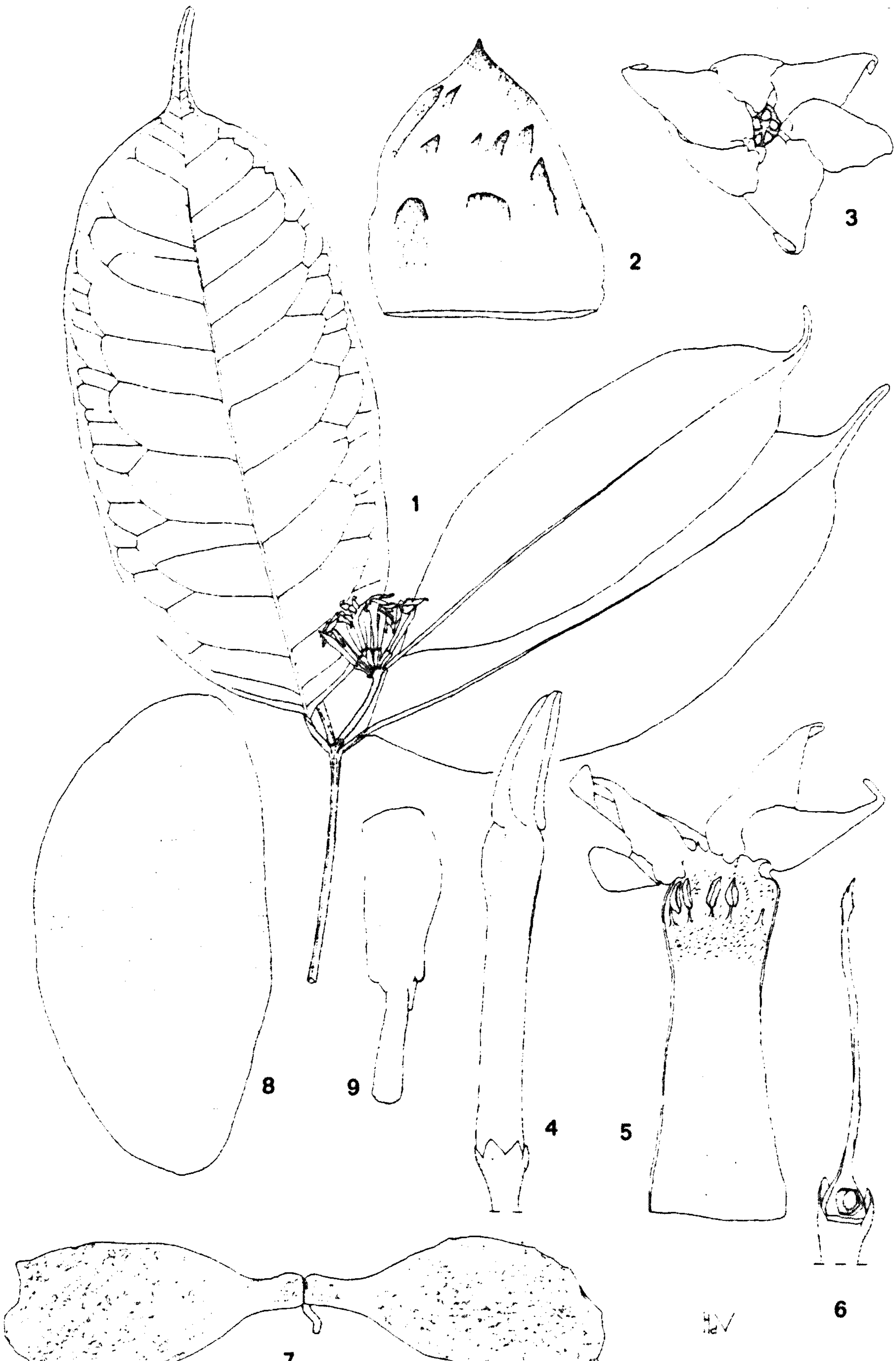
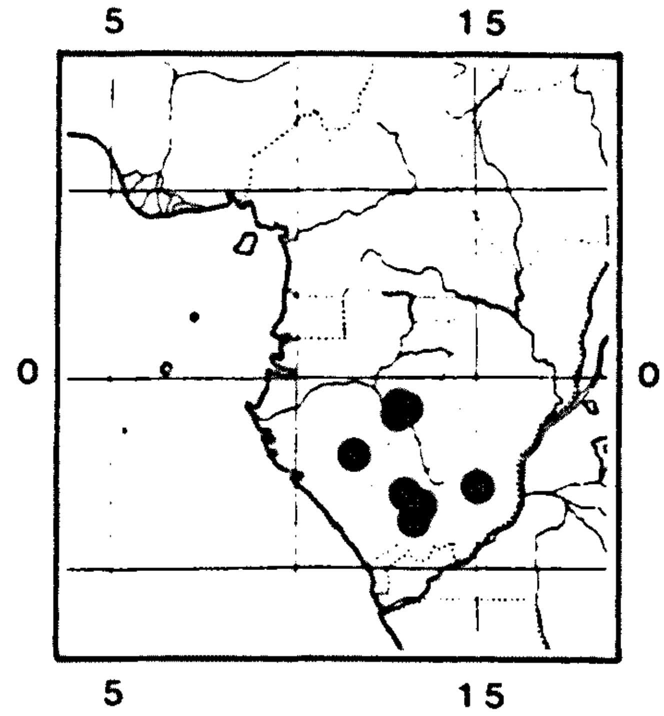


Figure 29. *Hunteria macrosiphon*. **1**, habit (× 2/3); 2, sepal inside (× 30); **3**, flower above (× 4); **4**, flower bud (× 4); **5**, opened corolla (× 4); **6**, pistil with opened ovary (× 4); **7**, fruit (× 2); **8**, longitudinal section of seed (× 4); **8**, embryo (× 4). 1-6 from Breteler et al. 9934; 7-9 from Breyne 4131.



Map 7. *Hunteria macrosiphon*.

carpel. *Fruits* yellow, smooth, of two divaricate mericarps, divergent at an angle of 180°, mericarps obovate or ellipsoid, slightly stipitate, 15-20 × 9-12 × 5-10 mm, with an obtuse apex, 1-seeded; wall about 2 mm thick; pulp smooth. *Seeds* ellipsoid, 11 × 5-6 × 4-5 mm. Embryo 6.8-7 mm long; cotyledons obovate, 1.9-2.7 × as long as wide, 3.5-4 × 1.5-1.8 mm, rounded at the apex and at the base; radicle 0.8-0.9 × as long as cotyledons, 3-3.3 × 0.5-0.6 mm.

DISTRIBUTION. Gabon and Congo.

ECOLOGY. In rain forest and secondary forest in Congo. Flowering in March-April and fruiting between November to July.

Specimens examined:

GABON. Ogooué-Lolo: 30 km NE of Lastoursville, *Breteler* 9920 (WAG), 9934 (WAG), 9867 (WAG); 30 km E of Lastoursville, *Breteler et al.* 11267 (WAG), 11351 (WAG); 6 km E of Lastoursville, *Van der Maesen* et al. 5534 (WAG); Lastoursville, *Le Testu* 7085 (BM, BR, P, LISC, type), 24-2-1930 (BR, BM, MO), 4.3.1931 (BM, BR, LISC). Woleu Ntem: 35 km on road from Lebamba to Yeno, *J. de Wilde & Sosef* 10454 (WAG).

CONGO. Komono, *Breyne* 4131 (BR); 25 km W of Sibiti, *Farron* 4362 (P); Loundji, Attims 98 (P); Mbaya Forest, *Sita* 4048 (P).

Note. The sepals are membranaceous and colleters are sparsely distributed on the inner side as opposed to the other species where the colleters cover at least half of the lower part of the sepals.

2.5.8 Hunteria myriantha Omino, sp. nov.

Frutex vel arbor parva. Folia opposita petiolata laminis ellipticis breviter acuminatis. Inflorescentia terminalis laxa. Sepala pallide viridia libera triangularia apice acute usque ad acuminata. Corolla rubra tubo lobis ovatis longiore. Stamina inclusa antheris anguste ovatis apice obtusis basi cordatis. Pistillum ovario carpellis duabus separatis. Fructus ignotus. – Type: Zaire, Kasai-Occidental, Kakenge, *Dechamps* 5 (holotype BR; isotypes MO, WAG).

Fig. 30, p. 110; map 8, p. 111

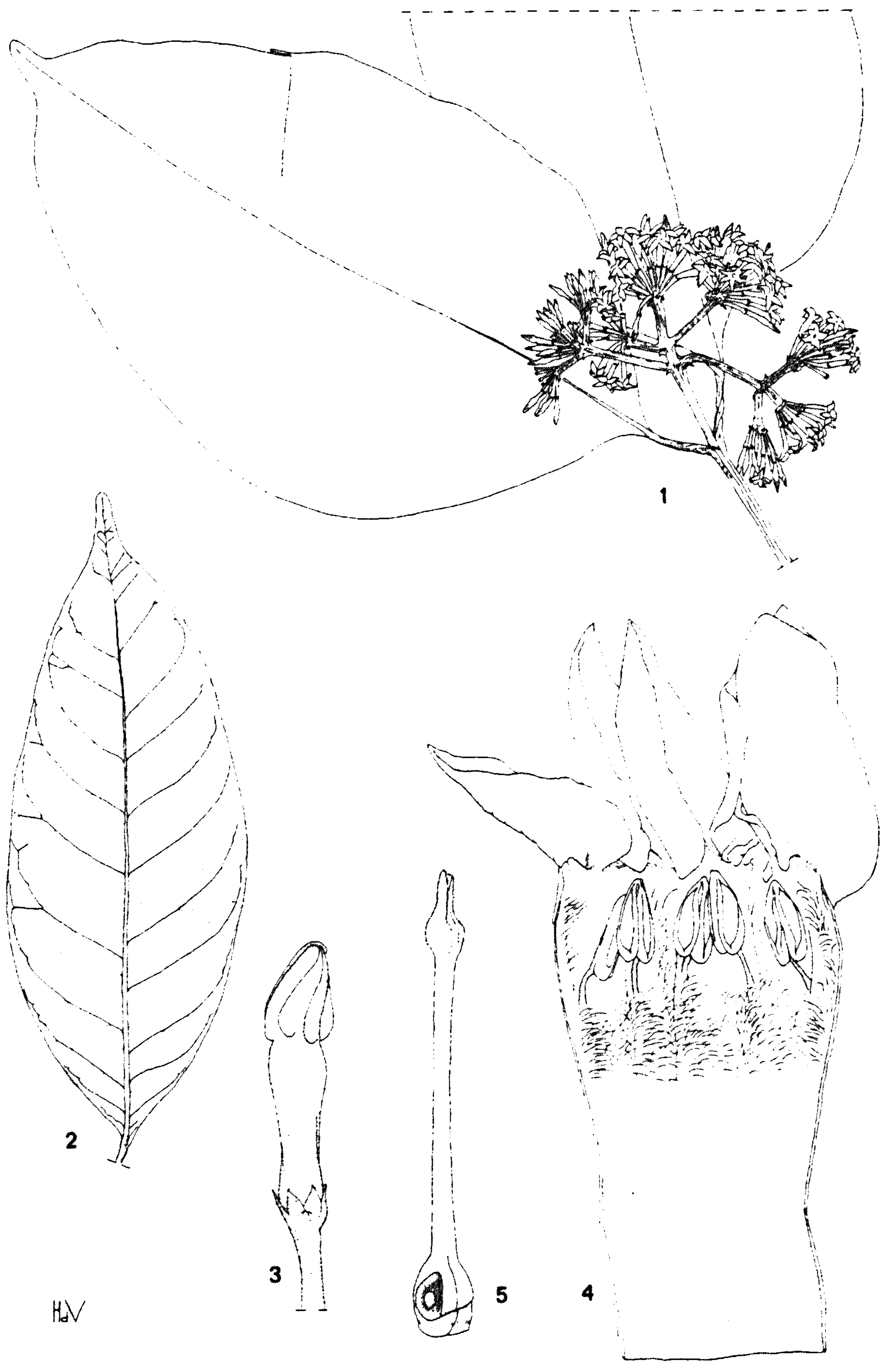
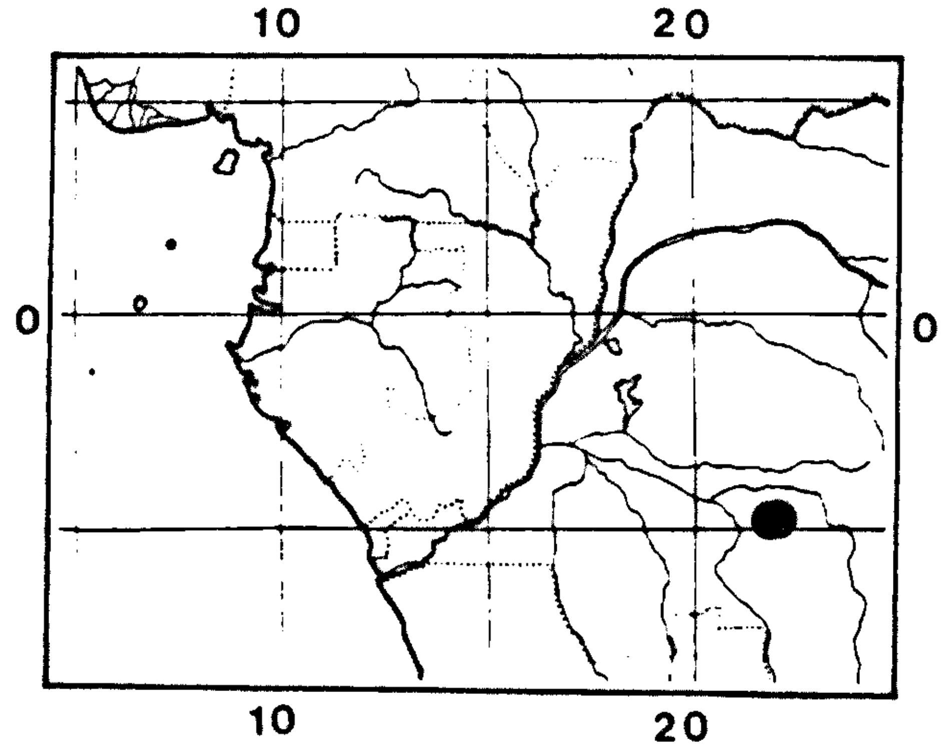


Figure 30. *Hunteria myriantha*. **1**, habit (× 2/3); **2**, leaf beneath (× 2/3); **3**, flower bud (× 4); **4**, opened corolla (× 12); **5**, pistil with opened ovary (× 12). 1 from Dechamps 5; 2 from Dechamps 242; 3-5 from Declercq 32.



Map 8. *Hunteria myriantha.*

Etymology: μυϱἰος, myrios, very many; ἄνθος, anthos= flower, referring to the many flowered inflorescence.

Shrub or small tree 2-14 m high with scanty, white, sticky latex. Trunk straight, 21-25 cm in diameter; outer bark greyish black, patched pale brownish yellow, 1 mm thick; inner bark orange brown, 4 mm thick. *Leaves* opposite; petiole 10-13 mm long; blade elliptic, 1.7-3.2 × as long as wide, 6-20 × 3.2-8.3 shortly acuminate at the apex, acumen obtuse, 5-14 × 2-5 mm, acute at the base; midrib prominent below in dried leaves; secondary veins oblique, obscure above, in 7-12 pairs, reaching the margin without looping to join their neighbours and forming an angle of 50-60° with the midrib, 10-18 mm apart at the approximate centre of the leaf. *Inflorescence* terminal, lax, in umbellate cymes, 1 or 2 × branched, 4.5-6.5 × 4-7 cm, 30-160-flowered; peduncle 13-32 mm; branches 5-18 mm; pedicels 2-3 mm. *Flowers: Sepals* pale green, free, erect, triangular, membranaceous, 1.1-2.2 × as long as wide, 0.7-1.1 × 0.4-0.5 mm, acute to acuminate at the apex and without colleters inside. *Corolla* red, 7.7-8.3 mm long in mature bud and forming a comparatively small ovoid head 0.3-0.4 of the bud length, 2.5 × 0.8 mm, with an obtuse apex, with a belt of pubescence 1.2-2 mm wide inside just below the insertion of the stamens and sometimes up to the mouth of the corolla tube; tube 4.7-7.9 × as long as the calyx, 1.4-2 × as long as the lobes, 5.2-5.8 mm long, almost cylindrical, 0.8-1 mm wide above the base, narrowed below the insertion of the stamens to 0.7-0.9 mm wide, again widened around the anthers to 1-1.3 mm wide; lobes ovate, 0.6-0.7 × as long as the tube, 1.7-2.4 × as long as wide, 2.8-3.9 mm, obtuse at the apex, entire and spreading. *Stamens* with apex 0.2-0.5 mm below the mouth of the corolla tube, inserted 0.77-0.82 of the length of the corolla tube at 4-4.5 mm from the base; filaments 0.4-0.5 mm long; anthers narrowly ovate, 2-4 × as long as wide, 0.6-1 × 0.2-0.3 mm, obtuse at the apex, cordate at the base. *Pistil* 4.8-5.5 mm long; ovary subglobose 0.5-0.8 × 0.4-0.7 × 0.25-0.4 mm, abruptly narrowed into the style, with a disk-like thickening uniting the carpels at the base, about 0.3 of the length, 0.4 mm high, of two separate carpels; style 3.2-4 mm long; pistil head with a stigmatic ellipsoid basal part

0.4-0.6 × 0.2 mm and a stigmoid apex 0.4-0.6 × 0.15 mm. Ovule 1 in each carpel. *Fruits* unknown.

DISTRIBUTION. Zaire.
ECOLOGY. Secondary forest. Alt. 520 m. Flowering between January and April.

Specimens examined:
ZAIRE. Kasai-Occidental: Benalongo, *Declerq* 32 (BR); Kakenge, *Dechamps* 5 (BR, WAG), 139 (BR), 242 (BR, MO, WAG).

Note. This species is very close to *H. densiflora* and *H. ghanensis*, and can be differentiated as follows:

1. Corolla lobes wider than long .... **H. ghanensis**
   Corolla lobes longer than wide **2**
2. Secondary veins oblique, in 7-12 pairs, reaching the margin without looping to join their neighbours, forming an angle of 50-60° with the costa; sepals without colleters; inflorescence lax .... **H. myriantha**
   Secondary veins straight, closely spaced, in 22-30 pairs, forming an angle of 70-80° with the costa; sepals with colleters within; inflorescence dense .... **H. densiflora**

2.5.9 Hunteria oxyantha Omino, sp. nov.

Arbuscula rarius scandens. Folia laminis papyraceis ellipticis vel oblongis apice acuminatis. Inflorescentia terminalis vel axillaris pauciflora. Sepala pallide viridia basi connata erecta ovata vel elliptica margine mebranacea apice rotundata vel obtusa. Corolla sordide alba extus glabra intus pro parte pubescens tubo cylindraceo lobis erectis. Stamina inclusa filamentis brevibus filiformibus glabris antheris fere ellipticis glabris. Ovarium subglobosum carpellis duabus. Fructus luteus vel aurantiacus laevis mericarpiis duabus divaricatis ellipsoideis. Semina ellipsoidea. – Type: Gabon, Ogooué-Lolo, 40-50 km SEE of Lastoursville, *Breteler* et al. 11299 (holotype WAG).

Fig. 31, p. 113; map 9, p. 114

Etymology: ὀξῦς, oxus, acute, ἄνθος, anthos, flower, referring to the acute apex of the flower bud.

Tree or shrub 1.5-18 m high, rarely a climber. Trunk up to 30 cm in diameter; bark rough, green grey with white spots of lichen, 8 mm thick, hard, brittle, bright yellow underneath; wood hard, dense, very brittle, with twisted fibres, lemon-yellow. Branches greyish-black, finely striate. *Leaves* opposite; petiole 4-6 mm long; blade papery to coriaceous when fresh, elliptic to oblong, 2.3-3 × as long as wide, 3.7-12.8 × 1.3-4.6 cm, acuminate at the apex, acumen obtuse, 4-19 × 2-3 mm, acute to obtuse at the base; midrib slightly prominent beneath; secondary veins straight,

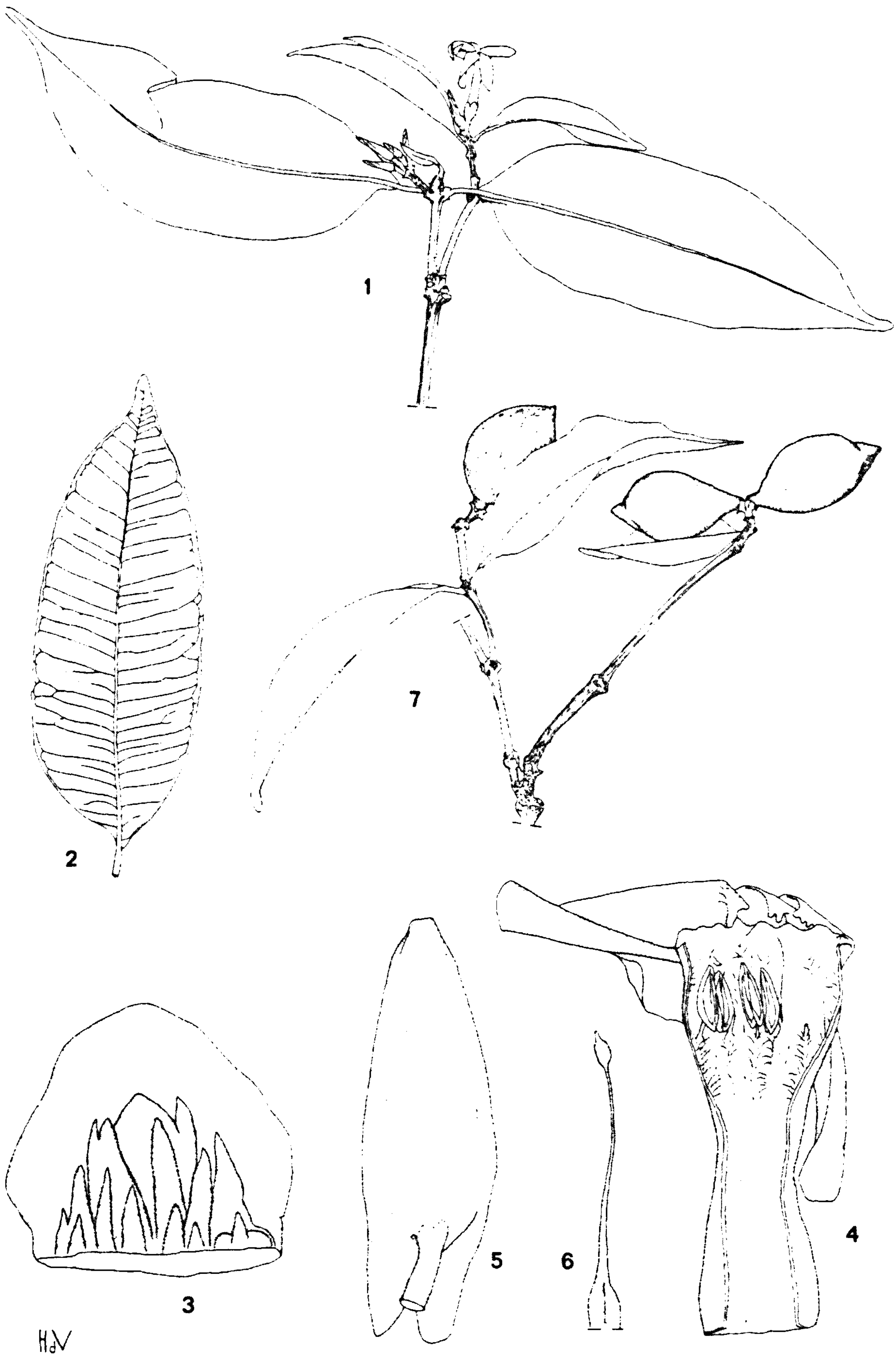
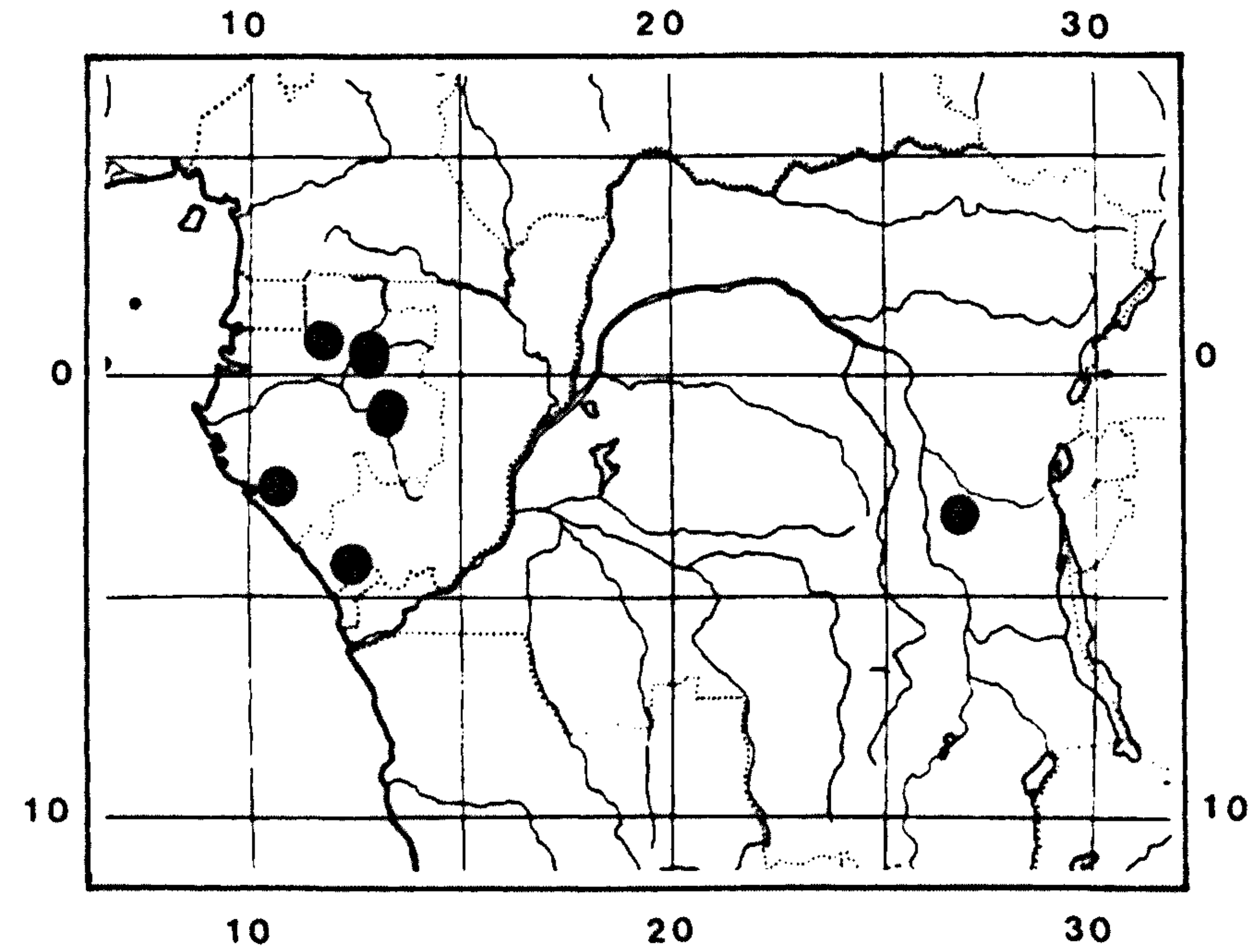


Figure 31. *Hunteria oxyantha.* **1**, habit (× 2/3); **2**, leaf beneath (× 2/3); **3**, sepal inside (× 30); **4**, opened corolla (× 4); **5**, stamen outside (× 30); **6**, pistil (× 4); fruiting branch (× 2/3). 1-7 from Breteler et al. 11299.



Map 9. *Hunteria oxyantha*.

slightly prominent beneath, in 15-25 pairs, forming a submarginal vein and an angle of 75-80°with the midrib, 3-6 mm apart at the approximate centre of the leaf. *Inflorescence* terminal or axillary, 2-3 × 1-2 cm, 1 × branched, 6-10-flowered; peduncle 1-11 mm long; primary branches, 2-10 mm long; pedicels 4-6 mm long. Bracts sepal-like, 0.5-1 × 0.4-0.5 mm. *Flowers*: *Sepals* pale green, free, erect, membranaceous at the edge and the apex, thicker towards the middle and at the base, with much resin within, ovate, 1-2.1 × as long as wide, 1-1.3 × 0.6-1.1 mm, obtuse to acute at the apex, with rows of colleters inside up to 0.75 of their length; colleters very small 0.2 × 0.1 mm. *Corolla* white to dirty white, red in bud, 15-15.5 mm long in mature bud and forming a comparatively small ovoid head, 0.35-0.43 of the bud length, 5.5-6.5 × 0.7-1.6 mm, with an acute apex, with a belt of pubescence 1.5-2 mm wide inside just below the insertion of the stamens, tube 8.6-9.5 × as long as the calyx, 1.5 × as long as the lobes, 9.5-12 mm long, almost cylindrical, 0.8-1.5 mm wide above the base, narrowed below the insertion of the stamens to 0.7-0.9 mm wide, again widened around the anthers to 1.5-2 mm wide; lobes oblong, 0.7 × as long as the tube, 2.9-3.8 × as long as wide, 7.5-7.9 × 2-2.7 mm, obtuse at the apex, spreading and recurved later. *Stamens* with apex 1 mm below the mouth of the corolla tube, inserted 0.73 mm of the length of the corolla tube, at 8.8 mm from the base; filaments 0.4-0.5 mm long; anthers almost elliptic, 4-4.5 × as long as wide, 1.8-2 × 0.4-0.5 mm, obtuse at the apex cordate at the base. *Pistil* 7.3-8.5 mm long, with apex halfway along the anthers; ovary subglobose, 1-1.4 × 0.6-0.7 × 0.3-0.7 mm, gradually narrowed into the style, with a disk-like thickening uniting the carpels at the base, about 0.3 of the length, 0.2-0.4 mm high; of two separate carpels; style 5.3-6 mm; pistil head composed of a globose to ellipsoid stigmatic basal part 0.5-0.7 × 0.3-0.4 and a bifid stigmoid apex 0.4-0.5 × 0.15-0.2 mm. Ovules 6-7 in each carpel. *Fruits* yellow to orange, smooth, mericarps ellipsoid, 28-35 × 20-26 × 15-20 mm, bluntly acuminate to rounded at the apex, acumen 4-6 mm, 3-7-seeded; wall about 1 mm thick; pulp slightly fibrous. *Seeds* oblong or ellipsoid, 12-14 × 8-

10 × 4-6 mm, testa smooth, orange. Embryo 7.5 mm long; cotyledons ovate, 1.5-1.6 × as long as wide, 3.8-4 × 2.5 mm, obtuse at the apex, rounded at the base; radicle 0.9-1 × as long as cotyledons, 3.5-3.7 × 0.8-1 mm.

DISTRIBUTION. Gabon, Congo and Zaire.

ECOLOGY. Old secondary forest or forest bordering savannah on humid rocks or river banks. Flowering and fruiting between May and September. Alt. 480 m.

Specimens examined:

GABON. Woleu-Ntem: Chantier Oveng, *A. M. Louis* 2101 (WAG). Ogooué-Ivindo: Mpassa Field Station, *Florence* 584 (P), 614 (P), *Caballé* 365 (WAG), near Makokou, *Gentry* 33027 (MO), 33177 (MO), 33264 (MO); 33506 (MO, WAG), *Gentry & Emmons* 33736 (MO). Ogooué-Lolo: 9 km E of Ndambi, *Breteler* et al. 13233 (WAG); 40-50 km SEE of Lastoursville, *Breteler* et al. 11229 (WAG, type). Nyanga: 25 km SSW of Doussala, *Reitsma* et al. 976 (WAG).

CONGO. Kouilou: Les Saras, *Sita* 1361 (P).

ZAIRE. Kivu: Maniema, Pangi, *Michelson* 85 (BR).

2.5.10 **Hunteria simii** (Stapf) H. Huber

in Kew Bull. 15: 437 (1962) & in Fl. W. Trop. Afr. ed. 2, 2: 62 (1963). Type: Liberia, Sino District, *Sim* 16 (holotype, K).

Fig. 32, p. 116; map 10, p. 117

Basionym and homotypic synonyms:

Polyadoa (?) simii Stapf in H. H. Johnstone, Liberia, 2: 624 (1906). *Pleiocarpa simii* (Stapf) Hutch. & Dalz. in Fl. W. Trop. Afr. ed. 1, 2: 38 (1931); *Tetradoa simii* (Stapf) Pichon in Bol. Soc. Brot. sér. 2: 120; p. 117 t. 3, fig 4-6; map C, p. 21 (1953).

Tree or shrub 0.3-8 m high, rarely climber 1 m high with white sticky latex. Trunk slender, slash creamish-yellow; branches greenish grey, branchlets greyish-brown to green, with a few lenticels. *Leaves* opposite; petiole 4-9 mm long; blade coriaceous or papery when fresh, smooth, ovate to elliptic, 2.2-2.8 × as long as wide, 5.5-19.2 × (1.8-) 3.8-7.4 cm, acuminate at the apex, acumen obtuse, 6-23 × 2-3 mm, acute at the base; midrib prominent beneath, slightly channelled above, secondary veins oblique, slightly prominent beneath, in 7-9 pairs, forming an angle of 55-56° with the midrib, 18-30 mm apart at the central part of the leaf. *Inflorescence* terminal or axillary, 2-4.5 × 0.5-3 cm, 1-10 flowered; peduncle 2-10 mm, primary branches 2-10 mm; pedicels 5-6 mm long. Bracts 0.7-1.3 mm. *Flowers*: *Sepals* pale green, almost free, erect, membranaceous at the edge, thicker towards the middle and at the base, coated with resin within, ovate 1.4-1.6 × as long as wide, 1-1.3 × 0.7-0.4 mm, acuminate at the apex, with rows of colleters inside up to 0.8 of their length; colleters very small 0.2 × 0.1 mm. *Corolla* cream-coloured, 16-23.7 mm long in mature bud and forming a comparatively large ovoid, sometimes falcate head, 0.38-0.5 of the bud length, 7-11.2 × 1.3 mm, with an acute apex; with a belt of pubes-

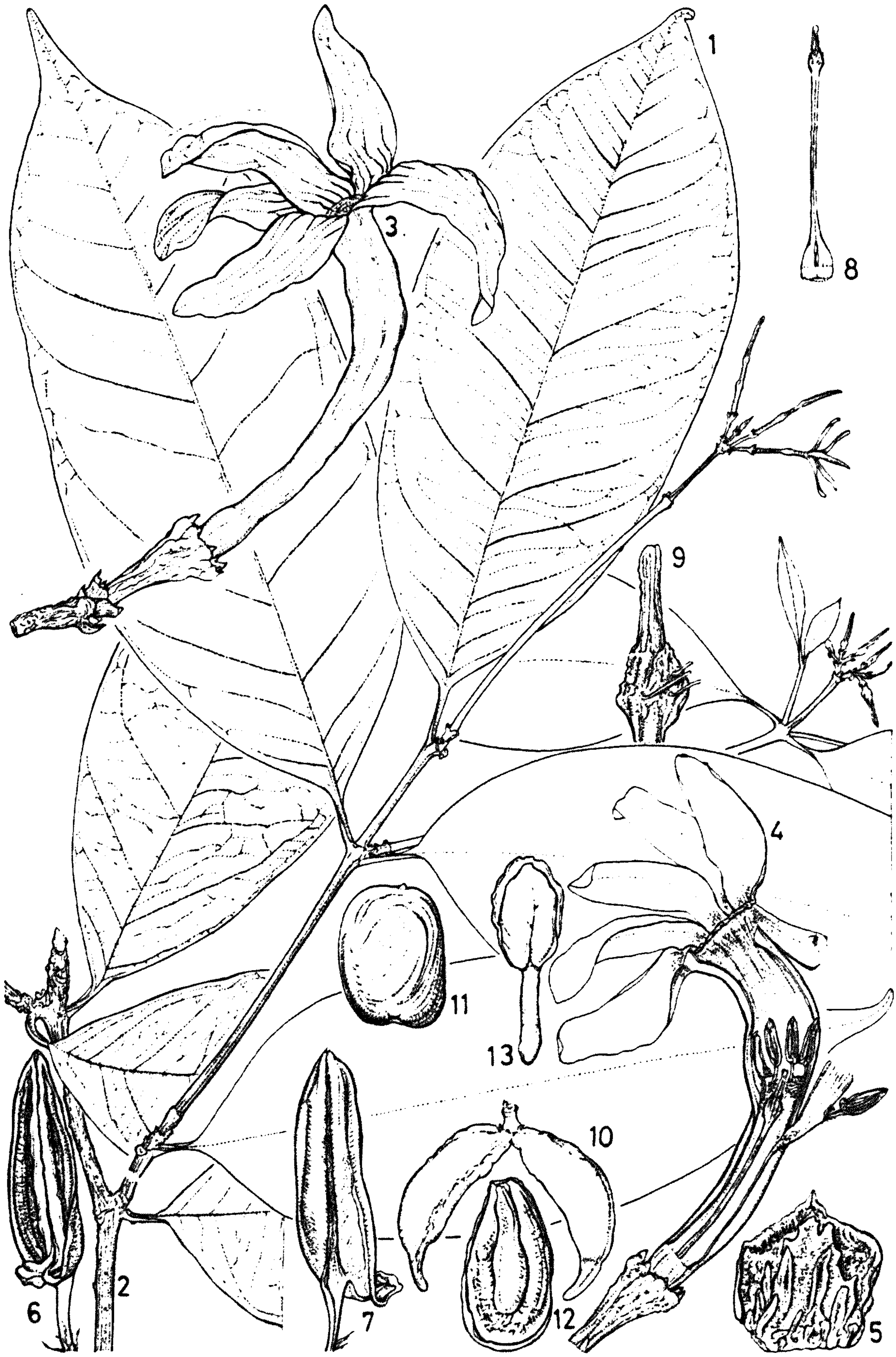
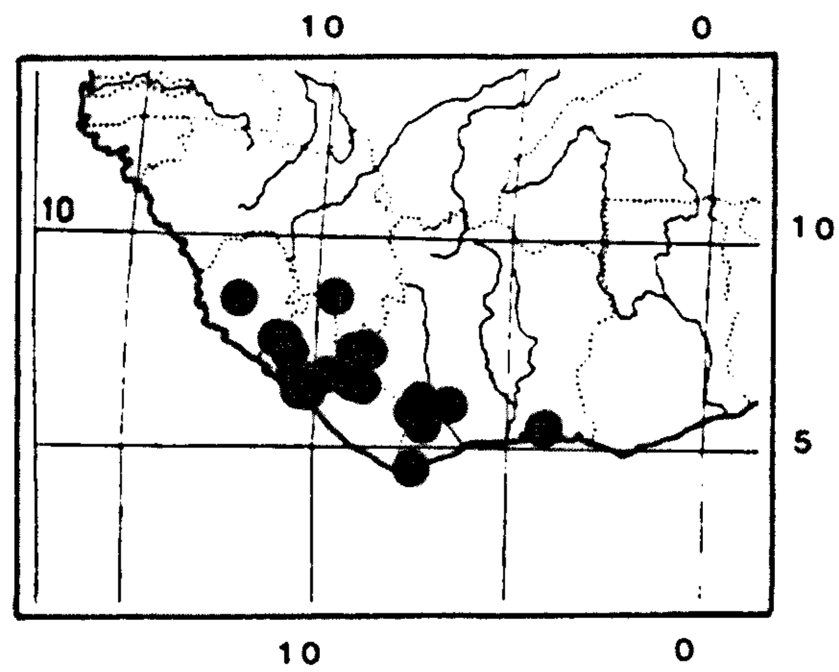


Figure 32. *Hunteria simii*. **1-2**, habit (× 2/3); **3**, flower (× 4); **4**, opened flower (× 4); **5**, sepal inside (× 20); **6-7**, stamen in- and outside (× 20); **8**, pistil (× 20); **10**, fruit (× 2/3); **11**, seed (× 2); **12**, longitudinal section of seed (× 2); **13**, embryo (× 4). 1-2 and 10-13 from Breteler 7388; 3-9 from Van Meer 464.



Map 10. *Hunteria simii.*

cence 1-1.2 mm wide inside just below the insertion of the stamens, tube greenish-white, 13-18 × as long as the calyx, 1-2.3 × as long as the lobes, 12.5-18.5 mm long, almost cylindrical, 0.8-1.7 mm wide above the base, narrowed below the insertion of the stamens to 0.5-1.3 mm wide, again widened around the anthers to 1-1.8 mm wide; lobes narrowly ovate to oblong, 0.4-1 × as long as the tube, 3.6-6.7 × as long as wide, 7-12 × 1.8 mm, obtuse at the apex, entire, spreading. *Stamens* with apex 3.2-3.7 mm below the mouth of the corolla tube, inserted 0.48-0.62 of the length of the corolla tube, at 6-8 mm from the base; filaments 0.4-0.5 mm long; anthers narrowly ovate to oblong, 4.8-5.3 × as long as wide, 1.6-1.9 × 0.3-0.4 mm, obtuse at the apex subcordate at the base. *Pistil* 6.5-7.8 mm long; ovary subglobose, 1.0 × 0.5-0.7 × 0.3-0.4 mm, abruptly narrowed into the style, with a disk-like thickening uniting the carpels at the base, about 0.2 of the length, 0.2-0.3 mm high; of two separate carpels; style 6-7 × 0.25 mm; pistil head composed of an ellipsoid stigmatic basal part 0.5-8 × 0.2-0.3 mm and a bifid stigmoid apex 0.4-0.6 × 0.1-0.2 mm. Ovules 6 in each carpel. *Fruits* yellow to orange, smooth, of two divaricate follicles, oblong, 37-60.5 × 10-18 × 10-13 mm, produced into a long slender beak at the apex, beak 6-15 × 2-3 mm, 5-6-seeded; wall about 1 mm thick; pulp smooth. *Seeds* oblong or ellipsoid, 11.5-15 × 6.5-8.5 × 5.5-6.5 mm, testa smooth, orange. Embryo 6-8.5 mm long; cotyledons ovate, thin and leafy, 2.2-4 × as long as wide, 3-4 × 1-1.8 mm, obtuse at the apex, rounded at the base; radicle 0.8-1.1 × as long as cotyledons, 3-4.5 × 0.5-0.6 mm.

DISTRIBUTION. Guinea, Sierra Leone, Liberia and Ivory Coast.

ECOLOGY. Dense forest or old secondary forest. Flowering from February to July and fruiting all the year round in all four countries. Alt. 0-450 m.

Geographical selection of the approximately 40 specimens examined:

GUINEA. Nzérékoré: Macenta, Koyama, *Adam* 59 (MO).

SIERRA LEONE. Yonibana, *N. W. Thomas* 4764 (K); Gola Forest, block III, *Small* 539 (K), 649 (K); Kambui Forest Reserve, *Jordan* 2037 (K).

LIBERIA. Genna Tanyehun, *Baldwin Jr.* 10736 (K); Mecca, *Baldwin Jr.* 10443 (K); 8 km N of Bomi Hills, *Jansen* 2282 (WAG); Dukwia R., *Cooper* 169 (K); Firestone Plantations, S of Kakata, *Stoop-van de Kasteele* 38 (WAG); Harbel Forest, *Bos* 2028 (WAG); Belafani, *Daniel* 238 (MO); Ganta, *Baldwin Jr.* 12561 (K, MO); 10 km N of Tappeta, *Van Meer* 464 (WAG); Yeképa, Mt. Nimba, *Adam* 21395 (MO, UPS); Sanikwele (= Sanniquellie), *Baldwin Jr.* 9460 (K); Tappeta, *Adam* 30299 (MO); sin. loc., *Sim* 16 (K, holotype).

IVORY COAST. 13 km NW of Tabou, *Breteler* 7388 (WAG); 14 km NW of Tabou, *Breteler* 7398 (WAG); Fort Binger (= Djiroubou), *Chevalier* 19535 (P); Taï Forest, *De Namur* 1423 (WAG); Kéeta, *Chevalier* 19311 (P, K), *Chevalier* 19367 (P); Zozoro R., *Chevalier* 19036 (P); Téké Forest, *Bamps* 2304 (BR, P), 2388 (BR, P).

CULTIVATED. Nigeria: Akampa Rubber Estate, *Latilo* 196 (K) (= FHI 40918 (A)).

2.5.11 Hunteria umbellata (K. Schum.) Hall. f.

in Jahrb. Hamb. Wiss. Anst. 17, 3 Beih., 190 (1900); Pichon in Bull. Soc. Brot. sér. 2, 27: 99, t. fig. map A, p. 85 (1953). – Type: Cameroun, Lolodorf, *Staudt* 130, (holotype B †; lectotype K, designated here; isotypes, A, COI, E, P, PRE, Z).

Fig. 33, p. 119; map 11, p. 120

Basionym and homotypic synonyms:

Carpodinus umbellata K. Schum. in Engler, Bot. Jahrb. 23: 221 (1896); Pierre in Bull. Soc. Linn. Paris 38, (1898). *Polyadoa umbellata* (K. Schum.) Stapf in Fl. Trop. Afr. 4, 1: 103 (1902). *Picralima umbellata* (K. Schum.) Stapf in Kew Bull. 1908: 302 (1908).

Heterotypic synonyms:

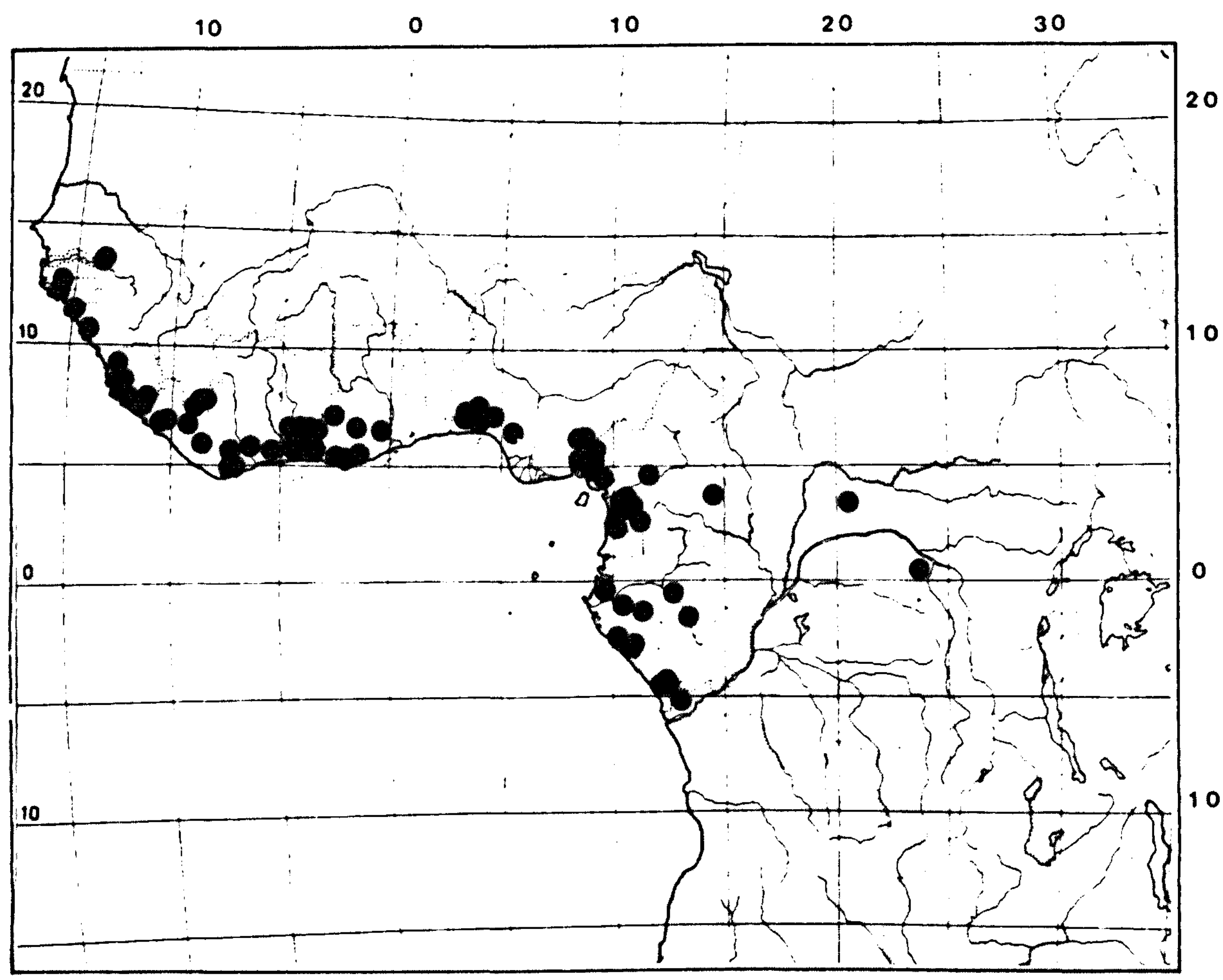
Polyadoa elliotii Stapf in op. cit. 104; Pichon in Mem. Mus. Natn. Hist. Nat. sér. 2, 24: 174 (1948). *Picralima elliotii* (Stapf) Stapf in Kew Bull. 1908: 302 (1908). *Hunteria elliotii* (Stapf) Pichon in Bol. Soc. Brot. sér. 2, 27: 97, t. 1 fig. 5-8; map A, p. 85 (1953), **syn. nov.** – Type: Sierra Leone, near Makunde, Limba, *Scott Elliot* 5690 (lectotype K, designated by Pichon in 1953).

Hunteria eburnea Pichon in Bol. Soc. Brot. sér. 2, 27: 91, t.1 fig 1; map A (1953), **syn. nov.** – Type: Ivory Coast, Danir, between Yaou and Ayiame, *Chevalier* 17766, (holotype P; isotypes K, P, MO, WAG).

Hunteria mayumbensis Pichon in Bol. Soc. Brot. sér. 2, 27: 95, t.1 fig. 2-4; map A (1953), **syn. nov.** – Type: Gabon, Mayumbe Bayaka, Inganga, *Le Testu* 1744 (holotype P; isotypes BR, K, NY, L).

Tree or shrub 1.5-22 m high, with a dense leafy crown. Trunk sinuous or straight, fluted, (3-)10-40 cm in diameter; outer bark grey to dirty brown, rough or smooth, 1 mm thick; inner bark 3-4 mm thick, white with orange stripes or spots; wood very hard, creamy, brown to yellow or orange. Branches greyish to dark brown; branchlets pale green, smooth. *Leaves* opposite; petiole 8-25 mm long; blade, thin, soft, leathery, subcoriaceous when dried, elliptic to oblong, 1.9-3.4 × as long as wide, 5.8-22.5 × 2-11 cm, obtuse to acuminate at the apex, acumen obtuse or acute, 5-18 × 3-7 mm, acute to obtuse at the base or decurrent into the petiole, midrib deeply channelled above, prominent beneath; secondary veins prominent beneath, more or less straight, in 13-25 pairs, forming a submarginal vein and an angle of 65-

Figure 33. *Hunteria umbellata.* **1**, habit (× 2/3); **2**, leaf beneath (× 2/3); **3**, flower bud (× 4); **4**, flowers (× 4); **5**, opened corolla (× 6); **6**, sepal inside (× 14); **7**, pistil (× 10); **8**, open fruit (× 2/3); **9**, seed with pulp (× 2); **10**, seed (× 2); **11**, longitudinal section of seed (× 2); **12**, embryo (× 6). 1-7 from Espírito Santo 3001; 8-12 from Jansen 2147.



Map 11. *Hunteria umbellata.*

75° with the midrib, 4-23 mm apart at the central part of the leaf. *Inflorescence* ter minal, rarely axillary, 1.5-5 × 1.3-5 cm, dense to lax, about 10-20(-80)-flowered; peduncle sometimes covered with resin at the base, 2-13 mm long, primary branches 3-10 mm long; pedicels sometimes covered with resin at the base, 3-7 mm long; bracts very small, 0.8 × 0.5 mm, without colleters. *Flowers* very fragrant. *Sepals* pale green, almost free, thicker towards the middle and at the base, erect and stuck to the corolla tube with thick resinous substance, membranaceous for about 0.2-0.3 mm of their edge, broadly ovate to triangular, 0.7-2.6 × as long as wide, 0.6-1.8 × 0.5-1.6 mm, acute to obtuse at the apex, with rows of colleters inside up to 0.75 of their length; colleters very small 0.2 × 0.1 mm. *Corolla* white, creamy or pale yellow, 8.5-17.5 mm long in mature bud and forming a comparatively narrow ovoid head (0.45-)0.5-0.68 of the bud length, 5.5-9.5 × 0.5-2.5 mm, with an acute apex; with a belt of pubescence 0.8-1.7 mm wide inside just below the insertion of the stamens, sometimes with a few hairs around the stamens, tube 2.9-12 × as long as the calyx, 0.4-1(-1.2) × as long as the lobes, 4-8.2 mm long, almost cylindrical, 0.9-1.8 mm wide above the base, narrowed below the insertion of the stamens to 0.5-2.2 mm wide, again widened around the anthers to 0.7-2.0 mm wide; lobes creamy, slightly pinkish, narrowly ovate to oblong and falcate, twisted in bud, (0.8-)1.2-2.7 × as long as the tube, 2.5-7.5 × as long as wide, 6.2-12 × 1.3-3.5 mm, obtuse at the apex, entire, spreading and recurved later. *Stamens* with apex 0.3-1.0 mm below the mouth of the corolla tube, inserted 0.54-0.86 mm of the length of the corolla tube, at 2.5-6.2 mm from the base; filaments 0.2-0.8 mm long; anthers narrowly ovate 2.7-5.5 × as long as wide, 0.8-1.4 × 0.2-0.3 mm, obtuse at the apex cordate at the base. *Pistil* 2.5-6.4 mm long; ovary subglobose, 0.6-1.1 × 0.5-1.0 × 0.3-0.8 mm, abruptly narrowed into the style, with a disk-like thickening uniting the carpels at the base, about 0.25-0.4 of the length, 0.2-0.3 mm high, of two separate carpels; style 0.7-4.8 mm long; pistil head composed of a stigmatic ellipsoid basal part 0.3-1.0 × 0.2-0.4 mm and a bilobed stigmoid apex 0.2-0.7 × 0.1 mm. Ovules 12-30 in each carpel. *Fruits* yellow, smooth of two separate mericarps, mericarps subglobose, 31-60 × 40-50 × 30-40 mm, 8-26-seeded; wall about 5-12 mm thick, slightly fibrous. *Seeds* oblong to ellipsoid, flattened at the side adjacent to one another, 11-17 × 5-11 × 4-7 mm. Embryo 6-10 mm long; cotyledons elliptic to obovate, 1.3-2.4 × as long as wide, 3-5.5 × 1.7-3.5 mm, obtuse to rounded at the apex and at the base, radicle 0.7-1.4 × as long as cotyledons, 3-4.5 × 0.5-0.8 mm.

DISTRIBUTION. Senegal to Zaire and Angola.

ECOLOGY. Secondary forest, rain forest and gallery forest. Alt. 0-600 m. Flowering and fruiting all the year round.

USES. The wood is cream-coloured or deep brown to yellow-orange, fine grained and very hard (*Punch* 138, E, K, 1900, Nigeria; *Onochie* FHI 4936, FHO, 1945, Nigeria; *Bakare* et al. FHI 22857, K, 1948, Nigeria; *Letouzey* 5477, BR, K, P, 1963, Cameroun; Burt & Hoyle 1937), used locally for carving combs, spoons, carpenters planes and weavers shuttles (Dalziel 1937; *Causdale* 166, FHO, 1944, Ghana); for making shuttles for weaving Native cloth (*Mc Ainsh* 890, Nigeria) and for making combs (*Scott Elliot* 5690, K, 1892, Sierra Leone; *Mc Ainsh* 890, Nigeria; *Chevalier* 19706, P, 1907, Ivory Coast). The forked stems are used as house posts and are considered very durable and immune to termites (Dalziel 1937). Fruits are consumed by ants (*Oldeman* 642, BR, K, P, WAG, 1963, Ivory Coast). Root are used as a bitter tonic (*Akpabla* 110, K, P, 1948, Nigeria). Bark and fruit are taken locally against belly ache (*Bos* 3065, WAG, P, Cameroun).

Geographical selection of the approximately 200 specimens examined:

SENEGAL. Catió, *Espírito Santo* 3001 (BR, MO, P); Catanhez, *Pereira* 3163 (K, MA); Chitole Cusselinta, *Espírito Santo* 3187 (MO, P, WAG). Oriental: Gouloumbo, *Berhaut* 2082 (BR, P); Berge du Nieriko, *Berhaut* 1669 (BR, P); Ouassadou, *Trochain* 3467 (P). Casamance: Kayanga R., *Monsier* 2594 (P).

GUINEA BISSAU. Canchungo, *Espírito Santo* 1940 (K, MO, P, WAG).

GUINEA. Bóke, *Pobéguin* 2015 (P); Mt. Nimba, *Adam* 28738 (MO).

SIERRA LEONE.. Mafinta, *Pyne* 115 (K, P); near Makundi, *Scott Elliot* 5690 (K, type of *H. elliotii*); Batkanu, *N. W. Thomas* 19 (K); Kasewe, *King* 231 (K), *Lane-Poole* 129 (K); Mano, *N. W. Thomas* 10102 (K); Kambui Forest Reserve, *Jordan* 2120 (K), *Samai* 522 (K); Gola Forest, *Small* 402 (K); Njala, *Deighton* 5010 (B, P, K).

LIBERIA. Mt. Huelliton, *Jaeger* 10019 (G); Bomi Hill-Mano Rd., *Van Meer* 380 (WAG); Gola National Forest, *Voorhoeve* 36 (BR, WAG), *Voorhoeve* 853 (WAG); Saniquellie, *Georges* 27814 (M); Mt. Tokadeh, *Adam* 21414 (MO, P, UPS); 29 km S of Tchien, *Jansen* 2147 (WAG).

IVORY COAST. Sassandra R. basin, *Chevalier* 16373 (P); Cavally R. basin, *Chevalier* 19706 (P); near

Tabou & Béréby, *Chevalier* 19975 (P); Béréby, *Oldeman* 642 (BR, K, P, WAG); Soubré, *Aké Assi* 11578 (B); Monogaga, *Geerling & Bokdam* 2419 (BR, MO, WAG); 21 km on Rd. to Monogaga, *Leeuwenberg* 12111 (WAG); Mafia, *Garnier* 653 E (P); Agnieby, *Chevalier* 17043 (P); Bouroukrou, *Chevalier* 16519 (P, WAG); 36 km NE of Sassandra, *Breteler* 6102 (BR, K, P, US, WAG); Banco Forest, *Aké Assi* 15904 (BR, WAG); Sofalco Plantations, *Leeuwenberg* 10722 (WAG); Aboubou Forest, *Leeuwenberg* 2386 (B, BR, FHO, K, LISC, P, WAG, Z); 20 km SW of Abengourou (BR, WAG); Borobo, *Chevalier* 17659 (MO, P, WAG); between Yaou & Ayiame, *Chevalier* 17766 (K, P, MO, WAG, type of *H. eburnea*); Assinie, *Chevalier* 17865 (P); Aboisso, *Chevalier* 16310 A (K, P, WAG).

GHANA. Western: Ankasa Forest Reserve, *Enti* R 973 (MO); near Simpa, *Enti* 6920 (B, BR, K, P); Benoo, *Andoh* FHI 5471 (BR, K, US, WAG); Subri R., *Hall & Abbiw* 45134 (MO, WAG). Eastern: Abua-Kwa, *Causdale* 166 (FHO); Essuboni (=Asuboni) Forest Reserve, *Juma* 1 (FHO); Kumasi, *Vigne* 2701 (FHO, US); Brong-Ahafo: Bia National Park, *Short* GC 47008 (MO).

NIGERIA. Ogun: Olokomeji Forest Reserve, *Gentry & Pilz* 32674 (US, WAG); Omo Forest Reserve, *Gentry & Pilz* 32810 (BR, MO, WAG). Erin, *Ross* 126 (K). Lagos: Lagos, *Foster* 5 (K, P, W). Oyo: Gambari, *Van Eijnatten* 1266 (WAG); Ibadan South Forest Reserve, *Keay* FHI 25705 (B, K, P); Ago-Owu Forest Reserve, *Wit & Geerling* 1260 (K, MO); Shasha Forest Reserve, *Ross* 8 (MO, S); Bendel State: Okomu Forest Reserve, *Akpabla* 110 (K, P). Cross River: North Forest Reserve, *Latilo* FHI 31840 (K); Ogoja, *Keay* FHI 28250 (K).

CAMEROUN. Sud-Ouest: Korup National Park, *D. W. Thomas* 3207 (K, MO, P, WAG); Masore, *D. W. Thomas* 4178 B (K); Kumba, *D. W. Thomas* 4195 (BR, K, MO, P, WAG); Abonando, *Rudatis* 59 (G, K, P, W, Z); Weme village, *Nemba* et al. 582 (MO, WAG). Centre Sud: Bafia-Ndikimeki Rd., *Benoit* 382 (P); 50 km NW of Eseka, *J. de Wilde* 1272 (P, WAG); Bank of Nyong R. near the new bridge, *J. de Wilde* 2863 (WAG); Lolodorf, *Staudt* 130 (A, COI, E, K, P, PRE, S, Z, type); 9 km N of Kribi, *Bos* 4978 (K, M, P, WAG); 2 km S of Kribi on Grand Batanga Road, *Bos* 3065 (WAG, P); 12 km on Grand Batanga to Campo, *Wieringa & Haegens* 2156 (WAG); 60 km on Kribi-Edea Rd., *Bos* 7106 (P, WAG); near Kribi, *Mildbraed* 6098 (B, HBG); 10 km N of Kribi, *J. de Wilde* 2922 (P, WAG); Bipindi, *Zenker* 1707 (BP, BR, COI, E, F, G, HBG, K, L, NY, P, S, W, WAG, Z), 1729 (BP, BR, E, G, HBG, K, L, MO, P, S, W, WAG), 3705 (BR, E, G, HBG, K, L, MO, P, S, US, W, Z), 4488 (B, BR, E, G, HBG, K, L, MO, P, S, W, WU, Z), II 287 (B, BR, C, G, GH, LD, P, UC, US, WAG); Akoakas rock, *J. de Wilde* 8371 (MO, P, WAG). Est: near Kolembong, *Letouzey* 5477 (BR, K, P).

GABON. Estuaire: 100 km S of Libreville, *J. de Wilde* et al. 812/83 (MO, WAG). Ogooué-Maritime: Gamba, *Wieringa & Haegens* 2524 (WAG); Mossomala, *Wieringa* 1285 (WAG); Doudou Mts., *Reitsma* 1952 (NY, WAG). Nyanga: Tchibanga, *Le Testu* 1744 (BR, K, NY, P, type of *H. mayumbensis*); Moyen-Ogooué: 7 km on Ndjole-Bijoun Rd., *Leeuwenberg* 12464 (MO, WAG). Ngounié: Maghounga, *Le Testu* 6408 (B, BR, K, MO, P). Nyanga: Mayombe, *Le Testu* 8025 (BR, P). Ogooué-Lolo: 30 km NE of Lastoursville, *Breteler* 9993 (WAG).

CONGO. Kouilou: Kakamoéka, *Sita* 1345 (P); Dimonika, *Groulez* 12.10.1954 (P); Mayombe, *Dowsett-Lemaire* 1447 (WAG); Kouilou, *Sargos* 75 (P).

ZAIRE. Equateur: Bosawa, *Evrard* 1614 (BR). Haut-Zaire: Yangambi, *Germain* 279 (BR, C, K, NY, WAG); Ile Tutuku, *Germain* 357 (BR, K).

ANGOLA. Cabinda: Chiluango, *Gossweiler* 7764 (BM, K, MO).

CULTIVATED. Netherlands: Wageningen Bot. Gardens, *Van Setten* 179 (WAG). Ivory Coast: Adiopodoumé Bot. Garden, *Garnier* 653 A (P); Adiopodoumé, *Leeuwenberg* 12026 (WAG).

Notes. Hardly open and open flowers are present on the tree itself, but abundant on the forest floor. Probably night flowering (*Wieringa & Haegens* 2524, WAG, 1994, Gabon).

2.5.12 **Hunteria zeylanica** (Retz.) Gard. ex Thw.

in Enum. Pl. Zeyl. 191 (1860); Tsiang Ying in Sunyatsenia 3: 135 (1936); Pichon in Bull. Soc. Brot. sér 2, 27: 104 (1953); Wyatt-Smith & Kochummen in Mal. For. Rec.

17: 72 (1965); Huber in Handb. Fl. Ceylon 1: 10 (1973); Tsiang Ying in Fl. Reip. Pop. Sin. 63: 15-17, fig. 4 (1977); Markgraf in Blumea 30: 169 (1984)). – Type: Sri-Lanka, *Koenig* s.n. (holotype C, isotypes BM, K-W 1608 C, MO).

Fig. 34, p. 124; map 12, p. 125

Basionym and homotypic synonym:

Cameraria zeylanica Retz. in Obs. Bot. 4: 24 (1786); A.DC., Prod. 8: 389 (1844). *Hunteria corymbosa* var. *zeylanica* (Retz) Hall. f., Jahrb. Hamb. Wiss. Anst. XVII, Beih. 3: 195 (1900).

Heterotypic synonyms:

Hunteria corymbosa Roxb., Hort. Beng. 84 (1814) nomen & Fl. Ind. ed. Carey et Wall., 2: 531 (1824) & ed. 2: 695 (1832); Wight Ic. 2 t. 428 (1843); A.DC., op. cit. 350 (1844); Hooker f. in Fl. Brit. Ind. 3: 637 (1882); Boerlage, in Bull. Inst. Bot. Btzg 5: 13 (1900); Hallier f. in op. cit. 195 (1900); Boerlage, Handl. 2: 93 (1907); Hunter in J. Str. Br. R. As. Soc. 53: 80 (1909); Rendle in J. Bot. 63 suppl. 67 (1925); Burkill & Hend. in Gard. Bull. Str. Settl. 3: 396 (1925); Pitard in Fl. Indo-Chine 1129 (1933); Sealy in Kew. Bull. 1956 348 (1956); Gamble in Fl. Madras 568 (1957); Desch in Man. Mal. Timb. 39, t. 6 (1957); Whitmore in Tree Fl. Mal. 2: 15 (1973). – Type: India, Bengal, sin. loc., *Hunter* July (holotype BM). *H. corymbosa* var. *genuina* Hall f. op. cit. 195.

Tabernaemontana salcifolia Wall. in Bot. Reg, 15: sub t. 1273 (1829); A. De Candolle, Prodr. 8: 376 (1844). *T. parviflora* Heyne ex Wall. Cat. 1580 & ex Hook. f., Fl. Brit. Ind. 3: 637 (1882), in syn., non Poiret (1817), nor Roxburg (1832), nor Decaisne (1834), nor Bojer (1837), nor Heyne ex Wallich Cat. 4453 A. *H. corymbosa* var. *salcifolia* (Wall.) Hall f. in op. cit. 195; *H. zeylanica* var. *salicifolia* (Wall.) Pichon in op. cit. 111. – Type: India, sin. loc., *Heyne* in *Wallich* 1580 a (holotype K-W; isotype BM).

Hunteria lanceolata Wall. ex A. DC. op. cit. 350. – Type: Burma, Tavoy, *Gomez* in *Wallich* 1611 (holotype G-DC, isotype K-W). *Gynopogon lanceolatum* (Wall. ex A. DC.) Kurz, For. Fl. Brit. Burma II: 177 (1877).

Hunteria roxburghiana Wight, Ic. Pl. Ind. Or. 4, 2: 2, t. 1294 (1850); Thwaites, Enum. Pl. Zeyl. 192 (1860), *H. corymbosa* var. *roxburghiana* (Wight) Trimen ex J. Gamble, Fl. Pres. Madras II: 808 (1923). – Type: India, Tamil Nadu: Courtallum (= Kuttalam), *Wight* 1874 (lectotype G, designated here; isolectotypes GH, L, M, P, S, W).

Hunteria africana K. Schum. in Engler Pflanzenw. Ost-Afr. C: 317 (1895). *Hunteria zeylanica* var. *africana* (K. Schum.) Pichon in op. cit. 112, **syn. nov.** – Syntypes: Tanzania, T3, Pangani, *Stuhlmann* 77 (B †); Bagamoyo *Stuhlmann* 206 (B †). Neotype: Tanzania, T3, Tanga Distr., Sawa, *Faulkner* 1626 (neotype K, designated here; isoneotypes B, BR, FT, P).

Hunteria legocii Livera, Ann. Roy. Bot. Gard. Peradeniya 10: 140 (1926). – Type: Sri-Lanka, Paradeniya, Thwaites C.P. 2518 (holotype PDA, not seen; isotypes G, K, P, W).

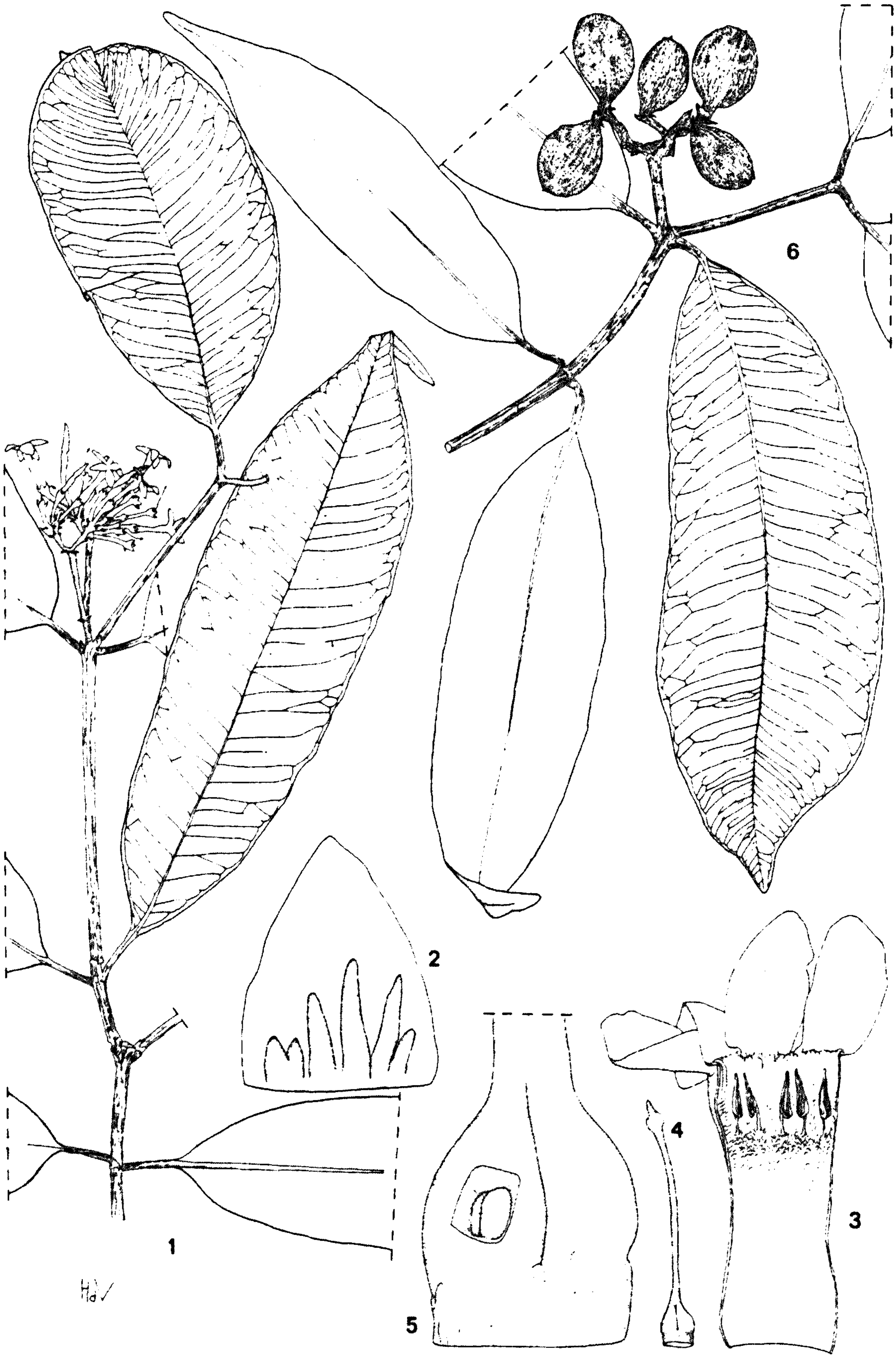
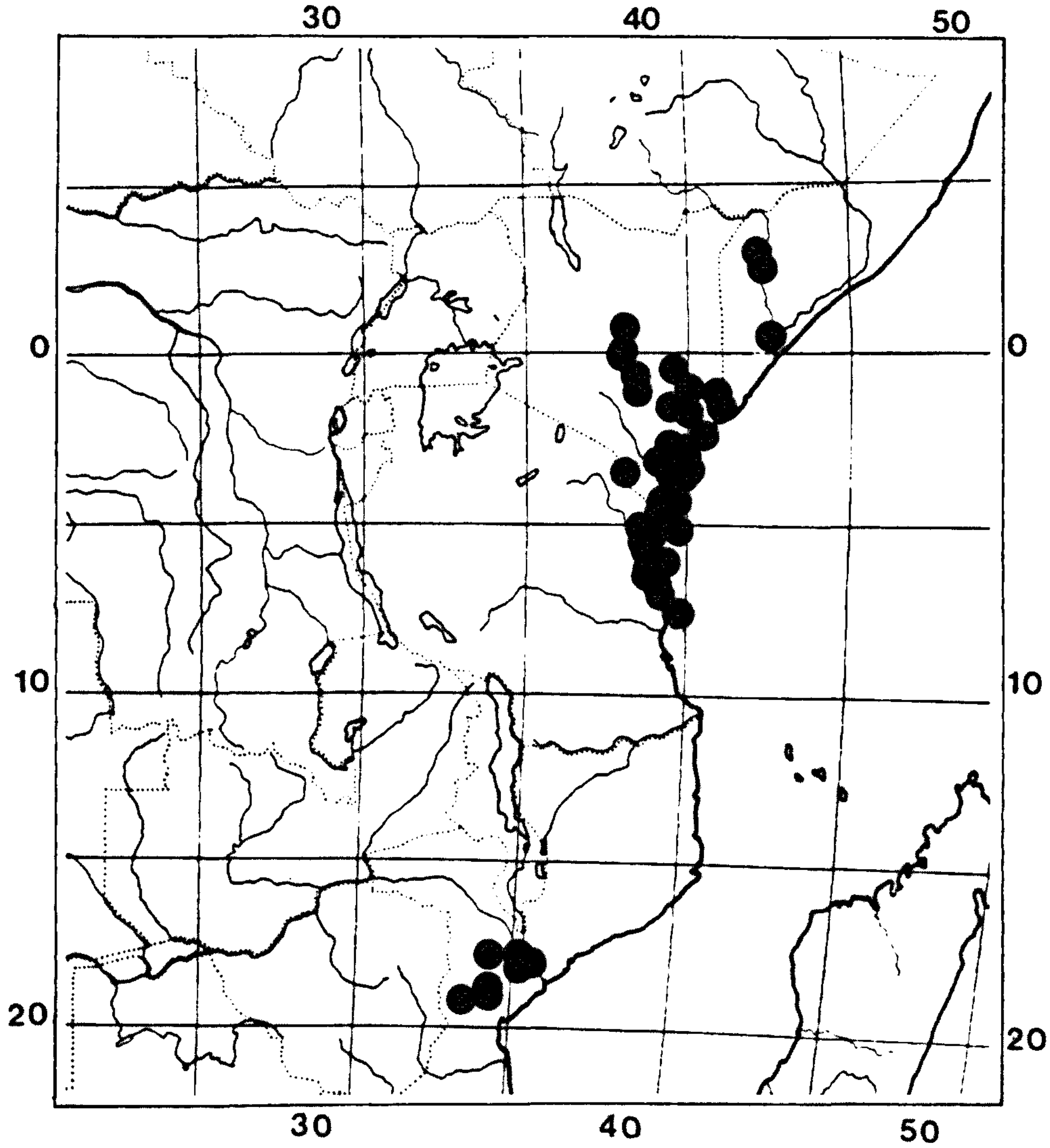


Figure 34. *Hunteria zeylanica*. **1**, habit (× 2/3); **2**, sepal inside (× 30); **3**, opened corolla (× 4); **4**, pistil (× 6); **5**, opened ovary (× 30); **6**, fruiting branch (× 2/3). 1 from Maxwell 85-675 (L), Thailand: 2-5 from Mycologist Bot. Garden Peradeniya, Sri Lanka 21 Nov. 1921 (A);
6 from Matuol F.D. 22004, Selangor, Malaysia (FHO).



Map 12. *Hunteria zeylanica*, African part of area of distribution.

Tree or shrub 1-15 (-40?) m high, with colourless to milky latex in all parts. Trunk 2-30 cm in diameter; bark pale to dark grey to dark brownish-yellow, smooth or rough, shallowly fissured; inner bark cream, yellow to bright orange; wood very hard, dense, whitish to yellow. Branches brownish-grey, lenticellate; branchlets thin. *Leaves*: petiole 6-17 mm long; blade coriaceous, elliptic or oblong to obovate, 1.4-5.7 × as long as wide, 2-20.7 × 0.9-6.7 cm, rounded to acuminate at the apex, acumen 4-17 × 2-3 mm, cuneate to acute to rounded at the base, glossy and very dark green above, dull and pale green beneath; midrib prominent beneath; secondary veins straight to very slightly curved, in 12-30 pairs, forming a submarginal vein and an angle of 50-77° with the midrib, 3-15 mm apart at the central part of the leaf. *Inflorescence* a compound dichasial cyme, lax, terminal, rarely also axillary and sometimes overtopped by a later axillary vegetative branch, 3.2-7.5 × 2.5-8.5 cm, 3-4 × branched, 10-65(-96)-flowered; peduncle, (5-)10-40 mm long; primary branches 6-20 mm long; secondary branches 4-10 mm long, tertiary branches 5-7 mm; pedicels 3.8-10 mm long. Bracts ovate to triangular, 0.7-1.3 × 0.5-1 mm. *Flowers* fragrant. *Sepals* green, thicker towards the base and at the middle, erect, with a little resin within, membranaceous at the edge and the apex, ovate to triangular or elliptic, obtuse to shortly acuminate at the apex, 1.2-3 × as long as wide, 1.0-2.5 × 0.5-

1.4 mm, with rows of colleters inside up to 0.7 of their length; colleters very small 0.2-0.4 × 0.1 mm. *Corolla* white to pale yellow, 10-17.3 mm long in the mature bud and forming a comparatively wide ovoid head 0.35-0.53 mm of the bud length, 4-7 × 1-2.5 mm, with an obtuse apex, with a belt of pubescence 1-3 mm wide inside just below the insertion of the stamens, sometimes with a few hairs around the stamens and up to the throat; tube creamy-green, 3.7-7.7 × as long as the calyx, 1.1-2.2 × as long as the lobes, 6-10 mm long, almost cylindrical, 0.8-1.8 mm wide above the base, narrowed below the insertion of the stamens to 0.7-1.5 mm wide, again widened around the anthers to 1.2-2.0 mm wide; lobes pure white, ovate, 0.5-0.9 × as long as the tube, 1.4-3.2 × as long as wide, 3.7-8.8 × 1.8-3.5 mm, obtuse at the apex, spreading or recurved later. *Stamens* with apex 0.2-0.8 mm below the mouth of the corolla tube, inserted 0.67-0.83 of the length of the corolla tube, at 4.5-8 mm from the base; filaments 0.3-0.9 mm long; anthers narrowly ovate to oblong, 3.0-8 × as long as wide, (1-)1.3-1.5 × 0.2-0.5 mm, obtuse at the apex, subcordate at the base. *Pistil* 5.5-9.5 mm long; ovary oblong, 0.9-1.8 × 0.6-1 × 0.4-0.6 mm, gradually narrowed into the style, with a disk-like thickening uniting the carpels at the base, about 0.3-0.4 of the length, 0.2-0.4 mm high, of two separate carpels; style 3.5-7.2 × 0.1-0.3 mm; pistil head composed of a subglobose stigmatic basal part, 0.3-0.7 × 0.25 × 0.5 mm and a conical stigmoid apex 0.3-0.8 × 0.2 mm. Ovules 2 at the extreme base in each carpel. *Fruits* yellow to orange, smooth, of two separate mericarps; mericarps obovoid to globose, 13-30 × 10-15 × 7-9 mm, rounded at the apex, sometimes stipitate at the base; stipe 4-8 mm long, 2-seeded; wall about 2-4 mm thick; pulp smooth. *Seeds* oblong or ellipsoid, 8.5-15 × 6-10 × 4-6 mm, testa smooth, orange. Embryo 3.8 mm long; cotyledons ovate, 2 × as long as wide, 2 × 1 mm, obtuse at the apex, rounded at the base; radicle 0.9 × as long as cotyledons, 1.8 × 0.4 mm.

DISTRIBUTION. Somali, Kenya, Tanzania, and Mozambique, India, Sri-Lanka, Burma, Thailand, Cambodia, Laos, Vietnam, S. China (Hainan), Malaysia, Indonesia.

ECOLOGY. Dry coastal forest, mixed evergreen forest gallery forest, or thick wooded bushland on sandy soil or coral rock along the coast and on sandy gravelly soils on rocky river banks, inland. Alt. 0-335 m. Flowering in January and February in Mozambique, in September to January in Kenya and fruiting in March-April and flowering all the year round in Tanzania.

USES. Wood used to make combs (*Kimberly-Medley* 231, K7, Kenya, 1987), as boxwood (*Bally* 16718, K7, Kenya) and to make bows for hunting (*Burstyn* 75/83A, K7, Kenya, 1975). Wood yellow, dense and not attacked by termites (*Poilane* 6774, P, 1923, Vietnam), used to make axe handles (*Poilane* 6721, P, 1923, Vietnam).

Geographical selection of the approximately 200 specimens examined:

SOMALIA. Bibahal, *Paoli* 850 (FT); Shooto Forest, *Synnot* 1949 (EA, K); Uabi, *Scassellati* 56 (FT); Jess, *Hemming & Deskmukh* s.n., (EA); Giuba, *Paoli* 478 (FT); 73 km N of Bardera, *Tardelli* 434 (WAG); Bardera, *Paoli* 815 (FT); 25 miles N of Gelib, *Mooney* 7666 (EA, FT, K, S).

KENYA. K 1: Nothern Frontier Distr., Chebele, *Bally* 6068 (K). Meru Distr., Meru National Park, Masanduku Camp, *Hamilton* 93 (EA); Rojweru R., *Gillett* 18905 (BR, EA, P); Bank of Ura R., *Ament & Magogo* 388 (EA, K). K1/7: Nothern Frontier/Tana Tiver: Garissa, *Greenway* 8860 (EA, K, NY); 2 km

ESE of Mararani, *Kuchar* 13478 (EA). K 4: Kitui Distr., Ukassi, *Edwards* 101 (EA); Endau Hill, *Gatheri* et al. 79/67 (EA, K). K 7: Lamu Distr., Mangai-Kiunga Rd., *Gilbert & Kuchar* 5860 (EA, K, UPS); Witu, *Rawlins* Jan. 1957 (EA, K). Tana River Distr., Tana R., *Battiscombe* K 226 (EA); Mchelelo Forest, *Luke* et al. TPR 31 (EA, K). Kilifi Distr., near Adu (= Hadu), *Dale* 1077 (EA, FHO); Marafa, *Polhill & Paulo* 818 (B, BR, EA, FT, K, P, UPS); 6.4 km N of Malindi, *Polhill & Paulo* 755 (B, BR, EA, FT, K, P, UPS); Arabuko Sokoke Forest, *Graham* 1976 (EA, FHO, K, NY); 9 km E of Bamba, *Reitsma* 144 (EA, WAG); Vipingo, *Bally* 4712 (EA, K). Taita Distr., Bura, *Bally* 2042 (EA, K). Kwale Distr., Kaya Waa, *Robertson* 3506 (E, K, MO, WAG); Shimba Lodge, *Omino* 64 (EA, WAG), 89 (EA, WAG); Diani Forest, *Robertson & Coverdale* 3668 (EA, K, MO, WAG); Likoni, *Jex-Blake* 4641 (EA, K); Diani Beach, *Hiepko* 2663 (B, EA); Mwele Mdogo Forest, *Spjut* 2745 (BR, EA, K, UC); 35 km S of Mombasa, *Leeuwenberg* 10800 (EA, WAG); Marenje Forest, *Faden & Faden* 74/321 (EA, K, MO, WAG); Vanga, *Graham* 2205 (EA, FHO, K, P, NY); Galana Ranch, *Bally* 16718 (EA, K). K 4/7: Kitui/Kilifi Distr., Lali Hills, *Adamson* 34 (EA).

TANZANIA. T 3: Tanga Distr., 13 km S of Moa, *Drummond & Hemsley* 3655 (B, BR, K, S); 8 km SE of Ngomeni, *Drummond & Hemsley* 3563 (B, BR, EA, FT, K, S); Sawa, *Faulkner* 1626 (B, BR, FT, K, P); Kumbatoni, *Tanner* 2463 (BR, K). Lushoto Distr., Sangarawe (= Sangerawe), *Zimmermann* 23.3.1917 (K). Pangani Distr., Msumbugwe Forest Reserve, *Hawthorne* 812 (K); Mkaramo Parish, *Tanner* 3366 (BR, K, NY, UC, WAG); Mkwapa (= Mkwaja), *Tanner* 3722 (BR, K, NY, UC). T 6: Bagamoyo Distr., Bagamoyo, *Sacleux* 482 (P); Kikoka Forest Reserve, *Semsei* 3723 (BR, EA, K); near Kawe (= Kawi). Uzaramo Distr., *Harris* 2828 (EA, K, WAG); Dar-es-Salaam, *Kirk* March 1968 (K); Vikindu Forest Reserve, *Paulo* 133 (EA, K). Rufiji Distr., Uranzi, *Greenway* 5077 (EA, K). P: Msitu Mkuu, *Beentje* 4381 (WAG); Pemba, *Vaughan* 2078 (EA, FHO), 2729 (EA). Z: Zanzibar, *Vaughan* 885 (EA, FHO).

MOZAMBIQUE. Zambezia, Mopeia, *Bowbrick* JC10 (LISC, SRGH). Sofala: Maringuè, *Bond* 9837 (LISC, SRGH); Villa Fontes (= Caia), *Greenwood* 12 (LISC, SRGH); 25 km from Lacerdónia, *Müller & Pope* 1926 (K, LISC, PRE, SRGH); 5 km E of Inhamitanga, *Müller & Pope* 1865 (K, LISC, SRGH); Gorongasa National Park, *Macedo* 1258 (WAG); Sangarassa Forest, *Tinley* 2369 (HBG, K, M, MO, P, SRGH, WAG). Manica: Chimoi, Simão 273/48 (LISC).

Notes. Pichon (1953) divided *H. zeylanica* into 3 varieties as follows:
var. *zeylanica*, leaves over 2.5 cm wide and with a well defined acumen.
var. *salicifolia* (Wall ex A. DC.) Pichon, leaves rarely more than 2.3 cm wide and without a distinct acumen.
var. *africana* (K. Schum.) Pichon, leaves mostly over 2.5 cm, but without a distinct acumen.

In my opinion, this species cannot be divided into varieties on the basis of the width of the leaves which proved to be very variable over the whole distribution range, e.g. *Tardelli* 434, Somalia (0.9-2 cm wide); *Reitsma* 144, Kenya (2-4.2 cm); *Drummond & Hemsley* 3563, Tanzania (1.4-4.1 cm); *Forbes* 2722, Sumatra (0.9-3.2 cm); *Poilane* 5562, N. Vietnam (2.1-3.7 cm) and *Van Steenis* 870, Anambas Islands (5.4-6.7 cm). In Africa the leaves are mostly rounded (*Gardner* 2205, Kenya; *Greenway* 8860, Kenya; *Tanner* 3366, Tanzania) to obtuse at the apex (*Robertson* 3506 Kenya), although they may sometimes be bluntly acute to acuminate with a blunt acumen (Beentje 4381). The leaf is very variable in size, shape and apex in Asia. The largest leaves are found in Malaysia (up to 20.7 × 5 cm) and the smallest in Sri Lanka (5.5 × 1.6 cm). In a majority of the Asian specimens, the leaf apex is very distinct but there are also many examples of specimens without a distinct acumen, especially from Hainan and Vietnam (*How* 71618, Hainan; *Poilane* 3002 and 6774, Vietnam). The leaf acumen of all the specimens formerly placed under var. *salicifolia* is also very variable and may be bluntly acuminate (*Wight* 543, India) to distinctly acuminate (*Alston* 262, Sri Lanka). I have therefore not maintained the varieties proposed by Pichon (1953) in the current taxonomic treatment.

In herb. *Simão* 273/48 (LISC) the ovary exists of 3 separate carpels.

2.6 PICRALIMA PIERRE

Picralima Pierre in Bull. Soc. Linn. Paris 2, 1278 (1896); Stapf in Fl. Trop. Afr. 4, 1: 96 (1902); Pichon in Mém. Mus. Nat Hist. Nat. 24: 158 (1948) & in Bol. Soc. Brot. sér 2, 27: 81 (1953); H. Huber in Fl. W. Trop. Afr. ed. 2, 2: 62 (1963). – Type species: *Picralima klaineana* (= *P. nitida* (Stapf) Th. & H. Dur.).

Tree or shrub with white latex in all parts; branchlets glabrous. Leaves opposite, petiolate, those of a pair equal or subequal; petiole glabrous; blade elliptic to oblong, entire and glabrous on both sides. *Inflorescence* a compound, umbellate cyme, terminal or sometimes axillary, pedunculate; peduncle glabrous. *Flowers* fragrant or not, actinomorphic except for the subequal sepals. *Sepals* pale green, imbricate even at anthesis, connate at the extreme base, glabrous outside, not ciliate and with 2-4 rows of colleters at the extreme base. *Corolla* white to yellow, tube often greenish, with a belt of pubescence up to 7.3 mm wide inside just below the insertion of the stamens; tube almost cylindrical, thick and fleshy, narrowed below the insertion of the stamens, glabrous outside; lobes overlapping to the left in bud, not ciliate, glabrous, entire, spreading and recurved later. *Stamens* included, inserted above the middle of the corolla tube; filaments short, filiform, glabrous; anthers ovate, cordate at the base, glabrous, of two parallel cells longitudinally dehiscent. *Pistil* glabrous; ovary composed of two separate carpels, united at the extreme base by a disk-like thickening; pistil head composed of a stigmatic oblong basal part and a filiform stigmoid apex up to 1.5 mm. long. Ovules numerous in each carpel. *Fruits* yellow to orange, smooth, composed of two separate divaricate mericarps; mericarps obovoid to ellipsoid, with a rounded apex, up to 80-seeded; wall very thick and fibrous. *Seeds* brown, variously shaped, somewhat angular smooth; testa hard brown. Embryo straight, spathulate, surrounded by thick rather hard and starchy endosperm leaving a hole around the radicle apex; cotyledons thick; radicle almost cylindrical, flattened and narrow at the apex, widened towards the base.

2.6.1 **Picralima nitida** (Stapf) Th. & H. Dur.

in Bull. Jard. Bot. Etat. Brux. 2: 338 (1910); Pichon in Bol. Soc. Brot. sér. 2, 27: 82, map A p. 85 (1953) & in Mém. Mus. Natn. Hist. Nat. 24: 158 (1948); H. Huber in Fl. W. Trop. Afr. ed. 2, 2: 62 (1963). – Type: Cameroun, Ambas Bay, *Mann* 710 (holotype K; isotypes GH, P).

Fig. 35, p. 129; map 13, p. 130

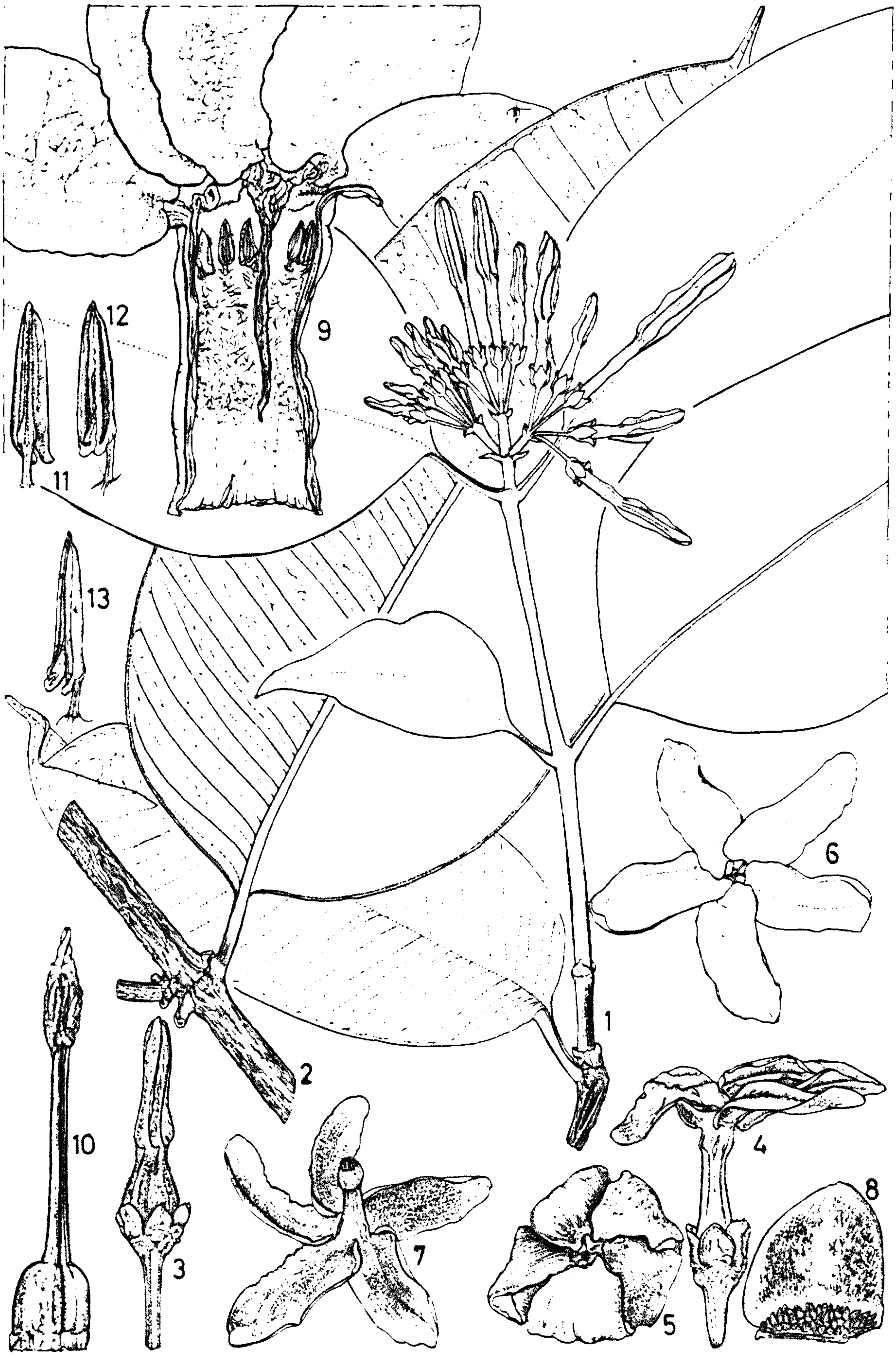
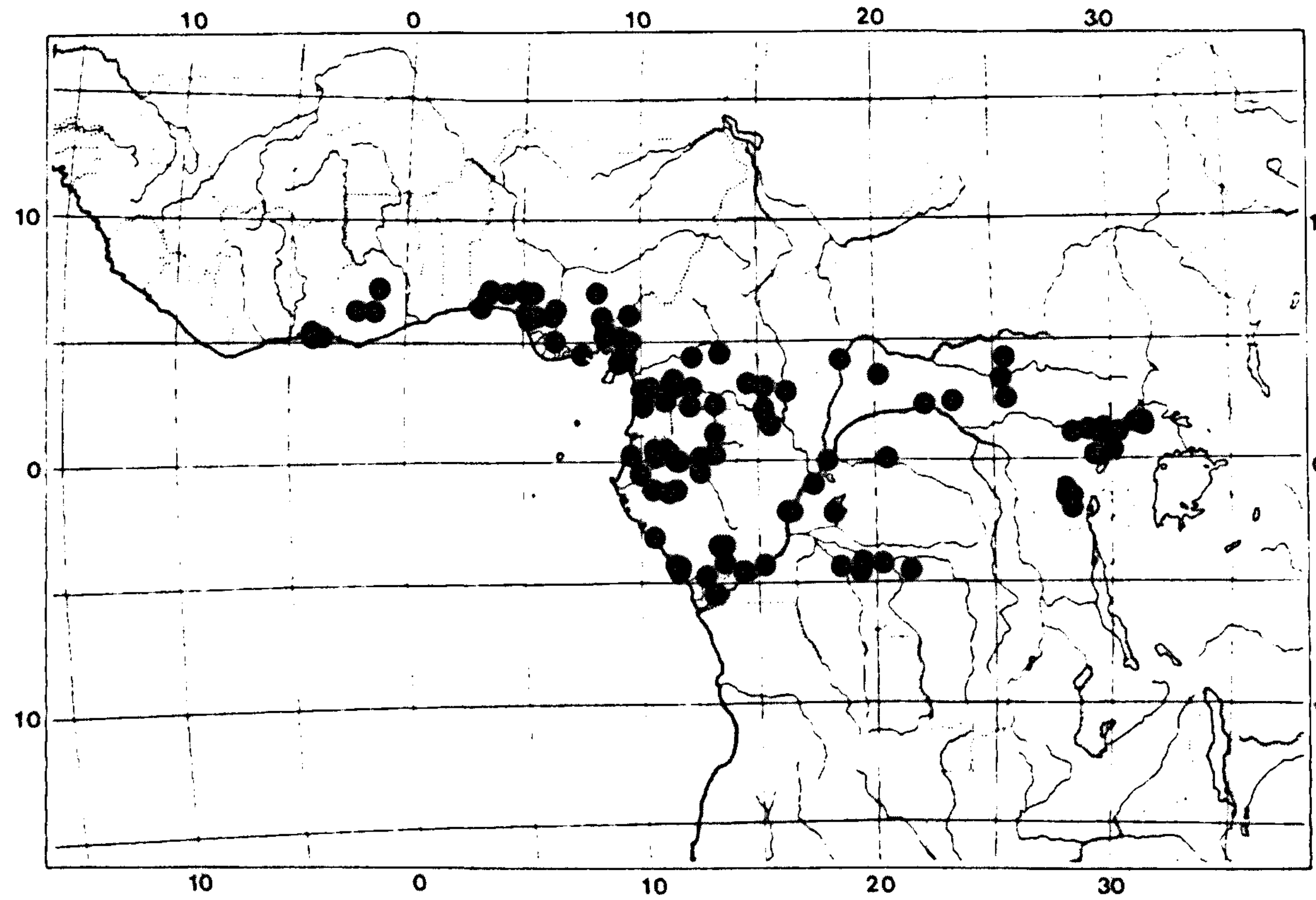


Figure 35. *Picralima nitida*. **1**, habit (× 2/3); **2**, branchlet (× 2/3); **3**, flower bud (× 1); **4**, flower (× 1); **5-6**, flower above (× 1); **7**, corolla beneath (× 1); **8**, sepal inside (× 2); **9**, opened corolla (× 2); **10**, pistil (× 4.6); **11-13**, stamens (× 6.4). 1-2 from W. de Wilde et al. 1952; 3-13 from Reitsma 899.



Map 13. *Picralima nitida*.

Basionym:

Tabernaemontana nitida Stapf in Kew Bull. 1894: 22 (1894); De Wildeman & Durand in Ann. Mus. Congo Bot. sér. 2, vol. 1, 1: 39 (1899) & sér. 3, vol. 1, 2: 153 (1901).

Heterotypic synonym:

Picralima klaineana Pierre in Bull. Soc. Linn. Paris, 2: 1279 (1896); Stapf in Hooker, Ic. Pl. 28: t. 2745-2746 (1902). – Type: Gabon, Libreville, *Klaine* 299 of 11.9.1896 (lectotype P, designated here).

Tree or shrub 4-35 m high with very dense crown. Trunk 5-60 cm in diameter, cylindrical; bark hard, brittle, pale to dark greyish black to brown, smooth to slightly rough to finely striate, sometimes lenticellate, very bitter; inner bark 6-12 mm thick, brown to yellow with orange-brown spots, granular, fibrous; wood very hard, resistant, whitish-yellow to pale brown or orange. Branches dark green, smooth; branchlets, smooth, dark green to dark brownish black. *Leaves* opposite; petiole 10-22 mm long; blade thickly papery to thinly leathery, papery to coriaceous when dried, ovate, broadly to narrowly elliptic or oblong, 2.1-4.3 × as long as wide, (5-)10.8-26.6 × 1.9-13 cm, abruptly acuminate at the apex, acumen acute, 6-14 × 2 mm, cuneate, acute or rarely rounded to obtuse at the base, glossy and dark green above, dull and paler beneath; midrib impressed above, vividly shiny and pale green beneath; secondary veins more or less straight, curved towards the margin, in 14-23 pairs, forming a submarginal vein and an angle of 70-72° with the midrib, 8-16 mm apart at the central part of the leaf; tertiary veins obscure below. *Inflorescence* 6-10 × 7.5-9 cm, 12-36-flowered, 1 × branched; peduncle medium to pale green, 2-37 mm long, with 3 primary branches each bearing 6-12 flowers; branches 3-15 mm; pedicels medium to pale green, 2-20 mm long. Bracts very small. *Sepals* vividly pale to medium green, fleshy, coriaceous when dried, free or connate at the base for 0.08-0.18 of their length, 0.5-1 mm thick at the base, erect, membranaceous for about 0.3 mm of the extreme edge, broadly ovate to suborbicular, (0.9-)1.1-1.6 × as long as wide, (3.5-) 5.5-7.5 × 3.5-5 mm, obtuse to rounded at the apex, and with 2-4 rows of colleters inside at the extreme base, colleters small 0.7-1 × 0.1-0.2 mm. *Corolla* white to lime-yellow, coriaceous when dried, 25.3-47 mm long in mature bud and forming a comparatively large ovoid head 0.47-0.7 of the bud length, 14.3-33 × 3-7 mm, with an obtuse apex, glabrous outside, not ciliate at lobes, with a belt of pubescence 3-7.3 mm wide inside, just below the insertion of the stamens, sometimes with a few hairs around the stamens; tube pale green, fleshy, coriaceous, 2-3.5(-6) × as long as the calyx, 0.6-1.2 × as long as the lobes, 14.5-21 mm long, almost cylindrical, 3-6 mm wide above the base, narrowed below the insertion of the stamens to 2-4.5 mm wide, again widened around the anthers to 3-5 mm wide; lobes pale green to yellow in bud, creamy at anthesis, ovate, not twisted in bud, 0.8-1.57 × as long as the tube, 1.9-3 × as long as wide, 13.5-29.8 × 5.5-10 mm, obtuse at the apex, entire, spreading or erect. *Stamens* with apex 1.2-4 mm below the mouth of the corolla tube, inserted 0.58-0.71 of the length of the corolla tube, at 9.5-15 mm from the base; filaments 0.7-1.4 × 0.1-0.2 mm long; anthers ovate, 3.4-6.4 × as long as wide, 2.8-3.7 × 0.5-1 mm, obtuse or acuminate at the apex, acumen 0.3 mm, sterile. *Pistil* 9.7-12.5 mm long; ovary ovoid, 2-3 × 1-2.5 × 0.5-1.8 mm, with a disk-like thickening 0.2-0.3 of the length, 0.5-0.6 mm high; style 5-7.3 × 0.3-0.4 mm; pistil head with apex 2 mm below stamens, 1.6-3.1 × 0.5-1 mm, stigmoid apex 0.6-1.5 × 0.1-0.15 mm. Ovules 120-150 in each carpel. *Fruits*: mericarps irregularly pyriform or obovoid to ellipsoid, laterally compressed, with an adaxial line of dehiscence, 11-20 × 8-15 × 13-14 cm, rounded at the apex; many-seeded; wall very hard, white to creamy on section, 4-8 mm thick, inside with a layer of large fibres like in the coconut. *Seeds* embedded in a soft white or orange pulp orange or brown, smooth, flat, obliquely ovate, obovate to oblong, flattened and more or less angular, 24-44 × 15-27 × 5-8 mm, testa smooth, coriaceous. Embryo straight, 16.5-22 mm long, endosperm excessively bitter; cotyledons ovate to obovate to oblong, thick and leafy, 1.4-3.3 × as long as wide 10.5-13 × 4-8 mm, obtuse to rounded at the apex, subcordate to rounded at the base; radicle 0.6-0.8 × as long as cotyledons, 6.5-9.5 × 1.5-2 mm.

DISTRIBUTION. Ivory Coast, Ghana, Nigeria, Cameroun, Gabon, Congo and Zaire and Uganda.

ECOLOGY. Understorey tree in rain forest or mature old secondary forest, remnant forest on plateaux in Zaire, and semi-deciduous forests by river banks or roadside growing on sandy clay soil. Alt. 20-900 m. Flowering and fruiting all the year round.

USES. All parts of the plant are bitter (Burkill 1985). The wood is pale yellow, fine grained, hard and elastic, finishes and polishes well (Dalziel 1937; Irvine 1961); used to make paddles (*Flamigni* 7116, BR, 1944, Zaire; *Dewèvre* 847, BR, Zaire); bows (*De Wilde* 393, BR, MO, WAG, Zaire; *Bates* 1421, MO, Z, 1919, Cameroun; *Harris & Fay* 504, MO, 1988, Central African Republic); shuttles for weaving clothes, dolls and combs (*Vigne* 864, K, 1922, Ghana; Dalziel 1937); walking sticks in Ghana (Dalziel 1937; Irvine 1961); pestle and Mortar (*Gille* 100, BR, C, MO, P, WAG, 1938, Zaire); in Gabon the wood is used for carvings, paddles, incense holders (Walker & Sillans 1965); spade handles (*N. W Thomas* 2061, 2101, K, 1912, Nigeria; Dalziel 1937); arrows and spoons (*Benoit* 235, P, 1956, Cameroun).

Immature fruits pounded and thrown into water to act as a fish poison (*Michelson* 231, BR, Zaire; *Dewèvre* 945, BR, Zaire; Irvine 1961, Ghana). Pulp which separates the grain is used in the composition of arrow poison (*Dewèvre* 1113, BR, Zaire). Seeds are intensely bitter (Dalziel 1937) and are extensively used by the natives in place of Quinine (*Oppenheimer, son & Co.* s.n., K); crushed and eaten for chest complaints, pneumonia and acute stomach ache without being regarded as a purgative (Dalziel 1937; Irvine 1961); decoction of seeds is used as an enema in Ghana (Dalziel 1937; Irvine 1961). Fruit used to cure cough (*Benoit* 235, P, 1956, Cameroun); eaten by elephants (*Harris & Fay* 504, MO, 1988, Central African Republic); used to poison arrows for hunting Monkeys (*Tisserant* 509, P, 1952, Central African Republic). Small dippers or spoons made from the hard shell of the fruit (Dalziel 1937); the fruit contents are removed and the shell filled with palm wine which is drunk when it has absorbed the bitter principle (Irvine 1961). In Gabon the Pahouin chew a little of the fruit and bark to allay hunger while on long marches in the bush (Raymond-Hamet 1951). In Gabon the seeds are recognised as toxic and use appears to be restricted for external treatment for ancesses (Aubreville 1959).

The bitter bark is boiled in a pot with two teaspoons of sugar and the decoction is drunk against food/drink poisoning (*A. M. Louis* 1844, WAG, 1985, Gabon); used against stomach ache (*J. M. Reitsma* et al. 1866, NY, WAG, 1986, Gabon; *Benoit* 232, P, 1956, Cameroun); chewed by the Bunyoro as a vermifuge (*Dawe* 707, K, Uganda; Eggeling & Dale 1952); used as a febrifuge (*Howes* 1157, FHO, 1926, Ghana; Dalziel 1937, Aubreville 1959); used in Gabon against venereal disease (Walker 1953; Walker & Sillans 1961); bark decoction taken in Congo as an anthelmintic and purgative, to treat hernia, with other drug plants to relieve blennorrhoea (Bouquet 1969), in Ivory Coast against jaundice and yellow fever (Kerharo & Bouquet 1950) and also in Nigeria (Ainslie 1937).

The roots and bark are used to ease chest complaints and combat fever with mild jaundice, popularly called 'yellow fever' (Dalziel 1937); the roots are used as a vermifuge in Gabon (Walker 1953; Walker & Sillans 1961) and against fevers and pneumonia (Ainslie 1937, Aubreville 1959).

Leaf-sap is dripped into ears for otitis in Congo (Bouquet 1969). A cooled decoction of leaves and bark is used against ascaris (*Floret* et al. 1633, WAG, 1983, Gabon).

Seeds have been found to contain about 10 alkaloids, seven of which have been crystallized; on trial alkaloids are ineffective on bird malaria; bark and leaves yield only amorphous alkaloids (Henry & Sharp 1927, 1932). Akuammine is the principal alkaloid from the seeds, is a powerful sympathicostenic and has a local anaesthetic action equal to that of cocaine. Akuammadine is hypotensive, and weaker but longer lasting in effect than Yohimbine (Burkill 1985).

Geographical selection of the approximately 200 specimens examined:

IVORY COAST. Near Bingerville, *Chevalier* 15600 (P); Anoumabo, *Chevalier* 22391B (B, LG, P, WAG), 22440 (P).

GHANA. Western: near Tarkwa, *Vigne* 208 (FHO). Ashanti: Obuasi, *Seward* 651 (K); Adiembra, *Vigne* 864 (K); Kumasi, *Vigne* 3956 (K, P).

NIGERIA. Ogun: Agege, *E. W. Forster* 220 (K). Oyo: Gambari, *Van Eijnatten* 1526 (WAG); Ibadan, *Onyeachusim* FHI 48005 (K, MO); Shasha F. R., *Osseyemeh* 3341 (BR, MO, S); ibid., Ross 7 (BR, MO, S). Ondo: Akwe F. R., *Van Meer* 792 (WAG); Okeluse F. R., *Onochie* FHI 33370 (K, MO). Bendel: Oshi, *Kennedy* 2056 (FHO, K); 15 km SW of Ekenwan, *Leeuwenberg* 11348 (WAG); Okomu F. R., *Brenan & Richards* 8910 (K); Sapoba, *Kennedy* 212 (FHO); Ogwashi, *N. W. Thomas* 2061 (K); Onicha Olona, *N. W. Thomas* 1941 (K). Benue: *Jones* 982 (FHO). Cross River: sin. loc., *Talbot* 219 (BM, K); Eket, *Talbot* 3146 (BM, K, Z); Eket District, *Talbot* 3256 (BM, K, Z), s.n. (BM, K); Oban, *Talbot* 1690 (B, BM, Z); Oban District, *Talbot* s.n. (BM, K); Iyamoyong, *Binuyo* FHI 41297 (BR, FHO, K, WAG); km 114 Calabar-Mamfe Road, *Latilo* FHI 53997 (K, P, WAG).

CAMEROUN. Sud-Ouest: Victoria (= Limbe), *Maitland* 284 (B, K); Ambas Bay, *Mann* 710 (GH, K, P, type); Ikilliwindi, 20 km N of Kumba, *Etuge & D. W. Thomas* 499 (MO, NY, WAG); near Kumba, *D. W. Thomas* 4684 (BR, MO, P, WAG); NE corner of Korup Nat. Park, *D. W. Thomas* 3313 (MO, WAG). Ouest: Wum District, *Ujor* FHI 29271 (K). Littoral: near Maleke, *Benoist* 326 (P);; near Nkongsamba, *Benoist* 256 (P). Centre-Sud: Nkolbewa, near Kribi, *Benoist* 232 (P); Bipindi, *Zenker* 3028 (B, BM, BP, BR, E, G, HBG, K, L, MO, P, S, W, WAG, WU), II 283 (B, BR, C, F, G, GH, MO, NY, P, U, UC, US, WAG); Melen, km 27 on Kribi-Ebolowa Road, *Bos* 6373 (WAG); Mvimi, 35 km E of Campo, *Kaji* 50 (P); Ebolowa, *W. de Wilde* 1952 (B, BR, K, MO, P, WAG, Z); Koumou Forest, *Benoist* 149 (P); between Zoetele and Nkolebang, *Asonganyi* 128 (P, WAG); near Yaoundé, *Letouzey* 1110 (P); Bitye, ca 60 km ENE of Sangmélima, *Bates* 1421 (BM, MO, Z); near Nanga Eboko, *Mildbraed* 8285 (HBG, K). Est: near Ndjangani, 46 km NW of Bertoua, *Breteler* 1358 (BR, P, WAG); 21 km S of Mboy I, *Letouzey* 5069 (K, P); 19 km W of Yokadouma, 5 km W of Mbol, *Leeuwenberg* 6176 (BR, K, MO, P, WAG); 70 km E of Djoum, *Letouzey* 11804 (BR, HBG, K, P, WAG); 5 km W of Bateka Malemba, *Villiers* 652 (K, P); Nginda, 21 km N of Moloundou, *Mildbraed* 4138 (HBG).

CENTRAL AFRICAN REPUBLIC. Sangha: *Harris & Fay* 504 (MO). Ombella-Mpoko: Boukoko, *Tisserant* 509 (K, P).

GABON. Estuaire: near Libreville, *Klaine* 106 (P), 299 of 11 Sept. 1896 (P, lectotype; possible isolectotypes BR, K), 299 of 9 Aug. 1896 (K, P, paratype). Woleu-Ntem: Oveng, *A. M. Louis* 2114 (WAG); near Abanga, *Reitsma* et al. 1866 (NY, WAG); Otuoma, *Dibata* 956 (BR); Ovengi, *Reitsma* et al. 899 (NY, WAG); Mindoumo, *A. M. Louis* 1884 (WAG). Moyen-Ogooué: Onangé Lake, *Pobéguin* 45 (P). Nyanga: Dibilila, *Le Testu* 1223 (BM, BR, G, P); Tchibanga, *Le Testu* 1841 (BM, BR, E, K, P, US, WAG). Ogooué-Ivindo: 10-15 km W of Akouba, *Floret* et al. 1633 (P, WAG); M'passa Field Station, *Gentry* 33512 (MO); Makokou, *Hladik* 1314, 2098, (P); near Ekobakoba, *Reitsma* 3132 (NY, WAG); Belinga, *Hallé & Le Thomas* 641 (P); Booué, *Vadon* s.n. (P). Ngounié: SE of Sindara, *Leeuwenberg & Persoon* 13695 (WAG); Gnyoungou, *Le Testu* 6035 (B, BR, K, P); Mimongo, *Le Testu* 5898 (B, BR, HBG, MO, P). Ogooué-Lolo: Poungui, *Le Testu* 7429 (P).

CONGO. Kouilou: Pointe Noire, *Farron* 4828 (P); Kouilou, *Sargos* 180 (BR, K, P, US); Region du Kouilou, *Moutsamboté*, 4-9-1990, (BR). Bouenza: Loubofo, *Bouquet* 672 (P); Massia, *Bouquet* 819 (P). Le Koumou: West of Sibiti, *Farron* 4247 (P). Pool: Mayombe, les Saras, *Bouquet* 1917 (P). Cuvette: Odzala, *Dowsett-Lemaire* 1833 (B). Sangha: Ouesso, *Hanie* 74 (P).

ZAIRE. Bas-Zaire: Boma, Luki, *Hombert* 556 (BR, K); Luki, *Maudoux* 171 (BR, MO, P); Kimbuya, *Donis* 165 (BR); Kinshasha, *Claessens* 66 (BR). Bandundu: Lac Leopold II (= Lac Tumba), *Claessens* 756 (BR); Bolobo Waterfall, *Flamigni* 7116 (BR); Ganya, *Flamigni* 10383 (BR, WAG); Illongonga, *Sapin* Dec. 1907 (BR); Ipamu, *Vanderyst* 11997 (BR). Equateur: Lukolela, *Toka* 57 (BR); Eala, *Corbisier 103* (BR, K); Eala, *Corbisier* 720 (BR, C, FHO, K, MO, NY); Befale, *Evrard* 3178 (BR, K); Tokaya, *Evrard* 785 (BR); Yambata, *De Giorgi* 1672 (BR, Z). Kasai-Occidental: Sankuru, *Van den Bossche & Luja* 31 (BR); Sankuru, *Demeuse* 105 (BR, HBG); Bena Longo, *Dechamps* 171 (B, BR, L, UPS, W, WAG, Z). Haut-Zaire: Mobwasa, *Lemaire* 388 (BR); Mobwasa, *Vermoesen* 287 (BR); Zobia, *Seret* 873 (BR); Itukpwo, *Gilbert* 425 (BR); Bambesa, *Gérard* 3839 (BR); Mambasa, *Hart* 91 (BR, K, MO); Mt. Homas(= Mt. Hoyo), *Germain* 5244 (BR, P); Semliki River, *Gille* 100 (BR, C, MO, P, WAG); Semliki, *De Wilde* 393 (BR, MO, WAG). Kivu: Beni, *Lebrun* 4378 (BR, G, K); Between Nazelube and Kamuhehe River, *Osmaston* 2644 (BR); 215 km on Kavumu-Walikale road, *Pierlot* 947 (BR); Ndarikwa River, *Michelson* 231 (BR); Kivu, *Troupin* 4487 (BR, K, WAG); 91 km on Kavumu-Walikale Rd., *Pierlot* 2811 (BR, WAG).

ANGOLA. Cabinda: Maiombe, *Gossweiler* 6258 (LISU), 6258 B (LISU); Buco Zau, *Gossweiler* 7232 (LISU).

UGANDA. Bunyoro Distr., Bugoma, *Dawe* 707 (K); Budongo Forest, *Eggeling* 3972 (BR, K), 4042 (K); Bunyoro, *Katende* 2127 (K). Toro Distr., Semliki Valley, *Dawe* 719 (K).

CULTIVATED. Netherlands: Wageningen Bot. Garden, *Leeuwenberg* 10779 (MO, WAG). Ivory Coast: Abidjan University Bot. Garden, *Aké Assi* 15143 (WAG); Adiopodoumé, *Leeuwenberg* 12025 (WAG). Ghana: Kumasi, *Irvine* 2817 (E); Aburi Gardens, *Howes* 1157 (FHO). Cameroun: Victoria (= Limbe) Botanic Garden, *Winkler* 660 (A). Hawaii: Homaluhia Botanic Garden, *Miller & Merello* 7893 (MO).

2.7 PLEIOCARPA BENTH.

Pleiocarpa Benth. in Benth. & Hook. f. Gen. Pl. 2: 699, (1876); in Hooker, Ic. Pl. 12: 71, (1876); K. Schumann in Engler & Prantl Nat. Pflanzenf. 4, 2: 134 (1895); De Wildeman & Durand In Ann. Mus. Congo Bot. sér. 2 vol. 1, 1: 37 (1899) & sér. 3 vol. 1, 2: 150 (1901); Stapf in Fl. Trop. Afr. 4, 1: 97 (1902); Pichon in Mém. Mus. Natn. Hist Nat. 24: 161 (1948) & in Bol. Soc. Brot. sér. 2, 27: 123 (1953); Hutchinson & Dalziel in Fl. W. Trop. Afr. ed. 1, 2: 37 (1931); H. Huber in Fl. W. Trop. Afr. ed. 2, 2: 63 (1963); Kupicha in Fl. Zamb. 7, 2: 432 (1985). – Lectotype species: *P. mutica* Benth. (designated by Pichon in Bol. Soc. Brot. sér. 2, 27: 123 (1953).

Heterotypic synonym:

Carpodinopsis Pichon in Bol. Soc. Brot. sér. 2, 27: 142 (1953). – Type species: *C. rostrata* (Benth.) Pichon (= *P. rostrata* Benth.), designated by Pichon 1953.

Shrubs or small trees, rarely lianescent, with white latex in all parts; branchlets glabrous. *Leaves* opposite or in whorls of 3-5, petiolate, those of a pair equal or subequal; blade mostly elliptic, entire and glabrous on both sides. *Inflorescence* predominantly axillary, sometimes at the same time terminal, ramiflorous, usually fasciculate; sessile. *Flowers* usually fragrant, rarely malodorous (in *P. pycnantha*), actinomorphic except for the subequal sepals. *Sepals* pale green, mostly thin, rarely coriaceous, free or connate at the extreme base, membranaceous at the edge, completely glabrous on both sides, without colleters. *Corolla* pure white to yellow, tube often greenish in bud, with a belt of pubescence up to 10.5 mm wide inside just below the insertion of the stamens; lobes overlapping to the left in bud, always shorter than the tube, spreading and often recurved later. *Stamens* included, inserted at or above the middle of the corolla tube; anthers ovate, obtuse to acuminate at the apex, cordate at the base, glabrous, of two parallel cells, longitudinally dehiscent. *Pistil* glabrous; ovary composed of 2-5 separate carpels, united at the extreme base by a disk-like thickening; pistil head oblong or ellipsoid; ovules 1-4(-6) in each carpel. *Fruit* yellow to bright orange, smooth or rugose, composed of 2-5 separate mericarps; mericarps variously shaped, with a rounded to hook-shaped apex, 1-6-seeded; wall 2-4 mm thick, fleshy and sometimes slightly fibrous. Seeds brown, variously shaped, somewhat angular. Embryo straight, spathulate, surrounded by a thick, rather starchy and hard endosperm, leaving a hole around the radicle base; cotyledons elliptic, thin and leafy; radicle almost cylindrical, flattened and narrower at the apex, widened towards the base.

Key to the species of *Pleiocarpa*

1. Leaves ternate or on the same branch both opposite and ternate, occasionally in whorls of 4-5 2
   Leaves opposite 3
2. Mature bud 8-13 mm long (rarely up to 15 mm long in Zaire); corolla lobes 1.3-4.8 mm long; ovary 2-carpellate; secondary veins usually more than 12 pairs; leaves in whorls of 3-5 in the whole distribution range .... 4. **P. pycnantha**
   Mature bud 14-26.6 mm long; corolla lobes (5-)6-13 mm long; secondary veins in 9-12 pairs; ovary (3-)5 carpellate; leaves ternate only in specimens from Liberia and Ivory Coast .... 3. **P. mutica**
3. Stamens inserted c. 0.5 of the length of the corolla tube at 4.3-5.5 mm from the base; style 1.2-1.5 mm long .... 2. **P. brevistyla**
   Stamens inserted 0.58-0.92 of the length of the corolla tube at 6.7-18 mm from the base; style 5.5-16 mm long 4
4. Stamens with apex 3-8 mm below the mouth of the corolla tube; secondary veins oblique, very prominent beneath, in 6-9(-12) pairs; inflorescence 1-4-flowered, fruits smooth to rugose with a rounded to beaked apex .... 5. **P. rostrata**
   Stamens with apex 0.2-1.3 mm below the mouth of the corolla tube; secondary veins in 9-30 pairs; inflorescence 10-15(-35) flowered; fruits smooth with a rounded apex 5
5. Secondary veins in 9-12 pairs, 8-20 mm at the central part of the leaf; ovary 3-5- carpellate with 1 ovule per carpel .... 3. **P. mutica**
   Secondary veins numerous, in 19-25 pairs, 4-9 mm at the central part of the leaf; ovary 2-carpellate with 2 ovules per carpel .... 1. **P. bicarpellata**

2.7.1 **Pleiocarpa bicarpellata** Stapf

in Kew Bull. 1894: 21 (1894), partly as for the lectotype & in Fl. Trop. Afr. 4, 1: 99 (1902); Pichon in Bol. Soc. Brot. sér. 2, 27: 125, p. 117 t.3, fig. 8-10, (1953); Hutchinson & Dalziel in Fl. W. Trop. Afr. ed. 1, 2: 38 (1931); H. Huber in Fl. W. Trop. Afr. ed. 2, 2: 63 (1963). – Type: Cameroun Mountain, 1200 m, *Mann* 1213 (lectotype K, designated by Pichon in 1953; isolectotype, P).

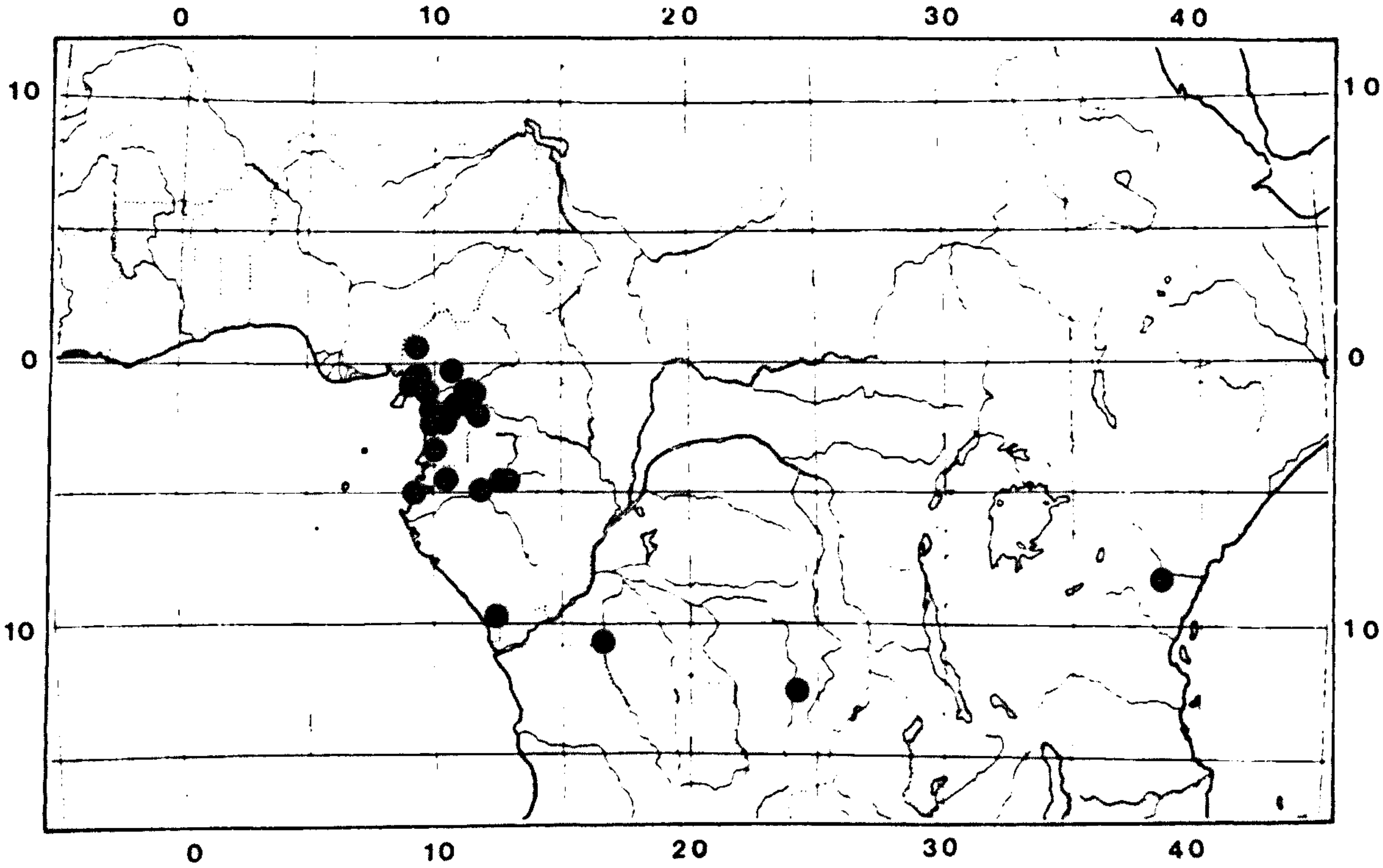
Fig. 36, p. 137: map 14, p. 138

Heterotypic synonym:

Hunteria ambiens K. Schum. in Engler, Bot. Jahrb. 23: 223 (1896); Hallier f. in Jahrb. Hamb. Wiss. Anst. 17 Beih 3: 191 (1899). Type: Cameroun, Lolodorf, *Staudt* 93 (lectotype K, designated here; isolectotypes A, E, G, Z).

Shrub or small tree 1.5-8 m high with white latex in all parts. Trunk very slender, smooth; bark and branches very pale brownish-grey to pale silvery grey, smooth; branchlets thin, quadrangular when young, later terete, very pale to dark brown. *Leaves* opposite; petiole 4-11(-14) mm long, glaucous green; blade papery to thinly leathery in fresh leaves, narrowly elliptic to oblong, (1.6-)2.0-3.8 × as long as wide, 5.1-16.8 × 1.8-7.2 cm, acuminate at the apex, acumen obtuse to acute, 10-22 × 2-4 mm, acute or cuneate at the base and decurrent into the petiole, midrib prominent in fresh leaves; secondary veins straight, in 19-30 pairs, obscure beneath, forming a neat submarginal vein and an angle of 65-80° with the midrib, 4-9 mm apart at the approximate centre of the leaf, tertiary venation inconspicuous beneath and more or less parallel to the secondary veins. *Inflorescence* axillary, ramiflorous, sometimes at the same time terminal, fasciculate, 1.5-2.5 × 2.5-3 cm, 10(-15) flowered, sessile. Pedicels 1-2 mm long. Bracts very small, scale-like. *Flowers* very fragrant. *Sepals* very pale green, free, erect, membranaceous for about 0.2-0.4 mm of their edge, ovate, 0.6-2.1(-3.1) × as long as wide, 1.1-2.8 × 0.6-1.7 mm, acute at the apex where it is usually damaged and appearing dentate. *Corolla* pure white, 15-18.5 mm long in mature bud and forming a comparatively large oblong head 0.31-0.4 of the bud length, (5-) 6.5-8 × 1.5-3 mm, with a rounded apex, with a belt of pubescence 2.8-4.5 mm wide inside just below the insertion of stamens, with longest hairs just below the anthers; tube 5.1-14.3 × as long as the calyx, 1.3-2.4 × as long as the lobes, (9.2-)10-15 mm long, almost cylindrical, 0.8-1.8 mm wide above the base, narrowed below the insertion of the stamens to 0.4-0.8 mm wide, again widened around the anthers to 0.7-2 mm wide; lobes narrowly oblong to broadly ovate, 0.4-0.8 × as long as the tube, 1.3-3.4 × as long as wide, 5-10.2 × (1.5-)2.1-5.5 mm, obtuse, spreading and recurved later. *Stamens* with apex 0.2-1 mm below the mouth of the corolla tube, inserted 0.68-0.86 of the length of the corolla tube, at 7.5-12 mm from the base; filaments 0.3-0.6 mm long; anthers narrowly ovate to oblong, 1.8-5.5 × as long as wide, 1-1.4 × 0.2-0.35 mm, acuminate at the apex, acumen up to 0.3 mm, cordate at the base. *Pistil* 7.5-12.2 mm long; ovary ovoid or subglobose, 0.7-1 × 0.5-0.7 × 0.3-0.7 mm, abruptly narrowed into the style, with a disk-like thickening uniting the carpels at the base, about 0.25-0.4 of the length, 0.2-0.4 mm high, of two separate carpels; style 5.5-10.7 mm long; pistil head oblong to ellipsoid, 0.3-1 × 0.15-0.3 mm. Ovules two in each carpel. *Fruits* orange, smooth, of two separate mericarps; mericarps obovoid or ellipsoid to obliquely ellipsoid in immature fruits, 11-18 × 7-12 × 8-9 mm, rounded at the apex; 2-seeded, wall about 1-2 mm. *Seeds* ellipsoid, oblong or subglobose, 9-11 × 5-7 × 3-4 mm. Embryo 5-7.8 mm long, cotyledons elliptic to ovate, 1.75-2 × as long as wide 2-4 × 1-2 mm, obtuse or rounded

Figure 36. *Pleiocarpa bicarpellata*. **1**, habit (× 2/3); **2**, branch (× 2/3); **3**, sepal (× 20); **4**, corolla (× 4); **5**, opened corolla (× 4); **6**, calyx with ovary (× 6); **7**, pistil (× 6). 1-2 from Zenker II 242; 3-7 from Zenker 1660.



Map 14. *Pleiocarpa bicarpellata.*

at the apex, rounded at the base; radicle 0.87-1.5 × as long as cotyledons, 3-4 × 0.5-0.8 mm.

DISTRIBUTION. Cameroun, Gabon, Zaire, Angola and Kenya.

ECOLOGY. Low bush, secondary or primary forest, sometimes in stream ravine. Alt. 300-1200 m. Flowering and fruiting all the year round.

Geographical selection of the approximately 70 specimens examined:

CAMEROUN. Sud-Ouest: Mamfe Rd., around Ekona Mombo, *Etuge & D. W. Thomas* 419 (MO, WAG); Barombi Lake, *Brenan & Jones* 9458 (FHO, K, P); Barombi Lake, *Preuss* 44 (K); Kumba, *Staudt* 573 (G, K, P, S, US, WU, Z), 683 (EA, G, K, P, Z), 791 (FHO); Bambuko F. R, *Keay* FHI 37457 (K, P); Cameroun Mt., *Mann* 1213 (K, P, type); NE slope of MT. Etinde, *Wieringa* 2070 (WAG). Littoral: near Douala, *Fleury* in *Chevalier* 33348 (P); Edea Reserve, near L. Tissongo, *D. W. Thomas* 294 (K). Centre-Sud: N of Mt. Elephant (Rouillon), *Bos* 6502 (BR, K, M, P, WAG); Calvary Mt., Bidou I, *Bos* 6215 (BR, C, K, P, UPS, WAG); Bipindi, *Zenker* 1658 (B, BP, BR, E, G, K, L, M, NY, S, W, WU, WAG, Z), 1660 (B, BP, BR, E, G, HBG, K, L, M, P, MO, S, W, WAG, WU, Z), 1728 (B, BP, BR, E, G, HBG, K, L, M, NY, S, W, WAG, WU, Z), 2501 B, BP, BR, E, G, HBG, K, L, M, MO, P, W, WAG, WU, Z), 2858 (B, BR, BP, E, G, HBG, K, L, M, P, S, W, WAG, WU, Z), 2893 (BR, BP, E, G, HBG, K, L, M, P, S, WAG, WU, Z), 4231 (BP, BR, E, G, HBG, K, L, M, MO, P, S, W, Z), 4470 (B, BR, E, G, K, L, M, P, S, W, Z), 4635 (B, BP, BR, G, HBG, K, L, M, MO, P, S, W, Z), 4882 (BR, G, HBG, K, L, M, MO, P, S, W, Z); 4889 (B, BP, BR, G, HBG, K, L, M, MO, P, S, W, Z), II 117 (B, C, NY, US, U, WAG), II 242 (B, BR, C, FT, G, GH, MO, NY, P, US, WAG); Efoulen, *Bates* 368 (G, K, Z); Lolodorf, *Staudt* 93 (A, E, G, K, P, W, Z); Ndikinimeki, *Asonganyi* 414 (P, WAG); 25 km ESE of Ebolowa, *Letouzey* 9850 A (P); near Oveng, *Breteler* 2650 (K, P, WAG); c. 5 km S of M'balmayo, *De Wilde & De Wilde-Duyfjes* 1798 B (BR, P, WAG); Ototomo Forest Reserve, *Farron* 7261 (P); Yaoundé, *Zenker & Staudt* 611 (B, M, US, WU), 753 (K); Meyang Hill, *Dang* 614 (P).

GABON. Estuaire: Monts de Cristal, *Hallé & Villiers* 5080 (P). Ogooué-Ivindo: near Ekobakoba, *Reitsma* 2717 (WAG), 3051 (NY, WAG); 10 km SSW of Makokou, *Leeuwenberg* 11451 (WAG); Booué

Forest, *Florence* 1798 (P). Woleu Ntem: E of Médouneu, *Hallé & Villiers* 5008 (P).

ZAIRE. Kivu: Kasongo, *Herman* 2-7-1955 (Z). Shaba: Galerie Luba, *Herman* 2179, 2248 (BR); Kaniama, *Gathy* 1908 (BR).

ANGOLA. Cabinda: Buco Zau, *Gossweiler* 6549 (K), 6687 (BM), 6648 (COI), 8024 (BM).

KENYA. K7, Taita Taveta Distr. Chawia forest, *Omino* 82 (EA), 157, 158 (EA, WAG).

Notes. When Stapf (1894) described *P. bicarpellata*, he distinguished it on the basis of its opposite leaves and bicarpellary ovary with 2 ovules each. All the specimens analyzed from Cameroun, Gabon and Taita hills maintain these characteristics. In Equatorial Guinea, the only specimen analyzed has 3 carpels and 2 ovules (*Tessmann* 549). As one approaches Congo, specimens that look quite similar to *P. bicarpellata* are found that have 5 carpels instead of the usual 2 (*Sita* 2977, *Bouquet* 514). Unfortunately, none of these specimens have flowers, therefore making it difficult to place them at the moment. In Zaire a few specimens from Kaniama maintain the original *P. bicarpellata* characteristics, but have comparatively much smaller flowers (*Herman* 2248, 2179 and *Gathy* 1908). The rest of the specimens from Zaire have an extremely variable number of carpels (3-5), even in the same inflorescence, one or two ovules per carpel and very short corolla lobes (less than 3.4 mm), (*Toussaint* 2411, *Donis* 1967, *Germain* 7622, *Ed Luja*, June 1910, *Vanderyst* 10270, 10271, and 15900). I, however hesitate to place these specimens under *bicarpellata* until thorough fieldwork has been carried out. In my opinion the genus *Pleiocarpa* has proved to be extremely variable as a whole, and one cannot merely unravel this mystery based on morphology alone. Other disciplines need to be employed to study the various populations to better understand the variation.

2.7.2 Pleiocarpa brevistyla Omino sp. nov.

Frutex foliis oppositis petiolatis lamina coriacea elliptica apice acuminata. Inflorescentia plerumque axillaris rariter terminalis vel ramiflora. Flores odorantes. Sepala pallide viridia ovata apice obtusa usque ad rotundata. Corolla alba tubo lobis ovatis longiore. Stamina inclusa circiter medio tubi corollae inserta antheris ovatis apice obtusis basi cordatis. Pistillum ovario carpellis quinque separatis. Fructus mericarpis quinque separitis. – Type: Gabon, Ogooué-Maritime, 5 km East of Gamba Airport, *Wieringa* 1267 (holotype WAG, photo. WAG).

Fig. 37, p. 140; map 15, p. 141

Shrub 1-1.2 m high. Trunk very slender. Branchlets drying greyish-black. *Leaves* opposite; petiole 5-7 mm long; blade leathery when fresh, broadly to narrowly elliptic, 2.2-4.2 × as long as wide, 4.5-16.8 × 2.1-5.9 cm, acuminate at the apex, acumen 7-17 × 2-3 mm, acute to cuneate at the base or decurrent into the petiole; midrib slightly prominent beneath in dried leaves; secondary veins more or less straight and slightly curved towards the margin, in 12-18 pairs, forming a submarginal vein and an angle of 60-70° with the costa, 4-10 mm apart at the approximate centre of the leaf. *Inflorescence* predominantly axillary, rarely terminal or ramiflorous, 1(-2) flowered, sessile. *Flowers* fragrant. *Sepals* pale greenish yellow,

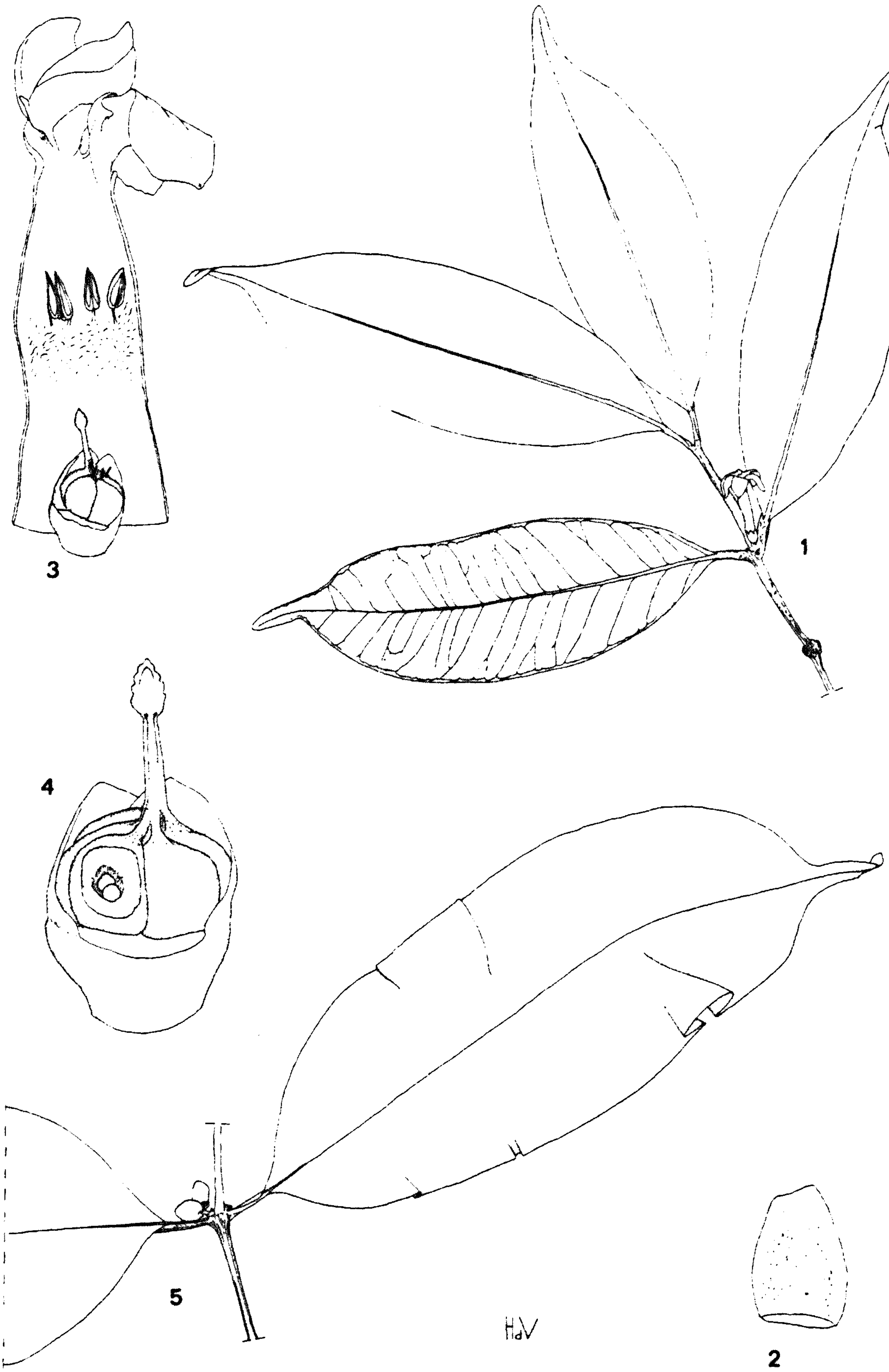
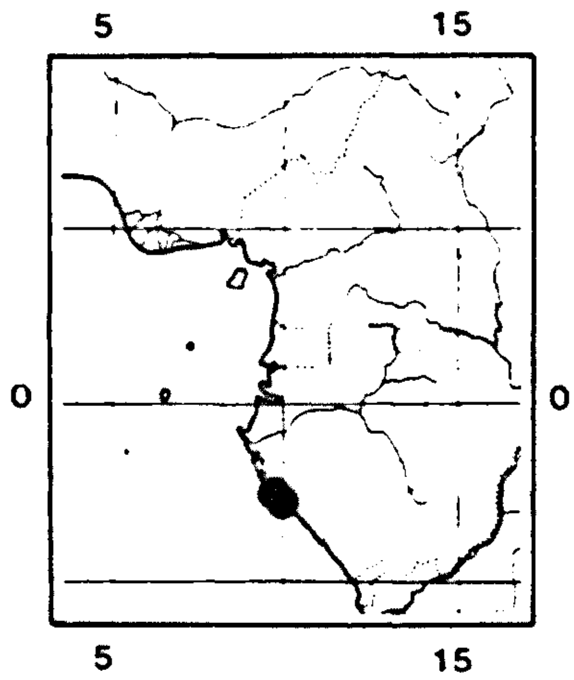


Figure 37. *Pleiocarpa brevistyla*. **1**, habit (× 2/3); **2**, sepal (× 12); **3**, opened corolla and above it pistil with part of calyx (× 4); **4**, pistil with opened ovary and part of calyx (× 12); **5**, branchlet with young fruits (× 2/3). 1 from Wieringa 1267; 2-4 from Van der Burgt 48; 5 from Wieringa & Haegens 2502.



Map 15. *Pleiocarpa brevistyla.*

erect, ovate, 0.8-1.2 × as long as wide, 1.4-1.5 mm, obtuse to rounded at the apex. *Corolla* white, with a belt of pubescence 1.5-2 mm wide inside just below the insertion of the stamens; tube 5.8-6 × as long as the calyx, 1.9-2.2 × as long as lobes, 8.5-10.5 mm long, almost cylindrical, 1.9 mm wide above the base, narrowed below the insertion of the stamens to 1.5 mm wide, again widened around the anthers to 1.9 mm; lobes ovate, 0.5 × as long as the tube, 1.6-1.8 × as long as wide, 4.5-4.8 mm long, obtuse at the apex, recurved. *Stamens* with the apex 3-3.2 mm below the mouth of the corolla tube, inserted 0.5-0.52 of the length of the corolla tube at 4.3-5.5 mm from the base; filaments short, filiform, 0.5 mm long; anthers ovate, 3.7-4.8 × as long as wide, 1.1-1.2 × 0.25-0.3 mm, obtuse at the apex, cordate at the base, *Pistil* 2.5-3 mm long; ovary broadly subglobose, 0.8-1.2 × 1-1.5 × 0.6-1.3 mm, abruptly narrowed into the style, of 5 separate carpels; style 1.2-1.5 mm long; pistil head narrowly ovoid to ellipsoid, 0.5-0.6 × 0.2-0.3 mm. Ovules (1-) 2 in each carpel. *Fruits* of five separate mericarps, mericarps immature, rounded, triangular from above, c. 9 × 6 mm.

DISTRIBUTION. Gabon.

ECOLOGY. Dense forest. Alt. 30 m. Flowering between July and March, fruiting in March to May.

Specimens examined:

GABON. Ogooué-Maritime: Gamba, *J. De Wilde* 11375 (WAG); Gamba near Namba Lake, *Van der Burgt* 48 (WAG); 5 km E of Gamba Airport, *Wieringa* 1267 (WAG); *Wieringa & Haegens* 2502 (WAG).

Notes. The leaves of *Pleiocarpa brevistyla* resemble those of *P. mutica*, the two species can be distinguished as follows:

Stamens with apex 3-3.2 mm below the mouth of the corolla tube, inserted 0.5-0.52 of the length of the corolla tube at 4.3-5.5 mm from the base; style 1.2-1.5 mm long . . . . **P. brevistyla**

Stamens with apex 0.8-1.3 mm below the mouth of the corolla tube, inserted 0.73-0.92 of the length of the corolla tube at 8-18 mm from the base; style 7.9-16 mm long .... **P. mutica**

2.7.3 Pleiocarpa mutica Benth.

in Hooker. Ic. Pl. 12: 71, Pl. 1181 (1876); K. Schumann in Engler & Prantl, Nat. Pflanzenf. 4, 2: 135, fig. 52, C & D, p. 134 (1895); Stapf in Fl. Trop. Afr. 4, 1: 98 (1902); Pichon in Bol. Soc. Brot. sér. 2, 27: 138, map c p. 121 (1953); Hutchinson & Dalziel in Fl. W. Trop. Afr. ed. 1, 2: 38 (1931); H. Huber in Fl. W. Trop. Afr. ed. 2, 2: 63, fig. 214, (1963). – Type: Nigeria, Cross River State, Old Calabar River, *Mann* 2277 (holotype K).

Fig. 38, p. 143; map 16, p. 144

Homotypic synonym:

Hunteria pleiocarpa Hall. f. in Jahrb. Hamb. Wiss. Anst. 17, Beih. 3: 193 (1899), partly as for the type.

Heterotypic synonyms:

Pleiocarpa salcifolia Stapf op. cit. 99 (1902); Hutchinson & Dalziel op. cit. 38 (1931). – Type: Sierra Leone, sin. loc., *Barter* 8 May 1851, (holotype K).
P. tricarpellata Stapf in Kew Bull. 1915: 47 (1915); Hutchinson & Dalziel op. cit. 38 (1938). – Type: Sierra Leone, Falaba, *Alymer* 35 (holotype K).

Shrub or small tree 0.5-7.6 m high, rarely a climbing shrub, 4-9 m high. Trunk 1.5-5 cm in diameter; bark smooth, dark brown to pale grey; wood pale brown to yellow, hard, very close-grained. Branches dark green with brownish patches, brown to dark brown, or dark grey, lenticellate; branchlets brownish, pale to medium green. *Leaves* opposite, sometimes ternate (in plants from Liberia and Ivory Coast); petiole, 5-13 mm long; blade papery to thinly leathery when fresh, rather stiff, broadly to narrowly elliptic, oblong to ovate 1.6-5 × as long as wide, 5.1-19.5(-29.5) × 1.9-8.1(-11.4) cm, acuminate at the apex, acumen acute, 4-25 × 2-5 mm, acute, obtuse or cuneate at the base and decurrent into the petiole, smooth and shiny on both sides, drying reddish beneath; midrib slightly channelled above, prominent beneath; secondary veins in 9-12 pairs, forming a submarginal vein and an angle of 50-70° with the midrib, 8-20(-30) mm apart at the centre of the leaf; tertiary veins obscure beneath. *Inflorescence* an axillary cluster or ramiflorous, rarely terminal, 1.5-2.5 × 2-3 cm, about 10 (-35)-flowered; sessile. Pedicels brown, 0.5-2 mm. Bracts very small, 0.8 × 0.5 mm. *Flowers* very fragrant. *Sepals* pale to dark green, free or connate at the base up to 0.2-0.4 mm of their length, erect, membranaceous for about 0.3-0.4 mm of their edge, ovate or elliptic, 0.7-2.6 × as long as wide, 1.3-2 (-2.4) × 0.7-1.9 mm, obtuse at the apex. *Corolla* pure white, 14-26.6 mm long in mature bud and

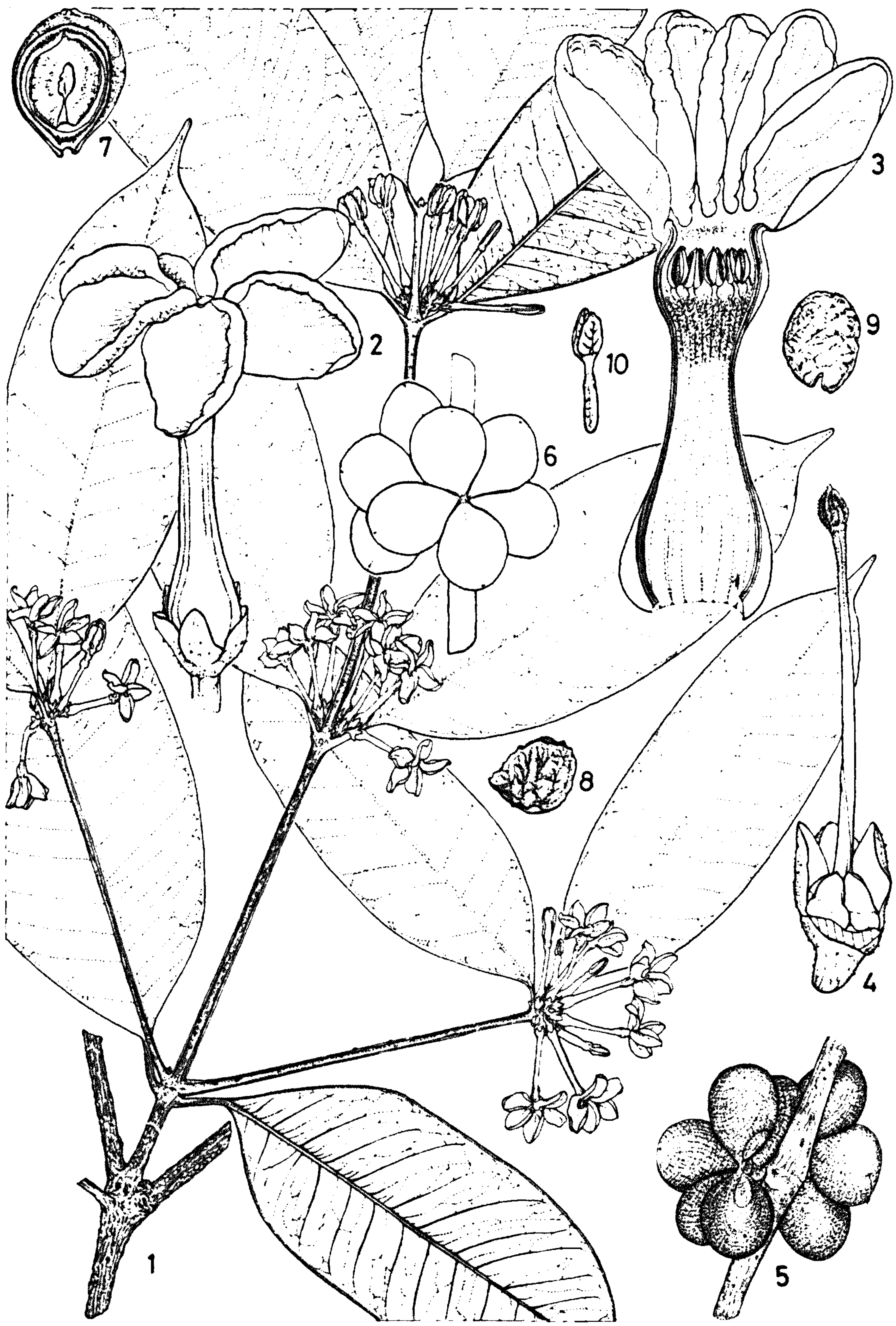
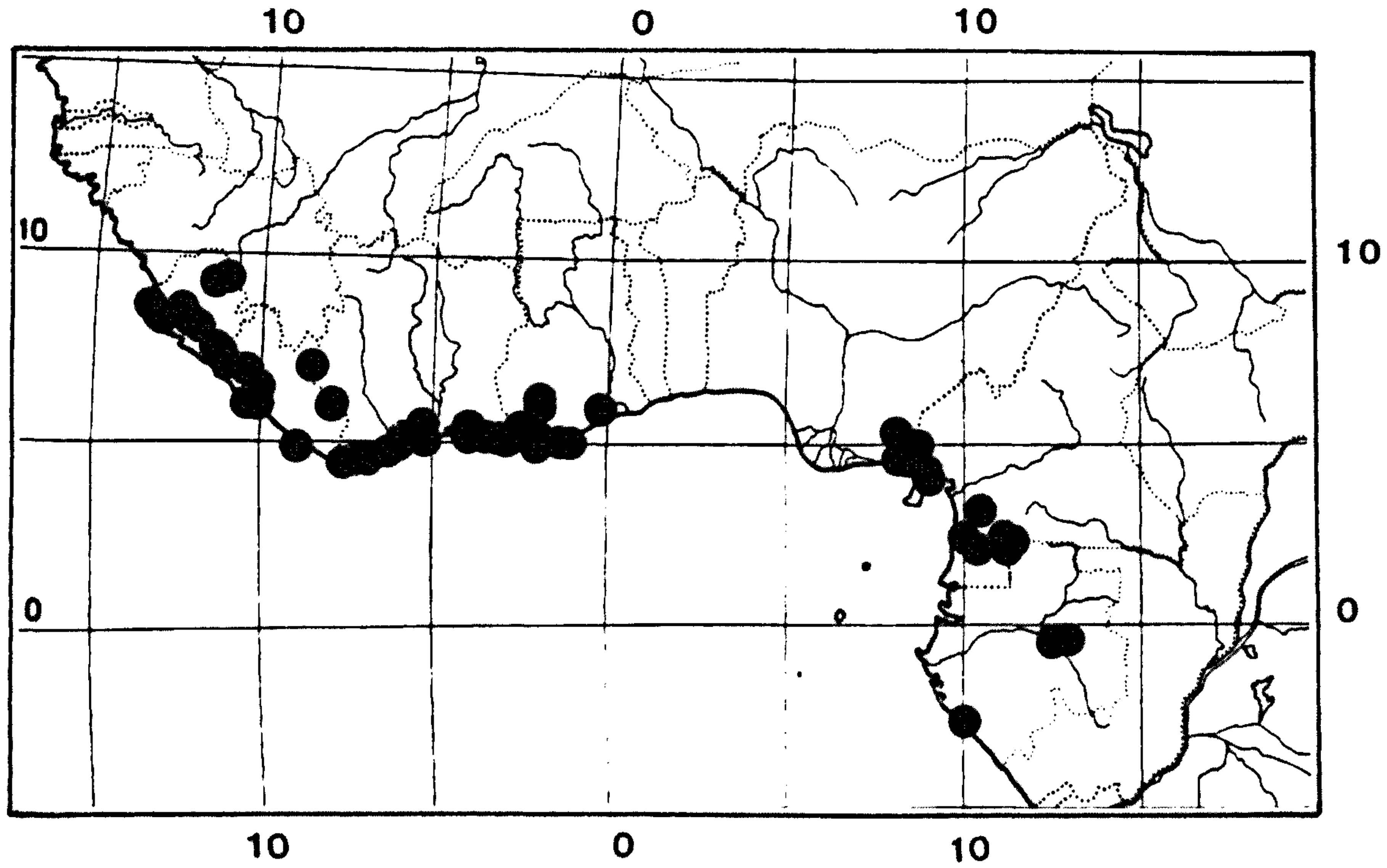


Figure 38. *Pleiocarpa mutica*. **1**, habit (× 2/3); **2**, flower (× 3.4); **3**, opened corolla (× 4); **4**, opened calyx with pistil (6); **5**, infructescence (× 2/3); **7**, longitudinal section of seed in fruit (× 1); **8**, pulp (× 1); **9**, seed (× 1); **10**, embryo (× 2). 1 from J.J. de Wilde 7548; 2-4 from Leeuwenberg 12219; 5-10 from De Koning 5790.



Map 16. *Pleiocarpa mutica.*

forming a comparatively large oblong head 0.29-0.37 of the bud length, 5-11 × 2.5-3.5 mm, with a rounded apex, with a belt of pubescence 2.5-6 mm wide inside just below the insertion of stamens, longest hairs just below the anthers becoming shorter and scarce further down and sometimes with a few hairs around the stamens up to the mouth; tube 5.3-13 (-18.4) × as long as the calyx, 1.4-2.4(-2.8) × as long as the lobes, 10.8-22 mm long, almost cylindrical, 1-3 mm wide above the base, narrowed below the insertion of the stamens to 0.4-1.8 mm wide, again widened around the anthers to 0.9-1.8(-2.5) mm wide; lobes ovate, elliptic to narrowly oblong, 0.4-0.7 × as long as the tube, 1.4-5.2 × as long as wide, (5-)6-13 × 2.1-4.3 mm, rounded or obtuse at the apex, entire, spreading and recurved later. *Stamens* with apex 0.8-1.3 mm below mouth of the corolla tube inserted 0.73-0.92 of the length of the corolla tube, at 8-18 mm from the base; filaments 0.2-0.6 mm long, glabrous; anthers narrowly ovate to oblong, yellow with red stripes, 2.8-6 × as long as wide, 1-1.9 × 0.25-0.6 mm, obtuse at the apex and sterile for 0.2 mm, cordate at the base. *Pistil* 9.2-18 mm long; ovary subglobose, 0.7-1.2 × 0.6-1.5 × 0.5-1 mm, abruptly narrowed into the style, with a disk-like thickening uniting the carpels at the base, about 0.4-0.5 of the length, 0.3-0.4 mm high, of 5 separate carpels, (occasionally 3-4 carpels found in the flowers of the same inflorescence or branch); style white, 7.9-16 mm long; pistil head white, oblong to ellipsoid, 0.6-1 × 0.2-0.4 mm rarely with a filiform stigmoid apex up to 0.3 mm long. Ovule one in each carpel. *Fruits* yellow to bright orange, smooth, dull, slightly wrinkled to finely lenticellate, 5 (rarely 3-4) separate mericarps; mericarps obovoid, subglobose, ovoid, or ellipsoid, sometimes somewhat curved and with a pointed apex, often in clusters, 13.5-20 × 8.5-20 × 7-11.6 mm, rounded at the apex, always 1-seeded; wall about 2-3 mm thick. *Seeds* subglobose to oblong, 7.5-12 × 4.5-9.5 × 4-8 mm. Embryo 7.1-9 mm long; cotyledons ovate to elliptic, thin and leafy, 1.2-2.3 × as long as wide, 3-4 × 1.5-3 mm, obtuse at the apex and rounded at the base; radicle 0.9-2.3 × as long as the cotyledons, 3.4-5 × 0.6-0.8 mm.

DISTRIBUTION. Sierra Leone, Liberia, Ivory Coast, Ghana, Nigeria, Cameroun and Gabon.

ECOLOGY. Dense primary or secondary forest in swampy areas rich in epiphytes or along the river banks on sandy soil or limestone out-crops. Alt. 0-600 m. Flowering and fruiting all the year round in Ivory Coast, flowering in January to April and fruiting between July to September in the other countries.

USES. The wood is yellow, hard, heavy, close-grained and tough (*Vigne* 269, FHO, K, P, Ghana; Burt-Davy 1937; Irvine 1969); used to make combs (*Deighton* 3270, K, P, 1936, Sierra Leone); for combs and planes (*Vigne* 269, FHO, K, P, Ghana); for sundry small objects (Aubreville 1959); used in Ivory Coast for canoe paddles and pestles (Bouquet & Debray 1974). An ornamental plant with clusters of narrow, tubular, white sweet-scented flowers known as the stove plant in Europe (Dalziel 1937; Irvine 1961). In Ivory Coast the plant is considered a general panacea for all ills by the coastal people, the Anyi use a decoction of the grated bark for stomach pains, and a similar preparation is used by the Kyama against oedema of the legs, probably due to kidney malfunction (Dalziel 1937); a decoction of the root bark used against kidney diseases and malaria (*Leeuwenberg* 12302, WAG, 1981, Ivory Coast); bark ground and rubbed on the body against fever (*Deighton* 3270, K, P, 1936, Sierra Leone). A number of alkaloids have been reported from the bark and roots (*Willaman & Li* 1970).

A selection of the approximately 130 specimens examined:

SIERRA LEONE. York Peninsula, *Morton* 23.11.1963 (K), SL 1268 (WAG); Falaba, *Alymer* 35 (K, type of *P. tricarpellata*); near Falama, *Deighton* 3869 (K), *Deighton* 3871 (K); Giehun, *Marmo* 65 (K); Gola Forest, *Small* 701 (B, K, P); Yonibana, *N. W. Thomas* 4235 (K); Kambui Forest Reserve, *Lane-Poole* 333 (K); Mabonto, *Deighton* 3270 (K, P); Sugar Loaf Mt., *Hepper* 2539 (K); Near Sugar Loaf, *Richards* 6.2.1971 (K), *Roberty* 17318 (G); Gbinti, *Deighton* 2501 (K); Kafa, *Alymer* 216 (K); sin. loc. *Barter* 8.5.1851 (K, type of *P. salicifolia*).

LIBERIA. Bonge Range, *Voorhoeve* 1140 (WAG), *Leeuwenberg & Voorhoeve* 4945 (B, BR, HBG, K, MO, P, WAG). Eastern Prov.: Tchien Distr., *Baldwin* 7013 (K); 16 km NW of Tchien, *Jansen* 1255 (WAG); Along Dukwai R., *Cooper* 248 (A, FHO, GH, K, NY, US); Monrovia, *Dinklage* 2976 (Z); Grand Cape Mt., *Baldwin* 10814 A (K); Greenville, *Baldwin* Jr. 11552 (K, MO); Ganta, *Harley* 317 (K); Road to Tappita, *Jansen* 2112 (P); Zeah Town, *Baldwin* 6991 (K); Firestone Plantation, *Linder* 2.8.1926 (A).

IVORY COAST. Mont Cope, *Chevalier* 19722 (P); Yokobo, *Leeuwenberg* 12302 (WAG); Fort Binger (= Djiroutou), *Chevalier* 19432 (P); Béréby, *Chevalier* 20011 (K, P); San Pedro, *Thoiré* 796 (P); 22 km NE of Monogaga, *Geerling & Bokdam* 2377 (BR, MO, WAG); Sassandra, *Thijssen* 118 (WAG); 60 km N of Sassandra, left bank of Davo River, *Leeuwenberg* 2835 (BR, FHO, GENT, K, L, MO, NY, P); 50 km NNE of Sassandra, *Breteler* 6120 (K, L, P, U, US, WAG, Z); West of Fresco, *Breteler* 5354 (BR, K, P); Yapo Forest, *Bamps* 2559 (BR); Banco Forest, *De Koning* 5790 (WAG); ibid., *Oldeman* 961 (B, BR, K, M, WAG); Between Port Bouet and Grand Bassam, *J. de Wilde* 3204 (A, B, BR, K, NY, P, WAG); Aboisso, Sanvi, *Chevalier* 17862 (P); Assinie, *Chevalier* 17869 (P).

GHANA. Western: Enchi, *Andoh* 5639 (BR); Tano Nimri, *Enti* FH 7544 (K, UPS); Ankasa Game Reserve, *Jongkind & Abbiw* 2073 (WAG); Asanwinso, *Vigne* 269 (FHO, K, P); Axim, *Irvine* 2173 (E, K, MO); Asenanyo Forest Reserve, *Andoh* 4305 (BR, K); Ndumfri R. Forest Reserve, *Enti & Hall* GC 38392 (FHO, K); Princes Town, *Akpabla* 792 (K); Neung Forest Reserve, *Enti* 2296A (MO); Daboase, *Hall & Abbiw* GC 45117 (K). Central: Eguafo, *Hall* 2944 (K). Eastern: Atewa Range Forest Reserve, *Vigne* 4345 (K).

NIGERIA. Cross River: Odukpani, *Ariwaodo* in FHI 88715 (MO); Abangara-Ndiakoro Rd., *Ujor* FHI 30169 (K); Old Calabar R., *Mann* 2277 (K, type); Stubbs Creek Forest Reserve, *Van Meer* 1178 (WAG); Ekinta R. Forest Reserve, *Van Meer* 1491 (WAG); Oban Group Forest Reserve, *Van Meer* 1266 (WAG); Oban, *Talbot* 1565 (K), 1654 (K), 1911-1912 (K).

CAMEROUN. Sud-Ouest: Korup National Park, *D. W. Thomas* 4575 (P, MO, WAG); Kondotiti-Mundemba Rd., *Gentry & D. W. Thomas* 52681 (MO, WAG); Near Ekondotiti, *Lowe* 3807 (K); 4 km W. of Onge River, *Watts* 760 (K); Idenao, *Tchouto* 740 (K); Weke, Kumba, *Smith* 75/36 (FHO). Centre-Sud: Lolodorf, *Staudt* 322 (G, K, P, S); 5 km NE of Lolodorf, *Letouzey* 12784 (P, YA); Near Meyo, Ntem, *Koufani* 107 (P, WAG), *Letouzey* 15209 (P); Ebolowa, *De Wilde & de Wilde-Duyfjes* 1964 (BR, K, P, WAG); Station du Cacaoyer de N'koemvone, *J. de Wilde* 7548 (BR, P, MO, WAG); 10 km SW of Ambam, *De Wilde & De Wilde-Duyfjes* 2032 (WAG); 25 km ESE of Ebolwa, *Letouzey* 9850 B (P).

GABON. Nyanga: Gamba, *Breteler & Van Raalte* 5635 (BR, WAG). Ogooué-Lolo: near Lastoursville, *Breteler* 6558 (BR, MO, WAG); 14 km NE of Bambidie, *Breteler* et al., 13338 (WAG).

CULTIVATED. Netherlands: Wageningen Bot. Garden, *Leeuwenberg* 14054 (WAG), *Van Setten* 415 (WAG), seedling of *De Koning* 576; Ivory Coast: Adiopodoume, *Breteler* 6207 (WAG); Université d'Abidjan, *Fredoux* 589 (P). Singapore: Botanic Garden, *Leeuwenberg* 13340 (WAG).

Notes. The only constant character in *P. mutica* is the number of ovules which is always one per carpel in all the specimens examined, even when the carpels vary from 3-5. The leaves, are opposite and sometimes ternate especially in specimens from Ivory Coast.

2.7.4 Pleiocarpa pycnantha (K. Schum.) Stapf

in Fl. Trop. Afr. 4,1: 99 (1902); Eggeling & Dale in Indig. Trees Uganda Prot. ed. 2: 29 (1951); Pichon in Bol. Soc. Brot. sér. 2, 27: 128, t. 4 fig. 1 (1953); F. White in F. F.N.R. 350 (1962); H. Huber in Fl. Trop. Afr. ed. 2, 2: 63 (1963); R.B. Drummond in Kirkia 10: 269 (1975); Kupicha in Fl. Zamb. 7, 2: 432, tab.99, p. 433 (1985). – Type: Uganda, Sesse Islands, *Stuhlmann* 1216, (holotype B†, isotype K).

Fig. 39, p. 147; map 17, p. 148

Basionym:

Hunteria pycnantha K. Schum. in Engler, Bot. Jahrb. 23: 222 (1896); Hall. f. in Jahrb. Hamb. Wiss. Anst. 17, Beih. 3: 191 (1899).

Heterotypic synonyms:

Pleiocarpa tubicina Stapf in Kew Bull. 1898: 304 (1898); De Wildeman & Durand in Ann. Mus. Congo Bot. Ser. 2 vol. 1, 1: 37 (1899) & 1, 2: 150 (1901). *P. pycnantha* var. *tubicina* (Stapf) Pichon op. cit. 132, map C, p. 121.; H. Huber l.c. – Type: Zaire, Lower Congo R., *Dewèvre* 945 (holotype BR; isotype K).

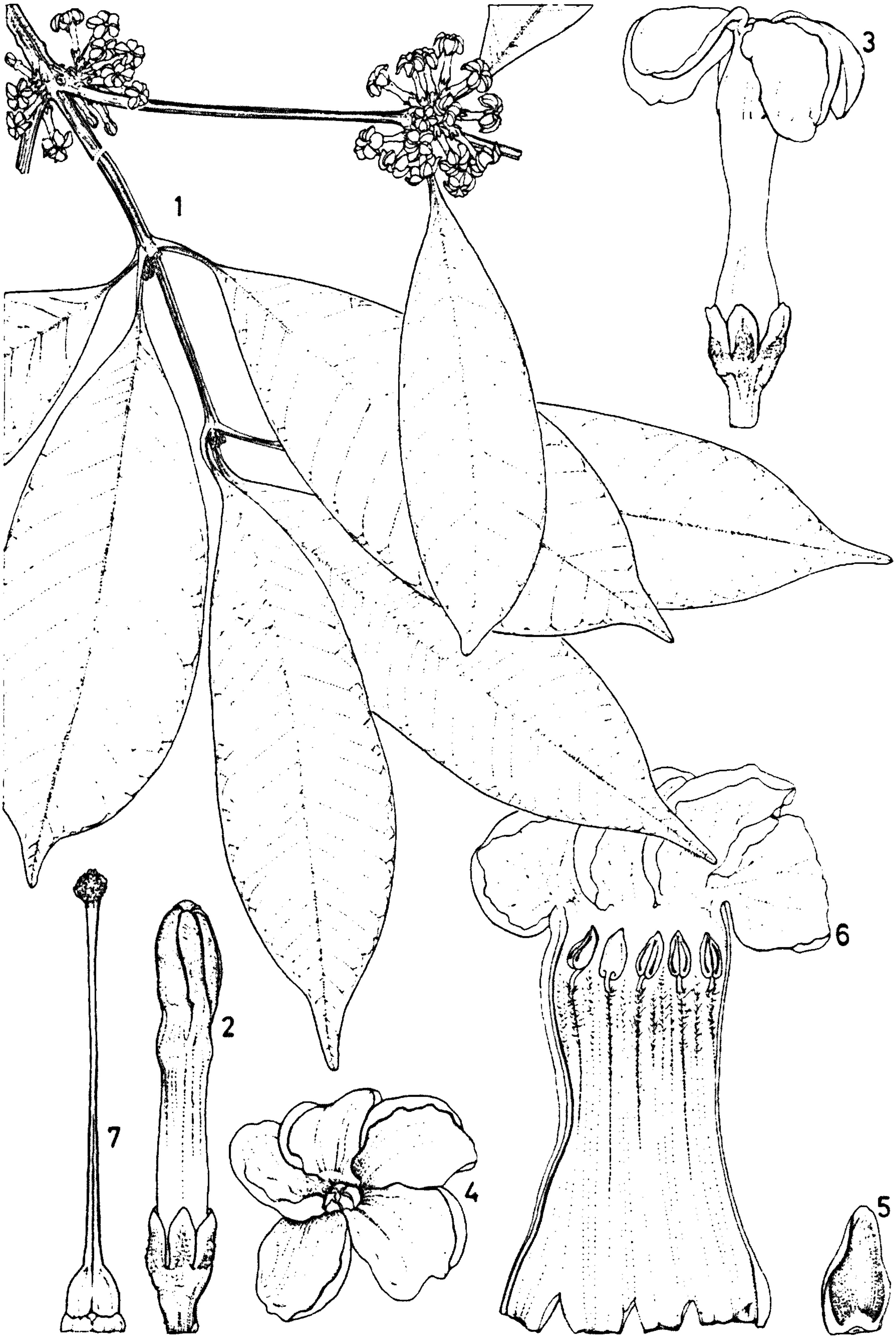
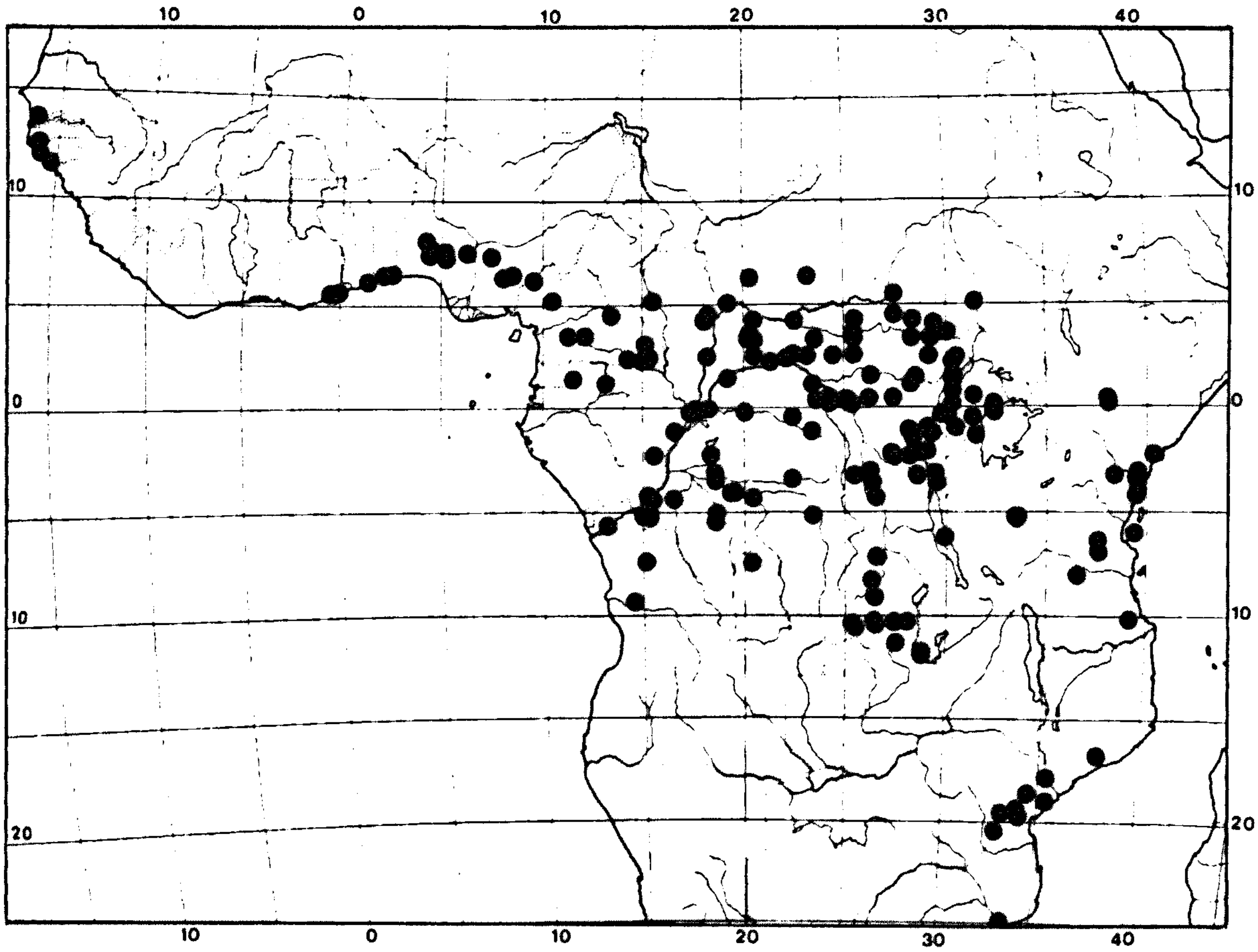


Figure 39. *Pleiocarpa pycnantha*. **1**, habit (× 2/3); **2**, flower bud (× 4); **3**, flower (× 4); **4**, flower above (× 4); **5**, sepal inside (× 8); **6**, opened corolla (× 6); **7**, pistil (× 8). 1 from J. Louis 12898; 2-7 from Breteler & De Wilde 636/78.



Map 17. *Pleiocarpa pycnantha*.

P. welwitschii Stapf ex Hiern in Cat. Welw. Afr. Pl. 1, 3: 665 (1898); Stapf in op. cit. 100. – Type: Angola, Golongo Alto, left bank of R. Cuango, *Welwitsch* 5981 (holotype K; isotypes B, BM, C, G, P).

Hunteria breviloba Hall. f. in Jahrb. Hamb. Wiss. Anst. 17, Beih 3: 189 (1899); Schlechter in Westafr. Kautschuk. Exped. 306 (1900). *Pleiocarpa breviloba* (Hall. f.) Stapf op. cit 102. – Type: Congo, near Sanga R., between Woso and Bonga, *Schlechter* 12706 (holotype B †).

Pleiocarpa micrantha Stapf in op. cit. 100; Hutchinson & Dalziel in Fl W. Trop. Afr. ed. 1, 2: 38 (1931); Irvine in Woody pl. Ghana, 630 (1961). – Type: Ghana, base of Aburi hills, *Johnson* 623 (holotype K).

P. flavescens Stapf in op. cit. 101; Hutchinson & Dalziel l.c. – Type: Ghana, Aburi hills, *Johnson* 616 (lectotype K, designated here).

P. microcarpa Stapf in op. cit. 102. – Type: Zaire, Haute-Zaire Niamniamland, Mbrowole R., *Schweinfurth* 3073 (holotype K).

P. bagshawei S. Moore, in J. Bot. 14: 49 (1907). – Type: Uganda, U2, Toro Distr., Durro (= Dura) Forest, *Bagshawe* 1086 (holotype BM).

P. swynnertonii S. Moore, in J. Linn. Soc. Bot. 40: 138 (1911). – Type: Zimbabwe, Chirinda Forest, *Swynnerton* 14 (lectotype BM, designated by Kupicha 1985; isolectotypes K, SRGH, US, Z).

Shrub or small tree 1.5-20 (-30) m high, rarely lianescent. Trunk 2-50 cm in diameter; bark 3-6 mm thick, smooth or slightly rough, fissured to reticulate with irregular longitudinal and straight horizontal cracks 1-2 cm deep, pale to dark grey, pale to reddish-brown, yellowish to brown on section, sometimes lenticellate, more or less flaky and peeling off; inner bark creamy-white to pale brown with dark yellow striations; wood very hard and durable, smooth, dark brown. Branchlets terete, very pale to dark brown in dried specimens, sometimes lenticellate, often with bark peeling off. *Leaves* opposite and in whorls of 3-5, always whorled in one node of each branchlet of a plant; petiole 5-20 mm long; blade coriaceous when fresh, papery when dried, narrowly elliptic to oblong, rarely obovate, 1.9-5.4 × as long as wide, 4-22.3 × 1.1-8 cm, acute, obtuse to acuminate at the apex, acumen 4-12 × 2-5 mm, acute or obtuse to rounded, or cuneate at the base and decurrent into the petiole, sometimes undulate, glossy, with 15-25 pairs of secondary veins, forming a neat submarginal vein and angle of 50-80° with the midrib, tertiary venation inconspicuous. *Inflorescence* axillary, rarely also terminal, fasciculate, sometimes ramiflorous, 1-2 × 1-3 cm, 10-30(-40)-flowered; sessile or with a peduncle 1-2 mm long. Pedicels 1-3 mm long. Bracts very small, scale-like. *Flowers* very fragrant to malodorous. *Sepals* green, free or connate at the base for up to 0.2 of their length, erect, often spreading in dried flowers, membranaceous for about 0.2-0.4 mm of their edge, broadly ovate or ovate to elliptic, 0.9-2.5 × as long as wide, 1.1-2.5(-3) × 0.6-2 mm, acute to rounded at the apex. *Corolla* pure white to orange-yellow, 8-12.8(-15) mm long in the mature bud and forming a comparatively narrow ovoid head 0.14-0.4 of the bud length, 2-4.5 × 0.5-2.5 mm, with a rounded apex, with a belt of pubescence 1-3 mm wide inside just below the insertion of stamens, hairs longest just below the stamens; tube greenish-white, 3.2-7.5 (-8.8) × as long as the calyx, 1.7-4.8 (-5.4) × as long as the lobes, 6.2-10 (-10.5) mm long, almost cylindrical, 0.6-2 (-3) mm wide above the base, narrowed below the insertion of the stamens to 0.6-1.5 mm wide, again widened around the anthers to 0.7-2 mm wide; lobes ovate or elliptic to suborbicular, 0.2-0.5(-0.6) × as long as the tube, 0.9-2.1(-2.5) × as long as wide, 1.3-4.5(-4.8) × 0.7-3.2(-3.5) mm, rounded to acute at the apex, entire, spreading and recurved later and with an upcurved apex. *Stamens* with apex 0.2-1 mm below the mouth of the corolla tube, rarely visible at the mouth, inserted 0.64-0.87 (-0.97) of the length of the corolla tube, at 4.6-8 (-9.5) mm from the base; filaments white, 0.3-0.7 mm long; anthers yellow, ovate, 1.75-5.3 × as long as wide, 0.6-1.3 × 0.15-0.5 mm, acuminate to obtuse at the apex, cordate at the base. *Pistil* glabrous, 4.6-8.6 (-9.7) mm long, ovary ovoid or subglobose, 0.5-1.4(-1.7) × 0.3-1.0(-1.2) × 0.2-0.8(-1) mm, abruptly narrowed into the style, with a disk-like thickening uniting the carpels at the base, about 0.25-0.4 of the length, 0.2-0.5 mm high, of two separate carpels; style 3.8-7.2 (-8) mm long; pistil head ellipsoid to ovoid 0.2-0.8 (-1.0) × 0.2-0.5 mm. Ovules two in each carpel, (4 in *Troupin* 4024, WAG and *Goldsmith* 38/65, SRGH). *Fruits* yellow to orange; mericarps smooth, sometimes rugose, subglobose or pyriform to ellipsoid, sometimes stipitate, 13-23 (-30) × 6.5-24 × 5-15 mm, acuminate to rounded at the apex, 2 seeded, wall about 2-5 mm thick, sometimes fibrous. *Seeds* ellipsoid to oblong, 6.5-13.5 × 4.5-9.5 × 2-4 mm. Embryo 4.7-9 mm long, cotyledons ovate to elliptic, thin and leafy, 1.1-3.7 × as long as wide, 2-4 × 0.8-

2.0 mm, rounded at the apex and at the base; radicle, 0.4-1.9 × as long as the cotyledons, 1.4-5 × 0.4-0.9 mm.

DISTRIBUTION. Tropical Africa from Senegal in the West to Kenya in the East and Angola and Mozambique in the South.

ECOLOGY. Montane forest, secondary forest or rain forest understorey rich in lianas, mosses and epiphytes, or gallery forest. Alt. 0-2300 m. Flowering and fruiting all the year round.

USES. The wood is very hard (Dalziel 1937) and is used for local construction (*Flamigny* 6123, BR); for making combs (Irvine 1961). Roots ground, mixed with guinea grains and palm wine and used to promote freedom of bowels, or used in palm wine to make it strong (*Irvine* 1759, E, K, 1932, Ghana); leaves are bitter (Irvine 1961).

A selection of the approximately 200 specimens examined:

SENEGAL. Sine Saloum: Delta du Saloum National Park, *Lykke* 356 (WAG). Casamance: Djibelor, *Van den Berghen* 5661 (BR); Oussouye *Adam* 13686 (MO); Boukitimgo, *Berhaut* 6922 (BR, M, P).

GUINEA BISSAU. Canchungo, Emapaca, *Espírito Santo* 1941 (BR, MO, P, WAG). Bolama, Entacha, *Espírito Santo* 1919 (MO, WAG); Fulacunda, *Espirito Santo* 2042 (WAG).

GHANA. Central: Winneba junction, *Hall & Abbiw* 47096 (BR, MO, WAG); Awutu-Winneba Rd., *Enti*, SP 393 (F, MO, NY). Eastern: Akropong, Akwapim, *Irvine* 1759 (E); 1 km S of Aburi, *Leeuwenberg* 11042 (WAG).

TOGO. near Lome, *Warnecke* 481 (EA, P).

BENIN. Ouidah, *Le Testu* 70 (P); near Sakété, *Chevalier* 22873 (P).

NIGERIA. Oyo: Ilesha, *Patel* 51694 (WAG); Igbajo, *Latilo* FHI 31754 (WAG); Iressa, *Latilo* FHI 58433 (EA). Ondo: Akure-Owo Rd., *Gbile* et al. FHI 20580 (P, WAG); Iyin, Ekiti, *Olurunfemi & Fagbemi* FHI 70757 (WAG). Kwara: Kabba, *Latilo* FHI 60556 (MO). Anambra: Abakaliki-Obubra Rd., *Okafor & Emwiogbon* FHI 66040 (WAG). Benue: Ankpa, *Okafor* FHI 36886 (FHO). Cross River: Ogoja, *Binuyo* FHI 41240 (BR, WAG).

CAMEROUN. Sud-Ouest: Mbilishe, *D. W. Thomas* 7432 (MO). Ouest: Bangwa, *De Wilde & De Wilde-Duyfjes* 2420 (P, WAG). Centre-Sud: Mt. Eloumdren, *Lejoly* 88/601 (BR); Lobo R., *Letouzey* 4589 (P). Est: 30 km N of Bertoua, *Breteler* 2203 (BR, P, WAG); 53 km SE of Ngoila, *Letouzey* 11963 (BR, K, P, WAG); Moloundou, *Mildbraed* 4588 (HBG); Near Ndongo, *Letouzey* 12087 (BR, G, HBG, P, WAG); 65 km NNE of Moloundou, *Letouzey & Villiers* 10492 (K, P).

CENTRAL AFRICAN REPUBLIC. Nana-Mambéré: Along Ndongue Forest, *Haxaire* 1345 (WAG). Lobaye: Ebure Forest, *Tisserant* 2411 (BR, K, P); Torogurade, *Tisserant* 2412 (K, P). Ombella-Mpoko: Bangui, *Chevalier* 10930 (P). Kemo-Gribingui: near Sibut, *Chevalier* 10793 (P). Ouaka: Kudu R., near Moroubas, *Tisserant* 1461 (P). Haute-Kotto: Yalinga, *Le Testu* 4524 B (P, US), 4566 (BR, P).

GABON. Ogooué-Ivindo: Belinga, *Hallé* 3773 (P). Woleu-Ntem: Oyem, *Le Testu* 9461 (EA, MO, P); Babiel North, *Breteler & De Wilde* 636/78 (WAG).

CONGO. Pool: Kaka Forest, *Koechlin* 5065 (P). Plateaux: Ngo Forest, *Sita* 3075 (P). Cuvette: Sangha R., *Pobéguin* 157 (P); Kassa, *Chevalier* 5084 (P). Likouala: Ibenga Forest, *Sita* 3797 (BR).

ZAIRE. Bas-Zaire: Matadi, *Dacremont* 329 (BR, EA, MO, P, UPS, WAG); Mbuami, *Dubois* 63 (BR, EA, K, WAG); between Dembo and Krango, *Butaye* Oct 1900 (BR); Nzuma, *Nsimundele* 937 (BR); Kinshasha: Maluku, *Breyne* 790 (BR), 2318 (BR). Bandundu: Bokoro, *Jans* 4.4.1948 (BR); Buna, *Flamigny* 6123 (BR); Kamtsha R., *Vanderyst* 11305 (BR), Kikwit, *Renier* 24.5.1944 (BR); Ipamu, *Vanderyst* 9314 (BR), 10432 (BR); Libue, *Luja* 292 (BR). Equateur: Wangata, *Lebrun* 915 (BR, C, EA, MO, P, WAG); Ikenge, *Huyghe* May 1907 (BR); Ingende, *Evrard* 6119 (BR); Djoa, *Evrard* 4082 (BR, K); Makanza, *De Giorgi* 1339 (BR, G, US); Bomputu, *Ghesquière* 2782 (B, BR, K, P); between Karawa and Businga, *Lebrun* 1950 (BR, WAG); Bobutu, *Evrad* 481 (BR); Bodangabo, *Evrard* 327 (BR); Businga, *Lebrun* 1987 (BR, MO, WAG); Likimi, *Malchair* 107 (BR); Molegbue, *Gutzwiller* 581 (BR, MO, WAG); Lisala, *Leontovitch* 228 (BR, MO); Yambata, *De Giorgi* 1737 (BR); Dundusana, *Reygaert* 125 (BR); Ubangi, *Lebrun* 2167 (BR, EA, MO, WAG); Ikela, *Hulstaert* 1306 (BR); Bokungu, *Jespersen* 86 (BR). Haut-Zaire: Yobahonde, *Germain* 8150 (BR, K, M, P); Barumbu, *Laurent* 1376 (BR); Mobwasa, *Reygaert* 1326 (BR); Kulu, *Van den Brande* 380 (BR); Buta, *Lebrun* 2479 (BR, MO, P, WAG); Yangambi, *Louis* 4275 (BR, C, K, NY), 12898 (BR, C); Isangi, *Louis* 6340 (BR, B, C, EA, NY, US); Kisangani, *Lejoly* 1933 (BR); Kisangani, *Lisowski* 47865 (BR); Wanie-Rukula, *Lisowski* 17126 (BR, K), 43425 (BR, K); near Bangoka, *Lisowski* 45508 (BR, K, WAG), 45511 (BR, K); Kongolo Island, *Mosango* 539 (BR); Kabondo, *Mosango* 431 (BR); Zobia Forest, *Seret* 893 (BR); Tukpwo, *Gérard* 2746 (BR, WAG), 3732 (BR); Batite, *Gérard* 5542 (BR, WAG); near Panga, *Bequaert* 1623 (BR); Bafwaboli, *Claessens* 258 (BR); Doruma, *De Graer* 237 (BR); Nala, *Boone* 11 (BR); Mabwasa, *Hart* 508 (BR, MO); 4 km SSW of Epulu, *Gereau* 5385 (WAG); Penghe, *Bequaert* 2298 (BR), 2229 (BR, K); Mniamnian, Mbrowole, *Schweinfurth* 3073 (K, type of *P. macrocarpa*); Gombari, *Seret* 482 (BR); Garamba National Park, *Troupin* 7 (BR, EA, K, P, WAG), 547 (BR, WAG); Kurukwata, *Gérard* 3580 (BR, WAG); Mokatji, *Van der Ben* 1433 (BR, K, M); Mahagi, *Meyers* 297 (BR, C, K, M); Lekwa, *Lebrun* 9898 (BR, MO, P, WAG); Djugu Forest, *Bamps* 261 (BR, K); Djugu Reserve, *Meyers* 195 (BR, C, EA, MO, WAG); Kawa Forest, *Van der Ben* 1262 (BR, K, M). Kivu: Rumangabo, *Germain* 3796 (BR, EA, MO, WAG); Kahe, *Gutzwiller* 1983 (BR) & 1995 (BR); Rutshuru, *Deru* 344 (BR); Burungu, *A. Léonard* 5230 (BR, EA, MO, WAG); Irangi, *Troupin* 3515 (BR, EA, K, WAG); Kilongo, *Gutzwiller* 1117 (BR, MO, WAG); Kavumu-Walikale Rd., *Pierlot* 2341 (BR, WAG); Walikale, *Lebrun* 5121 (BR, MO, P, WAG); Bukavu-Shabunda Rd., *Pierlot* 2523 (BR, C, EA, MO, WAG); Bukavu-Walikale Rd., *Stauffer* 1021 (BR, K, UPS, WAG); Mt. Kaluli, *Pierlot* 2390 ((BR, WAG); Bitale, *Pierlot* 1045 (BR); Lusheni, *A. Léonard* 4704 (BR, EA, MO, P, WAG); Kitole, *A. Léonard* 3948 (BR, EA, MO, WAG); Nyakigunda, *A. A. Léonard* 3871 (EA, MO, P); Urega, *Lebrun* 5586 (BR, WAG); near Kindu, *Lebrun* 6088 (BR, M)); Elundu, *Henrad* 331 (BR); Maniema, *Michelson* 133 (BR); Lumuna, *Lebrun* 5877 (BR, MO, WAG); Kapanga, *Michelson* 736 (BR, P); Mutambo, *A. Léonard* 5690 (BR, EA, MO, P, WAG); Kasongo, *Dewèvre* 945 (BR, K, type of *P. tubicina*); Kahusi, *A. Léonard* 3981 (BR, EA, MO, WAG). Kasai-Occidental: Lutshuadi Forest, *Deffet* 10 (BR, P). Kasai-Oriental: between Lodja and Kole, *Lebrun* 6220 (BR, WAG); Bena-Kabindi, *Liben* 1835 (BR). Shaba: Monono, *Thiebaud* 203 (BR); near Kilwesi National Park, *De Witte* 4198 (BR, EA, WAG); Upemba National Park, *De Witte* 6942 (BR, WAG); N'zilo near Kolwezi, *Schmitz* 3704 (BR); near Luambo & Bunkeya, *Devlaux* 409 (BR); Lukafu Forest, *Schmitz* 7334 (BR, MO), *Schaijes* 3119 (BR); Boa, *Malaisse* 6763 (BR, WAG); Kafubu Forest, *Malaisse* 8599 (BR).

RWANDA. Rangiro, *Troupin* 14693 (BR, EA).

BURUNDI. Bugarama, *Niyongere* 1/84 (BR); Siguvyaye valley, *Lewalle* 3990 (BR).

ANGOLA. Cabinda: Sumba, Peco, *Gossweiler* 729 (K), 8729 (US). Malanje: Golungo-Alto, *Welwitsch* 5981 (B, BM, BR, C, G, K, MO, P, type of *P. welwitschii*). Congo: Uige, Gossweiler 1139 (K, P). Lunda: Dundo, Gossweiler 13862 (K), 14051 (B, K, P, US).

SUDAN. Source of Yubu R., *Hoyle* 725 (FHO); Azza Forest, *Turner* 160 (K).

UGANDA. U 2: Kigezi Distr., Kigezi Forest, *Forest Dept.* EAH 12437 (EA, K). Toro Distr., Mungilo, Bwamba Forest Reserve, *Paulo* 607 (EA, K); Hima Forest, *Osmaston* 684 (EA, K); Durro (= Dura) Forest, *Bagshawe* 1086 (BM, type of *P. bagshawei*). Ankole Distr., Kalinzu Forest Reserve, *Osmaston* 2767 (K), *Paulo* 619 (BR, EA, K); Ruampara, Kikagati near Kagera River (EA, K). Masaka Distr., W of Katera, *Katende* 1429 (EA); Malabigambo Forest, *Drummond & Hemsley* 4546 (K). Mengo Distr., near Budo, *Eggeling* 517 (BR, EA, K); 16 km on Borbo Road, *Chandler* 2125 (B, BR, K, P); Kyewaga (= Kyiwaga) Forest, *Maitland* 606 (K); Sesse Islands, *Stuhlmann* 1216 (K, type).

KENYA. K 4: Meru Distr., Ngaia Forest, *Wachiori* 41 (EA, K); Meru National Park, Rojwero R., *Ament & Magogo* 169 (BR, EA, K). K 7: Kwale Distr., Mrima Hill, *Faden & Faden* 77/751 (K, US), *Kokwaro* 3959 (EA); Shimba Hills Lodge, Mkomba R., *Robertson & Luke* 5153 (EA); Shimba Hills, Mwele Mdogo Forest, *Omino* 32 (EA, WAG). Kilifi Distr., Kaya Ribe, *Robertson & Luke* 4830 (EA, K); Arabuko Sokoke Forest, *Omino* 69 (EA, WAG). Lamu Distr., Witu Forest Reserve, *Luke & Robertson* 1405 (EA, K).

TANZANIA. T 1: Bukoba Distr., Kaige, *Gillman* 352 (BR, EA, K). T 3: Lushoto Distr., Kwamkoro Forest Reserve, *Ruffo & Mmari* 2129 (K); Lushoto/Tanga Distr., Longuza, *Ruffo & Mmari* 1873 (K). T 4: Kigoma Distr., Kasakati, *Suzuki* B 23 (EA); Mpanda Distr., near Selimwenguru below Kungwe Mt., *Harley* 9587 A (B, BR, EA, K); Kungwe Mt., *Harley* 9596 (BR, K). T 6: Ulanga Distr., Ifakara, Vikundu

Forest Reserve (= Vikindu), *Haerdi* 033-1963 (Z). Morogoro Distr., Uluguru Mts. near Ruvu Bridge, *Luke* 747 (EA); Morogoro, *Wallace* 475 (EA, FHO, K). T 8: Lindi Distr., Mchinjiri, Rondo Plateau, *Semsei* 679 (BR, EA, K). Z: 27 km from Chwaka, *Faulkner* 3022 (BR, P, UPS); Ufufuma, *Vaughan* 1777 (EA, K); Kizi Kazi Cave, *Vaughan* 1820 (EA, K); Zanzibar, sin. loc., *Sacleux* 1457 (P).

ZAMBIA. Chembe Ferry, *Angus* 218 (BR, FHO, K, MO). Nothern: *Brenan & Greenway* 8011 (BR, EA, FHO, K).

ZIMBAMBWE. Melsetter (= Chimanimani), *Swynnerton* 21 (PRE); Chirinda Forest, *Goldsmith* 38/65 (BR, COI, K, MO, PRE, SRGH), *Swynnerton* 14, (BM, K, SRGH, US, Z, type of *P. swynnertonii*).

MOZAMBIQUE. Zambezia: Gobene Forest, *Torre & Correia* 14541 (COI, LISC), 16199 (LISC), 17015 (LISC). Manica: Serra Macuta, *Müller & Gordon* 1784 (LISC, SRGH); Chibabava, *Carvalho* 1228 (BR). Sofala: Gorongosa National Park, along Urema Rd., *Tinley* 2718 (K, MO, SRGH); Chiniziua, *Gomes & Sousa* 4407 (COI, K, MO, PRE); 25 km from Lacerdonia, *Müller & Pope* 1916 (LISC, K, PRE, SRGH); Serracao de Corboso, *Torre* 5904 (LISC). Gaza: Macia, *Balsinas* 1453 (LISC, WAG).

Notes. *P. pycnantha* can easily be distinguished from the other *Pleiocarpa* species by the presence of at least one node on every branchlet with leaves in whorls of 3-5 and from the ternate *P. mutica* specimens by the more numerous secondary veins and shorter corolla lobe and tube. The carpels are always 2 except in *Lebrun* 9898 where 3-carpelled ovules are reported by Pichon (1953). The number of ovules is almost always 2 except in *Troupin* 4024 WAG, and *Goldsmith* 38/65, SRGH, where four ovules were found, but the leaves occur in whorls of 3-5. The habit and size of the corolla tube and lobes is greatly affected by the habitat. Plants growing near rivers tend to be small shrubs, 2-3 (-6) m high with bark of the branchlets easily peeling off. The flowers are very small, with very short corolla lobes and often have an unpleasant odour (*Breteler* 2203, *Letouzey* 4589, *Tisserant* 1461 & 2412). All these specimens were previously placed under var. *tubicina*.

All the material from Usambara Mts., cited below, have opposite leaves unlike the rest of the material and all flowers analyzed from this region have 4-ovulate carpels. More material is needed to verify whether the leaves are always opposite or not, and to verify the taxonomic position of these specimens.

TANZANIA. T 3: Tanga Distr., Usambara Mts. Bulwa, near Amani, *Zimmermann* G7712 (NY), *Peter* 58222 (B); Kwamkoro, *Peter* 58229 (B, WAG), 58267 (B), 58305 (B), *Zimmermann* 27.12.1916 (K), G 7724 (EA); Amani, East Usambara Mts., *Botany Students* 252 (WAG), *Peter* 58199 (B, WAG); Mlinga Peak, East Usambaras, *Drummond & Hemsley* 1449 (B, BR, EA, K, S), *Greenway* 4905 (EA, FHO, K).

2.7.5 Pleiocarpa rostrata Benth.

in Hook. Ic. Pl. 12: 71, t. 1182 (1876); K. Schumann in Engler & Prantl, Nat. Pflanzenf. 4, 2: 135, fig 52 E (1895); Stapf in Fl. Trop. Afr. 4, 1: 98 (1902); Hutchinson & Dalziel in Fl. W. Trop. Afr. ed. 1, 2: 38 (1931). – Type: Cameroun, Wouri R., *Mann* 720 (holotype K, photo. MO).

Fig. 40, p. 153; map 18, p. 154

Homotypic synonyms:

Hunteria rostrata (Benth.) Hall. f. in Jahrb. Hamb. Wiss. Anst. 17, Beih 3: 194 (1899). *Carpodinopsis rostrata* (Benth.) Pichon in Bol. Soc. Brot. sér. 2, 27: 147, t. 5, 4 p. 145, map c, p. 121 (1953).

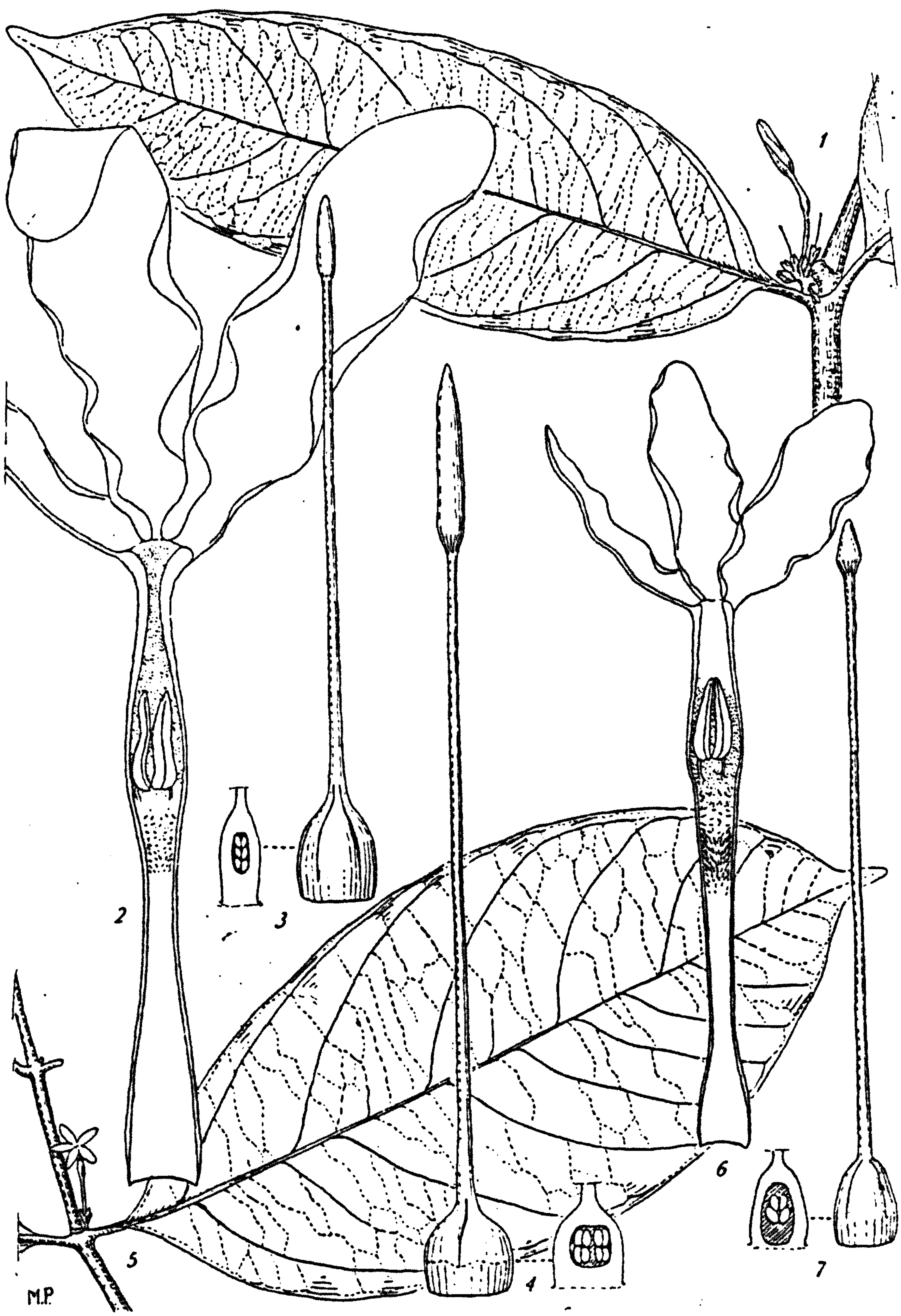
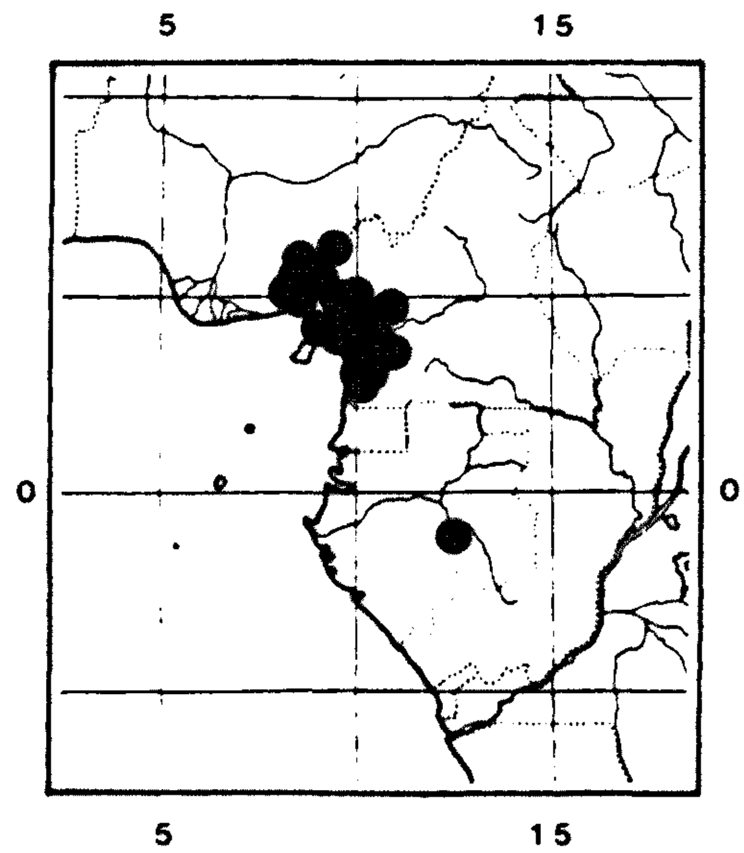


Figure 40. *Pleiocarpa rostrata*. **1** and **5** habit (× 2/3); **2** and **6**, opened corolla (× 5); **3**, **4** and **7**, pistil with opened ovary (× 10). 1-3 from Talbot 1037; 4 from Le Testu 8871; 5-7 from Zenker 4362.



Map 18. *Pleiocarpa rostrata.*

Heterotypic synonyms:

Pleiocarpa talbotii Wernham in Cat. Talb. Nig. pl. 62 (1913); H. Huber in F. W. T. A ed. 2, 2: 64 (1963), **syn. nov.** *Carpodinopsis talbotii* (Wernh.) Pichon in op. cit. 144, t. 5, 1-3, map C, p. 121. – Type: Nigeria, Oban district, *Talbot* 1037 (holotype BM; isotype K).

Carpodinopsis uniflora Pichon op. cit. 148, t. 5, 5-7, **syn. nov.** – Type: Cameroun, Bipindi, *Zenker* 1181-b (holotype P; isotypes BM, E, G, HBG, K, L, M, W, WU).

Shrub or small tree 0.6-5 m high with a semi-scrambling habit and white, sticky latex. Trunk up to 4 cm in diameter; bark smooth, light to dark brown, purple-brown or dark grey, inner bark pale green or cream to yellow, wood dark cream. Branches brown to dark olive-brown or grey; branchlets thin, quadrangular when young, dark brown, with a few lenticels. *Leaves* opposite; petiole 5-14 mm long; blade coriaceous or subcoriaceous when fresh, broadly to narrowly elliptic to obovate, 2.1-3.5 × as long as wide, 10.6-28 × 3.8-11.3 cm, acuminate, rarely obtuse at the apex, acumen 4-12 × 3 mm, acute at the base or decurrent into the petiole; midrib prominent beneath; secondary veins oblique, very prominent beneath, in 7-12 pairs, forming a submarginal vein on the entire or only the upper 0.3-0.75 of the leaf and an angle of 40-58° with the midrib, 12-37 mm apart at the central part of the leaf. *Inflorescence* axillary, rarely terminal, ramiflorous, 1.5-3.5 × 2-4 cm, about 1-4-flowered, sessile. Pedicels 0.5-5 mm long. Bracts very small, scale-like. *Flowers*: *Sepals* pale green, free or connate at the extreme base, erect, membranaceous at the edge and the apex, ovate, 1-2.7 × as long as wide, 2-4.5 × 1.2-3 mm, coriaceous or not, acute to obtuse at the apex. *Corolla* white, creamy to pale green in bud, 13-37 mm long in mature bud and forming a comparatively wide oblong head 0.25-0.43 of the bud length, 6-15 × 1.5-4 mm, with a rounded apex, with a belt of pubescence 3-10.5 mm wide inside just below the insertion of stamens; tube yellow at the narrow throat, thick or not, 4-16 × as long as the calyx, 1.4-2.9 × as long as the lobes, 12-32 mm long, almost cylindrical, 1-3 mm wide above the base, narrowed below the insertion of the stamens to 0.5-2.0 mm wide, again widened around the anthers to 0.5-3.5 mm wide; lobes obovate to elliptic, 0.3-0.9 × as long as the tube, 1.6-3.1 × as long as wide, 5.5-26 × 4-15 mm, rounded, spreading to recurved. *Stamens* with apex 3-8 mm below the mouth of the corolla tube, inserted 0.58-0.74 of the length of the corolla tube, at 7-18 mm from the base; filaments 0.5-1 mm long; anthers ovate to elliptic, 3.3-7 × as long as wide, 1.8-4 × 0.4-0.9 mm, acuminate at the apex, acumen 0.2-0.5 mm long, sterile, cordate at the base. *Pistil* 10-13.8 mm long, with apex 1-5 mm below the stamens; ovary subglobose, 0.9-1.5 × 0.6-1.5 × 0.4-0.9 mm, abruptly narrowed into the style, with a disk-like thickening uniting the carpels at the base, about 0.3-0.5 of the length, 0.3-0.8 mm high, of 3-5 separate carpels; style 6.5-11 × 0.2 mm long; pistil head ellipsoid to oblong 1.5-3.4 × 0.2-0.4 mm. Ovules 3-4(-6) in each carpel. *Fruits* bright orange, waxy, smooth, minutely tubercled to rugose, of 3-5 separate mericarps; mericarps narrowly ellipsoid, ovoid to slightly crescent-shaped, 20-50 × 15-25 × 10-13 mm, rounded or with a straight to hook-shaped beak at the apex, beak 4-15 × 2-4 mm; 1-5-seeded; wall about 2-4 mm thick. *Seeds* orange, smooth, 14-17 × 8-11 × 4-5 mm. Embryo 9.5 mm. long; cotyledons elliptic, 1.8 × as long as wide, 5.5 × 3 mm. obtuse at the apex and at the base, radicle 0.7 × as long as the cotyledons, 4 × 0.5 mm.

DISTRIBUTION. Nigeria, Cameroun and Gabon.

ECOLOGY. Dense rain forest, primary or secondary forest along rivers, creeks and swamps in clayish and sandy soil. Alt. 0-1400 m. Flowering and fruiting in November to January.

USES. Cold infusion used against stomach ache (*Watts* 954, Cameroun, 1993).

Geographical selection of the approximately 60 specimens examined:

NIGERIA. Cross River: Akampa Rubber Estate, *Latilo* FHI 40918 (K); Oban, *Talbot* 1037 (K, P, type of *P. talbotii*), 1313 (K); Oban Forest Reserve, *Onochie* FHI 36293 (FHO, K); North Forest Reserve, *Van Meer* 1725 (WAG); Ayuk, *Latilo* FHI 67755 (K); British Obokum, *Keay* FHI 28277 (K).

CAMEROUN. Sud-Ouest: Mbilishe, *D. W. Thomas* 7444 (MO, WAG); Ejagham Forest Reserve, *Satabie* 743 (YA); Bokossi Mts., *D. W. Thomas & McLeod* 5339 (MO, P, WAG); S Bakundu Forest Reserve, *Keay* FHI 28571 (K, P); near Fabe, *Manning* 910 (MO); Korup National Park, *D. W. Thomas* 4136 (MO, P, WAG); big Ekombe Forest, *Nemba & D. W. Thomas* 450 (MO); Meme, *Wheately* 691 (K); Idenau, *Watts* 954 (K); Etinde, *Cable* 289 (K); Limbe, *Wieringa* 2040 (WAG). Ouest: 40 km WNW of Ndikinimeki, *Letouzey* 11229 (P, WAG). Littoral: 15 km N of Yabassi, Letouzey *14421* (P); 5 km SSE of Nkongsamba, *Letouzey* 14483 (P, WAG); Likomba plantation, *Mildbraed* 10692 (A); Wouri R., *Mann* 720 (K, Type), *Mann* 2189 (K); 50 km NW of Eseka, *De Wilde & De Wilde-Duyfjes* 1245 (K, P, WAG); 30 km ENE of Edea, *Letouzey* 12378 (YA); Between Dibamba and Ebo, *Letouzey* 11028 (BR, K, P, YA, WAG); 7 km E o Yingui, *Leeuwenberg* 9091 (WAG). Centre-Sud: Dibombe-Mabombe Forest Reserve, *Beentje* 1501 (WAG); 15 km N of Eseka, *J. de Wilde* et al. 3887 (MO, P, WAG); Eseka, *Bamps* 1307 (BR, WAG); 2 km N of Longii Forest, *Bos* 4916 (WAG); Bipindi, *Annet* 355 (P), *Zenker* 1181 b (E, G, HBG, K, L, M, P, W, WU, Z, type of *Carpodinopsis uniflora*), 4362 (B, BR, E, G, K, L, M, MO, P, S, W, Z); 8 km S of Kribi, *Bos* 3968 (WAG); Njabilobé, *Raynal* 10403 (P); Mambe Forest, *Letouzey* 12275 (P, YA); 29 km NW of Eseka, *De Wilde & De Wilde-Duyfjes* 1278 (B, K, MO, P, WAG).

GABON. *Boudinga*, Le Testu 8871 (P).

Notes. The secondary veins may form a submarginal vein along the entire edge or only in the upper 0.3-0.75 of the leaf. The corolla tube and lobes are very variable in size and in *Beentje* 1501 both small and large flowers are found on the same branch. The carpels also vary from 3-5, *D. W. Thomas & McLeod* 5339 has 4-5-carpellate ovaries on the same branch. The fruits are also very variable in size, shape, texture and at the apex. *Watt* 608 and *Wheatly* 691 have rugose fruits which are smooth towards the centre, the fruits may also be entirely rugose or smooth and may have a rounded to rostrate apex. The inflorescence always has very few flowers, rarely more than four.

2.8 Doubtful species

Pleiocarpa picralimoides (Pichon) Omino, **comb. nov.**

Basionym:

Carpodinopsis (?) picralimoides Pichon in Bol. Soc. Brot. sér. 2, 27: 143, t. 4 fig. 2 (1953). – Type: Angola, Cabinda, near Belize, *Gossweiler* 7994 (LISU; isotype K).

Shrub (sarmentose) to 2 m high. Trunk very slender. Leaves opposite; petiole 5-10 mm long; blade elliptic, acuminate at the apex, cuneate at the base; secondary veins in 11-18 pairs, forming a submarginal vein and an angle of 60-70° with the costa. Flowers unknown. Fruits yellow to orange, smooth to rugose, of 4-5 separate mericarps, mericarps 14-30 × 9.5-16 mm, rounded at the apex, 3-4 seeded, wall 2-5 mm thick. Seeds variously shaped, 11-15 × 6.2-10 × 4-8 mm.

Distribution. Angola.
Ecology. Forest, sometimes riverine. Alt. low.

Other specimens examined:

Gabon. Moyen-Ogooué. Lac Ezanga, *N. Hallé* 2087 (P).

Congo. Kouilou: Mayumbe, *Thollon* 1139 (P); ibid., *Bitsindou* 8 Jan. 1977 (P); Between Pounga and Dimonika, *Cusset* 546 (P); Dimonika, *Dechamps* 13016 (BR); ibid., *De Foresta* 883 (P); ibid., *F. Hallé* 1851 (P); ibid., *Moutsambote* 68 (WAG); ibid., *Sita* 4698 (WAG): Cofibois, *De Foresta* 1184 (P).

Notes. Pichon (1953) first described the above species under *Carpodinopsis* which is currently a synonym of *Pleiocarpa*. Since then more specimens have been collected in Angola and Congo, but unfortunately all are either fruiting or with very immature flower buds. It is therefore not very easy to comment on the current taxonomic position of this species which is definitely a *Pleiocarpa*. In my opinion it is not close to *P. mutica* which always has one ovule per carpel as opposed to its 4 ovules per carpel. It is, however, very close to *P. rostrata* which also has 3-4 (-6) ovules per carpel but has 9 (-12) strongly curved and widely spaced secondary veins as opposed to its 11-18 pairs of slightly curved secondary veins. Perhaps when flowering specimens become available it will be easier to tell how close it is to *P. rostrata*.

2.9 Excluded species

Hunteria atrovirens Wall. ex G. Don, Gen. Syst. 4: 105 (1837) = *Chilocarpus denudatus* Bl.

Hunteria coriacea Wall ex G. Don, Gen. Syst. 4: 105 (1837); A. DC. Prod. 8: 350 (1844) = *Alyxia coriacea* Wall. ex Roxb.

Hunteria? cuspidata Wall. ex A. DC. in Prod. 8: 350 (1844) = *Melodinus orientalis* Bl.

Hunteria eugenifolia Wall ex G. Don, Gen. Syst 4: 105 (1837) = *Wrightia arborea* (Dennst.) Mabberley.

Hunteria fascicularis G. Don., Gen. syst. 4: 105 (1837); A. DC in Prod. 8: 350 (1844) = *Alyxia fascicularis* Benth.

Hunteria gracilis Wall. ex A. DC., Prod. 8: 350 (1844) = *Alyxia gracilis* (Wall. ex A. DC.) Benth.

Hunteria sundana Miq. in Fl. Ind. Bat. 2: 409 (1856) = *Rauvolfia serpentina* (L.) Benth ex. Kurz.

Hunteria ballayi (ba), *H. camerunensis* (ca), *H. congolana* (co), *H. densiflora* (d), *H. ghanensis* (g), *H. hexaloba* (h), *H. macrosiphon* (ma), *H. myriantha* (my), *H. oxyantha* (o), *H. simii* (s), *H. umbellata* (u), *H. zeylanica* (z); *Picralima nitida* (n); *Pleiocarpa bicarpellata* (bi), *P. brevistyla* (br), *P. mutica* (mu), *P. pycnantha* (p), *P. rostrata* (r).

Adam, J.G., 59 (s), 6549 (mu), 13606 (p), 13686 (p), 16636 (s), 16708 (s), 16759 (s), 17334 (u), 17361 (u), 17937 (u), 21395 (s), 21414 (r), 21422 (s), 21606 (s), 24140 (s), 25768 (s), 26048 (s), 27452 (s), 27599 (s), 28500 (s), 28608 (s), 28733 (u), 30466 (p), 30294 (s), 30299 (s).
Adams, C.D., 3789 (p); 4331 (p).
Adamson, J., 22 (z), 34 (z), 37 (z), 224 (z).
Adebusuyi, J.K., FHI 43383 (mu).
Aké Assi, L., 7478 (g), 9738 (u), 11578 (u), 11222 (g), 12676 (s), 13665 (u), 13763 (g), 15143 (n), 15904 (u), 17243 (mu).
Akpabla, G.K 110 (u), 792 (mu).
Alymer, G., 35 (mu), 216 (mu).
Ament, J., 169 (p), 388 (z).
Andrada, E.C. da, 1062 (z).
Andoh, J.E., 3335 (n), 4222 (n), 4305 (mu), FHI 5471 (u), 5639 (mu).
Angus, A., 218 (p).
Annet, E., 355 (r).
Ariwaodo, J.O., FHI 88715 (mu), FHI 89126 (r).
Asonganyi, J.N., 128 (n), 414 (bi).
Attims, Y., 98 (ma).
Aubréville, M.A., 23 (u), 95 (s), 350 (mu), 1342 (mu), 1343 (u), 1383 (n).
Bagshawe, A.G., 1086 (p).
Bakare, FHI 22857 (u).
Baldwin J.T.Jr., 6991 (mu), 7013 (mu), 9460 (s), 10443 (s), 10736 (s), 10814 A (mu), 11552 (mu), 12561 (s).
Ballay, M., May 1906 (ba).
Bally, P.R.O., 2042 (z), 2157 (z), 4712 (z), 5919 (z), 6068 (z), 16718 (z).
Balsinhas, A., 1453 (p).
Bamps, P., 225 (p), 261 (p), 1307 (r), 1351 (r), 2035 (mu), 2047 (mu), 2304 (s), 2388 (s), 2559 (mu).
Barker, A.J.D., 1139 (s).
Barret B., BJH 6542 (z).
Bartin, D., 1858 (p).
Bates, G.L., 368 (bi), 1421 (n).
Battiscombe, E., K 226 (z).
Beentje, H., 1450 (ca), 1501 (r), 4381 (z).
Begné, 3120 (mu).
Benoit, M., 149 (n), 232 (n), 235 (n), 256 (n), 326 (n), 382 (u).

Dubois, L., 401 (p), 651 (co), 851 (co).
Earle, P.G., 5 PID (z).
Edwards, L.C., E 101 (z), 178 (z).
Edwardson, T.E., 41 (u).
Eggeling, W.J., 517 (p), 3115 (p), 3854 (n), 3972 (n), 4042 (n).
Ejiofor, M.C., FHI 14010 (n), FHI 26897 (u).
Else, 10 (z), 16 (z).
Emwiogbon, J.A., FHI 33321 (p), FHI 45328 (n), FHI 61669.
Enti, A.A., R 973 (u), R 1168 (mu), FE 1203 (u), FE 2175 (p), 2296 A (mu), 2296 B (u) SP 393 (p), FE 1875 (n), FH 6920 (u), FH 7544 (mu), GC 38392 (mu), GC 38426 (u).
Espírito Santo, J.V. da Graca do, 1940 (u), 1941 (p), 1919 (p), 2042 (p), 2257 (u), 3001 (u), 3016 (u), Santo (u).
Etuge, M., 207 (r), 419 (bi), 499 (n).
Evrard, C., 327 (p), 481 (p), 571 (p), 785 (n), 1614 (u), 3178 (n), 3562 (p), 4082 (p), 4306 (n), 4354 (co), 5482 (co), 5675 (d) 6119 (p), 6270 (co).
Faden, R.B., 70/200 (z), 74/321 (z), 77/648 (z), 77/751 (p) 77/760 (z).
Fanshawe, D.B., 3904 (p), 4676 (p).
Farmar, L., 540 (n).
Farron C., 4247 (n), 4362 (ma), 4828 (n), 7261 (bi), 7554 (ca).
Faulkner, H.G., 1280 (z), 1626 (z), 3022 (p).
Fay, J.M., 8127 (ba), 8782 (ba), 8835 (ba).
Fischer, 202 (z).
Flamigni, A., 6014 (p), 6123 (p), 7116 (n), 10383 (n).
Fleury in Chevalier 33348 (bi), 33099 (u).
Florence, J., 154, 514, 516, 566 (ca), 584 (o), 614 (o), 1026 (ca), 1798 (bi).
Floret, J.J., 1633 (n).
Forest Dept., EAH 12437 (p).
Foster, E.W., 5 (u), 182 (p), 220 (n).
Fox, 10 (u), 11 (u).
Frédoux, A., 46 (n), 182 (K), 413 (mu), 584 (mu), 589 (mu).
Gardner, H.M., 2205 (z).
Garnier, 652 A (u), 653 B (u), 653 C (u), 653 D (u), 653 E (u).
Gatheri, G.W., 79/67 (z).
Gathy 1908 (bi).
Gautier-Béquin, D., 737 (mu), 792 (mu), 800 (mu), 967 (n).
Gbile, Z.O., FHI 20580 (p)
Geerling, G., 1516 (mu), 2361 (mu), 2377 (mu), 2379 (mu), 2419 (u).
Gentry, A.L., 32674 (u), 32703 (u), 32758 (u), 32793 (u), 32810 (u), 33027 (o), 33177 A (o), 33177 B (ca), 33264 (o), 33503 (n), 33506 (o), 33512 (n), 33736 (o), 52681 (mu).
Georges, J., 27814 (u).
Gérard, P.H., 1701 (p), 2746 (p), 3580 (p), 3689 (p), 3732 (p), 3796 (p), 3839 (n), 5542 (p).
Gereau, R.E. 5253 (p), 5385 (p).

Menavanza, F., 143 (co).
Mendonga, F. A., 4447 (p).
Meyers, S., 195 (p), 262 (p), 290 (p), 297 (p).
Mezili, P., 120 (ba).
Michelson, A., 85 (o), 133 (p), 736 (p), 231 (n), 914 (co), 921 (d).
Mildbraed, J., 4038 (ba), 4138 (n), 4588 (p), 6098 (u), 8285 (n), 10692 (r), 10716 (ca).
Miller, J. S., 7893 (n).
Mooney, H. F., 7666 (z).
Moonmaw, J. C., 1295 (z).
Moor, A. W., 1151 (u), 2241 (u).
Mortehan, M. G., 520 (p).
Morton, J. K., S.L. 1268 (mu).
Mosango, 431 (p), 539 (p).
Mosnier, M., 2537 (u), 2594 (u).
Muchiri, J., 424 (z).
Müller, T., 1320 (p), 1784 (p), 1865 (z), 1916 (p), 1926 (z).
Muwin, A. H., 26 (u).
Mwasumbi, L. B., 13861 (p).
Nchami, V. C., FHI 14341 (u).
Ndele, 759 (co), 767 (p), 771 (p).
Nemba, J., 281 (r), 450 (r), 582 (u).
Niyongere, L., 1/84 (p).
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Nsimundele, 937 (p), 1077 (p).
Nsola, 1261 (co).
Obermeyer, A. A., 37485 (p).
Ohnson, M., 903 (p).
Okafor, J. C. FHI 36886 (p).
Oldeman, R. A. A., 642 (u), 961 (mu).
Olorunfemi, J., FHI 30579 (u), FHI 70757 (p).
Omino, E. A., 32 (p), 63 (z), 69 (p), 82 (bi), 89 (z), 157 (bi), 158 (bi).
Onochie, C., FHI 4936 (u), FHI 33370 (n), FHI 36293 (r).
Onyeachusim, FHI 48005 (n).
Orokoro, 228 (p).
Osmaston, H. A., 684 (p), 2644 (n), 2767 (p).
Osseyemeh, J., 3341 (n).
Patel, M. B., 51694 (p).
Paoli, G., 815 (z), 478 (z), 850 (z).
Pardy, A. A., 2 (p).
Paulo, S., 133 (z), 607 (p), 619 (p).
Perdue, R. E., 10012 (z).
Pereira, J. A., 1889 (u), 2704 (u), 3163 (u).
Pierlot, R. 947 (n), 1045 (p), 1844 (p), 1936 (p), 2025 (p), 2181 (p), 2341 (p), 2437 (p), 2523 (p), 2596 (co), 2811 (n), 3210 (p), 3184 (p), 950 (co).

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CURRICULUM VITAE

Elizabeth Anyango Omino was born on 6 July 1962. She joined the University of Nairobi in 1983, where she graduated in September 1986 with a Bachelor of Science degree in botany and zoology. She immediately joined the Kenya Marine and Fisheries Research Institute as an assistant Research Officer. Between September 1987 and June 1991, she rejoined the University of Nairobi for her Masters of Science degree in plant taxonomy. During this period, she demonstrated plant taxonomy in the undergraduate class, and taught as a part-time lecturer in Medical Training Centre, Nairobi, for the herbal medicine course. Between September 1992 and 1996, she joined the Department of Plant Taxonomy, Wageningen Agricultural University, for a Ph.D. study, made possible by the sandwich programme. During this time, she operated in liaison to the Botany Department, University of Nairobi (with Prof. Kokwaro), the East African Herbarium and Anatomy Lab., Jodrell Laboratory, Royal Botanic Gardens, Kew, with Dr. David Cutler and Mr. Tim Lawrence. She is currently lecturing at the Jomo Kenyatta University of Agriculture and Technology, in the Department of Botany. She is married and has two children.

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