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WORKING PAPER

PART 1

Taxonomic characters for identifying tree species

Douglas C. Daly, Ph.D.

The New York Botanical Garden, New York, USA

(ddaly@nybg.org)

&

Martin Ricker, Ph.D.

Estación de Biología Tropical “Los Tuxtlas”, Veracruz, Mexico

(mricker@ibiologia.unam.mx)

INTRODUCTION

The following illustrated and annotated list of characters was developed during Martin Ricker's sabbatical year at the New York Botanical Garden as part of his project "*A mathematical approach to develop a non-authoritative tree taxonomy.*" The objective was to develop a presence/absence matrix of morphological character states that can be used to develop interactive electronic keys to identify the tree species of the Los Tuxtlas region in Veracruz, Mexico.

An initial set of characters and character states was taken from Goldberg (2003), whose matrix for the world's angiosperm families was based mostly on traditional characters from fertile specimens, i.e., flower and fruit characters. We were, however, especially interested in sterile or non-reproductive characters that can readily be observed on living trees in tropical moist forests most of the year. Our work was assisted in several ways. First, a research group involving Douglas Daly had worked for a number of years on leaf architectural characters; the current work benefited greatly from their resulting document, which provides character state definitions and over 350 exemplifying images (Ellis et al., in review). Second, scoring the character states for specimens from a broad spectrum of tree families at Los Tuxtlas helped us to supplement, refine, and adjust the matrix. Moreover, we consulted a broad selection of glossaries and dictionaries of morphological terms, notably Keller (2004), Hickey & King (2005), Lawrence (1951), Mori et al. (1997), Mori et al. (2002), Stearn (1985), and Zomlefer (1994). Our work benefited also strongly from the descriptions and illustrations in the floristic work of Mori et al. (2002). Finally, our own experience in tropical forest exploration helped to complete the list of 203 characters in 898 character states that we find useful to score and distinguish morphological patterns among tree species. A second working paper shows how we use the resulting matrix of character states among 11 specimens from 9 tree species from Los Tuxtlas.

1) Elevation above sea level:

- a) 0-700 m (lowland tropical forest).**
- b) 701-1,400 m (pre-montane tropical forest).**
- c) 1,401-2,700 m (montane tropical forest).**

2) Vegetation type (habitat):

- a) Mangrove forest.**
- b) Irregularly flooded forest.**
- c) Seasonally flooded forest.**
- d) Swamp forest.**
- e) Beach.**
- f) Pasture.**
- g) Palm forest.**
- h) Lowland tropical rainforest.**
- i) Pre-montane forest.**
- j) Montane (cloud) forest.**
- k) Elfin forest.**
- l) Scrub.**
- m) Dry forest.**
- n) Oak forest.**
- o) Coniferous forest and mixed coniferous-broadleaf forest.**

3) Disturbance regime:

- a) Primary vegetation.**
- b) Secondary vegetation.**

4) Light regime:

- a) Closed canopy.**
- b) Open canopy.**

5) Soil:

- a) Clay.**
- b) Sand.**
- c) Rocky substrate (including volcanic pedregal).**

6) Stratum:

- a) **Understory tree.**
- b) **Canopy tree (includes mid-canopy).**
- c) **Emergent (above canopy) tree.**

7) Lifeform:

- a) **Angiosperm tree (without recognizable “stranglers”).**
- b) **Recognizable “strangler”.**
- c) **Conifer tree.**
- d) **Arborescent bamboo.**
- e) **Trunked palm, cycad, or fern.**
- f) **Acaulous palms & cycads.**
- g) **Shrub (polypodial = multiple stems).**

8) Lifestyle:

- a) **Autotrophic.**
- b) **Assumed or known to be parasitic (leaves become black in herbarium).**

9) Rooting:

- a) **Terrestrial or flooded land.**
- b) **Epiphytic tree.**
- c) **Hemi-epiphytic (including “stranglers”).**

10) Phenology:

- a) **Evergreen.**
- b) **Seasonal deciduous.**
- c) **Short-term deciduous.**

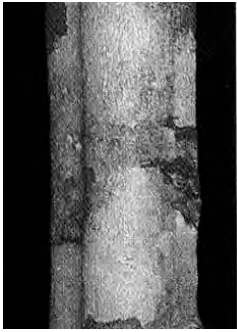
11) Trunk bole shape:

- a) **Round cross-section.** Circular cross-section.
- b) **Angular cross-section.** The cross-section has corners, where an angle is apparent.

c) **Sulcate.** Groofed or furrowed part of its length. Figure from Mori et al. (1997, plate 1a).



d) **Fluted.** Groofed or furrowed most to all of its length. Figure from Ribeiro et al. (1999: 27).



e) **Fenestrate.** Perforated with openings (e.g., strangler figs). Figures from left: Mori et al. (1997, plate 1c), Ribeiro et al. (1999: 27), again Ribeiro et al. (1999: 27), and photo from Douglas C. Daly.



f) Simple plank buttresses. A tabular extension of the trunk that serves as support. Figure from Mori et al. (1997, plate 2b).



g) Branched plank buttresses. Figures from left: Mori et al. (1997, plate 2 top), and photo from Douglas C. Daly.



h) Prop or stilt roots. Aerial roots circular in cross section. In contrast to flying buttresses, these are cylindrical (round in cross-section). Figures from left: Mori et al. (1997, plate 3c), and Mori et al. (1997, plate 3d).



i) Flying buttresses. A tabular extension of the trunk with a gap at the base. In comparisons with prop or stilt roots, flying buttresses are not cylindrical. Figure from Mori et al. (1997, plate 3b).



12) Outer bark color:

- a) Whitish.**
- b) Gray.**
- c) Yellow.**
- d) Green.**
- e) Reddish.**
- f) Brown.**
- g) Black.**

13) Bark surface

a) Smooth. Without indentations; no rough surface whatsoever except possibly lenticels. Photo from Douglas C. Daly.



b) Pock-marked or pitted. Bark cover with small, shallow, circular depressions, less than 1 cm in diameter.



c) Fissured or striate. Vertical splits of diverse depth and width in the bark. Fissured on left, striate on right. Photos from Douglas C. Daly.



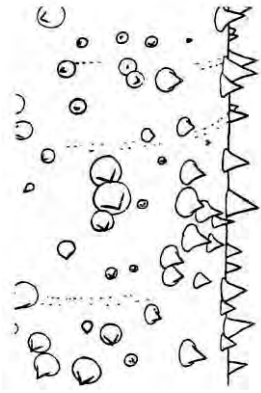
d) Scalloped. The same as pock-marked or pitted, but at least 1 cm in diameter. Photo from Douglas C. Daly.



e) Scaly. Small papery plates (< 1 cm). Photo from Douglas C. Daly.



f) Spiny or with spinose projections. Figure from Vaucher (2003: 18, type 17).



14) Obvious bark exfoliation (shedding):

a) Non-apparent.



b) Shed in small plates (≤ 2 cm).

c) Shed in large plates (> 2 cm) relatively consistent in shape, usually quadrangular.

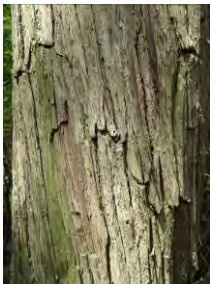
d) Shed in large plates (> 2 cm) inconsistent in shape. Photo from Douglas C. Daly.



e) Shed in papery sheets or scrolls. Thinner than plates (like paper).



f) Shed in elongate strips (length width > 3:1).



g) Shed in granules (= small grains).



15) Shape of fissures (when present):

a) Straight.

b) Wavy but not interlacing. Photo from Douglas C. Daly.



c) Wavy and interlacing.

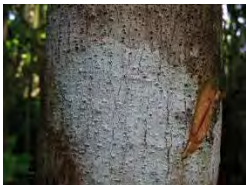


d) Polygonal reticulate, plates not overlapping. Forming a network. Photo from Douglas C. Daly.



16) Fissuring density of outer bark (when fissures present): Different conspecific trees may have smooth and fissured bark.

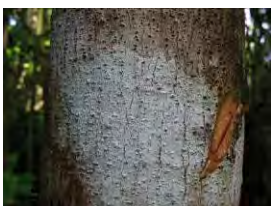
a) Sparse. More than 2 cm between fissures. Photo from Douglas C. Daly.



b) Dense. Less than 2 cm between fissures.

17) Fissuring depth of outer bark (when fissures present):

a) Shallow or striate. Less than 5 mm. Photo from Douglas C. Daly.



b) Deep. More than 5 mm.



18) Lenticels on outer bark: These are often raised corky spots or pustules for gas exchange; they have a pore or hole. Range of diameter approximately 1-10 mm.

a) Absent.



b) Circular. Photo from Douglas C. Daly.



c) Horizontally elongate.

d) Vertically elongate. Photo from Douglas C. Daly.



19) Hoop marks on outer bark: Raised transverse ridges or lines of lenticells that partially or completely circle the trunk.

Present. Photos from Douglas C. Daly.



20) Inner bark color: Inside the layer where the cork is, corresponds to phloem.

- a) **White.**
- b) **Tan (beige).**
- c) **Yellow.**
- d) **Pink.**
- e) **Red.**
- f) **(Dark-)brown.**

21) Inner bark texture:

a) **Brittle (= easily broken).** Photo from Douglas C. Daly.



b) **Fibrous.** You don't see fibres necessarily, but large pieces hold together (or can be peeled off in one piece).

22) Sap opacity:

a) Transparent. It is clear (like water).



b) Translucent. Light goes through (like frosted glass).



c) Opaque. Light does not go through.



23) Sap color:

a) Colorless.

b) White.

c) Yellow, tan, orange.

d) Red.

e) Brown.

24) Sap consistency:

a) Watery.

b) Oily.

c) Sticky.

25) Sapwood color:

- a) **White/beige.**
- b) **Yellow.**
- c) **Reddish.**
- d) **(Dark)brown.**
- e) **Almost black.**
- f) **More than one color.**

26) Wood density:

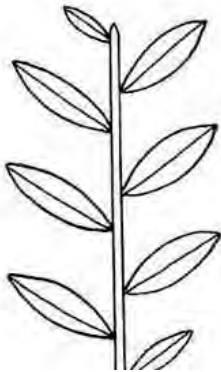
- a) **Light (< 0.5 g/cm³).**
- b) **Intermediate (still floats): 0.5-0.7 g/cm³).**
- c) **Heavy (> 0.7 g/cm³).**

27) Hollow branchlets: Like a straw.

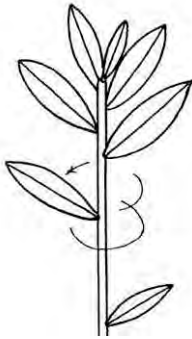
Present.

28) Leaf arrangement:

- a) **Alternate distichous.** In one plane. Figure from Keller (2004: 141 Fig. a).

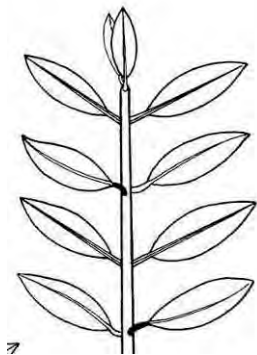


b) Alternate spiral. Figure from Keller (2004: 141 Fig. b).



c) Subopposite. Not perfectly opposite.

d) Opposite. Figure from Keller (2004: 141 Fig. j).



e) Whorled.

29) Formation of leaf stipules: Pair of outgrowths (sometimed fused) associated with petiole base, and developing early from part of leaf primordium.

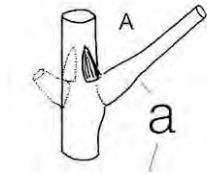
a) Absent.

b) Apparently single (fused).

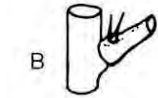
c) Paired.

30) Location of leaf stipules:

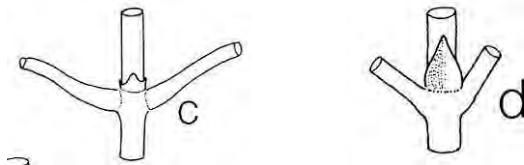
a) **At the base of the petiole.** Figure from Keller (2004: 149, Fig. a-A).



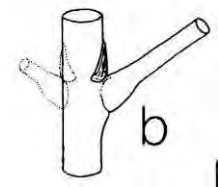
b) **On the base of the petiole.** Figure from Keller (2004: 149, Fig. a-B).



c) **Lateral (= interpetiolar).** Figures from Keller (2004: 149, Figs. c, d).



d) **Adaxial (= intrapetiolar).** Figure from Keller (2004: 149, Fig. b).



e) **Adnate to base of petiole.** Figures from Keller (2004: 149 Figs. g, j).



f) **Leaf-opposed.**

31) Shape of leaf stipules:

a) **Linear.**

b) **Bract-like or scale-like.**

c) **Foliose.** Photos from Douglas C. Daly.



d) **Modified to spines.**

e) **Modified to glands.**

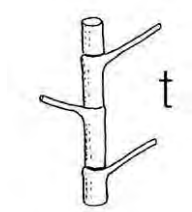
f) **Fused into ring and persistent.** Photo from Douglas C. Daly.



g) **Fused into ring, leaving an annular scar (non-persistent), sheathing apical bud.** Photo from Douglas C. Daly.



h) Fused into ring, leaving an annular scar (non-persistent), not sheathing apical bud. Figures from Keller (2004: 149, Fig. t)



32) Leaf organization: A leaf subtends almost always an axillary bud, not so a leaflet. A leaf falling off leaves a scar, a leaflet rarely falls off independently. A leaflet is a stacked laminar structure on a leaf.

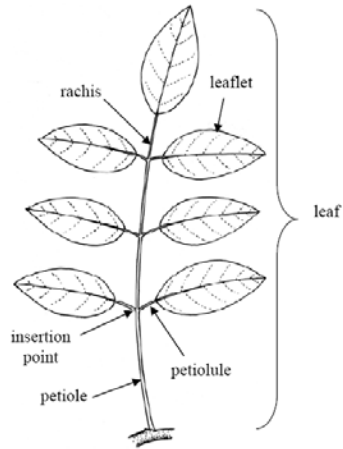
a) Simple. Leaf consisting of a single lamina attached to a simple, unjointed petiole. Figure from Ellis (in review, Fig. 27).



b) Palmately compound. Figures from Ellis (in review, Figs. 29, 30, 31).



c) **Once pinnately compound**. Figure from Ellis (in review, Fig. 8).



d) **Twice pinnately compound (bipinnate)**. Figure from Ellis (in review, Fig. 31).



e) **Thrice pinnately compound (tripinnate)**. Figure from Ellis (in review, Fig. 32).



f) Unifoliolate (compound). Figure from Ellis (in review, Fig 28).

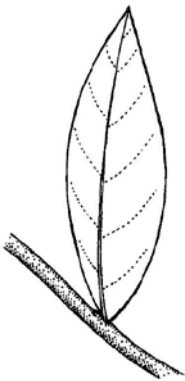


33) Leaf attachment:

a) Petiolate. Figure from Ellis (in review, Fig. 23).

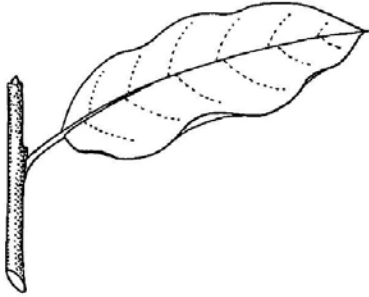


b) Sessile. Figure from Ellis (in review, Fig. 22).

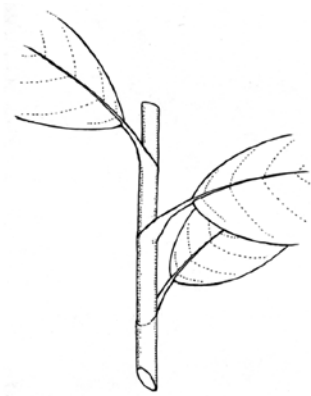


34) Leaf petiole base:

a) **Not sheathing nor pulvinate.** Figure from Ellis (in review, Fig. 27).



b) **Sheathing.** Figure from Ellis (in review, Fig. 40).



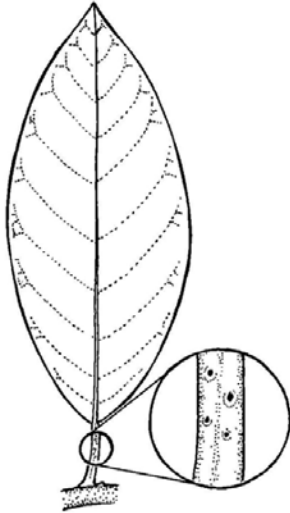
c) **Pulvinate.** A swelling of fleshy tissue, indicating often the ability of flection. Figure from Ellis (in review, Fig. 41).



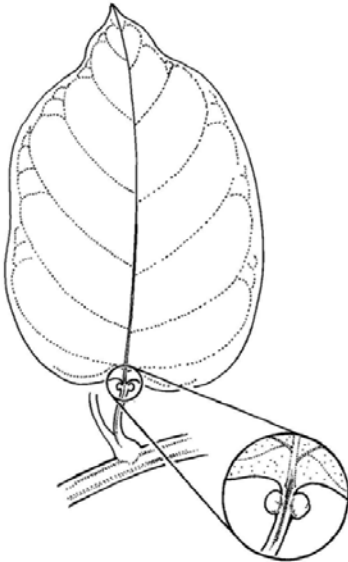
35) Leaf petiole glands:

a) **Absent.**

b) **Petiolar glands.** Figure from Ellis (in review, Fig. 44).

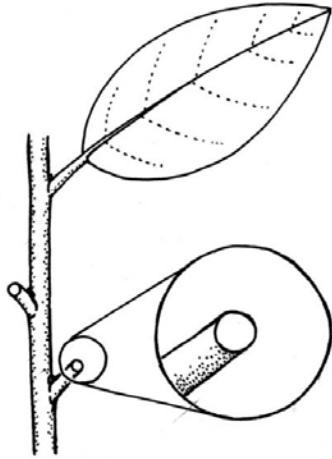


c) **Acropetiolar glands.** Figure from Ellis (in review, Fig. 45).

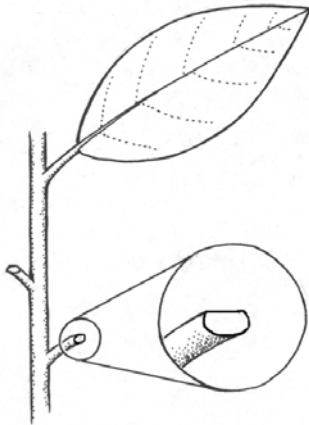


36) Cross-Section of the leaf petiole:

a) **Terete.** Figure from Ellis (in review, Fig. 46).



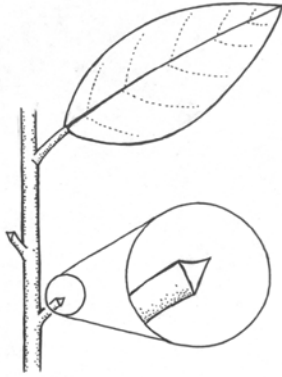
b) **Semi-terete.** Figure from Ellis (in review, Fig. 47).



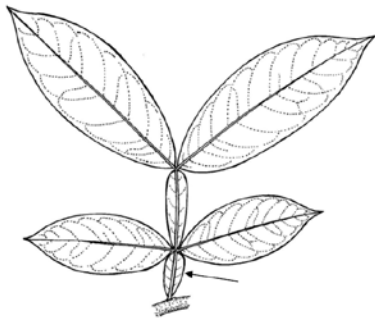
c) **Canaliculate.** Figure from Ellis (in review, Fig. 48)



d) Triangular. Figure from Ellis (in review, Fig. 49).



e) Alate. Figure from Ellis (in review, Fig. 50).



37) Leaf phyllodes:

Present. The petiole expands to make a leaf-like lamina. In Figure from Ellis (in review, Fig. 51, *Acacia mangium*, the structure that looks like a leaf is the transformed petiole, and the leaf blade has been lost.

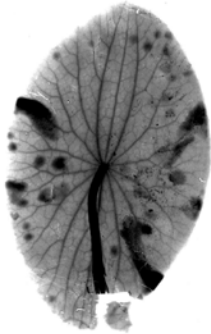


38) Position of leaf petiolar attachment:

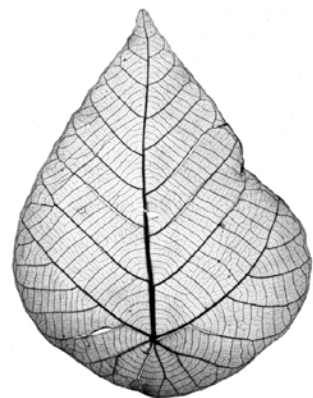
a) Marginal. Figure from Ellis (in review, Fig. 52).



b) Peltate central. Figure from Ellis (in review, Fig. 53).



c) Peltate excentric. Figure from Ellis (in review, Fig. 54).



39) Leaf length: Includes the petiole and the acumen.

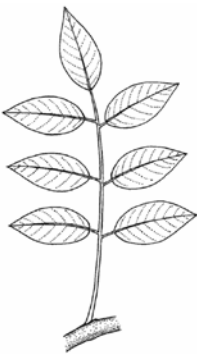
- a) < 2 cm.
- b) 2-5 cm.
- c) 5-10 cm.
- d) 10-20 cm.
- e) 20-50 cm.
- f) >50 cm.

40) Leaflet organization:

a) **Alternate**. Figure from Ellis (in review, Fig. 33).

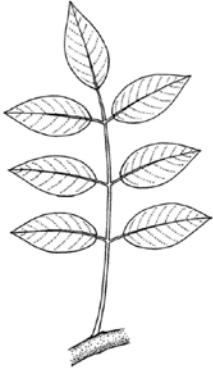


b) **Subopposite and odd-pinnately**. Figure from Ellis (in review, Fig. 34).



c) **Subopposite and even-pinnately**.

d) Opposite and odd-pinnately. Figure from Ellis (in review, Fig. 35).



e) Opposite and even-pinnately. Figure from Ellis (in review, Fig. 36).



41) Leaflet attachment:

a) Petiolulate.

b) Sessile.

42) Occurrence of pulvinuli on base or apex of leaflet petiolule:

a) Absent.

b) On terminal petiolule.

c) On all petiolules.

43) Position of pulvinuli on the leaflet petiolule:

a) Basal. Figure from Ellis (in review, Fig. 42).



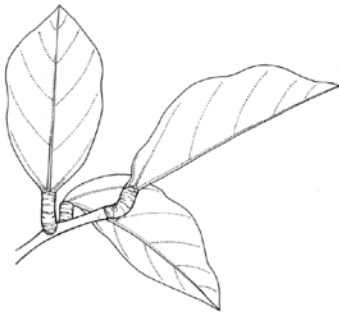
b) Distal (on apex). Figure from Ellis (in review, Fig. 43).



c) Basal and distal.

44) Articulation (abscission joint) of the leaflet petiolule:

Present. Figure from Ellis (in review, Fig. 39).



45) Interpetiolular glands of the leaflet:

Present.

46) Cross-section of the petiolule: For illustrations see character #36 (of leaf petiole).

a) Terete.

b) Semi-terete.

c) Canaliculate.

d) Triangular.

e) Alate.

47) Leaflet length:

a) < 2 cm.

b) >2-5 cm.

c) >5-10 cm.

d) >10-20 cm.

e) >20-50 cm.

f) >50 cm.

48) Laminar length-to-width ratio of the leaf or leaflet:

a) <2.

b) >2-4.

c) >4-6.

d) >6.

49) Specific leaf or leaflet mass (SLM):

a) Low.

b) Intermediate.

c) High.

50) Laminal shape of the leaf or leaflet:

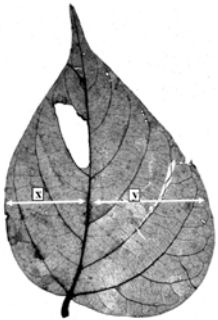
- a) **Elliptic.**
- b) **Obovate.**
- c) **Lanceolate.**
- d) **Oblong.**
- e) **Ovate.**

51) Medial symmetry of leaf or leaflet:

a) **Symmetrical.** Figure from Ellis (in review, Fig. 62).



b) **Asymmetrical.** Figure from Ellis (in review, Fig. 63).

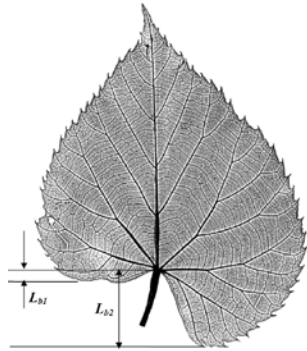


52) Base symmetry of leaf or leaflet: The base is the lower 25% length portion of the leaf.

a) **Base (sub)symmetrical**. Figure from Ellis (in review, Fig. 62).



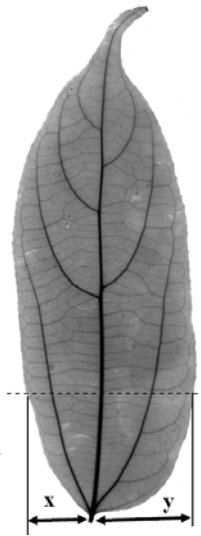
b) **Basal extension asymmetrical**. Figure from Ellis (in review, Fig. 64).



c) **Basal insertion asymmetrical**. Figure from Ellis (in review, Fig. 65).

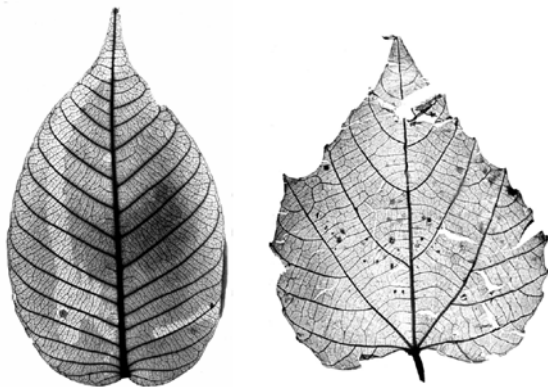


d) Basal width asymmetrical. Figure from Ellis (in review, Fig. 66).



53) Lobation of leaf or leaflet:

a) Unlobed. Figures from Ellis (in review, Figs. 67, 68).



b) Palmately lobed. Figure from Ellis (in review, Fig. 69).



c) **Palmately lobed almost to the base (palmatisect)**. Figure from Ellis (in review, Fig. 70).



d) **Pinnately lobed**. Figure from Ellis (in review, Fig. 71).



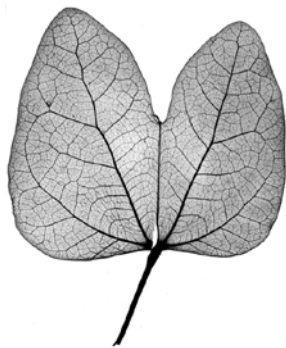
e) **Pinnately lobed almost to the base (pinnatisect)**. Figure from Ellis (in review, Fig. 72).



f) Palmately and pinnately lobed. Figure from Ellis (in review, Fig. 73).



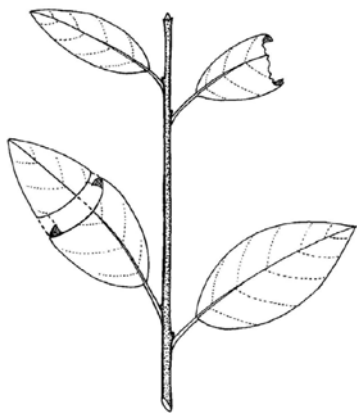
g) Bilobed. Figure from Ellis (in review, Fig. 74).



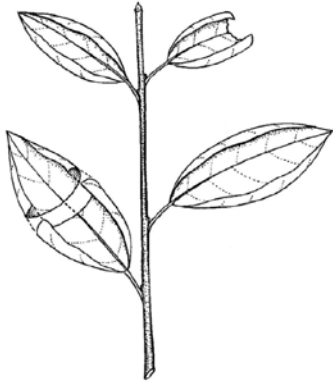
54) Margin of leaf or leaflet rolled or folded:

a) No.

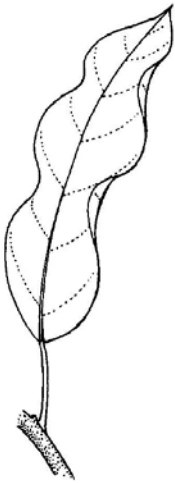
b) Revolute. Figure from Ellis (in review, Fig. 83).



c) Involute. Figure from Ellis (in review, Fig. 84).

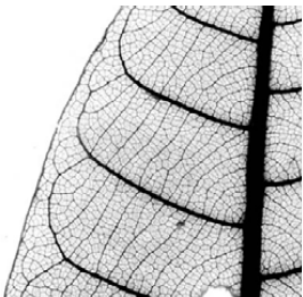


d) Sinuous. An entire margin is wavy out of the plane of the leaf. Figure from Ellis (in review, Fig. 85).

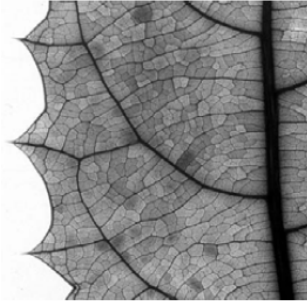


55) Margin type of leaf or leaflet:

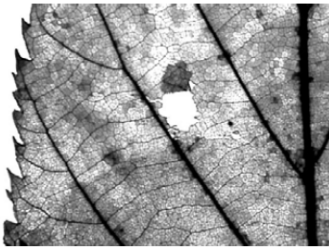
a) Entire (untoothed). Figure from Ellis (in review, Fig. 75).



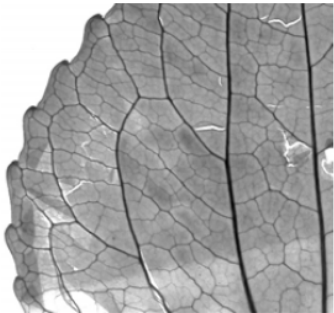
b) Toothed and dentate. Figure from Ellis (in review, Fig. 76).



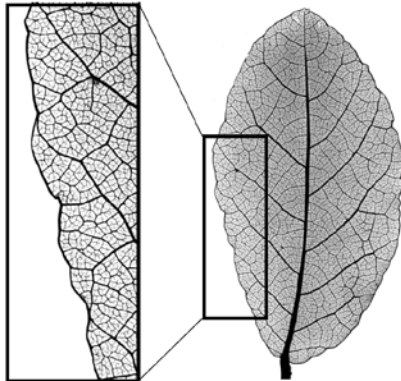
c) Toothed and serrate. Figure from Ellis (in review, Fig. 77).



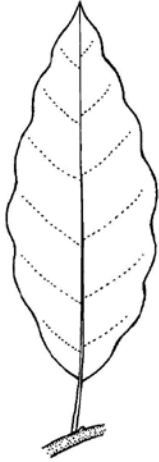
d) Toothed and crenate. Figure from Ellis (in review, Fig. 78).



e) Erosee. Figure from Ellis (in review, Fig. 81).

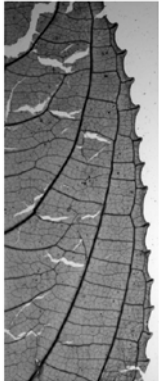


f) Undulate. The outline of the leaf is wavy in one plane only (two dimensions). Figure from Ellis (in review, Fig. 82).



56) Tooth spacing of leaf or leaflet:

a) Regular. Figure from Ellis (in review, Fig. 320).

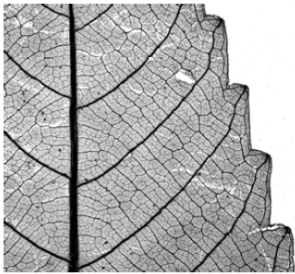


b) Irregular. Figure from Ellis (in review, Fig. 321).



57) Number of orders of teeth of the leaf or leaflet:

a) **Teeth of one size only.** Figure from Ellis (in review, Fig. 322).



b) **Teeth of two distinct sizes.** Figure from Ellis (in review, Fig. 323).



c) **Teeth of three distinct sizes.** Figure from Ellis (in review, Fig. 324).



d) **Teeth vary in size continuously.**

58) Number of teeth per centimeter of the leaf or leaflet (measured in the middle 50% of the leaf):

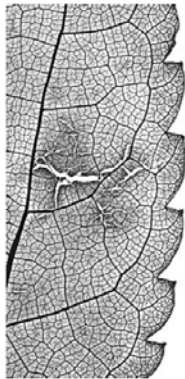
- a) One.
- b) Two.
- c) Three.
- d) Four.
- e) More than four.

59) Sinus shape of teeth of leaf or leaflet:




































a) **Rounded.** Figure from Ellis (in review, Fig. 327).



b) **Angular.** Figure from Ellis (in review, Fig. 326).



60) Tooth shape on distal (= apical) side of leaf or leaflet: Chart figure from Ellis (in review, Fig. 328).

		APICAL SIDE				
		CV 	ST 	CC 	FL 	RT 
B A S A L S I D E	CV 					
	ST 					
	CC 					
	FL 					
	RT 					

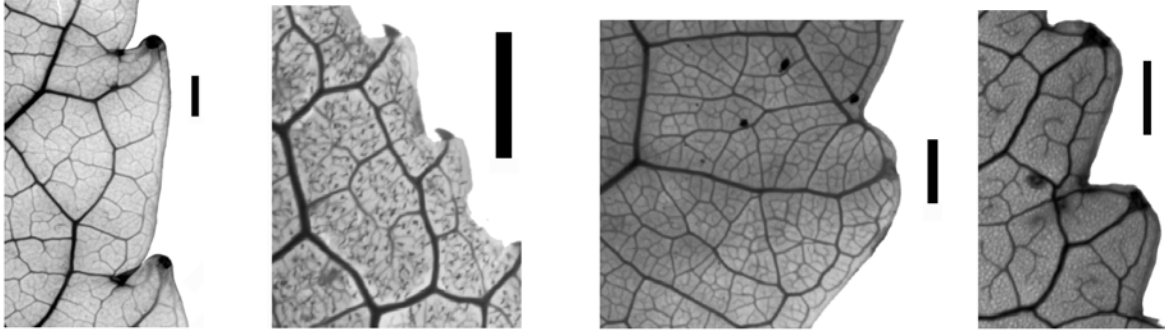
- a) **Convex (= CV).**
- b) **Straight (= ST).**
- c) **Concave (= CC).**
- d) **Flexuous (= FL).**
- e) **Retroflexed (= RT).**

61) Tooth shape on proximal (= basal) side of leaf or leaflet: See chart for character #60.

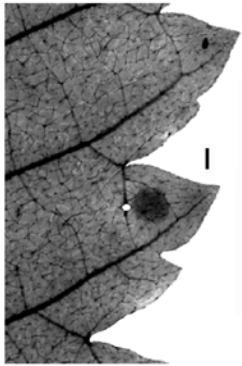
- a) **Convex.**
- b) **Straight.**
- c) **Concave.**
- d) **Flexuous.**
- e) **Retroflexed.**

62) Tooth apex of leaf or leaflet:

a) Glandular. Figures from Ellis (in review, Figs. 348, 351, 353, 354; scale bars = 1 mm).



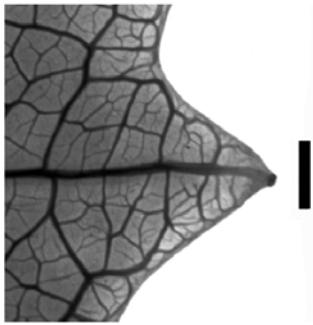
b) Acute. Figure from Ellis (in review, Fig. 346; scale bar = 1 mm).



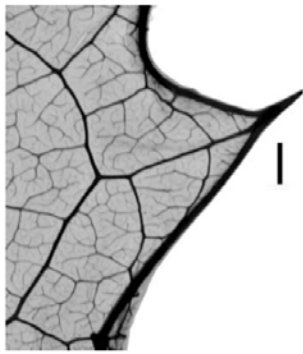
c) Rounded. Figure from Ellis (in review, Fig. 332; scale bar = 1 mm).



d) Mucronate. Figure from Ellis (in review, Fig. 350; scale bar = 1 mm).



e) Spinose. Figure from Ellis (in review, Fig. 331; scale bar = 1 mm).



63) Coloration of veins of leaf or leaflet (both sides):

a) Concolorous with rest of leaf.

b) Discolorous (distinct color).

64) Primary (= mid) vein prominence abaxially (= bottom) of leaf or leaflet:

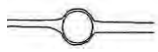
a) Flat or impressed. Figure from Ribeiro et al. (1999: 64).



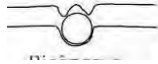
b) Acutely (= sharply) prominulous or prominent. Figure from Ribeiro et al. (1999: 64).



c) **Obtusely (= rounded) prominulous or prominent.** Figure from Ribeiro et al. (1999: 64).



d) **Raised but sunk in a groove.** Figure from Ribeiro et al. (1999: 64).



65) Secondary vein prominence abaxially (= bottom) of leaf or leaflet:

a) **Flat or impressed.** Figure from Ribeiro et al. (1999: 64).



b) **Prominulous.** Slightly raised.

c) **Prominent.** Conspicuously raised.

66) Tertiary and quaternary vein prominence abaxially (= bottom) of leaf or leaflet:

a) **Flat or impressed.** Figure from Ribeiro et al. (1999: 64).



b) **Prominulous.** Slightly raised.

c) **Prominent.** Conspicuously raised.

67) Primary (= mid) vein prominence adaxially (= top) of leaf or leaflet: For illustrations see character #64.

a) **Flat or impressed.**

b) **Acutely (= sharply) prominulous or prominent.**

c) **Obtusely (= rounded) prominulous or prominent.**

- d) **Raised but sunk in a groove.**
- e) **Sunk in a groove with raised sides.**

68) Secondary vein prominence adaxially (= top) of leaf or leaflet:

- a) **Flat or impressed.** Figure from Ribeiro et al. (1999: 64).



- b) **Prominulous.** Slightly raised.
- c) **Prominent.** Conspicuously raised.

69) Tertiary and quarternary vein prominence adaxially (= top) of leaf or leaflet:

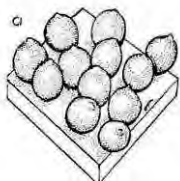
- a) **Flat or impressed.** Figure from Ribeiro et al. (1999: 64).



- b) **Prominulous.** Slightly raised.
- c) **Prominent.** Conspicuously raised.

70) Leaf surface texture abaxially (= bottom): The surface does not take into account hairs.

- a) **Smooth.**
- b) **Papillate.** Figure from Lawrence (1951: 748, Fig. 310a).



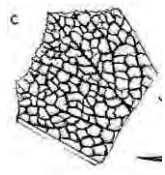
c) Pustulate.

d) Scaly.

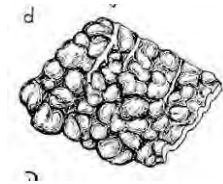
e) Punctate.

f) Pitted.

g) Rugose (= wrinkled). Figure from Lawrence (1951: 748, Fig. 310c).



h) Bullate (= “bubbled”). Figure from Lawrence (1951: 748, Fig. 310d).



71) Leaf surface texture adaxially (= top): The surface does not take into account hairs. For illustrations see character #70.

a) Smooth.

b) Papillate.

c) Pustulate.

d) Scaly.

e) Punctate.

f) Pitted.

g) Rugose (= wrinkled).

h) Bullate (= “bubbled”).

72) Leaf surface reflectivity abaxially (= bottom):

a) Glossy (= shiny).

b) Dull.

73) Leaf surface reflectivity adaxially (= top):

a) Glossy (= shiny).

b) Dull.

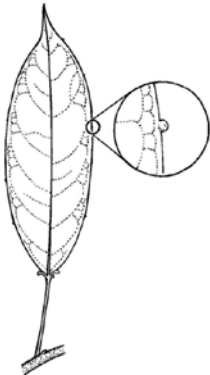
74) Surficial glands abaxially (= bottom) of leaf or leaflet:

a) Absent.

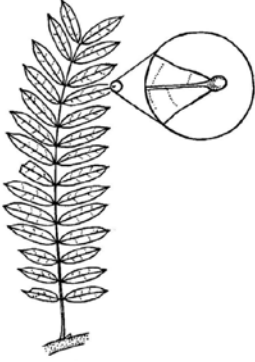
b) Laminar. Figure from Ellis (in review, Fig. 122).



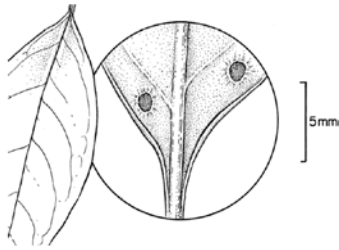
c) Marginal. Figure from Ellis (in review, Fig. 123).



d) Apical. Figure from Ellis (in review, Fig. 124).



e) Basal laminar. Figure from Ellis (in review, Fig. 125).



75) Surficial glands adaxially (= top) of leaf or leaflet:

- a) Absent.**
- b) Laminar.**
- c) Marginal.**
- d) Apical.**
- e) Basal laminar.**

76) Dense trichomes in axils of secondary veins abaxially (= bottom):

Present.

77) Leaf or leaflet trichome type abaxially (= bottom):

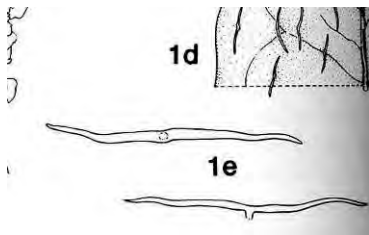
a) Simple hairs. Figure from Lawrence (1951: 746, Fig. 308b).



b) Capitate glands.

c) Snail-shaped glands.

d) Malpighiaceae hairs. Figure from Zomlefer (1994: 142, Figs. 1d, 1e).



e) Stellate hairs. Figure from Lawrence (1951: 747, Fig. 309e).



f) Peltate scales.

78) Leaf or leaflet trichome orientation abaxially (= bottom):

a) Erect straight. Figure from Lawrence (1951: 746, Fig. 308b).



b) Erect flexuous. Figure from Lawrence (1951: 746, Fig. 308e).



c) Ascending. Figure from Lawrence (1951: 747, Fig. 309b).



d) Appressed. Figure from Lawrence (1951: 747, Fig. 309f).



79) Leaf or leaflet trichome color abaxially (= bottom):

a) Transparent.

b) White.

c) Yellow to gold.

d) Ferruginous (rust brown).

e) Red.

80) Leaf or leaflet trichomes on midvein abaxially (= bottom):

a) Glabrous (absent).

b) Scattered.

c) Sparse.

d) Dense.

81) Leaf or leaflet trichomes on blade abaxially (= bottom):

a) Glabrous (= absent).

- b) Scattered.**
- c) Sparse.**
- d) Dense.**

82) Leaf or leaflet trichome type adaxially (= top):

- a) Simple hairs.**
- b) Capitate glands.**
- c) Snail-shaped glands.**
- d) Malpighiaceae hairs.**
- e) Stellate hairs.**
- f) Peltate scales.**

83) Leaf or leaflet trichome orientation adaxially (= top):

- a) Erect straight.**
- b) Erect flexuous.**
- c) Ascending.**
- d) Appressed.**

84) Leaf or leaflet trichome color adaxially (= top):

- a) Transparent.**
- b) White.**
- c) Yellow to gold.**
- d) Ferruginous (rust brown).**
- e) Red.**

85) Leaf or leaflet trichomes on midvein adaxially (= top):

- a) Glabrous (absent).**

- b) Scattered.**
- c) Sparse.**
- d) Dense.**

86) Leaf or leaflet trichomes on blade adaxially (= top):

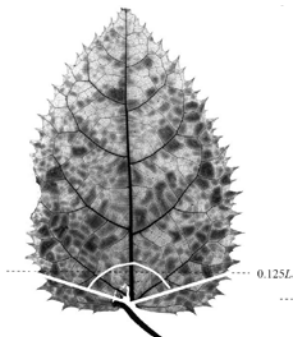
- a) Glabrous (= absent).**
- b) Scattered.**
- c) Sparse.**
- d) Dense.**

87) Base angle of leaf or leaflet:

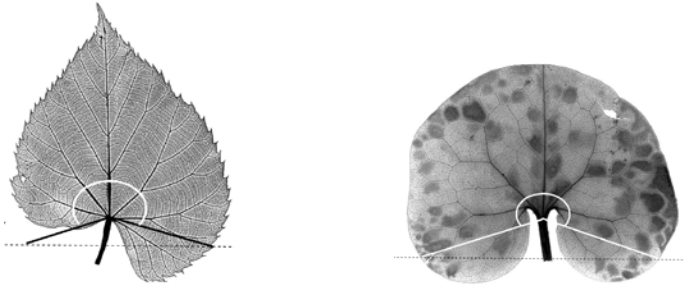
- a) Acute ($<90^\circ$). Figure from Ellis (in review, Fig. 86).**



- b) Obtuse ($>90^\circ$). Figure from Ellis (in review, Fig. 87).**

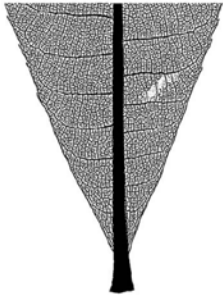


c) **Wide Obtuse ($>180^\circ$)**. Figures from Ellis (in review, Figs. 88, 89).



88) Base shape of leaf or leaflet, when there is *no* basal extension:

a) **Straight (cuneate)**. Figure from Ellis (in review, Fig. 90).



b) **Concave**. Figure from Ellis (in review, Fig. 91).



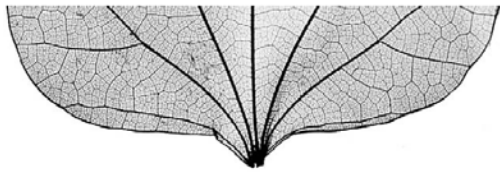
c) **Convex rounded**. Figure from Ellis (in review, Fig. 93).



d) Convex truncate. Figure from Ellis (in review, Fig. 94).



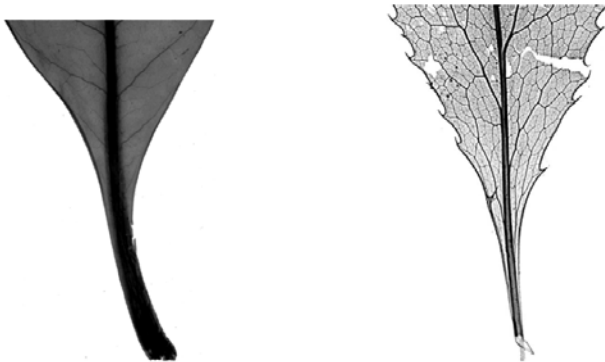
e) Concavo-convex. Figure from Ellis (in review, Fig. 95).



f) Complex. Figure from Ellis (in review, Fig. 96).

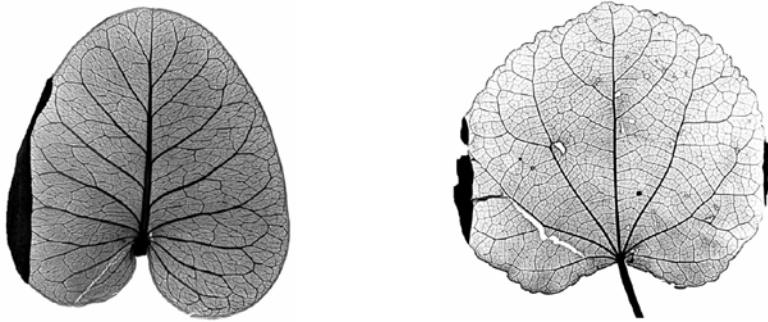


g) Decurrent. Figures from Ellis (in review, Figs. 97, 98).

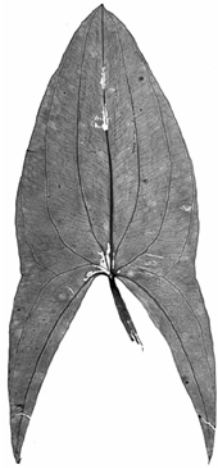


89) Base shape of leaf or leaflet, when there is a basal extension:

a) **Cordate.** Figures from Ellis (in review, Figs. 99, 100).



b) **Lobate sagittate.** Figure from Ellis (in review, Fig. 103).

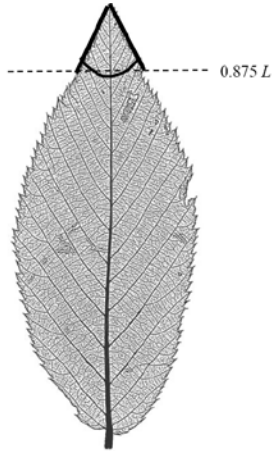


c) **Lobate hastate.** Figure from Ellis (in review, Fig. 104).

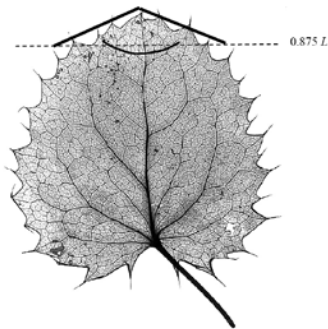


90) Apex angle of leaf or leaflet:

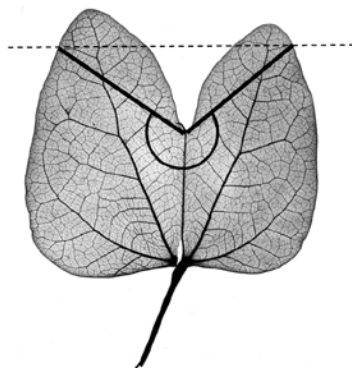
a) **Acute ($< 90^\circ$)**. Figure from Ellis (in review, Fig. 105).



b) **Obtuse ($90-180^\circ$)**. Figure from Ellis (in review, Fig. 106).

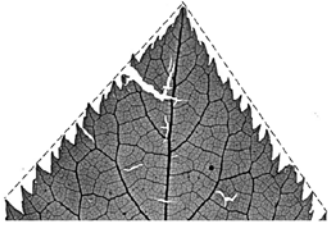


c) **Wide Obtuse ($> 180^\circ$)**. Figure from Ellis (in review, Fig. 107).



91) Apex shape of leaf or leaflet:

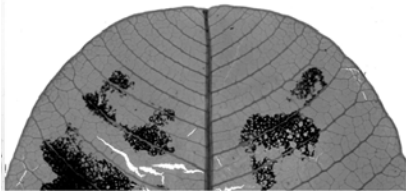
a) **Straight.** Figure from Ellis (in review, Fig. 111).



b) **Concave (acuminate).** Figures from Ellis (in review, Figs. 116, 117).



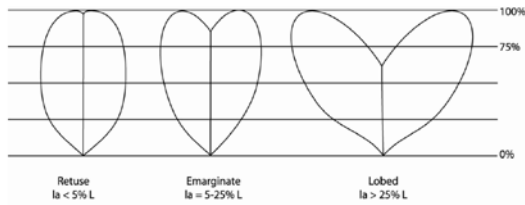
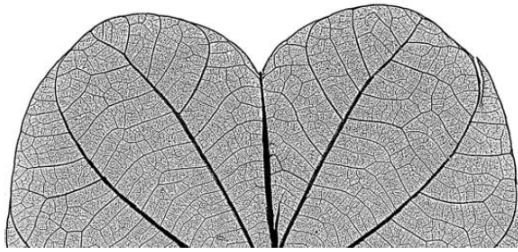
c) **Convex rounded.** Figure from Ellis (in review, Fig. 114).



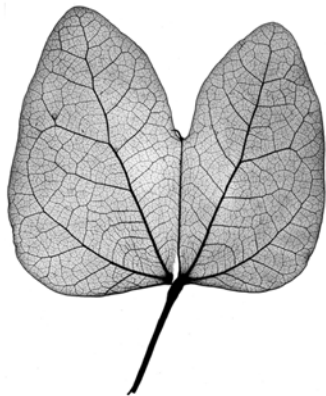
d) **Convex truncate.** Figure from Ellis (in review, Fig. 115).



e) **Emarginate.** Figure from Ellis (in review, Fig. 118).



f) **Lobed.** Figure from Ellis (in review, Fig. 74).

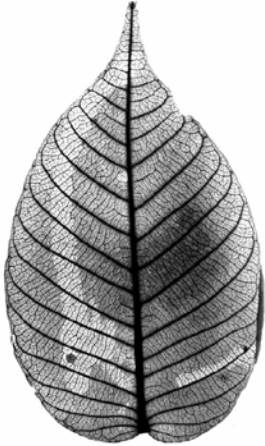


92) Apex shape of acuminate leaf or leaflet:

a) **Abruptly acuminate (measured at inflection point).** Figure from Ellis (in review, Fig. 116).



b) Gradually acuminate. Figure from Ellis (in review, Fig. 67).



93) Apex width of acuminate leaf or leaflet:

a) Broadly acuminate. Figure from Ellis (in review, Fig. 150).



b) Narrowly acuminate. Figure from Ellis (in review, Fig. 116).



94) Apex length of acuminate leaf or leaflet (= acumen length): This length is measured from the apex back to the point where the outline of the leaf turns from concave to convex.

a) < 10 mm.

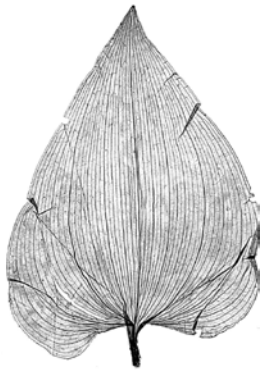
b) 11-20 mm.

c) 21-30 mm.

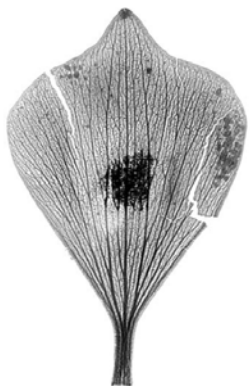
d) > 30 mm.

95) Terminal apex features of leaf or leaflet:

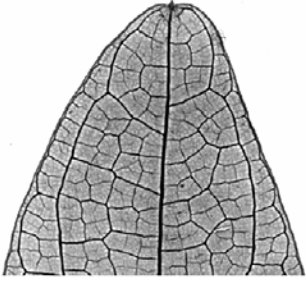
a) **Acute**. Figure from Ellis (in review, Fig. 167).



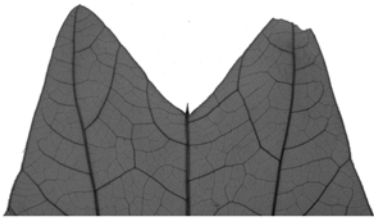
b) **Rounded**. Figure from Ellis (in review, Fig. 165).



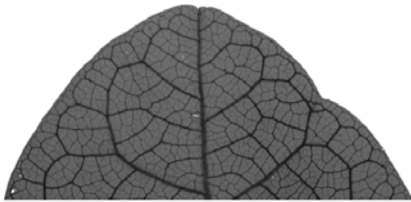
c) **Mucronate.** Figure from Ellis (in review, Fig. 119).



d) **Spinose.** Figure from Ellis (in review, Fig. 120).



e) **Retuse.** Figure from Ellis (in review, Fig. 121).



96) Primary vein pattern of leaf or leaflet:

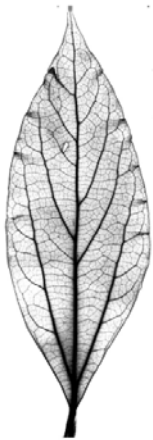
a) **Pinnate.** Figures from Ellis (in review, Figs. 151-154).



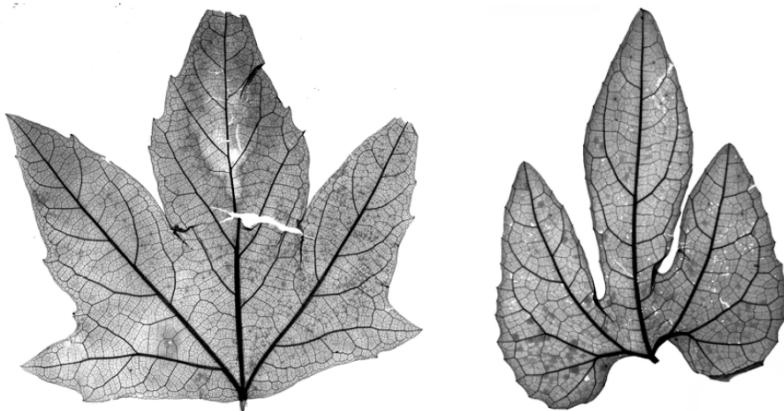
b) Palmate and actinodromous basal. Figure from Ellis (in review, Fig. 155-157).



c) Palmate and actinodromous suprabasal. Figure from Ellis (in review, Fig. 158).



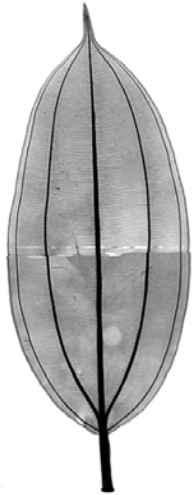
d) Palmate and palinactinodromous. Figure from Ellis (in review, Fig. 159-160).



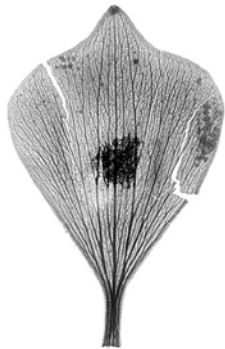
e) Palmate and acrodromous basal. Figure from Ellis (in review, Fig. 161-163).



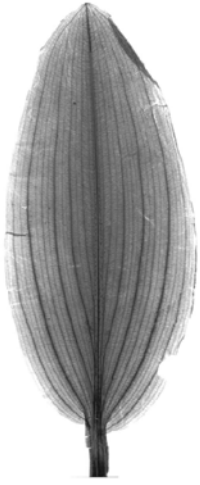
f) Palmate and acrodromous suprabasal. Figure from Ellis (in review, Fig. 164).



g) Palmate and flabellate. Figure from Ellis (in review, Fig. 165).



h) Palmate and parallelodromous (including campylodromous). Figure from Ellis (in review, Fig. 166).

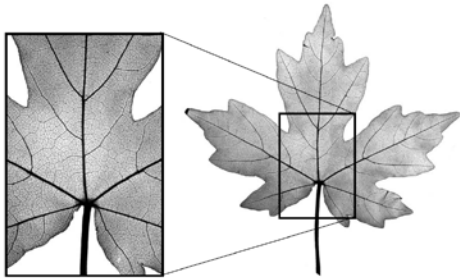


97) Number of basal primary veins of leaf or leaflet:

a) One.

b) Three.

c) Five. Figure from Ellis (in review, Fig. 169).

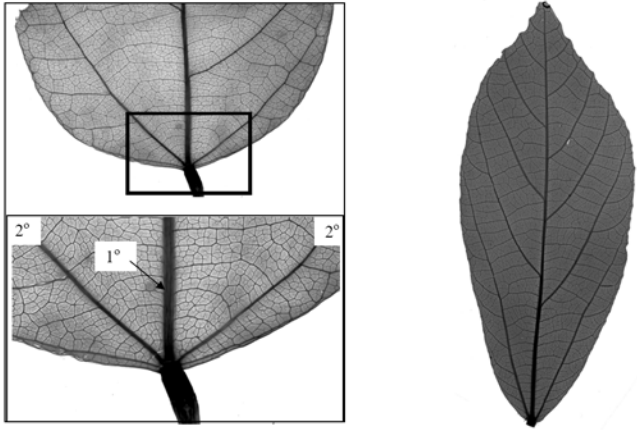


d) More than five.

98) Number of basal secondary veins of leaf or leaflet:

a) **Absent.**

b) **Two.** Figure from Ellis (in review, Figs. 141, 225).



c) **Four.**

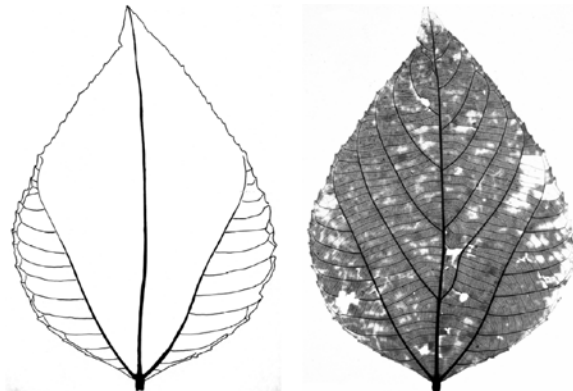
d) **Six.**

e) **More than six.**

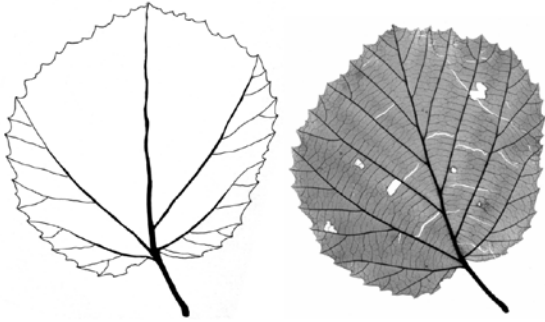
99) Agrophic veins of leaf or leaflet:

a) **Absent.**

b) **Simple.** Figure from Ellis (in review, Fig. 171-172).



c) **Compound.** Figure from Ellis (in review, Fig. 173-174).

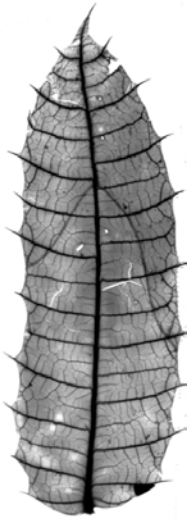


100) Major secondary vein pattern of leaf or leaflet:

a) **Major secondaries reach the margin.** For illustration see character #101a.

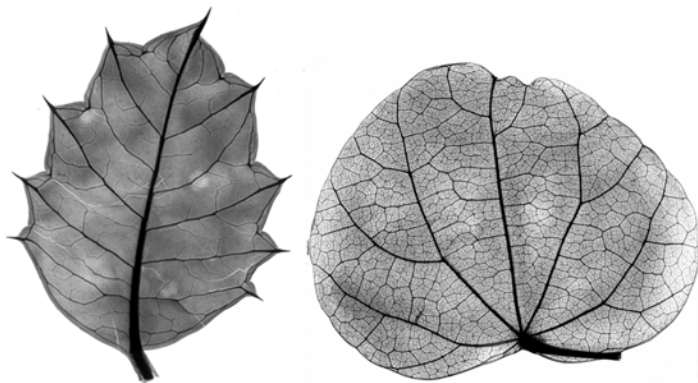
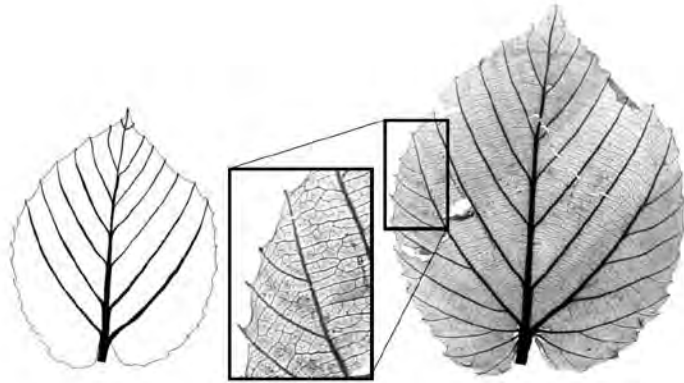
b) **Major secondaries do not reach the margin and lose gauge by attenuation.** For illustration see character #102a.

c) **Mixed.** Figure from Ellis (in review, Fig. 203).

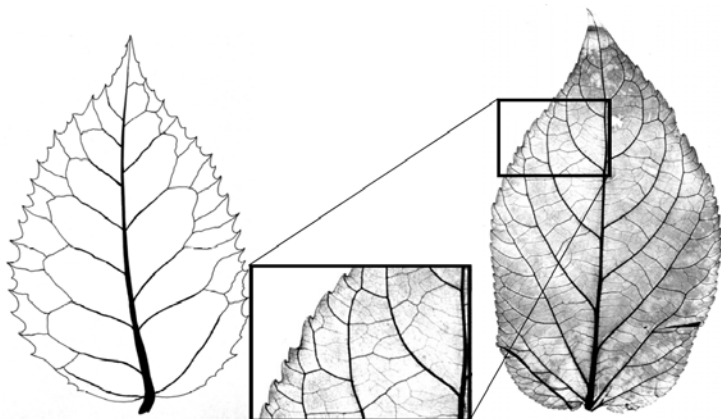


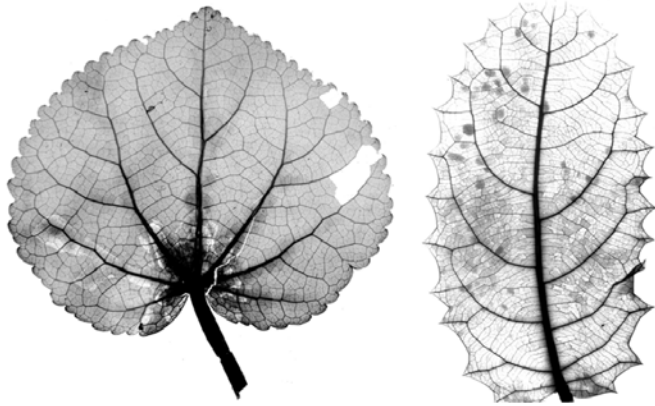
101) Major secondary vein pattern of leaf or leaflet, when major secondaries **reach** the margin:

a) **Craspedodromous**. Strikes margin without branching. Figure from Ellis (in review, Fig. 175-178).

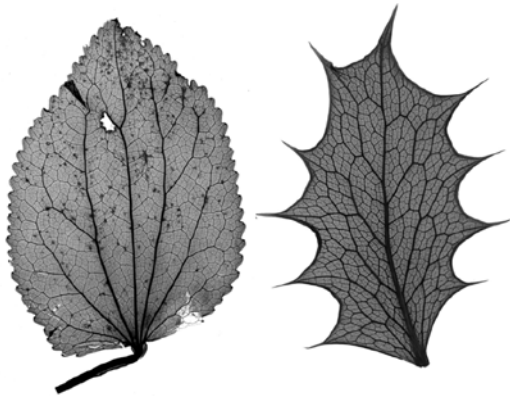
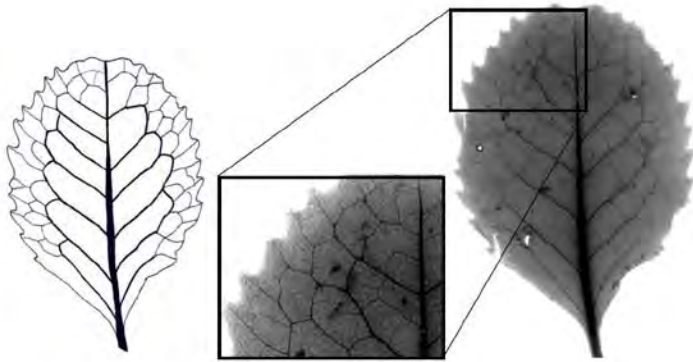


b) **Semicraspedodromous**. Usually found in toothed leaves. Figure from Ellis (in review, Fig. 179-182).



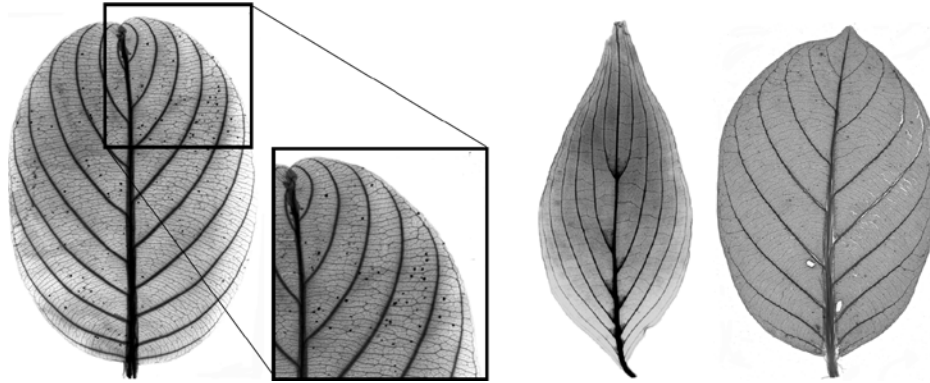


c) Festooned semicraspedodromous. Figure from Ellis (in review, Fig. 183-186).

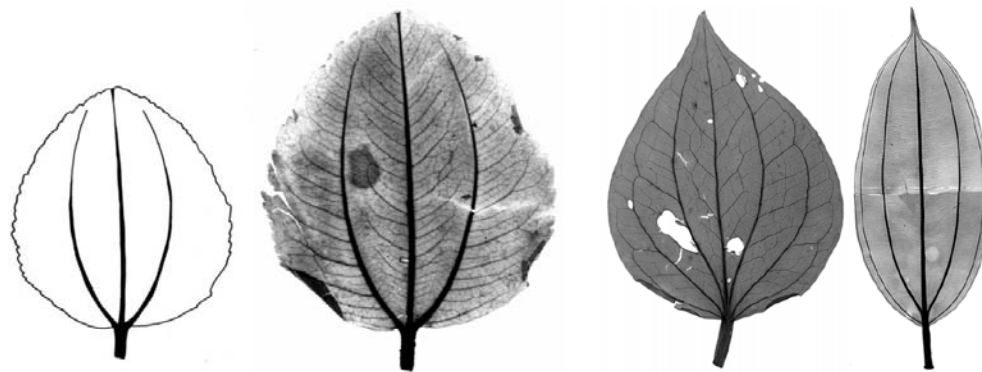


102) Major secondary vein framework of leaf or leaflet, when major secondaries **do not reach** the margin and lose gauge by attenuation:

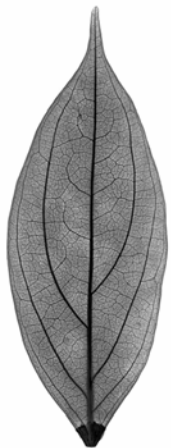
a) **Simply eucamptodromous.** Figure from Ellis (in review, Fig. 188-190).



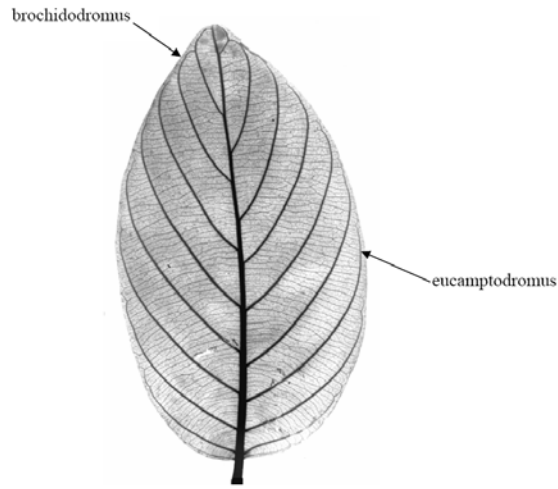
b) **Basal eucamptodromous.** Figure from Ellis (in review, Fig. 161-164).



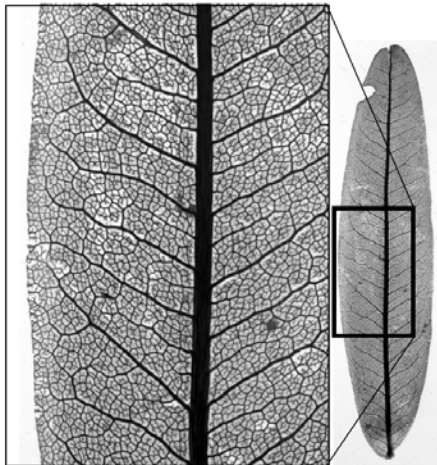
c) **Hemi-eucamptodromous.** The veins take off up to lower half of the leaf. Figure from Ellis (in review, Fig. 192).



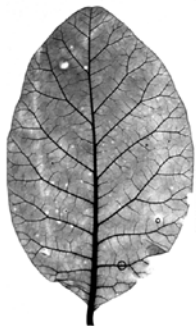
d) Eucamptodromous, becoming brochidodromous distally. Figure from Ellis (in review, Fig. 193).



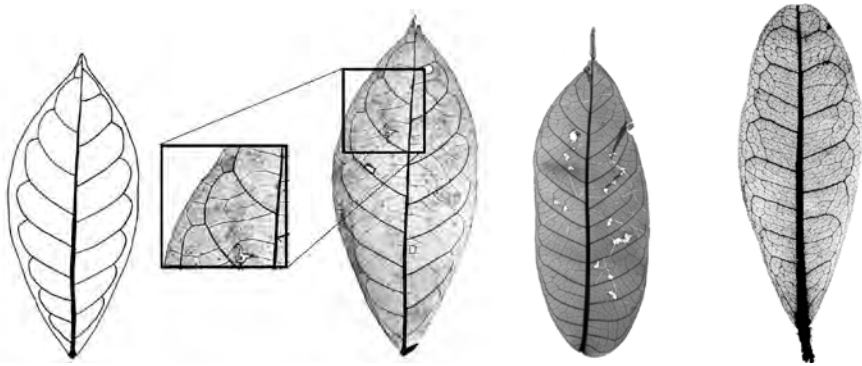
e) Reticulodromous. Figure from Ellis (in review, Fig. 194)



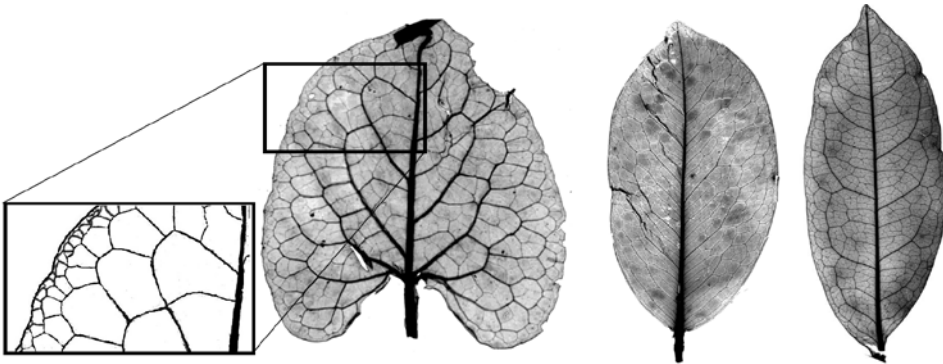
f) Cladodromous. Figure from Ellis (in review, Fig. 195).



g) Simple brochidodromous. Figure from Ellis (in review, Fig. 196-199).



h) Festooned brochidodromous. Figure from Ellis (in review, Fig. 200-202).



103) Interior secondaries of leaf or leaflet:

Present. Figure from Ellis (in review, Fig. 204-206).



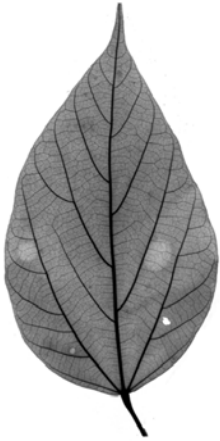
104) Minor secondary course of leaf or leaflet:

a) Absent.

b) Craspedodromous. Figure from Ellis (in review, Fig. 208).



c) Simple brochidodromous. Figure from Ellis (in review, Fig. 209).



d) Semicraspedodromous. Figure from Ellis (in review, Fig. 210).

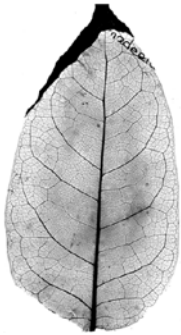


105) Major secondary spacing in central half (0.25-0.75 of length) of leaf or leaflet:

a) Regular. Figure from Ellis (in review, Fig. 215).



b) Irregular. Figure from Ellis (in review, Fig. 216).



106) Proximal trend of major secondary spacing of leaf or leaflet:

a) Uniform.

b) Decreasing proximally. Figure from Ellis (in review, Fig. 217).



c) Increasing proximally. Figure from Ellis (in review, Fig. 218).

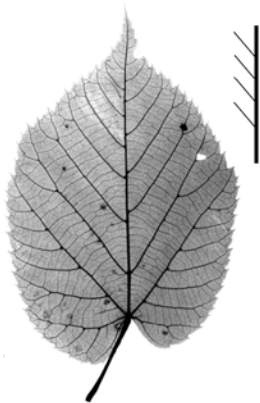


107) Distal trend of major secondary spacing of leaf or leaflet:

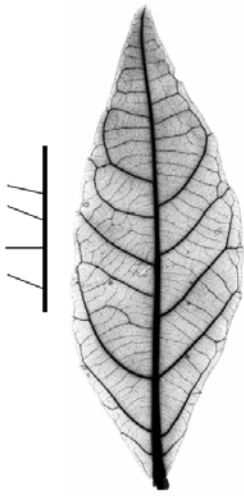
- a) **Uniform.**
- b) **Decreasing distally.**
- c) **Increasing distally.**

108) Trend (or variation) towards base of major secondary angle to midvein of leaf or leaflet:

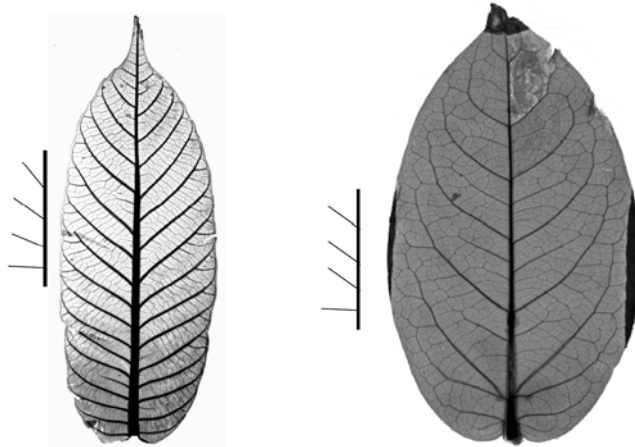
a) **Uniform.** Figure from Ellis (in review, Fig. 220).



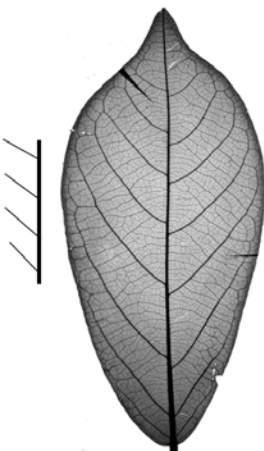
b) Inconsistent. Figure from Ellis (in review, Fig. 221).



c) Increasing toward base. Figure from Ellis (in review, Fig. 222, 224).



d) Decreasing toward base. Figure from Ellis (in review, Fig. 223).



e) **One pair of acute basal secondaries.** Figure from Ellis (in review, Fig. 225).



109) Trend (or variation) towards apex of major secondary angle to midvein of leaf or leaflet:

a) **Uniform.**

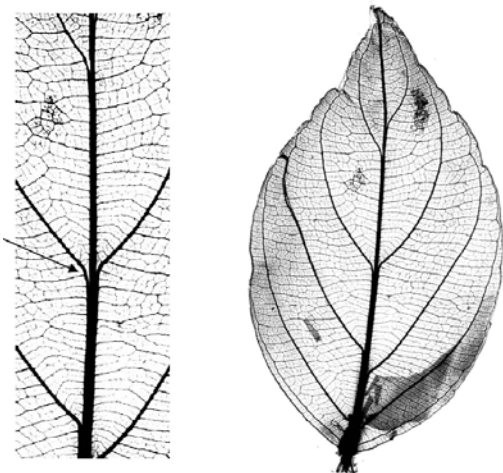
b) **Inconsistent.**

c) **Increasing toward apex.**

d) **Decreasing toward apex.**

110) Major secondary attachment to midvein of leaf or leaflet:

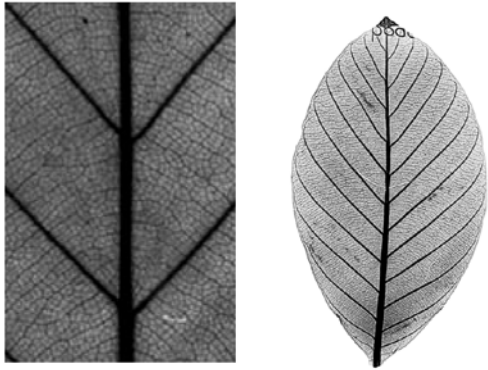
a) **Decurrent.** Figure from Ellis (in review, Fig. 6, 226).



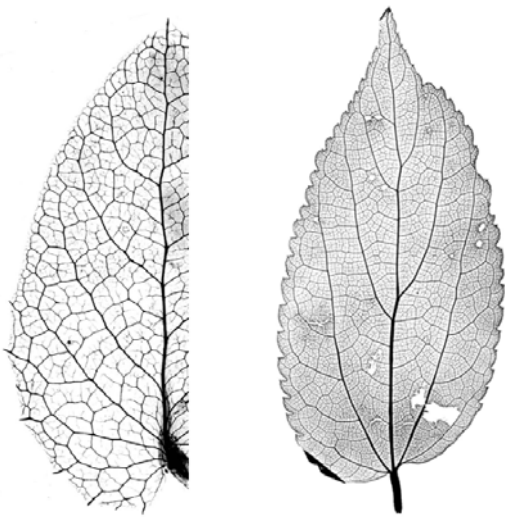
b) Basally decurrent. Figure from Ellis (in review, Fig. 227).



c) Excurrent. Figure from Ellis (in review, Figs. 130, 228).



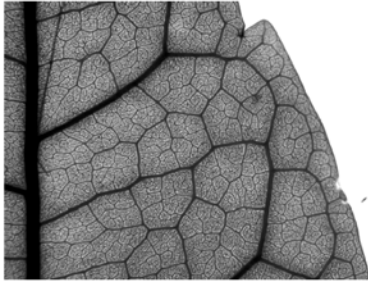
d) Deflected (midvein sympodial). Figure from Ellis (in review, Figs. 135, 229).



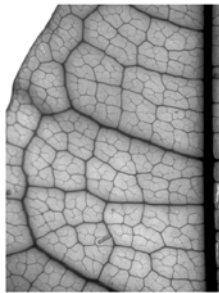
111) Intersecondary veins of leaf or leaflet:

a) **Absent.**

b) **Proximal course parallel to major secondaries.** Figure from Ellis (in review, Fig. 231).

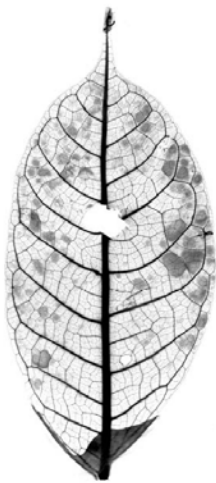


c) **Proximal course perpendicular to midvein.** Figure from Ellis (in review, Fig. 232).

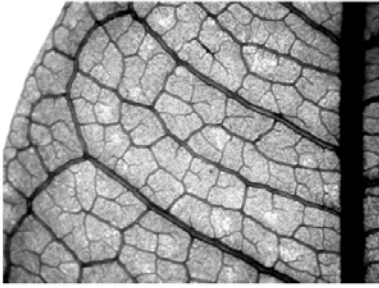


112) Length of intersecondary veins of leaf or leaflet:

a) **Intersecondary Length <50% of subjacent secondary.** Figure from Ellis (in review, Fig. 233).

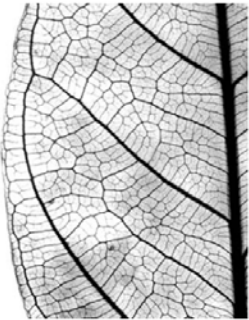


b) Intersecondary Length \geq 50% of subjacent secondary. Figure from Ellis (in review, Fig. 234).

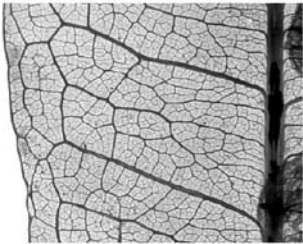


113) Distal course of intersecondary veins of leaf or leaflet:

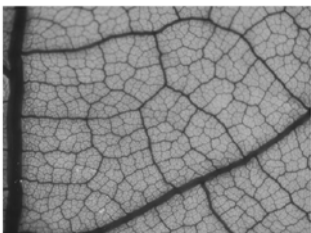
a) Reticulating. Figure from Ellis (in review, Fig. 235).



b) Parallel to subjacent major secondary. Figure from Ellis (in review, Fig. 236).

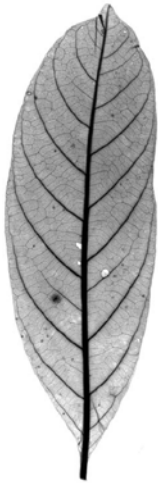


c) Perpendicular to and joining subjacent major secondary. Figure from Ellis (in review, Fig. 237).

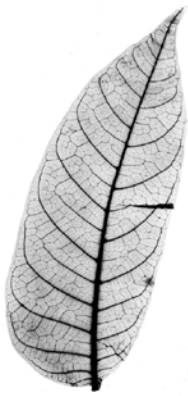


114) Average number of intersecondary veins relative to major secondaries of leaf or leaflet:

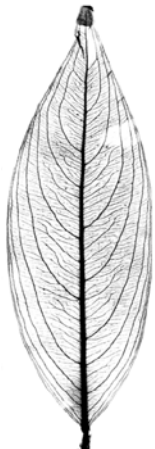
a) <1 per intercostal area. Figure from Ellis (in review, Fig. 238).



b) ~1 per intercostal area. Figure from Ellis (in review, Fig. 239).

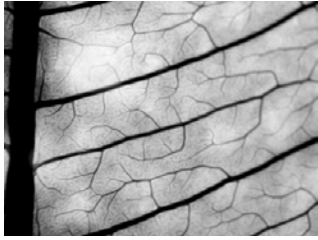


c) >1 per intercostal area. Figure from Ellis (in review, Fig. 240).

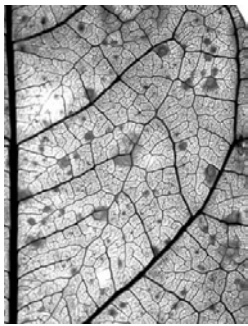


115) Intercostal tertiary vein pattern:

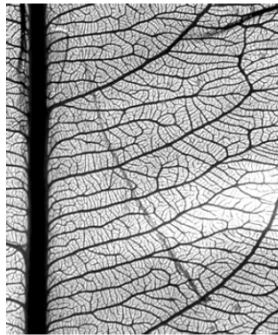
a) Admedially ramified and simple. Figure from Ellis (in review, Fig. 253).



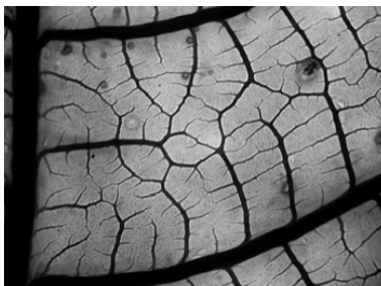
b) Admedially ramified and trunked. Figure from Ellis (in review, Fig. 254).



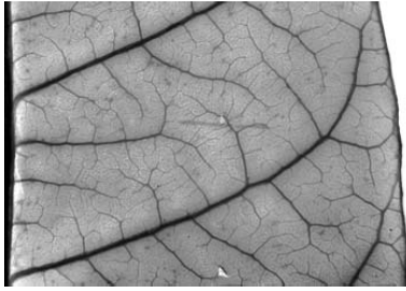
c) Exmedially ramified. Figure from Ellis (in review, Fig. 255).



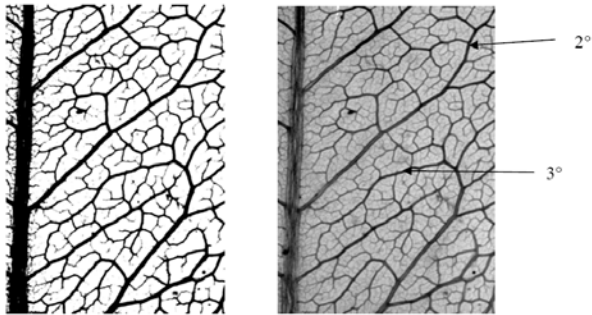
d) Transverse ramified. Figure from Ellis (in review, Fig. 256).



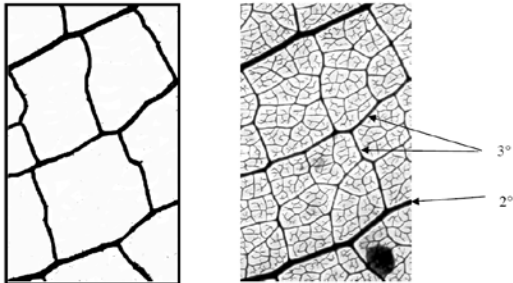
e) **Transverse freely ramified.** Figure from Ellis (in review, Fig. 257).



f) **Random reticulate.** Figure from Ellis (in review, Fig. 251).



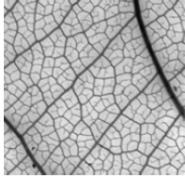
g) **Regular reticulate.** Figure from Ellis (in review, Fig. 252).



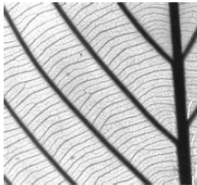
h) **Percurrent.** Crossing between major secondaries. See character #116.

116) Course of percurrent tertiaries of leaf or leaflet:

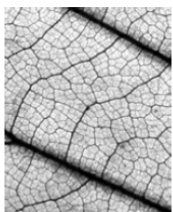
a) Opposite and straight. Figure from Ellis (in review, Fig. 241).



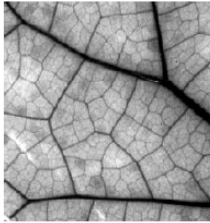
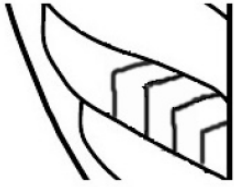
b) Opposite and convex. Figure from Ellis (in review, Fig. 242).



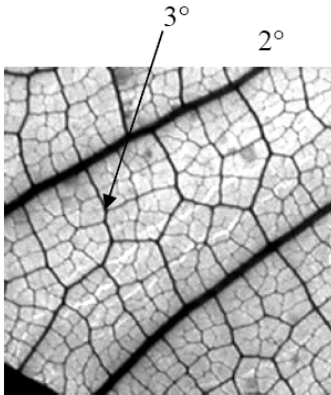
c) Opposite and sinuous. Figure from Ellis (in review, Fig. 243).



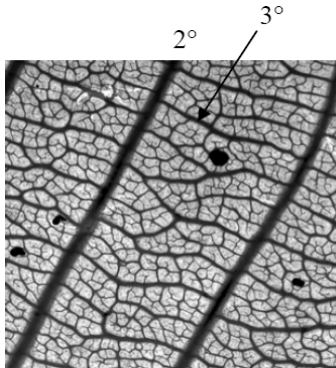
d) Opposite and chevroned. Figure from Ellis (in review, Fig. 244).



e) Alternate. Figure from Ellis (in review, Fig. 245).

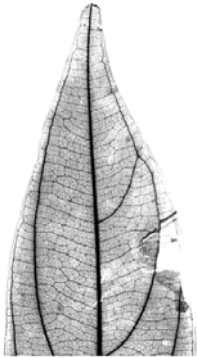


f) Mixed opposite-alternate. Figure from Ellis (in review, Fig. 246).

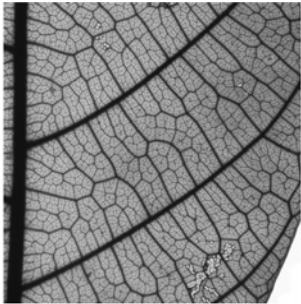


117) Angle to midvein of percurrent tertiaries of leaf or leaflet:

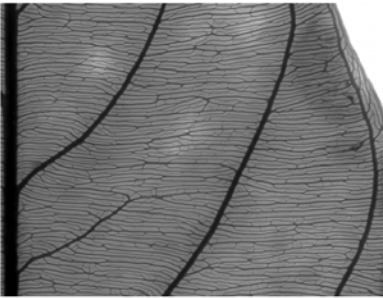
a) Acute ($< 90^\circ$). Figure from Ellis (in review, Fig. 248).



b) Obtuse ($> 90^\circ$). Figure from Ellis (in review, Fig. 249).

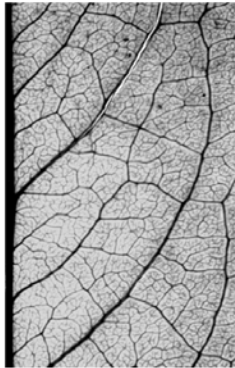


c) Perpendicular ($\sim 90^\circ$). Figure from Ellis (in review, Fig. 250).

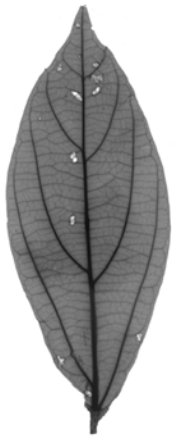


118) Intercostal tertiary vein angle trend of leaf or leaflet:

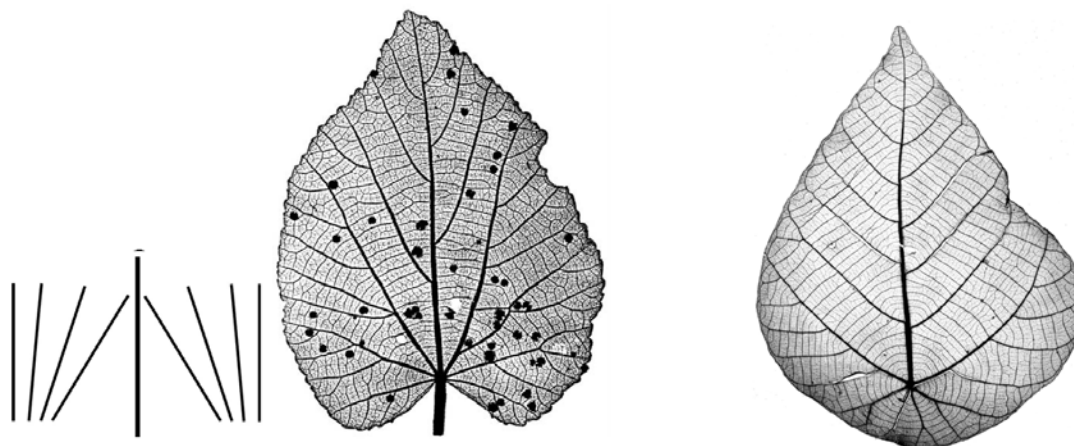
a) Inconsistent. Figure from Ellis (in review, Fig. 258).



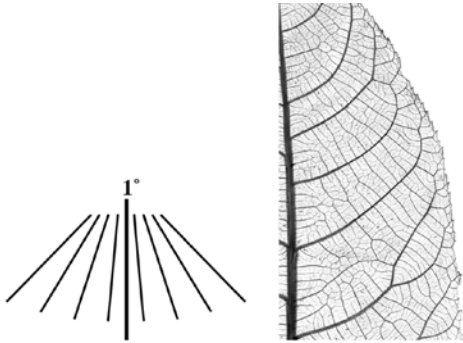
b) Consistent. Figure from Ellis (in review, Fig. 259).



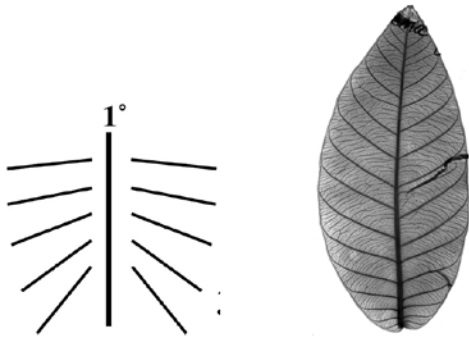
c) Increasing exmedially (including basally concentric). Figure from Ellis (in review, Fig. 260-261, and on the right here basally concentric Fig. 262).



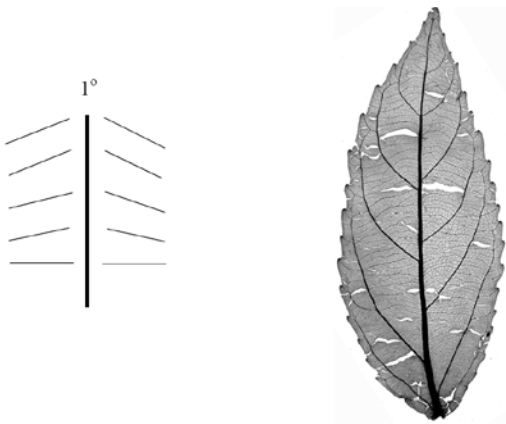
d) Decreasing exmedially. Figure from Ellis (in review, Fig. 263-264).



e) Increasing proximally. Figure from Ellis (in review, Fig. 265-266).



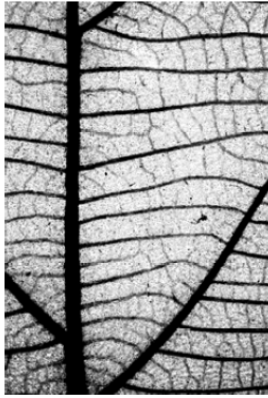
f) Decreasing proximally. Figure from Ellis (in review, Fig. 267-268).



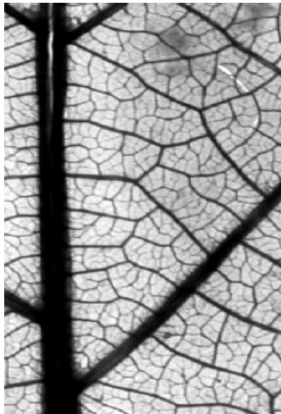
119) Epimedial tertiary pattern of leaf or leaflet:

a) **Absent.**

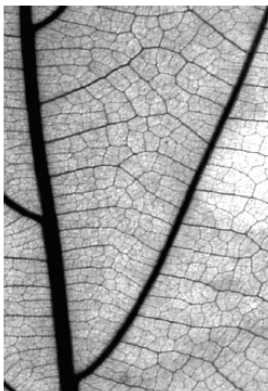
b) **Opposite percurrent.** Figure from Ellis (in review, Fig. 269).



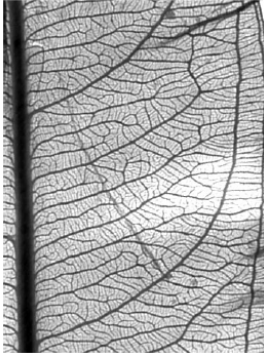
c) **Alternate percurrent.** Figure from Ellis (in review, Fig. 270).



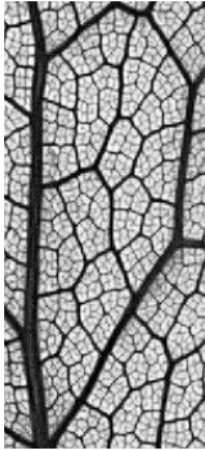
d) **Mixed opposite-alternate percurrent.** Figure from Ellis (in review, Fig. 271).



e) **Ramified.** Figure from Ellis (in review, Fig. 272).

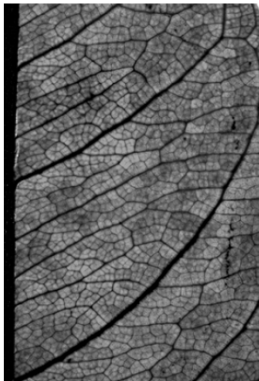


f) **Reticulate.** Figure from Ellis (in review, Fig. 273).

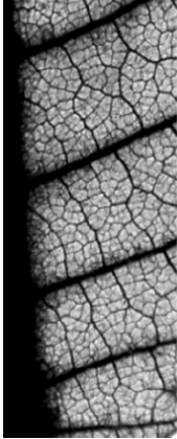


120) Admedial (= inner portion) course of epimedial tertiaries of leaf or leaflet:

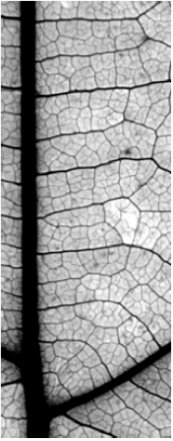
a) **Parallel to subjacent secondary.** Figure from Ellis (in review, Fig. 275).



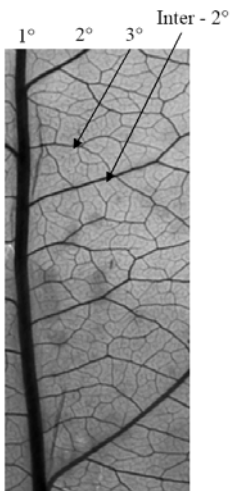
b) **Parallel to intercostal tertiaries.** Figure from Ellis (in review, Fig. 276).



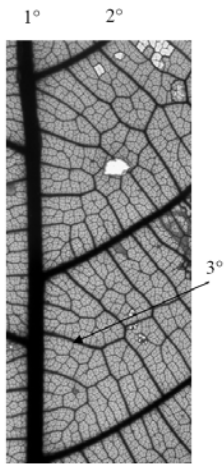
c) **Perpendicular to midvein.** Figure from Ellis (in review, Fig. 277).



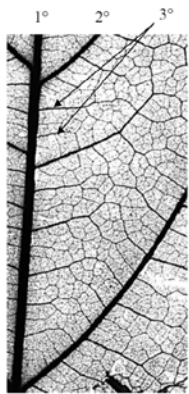
d) **Parallel to intersecondary.** Figure from Ellis (in review, Fig. 278).



e) **Obtuse to midvein.** Figure from Ellis (in review, Fig. 279).

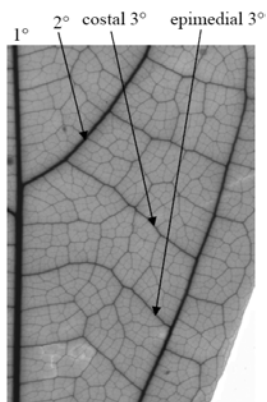


f) **Acute to midvein.** Figure from Ellis (in review, Fig. 280).

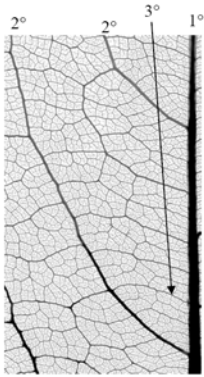


121) Exmedial (= outer portion) course of epimedial tertiaries of leaf or leaflet when percurrent:

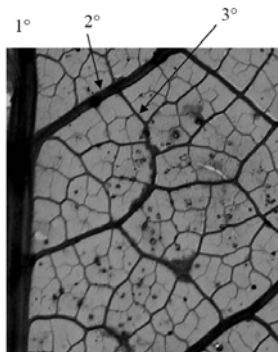
a) **Straight.** Figure from Ellis (in review, Fig. 281).



b) Basiflexed. Curved toward base. Figure from Ellis (in review, Fig. 282).



c) Acroflexed. Curved toward apex. Figure from Ellis (in review, Fig. 283).

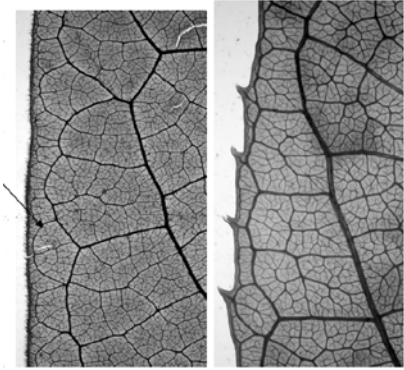


122) Exterior tertiary course of leaf or leaflet:

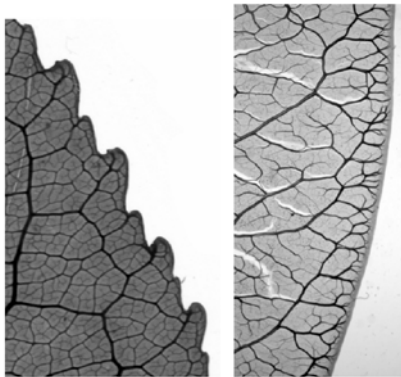
a) Absent. Figure from Ellis (in review, Fig. 284).



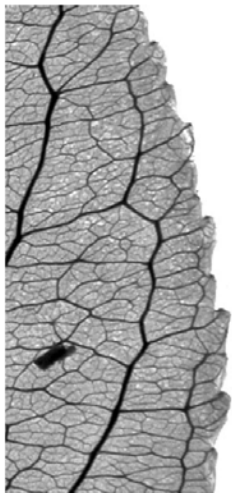
b) Looped. Figure from Ellis (in review, Figs. 285, 286).



c) Terminating at the margin. Figure from Ellis (in review, Fig. 287, 288).

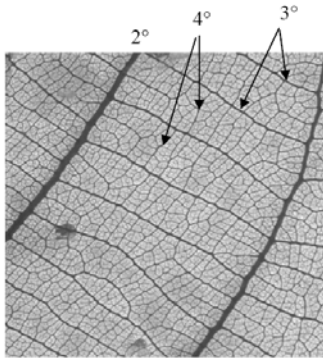


d) Variable. Figure from Ellis (in review, Fig. 289).

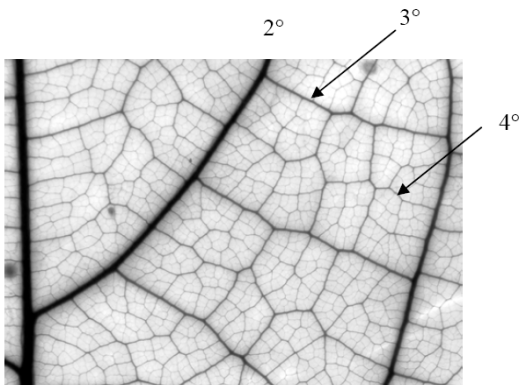


123) Quaternary vein pattern of leaf or leaflet:

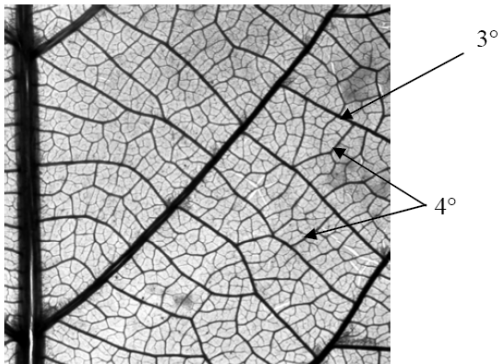
a) Opposite percurrent. Figure from Ellis (in review, Fig. 290).



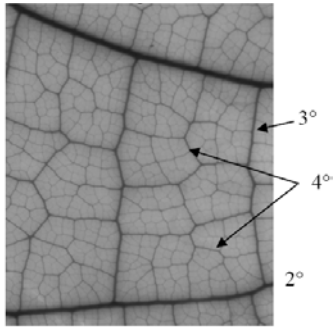
b) Alternate percurrent. Figure from Ellis (in review, Fig. 291).



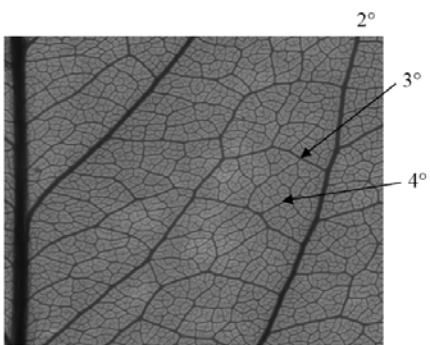
c) Mixed percurrent. Figure from Ellis (in review, Fig. 292).



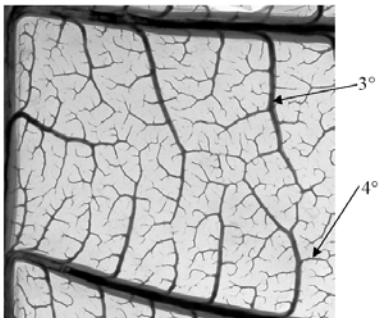
d) Regular reticulate. Figure from Ellis (in review, Fig. 293).



e) Random reticulate. Figure from Ellis (in review, Fig. 294).

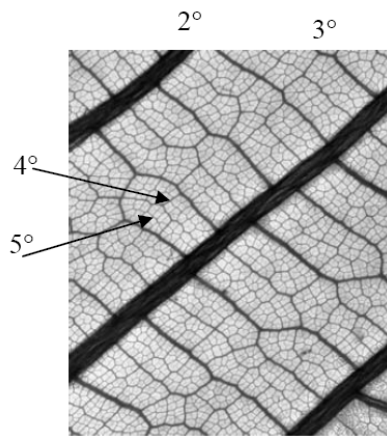


f) Freely ramifying. Figure from Ellis (in review, Fig. 295).

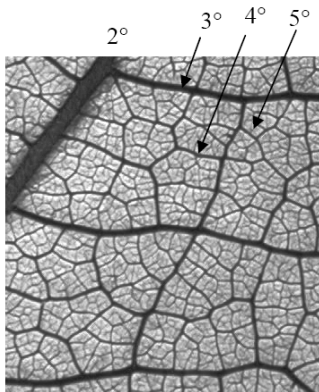


124) Quinternary vein pattern of leaf or leaflet:

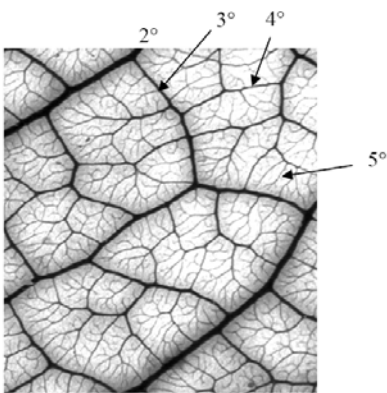
a) **Regular reticulate.** Figure from Ellis (in review, Fig. 296).



b) **Random reticulate.** Figure from Ellis (in review, Fig. 297).

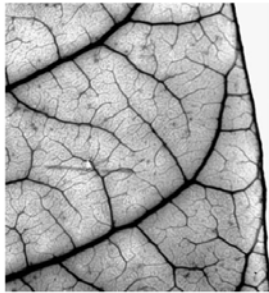


c) **Freely ramifying.** Figure from Ellis (in review, Fig. 298).

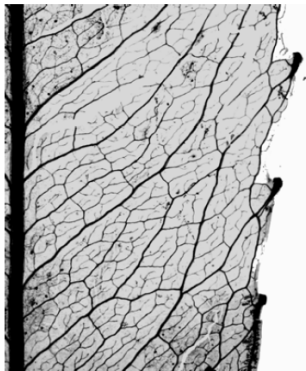


125) Leaf or leaflet areolation: The smallest area surrounded by veins on all sides.

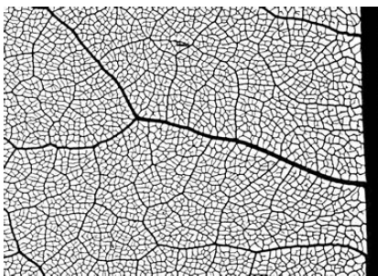
a) Lacking. Figure from Ellis (in review, Fig. 299).



b) Poor development. Figure from Ellis (in review, Fig. 300).



c) Good development. Figure from Ellis (in review, Fig. 302).



d) Paxillate. Figure from Ellis (in review, Fig. 303).



126) Course of freely ending veinlets (FEVs) of leaf or leaflet:

a) FEVs absent. Figure from Ellis (in review, Fig. 304).



b) Mostly unbranched. Figure from Ellis (in review, Fig. 305).



c) Mostly 1-branched. Figure from Ellis (in review, Fig. 306).



d) Mostly 2- or more branched with equal branching (dichotomous). Figure from Ellis (in review, Fig. 307).

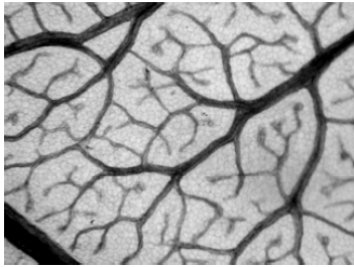


e) **Mostly 2- or more branched with unequal branching (dendritic).** Figure from Ellis (in review, Fig. 308).



127) Terminae of freely ending veinlets (FEVs) of leaf or leaflet:

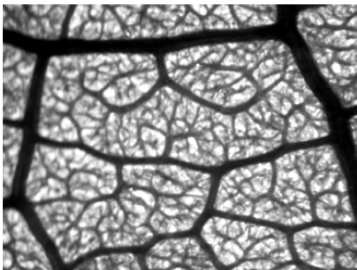
a) **Simple.** Figure from Ellis (in review, Fig. 309).



b) **Tracheoid idioblasts.** Figure from Ellis (in review, Fig. 310).



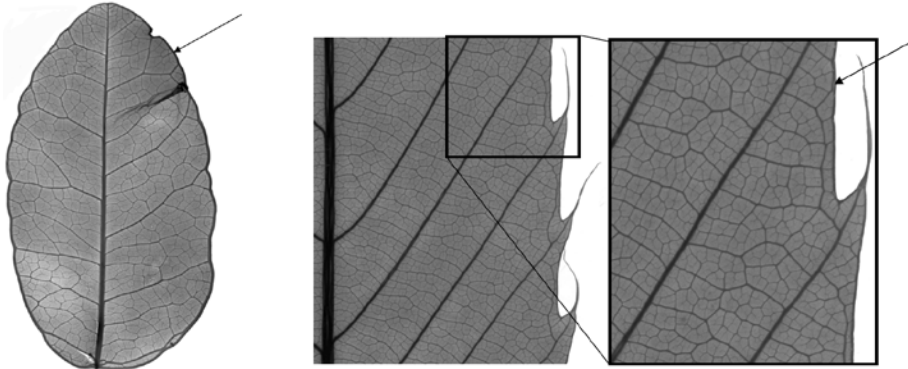
c) **Highly branched sclereids.** Figure from Ellis (in review, Fig. 311).



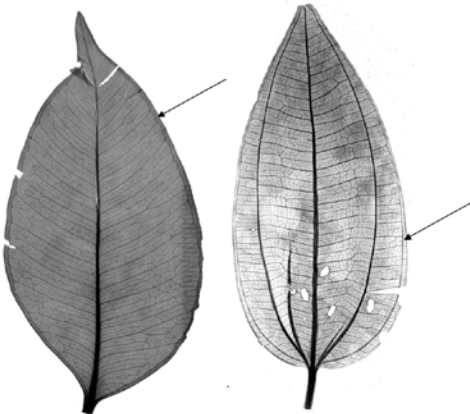
128) Perimarginal veins:

a) **Absent.**

b) **Marginal secondary or fimbrial vein.** Figure from Ellis (in review, Figs. 211, 214).

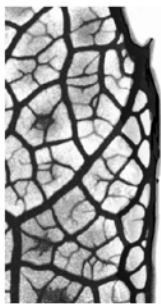


c) **Intramarginal secondary.** Figure from Ellis (in review, Figs. 212, 213).



129) Marginal ultimate venation of leaf or leaflet:

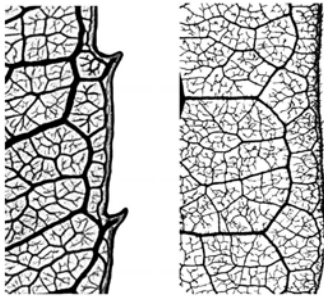
a) **Absent.** Figure from Ellis (in review, Fig. 312).



b) Incomplete looping. Figure from Ellis (in review, Figs. 313-314).



c) Looped. Figure from Ellis (in review, Figs. 315-316).



130) Inflorescence timing:

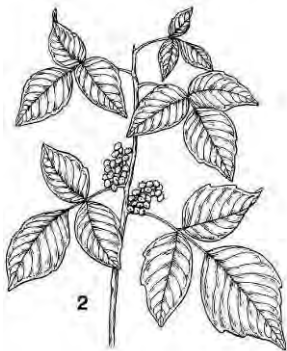
a) Present when the tree is without leaves.

b) With new flush of leaves.

c) With mature leaves.

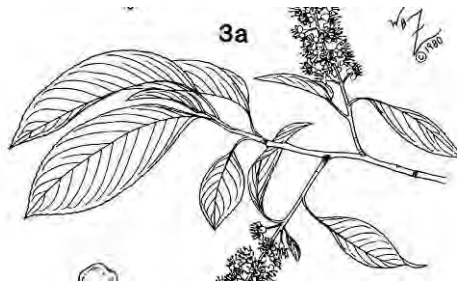
131) Inflorescence position:

a) Axillary to present leaves. Figure from Zomlefer (1989: 72, Fig. 2).



b) Axillary to fallen leaves.

c) (Sub-)terminal. Figure from Zomlefer (1989: 111, Fig. 3a, p. 87 Fig. 39-3a).



d) Ramiflorous.

e) Cauliflorous.

f) Stoloniferous (on the ground).

132) Density of trichomes on inflorescence axes:

a) Glabrous (absent).

b) Scattered. Very few over the surface.

c) Sparse. Closely spaced but not touching

d) Dense. Touching or even overlapping.

133) Color of trichomes on inflorescence axes:

a) Transparent.

b) White.

c) Yellow to gold.

d) Ferrugineous (rust brown).

e) Red.

134) Shape of trichomes on inflorescence axes:

- a) **Simple hairs.**
- b) **Capitate glands.** Swollen at the tip.
- c) **Snail-shaped glands.** Tightly curled.
- d) **Malpighiaceae hairs.** T-shaped.
- e) **Stellate hairs.** Star-shaped, sometimes on a stock.
- f) **Peltate scales.** Mushroom-shaped; attached to its stock inside the margin.

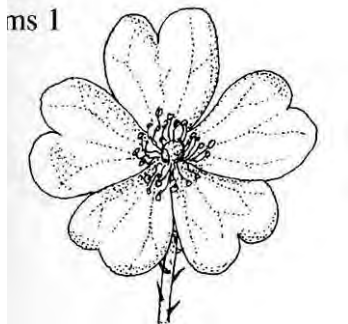
135) Orientation of trichomes on inflorescence axes:

- a) **Erect straight.**
- b) **Erect flexuous.**
- c) **Ascending.**
- d) **Appressed.** Flattened along the surface.

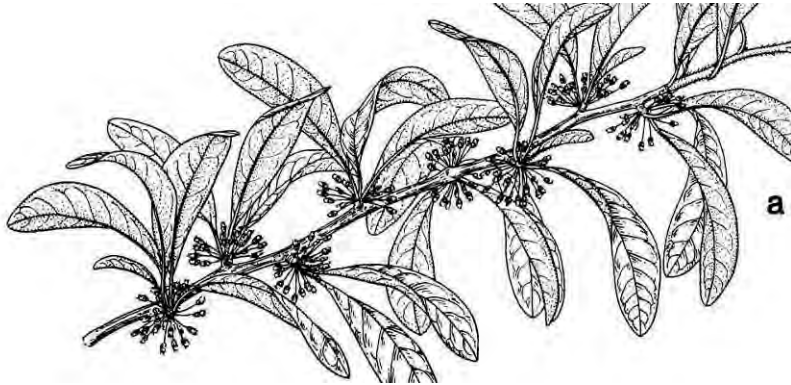
136) Inflorescence type:

- a) **Solitary flower.** Figure from Hickey & King (2005: 127).

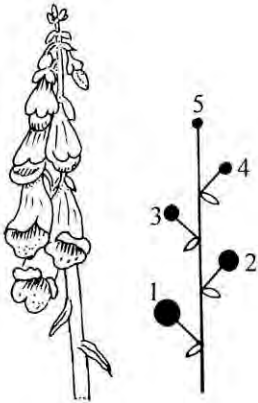
ms 1



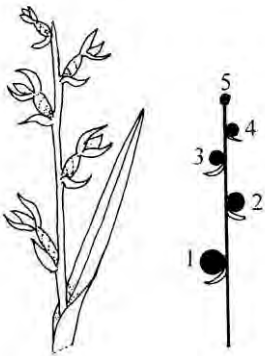
b) Fascicle/fasciculate. Dense cluster that can be formed from compressing (shortening the axes) of a number of inflorescence types. Figure from Zomlefer (1989: 32, fig 14a).



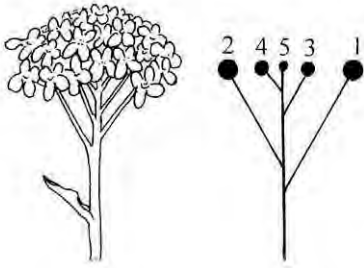
c) Raceme. Flowers stocked along a single, unbranched axis. Figure from Hickey & King (2005: 121).



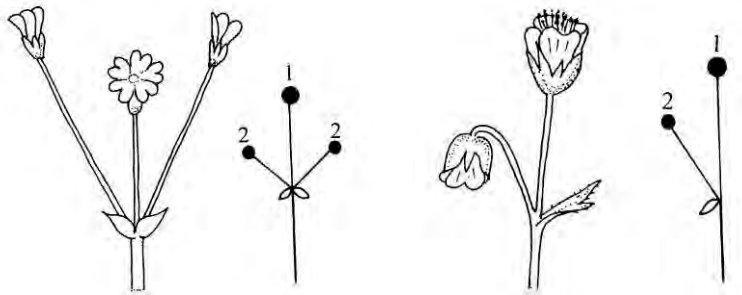
d) Spike. As raceme but flowers unstocked (sessile). Figure from Hickey & King (2005: 121).



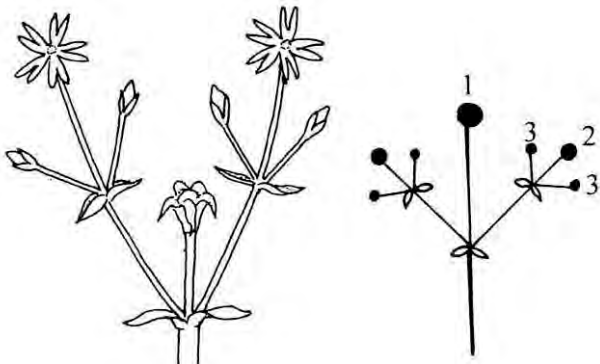
e) **Corymb.** Short, broad, more or less flat-topped inflorescence, indeterminate (does not stop growing), where the outer flowers open first. Figure from Hickey & King (2005: 122).



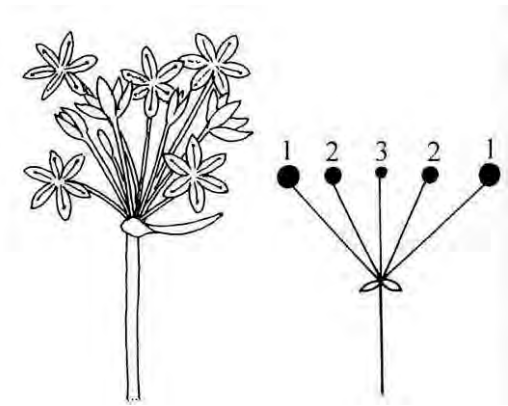
f) **Cyme.** Like a corymb, but determinate, and the central flowers open first. Figure from Hickey & King (2005: 121).



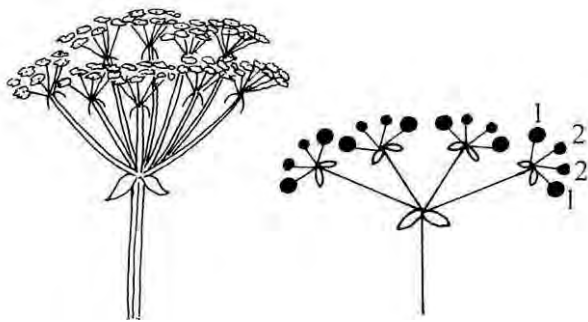
Compound cyme:



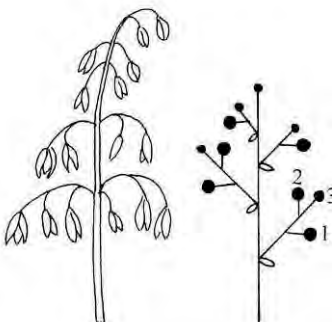
g) Umbel. Like a corymb, but all axes rise from a single point. Figure from Hickey & King (2005: 122).



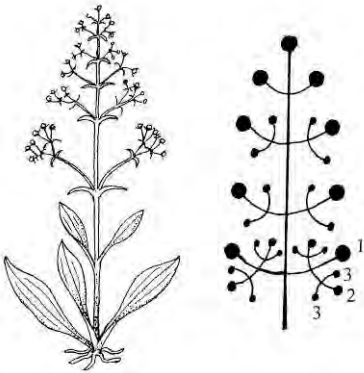
Compound umbel



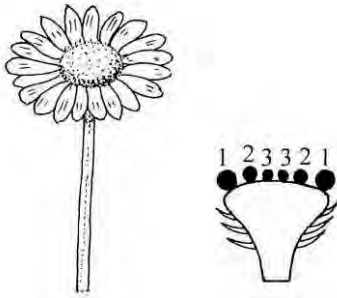
h) Panicle. Indeterminate, branching raceme. Figure from Hickey & King (2005: 122).



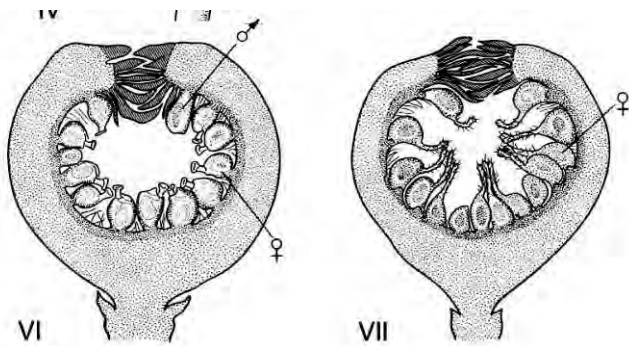
i) Thyrses. A compound panicle, with the main axes indeterminate and the lateral axes determinate.
 Figure from Hickey & King (2005: 123).



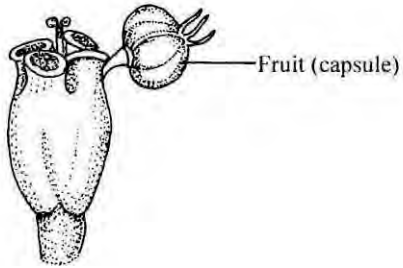
j) Capitulum (= head). A dense inflorescence of aggregated sessile or short-pedicillate flowers.
 Includes the “synanthium” of the Asteraceae. Figure from Hickey & King (2005: 122).



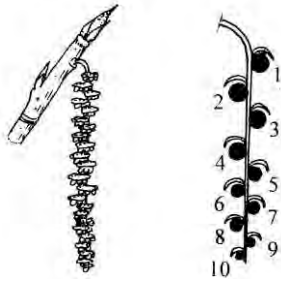
k) Syconium. The globose, closed inflorescence of a *Ficus*. Figure from Weberling (1989: 293).



l) Cyathium. A small, condensed inflorescence with unisexual flowers of both genders in a bracteate envelope. Figure from Hickey & King (2005: 124).

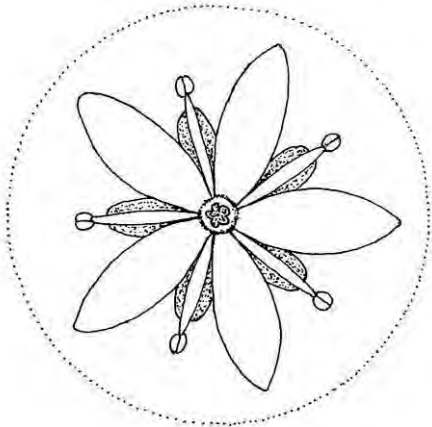


m) Catkin. A spike or spike-like inflorescence of cymules (= little cymes) with scaly bracts, usually wind-pollinated. Figure from Hickey & King (2005: 121).

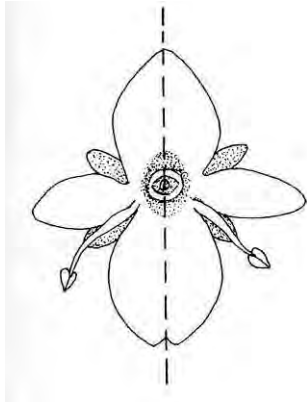


137) Flower symmetry:

a) Radially symmetrical (= actinomorphic). Figure from Hickey & King (2005: 126).

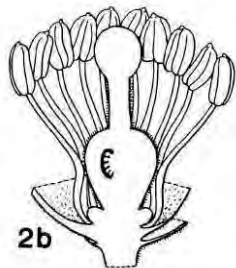


b) Bilaterally symmetrical (= zygomorphic). Figure from Hickey & King (2005: 126).

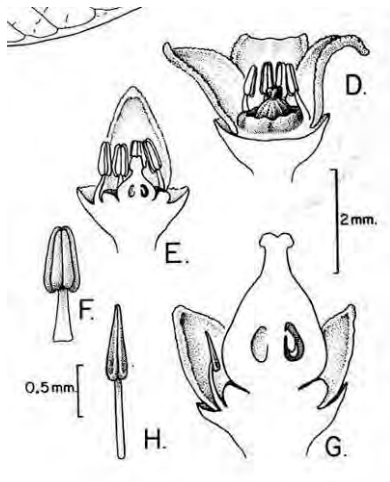


138) Flower breeding system:

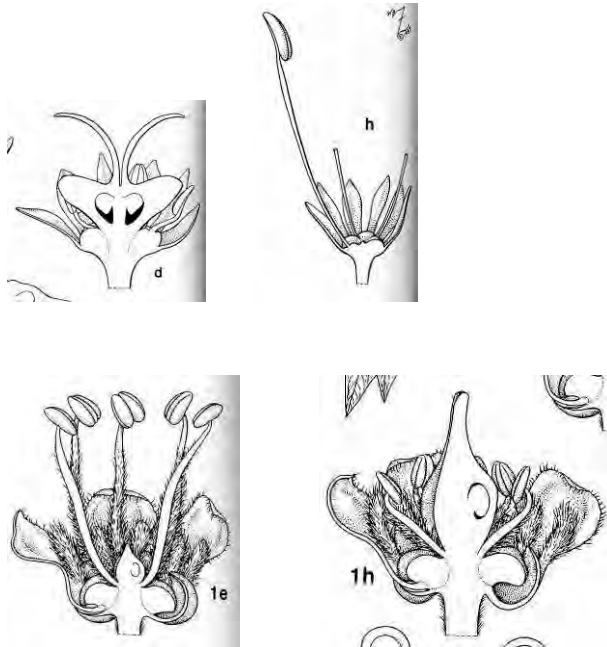
a) Flowers perfect (= hermaphroditic). All flowers have both pistils and stamens that are functioning (they are not reduced and the anthers contain pollen). Figure from Zomlefer (1994: 146, Fig. 64-2b).



b) Dioecious. Male and female flowers are on separate plants. Figure from Douglas C. Daly.



c) Monoecious. Separate male and female flowers are on the same plant. Top figure from Zomlefer (1994: 156, Figs. 68d, h). Bottom figure from Zomlefer (1994: 154, Figs. 67-1e, h).



d) Andromonoecious. Male flowers and hermaphroditic flowers are on the same plant.

e) Androdioecious. There are plants with only male flowers, and plants with hermaphroditic flowers.

f) Gynomonoecious. Female flowers and hermaphroditic flowers are on the same plant.

g) Gynodioecious. There are plants with only female flowers, and plants with hermaphroditic flowers.

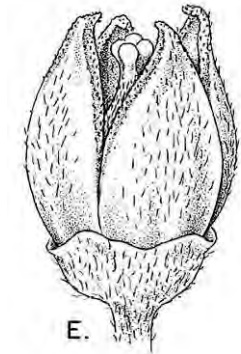
h) Serial changes in sexuality (both within and among years).

139) Number of perianth series in the flower: The perianth comprises sepals, tepals, and petals, while the corolla comprises only petals.

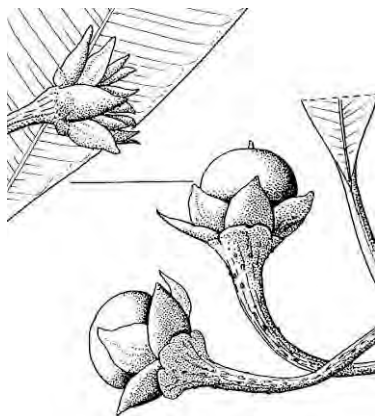
a) **None**. Figure from Smith et al. (2004: 337, Fig. 174h).



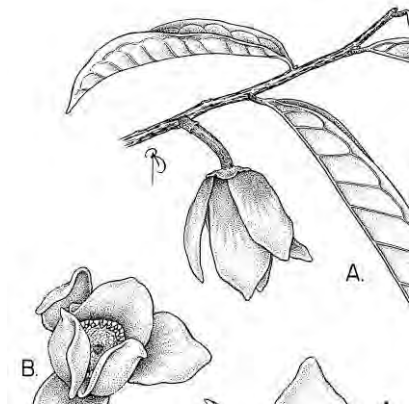
b) **Perianth (= “leaves” of flower) in two series, one of sepals (= calyx) and one of petals (= corolla)**. Figure from Mori et al. (2002: 159, fig 58e).



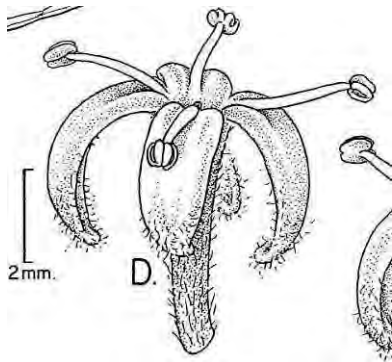
c) **Perianth in three series, two of sepals and one of petals**. Figure from Pennington (1990: 49, Fig. 4d).



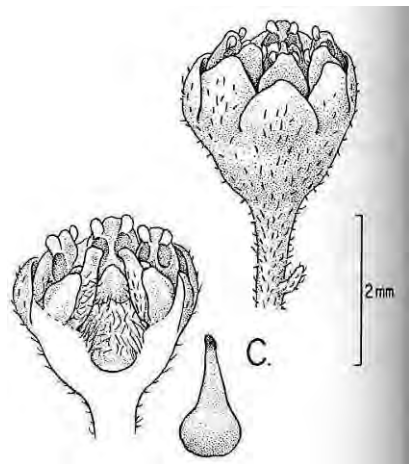
d) Perianth in several series, one series of sepals and more than one series of petals. Here 2 series of petals. Figure from Mori et al. (2002: 61, fig 15a, b).



e) Perianth in one series of tepals. Figure from Mori et al. (2002: 712, Fig. 306d).

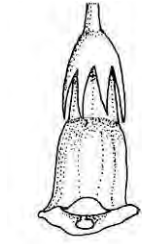


f) Perianth in two series of tepals. Figure from Mori et al. (2002: 374, Fig. 156c).

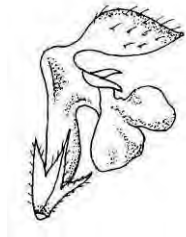


140) Shape of the corolla (or all tepals collectively when petals are missing) of the flower:

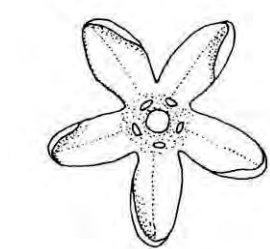
a) Tubular. Like a cylinder. Figure from Hickey & King (2005: 128).



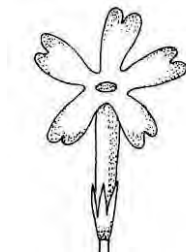
b) (Bi-)labiate. The tubular corolla unequally divided (this includes papilionoid). Figure from Hickey & King (2005: 128).



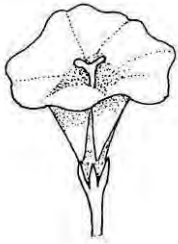
c) Rotate. Wheel-shaped, with a short tube, and the lobes flat. Figure from Hickey & King (2005: 128).



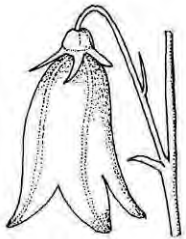
d) Salverform (= salver-shaped). A long tube and the lobes flat. Figure from Hickey & King (2005: 128).



e) **Funnel-shaped.** Inverted-conical. Figure from Hickey & King (2005: 128).



f) **Campanulate.** Bell-shaped. Figure from Hickey & King (2005: 128).

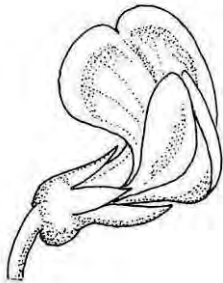


g) **Urceolate.** Campanulate but restricted at the apex. Figure from Hickey & King (2005: 128).



h) **Cup-shaped.**

i) **Papilionoid.** Also in the families Vochysiaceae, Trigoniaceae, and Polygalaceae. Figure from Hickey & King (2005: 128).



j) Ligulate. The single flower of a Asteraceae capitulum. Figure from Hickey & King (2005: 128).



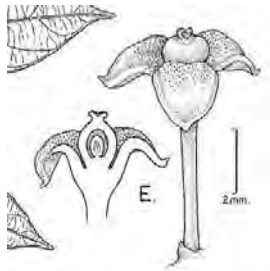
k) Spurred. The flower has an elongate nectary extending below the calyx.

141) Number of sepals or tepals of the flower:

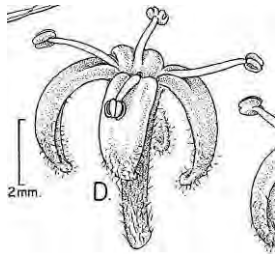
a) Absent. Figure from Smith et al. (2004: 337, Fig. 174h).



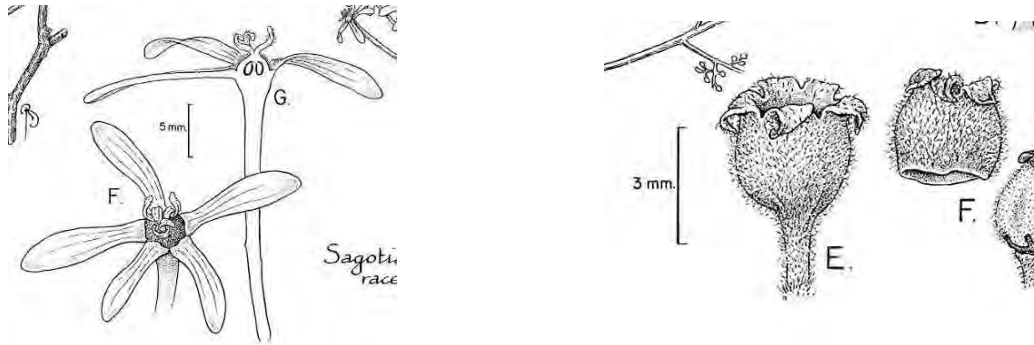
b) Three. Figure from Mori et al. (2002: 527, Fig. 226e).



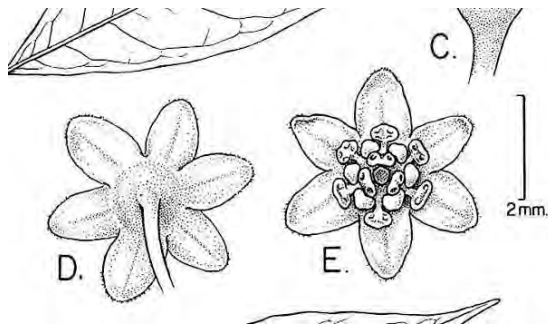
c) Four. Figure from Mori et al. (2002: 712, Fig. 306d).



d) Five. Figure of male flower with 5 sepals on the left from Mori et al. (2002: 295, Fig. 120f-g); figure of 5 tepals on the right from Mori et al. (2002: 283, Fig. 113e-f).

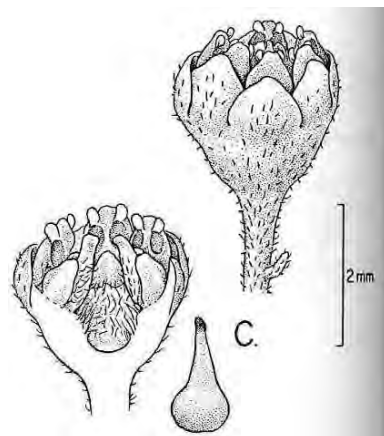


e) More than 5. Figure with 6 tepals from Mori et al. (2002: 379, Fig. 157d-e).

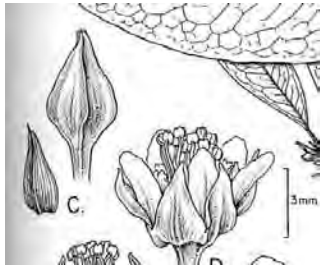


142) Aestivation of the sepals or tepals: How the sepals or tepals are arranged (or folded) in bud.

a) Imbricate. Overlapping. Figure from Mori et al. (2002: 374, Fig. 156c).



b) Valvate. Touching but not overlapping. Figure from Mori et al. (2002: 265, Fig. 104c).



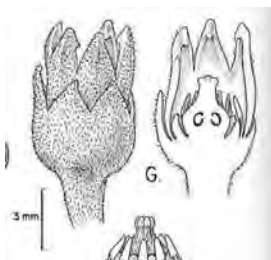
c) Apert (= open). Not touching (literally “open”).

143) Fusion (= connation of like parts) of sepals or tepals: Sepals form the calyx.

a) Distinct (free). Figure from Mori et al. (2002: 45, Fig. 5c).



b) Partly connate. Fused on less than 2/3 of its length. Figure from Mori et al. (2002: 162, Fig. 59g).



c) Connate. Fused on at least 2/3 of its length. Figure from Mori et al. (2002: 141, Fig. 53a).



144) Color of sepals or tepals:

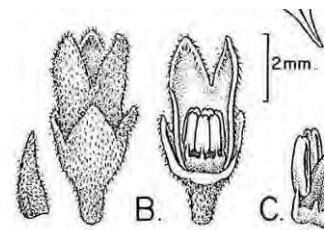
- a) **White.**
- b) **Yellow.**
- c) **Red.**
- d) **Purple.**
- e) **Blue.**
- f) **Green.**
- g) **Brown.**

145) Number of petals of the flower:

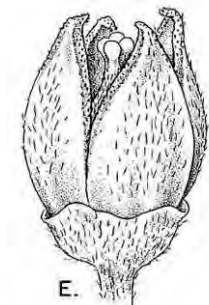
- a) **Absent.** Figure from Smith et al. (2004: 337, Fig. 174h).



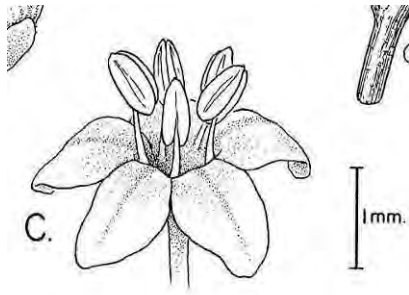
- b) **Three.** Figure from Mori et al. (2002: 164, Fig. 60b).



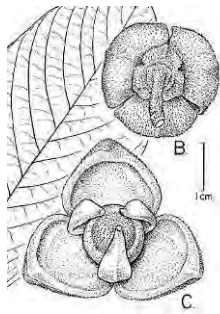
- c) **Four.** Figure from Mori et al. (2002: 159, Fig. 58e).



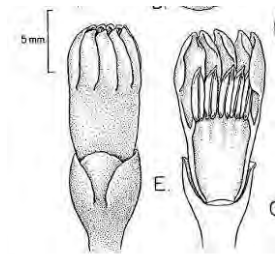
d) Five. Figure from Mori et al. (2002: 46, Fig. 6c).



e) Six. Figure from Mori et al. (2002: 57, Fig. 13b, c).

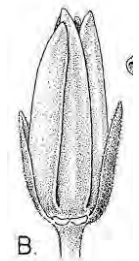


f) More than 6. Figure from Mori et al. (2002: 403, Fig. 168e).

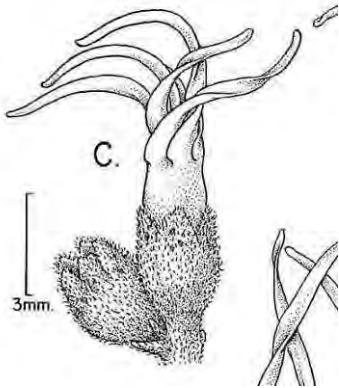


146) Fusion (= connation of like parts) of petals:

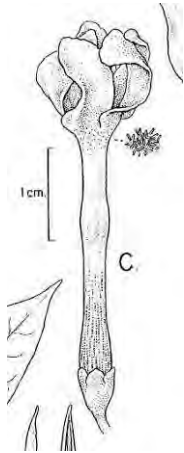
a) Distinct (free). Figure from Mori et al. (2002: 45, Fig. 5b).



b) Partly connate. Fused on less than 2/3 of its length. Figure from Mori et al. (2002: 72, Fig. 20c).

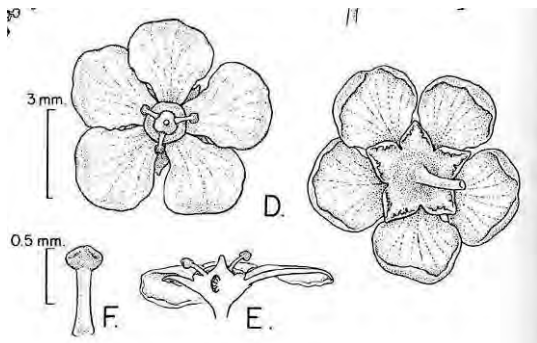


c) Connate. Fused on at least 2/3 of its length. Figure from Mori et al. (2002: 75, Fig. 21c).



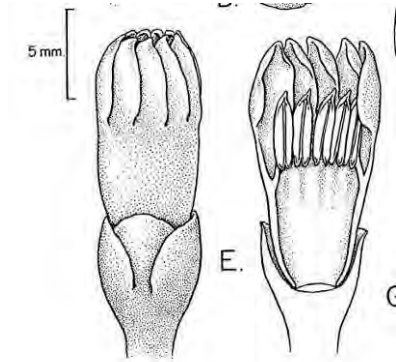
147) Numerical relation of petals to sepals:

a) Isomerous to sepals. The same number of petals and sepals. Figure from Mori et al. (2002: 352, Fig. 145d).



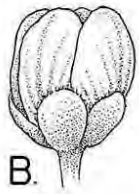
b) Meiomeros (= oligomeros) to sepals. Fewer petals than sepals.

c) Pleiomeros to sepals. More petals than sepals. Figure from Mori et al. (2002: 403, Fig. 168e).

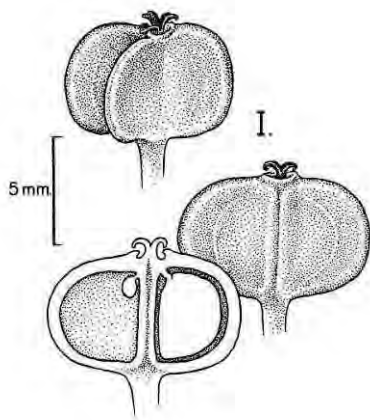


148) Aestivation of the petals: How the petals are arranged (or folded) in bud.

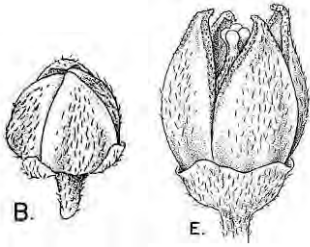
a) Imbricate. Overlapping. Figure from Mori et al. (2002: 46, Fig. 6b).



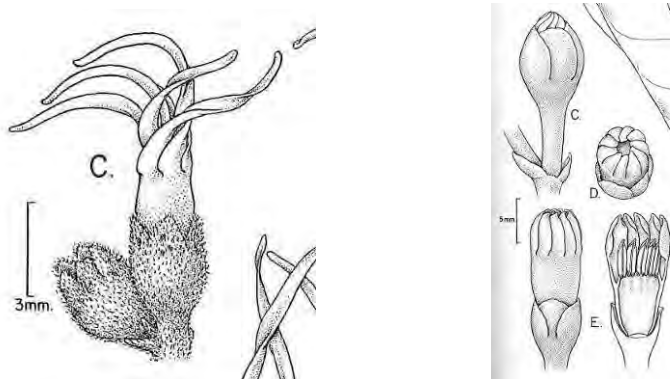
b) Simply valvate. Touching but not overlapping. Figure from Mori et al. (2002: 86, Fig. 27b).



c) Induplicate valvate. Infolded lengthwise and touching. Figure from Mori et al. (2002: 159, Fig. 58b+e).



d) Contorted. Figures from Mori et al. (2002: 72, Fig. 20c; p. 403, Figs. 168c-e).



149) Main color of petals:

- a) White.
- b) Yellow (or cream).
- c) Red.
- d) Purple.
- e) Blue.
- f) Green.
- g) More than one color.

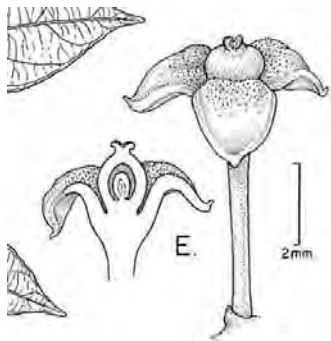
150) Distal color of petals:

- a) White.
- b) Yellow (or cream).

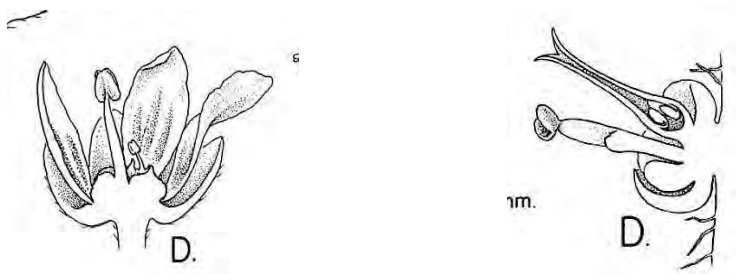
- c) Red.
- d) Purple.
- e) Blue.
- f) Green.
- g) More than one color.

151) Number of stamens in the flower: Stamens are fertile.

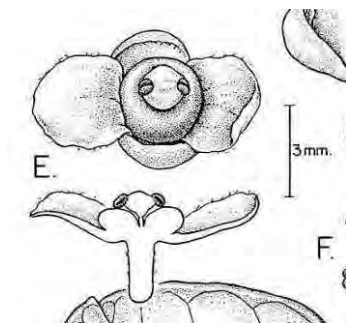
a) **Stamens absent.** Figure from Mori et al. (2002: 527, Fig. 226e).



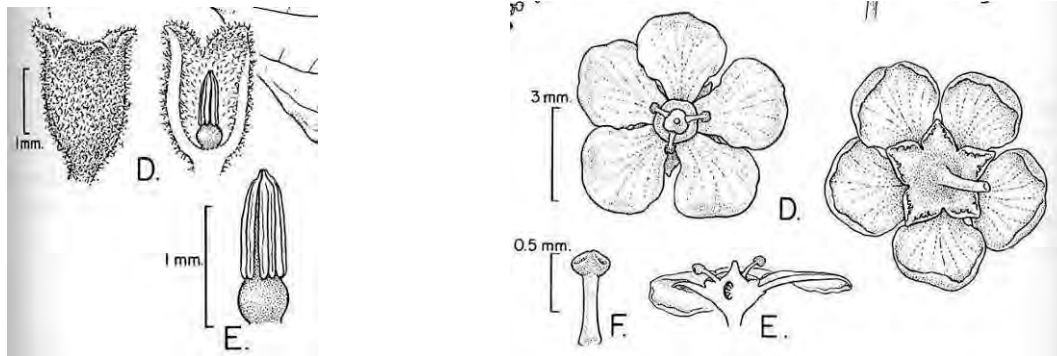
b) **One.** Figures from Mori et al. (2002: 47, Fig.7d, p. 363 Fig. 150d).



c) **Two.** Figure from Mori et al. (2002: 292, Fig. 119e).



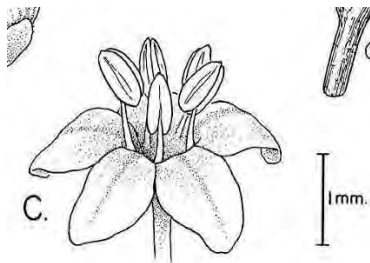
d) Three. Figures from Mori et al. (2002: 531, Figs. 229d, e; p. 352, Fig. 145d).



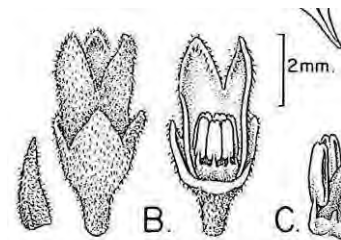
e) Four. Figure from Mori et al. 2002: 138, Fig. 52d).



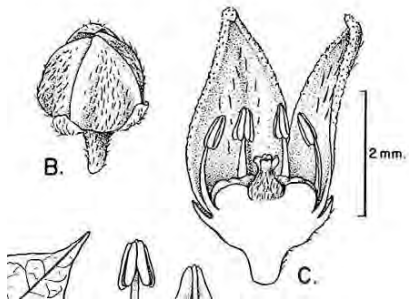
f) Five. Figure from Mori et al. (2002: 46, Fig. 6c).



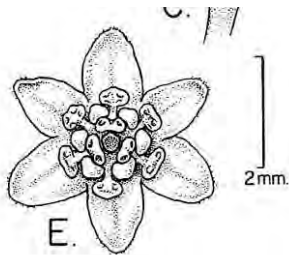
g) Six. Figure from Mori et al. (2002: 164, Fig. 60b).



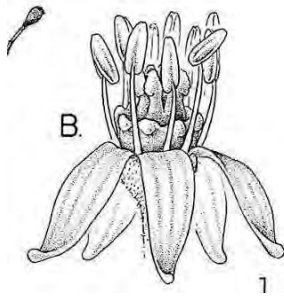
h) Eight. Figure from Mori et al. (2002: 159, Fig. 58b, c).



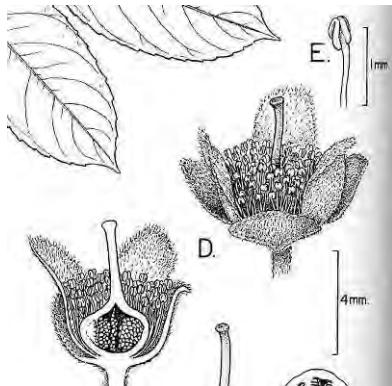
i) Nine. Figure from Mori et al. (2002: 379, Fig. 157e).



j) Ten. Figure from Mori et al. (2002: 48, Fig. 8b).



k) More than 10. Figure from Mori et al. (2002: 320, Fig. 128d).

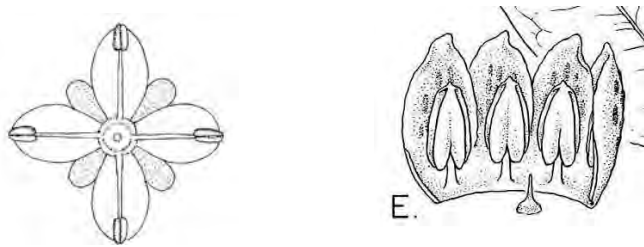


152) Numerical relation between stamens and petals:

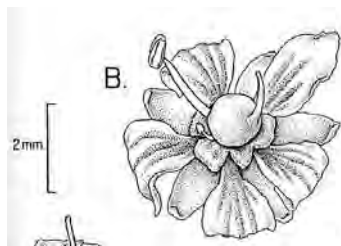
a) Isomerous to petals and antesepalous (or antetepalous). The same number of stamens and petals, located in front of the sepals. Figures from Hickey & King (2005: 131) and Mori et al. (2002: 46, Fig. 6d).



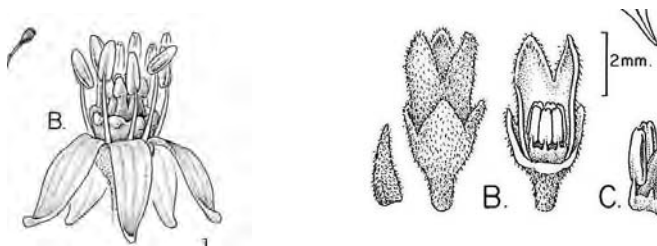
b) Isomerous to petals and antepetalous. The same number of stamens and petals, located in front of the petals. Figures from Hickey & King (2005: 131) and Mori et al. (2002: 538, Fig. 232e).



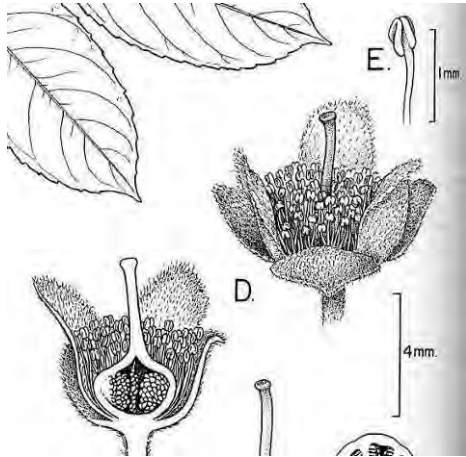
c) Meiomorous (= oligomorous) to petals. Fewer stamens than petals. Figure from Mori et al. (2002: 47, Fig. 7b).



d) Diplomerous to petals. Twice the number of stamens than petals. Figures from Mori et al. (2002: 48, Fig. 8b; p. 164, Fig. 60b).

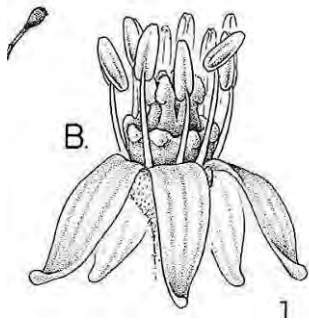


e) **Pleiomorous to petals.** More stamens than petals, but not diplomerous. Figure from Mori et al. (2002: 320, Fig. 128d).

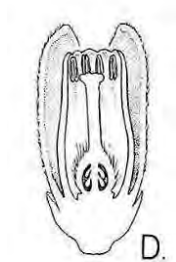


153) Filament connation of stamens:

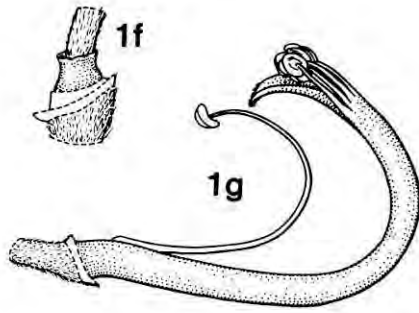
a) **Distinct (free).** Figure from Mori et al. (2002: 48, Fig. 8b).



b) **Connate.** Figure from Mori et al. (2002: 470, Fig. 201d).

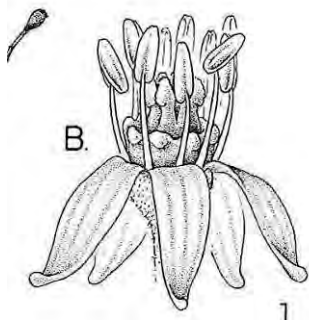


c) **Connate but 1 stamen free.** Figure from Zomlefer (1989: 79, Fig. 35-1g).

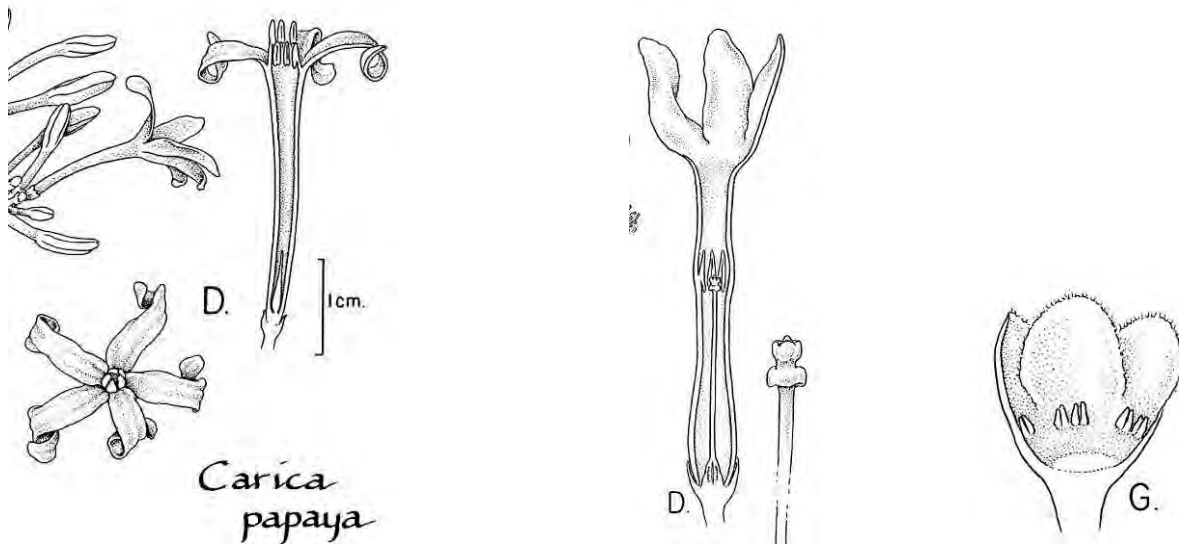


154) Filament attachment of the stamens to the perianth:

a) **Free from perianth.** Figure from Mori et al. (2002: 48, Fig. 8b).



b) **Adnate (connected with unlike part) to perianth.** Figures from Mori et al. (2002: 189, Fig. 67d; p. 75, Fig. 21d, g).



155) Color of stamen filaments:

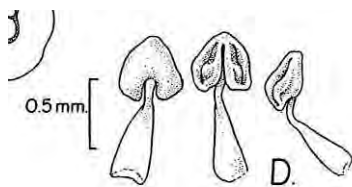
- a) White.
- b) Yellow.
- c) Red.
- d) Purple.
- e) Blue.
- f) Green.

156) Color of stamen anthers:

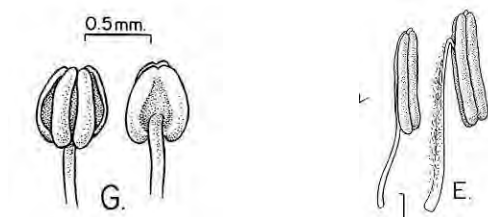
- a) White.
- b) Yellow.
- c) Red.
- d) Purple.
- e) Blue.
- f) Green.

157) Anther attachment to the filament of the flower

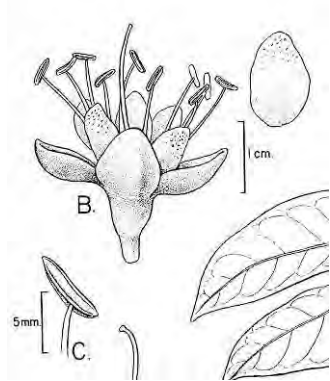
a) Basifixed. The anthers are attached by its base. Figure from Mori et al. (2002: 201, Fig. 75d).



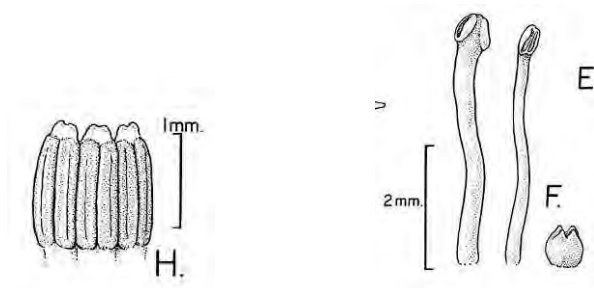
b) Dorsifixed. The anthers are attached to the back. Figures from Mori et al. (2002: 229, Fig. 86g; p. 289, Fig. 117e).



c) **Versatile**. The anthers are attached at its middle to the filament, and anthers move freely. Figure from Mori et al. (2002: 175, Fig. 61b).

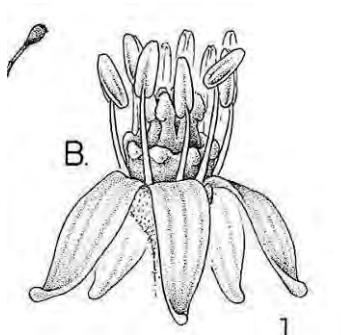


d) **Adnate**. The anthers are continuous with the filaments. Figures from Mori et al. (2002: 185, Fig. 65h, p. 220, Fig. 82f).

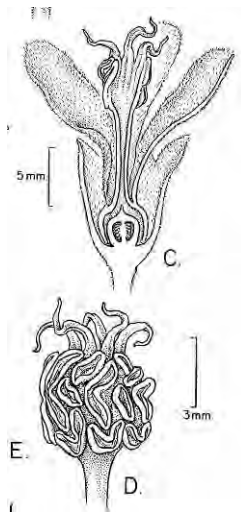


158) Fusion of the anthers:

a) **Distinct (= free, not fused)**. Figure from Mori et al. (2002: 48, Fig. 8b).

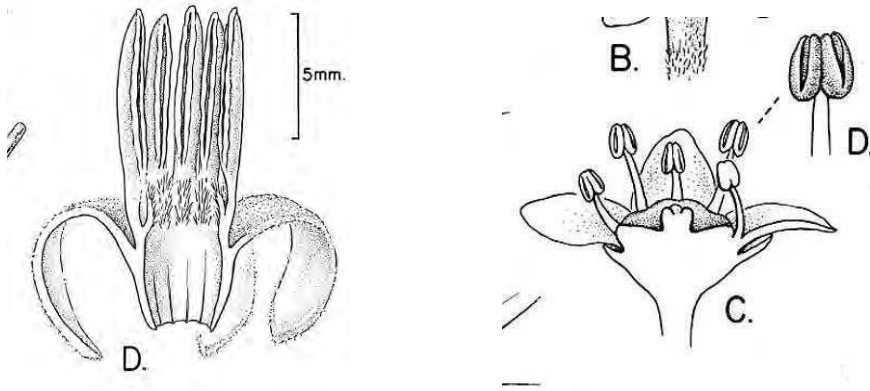


b) Connate. Figure from Mori et al. (2002: 143, Fig. 54c, d).

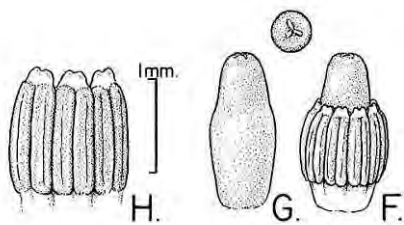


159) Dehiscence of anthers:

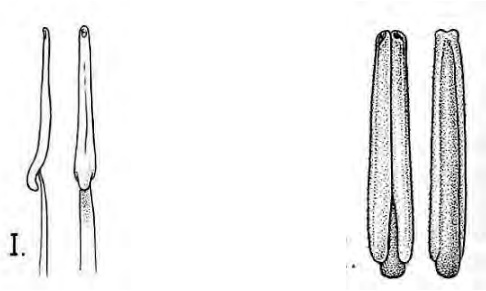
a) Introrse or lateral. The pollen is released toward the flower's center or to the side. Figures from Mori et al. (2002: 707, Fig. 303d, p.50 Fig. 9c, d).



b) Extrorse. The pollen is released away from the flower's center. Figure from Mori et al. (2002: 185, Fig. 65f-h).



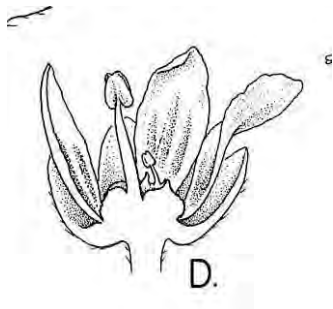
c) **By apical pores.** The pollen is released through pores at the apex of the anthers. Figures from Mori et al. (2002: 464, Fig. 198i; p.692, Fig.295e).



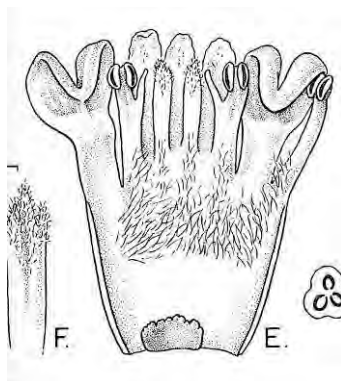
160) Number of staminodes in the flower: Stamines are infertile.

a) **Staminodes absent.**

b) **One.** Figure from Mori et al. (2002: 47, Fig. 7d).



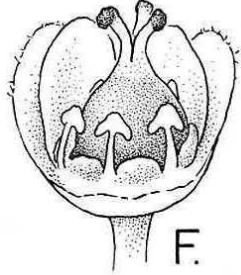
c) **Two.** Figure from Mori et al. (2002: 249, Fig. 98e).



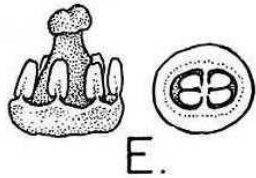
d) **Three.**

e) **Four.**

f) **Five.** Figure from Mori et al. (2002: 46, Fig. 6f).

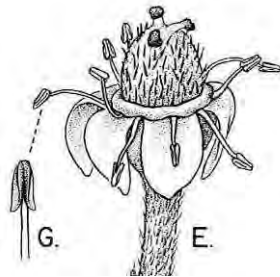


g) **Six.** Figure from Mori et al. (2002: 164, Fig. 60e).



h) **Eight.**

i) **Ten.** Figure from Mori et al. (2002 50, Fig. 9e).



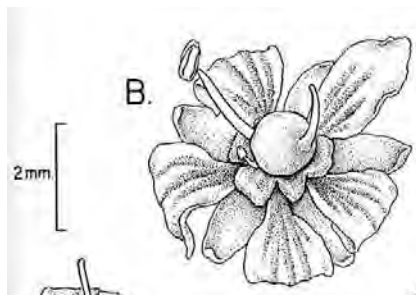
j) **More than 10.**

161) Numerical relation between staminodes and petals:

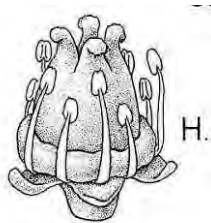
a) Isomerous to petals and antesepalous (or antetepalous). The same number of staminodes and petals, located in front of the sepals.

b) Isomerous to petals and antepetalous. The same number of staminodes and petals, located in front of the petals.

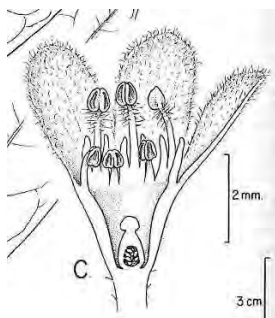
c) Meiomerous (oligomerous) to petals. Fewer staminodes than petals. Figure from Mori et al. (2002: 47, Fig. 7b).



d) Diplomerous to petals. Twice the number of staminodes than petals. Figure from Mori et al. (2002: 48, Fig. 8h).

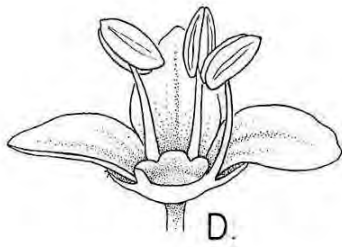


e) Pleiomerous to petals. More staminodes than petals, but not diplomerous. Figure from Mori et al. (2002: 324, Fig. 130c).

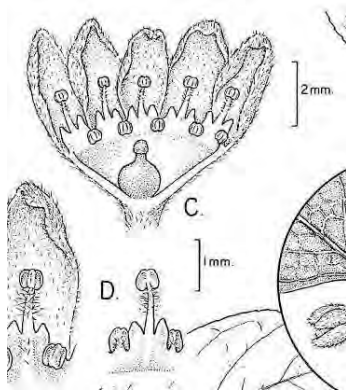


162) Filament connation of staminodes:

a) Distinct (free). Figure from Mori et al. (2002: 46, Fig. 6d).

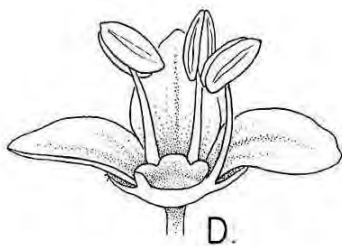


b) Connate. Figure from Mori et al. (2002: 326, Fig. 132c+d).

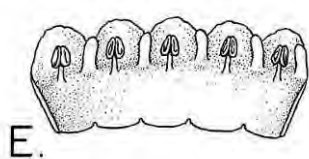


163) Filament attachment of staminodes to perianth:

a) Free from perianth. Figure from Mori et al. (2002: 46, Fig. 6d).



b) Adnate to perianth. Figure from Mori et al. (2002: 676, Fig. 290e).



164) Color of staminode filaments:

- a) White.
- b) Yellow.
- c) Red.
- d) Purple.
- e) Blue.
- f) Green.

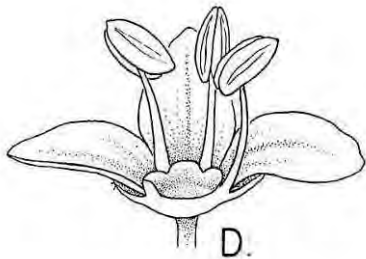
165) Color of staminode anthers:

- a) White.
- b) Yellow.
- c) Red.
- d) Purple.
- e) Blue.
- f) Green.

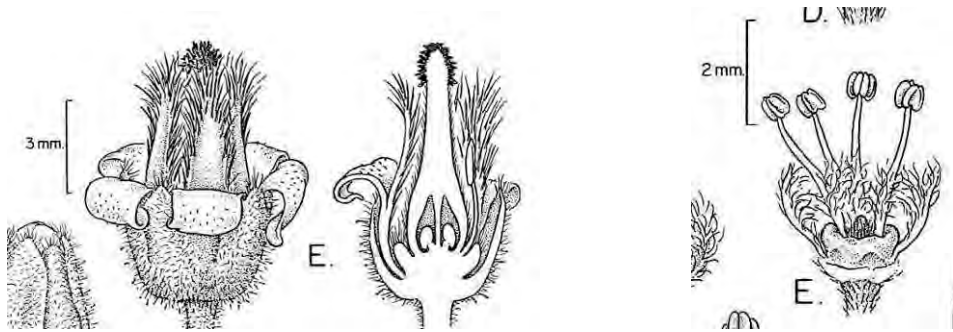
166) Flower disk position: The disk is a glandular, usually nectar-producing structure of the flower.

a) Disk absent.

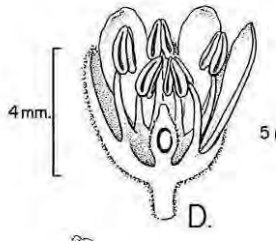
b) **Intrastaminal.** The disk is between the stamens and the flower center. Figure from Mori et al. (2002: 46, Fig. 6d).



c) Extrastaminal. The stamens are between the disk and the flower center. Figures from Mori et al. (2002: 667, Fig.287e; p. 668, Fig. 288e).



d) Adnate to perianth. The disk is fused with the sepals or tepals. Figure from Mori et al. (2002: 182, Fig. 63d).

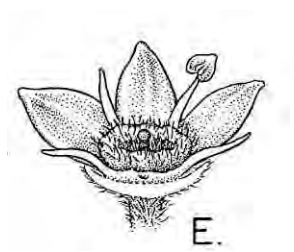


167) Color of flower disk (when present):

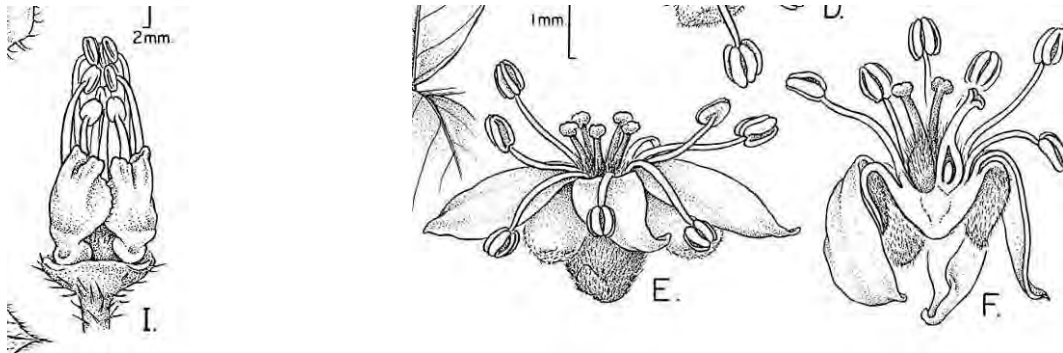
- a) Green.
- b) White.
- c) Yellow.
- d) Red.

168) Shape of the flower disk:

a) Annular. Ring-shaped. Figure from Mori et al. (2002: 653, Fig. 282e).

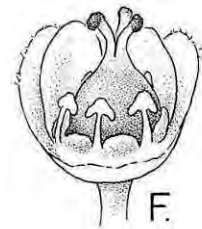


b) Discontinuous. In several parts. Figures from Mori et al. (2002: 661, Fig. 285i [liana]; p. 229, Fig. 86e, f).



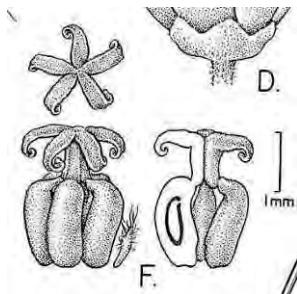
169) Number of distinct pistils or carpels (or fused at base): The pistil is the female reproductive structure consisting of the stigma, style, and ovary. If the carpels are not fused, then pistil and carpel are equivalent terms and the number of carpels equals the number of pistils. If there are two or more carpels that are fused, they constitute a single pistil (Castner 2004: 25).

a) One. Figure from Mori et al. (2002: 46, Fig. 6f).



b) Two.

c) Five distinct. Figure from Mori et al. (2002: 688, Fig. 293f).

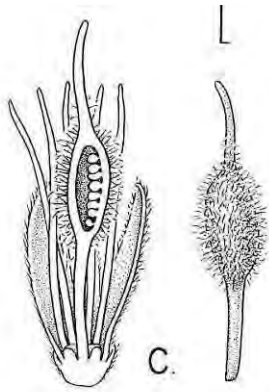


d) More than 5. Figure from Mori et al. (2002: 55, Fig. 12g).

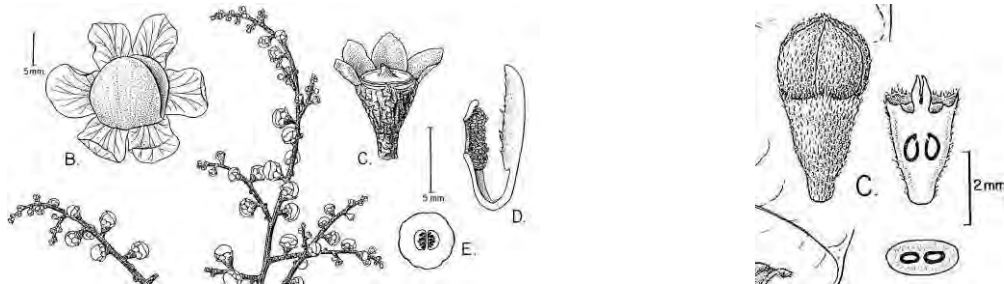


170) Number of locules: The locules are the chambers of the ovary. One has to cut through the ovary, which is part of the pistil.

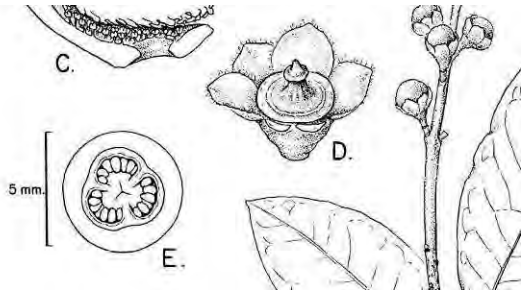
a) One. Figure from Mori et al. (2002: 506, Fig.216c).



b) Two. Figures from Mori et al. (2002: 386, Fig.160e; p. 86, Fig. 27c).

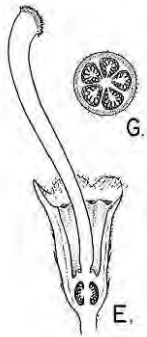


c) **Three.** Figure from Mori et al. (2002: 388, Fig. 161e).

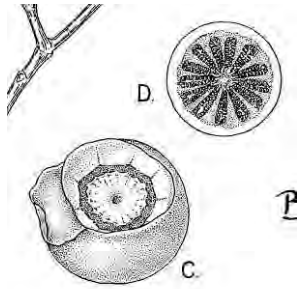


d) **Four.**

e) **Five.** Figure from Mori et al. (2002: 447, Fig. 191e, g).

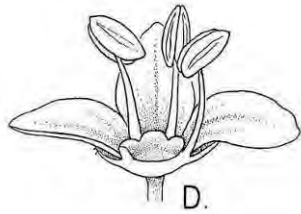


f) **More than 5.** Figure from Mori et al. (2002: 441, Fig. 188c, d).

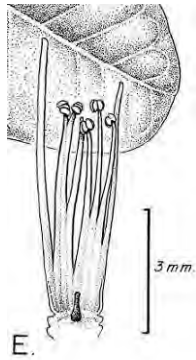


171) Flower pistillode: The pistillode is the non-functional pistil of the stamenoid flower.

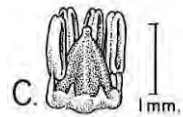
a) **Absent**. Figure from Mori et al. (2002: 46, Fig. 6d).



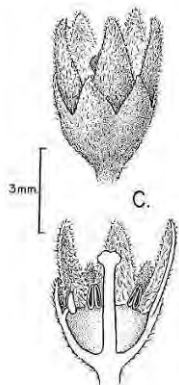
b) **Reduced pistil**. Figure from Mori et al. (2002: 45, Fig. 5e).



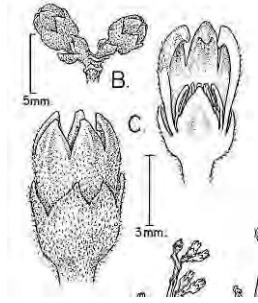
c) **Parenchymatous and not isomorphic with pistil**. Undifferentiated tissue rather than chambers. The position is still at the center of the flower. Figure from Mori et al. (2002: 164, Fig. 60c).



d) **Reduced to style(s)**. Figure from Mori et al. (2002: 51, Fig. 10c).

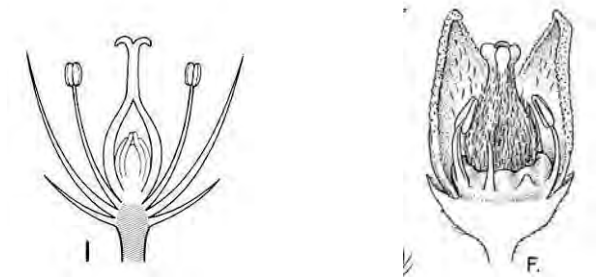


e) **Fused with disk.** Figure from Mori et al. (2002: 162, Fig. 59c).



172) Flower ovary:

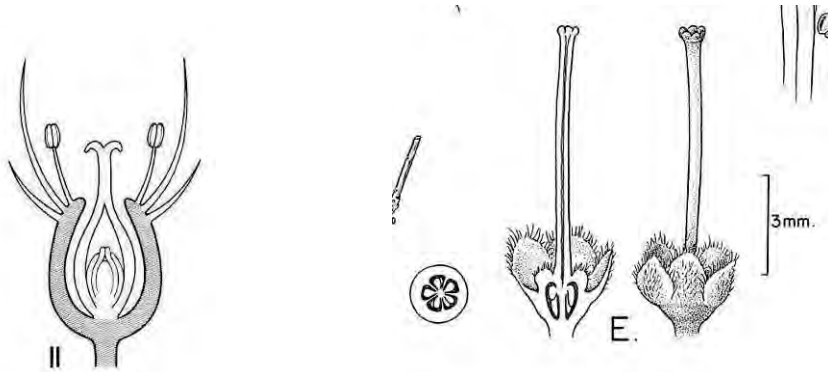
a) **Superior without hypanthium.** The perianth is hypogynous. Figures from Weberling (1989: 20, Fig. 10) and Mori et al. (2002: 159, Fig. 58f).



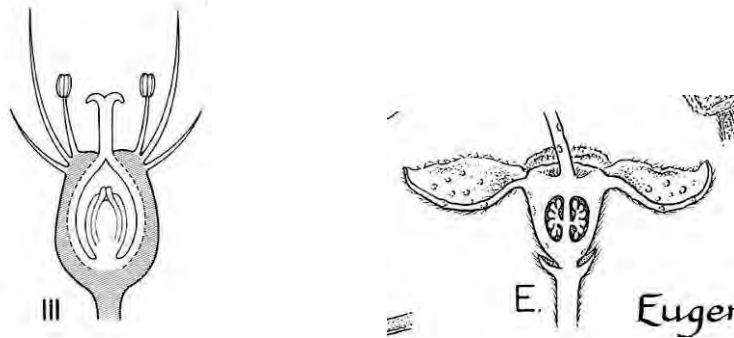
b) **Superior with hypanthium.** The perianth is hypogynous. Figure from Mori et al. (2002: 51, Fig. 10d; p. 209, Fig. 78c).



c) Semi-inferior. The perianth is perigynous. Figures from Weberling (1989: 20, Fig. 10) and Mori et al. (2002: 709, Fig. 304e).

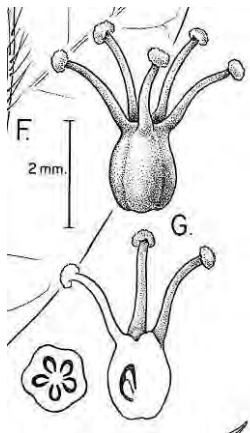


d) Inferior. The perianth is epigynous. Figures from Weberling (1989: 20, Fig. 10) and Mori et al. (2002: 543, Fig. 234e).

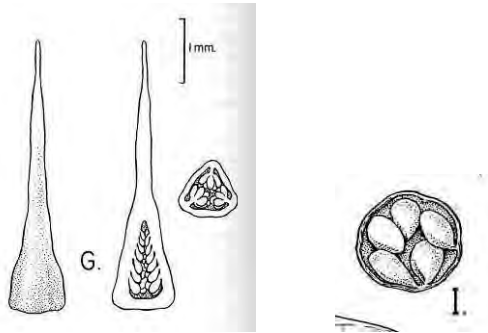


173) Placentation in flower and fruit:

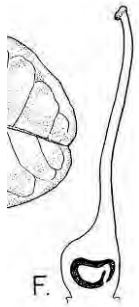
a) Axile. Figure from Mori et al. (2002: 223, Fig. 83g).



b) Parietal. Figure from Mori et al. (2002: 734, Fig. 320g, i).



c) Basal. Figure from Mori et al. (2002: 45, Fig. 5f).



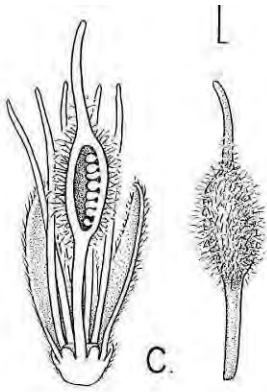
d) Apical. Figure from Mori et al. (2002: 46, Fig. 6g).



e) Free-central.

f) Ventral.

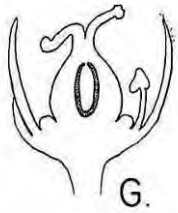
g) Laminar. Figure from Mori et al. (2002: 506, Fig.216c).



h) Marginal.

174) Number of flower ovules:

a) One per locule. Figure from Mori et al. (2002: 46, Fig. 6g).

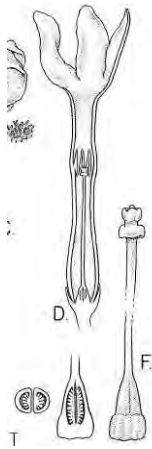


b) Two per locule. Figure from Mori et al. (2002: 164, Fig. 60e).



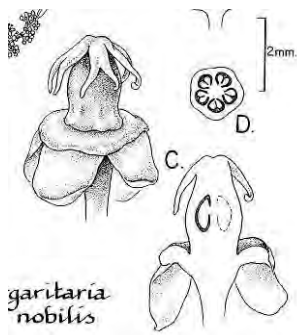
c) Three to four per locule.

d) Many per locule. Figure from Mori et al. (2002: 75, Fig. 21f).

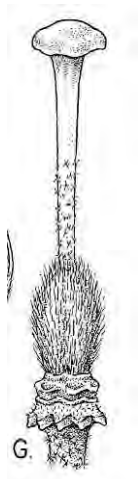


175) Number of flower styles:

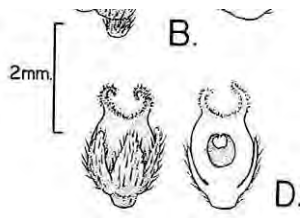
a) Styles absent. Figure from Mori et al. (2002: 291, Fig. 118c).



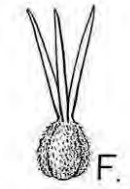
b) One. Figure from Mori et al. (2002: 715, Fig. 308g).



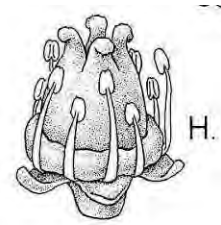
c) **Two.** Figure from Mori et al. (2002: 721, Fig. 312d).



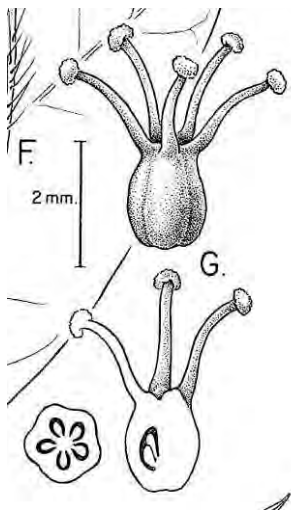
d) **Three.** Figure from Mori et al. (2002: 416, Fig. 174f).



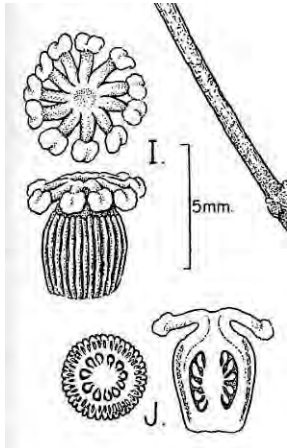
e) **Four.** Figure from Mori et al. (2002: 48, Fig. 8h).



f) **Five.** Figure from Mori et al. (2002: 223, Fig. 83g).

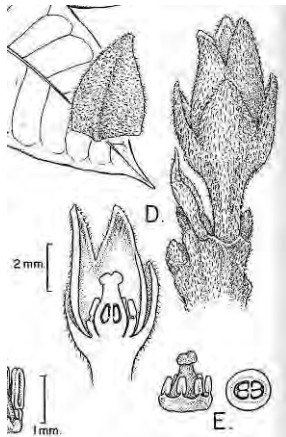


g) More than five. Figure from Mori et al. (2002: 595, Fig. 259i+j).

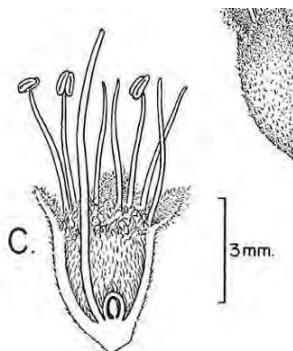


176) Position of flower styles:

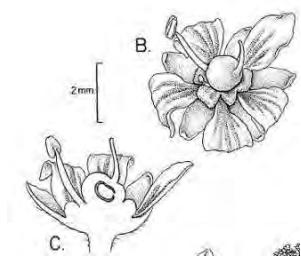
a) Apical. The style arises from the top of the ovary. Figure from Mori et al. (2002: 164, Fig. 60d).



b) Gynobasic. The style arises from the base of the ovary. Figure from Mori et al. (2002: 209, Fig. 78c).

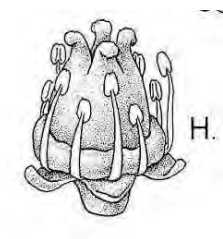


c) **Lateral.** The style arises from the side of the ovary. Figure from Mori et al. (2002: 47, Fig. 7b, c).



177) Separation of multiple flower styles:

a) **Styles separate.** Figure from Mori et al. (2002: 48, Fig. 8h).



b) **Styles meet at base.** Figure from Mori et al. (2002: 416, Fig. 174f).

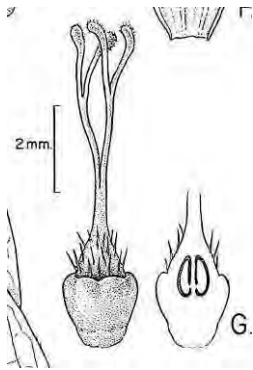


178) Branching of flower styles:

a) **Unbranched.** Figure from Mori et al. (2002: 715, Fig. 308g).

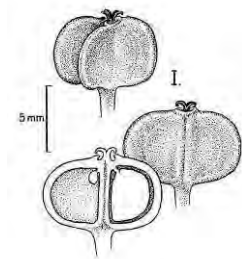


b) Branched. Figure from Mori et al. (2002: 148, Fig. 56g).

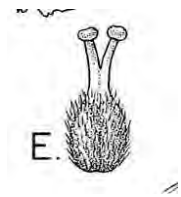


179) Number of stigmas per style:

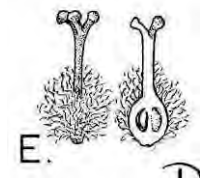
a) One. Figure from Mori et al. (2002: 86, Fig. 27i).



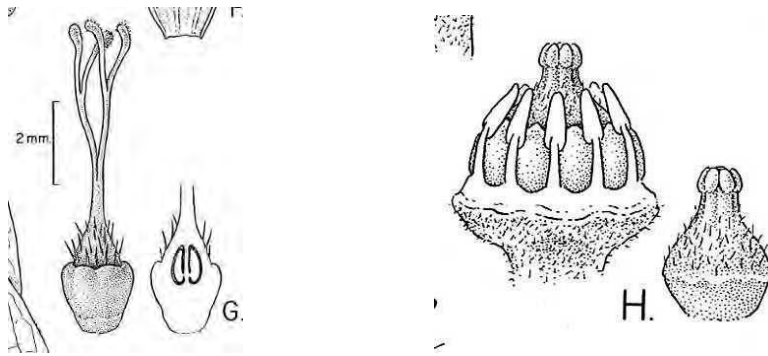
b) Two. Figure from Mori et al. (2002: 415, Fig. 173e).



c) Three. Figure from Mori et al. (2002: 248, Fig. 97e).

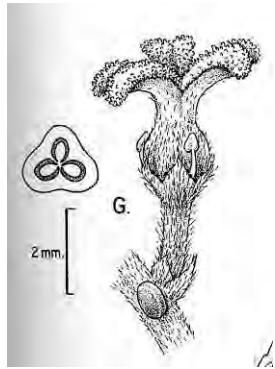


d) More than three. Figures from Mori et al. (2002: 148, Fig. 56g; p. 162, Fig. 59h).



180) Position of the stigmas relative to the style:

a) Decurrent. The stigma(s) is/are running along the style near the apex. Figure from Mori et al. (2002: 271, Fig. 106g).



b) Capitata. The stigma(s) is/are terminal on the style. Figure from Mori et al. (2002: 715, Fig. 308g).



181) Surface of sepals or tepals:

- a) **Glabrous (no trichomes).**
- b) **Scattered trichomes.**
- c) **Sparse trichomes.**
- d) **Dense trichomes.**
- e) **Papillate.**

182) Color of trichomes on sepals or tepals:

- a) **Transparent.**
- b) **White.**
- c) **Yellow to gold.**
- d) **Ferruginous (rust brown).**
- e) **Red.**

183) Shape of trichomes on sepals or tepals:

- a) **Simple hairs.**
- b) **Capitate glands.**
- c) **Snail-shaped glands.**
- d) **Malpighiaceae hairs.**
- e) **Stellate hairs.**
- f) **Peltate scales.**

184) Orientation of trichomes on sepals or tepals:

- a) **Erect straight.**
- b) **Erect flexuous.**
- c) **Ascending.**
- d) **Appressed.**

185) Surface of petals:

- a) **Glabrous (no trichomes).**
- b) **Scattered trichomes.**

- c) **Sparse trichomes.**
- d) **Dense trichomes.**
- e) **Papillate.**

186) Color of trichomes on petals:

- a) **Transparent.**
- b) **White.**
- c) **Yellow to gold.**
- d) **Ferruginous (rust brown).**
- e) **Red.**

187) Shape of trichomes on petals:

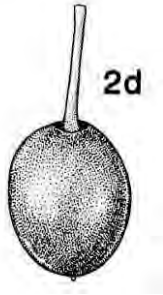
- a) **Simple hairs.**
- b) **Capitate glands.**
- c) **Snail-shaped glands.**
- d) **Malpighiaceus hairs.**
- e) **Stellate hairs.**
- f) **Peltate scales.**

188) Orientation of trichomes on petals:

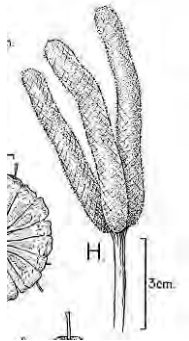
- a) **Erect straight.**
- b) **Erect flexuous.**
- c) **Ascending.**
- d) **Appressed.**

189) Fruit shape: Also of composite fruits.

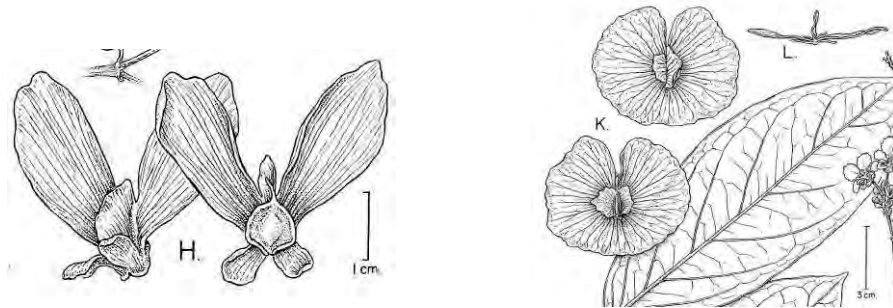
a) Globose, ovoid (= egg-shaped), or obovoid (inverse egg-shaped: the broadest part of the fruit is in the distal half). Ovoid = egg-shaped; obovoid = inverse egg-shaped: the broadest part of the fruit is in the distal half. Figure from Zomlefer (1989: 96, Fig. 2-d).



b) Elongate, ellipsoid. Figure from Mori et al. (2002: 195, Fig. 71h).



c) Winged. Figures from Mori et al. (2002: 427, Fig. 181h; p. 424, Fig. 179k, l).



190) The base of the fruit is enveloped in a fleshy cup (formed e.g. by the calyx):

a) Present. Figure from Mori et al. (2002: 379, Fig. 157j; p. 144, Fig. 55f).



191) Fruit size (= vertical length):

a) < 1 cm.

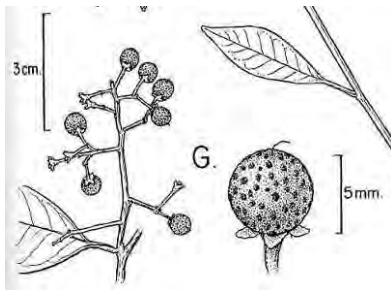
b) 1-5 cm.

c) 5-10 cm.

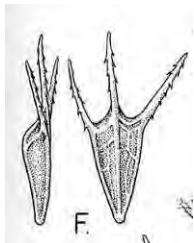
d) > 10 cm.

192) Dispersal syndrome of fruits:

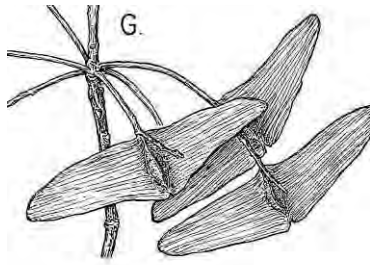
a) Endozoochorous. The fruit is ingested and the seed or unit of dispersal is defacated. Figure from Mori et al. (2002: 533, Fig. 230g).



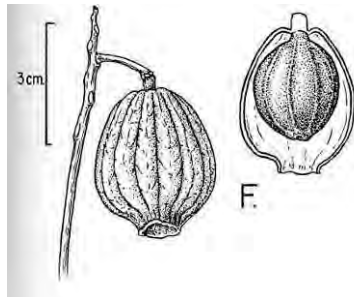
b) Exozoochorous. The fruit either adheres to the animal or is transported because the animal chews on it (without swallowing it). Figure from Mori et al. (2002: 429, Fig. 182f).



c) **Anemochorous.** Wind-dispersed. Figure from Mori et al. (2002: 226, Fig. 85g).



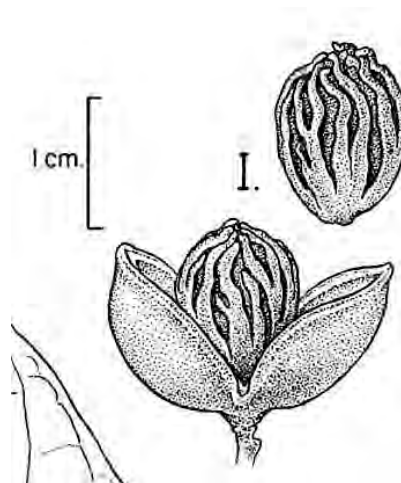
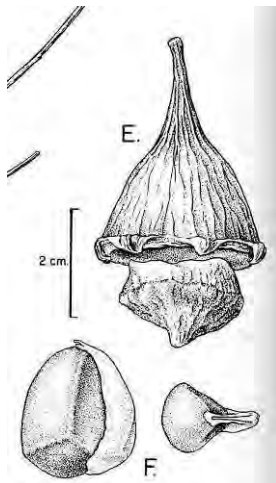
d) **Hydrochorous.** Water-dispersed. Figure from Mori et al. (2002: 345, Fig. 142f).



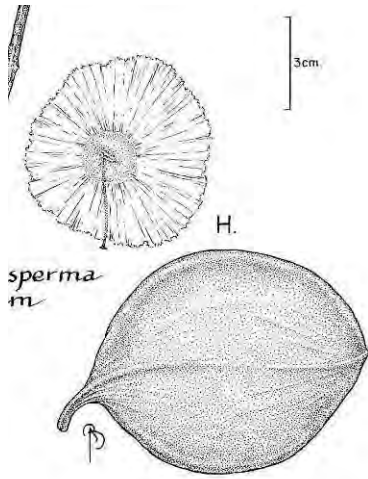
193) Unit of dispersal of the fruit:

a) **Fleshy seed.**

b) **Arillate/arilloid seed or stone.** Figure from Mori et al. (2002: 392, Fig. 162f; p. 531, Fig. 229i).

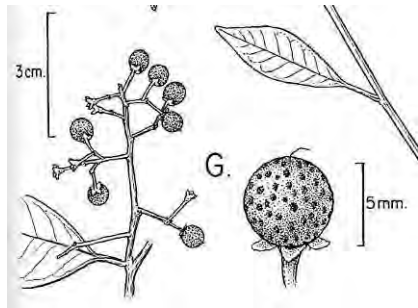


c) **Winged seed.** Figure from Mori et al. (2002: 72, Fig. 20h).

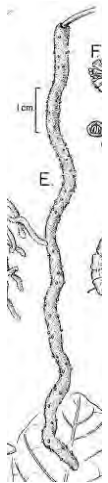


d) **Plumed seed.**

e) **Entire fruit.** Figure from Mori et al. (2002: 533, Fig. 230g).



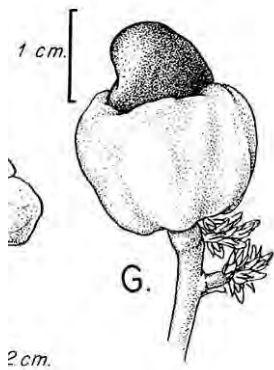
f) **Infructescence (all or partial).** Figure from Mori et al. (2002: 195, Fig. 71e).



g) Merocarp (= mericarp). Figure of 3 merocarps from Mori et al. (2002: 663, Fig. 286i).



h) Fruit plus accessory. Figure from Mori et al. (2002: 45, Fig. 5g).



194) Color of fruit outside (exocarp):

- a) White.**
- b) Yellow.**
- c) Orange.**
- d) Red.**
- e) Purple.**
- f) Blue.**
- g) Green.**
- h) Brown.**
- i) Black.**

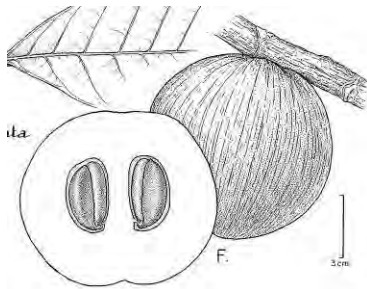
195) Fruit consistency:

a) Fleshy.

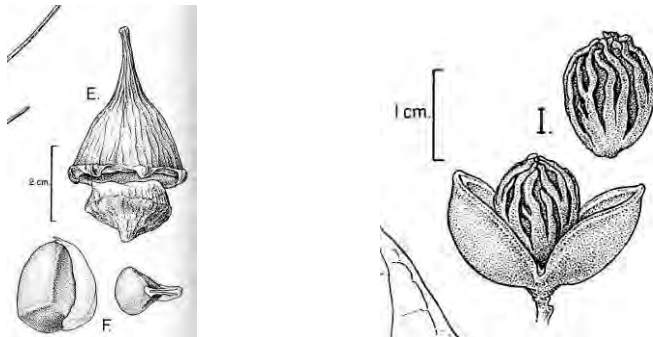
b) Dry.

196) Interior of fleshy fruit:

a) Seeds embedded in a pulp. Figure from Mori et al. (2002: 673, Fig. 289f).



b) Seeds arillate. Figures from Mori et al. (2002: 392, Fig. 162f; p. 531, Fig. 229i).



197) Color of fruit pulp when pulp is present:

a) White.

b) Yellow.

c) Orange.

d) Red.

e) Purple.

f) Blue.

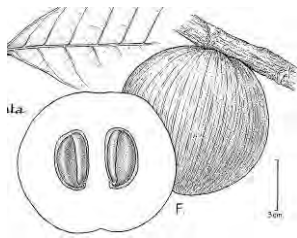
g) Green.

h) Brown.

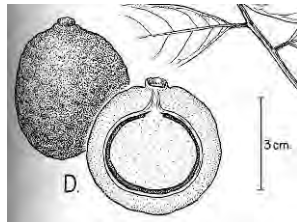
i) Black.

198) Indehiscent fruit type: Indehiscent fruits don't open. (See also Spjut's 2003 classification of fruit types at http://www.worldbotanical.com/fruit_types.htm#Classification).

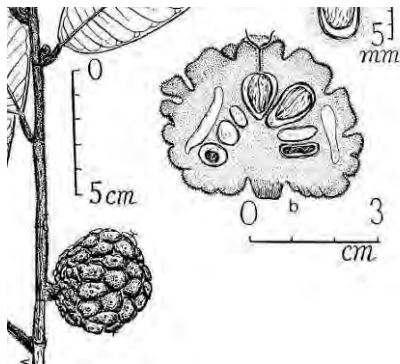
a) Berry. Few to many seeds embedded in a soft pulp. Figure from Mori et al. (2002: 673, Fig. 289f).



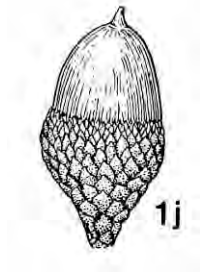
b) Drupe. A rigid to bony endocarp (hard “stone”), embedded in a fleshy mesocarp with a skin = exocarp (e.g., cherry). Figure from Mori et al. (2002: 209, Fig. 78d).



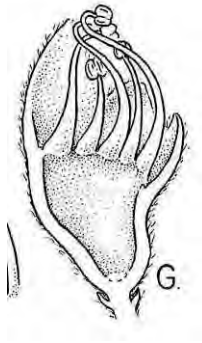
c) Drupaceous (indehiscent). A small drupe that is fused to other drupes in an aggregate fruit (e.g., blackberry). Figure from Berg (1985: 134).



d) Nut (or nutlet). A one-seeded, unilocular (one-celled) hard fruit. A nutlet is smaller than a nut.
Figure from Zomlefer (1989: 83, Fig. 1j).

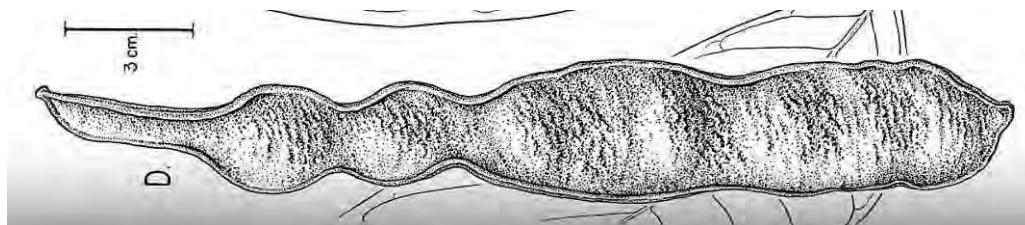


e) Samara (or samaroid). Pericarp extended into a wing, longer than the seed. Figure from Mori et al. (2002: 308, Fig. 125g).



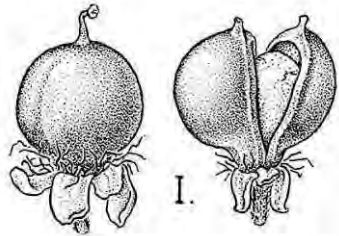
f) Achene. A small dry, indehiscent, one-seeded fruit with a thin pericarp.

g) Indehiscent legume. A laterally compressed fruit, with two sutures that do not open. Figure from Mori et al. (2002: 495, Fig. 212d).

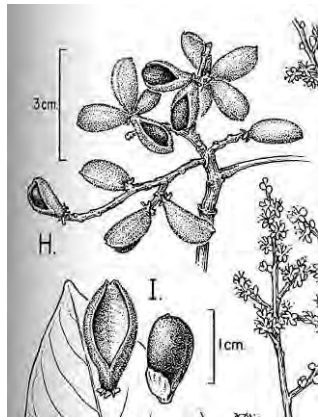


199) Dehiscent fruit type: Dehiscent fruits open. (see Spjut's 2003 classification of fruit types at http://www.worldbotanical.com/fruit_types.htm#Classification).

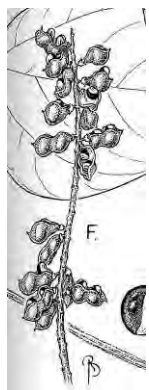
a) Capsule. A dry and multicarpelate fruit, usually opening along one or more lines of dehiscence. Figure from Mori et al. (2002: 252, Fig. 99i).



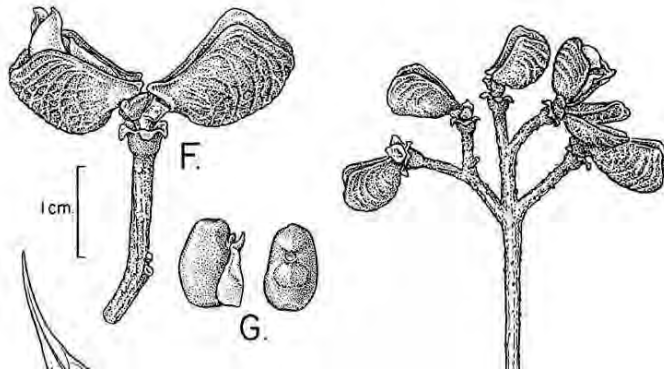
b) Follicle. A laterally compressed schizocarp, opening along one suture. Figure from Mori et al. (2002: 229, Fig. 86h, i).



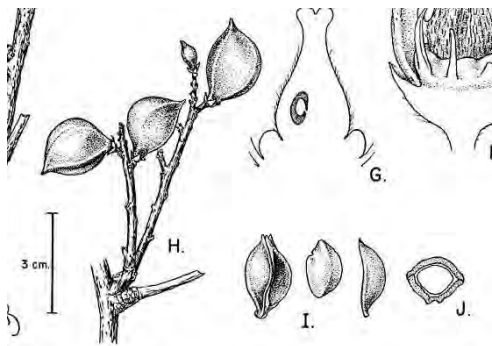
c) Dehiscent legume. A laterally compressed fruit, opening along two sutures (rarely indehiscent). Figure from Mori et al. (2002: 315, Fig. 126f).



d) Schizocarp. A dry dehiscent fruit that splits into at least two segments called mericarps that each contain one seed. Follicle and samaras are schizocarps. Figure from Mori et al. (2002: 650, Fig. 280f, g).

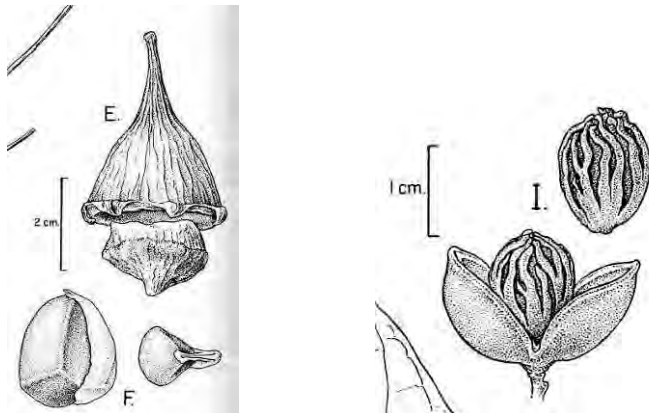


e) Drupaceous (dehiscent). Figure from Mori et al. (2002: 159, Fig. 58h-j).

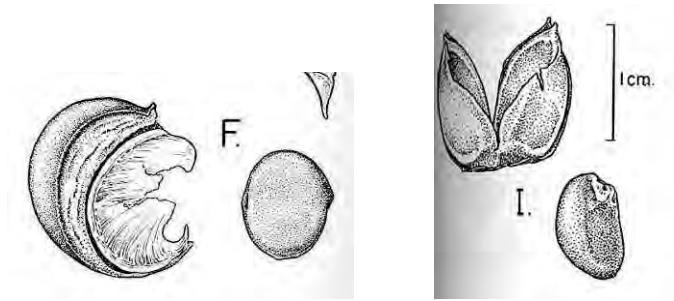


200) Site of rupture of dehiscent fruit:

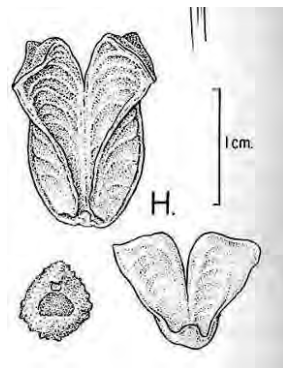
a) Circumscissile. Figures from Mori et al. (2002: 392, Fig. 162f, p. 531, Fig. 229i).



b) Septicidal (= ventricidal). Figures from Mori et al. (2002: 284, Fig. 114f, p. 295, Fig. 120i).



c) Loculicidal. Figure from Mori et al. (2002: 652, Fig. 281h).



201) Color of seed aril when present:

- a) White.
- b) Yellow.
- c) Orange.
- d) Red.
- e) Purple.
- f) Blue.
- g) Green.
- h) Brown.
- i) Black.

202) Color of the seed(s) or stone(s):

- a) White.

- b) Yellow.**
- c) Orange.**
- d) Red.**
- e) Purple.**
- f) Blue.**
- g) Green.**
- h) Brown.**
- i) Black.**

203) Seeds per fruit locule:

- a) One.**
- b) Two to three.**
- c) Four to five.**
- d) More than five.**

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