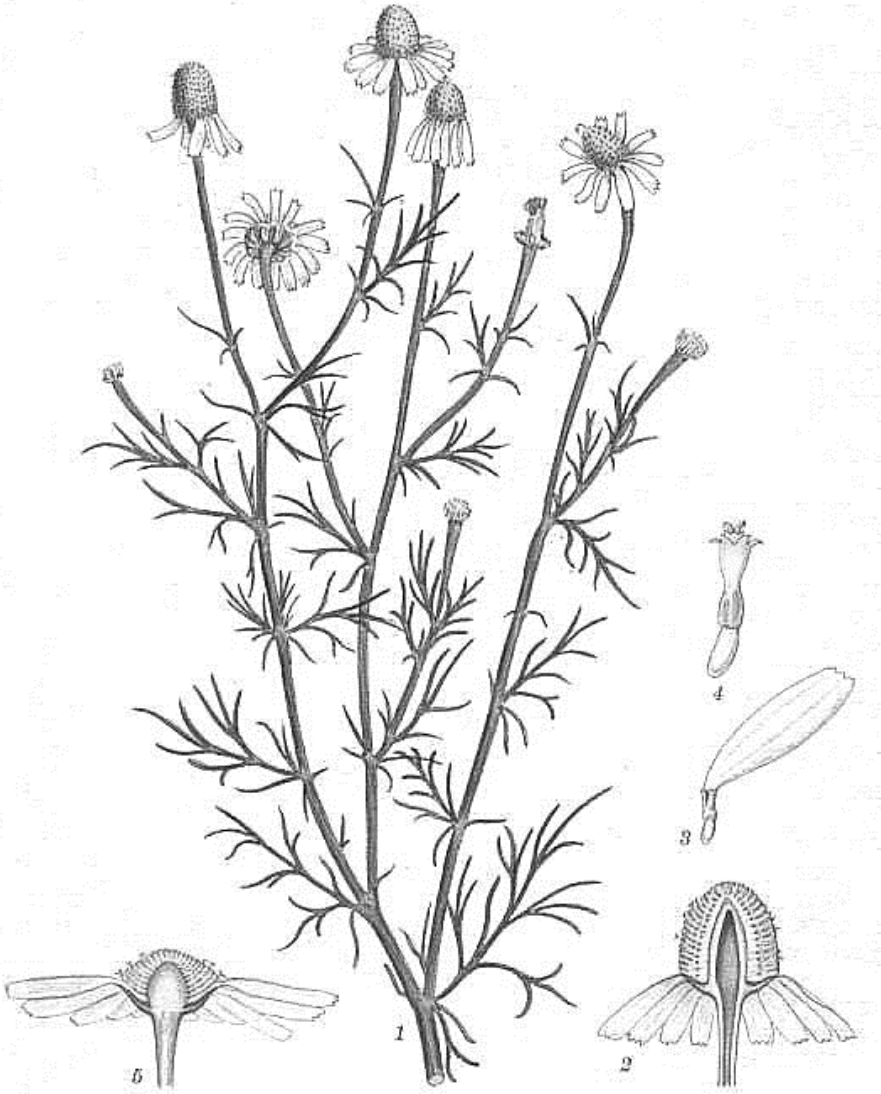
Figures for morphology

Edited by Zsolt Erős-Honti
Reviewed by Mária Höhn



SÖTBLOMSTER, MATRICARIA CHAMOMILLA L.

- 2017 -

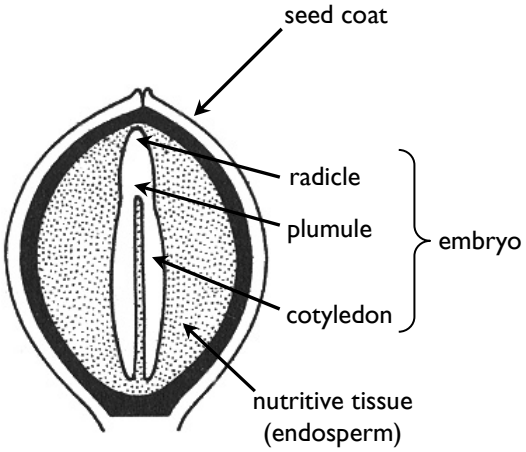


Figure 1. Structure of seed and germ (eudicot).

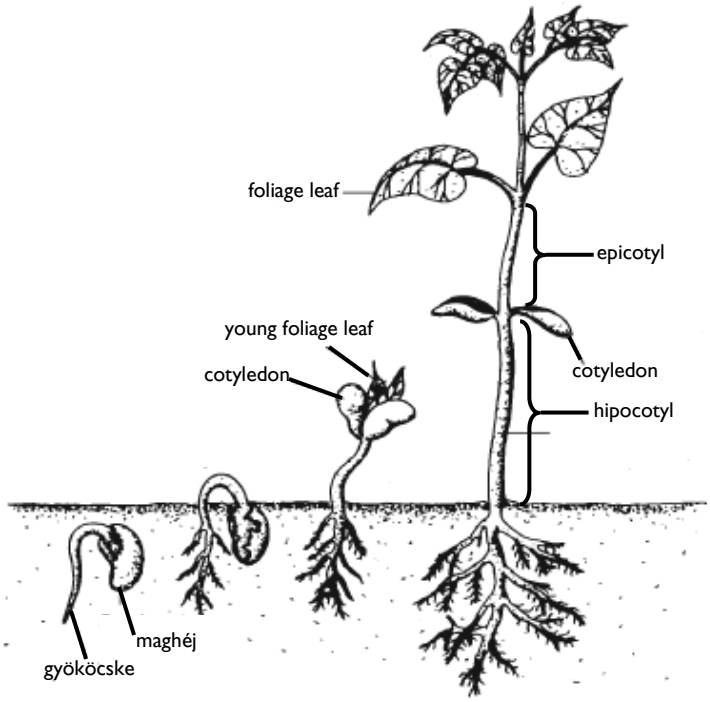


Figure 2. Process of germination and the structure of seedling.

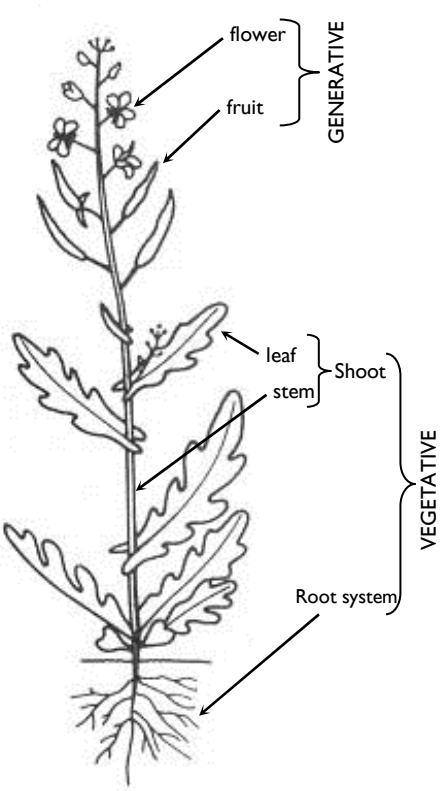


Figure 3. Plant organs.

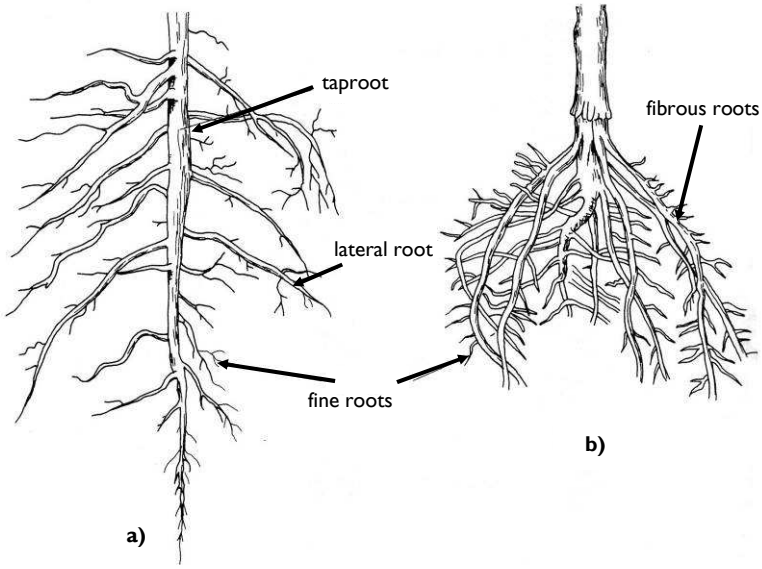


Figure 4. Taproot (a) and fibrous (b) root system.

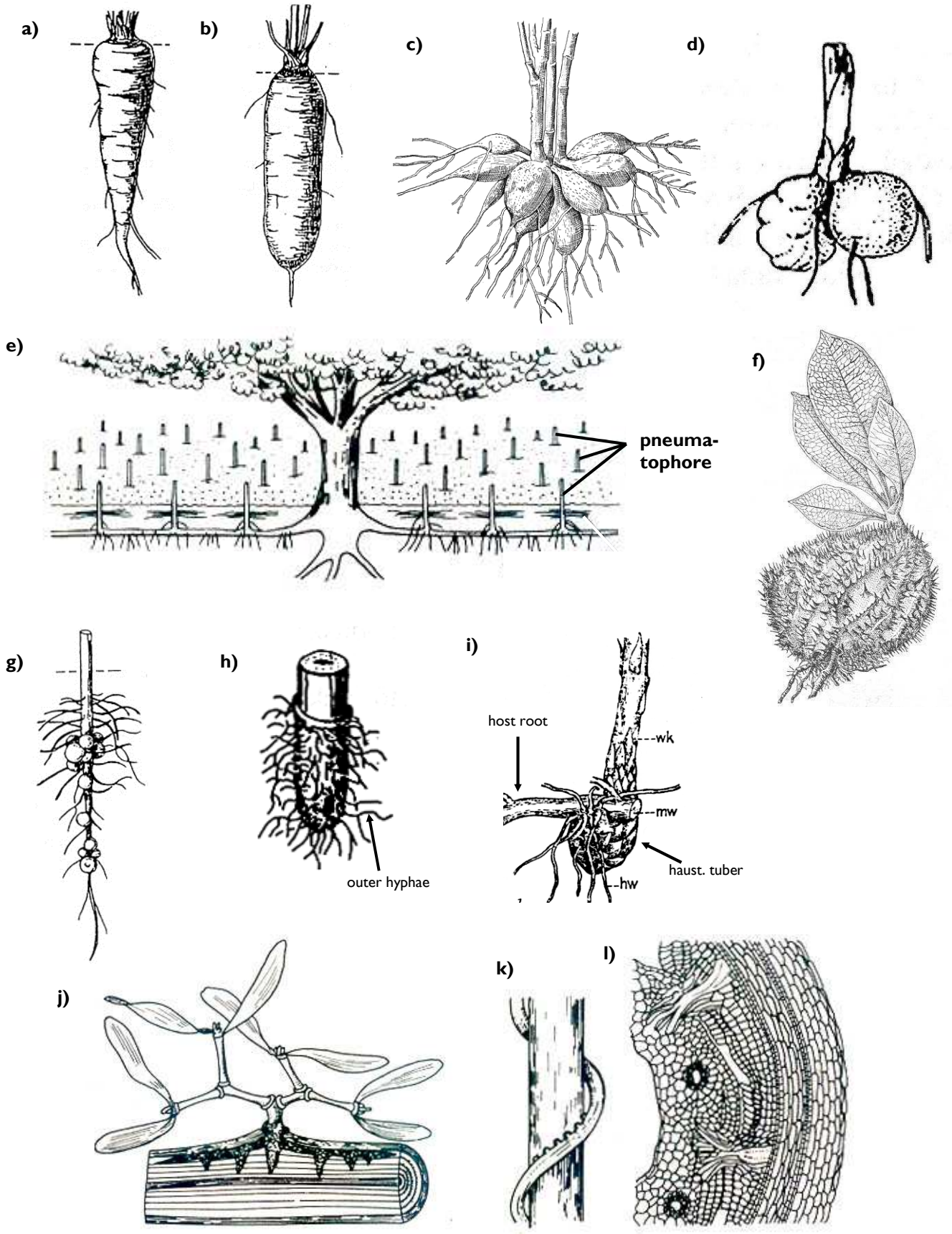


Figure 5. Modified and adventitious roots. Storage roots (a-d): conical storage taproot (a), fusiform storage taproot (b), fasciculated / tuberous root (c), tuberous root pair (d). Pneumatohpore (respiratory root) (e); root thorns (f). Roots of symbioses (g-l): root nodules (g); actomycorrhiza (h); haustorial tuber (i); haustorial roots (j-k) and their anatomy (l).

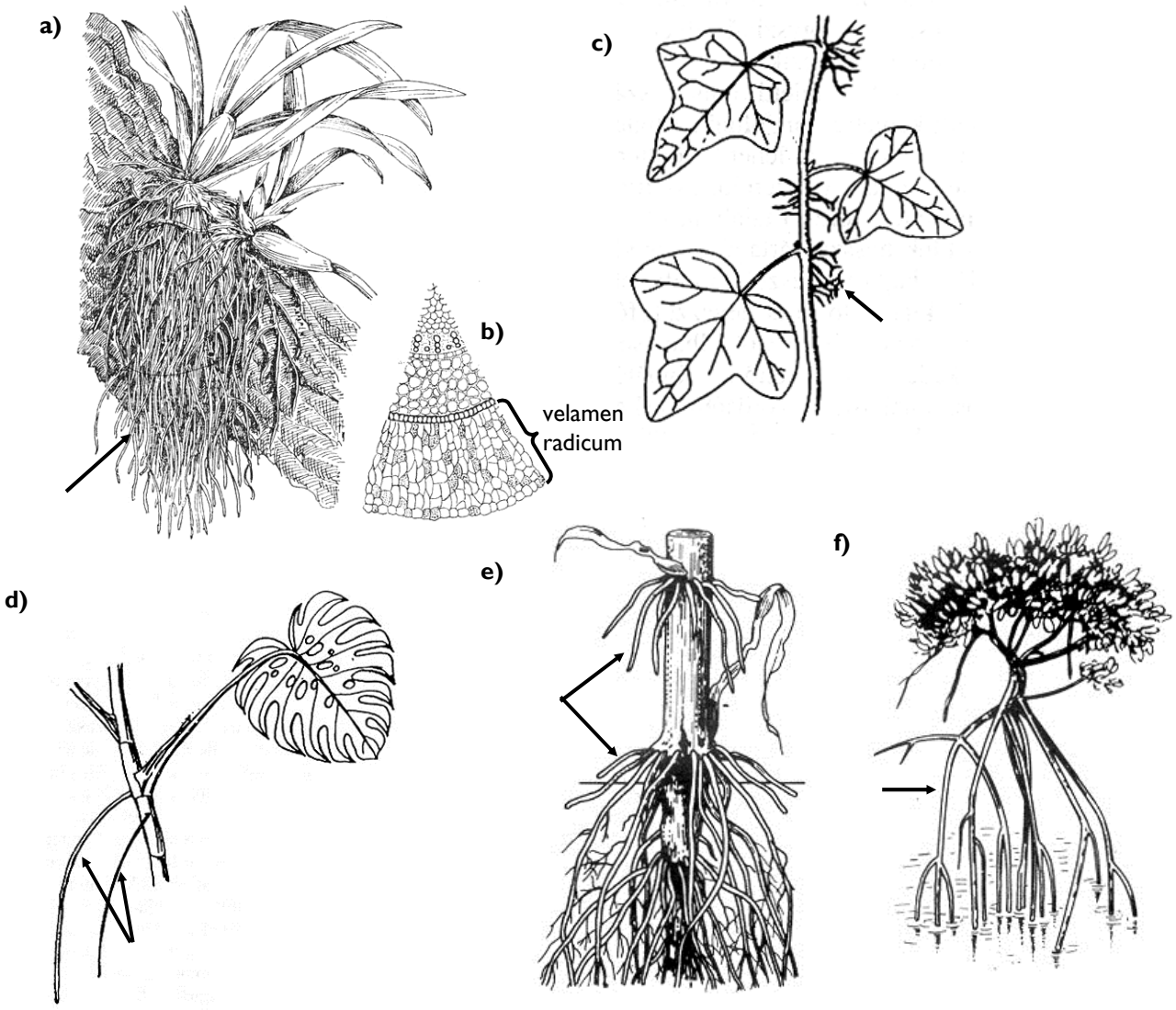


Figure 6. Aerial roots. Epiphytic root (a) and its anatomy (b), climbing root (c), transportage aerial root (d), brace root (e), prop (pillar) root (f).

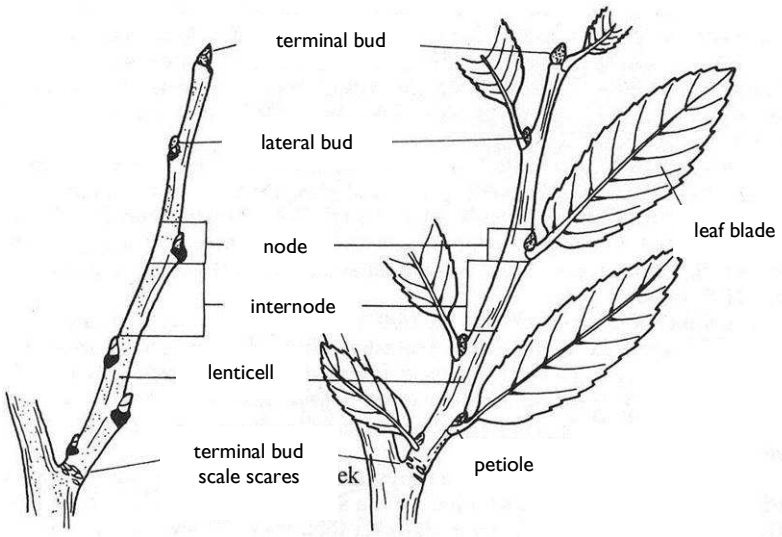


Figure 7. Shoot structure.

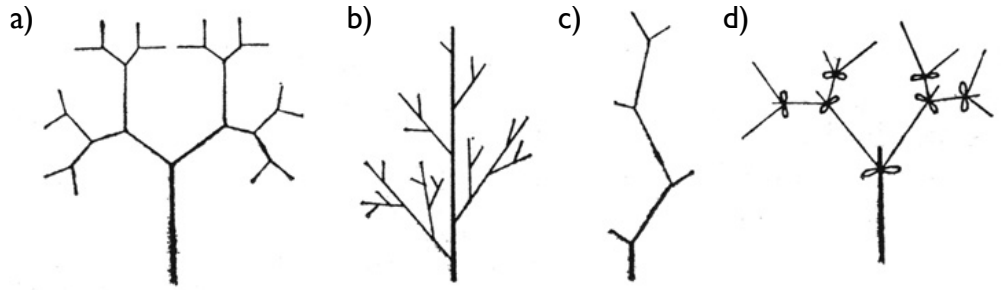


Figure 8. Types of stem branching. Dichotomous (a), monopodial (b), sympodial (c), pseudo-dichotomous (d) branching.

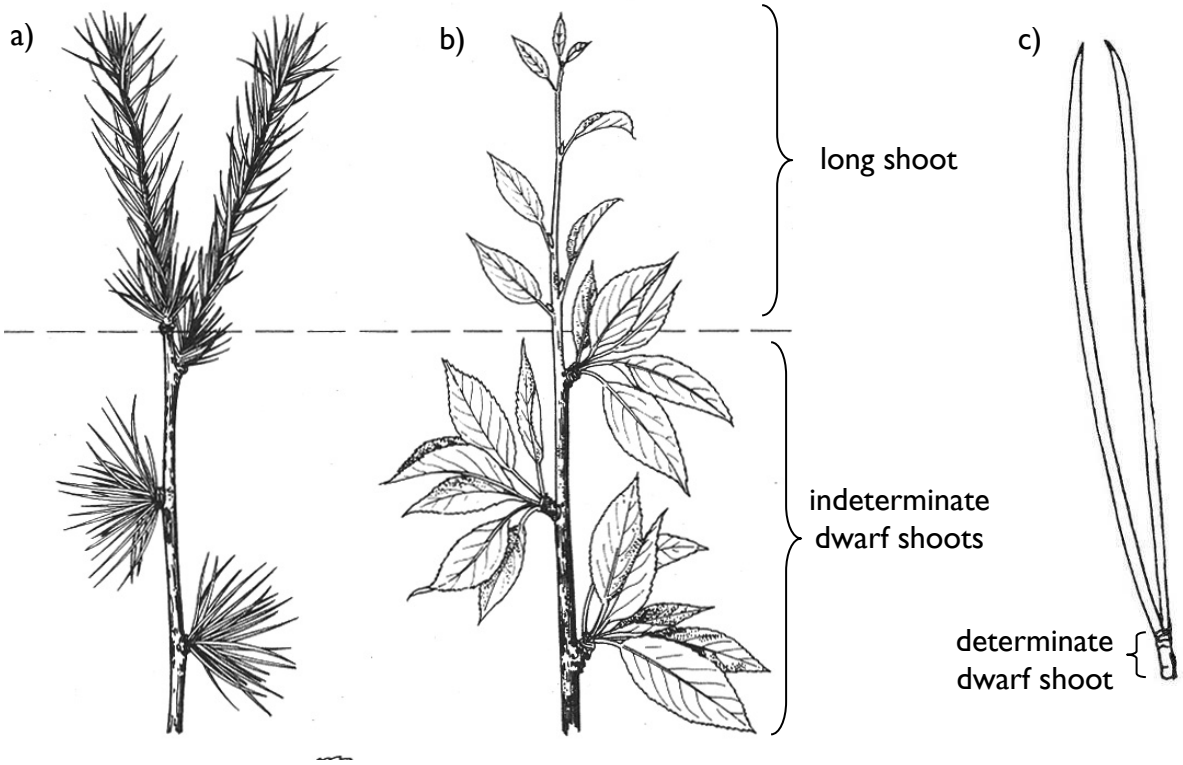


Figure 9. Shoot types. Long shoot, indeterminate dwarf shoot / spur (a: Larix decidua, b: Cerasus vulgaris) and determinate dwarf shoot (c: *Pinus nigra*).

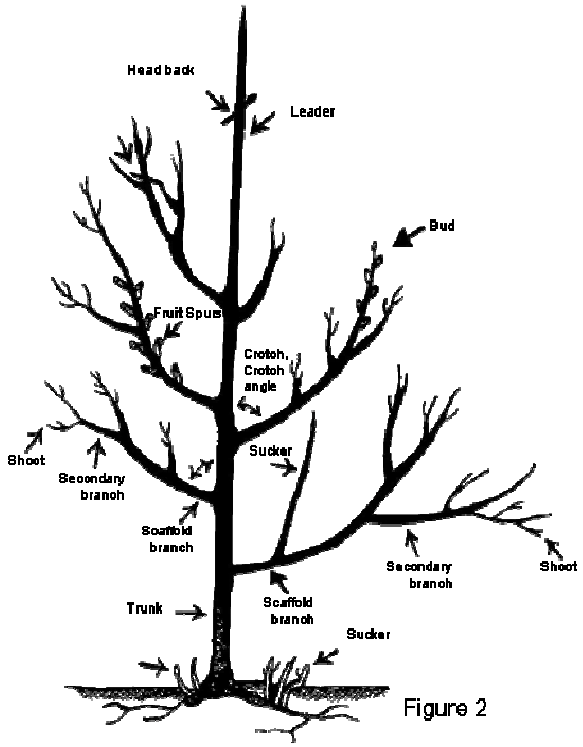


Figure 10. Structure of the woody stem.

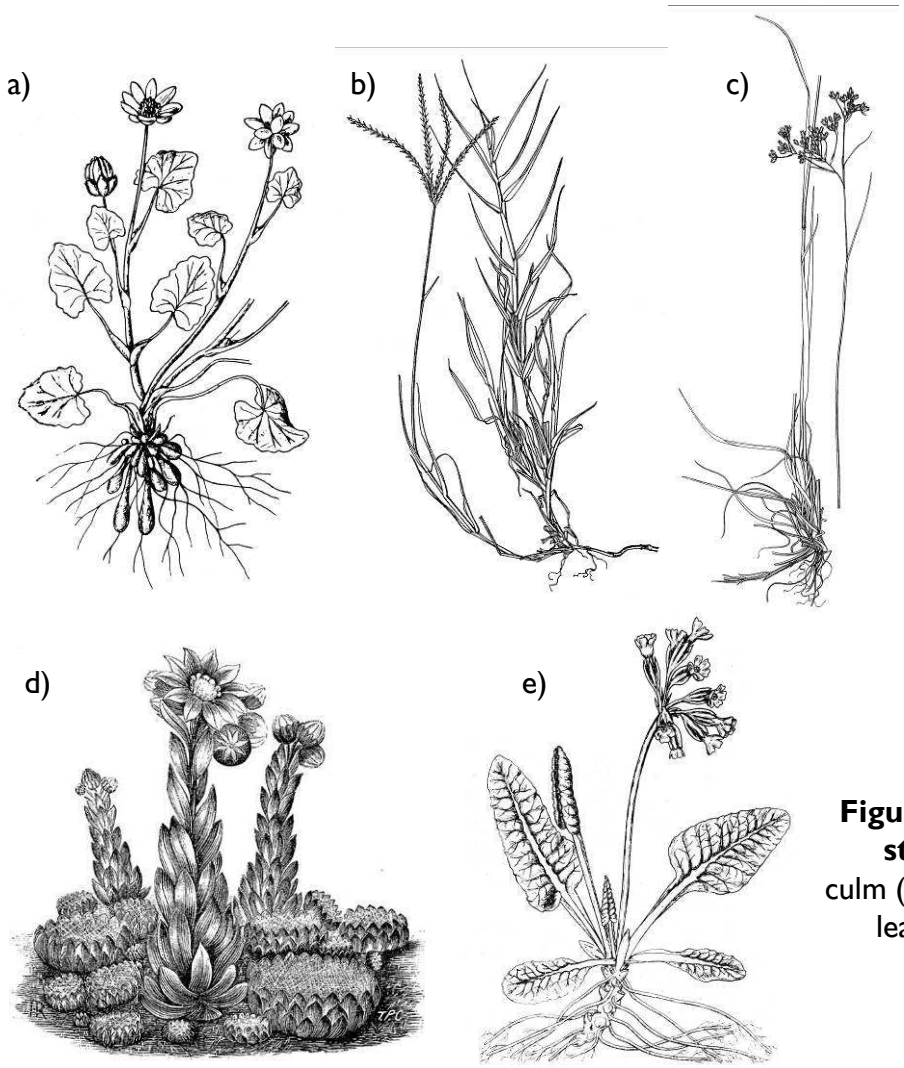


Figure 11. Types of non-woody stem. Herbaceous stem (a), culm (b), calamus (c), leaf rosette with leafy stem (d) and a scape (e).

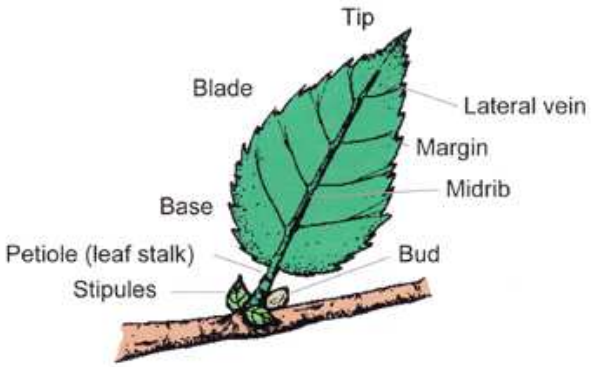


Figure 12. Parts of the leaf.

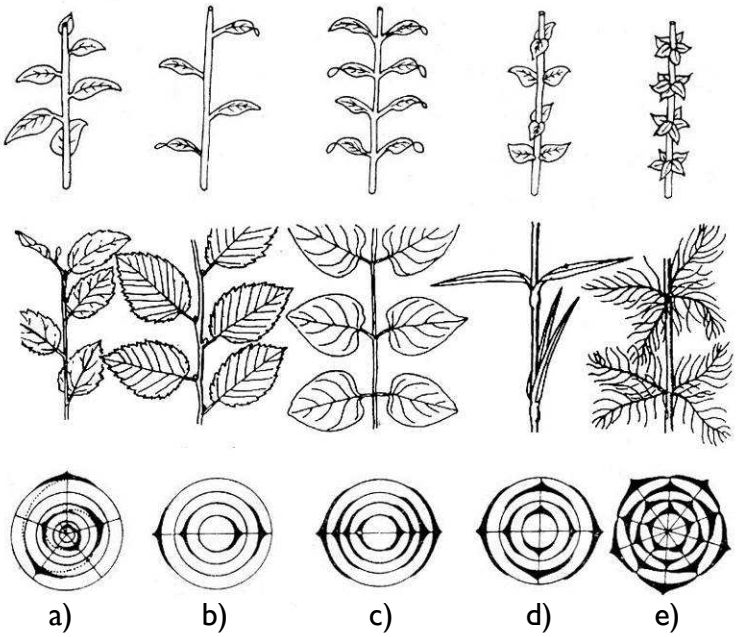


Figure 13. Leaf arrangement. Alternate (a – spiral, b-two-rowed), opposite (c), decussate (d) and whorled (e).

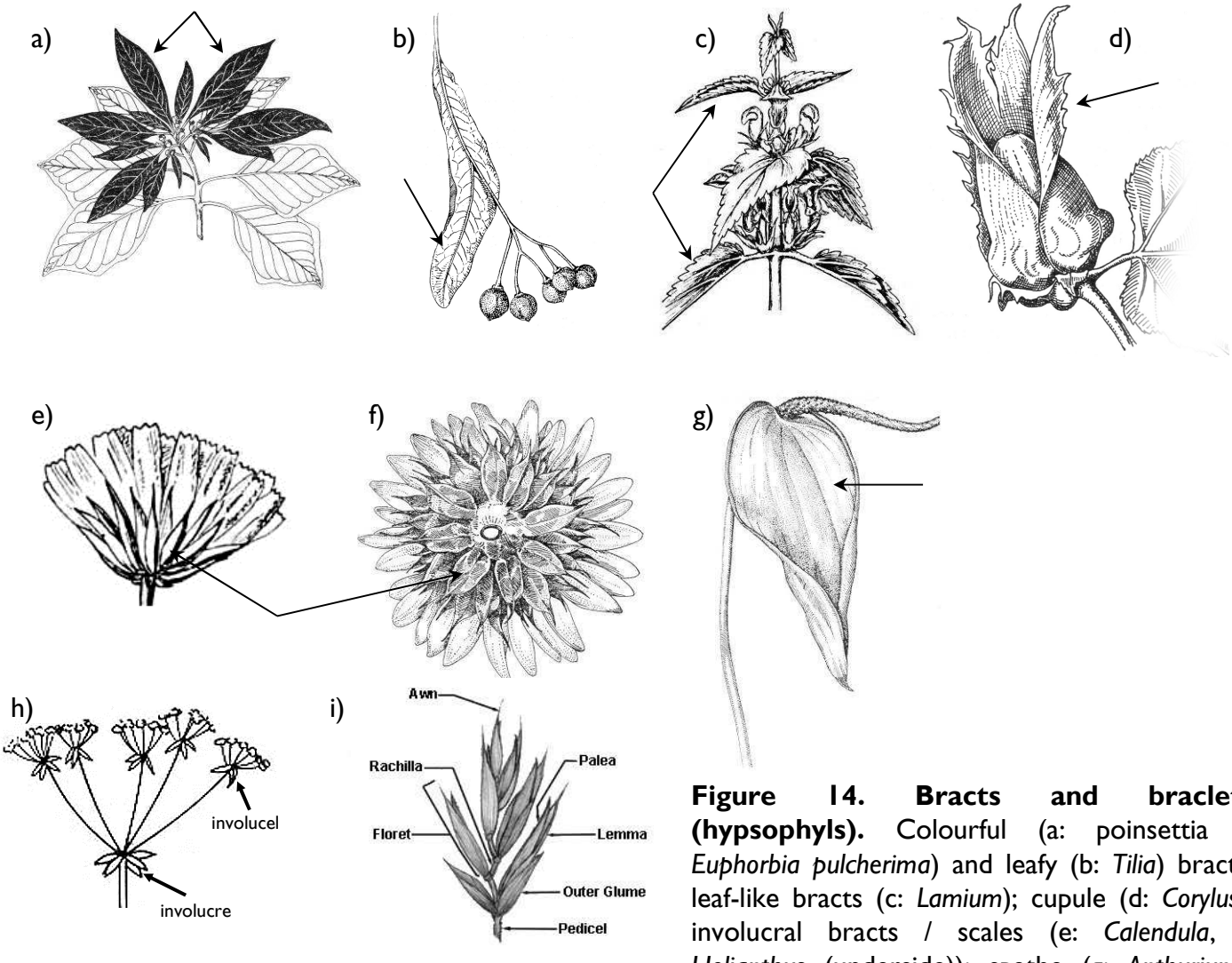


Figure 14. Bracts and braclets (hypsophyls). Colourful (a: poinsettia – *Euphorbia pulcherima*) and leafy (b: *Tilia*) bracts; leaf-like bracts (c: *Lamium*); cupule (d: *Corylus*); involucral bracts / scales (e: *Calendula*, f: *Helianthus* (underside)); spathe (g: *Anthurium*); involucres and involucels (h); glume, palea and lemma (i).

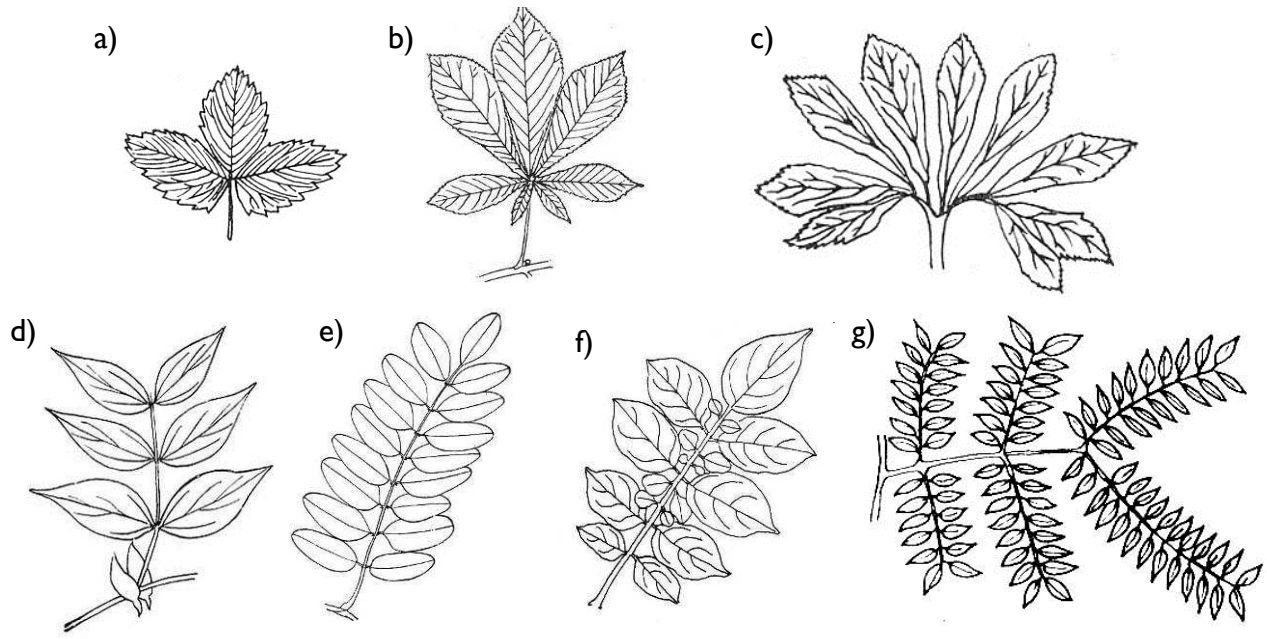


Figure 15. Compound leaf types. Trifoliolate (a: *Fragaria* x *ananassa*); palmate (b: *Æsculus*); palmate with sympodially branching leaflets (c: *Helleborus*); paripinnate (d: *Lathyrus*); imparipinnate (e: *Robinia*); compound leaf with primary and secondary leaflets (f: *Solanum tuberosum*); bipinnate (g: *Acacia*).

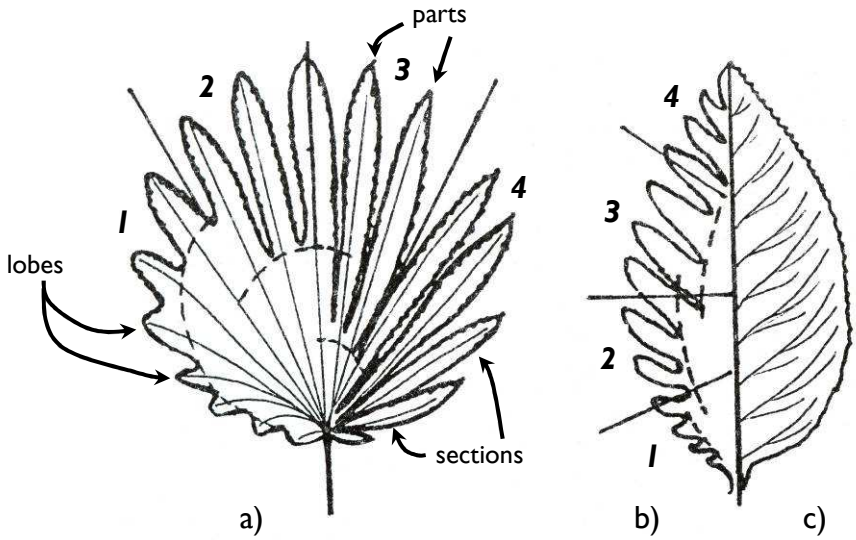


Figure 16. Lobed (palmately - a, pinnately - b) and entire (c) leaves. 1-4 differs concerning the depth of the lobes. (1: palmitifid/pinatifid, 2-3 palmitipartite/pinnatipartite, 4: palmitisect/pinnatisect.)

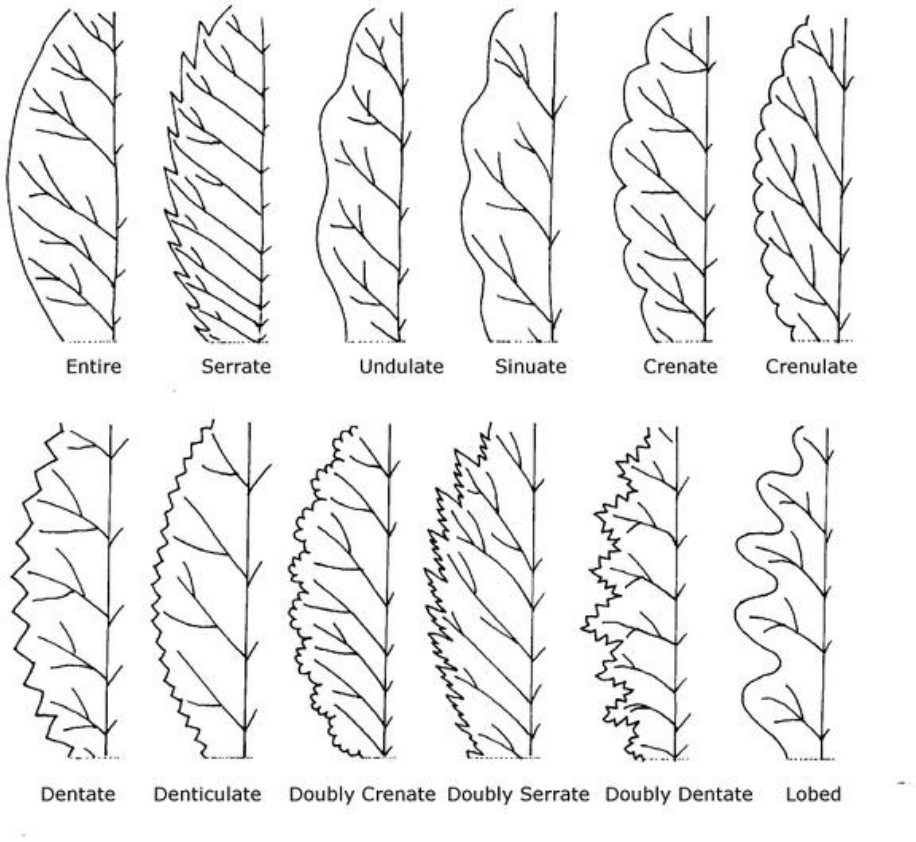


Figure 17. Different types of leaf margin.

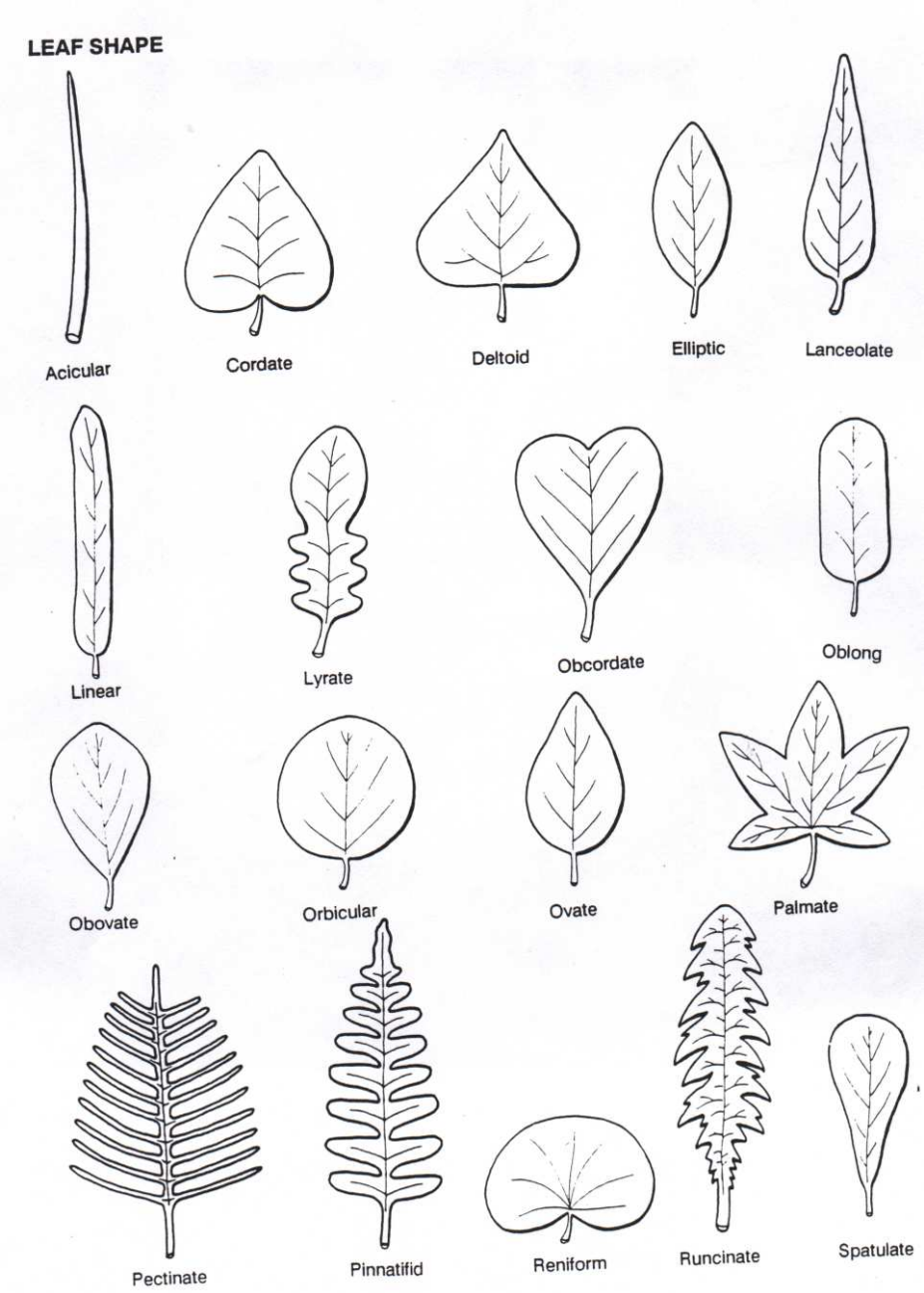


Figure 18. Different types of leaf shape.

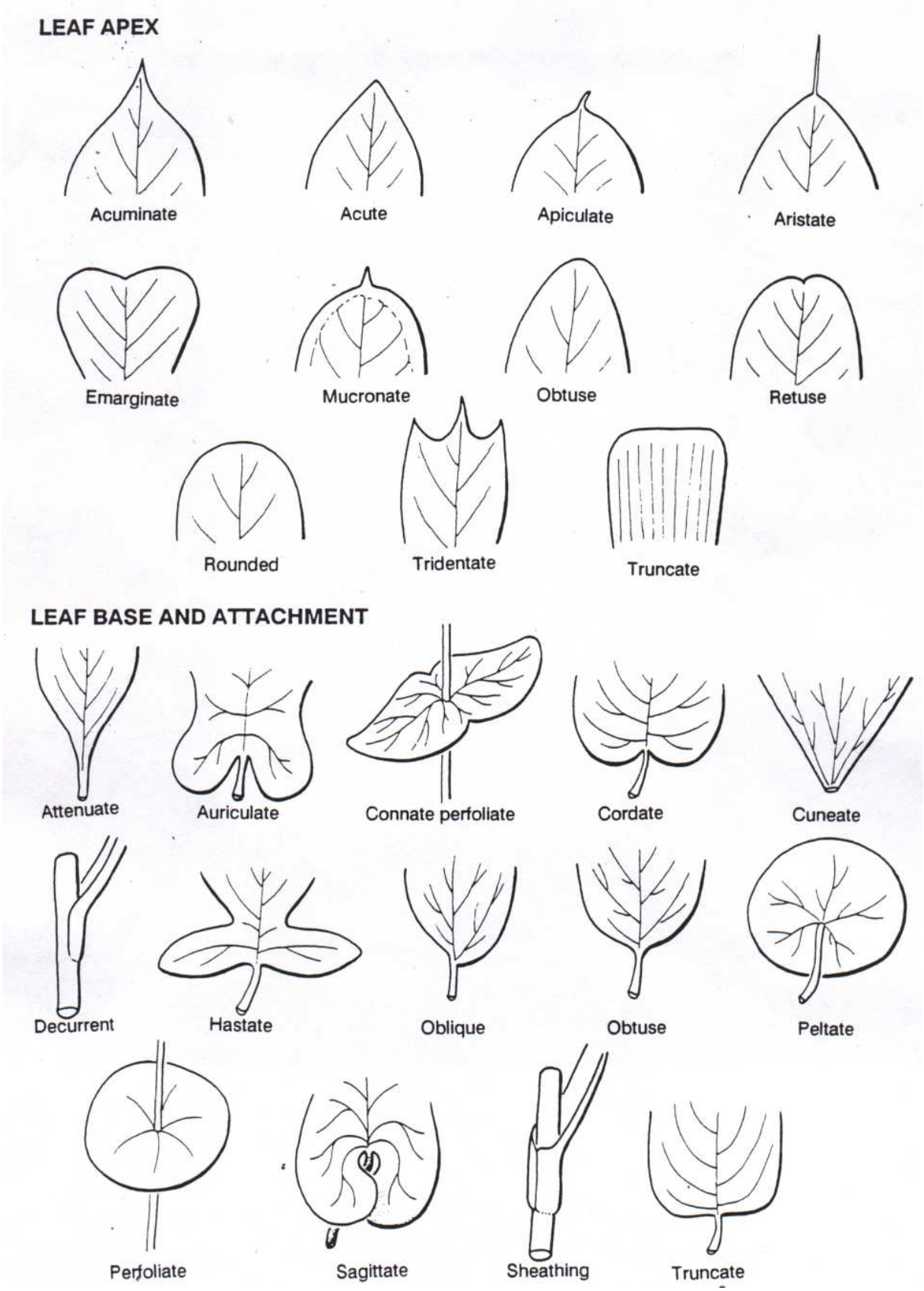


Figure 19-20. Different types of leaf tip (apex) and leaf base.

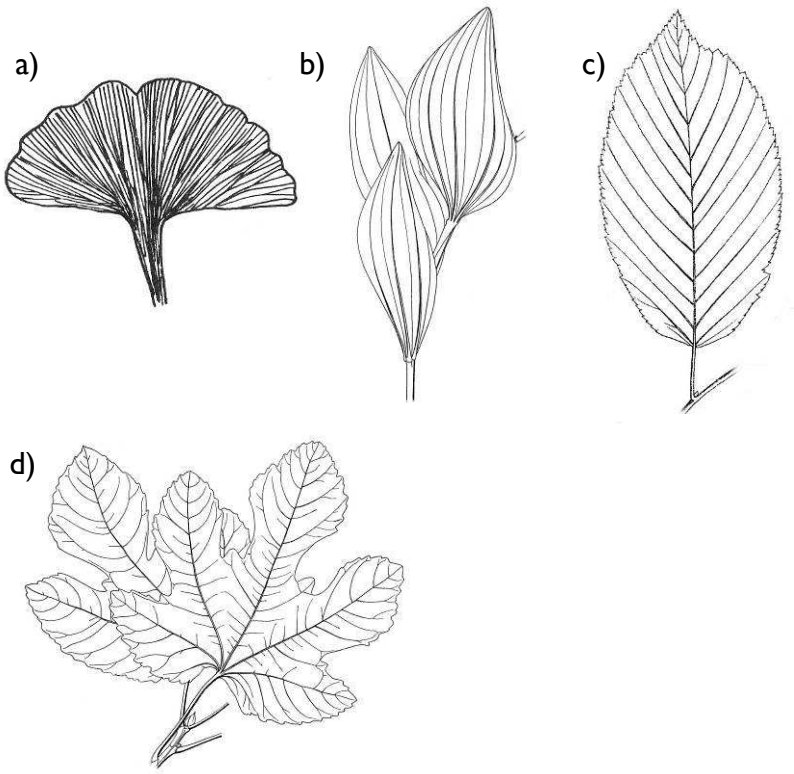


Figure 21. Venation. Dichotomous venation (a: *Gingko biloba*); parallel venation (b: *Polygonatum multiflorum*); pinnate venation (c: *Carpinus betulus*); palmate venation (d: *Ficus carica*).

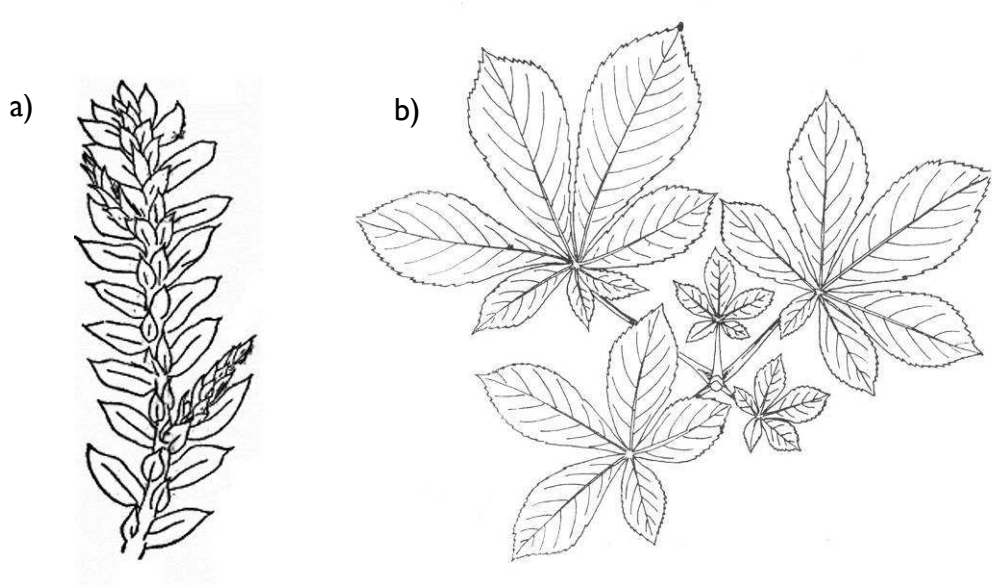


Figure 22. Mature leaves of differet size. Anisophylly (a: *Selaginella helvetica*); leaf mosaic (b: *Aesculus hippocastanum*).

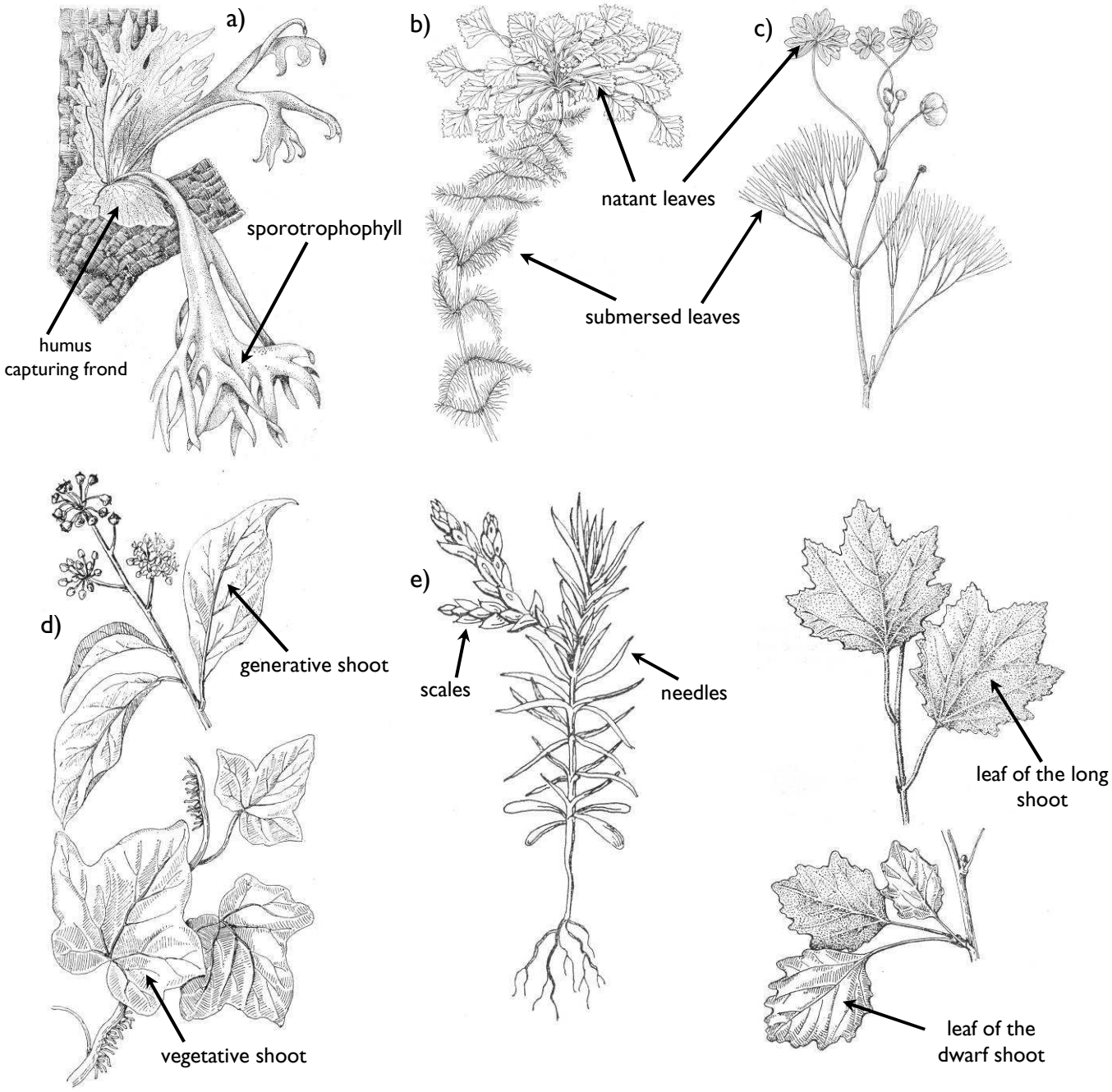


Figure 23. Heterophylly. Functional heterophylly (a: *Platycerium alcicorne* – humus capturing leaf and sporotrophophyll); ecological heterophylly (c: *Trapa natans*, d: *Ranunculus aquatilis* – submersed and natant leaves); developmenta heterophylly (d: *Hedera helix* –leaves of vegetative and generative shoots; e: *Platycladus orientalis* – retinospora); topophysis (f: *Populus alba* – leaves of long and dwarf shoots).

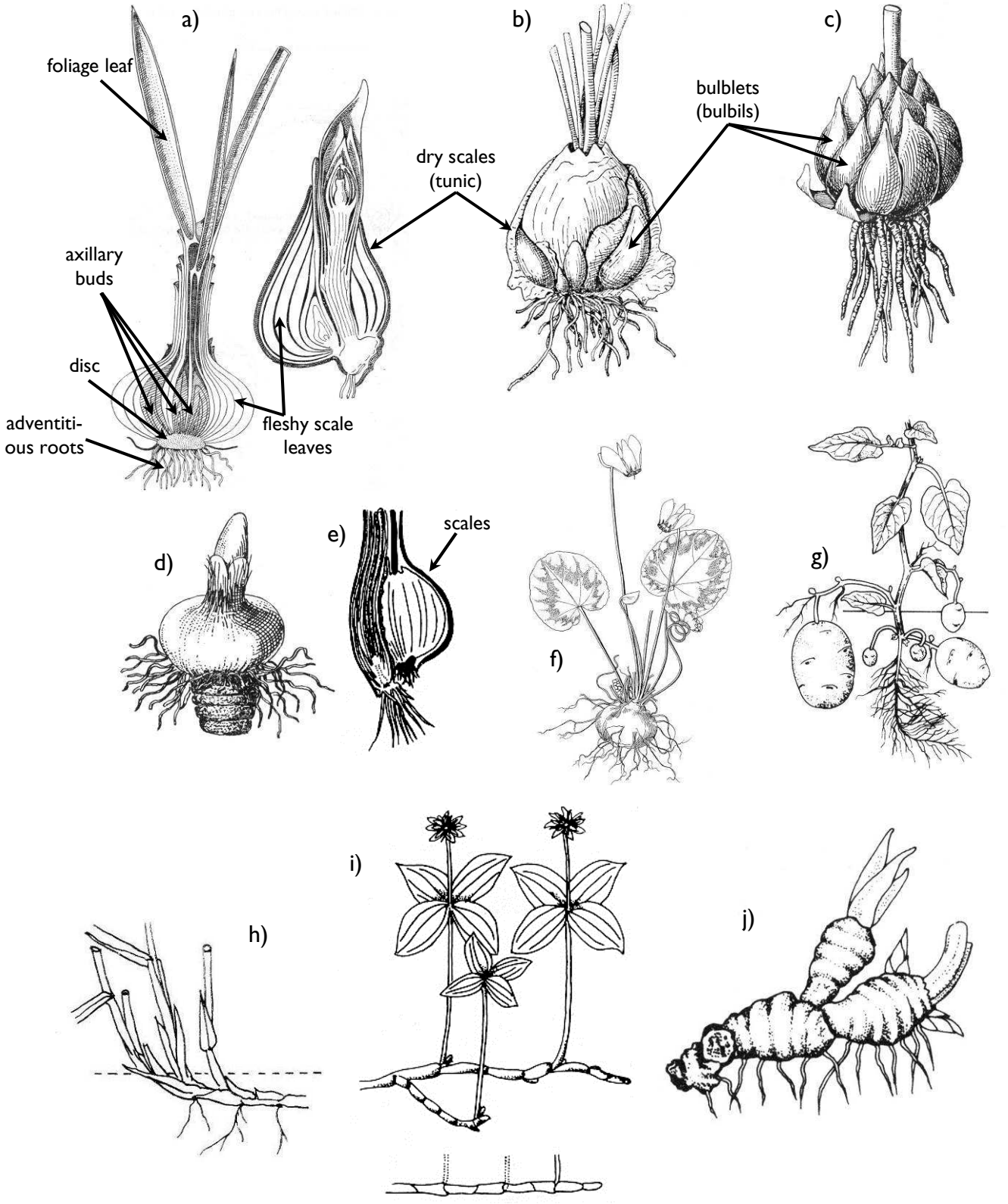


Figure 24. Hypogaeous modified shoots. Bulb (a: *Allium cepa*); bulb with bulblets (b: *Ornithogalum* sp.); unsheathed bulb (c: *Lilium* sp.); corm (d: *Crocus* sp., e: *Colchicum autumnale*); hypogaeous tuber (f: *Cyclamen persicum*); stem tuber (g: *Solanum tuberosum*); runner (h: *Elymus repens*; i: *Paris quadrifolia*); rhizome (j: *Iris germanica*).

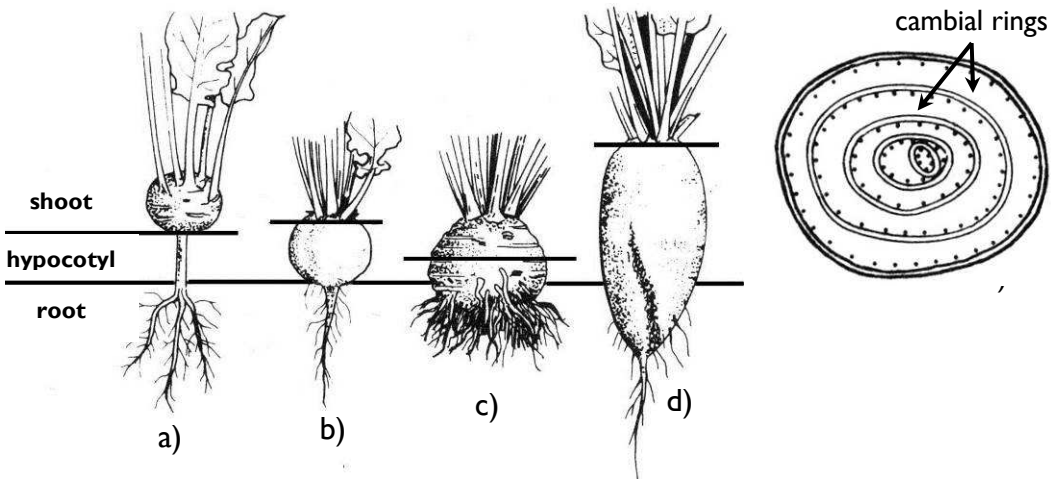


Figure 25. Storage organs close to the soil surface. Epigaeous stem tuber (a: *Brassica rupestris* convar. *gongyloides*, b: hypocotyl tuber *of Raphanus sativus* convar. *sativus*, c: *Apium graveolens*); beetroot (d: *Beta vulgaris*); cross section from the polycambial beetroot (e).

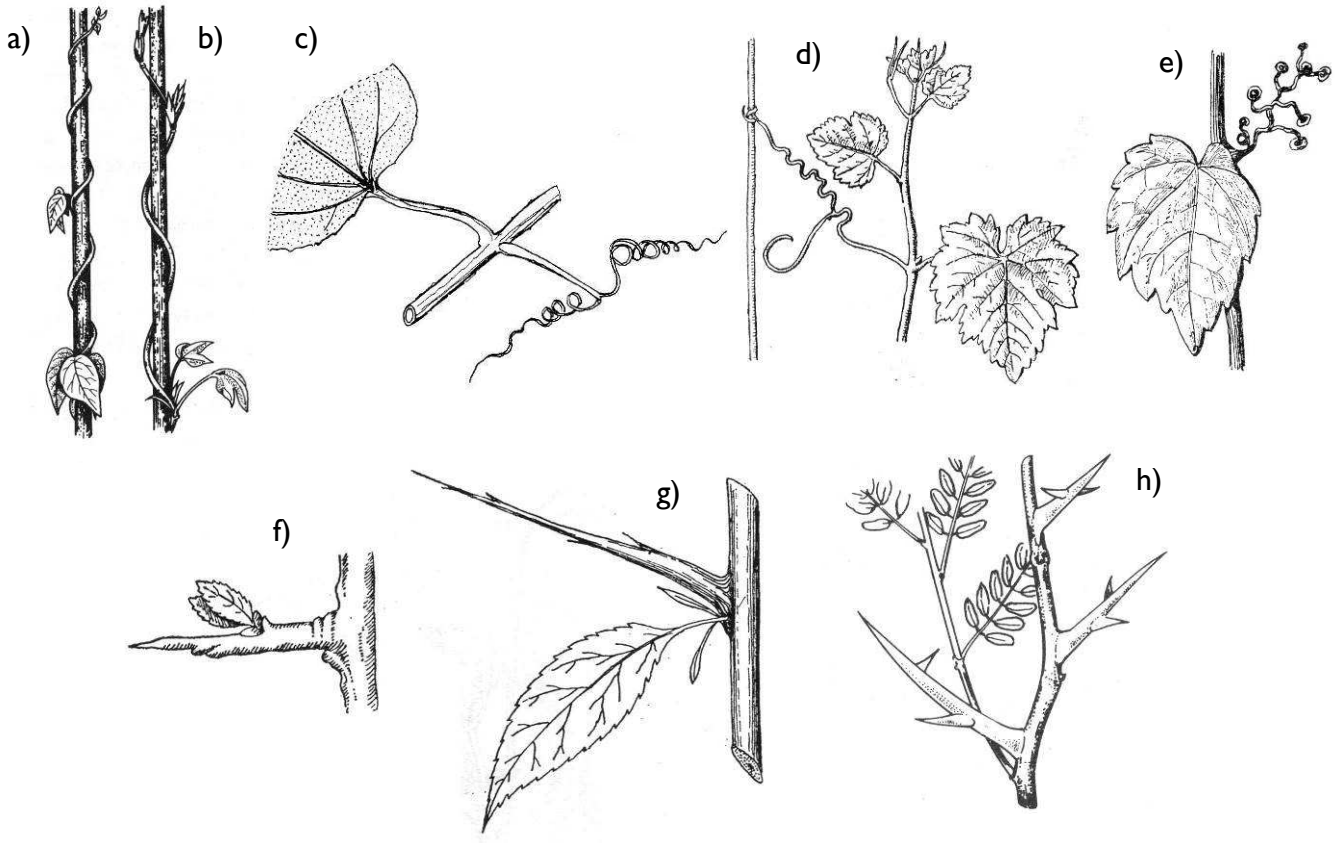


Figure 26. Epigaeous modified shoots I. Tendril (a: *Phaseolus vulgaris*, b: *Humulus lupulus*, c: *Cucurbita* sp.; d: *Vitis* sp.); tendril with suckers (e: *Parthenocistus* sp.); stem spine / thorn (f: *Prunus spinosa*, g: *Cratægus* sp., h: *Gleditsia triacanthos*).

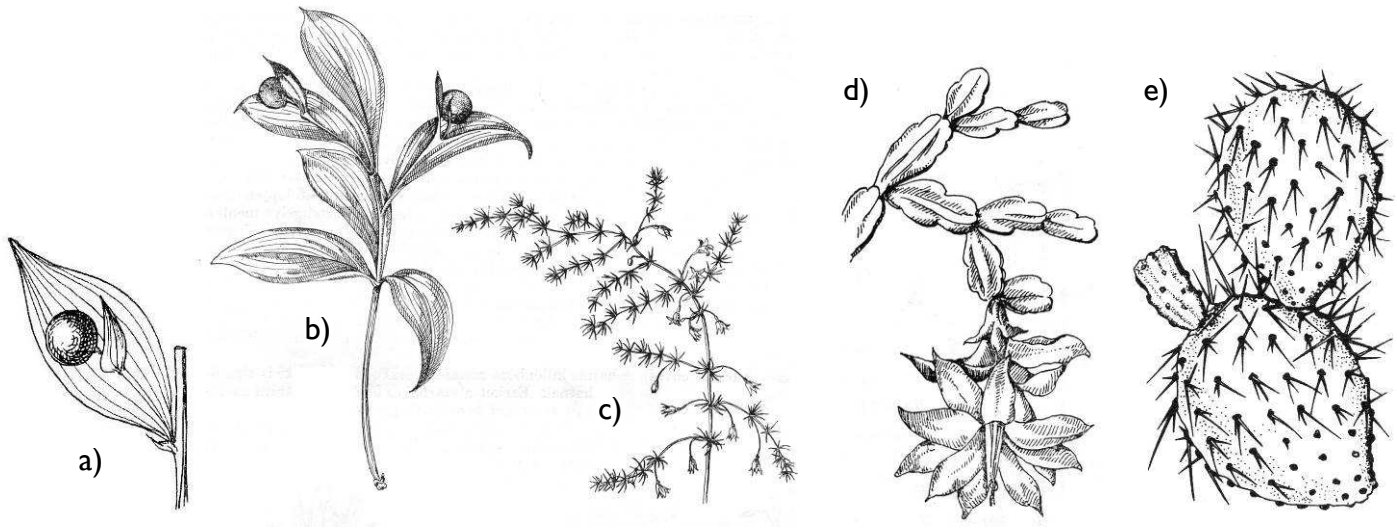
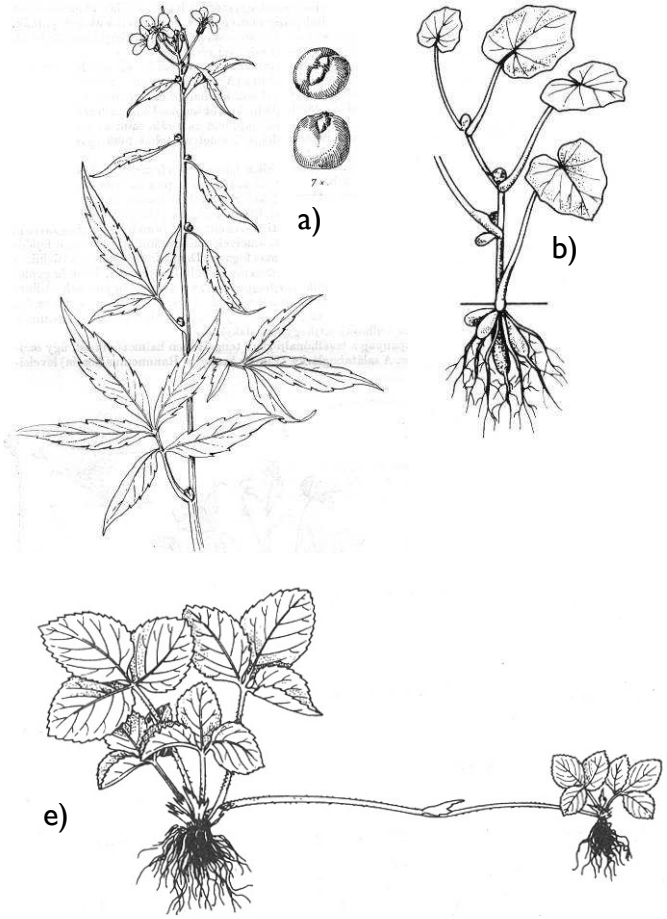


Figure 27. Epigaeous modified shoots II. Phylloclade (a-b: *Ruscus* sp., c: *Asparagus officinalis*); cladode (d: *Zygocactus truncatus*; e: *Opuntia* sp.).



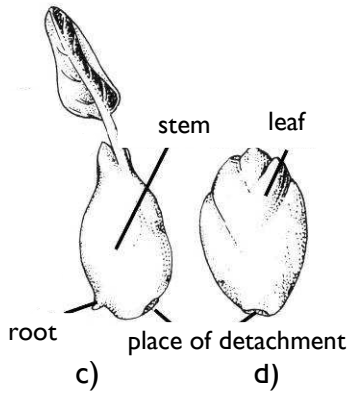


Figure 28. Epigaeous modified shoots III. Bulbils (a: *Dentaria bulbifera*), basal tubers (b: *Ficaria verna*); basal tubers of stem (c) and leaf origin (d); runner (e: *Fragaria* x *ananassa*).

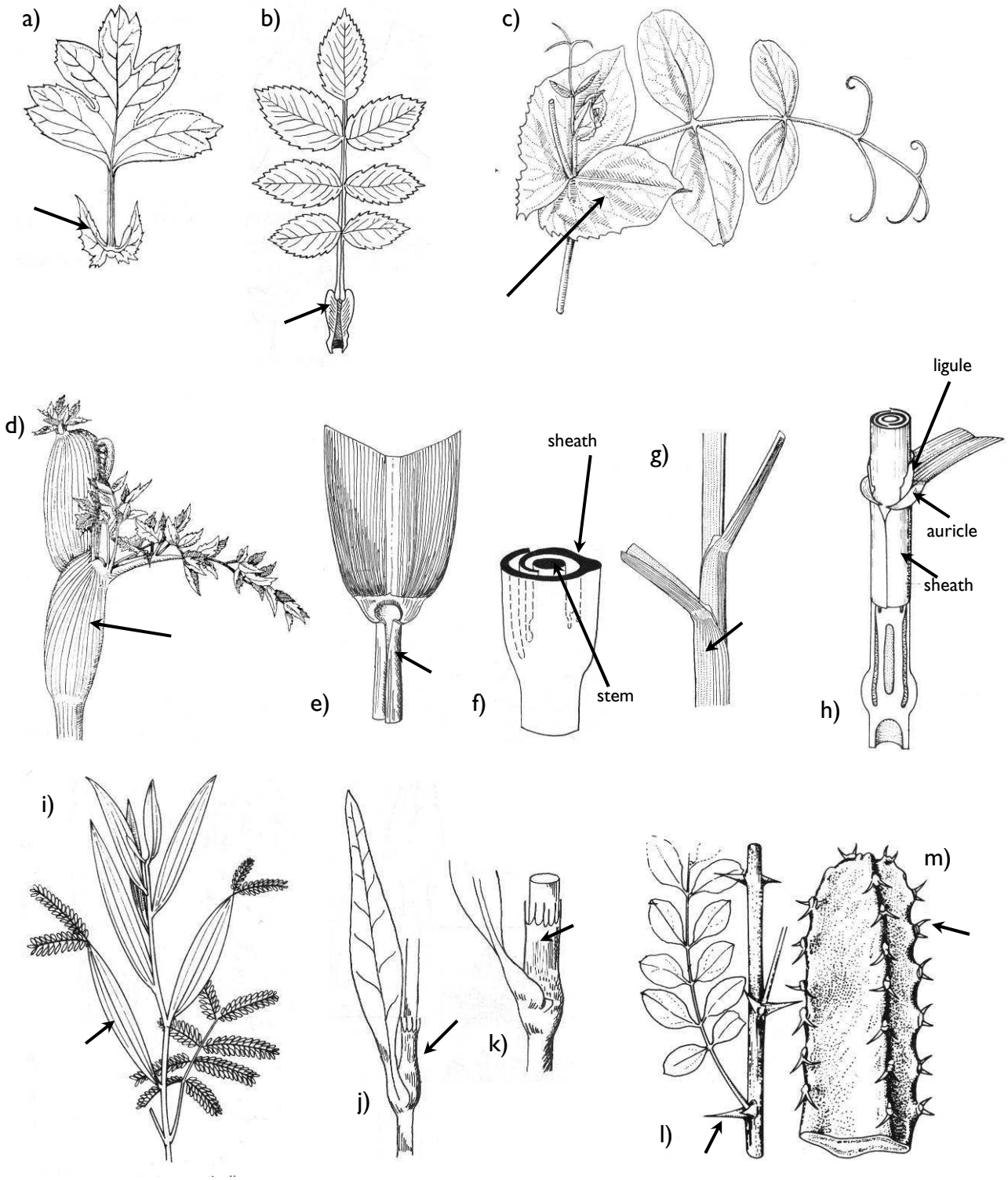


Figure 29. Derivatives and modifications of the leaf base. Stipule (a: *Cratægus monogyna,* b: *Rosa canina*), leaf-like stipule (c: *Pisum sativum*); swollen leaf sheath (d: *Angelica sylvestris*), open leaf sheath (e: *Phragmites australis*, f: figure e in section, g: *Cynodon dactylon*); open sheath with auricle and ligule (h); phyllode (i: *Acacia* sp.); ochrea (amplexicaul stipule) (j-k: *Polygonum* sp.); stipule spine (l: *Robinia pseudo-acacia*, m: *Euphorbia* sp.).

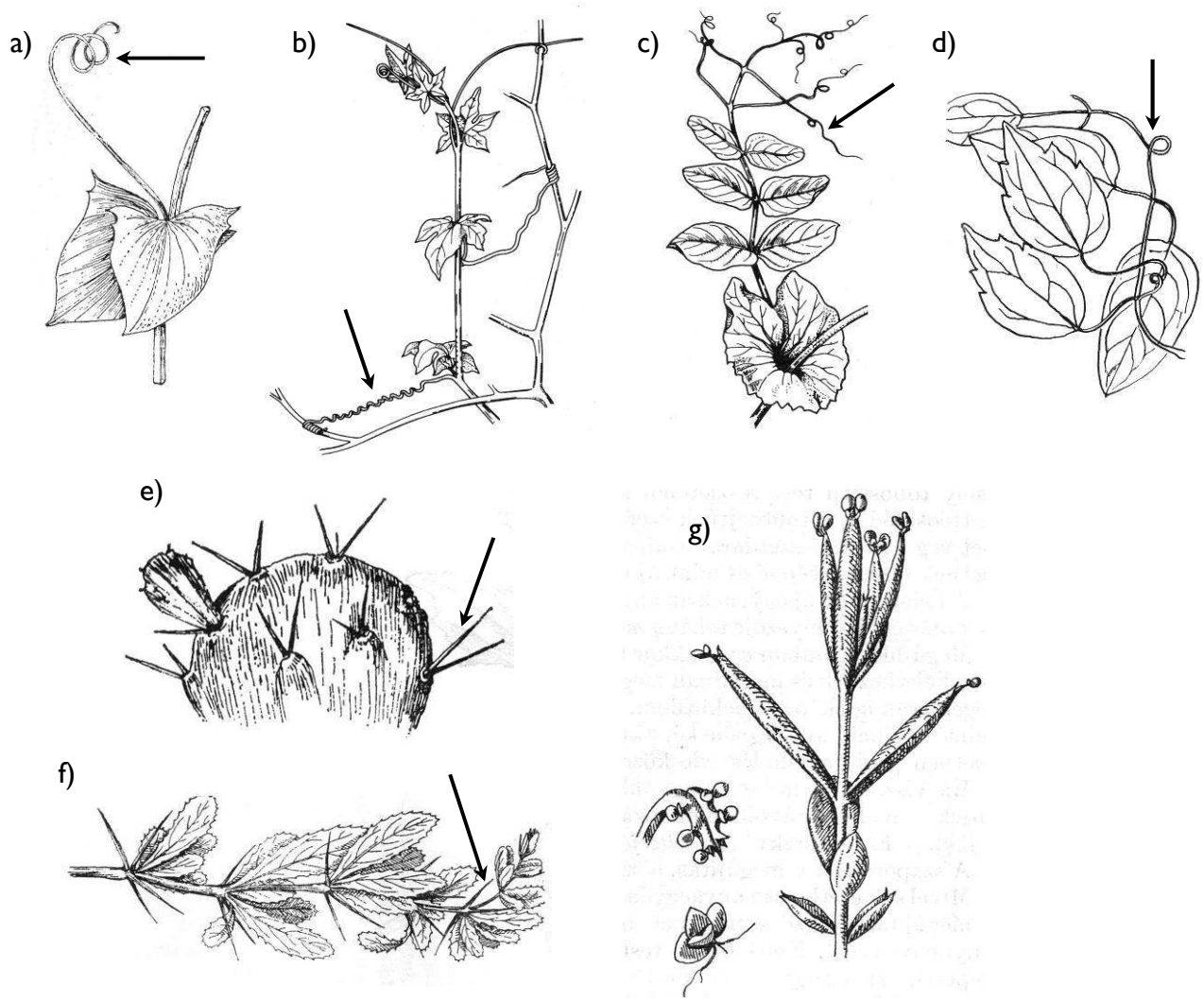


Figure 30. Modified leaves. Leaf tendril (a: *Lathyrus aphlaca,* b: *Brionia dioica*), leaflet tendril (c: *Pisum sativum*); petiole tendril / tendriller petiole (d: *Clematis vitalba*); leaf spine (e: *Opuntia*, f: *Berberis vulgaris*); viviparous leaf (g: *Bryophyllum*).

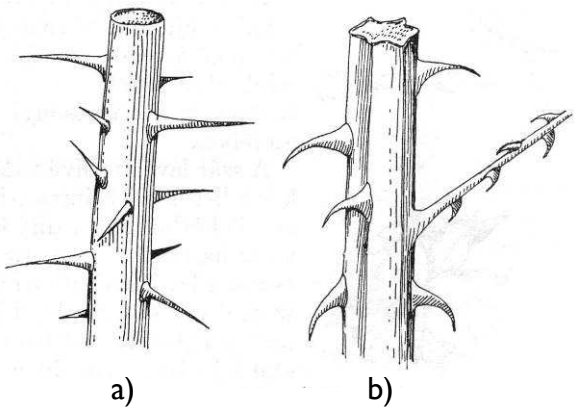


Figure 31. Prickled stems. *Rosa spinosissima* (a); *Rubus fruticosus* (b).

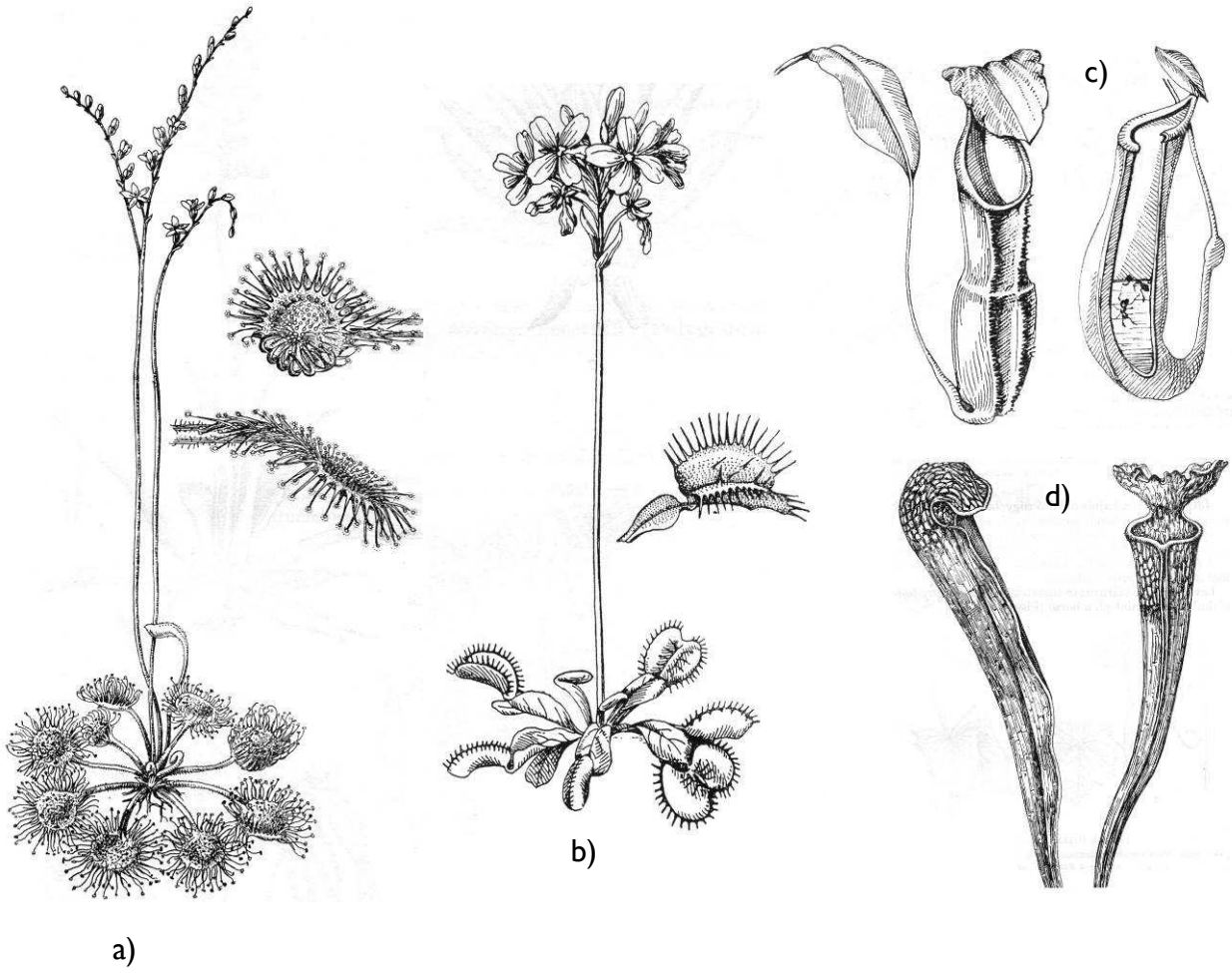


Figure 32. Insectivorous leaves. *Drosera rotundifolia* (a), *Dionæa muscipula* (b), *Nepenthes* sp. (c), *Sarracenia* sp. (d).

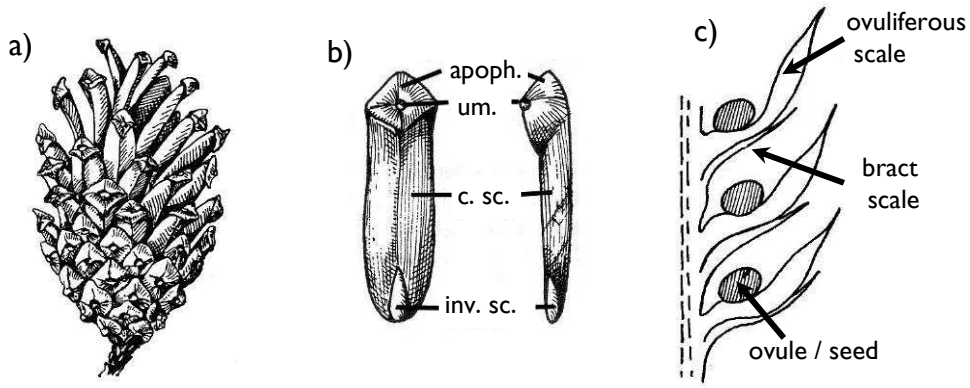


Figure 33. Gymnospermous cone. Habit of the cone (a), composition of the ovuliferous scale - (b) structure of the cone (c). [apoph.: apophysis, um.: umbo, c.sc.: cone scale, inv.sc.: involucral scale]

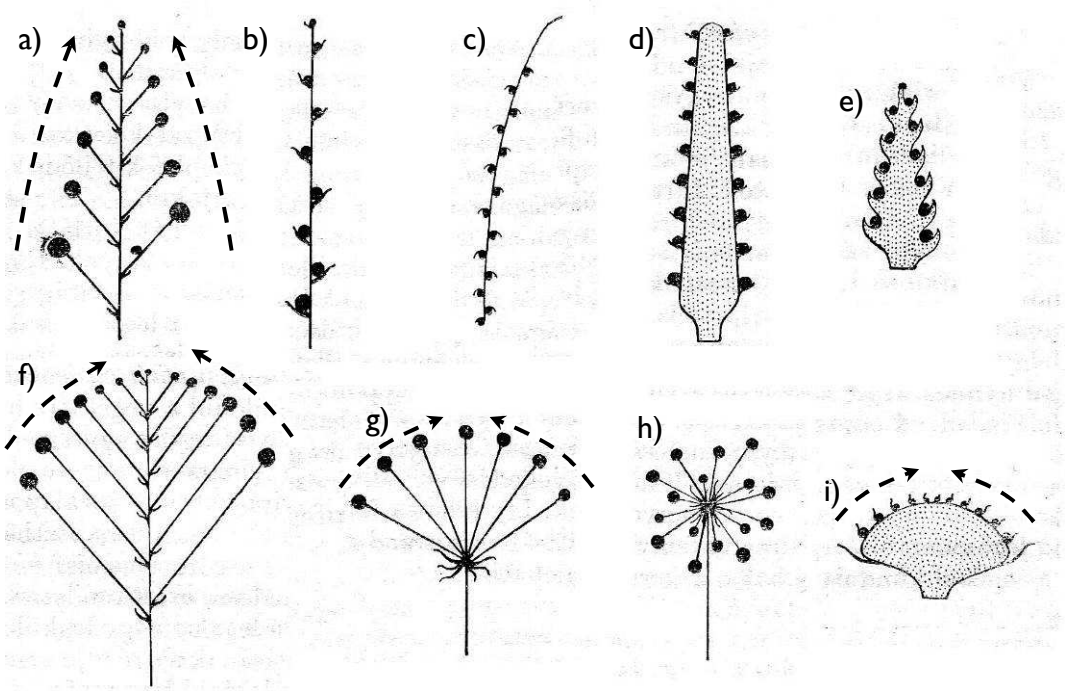


Figure 34. Racemose (indeterminate), simple inflorescences. Raceme (a), spike (b), catkin (c), spadix (d), cone-like spike (e), corymb (f), umbel (g), dense umbel („head") (h), capitulum / head (i). (Dashed arrows indicate the sequence of flowering.)

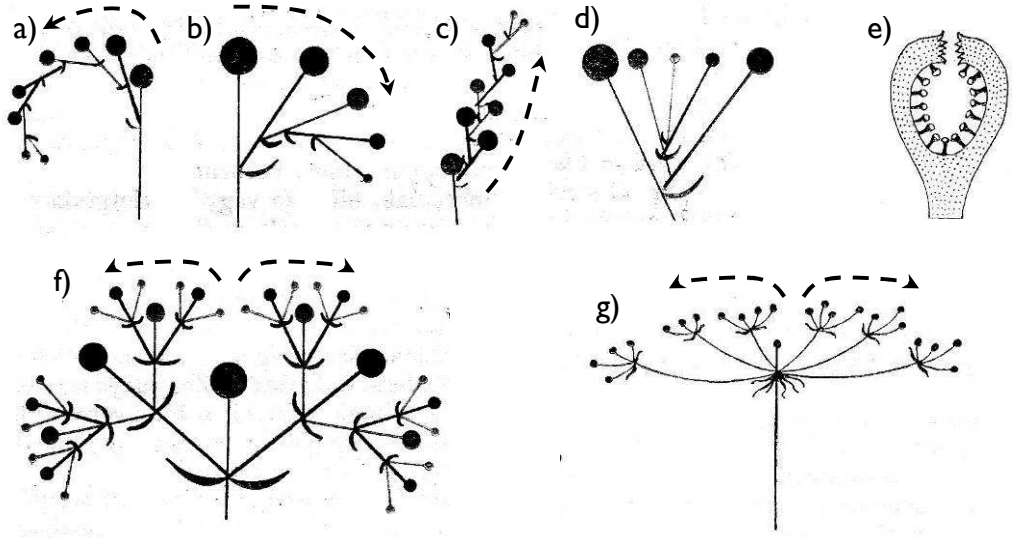


Figure 35. Cymose (determinate), simple inflorescneces. Uniparous (monochasial) cyme (a: helicoid (bostryx), b: rhipidium, c: scorpioid (cicinnus), d: drepanium); hypanthodium (e); biparious (dichasial) cyme (f); compund multiparous (polychasial) cyme (g). (Dashed arrows indicate the sequence of flowering.)

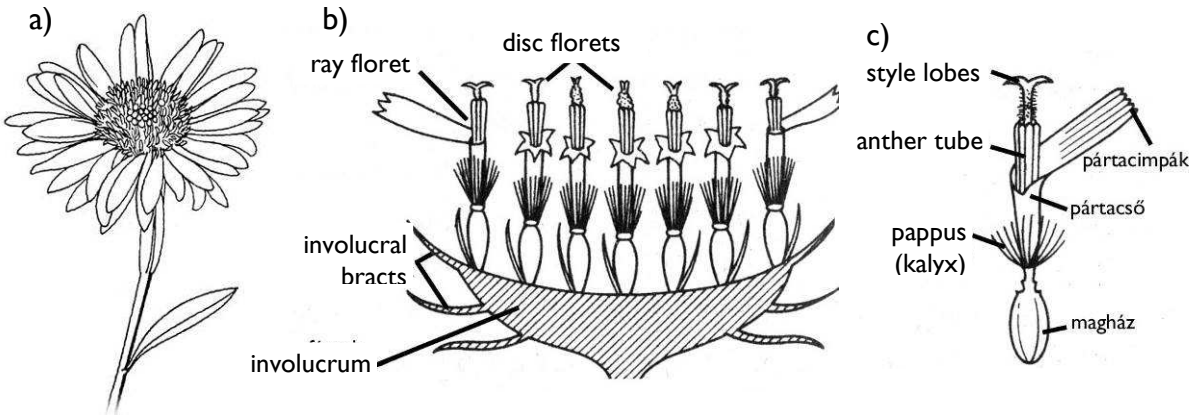


Figure 36. Structure of the capitulum. Capitulum (head) of *Aster amellus* (a), composition of the inflorescence [ray floret, disk floret, invloucral scale/bract, involucrum] (b), structure of a single ray floret (c).

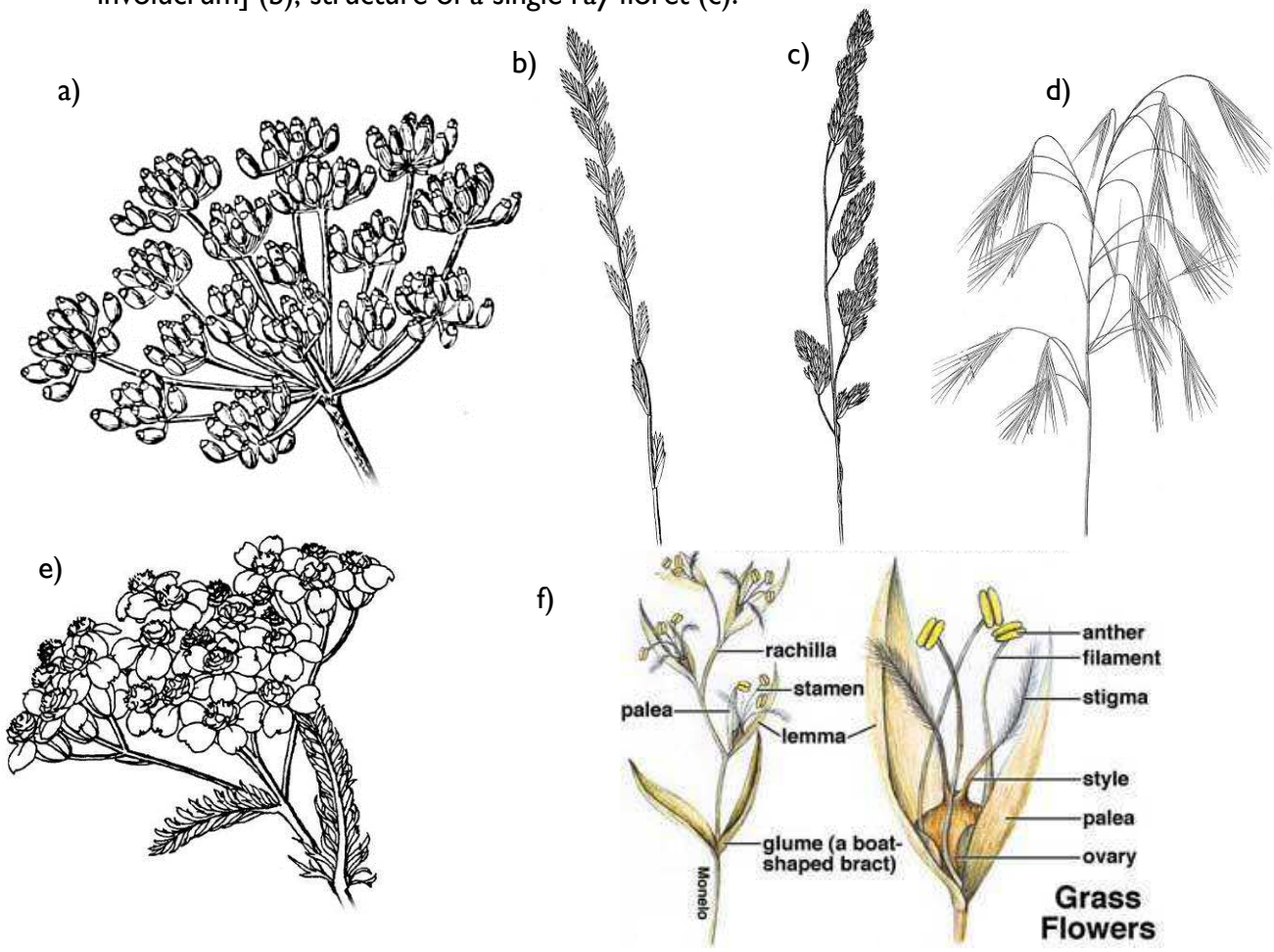


Figure 37. Compound inflorescences. a. compound umbel – *Anethum graveolens* b: „spike of spikelets" (simply *spike*) – *Lolium perenne*c, d: „raceme of spikelets" = panicle – c: *Dactylis glomerata*, d: *Bromus sterilis*; e: cormyb of heads – *Achillea millefolium*. Composition of the spikelets of grasses (f).

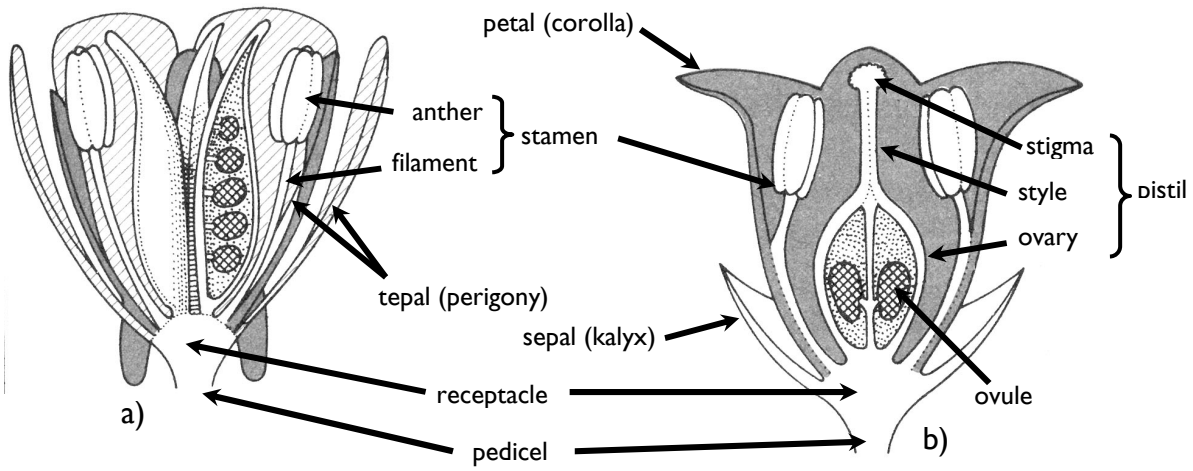


Figure 38. Composition of the flower. Homochlamydeous (a) and heterochlamydeous (b) flowers. [recepetacle = thalamus]

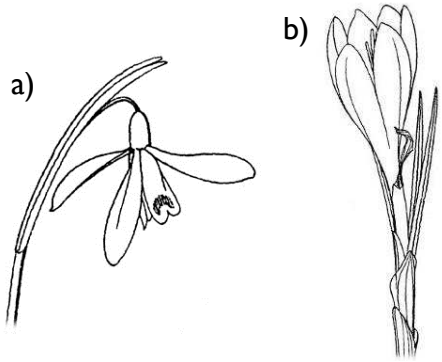


Figure 39. Perianth types. Homochlamydeous (a: *Galanthus*, b: *Crocus*) and heterochlamydeous (c: *Geranium*) flower.

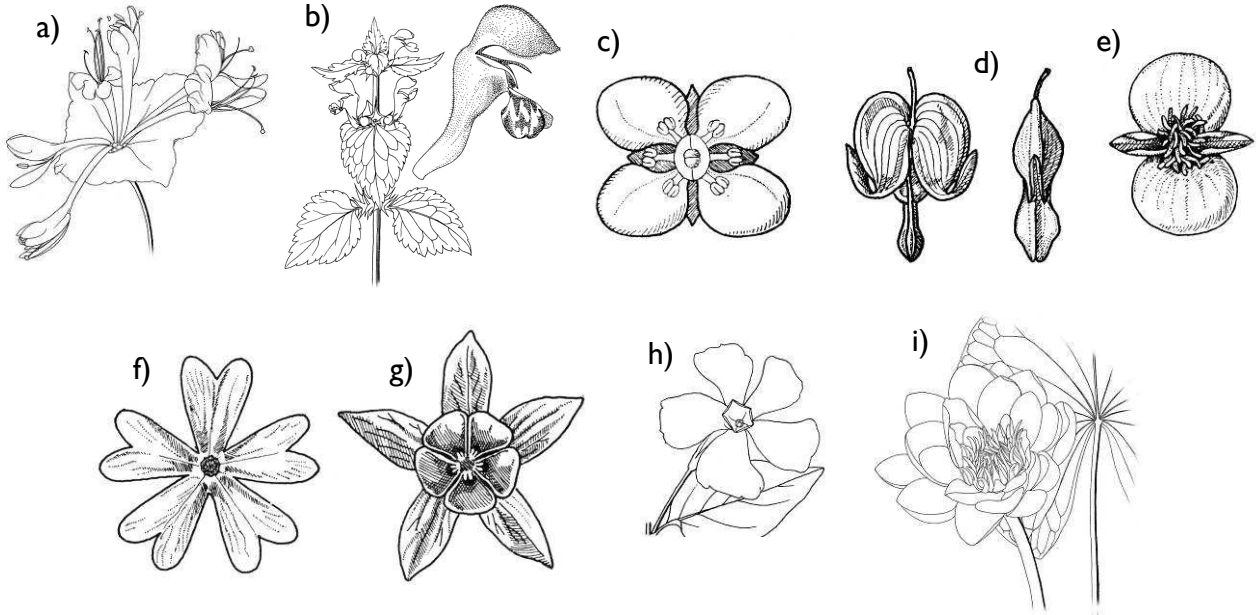


Figure 40. Types of floral symmetry. Zygomorphic / bilateral (a: *Lonicera*; b: *Lamium*), bisymmetric (c: cruciform flower; d: *Dicentra*; e: male flower of *Begonia*), actinomorphic / radial (f: *Primula*; g: *Aquilegia*), distorted actinomorphic (h: *Vinca*), spiral flower (i: *Nymphæa*).

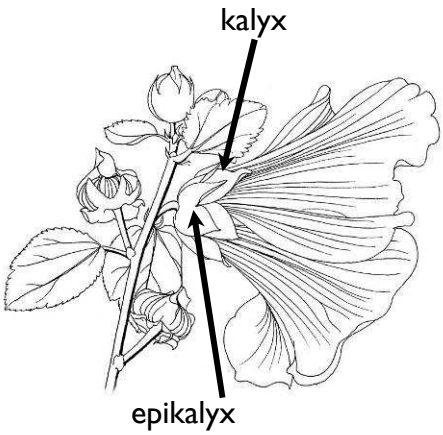


Figure 41. Epikalyx. (*Hibiscus syriacus*).

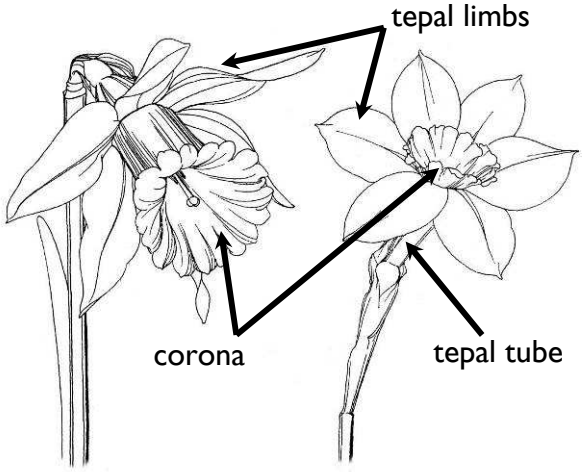


Figure 42. Fused tepals with corona. (*Narcissus* spp.).

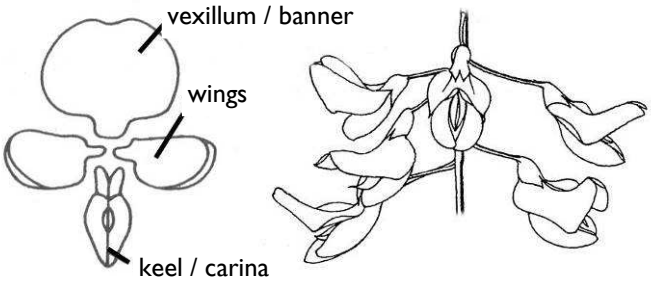


Figure 43. Structure of the papillionaceous flower. [vexillum/banner, wings, keel/carina]

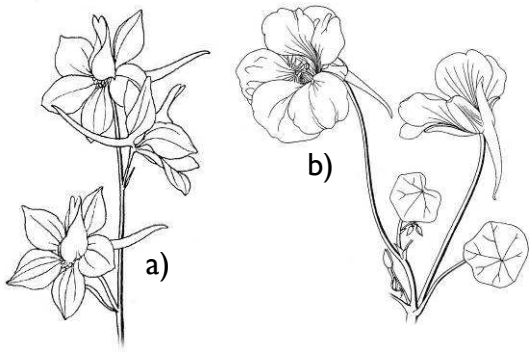


Figure 44. Corolla with spur (a: *Consolida*, b: *Trapæolus*).

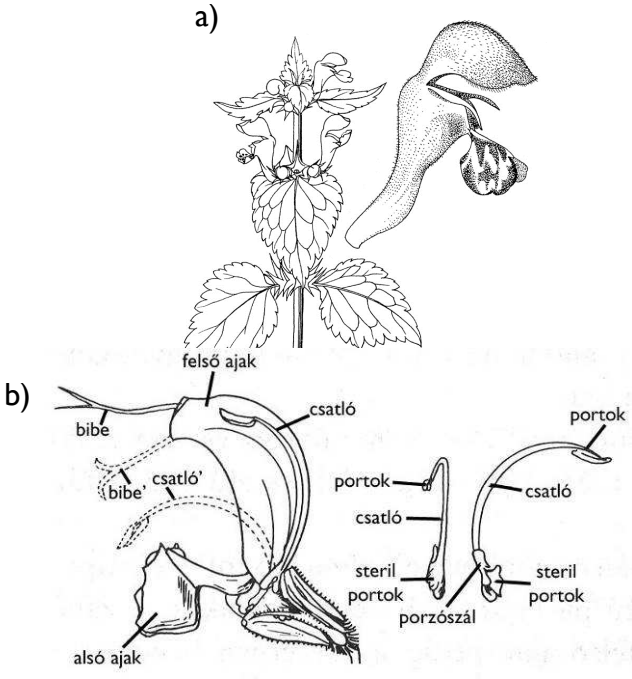


Figure 45. Structure of the bilabiate flower [upper/lower lip, corolla mouth]. (a: *Lamium*, b: *Salvia*).

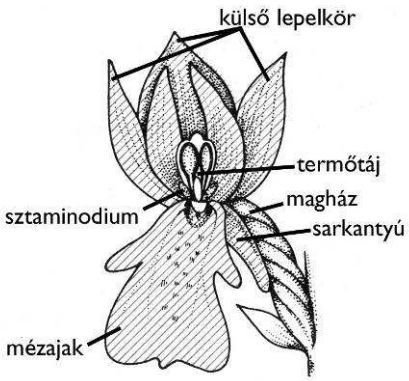


Figure 46. Structure of the orchid flower. (*Orchis*) [labellum, spur, staminode]

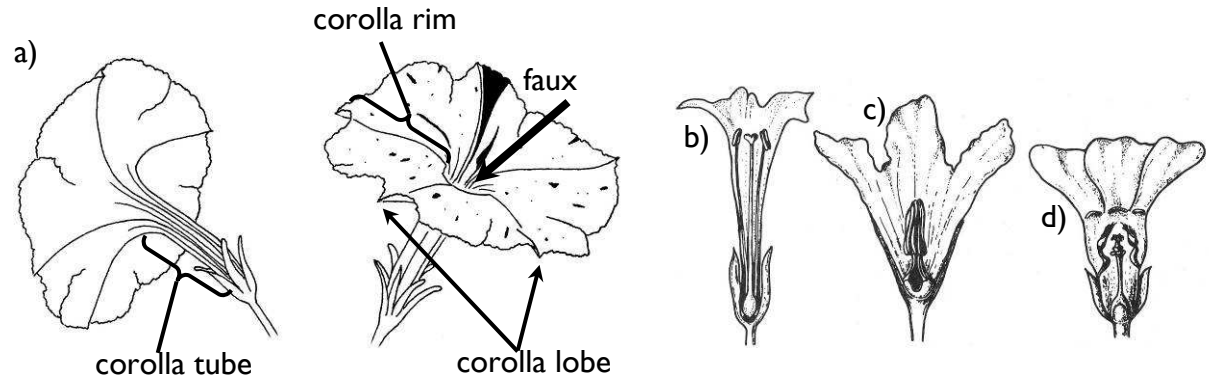


Figure 47. Fused corolla. Structure of the fused corolla (a: *Petunia* sp.), flowers with fused corolla (b: *Nicotiana tabacum*, c: *Cucurbita pepo,* d: *Vinca minor*).

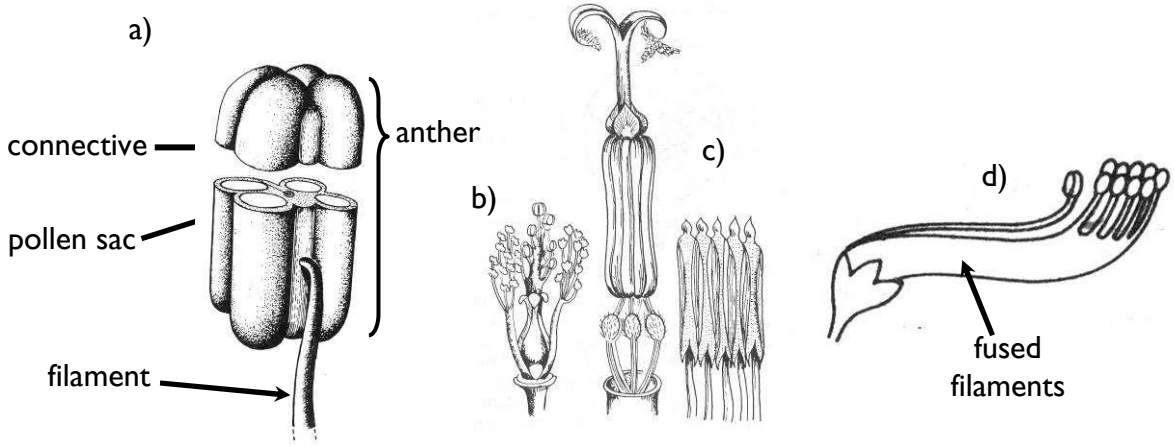


Figure 48. Androecium. Structure of the stamen (a), dichotmously branching filaments (b: *Ricinus*), synandrium (c: Asteraceæ), diadelphous androecium (d: Fabaceæ/Fabiodeæ).

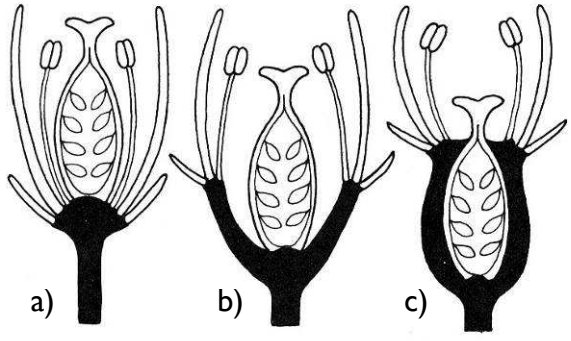


Figure 49. Position of the ovary. Superior ovary (hypogynous flower) (a), intermediate / half-inferior ovary (perigynous flower) (b) inferior ovary (epigynous flower) (c).

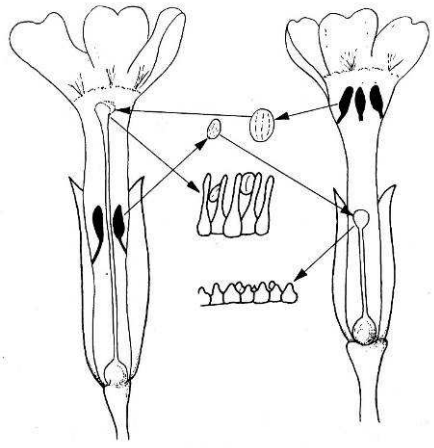


Figure 50. Heterosytly. (*Primula vulgaris*).

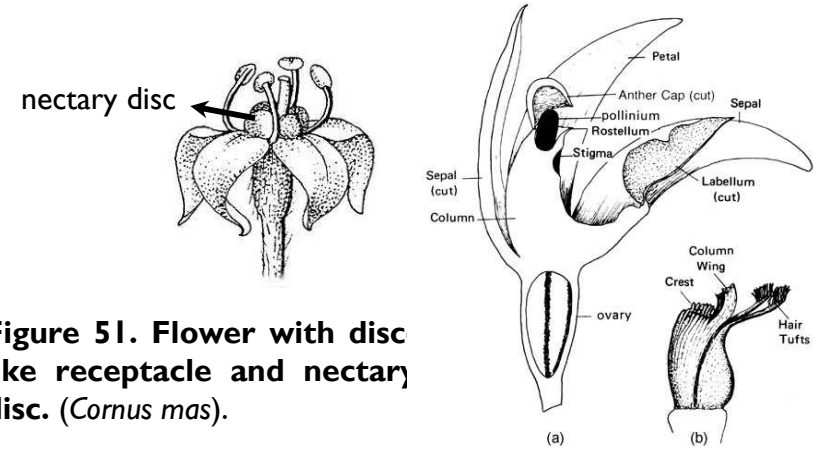


Figure 51. Flower with disc like receptacle and nectary disc. (*Cornus mas*).

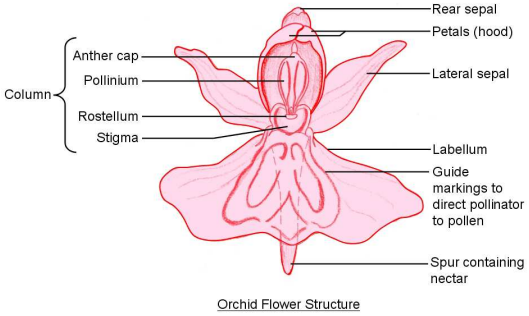


Figure 52. Structure of the column (gynostemium) and the pollinaries in the orchid flower.

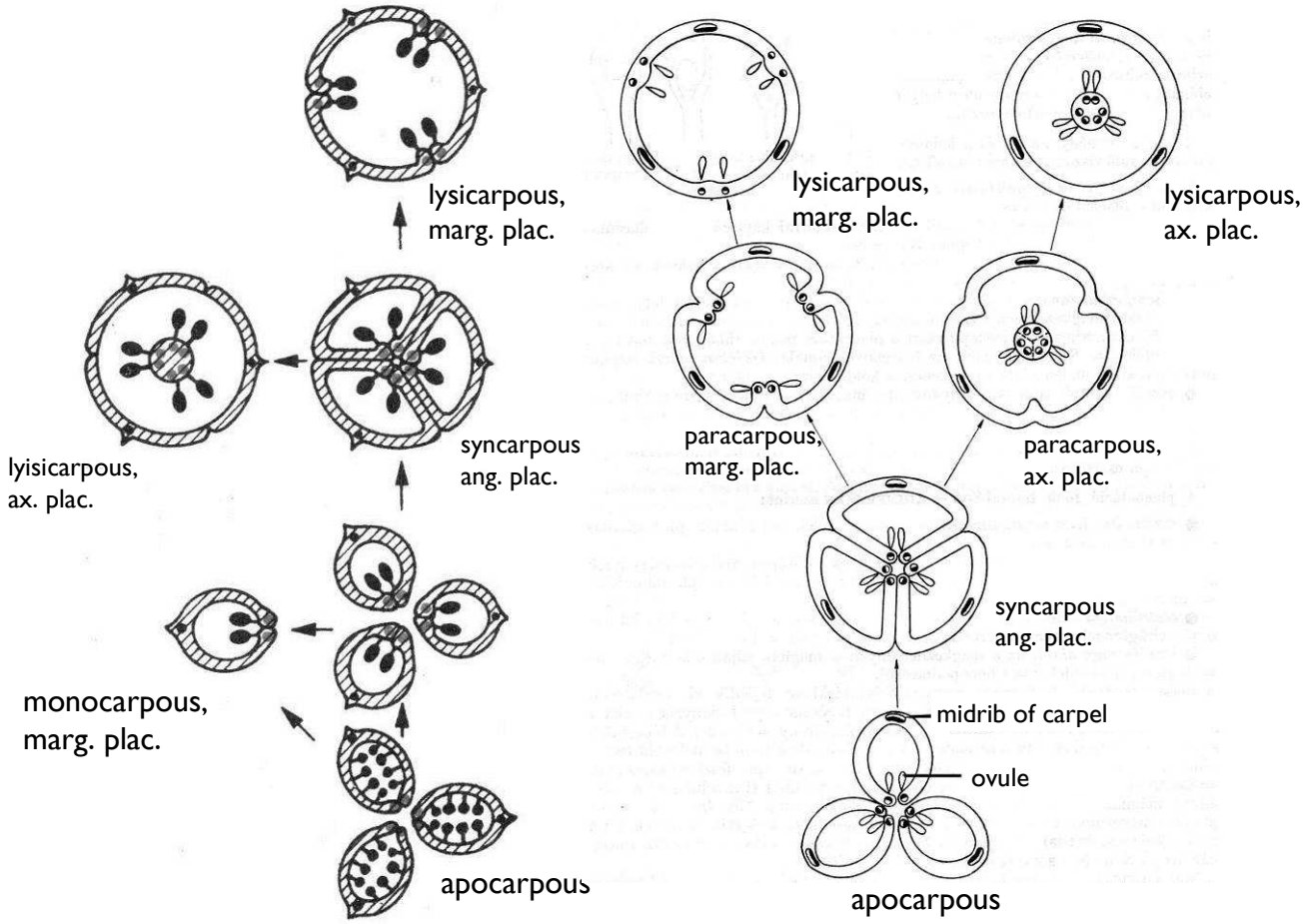


Figure 53. Evolutionary relationship between different types of gynostemia and placentation. (Marg. plac.: marginal placentation; ax. plac.: axile placentation; ang. plac.: angular placentation)

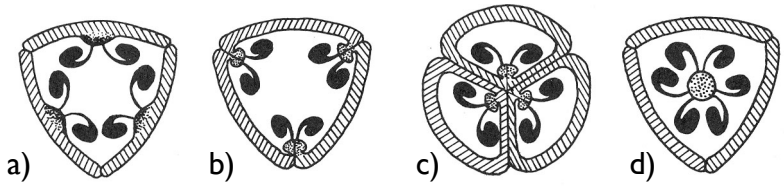


Figure 54. Types of placentation. Parietal (a); marginal (b); central-angular (c); central-axile (d).

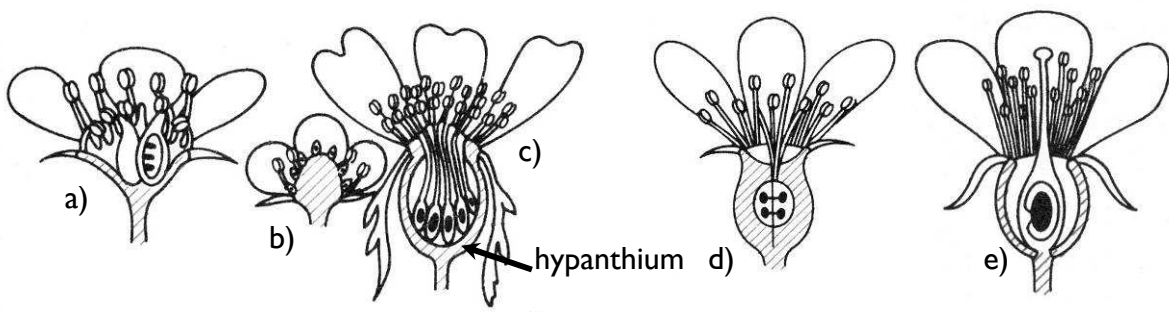


Figure 55. Gynoecium in the family Rosaceae. Apocarpic, superior (a: Spiroideæ); apocarpic, superior (b: Rosoideæ), apocarpic, inferior (c: Rosoideæ); apocarpic inferior (d: Maloideæ), monocarpic, half-inferior (e: Prunoideæ).

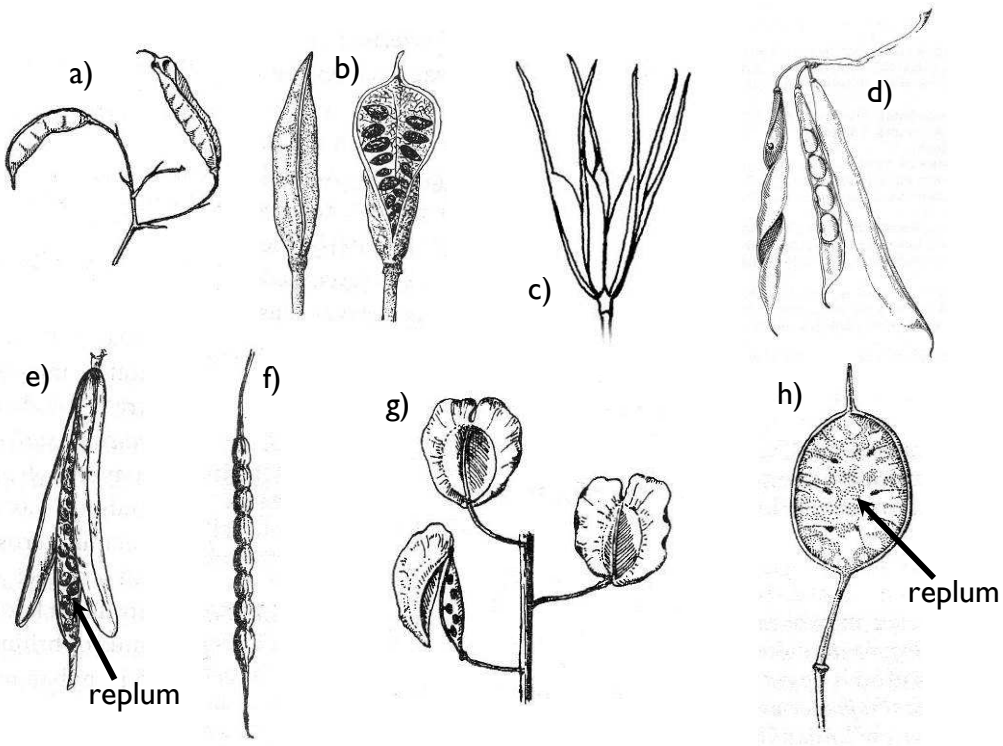


Figure 56. Simple, dry, dehiscent fruits I. Follicle (a, b: *Consolida*); Nigella-fruit / Nigella-capsule (Nigella-termés) (c: *Nigella*); legume (pods) (d: *Phaseolus*); siliqua (e: *Brassica*); beaked, segmented siliqua (f: *Raphanus*); silicula (g: *Thlaspi*, h: *Lunaria*).

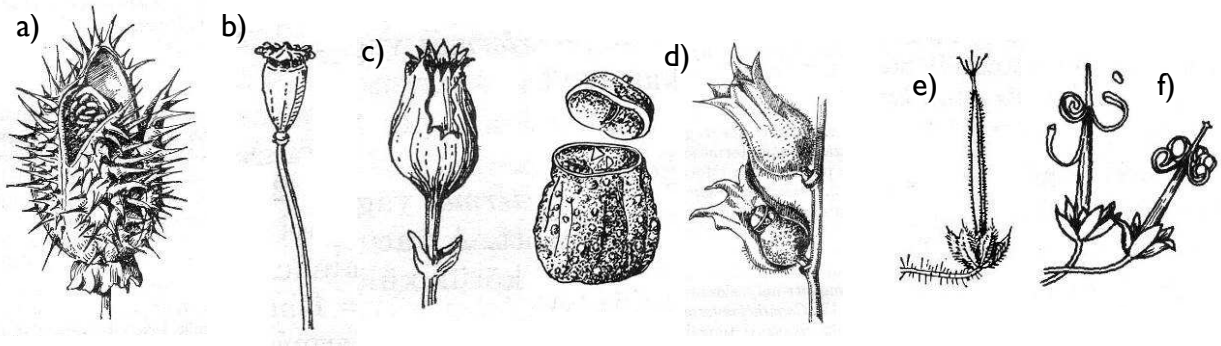


Figure 57. Simple, dry, dehiscent fruits II. Different typse of capsule. Septifragal capsule (a: *Datura*); poricidal (operculate) capsule (b: *Papaver*); denticidal / valvate (c: *Melandrium*); circumscyssile capsule / pyxis (d: *Hyosciamus*); cranesbill capsule (e-closed, f-open: *Geranium*).

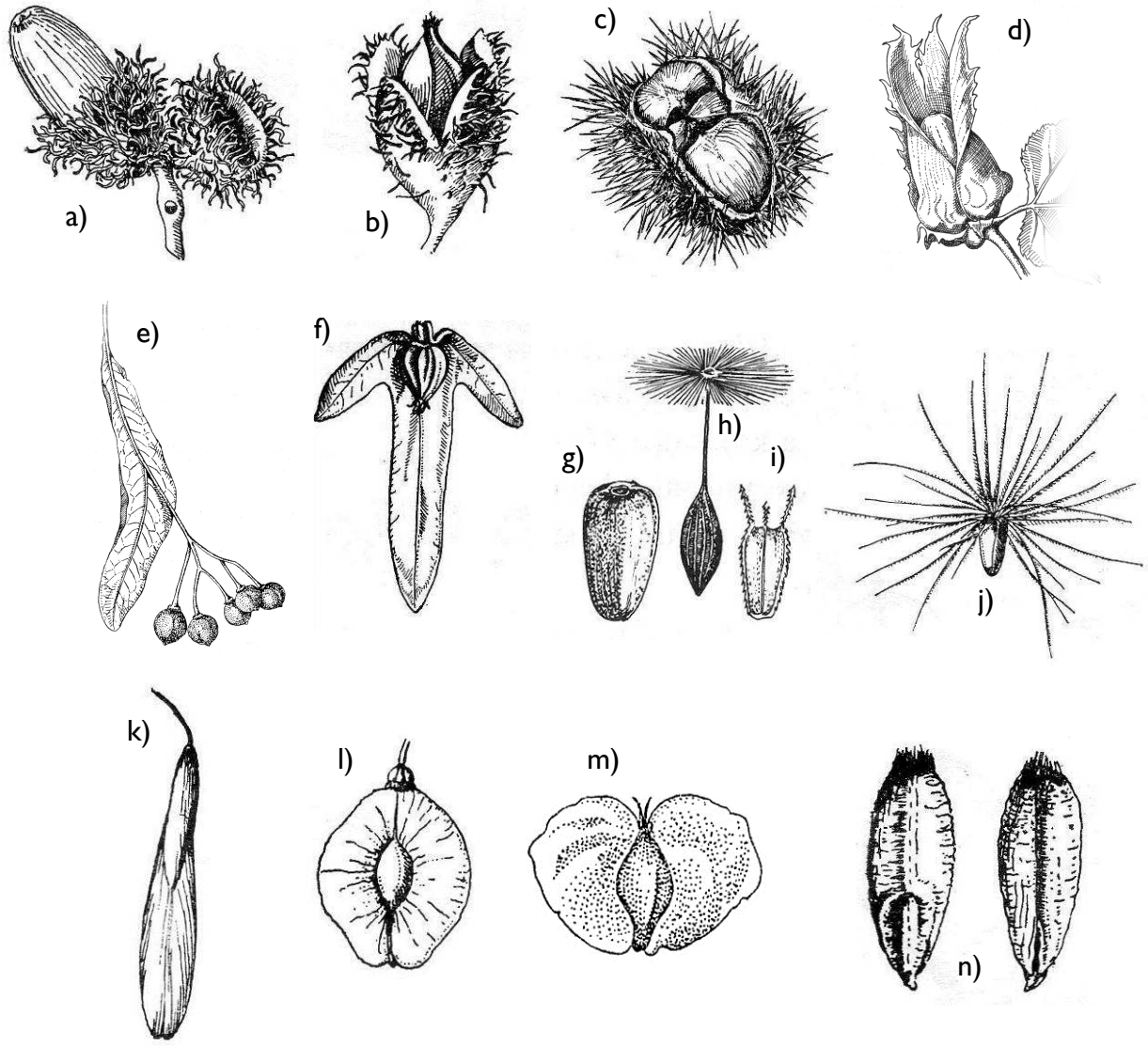


Figure 58. Simple, dry, indehiscent fruits. Different types of nuts. Nuts with cupule (a: *Quercus*, b: *Fagus*, c: *Castanea*), nut with involucre (d: *Corylus*, e: *Tilia*, f: *Carpinus*), cypsela (g: *Helianthus*, h: *Lactuca*, i: *Bidens*, j: *Cynara*; h,j: cypsela with pappus), samara (k: *Fraxinus*, l: *Ulmus*, m: *Betula*), caryopsis (n: *Secale*).

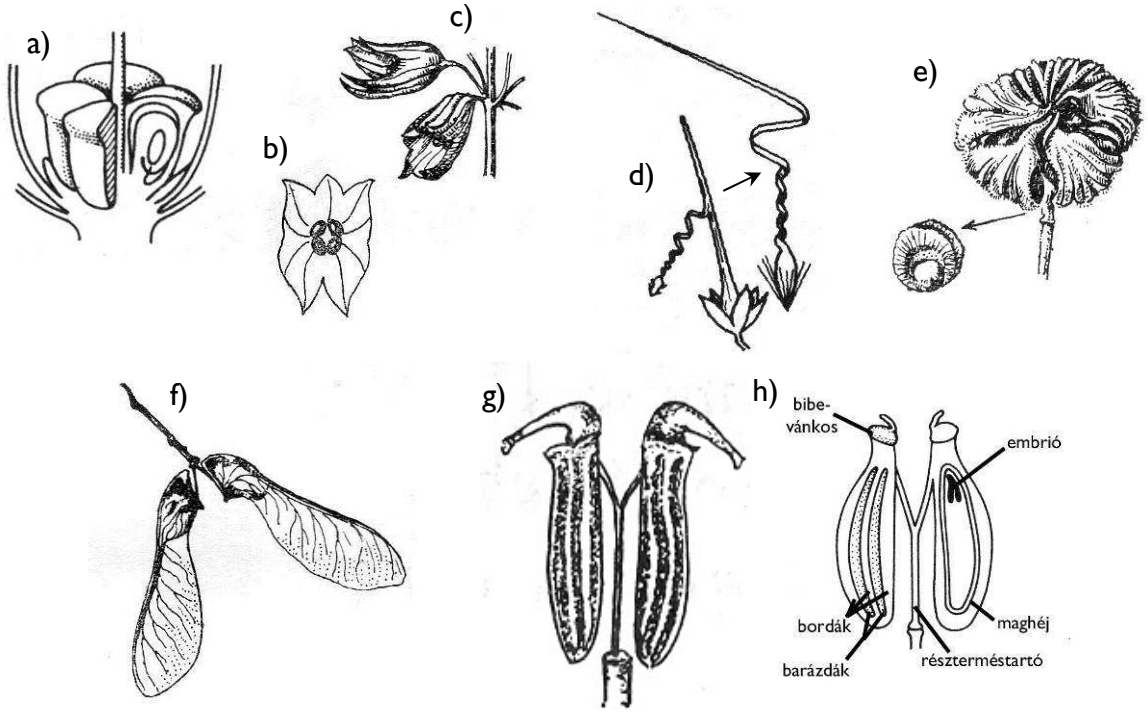


Figure 59. Simple, dry, schizocarpic fruits. Carcerulus / nutlets (a: habit of fruit, b: looking into the permanent calyx, c: side-view); regma (with five cocci; d: *Erodium*); nutlets of mallow (e: *Malva*); double samara (f: *Acer*); cremocarp (g: Apiaceæ, h: structure of cremocarp).

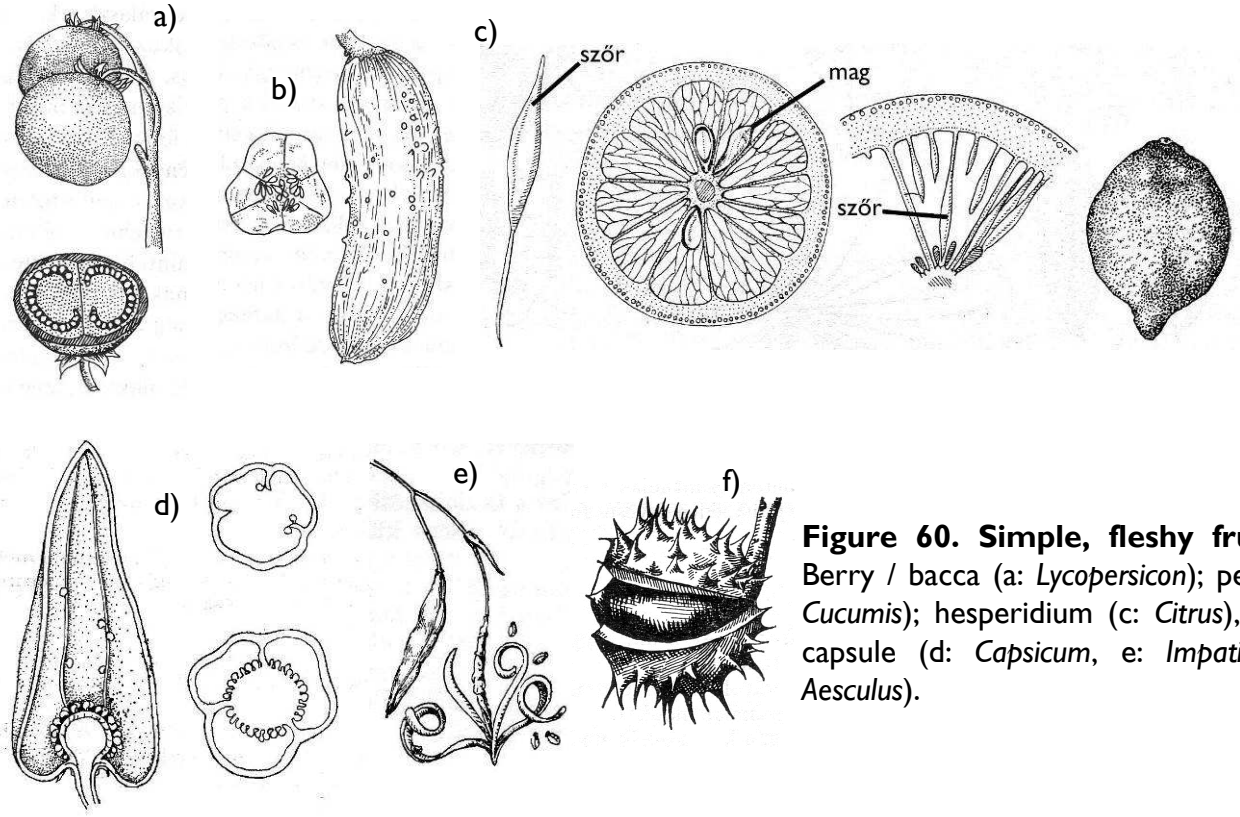


Figure 60. Simple, fleshy fruits I. Berry / bacca (a: *Lycopersicon*); pepo (b: *Cucumis*); hesperidium (c: *Citrus*), fleshy capsule (d: *Capsicum*, e: *Impatiens*, f: *Aesculus*).

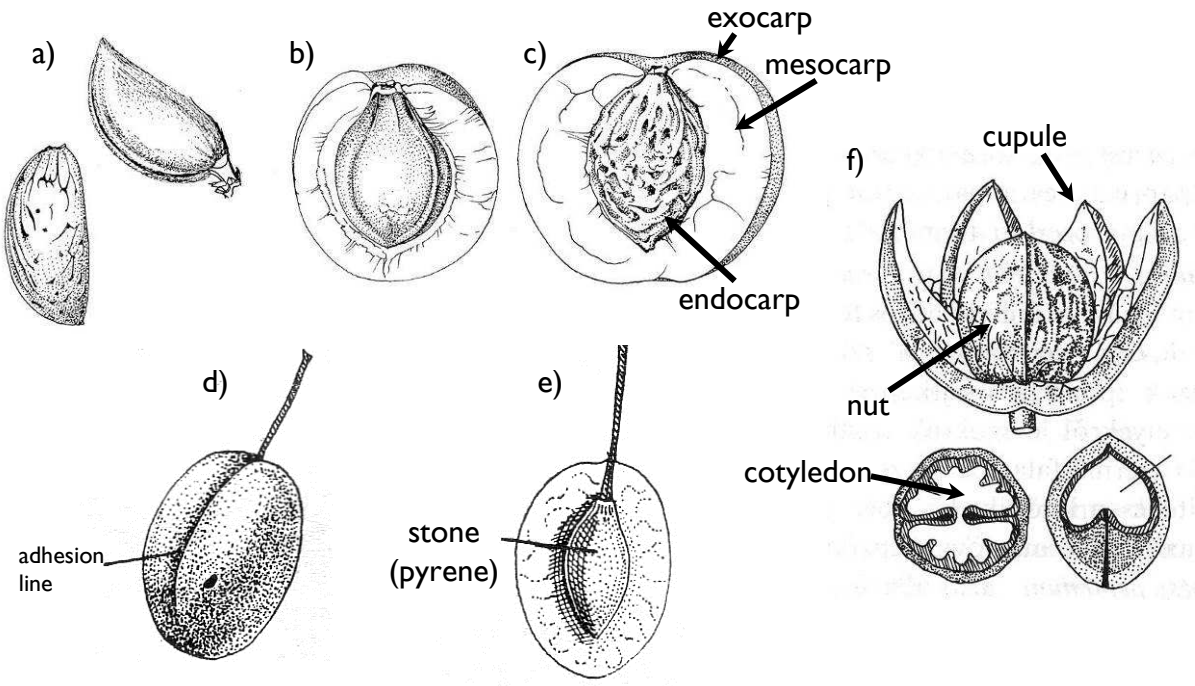


Figure 61. Simple, fleshy fruits II. Drupe (a: desiccating drupe – *Prunus dulcis*, b: *Prunus armeniaca*, c: *Prunus persica*. d,e: *Prunus domestica*); nut with closed cupule („wallnut fruit") (f: *Juglans regia*).

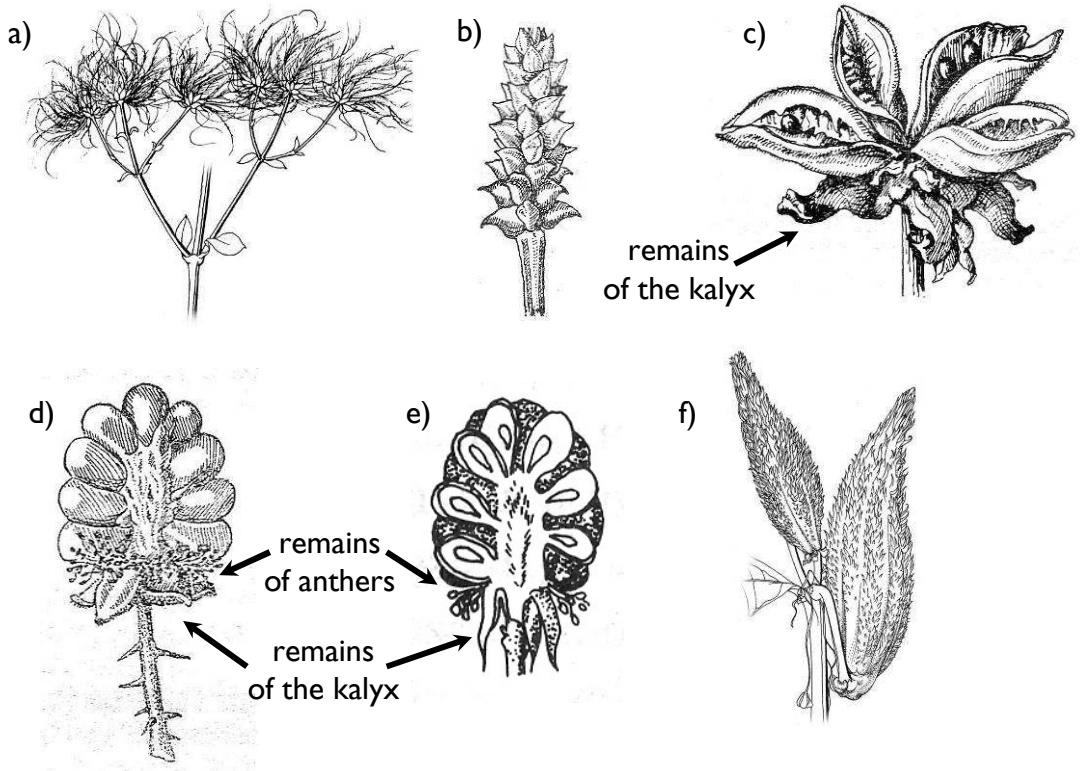


Figure 62. Aggregate fruits. etaerio of achenes (a: *Clematis*, b: *Adonis*), etaerio of follicles (c: *Pæonia*), etaerio of drupes (d,e: *Rubus*), twin follicles (f: *Asclepias syriaca*).

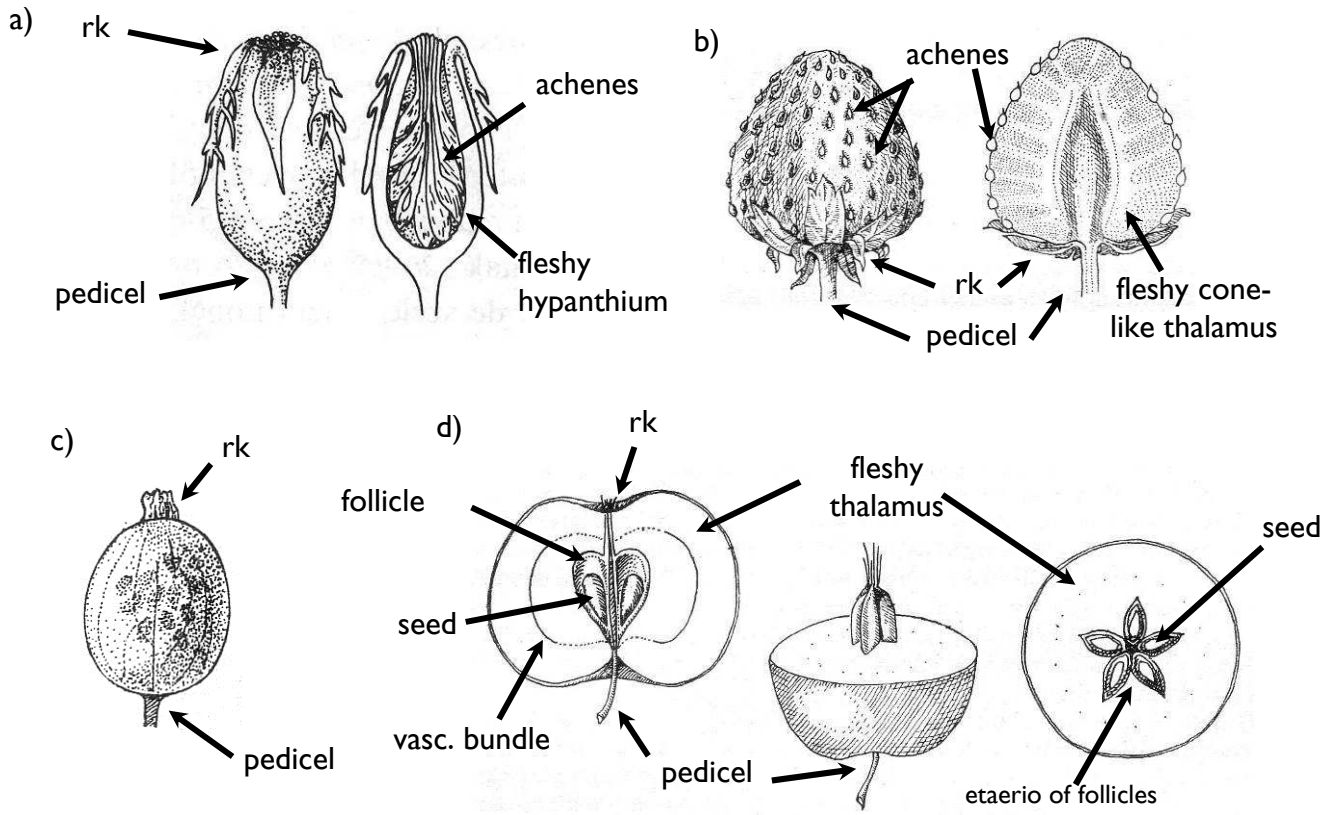


Figure 63. False fruits. Rosehip (a: *Rosa*), strawberry (b: *Fragaria*), false berry (c: *Ribes*), pome (f: *Malus*). (rk: remains of the kalyx)

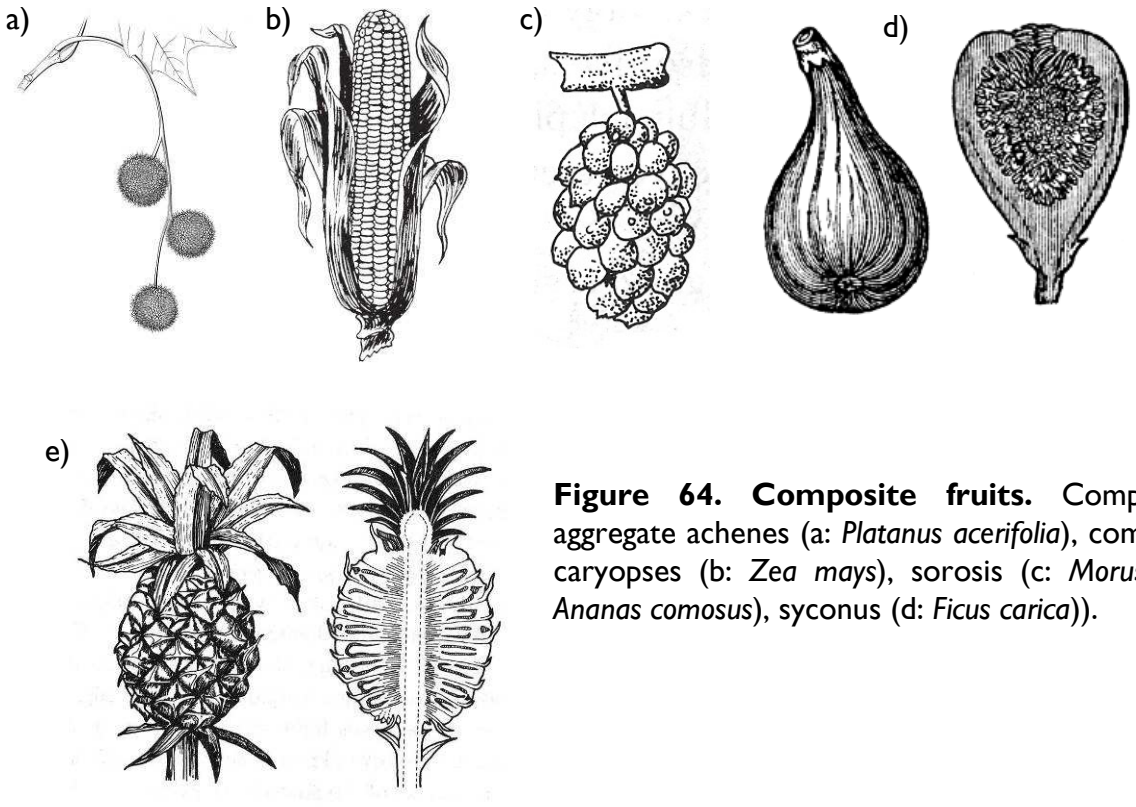


Figure 64. Composite fruits. Composite of aggregate achenes (a: *Platanus acerifolia*), composite of caryopses (b: *Zea mays*), sorosis (c: *Morus alba,* e: *Ananas comosus*), syconus (d: *Ficus carica*)).