Aotearoa New Zealand Pteridophyte (Fern & Lycophyte) Glossary

A CONTRIBUTION TO THE COMMONWEALTH OF KNOWLEDGE ABOUT OUR NATURAL WORLD

Tmesipteris tannensis **chain fern growing epiphytically on a tree fern trunk**
Leith Saddle Track, Dunedin, New Zealand

Version 1: 2022

NEW ZEALAND /AOTEAROA PTERIDOPHYTE (FERN & LYCOPHYTE) GLOSSARY

GLOSSARY WITH EXPLANATORY NOTES.

Compiled and composed by Iain C. Reid

In memory of Vale John Sawyer (1968 – 2015) founder of the New Zealand Plant Conservation Network (www.nzpcn.org.nz) also the late Finn Bruce, driving force behind establishment of a filmy fern house at the Margie Maddren Fernery and Snow Conservatory (Botanica), Whangarei, Northland, New Zealand, I had the pleasure of searching for 'filmies' upon Maungatapere crater with him, many years ago.

This glossary has been compiled and composed to provide a definition of terms encountered by people studying ferns and the so called fern allies (the lycophytes) and too briefly give their derivation or etymology The latter is sometimes helpful in understanding the first and a whole family of related words. Some of the terms relate to the morphology or anatomy of ferns and fern allies. Other terms relate to the life cycle, ecology, biogeography or taxonomy. Sometimes the derivation is a bit quirky by today's standards, words such as parenchyma, unless you know the history I have aimed for two slightly conflicting goals: one to keep things simple and two: to be comprehensive – like a one stop shop; even though there are a plethora of botanical terms or "jargon" relating to the ferns and fern allies, botany in general. Many are synonyms (often a Greek and Latin version), some terms are archaic or obsolete, so select the ones you like. A favourite mouthful is achloromycoheterotrophic – this is a word you can use to impress people at parties with. There will no doubt be some terms not included, or missed which could be included in future versions. Some of the terms are included to complete a set of related terms and may not be directly fern related or applicable to New Zealand ferns or clubmosses.. Note the appearance of combining forms such as *ptero*-, *morph*,*-ferous*, *-colous*,*-phyll, -phyte, -phore*, *spore* etc. A word in bold indicates it is defined in the glossary.

It does not matter whether you used a technical term like sporangium or its less technical equivalent spore case, leaflet, frondlet or pinna provided you and your audience know what is being referred to. As logician Alfred Korzybski said "the map is not the territory, and the name is not the thing named". Remember as Gregory Bateson quoted in 'Mind and Nature' said " all information is news of difference", that is ideas are constructs from perceived differences, so we can note the difference between pinnate and bipinnate, megasporangium and microsporangium for instance. If we want to identify a fern or any plant we look for what is distinctive or 'different' about it. Note also the constant relationships between things, such as sporangia and sporophylls. Magnification through hand lens or microscopes may be required to see some features.

I cannot clain originality for the definitions – I have harvested them from multiple sources tweaking them where needed to suit my understanding. I had not initially intended to add illustrations, I am no botanical artist, in fact have zero artistic ability, but illustrations are invaluable for conveying ideas that definitions are inadequate for. I take my hat off to the botanical illustrators of the present and past. I have taken the liberty of adapting illustrations where appropriate. Some will best be replaced, but will suffice in the meantime. All the best with your fern (and lycophyte) studies. I take full responsibility for any errors made.

Information about fern and lycophyte species in New Zealand and etymology of generic and specific names are to found at the New Zealand Plant Conservation Network website https://www.nzpcn.org.nz/ and the Landcare Research New Zealand- site https://www.nzflora.info/publications.html. Appendix 1 is a checklist of New Zealand Ferns and Lycophytes. The most up to date and still available reference book is Brownsey's, although 20+ years old and a few newly described species and recently found to be naturalized species are missed.

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Acknowledgements:

The Reid/McNeur and Sinclair family of Dunedin (Robyn, Nicholas, Victoria, Brendan and Lyla).

Content

Abbreviations used: L. Latin; Gr. Greek; pl. plural; f. from (derived from); + plus (combined with), spp. species (plural) sp. species (singular) ± approximately, Ma. million years ago, c. circa.

GLOSSARY

ab- (L. prefix *ab*- away from) from or out of (antonym **ad-**)

abaxial (L. prefix *ab*- away from + *axis* , axle, pivot) The side or surface of an organ (e.g. leaf), facing away from the axis (e.g. stem or midrib (rachis)) such as the undersurface (**dorsal** surface) of a frond. Compare **adaxial**.

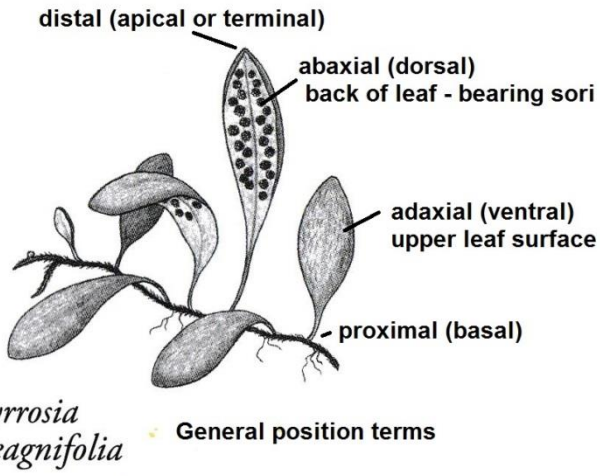


Diagram from "Plant Life on Banks Peninsula' 2013.
Hugh D. Wilson (author and artist). Manuka Press

***Zealandia* (*Microsorum*) *pustulata* subsp. *pustulata* showing fronds from adaxial (upper leaf surface) and abaxial (lower leaf surface -bearing sori) aspect**
Leith Saddle Track, Dunedin (photo Iain Reid)

Figure 1 abaxial adaxial

abbreviated (L. *ab*- from, + *brevis* shorten) Shortened.

aberrant (L**.** *aberro*, go astray; err, f. *ab* + *erro*, to wander) Unusual or not typical, differing from the normal form. Abnormal.

abortive (L. *abortio*, miscarriage, abortion) Barren or imperfectly developed, infertile; applied to spores incapable of germination as is common in the spores of hybrid ferns due to chromosomal incompatibily. Also in the production of megaspores of the four meiospores produced 3 are aborted leaving one as the megaspore.

abrupt (L. *abruptus*, broken off), Changing suddenly not gradually.

abruptly pinnate (abrupt + pinnate) Where a pinnate leaf is without a odd or terminal leaflet, ending instead in a pair of leaflets. Same as **even-pinnate** or **paripinnate**. Compare **odd-pinnate**, **imparipinnate**.

abscise (L. *abscissus* cut off) Shedding of plant parts such as fronds from stipe bases or pinnae from rachises often at a special separation layer either naturally from old age or prematurely from stress. **abscission** feature of deciduous plants.

acaulescent: (L prefix *a*- without *caulex* , stem) Appearing as though without a stem or trunk. Stem abbreviated, short or compact,internodes minimal, maybe partially underground - but not actually absent. Leaves close set.. **Basal/radica**l plants can be so described. Compare: **caulescent** and **acrocaulis**.

accessory (accessory f. L. *accedere*, *accessum*, to go near) In fern anatomy, a stellar perforation not linked to frond insertion.

accessory buds (accessory f. L. *accedere*, *accessum*, to go near + bud (Middle. English *budde*) Also known as lateral buds, buds that develop in leaf axils on the rhizome.

-aceae Suffix denoting the rank of **family** in the taxonomic hierarchy e.g. Aspleniaceae (spleenwort family), Dryopteridacea (wood fern family), Lycopodiaceae (club moss family.).

achloromycoheterotrophic (Gr. *a*- without + *chloro*- abbreviation of chlorophyll + *myco* fungus + heterotroph) or simply **mycoheterotroph**. Plants or plant stages (e.g. gametophytes) that lack chlorophyll and are unable to photosynthesize but instead depend on a mycorrhizal fungus for nourishment. Synonym **saprotroph, holosaprophyte**. Compare **autotroph**. See **mycorrhiza**.

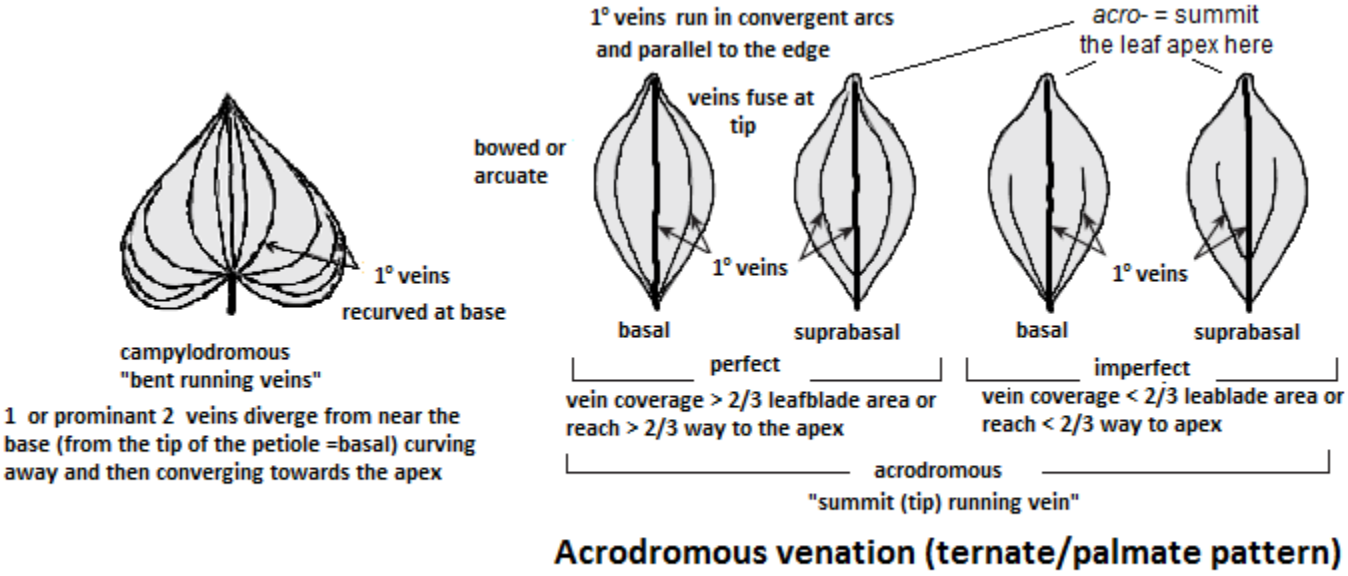
acicular (L. diminutive of *acus* needle) Needle-shaped, very narrow and sharp-tipped; said of hairs or conifer leaves, such as pine needles.

acidophil/acidophile (L. *acid*, sour,sharp + Gr. *phile*, loving) Preferring to grow in an acidic habitat. Synonym **oxylophil**. Similar to **calcifuge** and **calciphobe** (lime-hating). Antonym: **basophil**.

acostate/ecostate (Gr. *a*-, or e- ,without, *costa*, rib) Lacking a midrib or costa. Synonyms **enervate** and **nullinervate**. Opposite of **costate**.

acrocaulis (Gr. . *acro*- summit, topmost,+ *kaulos*, a plant stem) With leaves positioned at the apex of the stem as in tree ferns, the nikau palm or cabbage tree. Hence **acrocaulescent**. Compare **Cauline** with leaves positioned along the length of the stem and **basal/radical** or **acaulescent** with leaves positioned at the base of a stem, near the ground as in a rosette type plant.

acrodromous (Gr. . *acro*- summit + *dromos*, running, racecourse) When two or more primary veins or prominent secondary veins run in convergent arches towards the leaf apex. The arches are not recurved at the base as in campylodromous. If the veins reach the apex or close to it are termed **perfect**, if they fail to reach or get close to the apex are termed **imperfect**. If these veins run from the base are termed **basal** and **suprabasal** if the veins diverge from above the base.



Adapted from "Plant Systematics' 2010. Michael G. Simpson.
Academic Press (Elsevier)

Figure 2 acrodromous venation

acrogens (Gr. . *acro*- summit, topmost,+*gens*- f. *genos* , birth) A fern or other nonflowering plant, with growth from the apex of the plant. (see **cryptogam**)

acrophore (Gr. . *acro*- summit, topmost,+ *phore* f. Gr. *phorus*, bearing, carrying) Tip bearing- Apical stalk.

acrophyll: (Gr. . *acro*- summit, topmost, + *-phyll* f. *phullon* , a leaf.) A mature or adult frond of a climbing fern, differing from the mature leaves (bathyphylls), lower down the plant. New Zealand examples *Rumohra adiantiformis, Blechnum filiforme.* See **bathyphyll**.

Figure 3 acrophyll

acroscopic: (Gr. . *acro*- summit, topmost, + scopic f. Gr. *skopein* to look at) Located or directed towards the tip (apex) of a frond, pinna or any organ on which its borne. Compare **basiscopic**.

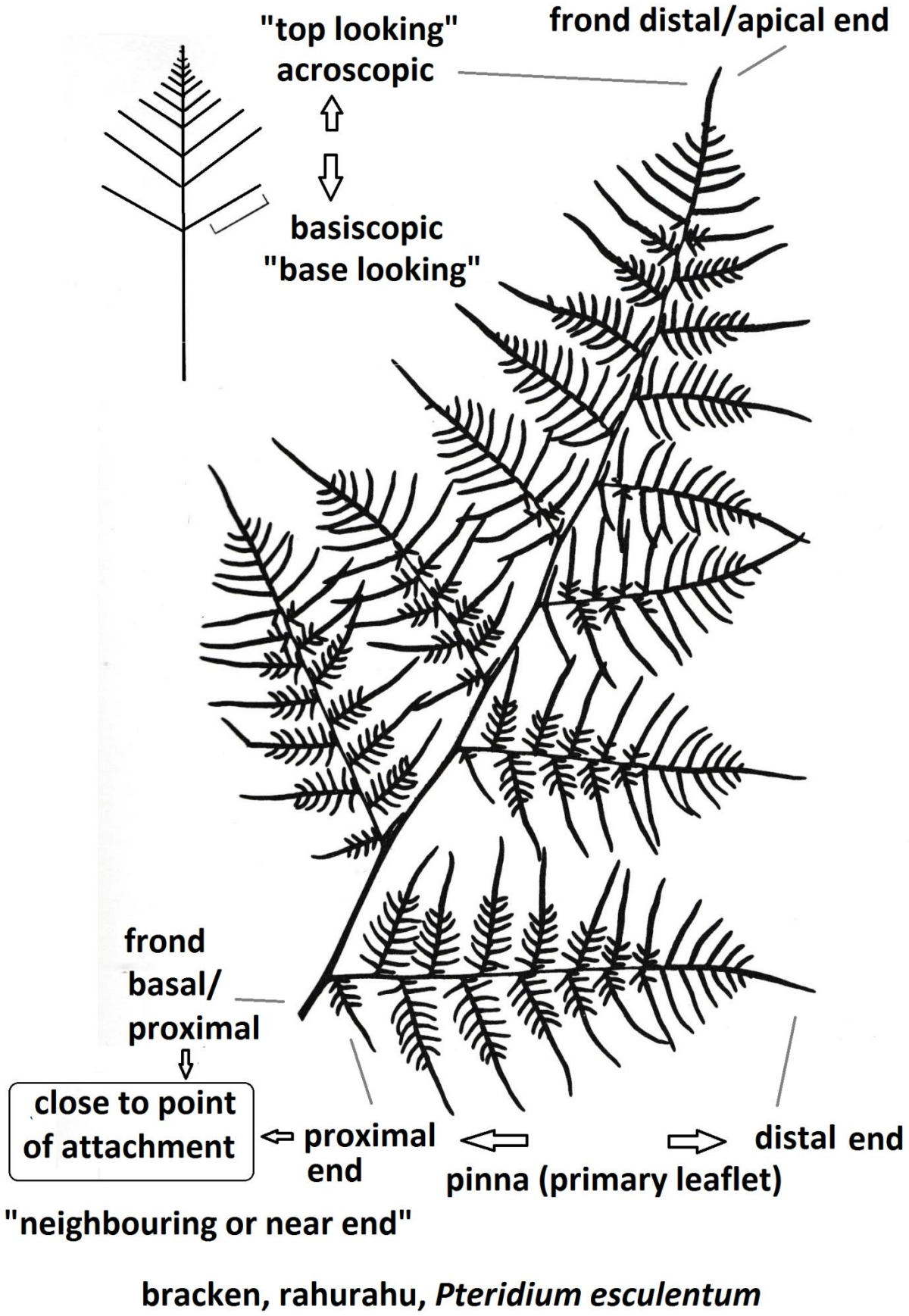


Figure 4 acroscopic

acrostichoid: (Gr. . *acro-* summit, topmost, furthest +. *stichos*, line, row, rank; the fern genus *Acrostichium* + *-oid*, resembling) Sporangia not in discrete sori, lines or dots but, singly placed, though crowded and

scattered throughout the underside of the frond,e.g. *Leptopteris* spp. or lower pinnae of *Todea barbara* family Osmundaceae. Also lacks indusia so is exindusiate or naked..

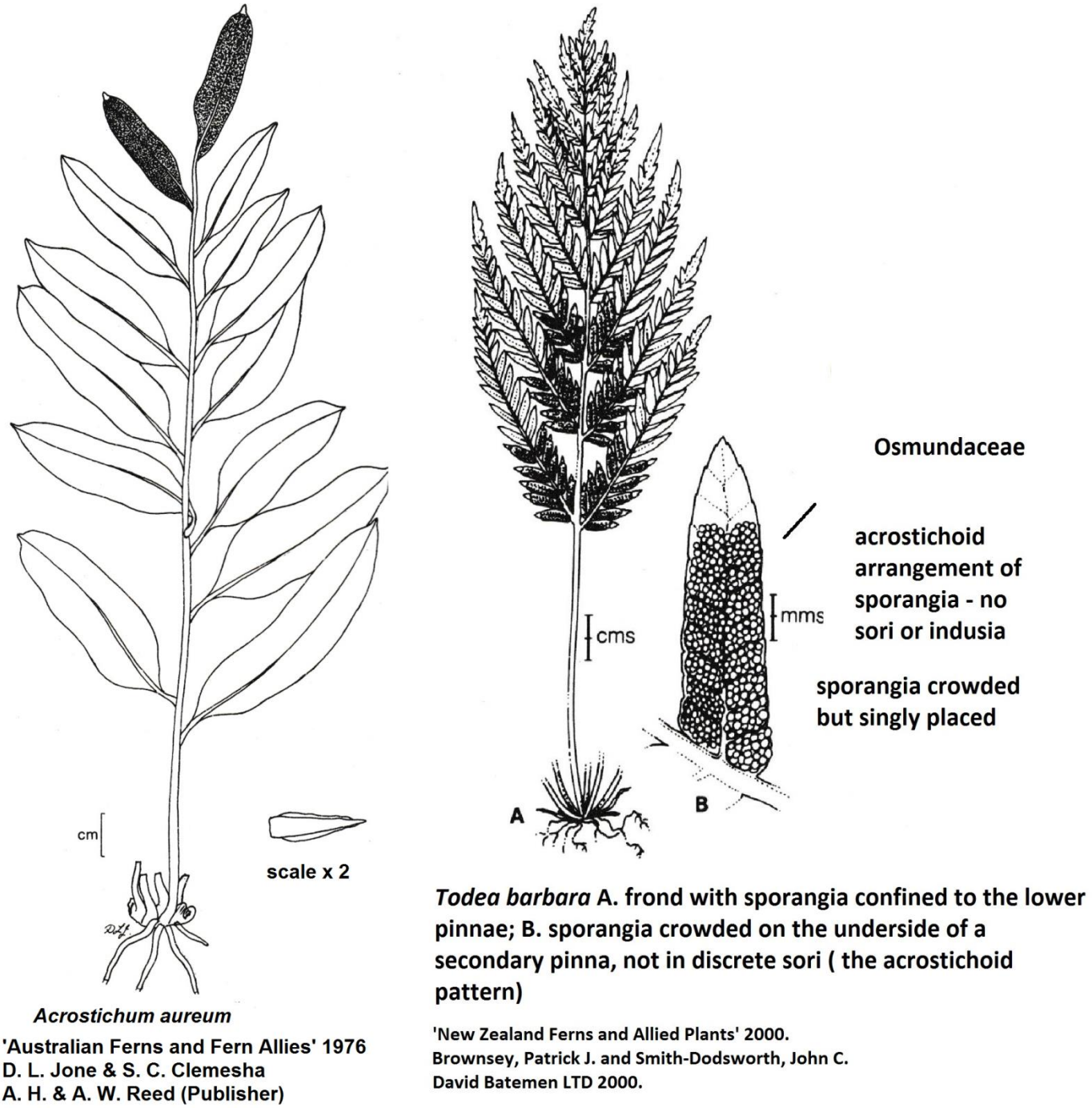


Figure 5 acrostichoid

actinodromous (Gr*. actino-* f. *aktis* ray + *dromos*, running, raceway) Leaf venation of the palmate or ternate pattern where three or more primary veins originate at the base of the lamina and run towards the margin. If the veins reach the margin –marginal, if not reticulate and flabellate- fan pattern where three or more primary veins diverge from one point and then branch finely towards the leaf apex.

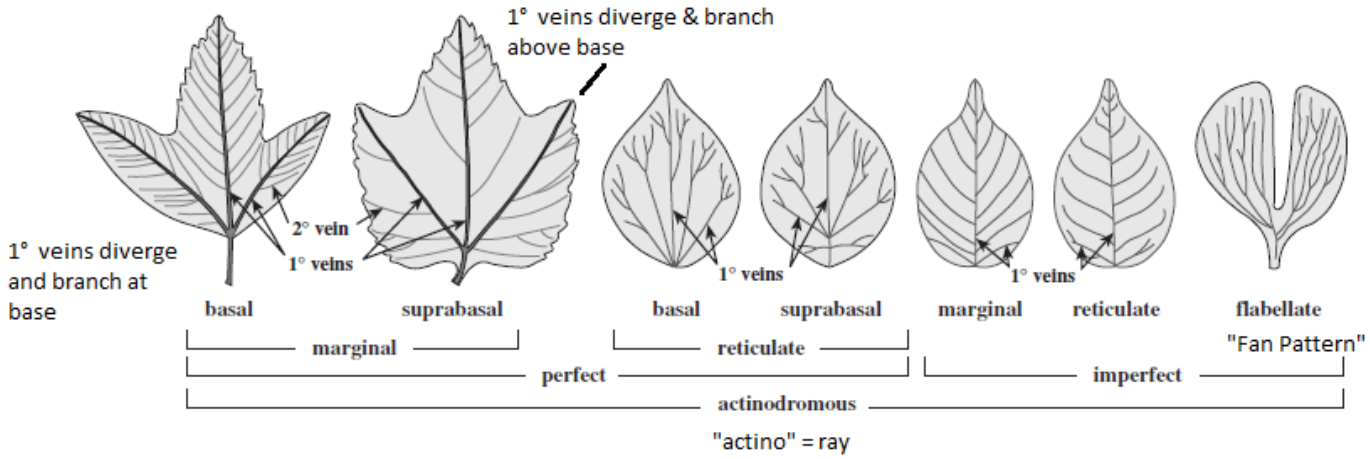


Figure 6 actinodromous venation

actinostelic (Gr. *actino-* f. *aktis* ray + stele f. *stele* pillar) Vascular architecture where the vascular strand has radiating arms (rays). A type of **protostele** (central vascular cylinder, no pith) found for example in *Lycopodium* spp. . Figure 208

aculeate (L. *aculeatus* prickly, *aculeus* a prickle) Armed with prickles.

acuminate (L. *acumen* a sharp point) Gradually tapering to a narrow sharp tip with slightly concave margins. Compare with **acute** which has straight margins.

acute: (L. *acutus* a sharp angle) Tapering with nearly straight margins (compare **acuminate**) to a point with an angle less than 90°.

acute-angled (L. *acutangulus*) Having projecting longitudinal angles that are sharp in contrast to **obtuse-angled** (L. *obtusangulus*) that are rounded.

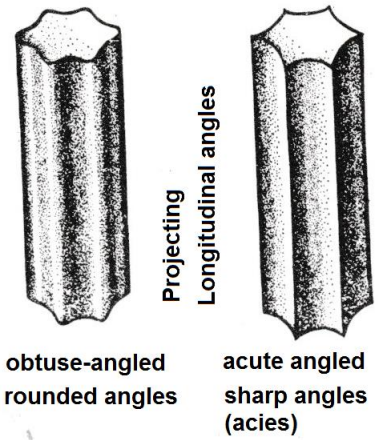


Figure 7 acute angled

ad- (L. prefix *ad-* meaning towards) Face near or at (antonym **ab**-)

adaxial: (L. prefix *ad-* towards + *axis* , axle, pivot) The surface of an organ (e.g. leaf) facing towards the stem or axis. Equals the upper, or ventral surface of a leaf.. Compare **abaxial.**

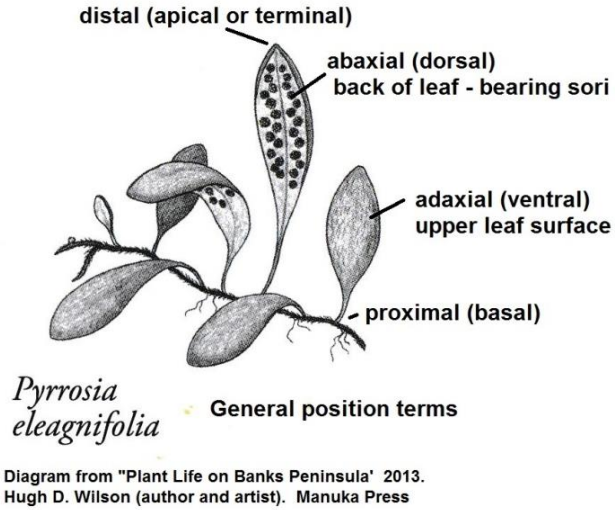


Figure 8 adaxial abaxial

admedial (L. prefix *ad-* meaning towards+ *medial*, middle) Towards the middle, e.g. sorus located towards the axis of symmetry of the leaf i.e. close to the midrib or or leaf vein directed towards the axis of symmetry of the leaf (admedially ramified) . Opposite **exmedial**. See **soral position**.

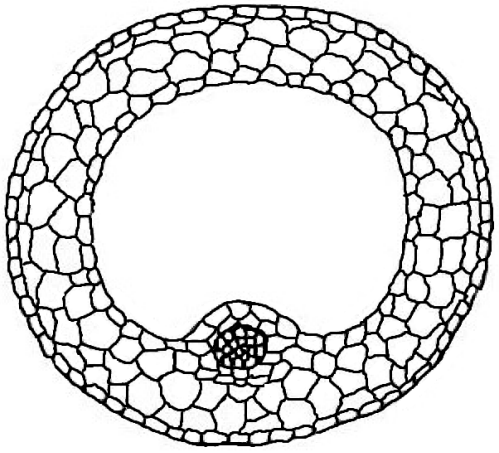
adnate: (L. prefix *ad-* + *nascor* , to be born) To grow attached to a different organ by the whole width, such as a leaflet base to a midrib. New Zealand examples *Blechnum colensoi*, *B. discolour*. Compare stalked, sessile, decurrent, surcurrent.

adpressed(L. prefix *ad-* + *premere* to press) Variant of **appressed**. Pressed flat, against a surface.

adventitious (L. *adventiciu*s, coming from outside, f. *adventus* a coming) Structures arising from an unusual place such as roots from stems or leaves, buds at places other than leaf axils. New Zealand example - *Asplenium bulbiferum*. The lower part of a tree fern trunk is surrounded by a adventitious root mass.

adventive (f. L *adventiucus*, f *adventus*, arrival) An introduced species, alien or exotic species, not native. If reproducing successfully in the wild by sexual or asexual means it is said to be naturalized. If a threat to native species is said to be invasive. Compare **indigenous** and **endemic**. New Zealand example *Dryopteris felix-mas*.

aerenchyma (Gr. *aer*, *aeros*, air + *enchyma* see parenchyma) Parenchymatic plant tissues with large intercellular spaces for aeration. More absence of tissues or cells than actual tissue.



The air chamber classes as Aerenchyma 'air tissue' is common in the cortex of the roots and stems of many aquatic plants

Root of *Isoetes lacustris* in cross section, showing the air chamber and the peripepheral vascular bundle. This anatomy is identical to the lepidodendrid trees of the Carboniferous

Modified from 'A Natural History of Ferns', 2004, Moran, Robbin C. . Timber Press

Figure 9 aerenchyma

aerial (Gr. aer, *aeros*, air) Applied to plant structures growing above the ground.

aerial roots (Gr. aer, *aeros*, air + root) Adventitious roots arising from a rhizome and growing in the air, e.g. on the trunks of tree ferns.

aerial stem (Gr. aer, *aeros*, air + stem) An upright stem arising from a horizontal rhizome. Example: **trunk** or **caudex** of a tree fern.

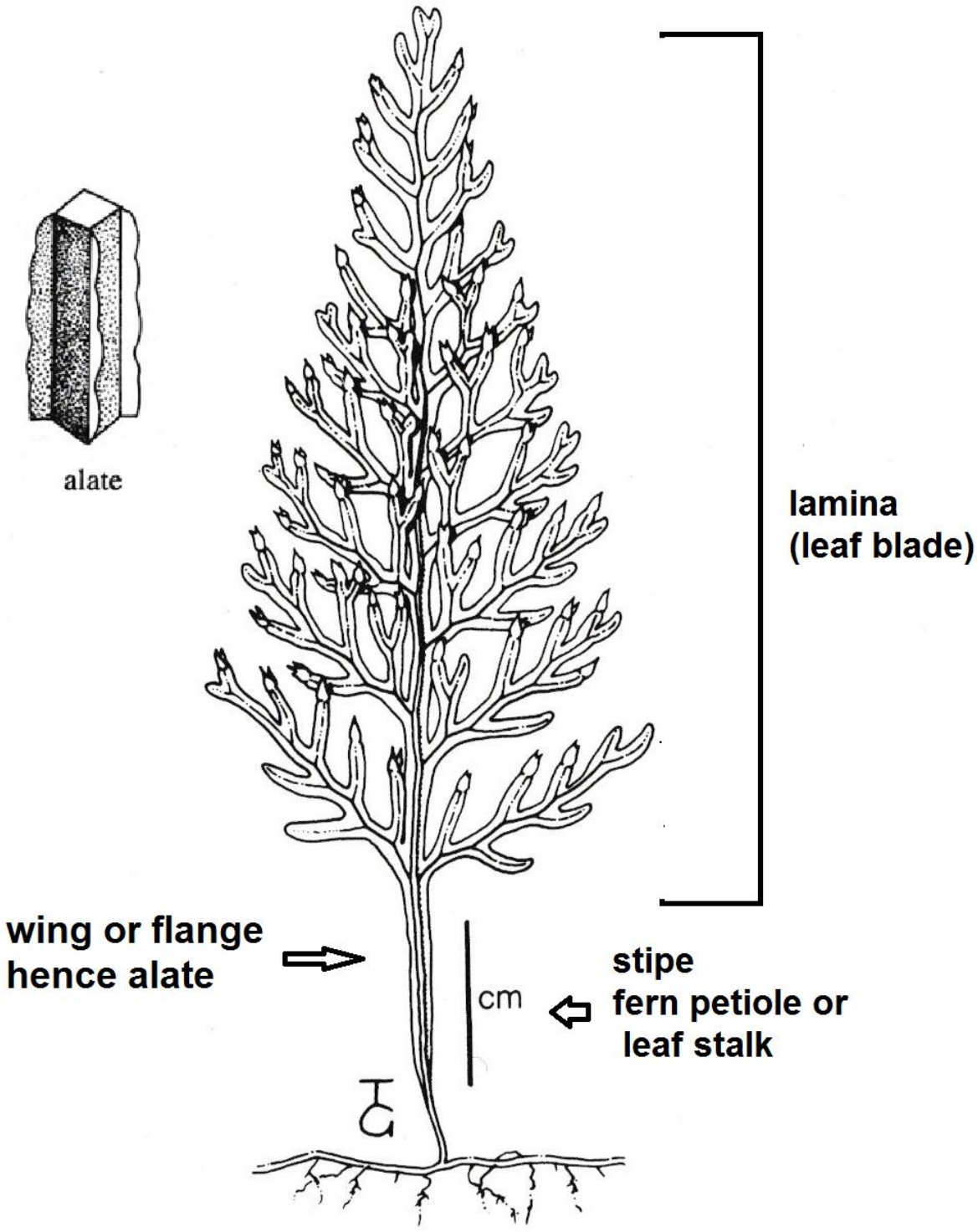
aerophore (Gr. aer, *aeros*, air + phore f. Gr. *phorus* , bearing, carrying) Specialized aerating tissue of the frond, provided with abundant stomata, occurring as outgrowths such as lines or swellings along the stipes, rachises, costae, or pinnule bases. Synonym **pneumatophore**. Only present in ferns, especially Thelypteridaceae and Cyatheaceae..

aerophyte (Gr. aer, *aeros*, air + *phyton* a plant) A synonym for **epiphyte** or perching plant. Example *Tmesipteris tannensis*.

aff. abbreviation of affinity (L. *affinis ,* neighbouring, related by marriage) A botanical reference used to denote an undescribed species which appears to be related to a described species. A formal tag name if you will.

air chamber Air filled cavity in the root of *Isoetes* sp. Classes as **aerenchyma**. Air filled cavities beneath the gametophyte thallus upper epidermis in many Liverworts of the order Marchantiales.

ala, pl. alae (L. *ala* wing) Wing-like leaf blade extensions, on the side of a stipe, rachis, or costa. Adjective **alate**. Thin high ridges or wings on a spore wall.



***Hymenophyllum australe* (syn. *H. atrovirens*)**
showing the narrowly triangular frond and flat wing to the stipe

Artist Tim Galloway 'Ferns and Fern Allies of New Zealand' 2000 ed. Brownsey, Patrick & Smith-Dodsworth, John C. . Bateman Publishers

Figure 10 alate

-ales Suffix denoting the rank of order in the taxonomic hierarchy, e.g. Salviniales, containing the water fern family Salviniaceae. Order: the taxonomic rank above family. See **order**, **classification**.

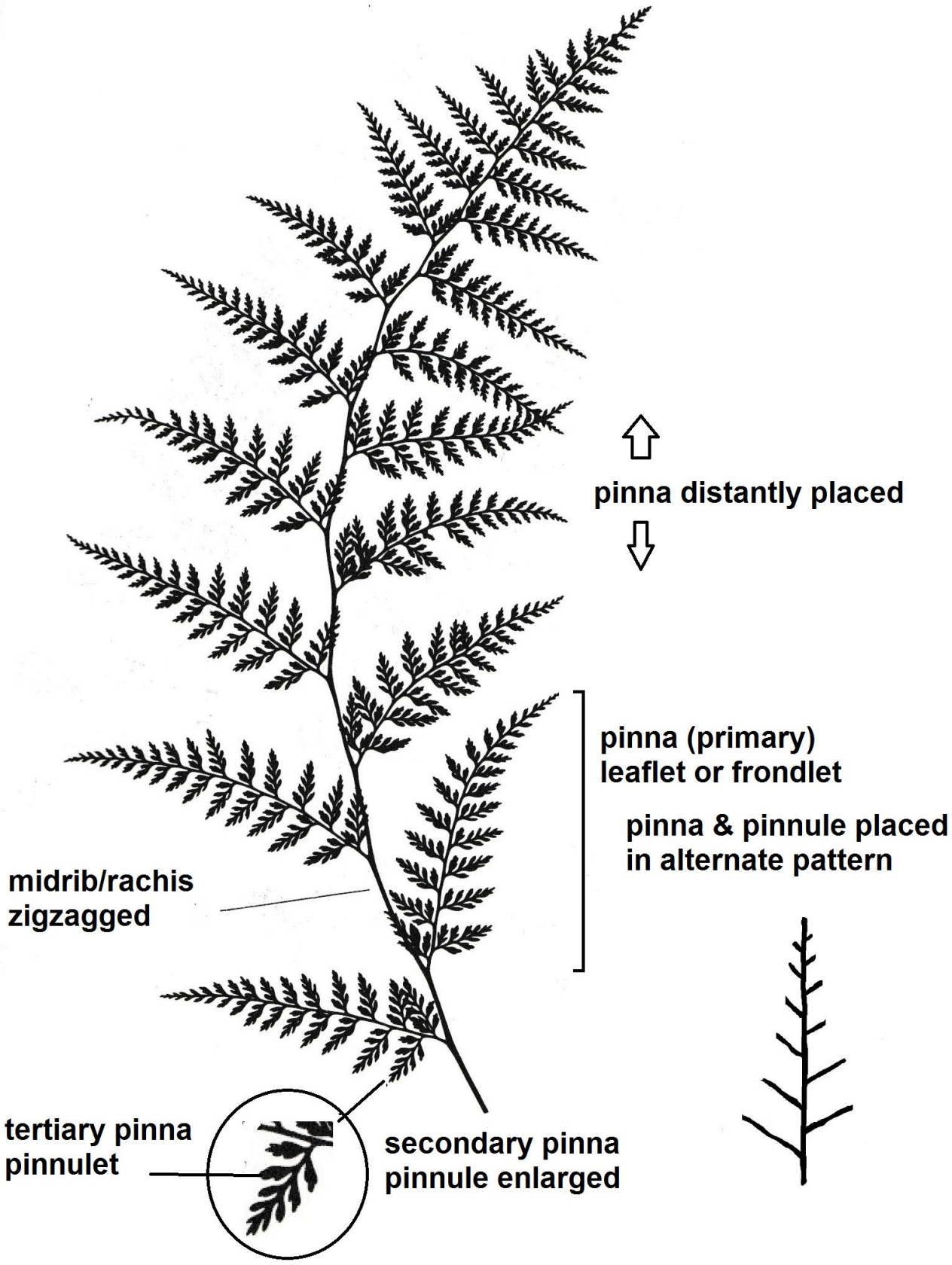
alate (L. *ala* wing) Winged, possessing **alae**. Some fronds and some spores. (fig. 10).

alete (L. *aletus*) A spore that has lost its **tetrad** scar(s) or **laesura** as a result of swelling after tetrad splt up. A **monolete** spore has a single tetrad scar on its surface, while a **trilete** spore has a three-pronged (triradiate) scar. The scar may be prominent or barely visible in the latter two cases.

allopatric (Gr. *allo*- , other +*patra* fatherland) Occupying different geographic ranges. Compare **sympatric**.

alpine (L. *Alpinus*, from *Alpes* , the Alps). Mountain zone, above the treeline. Subdivided into low and high alpine. Altitudinal stratification term compare, subalpine, montane, lowland, coastal. Alpine plants and lichens grow below the nival zone (permanent snowline) and above the treeline. In New Zealand 3 clubmosses and 15 ferns reach the alpine zone (source: 'Above the Treeline '. a nature guide to alpine New Zealand" revised ed. 2021. Alan Mark. Potton & Burton Publishers). *Isoetes alpina*

alternate (L. *alternate* done by turns, f. *alternus* every other) Borne singly at different levels on opposite sides in straight lines (distichous) or spiral (helical) pattern e.g. fronds, pinna, pinnules, segments, arising from rachis, costae or midribs) . Compare **opposite** and **subopposite**. e.g. *Blechnum novae zealandiae*.



Paesia scaberula **Scented fern, Matata**

A fern displaying alternate leaflet arrangement
(adapted from Brian Molloy)

Figure 11 alternate

alternation of generations Reproductive life cycle that requires alternation between two morphologically different generations of the same species, a **gametophyte** (usually **haploid** 1n) and a **sporophyte** (usually **diploid** 2n). In ferns and lycophytes the gametophyte and sporophyte are independent at maturity. The sporophyte, being the typical fern or clubmoss when mature. The fern or lycophyte gametophyte is also known as the **prothallus**. Synonym **haplodiplontic life cycle**, diplohaplontic life cycle or diplobiontic life cycle.

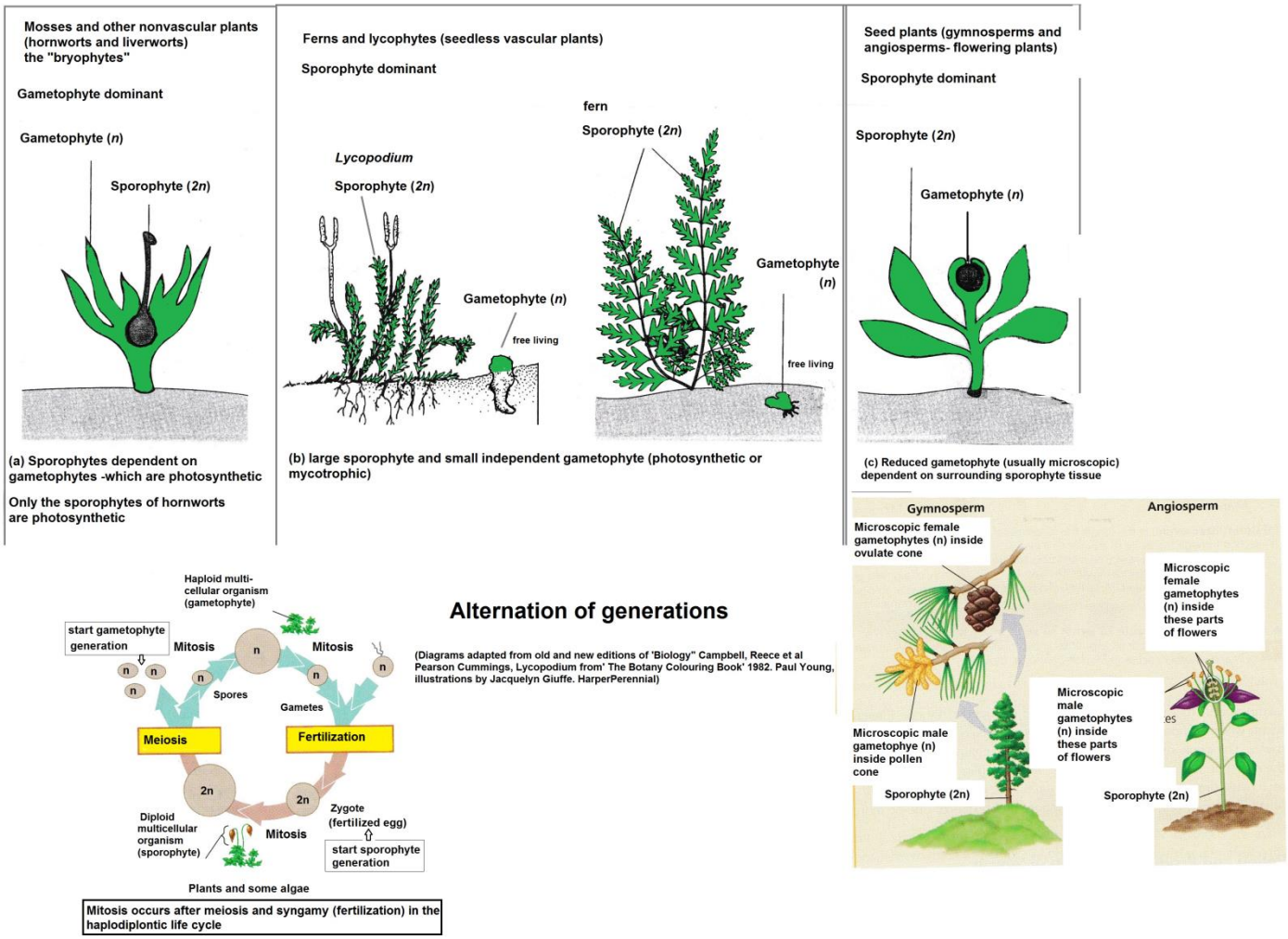


Figure 12 alternation of generations

altitude (middle English from L. *altitudo*, height depth f. *altus* high deep.) Height above sea level (metres above sea level (a.s.l.). Altitudinal distribution refers to the range of a species or taxon in relation to altitude. Compare latitudinal distribution – the range of a species or taxon related to latitude.

altitudinal zones: nival, alpine (high & low), subalpine, montane (upper & lower), lowland, coastal. Note these zones alter with the macroclimatic effect of latitude and maritime (distance from the sea or continentatlity) influences.

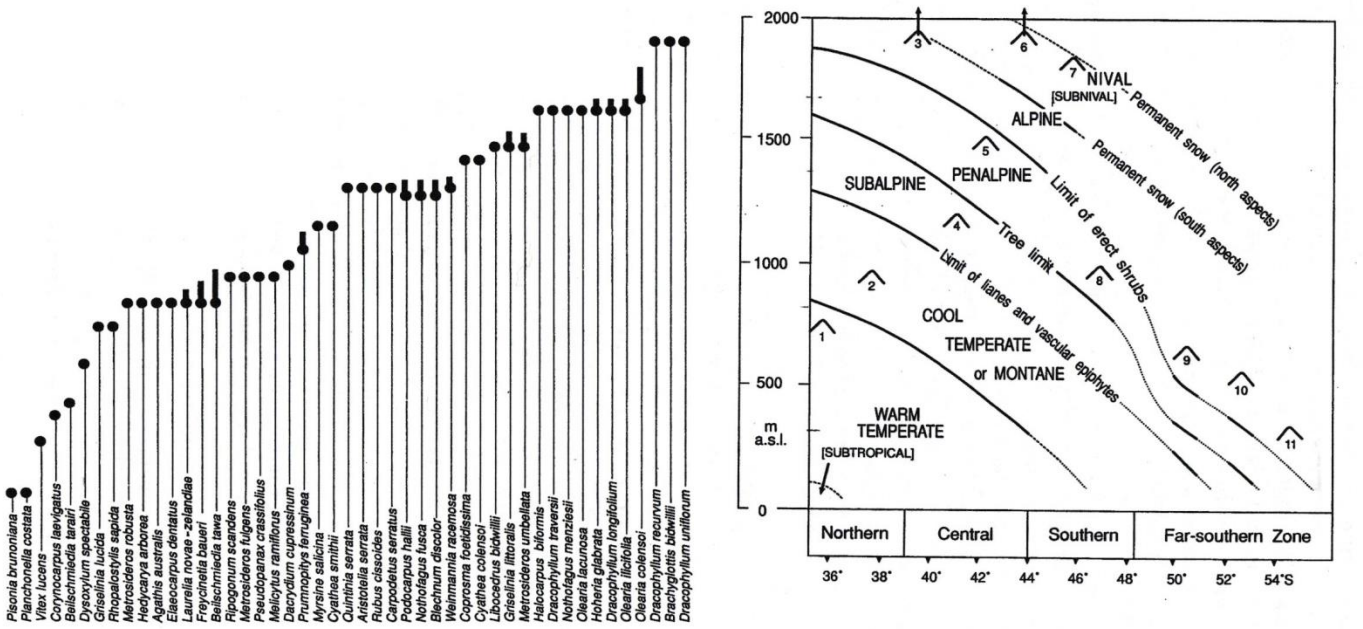
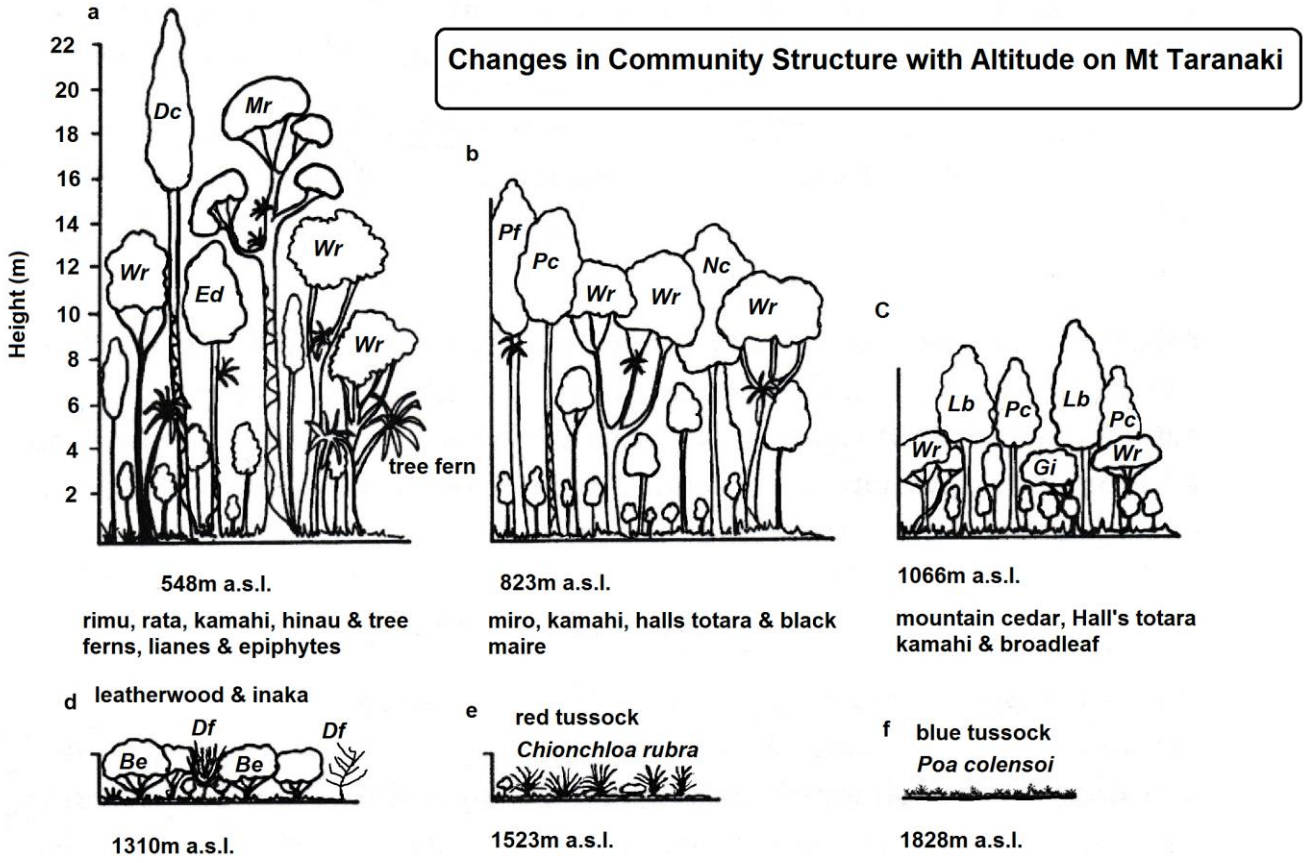


Fig. 5.2. Relative upper limits of common plants, mainly woody, on maritime slopes near western coasts (left). These limits define belts that decrease in altitude with increasing latitude (right).
Numbers represent the following summits.

1. Mataraua Forest	716 m	5. Paparoa Range	1501 m	9. Auckland Island	668 m
2. Mt Te Aroha	953 m	6. Mt Tasman	3497 m	10. Campbell Island	569 m
3. Mt Taranaki	2518 m	7. Mt Soaker	1853 m	11. Macquarie Island	434 m
4. Mt Stokes	1204 m	8. Mt Anglem	676 m		

'Vegetation of New Zealand" 1991. Peter Wardle. The Blackburn Press.



Vegetation profiles from Mt Taranaki, showing diminishing stature and reducing number of tiers with increasing altitude and exposure (Clarkson 1986). Only major species shown. Abbreviations *Be*, *Brachyglottis eleagnifolia* (leatherwood), *Dc*, *Dacrydium cupressineum* (rimu), *Df*, *Dracophyllum filifolium* (inaka); *Ed*, *Elaeocarpus dentatus* (hinau), *Gl*, *Griselinia littoralis* (broadleaf),; Lb, *Libocedrus bidwillii* (mountain cedar); Mr, *Metrosideros robusta* (northern rata); *Nc*, *Nestegis cunninghamii* (black maire); *Pc*, *Podocarpus cunninghamii* (Hall's totara); *Pf*, *Prumnopitys ferruginea* (miro); *Wr*, *Weinmannia racemosa* (kamahi)

adapted from 'Vegetation of New Zealand' 1991. Peter Wardle. The Blackburn Press

Figure 13 altitudinal zonation

amphibious (Gr. *amphi-* both f. *amphoos* around or both sides + *bios* life) Plant capable of growing equally well on land or water, e.g. *Pilularia novae-zealandiae*.

amphiphytic (Gr. *amphi-* both f. *amphoos* around or both sides + *phyton* plant) Growing in mud either seasonally wet or permanently wet. See **amphibious**.

amphistomatic (Gr. *amphi-* both f. *amphoos* around or both sides + *stoma* mouth) With stomata on both upper and lower leaf surfaces.

Anabaena azollae. Cyanobacterium symbiotically associated with the water ferns *Azolla* sp. Known to be a nitrogen fixer.

anadromous (Gr. *ana-* up, upwards + *dromous* racecourse,run) When the first branch (basal) of a frond, or segment, is given off (runs) towards the apex of the lamina, pinna or pinnule; or a vein of a primary pinna is produced on side facing towards the frond apex,e.g. *Hymenophyllum, Polystichum* spp. Opposite of **catadromous**.

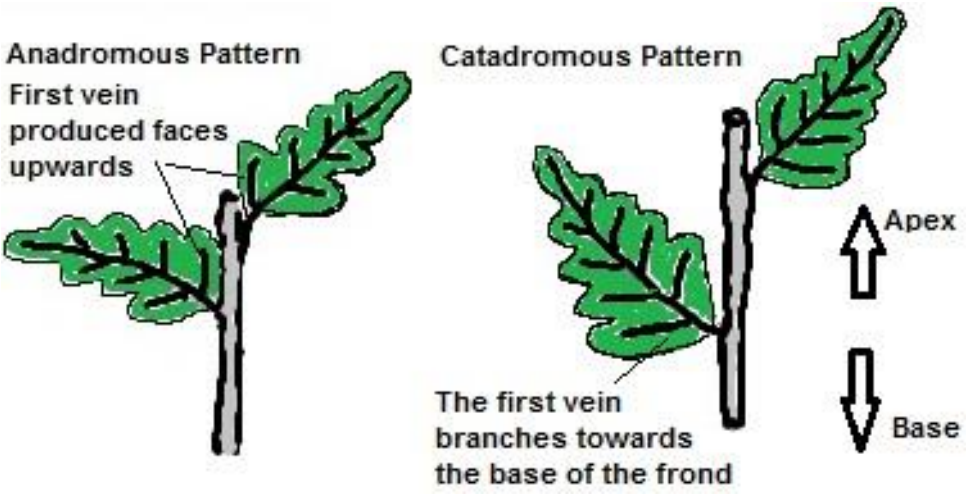


Figure 14 anadromous

analogous variation (Gr. *analogia* f. *ana* according too + *logos*, ratio + variation) Features with similar functions or which appear similar, but which have developed independently in unrelated taxonomic groups in response to a similar way of life. Examples include leafy structures such as microphylls(lycophylls), megaphylls(euphylls), phyllodes, phylloclades, and phyllids (moss & liverwort leaves). Compare **homologous** and convergent evolution

anastomose (Gr. *anastamoo ana-* up, upwards + *stoma* mouth furnish with a mouth or outlet) Interconnected or joined veins, framing a mouth shape – the enclosed areoles. Hence anastomosing or anastomising. The result is network or **reticulate venation**. Opposite of **free veins**.

ancient rafters An informal biogeographical term for members of the New Zealand flora and fauna present since before Zealandia (continent comprising present day New Zealand and New Caledonia) separated from Gondwana (Eastern Australia , Antarctica) circa 80million years ago. New Zealand biogeographer C.A. Fleming used the term **archaic endemics** (ancient + endemic) in part for this biota plus very early drifters.. The more formal term **vicarience** is used for this geological separation of ancestral populations. New Zealand animal example Tuatara, plant example kauri *Agathis australis*. **Drifters** are the informal term for biota (plants, animals etc) that have arrived by **dispersal**, after geological separation. The debate then becomes did this or that taxa attain its current distribution (or historical distribution in the case of fossil taxa) largely by vicarience (rafting) or dispersal (drifting).

anemochory (+ -chore f. *khoreo*, to move) Dispersal of seed, spores and other propagules by wind.

angle of divergence The angle a secondary vein leaves a primary vein or a tertiary vein leaves a secondary vein. May be termed acute, obtuse or perpendicular depending on the angle.

angulate (L. *angularis*, from *angulus* angle) Having sharp corners or angles such as a stem which is not round.

anisophyllous (Gr. *aniso*s, f. *a-* , not + *isos* equal + -phylous f.–*phyllos*, f. Gr. *phyllon* leaf) Bearing leaves of unequal size at any one point along a branch. Synonym **heteromorphic**. Compare **isophyllous**.

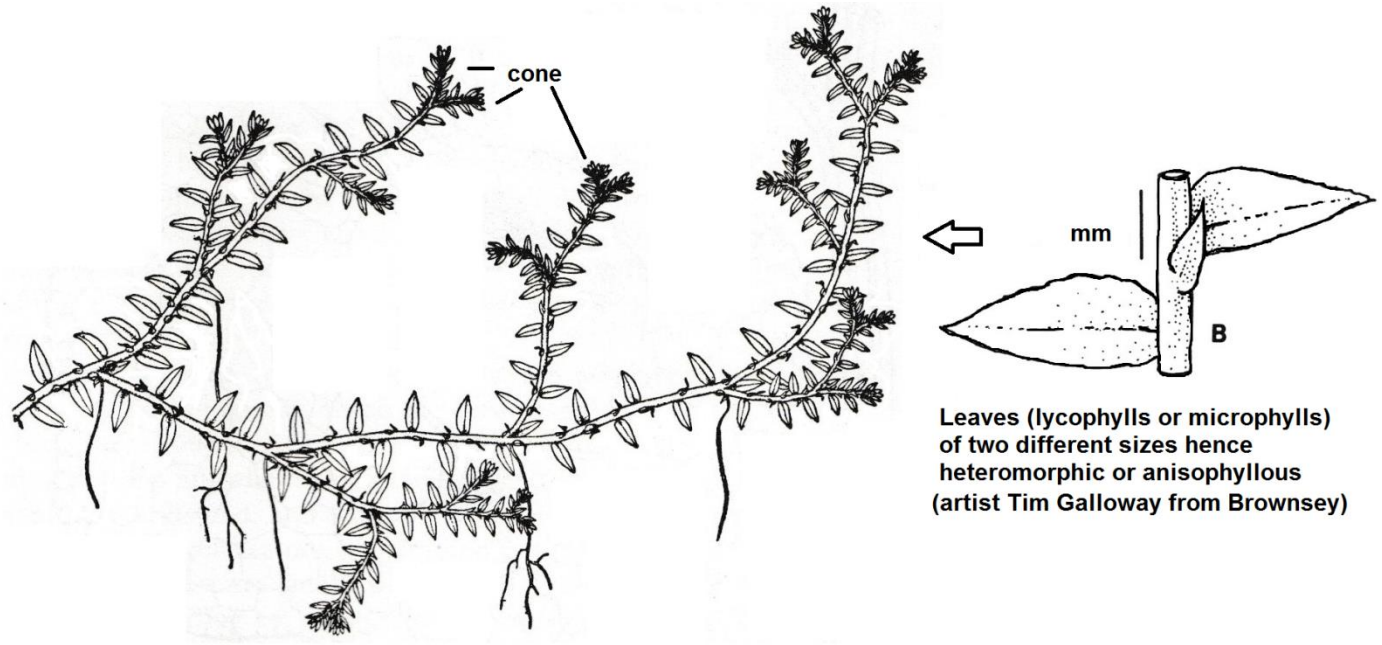


Figure 15 anisophyllous

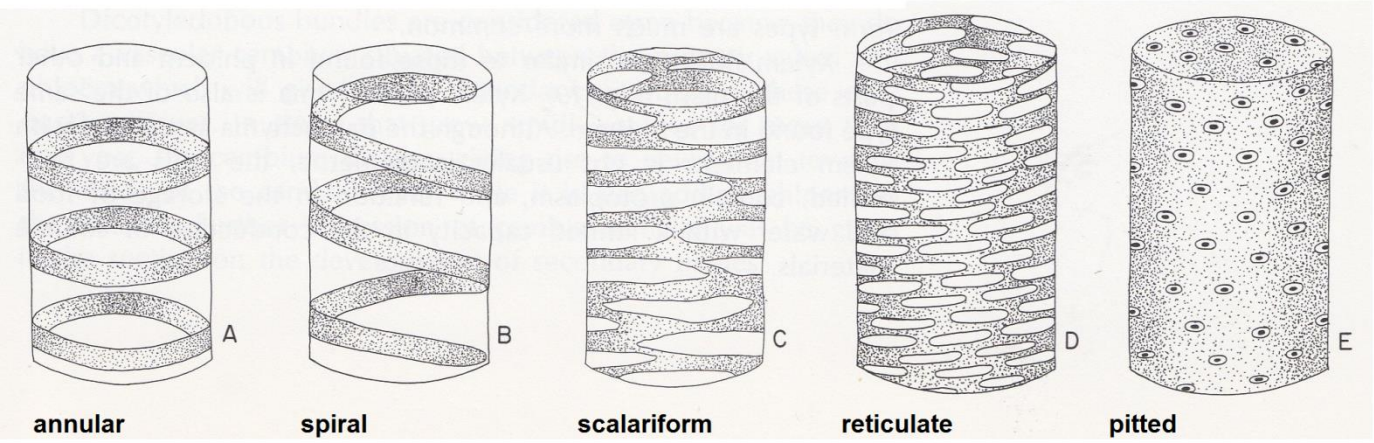
anisosporous (Gr. *aniso*s, f. *a*- , not + *isos* equal + *spora*, seed) - Bearing spores of unequal size: megaspores and microspores in one sporangium. Contrast **heterosporous**- bearing spores of unequal size: megaspores and microspores in seperate sporangia (hence megasporangium & microsporangium) and **homosporous** or **isosporous** bearing one type of spore. Anispory was common in the Devonian but is rare in living species of plant.

anisotomous (Gr. *aniso*s, from *an*- not +*isos* equal ;+ *tomous* cut, divided) Dichotomy resulting in unequal branching. Opposite of **isotomous**.

anisovalvate (*aniso*- not equal f. New Latin *anis*- from Gr. *anisos*, from *a*- not +*isos* equal + valvate f. *valae* folding doors) When the two valves in a sporangium are unequal in size. Compare **isovalvate**.

annual (L. *annualis*, within a year) A plant completing its life cycle within 12 months. Compare **perennial**. Annual fern *Anogramma leptophylla*.

annular (L *annulus* or *annulus*, a ring) Forming a ring.



Patterns of wall thickening in tracheids and vessel elements (conducting cells of the xylem) (from 'Modern Plant Biology' 1972. Howard J. Dittmer. Publisher: Van Norstran Reinhold Company)

Figure 16 annular

annulate Having an **annulus**.

annulus (L *annulus* or *annulus*, a ring) A crest, partial or complete ring of dead, water-filled, thick-walled cells on the sporangium (spore case or capsule) – part of the catapult mechanism for the release of spores. Has been likened to a bow – the spores then being the arrows. Usually associated with the **stomium** – thin walled cells where **dehiscence** (splitting) occurs. A novel feature of **leptosporangiate** ferns – bar the highly modified water ferns (Salviniales). Synonym **ring cells**.

Eusporangiate ferns (and all other vascular plants) plus the aforementioned water ferns lack this feature.

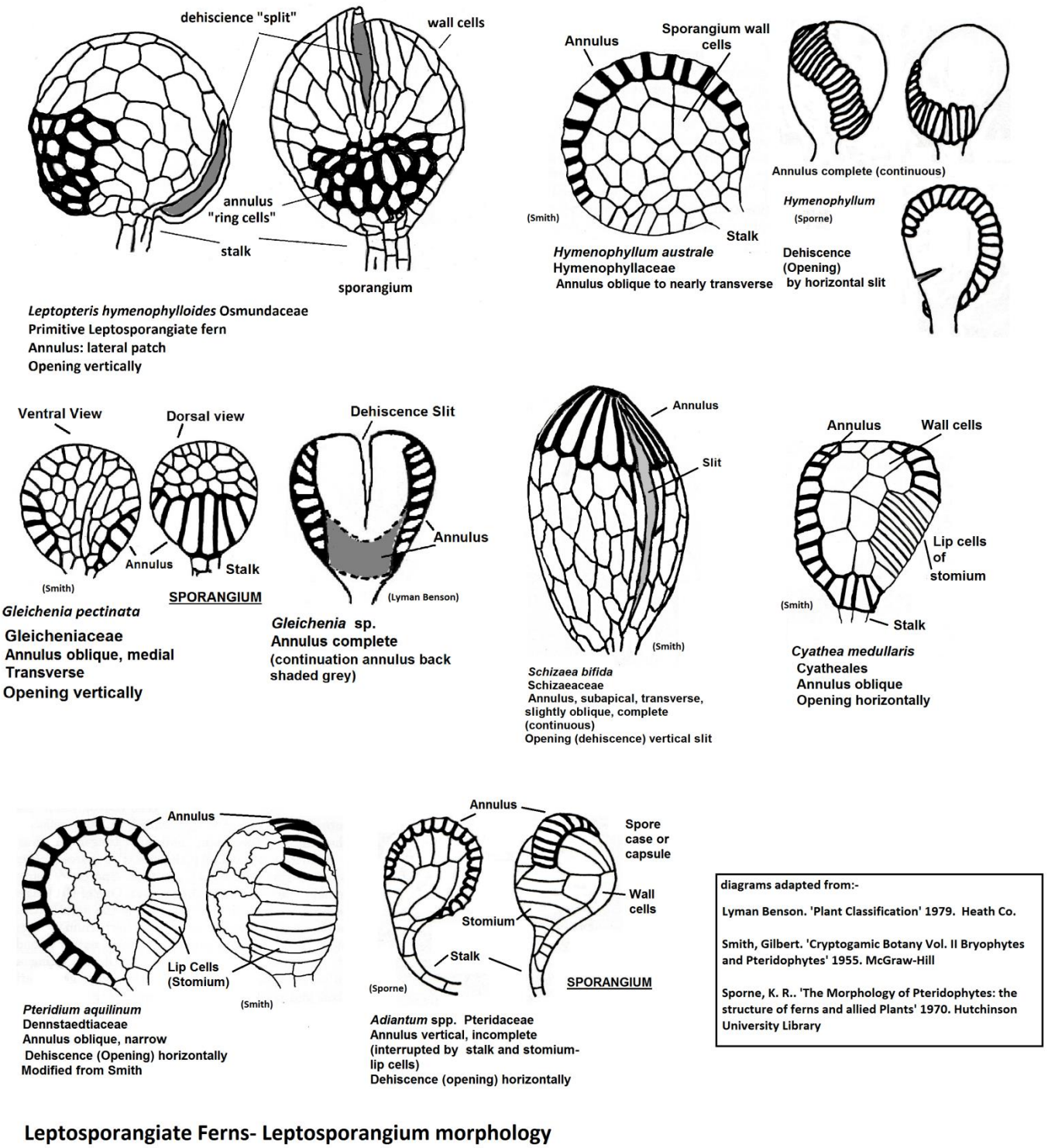


Figure 17 annulus

anomalous Greek *anōmalos* (from *an-* not + *homalos* , even) abnormal form.

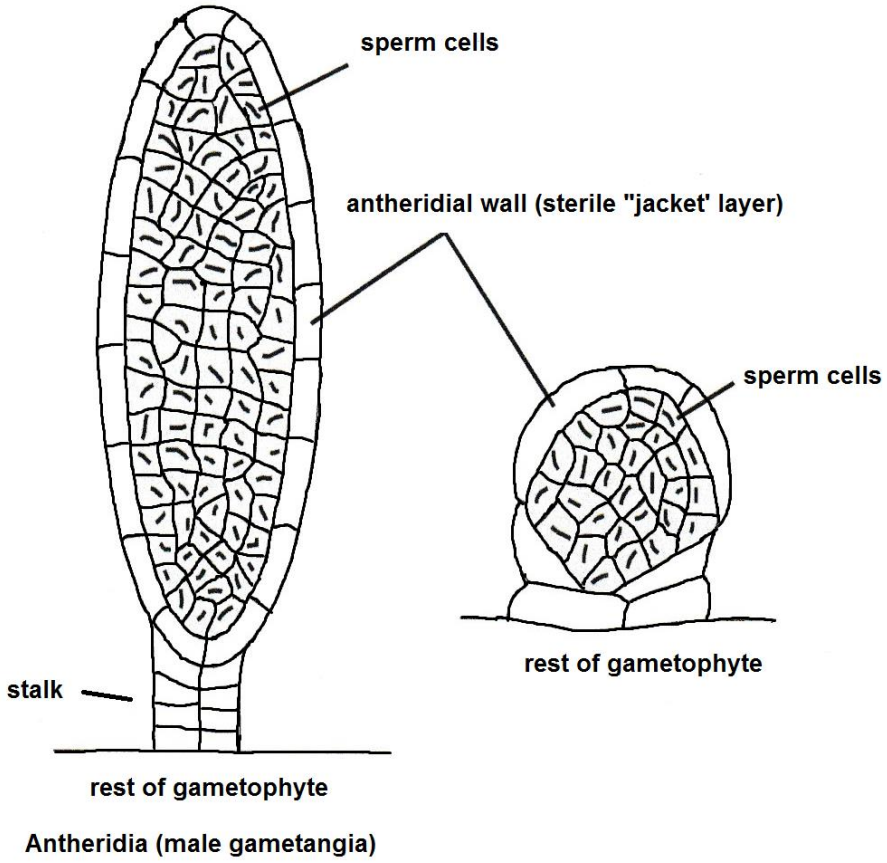
anterior (L. *ante-* before) On the frond side of an organ away from the axis.

antheriogens (antheridium + Gr. *gens*, bear, produce) Plant hormones released by a bisexual gametophyte causing nearby immature gametophytes to develop antheridia that produce sperm. Once an egg cell is fertilized, the gametophyte stops production of antheridiogen and neighbouring functionally

unisexual male gametophytes can then become female or bisexual by developing archegonia (structures that produce eggs). This prevents the chance of gametophytic selfing.

antheridiophore (antheridium + phore, to carry, bear) In ferns with filamentous gametophytes e.g. filmy ferns, the branch that bears antheridia only. In contrast to the **archegoniophore** – the branch that bears archegonia only.

antheridium pl. **antheridia**. ("Little anther" from Gr. *anthros* flower+ *idium* diminutive ending). The male sex organ – a small spherical structure, borne on the underside of a gametophyte (prothallus), producing flagellate sperm.**.** Compare **archegonia** the female sex organ. See gametophyte diagram.



Modified from 'Plant Systematics' 2019. Simpson, Michael G..
Academic Press (Elsevier)

Figure 18 antheridia

antherozoid (Gr. *antheros*, flowery + *zoion*, animal + *-oid* resembling) A male gamete or sperm. Synonym **spermatozoid**.

antrorse (L *antero-* front + *-orsus* f. *introrsus* contraction of *introversus* f. *intro-* + *versus* turned.) Bent and directed towards the apex. Compare **retrorse**.

apex, pl. apexes (L. *apex*, a tip, point or extremity) The tip, free end or distal end of an organ (e.g. stem, blade tip, pinna or ultimate segment) hence **apical**. The opposite of **base**: the lowermost or attached end of an organ.

aphlebiae (Gr. *a-* without + *phlebos* , veins "without veins") A term applied to the basal pair or pairs of pinnules (pinnae) of some species of tree-ferns which are reduced and finely divided.

apical (L *apex* , a tip, point, or extremity) Located at the apex. Related **distal** . Opposite **basal**.

apical branching (apical + branching) Is a type of branching where a meristem at the tip of the shoot (or root) splits in two and divides to continue growth of the axis in a forked or bifurcate manner. **Dichotomous**

(dicho- two) branching is a form where the meristem splits in two and if it divides equally produces the dichotomous or forking branching pattern also known as **isotomous** (*iso-* equal). This pattern is found in early land plants of the protracheophye, and tracheophye clades and in living plants such as *Psilotum nudum* and *Lycopodium* spp. In the lycophytes the roots also exhibit dichotomous or **dichopodia**l branching. **Anisotomous** (*aniso-* unequal) branching results when one of the pair of apical meristems is suppressed becoming a lateral branch and the other dominates (overtops), becoming the lead apical axis (**monopodium**:- a single dominant stem). The **pseudomonopodial** is an extreme form of anisotomous branching. *Selaginella* exhibits anisotomous branching, while *Equisetium,* some lycophytes, the extinct "trimerophytes" (ancestors of ferns and seed plants) and othe extinct Devonian plants followed the pseudomonopodial pattern. In true **monopodial** – a single apical meristem divides to form the vertical axis; lateral branches develop from seperate lateral meristems acropetally. **Sympodial** modifies the monopodial system, when the apical meristem aborts or changes direction and the immediate proximal lateral bud continues the original direction of growth (upwards, or sideways as in a rhizome). The growth is thus derived from multiple separate apical meristems. Apical branching is therefore a feature of dichotomous, anisotomous and pseudomonopodial branching, but not monopodial or sympodial growth. See also **telome theory.**

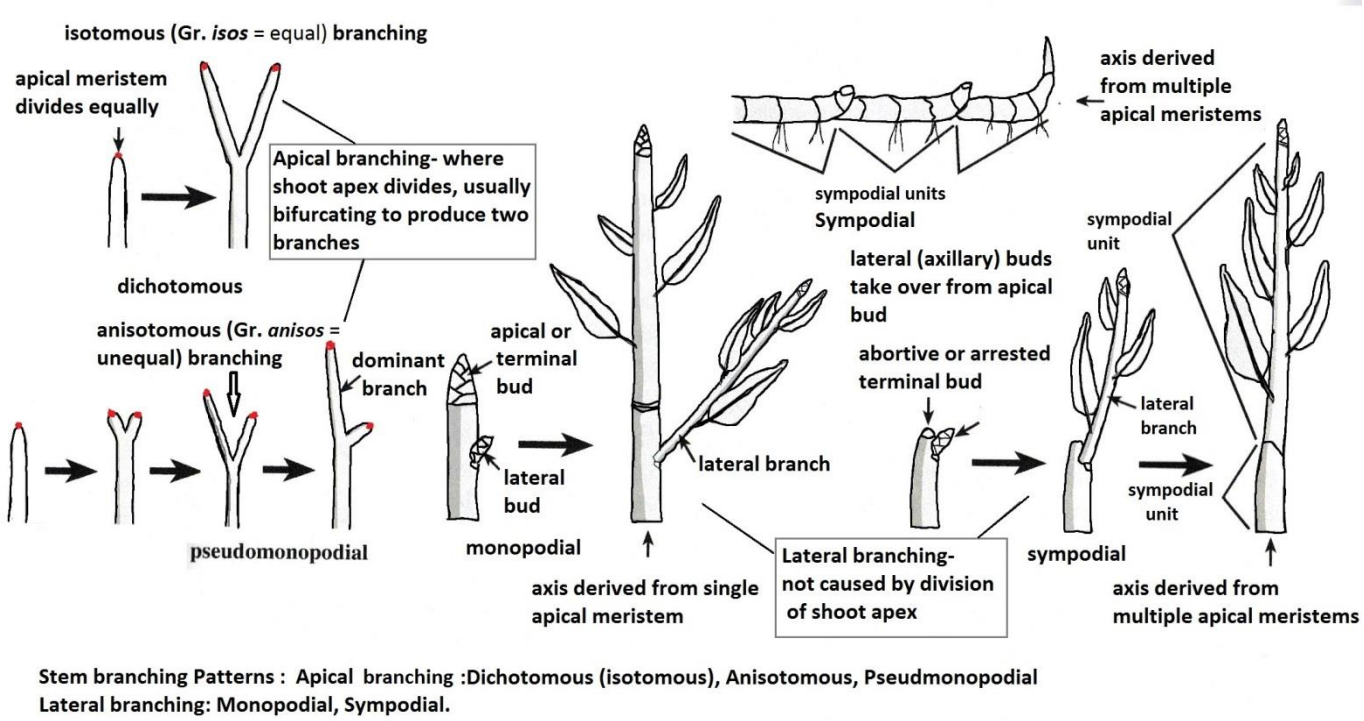


Figure 19 apical branching

apical notch (apical + notch) Having an apical cleft.

apical projection or **process** Typically an extension of the mid vein (costa) of a leaf . See **apiculate**, **aristate**, **cirrhose**, **mucronate**, **mucronulate** and **spinose** or **pungent**.

apiculate (L *apex* , a tip, point, or extremity) Ending abruptly in a small sharp tip (**apiculus**).

apiculus: adj. **apiculate**. (L. diminutive of *apex* , a tip, point, or extremity) A small abrupt flexible point at the apex of a pinna, pinnule or ultimate segment.

apogamous (Gr. *apo-* away from + *-gamos* marriage) Producing sporophytes directly from the gametophyte (prothallus) by asexual budding rather than by sexual fertilization of egg by sperm . Juvenile sporophytes that develop by apogamy tend to develop a leaf first, wheras sporelings that develop from fertilization the root appears first.

apogamy The state of being **apogamous** – vegetatively producing sporophytes from the tissue of gametophytes without fertilization. Opposite of syngamy –fusion of sex cells (gametes).

apolar (*a-,* without + polar f. L. *polus*, f. Gr. *polos*, pivot, axis), Without poles

apomict (Gr. *apo-* away from + *mixis* mixing) The development of a sporophyte from a viable spore that results from vegetative cells rather than a gametes or an unfertilized egg.. Fertilization (mixing) does not take place.

apopmorphy (Gr. *apo-* away from + + *-morphos,* f. *morphe*, shape.) A derived condition or character state, representing an evolutionary novelty –descent with modification. **Synapomorphy** is an apomorphy shared (*syn-* together + apomorphy) by two or more taxa in whose common ancestor the derived condition arose. Compare **plesiomorphy** and **symplesiomorphy**. See also **primitive**.

apospory (Gr. *apo-* away from + *spora* seed) The formation of the gametophyte (prothallus) directly from the sporophyte without the production and germination of spores produced by meiosis (meiospores). As a result the gametophyte has the same chromosome number diploid (2n) as the sporophyte. A form of vegetative or asexual reproduction. Compare **apogamy** –producing sporophytes from a gametophyte without fertilization.

appressed (*ad-* + *premere* to press) Pressed closely and flatly to a surface. See **orientation**.

Figure 20 appressed

approximate (L. *approximatus*, past participle of *approximare* to come near, f. *ad-* + *proximare* to come near) Close together but not touching, united or overlapping. Compare **confluent, connivent, contiguous**, **distant** and **remote**. Applied to leaf or leaflet spacing etc.

aquatic (L. *aquatilis* growing in water f. *aqua* water) A plant growing wholly or partially submerged or floating in water. See **hydrophyte** and **hygrophyte**. Examples: *Isoetes alpina*, *I. kirkii*, *Azolla filiculoides*.Compare **terrestrial, amphibious** and **epiphyte**.

aquatic systems Lakes, large ponds, tarns, rivers and streams, in which the substrate is immersed most or all of the time.

arachnoid (Gr. *arachne* spiderweb,spider + *-oid*, resembling) Entangled and hairy like a cobweb. See **hairiness** terms.

arapod forest (f. conifer families **Ara**uacariaceae and **Pod**ocarpaceae) or Kauri-Podocarp forest – forest including kauri *Agathis australis* family Araucariaceae and Podocarp trees such as rimu, totatara, miro, matai, kahikatea, manao and the celery pines (sometimes included in Podocarpaceae or kept separate in Phyllocladaceae) intermixed. The two conifer families form a clade- are closely related, Podocarpaceae appearing in the Triassic period, kauri in the Jurassic period and they have coexisted since then.

arborescent (L. *arbor*, tree) Becoming tree-like. Applied to tree ferns.

arbuscular mycorrhiza (arbuscule+ mycorrhiza) Group of symbiotic fungi that grow inside the cortex cells and intercellular spaces of roots. Often form arbuscules which see. About 80% of species also form vescicles within the colonized root. The hypha (fungal filaments) are largly aseptate –lack cross walls (septa) –only forming cross walls at branch points. Classes as a Endomycorrhiza (inside +mycorrhiza).

arbuscule (L. *arbuscula*, little tree). Branched tree-like structure that promotes nutrient exchange between endommycorrhizal fungi and their host plant. See **arbuscular mycorrhiza**.

arched curved or bowed. Synonym **arcuate**. See also **campto**- and **campylodromous** venation.

archegonial cushion (Archegonium +cushion) Area of gametophyte (prothallus) tissue that is more than one cell thick and accomidates the archegonia (female sex organs).

archegoniophore (archegonium + -phore, to carry, bear) In ferns with branched filamentous gameotophytes, e.g. filmy ferns, a branch that bears archegonia only in contrast to the **antheridiophore** – the branches that bear antheridia only.

archegonium: pl. **archegonia**. (Gr. *archegonos* ,originator f. *archein* , to begin + *gonos* procreation) The usually flask shaped, female sex organ borne on the underside of the **gametophyte** (**prothallus**). Produces a female **gamete** (**egg**) at the bottom,reached by the flagellated **sperm** by swimming down the neck. Chemical attractants are involved in this, derived from the breakdown of **neck canal** cells. The egg cell is surrounded immediately by sterile cells called the **venter** (belly) and the neck cells forming the neck above. Immediately above the egg is the ventral canal cell followed by several neck canal cells which latter disintegrate. The archegonium may be stalked or embedded in the parent gametophyte.The egg when fertilised is the **zygote**, which develops as the sporophyte. The sporophyte therefore always develops beside the gametophyte and is partly parasitic on the gametophyte for a short time, until it develops chlorophyll and its own root system. Compare **antheridium** the male sex organ. Both archegonia and antheridia are minute structures.

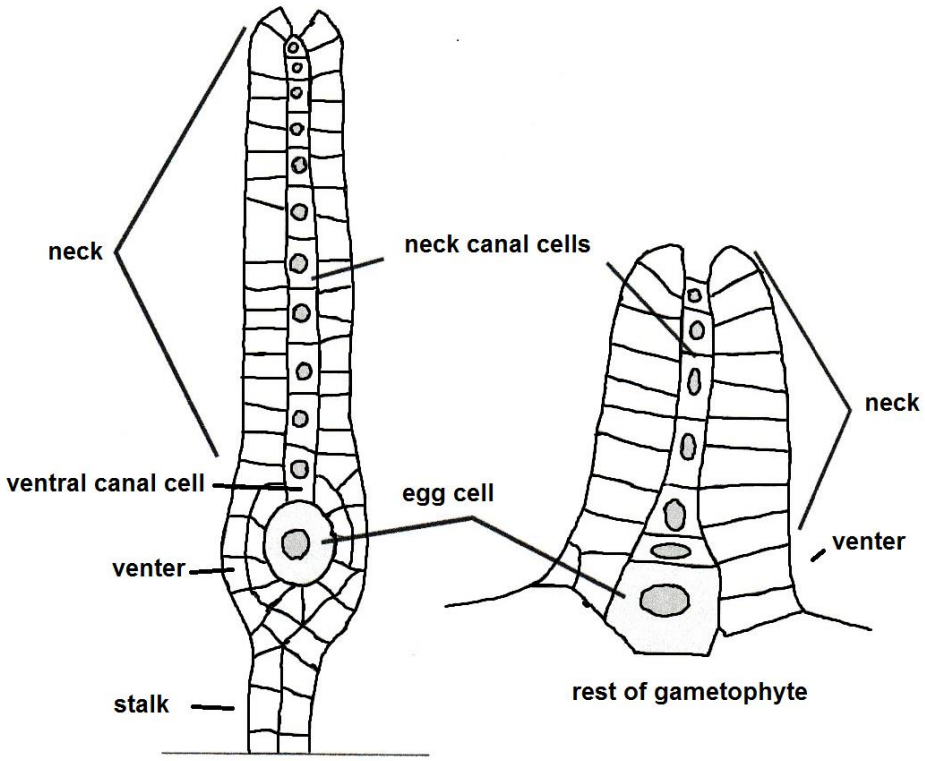


Figure 21 archegonia

archesporial cell (Gr. *archein* to begin +spore cell) The mother cell that divides by meiosis to produce all the spores in a sporangium.

archesporium (Gr. *archein* to begin + sporangium) The region of the sporangium capsule that contains the sporogenous cells –spore mother cells giving rise to spores (after undergoing meiosis) and in some cases tapetal cells.

arcuate (L. *arcus* a bow) Curved or arched like a bow.

areole (L. *areole* small open space diminutive of *area* little beds in a garden) The spaces enclosed by veins with **reticulate**, **anastomosing** or **network** venation pl. **areoles.** In some cases a secondary areole is formed within a primary areole **.** Synonym **lacuna.** See **venation.**

aristate (L. *aristatus* f. *arista* a beard of grain) Having a stiff bristle or **awn** like tip. Long slender extensions of leaf tips.

armed Bearing spines or prickles or other projections such as teeth or cilia that are usually sharp.

arthrophytan (f. Arthrophyta**,** f. Gr. *arthon*, joint + *phyta* plant) The horsetails and their extinct relatives Equisetales) synonym **equisetoid** (L. horsetail genus *Equistum* + oid, like). Pertaining to a horsetail like feature e.g. sporangiophore.

articulate (Latin *articulates* jointed, distinct f. *articulus* a knot or joint) Jointed, having a swollen or knotty area in leaves, leaflets or stems. E.g. horsetails *Equisetum* spp.

ascending (L. *ad-* + *scandere* to climb) Sloping or curving upwards similar to assurgent. See **orientation**.

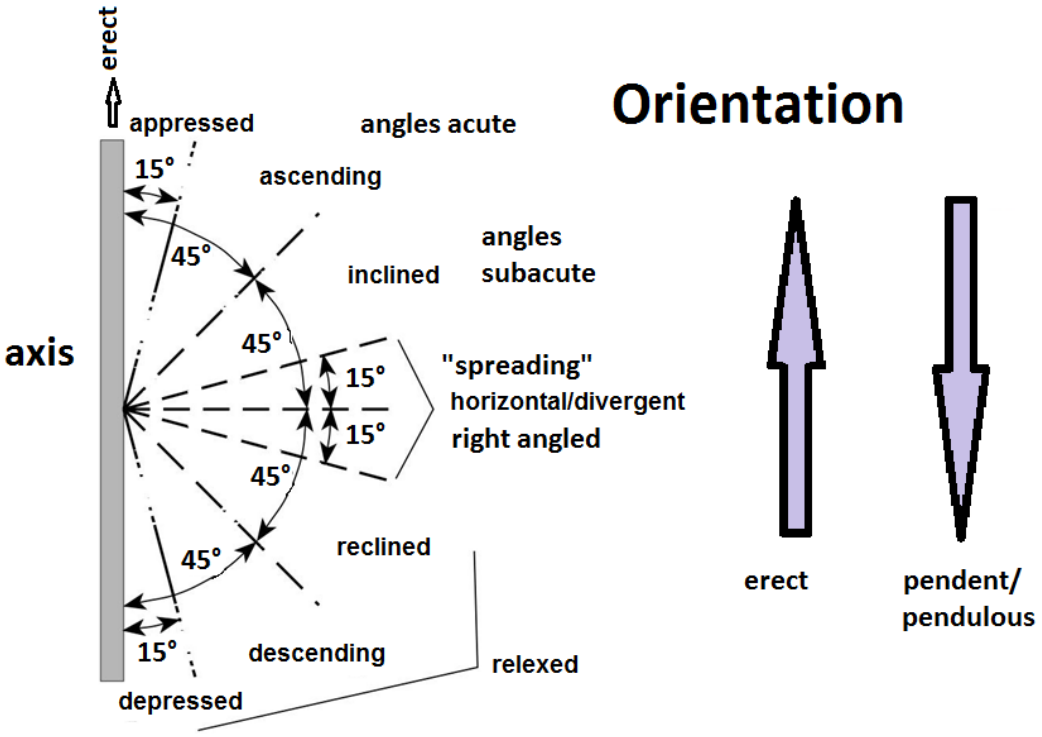


Figure 22 ascending

asexual reproduction Reproduction by vegetative means without the fusion of sex cells, e.g. bulbils of *Asplenium bulbiferum*… also called **vegetative reproduction** – only mitotic cell division involved. In the ferns and lycophytes spore production may be considered asexual as well. Opposite sexual reproduction. See **apogamy**, **apospory**.

asperous (L. **asper** rough) Rough to touch. *Doodia aspera* Prickly rasp fern.

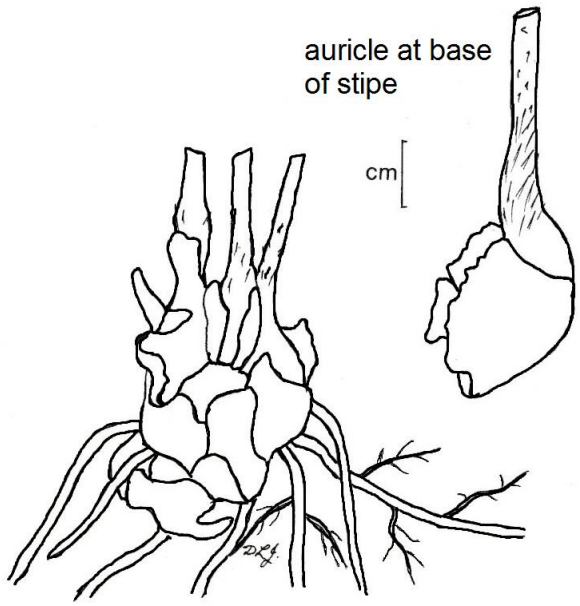
asplenoid (f. genus *Asplenium* + *-oid*, resembling) Having a similar arrangement of sori to *Asplenium*, with the elongate sporangia confined to a single side of each vein. Also implying related to *Asplenium*.

assurgent (L. *ad-* + *surgere* to rise) Curving or growing upwards (similar to **ascending**). See **orientation**.

athyroid (f. fern *Athyrium* spp. + *-oid* resembling) Having a similar arrangement of sori to the fern *Athyrium* spp. The elongate sorus hooking over the vein tip or wrapping around the vein in a j or horseshoe shape. Also implying related to *Athyrium*.

attenuate (L. *attenuatus,* diminished) Tapering narrowly and concavely to a long point at either extremity (apex or base) applied to leaves, leaflets (pinnae) etc.

auricle:. adj. **auriculate**. (L. *auricular,* diminutive of *auris* ear) An ear shaped lobe or projection at the base of blade, pinna, pinnule or pinnulet, e.g. *Phyllitis scolopendrium, Ptisana salicina*.



***Ptisana (Marattia) salicina* rhizome**

From 'Australian Ferns And Fern Allies' 1976.
Jones, D. L. and Clemesha, S. C..
A. H. & A. W. Reed

Figure 23 auricle *Ptisana*

austral- or australo- (L *australis* southern) Of southern distribution or range. Particularly of the Southern Hemisphere. Compare boreal –northern. *Doodia australis*.

austral element (Antarctic, Subantartic, Fuegian, Antarcto-Tertiary in part)– Biogeographers term for fauna and flora related to taxa from other southern lands- divided into a Palaeoaustral element – distinct and distantly related to taxa from other southern (Gondwana) lands, and either vicariants (ancient rafters) or early dispersers (drifters) and a Neoaustral element –closely related to overseas taxa and geologically recent dispersalists.

Australian element – Biogeographers term for fauna and flora of relatively recent arrival from Australia. Not or barely distinct from their Australian relatives. Late West Wind drifters and recent drifters, vagrants. Species shared with Australia may fall into this category.

autochory (+ -chore f. *khoreo*, to move) Dispersal by parent plant. Usually referring to plants that sow their own seeds; plants such as peanut or groundnut *Arachis hypogaea,* and *Cymbalaria muralis*. Vegetative propagation could be seen as a asexual version of autochory. *Asplenium bulbiferum* (bulbils)*, Lycopodium australianum* (bulbils), *Dicksonia squarrosa* (stolons). Gynochory (Gr. *gune*, women + -chore f. *khoreo*, to move) is dispersal by a motile female.

autotrophic. Gr. *autos,* self, + *trophe*, food) Able to generate its own nourishment as in green plants by photosynthesis – hence photoautotrophic. Opposite of **heterotrophic** (Gr. *hetero*- other + *trophe* , food). All fern and lycophyte sporophytes are photoautotrophic and most gametophytes as well. But some have subterranean **mycoheterotrophic** gametophyes.

awn / arista A stiff bristle like projection.

awned: bearing awns, synonym **aristate**.

auxin (Gr *auxein* to increase) A growth regulating substance controlling many growth processes in plants. A type of plant hormone.

axil (Gr. *axilla* armpit) The upper angle formed by a leaf or leaflet with the stem (rhizome) or rachise (midrib). Of coarse armpits face downwards so you have to imagine someone doing a handstand. In

lycophytes the sporangia are borne singly in the axils of specialized leaves called sporophylls which may be grouped together in stobili (cones, spikes or clubs), in true ferns the sporangia are borne on the lower surface of the leaf or at the margins.

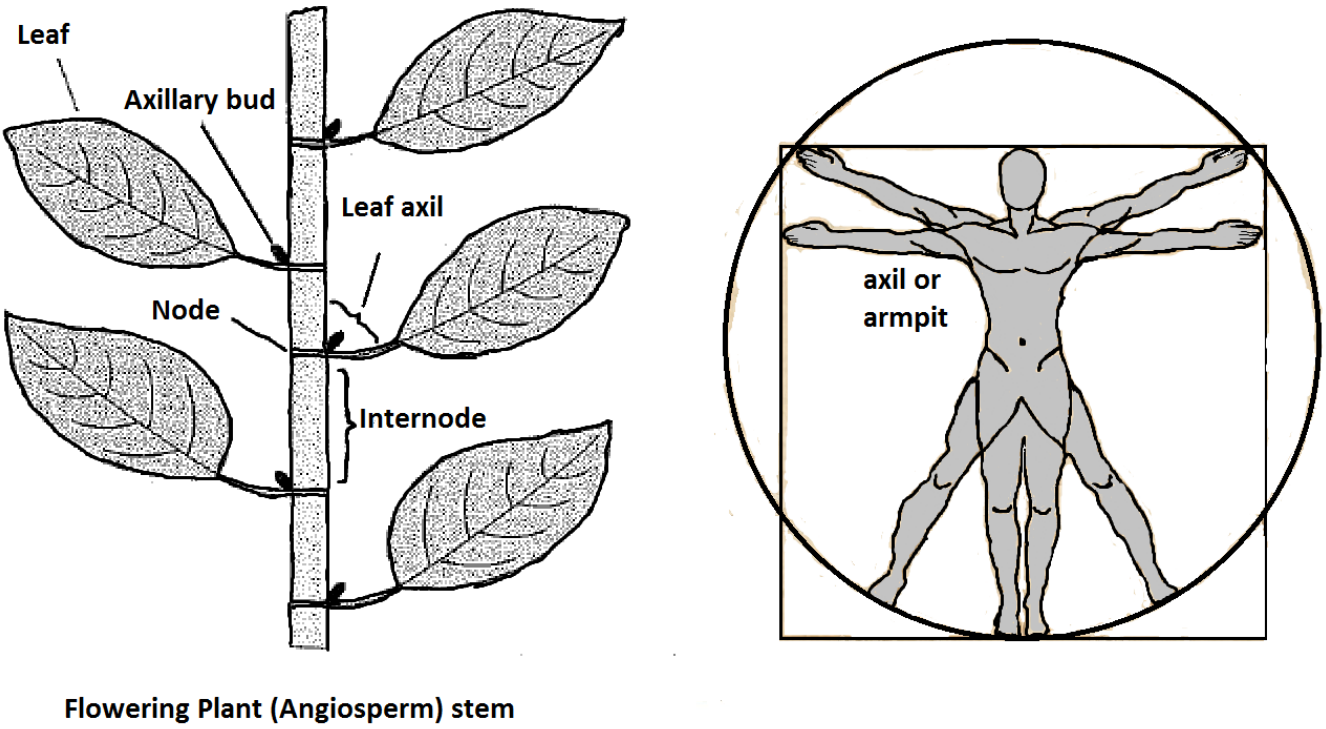


FIGURE 24 AXIL

axillary Borne within the axil. The sporangia of lycophytes are borne in the axils of leaves, bracts or sporophylls and are hence axillary, the sporophylls often aggregated into cones (stobili).

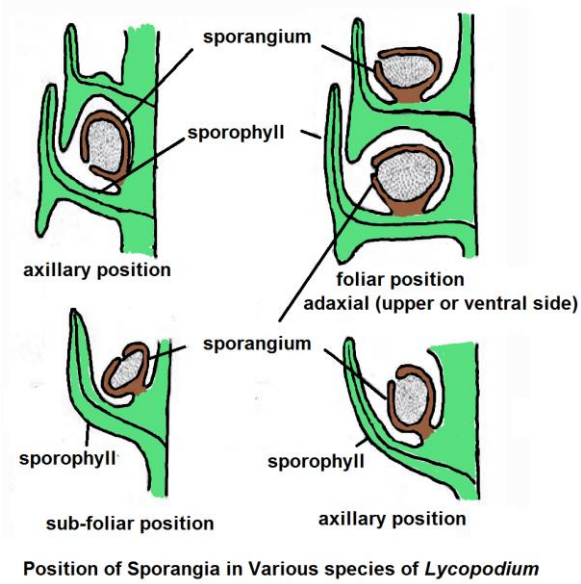


Figure 25 axillary

axillary leaves Leaves borne in the axils of branches, as in heterosporous species of *Selaginella*.

axis (L. *axis* axis or pivot) The central longitudinal support in plant anatomy such as a stem, stipe, midrib, rachis, costa.

baculate (Latin *baculum* stick, rod, staff, sceptre, cudgel) Of a spore, having pillar-like processes, rods or **bacula**, always longer than broad and higher than 1 µm.

baculum/bacula (Latin *baculum* stick, rod, staff, sceptre, cudgel) Pillar or rod-like processes higher than broad; rod or rodlet. Synonym **columnella**. Spore/pollen ornamentation –rod diameter approximately the same throughout.

barachory (Gr. *baros*, weight + -chore f. *khoreo*, to move) Dispersal of seed and other propagules by own weight. Synonym **clitochory** (Gr. *clito*- close + -chore f. *khoreo*, to move) .

Baragwananathia (The name derives from William Baragwanath who discovered the first specimens of the type species, *Baragwanathia longifolia*, at Thomson River (Victoria, Australia).) The oldest identifiable fossil lycopod (Lycopodiophyta) . The plant bore spirally arranged microphylls with sporangia in the leaves (sporophylls) placed towards the end of the stem. The species *Baragwanathis brevifolia* has been dated to the lower Pridoli epoch (late Silurian Period) about 422 million years ago.

barren frond See **sterile frond, trophophyll** or **vegetative frond.**

basal (*base* f. Gr *basis* foundation) At the base, point of attachment, similar to **proximal**. Opposite **apical**.

basal /radical (L*. radix*, root) Leaf architecture: With leaves positioned at the base of a stem as in a **rosette** type plant. Tufted or caespitose ferns.The term **acaulis** can be applied as the stem is condensed, so as to appear lacking. Compare **cauline** with leaves positioned along the length of the stem as in a creeping or climbing fern and **acrocaulis** with leaves positioned at the apex of the stem as in tree ferns. **Leaf venation** –where primary veins originate from the leaf base (just above the petiole if petiolate, or from stem attachment area if sessile). **Suprabasal** means the veins branch from a point above this.

base frond A frond designed to capture litter. Synonyms **mantle frond**, **shield frond**, e.g. *Platycerium* sp.

basiscopic (Gr *basis* foundation + *skopein* to look at) Located towards the base of a structure-. “base looking”. Compare **acroscopic**.

basifixed (base f. Gr *basis* foundation + fixed) Attached at base.

basipetalous (Gr. *basis* foundation + *-petal* f. L. *pet*(*ere*) to seek “Base seeking”) Maturing in succession from the apex to the base, hence with the oldest tissue or organs at the apex. Compare **acropetal**.

basophil /basophile (Chemistry *base* + any of a class of generally water-soluble compounds, having bitter taste, that turn red litmus blue, and react with acids to form salts. + *phile*, loving) –Preferring a basic (alkaline) habitat. Similar to **calciphil**. Opposite **acidophilic**, **oxylophil**, calcifuge,**calciphobe**.

bast bundles (**peripheral strands**). (old English *bast* bark from which ropes were made) Bundles of thick walled cells that occur parallel to the midrib in *Isoetes.*

bathyphyll (Gr. *bathos* depth + *-phyllos,* f. *phyllon* leaf) The mature basal fronds, of some climbing ferns that are usually smaller than those on the higher parts of the fern, e.g. *Blechnum filiforme* and *Rumohra adiantiformis*. Compare **acrophyll**.

beech/tawhai forest Forest type in New Zealand dominated by members of the southern beech family, Nothofagaceae: five species *Fuscospora fusca* (red beech), *F. truncata* (hard beech), *F. solanderi* (black beech), *F. cliffortioides* (mountain beech), and *Lophozonia menziesii* (silver beech) the last two often reach and form the treeline. Formerly they were all included in the genus *Nothofagus*. A type of broadleaf/hardwood forest (trees that are flowering plants or angiosperms).

bicolorous (L. *bis* twice +*colourous* coloured) Having two distinct colours. Similar term **bifacial.** Compare **concolourous**. The silver tree fern *Cyathea dealbata* has distinctly coloured lower and upper leaf surfaces.

biconic (L. *bis* twice + conic f. Gr. *konos*, cone) Having two, cone-shaped organs on a common axis with their apices as if two cones were placed base to base, e.g. the synangia of *Tmesipteris tannensis*. Compare **testiculate**.

bi-convex (L. *bis* twice + convex f. L. *comvexsus*, *com-* + *vehere*, to carry) Bulging outwards on both sides. As in **lenticular**.

bicrenate (L. *bis* twice + crenate f. *crena* notch) Crenate (scalloped) with the lobes themselves crenate.

bifacial (L. *bis*, twice+ *facia*, face) When the opposite surfaces are different in colour as for some leaves, e.g. *Cyathea dealbata*. See **bicolorous**.

bifarious (L. *bis*, twice + *farius*, f. *fariam* ranked in a row or line) In two rows, equivalent to **biseriate**. Compare **unifarious**/**uniseriate** and **multifarious**/**multiseriate**.

bifid (L. *bis* twice + *-fid* f. *findere* to split, cleave) or 2-fid, deeply notched for more than half its length. *Schizaea bifida*.

Figure 26 bifid

biflagellate (L. *bis* twice + *flagellum* a whip) Possessing two flagella, such as some sperm cells (antherozoids or spermatozoids). Compare **multiflagellate**.

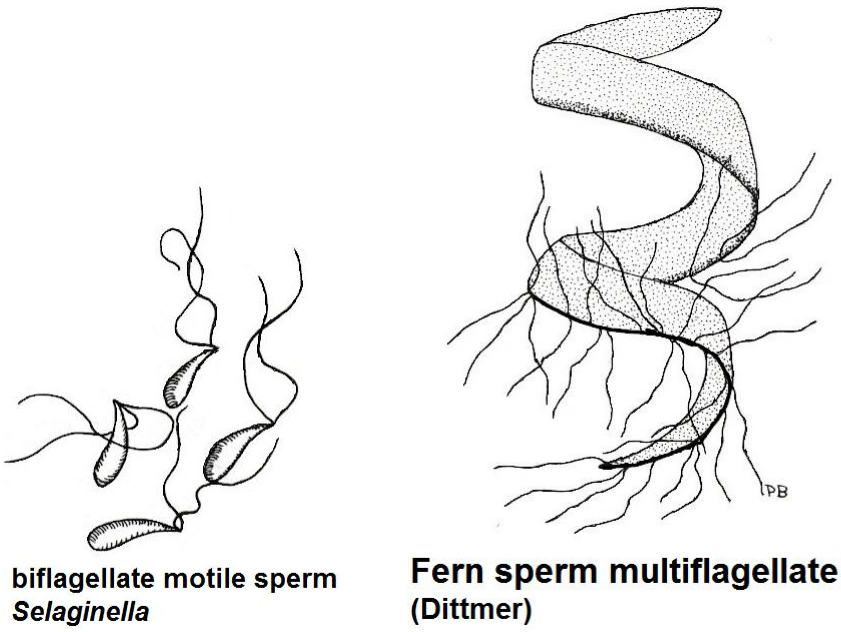


Figure 27 biflagellate and multiflagellate

bifoliar (L. *bis* twice + *foliola* leaflet) With two leaflets arising from the same point.

bifurcate (L. *bis* twice +*furcate* forked f. *furca* a two pronged fork) Forked ,divided into two parts (**dichotomous**). If evenly divided **isotomous**, if unevenly divided **anisotomous**. *Platycerium bifurcatum*

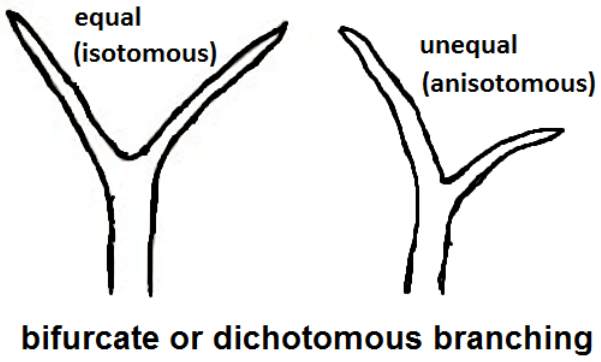


Figure 28 bifurcate

bilateral (L. *bis* twice + *lateralis*, belonging to the side f. *latus* side) Having two sides symmetrical about a central axis. Also another term for monolete spores.

bilobed (L. *bis* twice + Gr *lobos* lobe of ear or of liver, the pod of a leguminous plant) Bearing two lobes.

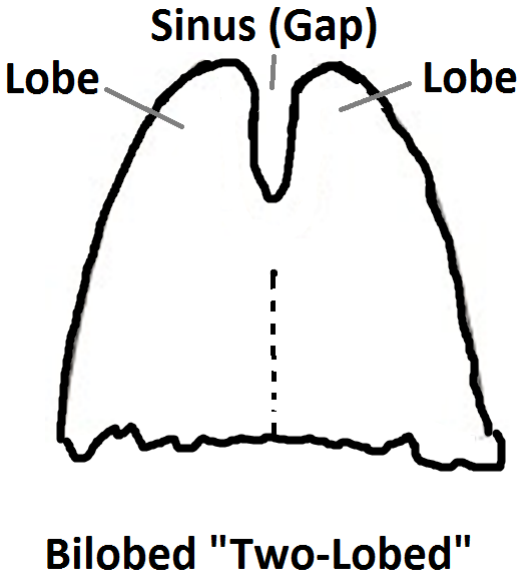


Figure 29 bilobed

bilocular (L. *bis* twice + *locus* place, *-loculus* a small place) **2-locular**, containing two cavities (locules). Such as the synangium of *Tmesipteris*.

binomial (L. *bis* twice + *-nominus* named *binominus* having two names) The two names that form the **scientific** or **botanical name** of a plant comprising first the generic name followed by the species name (specific epithet), e.g. *Adiantum cunninghamii* . A third name (trinomial) is added if a subspecies or variety is involved, e.g. *Dicranopteris linearis* var. *linearis*. The names are put in italics in print or underlined if handwritten with the genus name only having a capital letter. See **nomenclature.**

biogeography (Gr. *bios*, life + geography) The study of the geographical distribution of organisms. The branch dealing with plants **phytogeography**.

biota (Gr. *bios*, life) General term for all the living organisms (flora and fauna) of a given area.

bipartite (L. *bis* twice +*partitus*: f. *partio*, I share, part) Divided in two parts at the apex.

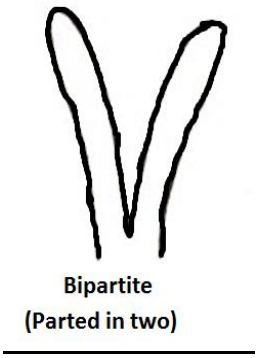
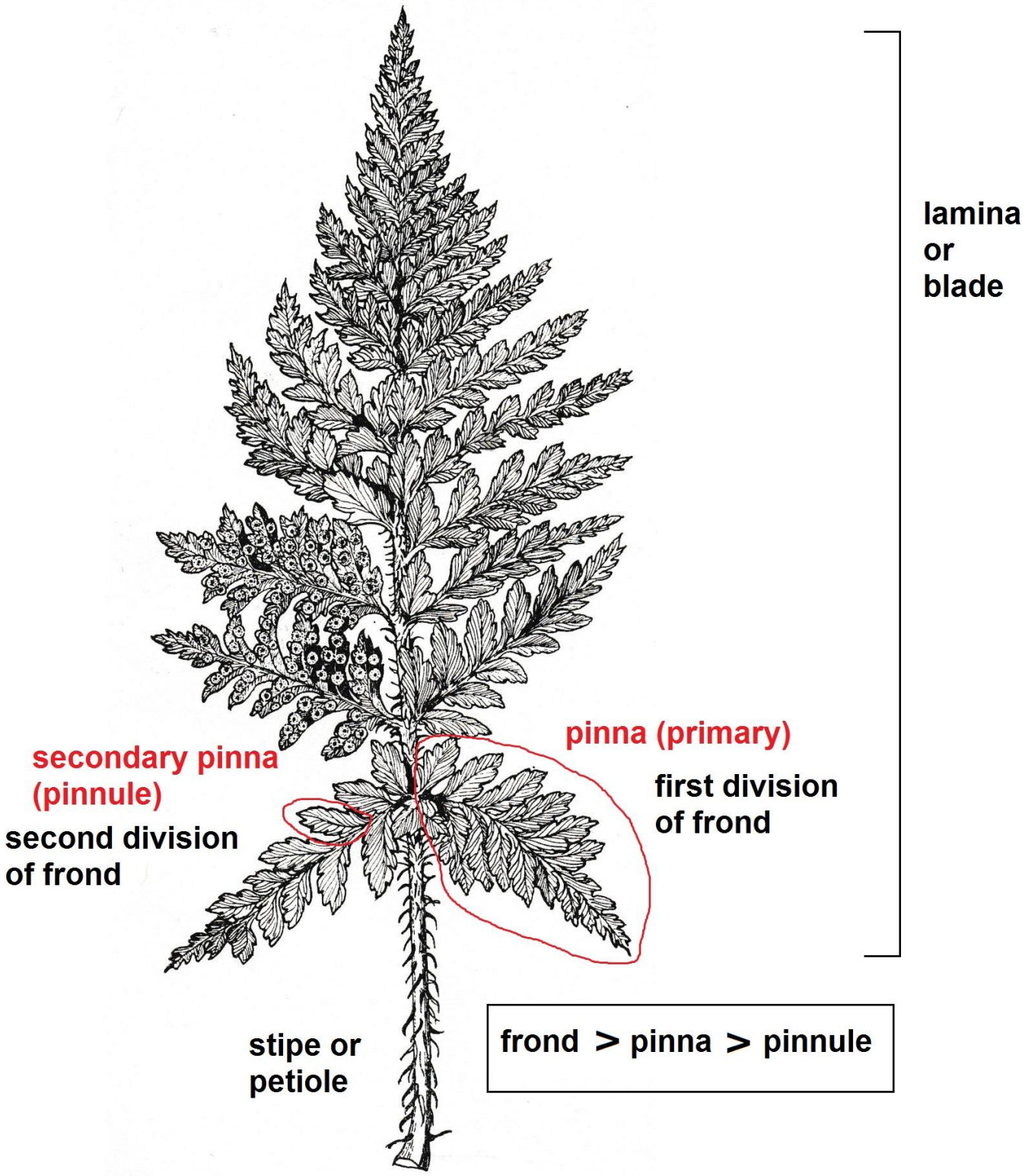


Figure 30 bipartite

bipinnate (L. *bis* twice +*pinna* feather) Twice pinnately divided or 2-pinnate, e.g. *Blechnum fraseri*. With primary and secondary leaflets. The primary leaflet is called a pinna; the secondary leaflet is called a pinnule or secondary pinna.



Polystichum richardii bipinnate frond

(artist Nancy M. Adams 'Encyclopedia of New Zealand' 1966)

Figure 31 bipinnate

bipinnatifid (L. *bis* twice +*pinna* feather+ *-fid* f. *findere* to split, cleave) Pinnate with the pinnae (1° leaflets) deeply notched (-fid) or partially divided (cleft). Sinus depth 1/4 to 1/2 distance to midrib. Nearly bipinnate. Synonym bipinnately cleft or **pinnate-pinnatifid** . Sometimes bipinnatifid is used more broadly to cover the next two terms. See **pinnatifid**.

bipinnatilobate (L. *bis* twice +*pinna* feather+ *-fid* f. *findere* to split, cleave) Pinnate with the pinnae (1° leaflets) shallowly notched (-fid) or partially divided . Sinus depth 1/8 to 1/4 distance to midrib. Synonym bipinnately cleft or **pinnate-pinnatifid**

bipinnatipartite (L. *bis* twice + pinnatipartite) Pinnate with the pinnae(1° leaflets) deeply but partially divided. Sinus depth 1/2 to 3/4 distance to midrib.Synonym bipinnately parted or . **pinnate-pinnatipartite** Sometimes covered by the term **bipinnatifid** broad sense. See **pinnatipartite**.

bipinnatisect (L. *bis* twice + pinnatisect) Pinnate with the pinnae (1° leaflets) very deeply but partially divided. Sinus depth 3/4 to circa 1 distance to midrib. Synonym bipinnately divided or **pinnate-pinnatisect.** Sometimes covered by the term **bipinnatifid** broad sense . See **pinnatisect**.

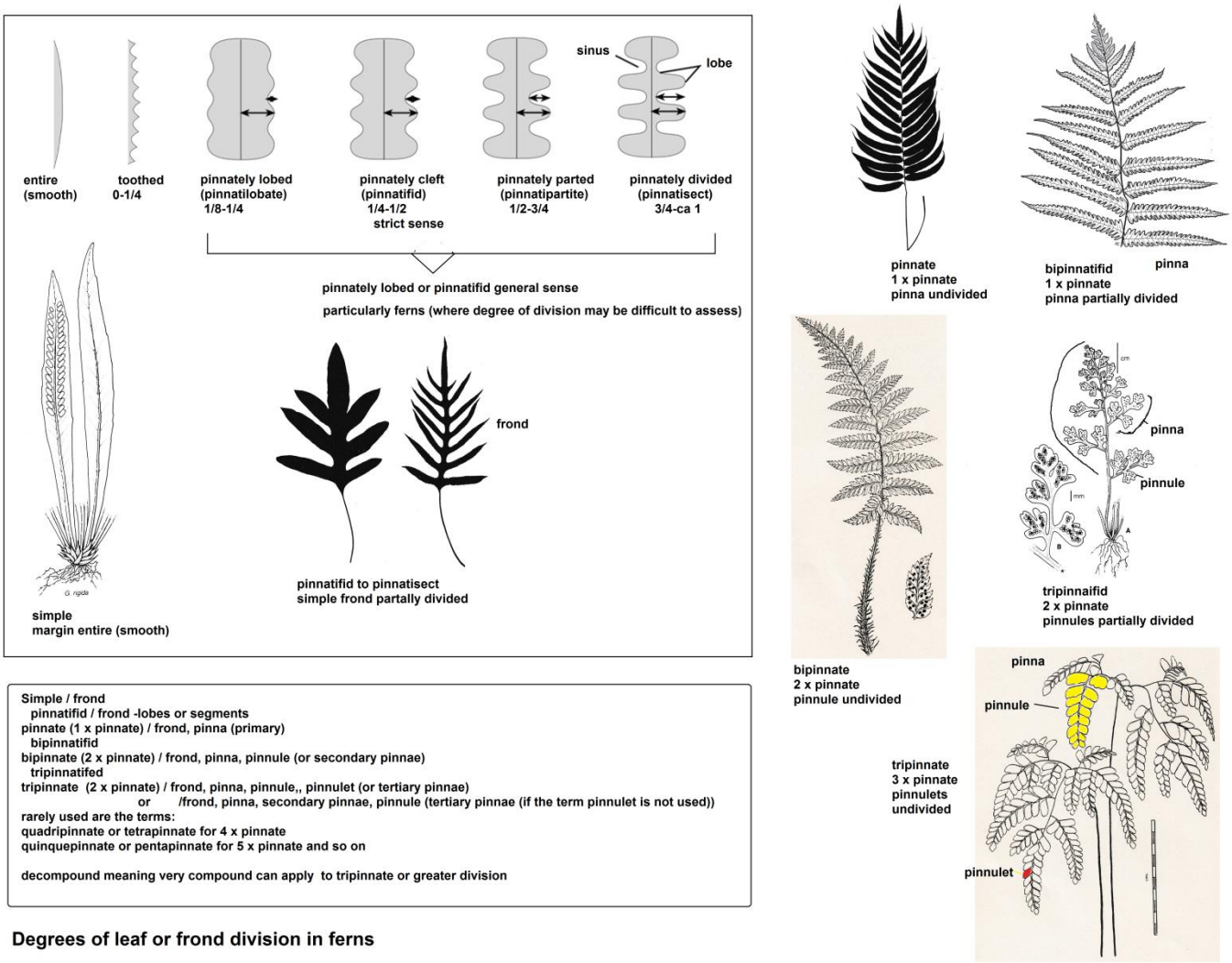


Figure 32 degrees of leaf or frond division in ferns

bipolar (L. *bis* twice + *polos*, axis, pivot) Plants with a true root system, as opposed to adventitious rhizoids or roots., Growing from both ends of the axis – stem and root. They possess separate stem and root apical meristems. Compare **monopolar** – growing from a single point. Note some angiosperms begin life as bipolar seedlings but become secondarily monopolar as the true root arrests development and adventious roots (from the stem) take over.

biramous (L. *bis* twice + ramus, branch) Branching in two. Cladose (branching) hairs that form two branches, which maybe equal or unequal. See **dichotomous**.

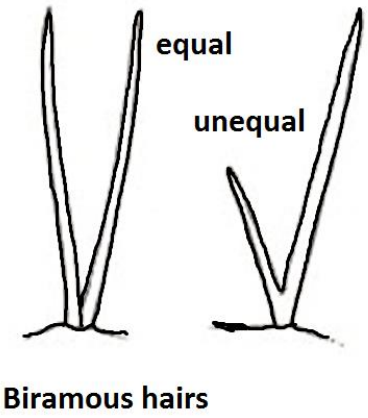


Figure 33 biramous

bisculptate (L. *bis* twice + *sculptate* carved) Of spores, with two different elements in the ornamentation, which cover the entire surface, as in the spores of some species of *Pyrrosia*.

biseriate (L. *bis* twice + *series* , to connect) Arranged in two rows or whorls. Said of a hair (trichome) which is multicellular with the cells arranged in two rows.

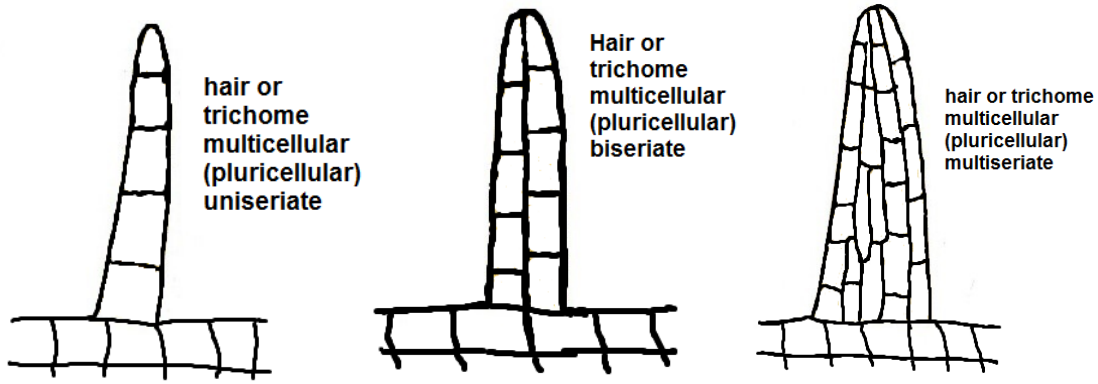


Figure 34 biseriate

biserrate (L. *bis* twice + *serra* saw) With the teeth of serrate margins themselves serrate.

bisexual (L. *bis* twice + *sexualis* f. *sexus* f *secare* to divide (i.e. male and female) Both male and female sexes present in individual plant body. In ferns and lycophytes, a prothallus (gametophyte) that bears both archegonium (the female sex organ) and antheridia (the male sex organ) and therefore produces both male and female gametes. Such a prothallus or gametophyte is therefore also **monoecious** ("one-housed").

bivalvate (L. *bis* twice – *bivalvis* two valved) Having two valves, as in the two-flapped indusium of *Hymenophyllum* spp. .

blade The flat expanded leafy part of a frond above the stipe (petiole), or a lycophyll leaf (which is sessile) also known as **lamina**. The blade may be simple or divided (compound).

bloom A waxy, powdery surface secretion.

bog Habitat with waterlogged vegetation, open, often *Sphagnum* moss dominated, acidic and nutrient-poor (ombro-trophic or oligotrophic), water largely derived from rainfall and relatively stationary. A subcategory of **mire** (any wetland, whether swamp or bog with substantial peat. In bogs, only a few well-adapted plants can grow. These include bog pine (*Halocarpus bidwillii*), umbrella fern (*Gleichenia dicarpa*), sundew (*Drosera* sp.), and sphagnum moss (*Sphagnum* sp.). **Decomposition** in bogs is slow and incomplete which leads to the formation of **peat**. Compare **fen** and **swamp**.

boreal (L. *borealis* northern) Northern, of northern distribution or native to Northern Hemisphere. Particularly of the northern coniferous forest (taiga). Opposite of **austral**.

botanical region A floristic geographic region such as the New Zealand botanical region with the native flora indigenous or endemic found there.

brachyblast (Gr. *brachy* short + *blast* bud, sprout) A short lateral branch.

branch A division or subdivision of an axis (e.g. stem).

branching patern (rachis):

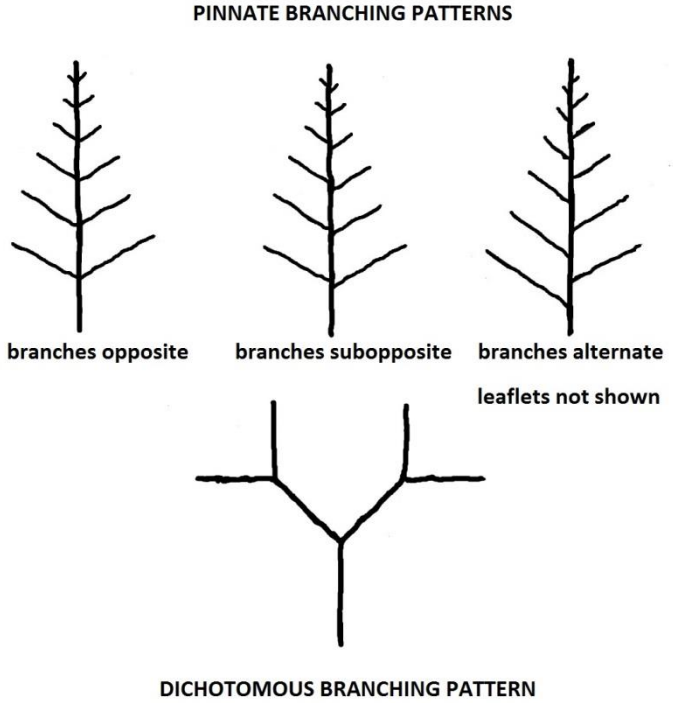
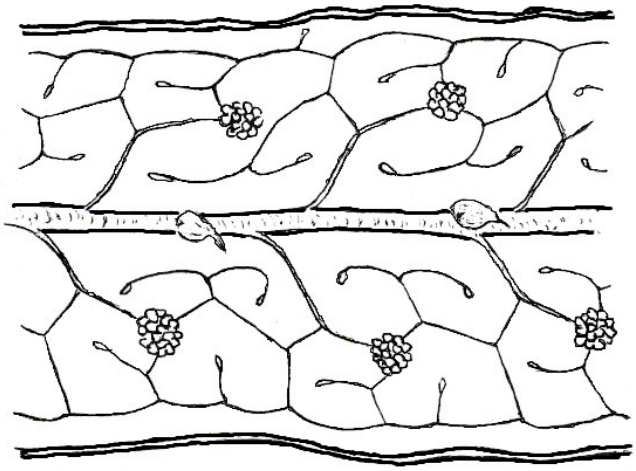


Figure 35 branching pattern

bristle: A stiff hair (**seta**) which is more than one cell thick at the base. See **seta**, **setaceous**.

broad-leaf forest Forest dominated by flowering plant trees or angiosperms other than beech trees, also known as hardwood forest. Trees include southern & northern rata, tawa, taraire, kamahi, towai, puriri, rewarewa, hinau, kohekohe, kanuka. Compare **beech forest**, **arapod forest**, **kauri forest**, **kauri/podocarp/broad-leaf forest**, **podocarp forest**, **mixed beech/podocarp/broad-leaf forest.**

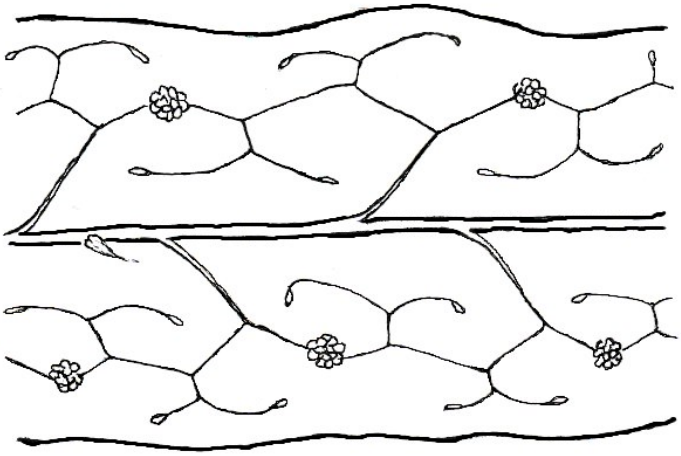
brochidiodromous (Gr. *brochido*, noose, loop + *dromos*, running, racecourse) A type of pinnate, **camptodromous** venation in which secondary veins do not terminate at the margin , but instead form a loop near the margin, joining other more distal, secondary veins. (**leaf venation**).

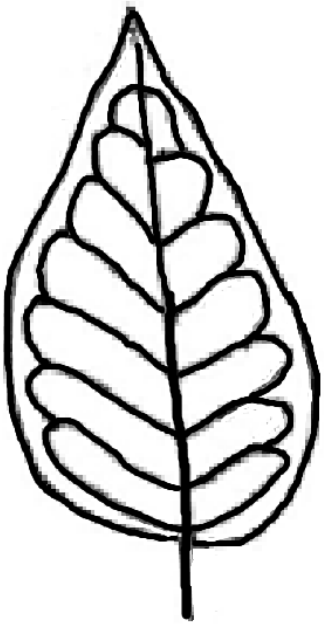


Clade Eupolypod I ferns with weak brochiodromous venation
Note continuous wavy vein near and parallel to margin
Areoles present with free included veinlets

4 mm

Zealandia pustulata* subsp. *pustulata
syn. *Microsorum diversifolium*





Brochiodromous 2° veins form a series of loops and don't reach the margin

Betty Dallas Duncan artist

Dendroconche scandens
syn. *Microsorum scandens*

Diagrams from 'Ferns and Allied Plants of Victoria, Tasmania and South Australia' 1986
Betty Dallas Duncan & Golda Isaac. Melbourne University Press.

Figure 36 brochiodromous venation

bryophytes (Gr. *bryon* moss + *phyton* a plant) The mosses (musci), liverworts and hornworts - nonvascular land plants that reproduce by spores and have a conspicuous and persistent independent gametophyte and a dependent sporophyte that is unbranched and with a single apical case. Comprising three separate phyla or evolutionary lines known as Bryophyta (Mosses, or Musci), Marchantiophyta (liverworts or Hepaticae) and Anthocerotophyta (Hornworts). Note “bryophytes” is a collective informal name for the mosses, liverworts and hornworts, while the formal name Bryophyta applies only to the mosses. All three lineages lack vascular tissue containing lignin and branched sporophytes bearing multiple sporangia (polysporangiate condition). The prominence of the gametophyte in the life cycle is also a shared feature of the three bryophyte lineages (extant vascular plants are all sporophyte dominant).The mosses and a majority of the liverworts are leafy (phyllid bearing), while many liverworts and all hornworts are thalloid. Frequent growing companions of ferns. The earliest embryophytes – plants where the egg is fertilized and remains in the archegonia, grows into a multicellular embryo and then into the plant-like sporophyte which when mature sheds spores. The three bryophyte lines plus the vascular plants (Tracheophytes) comprise the clade embryophyta, = land plants. The vascular plants evolved from an

unknown “bryophyte” ancestor possibly close to the hornwort clade.

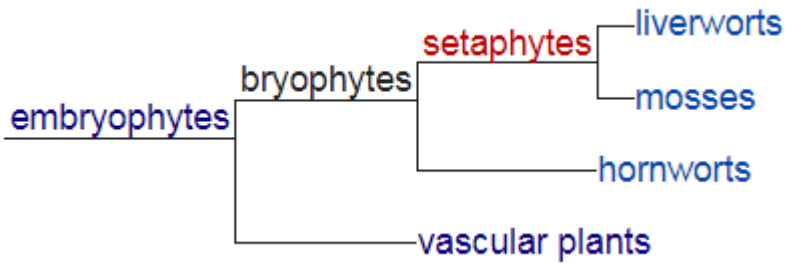


Figure 37 Monophyletic Bryophyte phyllogeny

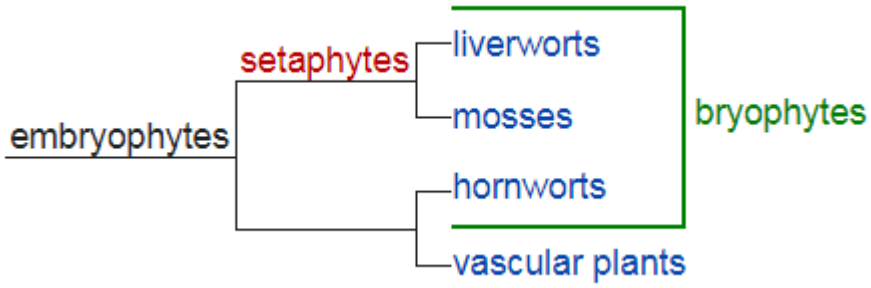
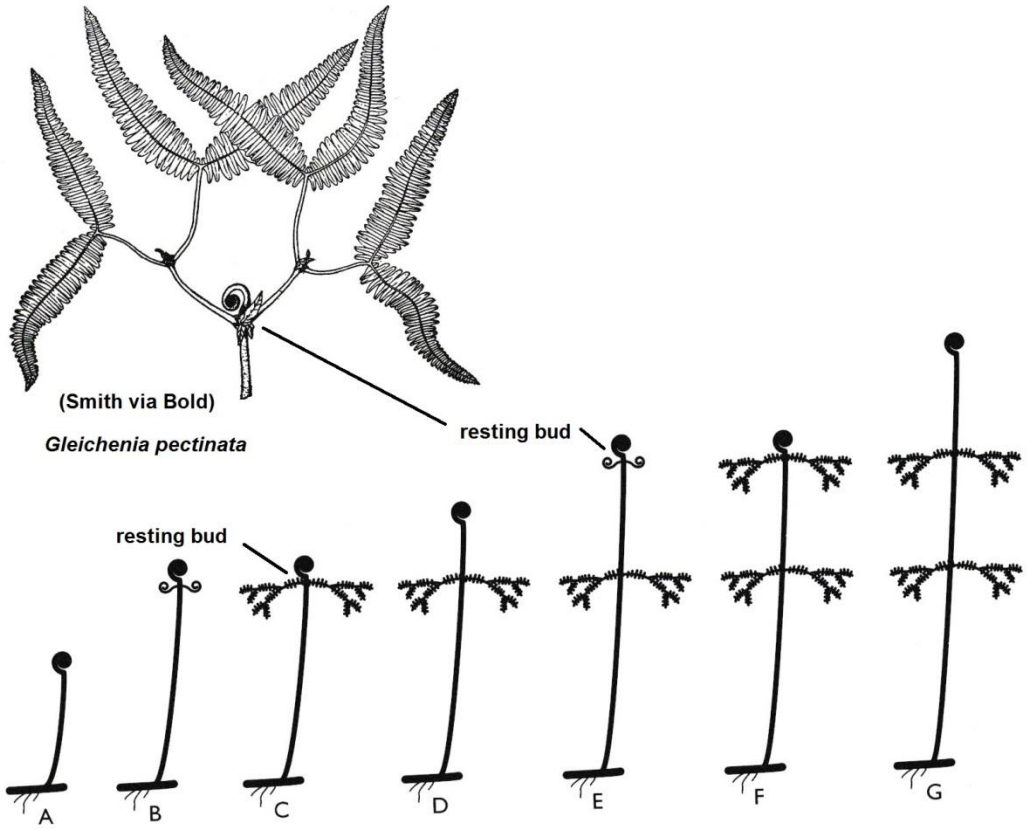


Figure 38 Polyphyletic bryophyte phylogeny

bud An undeveloped shoot; in ferns often used as an alternative to bulbil or bulblet, that is capable of growing into a new fern plant. Forms from secondary meristematic tissue that develops into a new plant. See **asexual reproduction**.



Characteristic leaf growth of forked ferns (Gleicheniaceae). A fiddlehead arises from a creeping rhizome (A); a resting bud forms at the apex while two pinnae develop beneath it (B); the pinnae unfurl (C); the bud resumes growth (D); the bud rests and another pair of pinnae develop beneath it (E); the pinnae unfurl (F); the process repeats itself (G). By this intermittant growth, the leaves of some forked ferns can reach 65 feet (20 m) in leangth, supporting their weight by reclining on surrounding vegetation.

'A Natural History of Ferns' 2004. Robbin C. Moran. Timber Press

Figure 39 bud

bulbiferous (L. *bulbus* a modified bud, usually underground + *-fer* bearing f. *ferre* to carry) Bearing bulbils (bulblets or buds), e.g. *Asplenium bulbiferum, Polystichum proliferum*. A form of asexual/vegetative reproduction**.**

bulbil or **bulblet** A small bulb or bud borne on the lamina; a mode of vegetative (asexual) reproduction. Synonym: **pikopiko**. Example *Asplenium bulbiferum*.

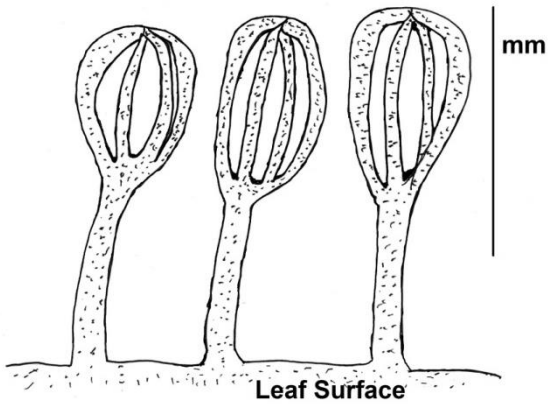
Bulbils or plantlets growing on a frond of *Asplenium bulbiferum*.

'FERNS' A COMPREHENSIVE GUIDE TO GROWING FERNS FOR THE HOME GARDENER'1994. Gilean Dunk. Angus & Robertson (publisher)

Figure 40 bulbil

bullate: (L. *bulla* bubble) Having a blistered or puckered surface. *Lophomyrtus bullata* a native shrub with blistered leaves.

buoancy hair/floatation hair A modified hair **(trichome**) – looped and united at the apices forming a cage like or egg-whisk like structure that aids flotation in some of the water ferns. *Salvinia* sp. Essentially stellate but with the arms curving upwards and fusing at the tip. (I confess I made up this term, but it seemed appropriate).



Buoyancy or flotation hair of the aquatic fern *Salvinia molesta*
Looped egg-whisk or egg-beater-like

Figure 41 buoancy hair

caducous (L. *caducus*, tending to fall) Shed easily.

caespitose (L. *caespes*, turf) Growing in a tuft or tussock. In general ferns of this habit are simply called **tufted**.

Cainnozoic/ Cenozoic era (Gr. *kainos*,new + *zōion* animal + -ic.) The geological time era beginning at end of the Cretaceous period 65 million years ago upto 10,000 years ago including the Tertiary (now Paleogene and Neogene periods) and Quaternary periods.

calcareous (L. *calx,* lime or chalk)) An area rich in lime (Calcium carbonate), as in soil derived from limestone.

calcicole (L. *calx,* lime or chalk + -*cole*, inhabitant) A plant preferring to grow in lime-rich (**calcareous**) soil. Synonym **calciphil**/**calciphile**. Antonym **calcifuge**/**cacliphobe**.

calcifuge ((L. *calx* , lime or chalk + *fugere* to flee) A lime-hating plant, e.g. *Cryptogramma crispa*. Synonym **calciphobe, oxylophil, acidophilic.**. *Antonym* **calciphil**.

calciphil or **calciphile** (L. *calx* , lime or chalk + Gr. *philos* loving) A lime-loving plant, e.g. *Adiantum capillus-veneris.* Synonym **basophil** –preferring a basic habitat. Opposite **calcifuge**, **calciphobe**, **oxylophil, acidophilic.**.

calciphobe (L. *calx,* lime or chalk +) A plant that wont grow in calcium rich habitats Synonym **calcifuge oxylophil, acidophilic.**. Opposite **calciphile**.

cambium (L. *cambiare*, to exchange) A meristem that gives rise to parallel rows of cells, commonly applied to the ‘twin cams’ - the vascular cambium –which produces wood and the cork cambium or phellogen which produces bark. Responsible for secondary growth in many seed plants, but rare in extant ferns and lycophytes. In the stems of the fern *Botrychium* cambium adds secondary vascular tissue to the primary and it also has periderm. While the aquatic lycophyte *Isoetes* has a cambium-like layer in the corm that increases its girth.

camptodromous (Gr. *kampe*, to bend, L. *campto*-, bent, curved f. *kamptos*, flexible + *dromos*, running, racecourse) “bent running veins”. Pinnate leaf venation in which secondary veins do not reach the margin. Includes **brochidiodromous**, **eucamptodromous**, **cladodromous**, **reticulodromous**.

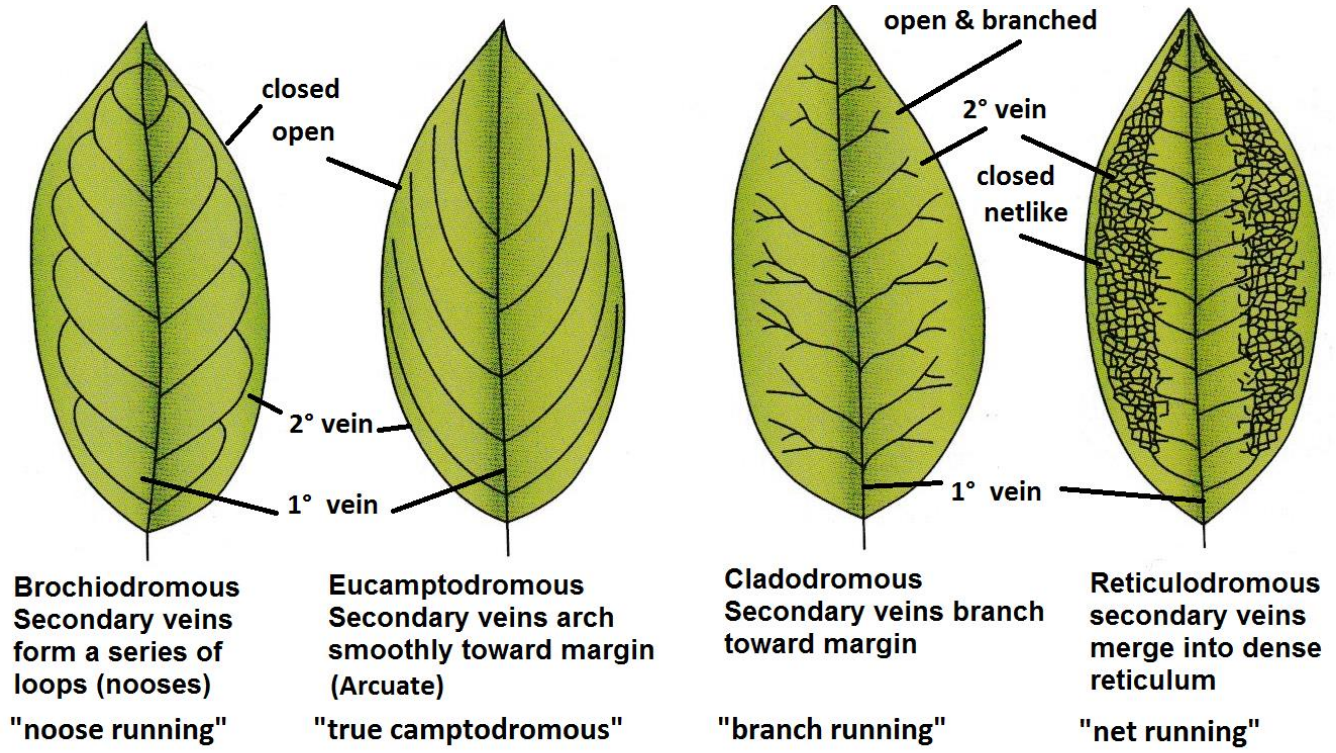


Figure 42 camptodromous venation

campylodromous (Gr. *kampylos*, bent + *dromos*, running, racecourse) “bent running veins” .Leaf venation where several primary veins run in prominent, recurved arches from the base towards the leaf apex. In acrodromous the arches are not recurved at the base. Note the etymology is allied to **camptodromous**.

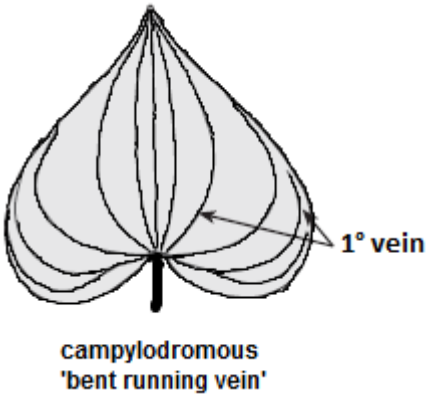


Figure 43 campylodromous venation

canescent (L. *canescens*, f. *canus* ,white, hoary) With a dense covering of short, grey or white hairs, e.g. *Hymenophyllum malingii.*

canopy (Gr. *kanopeion* , a cover over a bed to keep off gnats or mosquitos) (1.) Uppermost layer of foliage in a forest. Forest emergents are the tallest trees and rise above the average canopy height (forest stratification). (2.) The leafy portion of a tree fern.

capillary (L *capillus* hair) Hair-like. More delicate than **filamentous**.

capitate (L. *capitatus*, headed, f. *capit-*, *caput* head) Said of hairs, having a rounded apical cell (head).

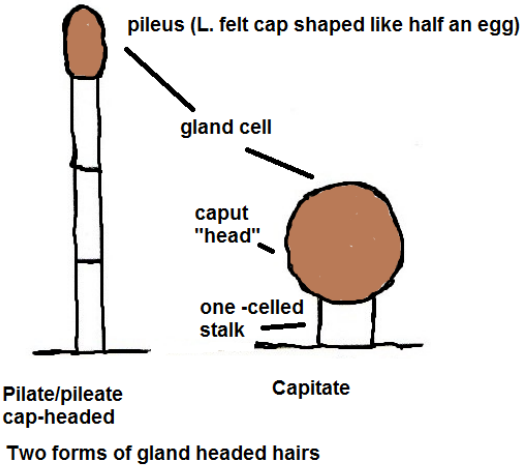
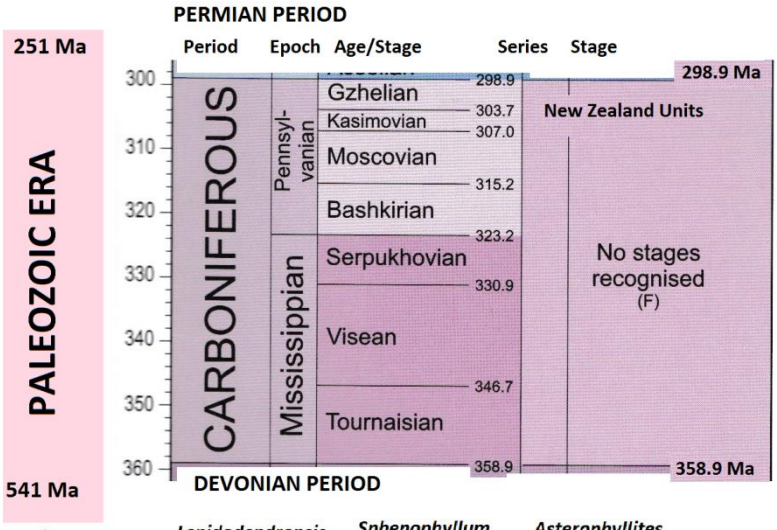


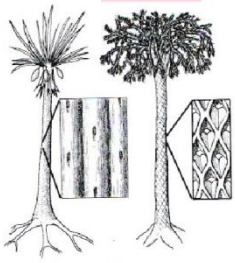
Figure 44 capitate

Carboniferous Period (L. *carbō* ,coal + *ferō* ,bear, carry- refers to the many coal beds formed globally during that time). The chronostratigraphic (geological) time period from the end of the Devonian Period 358.9 million years ago (Mya), to the beginning of the Permian Period, 298.9 million years ago.



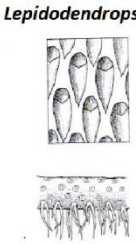
Carboniferous Period approximately 360 - 299 million years ago.

The first trees and forests hence the coal Marratoid tree ferns (*Psaronius*) and arborescent Lycopods (*Lepidodendron*) and arborescent horsetails (*Calamites*) + the first conifers and many pteridosperm trees and lianes.



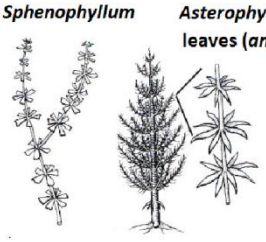
Sigillaria ***Lepidodendron***

Arborescent lycopsids (related to *Isoetes*) (1)



Lepidodendropsis

Stimaria **lycopsid root**



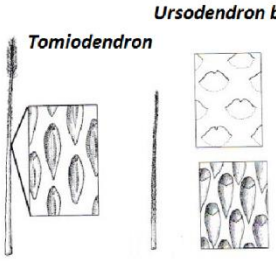
Sphenophyllum

Asterophyllites **leaves (*annularia*)**

Calamites

Sphenopsids (horsetail relatives) (1 & 2)

Pteridosperms (Gymnosperm) (1)



Ursodendron bark

Tomiodendron

juvenile lycopsid

Non-arborescent lycopsids (1)

Medullosa noei

Pteridospem (2)

Lepidodendron

Lycopsid (2)

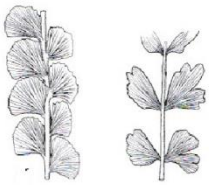
Psaronius

Tree fern (2)

Cordaite tree (2) (Gymnosperm-conifer line)

Lebachia piniformis

early conifer (2)



Botrychioperis plantaniana

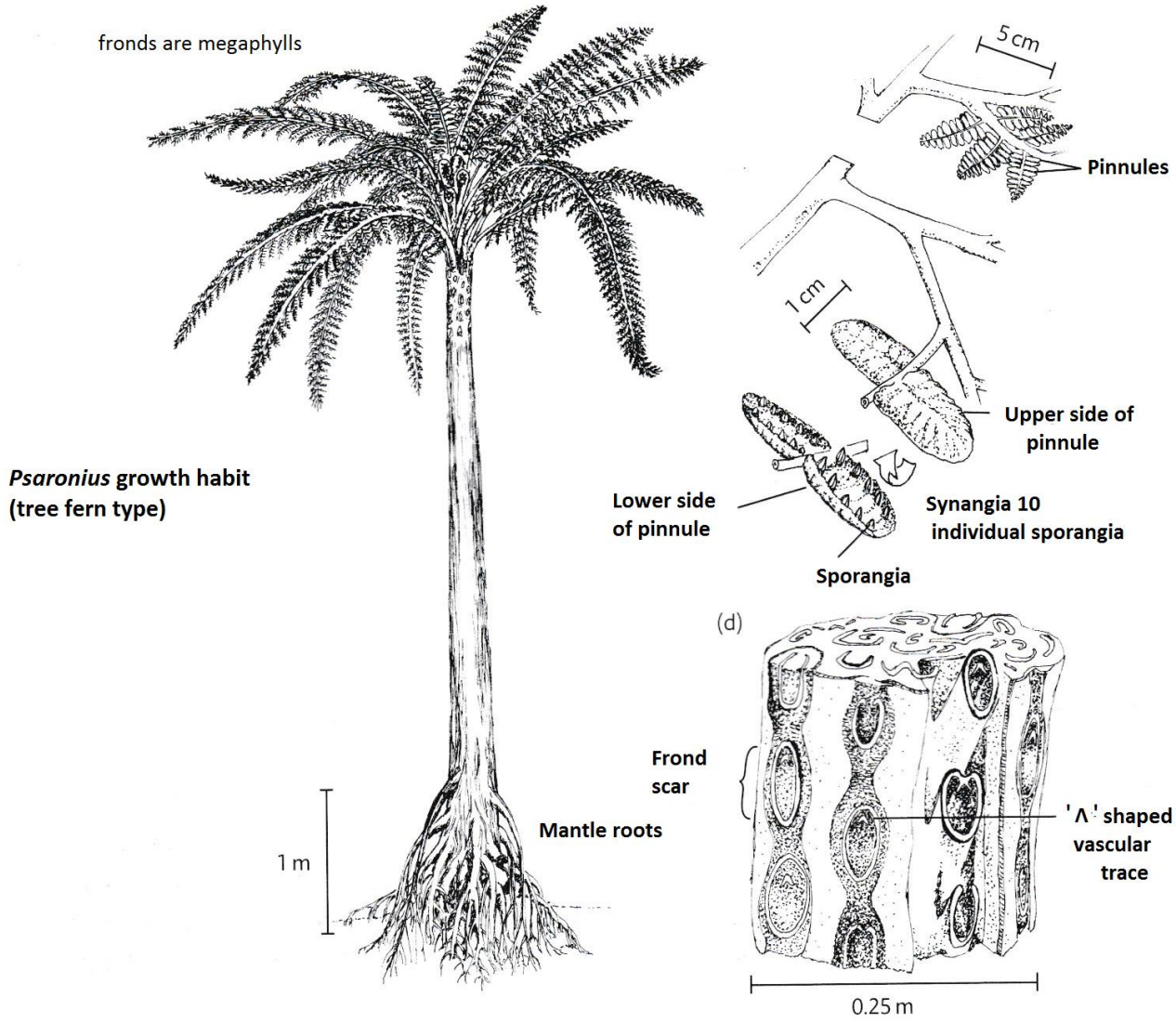
frond

Rhacopterid frond Pteridosperms (2)

A variety of plants from the early (1) and late Carboniferous period (2)

adapted from 'The Evolution of Plants'. 2014 (2nd ed.). K. J. Willis and J. C. McElwain Oxford University Press

Figure 45 Carboniferous Period

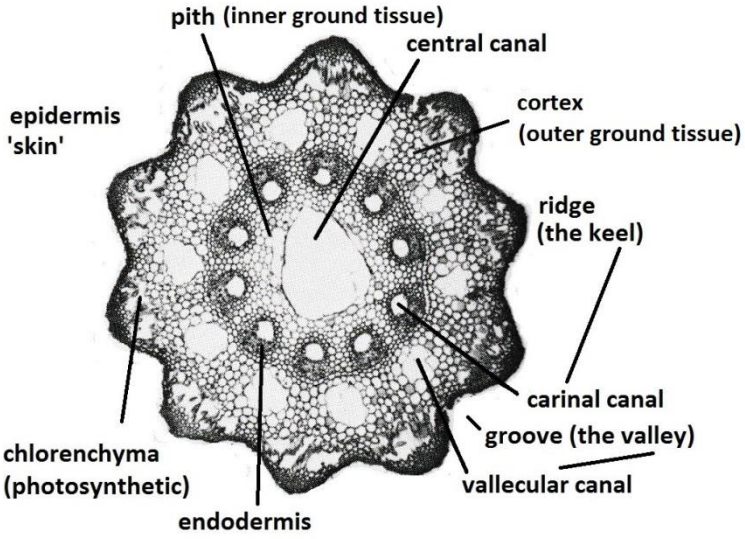


Psaronius a Carboniferous Marratoid fern circa 360 (Ma) grew in *Lepidodendron* swamp forest

Adapted from 'The Evolution of Plants' 2014 (2nd ed.). K. J. Willis and J. C. McElwain. Oxford University Press

Figure 46 Carboniferous fern (*Psaronius*)

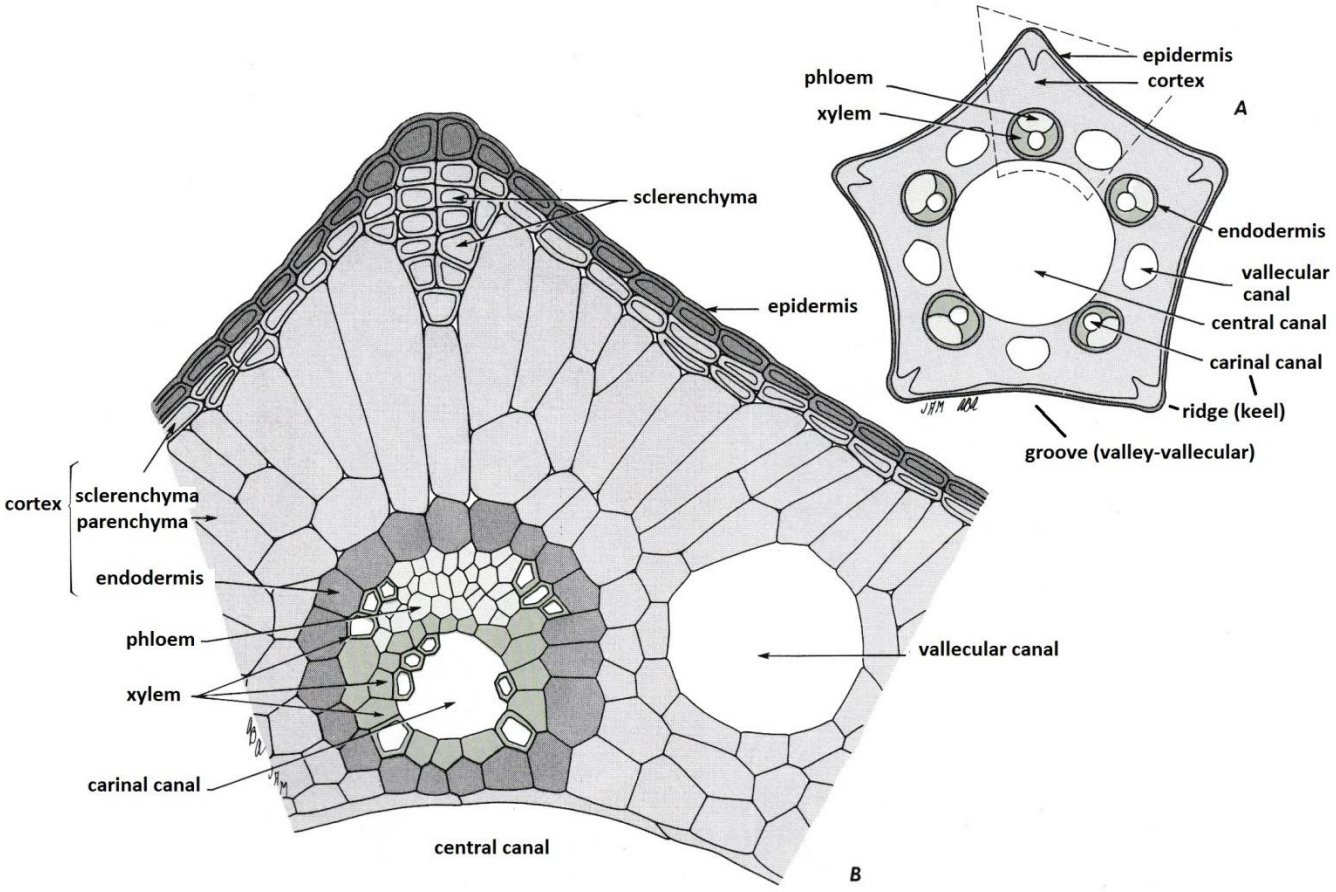
carinal canal (L. *carinal* f. *carina* , hull or keel, half of a nutshell) A canal beneath a stem ridge (the keel) associated with a vascular bundle. Compare **vallecular canal**. See **carinate**.



Equisetum sp. C.S. stem -note three longitudinal cavities (canals)

Modified form 'Morphology of Plants and Fungi' 4th ed. 1980
Harold C. Bold, Constantine Alexopoulous, Theodore Delevoras
Harper International Edition

Figure 47 carinal canal

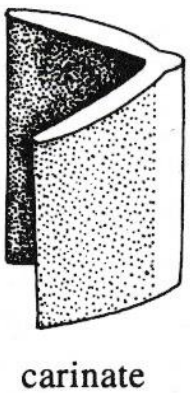


Cross section of *Equisetum* stem. A. diagram showing arrangment of stem tissues x 70. B. elarged view showing details of cellular structure x 400. Note three types of longitudinal cavities: central canal, vallecular canal and carinal canal.

Adapted from: Weir, T. Elliot, Stocking, C. Ralph, Barbour, Michael G., Rost, Thomas L. 1982. Botany An Introduction To Plant Biology. John Wiley& Sons

Figure 48 carinal canal, vallecular canal & central canal *Equisetum*

carinate (L. *carinatus* f. *carina* , hull or keel, half of a nutshell) Bearing a keel on the lower surface or **keeled.** Sharply folded in the middle producing the shape of a boat keel. Bearing a ridge.



carinate

Figure 49 carinate

cartilaginous (L. *cartilago*, gristle) Hard and tough but flexible ,like cartilage or gristle.

castaneous (L. *castanea*, chestnut) Deep reddish brown or chestnut coloured.

catadromous (Gr. *kata*, down + *dromos* run, running, raceway – running down) Tending downward, applied to a type of venation in which the first set of veins in each segment of the frond develops from the basiscopic (basal/lower) side of the midrib, and in leaf architecture to first lobe or segment of a pinna arising acroscopically in compound leaves, e.g. *Cyathea dealbata, Lastreopsis* spp. Opposite **anadromous**. See illustration below.

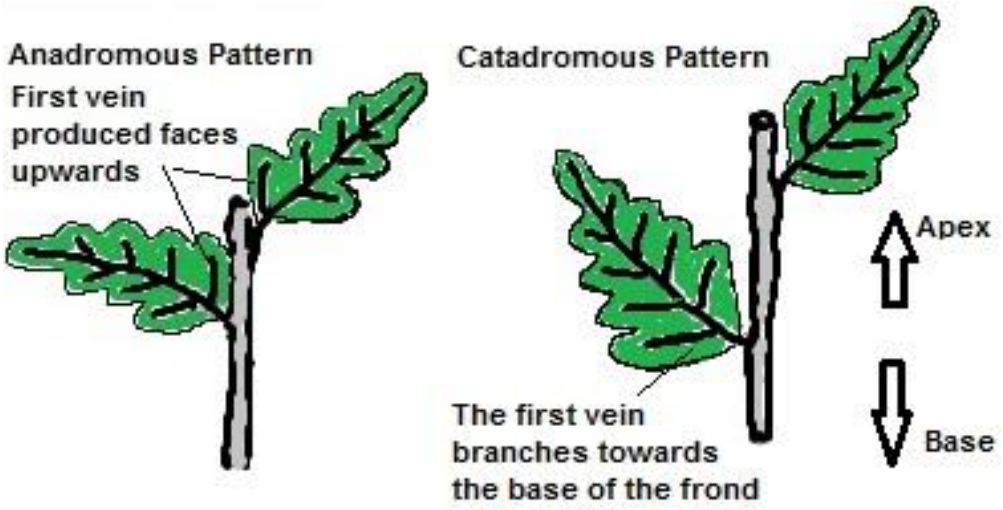


Figure 50 catadromous

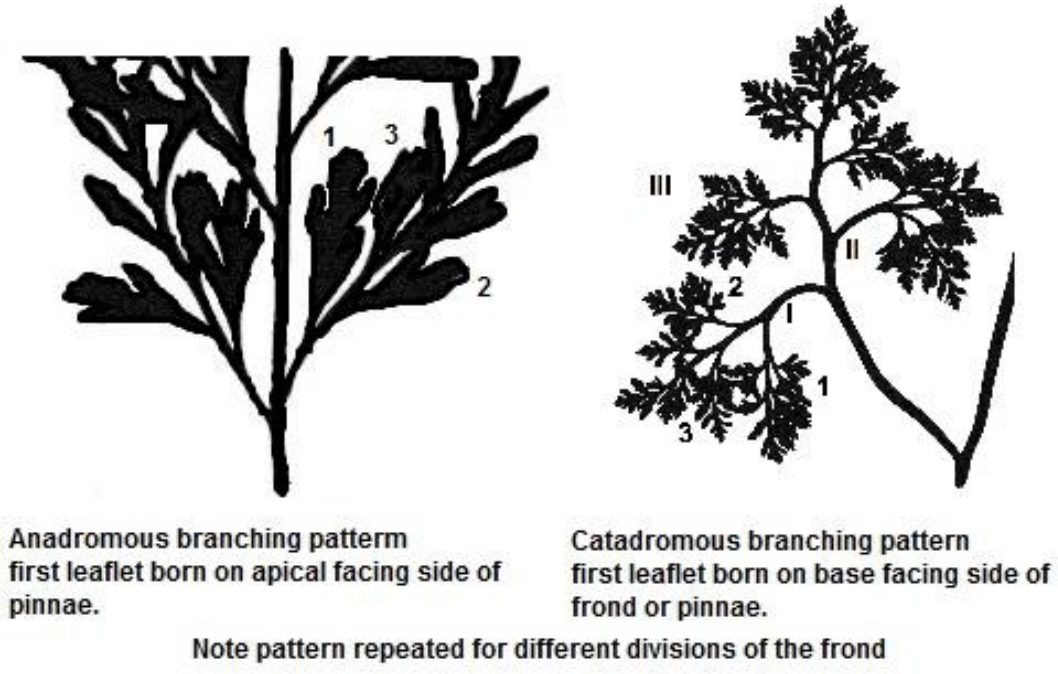


Figure 51 catadromous venation & branching

catadromic branching (Gr. *kata*: down, against; *dromos*: raceway,run) Where the first branch of a segment is given off towards the base of the lamina, pinna or pinnule. Opposite of **anadromic branching.**

catenate (L. *catena*, chain) United or linked as in a chain.Such as catenate hairs.

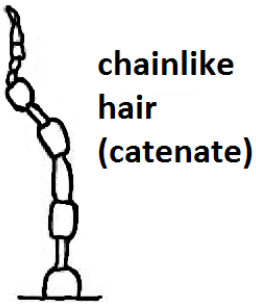


Figure 52 catenate or chain-like hair

cathetogyrates (Gr. *kathetḗr*, surgical instrument for emptying the bladder, f. *kathíēmi*, to descend, let down + *gyros* a circular motion,) A informal synonym for the Polypodiales which are unique in bearing sporangia with a vertical annulus interrupted by the stalk and stomium. These sporangial characters were used by Johann Jakob Bernhardi (1806) to define a group of ferns he called the "Cathetogyratae"; the Pteridophyte Phylogeny Group has suggested reviving this name as the informal term cathetogyrates, to replace the ambiguously circumscribed term "polypods" when referring to the Polypodiales. The sporangia (cathetogyrate) are born on stalks 1–3 cells thick and are often long-stalked.

cauda (L. *cauda*, tail) A narrow tail-like appendage. adj. **caudate**. With a tail-like appendage.

caudex pl. **caudices** (L. *caudex*, trunk or stem of tree) The erect trunk-like rhizome, of tree ferns. Or the small erect fern rhizome e.g. *Diploblechnum fraseri* sometimes called a miniature tree fern.

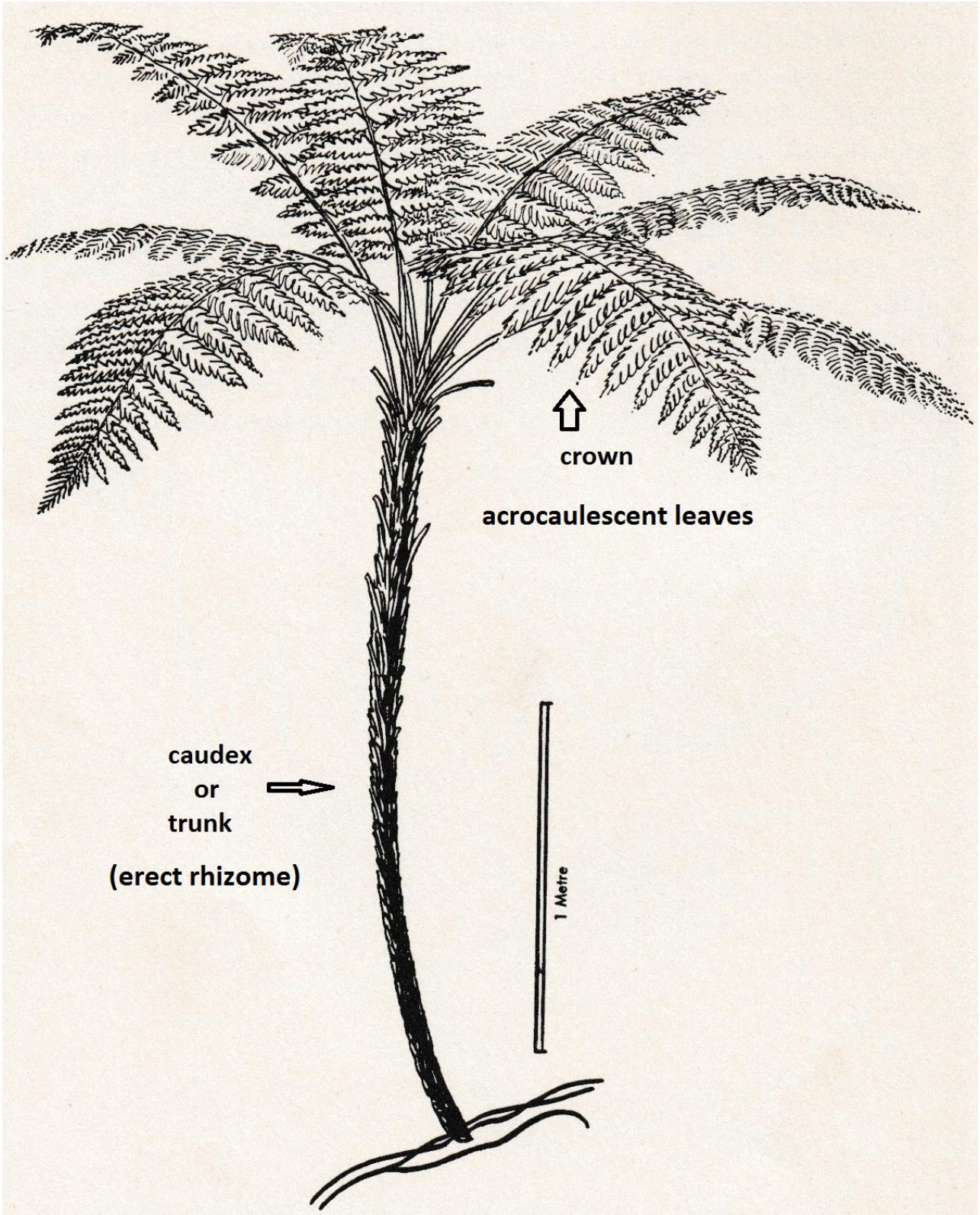


Figure 53 caudex (trunk)

caulescent: (Gr. *kaulos*, a plant stem) Developing an aerial stem or trunk. Compare **acaulescent**.

cauline (Gr. *kaulos*, a plant stem) With leaves positioned along the length of the stem. The leaves separated by elongated internodes. Compare **basal/radical** with leaves positioned at the base of a stem

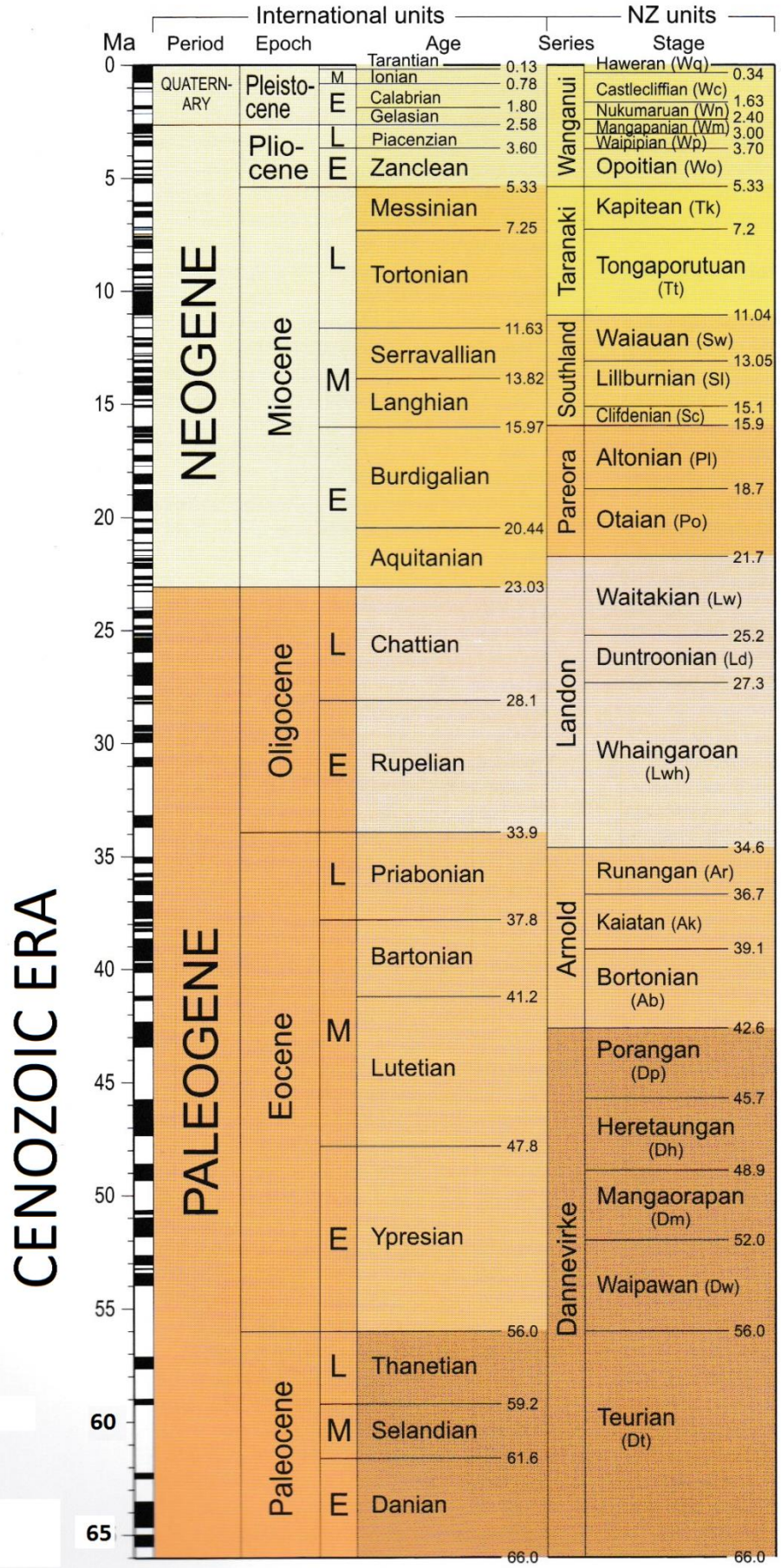
as in a rosette type plant, where the stem may not be evident and hence the term **acauline** applied or **acrocaulis** with leaves positioned at the apex of the stem as in tree ferns.

central canal. The large centrally located air space in the stem of *Equisetium* .

cell types Plants cells can be broadly categorized into three types with a bit of license: namely : **parenchyma** (including meristematic cells), **collenchyma** (partly lignified) and **sclerenchyma** (strongly or completely lignified cells including fibres, sclereids & vascular or conducting cells:- tracheids(xylem), vessel elements (xylem), and sieve cells or elements (phloem). Photosynthetic cells with chloroplasts are called **chlorenchyma**.The three cells types are distributed amongst the three tissue systems: dermal, ground (fundamental) and vascular (conductive). Meristematic cells are the young actively dividing cells whose daughter cells mature as one of the three cell types depending on cell fate.

Cenozoic/ Cainnozoic Era (Greek *kainós* 'new' + *zoḯ* , life). The geological time era beginning at end of the Cretaceous period 66 million years ago upto 10,000 years ago including the Tertiary (now Paleogene and Neogene periods) and Quaternary periods. New Zealand (and Zealandia) had seperated fully from Gondwana by the start of this period. The modern flora of New Zealand evolved. Important events include the “Oligocene drowning”, the Kaikoura orogeny (rise of the Southern Alps), Southern Ocean develops, spots of volcanism and the Quaternary ice ages.

Geological Timescale



Ice ages (glaciation)

Mountain Building Phase Begins (formerly Kaikoura orogeny)

Maximum subsidence 'Oligocene Drowning'

Cenozoic Era from approximately 66 million years ago to 10,000 years ago

66 (Ma)

K/P Extinction event dinosaurs bar birds extinct

MESOZOIC ERA: CRETACEOUS PERIOD (141 -66 Ma)

ceraceous (L. *cera* , wax) Waxy.

ceriferous (L. *cera* , wax + *ferre* , to carry) Wax-producing.

cernuous (L. *cernus*, inclined forwards) Nodding or drooping. *Lycopodium cernuum*.

chaff (old English *ceof* , husks of corn, as threshed or winnowed:cut hay and straw**)** A term sometimes used for masses of thin, dry scales hence **chaffy**. Equivalent to **scurfy.**.

chainlike Multicellular, or uniseriate hairs with adjaceant cells, often with thick end walls, flattened at right angles to each other forming chainlike hairs (**catenate** hairs).

chamaephyte (Gr. *chamae* , ground + *phyte* , plant) A perennial plant less than 25cm tall, having buds at or just above ground level from Danish botanist Raunkiers classification system. A low growing ground fern, e.g. *Hymenophyllum bivalve*. See **hemicryptophyte**, **cryptophyte**, **phanerophyte**.

channelled Deeply grooved longitudinally. See **sulcate**.

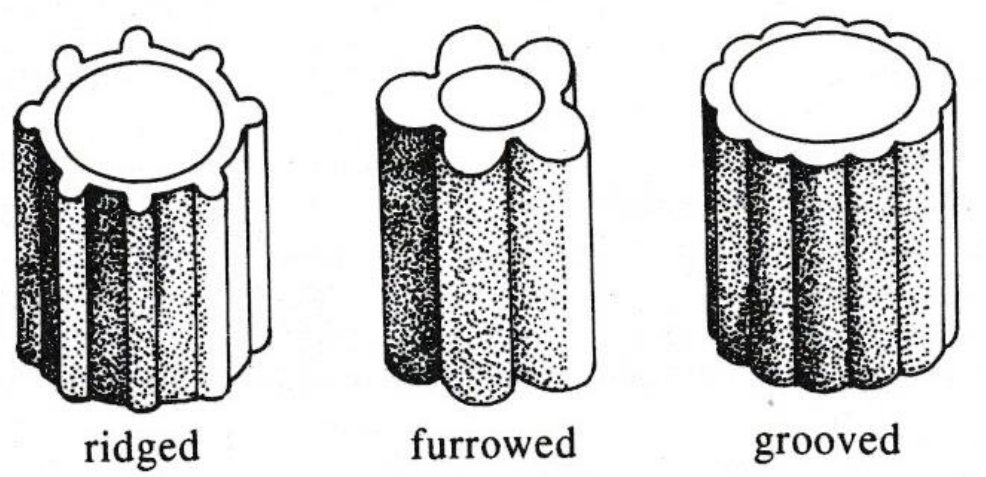


Figure 54 channeled

chartaceous (L. *charta* , a sheet of paper made from papyrus) Thin and papery and often with a brownish green colouration, said of scales etc.

chasmocolous (L. *chasma* f. Gr. *khasma* , abyss, cleft + *colous* living or growing in or on, f. *–cola*, inhabitant) Growing in cracks or crevices, e.g. *Grammitis gunnii*. Similar to **rupestral** etc.

chasmophyte (L. *chasma* f. Gr. *khasma* , abyss, cleft + Gr. *phyton*, plant) A plant rooting in rock crevices of cliff-faces, gorges etc. A **chasmocolous** plant. Similar to **cremnophilous** and **cremnophyte.**

chelanthoid (like *Cheilanthes* (fern genus)) Mostly drought resistant (xeromorphic) ferns belonging to the subfamily Cheilanthoideae within the family Pteridaceae. *Cheilanthes distans, C. sieberi*.

chlorophyll (Gr. *chloros* , green + *phyllon*, leaf) Pigment(s) constituting the green colouring matter of plants and absorbing radiant energy in photosynthesis. adj. **chlorophyllous**.

chlorophyllous (Gr. *chloros* , green + *phyllon*, leaf) Containing chlorophyll, the green pigment for photosynthesis in plants. Opposite **achlorophyllous** – lacking chlorophyll.

chromosome ((Gr. *chroma*, colour + *soma* , body) Structure that carries the genes in a linear order ; in eukaryotes (plants, animals,fungi , protists), chromosomes are found in the nucleus and become visible only during cell division. **Chromosome number** (n) characteristic for species and may be haploid (n) as in gametophytes or diploid (2n) as in the sporophytes and triploid (3n) or polyploid (x?n) in hybrids.

ciliate (L. f. *cil* , eyelash) Fringed with fine hairs (**cilia)** often on the margins of scales.*Notogrammitis ciliata* syn. *Grammitis ciliata* .

cilium, pl. **cilia** (L. f. *cil* , eyelash) Minute, hair-like process. **Ciliate –** bearing cilia.

circinate (L. *circo* , *circino* to turn round)) Coiled from the apex downwards, as in young fern fronds. The **koru**,**fiddlehead, monkey tail** or **crozier** pattern of leaf vernation.

circinate vernation (circinate + vernation) The circinate pattern of leaf development. The majority of ferns follow this pattern as do two cycad genera. The **koru**,**fiddlehead, monkey tail** or **crozier** pattern of leaf vernation. See also **non-circinnate** or **erect vernation**

circumaustral (L. *circum* , around + *austral,* southern) In biogeography, distributed around the southern hemisphere particularly the colder southern regions. Compare **circumboreal**. See **austral** and **boreal**.

circumboreal (L. *circum* , around + *borealis* northern) In biogeography distributed around the northern hemisphere particularly the colder northern regions. Compare circumaustral. See boreal and austral.

clade (Gr. *klados*; branch, shoot) A a group of closely related organisms – a monophyletic group or lineage. The taxa share a common ancestor. **Classification** gives a formal rank name to the clades e.g. family or genus. However some clades are informal such as the two filmy fern clades, sister groups in the family Hymenophyllaceae referred to as the “trichomanoid” clade (including *Trichomanes*) and the “hymenophylloid” clade” (including *Hymenophyllum*). See **monophyletic**.

cladodromous (Gr. *klados*; branch, shoot + dromos, running, racecourse) A form of pinnate, camptodromous leaf venation in which the secondary veins do not terminate at the margin and branch towards and near the margin. A study by Tan and Buoy indicated that many ferns belonging to the polypod clade Eupolypod I had cladodromous venation this group included *Davalia* sp, *Nephrolepis* sp..

cladose hairs (Gr. *klados*; branch, shoot + hairs) Hairs or trichomes that branch. See **biramous**, **dendritic and stellate** hairs.

class The taxonomic rank above and which includes **orders** (which include **Families**) in **classification**. Ending –**opsida**, e.g. Psilopsida (fork ferns), Lycopsida (club mosses, spike mosses and quillworts), Equisetopsida (Horsetails), Filicopsida (True Ferns). See **classification**.

classification Organisms are grouped with related organisms descended from a common ancestor and ranked according to the degree of relatedness. The groups are either given a formal rank name, such as species, genus, family or an informal clade name. Informal clades can be squeezed in between formal ranks. Below is a table of the taxonomic hierarchy with examples from the fern group of plants.

Rank	Suffix used	Abbreviation if applicable not italicized or underlined	Clade name
domain (Woesse 1990)	There are 3 domains: Eubacteria, Archae and		Eukaryota
kingdom	The plant kingdom:		Plantae
subkingdom	-bionta		Tracheobionta (vascular plants)
division (phyla animals)	-phyta		Polypodiophyta (ferns)
subdivision	-phytina		Euphyllophytina (euphyllophytes)
infradivision	- opses		Moniliformopses (monilophytes)
class	-opsida		Polypodiopsida/Filicopsida or Leptosporangiatea
subclass	-idea		Polypodiidae (leptosporangiate ferns)
order	-ales		Cyatheales (tree-ferns)
suborder	- ineae		
family	-aceae		Dicksoniaceae or Cyatheaceae -sensu lato
subfamily	-oideae		Dickconioideae
tribe	-eae		
subtribe	ineae		
genus	(lacks a uniform ending)		*Dicksonia*
subgenus			
section		sect.	
subsection		subsect.	
species		sp. spp. (plural)	
subspecies		subsp. subspp. (plural)	*Dicksonia lanata* subsp. *lanata* *Dicksonia lanata* subsp. *hispida*
variety forma		var. f.	

Note not every rank is used depending on the taxa

Generic names and names of ranks below italicized or underlined (writing) but not the abbreviations.

two subspecies of *Dicksonia lanata*

wooly dwarf tree fern

stumpy tree fern, tuokura

clathrate (L. *clathratus* fitted with bars as in a lattice) Lattice-like (clathroid) as in the scales of *Asplenium* spp. the cell walls are thickened or darkened, giving a lattice-like appearance. Pierced with holes, like a lattice.

clava pl. **clavae** (L. *clava* , a club, knotty branch) Club-shaped, spore wall ornament or a hair with the greatest diameter less than the height, the diameter greatest at the top, less at the bottom.

clavate (L. *clava* , a club, knotty branch) With **clavae**,club-shaped (**claviform**) elements or hairs.. **Terete/cylindrical** with gradually tapering and thickened and rounded end.

claviform (L. *clava* , a club, knotty branch) Club-shaped (**clavate**). **Terete/cylindrical** with gradually tapering and thickened and rounded end.

cleft Deeply cut, with sinuses extending from ¼ to ½ the distance to the central axis (e.g. midrib). Leaf division term. See **–fid**, **pinnatifid**, **palmatifid**.

climbing fern/clubmoss A fern or lycophyte that climbs over other plants with the help of a slender, elongate rhizome (bearing roots) e.g. *Blechnum filiforme* or elongate rhachis (rootless) with twinning leaves, e.g. *Lygodium,* See also **liane**.

clone (Gr. *klon* , shoot)) A group of vegetatively propagated and therefore genetically identical plants derived from a single individual; in nature a form of asexual reproduction that can be achieved by long-creeping rhizomes, gemmae, budding, etc.

close Closely spaced, nearly touching; said of hairs, scales, stipes, pinnae, or segments. Synonym **close-set**. Opposite of **distal** or **remote**.

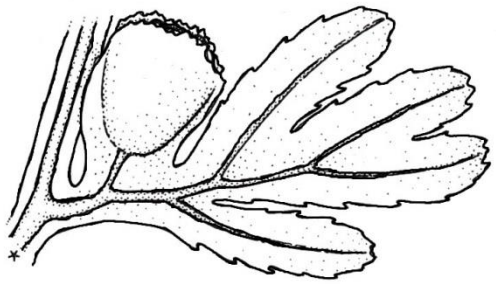
close-set Set very close or touching. Said of leaves, leaflets, hairs, scales etc. See **close**.

climate zone In New Zealand ranges from subtropical (Kermadec Islands) , warm temperate (Northern lowland NZ -coastal extends the warm temperate zone further south, cool temperate and cold temperate (subantarctic islands). Latitude and altitude and proximity to sea, ocean currents combine to influence this. Alpine resembles arctic or antarctic climate. Montane will be cool to cold temperate. While geothermal areas introduce a tropical or subtropical element.

clustered Fronds clustered at the tips of rhizomes. See **close-set**.

coalescent (Gr. *koinos* , shared in common + L. *alescere* , to grow up) Separate organs united by growth.

coenopteridian (f. fossil fern genus *Coenopteris*) Venation pattern in which there is a single unbranched midrib in each undivided frond or segment of a divided frond. Example



Hymenophyllum cupressiforme
Coenopteridian Venation

Drawing Tim Galloway in 'New Zealand Ferns and Allied Plants' (2000) P.J. Brownsey & J. C. Smith-Dodsworth; Bateman

Figure 55 Coenopteridian venation (Mettenius)

coenosorus pl. **coenosori** (Gr. *koinos* , shared in common + L. *soru*s, f. Gr *soros* , heap) An extended sorus or a combination of sori which have united/fused with contiguous sori so as to appear as one. Also known as a **fusion-sorus.** Example *Lindsaea* spp., *Blechnum* spp., *Pteris* spp., *Pyrosia eleagnifolia* etc.

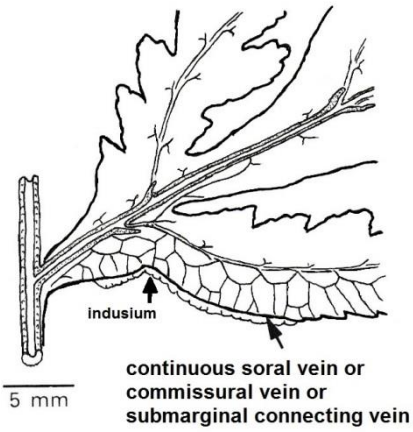
-cola, -colous (L. –*cola*, inhabitant, *colous* living or growing in or on. L. *cola*, inhabitant f. *colere* or *coloreto*, to live in a place, to inhabit) Suffix meaning living in or on habitat denoted by prefix e.g. **saxicolous**, growing on rock or **terricolous**, growing in earth (soil). Compare –**philous.**

collenchyma (Gr. *kola*, glue + *enchyma*, to pour in f. parenchyma) A cell type with unevenly thickened primary walls (thickening usually occurs in the corners) usually elongate with chisel-shaped interlocking ends ; important support tissue in primary growth- young stems and leaves. Often photosynthetic as well, hence may class as **chlorenchyma**. Modified from the **parenchyma** cell type, but not as modified as **sclerenchyma**. Like parenchyma they are not lignified.

columella (diminutive of L. *columna* a pillar or column) The axis of a cone or cone-like fruit, e.g. in *Diselma*. The stem of a branched (e.g. stellate) hair, e.g *Pyrossia eleagnifolia.*

commissural face (L. *commissura* a joint, juncture or seam f. *commissus* to join together + face) The face of a spore in contact with an adjaceant spore.

commissural vein (L. *commissura* a joint, juncture or seam f. *commissus* to join together + vein) When veins unite at the ends to form a continuous joint vein. Maybe marginal, submarginal or lateral (when secondary veins themselves lateral to the lateral veins, unite with adjaceant veins in a pinnate pattern). See **venation patterns**.



Pteris carsei* syn. *P. comans
Base of secondary pinna

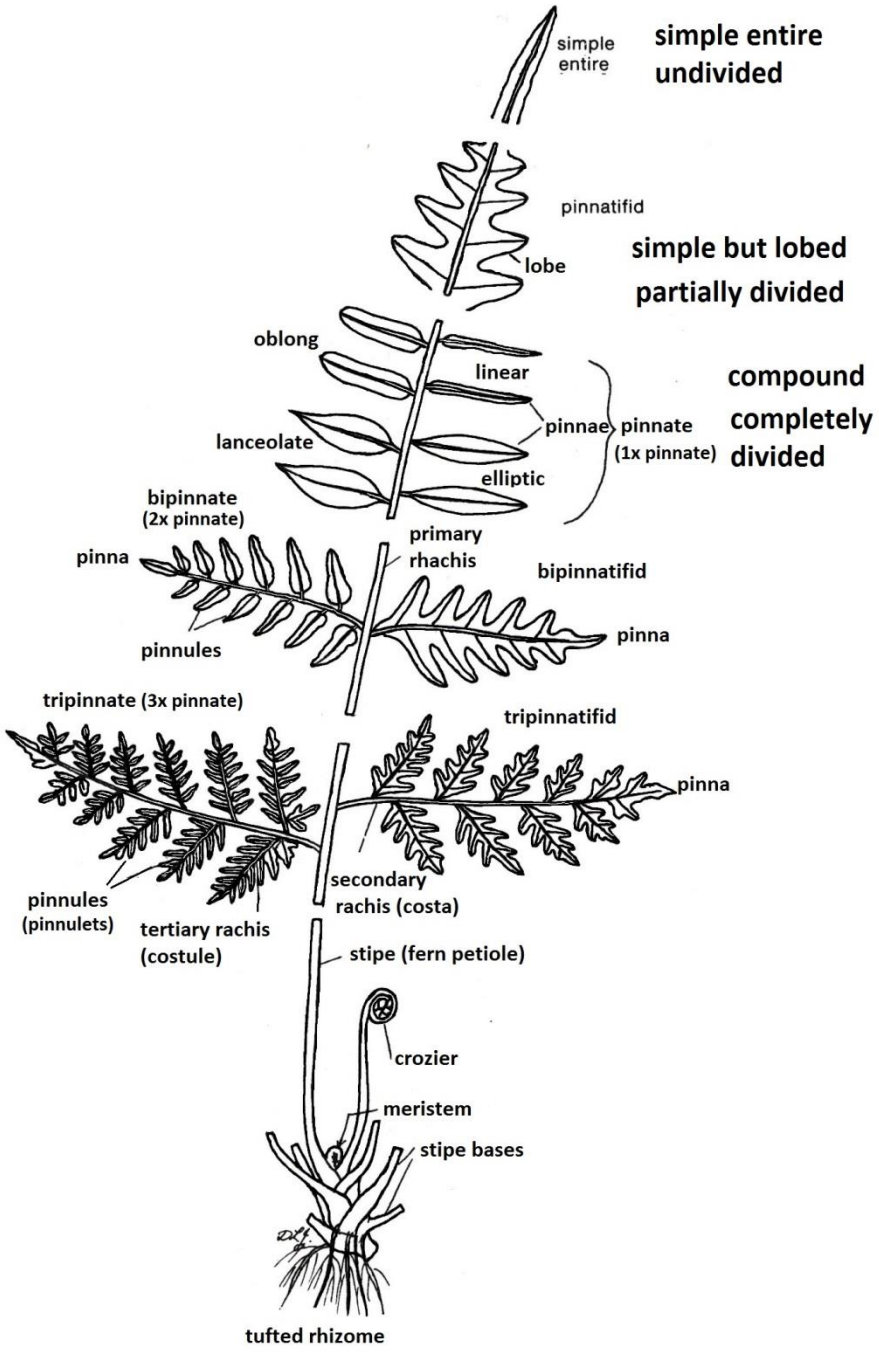
adapted from 'Ferns and Allied Plants of Victoria, Tasmania and South Australia' 1986. Betty D. Duncan and Golda Isaac. Melbourne University Press

Figure 56 commisural vein

commissure (L. *commissura* a joint, juncture or seam f. *commissus* to join together) 1. A joint or seam, place of joining. In *Pellaea*, a continuous marginal sorus formed when laterally expanded fertile vein endings coalesce. 2. Regarding spores, the line of dehiscence in the tetrad scar.

common name (s) An informal name by which a species is named, e.g. hen and chick fern, the common name may be a Maori name for the species, e.g. *mamaku*. Compare **scientic/botanical name**.

compound (L. *compositura* , a joining together, connection) Of a leaf, having the blade divided into two or more distinct leaflets (**pinnae** in ferns). The leaflets may be arranged in a pinnate or palmate pattern – hence pinnately compound or palmately compound. The leaflets themselves maybe divided into seperate segments so compound leaves can be quite complicated in ferns, as is the jargon regarding how lobing merges gradually into separate leaflets.,**Decompound** means very compound – bipinnate or greater.. Most ferns are pinnately compound and maybe 1-pinnate (pinnate), 2-pinnate (bipinnate) and upto 8-pinnate. Opposite of **simple** (undivided).



Modified from "Australian Ferns and Fern Allies' 1976. Jones D. L. and Clemesha S. C. .
A. H. & A. W. Reed PTY LTD

Figure 57 compound leaf terminology

compressed (L. *compressus* flattened laterally) Somewhat flattened lengthwise.

concave (L. *con-* with, *cavus* cavity) Curving inwards,arched inwardly or dished like a shallow bowl. The opposite of **convex** curving outwards.

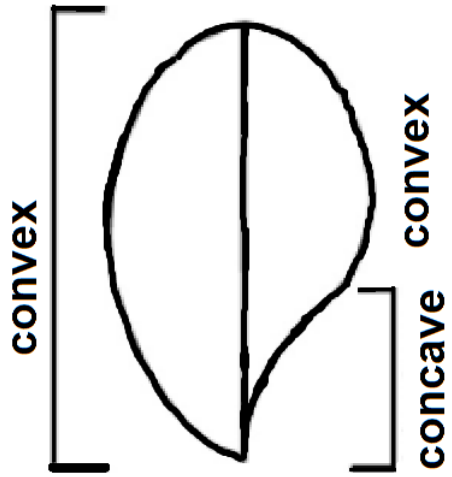


Figure 58 concave and convex

concavo-convex (concave +convex) With the upperside curved inward, lowerside curved outward; concave uppermost convex lower. Bean-shaped in outline.

conceptacle (L. *conceptacalulum*, a receptacle) Reproductive cavity or fruit case of a sporocarp, a sac-like reproductive structure containing several sporangia – as in *Marsilea*.

concolorous (L. *com-*,*co-*, with, in, among, *colos* colour) Coloured uniformly; the same colour on both sides. Compare **bicolorous** or **discolorous**.

conduplicate (l. *con-* with + *duplicate* f. *duplex* double, twofold) Folded flat together lengthwise; with the upper surface inwards of developing leaves.

cone (L. *conus*, cone, wedge, peak f. Gr *konos* cone, spinning top, pine cone) A group of sporophylls arranged compactly on a central axis. Also known as a **strobilus**. *Lycopodium* sp. *Selaginella* sp. *Equisetum* sp.. In *Ophioglossum* and *Botrychium* sp. a similar structure is termed a fertile spike.

confertate (L. *confercire* to press or cram together) Crowded together, or pressed together closely.

configuration (L. *configurare,* to form) The gross surface patterns of the epidermal cells other than that caused by venation, excrescences, or vestiture (hairs). Examples:- **canaliculated, punctate**, **rugose**, **bullate** and **striate**.

confluent (L. *confluere*, *confluo*, to flow or run together) Blending or merging together. Such as the upper pinnules of *Cyathea medularis*.

conform (L. *conformare* f. *con-* together + *formare,* to form, f. *forma*, form) Similar in shape or outline to an earlier mentioned organ e.g. in Thelypteridaceae, plants have pinnate fronds with the apical pinnae similar to the lateral pinnae.

congeneric (L. *con- com-* same + *genus* kind) Belonging to one and the same genus.

congested (L. *congerere*, to crowd together, heap up) Crowded closely together.

connate (L. *connecto* , to join together) With like parts fused or joined.

conifer (Gr *konos* cone + + *ferre*, to bear, carry) Trees or shrubs that bear seeds in cones (sometimes modified and unrecognizable as in the Podocarps). In New Zealand includes the native kauri *Agathis australis* (family Araucariaceae), two cedars *Libocedrus* spp. (Cupressaceae) and seventeen podocarps- (family Podocarpaceae) including rimu, totara, matai miro, kahikatea and three celery pines- tanekaha, toatoa and mountain toatoa (sometimes seperated off in the family Phyllocladaceae). Conifers class as gymnosperms along with the exotic cycads, gingko and gnetophytes. Conifers may dominate certain forests as canopy trees, be mixed with broadleaf canopy trees, beech forest or be rare or absent.

connivent (L. *connivere* to be tightly closed) Converging.

conspecific (L. *con*-, *cum* with, together + *specificus* specific, particular f. *species*, kind + *facio* make) Belonging to one and the same species.

contact faces The area/s adjaceant to the tetrad scar, proximal.

contiguous (L. *contingere* to have contact with) Adjoining, touching or in contact at a boundary but not united.

continuous (*continuus*, f. *continere* to hold together) Without interruption. Said of an **annulus** that forms a complete ring. Opposite **interrupted.** Also a **sorus** that extends along the length of a vein or **coenosorus** (**fusion-sorus**).

contorted (Contortus, f. com- *torquere* to twist) Twisted.

contracted (L. *contractus* , tightened, narrowed)) Narrowed and/or shortened.

contractile (L. *contractus* c *con*- together + *trahere* , *tractum* to draw) Used of roots which shorten and thus pull the plant further into the ground. Contractile-roots.

convergent evolution (L. *con*, *together* + *verge*re, to bend and evolution**)** The evolution of similar characteristics in organisms that are unrelated (except through a distant ancestor) as each adapts to a similar way of life. See **analogous variation**.

convex (L. *convexus* , arched) Curved like the outside of a circle or sphere, a low outward curve,curved or arched outward. Opposite **concave**. See concavo-convex.

convolute (L. *convolvo* , to roll together) Rolled together longitudinally.

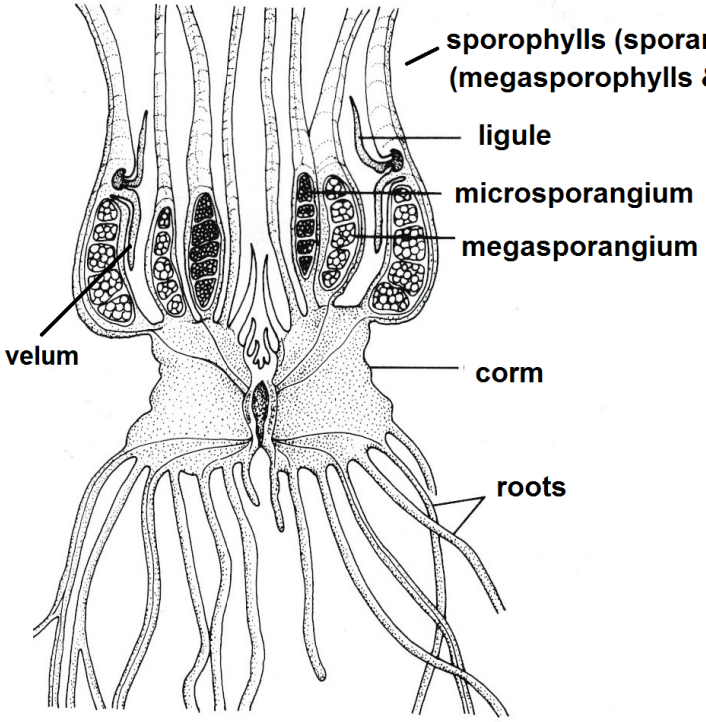
Cooksonia (after **Isabel Clifton Cookson** (25 December 1893 – 1 July 1973) was an Australian botanist who specialised in palaeobotany and palynology.) The genus *Cooksonia* includes the oldest known plant (ca.432 mya, *Cooksonia barrande*) to have a stem with vascular tissue and is thus a transitional form between the primitive non-vascular bryophytes and the vascular plants. The genus is polyphyletic and some species have been transferred to other genera. Simple small plants with naked axes showing dichotomous branching and terminal sporangia. Some appear related to the zosterophyte-lycophyte clade although they had terminal sporangia and others to the rhyniophyte- trimerophyte- fern/horsetail/seed plant clade while one or two are closer to bryophytes (liverwort/moss/hornwort plants)

coralline (L. *coralium*, Gr. *koralion*, coral) Spore ornamentation resembling coral; with many multibranched fenestrate elements.

cordate (L. *cor*, heart) Of a leaf blade or gametophyte (prothallus) broad and notched at the base; heart-shaped (in two dimensions).

coriaceous (L. *corium*, leather) Leathery. e.g. leather fern *Pyrossia eleagnifolia*, adders tongue fern *Ophioglossum coriaceum*.

corm (Gr. *kormos*, trunk minus its boughs) In *Isoetes*, the condensed stem, which may be 2–5-lobed.



***Isoetes* quilwort, mostly submerged aquatic lycophytes. Vertical section. Leaves are borne on the upper surface and roots on the lower surface of a short underground stem (corm). Some leaves (megasporophylls) bear megasporangia and others (microsporophylls) with microsporangia. The microsporophylls tend to be produced on the inside, near the centre. Note also the presence of ligules. This feature plus the heterosporous habit links *Isoetes* to *Selaginella,* but is not present in the other lycophyte clade the Lycopodiaceae.**

Adapted from 'Biology of Plants' 2005 ed.. Raven, Peter H.. Evert, Ray F.. Eichhorn, Susan E.. W. H. Freeman and Company.

It should be noted that microphylls in *Isoetes* and their extinct relatives can be quite large, so the term lycophyll may be preferred.

Figure 59 corm *Isoetes*

cosmopolitan (Gr. *Kosmopolites*, citizen of the world, f. *kosmos*, world + *polites* citizen) World-wide in distribution. The horsetail family Equisetopsida is almost cosmopolitan in distribution but is naturally absent from present day Australasia.

costa (L.*costa*, rib) The midrib or main vein of a pinna. pl. **costae** Compare **rhachis** (midrib of the whole frond), and the dimunitives **costule** (midrib of a pinnule) and **costulet** (midrib of a pinnulet). Regarding spore/pollen wall ornamentation, broad individualized, regular ridges (ribbed).

costal (L.*costa*, rib) Near or adjaceant to the costa, costule, or midrib. Applied in particular to **soral position.**

costate (L.*costa*, rib) Ribbed, with ridges. Opposite **acostate**-without ribs. Regarding spore/pollen wall ornamentation,regular ribs more or less encircling the spore/pollen grain.

costate-alate (L.*costa*, rib + *ala* wing) Winged-ridges or wing-like crests, ribbed and winged said of some spores.

costule (diminutive of L.*costa*, rib) The midrib or main vein of a pinnule, lobe or segment of lower order.

costulet (diminutive of costule) Midrib of a pinnulet (leaflet).

cottony (from cotton) With long soft, weak, filamentous hairs, somewhat flocculent and entangled. Also known as **gossypinus**/**gossipinus** like the the cotton of *Gossypium* seeds.

craspedodromous (Gr. *kraspedon*, border, edge + *dromos*, running, racecourse) Pinnate venation pattern whereby the secondary veins reach the leaf margin. Divided into **simple craspodromous**- the secondary veins directly reach the margin and **semicraspedromous**, the secondary veins branch near the margin, one terminating at the margin and the other looping upward to join the next secondary vein and **mixed**

craspedodromous when only some veins terminate at the margin, the others terminating away from the margin. A study by Tan & Buot indicated ferns belonging to the Polypod clade Eupolypod II are characterized by craspedodromous venation plus some cathetogyrates. This group includes *Asplenium* sp., *Athyrium* sp. *Blechnum* sp*.. Dennstaedtia* sp *Diplazium* sp. *Pteris* sp. *and Thelypteris* sp. .

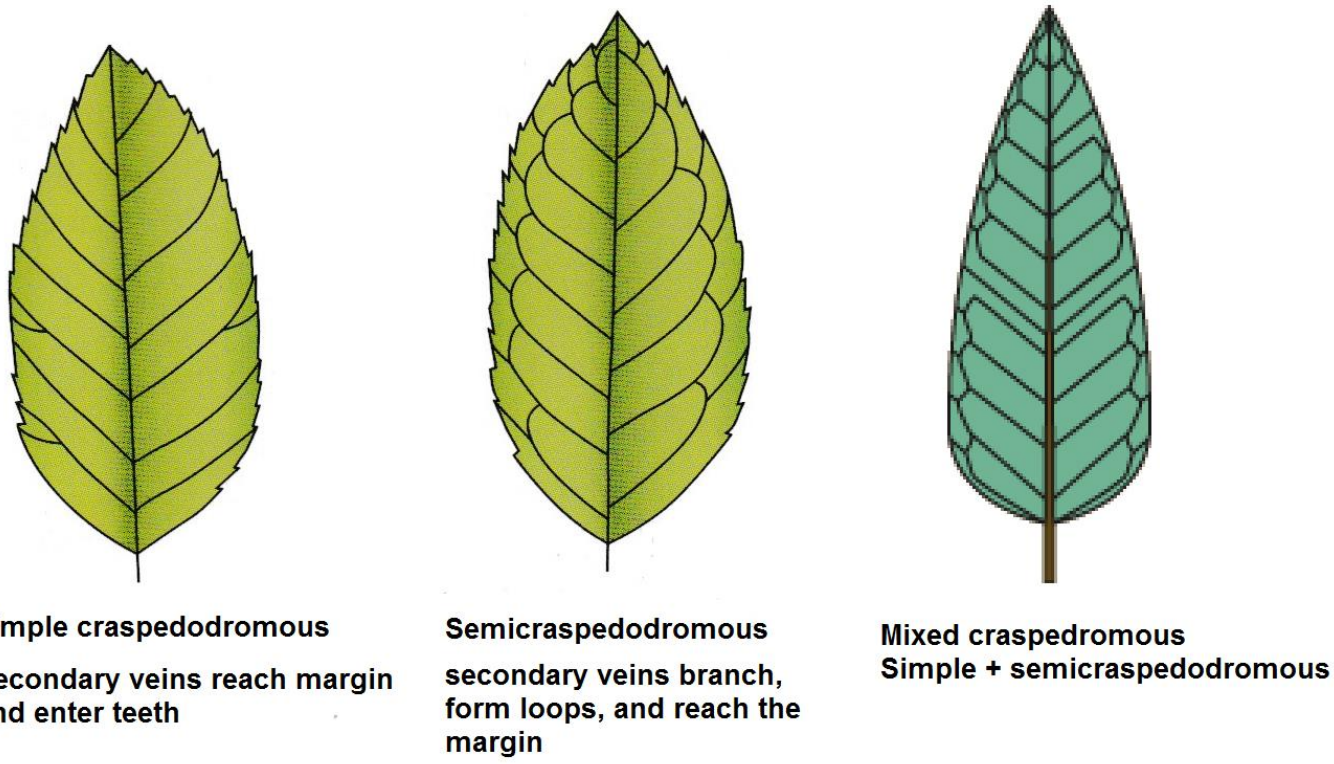


Figure 60 craspedodromous venation

creeping Said of rhizomes or stolons running along the ground and rooting at intervals. May be classed as either short creeping e.g. *Lindsaea linearis,* medium creeping or long creeping e.g. *Lindsaea viridis*. Compare: tufted (caespitose) or caudex (trunked).

cremnophilous (Gr*. kremnos*, cliff, + *philous,* loving) A plant that grows on cliffs e.g. *Pleurosorus rutifolius*. Synonym: **cremnophyte** similar **rupestral** etc

cremnophyte (Gr. *kremnos*, cliff, + *phyton* , plant) A plant that grows on cliffs, e.g. *Pleurosorus rutifolius*. Synonym **cremnophilous** similar **rupestral** etc

Crevice growing plants on a stack of rocks, Punakaiki, South Island
Veronica* (*Hebe*) *elliptica* and shore spleenwort *Asplenium obtusatum

'Moa's Ark The Voyage of New Zealand' 1990. David Bellamy et al Television New Zealand. Viking Press.

Figure 61 cremnophytes (Photo Peter Johnson)

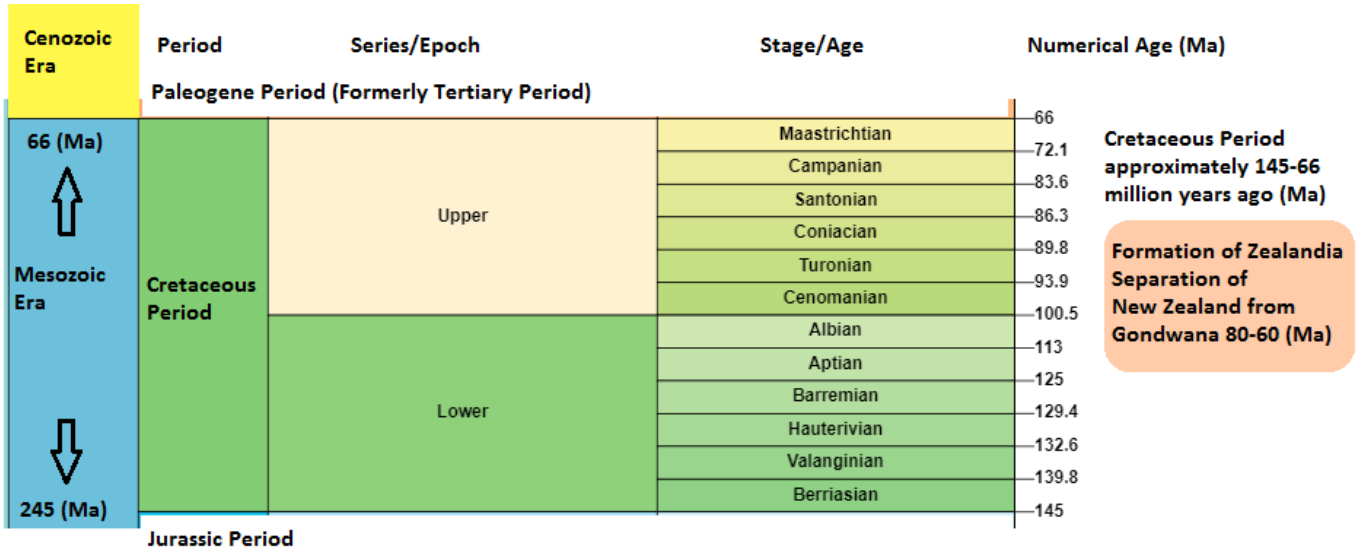
crenate (L. *crena*, a notch) With small, rounded teeth; scalloped. Pinnulets of *Pteris tremula.* See **bicrenate**.

crenate- serrate (Combination **crenate** and **serrate**) Bearing teeth varying from small rounded (**crenate**) to small sharp teeth pointing forwards (**serrate**).

crenulated (diminutive L. *crena*, a notch) Of a margin finely crenate, minutely scalloped.

crested With an elevated ridge or crest, forked tips, usually many,; usually referring to the leaf, pinnae or segments. Many fern cultivars are characterized by crested leaves.

Cretaceous (Derived from *Terrain Crétacé* used in 1822 by Jean d'Omalius d'Halloy in reference to extensive beds of chalk within the Paris Basin. Ultimately derived from the L. *crēta*, chalk.) The chronostratigraphic (geological) time period from the end of the Jurasic 144 million years ago to 65 million years ago; Part of the Mesozoic era. Flowering plants and some fern families evolved during this period. Notably the dinosaurs died out (apart from the bird line) at the end of this period. Zealandia including New Zealand seperated from Gondwana (adjaceant parts of todays Australia and Antarctica) in the later part of the Cretaceous, the Tasman Sea filling the gap, an important isolating biogeographical factor. A fossil site (mid-Cretaceous, circa 97 Ma) in the Clarence River valley in eastern Marlborough has fossil Cycads, ginkgos, ferns, conifers and primitive angiosperms.



crisped (L. *crispus*, curled) The margins finely wavy, curled or crumpled.

crista pl. **cristae** (L. *crista*, the comb or tuft on the head of animals, tuft of leaves on plants, crest of a helmet) Spore ornamentation where different kinds of sculptural elements join laterally to form crests or ridges.

cristate (L. *crista*, the comb or tuft on the head of animals, tuft of leaves on plants, crest of a helmet) In ferns, having a tasselled margin to the fronds. Spore ornamentation- with crest/ridges, when portions of the outer wall unite, forming seams or crests.

crown The foliage canopy of a fern.

crozier (French *crossier*, staff bearer, the pastoral staff of a bishop) The coiled young frond of a fern, the fiddlehead, koru or monkey's tail. See **circinate venation**, contrast **non-circinnate venation.**

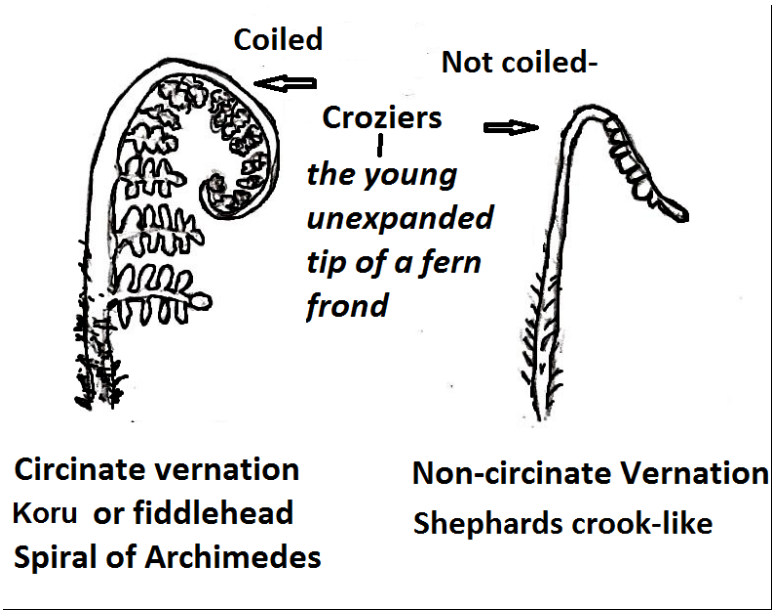


Figure 62 crozier - circinate vernation & non-circinate vernation

cruciate (L. *crux*, cross) In the form of a cross. Also known as **cruciform.**

cryptic (Gr. *Kruptos*, hidden) Hidden.

cryptogam (Gr. *Kruptos*, hidden + *gamos*, marriage) Plants which are cone less and flowerless and reproduce by spores not seeds. An older term applied to the algae, bryophytes, ferns and fern allies whose reproduction process was not obvious to the early botanists, hence hidden.. Opposite **phanerogam** (Gr. *phaneros*, visible + *gamos*, marriage) – the seed plants.

crystalochory (Gr. *krystallos*, ice, crystal + -chore f. *khoreo*, to move)) Dispersal of seed, spores etc by ice or glaciers.

***Ctenitis*-hairs** Articulated hairs with dark red septae (walls), as in *Ctenitis*, *Lastreopsis* and allied genera (Dryopteridaceae).

Ctenopteridian venation: (After fern genus *Ctenopteris*) Venation pattern (from German botanist Mettenius 1823-1866) in which a series of simple or forked secondary veins branch off the primary vein or midrib in a pinnate manner. This form of venation is subdivided into three types based on the angle at which the secondaries leave the midrib:-

1 **Taenopteridian** (f. fossil genus *Taeniopteris*) ± right angles secondaries continue to margin. Any tertiary veins run parallel with secondaries.

2. **Sphenopteridian** (f. fossil seed-fern (Pteridosperm) genus *Sphenopteris*) Seconday veins leave midvein at acute angles and any tertiary veins leave the secondaries at acute angles reaching the frond margin

3. **Eupteridian** (f. Fern genus *Eupteris* now *Pteridium)* The secondaries leave the midrib at an angle that is intermediate between Taenopteridian and Sphenopteridian.

cucullate (L. *cucullatus*, hooded, capped) Hood-shaped.

cultrate (L. *cultratus*, knife shaped f. culter, kife) Knife-shaped.

cuneate (L. *cuneus*, wedge) Wedge-shaped sometimes used to describe the base of a leaf or leaflet.

cuneiform (L. *cuneus*, wedge + form) Wedge-shaped (**cuneate**), attached by the narrow end.

cupular, cupulate, or **cupuliform** (L. *cupula*, a little cup.) Cup-shaped. In Greek *kyatheion*, little cup from whence we get the tree fern genus *Cyathea*. See **cyathiform**.

cushion (**archegonial cushion**) Area of gametophyte (prothallus) tissue that is more than one cell thick and accomodates the **archegonia** (female sex organs).

cuspidate (L. *cuspus*, a point, spike) Tipped with a sharp, firm point.

cuticle (L. *cuticula*, dimin. of *cutis*, the skin) A protective layer containing cutin, that is secreted to the outside of epidermal cells and functions to inhibit water loss: found in all land plants.

cutin (L. *cutis*, skin) A polymer of fatty acids functioning as a sealant, deposited in the cuticle of the epidermal cells of all land plants.

cv. Abbreviation for cultivated variety (cultivar). A horticultural variety, bred or selected, e.g. *Nephrolepis exaltata* 'Fluffy Ruffles'. Note the species name is written or typed in the conventional botanical way:

Plant name is italicized
Capitalize genus name
Lower case specific epithet
Cultivar in single quotation marks & not italicized
Only one name per plant

cyanobacteria (Gr. *kyanos,* dark blue + bacteria) Blue-green algae; photosynthetic bacteria, some also capable of nitrogen fixation and associated with water ferns. Chloroplasts are thought to be derived from them by endosymbiosis.

cyathiform (Gr. *kyathos* cup + L. *forma* form) Cup-like shape. Synonym **cupulate**. Similar to urceolate – urn –shaped.

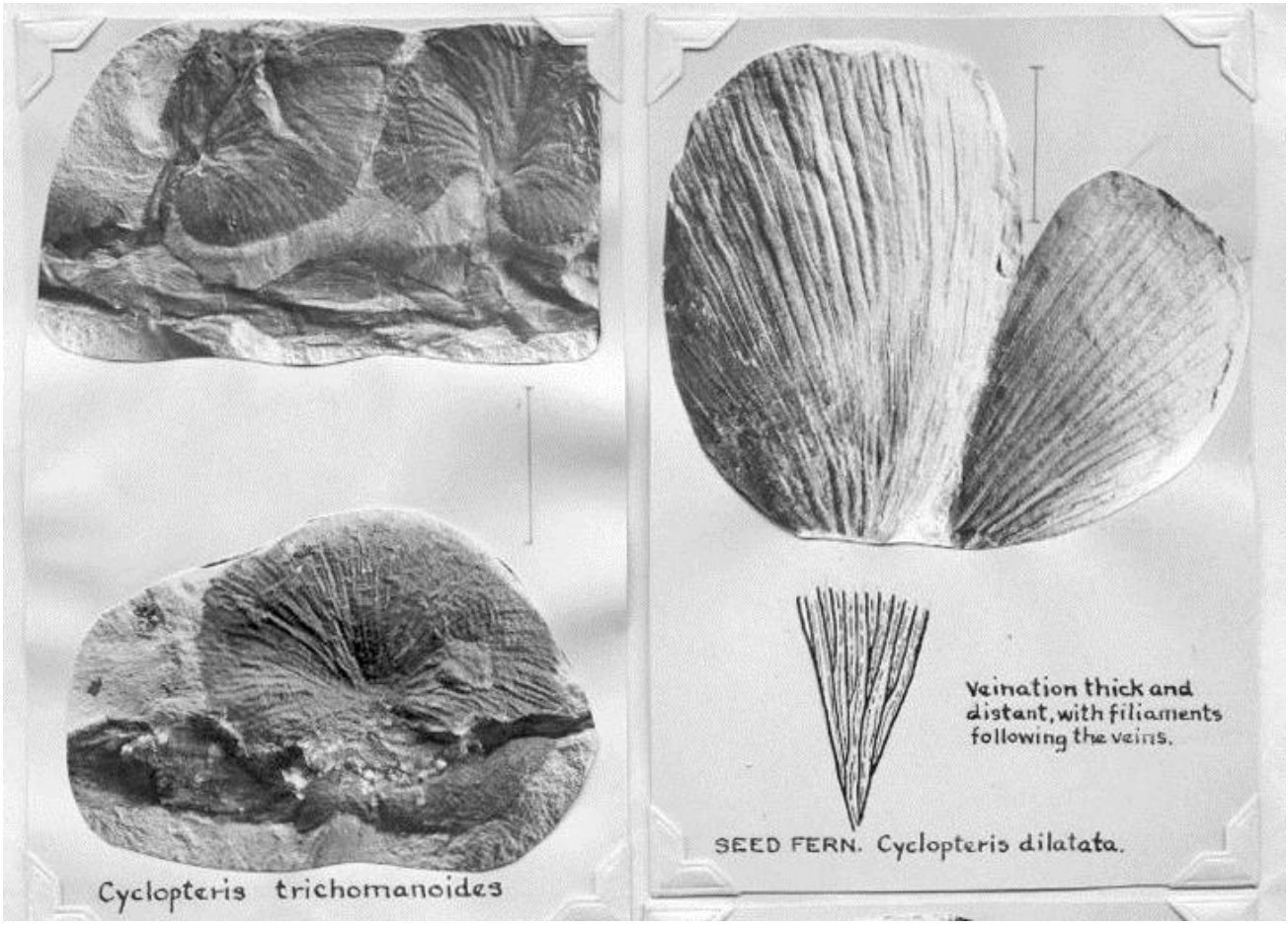
cyathiform indusium (Gr. *kyathos* cup + L. *forma* form + indusium) In tree ferns genus *Cyathea* those species that bear a cup-shaped indusium. Compare **hemitelioid indusium** and **sphaereopteroid indusium**.

cyclopteridian venation (f. fossil Pteridosperm (seed-fern) foliage type *Cyclopteris*) Venation pattern, pinnules rounded without apparent midrib the veins radiating out from the point of attachment and subordinate veins branch repeatedly in a fan-like pattern. The veins branch dichotomously (forking in two) along the way. Approximately the same as **actinodromous-flabellate** (ray pattern and fan shape) venation.

***Botrychium lunaria* exhibiting Cyclopteridian venation**

'Welsh Ferns a descriptive handbook'
1954
H. E. Hyde and A. E. Wade

Figure 63 cyclopteridian venation (Mettenius –German botanist))



Division †Pteridospermatophyta (seed ferns) , Order †Medullosales, Family†Cyclopteridaceae († denotes extinct)

https://www.georgesbasement.com/Langford-WilmingtonCoalFlora/Webpage/GL062CyclopterisCB.jpg

Figure 64 cyclopteridian venation (Mettenius – German Botanist 1823 -1866)

Cylindrical (L. *cylindricus* f. *cylindrus*, roller) In the form of cylinder, also known a **terete** (L . *terese*, *teretis*, ,smooth, f. *terere*, to rub). Said of an axis such as a stem.

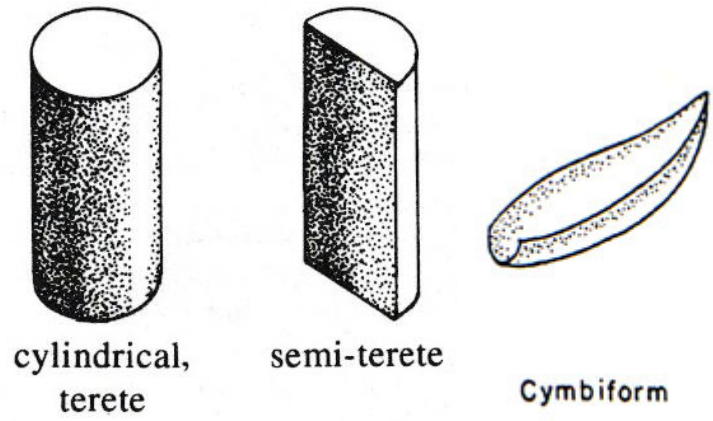


Figure 65 cylindrical/terete and cymbiform

cymbiform (L. *cymba*, boat) Boat-shaped.

deciduous (L. *deciduous*, falling) Shed seasonally. Falling off, after maturity or at the end of the growing season, not persistant, or evergreen. Applied to foliage, most New Zealand native ferns are perennial evergreen, an exception is the annual fern *Anogramma leptophylla*. While a number of cold hardy exotic ferns are deciduous e.g. *Athyrium felix-femina, Dryopteris affinis, D. dilatata* and *D. filix-mas*.

decompound (L. *de*-, very + *compositus*, compound) (1) Divided several times, multi-compound, e.g. bipinnate (2-pinnate) or greater, some ferns e.g. *Adiantum* spp. are up to 8-pinnate (8 x pinnate). (2) Deeply divided into numerous segments such that leaflets are not clearly defined, e.g. fennel leaf.

decrescent: (Anglo-French *decressant* f. *decrestre* to decrease) Gradually decreasing in size, e.g. lower or basal pinnae of some thelypteroid ferns, e.g.*Christella* species.

decumbent (L. *decumbo*, to lie down, recline) Lying down (prostrate), but with the tips growing upwards (ascending). E.g. *Cyathea colensoi*.

decurrent (L. *decarro*, to run down) Extending downwards beyond the point of attachment, e.g. of a lamina extending downwards to form a flange or wing along the rachis,e.g. *Blechnum colensoi*. Opposite of **surcurrent** where the flange or wing extends upwards. *Asplenium decurrens* syn. *A. obtusatum* subsp. *northlandicum*.

decurved (*de*- + *curvatus*, f. *curvare*, to curve) Curved downwards.

decussate (L. *decussatim* in the form of the Roman number ten (X) hence *decussatus*, cut crossways) Borne in pairs alternately at right angles to each other making four rows,e.g. *Veronica* (syn. *Hebe*) spp. Compare opposite distichous, alternate (helical/spiral), alternate distichous and whorled. Said of leaf arrangement (phyllotaxy).

deflexed ((L. *deflex,* turned or bent down) Bent abruptly downwards. For example leaf margins.

defoliate (*defoliatus,* past participle of *defoliare*, from Latin *de*- + *folium* leaf) Shedding of leaves.

dehisce (L. *dehisco*: to yawn, gape, open, split asunder). To split open, so as to scatter the seeds or spores. Hence **dehiscence**.

dehiscence (Latin de- + *hiscere* to split, from *hiare* to be open)) The process of opening by valves or splits. In ferns and lycophytes the manner in which the sporangium opens to release the spores..

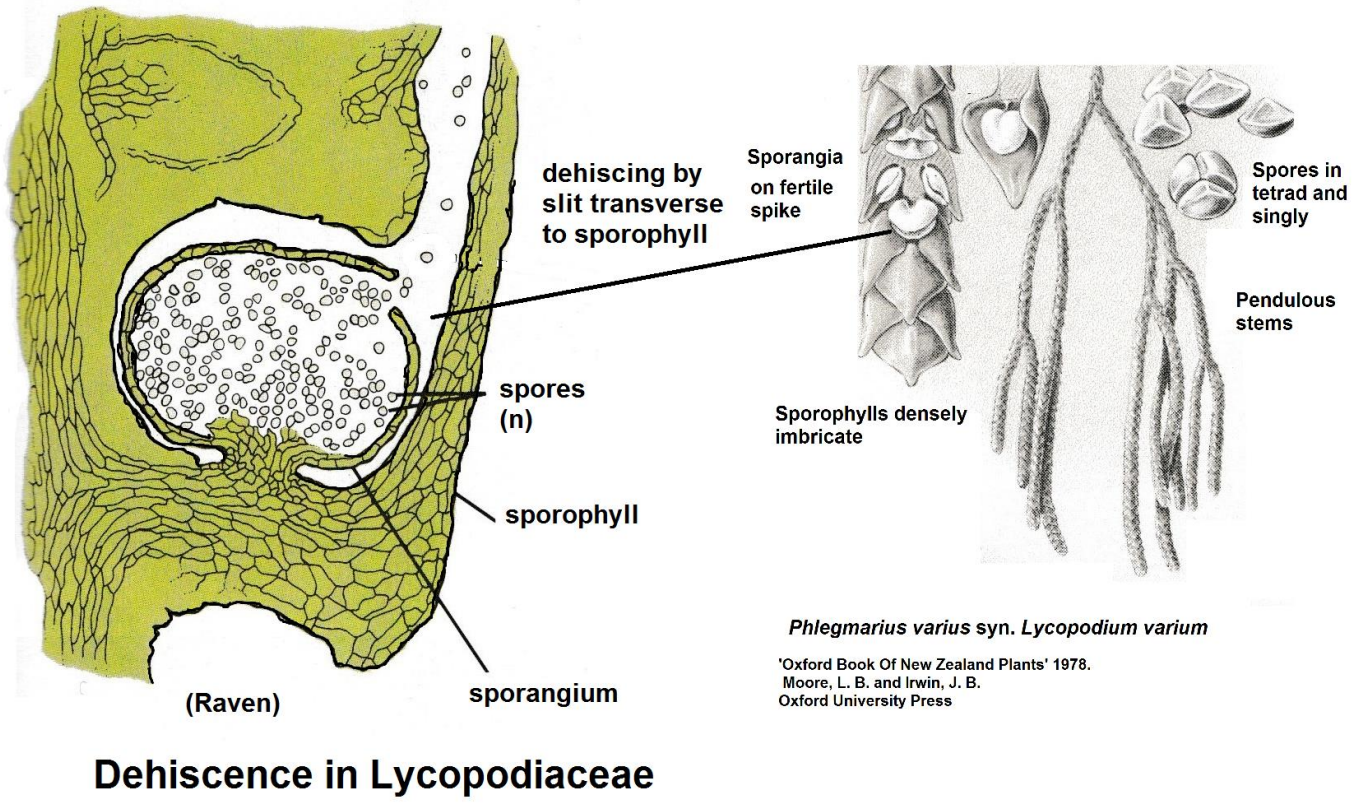


Figure 66 dehiscence Lycopodiaceae

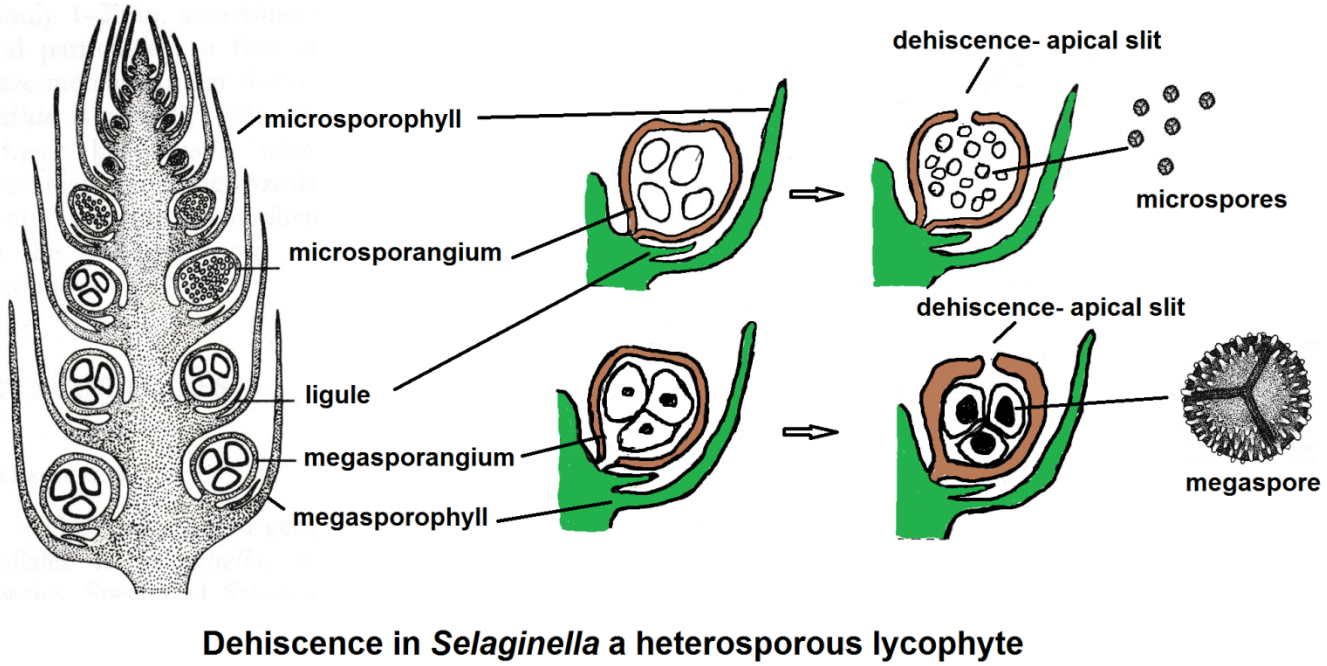


Figure 67 dehiscence *Selaginella*

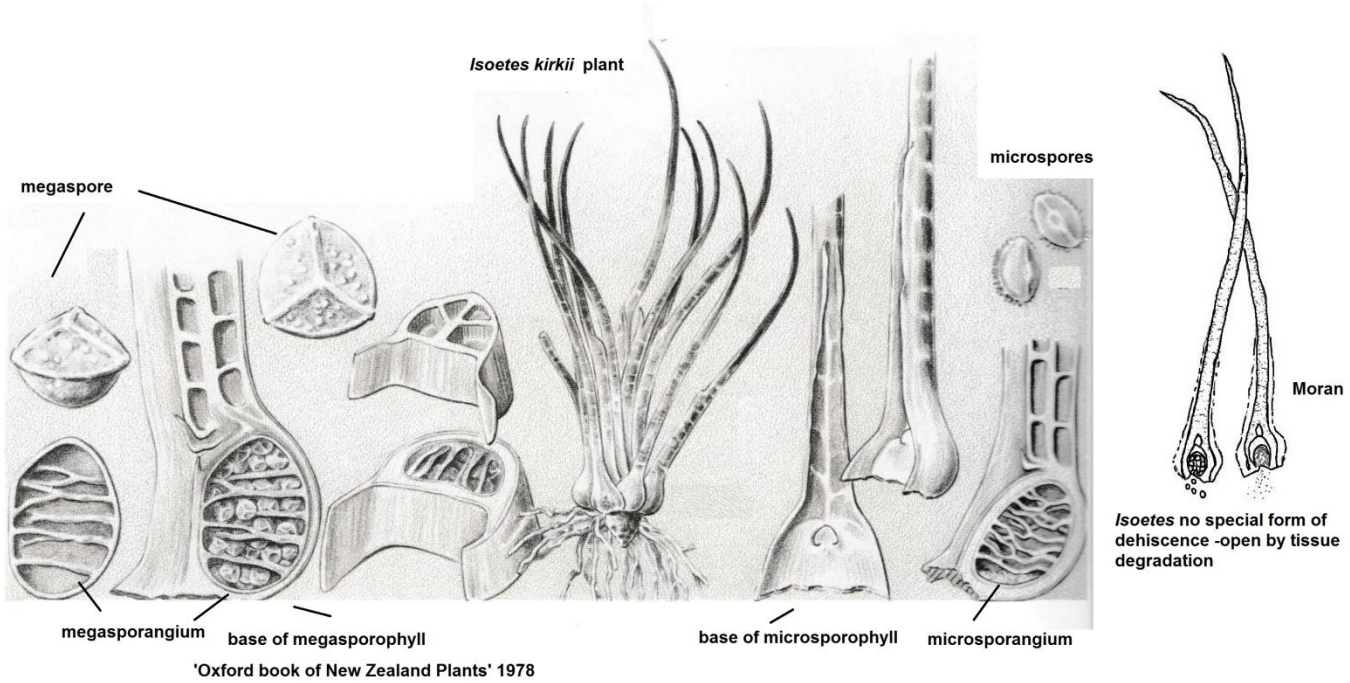
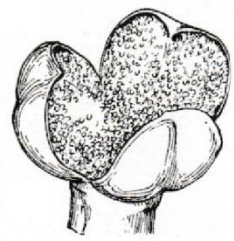
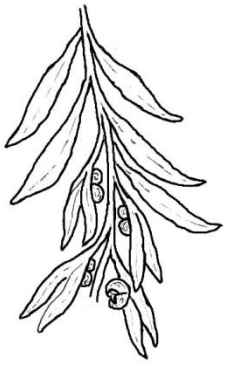


Figure 68 Dehiscence in *Isoetes*



Psilotum nudum
three -lobed synangium dehiscence
spores released through three radial slits

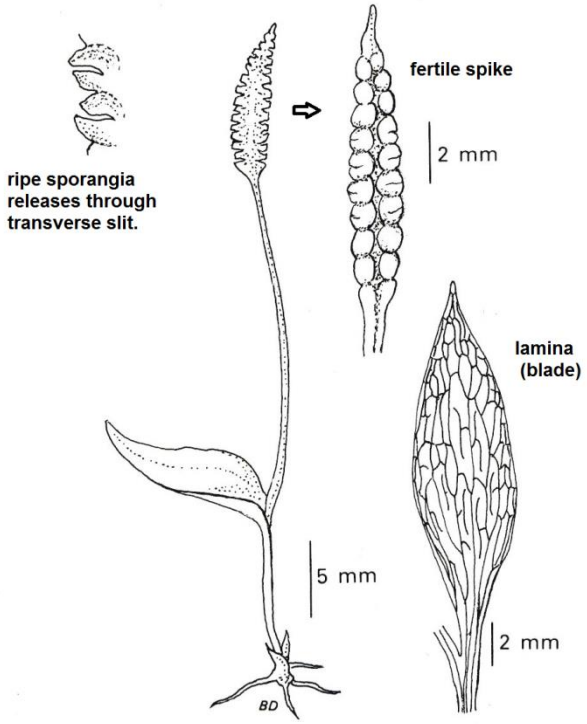
(Lawrence) **Psilotaceae**



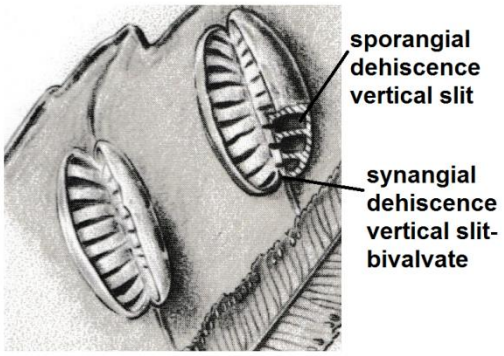
Tmesipteris sp.
2-lobed synangium splits
longitudinally to release spores

Psilotaceae

Botrychium australe
Ophioglosasales (artist J. B. (Bruce) Irwin)



Ophioglossum lusitanicum
Ophioglossales
(artist Betty Duncan)



Ptisana salicina syn. *Marattia salicina*
Marattiaceae (artist J. B. (Bruce) Irwin)

Dehiscence in Eusporangiate ferns
(various sources)

Figure 69 Dehiscence in Eusporangiate ferns

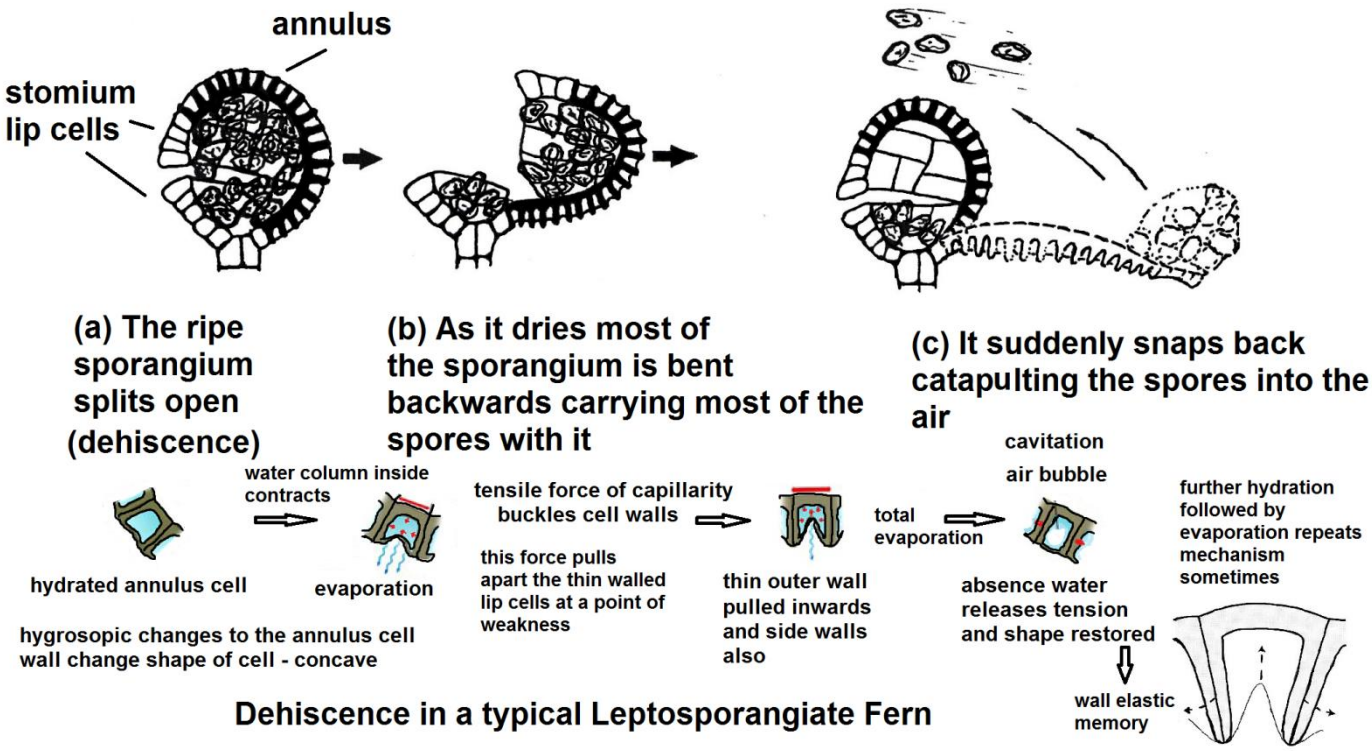
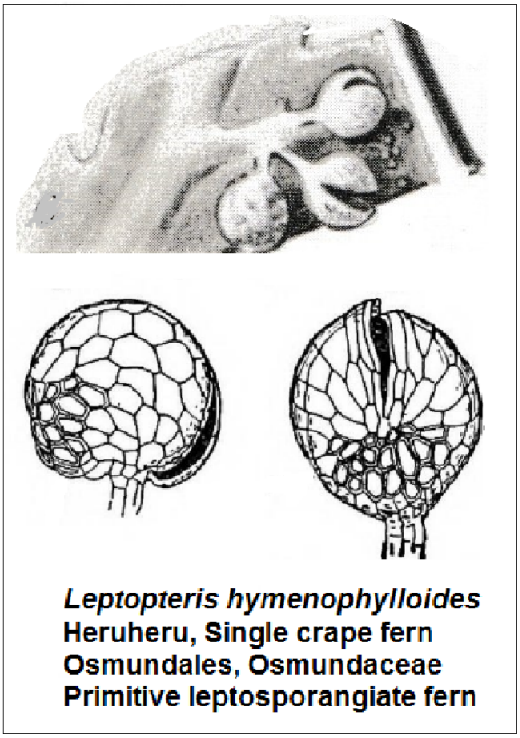
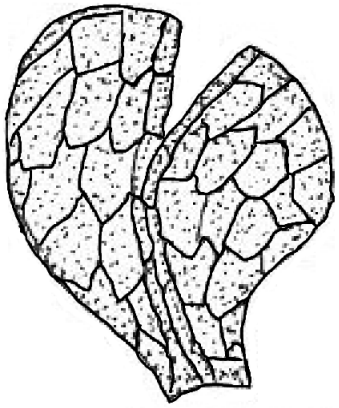


Figure 70 dehiscence (leptosporangiate)

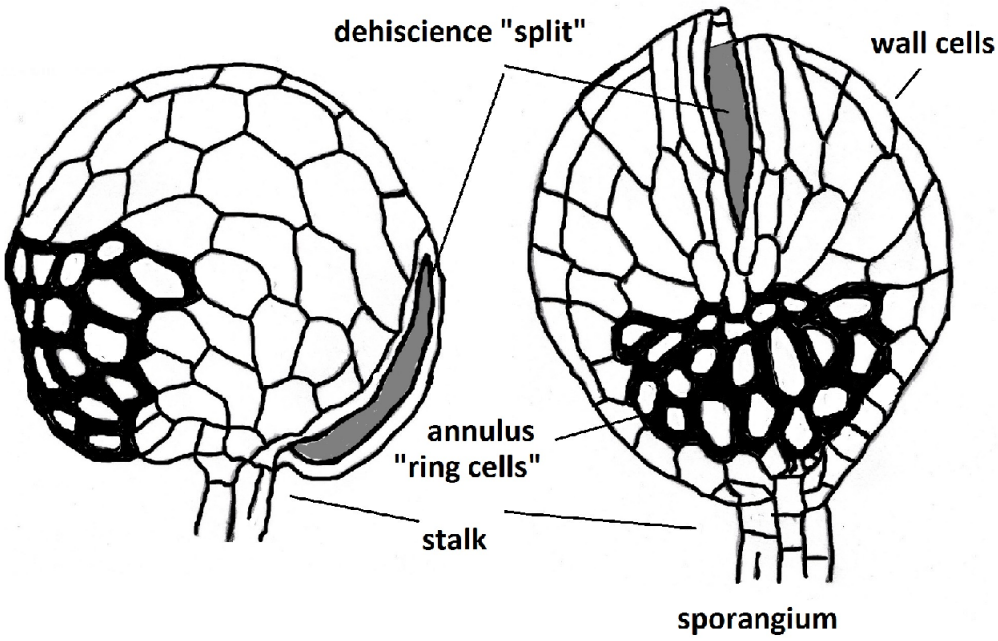
Leptopteris superba



Leptopteris hymenophylloides
Heruheru, Single crape fern
Osmundales, Osmundaceae
Primitive leptosporangiate fern



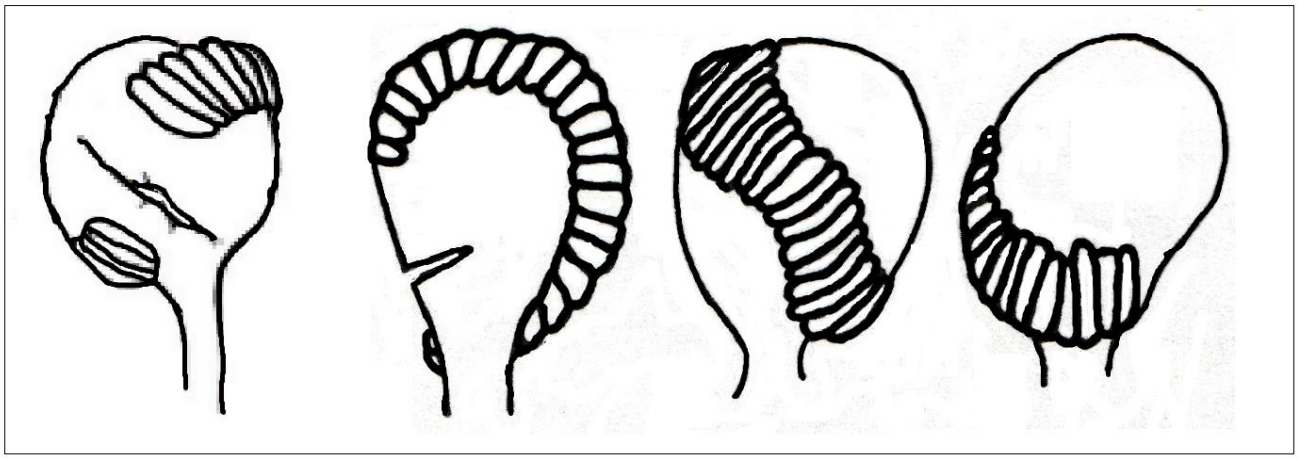
Todea barbara



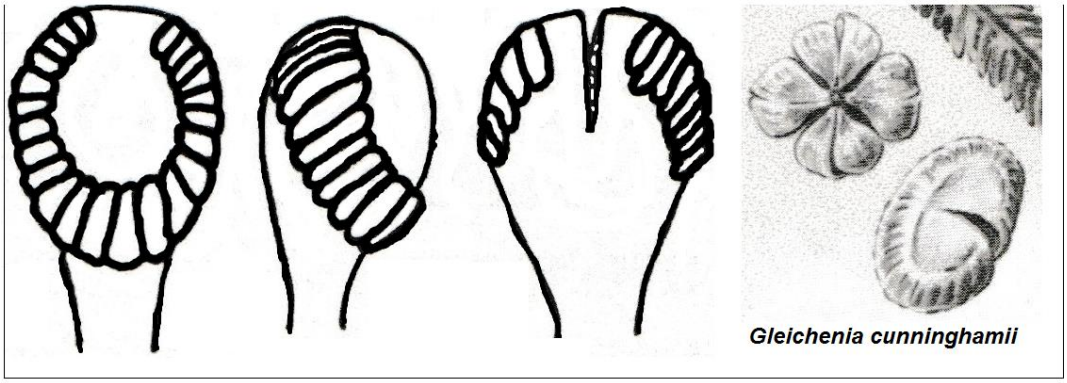
Leptopteris hymenophylloides

Dehiscence in primitive leptosporangiate ferns Osmundaceae

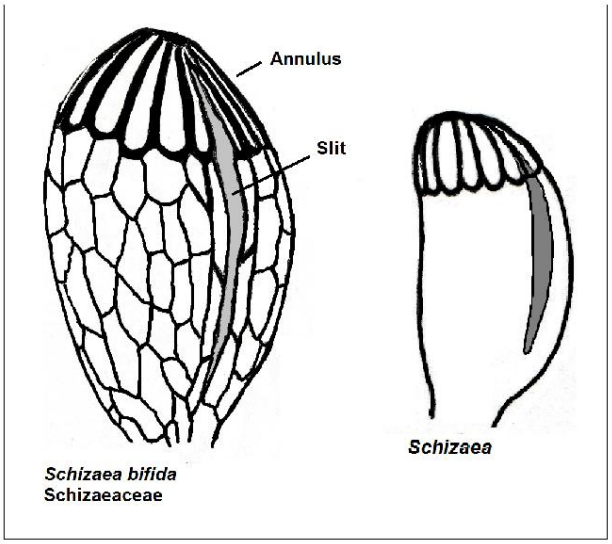
Figure 71 Dehiscence in Osmundaceous ferns



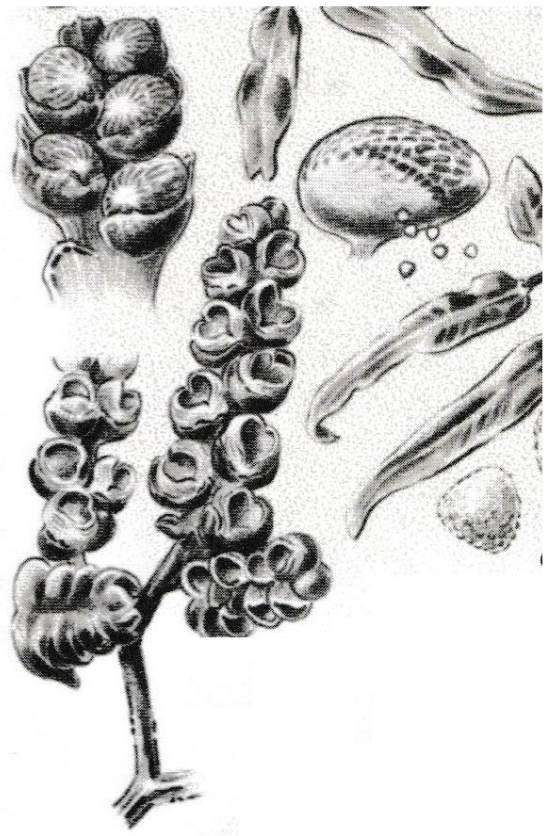
Hymenophyllum



Gleichenia cunninghamii



Schizaea bifida
Schizaeaceae

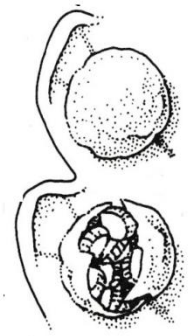


Lygodium articulatum

Dehiscence in primitive leptosporangiate ferns

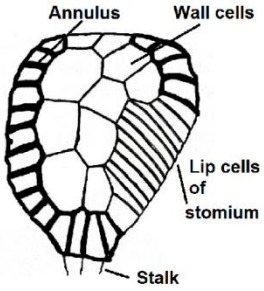
Figure 72 Dehiscence in primitive leptosporangiate ferns

Loxoma cunninghamii

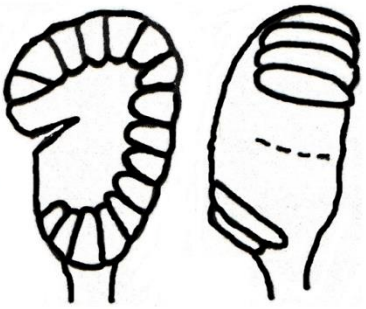


indusium splitting irregularly at maturity

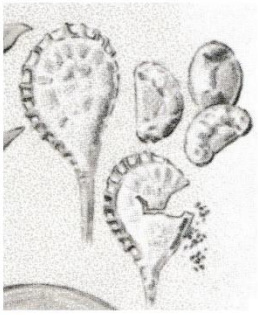
Cyathea medularis



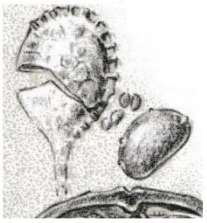
Cyathea medullaris
Cyatheales
Annulus oblique
Opening horizontally



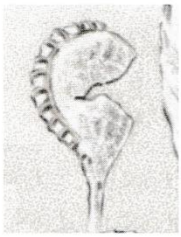
Cyathea (Hemitelia)



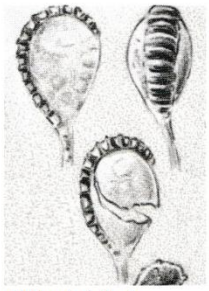
Dendroconche scandens
syn. ***Microsorum scandens***



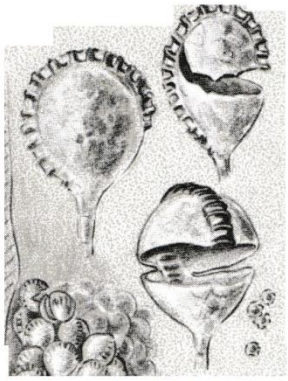
Blechnum penna-marina



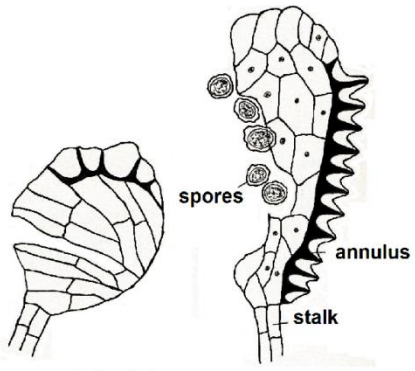
Lindsaea trichomanoides



Histiopteris incisa



Asplenium flabellifolium



Polystichum

Dehiscence in some other leptosporangiate ferns
(diagrams from various sources including 'Oxford Book of New Zealand Plants')

Figure 73 Dehiscence in other leptosporangiate ferns

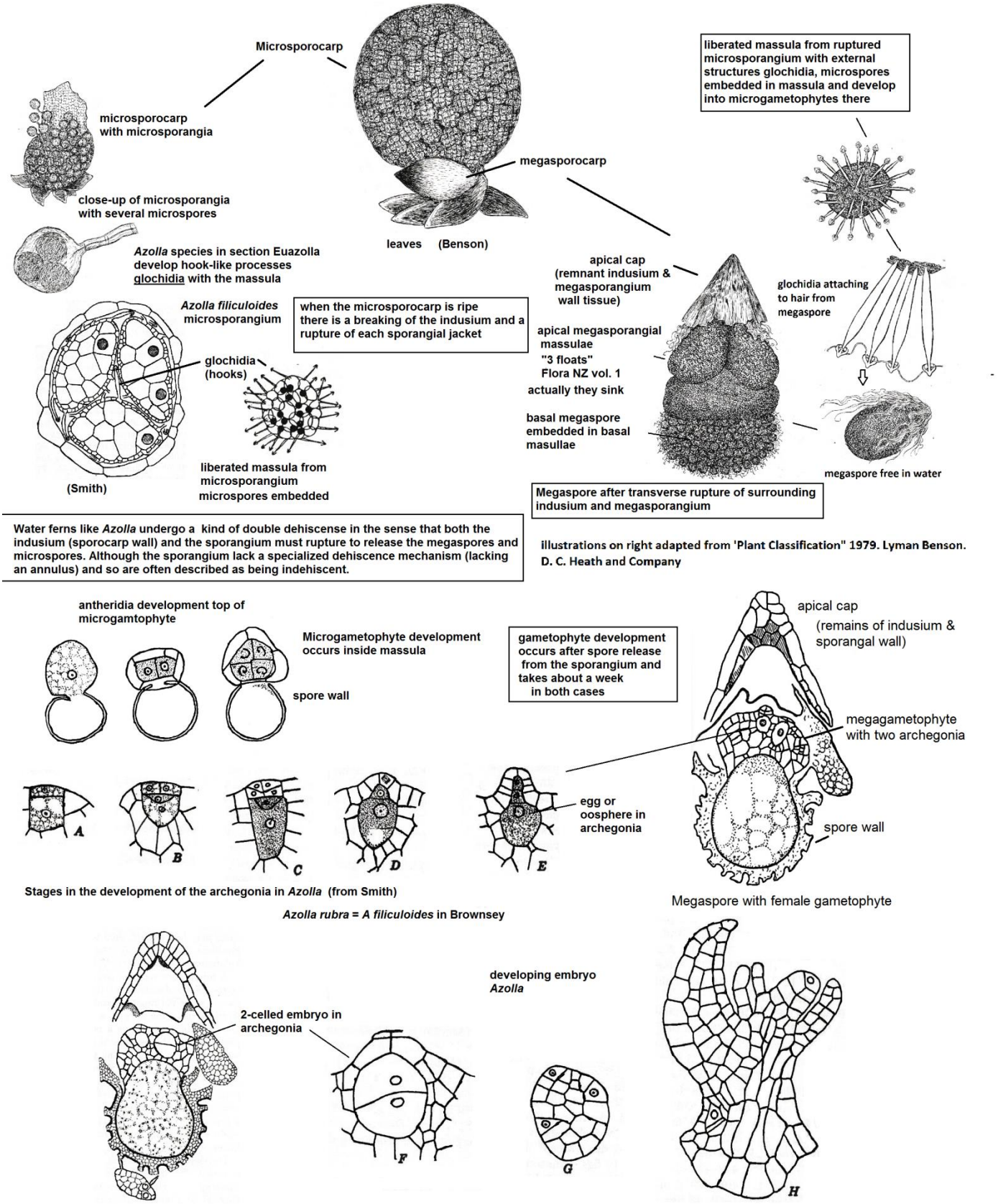


Figure 74 Dehiscence in *Azolla*

delicate Finely made. The leaves of filmy ferns, family Hymenophyllaceae, may be described as delicate,as very thin, one cell thick (apart from veins).

deltate (L. *deltoides*, from Greek *deltoeides* Shaped like the fourth letter of the Greek alphabet delta, and a capital delta is triangle-shaped (Δ) A flat plate with the outline of a triangle**-** broadly triangular with an obtuse tip.

deltoid: Triangular like the Greek letter Δ (delta). *Cranfillia deltoides* syn. *Blechnum vulcanicum*

dentate (Latin *dens*, *dentis* tooth) With sharp teeth perpendicular (at right angles) to the margin . The orientation of the projections (teeth) distinguishes from serrate and retorse.

denticulate (Diminutive of dentate) Finely toothed. Minutely dentate. See **leaf margin**

dendritic (Gr. *dendrites*, of or pertaining to a tree f. *dendron*, tree). Said of a hair that branches in a tree-like manner.

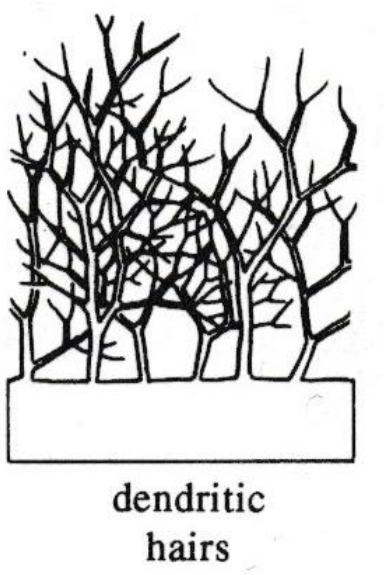


Figure 75 dendritic hairs

depauperate (Latin *de*- + *pauper* poor, impoverished) Weak, reduced in size, starved and impoverished.

descent with modification Charles Darwin's (1809-1882) term for evolution.

determinate (L. *determinatio* a boundary, termination, end, *determinatus*, limited) With a definite cessation of growth in the main axis. Limited growth of leaves (or plants) that ceases after differentiation and complete development of its tissues. Determinate leave stop their growth when the genetically determined leaf form is completed.The opposite of **indeterminate**.

Devonian (after Devon in England) The chronostratigraphic (geological) time period from about 420 million years to 360 million years ago. During the early Devonian – spore bearing vascular plants developed and two major clades had evolved:- one the lycophyte branch and the other leading to the ferns, horsetails and seed plants.

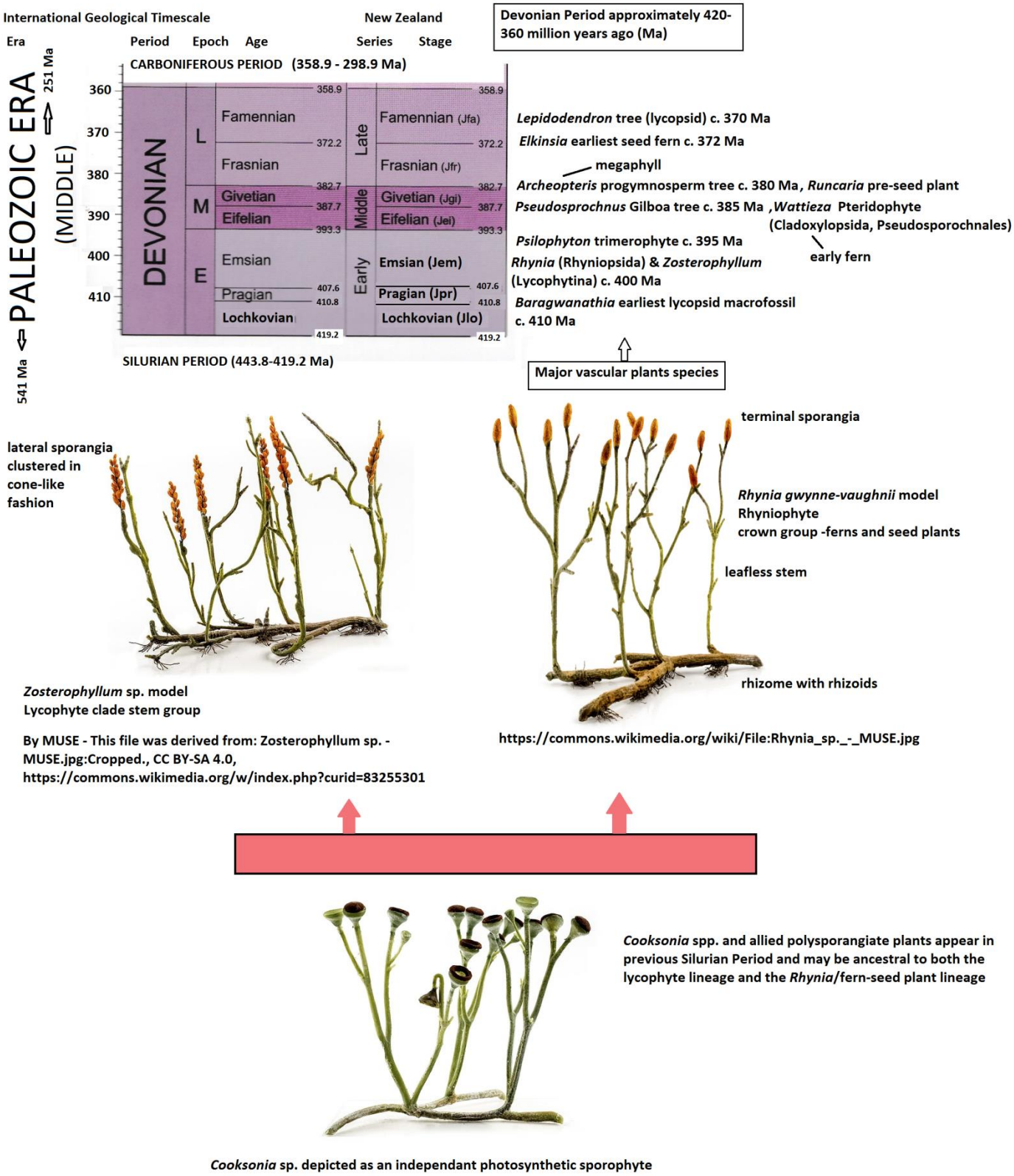
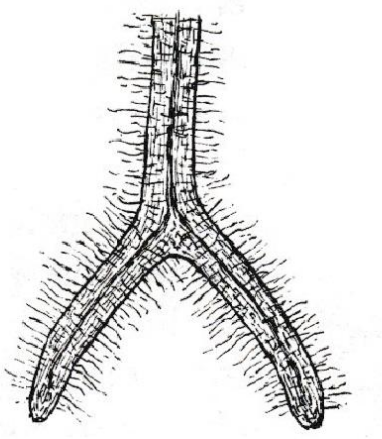


Figure 76 Devonian Period

diaspore (Gr. *dia* – through + spore or f. *sperein*, to scatter) A reproductive unit such as a spore, seed or other structure that functions in dispersal. Synonym: **propagule, disseminule**.

dichopodial (Gr. *dicha*, akin to *di-* in two + L. *podium*, foot) Roots in which the apical meristem branches in two. A form of **dichotomous** branching in the roots of lycophytes.

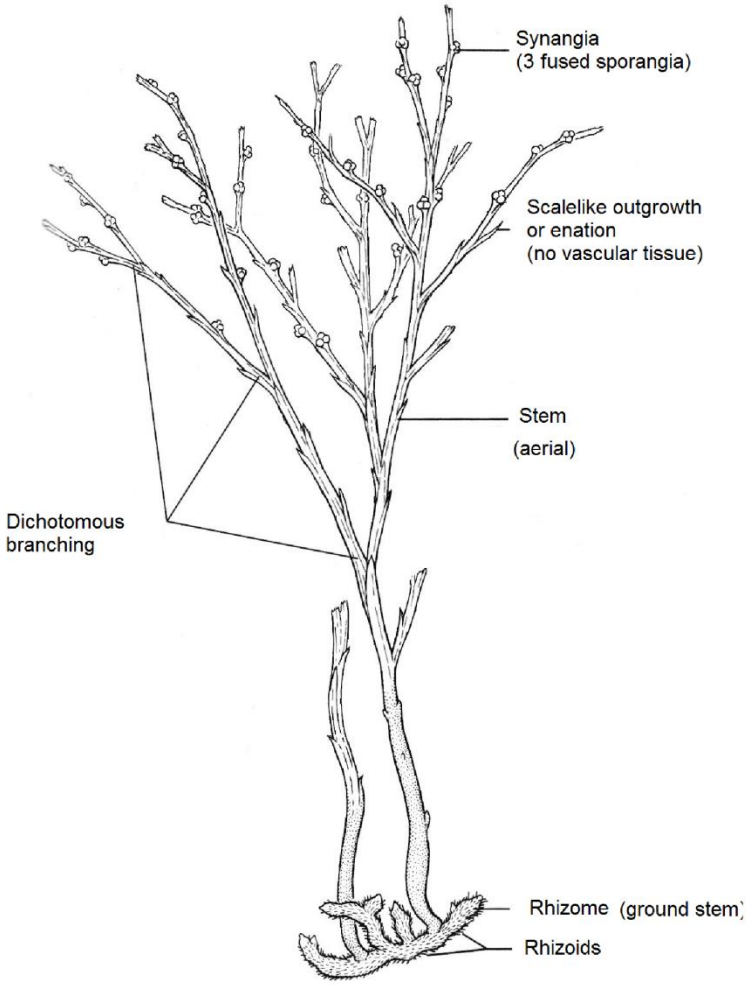


Dichopodial - dichotomous branching in root of *Selaginella bigelovii*

'Plant Classification' 1979. Benson, Lyman D. C. Heath and Company

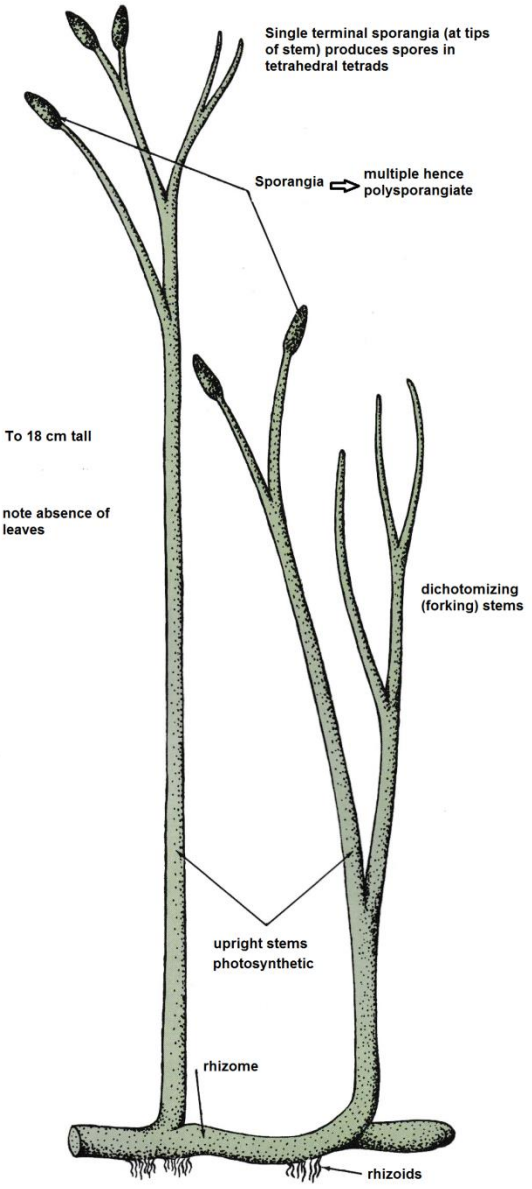
Figure 77 dichopodal

dichotomous (Gr. *dikhotomous*, cut in half, f. *dich-*, in two+ *temnein*, to cut) A branching pattern in which each branch or axis splits into two approximately equal branches like the arms of the letter "**Y**" resulting from the division of a growing point, e.g. *Gleichenia microphylla*. .Also known as **bifurcation**. Common in lycophytes and primitive ferns e.g. whisk ferns (Psilophyta) and their fossil relatives such as the rhyniophytes and *Cooksonia*.. If forking is equal- **isotomous** and if forking is unequal **anisotomous**. **Dichopodial** is a form of dichotomous branching in the roots of lycophytes. See **apical branching**, **pseudodichotomous**. *Schizaea dichotoma*



Psilotum nudum Fork fern, displaying dichotomous branching.

Modified from 'Five Kingdoms: An Illustrated Guide To The Phyla of Life on Earth' 1998. Margulis, Lynn and Schwartz Karlene V. . A W. H. Freeman/ Owl Book



Reconstruction of *Rhynia* sp. from the Rhynie chert fossil flora Scotland. Dated to circa 400 million years ago.

Polysporangiophyte, tracheophyte, Rhyniopsida

Diagram modified from 'Biology of Plants' 2005. Raven, Peter H., Evert, Ray F., Eichorn Susan E. . W. H. Freeman and Company

Examples of dichotomous branching in a living fern allie and an extinct early rhyniophyte

Figure 78 dichotomous branching *Psilotum* and *Rhynia*

dictyostele (Gr. *diktyon*, from *dikein* to throw (net) + Gr. stēlē stela, pillar) A complex stele (vascular plumbing) with large, overlapping leaf gaps, in section composed of many meristeles- a number of separate vascular strands (xylem surrounded by phloem); in transverse section these strands appear as a ring of separate bundles. Multiple siphonostele also known as a **dissected amphiphloic siphonostele**.. Found in some ferns. See **stele.**

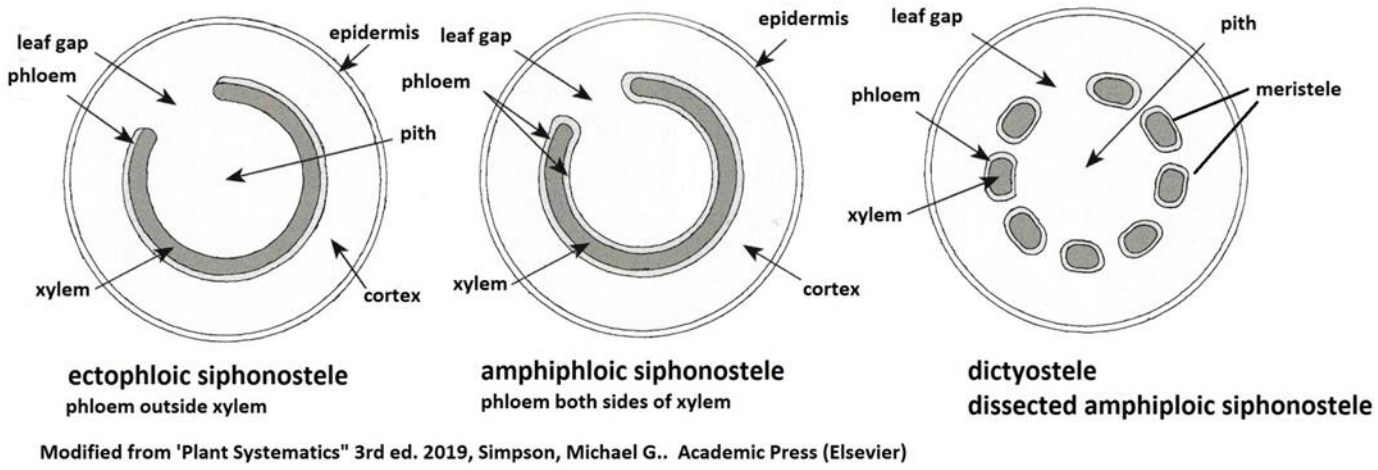


Figure 79 dictyostele

didymous ((Gr. *didymos* ,doubled) Twinned, (or in pairs) the two parts similar and attached by a short portion of the inner surface, e.g. *Dipteris* fronds.

differentiation (L. differre, to carry different ways) Refers to the way cells divide and the daughter cells become modified for different fuctions. As a result have different cell types, tissue sytems and organs.

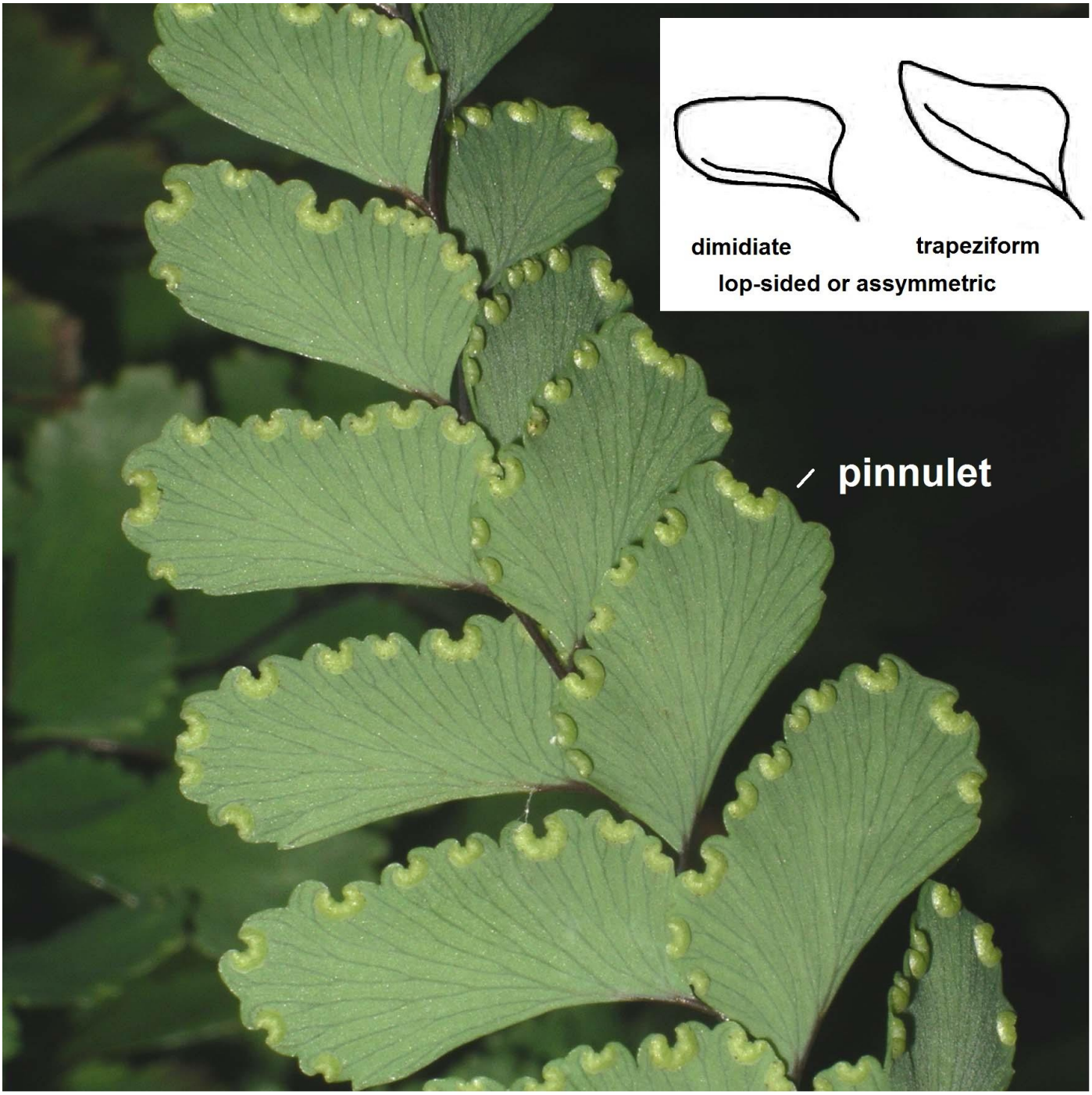
difform (*de-,* from, *formis* , form) Dissimilar.

diffuse (L. *diffundere* ,to spread, scatter)) Spreading or open or straggling form. *Lateristachys diffusa* syn. *Lycopodium diffusum*.

digitate (L. *digitus*: finger) A compound frond with the parts spreading from the centre like the fingers of a hand. Form of **palmate** with narrow leaflets.

dilated (L. *dilato* , I spread out) Widened. *Hymenophyllum dilitatum*

dimidiate (L. *dimidiatus*, past participle of *dimidiare*, from di- (from *dis-* apart) + *-midiare* (from *medius* mid) Halved, as when half of an organ is so much smaller than the other half that it seems absent. Lop-sided In *Adiantum*, *Asplenium*, and *Lindsaea* applied to pinnules in which the basiscopic lamina is reduced. The pinnule therefore appears ± rectangular or trapeziform rather than flabellate.

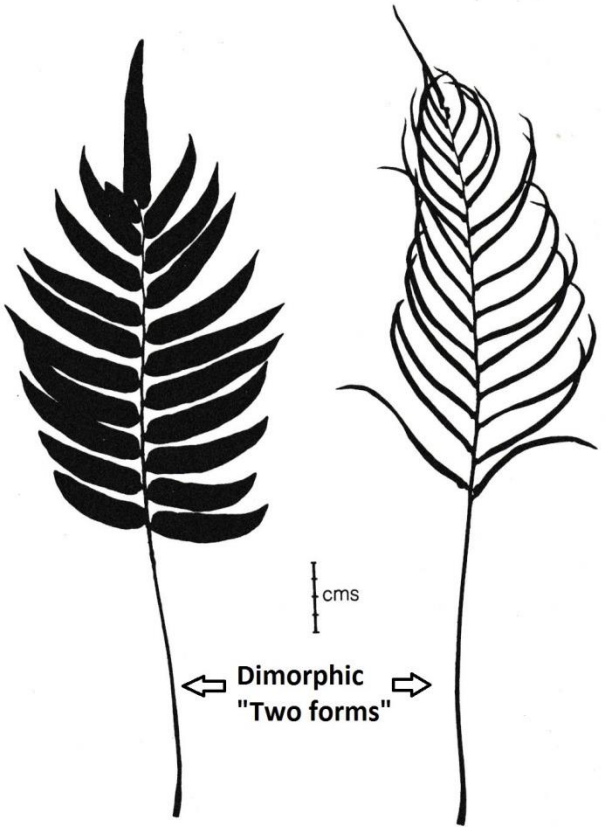


***Adiantum cunninghamii* pinnule**

https://en.wikipedia.org/wiki/Adiantum_cunninghamii#/media/File:Adiantum_cunninghamii.jpg

Figure 80 dimediate

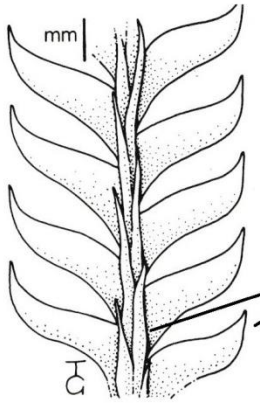
dimorphic (Gr. *dis*: twice + *morph* shape) Having two different forms, said especially of fronds, where the fertile and sterile (vegetative) blades differ in size or shape. *cf.* **monomorphic**. The dimorphism may vary from -Complete Dimorphism- Leaves completely fertile or vegetative,to Partial Dimorphism:- Leaves with only a part modified as fertile sporangia to Slight Dimorphism: - with Fertile and vegetative leaves only slightly different in appearance. See **sporophyll, trophophyll**.



Sterile and fertile fronds of ***Blechnum montanum***

Silhouetes Patrick Brownsey and W. N. Wilson

Dimorphic



Dimorphic leaves
(Two types)

Tim Galloway (artist)

Lycopodium volubile **two types of sterile leaves (microphylls/lycophylls) flattened in one plane; smaller linear leaves appressed, larger falcate leaves, subdistichous, spreading.**

'New Zealand Ferns and Allied Plants' 2nd ed. 2000, Patrick Brownsey and John C. Dodsworth-Smith; Bateman

Figure 81 dimorphic leaves

dioecious (Gr. *dis*-, twice; *oikos* , house) Having the male and female reproductive structures housed on separate plants or prothalli. Compare **monoecious**.

diplazoid (Resembling *Diplazium*) In the form of *Diplazium,* usually a comparison with the paired elongate sori of that genus. The sorus divided into two parts –the sporangia 'back to back' on both sides of veins, but not crossing over the vein itself.

diploid (Gr. *diploos*, double + *oides* , like) Having two of the basic sets of chromosomes in the nucleus or 2n. Characteristic of the sporophyte generation. Compare **haploid**, **polyploid**.

disarticulate (L. *dis*- reverse, opposite of + articulate f. *articulatus*, past participle of *articulare* to separate into joints, f. from *articulus* a part, a member, a joint) To separate readily at a joint

discolorous (L. *dis-, + cololare*, coloratum, to colour) Of different colours; of leaves, having the two surfaces different in colour; e.g. silver tree fern , *Cyathea dealbata* , Compare concolorous.

discontinuous Interrupted or lacking sequence

discrete (L. *dis* + *cretus* f. *cernere*, sift ,seperate) Clearly separate and not united. Said of sori that are not united (as in a coenosorus), or continuous. Or sporangia not united in a sorus as in the **acrostichoid** state.

disjunct distribution (Gr. disjunct f. *dis* separate, apart, two + *jungere*, *juncti*-, join) Distribution seperated geographically. (biogeography term).

dispersal (L. *di-* + *spergere* scatter) In biogeography, the movement of organisms or their propagules/ disseminules into or out of an area. The evolution of ancestral populations separated by dispersal can then proceed. Normal dispersal is the localized reproduction of organisms in an area via disseminules (syn. propagules). See **drifters**. Compare **vicarience**, **ancient rafters**.

dispersion The geographic range of an organism.

dissected (L. *dissecare*, cut up from *dis-* asunder + *secare* to cut) Deeply divided or cut into many segments.

disseminule (L. *dis-*, asunder, + *seminare*, to sow f. *semen*, seed) Any reproductive unit such as a spore, seed , or asexual structure such as a bulblet. Synonym **diaspore**, **propagule**.

distal (L. *distantia* , to stand apart, remote) Remote from the point of origin or attachment. Towards the free end or tip of an organ. The opposite of **proximal**. Regarding spores: facing away from the centre of the tetrad, remote from the point of attachment – the side opposite to the tetrad scar.

distal face The distal hemisphere of a spore or pollen surface,that is directed away from the tetrad.

distant (L. *distantia* , to stand apart, remote) Widely spaced, similar parts that are well separated and not overlapping or touching; said of stipes, pinnae, or segments. Synonym **remote**, compare approximate, confluent, connivant, contiguous, congested, close set. *Cheilanthes distans*.

distelic (Gr. *dis-* , twice + *stele* , pillar, column, post) With two steles (vascular cylinders or central columns).

distichous ((Gr. *dis:* twice+ *stikhos:* rows) Arranged in two, opposite rows in either **opposite distichous** or **alternate distichous** pattern (Phyllotaxy). The leaves of the water fern *Azolla filiculoides* are arranged in a distichous (2-ranked) manner.

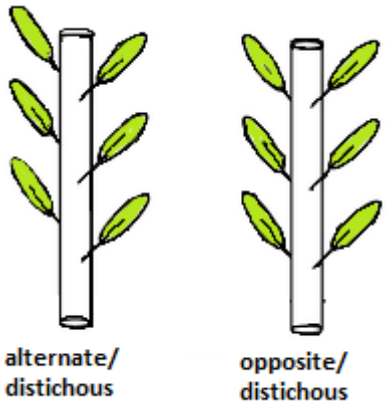


Figure 82 distichous (phyllotaxy)

distinct Separate, clear.

distribution The areas where a species (or taxa) occurs. The geographic range of taxa. Altitudinal distribution refers to the range in height above sea level (altitude) a species or taxa occurs. See **disjunct distribution**.

disturbance (*dis*, separate + *turbare*, f. *turba*, crowd) Relatively abrupt event (e.g. fire, storm,) causing loss of biomass or structure. (Plant ecology term). Provides an opportunity for **succession**. Some species may depend on disturbance to create living space or habitat.

disturbance regime Characteristic of disturbance (such as fire), occurring in a given ecosystem; generally described by intensity, size or frequency.

divaricate (L. *divaricare* , to stretch apart)) Attached or spreading at a very wide angle (nearly 90°).

divergent (L. *divergens* , diverging ,differing from) Spreading apart at a wide angle. Similar to divaricate.

divergence/diversification. The evolution of separate lineages from a common ancestor.

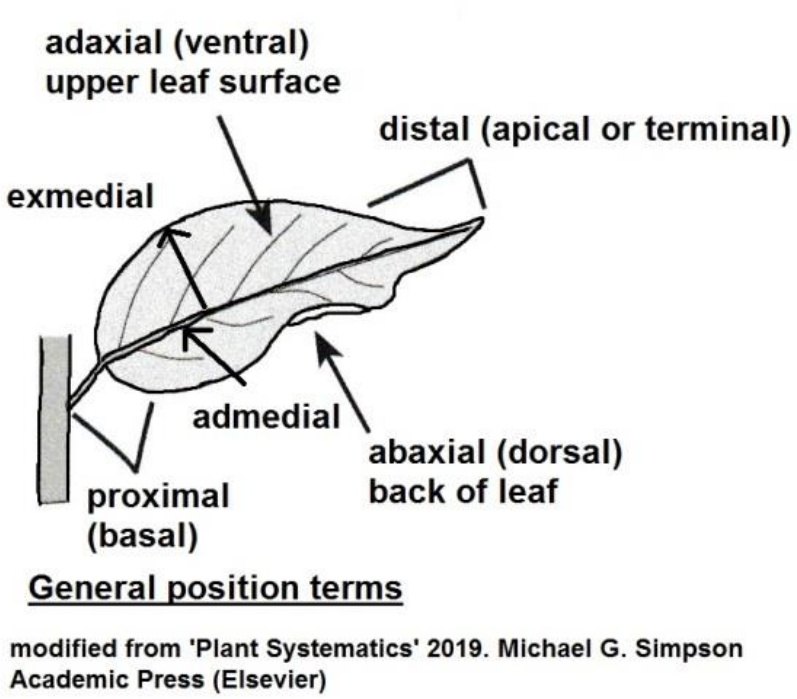
divided (L. *dividere*, *divisum* f. *dis*- asunder+ root *vid*, to seperate) Separated at the base.

dorsal (L. *dorsum* , back of a man or beast) Pertaining to, or attached to the back of an organ; lower surface of a leaf also known as **abaxial** surface.. Compare **ventral, adaxial.**

dorsal sori (dorsal + sori) Sori located on the back (dorsal or abaxial surface) of the leaf rather than the margin.

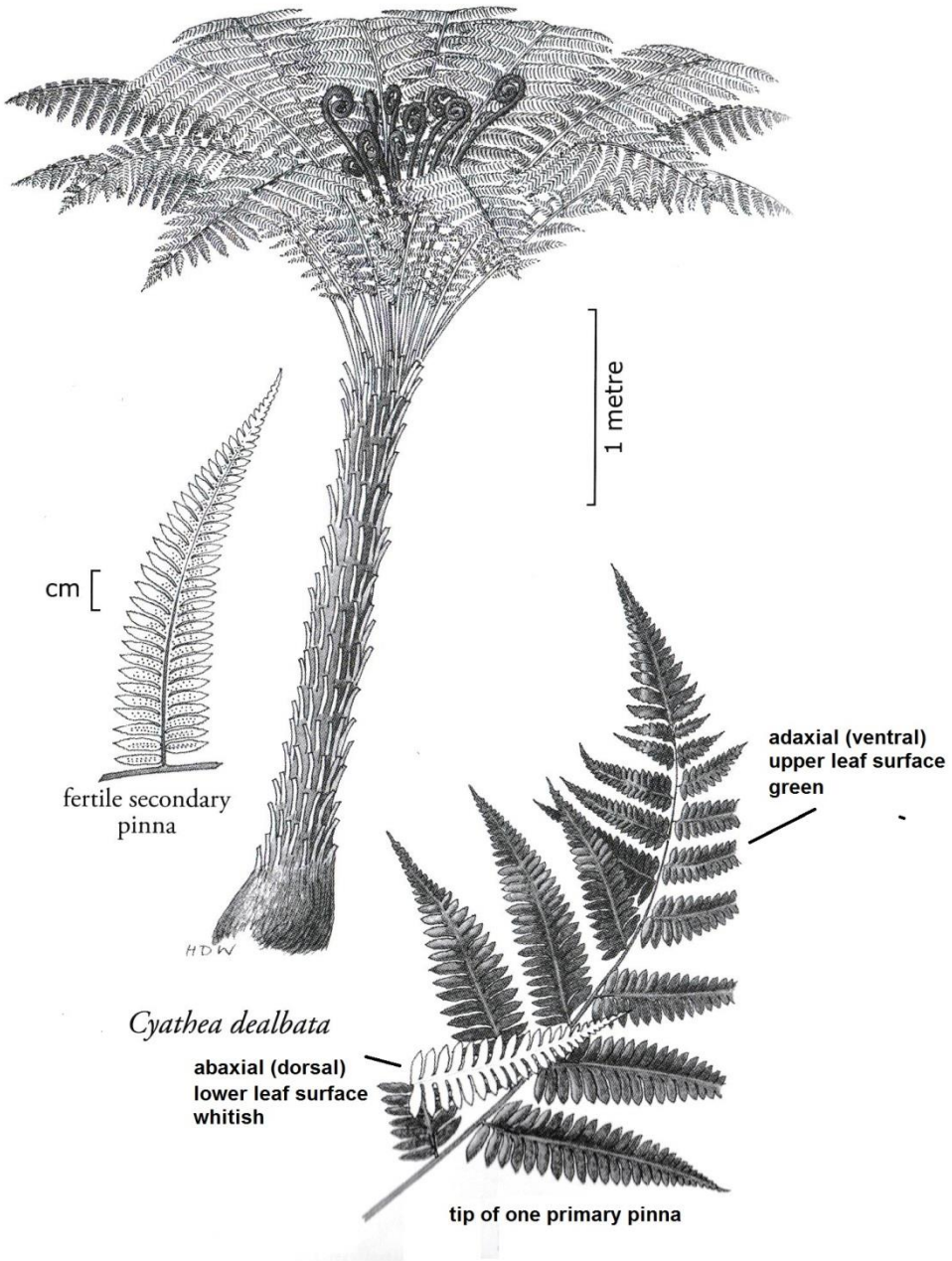
dorsifixed (L. *dorsum,* back + fixed) Attached by or at the back.

dorsiventral (L. *dorsum*, back + *venter*, belly) Having a back side and belly side, as a leaf does. With a distinct upper and lower surface or structure: as in a creeping rhizome which bears roots on the lower surface and fronds on the upper surface. Opposite of isobilateral – same both surfaces as in some monocotyledon leaves.



modified from 'Plant Systematics' 2019. Michael G. Simpson
Academic Press (Elsevier)

Figure 83 dorsiventral



In the silver tree fern *Cyathea dealbata* the upper and lower frond surfaces typically have distinct colours

Diagram from "Plant Life on Banks Peninsula' 2013. Hugh D. Wilson (author and artist). Manuka Press

Figure 84 dorsiventral *Cyathea dealbata*

drifters Drifters is the informal term for biota (plants, animals etc) that have arrived in New Zealand by **dispersal**, after the geological separation of Zealandia from Gondwana circa 80 million years ago. Compare **ancient rafters**, **vicarience**. For plants this could occur through wind, sea or animal transport of propagules (such as seed or spores). Following colonization by dispersal, the population is free to evolve seperately from the parent population. Late dispersal probably? accounts for the indigenous element of the flora, e.g. species shared with Australia and or South America. The endemic element, is derived either from vicariance (ancient rafters) or early dispersal. Recent 'drifters' that occasionally arrive but fail to establish permanenty as yet are known as **vagrants**.

dromy (f –dromous, Gr. *dromos,* running, racecourse) **Leaf venation** term referring to the way veins run in the leaf blade. See **actinodromou**s, **brochiodromous**, **campylodromous**,**cladodromous**, **craspedodromous**, **hyphodromous**, **parallelodromous** and **reticulodromous.**

dryopteroid ferns or **family** (Gr. from *Dryopteris,* f. *drys,* oak + *pteris*, fern) Ferns of the family Drypteridaceae e.g. *Polystichum*, *Dryopteris*.

dune A mound formed from wind blown sand.

eccentric (L. f. *excentricus*, one-sided, placed out of the centre) Said for instance of a peltate leaf or scale where the point of attachment of the stalk is one sided or off-centre.

echinate: (L. *echinatus* , set with prickles) Of a spore, spiny, with **echinae** or spine-like projections The Australian spiny anteater (mammal) is also known as an echidna

echinate-rugose (L. *echinatus* , set with prickles + L*. rugo*: to crease, wrinkle or crumple) Combination of spiny and wrinkled as in the surface of some spores.

eciliate (L*. e*- without + ciliate, f. *cil* , eyelash)) Lacking trichomes (cilia) on the margins, regardless of the prescence of teeth. The opposite of **ciliate**.

ecology (Gr. *oikos*, house + *logos* , discourse, study of) Study of the interactions of living organisms such as plants and animals within their natural environment (other organism and the physical environment including the soil, air, climate).

ecostate or **acostate** (L. *e*- or *a*- , without + *costa*, rib) Lacking a costa or midrib. Synonym **enervate** (lacking nerves i.e. main veins) or nullinervate (zero nerves).

ecotype (Gr. *oikos*, house + *typos*, the mark of a blow) A form of taxon arising under different local ecological conditions.

ectendomycorrhiza pl. **ectendomycorrhizae** (combines *ecto*- outside & *endo*- inside) Mycorrhiza that is formed by septate Ascomycota (sac fungi) and is intermediate between **endomycorrhiza** and **ectomycorrhiza**. Although the **Hartig net** forms outside the root cells, penetration of plant cortical cells occasionally occurs. Many species of ectomycorrhizal fungi can function either as ectomycorrhizas or in the penetrative mode typical of arbuscular mycorrhizas, depending on the host. Because these associations represent a form of symbiosis in between arbuscular mycorrhizas and ectomycorrhizas, they are termed ectendomycorrhizas. Hosts include *Pinus* (pine)*, Picea* spruce)*and Larix* (larch).

ectohydric (Gr. ecto- f. ektos, outside + *hydor*, water) Conducting water externally as is the case with many 'bryophytes'. Synonym exohydric (exo- = ecto). Compare with **endohydric**, conducting water internally (vascular plants) and **mixohydric**, conducting water both internally and externally.

ectomycorrhiza pl. **ectomycorrhizas** or **ectomycorrhizae** (Gr. *ecto*- f. *ektos*, outside + *mykes*, fungus + *rhiza*, root) **Mychorrhiza** (abbreviated EcM) in which the fungal hyphae forms a sheath (mantle) around the root of the host plant and penetrates the intercellular spaces of the root cortex (termed Hartig net), but not into the root cells (as endomycorrhiza do). Hosts include dominant forest trees. The edible truffle is the fruiting body of one such fungi. Compare **endomycorrhiza** and **ectendomycorhiza**.

edaphic (Gr. *edaphos*, soil) Pertaining to soil. There are plenty of terms for plants growing on rocks, but not for plants that regularly or preferably grow in soil: **terrestrial** in a sense does, but what about edaphophyte or edaphicolous, edaphophilous?. Geophyte comes close but already has a specific meaning. Latin equivalent: *solum*, soil.

effuse (L. *effundere*, *effusum*, *ex*-, out + *fundere* to pour) Very open and spreading loosely.

egg The nonmotile enlarged haploid gamete (ovum) produced by the female sex organ (**archegonium**) on the **gametophyte** or **prothallus**. The female gamete, also known as oosphere. Compare **sperm** and **zygote**.

eglandular (*e*- without + *gland* f. *glandula* ,little acorn (*glans*)) Without glands (Secretory organs). Opposite of **glandular**- possessing glands..

ektexine (*ekt-* or *ect-* , outer + exine) A structurally variable outer layer of the **exine**- itself the outer layer of a spore wall or pollen grain wall. **Intexine** (or **intextine**) being the inner layer of the exine.

elater (Gr. *elater*, driver, that which drives away) One of four filamentous appendages of the spores of *Equisetium*: A spirally thickened cell that is hygroscopic - changes shape with changes in humidity, associated with the spores and aiding in their dispersal. Sometimes called bands or hygroscopic ribbons. In liverworts (Hepataceae) sterile cells interspersed among the spores in a liverwort capsule. The cells stiffened with spiral thickenings, change shape with changes in humidity, breaking up the spore mass as they do so and thus aiding spore dispersal in these plants.

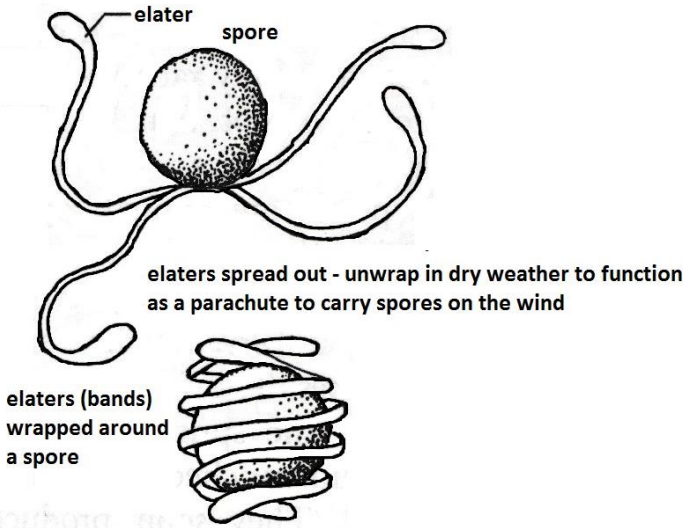


Figure 85 elators *Equisetum*

eligulate (L. *e-* without, + *ligule* f. *ligula*: a little tongue) Lacking a ligule. Opposite of ligulate. Of the lycophytes, lycopodiacea are eligulate, while Isoetopsida (Isoetiacea and Selaginellacea) are ligulate.

ellipsoid (L. *ellipsis*, f. Gr. *elleipsis*, f. *elleipo* come short f. *en-* in + *leipo* , leave + -oid, resembling) A solid object with a three-dimensional elliptical shape.

elliptic Having the outline of an elongated circle. Widest in the middle, 1.5-2 times longer than wide, with equal tapers at each end. See leaf shape

elliptical (L. *ellipsis*, f. Gr. *elleipsis*, f. *elleipo* come short f. *en-* in + *leipo* , leave) In the shape of an ellipse with the widest part in the centre; rounded at both ends. A regular oval shape.

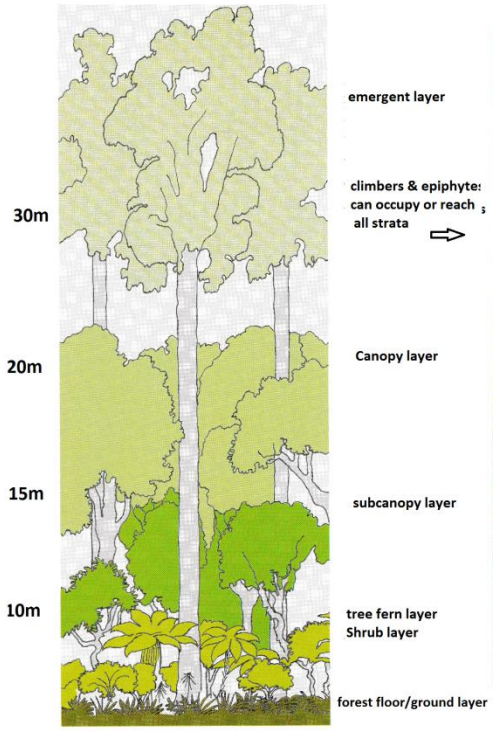
elongate (L. *elongare* , to lengthen) Drawn out in length. Said of a **sorus** that extends in length along a vein for a distance such as in *Asplenium sp.*, *Trichomanes elongatum*.

emarginate (L. *e-* , without + *margino*, edge) Having a broad shallow apical notch on an otherwise round or truncate apex.

embryo (Gr. *embruon*, fetus f. *en-* + *bryein* to swell) The developing zygote in the fertilized archegonium. The immature diploid sporophyte in land plants.

embryophyte/embryophyta (embryo + phyte, Gr. plant) Eukaryotic green plants forming a monophyletic group united by an outer cuticle, specialized gametangia –antheridia and archegonia – and a diploid phase of the life cycle, that includes the embryo. The land plants: bryophytes, lycophytes, ferns and seed plants, but not terrestrial algae.

emergent (L. *emergere*, *emersum*, *e-,* out of, *mergere*, to plunge) In forest stratification, a canopy tree that towers above the surrounding trees.



Forest layers (Stratification)
adapted from
'A Natural History OF NEW ZEALAND' 1992
Nic Bishop. Hodder & Stoughton

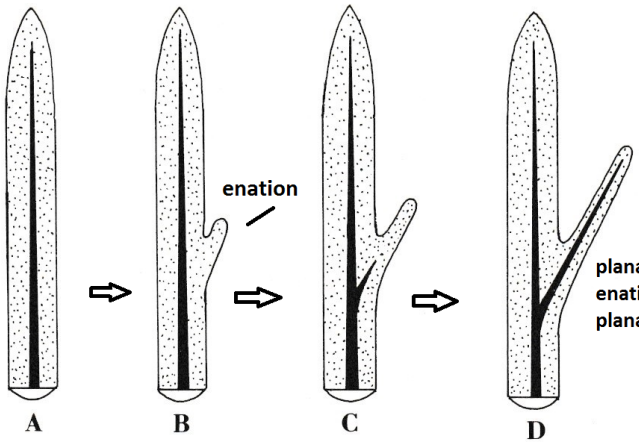
High canopy of the Waitakere rain forest from Piha Road
Mature kauri dominates, along with rimu (right), tanekaha (centre) and epiphyte-laden rewarewa (left). In the middle ground are nikau, the prominant scrambler kiekie and puka *(Griselinia lucida)*
'A Natural History of Auckland' 1993. Editor John Morton. Auckland Regional Council & David Batemen Ltd

Figure 86 emergent (forest stratification)

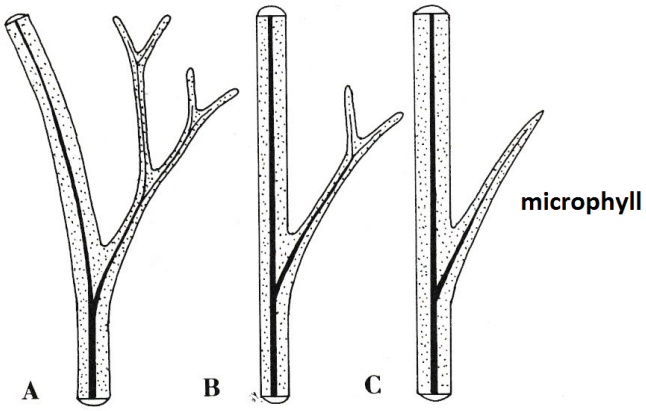
emergent hydryophyte A aquatic plant that is partially submerged and partially aerial, such as raupo *Typha orientalis*. Aquatic zonation term

emersed (L. *emergo*, to swim) Occurring under water, e.g. *Isoetes* spp. Synonym **submerged.** Most often rooted in bottom substrate but some species unrooted. See **aquatic** or **hydrophyte**. Contrast **floating aquatic**, **emergent hydrophyte**.

enation (L. *enato*, f. *enascor*, to sprout, to be born f. *e*- from + *natus* , born) A structure, which takes its evolutionary origin as an outgrowth from another structure. A rudimentay leaf-like structure, that lacks vascular tissue, e.g. *Psilotum nudum*. The **microphylls/lycophylls** of the lycophytes may have evolved as an enation from the stem of early lycophytes, which became vascularized (received a vein from the stems vascular cylinder). This hypothesis is termed the **enation theory**. The enation theory is contrasted with the telome theory for the origin of **megaphylls/euphylls** and the telome theory for the evolution of the microphyll by reduction.

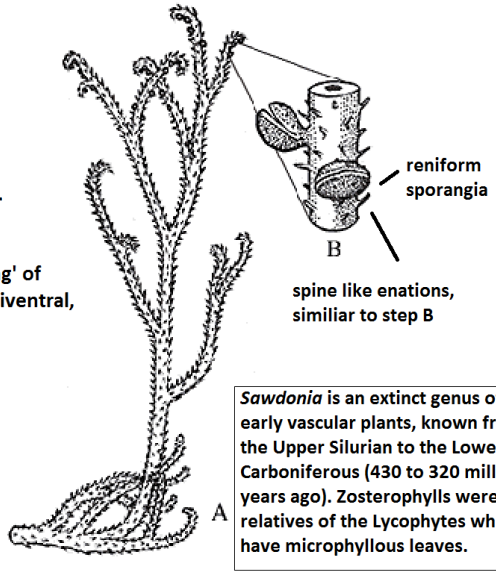


Hypothetical evolution of the microphyll according to the enation theory



Hypothetical origin of the microphyll by reduction alternative theory

Modified from "Morphology of Plants and Fungi' 1980. Harold C. Bold, Constantine Alexopoulos and Theodore Delevoras. Harper International Edition



Sawdonia **is an extinct genus of early vascular plants, known from the Upper Silurian to the Lower Carboniferous (430 to 320 million years ago). Zosterophylls were early relatives of the Lycophytes which do have microphyllous leaves.**

Reconstruction of the zosterophyll *Sawdonia ornata*

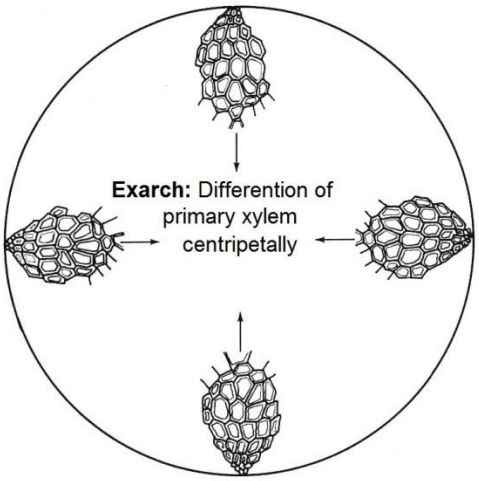
By http://www.ucmp.berkeley.edu/IB181/VPL/Lyco/Lyco1.html, Fair use, https://en.wikipedia.org/w/index.php?curid=13665109

A third theory, suggests that lycophylls evolved by the sterilization and planation of lateral sporangia.

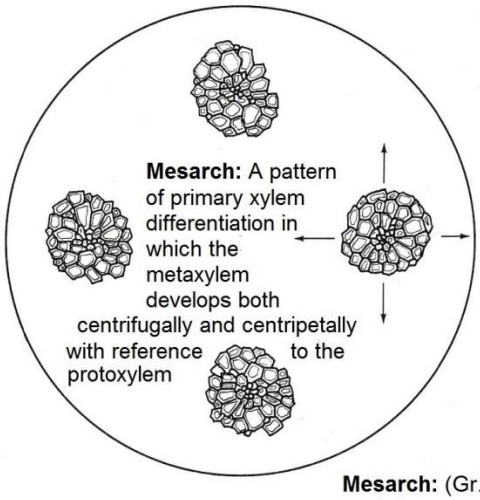
Horsetails (*Equisetum*) have microphylls too. The leaves are small, simple, whorled (several per node), non-photosynthetic at maturity (brown) and laterally connate into a sheath, with distinct tooth like apices. As fossil relatives were megaphyllous, the evolution of these microphylls may be closer to reduction theory.

Figure 87 enation theory and alternative

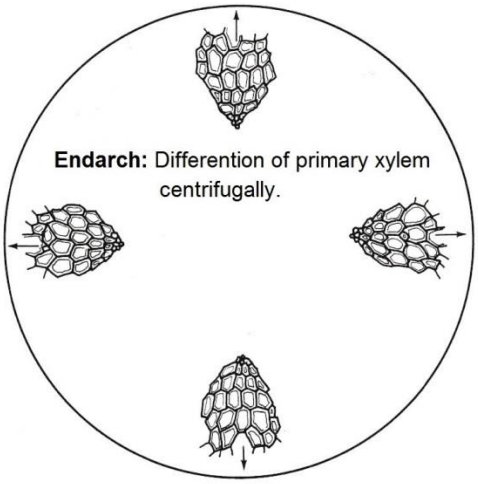
endarch (Gr. *endon*, within + *archein*, to be first) Differention of primary xylem centrifugally.



exarch: (Gr. *ex*-, out of + *archein*, to be first)



Mesarch: (Gr. *mesos*, in the middle + *archein*, to be first)



Endarch: (Gr. *endon*, within + *archein*, to be first)

Some common patterns of primary xylem differentiation from procambium. Protoxylem cells form first (hence the "arch" which here means first point of origin) are small, metaxylem cells are large and thicker walled. Synchronous type, consisting of metaxylem only not illustrated.

Centrifugal from Greek *kentron* centre + *fugo* to fly from

Centripetal from Greek *kentron* centre + *Peto, petere* to seek

Protoxylem: The first-differentiated primary xylem, usually in a region where the organ is increasing in length.
(Gr. *protos*, first + xylem f. *xylon*, wood).

Metaxylem: The primary xylem that differentiates from procambium after elongation of the organ has ceased and after the protoxylem has matured. (Gr. *meta*-, beyond, after + xylem).

Modified from 'Morphology of Plants and Fungi' 4th ed. 1980. Bold, Harold C., Alexopoulos, Constantine J., and Delevoryas, Theodore. Harper International Edition

Figure 88 endarch xylem differentiation

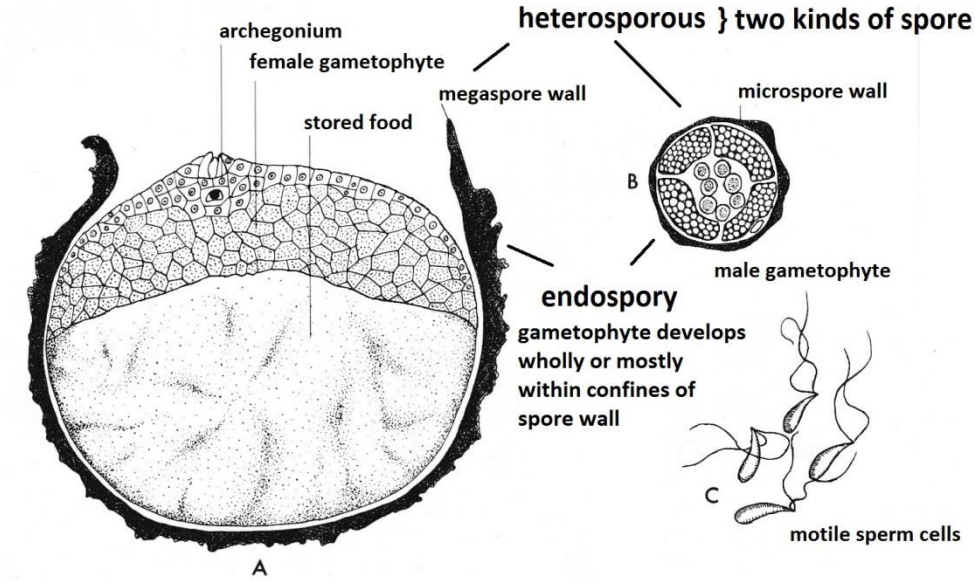
endemic (Gr. *endemos*, among one's people, native f. *en*, in + *demos* , people) Exclusively native or restricted to a particular country, region or area. Whereas **indigenous** can be native to more than one area, region or country. Endemism may occur at different levels, such as subspecies, species, genus, family etc. Compare the non-native terms: **exotic**, **adventive**, **naturalized**.

endohydric (Gr. *endo*- , inside + *hydor*, water) Conducting water internally (vascular plants). Compare with **ectohydric**/**exohydric**, conducting water externally as in many 'bryophytes' and **mixohydric**, conducting water both externally and internally.

endomycorrhiza pl. **endomycorrhizae** (Gr. *endo*- , inside, within + mycorrhiza f + *mykes*, fungus + *rhiza*, root) Internal mycorrhiza with fungal hyphae that penetrate the cells of the root cortex (intraradicle) but do not form a sheath (mantle) around the root. **Arbuscular mycorrhiza** is an example.(others are associated with plant groups: ericoid, arbutoid, monotropoid and orchid). Compare **ectomycorrhiza** .

endospore (*endo*- , inside + spore) The innermost layer of a fern spore adjaceant to the cytoplasm and consisting of a relatively thin layer of cellulose. Equivalent to **intine**. The outer layer is the **exospore**.

endosporic gametophyte A gametophyte that develops within a spore. For example in *Selaginella* the female gametophyte is contained within the megaspore and at maturity only a portion bearing archegonia, is exposed through the spore wall.



A. Sectioned female gametophyte of *Selaginella* within megaspore wall. B. Section of reduced microgametophyte of *Selaginella* within microspore wall. C. Motile sperm cells of *Selaginella* released from the male gametophyte.
Adapted from "Plant Diversification" 2nd ed. 1977. Theodore Delevoryas. Modern Biology Series. Holt, Rhinehart and Winston. Redrawn from 'The Plant Kingdom' by William H. Brown. 1935. Ginn & Co. (Xerox Company).

Figure 89 endosporic gametophytes

enervate (Gr. *e*-, without, *nerve*, vein) Lacking a midrib or costa. Synonym **acostate**,**ecostate**, and **nullinervate**. Opposite of **nervate**, and **costate**.

ensiform (L. *ensis* , a sword + *forma* , shape) Sword-shaped. With a length: width ratio greater than 12:1 e.g. the frond outline of *Blechnum discolor*. *Pteris ensiformis* (exotic fern). Leaf shape term.

entire (L. *in*, not + *teger*, f. *tag*- , *tangere*, touch f. *integer* , untouched, whole) With a smooth continuous margin, not toothed, divided or lobed in any way. Integer – having no kind of marginal division & integerrimus (quite entire) perfectly free from division of the margin (Stearn-'Botanical Latin')

entomochory (Gr. *entomos*, insect f. *en* + *temmnos* cut up (referencing the way insect bodies are divided) + -chore f. *khoreo*, to move) Dispersal of seeds, spores etc by insects or invertebrates in general. A form of **zoochory** (animal dispersal).

Eocene The geologic time epoch following the paleocene epoch from 56 to 34 million years ago. Included in the Paleogene period (formerly Tertiary period).

ephemeral (Gr. *ephemeros* , of the day, f. *epi* , on + *hemera,* day) A plant with a very short life cycle (sub-annual) or plant part that does not exist for very long. Compare: annual, biennial and perennial. See also **marcesent** : ephemeral but with persistent remains.

epidermal excrescence (epidermal + Gr. *ex*- f. *exo*- outside +*crescere*, grow) Surface outgrowths other than hairs or scales (**vestiture**), surface patterns and secretions of the epidermis (skin). Secretion related terms include **glandular**, **shining** through waxy coating (**nitid** or **laevigate**) and sticky:- **viscid** or **glutinous**, Terms related to epidermal outgrowths or protuberances include **prickly** (**aculeate**), **farinaceous** /**mealy** (**scurfy** –coarsly mealy or **granular** –finely mealy), **muricate**-having coarse, radially elongate, rounded protruberances, **papillate**- small nipple-like protuberances, **tuberculate**- having minute, rounded protuberances, **verrucate** or **warty** – having small wart-like protuberances and **vesciculate**-

having small- rounded bladder-like outgrowths and **scabrate-** bearing small firm sharp protuberances (or hairs) giving a rough surface like sandpaper. See **vestiture** which covers hairs and scales and **leaf indumentum (covering)**. Scaly or lepidote intergrades with epidermal excrescence characters.

epidermis (Gr. *epi*, upon + *dermis*, skin) The outermost layer of cells of an organ (leaf, stem, young root) usually only one cell thick. adj. **epidermal.** The epidermis serves to provide mechanical protection of inner tissue and control water loss. The presence of **cutin** – a polymer of fatty acids, acts as the sealant. Pores in the epidermis called **stomata** allow the entry and exit of gases. For epidermal surface patterns see **epidermal excrescence** and **hairiness terms (vestiture)**.

epigeal/ epigeous (Gr. *epi* , upon, above *geo* , earth) Growing above but near the surface of the ground (e.g., in moss mats at base of trees.). Gametophytes growing on the soil surface rather than underground and so usually photosynthetic. Synonyms: **epiterranean, surficial**. Contrast **subterranean**, **hypogeal**/**hypogeous**.

epipelic (Gr. *epi* , upon + *pelo*, clay, mud) Growing on mud. In New Zealand, the aquatic quillworts, *Isoetes kirkii* and *I. alpina* and the pillwort *Pilularia novae-zealandiae* could be described as epipelic, though they also grow on stony bottoms. See **limicolous**.

epipetiolar. (Gr. *epi*- , upon + L. *petiolus*: a little foot, leg f. *pes* , foot) With branches arising from buds on the petiole- footstalk of a leaf (stipe in ferns).

epipetiolar bud (Gr. epi- ,upon + petiole + bud) Buds produced at the base of the petiole in some ferns such as *Histiopteris incisa, Microlepia* sp. and *Hypolepis* sp.

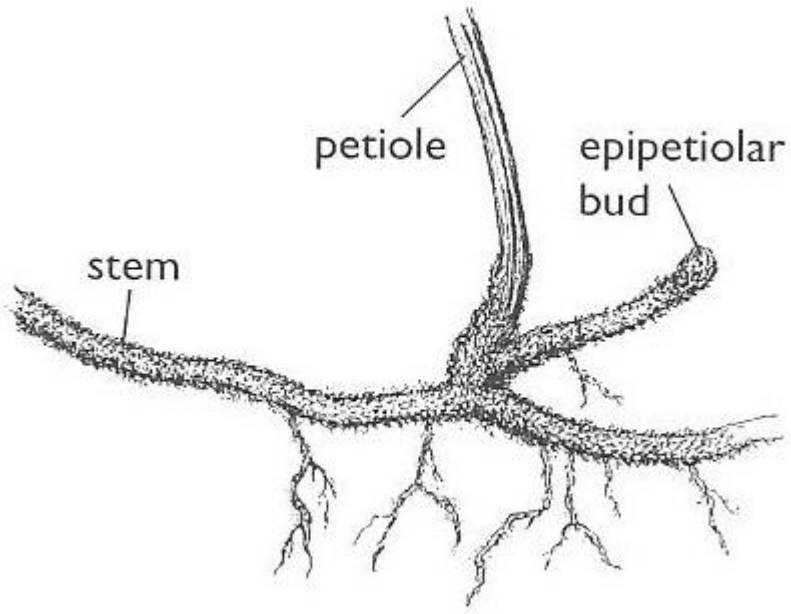


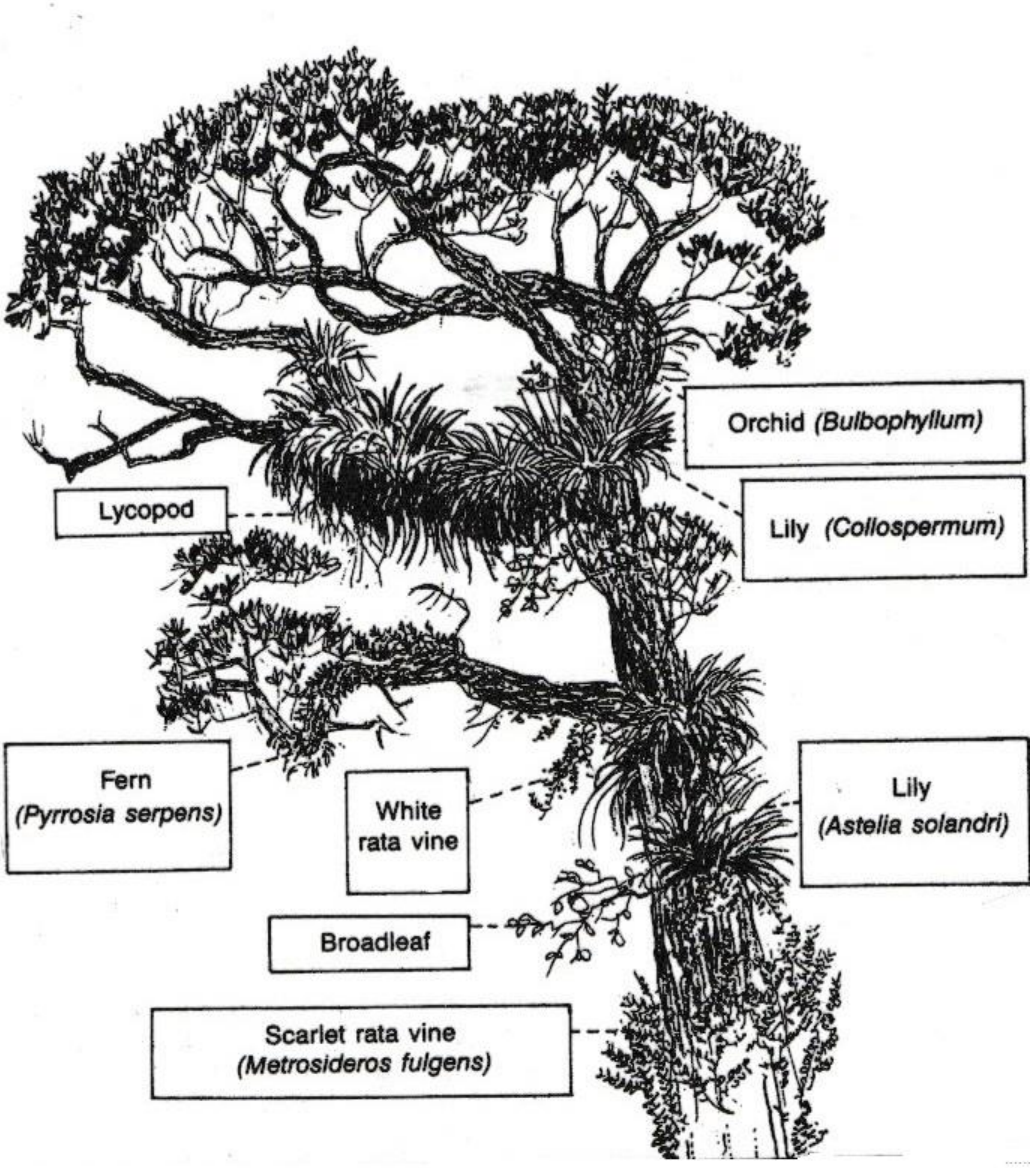
Figure 90 epipetiolar bud bat-winged fern *Histiopteris incisa* (Moran – Michel and Beitel (1988))

epilithic (*epi*- , on top of, + *lithos*, rocks).) Growing on rocks. Synonyms: **epipetric, lithophyte, petrocolous**, **rupestral**, and **saxicolous**). Example: Leather-leaf fern *Pyrossia eleagnifolia* which also grows as an epiphyte. See also **chasmophyte**.

epipetric (*epi*- , on top of, L. *petra* stone, rock, f. Greek *pétra*, stone, rock). Growing on rock (synonyms **epilithic, petrocolous**, **rupestral**, and **saxicolous.** Example: Leather-leaf fern *Pyrossia eleagnifolia* which also grows as an epiphyte.

epiphyllous (Gr. *epi*- ,upon + *phyllos:* , leaf)) Borne on or growing on leaves. Some algae,bryophytes and lichens do this. See **foliocolous**.

epiphyte (Gr. *epi* ,upon + *phyton* a plant) - A plant growing on (but not parasitic on) another plant for support. adjective. A perching fern or lycophyte, e.g. *Davallia tasmanii*, *Lycopodium varium, Tmesipteris* spp. . Some epiphytes may also grow on rocks (see **rupestral** etc). Synonym **aerophyte, perching plant**.



Epiphyte and climbers on a tree

'A Living New Zealand Forest: A community of plants and animals'. 1992. Robert Brockie. David Bateman Ltd

Figure 91 epiphyte

epispore (Gr. *epi-* ,upon+*spore*, a seed) Another name for **perispore**. An outer layer of the **exospore** found in some species.

epitactic (Gr. *epi-* , upon + *taxis*, I arrange,order) With sori borne on the apical veins of an ultimate branch system of a lamina with **catadromic branching** (the first branch of a segment is given off toward the base of the lamina, pinna or pinnule). Compare **paratactic** and **pantotactic**. Terms mostly applied to filmy ferns- Hymenophyllaceae . See **soral position**.

equater (L. *aequalis*,*aequus*, equal), The circle, half-way between the poles, dividing a spore or pollen grain into two polar hemispheres.

equatorial dimension "E" The greatest equatorial axis, the distance across the equator of a spore or pollen grain, from one side to the other, measured from the equatorial view in trilete spores or equatorial longitudinal view in monolete spores.

equatorial longitudinal view In monolete spores, side view parallel to the **laesura** (dehiscience fissure).

equatorial transverse view In **monolete** spores, side view tangential or transverse to **laesura** (dehiscience fissure)

equatorial ridge Ridge extending around the circle mid-way between the poles; a ridge circling the equater dividing the spore into two prominent hemsiphers.

equisetoid (L. horsetail genus *Equistum* + oid, like) Pertaining to a horsetail like feature e.g. sporangiophore characteristic of the horsetails and their extinct relatives. Synonym: **arthrophytan**.

erect Upright orientation. Similar **ascending**. Example tree fern trunk.

erose (L. *erosus* eaten away, gnawn, from *erodere* to erode) Of a margin, finely and irregularly eroded or incised as if chewed.

estuarine Pertaining to estuaries or river mouths, usually brackish conditions.

eucamptodromous (L *eu*- , well, good, true + camptodromous - Gr. *kampe*, to bend, L. *campto*-, bent, curved f. *kamptos*, flexible + *dromos*, running, racecourse)) Pinnate, camptodromous **leaf venation** pattern in which secondary veins do not terminate at the margin, curving upwards near the margin but not directly joining adjaceant secondaries.

euphyll (L *eu*- , well, good, true + Gr. *phyllos* , leaf) Leaves that developed evolutionarily from three-dimensional branching systems of early (Devonian) vascular plants; also known as a **megaphyll.** Leaves borne by ferns and the seed plants and their extinct relatives, distinct from the **microphyll** (or **lycophylls**) of the lycophyte clades. Characterized by a branching vein system and often petiolate. It is thought the leaves of horsetails are microphyll-like through reduction from megaphylls, as fossil forms bore megaphylls.. Compare **microphyll**. See **telome theory**.

eupteridian venation (f. fern genus *Eupteris*, now *Pteridium* bracken) A venation pattern of the **Ctenopterian** form (pinnate) in which the secondary veins leave the midrib at an angle intermediate between the acute angle of the **Sphenopteridian** type and the right angle form of the **Taenopteridian** type.

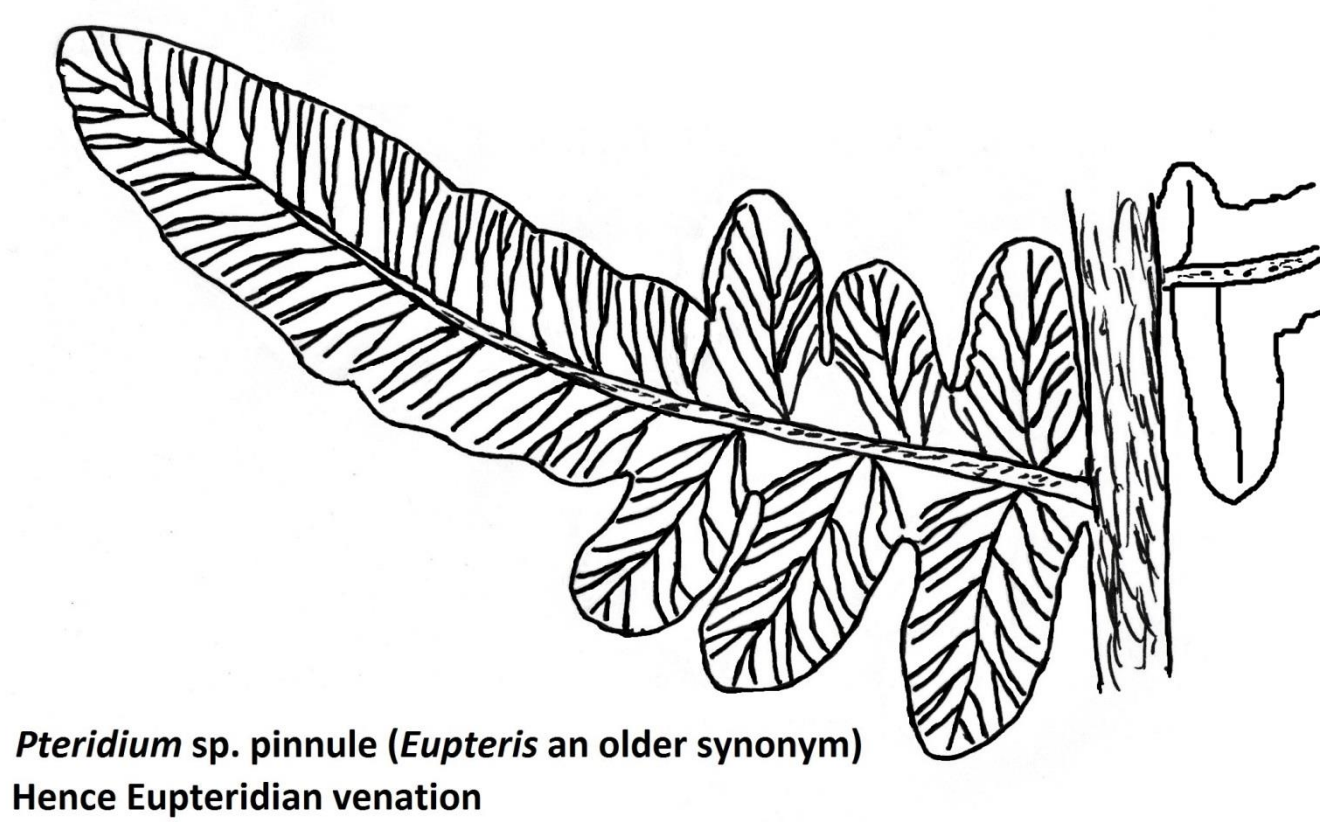


Figure 92 eupteridiun venation (Mettenius German botanist 1823-1866)

eusporangiate (L *eu-* , good, true + sporangium) With the sporangial wall more than one cell in thickness, originating from several cells in the sporophyll leaf tissue**.** Distinguishes,a major clade of ferns – the eusporangiate ferns from the leptosporangiate ferns. The lycophytes and seed plants are also eusporangiate the presumed ancestral state in vascular plants. Compare **leptosporangiate.** See diagram below.

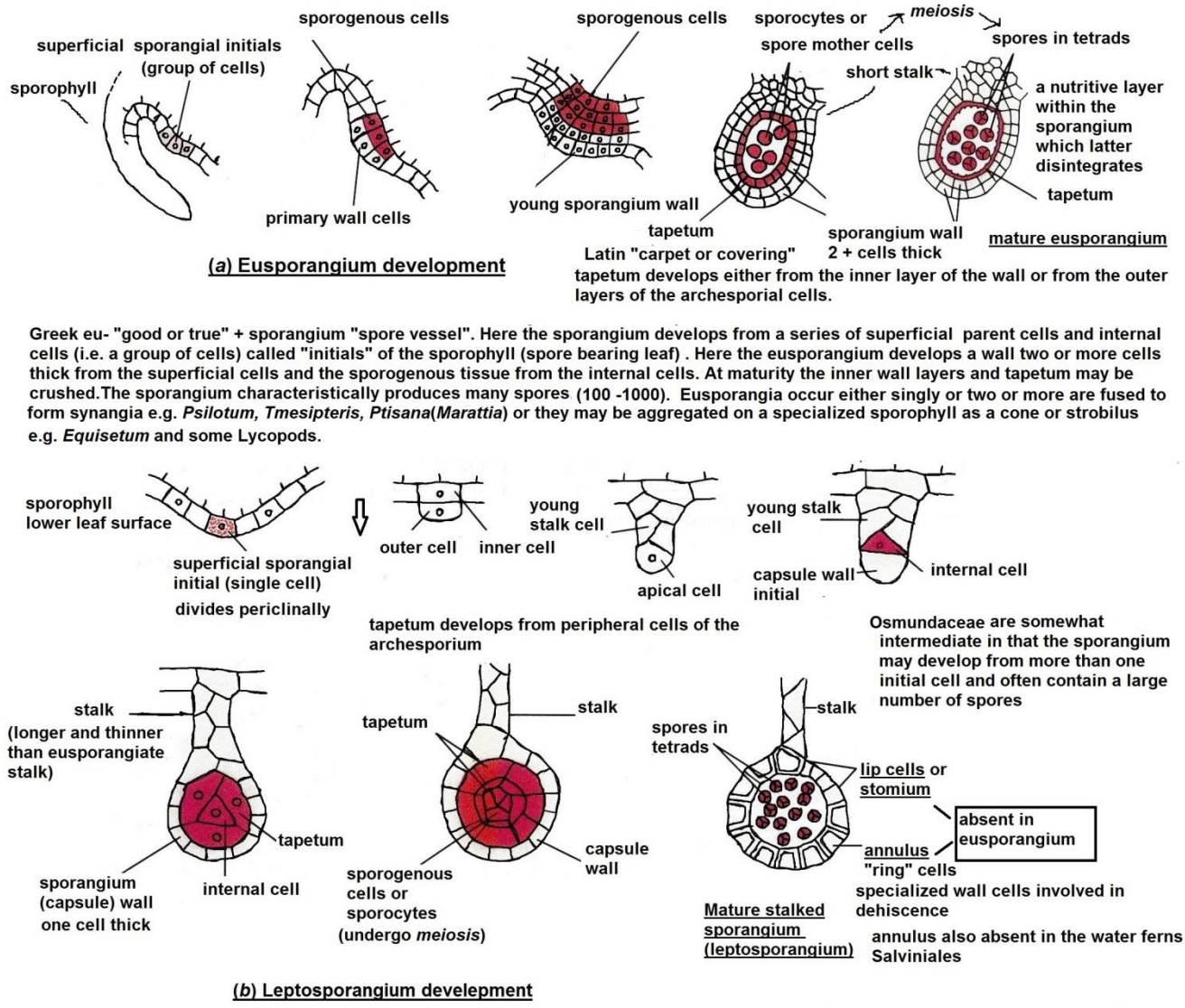


Figure 93 comparisom eusporangiate and leptosporangiate development

eustele (L *eu-* , true, good + *stele*, pillar) A stele, in which the primary vascular tissues are arranged in discrete strands around a pith; characteristic of seed plants – gymnosperms and angiosperms. Not in ferns or lycophytes. The monocotyledons (of the angiosperms) have a modified eustele called an atactostele (Greek, *atacto-* scattered, irregular, disordered + stele), in which the vascular bundles appear scattered in the ground tissue (ground meristem) so there is no distinct pith.

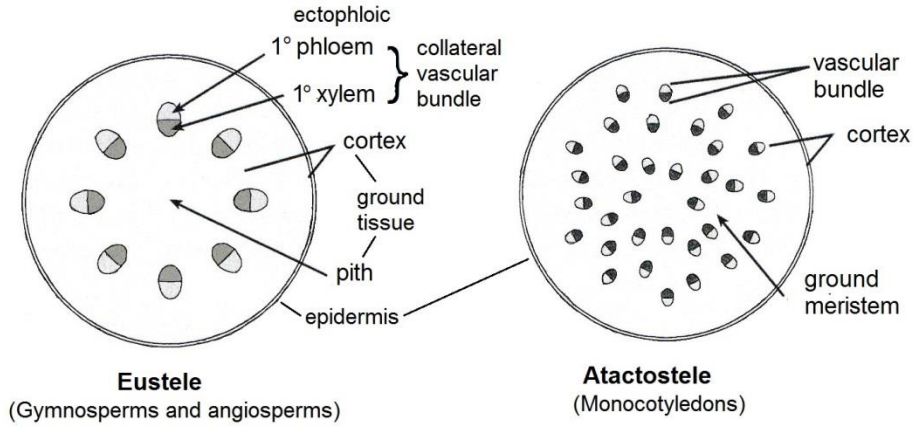


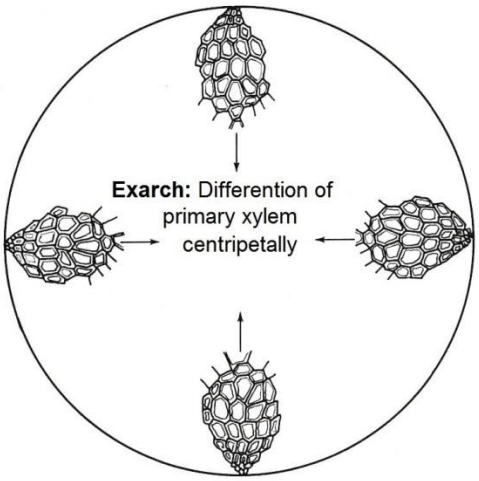
Figure 94 eustele

evanescent (Fr. f. *evanescent* f. *e-* + *vanescere,* vanish) Short-living, shrinking, falling. See **ephemeral** and **marescent**.

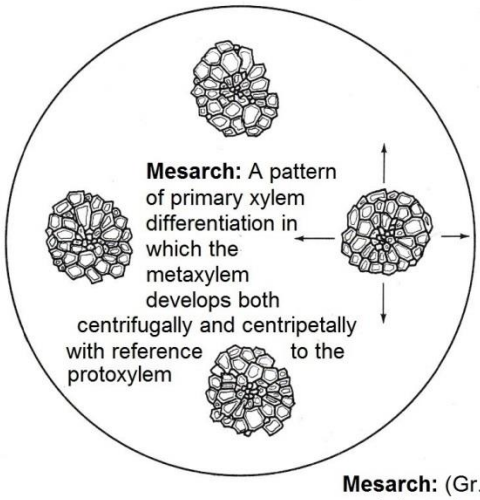
evergreen Retaining green leaves throughout the year. Leaves are shed and replaced gradually, not all at once. Opposite: **deciduous.** The majority of New Zealand native ferns are evergreen; a few e.g. annual fern *Anogramma leptophylla* are deciduous as are a number or naturalized exotic ferns – e.g. *Dryopteris filix-mas*.

exannulate (L. *ex-* out of + annulus) Lacking an **annulus**, as in the eusporangiate ferns and water ferns (Salvinniales) and lycophytes..

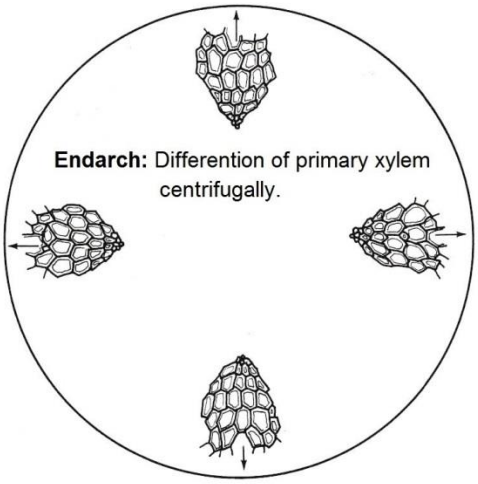
exarch (Gr*. ex-,* out of + *archaein*, to be first) Differention of primary xylem centripetally. The first formed protoxylem forms towards the centre of stem or root axis, the later metaxylem on the outside.



exarch: (Gr. *ex*-, out of + *archein*, to be first)



Mesarch: (Gr. *mesos*, in the middle + *archein*, to be first)



Endarch: (Gr. *endon*, within + *archein*, to be first)

Some common patterns of primary xylem differentiation from procambium. Protoxylem cells form first (hence the "arch" which here means first point of origin) are small, metaxylem cells are large and thicker walled. Synchronous type, consisting of metaxylem only not illustrated.

Centrifugal from Greek *kentron* centre + *fugo* to fly from

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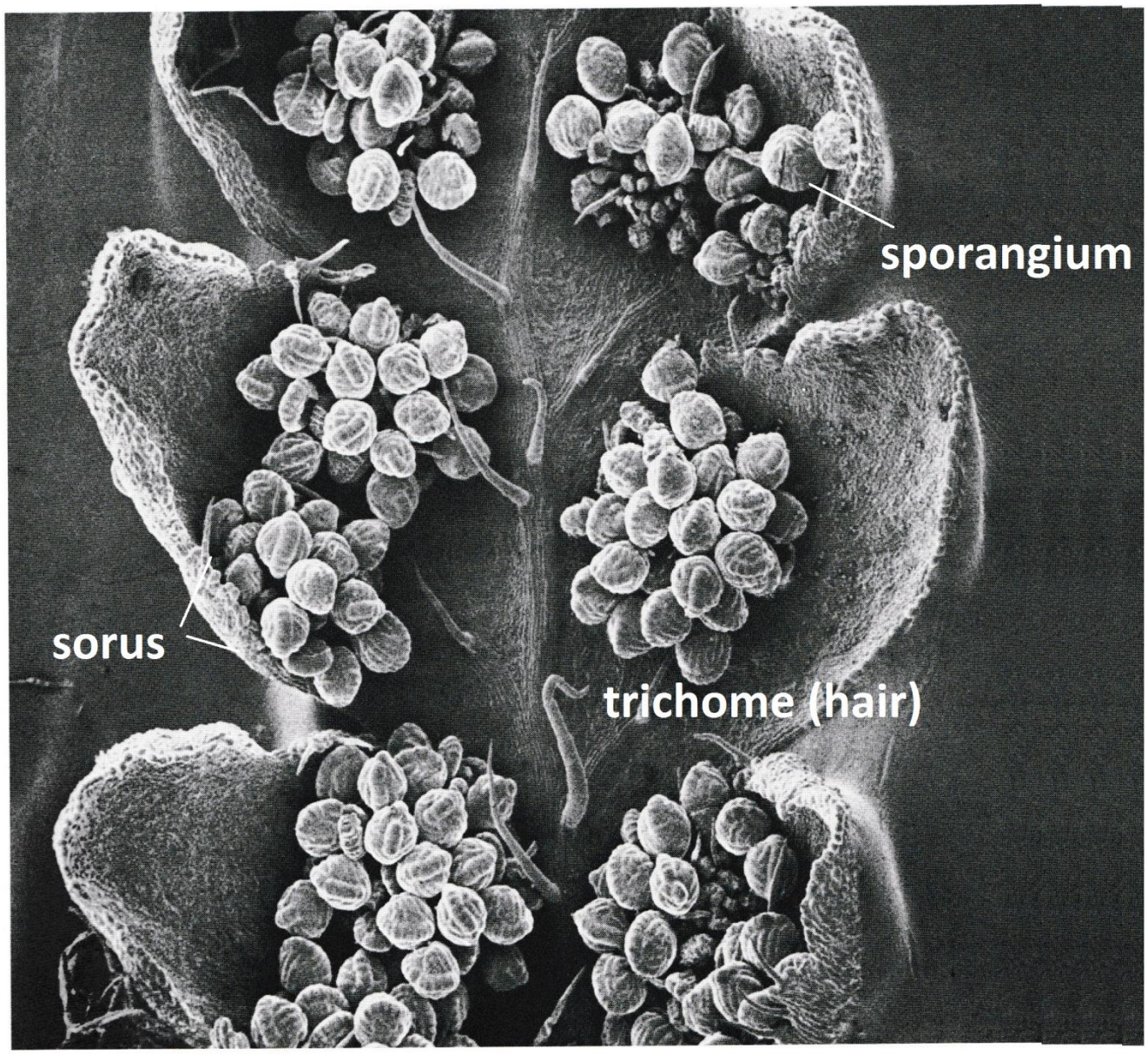
Modified from 'Morphology of Plants and Fungi' 4th ed. 1980. Bold, Harold C., Alexopoulos, Constantine J., and Delevoryas, Theodore. Harper International Edition

Figure 95 exarch xylem differentiation

excrescence (L. *ex*- out of + *crescere*, *cret*-, grow) Outgrowth from the surface.

excurrent (L. *Ex*- out of + *currere*, *curs*- run) Having the vein extend beyond the apex of a segment as a sharp point (mucro). *Tmesipteris* sp..

exindusiate (L.*ex*- , without + indusium) Lacking an **indusium**. Sorus or sporangium is said to be naked. Opposite of **indusiate** – possessing an indusium. The fern family Polypodiacea are exindusiate, while Aspleniaceae are indusiate.



Sporangia on pinna of *Hypolepis ambigua* the sporangia arranged in clusters (sori) on either side of midrib on the underside of leaflets, not all sporangia within each sorus are at the same stage of development. The sori not or hardly protected by green reflexed laminal flaps. Essentially exindusiate or with what could be called a false indusium.

'Plants: A Scanning Electron Microsscope Survey' 1973.
Troughton, J. H. & Sampson F. B. . John Wiley & Sons Australasia Pty Ltd

Figure 96 exindusiate *Hypolepis*

exine: (L. *ex-* , without + *in-* fibrous tissue, f. Gr. *in-*, *is,* tendon, or L. *extimus*,outside +ine) Outer layer of a spore wall ,pollen grain (or second layer, if **perine** is present). It is very resistant to decay due to deposition of sporopollenin within. Also known as the **exospore** (fig.90). The exine itself has layers –an outer **sexine** (sculptured exine) and an inner **nexine** (non sculptured exine).. **Intine** is the inner layer of the spore wall.

exmedial (L *ex-* ,without + *medial*, middle) Located away from the middle. Opposite of **admedial**. See **soral position.**

exospore (L *ex-* ,without + spore) or **exine** (1) The outer layer of a fern spore or pollen grain; it consists of several layers and may be pitted or bear canals . (2) Apically abstracted spores in cyanobacteria (blue-green algae). (3) The outer layer of a zygote (cyst) of some algae and fungi.

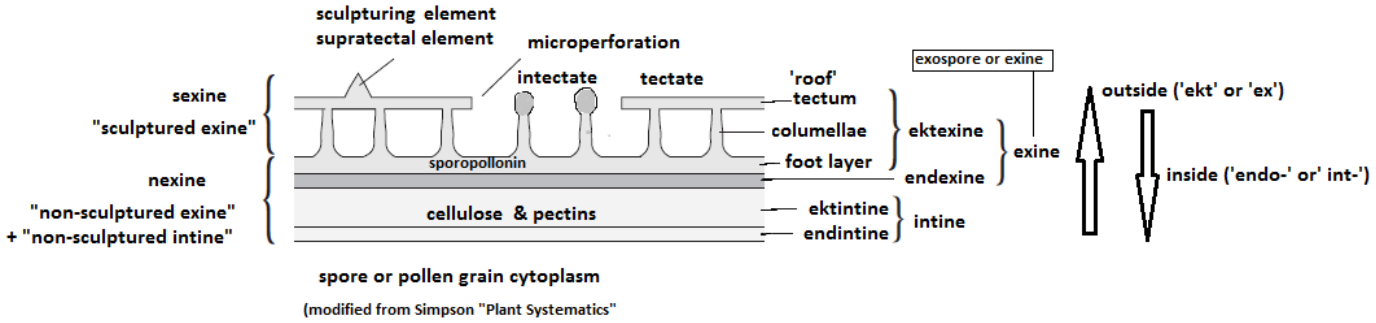


Figure 97 exospore

exserted (L. *exsertus* , thrust forward, protruding, projecting) Protruding beyond the surrounding parts. Sticking out or projecting beyond. Example the receptacle (stalk) of *Trichomanes* spp. extends beyond the indusium at maturity. Opposite **included**.

extraradicle hyphae/mycelium (L. *extra-* outside +*radix*, root) The fungal filaments(hyphae) that make up the fungal body in the soil outside the roots. These aquire nutrients, propagate associations with plant roots and produce spores and other structures. Compare **intradicle hyphae/mycelium**.

extrorse ((L. *exstra-*, outside + *versus*, towards) Directed or bent outward. Opposite of **introrse**, turned or bent inwards or towards the center. Compare also **antrorse**, facing towards the tip, and **retrorse**, facing away from the tip.

exudate (Ex- + *sudare*, sweat)) A liquid, resinous or gelatinous substance excreted by a plant organ.

facilitation (L. *facilis*, easily done, f. *facere*, do) Positive interaction amongst plants; a process by which early pioneer species increase the establishment and survivial of later successional species, e.g. a moss species favouring a fern species, a tree fern favouring establishment of epiphytes.

facultative (L. *facultas* , ability, power) Not essential, not restricted to,able to exist without. Opposite of **obligate**.

falcate (L. *falcula* , a small sickle, pruning hook) Scythe or sickle shape: curved and tapered toward tip, e.g. *Blechnum montanum*, *Pellaea falcata* (sickle fern), *Cyrtomium falcatum.*. Synonym: **seculate**.

false indusium (False + indusium) A covering over the sorus formed by a reflexed leaf margin, characteristic of many genera in the Pteridaceae such as *Adiantum, Cheilanthes*, and *Pellaea*. Some ferns possess both a false and a true indusium e.g. *Pteridium esculentum*.

false veins Rows of thickened epidermal cells in a leaf/leaflet which are not part of the vascular system, as in some genera of the Hymenophyllaceae. Or a thinned area of the lamina that is translucent and resembles a vein as in *Davallia*. Also known as **falsinervis**.

family Rank in the taxonomic hierarchy consisting of a group of related genera: plant family names end with the suffix- -aceae e.g. Pteridaceae. The rank is above the rank of genus.

farina (L. *farinosus* mealy, f. L. *farina*, meal) A white,or yellow mealy or flour like covering, as on the fronds of *Cheilanthes farinose*. Adjective **farinise.**

fascicled (L. *fasiculus*: a little bundle or package, a bouquet)) Arranged in bundles or clusters, as the stipes of some ferns.

fastigiated, fastigiate (L. *fastigo* , to bring or raise to a point, to elevate) With stems or branches more or less erect and close to the axis. *Lycopodium fastigiatum*.

faveolate (L. *favus*, honeycomb) Forming a honeycomb pattern. Seed, spore or pollen wall sculpturing.

female gamete See **egg**.

female sex structure The **archegonium** borne on the gametophyte or prothallus. Produces the egg cell (female gamete). Compare **antheridium** the **male sex structure**.

fen A habitat that is wet with running water, neutral in pH, relatively nutrient rich, and well aerated. A type of wetland that accumulates peat deposits. Fens are less acidic than bogs, deriving most of their water from groundwater rich in calcium and magnesium. Over time may transition in a form of succession from rich fen to poor fen to bog.

fenestra or **fenestrae** (L. *fenestra* , an opening in a wall to admit the light. A window) Windows, holes.

fenestrate: (L. *fenestra* , an opening in a wall to admit the light. A window) Pierced with small window-like openings or holes called **fenestra** or **fenestrae**,.

fern allies Vascular plants that reproduce by liberating their spores and having a life cycle like that of true ferns with mostly independent gametophytes and sporophytes; but differing in how they bear their sporangia and by having small leaves with simple, unbranched veins (microphylls) versus the megaphylls of true ferns.. Living familes of fern allies are the Equisetaceaea, Isoetaceae, Lycopodiaceae, Psilotaceae, and Selaginellaceae. The term “fern ally” is now obsolete because it has been shown that the Equisetaceae (horsetails) and Psilotaceae (whisk and fork ferns) are ferns, and ferns are more closely related to seed plants than to the lycophytes :- Isoetaceae (quillworts), Lycopodiaceae (club mosses) and Selaginellaceae (Club mosses). The two evolutionary lines split over 400 million years ago. The grouping of ferns and fern allies as pteridophytes is thus polyphyletic and one of tradition and convenience. Compare Monilophytes and Lycophytes (Microphyllophyta). A pteridologists studies both monilophytes (real ferns) and Lycophytes.

ferruginous (L. *ferrugo* ,iron rust) Rust-coloured. Rusty filmy fern *Hymenophyllum frankliniae* formerly regarded as *H. ferrugineum* a South American species.

fertile (L. *fertilis*, capable of producing fruit) Of fronds capable of bearing spores Synonym **sporophyll**. In some ferns there are separate fertile and **sterile fronds** –the latter also known as a **trophophyll**. Producing spores capable of germination synonym **viable**..

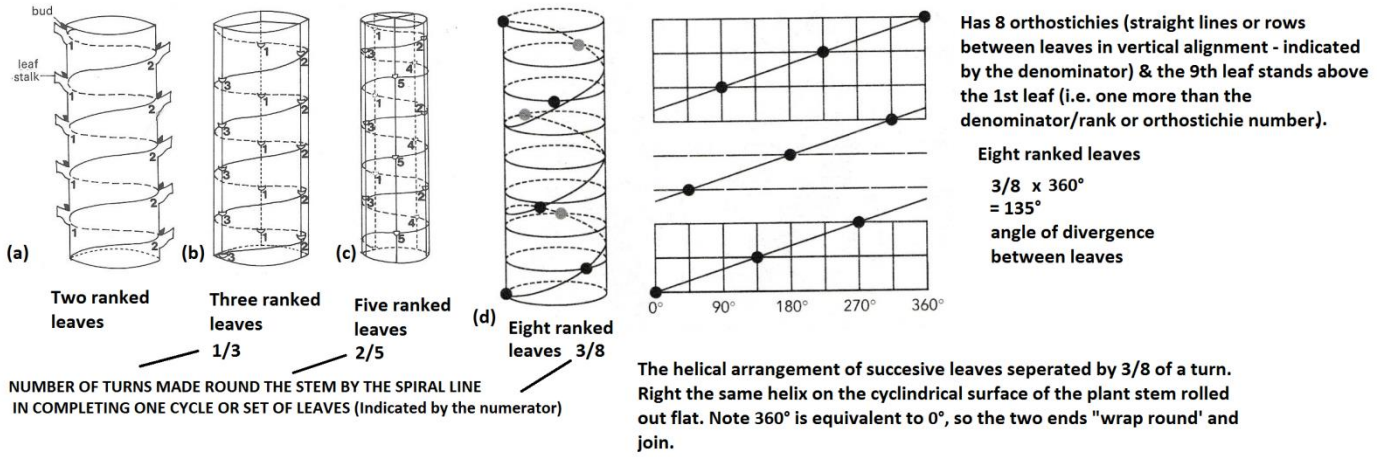
fertilization (L. *fertilis*, capable of producing fruit) The act of union of the sperm and the egg cell in the archegonium. The union of male and female gametes which are haploid.The result is the zygote, fertilized egg, the start of the diploid sporophyte generation.

feuillettes (French A puff pastry case with a sweet or savoury filling, f. flakey) Plates of material which make up layers of the exospore.

“**FEVs**” (freely ending ultimate veins of a leaf) Included veinlets within a reticulately veined leafs areola’s. They maybe absent, simple unbranched –straight or curved, or branched one or more times.

fibbonachi series (Italian mathematician Leonardo of Pisa, later known as Fibonacci, who introduced the sequence to Western European mathematics in his 1202 book *Liber Abaci)*) In mathematics, the Fibonacci numbers, commonly denoted Fn, form a sequence, the Fibonacci sequence, in which each number is the sum of the two preceding ones. The sequence commonly starts from 0 and 1, although some authors omit the initial terms and start the sequence from 1 and 1 or from 1 and 2. Starting from 0 and 1, the next few values in the sequence are: 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, ... The appear in biological settings, such as branching in trees, the arrangement of leaves on a stem, the fruit sprouts of a pineapple, the flowering of an artichoke, an uncurling fern, and the arrangement of a pine cone's bracts.

Fibonacci numbers are strongly related to the golden ratio: Binet's formula expresses the *n*th Fibonacci number in terms of *n* and the golden ratio, and implies that the ratio of two consecutive Fibonacci numbers tends to the golden ratio as *n* increases. Fibonacci numbers are also closely related to Lucas numbers, which obey the same recurrence relation and with the Fibonacci numbers form a complementary pair of Lucas sequences.



Phyllotaxy (Leaf Arrangement) and Fibonnacci

Diagrams (a-c) from 'Bellamy on Botany' 1972. David Bellamy. BBC
(d) from 'mathematics of Life: Unlocking the secrets of Existence' 2011. Ian Stewart. Profile Books

Figure 98 phyllotaxy

PHYLLOTAXY (synonym DISPOSITIO)				
RANK = NUMBER OF LEAVES IN EACH CYCLE, OR THE NUMBER OF PERPENDICULAR RANKS (ORTHOSTICHIES). (Indicated by the denominator)	**FRACTION**	NUMBER OF TURNS MADE ROUND THE STEM BY THE SPIRAL LINE IN COMPLETING ONE CYCLE OR SET OF LEAVES (Indicated by the numerator)	NUMBER OF **ORTHOSCTICHIES** (STRAIGHT LINES BETWEEN LEAVES IN VERTICAL ALIGNMENT (Indicated by the denominator) & LEAF NUMBER THAT STANDS OVER THE FIRST LEAF	**ANGLE OF DIVERGENCE** (Divide the number of turns in a cycle by the number of leaves passed on the way, or by the number of orthostichies. x 360°)
Two –Ranked Three – ranked Five-ranked Eight- Ranked Thirteen - Ranked	½ 1/3 2/5 3/8 5/13 8/21 13/34	One One Two Three Five Eight thirteen	(2 orthostichies)3rd leaf over first (3 orthostichies) 4th leaf over 1st (5 orthostichies) 6th leaf over 1st (8 orthostichies) 9th leaf over first (13 orthostichies) 14th leaf over first (21 orthostichies) 22nd leaf over first (34 orthostichies) 35th leaf over first	180° 120° 144° 135° 138.5° 137.14° 137.6°
The **Lucas Numbers** Pattern (Numbers 1, 3, 4, 7, 11, 18, 29, 47, 76, 123) example four petals of Fuchsia flower				
Ratios =Pairs of numbers of spirals		Angle –converges to 99.5°	example	
1/3 3/4				

4/7 7/11 11/18 18/29 …		29 ribs *Echinocactus* sp. 47 and 76 spirals in sunflowers	
Non conforming pattern = RANDOM			

fibrillose (L. *fibra*, a filament) With thread like fibres or scales.

fibrose (L. *fibra*, a filament) Composed of, or resembling fibres. *Dicksonia fibrosa*

fiddlehead A popular term for a fern crozier , koru (Maori), monkey's tail. A Young fern leaf coiled in bud. See **circinate venation**. Contrast **non-circinate vernation**.

filamentose (L. *filatim*: *, filum*, a thread) Hair-like. Bearing filaments.

fid -fid (L. *-fid* f. *-fidus,* f. *findere*, to split, cleave) Cleft or lobed. See **pinnatifid**, **palmatifid**. *Hymenophyllum multifidum* much-divided filmy fern.

filament (adjectective **filamentous**) (L. *filatim*, *filum*, a thread) Thread-like row of cells attached end to end, usually uniseriate, long and sometimes branched.

filamentous (L. *filatim*, *filum*, a thread) Composed of filaments, thread-like. Some fern gametophytes are filamentous rather than thalloid.

filicetum (L. *filici* , fern) A fernery, place for growing ferns.

filici- (L. *filici* , fern) Prefix from the Latin for fern hence **Filicopsida** the order of true ferns and the fern *Dryopteris felix-mas*. Equivalent to Greek *pteris*.

Filicopsida or **Filicales** (L. *filici* , fern) The leptosporangate ferns, also known as Polypodiopsida-**Leptosporangiatae**. The bulk of ferns sometimes called true ferns. See **leptosporangium**.

filiform (L. *filatim*, *filum*, a thread + *forma* , shape) Thread-like, long and slender. Synonym: **filamentous**. Compare **capillary**- hair-like and therefore more delicate. *Icarus filiformis* syn. *Blechnum filiforme,* Thread or climbing hard fern.

filmies Informal collective name for the filmy ferns, family Hymenophyllaceae.

filmy Thin and membraneous, nearly translucent.

fimbria (L. *fimbriae* , fringe, border, edge) The fine hair-like fringes of a scale. Hence **fimbriate**.

fimbriate (L. *fimbriae* , fringe, border, edge) Of a margin, fringed with fine hairs (fimbria).

flabellate (L. *flabellum* fan) Fan-shaped. Fan-like filmy fern *Hymenophyllym flabellatum*, *Asplenium flabellifolium*.

flabelloid scale (L. *flabellum* fan +*oid*- resembling + scale) Or **marginate scale**.In tree ferns (genus *Cyathea subgenus Cyathea*) scales at the base of the stipe that are relatively broad with a marginal layer of fragile, shorter cells which turn outwards from the main body of of elongate coarser cells. In some species the fragile marginal cells terminate in short setae (bristles). Contrast **setiferous scale**.

flaccid (L. *flaceo* . flabby, to droop, flags) Soft, limp, lax. *Asplenium flaccidum*, Drooping or Hanging spleenwort.

flagelliform (L, *flagellum*, diminutive of *flagrum* whip+ + *forma* , shape)) Long and whip-like.

flagellum (L. *flagellum*, diminutive of flagrum whip;) A whip-like, motile hair.

flange (connected with Fr*. flank*) A projecting flat edge.

flexible (L. *flexus* , bending, turning, winding) Easily bent but recovering the original form.

flexuose (L. *flexus* , bending, turning, winding) Wavy or zig-zag

floccose (L. *floccus* a lock or flock of wool) Covered with soft tangled woolly hairs in tufts.

flora (L. *floris*, a flower) (1) The vegetation, plant species or plant populations of a given region (2) also a book systematically detailing with the plant species of an area.

flush A period of rapid vegetative growth.

fluvial (L. *fluvialis*, belonging to a river) Occurring in rivers and streams or associated with them e.g. on the margins (banks). *Azolla filiculoides* (slow flowing)*, Equisetum fluviatile*, *Cranfillia fluviatilis* syn. *Blechnum fluviatile*.

foetid (L. *fetidus* (commonly, but incorrectly, *foetidus* , stinking, f. *fetere* "have a bad smell, stink.") With a stinking offensive odour.

foliaceous (L. *folium* , leaf) Leafy.

foliar (L. *folium* , leaf) Pertaining to the leaves.

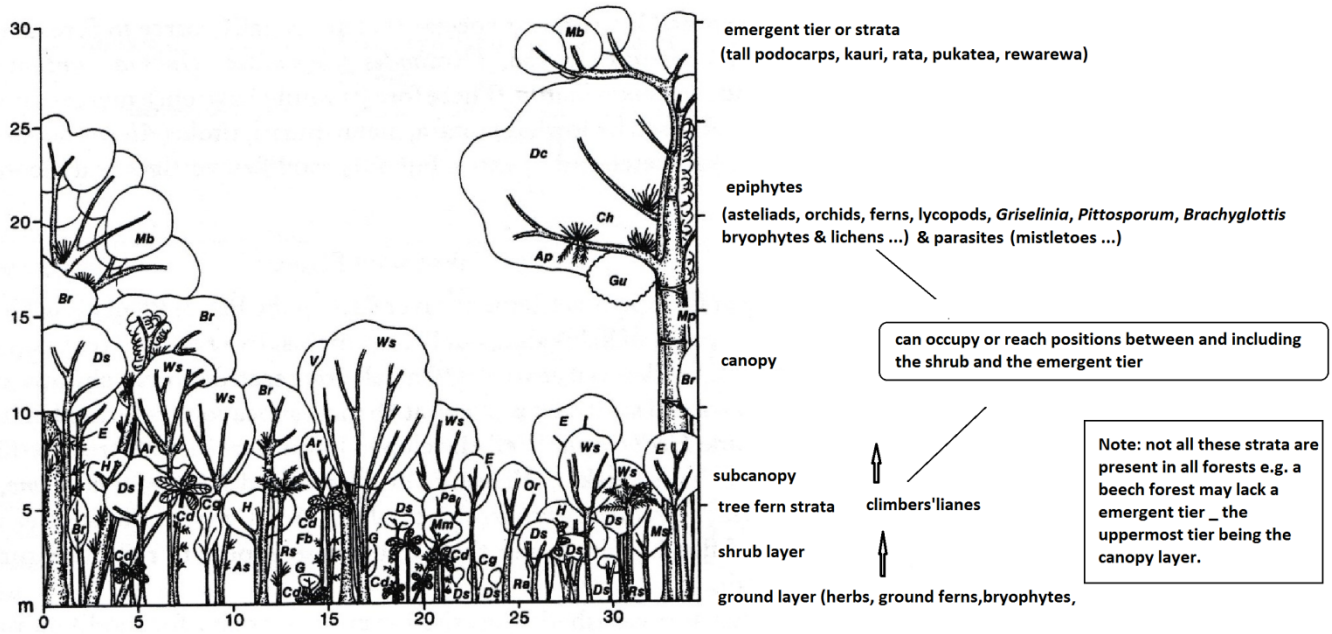
foliocolous (L. *folium* , leaf + -colous) Living on leaves e.g. some lichens or mosses living on plant leaves. Synonym **epiphyllous**.

foot Area of cells by which the **embryo** attaches to the **gametophyte** (**prothallus**) and receives nutrition,acting as a haustorium or placenta in the early stages of the development of the sporophyte. See gametophyte illustration.

forked Divided into two equal branches (**isotomous**)arising at a common point on an axis. If unequal **anisotomous**. See **dichotomous**, **bifurcate** and **furcate**.

fossulate (L. *fossa*, a ditch) Grooved, cavities elongate and regular or irregular, but not anastomosing. Connected to the word fossil, by the digging link.

forest stratification



Profile of a ridge crest transect at Maungataniwha, Northland, including a patch of smaller trees that have grown up in a canopy gap (Dawson & Sneddon 1969). Abbreviations for profile diagrams in conifer/broadleaved forest: *Ap, Asplenium polyodon; Ar, Ackama rosifolia; As Astelia solandri; Br, Beilschmiedia tarairi; Cd, Cyathea dealbata, Cg, Coprosma grandifolia; Ch, Collospermum hastatum; Cj, arpodetus serratus; Dc, Dacrydium cupressineum; Dq, Dicksonia squarrosa; Ds, Dysoxylem spectabile; E, Elaeocarpus dentatus; F, Freycinetia baueriana; G, Geniostoma rupestre; Gu, Griselina lucida; H, Hedycarya arborea; Ma, Myrsine australis; Mav, Microlaena avenacea; Mb, Metrosideros robusta; Md, Myrsine divaricata; Mm, Mida salicifolia* var. myrtifolia; Ms, *M. salicifolia* var. *salicifolia; Mp, Metrosideros perforata; Or, Olearia rani; Pa, Pseudopanax arboreus, Ra, Rubus australis; Rs, Rhopalostylis sapida; V, Vitex lucens; Ws, Weinmannia silvicola.*

Forest Stratification in a Northland Forest (adapted from 'Vegetation of NewZealand' 1991. Wardle, Peter. The Blackburn Press.)

Figure 99 forest stratification

fovea (L. *fovea* , a small pit, the womb) Pit or depression containing the sporangium in the leaf base of the quillwort *Isoetes*. Concave space for the sporangium.

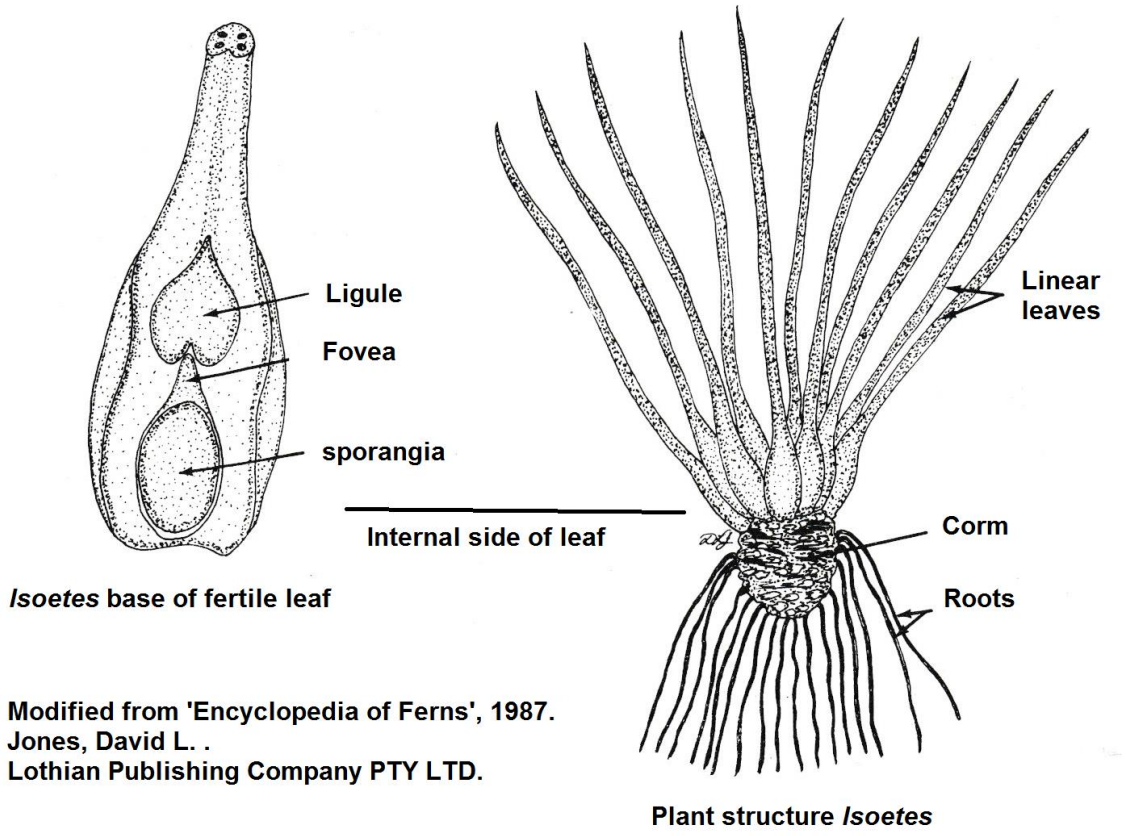


Figure 100 fovea *Isoetes*

foveate and **foveolate** (L. *fovea* , a small pit, the womb + ate) Seed coat, pollen or spore wall sculpturing with a pitted surface. Similar to **punctate**- covered with minute, pitlike depressions.

form (L. *forma*, shape) A minor botanical division below the level of variety, within a species. Abbreviation f. No New Zealand fern examples but native herb *Mazus novaezelandiae* subsp. *impolitus* f. *impolitus* and *Mazus novaezelandiae* subsp. *impolitus* f. *hirtus*.

fractflex (L. *fracti- frango* ,break, shatter + flex L. *flexus*, past participle of *flecto* to bend) In intermittent zig-zag lines.

free Not joined to any other part. Unattached end of an organ or structure.

free veins (or open veins) Means simple or forked but without uniting branches. See **venation patterns**.

frond (L. *frona* , *frons*, the leaf) The whole leaf of a fern , palm or cycad, including the lamina (blade) and the stipe or petiole. The lamina often much divided (compound). Fern fronds or leaves have both a photosynthetic function and a reproductive function either combined in one frond (**monomorphic** fronds) or in the case of ferns with **dimorphic** fronds producing separate fertile and sterile fronds called **sporophylls** (fertile frond) and **trophophylls** (= sterile frond)**.**

frond dissection /division Fronds can be simple and undivided, pinnate (once divided), bipinnate (2x pinnate), tripinnate (3x Pinnate) and up to 8x pinnate. The leaflets are termed **pinna** pl. **pinnae** , primary division (1° pinna), **pinnule** for the secondary division (2° pinna), and some botanists use the diminutive term **pinnulet** for a tertiary division (3° pinna), otherwise pinnule is used for the last complete leaflet division. The last division may itself be toothed or partially divided and termed **pinatilobate**, **pinnatifid, pinnatipartite** or **pinnatisect** depending on how deeply cut it is (or the **palmate** equivalent). The **ultimate segments** are the last, apical or terminal and smallest divisions of a blade.

frondlet (diminutive of frond) A segment of a divided frond = pinna, or leaflet.

fruit dot A popular term for sorus. Technically not a fruit at all only flowering plants have fruits.

fugacious (L. *fugax* inclined to flee, swift, from *fugere* to flee) Shed or withering away very early.

fulvous (L. *fulvus* reddish yellow, gold-coloured, tawny) Tawny-yellow or dull yellow.

funnelform (funnel + forma , shape) Shaped like a funnel.

furcate (L. *furca*:, a two pronged fork)) Forked. See also **bifurcate** – forked in two and **dichotomous**.

furfuraceous (L. *furfur* bran, scurf) With soft, minute, flakey or scurfy scales **.**

furrowed With longitudinal grooves or furrows. Such as a stipe.

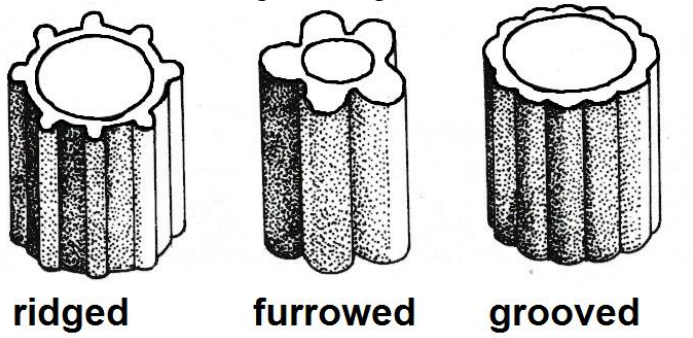


Figure 101 furrowed

fuscous: (L. *fuscus* dark,) Dusky, blackish. *Fuscospora* (*Nothofagus*) *fusca* – Red Beech.

fused Joined and growing together, e.g. sporangia fused together termed **synangia.**

fusiform (L. *fusus* , a spindle + *forma:* shape) Spindle-shaped, swollen in the middle and tapering to both ends.

fusion-sorus (fusion + sorus) See **coenosorus**.

gamete (Gr. *gametes*, a husband, and *gamete* , a wife, *gamos* , marriage) The female and male sex cells (egg and sperm) that unite at fertilization to form the zygote **.** These cells are produced by mitosis, in the gametophyte sex organs (gametangia: archegonia and antheridia), not meiosis as in animals. The gametophyte is already haploid (1n) and grew from a meiospore produced by the sporophyte in a sporangium where meiosis occurs.

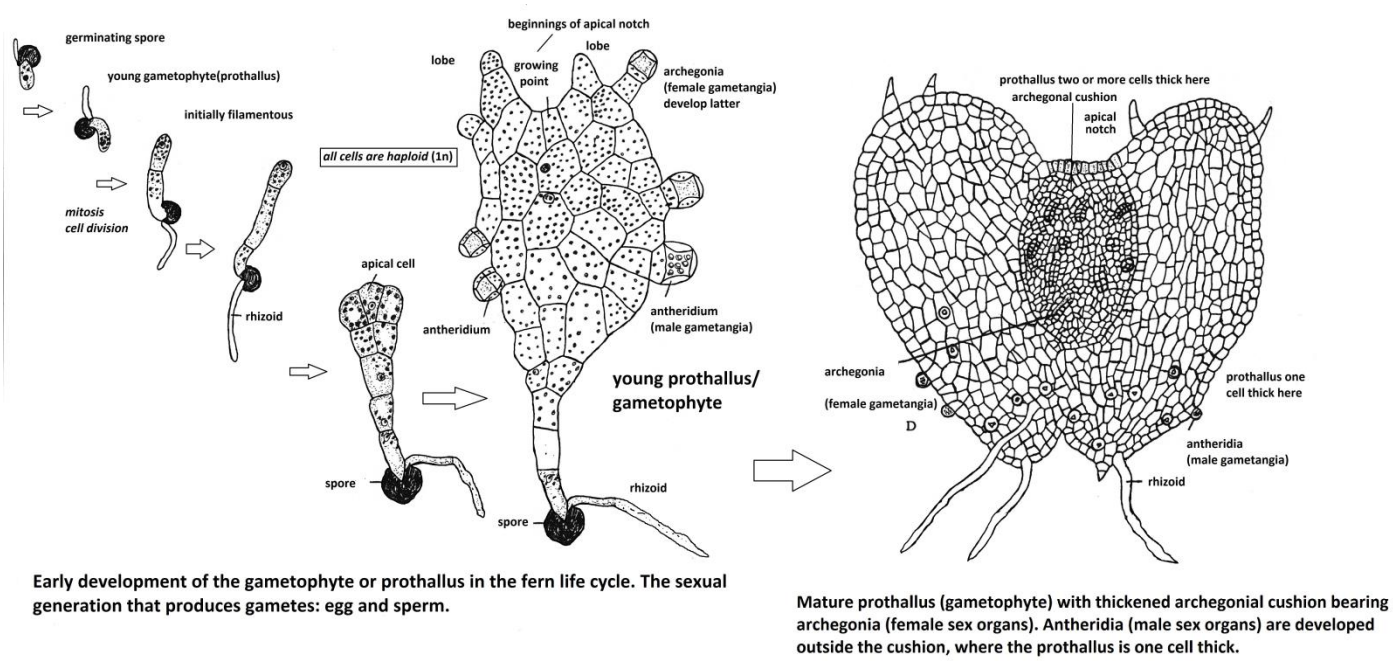
gametangium pl **gametangia** (Gr. *gametes*, a husband, and *gamete* , a wife, *gamos* , marriage + *angeion*, a vessel) Organ producing gametes. In ferns the **antheridia** (male gametangia) producing sperm and the **archegonium** (female gametangium) producing the egg.

gametophyte (gamete + Gr. *phyton* , plant) Gametophyte or **prothallus**- plant or generation that bears gametes (sperm and egg cells) during the sexual life cycle. In ferns, a small, usually flat plant (thalloid) bearing the minute sex organs; (archegonia and antheridia) that in turn produce the gametes; each cell in the body of the gametophyte is **haploid** (1n). The **archegonia** produce the egg, while the **antheridia** produce the sperm.The gametophyte grows from a haploid spore (meiospore) produced by the **sporophyte**. **Sperm** from the antheridia (of another gametophyte:- in life cycle diagrams self fertilization is usually depicted) swim across the surface of the gametophyte to the flask shaped archegonia and there fertilize the **egg** cells. Cell division from spore germination to mature gametophyte and production of gametes (sperm and eggs) is by **mitosis**.

The fertilized egg cell – **zygote** which is diploid (2n) represents the start of the sporophyte generation. The zygote grows into an embryo, which may still receive nourishment from the gametophyte via a placental foot. The gametophyte withers and dies leaving the sporophyte to lead an independent existence. In lycophytes the gametophyte is often tuberous and partly or wholly underground – in the latter case the plant is totally dependent on a mycorrhizal fungus for nourishment (see **achloromycoheterotrophic**). In the heterosporous water ferns (Salvinniale), and lycophytes (Isoetales - *Selaginella* and *Isoetes*) – there are separate male and female gametophytes called **microgametophytes** and **megagametophytes**

respectively. Here the minute gametophytes develop entirely or mostly within the original spore wall, a condition known as **endospory** (inside the spore).

In leafy bryophytes it is the gametophyte that bears leaves (called phyllids); in ferns, lycophytes and seed plants it is the sporophyte that bears leaves.



Early development of the gametophyte or prothallus in the fern life cycle. The sexual generation that produces gametes: egg and sperm.

Mature prothallus (gametophyte) with thickened archegonial cushion bearing archegonia (female sex organs). Antheridia (male sex organs) are developed outside the cushion, where the prothallus is one cell thick.

Figure 102 gametophyte developing from spore

Figure 103 gametophyte (typical)

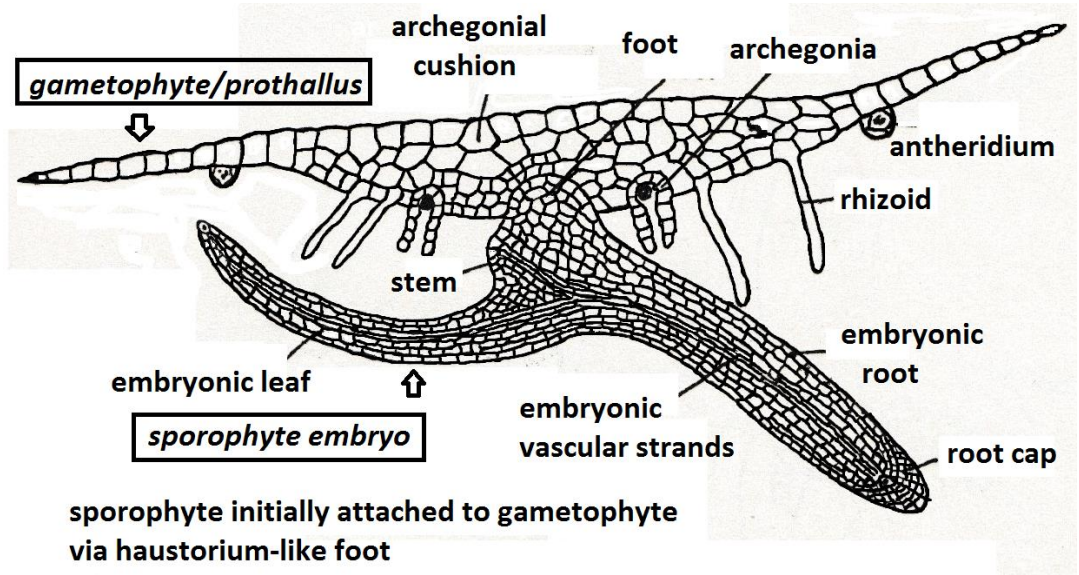


Figure 104 gametophyte with embryo

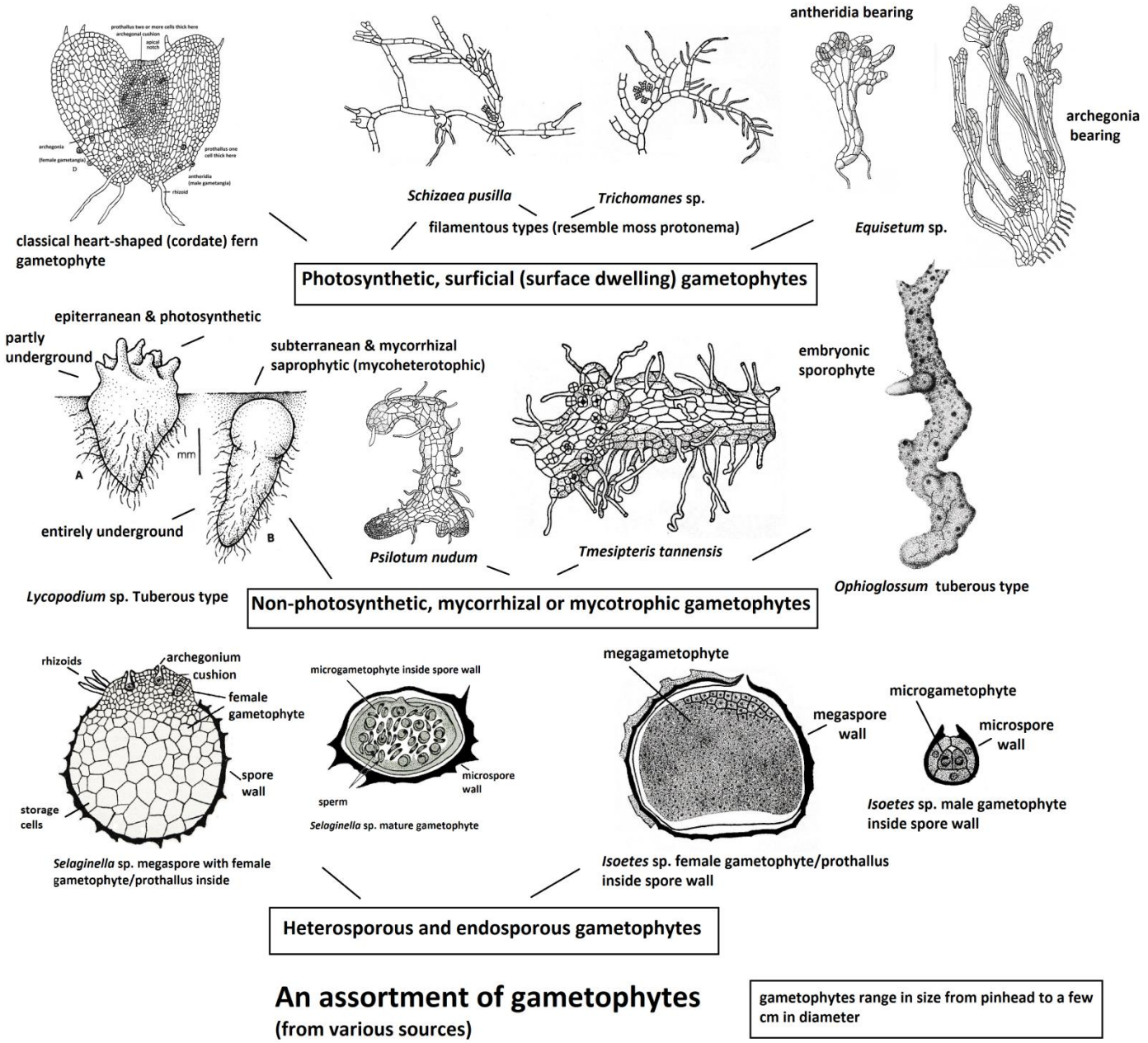


Figure 105 gametophytes (various)

gap colonization Plant colonization of a gap in the forest caused by localized disturbance (tree fall) the plants taking advantage of changes in light levels or soil disturbance. In many rainforests, tree ferns are gap colonists that form a lower canopy between and under larger trees, as long as the overstory does not become so dense that shade inhibits growth.

gastropodochory (+ -chore f. *khoreo*, to move) Dispersal of seed or spores by snails and slugs. A form of **zoochory** (animal dispersal).

gelatinous (L. *gelatio*, a freezing, or congealing) Jelly-like, of a slimy, clear sticky nature.

gemmiferous (L. *gemma* , bud + *-ferous* , bearing) Bearing asexual buds (gemmae) or bulbils e.g. *Asplenium bulbiferum*. Synonym **gemmiparous**.

geminate (L. *geminus*, twin, *geminatus*, doubled) Arranged in pairs, like twins (gemini twins).

gemma pl. gemmae: (L. *gemma* , bud) A vegetative bud, by which a plant propagates and disperses itself.

gemmiparous (L. *gemma* , bud + *parere*, to begat) Bearing vegetative buds. Synonym **gemmiferous.**

gemmiphore: L. *gemma* , bud + *phoreus* , bearer). A structure bearing **gemma**.

gene (Gr. *genos*, race, stock) A unit hereditary factor (DNA) located in a linear order on a chromosome that determines the inheritance of a particular character.

generalist A plant that is tolerant of a wide range of habitats. Opposite of **specialist**.

genet (Gr. *genos*, race, stock) Sexually produced, genetically unique plant individual –sporophyte that develops from a fertilized egg (zygote). The opposite of **ramet**- a vegetatively produced plant individual that may detach from the gentetically identical parent e.g. the bulbil type asexual reproduction of *Asplenium bulbiferum*.

geniculate ((L. *genu ,* the knee) Bent like a knee.

genus pl. **genera** (Gr. *genos*, race, stock) Rank in the taxonomic hierarchy consisting of a group of related species. Examples of genera include: *Adiantum*, *Blechnum*, *Cyathea, Pteridium.* The genus name plus the specific epithet provides the **scientific/botanical name** of a plant species in the binomial system. Genera are included in the next highest taxonomic rank the family. See **classification**.

geophyte (Gr. *ge-,* earth + *phyton ,* plant) A plant well anchored in the soil cf. *hemicrytophyte*. Bulbs and corms are geophytes. Raunkier Danish botanist.

geothermal areas In New Zealand areas of the earths surface that receive heat from underground geolgical sources, such areas have a warmer microclimate, enabling species of an otherwise tropical to subtropical distribution to grow, nearby. Examples *Christella dentata, Cyclosorus interruptus, Nephrolepis* sp. .

germination (L. *germinare*, to sprout) The resumption of growth by a spore, seed or other propagule, after a period of dormancy.

germination furrow A term for the **laesura** (**tetrad scar**), a line of weakness in the spore wall, through which a spore commonly germinates.

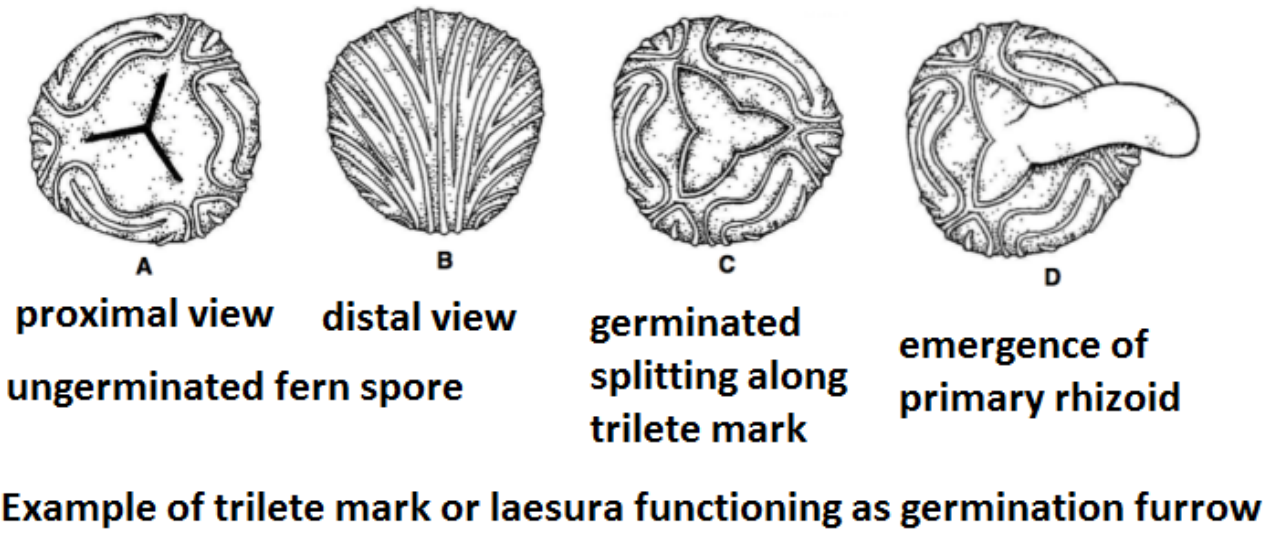


Figure 106 germination furrow

gibbous (L. *gibbus*: crouched, hunched) Humped or swollen on one side.

glabrate (L. *glaber:* without hair, bald, smooth) Smooth and lacking hairs or scales.

glabrescent Becoming glabrous. or nearly glabrous.

glabrous (L. *glaber:* without hair, bald, smooth) Without hairs or scales – smooth, e.g. *Hymenophyllum bivalve*, *Parapolystichum glabellum* syn. *Lastreopsis glabella*

gland (L. *glans* acorn) A structure with a secretory function, embedded or projecting from the surface of the plant. Often club-shaped,or globular.

glandular Having glands or functioning as a gland.

glandular hair Hair with a swollen head that secretes oil or some sticky substance.

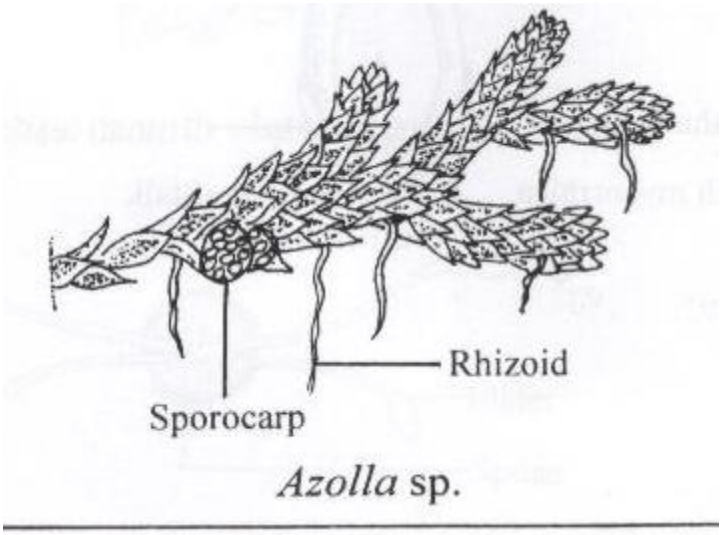
glaucescent Slightly glaucous or becoming glaucus

glaucous (L. *glaucus* , bluish, grey) With a distinct, waxy bloom which gives it a bluish grey appearance.

Gleichenoid Ferns Members of the Forking Fern or Umbrella fern group: Gleicheniales, family Gleicheniaceae represented in NZ by *Dicranopteris linearis, Gleichenia dicapra, G. microphylla* and *Sticherus cunninghamii*.

globose (L. *globosus*: spherical) Almost spherical. Globe-like.

glochidium (Gr. *glochid* , the point of an arrow) A small barbed hair or spine, e.g. in *Azolla*.



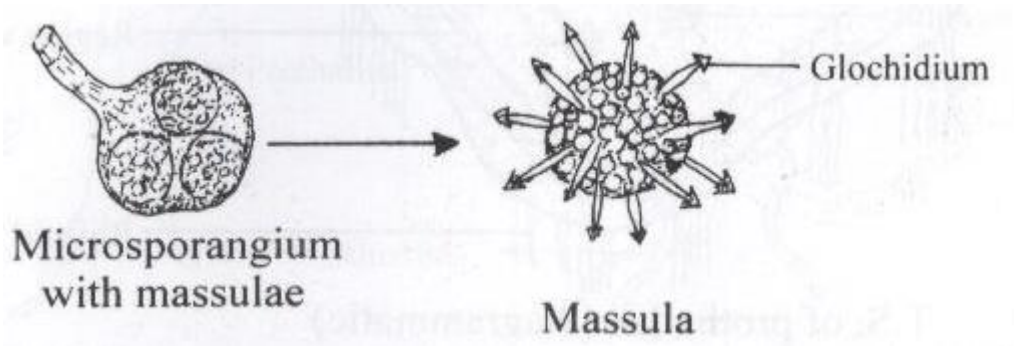


Figure 107 glochidium *Azolla*

glomerule (L. diminutive *glomer-*, *glomus* ball;) A very dense cluster. Ball-like.

glossy Smooth and shining. Fronds of *Asplenium oblongifolium* syn. *A. lucidum* – shining spleenwort.

glutinose ((L. *gluten* , glue)) Covered with a sticky exudate.

gossypinus/gossipinus also known as **cottony** (from cotton) With long soft, weak, filamentous hairs, somewhat flocculent and entangled. Latin from the cotton of *Gossypium* seeds.

gradate Said of sorus with the younger sporangia at the apex and the older ones lower down (basipetalous) or the reverse (acropetalous). Contrast **mixed**. Synonym **sequential**.

grammitid Ferns usually epiphytic or rupestral, closely related to *Grammitis* within the family Polypodiaceae.

granular/granulate/granulose Appearing as if covered with very small grains,or more or less globular particles. Hence **granulate**. Applied for instance to a spore surface.

grooved Channeled or furrowed, having one or more longitudinal grooves or channels on an axis, such as stipes, rachises, costae. See **furrowed**.

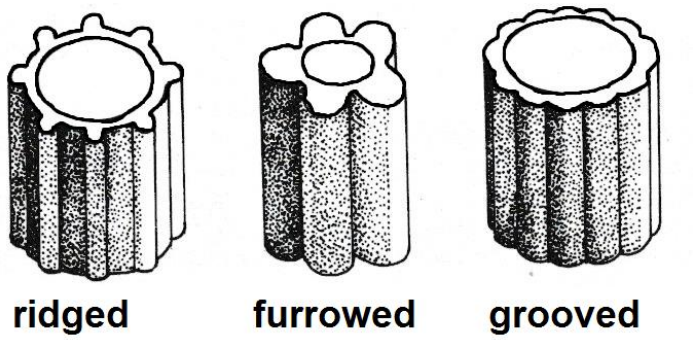
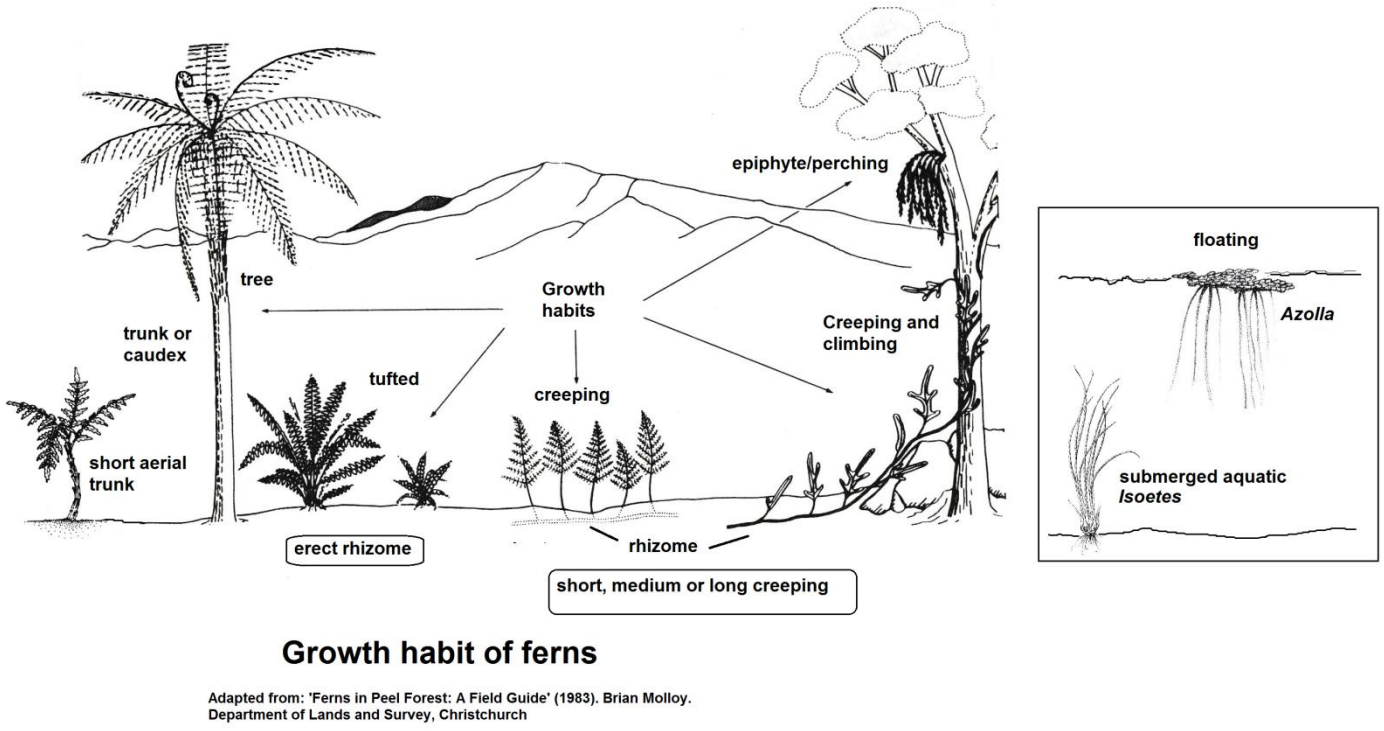


Figure 108 grooved

growth form With ferns and lycophytes the following growth forms are found:- rossete, tufted or caespitose, creeping (short, medium or long), scrambling, climbing, tree fern, stoloniferous, tuberous, aquatic floating, aquatic emergent and submerged aquatic.. Similar to **habit**. See also **rhizome**.

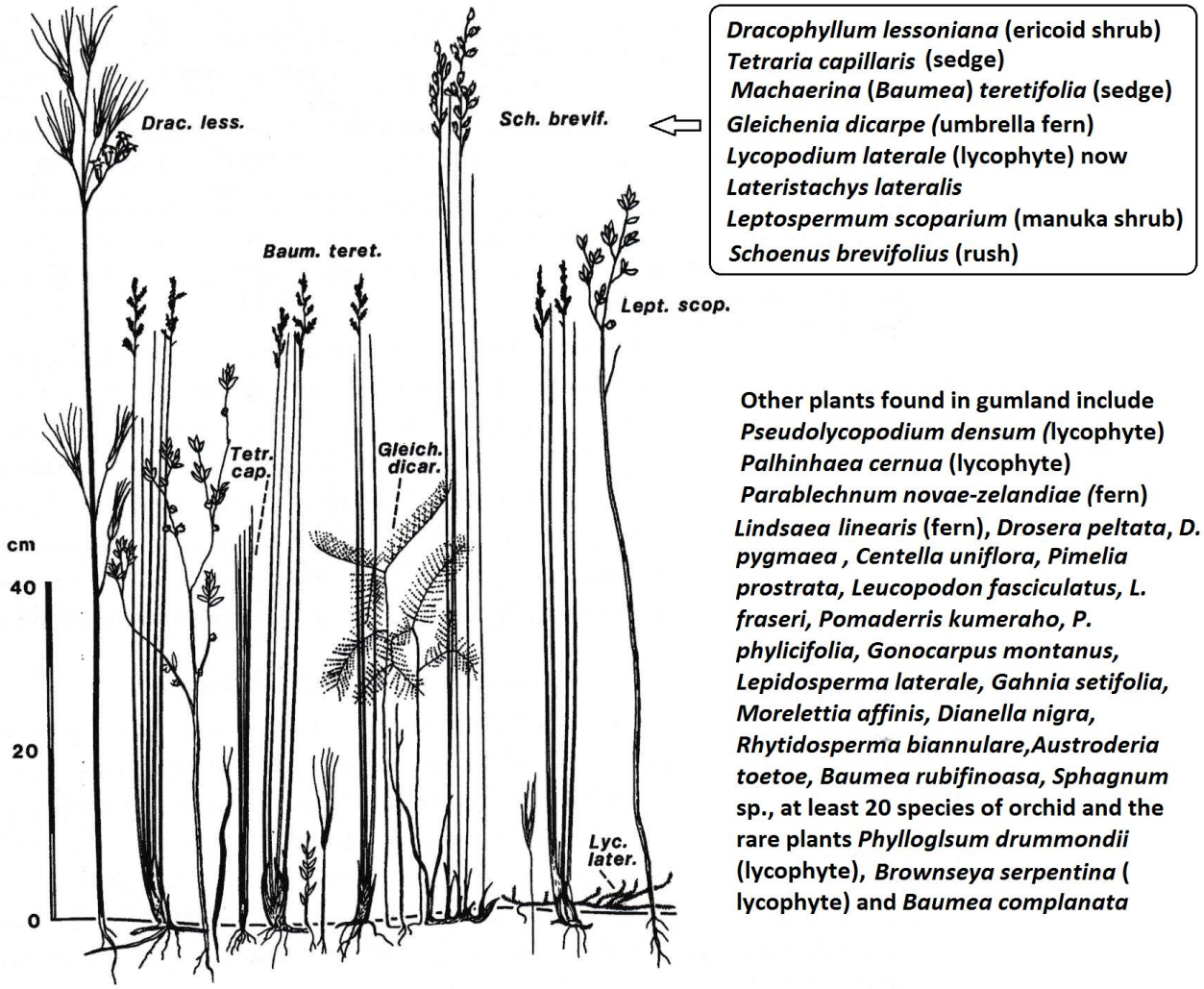


Growth habit of ferns

Adapted from: 'Ferns in Peel Forest: A Field Guide' (1983). Brian Molloy. Department of Lands and Survey, Christchurch

Figure 109 growth habit of ferns

gumland (gum –kauri gum or resin) Tracts of infertile soils found in Northland and Coromandel Peninsula, with perched water tables, that contain kauri resin.



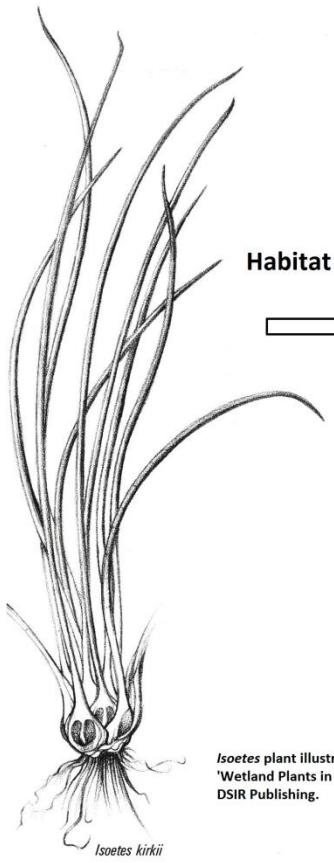
Profile of gumland vegetation near kaikohe (Esler & Rumball 1975) reproduced in "Vegetation of New Zealand" 1991. Peter Wardle The Blackburn Press

Figure 110 gumland plants

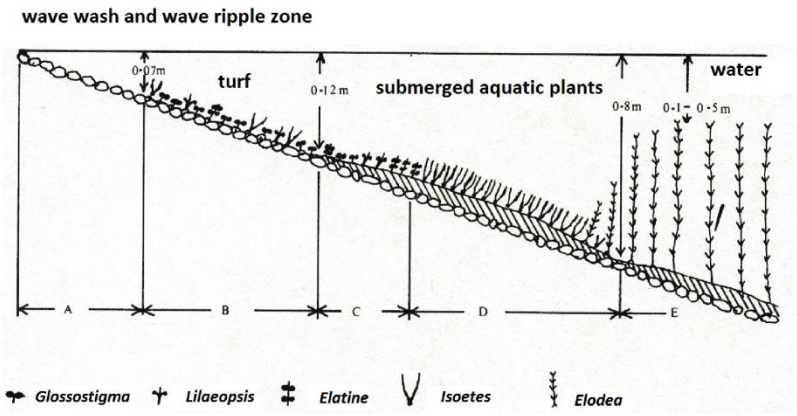
gymnosperms The naked seed plants including– the conifers – such as New Zealand's podocarps, kauri and native cedars; the cycads, ginkgo's and gnetophytes. The seed (ovule) is not enclosed-hence naked. The angiosperms are the flowering plants with the seed enclosed in a fruit. The pteridosperms (seed ferns) are extinct polyphyletic paleozoic to Mesozoic seed plants. The ancestors of the angiosperms (flowering plants) derive from mesozoic pteridosperms

habit (L. *habitus*, the external aspect) The general appearance of a plant, not to be confused with **habitat**. Similar to **growth form**.

habitat (L. *habitare*, inhabit, dwell) The environment in which a plant grows. not to be confused with **habit.**



Habitat of *Isoetes*



Diagrammatic section of the shingle low mixed community of Lake Rotoroa (Nelson): A = bare zone; B = initial colonization zone with *Glossostigma*, *Isoetes*, *Lilaeopsis* and *Elatine*; C = zone of surviving plants from mild erosion: *Glossostigma* less frequent here presumably because of shallow root system: D = zone of species able to withstand more marked erosion - *Isoetes* only: E = silty *Elodea* community.
'New Zealand Lakes' 1975. Edited by V. H. Jolly and J. M. A. Brown.
Auckland University Press/ Oxford University Press

Isoetes plant illustration from
'Wetland Plants in New Zealand' 1989. Peter Johnson and Pat Brook.
DSIR Publishing.

Figure 111 habitat *Isoetes*

hair A slender epidermal appendage either unicellular or multicellular (pluricellular) consisting of a single row of cells (uniseriate and septate)or multiseriate with more than one vertical row of cells.. Maybe erect, or appressed, branched or unbranched, tangled, glandular, hooked, stellate, dendritic, bristly. Synonym : **trichome**. **Vestiture** refers to the mass appearance of hairs e.g. tomentose. Compare **scale**.

Some authorities will differ in their definition, and there may be overlap and intermediates occur.

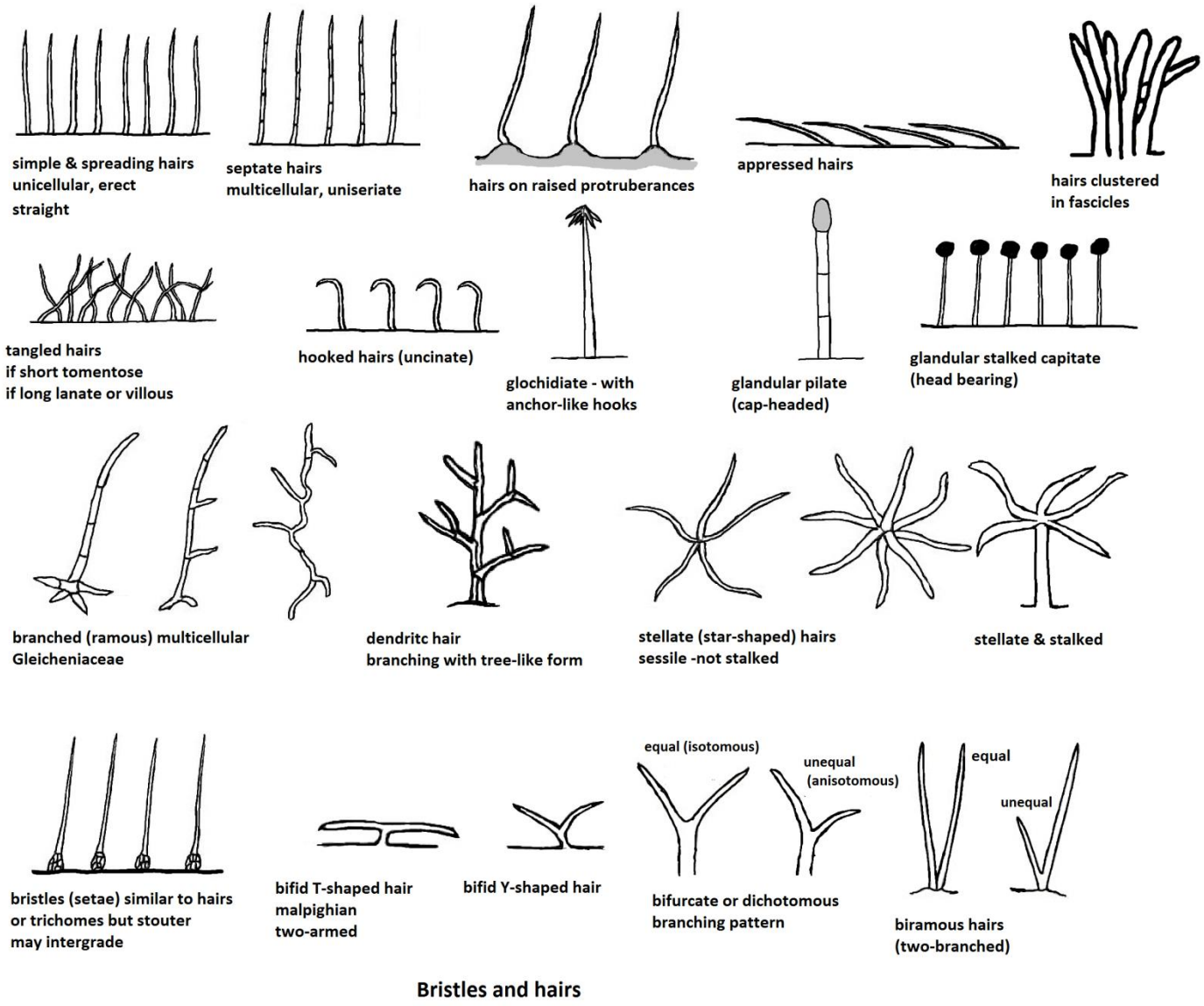


Figure 112 bristles and hairs

hairiness Synonym **vestiture**, trichome cover, pubescence (broad sense).

hairiness terms (vestiture) A number of terms describe hairiness, some intergrade or can be treated as synonymous,**scales** are broader, multicellular and multiseriate, though some are hair-like. **Protruberances** (prickles, papillae, tuberculae, vescicles and murae).are covered under **epidermal excrescence:**

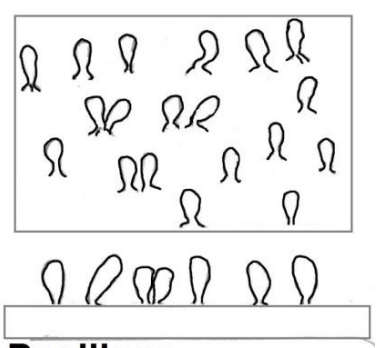
absence hairs: glabrous/glabrate (usually smooth)and **subglabrous-** nearly glabrous.

adpressed/appressed Lying flat against the surface. Opposite of erect ,spreading or upright.

arachnoid/archnose Covered with white,entangled hairs, forming a cobwebby mass.

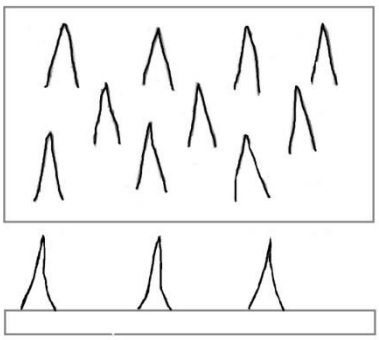
barbate	Bearded with long tufts of hair
ciliate	Bearing fine hairs on the margin.
comose	Hairy, bearing an apical tuft of hairs.
echinate	Roughened by firm, bristly hairs or prickles
fimbriate	Of a margin, fringed with fine hairs (fimbria).
floccose	Covered with soft tangled woolly hairs that fall off in tufts.
hirsute	Bearing coarse rough relatively long hairs.
hispid	Clothed with short stiff hairs or bristles.
lanate	Wooly, covered with long, soft,crooked hairs**.**
lepidote	Covered with scales
pilose	Clothed with soft, straight to slightly shaggy hairs.

plumose Feathery
pubescent **(1)** Downy, clothed with short soft erect hairs. **(2)** Hairy in general.
sericeus Clothed with silky hairs.
strigose With stiff sharp slanting hairs, hair-like scales or bristles.
velutinous Covered with fine, soft, velvety, spreading hairs.
villose Clothed with long (longer than lanate) soft hairs. Maybe irregularly twisted or curled.



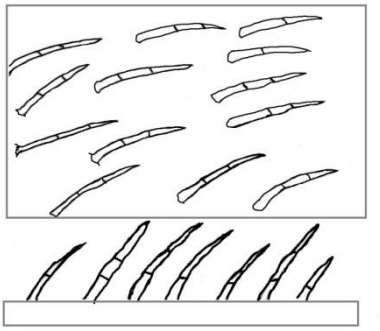
Papillose

With short soft, nipple-like protruberances



Echinate

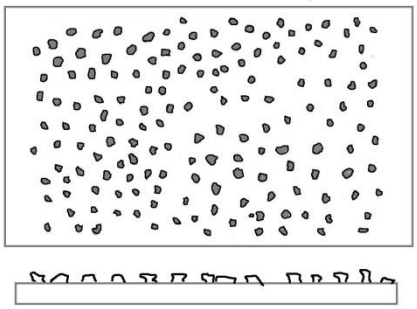
Spiny, prickly bristles or protruberances



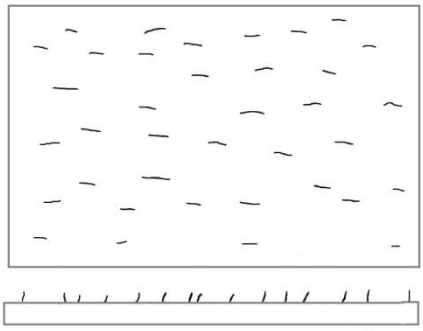
Pilose

Short thin, upright straight hairs

Short thin, upright straight hairs

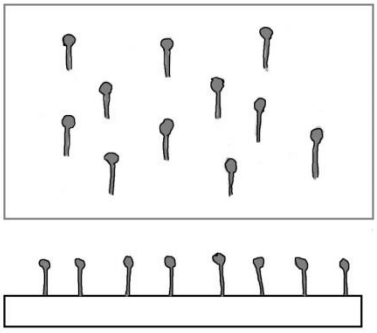


Farinose/Farinaceous
Mealy with a powderry covering



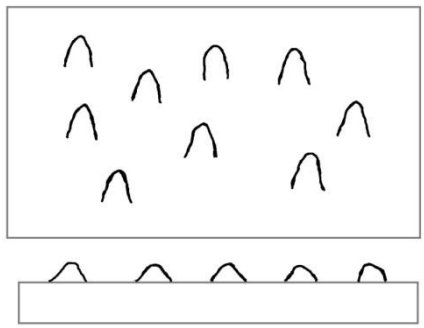
Puberulous/Puberulose /Puberulent

Minutely pubescent, covered with minute, soft hairs, barely visible.



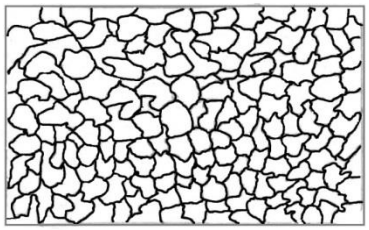
Glandular

With gland bearing usually capitate hairs



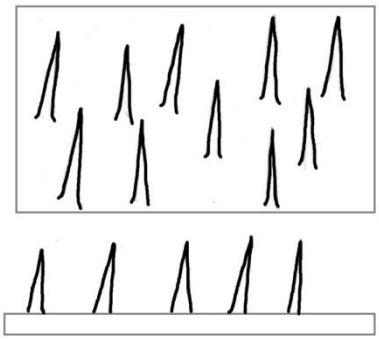
Muricate

Rough with short rounded protruberances



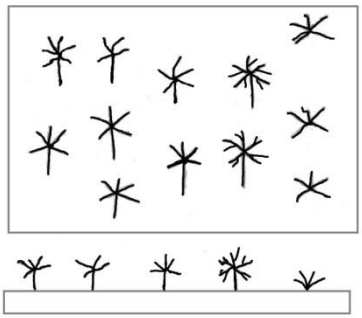
Scurfy/

Scaly or shredded like dry skin, or Coarsely Farinaceous



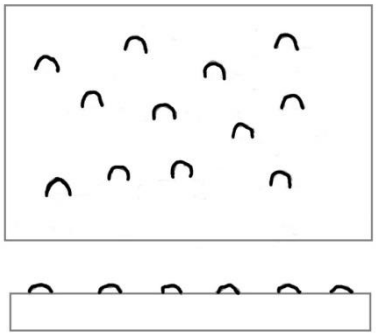
Setose/Bristly

Covered with setae or bristles



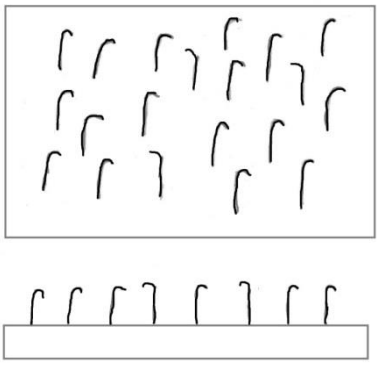
Stellate

Hairs that branch in a starlike manner



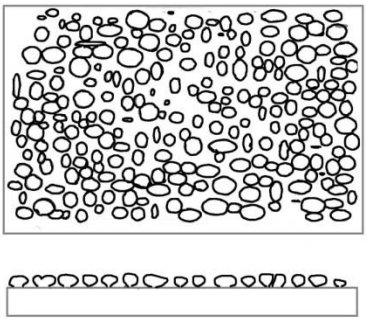
Tuberculate

Covered in small rounded raised growths



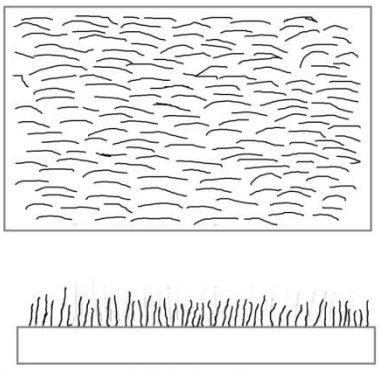
Uncinate

Covered in hook-like hairs



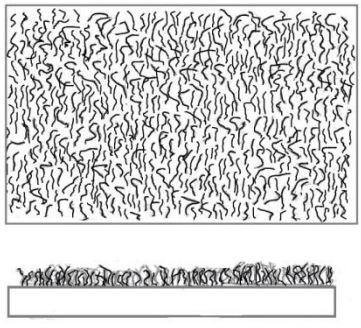
Vesciculose

With bladder-like growths



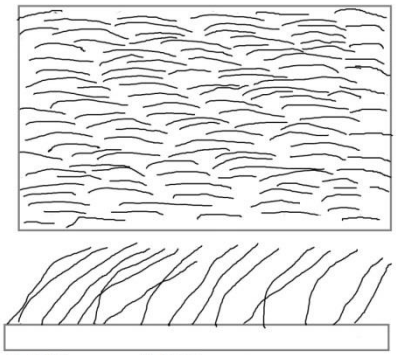
Velvety/ Velutinous

With fine, dense,straight, long and soft hairs



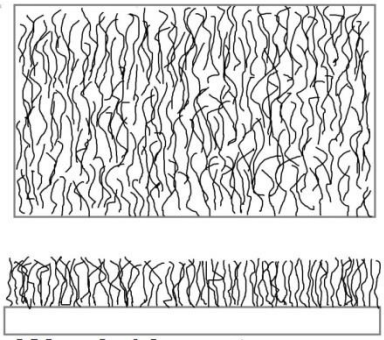
Tomentose

With matted, interwoven, soft, wooly hairs



Villous/Villose

With long, weak, soft hairs



Wooly/ Lanate

With long, dense, matted, curly, hairs

Figure 113 hairiness terms (vestiture)

hairy Covered with hairs or producing hairs. Contrast a hairy stipe as in the tree fern genus *Dicksonia* with a scaly stipe as in *Cyathea* hence the mnemonic “hairy dick and scaly cy”.

hair-like scale: Very narrow scale, 2 – 5 cells wide at base and tapering to a long tip.

halophyte (Gr. *hals*, sea, salt+ *phyton ,* plant) A plant which grows in saline soils.

haplodiplontic life cycle Life cycle having both a **haploid (1n)** and **diploid (2n)** phase, as in all land plants and corresponding to the gametophyte and sporophytes phases. Synonym **alternation of generations**, diplohaplontic life cycle, diplobiontic life cycle. In ferns and lycophytes,the spore, prothallus and gametes are the haploid phase, the zygote,sporeling, juvenile sporophyte, mature sporophyte are the diploid generation.

haploid (Gr. *haploos* , single or simple + *oides* , like) Having a single set of chromosomes (n or 1n) in the nucleus a condition, characteristic of the gametophyte generation, the gametophyte or prothallus, the gametes (egg and sperm) and the spores produced by the diploid sporophyte by meiosis (reduction division). Compare with diploid, polyploid.

harsh See **Asperous** (L. *asper* rough) Rough to touch.

Hartig net The nutrient-tranfer structure (network of hyphae) formed by ectomycorrhizal fungi that weaves between the outer cortical cells in plant roots or outer epidermal cells in angiosperms. The hyphae although inside the root (intraradicle hyphae) they do not penetrate the cells so ecto- outside.

hastate: (L. *hasta* ,a spear) Spear-shaped; or arrow-head shaped of a leaf blade, narrow and pointed but with two basal lobes spreading laterally.

haustorium (L. *haustor*, a drawer, f. *haurire*, *haustum*, to draw, to drink) A specialized organ or organelle through which a parasite absorbs nourishment from its host. In ferns the foot of the sporophyte embryo temporarily acts as a haustorial organ attached to the gametophyte.

helicoid (Gr *helikoeides* f. *helix,* a spiral ++ *oides* , like) Branching repeatedly on the same side. In *Adiantum*, applied to anadromous fronds in which basal basiscopic pinnae are well-developed (i.e. pinnate), but corresponding acroscopic pinnae are reduced to simple pinnules. The stipe thus appears to branch dichotomously into two helically curved rachises, with pinnate pinnae apparently arising from their upper sides.

heliophilic (Gr. *helios*, sun + *phílos*, “love”) Sun and light loving. Synonyms **photophilous** and **photophilic**. A “sun fern” e.g. bracken fern, *Pteridium esculentum* and pig fern, *Paesia scaberula*. The plant prefers open, well-lit places. Opposite of **heliophobic**, **sciaphilous**.

heliophobic (Gr. *helios*, sun + *phobos*, fear) Sun fearing, essentially Shade loving. Synonyms **sciaphilous** also spelt **skiophilous, umbrophile** or **umbraticolous** . Opposite of **heliophilic** or **photophilous.**

helophyte (Gr. *helos,* marsh + *phyton ,* plant) Marsh-dweller. A plant growing in permanent or seasonaly wet mud e.g. *Pilularia novae-hollandiae*. See **limicolous** and **epipelic.**

hemicryptophyte (Gr. *hemi-* half + cryptophyte, f. *crypto-* hidden + *phyton ,* plant) A plant rooting shallowly and poorly in soil; not well anchored . Perennating buds at soil surface level. See, **cryptophyte**, **chamaephyte, geophyte** and **phanerophyte**.

hemispherical (Gr. *hemi-* half + spherical) Half-sphere like.

hemitelioid indusium (f. genus *Hemitelia,* half-completed, f. Gr. *hemi-* half + *telos*, end) Tree ferns now in genus *Cyathea* (broad sense) that bear indusium that are usually half cup-shaped. In New Zealand *Cyathea smithii* has a indusium that has been described as hemispherical to nearly cup-shaped. Compare **cyathiform indusium** and **sphaeropteroid indusium**.

herb (L. *herba*, grass) Any vascular plant which is not woody.

herbaceous (L. *herbaceous* , grassy) Soft in texture; midway in thickness between membranous and coriaceous, usually applied to the lamina. Also referring to plants with the characteristics of herbs. All living ferns and lycophytes including tree ferns are technically herbs.

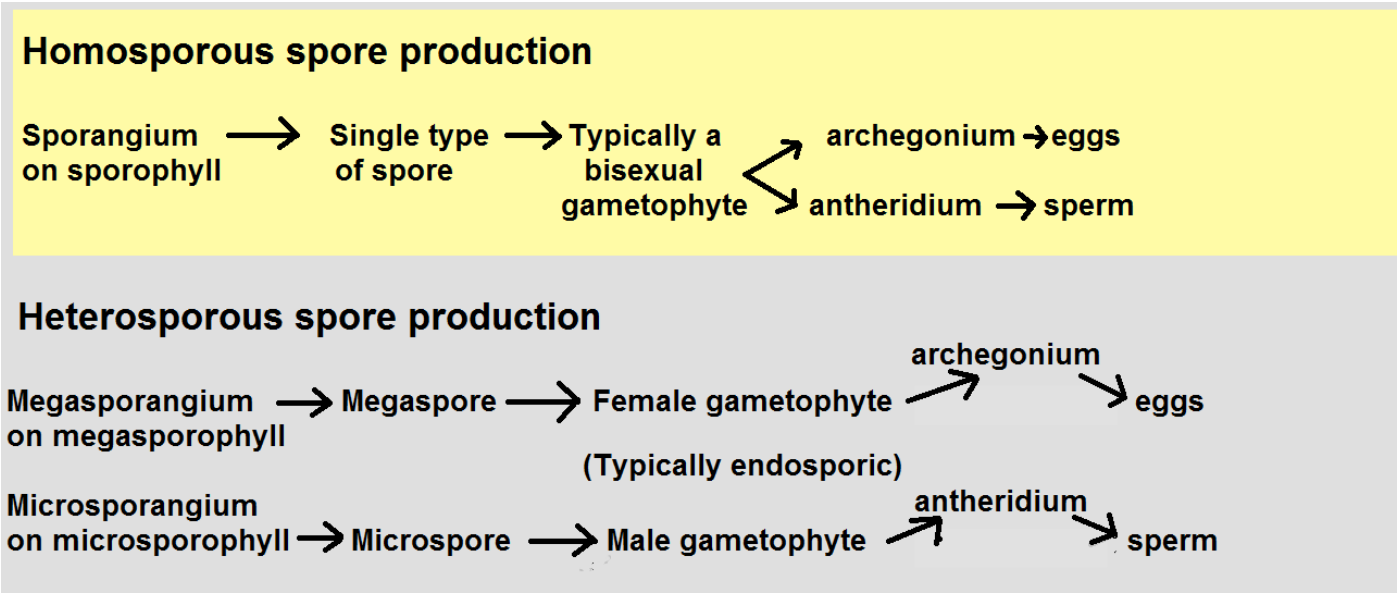
heteroblastic ((Gr. *heteros*, other, different + *blastos* , bud, sprout) With two or more distinct kinds of shoot. *cf.* **homoblastic**.

heteromorphic (Gr. *heteros*, other, different + *-morphos*, from *morphē*, shape) Existing in two or more easily distinguishable forms. Opposite of **homomorphic**. See **dimorphic**.

heterophilous (Gr. *heteros ,* other, different + *phyllos* ,leaf)) Bearing fronds of more than one kind such as having leaves that are not uniform along a branch, e.g. in *Huperzia*, with long leaves in the lower portions and smaller reduced leaves distally. Compare **homophyllous**. *Ctenopteris heterophylla*.

heteropolar (Gr. *heteros ,* other, different + polar) With different poles as when the extremities (poles) differ. In heteropolar spores the distal and proximal faces are distinctly different. Compare **homopolar**.

heterosporous (Gr. *heteros ,* other, different + *spora*, seed) Producing two kinds of spores (male and female, or **microspores** and **megaspores**). Heterosporous fern and lycophyte genera include *Azolla, Isoetes, Marsilea, Pilularia, Regnellidium, Salvinnia,* and *Selaginella*. The microspore develops into the male gametophyte and the megaspore into the female gametophyte or prothallus often within or nearly within the confines of the original spore wall, hence **endosporic**.. Compare **homosporous** and **anisosporous**. Heterospory is regarded as a step in the evolution of the seed habit.



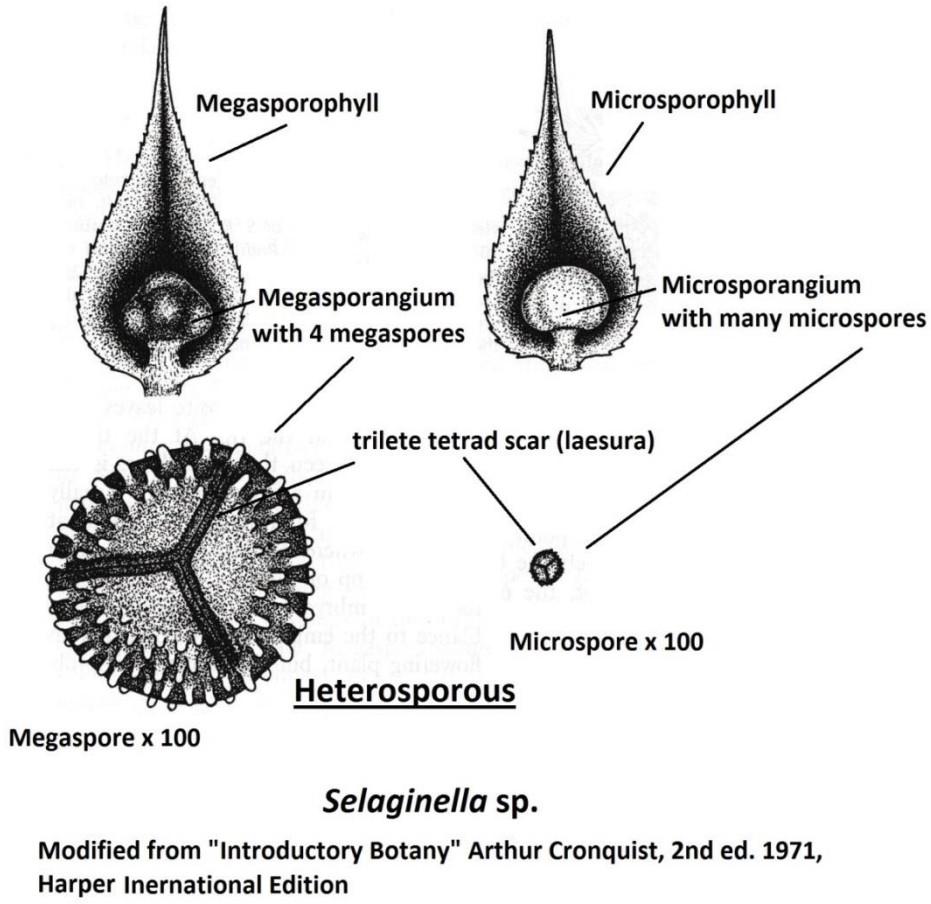


Figure 114 heterosporous *Selaginella*

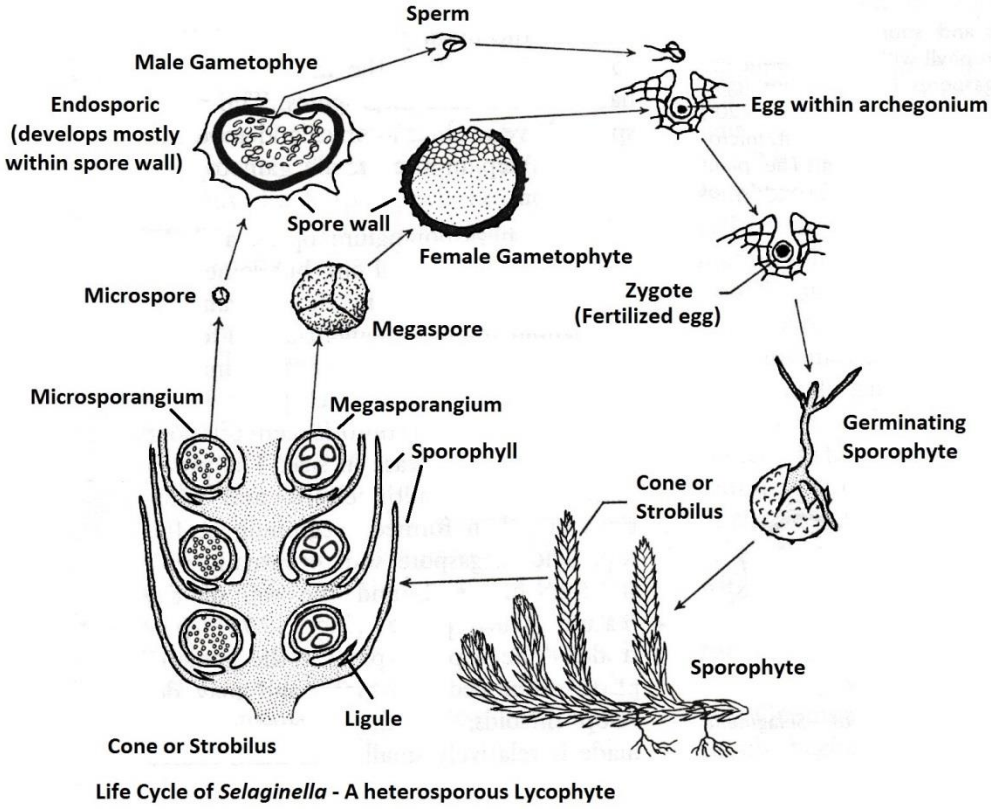


Figure 115 heterosporous life cycle *Selaginella*

heterotroph (Gr. *heteros*, other, + *trophe*, nourishment) An organism that does not make its own food, depending on other organisms for nourishment e.g. animals and fungi. Some plants are heterotrophic either mycohetrotrophic (dependent on fungus for food) or as holoparastes on other plants. The gametophytes of some lycophytes and ferns are mycoheterotophic, the sporophytes photoautotrophic. Opposite of **autotroph** or **photoautotroph**.. See **mycoheterotroph.**

hirsute (L. *hirsutus* , bristly, shaggy) Bearing coarse rough relatively long hairs. *cf.* **villous**. *Nephrolepis hirsutula* (in New Zealand now *N. brownii* & *N. exaltata*). See **hairiness terms.**

hispid (L. *hispidus*: rough, shaggy) Clothed with short stiff hairs or bristles. *Adiantum hispidulum*. See **hairiness terms**.

hispidulous (L. diminutive of *hispidus*: rough, shaggy) Minutely hispid. See **hairiness terms**.

hoary (Old English *har ,* hoary, grey, old) Covered with short white hairs giving the surface a greyish appearance. **Hairiness term**.

holosaprophyte: (Gr. *holos* whole + saprophyte: (Gr. *sapros* , rotten, + *phyton* , plant) A plant which obtains its nutriment or energy entirely from dead organic matter with the aid of endophytic fungi. Also known as a **achloromycoheterotroph** meaning a non-photosynthetic (without chlorophyll), fungi (mycorrhizal) dependent , heterotroph or simply **mycoheterotroph**. The gametophytes of some ferns and lycophytes fit this category.

homoblastic (Gr. *homo ,* same + *blastos* , bud, sprout) With one kind of shoot. *cf.* **heteroblastic**.

homogenous (Gr. *homos,* same + *genos*, kind) Uniform or relatively so.

homology (Gr. *homos,* same + *logos*, ratio) Similarity caused by the inheritance of a characteristic from a common ancestor hence homologous. Compare **analogy**.

homomorphic (Gr. *homos,* same +-*morphos*, from *morphe*, shape.) Having the same shape or form. Synonym **isomorphic**. Compare heteromorphic.

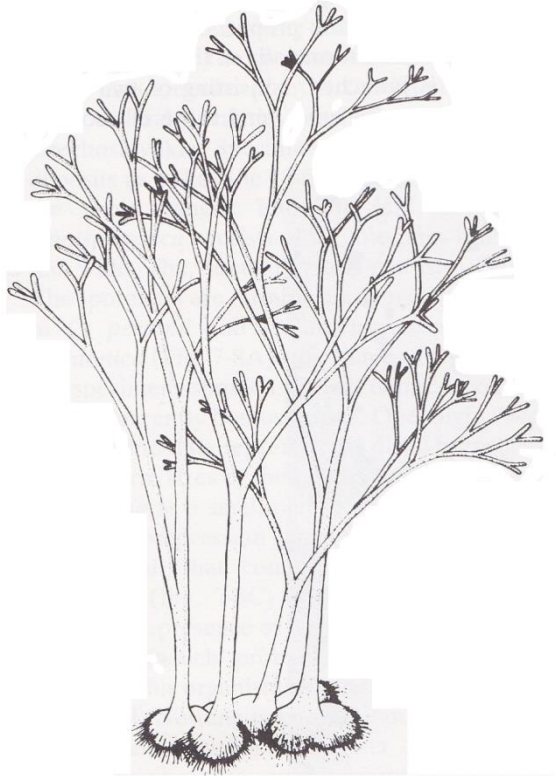
homophyllous: (Gr. *homo* ,same + *phyllos* , leaf) With all leaves uniform along a branch. Synonym **isophyllous** *cf.* **heterophyllous**.

homopolar (Gr. *homos* ,same + polar) In palynology, when poles are the same; the distal and proximal faces are the same. Compare **heteropolar**.

homosporous: (Gr. *homos* ,same + *spora*, seed) Producing only one type of spore from which develops a gametophyte producing both male and female gametes. Opposite of **heterosporous.**

hormone (Gr. *hormaein* , to excite) A chemical substance produced in one part of a plant and inducing a growth response, or process when transferred to another part.

horneophytaceae (After genus name of *Hornea* is in honour of John Horne (1835–1905), a Scottish botanist a name occupied by a flowering plant in the Sapindaceae –so fossil was renamed *Horneophyton* to correct the mistake) Very early (early Devonian age) polysporangiate plants (multibranched sporophytes with terminal sporangia) that lacked true vascular tissue and hence class as prototracheophytes. Precede the *Cooksonia* and rhyniophyte type plants,and intermediate between them and hornwort type plants.



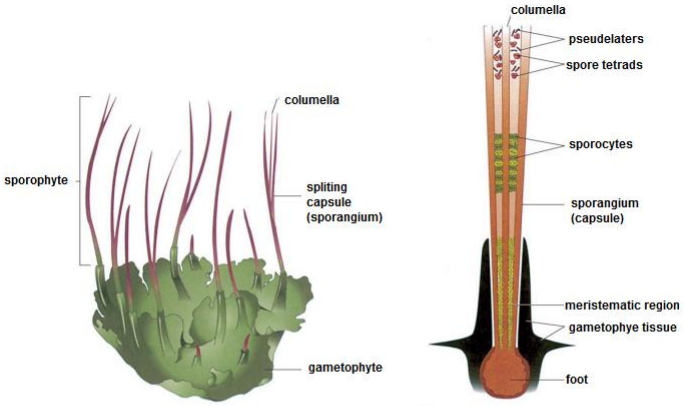
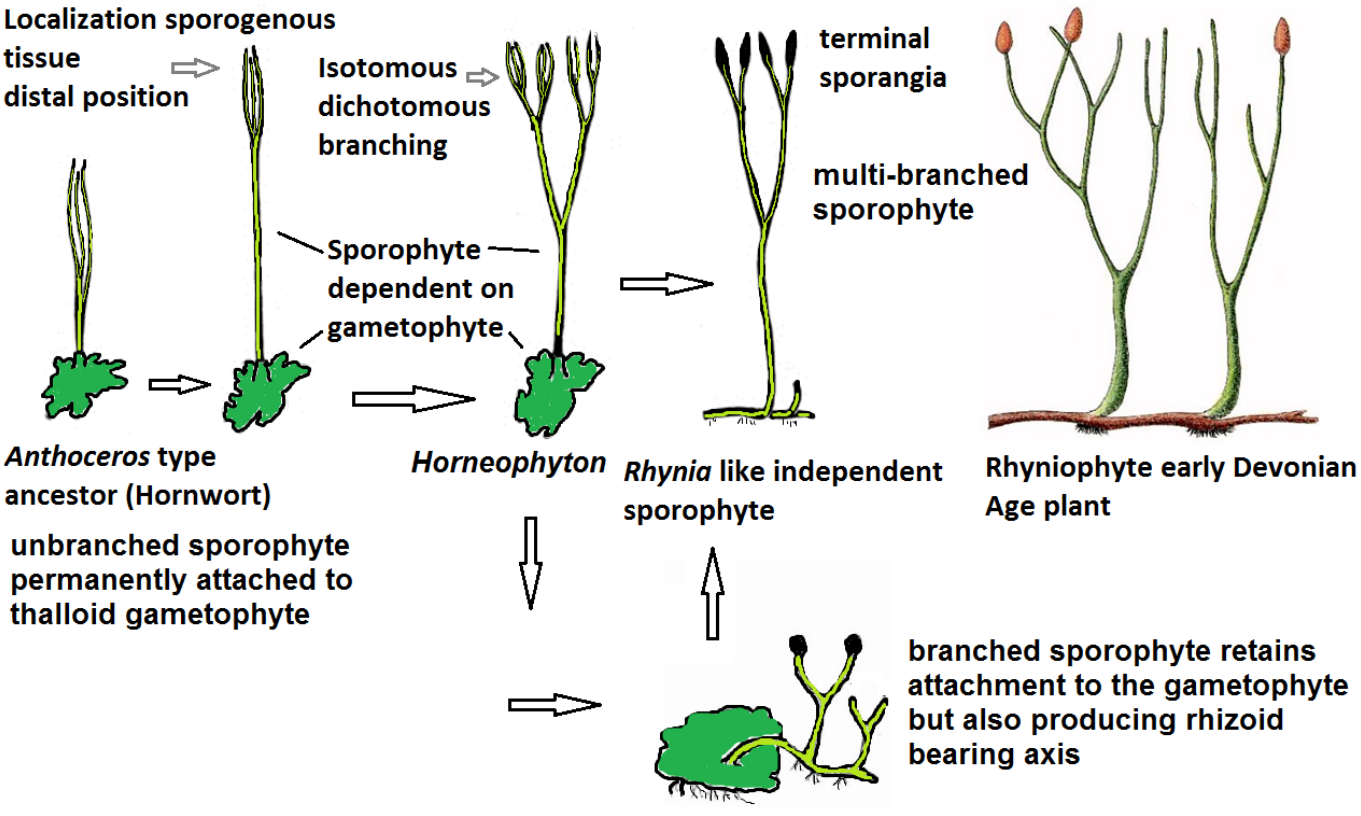


Figure 22.6 (left). The hornwort *Phaeoceros*, showing gametophyte and sporophyte stages. Mature hornwort sporangia split into longitudinal strips, beginning at the tip and opening downward. Rhizoids, which anchor gametophytes to the ground, are not shown. Figure 22.7 (right). A longitudinal section through a hornwort (*Anthoceros*) sporophyte. Only the mid-portion of the sporophyte is shown, omitting the tip of the sporangium and rhizoids at the base. The tubular sporophyte is mainly an elongated sporangium. Sporophyte cells within the sporangium undergo meiosis to produce haploid spores. Other cells produce twisted pseudoelaters, which assist in the ejection of spores from the sporangium.

https://labs.plb.ucdavis.edu/courses/bis/1c/text/Chapter22pf.pdf

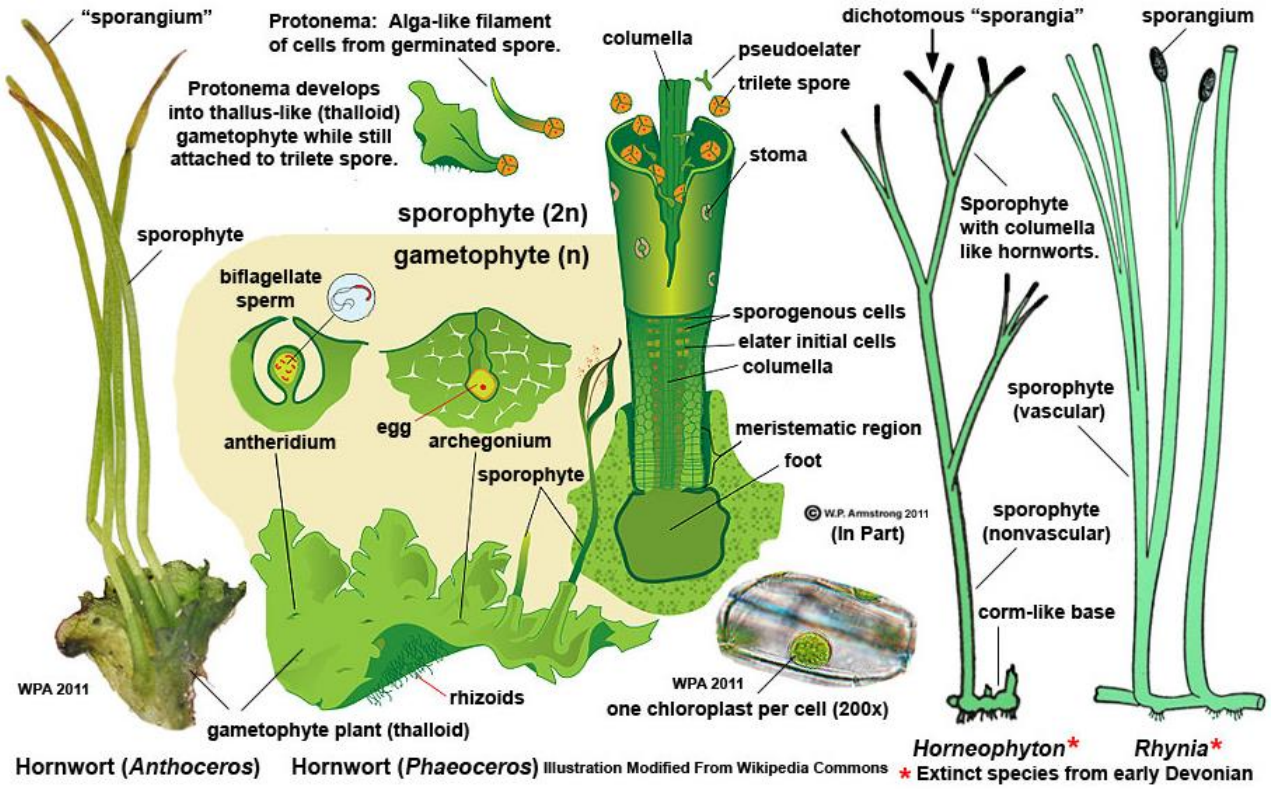
bryophyte clade | **polysporangiates**



Hypothetical steps in the evolution of a *Rhynia* type sporophyte from a anthoceratan (hornwort) type ancestor

Figure 116 hornwort to *Rhynia*

hornwort Anthoceratae “flower horn” both names from the horn-like sporophyte which is axial, elongate, cylindrical, long-lived (occasionally persisting after the death of the thalloid gametophyte).,stomatic and photosynthetic.The sporophyte has a basal, intercalary meristem so has indeterminate (potentially continuous) growth. They house nitrogen fixing cyanobacteria in gel-like lumps in cavities in the gametophyte thallus. Most species are unusual in having a single pyrenoid chloroplast in each cell. Non-vascular land plants similar to thalloid liverworts as opposed to the leafy liverworts and mosses. The third extant lineage of ‘bryophytes’ (liverwort/moss/hornwort clade). Studies indicate they are sister to the tracheophytes (vascular plants).



A hornwort compared with the extinct 400 million-year-old land plants **Horneophyton** and **Rhynia**.

Figure 117 comparisom hornwort and early vascular plants

humicolous (humus + *-colous*, *inhabiting*) Growing on humus (decaying organic matter).

humus (L. *humus*, the ground) Organic material resulting from the decomposition of plant leaf and branch litter, or forest duff in the ground or collected on branches or epiphytes. The uppermost soil horizon.

humus-collecting fronds Specialized overlapping or erect fronds that collect litter. See **base frond**, **shield frond** or **mantle frond**.

hyaline: (Gr. *hyaleos* , transparent) Transparent or translucent.

hybrid (L. *hybrida*, offspring of a tame sow and a wild boar) Offspring of two different species, nearly all fern hybrids are sterile, having aborted spores.

hydathode (Gr. *hydro-* f. *hudor* , water + *hodos* way) A water and or salt secreting gland on the surface or margin of a leaf; usually situated at the end of a vein e.g. in Grammitidaceae and some Davalliaceae. and often surrounded by a concretion of white salts; similar to a stoma but with functionless guard cells; popularly termed **lime-dot**.

hydrenchyma (Gr. *hydro-* f. *hudor* , water + + *en-* + *chein* to pour, an infusion) Water storing tissue in ferns such as *Pyrossia* consisting of large parenchymatous cells. In drought these cells shrink and the cell wall folds like the bellows of a camera, shrinking the thickness of the lamina, but maintaining the photosynthetic cells in a hydrated state for longer.

hydric (Gr. *hydro-* f. *hudor* , water) Habitat having an abundant supply of water. Compare **xeric** and **mesic**.

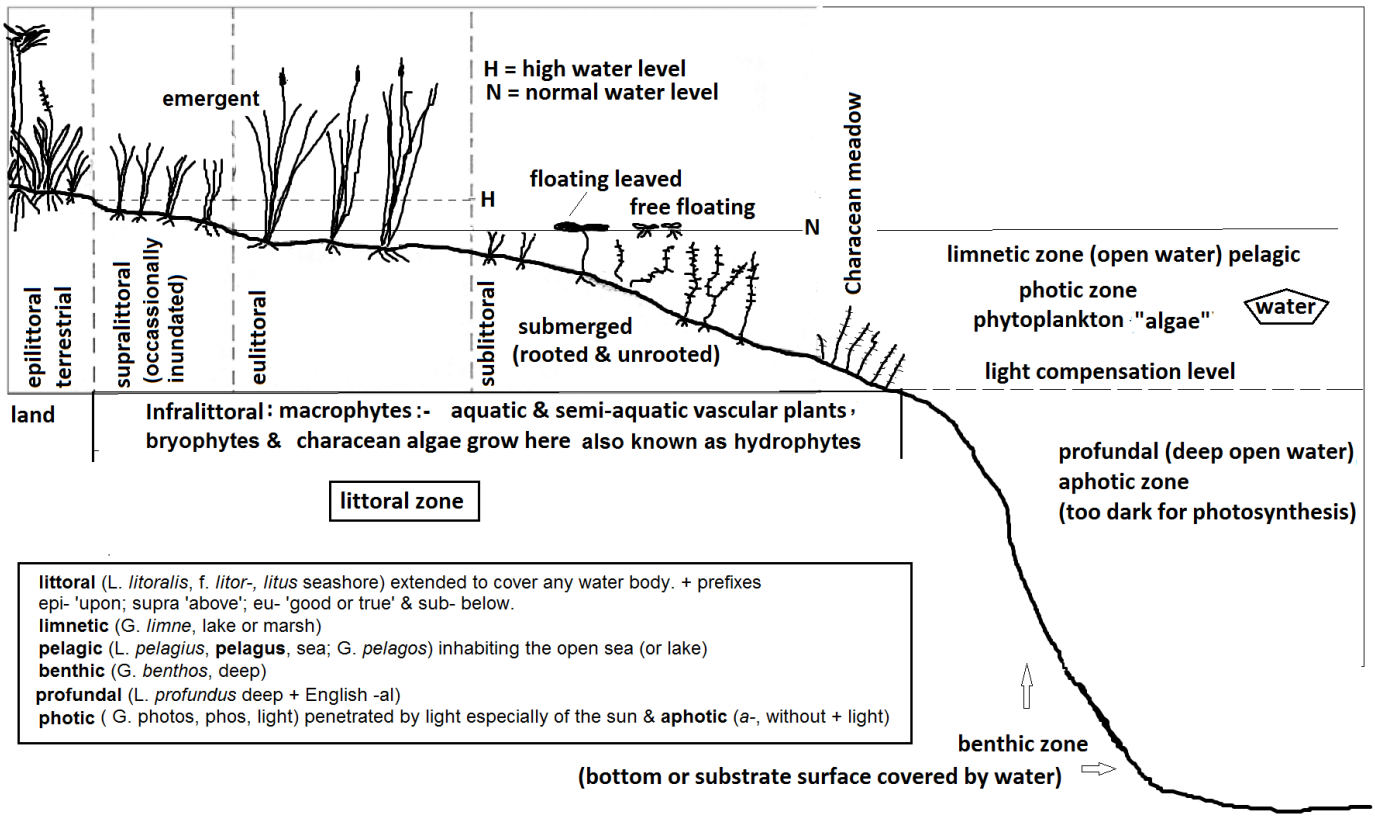
hydrochory (Gr. *hydro-* f. *hudor* , water + -chore f. *khoreo*, to move) Dispersal of seeds, spores, gametes and other propagules by water. Dispersal by sea (thallasochory), Dispersal by ice or glaciers (crystalochory).

hydroid (botany) (Gr. *hydro-* f. *hudor*, water + *eîdos*, form, likeness) Water conducting cells of some mosses e.g. *Dawsonia* sp. , with a central strand in their stems, setae, or leaf costa (midrib). They are narrow and elongate, dead and empty at maturity, conduct water and are analogous to (but not homologous to) the tracheid's of vascular plants. Unlike tracheid's they lack secondary thickening (lignin). Leptoids are comparable to phloem cells in these plants. See **hydrom**/**hydrome**.

hydrom or **hydome** (Gr. *hydro-* f. *hudor*, water + *soma*, body) The vasculature (specialized conducting tissue) of some mosses, found in the central strand, costa and seta which is analogous but not necessarily homologous with the xylem of vascular plants. Includes hydroids (narrow, elongate, empty cells that are dead at maturity,that resemble tracheids but are not lignified), conducting parenchyma and thick walled stereids. Compare leptome, parenchymatous cells (leptoids) that function as phloem cells conducting photosynthates in these plants.

hydrophilous (Gr. *hydro-* f. *hudor*, water + *phílos*, love) Growing in a aquatic habitat, submerged or floating or emergent. Same as **hydrophyte** or **aquatic plant**. Compare **hygrophilous**,**mesophilous**, and **xerophilous**.

hydrophyte (Gr. *hydro-* f. *hudor*, water+ *phyton ,* plant) A plant that grows wholly or partly submerged (emergent or floating) in water. A aquatic plant e.g. water fern *Azolla* sp. or quillwort *Isoetes* sp. (see habitat diagram). Hydrophytes occur in the littoral zone of water bodies. . See **hydrophilous**. Compare **hygrophyte**, **mesophyte** and **xerophyte.**



A generalized diagram of lake zonation & hydrophyte types

Figure 118 aquatic zonation

hydropteridales (Gr. *hydro-* f. *hudor*, water+ *pteris*, fern +-ales) An older name for the order of water fern families now Salviniales.

hygromorphic (Gr. *hygro-* , f. *hugros*, wet, moist + *morphos*, f. *morphe*, shape) A plant adapted to wet but not aquatic conditions. Compare **hydromorphic**, **mesomorphic** and **xeromorphic**.

hygrophilous (Gr. *hygro-* , f. *hugros*, wet, moist + *philous*, loving) Preferring wet climate or moist environment. Not quite hydrophilous, slightly mesophytic.

hygrophyte (Gr. *hygro-* , f. *hugros*, wet, moist + *phyton ,* plant) A plant that grows in and is adapted to a wet but not aquatic environment. Intermediate between hydrophyte and mesophyte in water dependency terms.

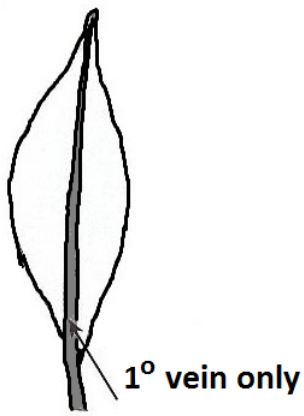
hygroscopic (Gr. *hygro-* , f. *hugros*, wet, moist + *skopéō*, examine, inspect, look to or into) Expanding or contracting by absorbing or losing water and thus changing shape or size. See **elater (hygroscopic ribbon** or **band), annulus.**.

hylophile adj. **hylophilous** (Gr. *hylo-* forest + *philous*, loving) Plant growing in forest habitats. Synonym **silvicolous.**

hymenophylloid (Like *Hymenophyllum*) Filmy fern in the family Hymenophyllacea that is more closely related to the genus *Hymenophyllum* than to *Trichomanes*. A clade of the filmy fern family.

hypha pl. **hyphae** (Gr. *hyphē* web; *hyphos* web) Branching filamentous structure of fungi. One of the threads that make up the mycelium of a fungus, increase by apical growth, and are transversely septate or nonseptate.

hyphodromous (L. *hypho*, weaving + Gr. *dromos*, racetrack) Pinnate leaf pattern, with only the midrib vein present or evident. Secondary (lateral) veins absent (± **uninervous** or **unicostate**) or hidden. **Microphylls**/**lycophylls** are hyphodomous as are many conifer leaves.



hyphodromous = uninervate

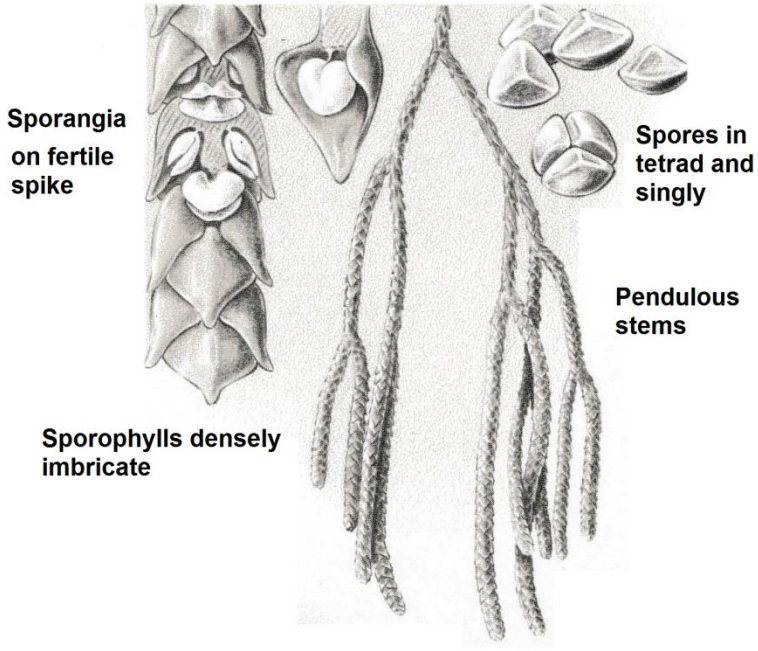
Figure 119 hyphodromous

hypogeal/hypogeous (Gr. *hypo:* below, under + *geo-* earth) Usually applied to seeds whose cotyledons develop underground. Growing or developing below the soil surface. Synonym **subterranean,** opposite of **epigeal** or **surficial.**

hypostomatic (Gr. *hypo:* below, under + Gr. *stoma*, mouth) Bearing stomata on one leaf surface only, usually the lower or abaxial surface. *cf.* **amphistomatic**.

idioblast (Gr. *ídios* , own, personal, distinct + *blastós* , germ, sprout) Specialized epidermal cells producing slime or gum.

imbricate (L. *imbricarus* , tiled)) Overlapping like fish scales or tiles on a roof; said of leaves and scales etc. *Lycododium serpentinum* –"leaves of main stem uniform, dense, ascending, imbricate, linear-lanceolate, acuminate, *c*. 3 mm. long; lvs of aerial branches less dense somewhat spreading." Flora of New Zealand. Volume 1.



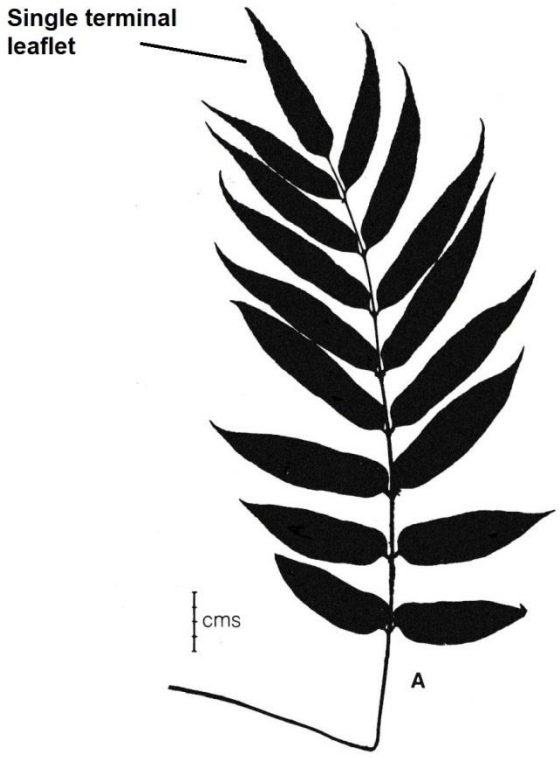
Phlegmarius varius* syn. *Lycopodium varium

'Oxford Book Of New Zealand Plants' 1978.
Moore, L. B. and Irwin, J. B.
Oxford University Press

Figure 120 imbricate *Phlegmarius* (*Lycopodium*)

immersed (L. *immersus*: plunged in, immersed) Sunken or embedded in the surrounding tissue. Such as sori that are surrounded by leaf-tissue. Opposite of **superficial**.

imparipinnate ((L. *impar*, *imparis*: unequal, odd; + *pinna*; feather) Pinnate with the rhachis terminated by a single leaflet. Also called **odd-pinnate** (Blade Architecture)**.** The most common pattern in ferns. Compare **paripinnate, even-pinnate, abruptly pinnate**.



Asplenium oblongifolium **Imparipinnate or odd pinnate**
'New Zealand Ferns and Allied Plants' 2000. Brownsey,Patrick J. and Smith-Dodsworth, John C.. David Bateman

Figure 121 imparipinnate

Imperfect In leaf venation said if vein branches cover less than two thirds of the leaf blade area (or reach less than two thirds of the distance toward the leaf apex). It is **perfect** if veins coverage is greater than this.

incised (L. i*ncisio*: a division, an incision) Cut deeply, sharply and often irregularly (an intermediate condition between toothed and lobed). *Histiopteris incisa*.

inclined (L. *inclinare*. to cause to lean) Angled upwards at a slight angle. See **orientation**.

included (L. *includere* , enclosed) 1. Contained within, as a veinlet within an areole. 2. In filmy ferns a receptacle that is not **exserted** - does not extend beyond the indusium/involucre.

inconspicuous Not easily seen, not prominent.

incrassate (L. *incrasso*: to make thick, stout) Thickened.

incurved (L. *incurvare* , bent in) Bent or curved inwards or upwards; of leaf margins, curved towards the adaxial (upper or ventral) surface.

indefinite (L. *in*-, not + *definitus*, definite *de*- +*finis* boundary, limit) Of apparent unlimited growth, e.g. the frond of *Lygodium articulatum* and the rhizome of *Pteridium esculentum*. Same as **indeterminate**. Opposite of **definite** or **determinate**.

indeterminate (L. *–in* , not + *determinatus* , limited) Same as **indefinite**. Not limited in longitudinal growth; continuously or intermittently elongating from the tip; said of blades,e.g. *Lygodium articulatum* .The

growth continues throughout the life span of an individual (or leaf) such that size and age are roughly correlated. indeterminate leaves grow until there leaf tip dies because of external factors. In *Lygodium* the long, repeatedly branching leaves result from indeterminate growth of the rhachis (midrib) and may reach 20 meters in some species. In scrambling ferns such *Dicranopteris* indeterminate growth results from repetitive development and expansion of dormant leaf buds. Opposite of **definite** or **determinate**.

Indeterminate leaf growth by long-lasting, growing leaf tip or growth of accessory leaf buds	Representative New Zealand Ferns Creeping Rhizome *Dicranopteris* (scrambler) *Gleichenia* (scrambler) *Hypolepis*(scrambler) *Lygodium* (climber) *Paesia* (climber) *Sticherus (*scrambler)

indigenous (L. *indigenus* , native, born in a country) Native to a country, region or area but not necessarily exclusively so. For example *Asplenium bulbiferum* is native to both New Zealand and Australia. Compare **endemic**, **exotic**, **adventive**.

indumentum: (L. *indumentum* , a covering) Epidermal appendages, e.g. hairs, scales or glands, collectively. See **vestiture**, **leaf indumentum (covering)**

indurated (L. *indurare* to make hard,f. *durus*, hard, harsh) Hardened, e.g. *Blechnum durum* foliage.

indusiate Bearing an indusium,e.g. *Hymenophyllum* spp. . Opposite of **exindusiate**, e.g. *Gleichenia* spp*.,Pleurosorus rutifolius*

indusium ((L. *indusium*: a woman's skirt) The covering of a **sorus** (sporangium cluster), a thin membranous , often colourless covering of the sorus, shrivels at maturity to expose the sporangia. Maybe either a **true indusium** specialised organ such as a scale-like epidermal outgrowth protecting the sorus or a **false indusium** the incurved margin of the lamina or part (flap) of the lamina protecting the sorus. Some ferns have both a true indusium (on one side) and a false indusium (on the margin side) e.g. *Pteridium*. An Inferior indusium is attached beneath the sorus with the sporangia appearing above it. In the water ferns, (Salviniales) the globose indusium forms a wall that encloses the sporangia and is called a **sporocarp** and in *Marsilia* this is reinforced by a folded pinnule. Plural **indusial** hence **indusiate**, having the sorus covered. See **exindusiate**, lacking an indusium or bearing naked sori or sporangia. Other ferns may instead have specialized hairs or scales called **paraphyses** intermingled with sporangia. Some ferns are both **paraphysate** and **indusiate**.

Indusium - mode of attachment basally including centrally attached –central stalk (**peltate**), or edge/sides **(lateral**), and shape :- round, orbicular, globose (sporocarp) kidney-shaped (reniform), crescent shaped or lunate, oblong, squamiform (fish scale-like), pateliform (plate-like) , linear, elongated, tubular, bivalved, reflexed margin or flap etc are useful for identification and taxonomic classification.

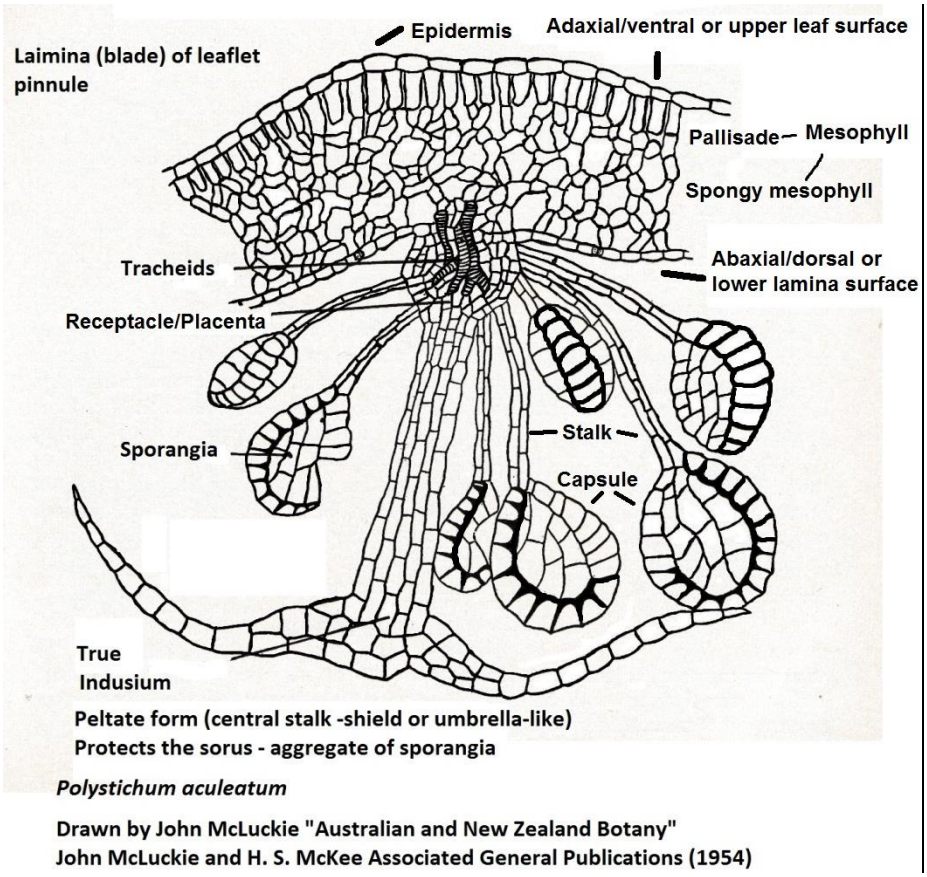


Figure 122 cross section peltate indusium *Polystichum*

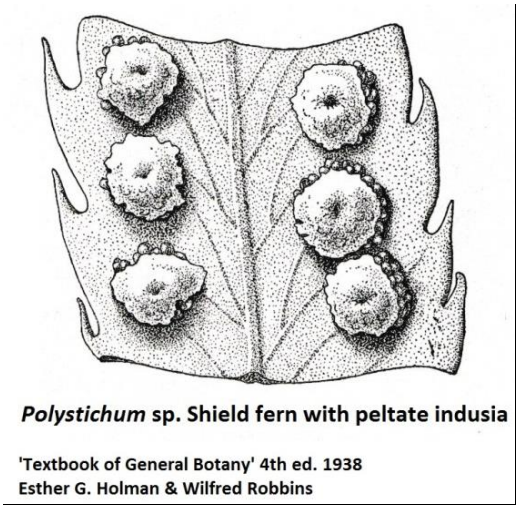


Figure 123 pelate indusium *Polystichum*

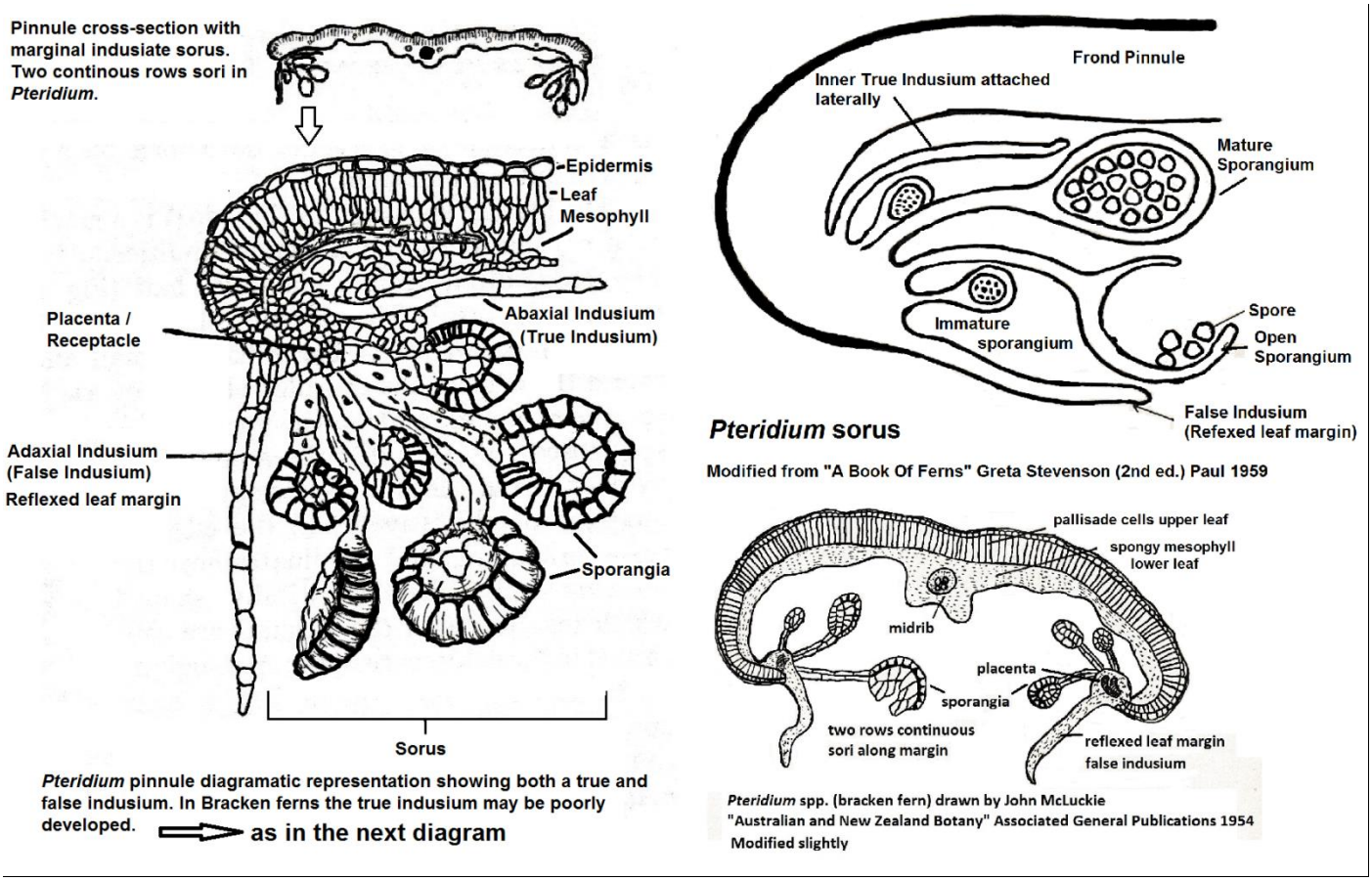


Figure 124 true and false indusium *Pteridium*

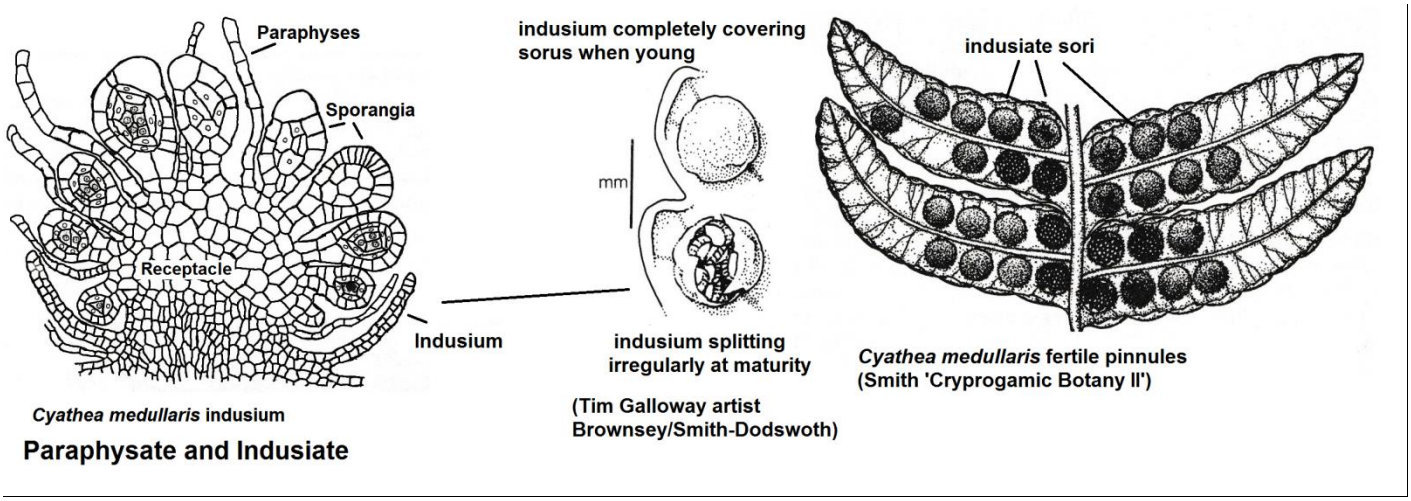


Figure 125 paraphystae and indusiate

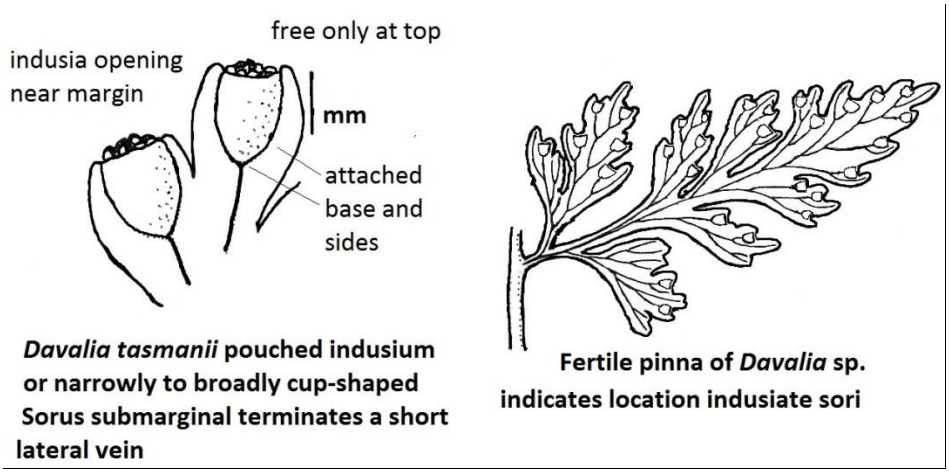


Figure 126 pouched indusium *Davalia*

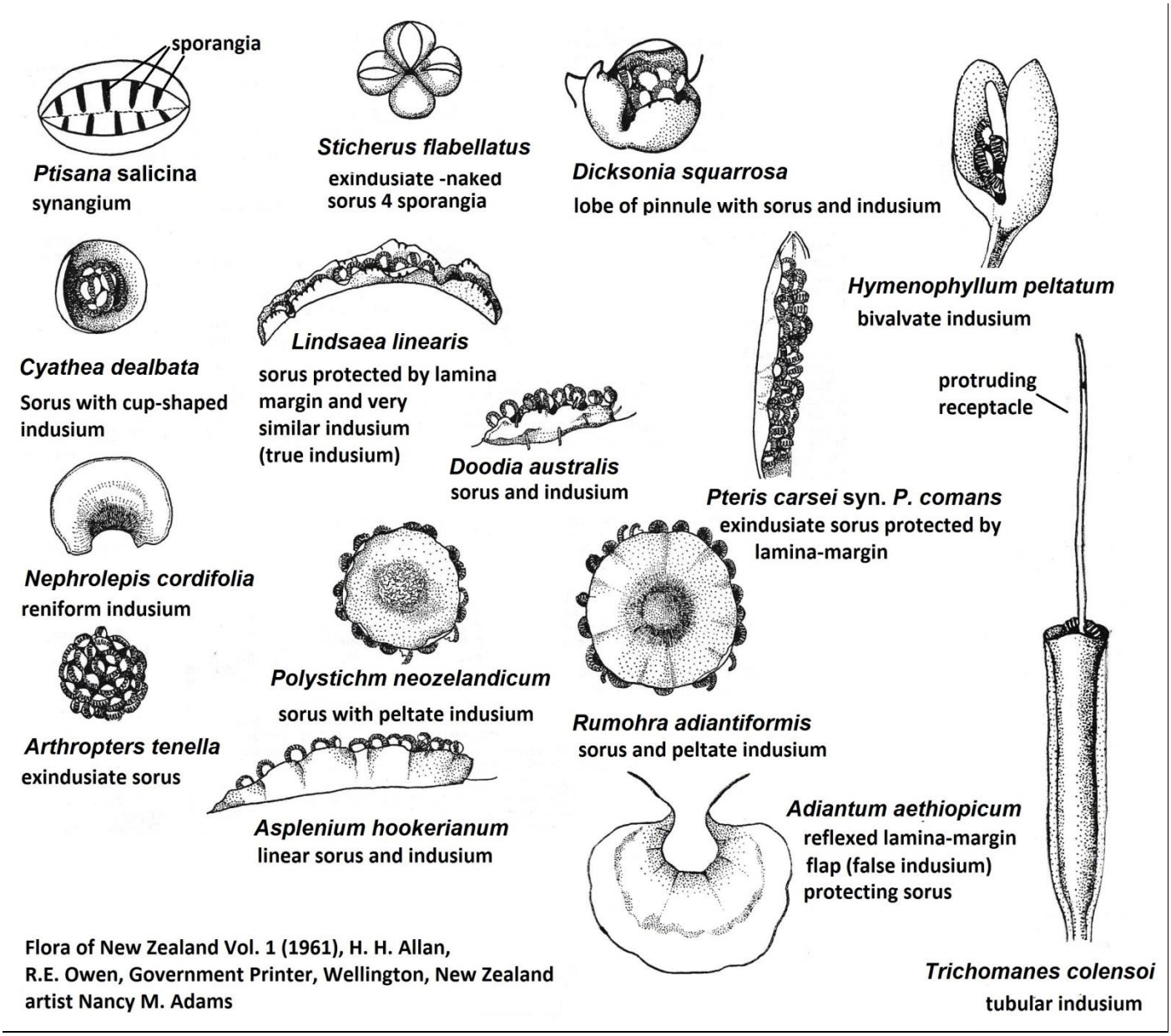
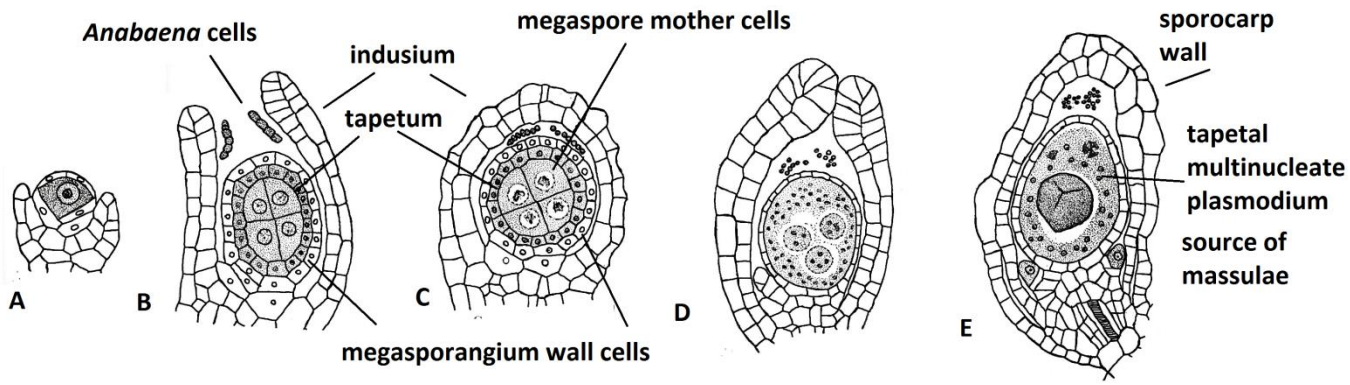


Figure 127 sori and indusia

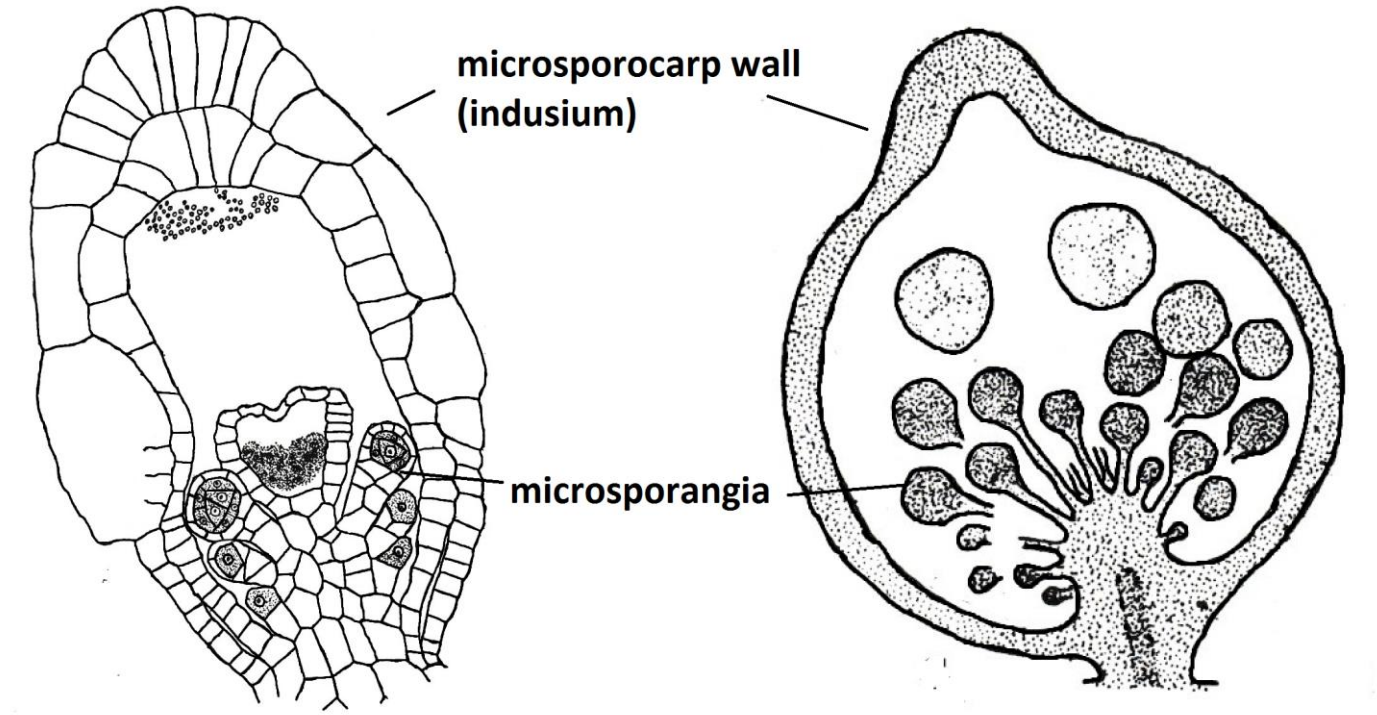


Azolla filiculoides. **Stages in the development of the megasporangium and sporocarp type indusium**

Note included *Anabaena* (cyanobacteria) cells (after Smith)

Sporocarp is essentially a modified indusium enclosing the sporangia

Figure 128 megasporocarp *Azolla*



Azolla filiculoides **L.S immature microsporocarp (left) and maturing microsporocarp (right) (after Smith)**

Figure 129 microsporocarp *Azolla*

inferior (L. *inferus* , below, underneath, lower) Situated below another organ. Opposite of **superior.** See inferior or partly inferior indusium below.

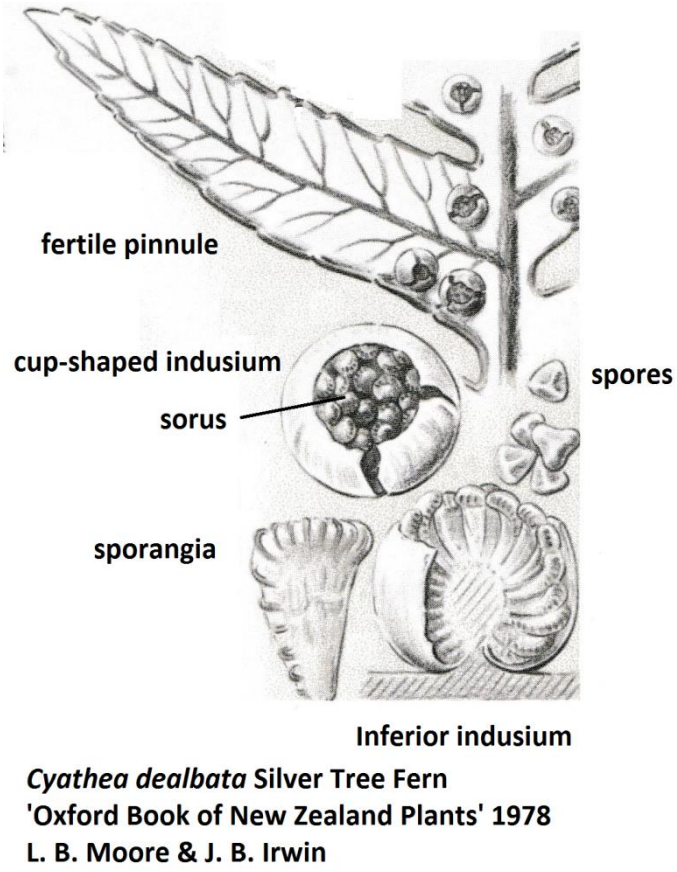


Figure 130 indusium *Cyathea*

inflated (L. in + *flare*, blow) Swollen, distended. Said of the indusium of *Deparia petersenii* subsp. *congrua* for instance.

infraspecific (L. *infra* , below + specific). Below the rank of species, referring to taxonomic subdivisions within a species includes subspecies, varieties, and forms.

internal hairs In leaves of *Isoetes*, projections into the **lacunae**.

Internode (L. *inter-* , between, + *nodus* , knot) The portion of a stem between two successive nodes. A **mesome** connecting **telomes** in telome theory.

interrupted (L. *interrupto* , a breaking off abruptly) Broken or discontinuous, e.g. an **annulus** not forming a complete circle, also known as an incomplete annulus. The opposite of a **continuous** annulus.

intine (probably from German, f. L. *intus* within + New Latin *in-* fibrous tissue, from Greek *in-, is* tendon) The inner cellulosic and pectinic wall layer of a spore or pollen grain. The outer layer is the **exine**.

intramarginal (L. *intra-* , within + *marginalis* f. *margo* ,margin) Within the margin and near the edge said of **soral position**.

intraradicle hyphae/mycelium (*intra-* inside +*radix*, root) Hyphae –fungal filaments that grow within (intra-) the cortex of a root and develop nutrient transfer structures within the host. These form the mycorrhizal fungal body inside the roots of plants. Contrast **extraradicle hyphae**.

introduced Not native to an area where it now occurs; introduced through human agency. See also **adventive, exotic**, **naturalized**.

introgression (L. *introgredior* , to step in, enter) The formation of a wide range of intermediate plants, with intermediate morphology, by hybridization and backcrossing among different taxa and their progeny.

involucre (L. *involucrum* a cover, wrapping, case, envelope) The tubular,urceolate or two-lipped (bivalvate) indusium of members of the filmy ferns family Hymenophyllaceae. The abaxial and adaxial surfaces are almost identical. A receptacle an extension of a veinlet bears the sporangia within, but may extend beyond the indusium in which case it is said to be exerted (as in *Trichomanes* spp.) if not **included.**

involute (L. *involutus* , in rolled *in-* + *volvo* , roll) With the edges rolled inwards. Longitudinal posture term, compare **revolute**.

isodromous venation (Gr. *isos* , equal + *dromos*, running, racecourse) Vein branching equally spaced

isomorphic (Gr. *isos* , equal + *morphe,* form) Of the same form or appearance. Synonym homomorphic but this term also applied to chromosomes of the same form. Compare **dimorphic** or **polymorphic**..

isophyllous (Gr. *isos* , equal + *-phyllos*, from *phyllon* leaf) Leaves equal in size and shape at any point on the branch. Compare **anisophyllous**.

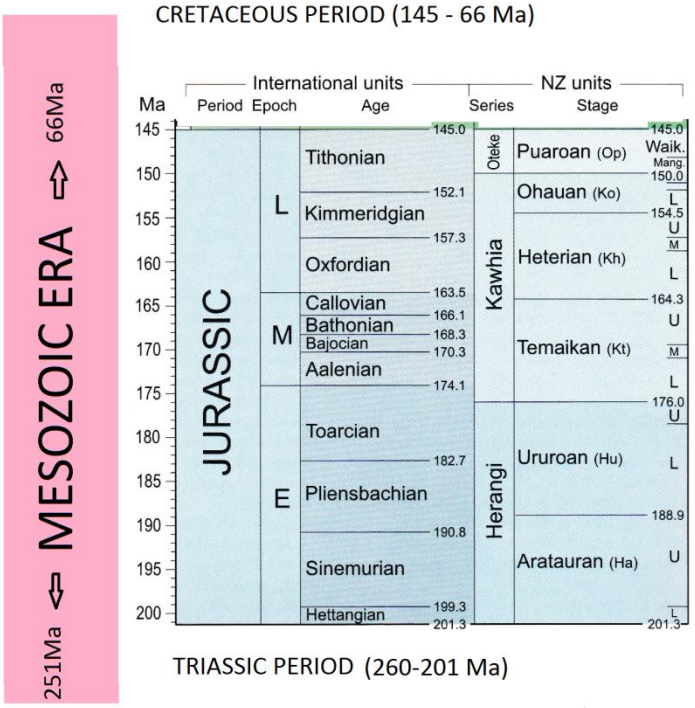
isosporous Gr. *isos* , equal + + *spora*, seed) Producing one type of spore (same size and shape). Synonym **homosporous**. The majority of ferns are isosporous bar the water ferns (Salviniales) which are heterosporous. While in the lycophytes (Lycopodiales) the Lycopodiaceae are isosporous, the Isoetales (Selaginellaceae & Isoetaceae) are heterosporous. Seed plants are heterosporous. Compare **heterosporous** or **anisosporous..**

isotomous: Gr. *isos* , equal + *tomous* cut, divided) Having all dichotomies resulting in equally thin branches. Forking or branching in two equally. Compare **anisotomous**.

isovalvate Gr. *isos* , equal + valvate f. *valae* folding doors) Having the two valves of a sporangium equal in size. Compare*.* **anisovalvate**.

jointed (articulate) Bearing joints or nodes, with the stems separating easily at the nodes as in *Equisetum.* An earlier name for this group of plants was arthrophytes which means “jointed plants”.

Jurassic The chronostratigraphic (geological) time period dating from 201 to 145 million years ago. The middle Mesozoic period preceded by the Triassic and followed by the Cretaceous. Some modern conifer and fern families arose here. Lurking here also was the unknown ancestor (Pteridosperm of some kind) of the flowering plants which evolved in the next period (Cretaceous). The Triassic/Jurassic extinction event left the dinosaurs in charge over their archosaur relatives. The first birds appear. Curio Bay in eastern Southland is a mid-Jurassic, circa 180 (Ma) fossil site. Araucarian and podocarp conifers,cycads and a variety of extinct tree ferns and ground ferns grew there at the time.



The Jurassic Period Approximately 201-145 million years ago (Ma)
L = Late; M = Middle; E = Early

FIG. 20. **Agathis australis**. *a*, spray with young male and female strobilus; *b*, young male strobilus; *c*, stamen from three aspects; *d*, winter buds; *e*, cone-scale with young seed; *f*, mature cone-scale showing scar to which the seed was attached; *g*, seeds with either one or two wings.

From 'A HANDBOOK OF CONIFERAE AND GINKOACEAE' 1966 Revised Edition. Dallimore and Jackson Revised by S. G. Harrison

The Araucarian conifer genus *Agathis* appears in the early Jurassic The Podocarpaceae and Araucariacea appear to have split in the Late Permian Period.

PARAHAKI BUSH, WHANGAREI

From 'New Zealand Ferns' 1930, 3rd ed. H. B. Dobbie; photographs by F. W. Birch. Southern Reprints 1987

Tree ferns belonging to Cyatheales appear in the Late Jurassic
though modern genera not until the Cenozoic Period

Figure 131 Jurassic Period

juvenile ((L. *juvenis:* young, youthful) The young stage of growth before a plant is capable of flowering or spore production.

kauri forest Forest dominated by kauri *Agathis australis*, found naturally north of latitude 38° South in the North Island and some offshore islands. A tall forest tree in the conifer family Araucariaceae. It may also be found mixed with other species as in mixed kauri/podocarp/broad-leaf forest. In the Miocene,several other Araucariacean conifers were present in New Zealand. The genus *Agathis* appears in the early Jurassic Period. See **arapod**.

keel A ridge, usually on the back.

keeled furnished with a keel, sharply folded in the middle like the keel of a boat. Synonym **carinate**. See also **marginate**.

koru (Maori *koru*, crozier) A young fern frond in the crozier or fiddlehead stage of growth, before it has uncoiled, and expanded at maturity. Synonym **crozier**, **fiddlehead**. See also **circinate vernation**.

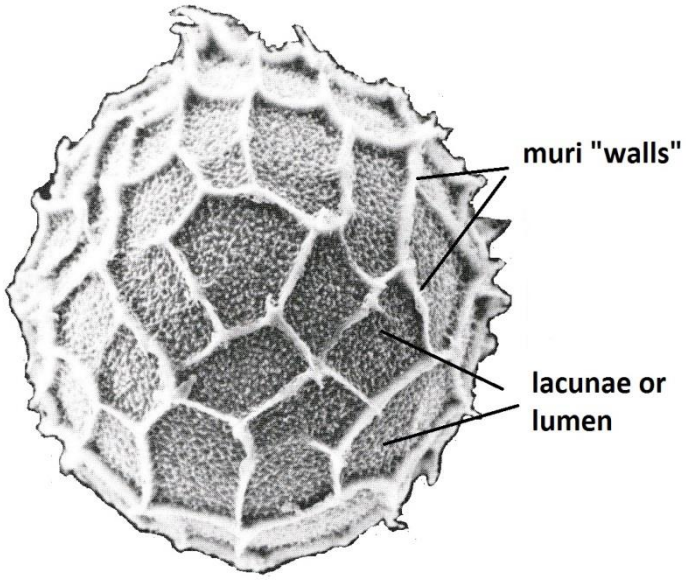
labium (L. *labium* lip) Lip- like structure such as an outgrowth above the sporangium which partially or wholly covers the ligule.

labiate (L. *labium* lip) Having lips.

lacerate (L *lacer*: mangled, torn to pieces) With an irregular, ragged margin as though torn said of pinnae and ultimate segments. Similar to lacinate.

lacinate ((L. *lacinia* , full of folds, fringed, indented, jagged) Deeply and irregularly cut into narrow, pointed segments.

lacuna pl. **lacunae** (L. *lacuna* a pit, small hole) The area of the lamina enclosed by joined veins in a reticulate-veined frond. Synonym **areole**. In *Isoetes*,a cavity within the leaves. In spores large meshes in a reticulum; a large pit or depression in the exine of reticulate grains. The cavity,or space between the walls (muri) of a reticulum formed by anastomosing ridges.



Selaginella krausiana **African clubmoss megaspore showing reticulate sculptural ornamentation.**

Figure 132 lacunae

laesura (L. *laesioni* , injury) The scar or suture line (dehiscience fissure) that shows how spores or grains separated from the original tetrad (group of four spores joined together –meiosis has four products (cells). pl. **laesurae**. When the spore germinates it is most likely to do so through one of these, as they split open readily. Therefore the laesura is also known as the **germination furrow**. A spore with one laesura is said to be **monolete,** whereas a spore with three laesurae is **trilete,** or rarely four **tetralete** and one where the laesura has disappeared **alete**.

lamelliform (L. *lamina* thin plate or sheet of metal/other material,+ form) In the shape of a plate or scale. applied to spore wall ornamentation.

lamina pl. **laminae** (L. *lamina* thin plate or sheet of metal/other material,) The blade or leafy part of a frond. The expanded green part of a fern frond. The lamina includes the rachis (midrib or stalk) and the pinnae (leaflets) if compound, but excludes the stipe/petiole (leaf stalk) if present.

laminar size The leaf blade area (mm^2) –petiole/stipe excluded, obtained approximately by measuring the length and width (widest part) in mm and multiply the length x width x 2/3. From there the leaf area can be fitted into a leaf size class:

Blade class (Gr. *-phyll* f. *phyllon*, leaf)	**Area of leaf in mm^2**
Leptophyll (Gr. *lepto*, fine, slender + phyll)	< 25
Nanophyll (Gr. *nano*-, dwarf + phyll)	25 - 225
***Microphyll** (Gr. *micro*- small + phyll)	225 – 2,025
Notophyll (Gr. *noto*- southern, back + phyll)	2,025 -4,500
Mesophyll (Gr. *meso*- middle + phyll)	4,500 – 18,225
Microphyll (Gr. *macro*-, large,long + phyll)	18,225 -164,025
***Megaphyll** (Gr *mega*- ,very large, great + phyll)	>164,025
*N.B. microphyll and megaphyll are used in another sense where microphyll = lycophyll and megaphylly = euphyll.	

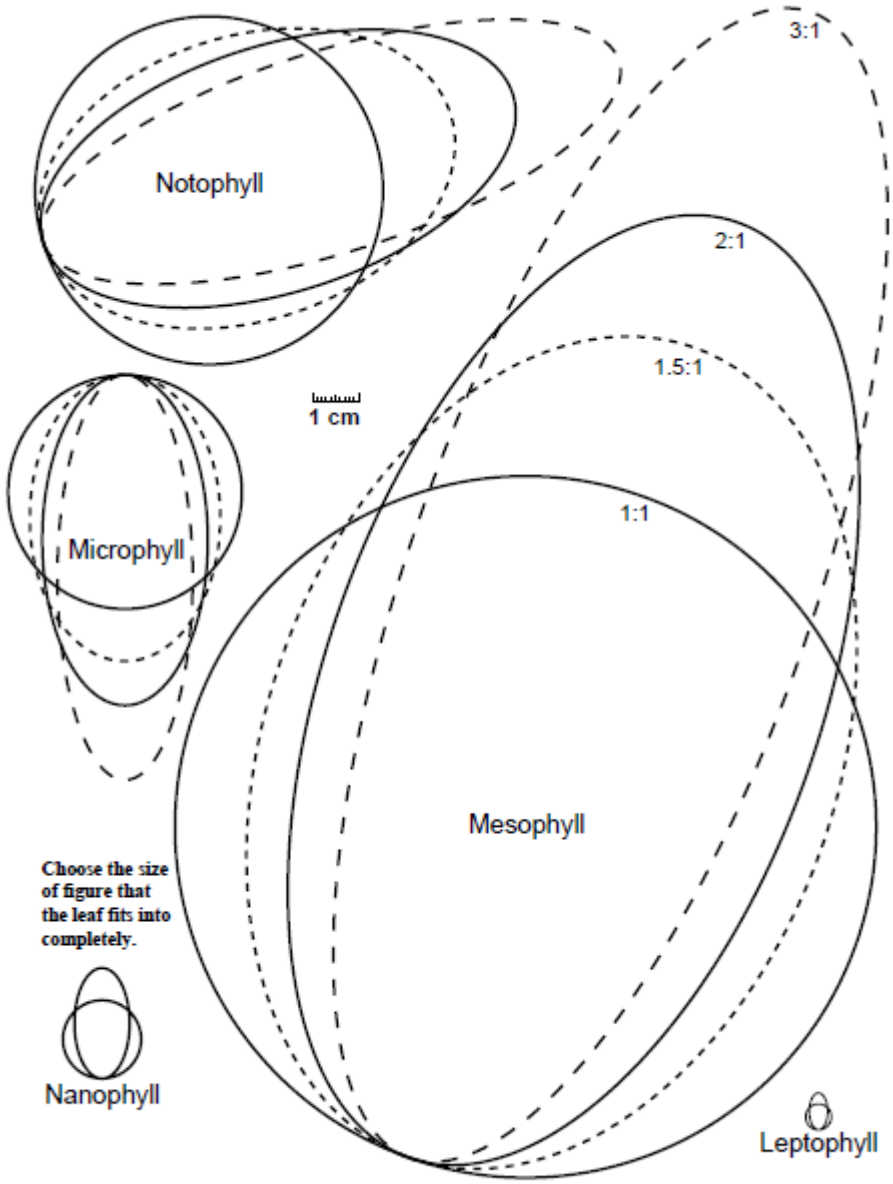


Figure 133 leaf size terms (1 cm bar for scale)

laminar stipules (L. *lamina* thin plate or sheet of metal/other material, + L *stipula* stalk of hay or straw, diminutive of stipe) Where the lowermost pair of secondary pinnae overlap the rachis as in *Histiopteris incisa.*

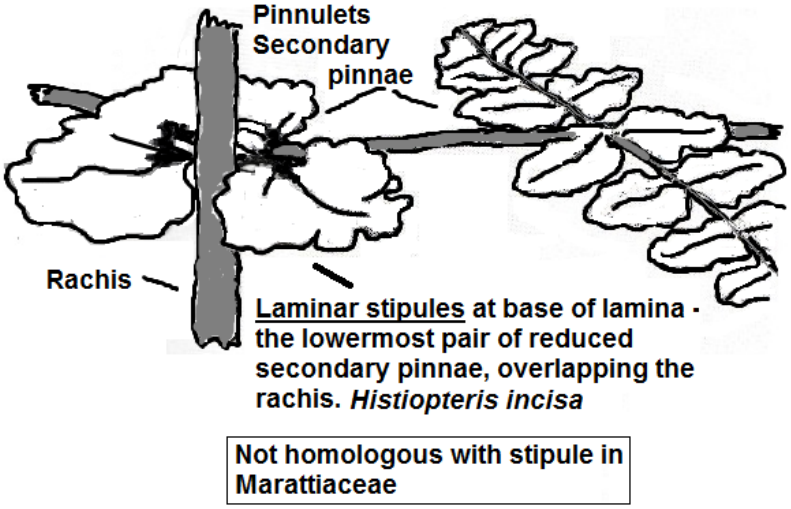


Figure 134 laminar stipules

lanate (Latin *lanatus* , wooly) Wooly, covered with long, soft, crooked or curly, interwoven, matted hairs. Similar to **villous** but hairs shorter**.** See **hairiness terms.** Wooly tree fern *Dicksonia lanata*.

lanceolate ((L. *lancea* ,a light spear, a lance) Lance-shaped: broadest between base and middle several times longer than wide (3: 6x) tapering slowly to the apex and rapidly to the base. *Tmesipteris lanceolata, Anarthropteris lanceolata*.

land plants Mosses, hornworts, liverworts, lycophytes, ferns, and seed plants (gymnosperms and angiosperms) known as embryophytes. These plants evolved from freshwater aquatic green algae ancestors. Some algae are also terrestrial. Algae and or cyanobacteria are present as photosymbionts in lichenized fungi – the lichens.

lanuginose (L. *lanuginosus* f. *lanugo* down f. *lana* wool) Downy, cottony or wooly. **Tomentose**. See hairiness terms.

lateral (L. *lateralis* : pertaining to the side, f. *latus* side) Arising at the side of an axis. *Lycopodium laterale*.

lateral indusium With indusium attached by one side as opposed to **peltate** or basally attached.

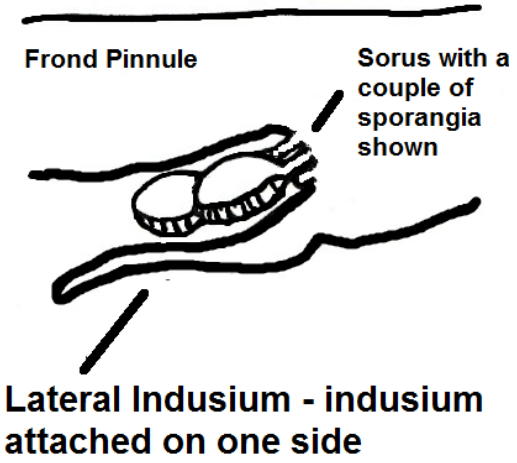


Figure 135 lateral indusium

lateral leaf. Leaf on the side of the stem, as in heterophyllous species of *Selaginella*.

lateral vein A vein that branches from a vein of higher order such as a secondary vein from a midrib (rachis or costa in ferns).

latitudinal diversity gradient Tendency for most taxonomic groups to have most of their species in the tropics, with diminishing numbers of species towards the poles. “Over two thirds of the species in the New Zealand region may be found north of Auckland, and in a single small area of Kauri forest one may find upwards of 60 species. Further south, in Westland, it is not uncommon to find over 40 different ferns on a single hillside in lowland podocarp forest. In contrast on the Auckland and Campbell Islands south of the New Zealand mainland, less than 40 fern species have been authentically reported. Fewer species are encountered in mountain areas”. David Given “Ferns: An Introduction’; New Zealand Natures Heritage’ Vol. 5 Part 74. 1975. Hamlyns Limited.

lax (L. *laxus*,loose) Loosely arranged, open, scattered.

leaf apex (tip) Compare **leaf base**.

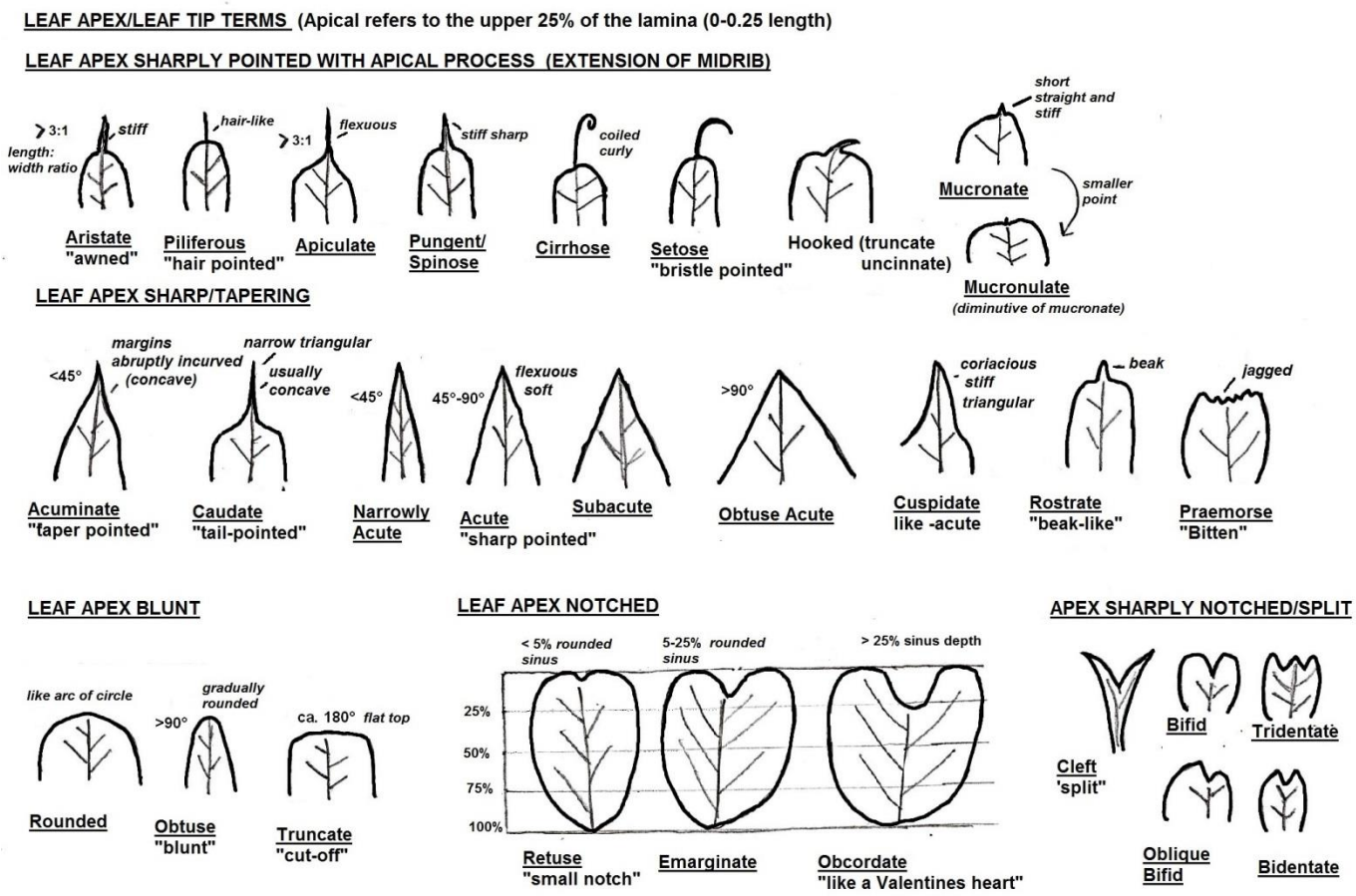


Figure 136 leaf apex (tip)

leaf base Compare **leaf apex**.

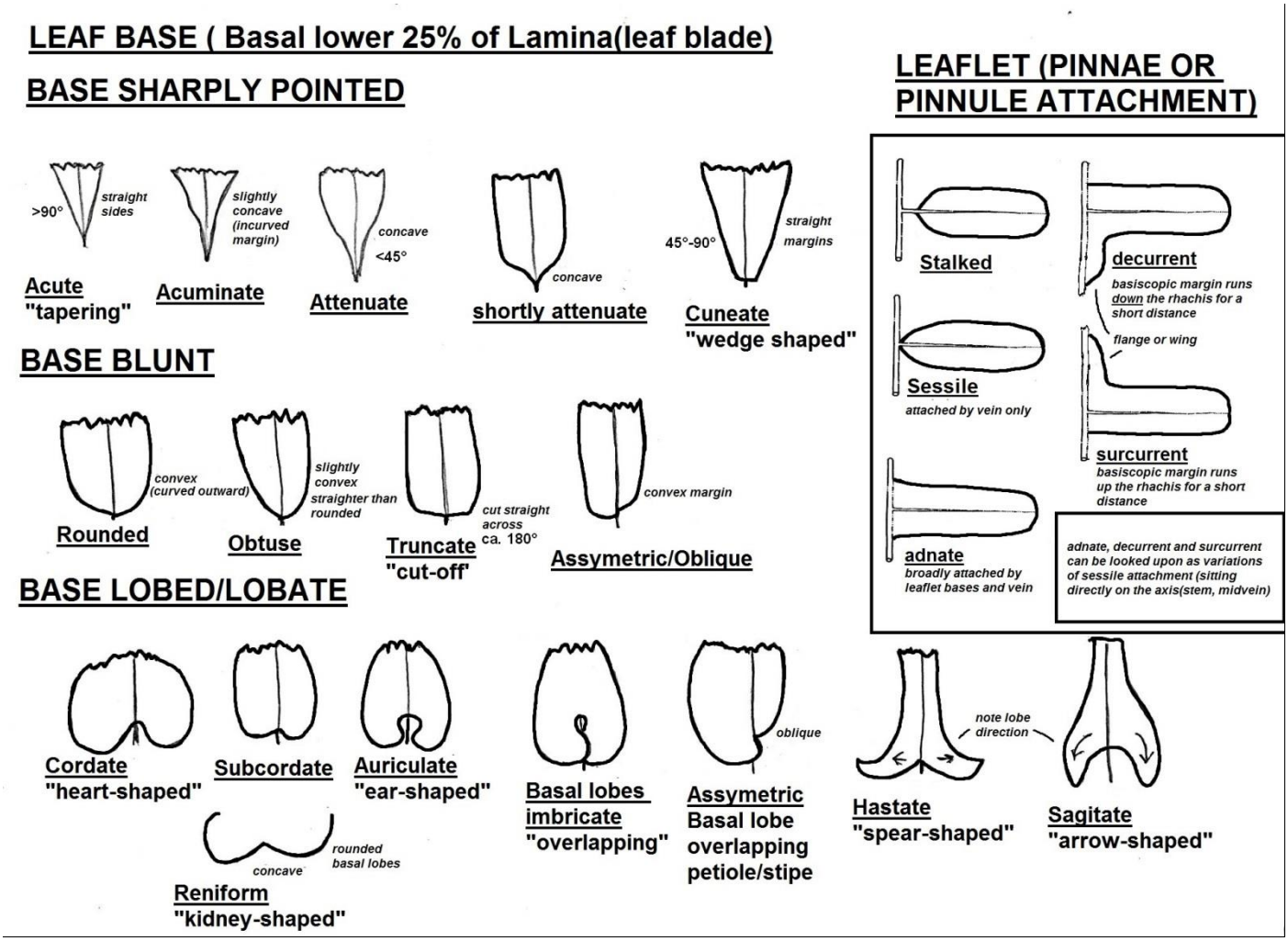


Figure 137 leaf base and leaflet attachment

leaf division (lobation) and margins Leaf or leaflet shape characteristics referring to the presence and characteristics of sinuses (incisions) spaces or gaps defining lobes or segments. **Margin** refers to features of the side of the leaf, such as the presence or absence of teeth. **Teeth** may be regarded as very shallow leaf divisions extending no more than 1/8 of the distance to the midrib or equivalent axis or point (in a palmately lobed leaf the junction of the primary veins). An **entire** margin lacks teeth or lobes altogether and is also called smooth. Teeth shapes and orientation include dentate, serrate, crenate.
Leaf divisions extending more than 1/8 of the distance to the midrib or equivalent axis or point (in a palmately lobed leaf the junction of the primary veins) include:

lobed (1/8-1/4), **cleft** (1/4 -1/2), **parted** (1/2 -3/4) and **divided** (3/4 – circa 1). Full or complete leaf division results in a leaflet.The terms lobed and division are sometimes used in a more general sense.
The terms **pinnatifid** or **palmatifid** means pinnately or palmately lobed to divided (≈ 1/8 -3/4); **pinnatipartite** or **palmatipartite** (≈1/2 – 2/3); and **pinnatisect** or **palmatisect** (≈3/4 –circa 1).

Decompound means deeply divided into numerous segments such that leaflets are not clearly defined.(Decompound also refers to a multi-compound leaf).

pedate is palmately divided with the lateral or basal lobes further divided. Special terms include:

incised means having sharp, deeply cut, jagged, lobes.

sinuate means shallowly wavy in horizontal plane,

undulate means shallowly wavy in horizontal plane and vertical plane.

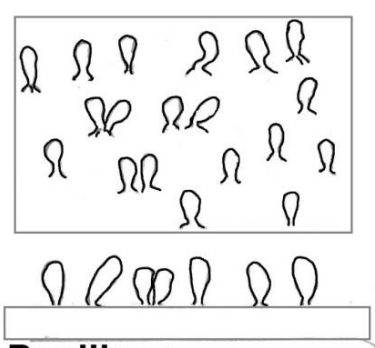
lacerate means irregularly cut as if torn;

lacinate has lobes cut into narrow, ribbonlike segments.

pectinate means comblike with pinnately divided with close-set, very narrow lobes.

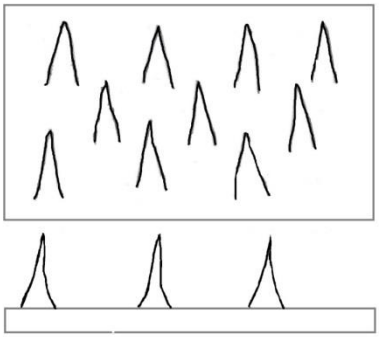
Note leaf division often varies along the length of a frond with the greatest division found near the base, decreasing towards the apex (leaf tip).

leaf indumentum (covering)



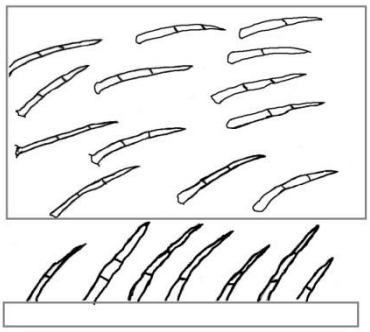
Papillose

With short soft, nipple-like protruberances



Echinate

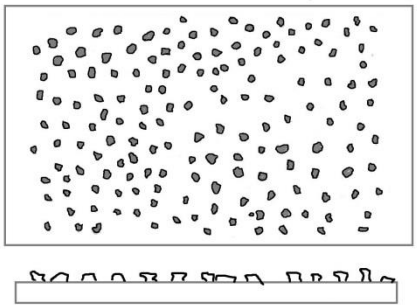
Spiny, prickly bristles or protruberances



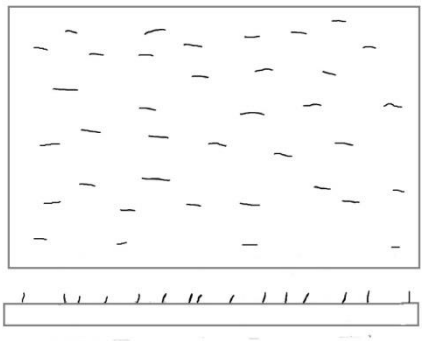
Pilose

Short thin, upright straight hairs

Short thin, upright straight hairs

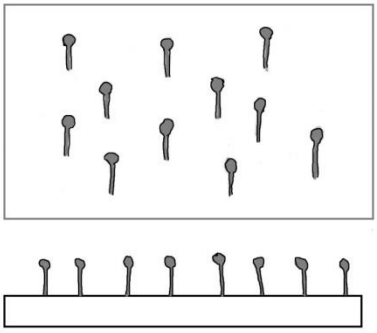


Farinose/Farinaceous
Mealy with a powderry covering



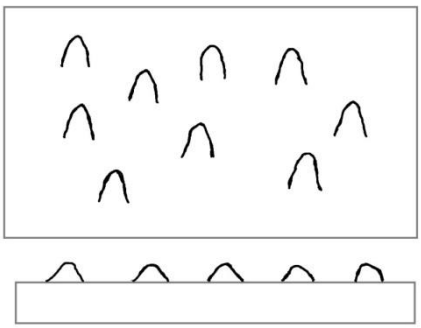
Puberulous/Puberulose /Puberulent

Minutely pubescent, covered with minute, soft hairs, barely visible.



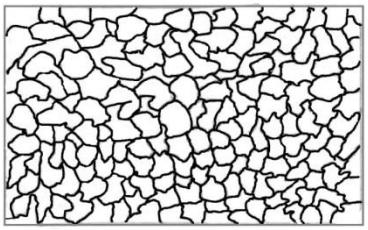
Glandular

With gland bearing usually capitate hairs



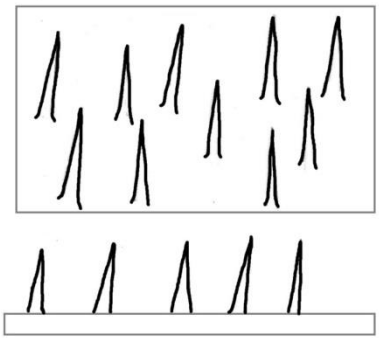
Muricate

Rough with short rounded protruberances



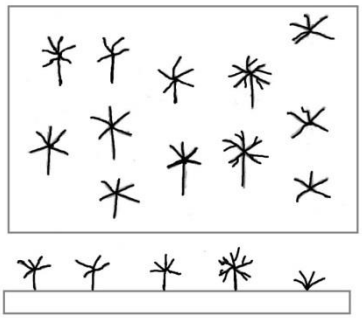
Scurfy/

Scaly or shredded like dry skin, or Coarsely Farinaceous



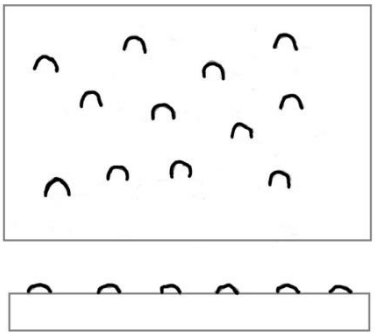
Setose/Bristly

Covered with setae or bristles



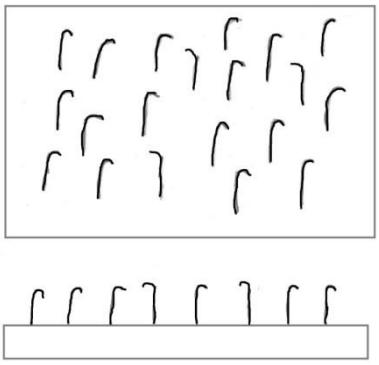
Stellate

Hairs that branch in a starlike manner



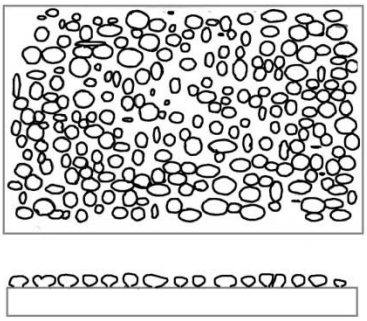
Tuberculate

Covered in small rounded raised growths



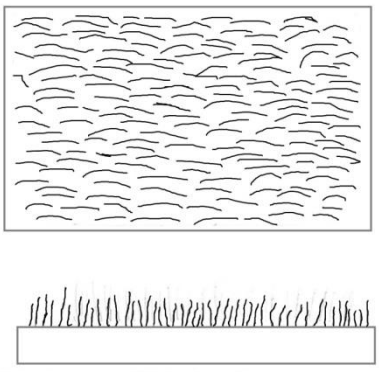
Uncinate

Covered in hook-like hairs



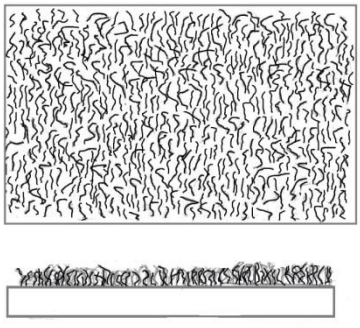
Vesciuculose

With bladder-like growths



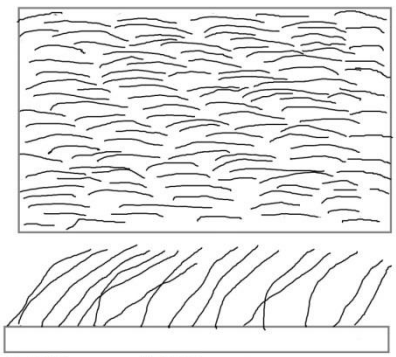
Velvety/ Velutinous

With fine, dense,straight, long and soft hairs



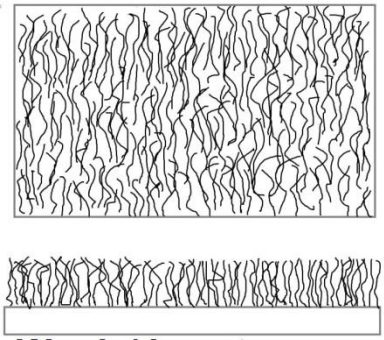
Tomentose

With matted, interwoven, soft, wooly hairs



Villous/Villose

With long, weak, soft hairs



Wooly/ Lanate

With long, dense, matted, curly, hairs

Figure 138 leaf indumentum

leaf gap A point in the stele or primary vascular cylinder at which the vascular supply to a leaf (leaf-trace) is attached. Feature of megaphylls (euphylls), absent in microphyll (lycopod leaves). It resembles a branch trace, perhaps indicative of the evolution of megaphylls from a branching system. The gap is filled with parenchyma tissue rather than vascular tissue – a break in the stele. See **telome theory**.

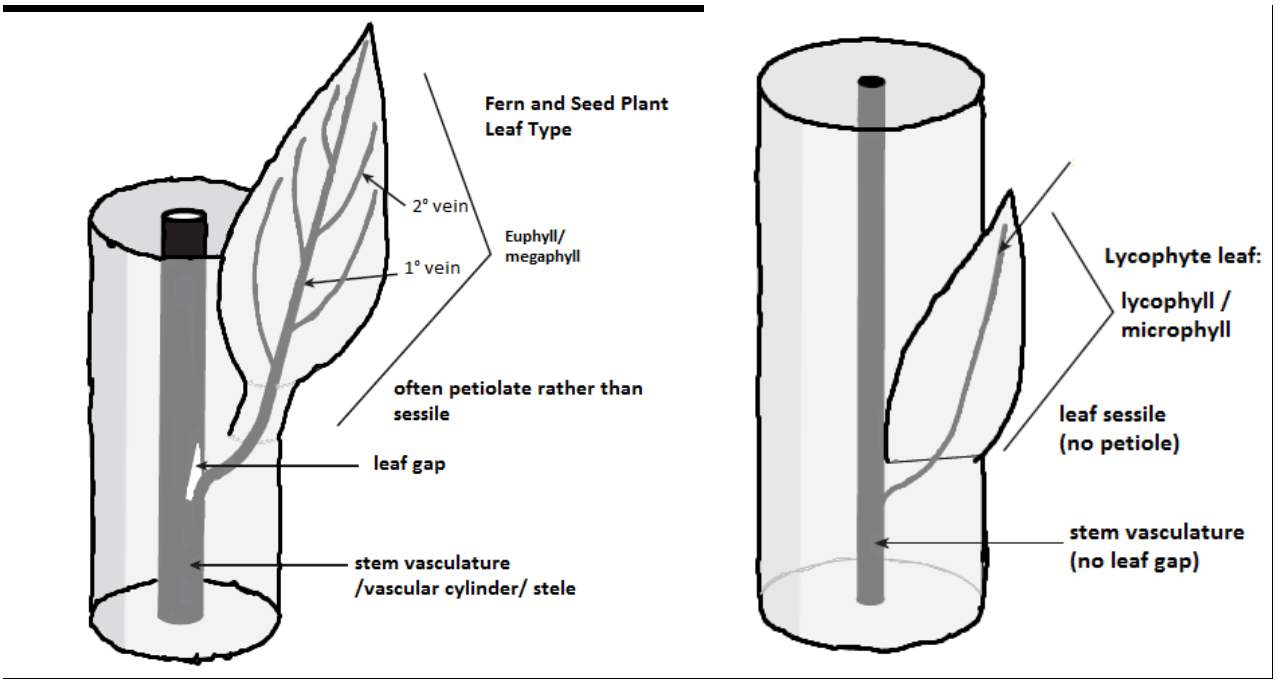


Figure 139 leaf gap

Leaf margin Margin refers to the side or boundary of an object, such as a leaf, bract sepal or petal. Terminolgy refers to the presence and morphology of teeth or lobes.

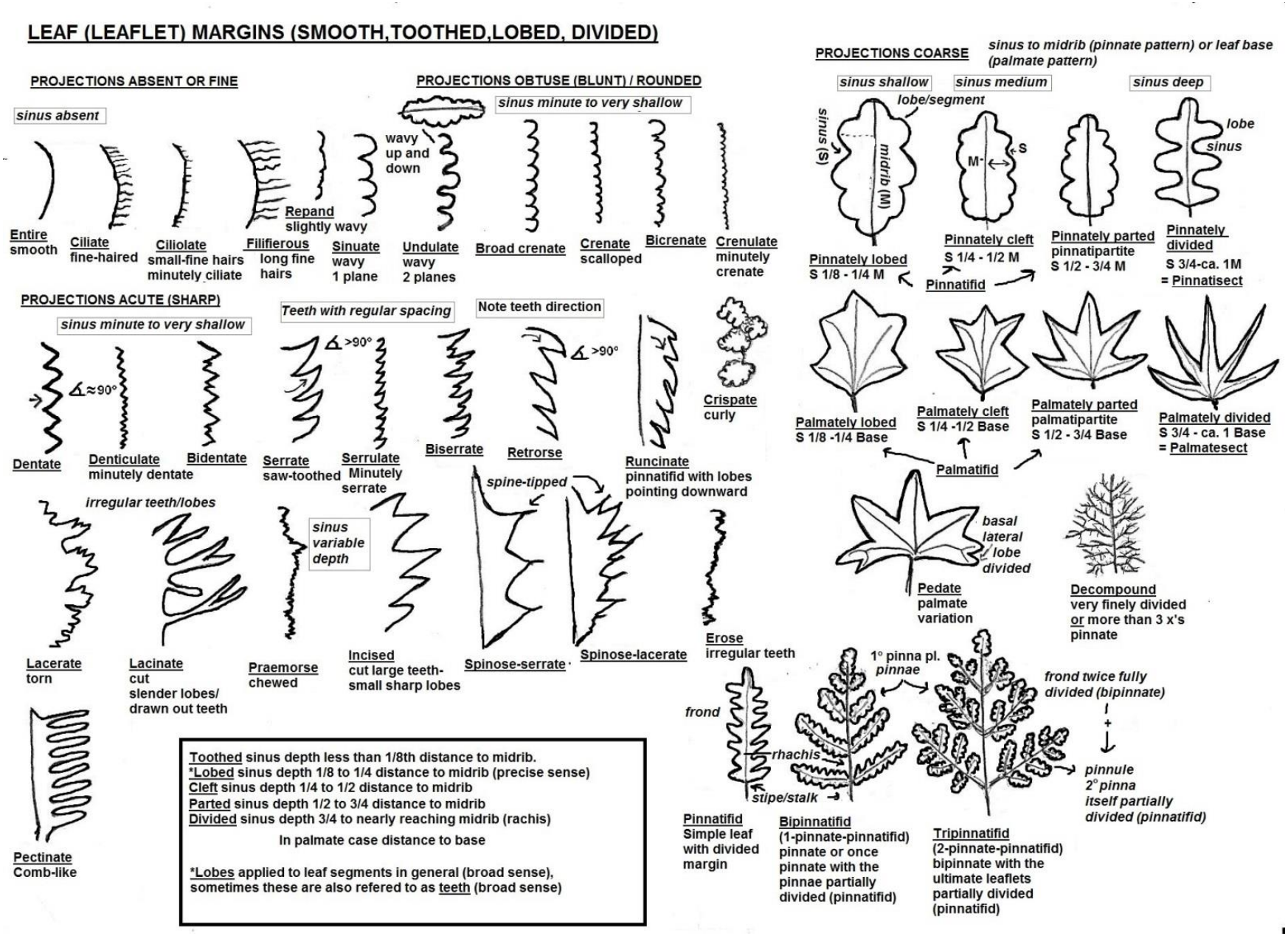
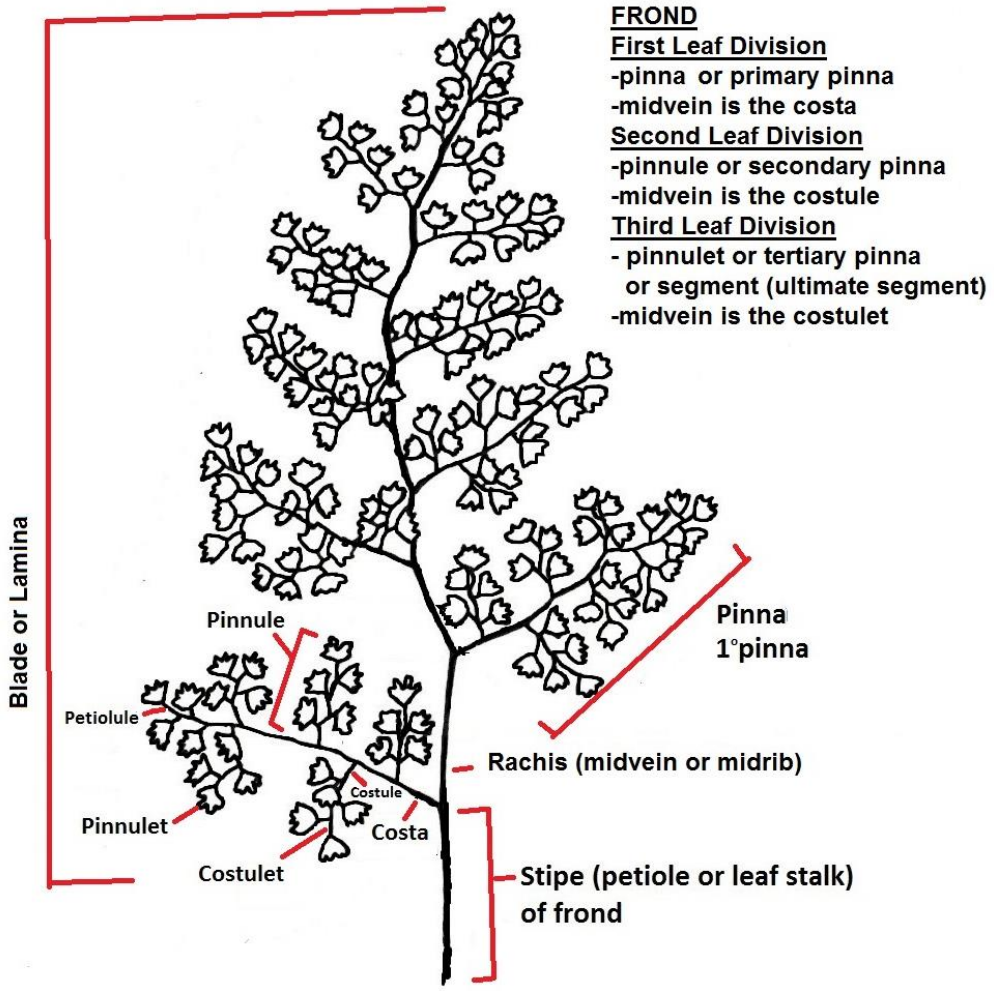


Figure 140 leaf margin



Maidenhair fern *Adiantum* spp. Frond tripinnate (3 x pinnate) or decompound (very compound)

Figure 141 frond division terms

Figure 142 pinnatifid leaf

Figure 143 pinnate leaf (1 x pinnate)

leaf primordium (leaf + L. neuter of *primordius* 'original', f. *primus,* first + *ordiri,* begin.) Embryonic stage of a leaf in the apical meristem.

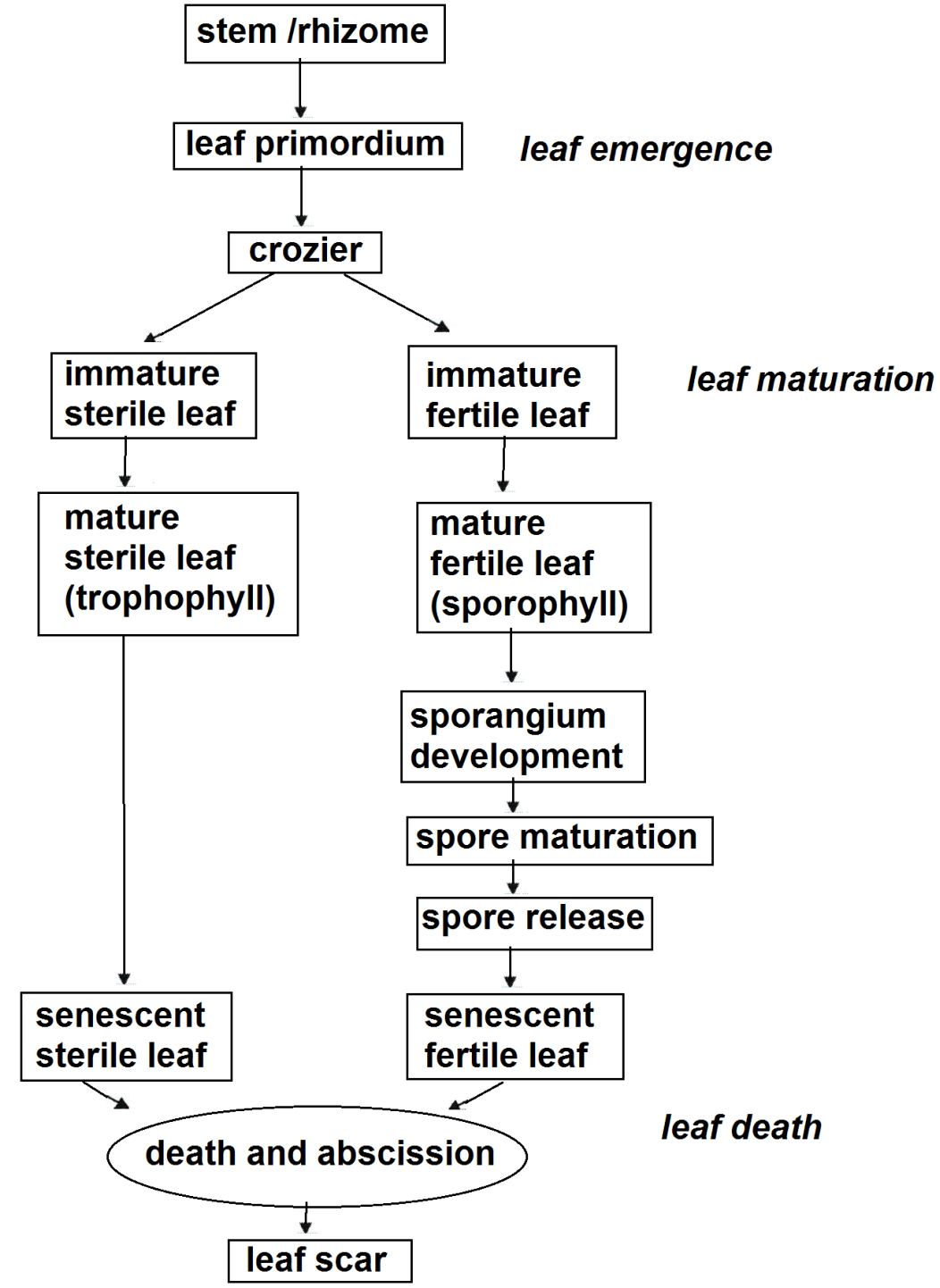


diagram showing life history stages of fern leaves dimorphic pattern, if monomorphic essentially same as for fertile leaf

Figure 144 fern leaf life history

leaf shape The terms for the names of simple symmetrical plane shapes have been standardized on a mathematical basis, based on the length to breadth ratio (l:b), whether the sides are curved or straight and parallel for some distance, or angular and the location of the widest part in relation to the latitudinal middle of the shape. There are also a number of special shape terms developed over the centuries. For a

compound leaf, shape is applied to an outline of the lamina. Leaflets or segments can be described by the same terms. **Leaf bases** and **apices**(**tips**) have their own terminology.

“Systematics Association Committee for Descriptive Biological Terminology. II. Terminology of Simple Symmetrical Plane Shapes (Chart 1).” Taxon, vol. 11, no. 5, 1962, pp. 145–156. JSTOR, www.jstor.org/stable/1216718.

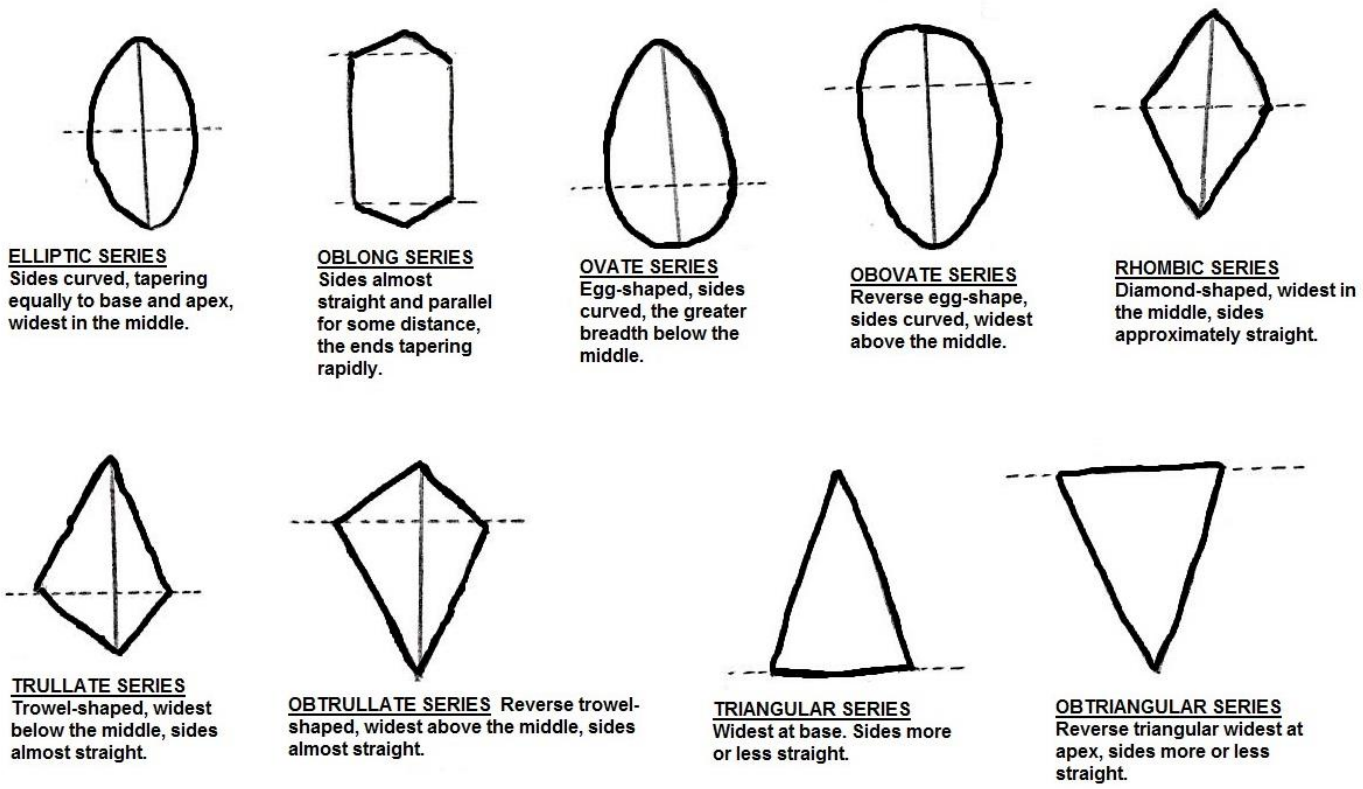


Figure 145 overview shapes

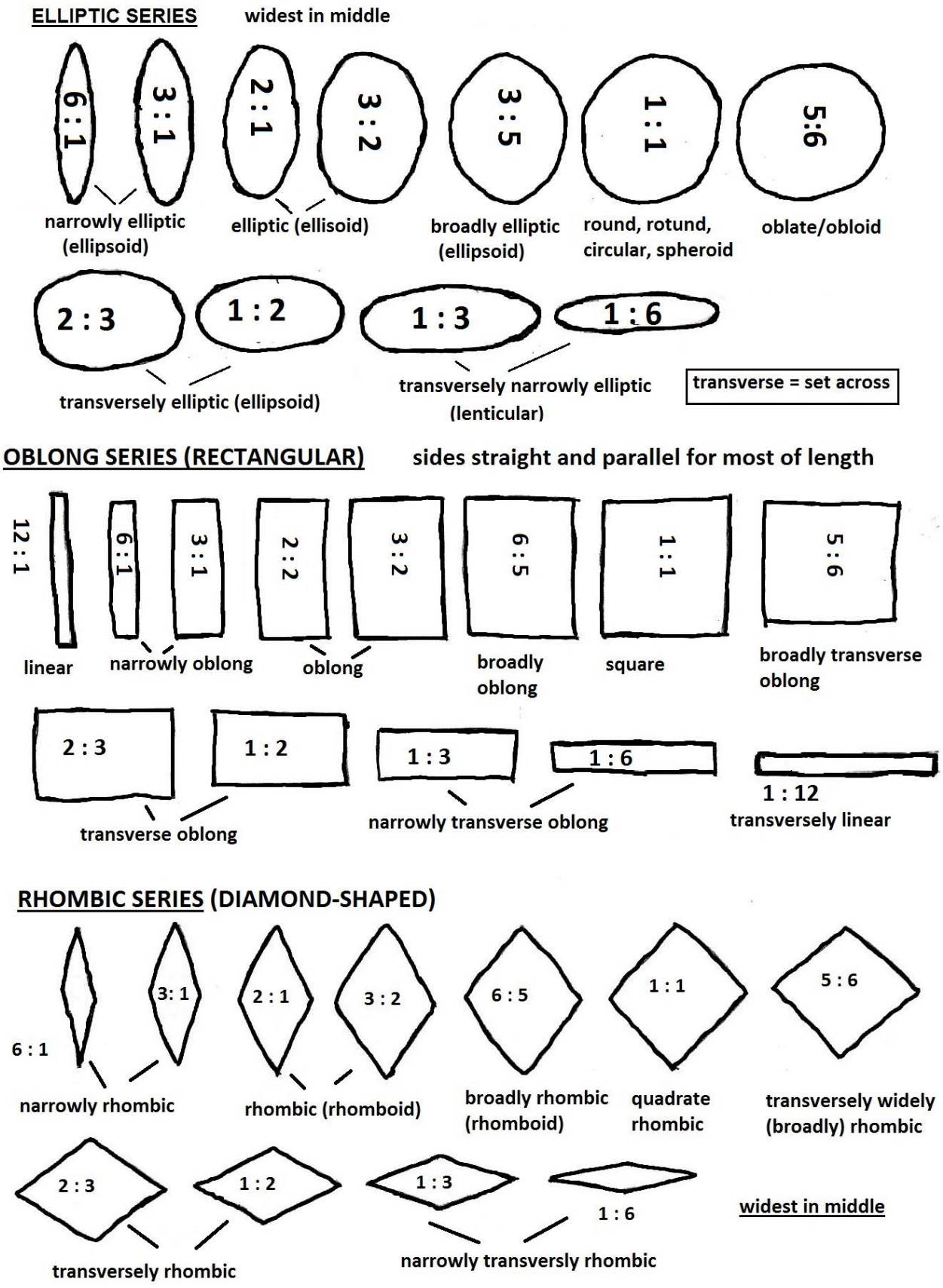

ELLIPTIC SERIES
widest in middle
6 : 1
3 : 1
narrowly elliptic (ellipsoid)
2 : 1
3 : 2
elliptic (ellisoid)
3 : 5
broadly elliptic (ellipsoid)
1 : 1
round, rotund, circular, spheroid
5:6
oblate/obloid
2 : 3
1 : 2
transversely elliptic (ellipsoid)
1 : 3
1 : 6
transversely narrowly elliptic (lenticular)
transverse = set across
OBLONG SERIES (RECTANGULAR)
sides straight and parallel for most of length
12 : 1
linear
6 : 1
3 : 1
narrowly oblong
2 : 2
oblong
3 : 2
6 : 5
broadly oblong
1 : 1
square
5 : 6
broadly transverse oblong
2 : 3
1 : 2
transverse oblong
1 : 3
1 : 6
narrowly transverse oblong
1 : 12
transversely linear
RHOMBIC SERIES (DIAMOND-SHAPED)
6 : 1
3: 1
narrowly rhombic
2 : 1
3 : 2
rhombic (rhomboid)
6 : 5
broadly rhombic (rhomboid)
1 : 1
quadrate rhombic
5 : 6
transversely widely (broadly) rhombic
2 : 3
1 : 2
transversely rhombic
1 : 3
1 : 6
narrowly transversly rhombic
widest in middle

Figure 146 elliptic, oblong and rhombic series of shapes

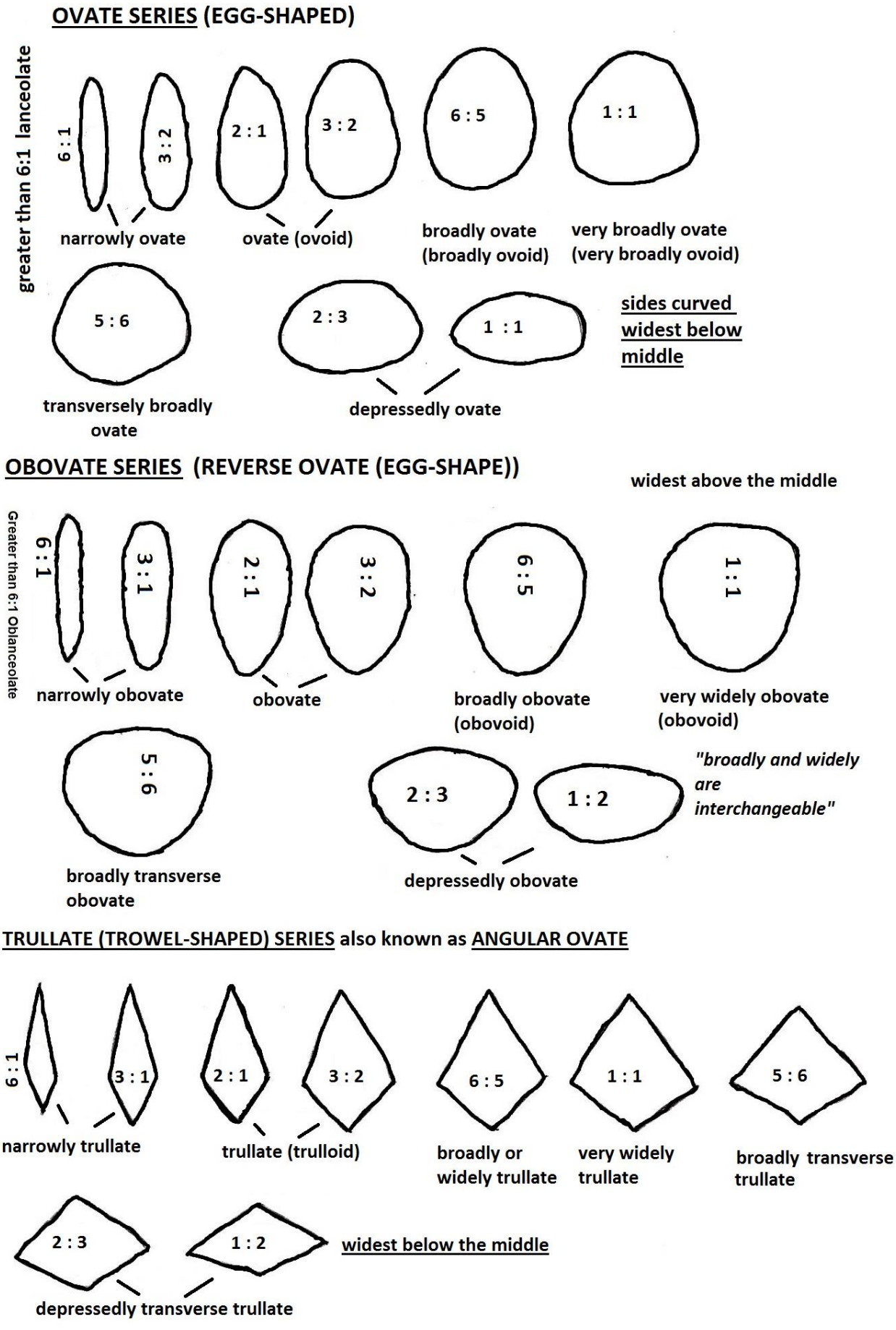


Figure 147 ovate,obovate and trullate series of shapes

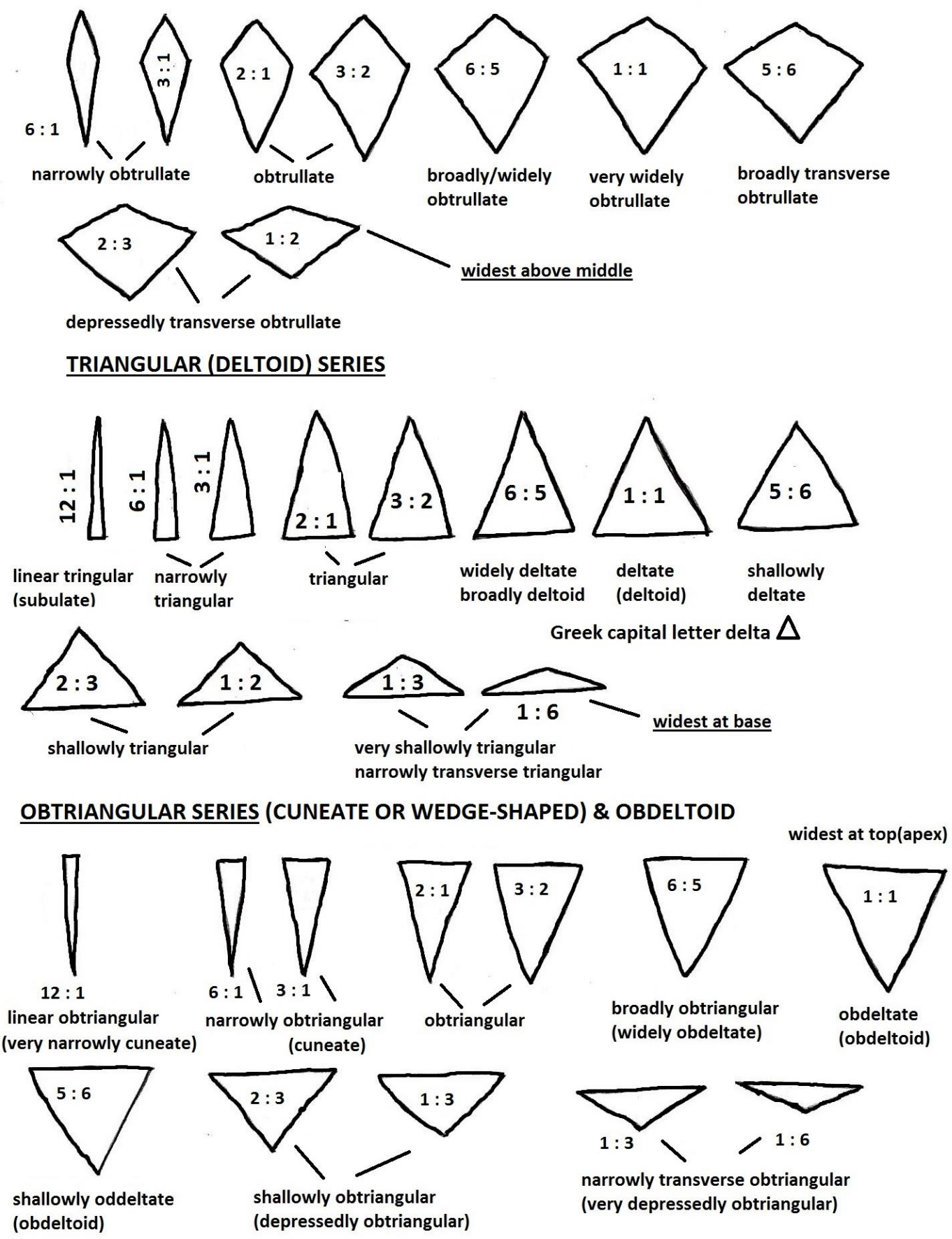


Figure 148 obtrullate, triangular and obtriangular series of shapes

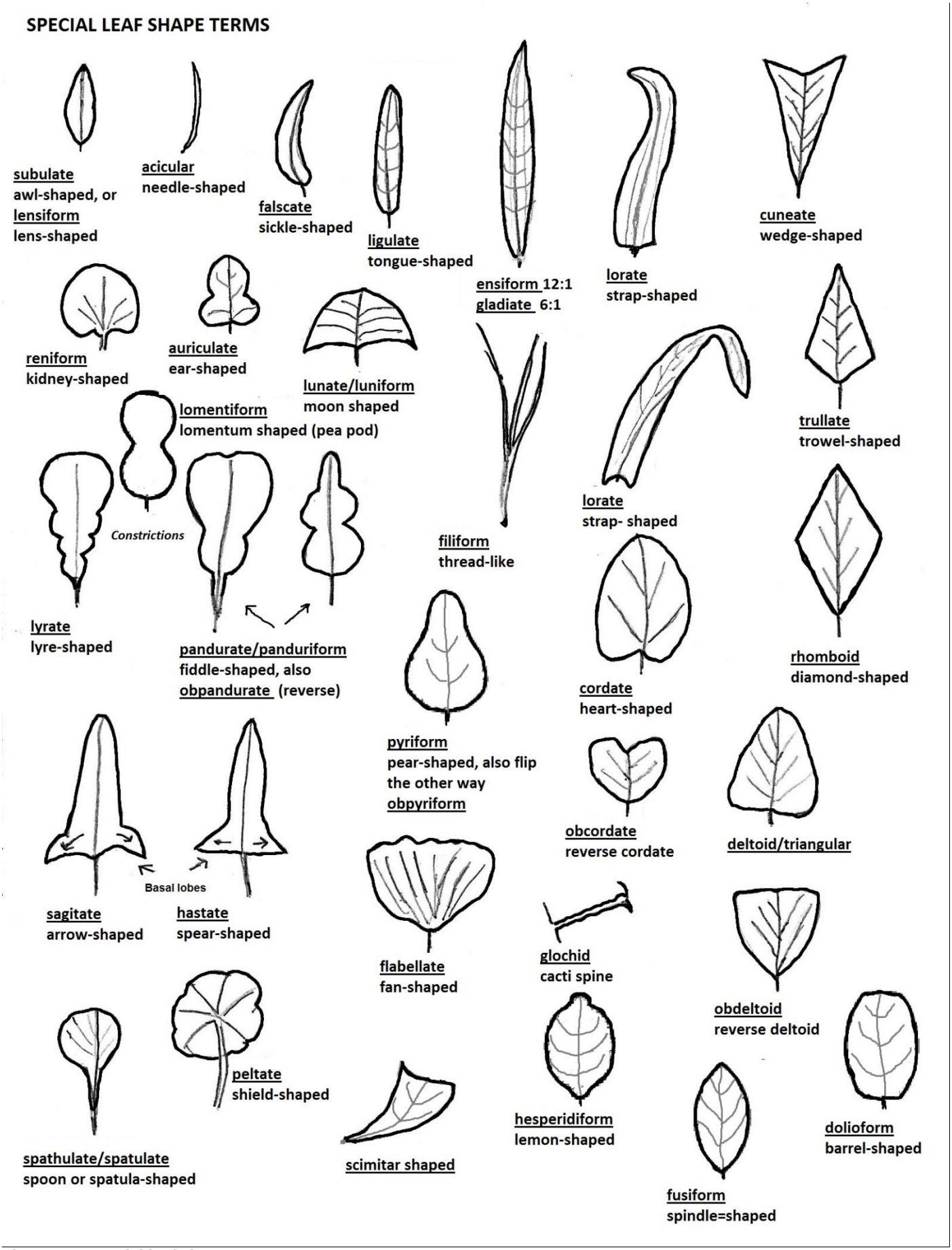


Figure 149 special leaf shape terms

Leaf size The petiole (stipe in ferns) and the lamina (leaf blade) are measured seperately. Both length and width measurements are taken, with width measured at the widest part of the blade. In a pinnately compound leaf, the length measurement would be taken from the leaf base, where the basal pinnae attach to the stipe and the rachis begins then to the leaf tip(apex) –end of terminal leaflet. See also **laminar size**.

Leaf transverse posture

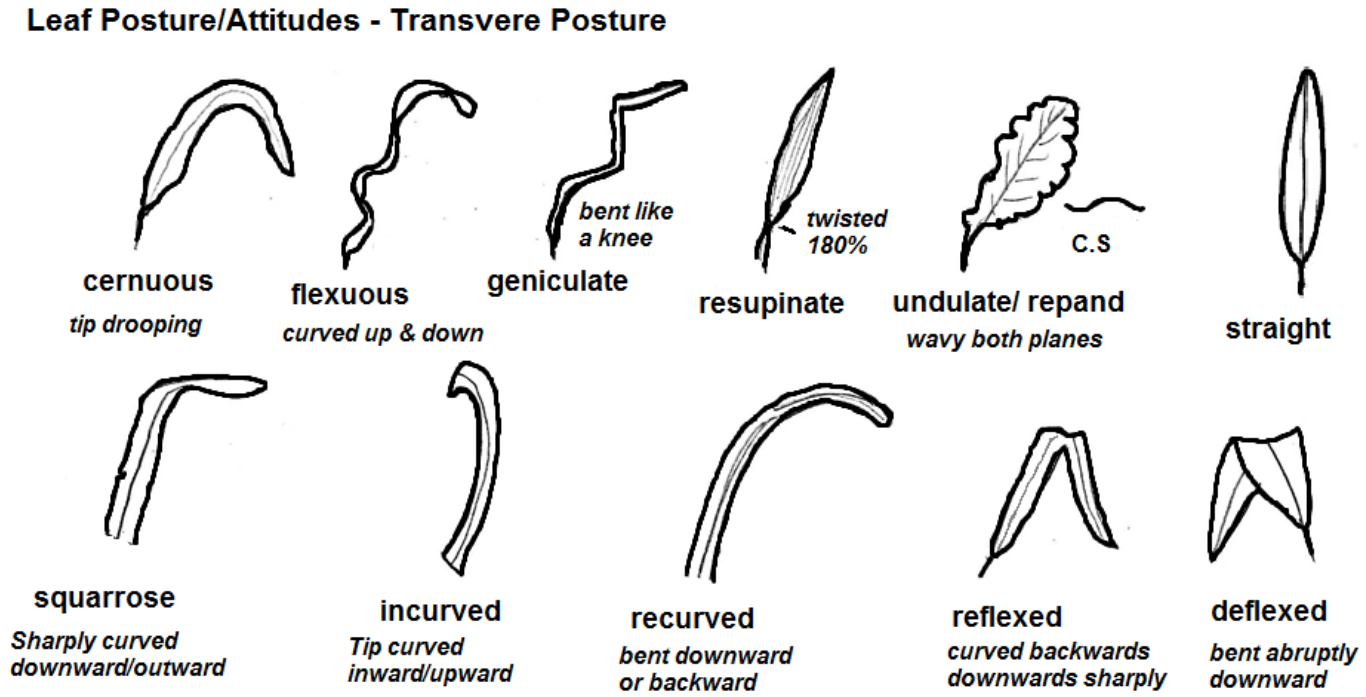


Figure 150 leaf transverse posture terms

Leaf or leaflet spacing (scales and **hairs** also**)** The following terms can be applied: **approximate**, **close** or **close-set, confluent, connivent**, **congested**,**contiguous, distant**,**imbricate** (overlapping like tiles), **remote**, **widely spaced** .

leaflet (Diminutive of leaf) The distinct and seperate segment of a compound leaf. Where the leaf blade (lamina) is completely divided to the midrib and seperated by a length of midrib from similar segments .In ferns with pinnate leaf arrangement, the leaflet is called a **pinna** pl. **pinnae**. Sometimes called a **frondlet**.

leaf-trace The vascular bundle that runs from the stele (vascular cylinder) to the petiole (stipe in ferns).

leathery Tough, thick and opaque.Synonym **Coriaceous**.

lensiform (L. *lens*, f. *lentil* in shape +*form* –shape) Lens shaped, awl shaped or subulate.

lenticular (L. *lens*, f. *lentil* in shape) Shaped like a biconvex lens.

lepidote (Gr. *lepidotos* , covered with scales, f. *lepis* , scale or flake) Furnished with small, scurfy scales.*Asplenium lepidotum*

lepto- (Gr- *leptos*, thin) Thin. *Anogramma leptophylla*. Opposite *crassus* thick.

Leptosporangiatae The clade of ferns with **leptosporangia**, also known as the **Polpodiopsida/ Filicopsida** or **Filicales**. The bulk of ferns species belong here. Contrast **eusporangiate** ferns.

leptosporangiate pl. **leptosporangia** (Gr. *leptos,* thin + sporangium). With each sporangium, originating from a single initial cell, and the sporangial wall consisting of a single layer of cells.The sporangium has an **annulus** and **stomium**. Compare **eusporangiate**. Leptosporangiate ferns form a clade which differs from

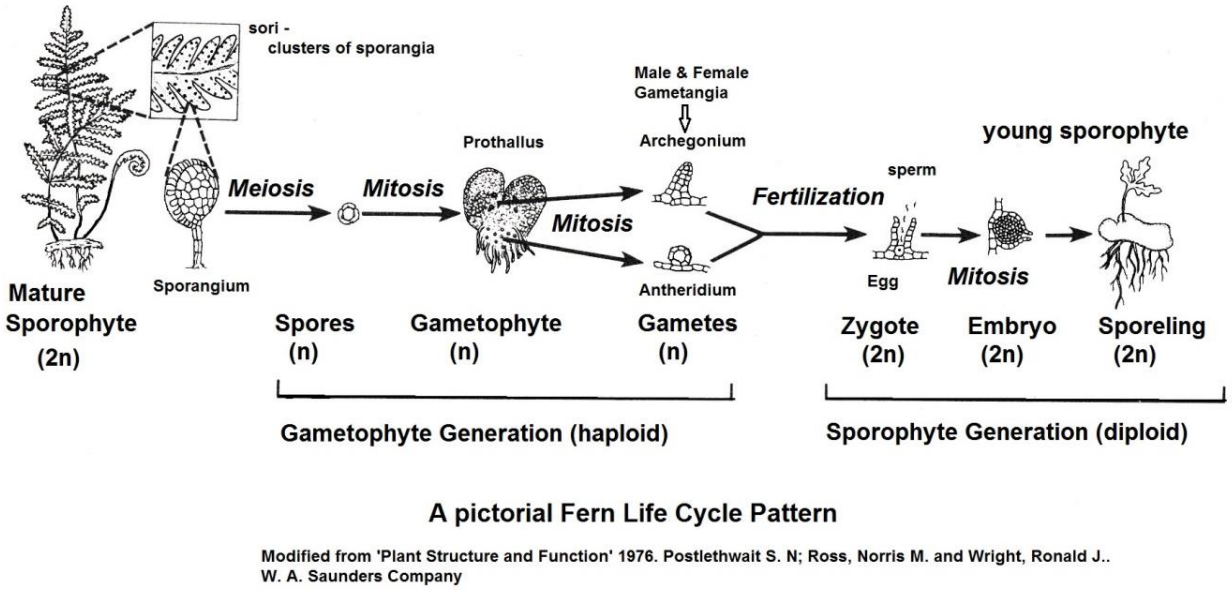
the eusporangiate ferns. The bulk of ferns are leptosporangiate comprising the order Polypodiopsida or Leptosporangiatae (or Filicopsida or Filicales).. Seed plants, Psilopsida (ferns), Marattiopsida (ferns), horsetails and Lycophytes have the eusporangiate condition. The leptosporangia is an **apomorphy** – a derived condition or character state representing an evolutionary novelty for this group of ferns.

liane (French *liane* f. *lier*, to bind) A woody climbing plant. As ferns are technically non-woody, climbing ferns are simply climbers.

life cycle The stages in the life of ferns and lycophytes, from spore, gametophyte, gametes, zygote and sporophyte and back to spore again. In these plants the gametophyte and sporophyte plants are mostly independent plants (contrast the 'bryophytes' where the sporophyte is dependent on the gametophyte and seed plants or spermatophytes, where the gametophyte is dependent on the sporophyte). This cycle is known as the alternation of generations – a gametophye and sporophyte generation.

The spore represents the start of the gametophyte generation and the zygote (fertilized egg) the start of the sporophyte generation.The life cycles in the "Pteridophyte" plants have a broad similarity, the main contrast is between homosporous (with ectospory) and heterosporous (with endospory) plants. Vegetative or asexual reproduction in certain ferns and lycophytes reproduces clonaly the sporophyte or gametophyte (less commonly) generation.

I have followed the example of David Jones "Encyclopedia of Ferns" of including diagrams of representative examples from different clades of lycophytes and ferns, this way you can see the similarities and differences between them. Approximately following evolutionary order.



A pictorial Fern Life Cycle Pattern

Modified from 'Plant Structure and Function' 1976. Postlethwait S. N; Ross, Norris M. and Wright, Ronald J.. W. A. Saunders Company

Figure 151 General fern life cycle

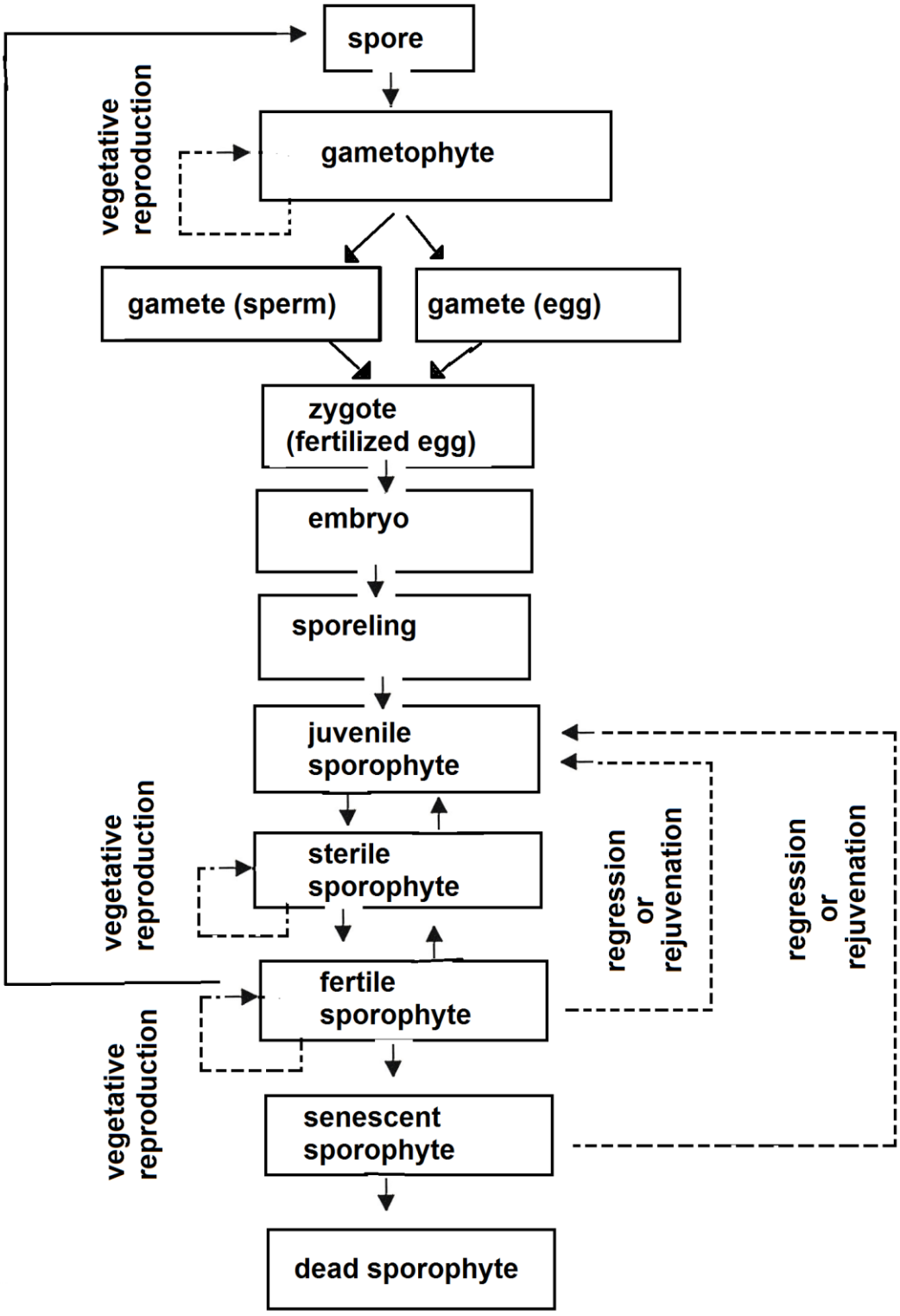
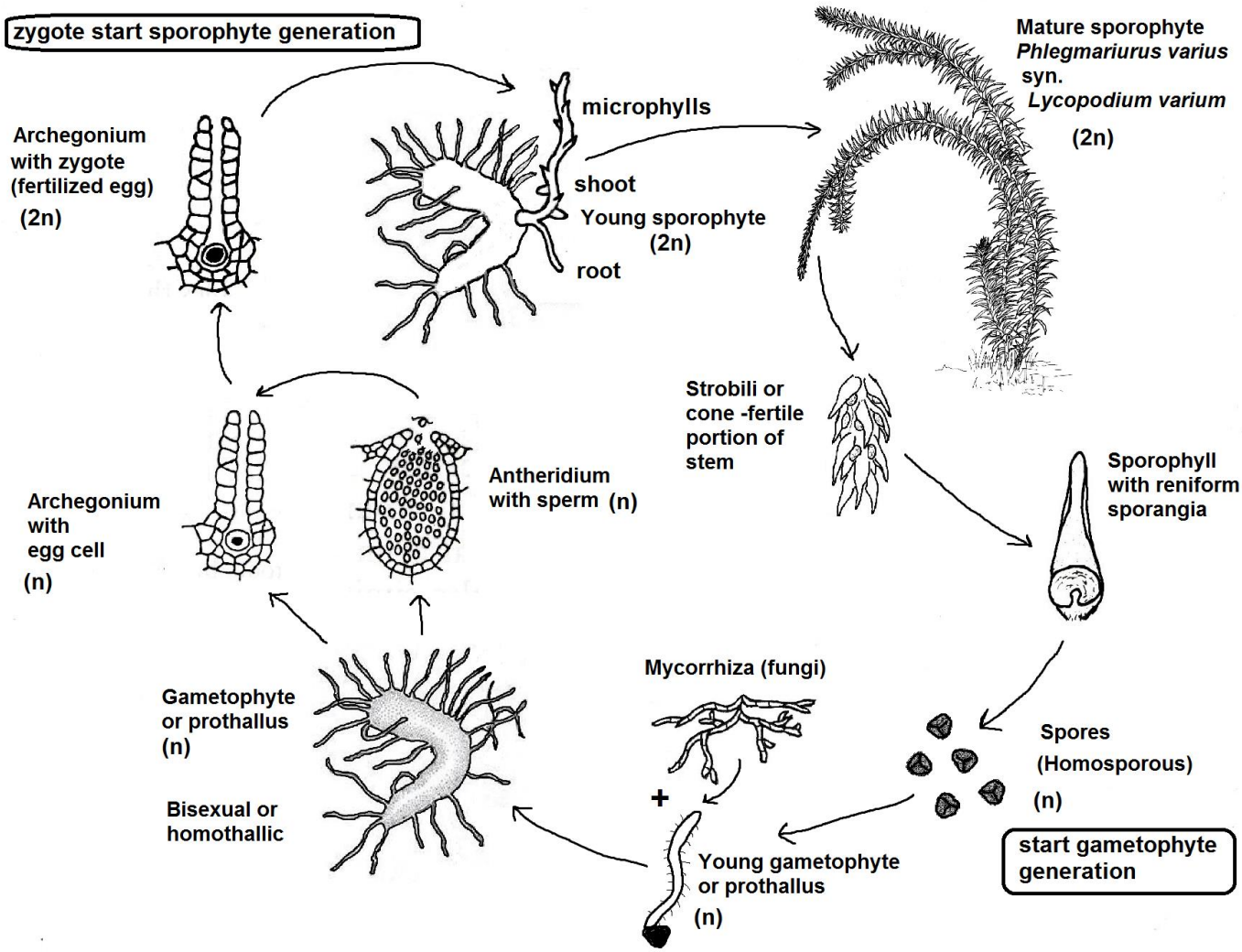
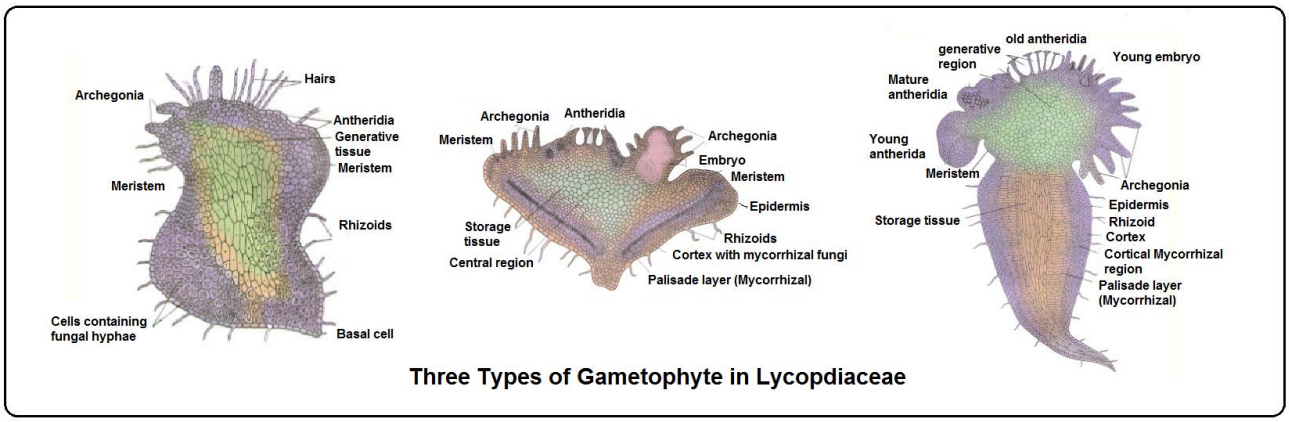


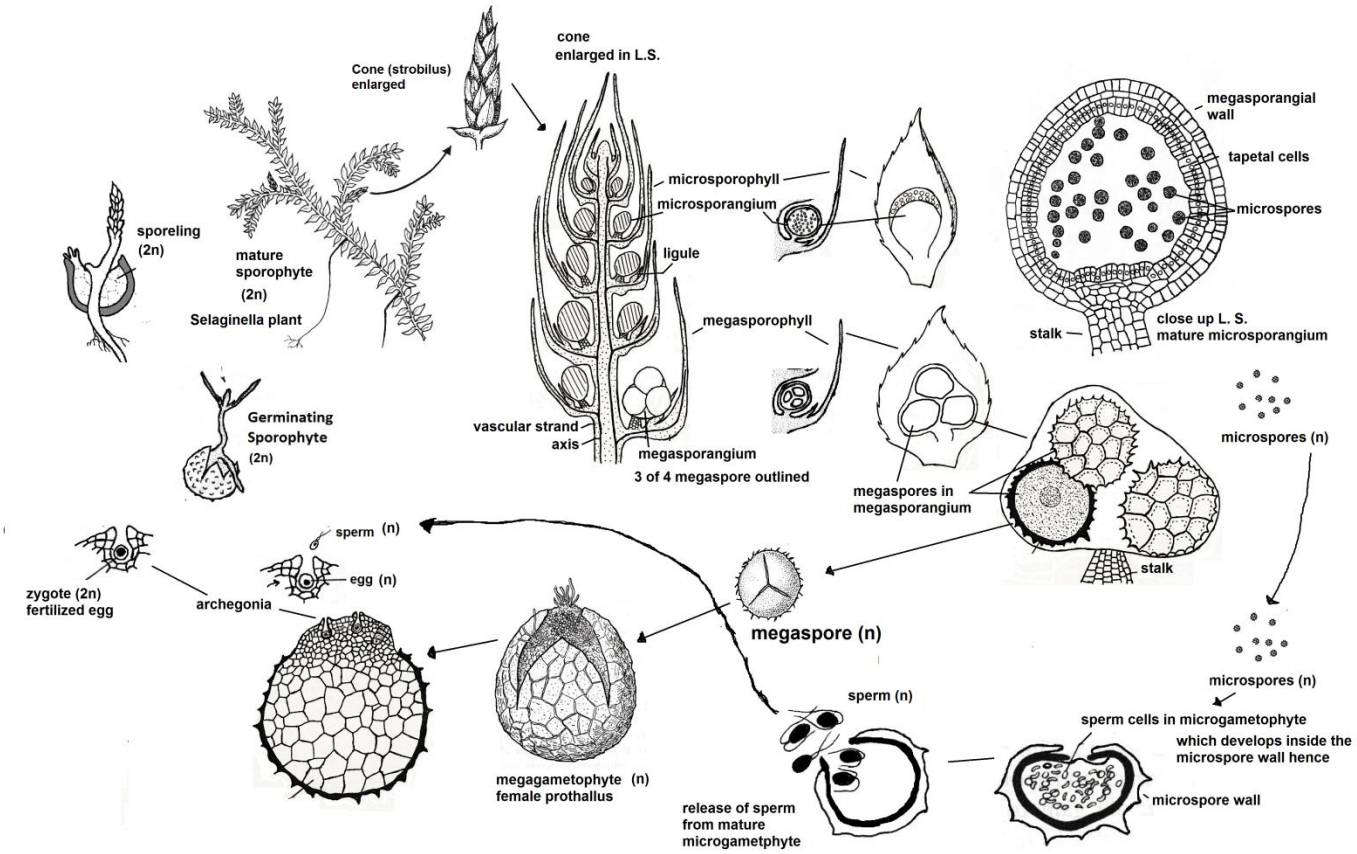
Figure 152 stages in the life history of a fern or lycophyte





Genus *Lycopdium* & allied genera Lycopdiophyta (lycophytes) Lycopodiales, family Lycopdiaceae

Figure 153 life cycle Lycopodiaceae



Life Cycle of *Selaginella*

Lycopodiophyta (lycophytes), Isoetales (oldername Glossopsida - from the ligula (glossa) family Selaginaceae

Modified from various sources.

Figure 154 life cycle *Selaginella*

The Life Cycles of *Lycopodium*, a Homosporous clubmoss and *Selaginella*, which is Heterosporous

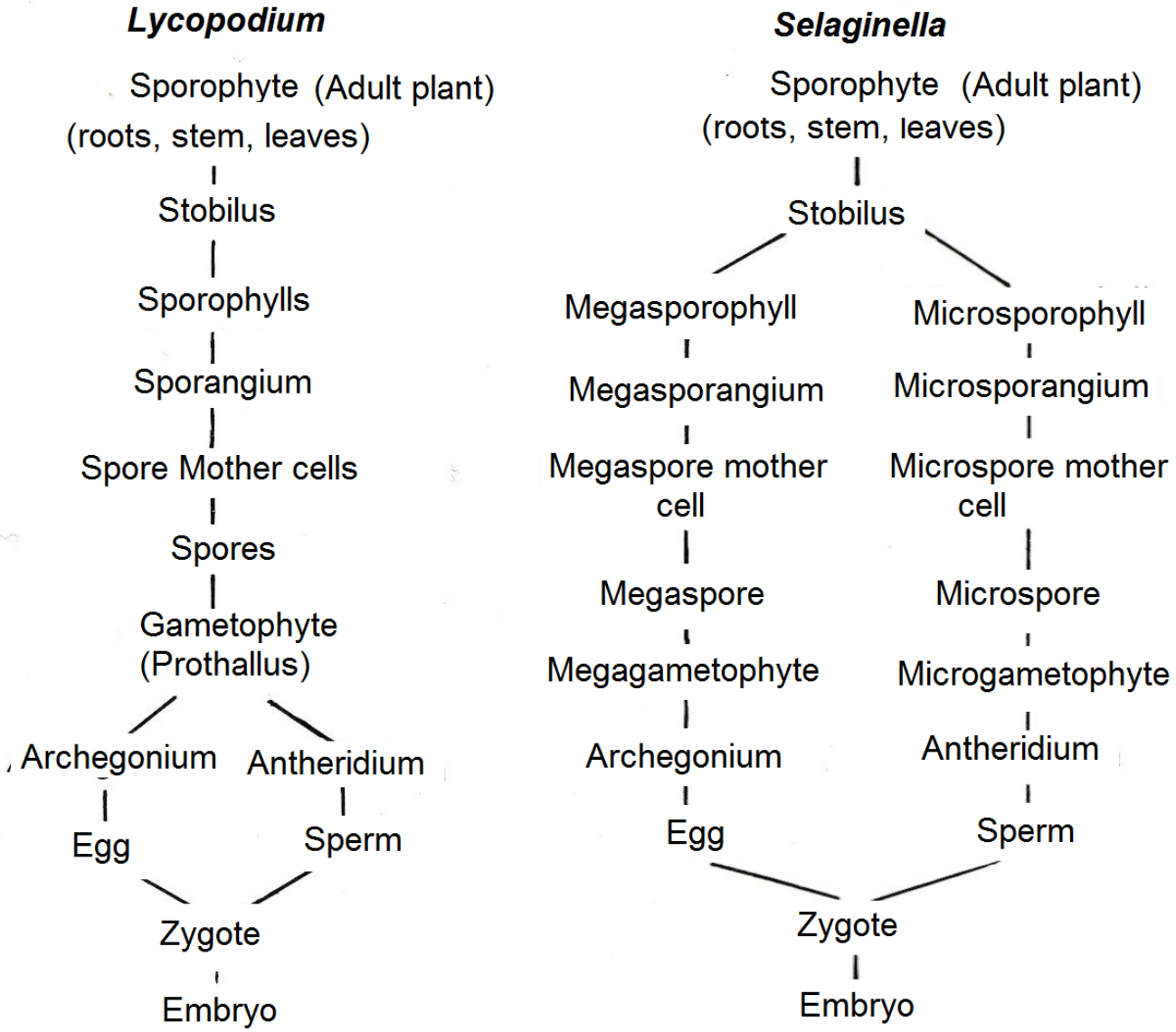


Figure 155 Life cycles of *Lycopodium* and *Selaginella* compared

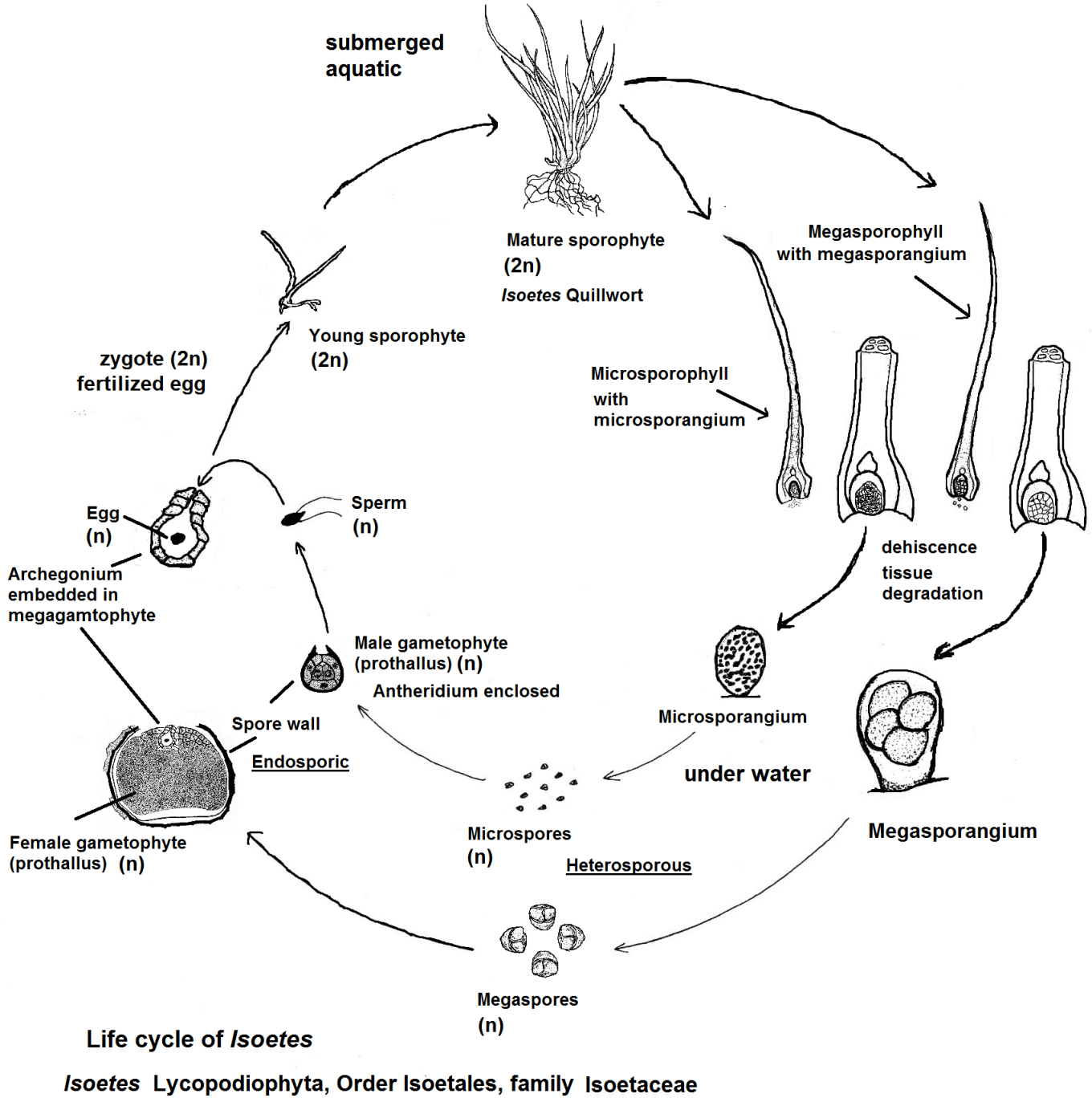


Figure 156 life cycle *Isoetes*

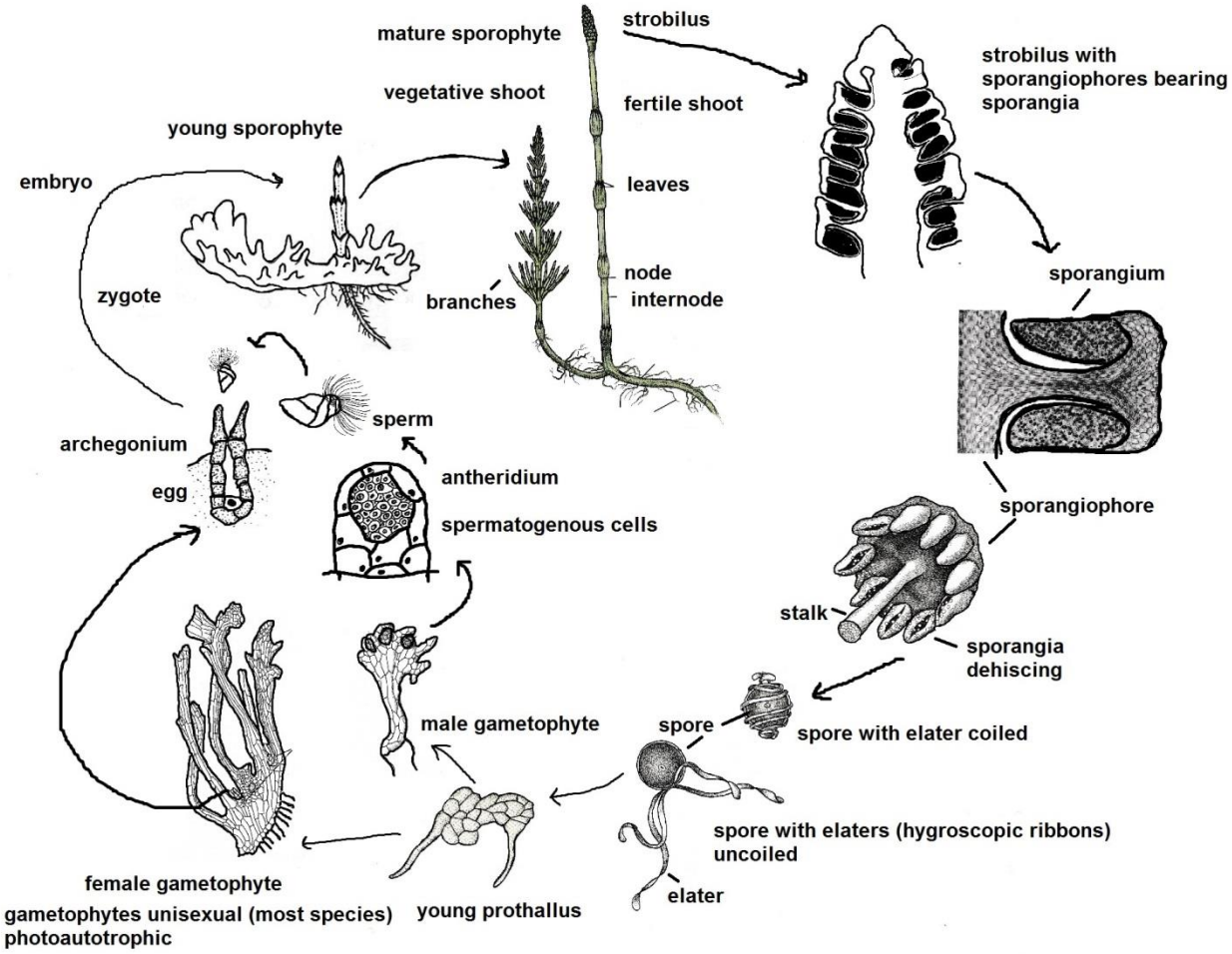
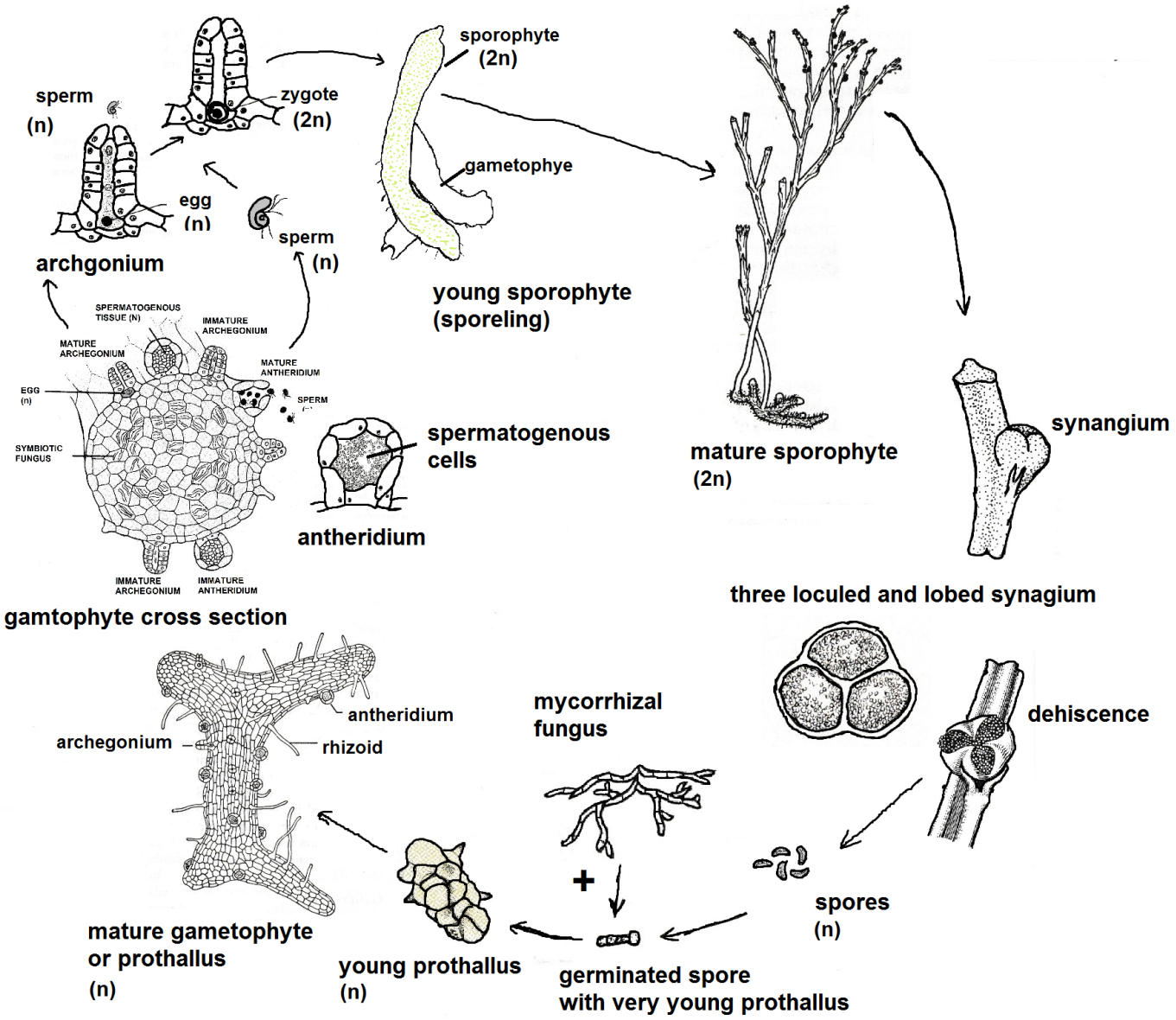


Figure 157 life cycle *Equisetum*



Life cycle of *Psilotum* whisk fern

Euphyllophyta, Monilophyta (ferns), Psilopsida, order Psilotales, family Psilotaceae

Figure 158 life cycle *Psilotum*

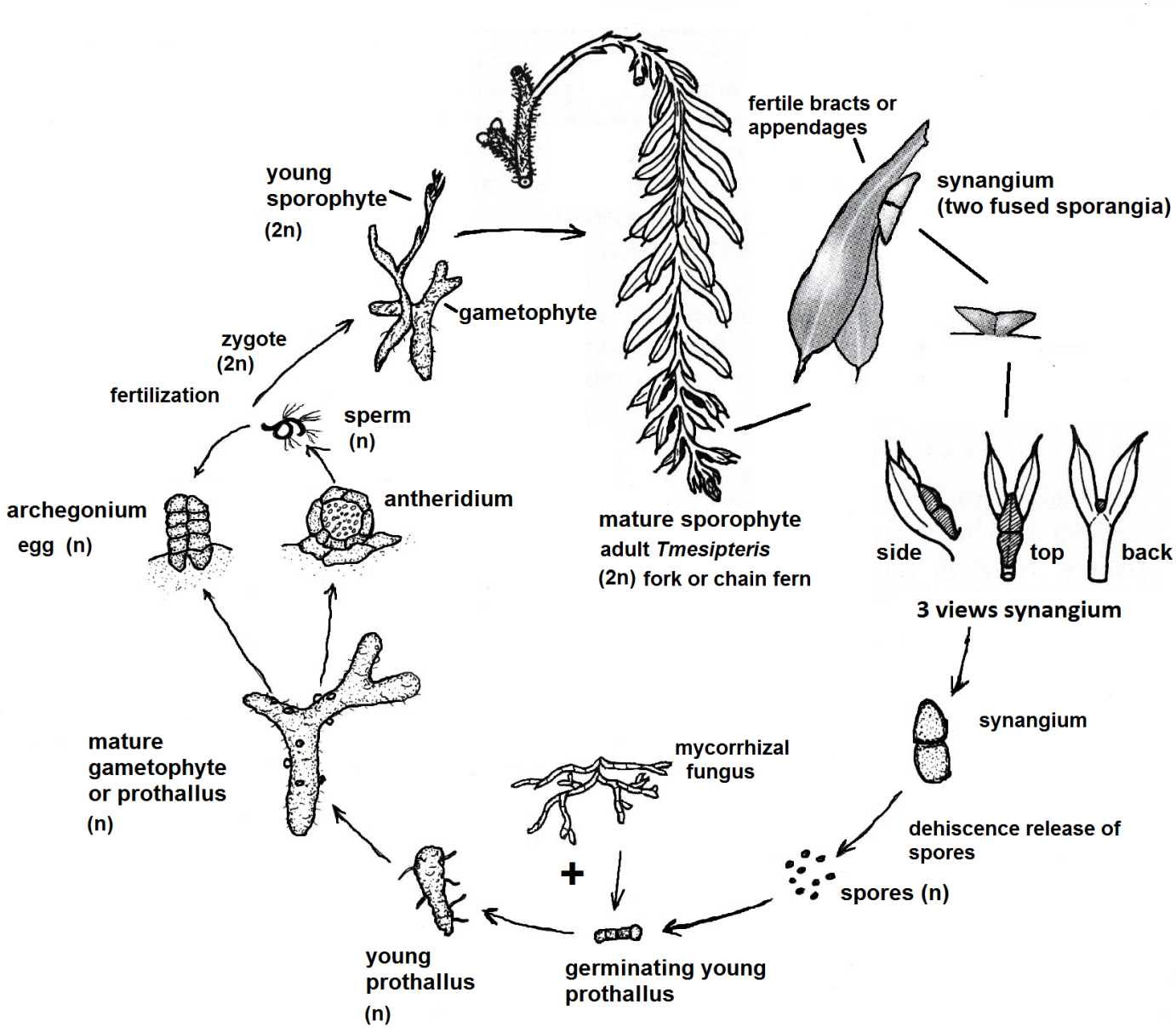
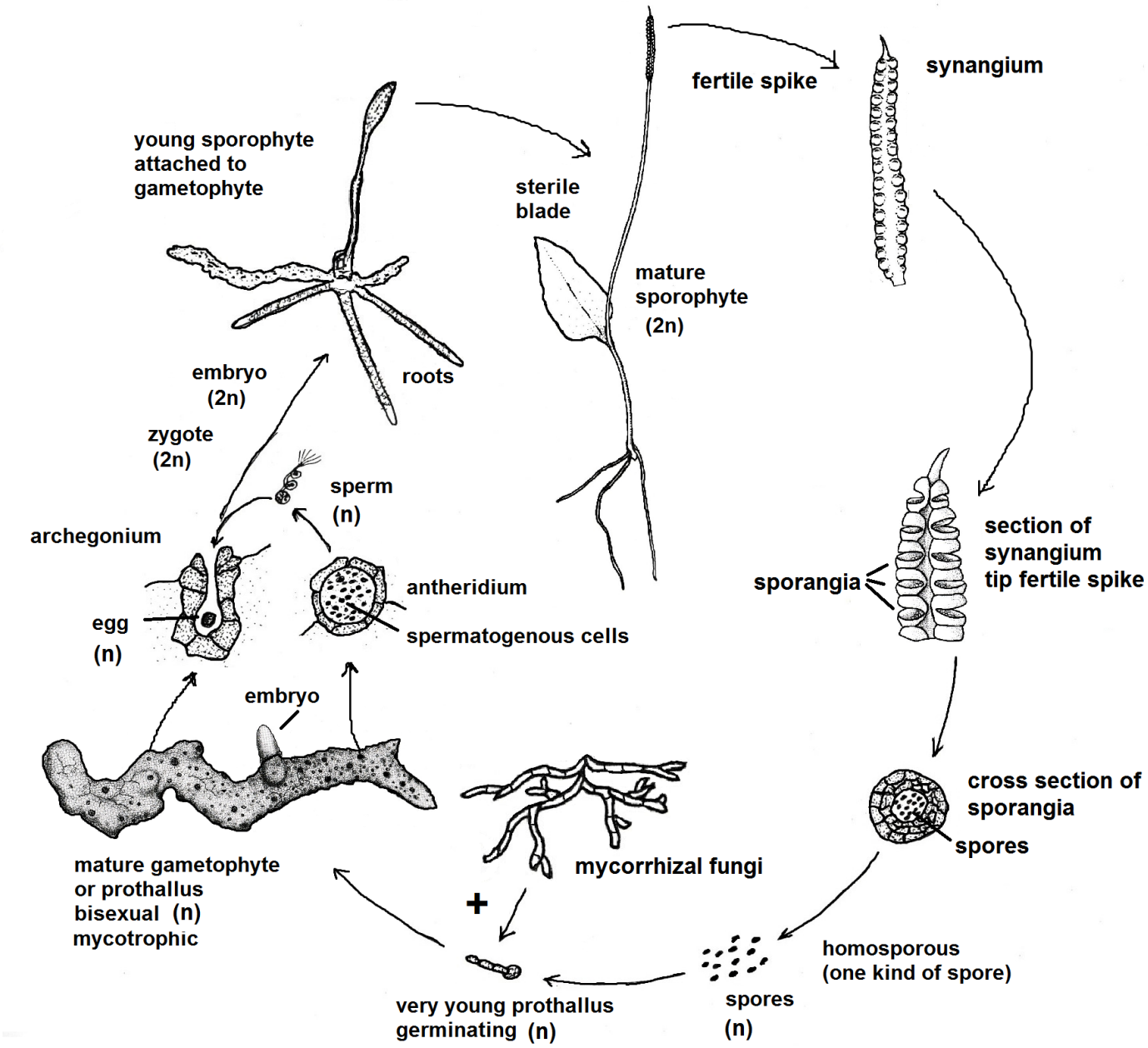


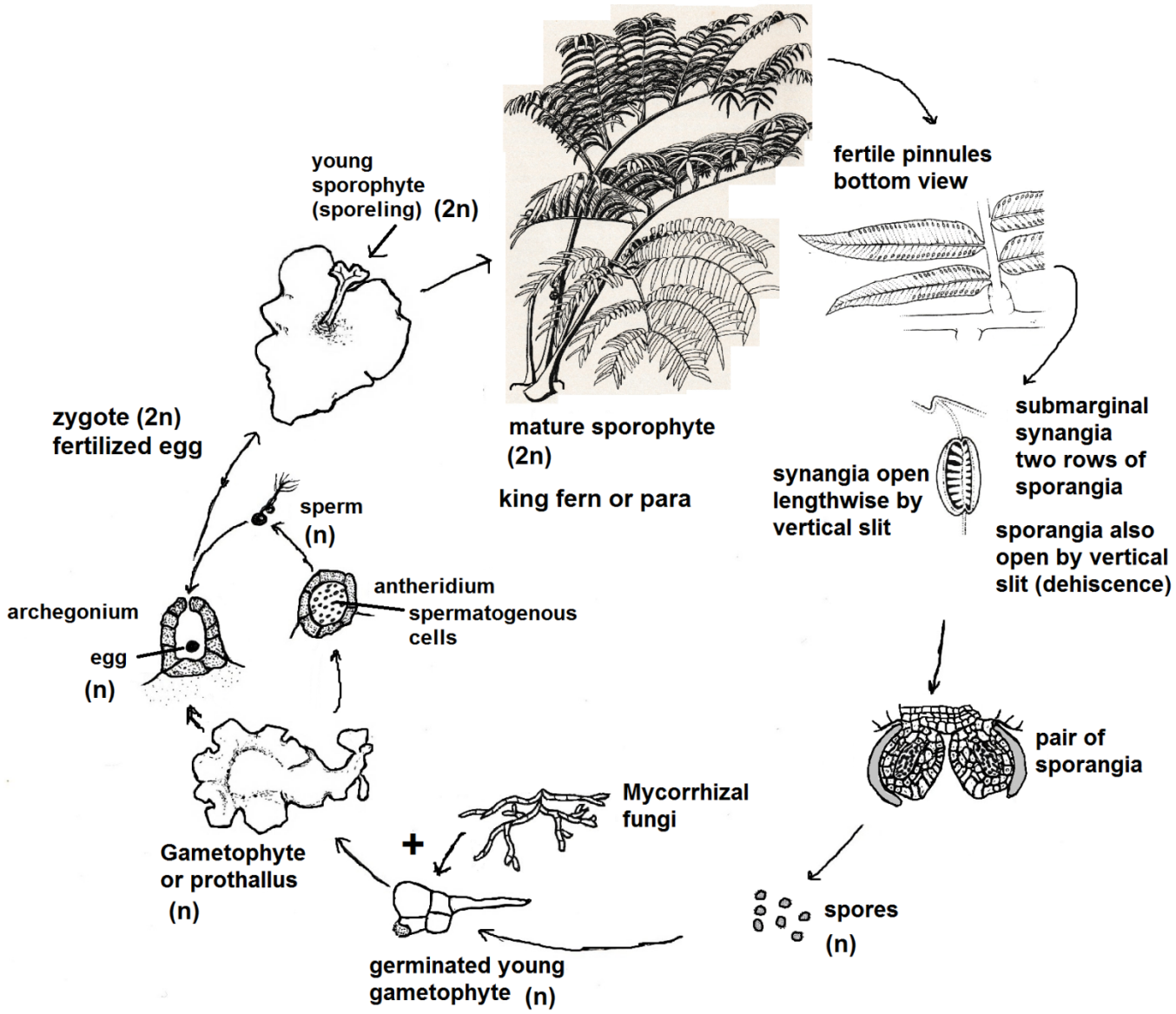
Figure 159 Life cycle *Tmesipteris*



Life cycle of *Ophioglossum*

Euphyllophyta, Monilophyta (ferns), Psilopsida,order Ophioglossales, family Ophioglossaceae

Figure 160 life cycle *Ophioglossum*



Life cycle of *Ptisana salicina* syn. *Marattia salicina*

Euphyllophyta, Monilophyta (ferns), Marattiopsida (Marattoid ferns), family Marattiaceae
A eusporangiate fern family.

Figure 161 Life cycle *Ptisana (Marattia*)

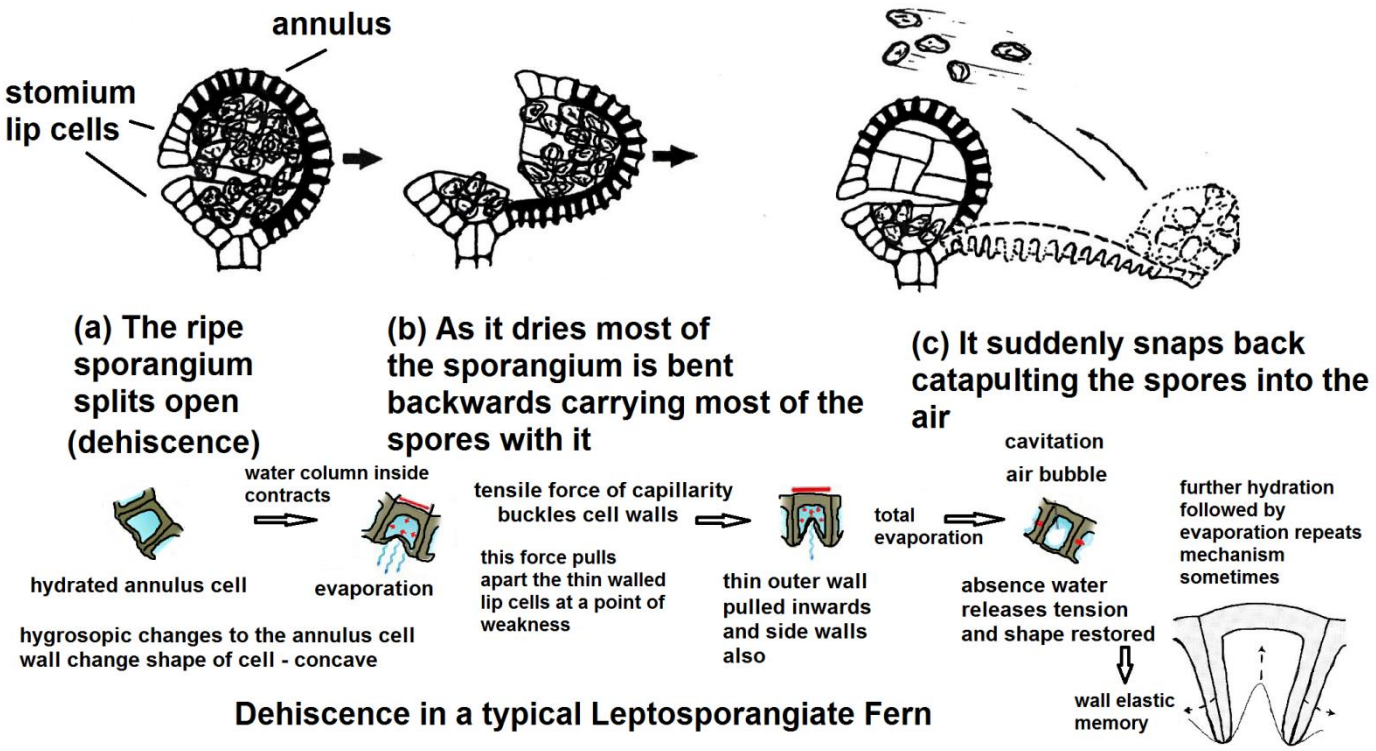


Figure 162 Leptosporangiate dehiscence

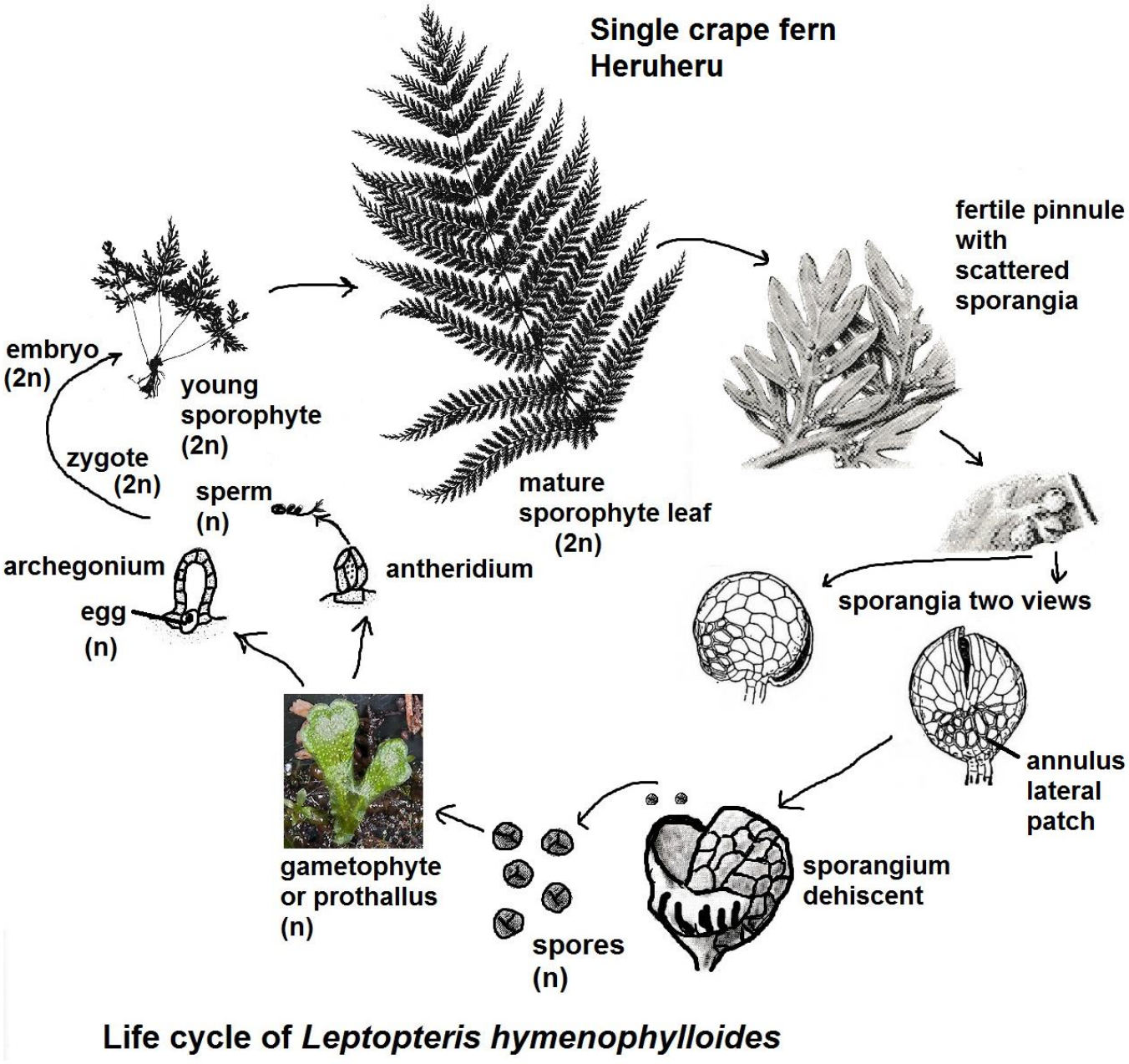


Figure 163 life cycle *Leptopteris* (Osmundaceae)

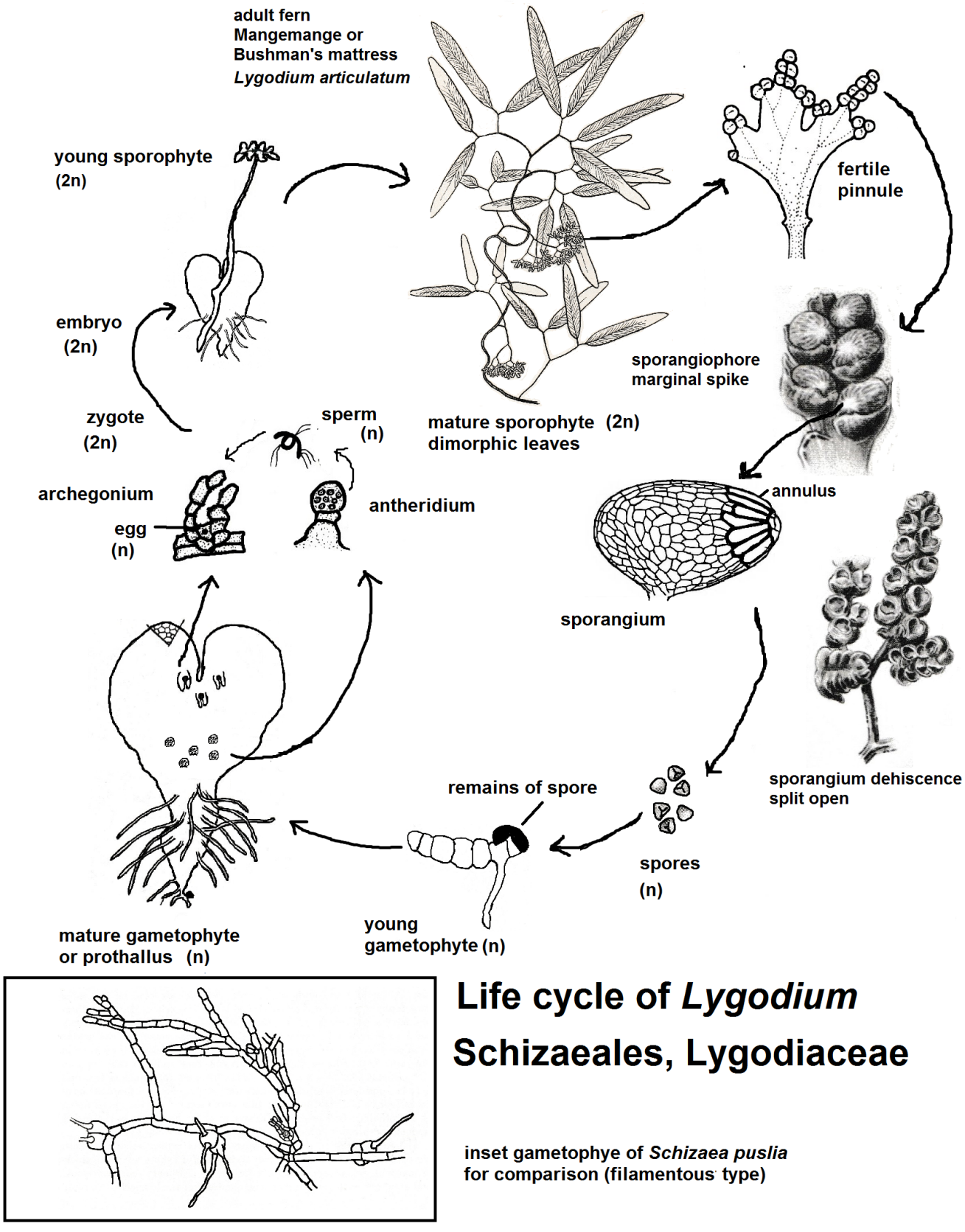


Figure 164 Life cycle *Lygodium* (Schizaeales)

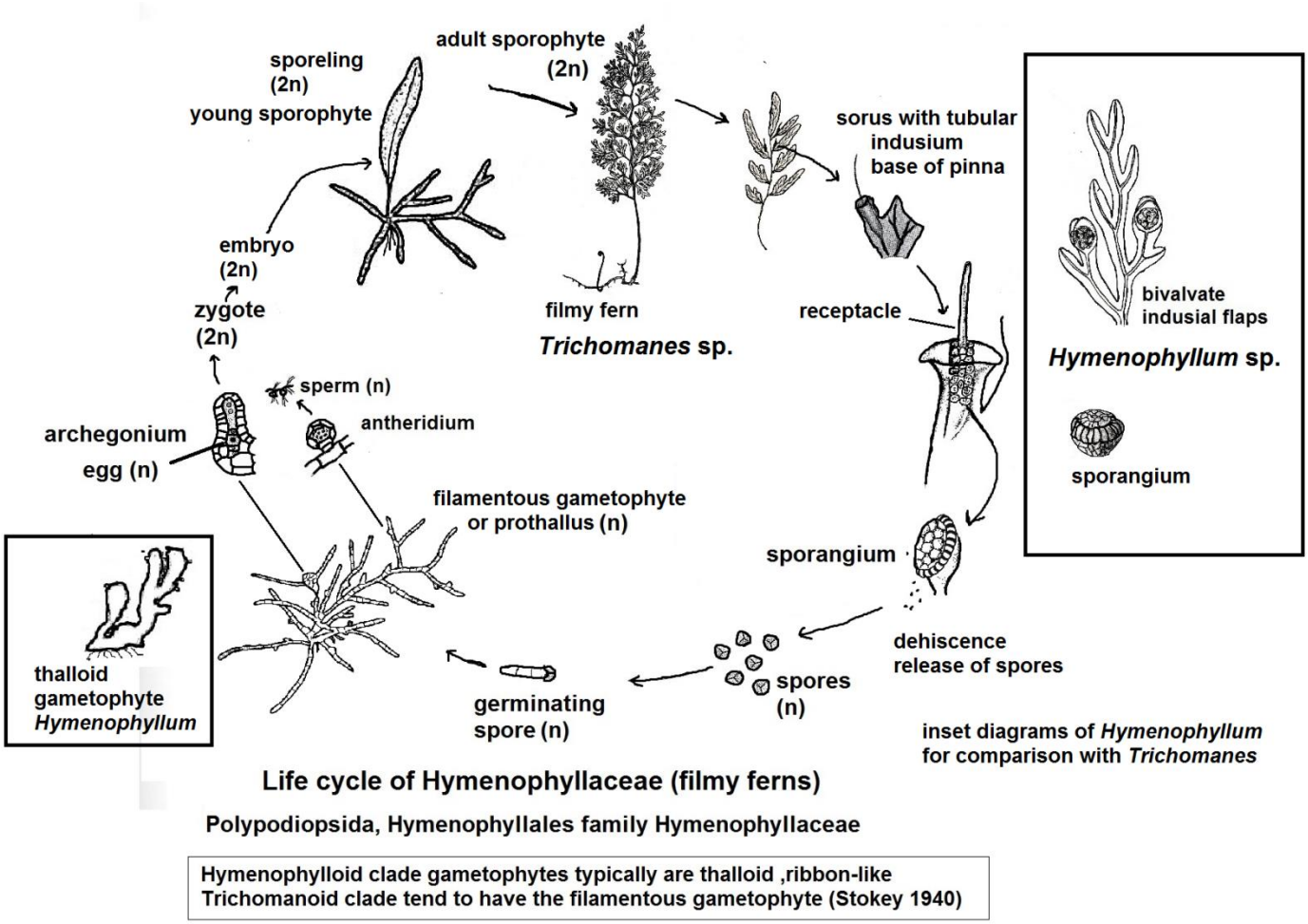
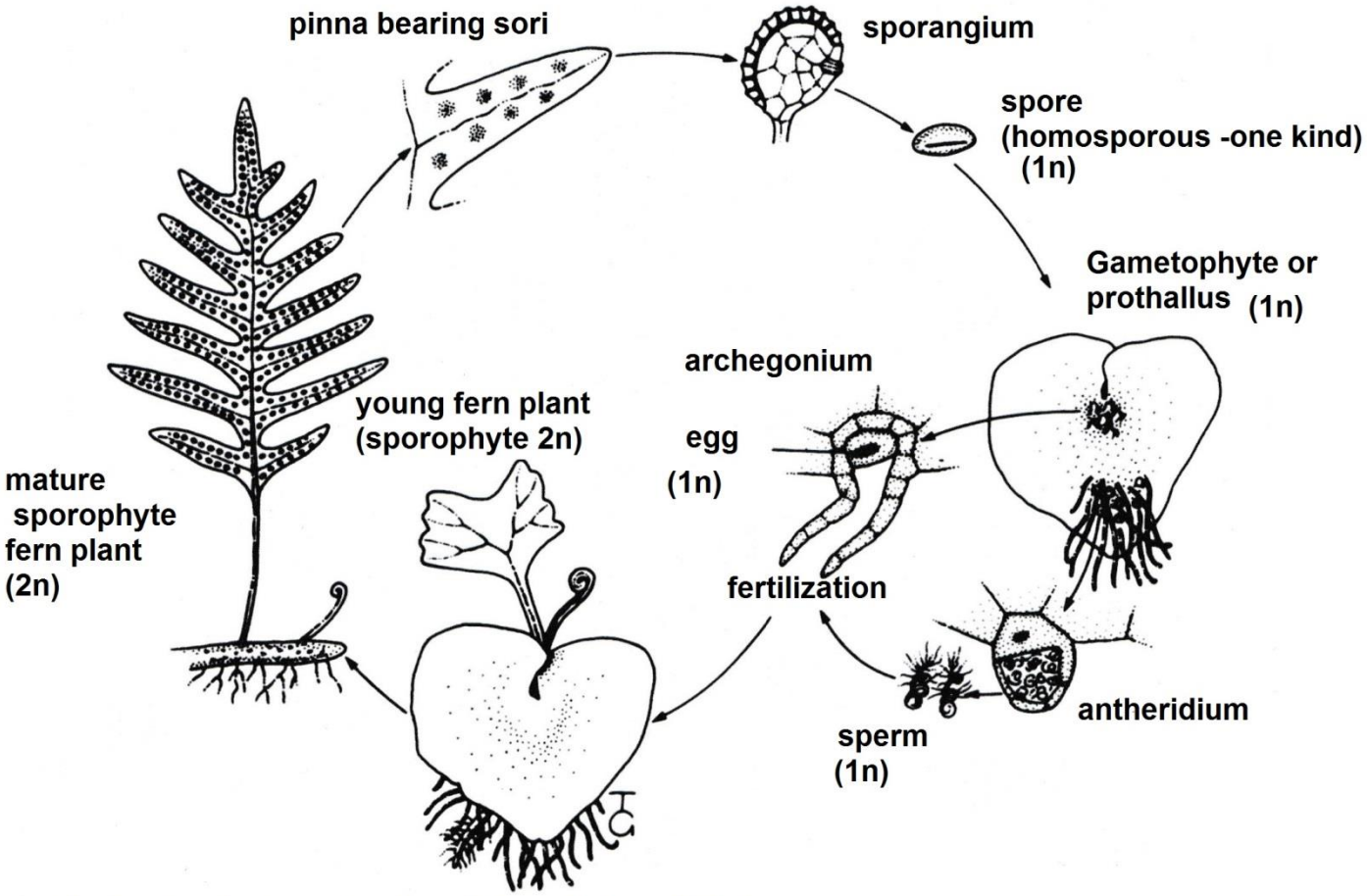


Figure 165 life cycle Hymenophyllaceae



Life Cycle of a typical polypod fern (Polypodiales)

Illustrations by Tim Galloway (taken from 'New Zealand Ferns and Allied Plants' 2000. Brownsey, P. J and Smith-Dodsworth, John. David batemen (publisher).

Figure 166 life cycle polypod fern

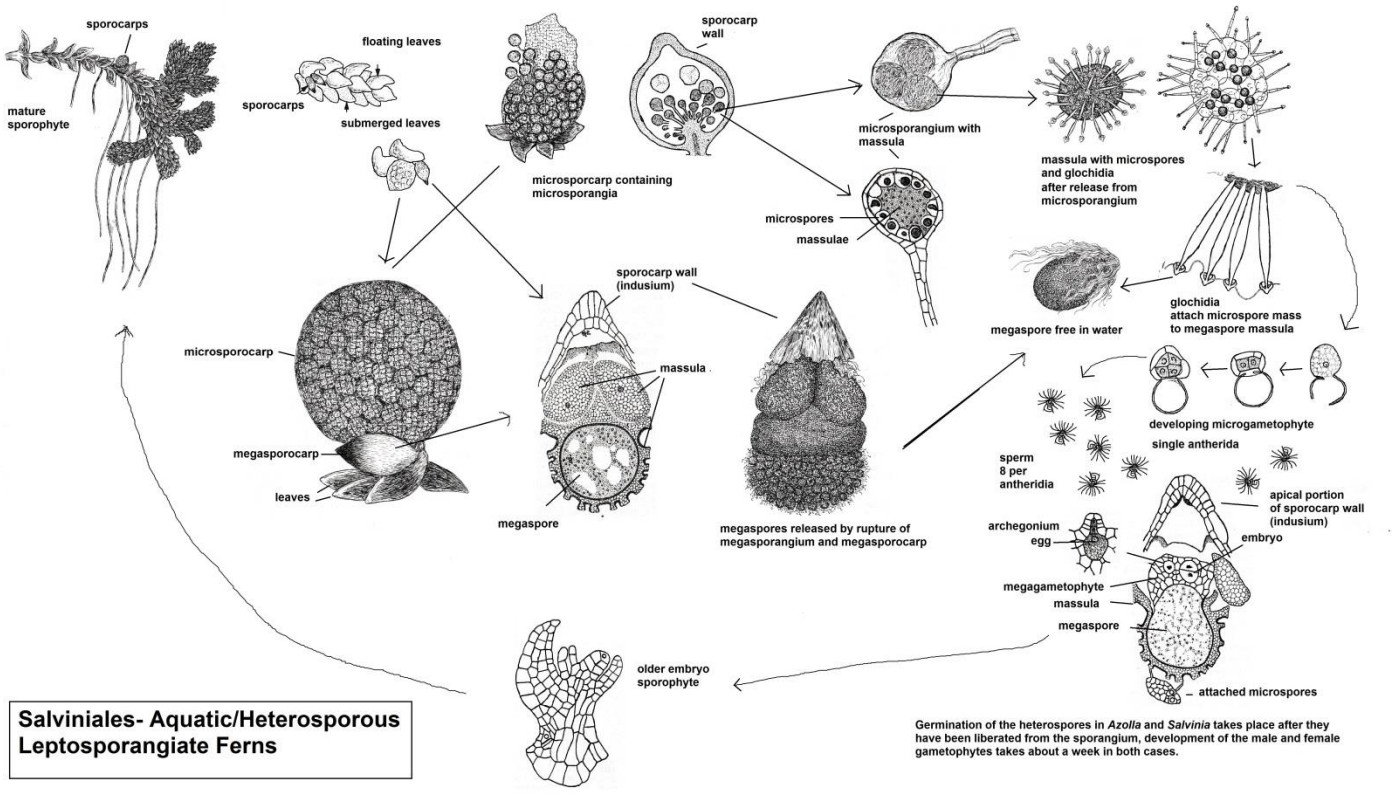


Figure 167 life cycle *Azolla*

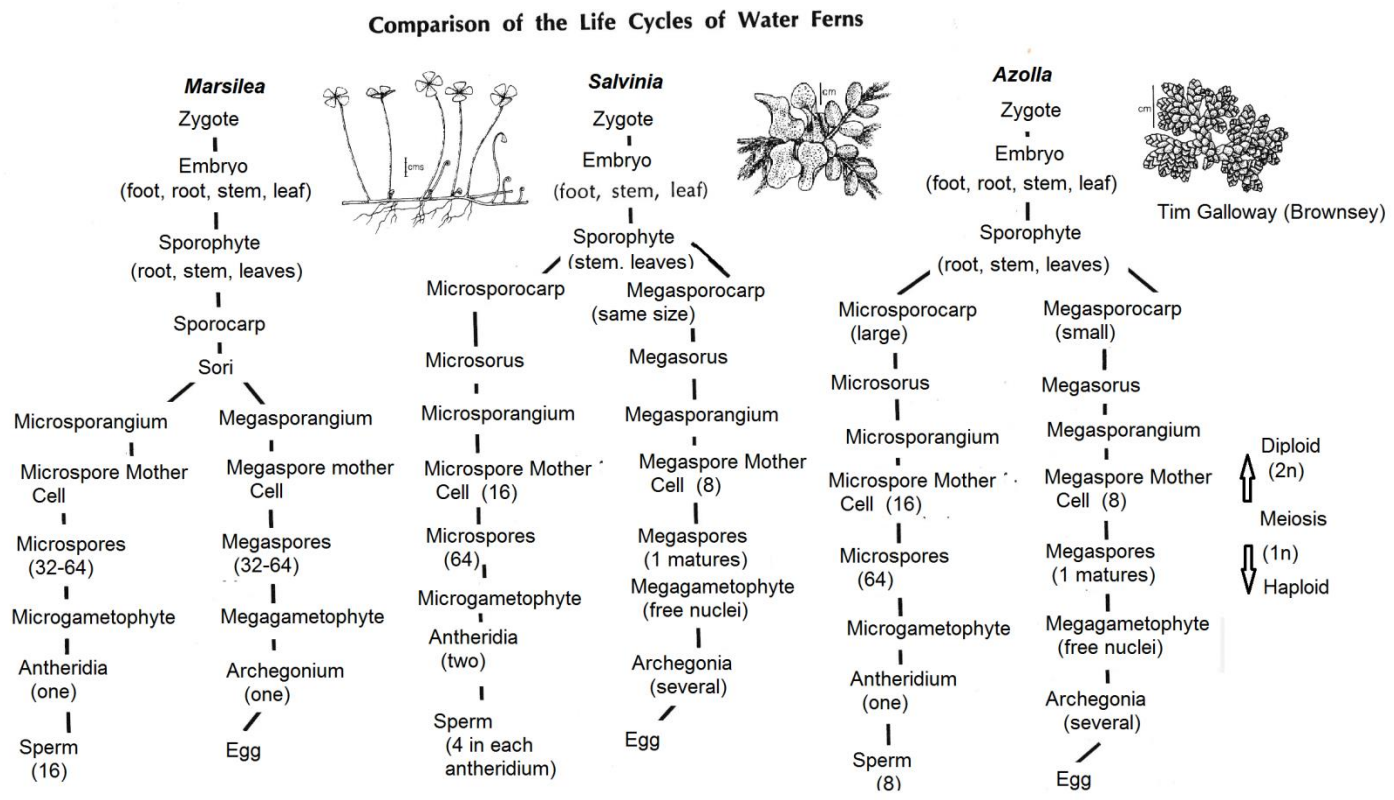


Figure 168 comparisom of the life cycles of water ferns

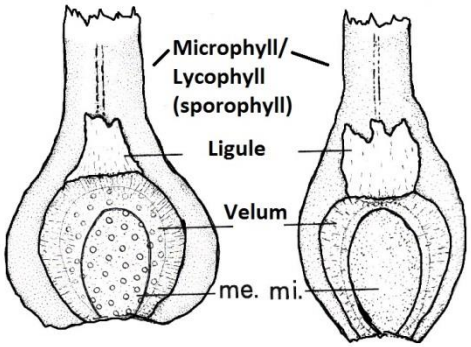
lignicolous (L. *lignum*, wood + *colous*, living on or growing in f. *-cola* ,inhabitant) Growing on decorticate wood.

lignified (L. *lignum*, wood) Cells that have had a large amount of **lignin** deposited in their cell walls. For example sclerenchyma and xylem cells: tracheids and vessel elements.

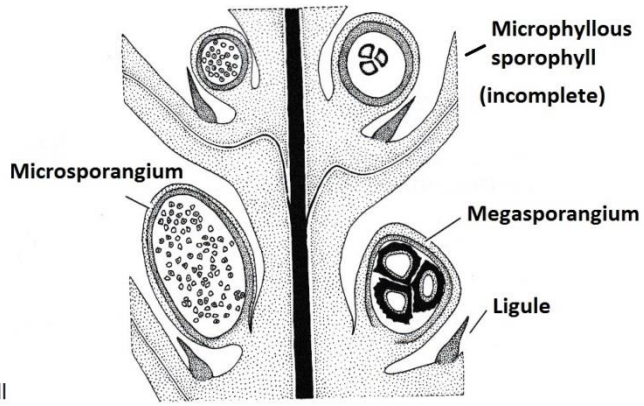
lignified sclenchymatic plates (see lignin & sclerenchyma) Supporting tissues of dead cells with lignin in the cell walls, providing stiffness to the tree fern trunk.

lignin (L. *lignum*, wood) Complex polymeric macromolecule of secondary cell walls in plants, providing strength and resistance against most microorganisms. It cements together cellulose fibres and stiffen cell walls.

ligulate (L. *ligula*: a little tongue, a strap) Bearing a ligule; strap-shaped structure. Amongst the lycophytes, the Isoetopsida (families Selaginellaceae and Isoetaceae) are ligulate, and an older name for the group was Glossopsida from the Greek equivalent of the Latin *ligula: glossa* “little tongue”. The members of the other family of lycophytes the Lycopodiaceae lacks ligules and the term **eligulate** applies.



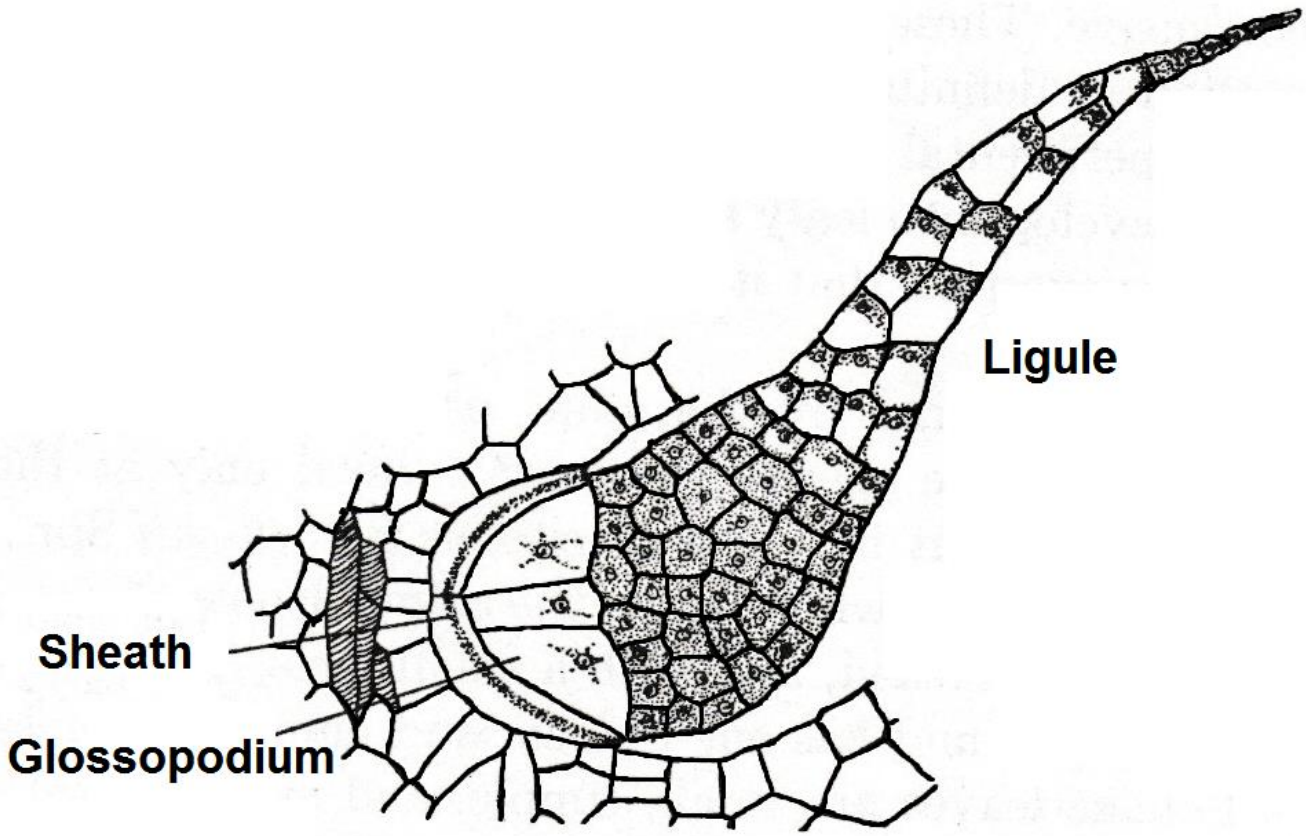
Isoetes sp. (quilwort) Adaxial view of megasporophyll (left) and microsporphyll (right) indicating location of megasporangium (m.e.) and microsporangium (m.i.), velum and the minute leaflike flap (tongue) of tissue the **ligule**



L.S. strobilus of *Selaginella harrisiana*

adapted from "Plant Systematics A Phyllogenetic Approach" 2008 Jung et al

Ligulate Lycophytes



Vertical section of a ligule (*Selaginella*) passing through the sheath (Smith)

Figure 169 ligules

ligule (L. *ligula*: a little tongue, a strap) A small membranous structure towards the base of the upper leaf surface and above the sporangium in the fertile leaves in *Isoetes* and *Selaginella*. Also a small membranous structure at the base of grass leaves and a ligulate flower is in many members of the Asteraceae (daisy family) a straplike, usually five toothed ,coroalla limb (petal).

lime-dots A popular term for the outlet point of a hydathode where white salt accumulates.

limicolous (L. *limi- limus* mud + *-colous* f. *-cola* ,inhabitant) Living in a mud habitat. See **helophyte** and **epipelic**. Example *Pilularia novae-zealandiae* (Pillwort).

lindsaeoid (Genus *Lindsaea* + -oid, resembling) Implying related to or resembling ferns of the genus *Lindsaea*.

lineage (L. *linea*, line) Line of common descent; a group of species sharing descent from a common ancestor. Synonym **monophyletic**.

linear ((L. *lineal* , a line) Long and narrow with parallel sides, more than 10 times as long as wide. See **Leaf shapes.**

lip Cells In leptosporangiate ferns, the line of thin walled slightly large cells between which the sporangium dehisces (the sporangium ruptures along a line between the lip cells to discharge the spores). Collectively the **stomium** which means mouth. See **stomium** and **annulus**.

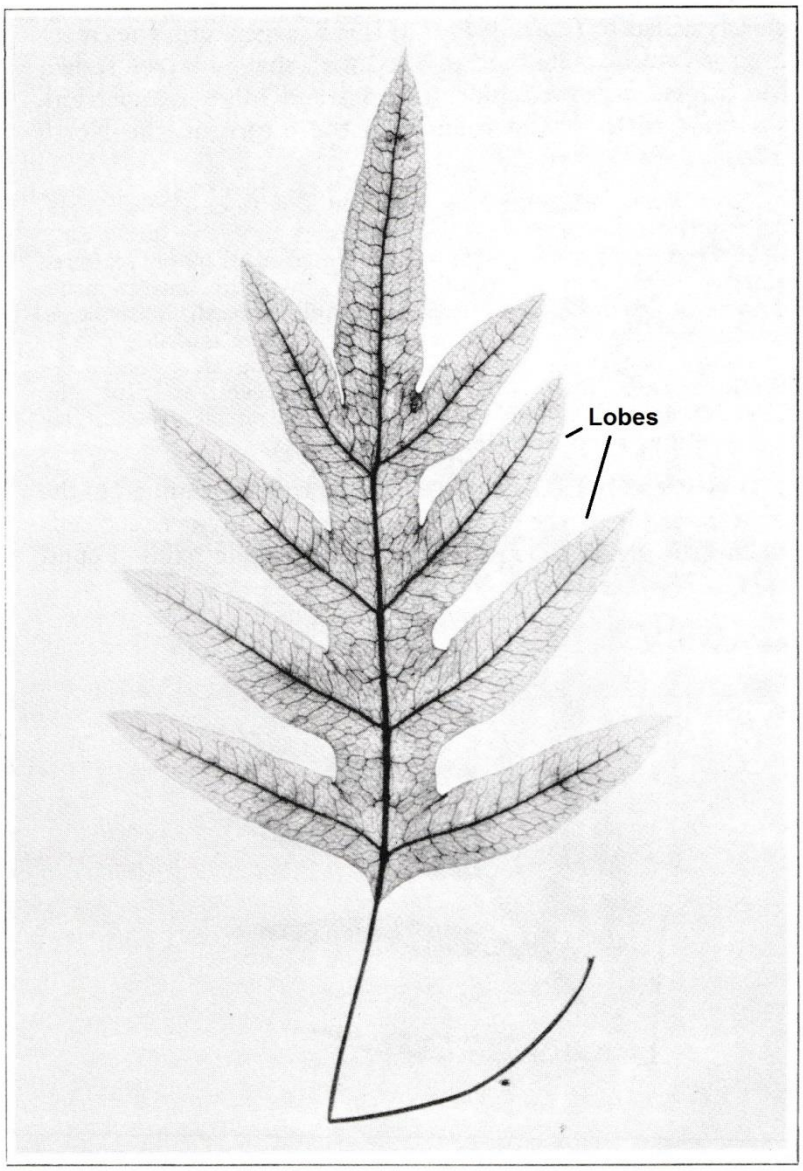
lithophyte (Gr. *litho-* , stone, rock + *phyton ,* plant) A plant growing on rock. Synonyms **epilithic**, **petrocolous**, **rupestral**, **saxicolous**. Example: Leather-leaf fern *Pyrossia eleagnifolia* which also grows as an epiphyte. See also **chasmophyte.**

lithophytic (Gr. *litho-* , stone, rock + *phyton ,* plant) A plant that grows on rocks, cliff faces etc. Synonyms **epilithic**, **petrocolous**, **rupestral**, **saxicolous**. Example: Leather-leaf fern *Pyrossia eleagnifolia* which also grows as an epiphyte. See also **chasmophyte.**

litter Predominantly dead plant material on the substrate surface (e.g. topsoil,branch,rock) that is not completely decomposed. Organic matter,forming a growing medium for ferns.

littoral (L. *litoralis*, from *litor-, litus* seashore) Growing in communities near the seashore, or lake shore, or banks of rivers. Compare **riparian**.

lobe (Gr. *lobos*, lobe of the ear or of the liver, the pod of a leguminous plant). A usually rounded segment of a leaf or leaflet e.g. *Zealandia pustulata* subsp. *pustulata*. More technically with a sinus 1/8 to ¼ the distance to the midrib or equivalent point. Hence lobed,and the diminutive lobulated. **Sinus** is the gap between the lobes. See **leaf division (lobation) and margin**.



(133a) POLYPODIUM BILLARDIERI. WAITEMATA.
A Medium Specimen. Upper Side. A Young Frond, showing Veins.

Zealandia pustulata* subsp. *pustulata
'New Zealand Ferns' 1930. Southern Reprints 1987.
by H. B. Dobbie

Figure 170 lobes

lobulate, Possessing small lobes..

lobule (Diminutive of lobe) A small lobe. Hence **lobulate**, possessing small lobes..

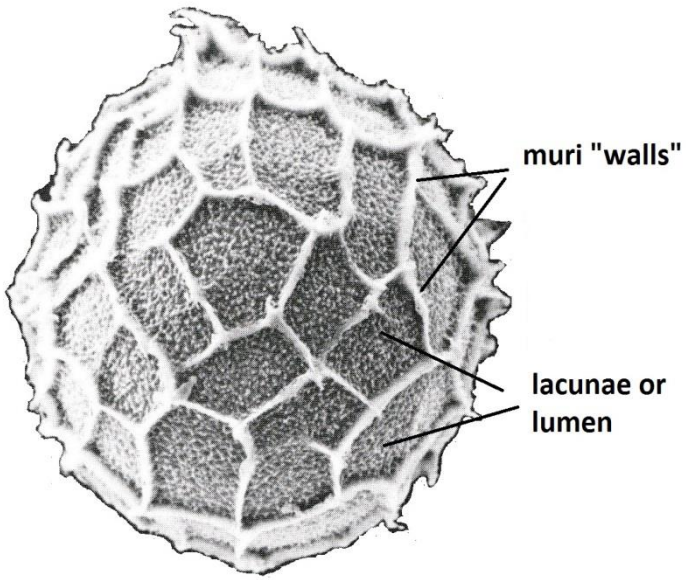
locule (L. *loculus*, a little place) A compartment of an organ.

long-creeping rhizome One that grows horizontally and produces stipes arising distantly from each other. Growth habit or form in ferns: compare **short creeping rhizome**,**medium creeping rhizome**, **tufted** or **caespitose**, trunked - tree fern or **caudex**.

longitudinal (L. *longitude*, length) Running lengthwise.

lowland In New Zealand, altitudinal distribution zone, approximately below 500 metres above sea level where the montane zone begins, depending on latitude and continentality (distance from the sea). Between coastal and montane zones. Enjoys a warm temperate climate in the north, cool to cold temperate in the south. See **coastal**, **montane**, **subalpine**, **alpine**, **nival**.

lumen pl. **lumina** (L. *lumen*, light, an opening) The spaces enclosed by muri (walls) within a reticulum. Similar to **lacuna**.



***Selaginella krausiana* African clubmoss megaspore showing reticulate sculptural ornamentation.**

Figure 171 lumen or lacunae

lunate (L. *lunatus* , crescent-shaped f. *luna* , moon). Half-moon or crescent-shaped. *Botrychium lunaria*.

lustrous (L. *lustrare*, illuminate) Shining, or with sheen. Such as the foliage of the shining spleenwort *Asplenium oblongifolium* (syn. *A. lucidum*).

lycophytes (Gr. *Lykos* , wolf + *phyton ,* plant) Abbreviated from Lycopodophyta (wolfs foot (f. Gr. *pous*) plant). Includes the families Lycopodiaceae (club mosses), Selagineaceae (spike mosses or club mosses), Isoetaceae (quillworts), and their fossil relatives (for example lepidodendrids), characterized by simple entire leaves with a single vein (microphylls) and a single sporangium borne on the upper surface of the leaf or its axil. Evolutionarily, these plants are the sister group to ferns and seed plants. The probable ancestral group, the zosterophylls first appear circa 430 million years ago. in the fossil record . Sometimes, termed **fern allies**, although not as allied (related) as once thought. See **Pteridophyte.**

lycopod (Gr. *Lykos* , wolf + *pous*, foot) Informal name for a herbaceous plant having scale-like leaves (microphylls) and spore-bearing cones, clubmosses,spikemosses and relatives. See **Lycophytes**.

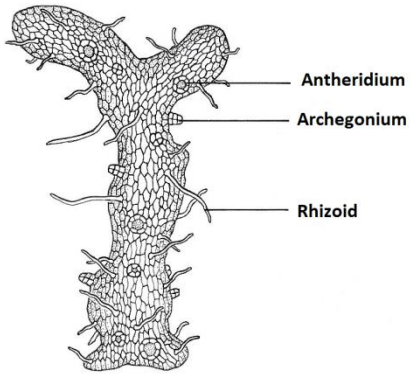
lycophyll (Gr. *Lykos* , wolf +) The sterile **microphyll** of a lycopod. Compare **euphyl**l or **megaphyll** of the ferns and seed plants.

macrogametophyte (Gr. *makros*, large, + *gamos*, marriage + *phyton ,* plant) The gametophyte or prothallus developing vegetatively from the macrospore/megaspore of a heterosporous plant e.g. *Selaginella* spp.*Isoetes* sp. ,*Azolla sp.* . Often **endosporic** as well. Compare **microgametophyte**.

macrospore (Gr. *makros*, large + spora, seed) Another term for **megaspore**. The larger spore type produced in heterosporous species. Compare **microspore**. The marcospore germinates into the macrogametophyte or female gametophye often developing mostly within the spore wall **(endosporic**).

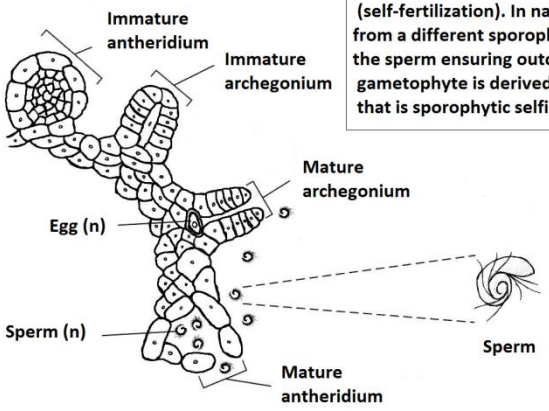
male gamete See **sperm**, **antherozoid** or **spermatozoid**.

male sex structure The **antheridium** borne on the gametophyte or prothallus. Sperm (male gametes) are produced within this structure – the male **gametangium**. Compare **archegonium** the **female sex structure**. See **Life cycle** entry.



A prothallus. This subterranean, bisexual, independent gametophyte of *Psilotum nudum* bears antheridia and archegonia, the reproductive organs. (Drawing by L. Meszoly)

Note many fern life cycle diagrams depict a single gametophyte and therefore gametophytic selfing (self-fertilization). In nature a neighbouring gametophyte from a different sporophyte may be the source of the sperm ensuring outcrossing. Though if the other gametophyte is derived from the same sporophyte that is sporophytic selfing.



Psilotum nudum prothallus cross section. Mature antheridia release spirally coiled, unidulipodated sperm (n) that swim to mature archegonia. Each archegonium contains an egg (n) which is fertilized by a sperm

'FIVE KINGDOMS: AN ILLUSTRATED GUIDE TO THE PHYLA OF LIFE ON EARTH' 1998. Margulis, Lynn & Schwartz Karlene V. . Owl Books

Figure 172 antheridium (male sex structure)

mangrove (Spanish f Caribean native term + grove) A specialized plant growing in brackish or sea water. Represented in the North of the North Island by the mangrove tree, manawa *Avicennia resinifera* . The habitat is referred to a mangal. Not a prime fern habitat but never the less some epiphytic ferns manage to grow here.

mantle frond A frond differentiated for litter collection, e.g. *Platycerium* spp. Synonym: **base frond**, or **shield frond**.

Maori name The common name for a species, or taxon in Maori, e.g. kiokio, for *Blechnum novae-zealandiae* and related ferns. Compare **scientific/botanical name** and **common name**.

marcescent (L. *marceo:* to wither, droop, break, shrivel) Withering without falling off. Such as the skirt of dead leaves beneath the living leaves of the tree fern *Cyathea smithii*.

Marattiopsida – Marratoid Ferns (f. genus *Marattia* after G. F. Maratti, Italian botanist (1723-1777). Primitive eusporangiate ferns represented in New Zealand by *Ptissiana salicina* syn. *Marattia salicina* King fern, Para or horseshoe fern. A large ground fern of northern regions of the North Island. This clade of ferns arose in the Carboniferous age.

margin (L. *margo* , edge) Edge or border of a surface; hence **marginate**.

marginal (L. *marginalis*. of the margin) Attached to or close to the edge, at the margin of flat structures such as pinnae, pinnules, ultimate segments, or scales; said of sori, cilia and veins.

marginate (L. *marginatus*, past participle of *marginare* , to margin) With a margin of distinct character; a term for a stipe or rachis that is minutely keeled not winged.

margo (L, *margo*, an edge) A transition zone between the commissure of the tetrad scar and the remainder of the exine in a spore wall.

marine (L. *marinus* , of the sea) Pertaining to sea or salt water.

maritime (Latin *maritimus*, growing by the sea) Belonging to the sea, coastal, influenced by the sea, e.g. maritime climate. Coastal ground spleenwort *Asplenium appendiculum* subsp. *maritimum*.

marsh A swamp.. A plant community developing on a wet but not peaty soil.

marsh plant: Synonyms: **helophyte, helophilous, paludicolous.**

massula pl. **massulae** (L. *massula*, a small mass, f. *massa*, lump, mass) A gelatinous mass of tissue from multinucleate plasmodium (tapetal cell origin) in the macrosporangium and microsporangium of water ferns Salvinniales. Clump of microspores enclosed in a hardened mucilage.. . In some microsporic massula hook like **glochidia** attach the clump of microspores to the megaspsoric massula of the megaspore, where they germinate and develop into mature microgametophytes producing sperm close to the female megagametophyte that develops from the megaspore. See **sporocarp**, **sorophore**, **life cycle**.

matted Closely tangled together, said of hairs etc.

mealy Covered with coarse, flour-like powder. Synonym **farinaceous**.

medial (L. *medialis*, in the middle, f. *medius* , middle) Positioned midway between the margin and the midrib, costa, midvein, or costule; said of **soral position**.

medium creeping rhizome A rhizome intermediate between short creeping and long creeping.

medullated protostele Medullated (Latin *medulla* ,pith, marrow) A protostele in which the xylem has a core of non-vascular tissue (pith) .

megagametophyte (Gr. *megas*, large, + gametophyte) The gametophyte developing vegetatively from the megaspore of a heterosporous plant, e.g. *Isoetes* sp. *Selaginella* sp. *Azolla* sp. . Identifies as the female gametophyte. Compare **microgametophyte** the male equivalent.

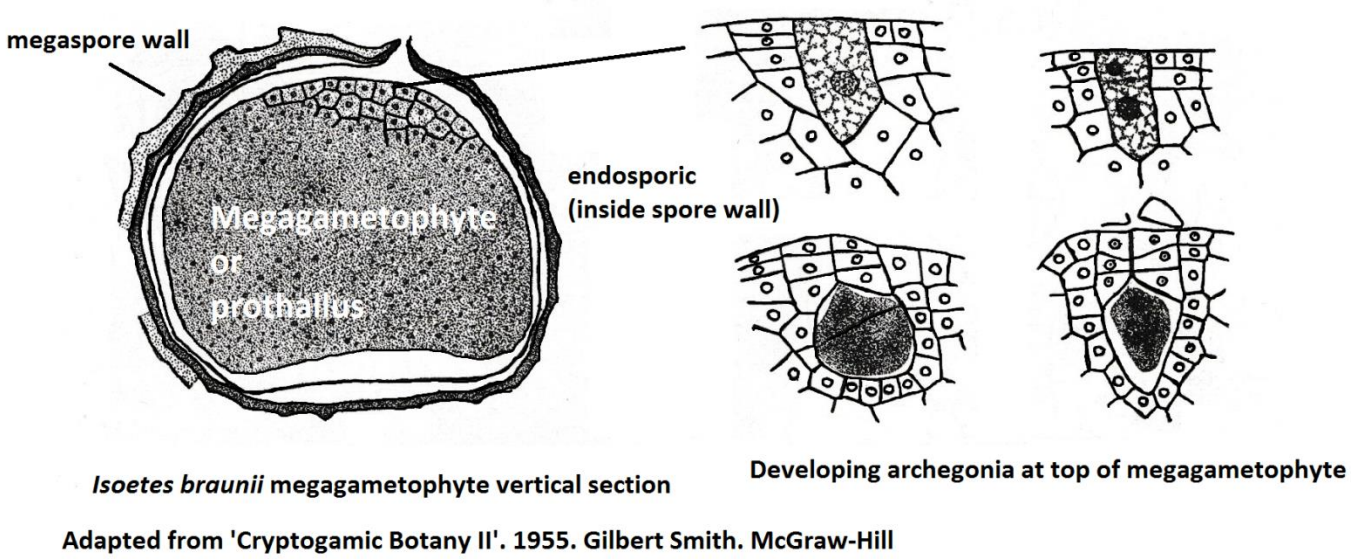


Figure 173 megagametophyte *Isoetes*

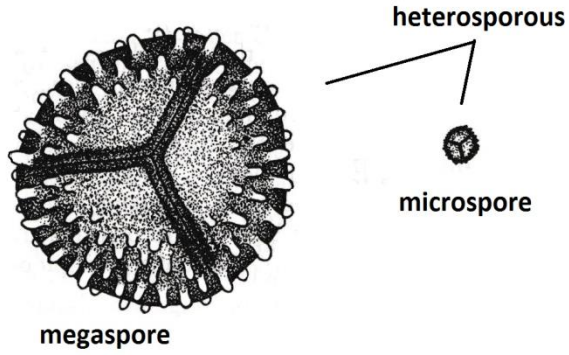
megaphyll (1) (Gr. *megas*, large, + *phyllon*, leaf) (1) A large (usually), complex sporophytic leaf, multiveined, with leaf gaps in the central vascular system (stele) e.g. a fern frond or leaf of a seed plant. In ferns comprising the stipe, rachis and lamina, growing by means of marginal or apical meristem, having multiple-branched veins and associated leaf gap. Synonym **euphyll**. Compare **microphyll** (synonym **lycophyll**). See **telome theory**.

megaphyll (2) (Gr. *megas*, large, + *phyllon*, leaf) Laminar/leaf size term for a leaf with an area (mm^2) >164,025mm^2 (Length x width x 2/3). See **laminar size**.

megaphylly Leaf development evolutionarily from three-dimensional branching systems of early (Devonian) vascular plants; also known as **euphyll** (True leaf). The **telome theory** is put forward to explain its evolution. Compare **microphyll**, **lycophyll.**

megasporangium pl. **megasporangia** (Gr. *megas*, great, large, mighty + sporangium) The larger of the two kinds of sporangia produced in the sexual life cycle of a heterosporous plant. Produces **megaspores**.

megaspore (Gr. *megas*, great, large, mighty + spore) The larger of the two kinds of spores produced in the sexual life cycle of a heterosporous plants such as water ferns and lycophytes - *Azolla, Isoetes, Salvinnia* and *Selaginella*, giving rise to the female gametophyte. Also known as a **macrospore**. Megaspores develop in megasporangia on megasporophylls or sporocarps and germinate to produce the female gametophyte. Compare **microspore**.



***Selaginella* sp. Megaspore (from megasporangium) and microspore (from microsporangium)**

Figure 174 megaspore *Selaginella*

megasporocarp : (Gr. *megas*, great, large, mighty + sporocarp f. *spora*, seed, + *karpos*, fruit) A sporocarp (modified indusium) containing **megasporangia**. In water ferns where the microsporangia and megasporangia are borne in separate sporocarps. In *Azolla* the megasporocarp is smaller than the microsporocarp. In *Salvinnia* they are the same size. In *Marsilea* the microsporangia and megasporangia arise in the same cavity of the sporocarps but are borne on separate sori.. See **sporocarp**.

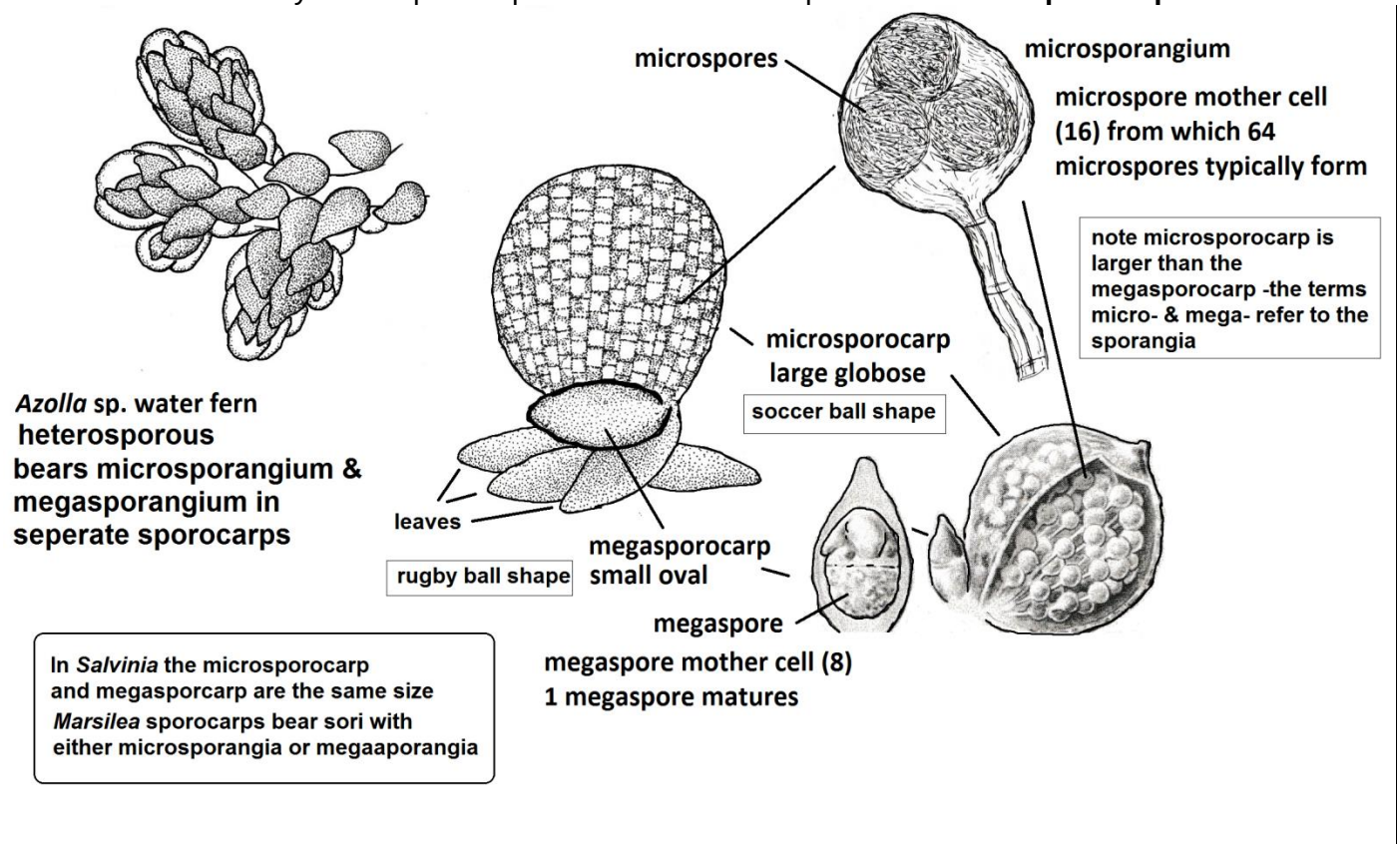


Figure 175 megasporocarp and microsporocarp *Azolla* sp.

megasporophyll (Gr. *megas*, large +spore + *phyllon*, leaf) A specialised leaf in heterosporous plants upon which (or in the axil of which) one or more megasporangia are borne.

meiosis (Gr. *meioun*, to make smaller) A reduction division whereby half the complement of chromosomes of a cell go into each of two daughter cells Kind of cell division that (in plants) gives rise to haploid spores.

During meiosis, the cell (spore mother cell) replicates its chromosomes once and divides twice. The result is four haploid (1n) cells, also called **meiospores**. Compare **mitosis**.

meiospore (meiosis + spore) Any spore resulting from meiotic divisions. The haploid (1n) spores produced by the fern or lycophyte sporophyte generation, which when dispersed and in the right conditions germinate and grow into the **gametophyte** or **prothallus** (by **mitosis** cell division). Represents the start of the gametophyte generation. See **meiosis**.

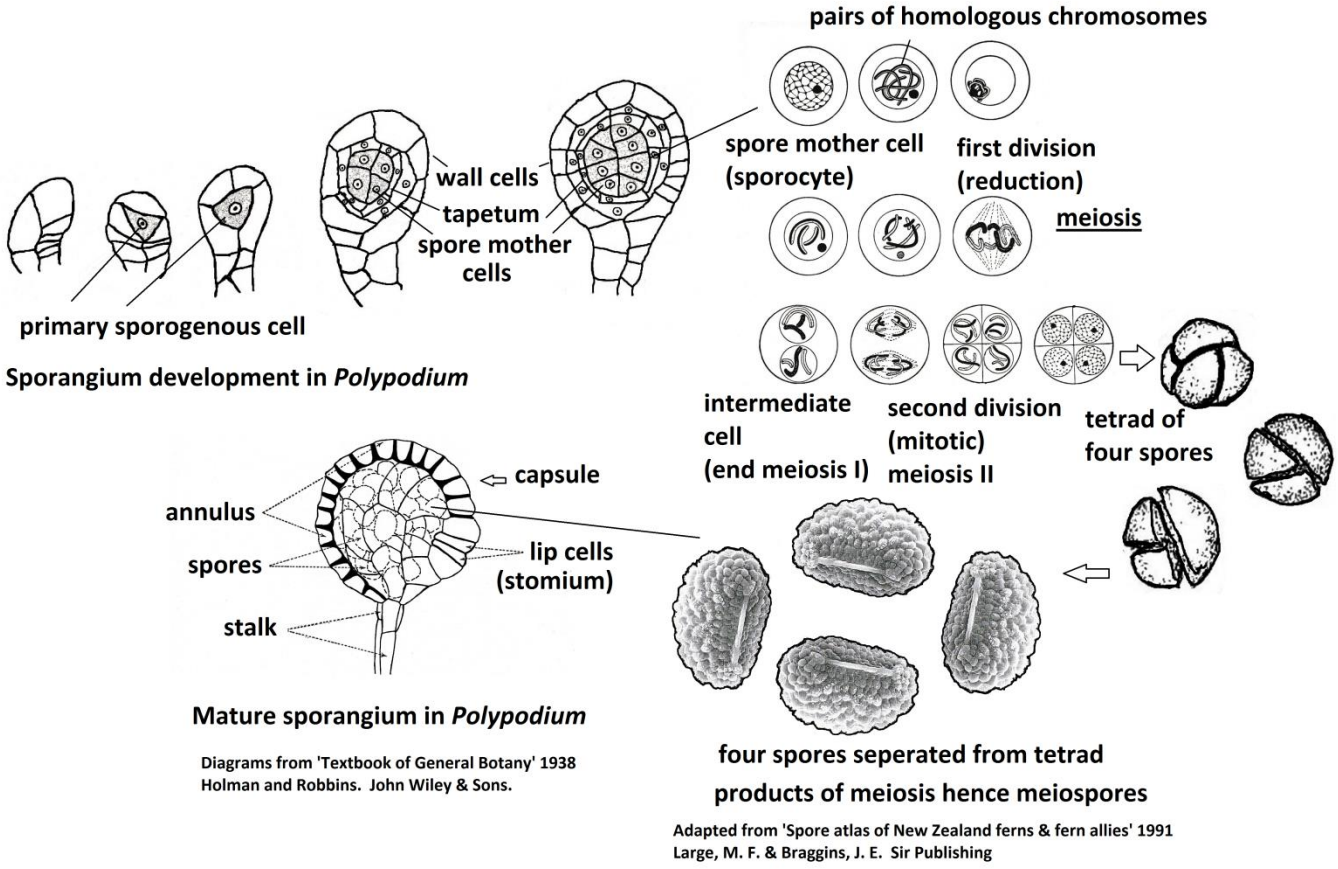
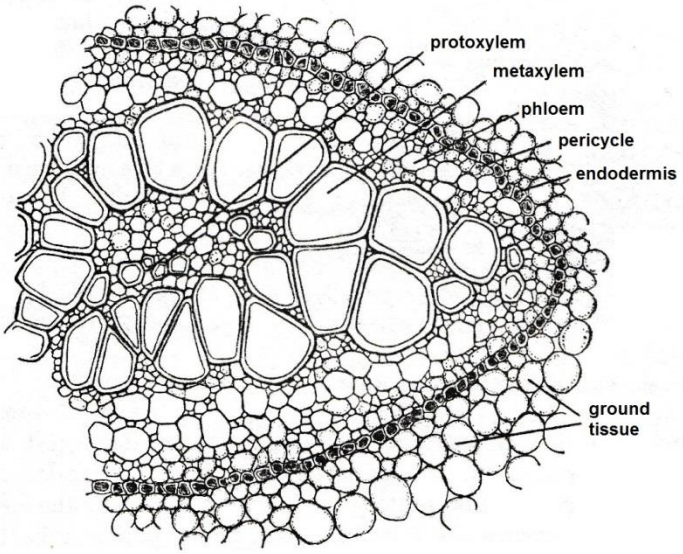


Figure 176 meiospores and meiosis

membranous (L. *membrane*, the skin) Thinly-textured pliable and often transparent. *Blechnum membranacaeum*. Synonym membranaceous – thin, flexible and more or less translucent.

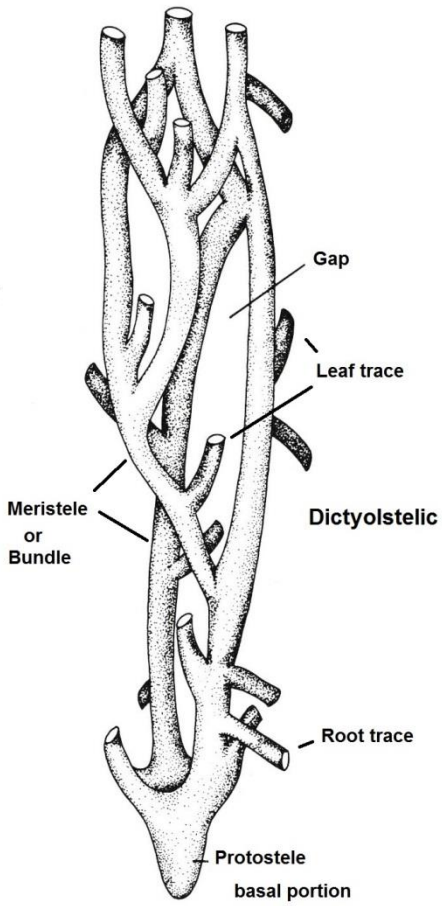
meristele: (Gr. *meristos* , divisible + stele) A division of the main vascular stele of a **dictyostele** (dissected amphiphloic siphonostele). The vascular tissue running between two leaf-gaps. The portion of a stele received by each leaf. The gaps are filled with ground tissue (mostly parenchyma).



Transverse section, portion of meristele of *Pteridium*

'Textbook of Botany', 1962. 13th ed. Lowson, J. M.
revised by Howarth, W. O. & Warne, L. G. G. . University Tutorial Press

Figure 177 meristele *Pteridium*



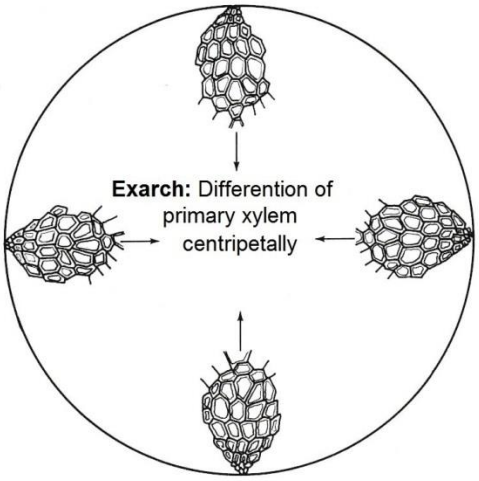
Three dimension diagram of the stele of *Ophioglossum lusitanicum*. Both leaf traces (directed upwards) and roots (directed downwards) arise from the bundles that surround the gaps

Adapted from "Plant Anatomy" 3rd ed. 1982.
Fahn, A. H..
Pergamon Press

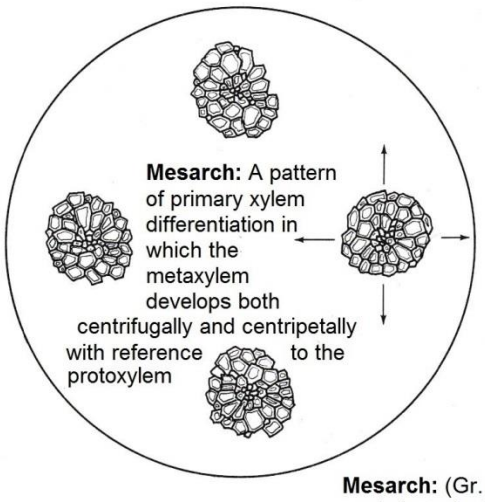
Figure 178 meristele

meristem (Gr. *meristos* , divisible) A growing point, or area of active cell division. Classified according to position: apical, intercalary, lateral or axillary,adventitious; classified by origin and development: **promeristem** or **primordial meristem**, **primary meristem** and **secondary meristem** (cork cambium and interfascicular cambium), classified by function : **protoderm** meristem gives rise to epidermal tissue system, the **procambium meristem** gives rise to vascular tissue and **ground meristem** which gives rise to the ground or fundamental tissue system (pith, cortex, leaf mesophyll).merstems may also be classified according to the planes of cell divisions: a **mass** or **block meristem** divides in all planes of cell division (anticlinal, periclinal, diagonal or oblique) results in growth in volume, a **rib** or **file meristem** divides in one plane only, resulting in the formation of filaments and lastly the **plate meristem** where cells divide in two planes resulting in an increase in the area of an organ as in leaf formation.

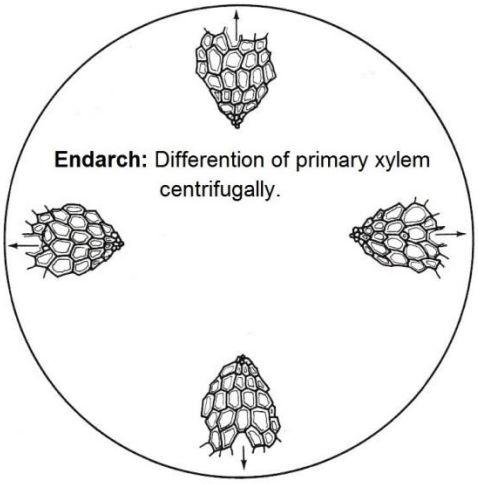
mesarch (Gr. mesos, in the middle + archaein, to be first) A pattern of primary xylem differention in which the metaxylem develops both centrifugally and centripetally with reference to the protoxylem.



exarch: (Gr. *ex*-, out of + *archein*, to be first)



Mesarch: (Gr. *mesos*, in the middle + *archein*, to be first)



Endarch: (Gr. *endon*, within + *archein*, to be first)

Some common patterns of primary xylem differentiation from procambium. Protoxylem cells form first (hence the "arch" which here means first point of origin) are small, metaxylem cells are large and thicker walled. Synchronous type, consisting of metaxylem only not illustrated.

Centrifugal from Greek *kentron* centre + *fugo* to fly from

Centripetal from Greek *kentron* centre + *Peto, petere* to seek

Protoxylem: The first-differentiated primary xylem, usually in a region where the organ is increasing in length. (Gr. *protos*, first + xylem f. *xylon*, wood).

Metaxylem: The primary xylem that differentiates from procambium after elongation of the organ has ceased and after the protoxylem has matured. (Gr. *meta*-, beyond, after + xylem).

Modified from 'Morphology of Plants and Fungi' 4th ed. 1980. Bold, Harold C., Alexopoulos, Constantine J., and Delevoryas, Theodore. Harper International Edition

Figure 179 mesarch primary xylem differentiation

mesic (Gr. *mesos*, middle) Habitat with moderate water balance, neither too wet (hydric) nor too dry (xeric).

mesoclinal (Gr. *mesos*, middle + *kleinen*, slope, to lean) Growing on the side of a slope where most rain falls c.f. **xeroclinal**.

mesomorphic (Gr. *mesos*, middle +) Adapted to a moist climate, neither too wet or too dry. cf. **xeromorphic**,**hydromorphic**.

mesophyll (Gr. *mesos*, middle + *phyllon*, leaf) Photosynthetic tissue of a green leaf. Tissue between the upper and lower leaf epidermis excluding veins. Cell types may include palisade cells and spongy mesophyll cells both types of parenchyma.

mesophyte (Gr. *mesos*, middle + *phyton* , plant) A plant which favours a moist climate, or moist conditions, neither too wet or dry. Compare **xerophyte**, **hydrophyte**.

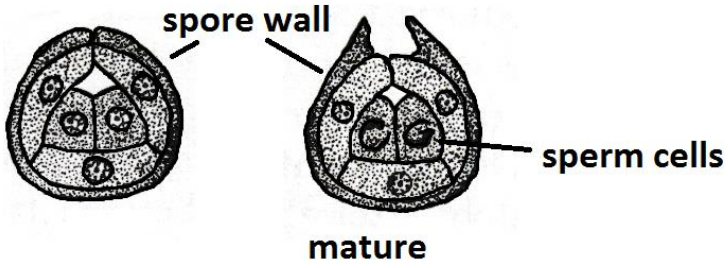
mesophytic (Gr. *mesos*, middle + *phyton* , plant) A moist habitat, neither too wet or too dry.

Mesozoic era (Gr. *mesos*, middle + *zoe*, life) The geologic time era from about 252 to 66 million years ago; Includes the **Triassic**, **Jurassic** and **Cretaceous** periods. It followed the **Permian period** of the **Paleozoic Era**. Many modern fern families arose in this period. It is followed by the **Cenozoic era**.

metaxylem (Gr. *meta* after + xylem f. . *xylon* , wood) The xylem of a group of tracheary elements that matures later (after the protoxylem) consisting of large diameter cells. Compare **protoxylem**.

micron A unit of length for microscopial measurements, equal to 1/25,000 of an inch or 1/1000 of a millimetre or one millionth of a metre. Symbol µm.

microgametophyte (Gr. *mikros* , small + gametophyte) In heterosporous ferns and lycophytes, the male **gametophyte** or **prothallus** that develops from a **microspore** often within the spore wall (**endosporic**).

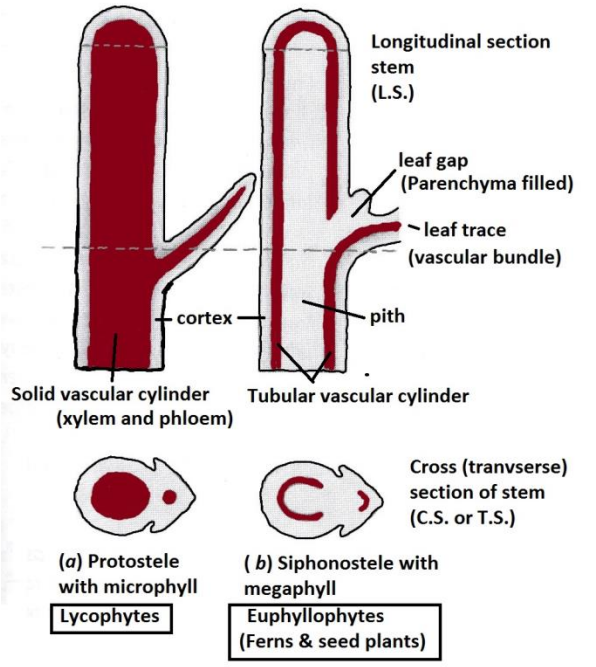


***Isoetes* microgametophyte**

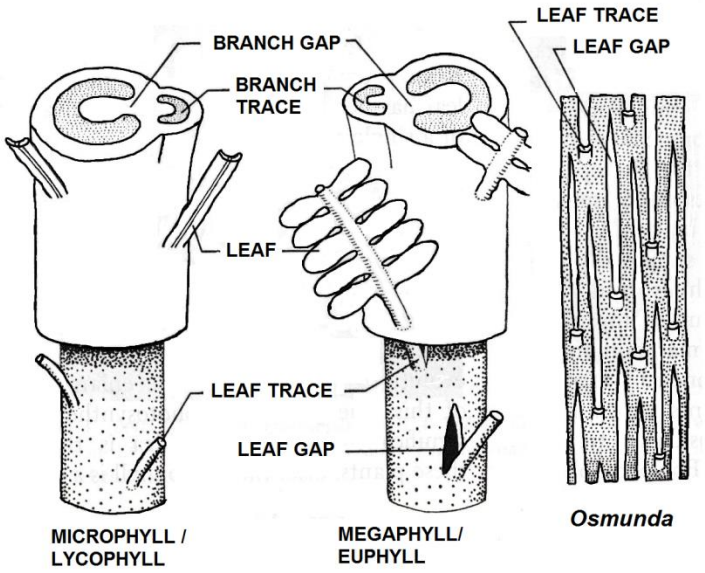
(Adapted from 'Cryptogamic Botany II' 1955. Gilbert Smith. McGraw-Hill)

Figure 180 microgamteophyte *Isoetes*

microphyll (Gr. *mikros* , small + *phyllon*, leaf) (1) The sterile leaves of lycophytes (Lycopodiacea, Selaginacea, Isoetaceae & their extinct relatives); a small leaf with only one unbranched vein, an intercalary meristem and no leaf gap and sessile.. The fertile version is the **sporophyll** (if homosporous) or the **microsporophyll** and **megasporophyll** (if heterosporous e.g. *Selaginella* and *Isoetes*). Thought to have evolved by a different process (**enation theory**) and independently from the **megaphyll**. This form of leaf evolved in the lycophytes earlier (circa 410mya) than the megaphyll or euphyll Note some megaphylls are smaller than microphylls (especially those of *Isoetes* and their extinct relatives), the terms are not used in a strictly size sense here. Also known as **lycophyll,** which avoids confusion with the term microphyll used in the next sense.. (2) **Laminar size term** for a leaf with an area (mm^2) between 225 and 2,025mm^2. (Length x width x 2/3).



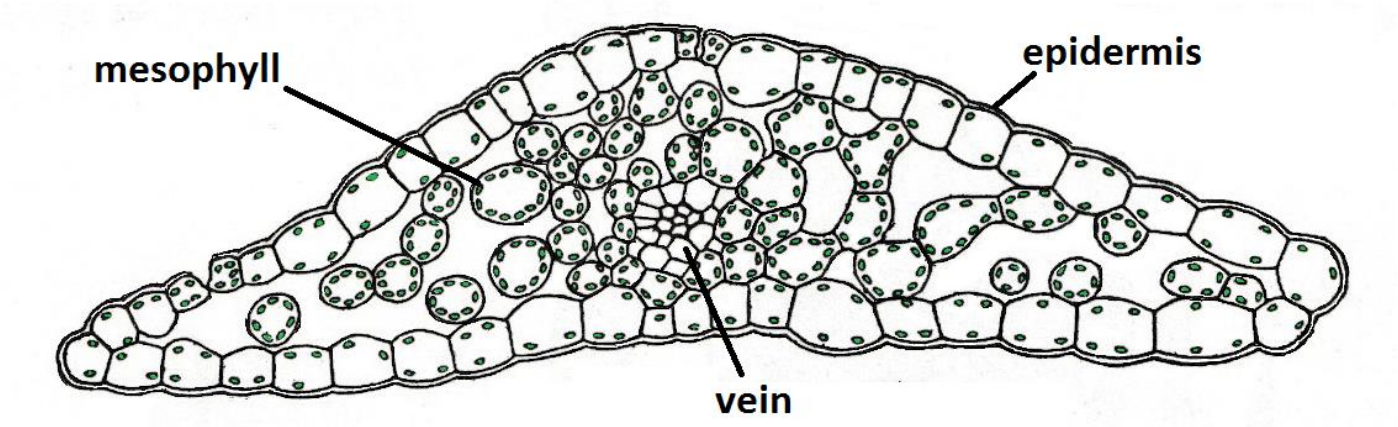
Adapted from "Biology of Plants' 7th ed. 2005. Raven Peter, Evert Ray F. and Eichhorn Susan E.. W. H. Freeman & Co.



Structure of lycopsid (left) and pteropsid (right and centre) shoots

Adapted from "Introductory Botany' 1971. Arthur Cronquist. Harper International Edition

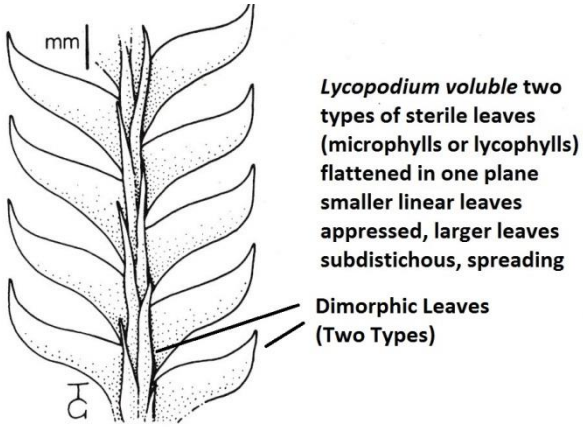
Figure 181 comparisom microphyll and megaphyll



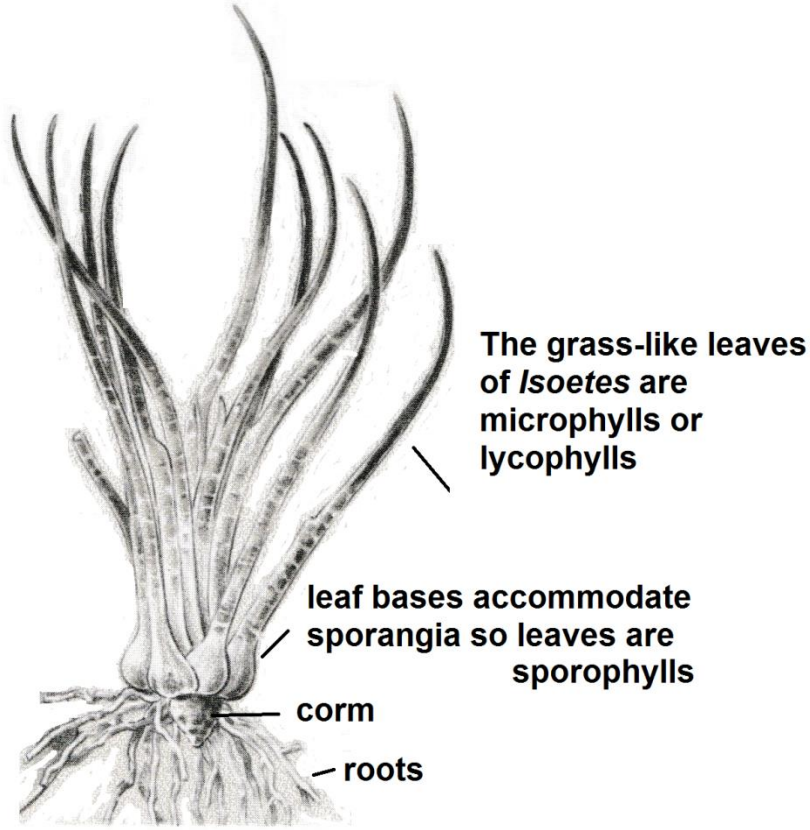
Transverse section of leaf (microphyll) of *Lycopodium volubile*

Modified from 'Cryptogamic Botany: Vol. II Bryophytes and Pteridophytes'. 2nd ed. 1955. Smith, Gilbert. McGraw-Hill

Figure 182 microphyll T.S. *Lycopodium volubile*



'New Zealand Ferns and Allied Plants' 2n. ed. 2000, Patrick Brownsey and John C. Smith-Dodswoth; Bateman
Illustrator Tim Galloway



Isoetes kirkii **New Zealand quilwort**

Figure 183 microphylls (lycophylls)

microsporangium: (Gr. *mikros* , small +sporangium) The smaller of the two kinds of sporangia produced in the sexual life cycle of a heterosporous plant. Produces microspores. Contrast **megasporangium**.

microspore: (Gr. *mikros* , small +spore) The smaller of the two kinds of spores produced in the sexual life cycle of a heterosporous ferns and fern allies *Azolla, Isoetes, Salvinnia* and *Selaginella*, giving rise to the male gametophyte. Designated as the male spore. Microspores develop in microsporangia on microsporophylls (lycophytes) or sporocarps (water ferns) and germinate to produce the male gametophyte or prothallus. Compare **megaspore**.

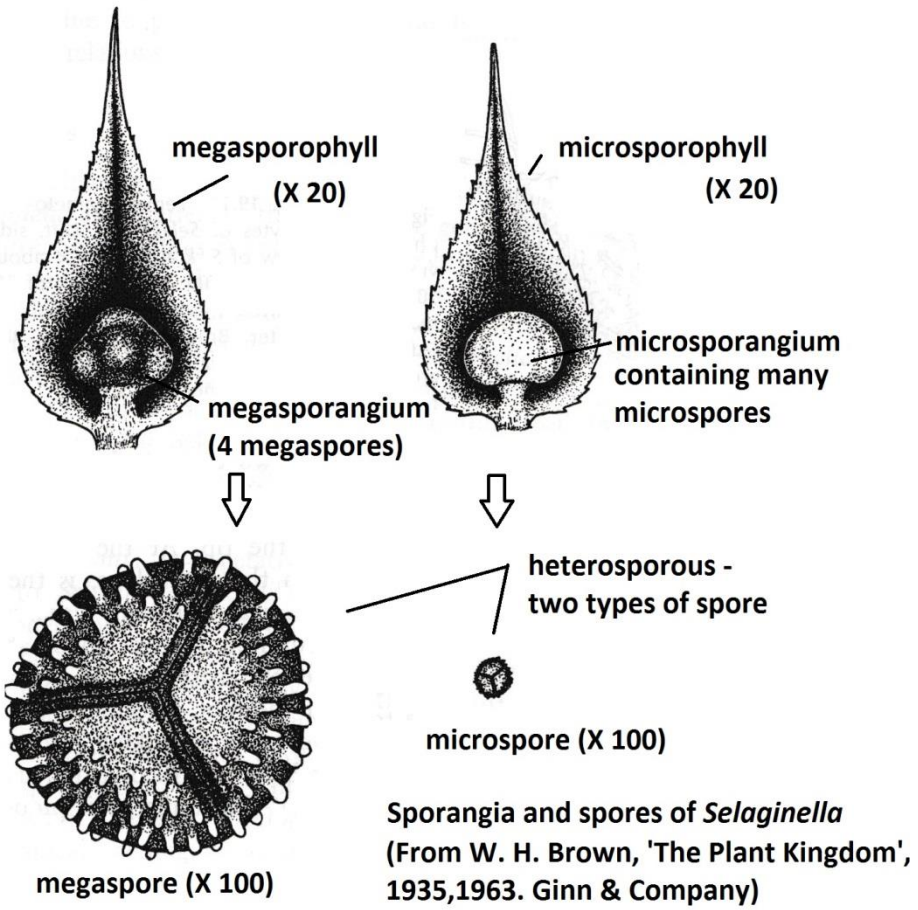


Figure 184 microspore

microsporocarp (Gr. *mikros* , small + sporocarp f. *spora*, seed, + *karpos*, fruit) Sporocarp containing **microsporangia** (male sporangia) in heterosporous water ferns (Salviniales).. Where the microsporangia and megasporangia are borne in separate sporocarps as in *Azolla* sp. and *Salvinia* sp. In *Azolla* the microsporcarp is larger than the megasporocarp, in *Salvinia* they are the same size. In *Marsilea* both microsporangia and megasporangia arise in the same cavity of the sporocarp so simply a sporocarps in this case..

microsporophyll (Gr. *mikros* , small +spore + *phyllon*, leaf) In lycophytes (clubmosses,quillworts, *Selaginella*) a specialized leaf in heterosporous plants bearing or subtending the microsporangia, . A fertile **microphyll** - simple entire leaf with one vein usually bearing a single **microsporangium** on its upper surface. The microsporangium produces many **microspores**. Compare **megasporophyll**.

midrib (mid-, middle + rib) The central, and usually the most prominent, vein (or nerve) of a leaf or leaf-like organ. In ferns the midrib of a frond is called the **rachis** (L. backbone), that of a primary leaflet or pinna a **costa** (L. rib), that of secondary leaflet or pinnule a **costule** and that of a tertiary leaflet or pinnulet a **costulet**.

mire pl. **mires** Synonymous with any peat-accumulating wetland. Term covers bogs and peaty swamps, fens, carr, moor, muskeg and peatland. Term excludes marsh which is non-peat forming.

A classification of inland wetlands identifies 3 categories. (1) Eutrophic mires have high nutrient levels, and are usually dominated by raupo. (2) Mesotrophic mires contain moderate nutrient levels, and are dominated by rushes, sedges, and flax. And finally (3) oligotrophic mires are characterised by low nutrient levels, and are dominated by sphagnum moss, sedges and rushes.

mitosis (Gr. *mitos*, thread, from the appearance of the chromosomes) Kind of cell division in which the chromosomes duplicate, then the two daughter chromosomes are pulled apart into separate cells to form two genetically identical daughter cells. All the cells share the same chromosome number. The gametophyte of ferns and lycophytes develops from a haploid spore (meiospore) by mitosis and so is haploid (1n) itself, the sex cells (gametes) are produced by the gametophyte by mitosis also, so are haploid as well. When the male and female sex cells- the egg and sperm unite in the fertilization process to form the zygote, the diploid (2n) condition is attained. The zygote then by mitotic cell division develops as the diploid (2n) sporophyte – the familiar fern. The mature sporophyte produces spores by **meiosis** (reduction division), which are therefore haploid (1n) meiospores and the cycle starts again. All vegetative or asexual growth is by mitosis.The process of mitosis is particularly active in **meristems**. Compare **meiosis**. See **Life cycle** entry.

mixed sporangia (spore + *angeion*, vessel) A term used when sporangia of all ages are borne at all levels in a sorus.

mixohydric (Gr. *mixis*, mixing, *misgein*, to mix + *hydor*, water) Conducting water both externally and internally. Synonym **mesohydric**. Compare with **endohydric**, conducting water internally as in vascular plants, and **ectohydric**/**exohydric**, conducting water externally as in many 'bryophytes'.

monilophyta (L. *monilo*, necklace, or string of beads + Gr. *phytum,* plant) The ferns and their true allies, divided into four major lineages: the first three lineages are eusporangiate: **Equisetiopsida** (horsetails), **Psilopsida** (whisk ferns and ophioglossoid ferns), **Marrattiopsida** (marrattoid ferns), and finally the leptosporangiate ferns **Polypodiopsida** or **Leptosporangiatae**/ **Filicopsida**/**Filicales**. The name derives from an apomorphy of the group where the stem protoxylem is mesarch position (xylem matures in middle first) and the tracheary element cells appear like a string of beads. Of the traditional fern allies only Equisetiopsida and Psilopsida belong here, the **lycophytes** are a separate clade (**Lycopodiophyta**) of early and living vascular plants. Monilophyta are megaphyllous Euphyllophytes (as are seed plants) – the megaphyll reduced or lost in some; whereas Lycophytes are Microphyllophytes. See phylogeny diagram below.

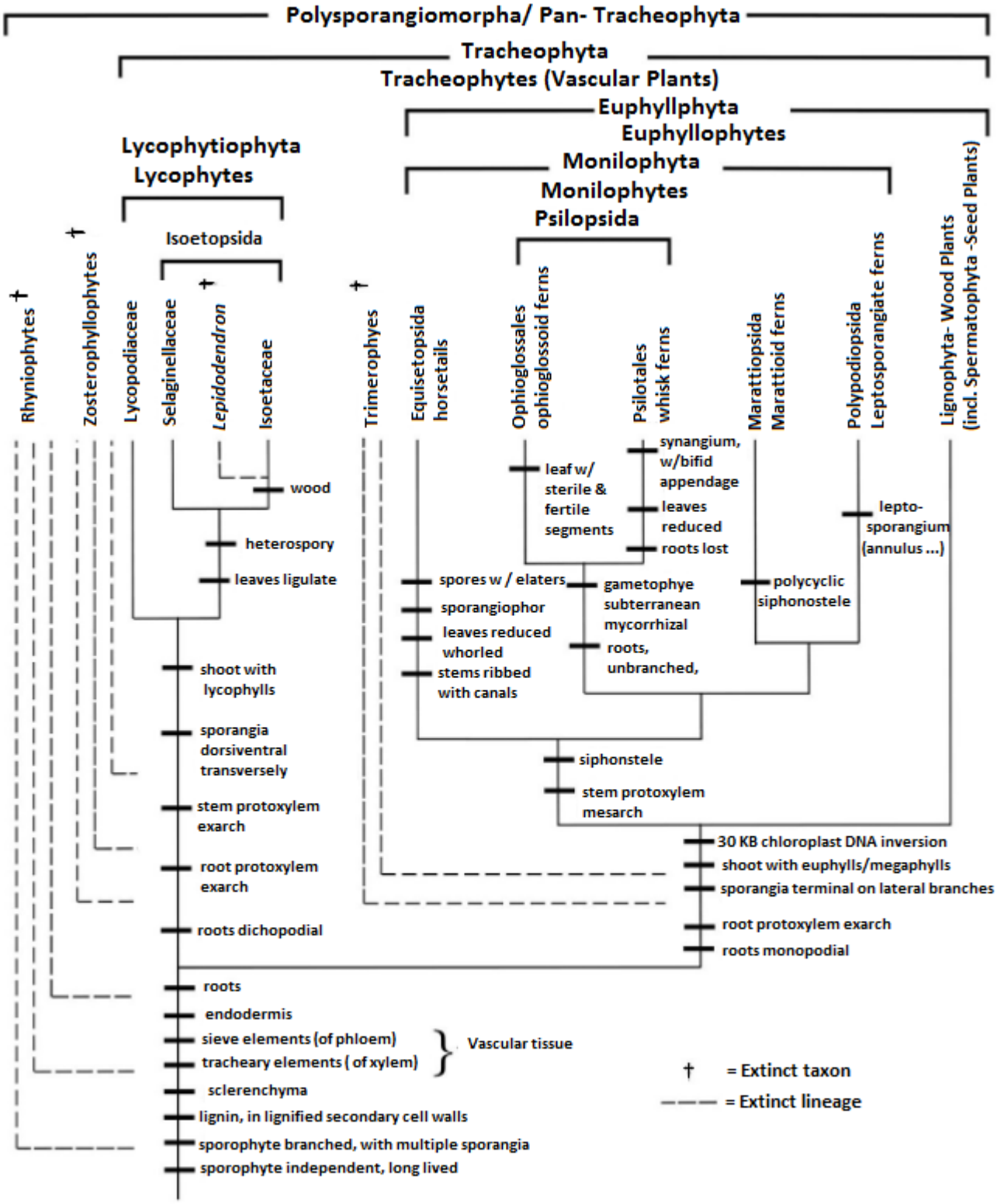


Figure 185 Tracheophyte phylogeny

monoecious (Gr. *monos*, solitary, one + *oikos*, house) Having the male and female reproductive parts in separate organs but on the same plant (the house). In ferns and lycophytes, bisexual gametophyte with both the male and female organs on the prothalli.

monolete (Gr. *monos*, solitary, one + possibly f. + *latus*, side) Of a spore having a single straight unbranched tetrad scar (**laesura**) or dehiscience fissure. Generally bean-shaped (concavo-convex); also called bilateral because the spore has two nearly flat sides. Compare **trilete**, **alete.** The scar may be

prominent or barely visible. The trilete or monolete scar (laesura) functions as an area of weakness which ruptures, allowing germination of the developing gametophyte –so is also known as the **germination furrow**.

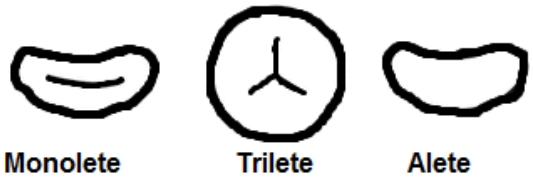


Figure 186 Monolete, trilete and alete

monomorphic (Gr. *monos*, solitary, one + *morphe*, form) Of uniform shape and size., with all fronds fertile. Compare **dimorphic**.

monophyletic: (Gr. *monos*, solitary,one + *phyle*, tribe) Said of taxa arising from the diversification of a single ancestor (i.e., all the several distinct species descended from a single ancestor species are monophyletic). Taxonomy aims to group species into monophyletic groups. Compare **polyphyletic**.

monopodial (Gr. *monos*, solitary, one, + *podion*, diminutive of *pod-*, *pous* foot) Branching pattern, having one main axis of growth. Compare **dichotomous**, **pseudomonopodial** and **sympodial**.

monopolar (Gr. monos, solitary, one, + *polos*, axis, pivot) The earliest vascular plants (Tracheophytes) exhibited **monopolar** growth- growth along one end of a single axis (essentially stem or rhizome only) lacking a true root axis , instead producing adventitious rhizoids. Modern byrophytes and lycophytes are monopolar. Any roots produced are adventitious in origin. Plants with true roots display **bipolar** growth.

monosulcate (Gr. *monos*, solitary, one + *sulcus* ,furrow, ditch, track) A type of spore with a single germination pore or furrow.

monotypic (Gr. *monos*, solitary, one + *tupos*, mark, impression, type) Having only one representative, eg a genus or a family with a single species e.g. *Loxsoma cunninghamii* is the sole species in the genus *Loxsoma*.

montane In the mountains (general sense). Higher elevation forest. In terms of altitudinal distribution between **lowland a**nd the tree line where the **subalpine** zone begins. Depending on latitude and continentality (distance from the sea), approximately between 500 metres above sea level and the treeline in New Zealand. Generally cool temperate to cold temperate.

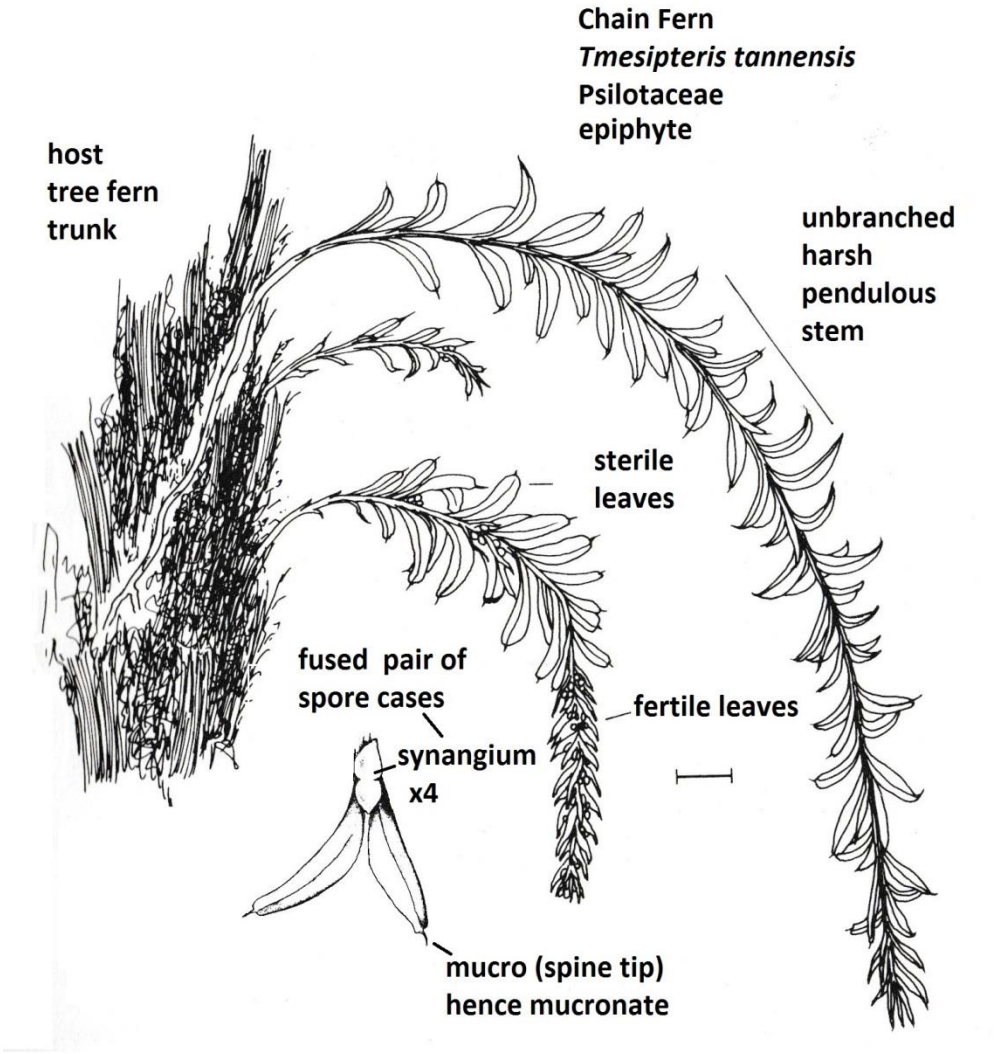
morphology (Gr. *morphe,* form + *logos*, discourse) The study of the form and structure of a plant.

motile (Latin *motus* moved, from *movere* to move) Actively moving by its own propulsion. Said of sperm (antherozoids).

mucilaginous Covered in mucilage, a vegetable jelly of slimy consistency

mucro (L. *mucro ,* a point, sharp end) A sharp abrupt terminal point, e.g.*Tmesipteris tannensis*.
adj. **mucronate**

mucronate (L. diminutive of *mucro ,* a point, sharp end) With a short sharp tip or **mucro**.



'Ferns in Peel Forest: A Field Guide' 1983. Brian Molloy
Department of Lands and Survey. Christchurch

Figure 187 mucronate

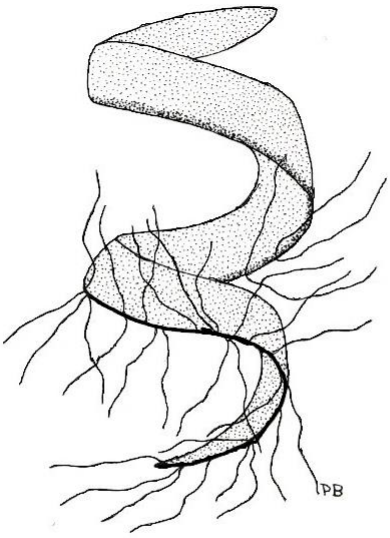
mucronulate (L. diminutive of mucronate) Having a very small mucro; diminutive of mucronate.

multicipital (L. *multus* , many +caput head).) With many heads, a term used for the knobby branches on some fern rhizomes.

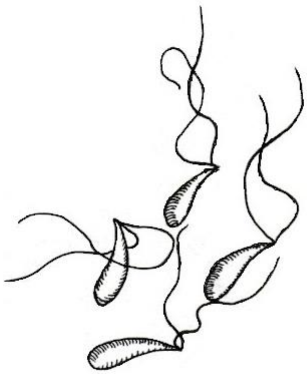
multifarious (L. *multus*, many + *farius*, f. *fariam* ranked in a row or line) In many rows or ranks. Equivalent to **multiseriate**. Compare **unifarious**/**uniseriate** and **bifarious**/**biseriate**.

multifid (L. *multus* , many + *fid*, from Latin *findere* , to cleave) Divided into many parts, e.g. *Hymenophyllum multifidum* frond.

multiflagellate (L. *multus* , many + *flagellum* a whip) A cell such as a sperm cell with many (more than two) flagella, compare **biflagellate** –possesing two flagella.



Fern sperm multiflagellate
(Dittmer)



biflagellate motile sperm
Selaginella

Figure 188 multiflagellate sperm

multiseriate (L. *multus* , many + series, f. *serere* , to join together, bind) Arranged in many rows, such as a hair (trichome) composed of several rows of cells (multicellular), multiseriate at base and tapering to uniseriate apically. Compare **uniseriate, biseriate.**.

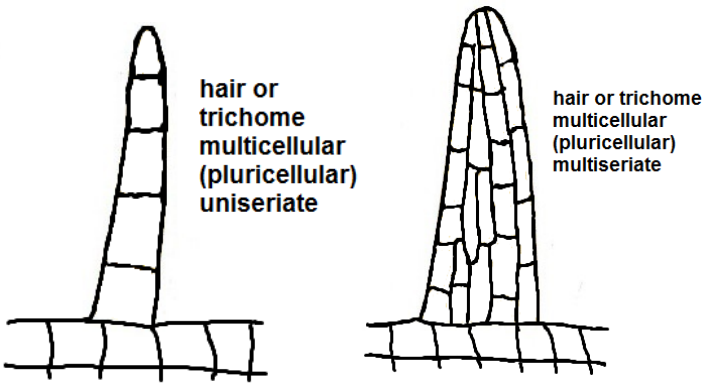


Figure 189 multiseriate versus uniseriate

muri (L. *murus*, a wall) Low ridges.

muricate (L. from *murex* , a pointed rock or stone, *murex* , purple shellfish). Rough, covered with short hard-pointed outgrowths or tubercles.. Similar to **tuberculate** and **verrucate (warty**).

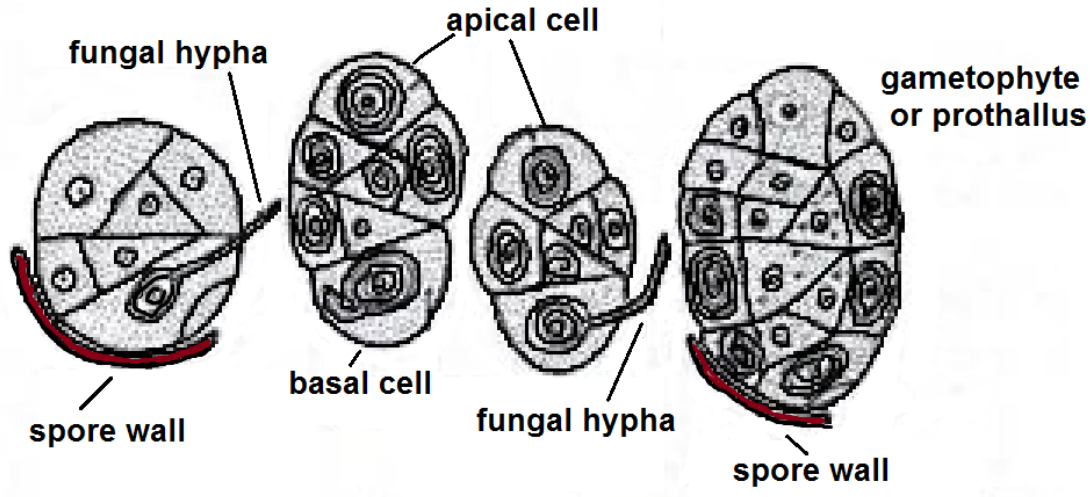
murus pl. **muri** (L. *murus*, a wall) A wall, low ridges separating the lumina of an ordinary reticulum. Spore or pollen wall.

mutualism (L. *mutus*, to exchange) Symbiosis; a relationship in which both organisms benefit. For example mycorrhiza, nitrogen fixation.

mycoheterotroph (Gr. *mykos*, fungus + *heteros*, other + *trophe*, nourishment) A plant which depends entirely on fungi for nourishment. Some fern and lycophyte gametophytes are mycoheterotrophic, quite what the fungus gets out of the relationship is unknown, perhaps it gets payback from the sporophyte generation. See **achloromycoheterotroph.**

mycorrhiza pl. **mycorrhizae** or **mycorrhizas** (Gr. *mykos*, fungus + *riza* , root) Fungi species that associate symbiotically with root systems of plants

mycorrhizal (Gr. *mykos*, fungus + *riza* , root) A beneficial relationship (symbiosis or mutualism) between the roots of a plant or a prothallus and fungi resulting in a nutrient exchange system. See **arbuscular mycorrhiza**, **endo-** and **ectomycorrhiza**.



Gametophyte of *Lycopodium* showing origin of the mycorrhizal association. Entry of the fungus takes place shortly after germination of the spore, and if it does not take place the gametophyte or prothallus never develops more than five cells.

Figure 190 origin of mycorrhizal association

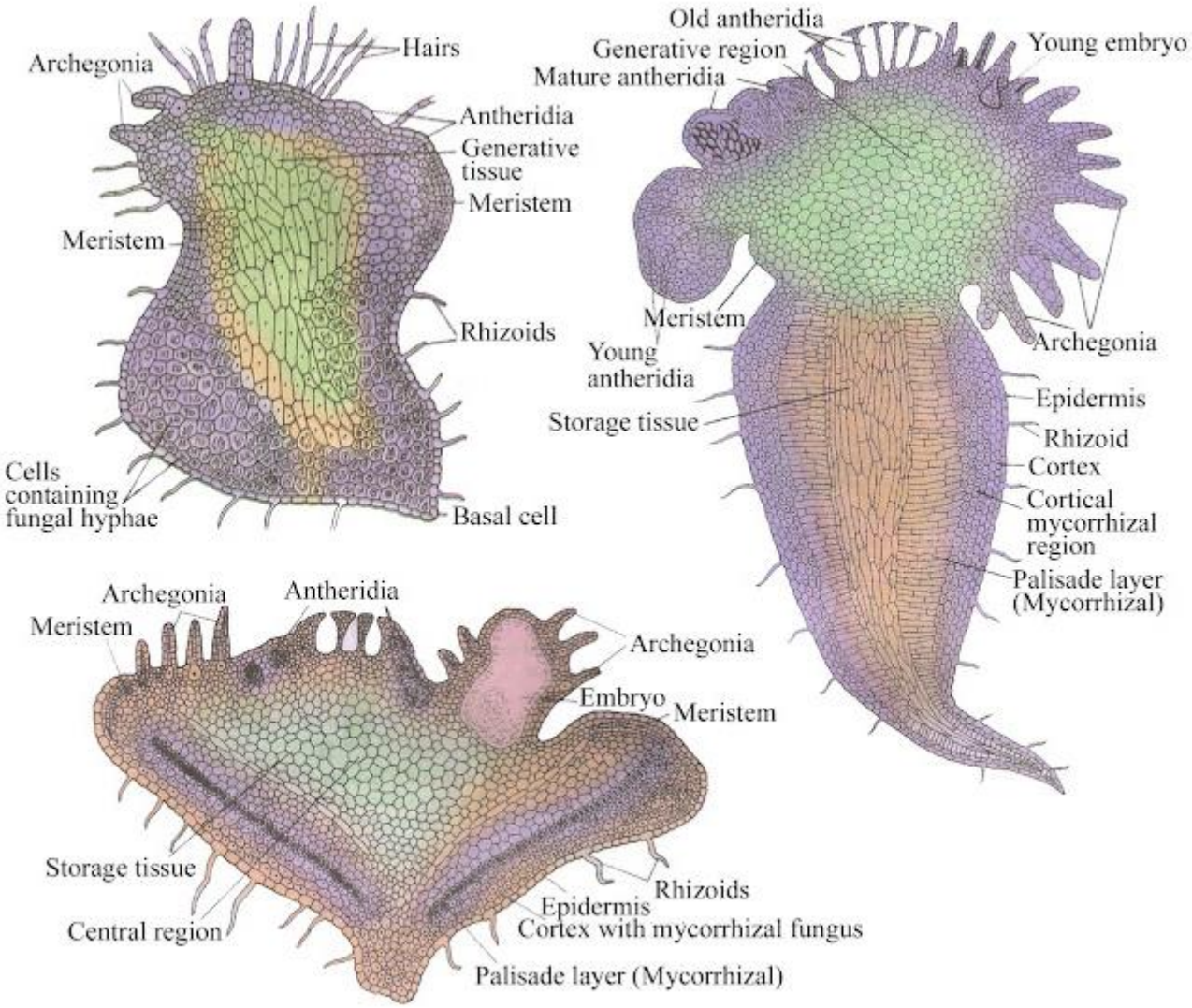


Fig: *Lycopodium*. Three different types of prothallus.

Figure 191 mycorrhizal gametophytes *Lycopodium*

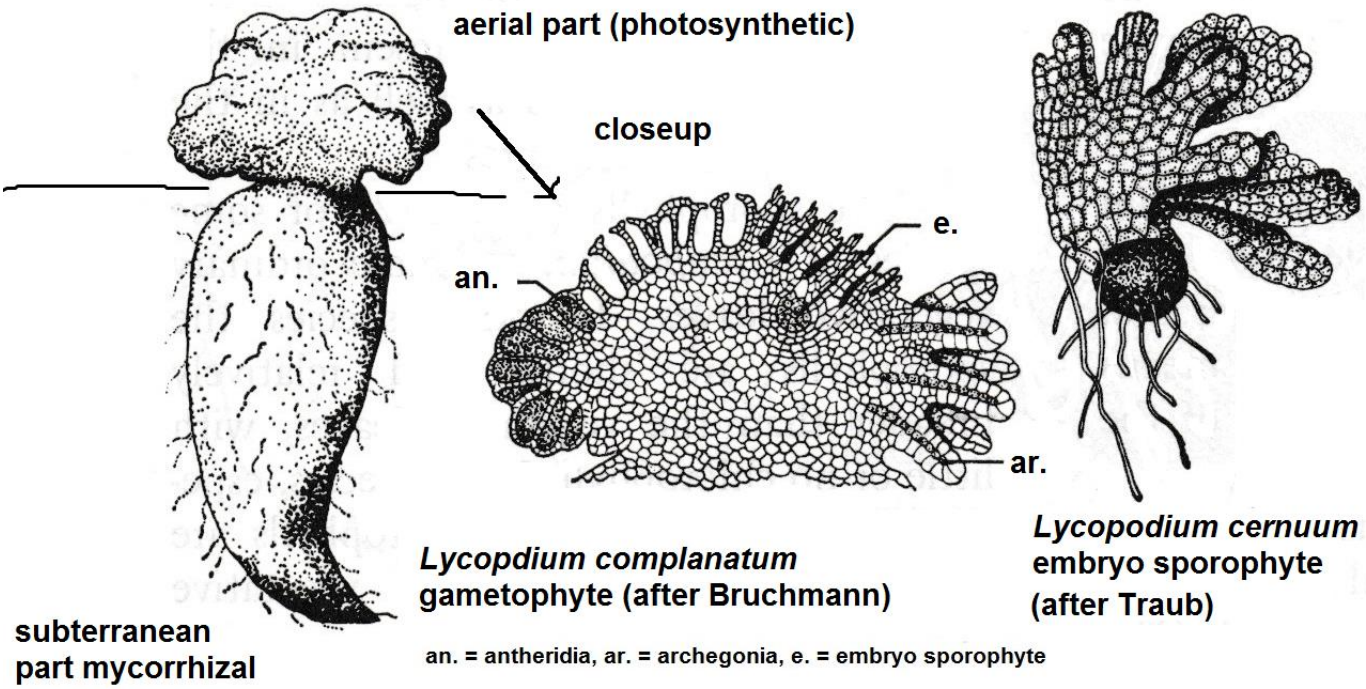


Figure 192 *Lycopodium* gametophytes harbour mycorrhiza (some entirely mycoheterotrophic)

n The abbreviation used for the number of chromosomes in a cell (n (1n) = haploid, 2n = diploid, 3n = triploid etc.

naked Lacking any covering or pubescence. Also said for instance of ferns with unprotected sori (exindusiate).

naked sorus A sorus lacking a protective cover or **indusium**. Synonym : **exindusiate**

naturalized An exotic (non-native) or adventive plant growing and reproducing itself unaided as though a native.

neck canal cells Cells that form a column of cells in the centre of the archegonial neck. The bottom cell is called the ventral canal cell, it sits above the egg cell. These cell disintegrate releasing chemical attractants to sperm, and allowing sperm access to the egg through the canal. See **archegonia**.

neck cells Cells that form the neck of the **archegonium** (female gametangium).

nerve A fine vein.

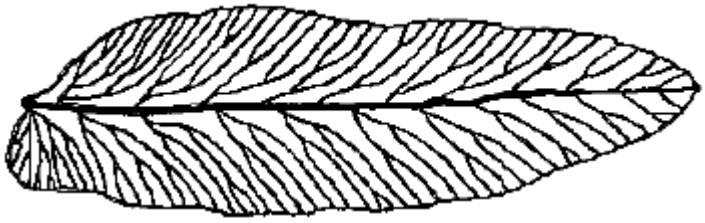
nest fronds Specialised shield-like basal fronds in some ferns (e.g. *Platycerium*) which accumulate leaf litter. Synonym **mantle frond**, **shield frond, nest-leaves.** .

nest-leaves Specialized sterile leaves modified for catching litter and debris, e.g. *Platycerium* sp. Synonym **mantle frond**, **shield frond, nest fronds**.

net-veined Another term for **reticulate venation**, **anastomosing** or anastomising veins.

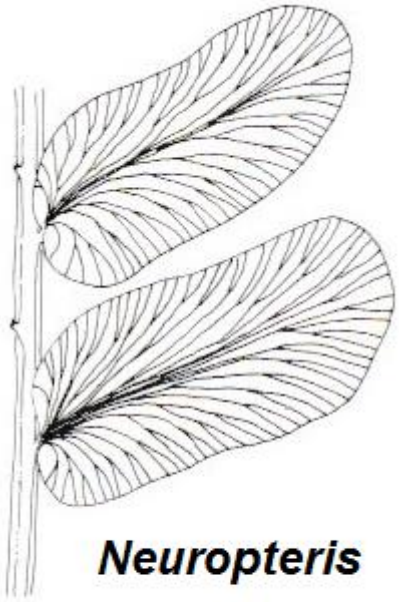
neuropteridian (F. fossil genus *Neuropteris*) A venation pattern in which secondaries leave the midrib (mid-vein) at an acute angle as in **Sphenopteridian** type, but differing in that the secondaries instead of running straight to the margin of the frond, turn sharply towards the margin, curving convexly in relation to the midrib, branching dichotomously distally. The tertiary veins leave the secondaries at an acute angle and run parallel with them towards the frond margin. Probably best regarded as a form of **cladodromous**

venation. Example the exotic Royal Fern *Osmunda regalis*.



***Osmunda regalis* Royal Fern, pinnule exhibiting Neuropteridian venation (type of Ctenopteridian venation - pinnate venation pattern)**

Redrawn from 'Welsh Ferns a descriptive handbook' 1954 by H. A. Hyde and A. E. Wade

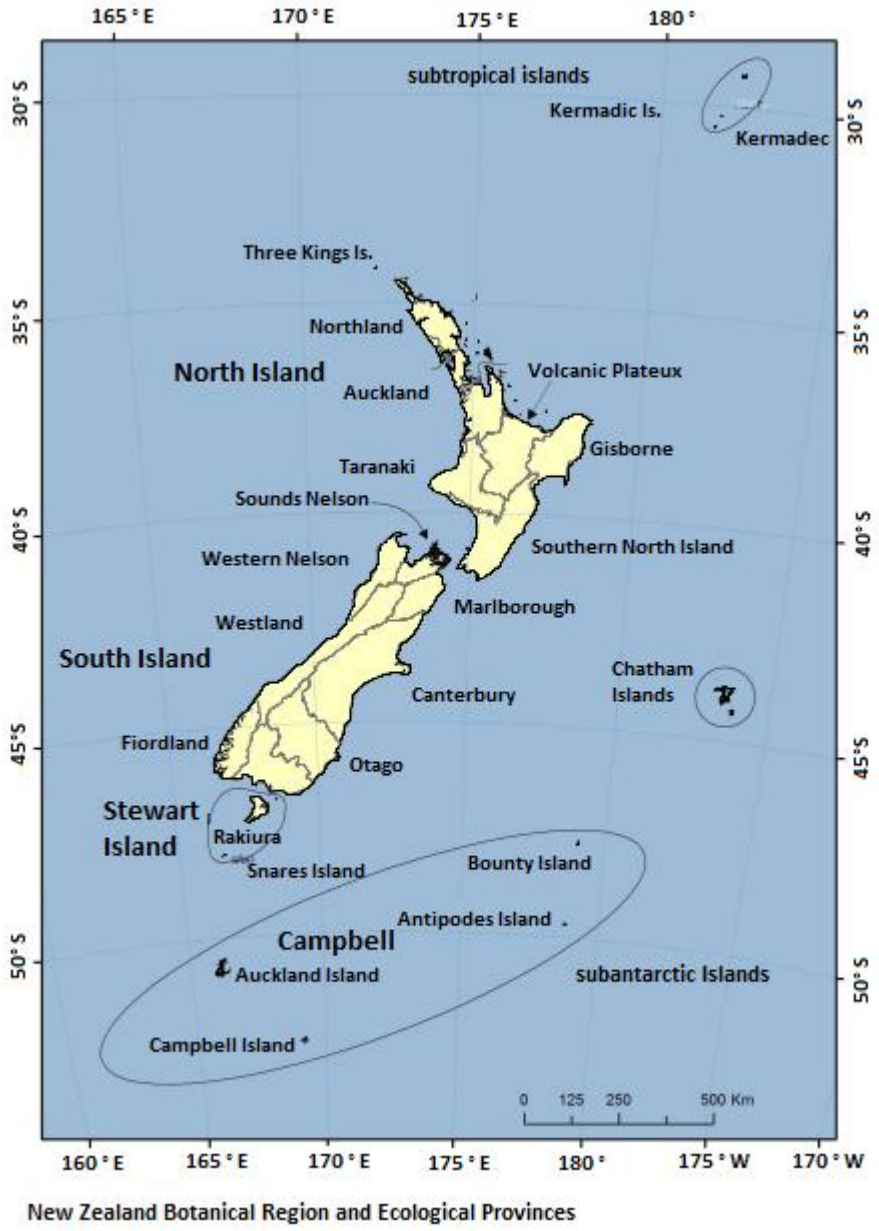


'Paleobotany An Introduction to Fossil Plant Biology' (1981) Thomas N. Taylor, McGraw-Hill Inc.

Figure 193 neuropteridian venation (Mettenius – German botanist 1823-1866)

nexine (‘n’ from non-sculptured, and exine). The part of the outer spore/pollen wall layer (**exine**) that is nonscuptured in contrast to **sexine**.

New Zealand Botanical Region The Islands that are politically New Zealand (Macquarie Island politically Australian sometimes included) Includes the three main islands: North Island, South Island and Stewart Island or Rakiura plus the offshore island groups such as the Kermadec island group in the North, the Chatham island group in the east and the so called subantartic Island group in the South. Ecologists have divided the country into Ecological districts that have the same type of ecosystem repeated throughout-related ecological districts are in turn grouped into ecological regions.



New Zealand Botanical Region and Ecological Provinces

Figure 194 New Zealand Botanical Region

nitrogen fixation Incorporation of atmospheric nitrogen, which is unusable by plants, into compounds that are usable; carried out only by certain kinds of bacteria, such as cyanobacterium *Anabaena azollae*, which inhabits the leaves of the mosquito fern (*Azolla*).

node (L. *nodus*: a knot) A point on a stem where leaves, bracts or branches arise.

nodosity (L. *nodus*: a knot) In *Adiantum*, a callus or swollen node, often lacking normal colouration, where a pinna or pinnule stalk arises from a rachis.

nomenclature (L. *nomenclatura* , a calling by name, list of names, f, *nomen* , name + *calare* call) The study of the application of the names of taxa. The ***International Code of Nomenclature for algae, fungi, and plants*** (**ICN**) formerly ***International Code of Botanical Nomenclature*** (**ICBN**) provides rules and guides for the correct application of botanical names. See **classification, binomial**.

non-circinate vernation A characteristic where the young leaves are hooked like a walking stick rather than coiled in the **circinate**(fiddlehead, crozier or koru) pattern. Ophioglossoid ferns exhibit this pattern. Compare **circinate vernation**.

non-paraphysate. Without **paraphyses** (sterile filaments,hairs or **paranema**) in the sorus. Opposite of **paraphysate** – bearing paraphyses in the sorus.

nullinervate (Gr. *nulli*-, no, none + *nerve*, vein) Lacking a midrib or costa. Synonym **acostate**, **ecostate**, and **enervate**. Opposite of **nervate** or **costate**.

nutrient (L. *nutrire*, to nourish) An element important in plant growth and supplied from the soil, water (aquatic plants) or by manures and fertilizers. Essential elements are nutrients required by plants, in the right amounts (too much can be toxic while too little can result in deficiency symptoms). Often divided into macronutrients and micronutrients (or trace elements) and some add the category mesonutrients (in between). Nutrients required by some but not all plants are called beneficial elements. Carbon (C), Oxygen (O) and Hydrogen (H) obtained from air or water by plants are essential too, (average 96% plant dry tissue). The other known essential nutrients include: the macronutrients: Nitrogen (N), Potassium (K) Calcium (Ca),Phosphorus (P) and Sulfur (S); the micronutrients: Chlorine (Cl), Iron (Fe), Boron (B), Manganese (Mn), Zinc (Zn), Copper (Cu), Nickel (Ni), and Molybdenium (Mo).. An example of a beneficial element is Silicon (Si) which is required by the horsetails *Equisetum* spp. .

NV (number of veins) A method of estimating the maturity of a frond based on the count of the veins extending from the midrib of sequentially-produced leaves.

ob-: a prefix signifying the opposite of, reverse of. Hence lanceolate and **ob**lanceolate cordate and **ob**cordate.

obconical (ob + conical) Cone-shaped but attached at the narrower end.

obcordate (ob + cordate) Cordate with the broadest part above the middle. See **leaf shape** terms.

oblanceolate (ob- + lanceolate) Lanceolate with the broadest part above the middle instead of below the middle. . See **leaf shape** terms.

obligate (L. *obligare*, *ob*-, down +*ligare* , to bind) Essential, unable to exist without. Compare **facultative**

oblique (L. *obliquua* f. *ob* – intensely, + *liquis* , slanting) With the sides unequal or slanting. The fern *Loxsoma cunninghamii* gets its generic name *Loxsoma* “oblique band” from Gk. *loxos*, oblique or slanting; and *zoma*, girdle alluding to the oblique band or annulus of the sporangium. See also **plagiotropic.**

oblique cell division Cell division angle that changes the direction of growth e.g. branching in filamentous growth pattern.. Diagonal cell division. Compare **anticlinal** and **periclinal** cell division.

oblong (L. ob- + *longus*, long) Longer than broad with mostly parallel sides and rounded ends **.** . See **leaf shape** terms.

obovate (Ob- + ovate) Ovate with the broadest part above the middle. See **leaf shape** terms.

obtuse (L. *obtundere* , f. *ob*- against + *tundere*, to thump, hence make blunt) Blunt or rounded at the apex, the converging edges separated by an angle greater than 90°. *Asplenium obtusatum.* See **leaf apices**

obtuse-angled (L. *obtusangulus*) Having projecting longitudinal angles that are rounded in contrast to **acute-angled** (L. *acutangulus*) when they are sharp.

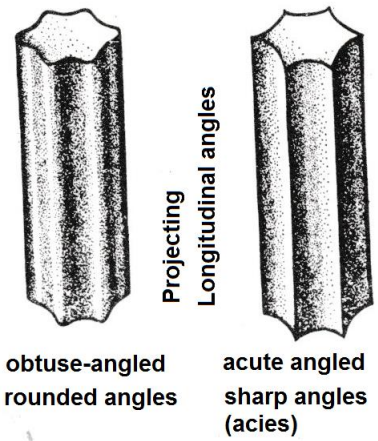


Figure 195 obtuse- angled versus acute angled

occluded (L. *occludere* f. *oc-* + *claudere* , shut) Filled with material making the structure opaque.

offset A growth arising at the base of a plant, or on a trunk. An asexual or vegetative **propagule**.

-oides (L. *–oides*, like) Suffix meaning resembling (as in *Leptopteris hymenophylloides* –resembling *Hymenophyllum*) and sometimes implying related to (as in Gleichinoid fern).

olivaceous Dark olive-green.

ombrogenous (Gr. *ombro-* rain, *ombros*, rain shower + *genesis*, origin) A wetland that is nourished solely by precipitation. Compare **soligenous** – a wetland such as a swamp, fen or marsh that is nourished by water flowing over or through soil.

opaque (L. *opacus*) Incapable of transmitting light. See **occluded.**

Ophioglossales- Ophiogossoid Ferns Primitive eusporangate ferns order Psilopsida Family Ophioglossaceae –adders tongue ferns with two genera *Ophioglossum* (2 species)and *Botrychium* (3 species) in New Zealand. Allied to Psilotales- the whisk ferns.

opposite Attached opposite each other along the stem, rachises or costae; said of leaves, pinnae and pinnules. **Subopposite** means nearly opposite or slightly alternate. Compare **alternate**, **whorled**.

opposite leaf phyllotaxy A pair of leaves at each node directly opposite each other and either with the next pair directly above, so there are two vertical rows of leaves (opposite and superposed, or nondeccusate or **distichous**) or the next pair of leaves are placed at right angles, so that there are four vertical rows of leaves (opposite and **decussate**) arrangement as in *Veronica* (*hebe*) sp. . Leaflets of a pinnately compound leaf normally follow the first pattern opposite distichous or alternate distichous..

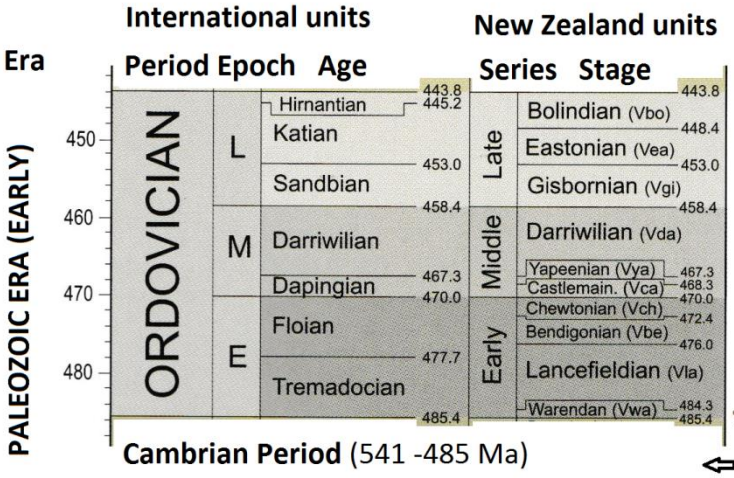
-opsida Suffix denoting the rank of **Class** in the taxonomic hierarchy. For example, Psilopsida (fork ferns), Lycopsida (club mosses, spike mosses and quillworts), Equisetopsida (Horsetails), Filicopsida (True Ferns). The rank between **Division** (or Phyllum) and **Order**. See **classification**.

orbicular (L. *orbicularis,* f. *orbiculus* , circular figure, small disk, f. *orbis* , disk, circle + *-culus,* diminutive suffix)) Circular or nearly circular in outline. Length = width.

order A taxonomic grouping of similar families. The suffix: –ales , denotes the rank of order in the taxonomic hierarchy. Examples include Lycopodiales, Equisetales, Psilotales, Ophioglossales , Marattiales, and Filicales. Order is below the rank of **class** and above **family**. See **classification**.

Ordovician Period (named after the Welsh tribe of the Ordovices) The chronostratgraphic period dating from the end of the Cambrian Period 485.4 million years ago (Mya) to the start of the Silurian Period 443.8 Mya.

Silurian Period (444 -419.2 Ma)



Cambrian Period (541 -485 Ma)

444 Ma approximate end Ordovician Period

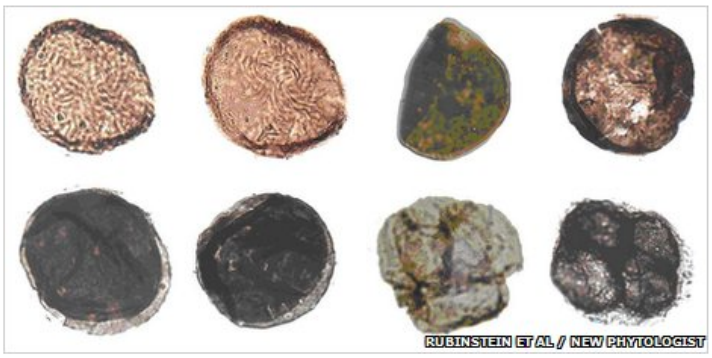
Proembryophytic epoch
'bryophyte' grade & clade plants develop

First liverwort type spores c. 470 Ma

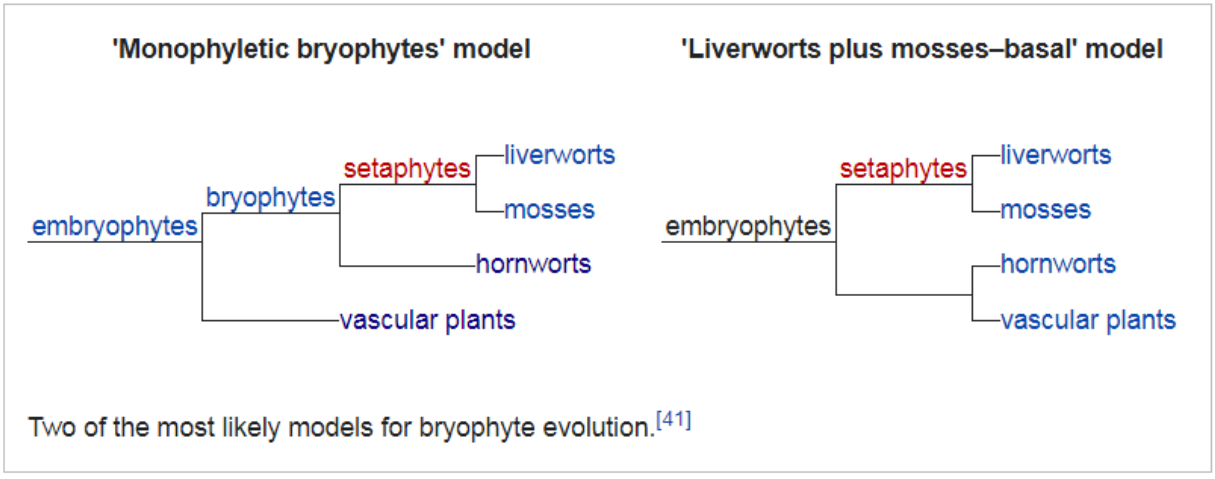
485 Ma approximate start Ordovician Period

⇦ terrestrial algae, cyanobacteria & lichens?

* **Evidence of Bryophyte grade or clade plants from this time (472 Ma)**



The cryptospores are the oldest land plant fossils yet found, have similarities to those of liverworts. Claudia Rubinstein of the Department of Palaeontology at the Argentine Institute of Snow, Ice and Environmental Research in Mendoza,



Two of the most likely models for bryophyte evolution.[41]

https://en.wikipedia.org/wiki/Marchantiophyta#cite_note-Walker_2010-1

Also evidence for the first land fungi may have been arbuscular mycorrhiza fungi (Glomerales), playing a crucial role in facilitating the colonization of land by plants through mycorrhizal symbiosis, which makes mineral nutrients available to plant cells; such fossilized fungal hyphae and spores from the Ordovician of Wisconsin have been found with an age of about 460 million years ago, a time when the land flora most likely only consisted of plants similar to non-vascular bryophytes.

organic matter Decaying and decomposed material in the soil that comes from living organisms. Includes **litter** or forest duff and humus. Rich in carbon.

orientation (L. *orients*, the quarter where the sun rises- the east, in relation to a point on a compass) The angle of a structure relative to a central axis.

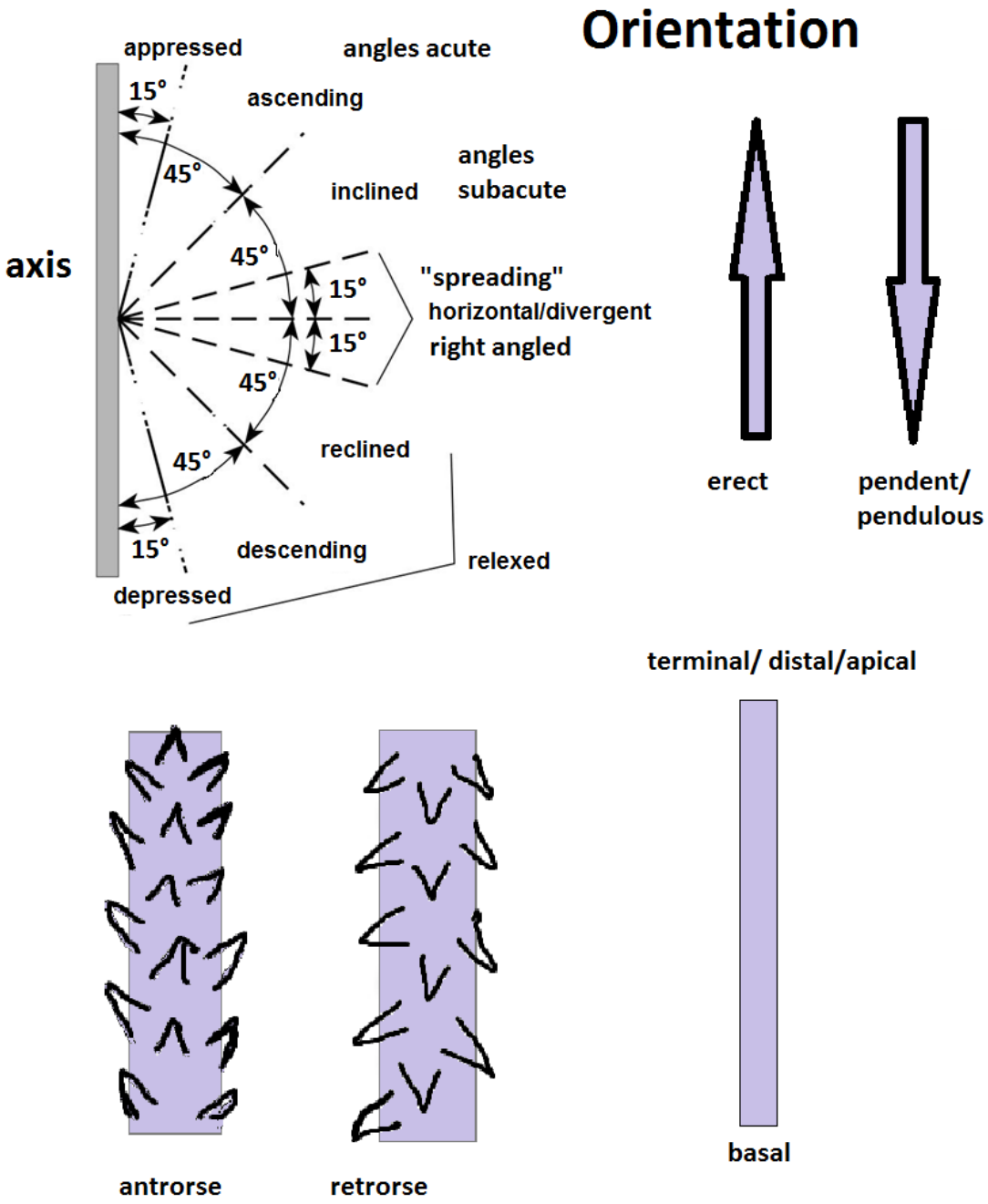


Figure 196 orientation terms

orthostichous (Gr. *orthós,* straight + *stichos* ,row) Arranged in regular vertical rows on a stem or axis.

osumundaceaous ferns. Ferns of the Osmundales, single family Osmundaceae. Primitive leptosporangiate ferns. In New Zealand, *Todea barbara, Leptopteris hymenophylloides, L. superba* and the naturalized *Osmunda regalis*.

outcrossing When a sperm fertilizes an egg cell of another gametophyte that came from a different sporophyte. The opposite of **selfing**. The resulting offspring are heterozygous in the case of outcrossing and homozygous in the case of selfing.

ovate (L. *ovum* , an egg) A flat plane with the outline like that of a longitudinal cross section of a hen's egg, with the basal end broader. Widest near the base; 1½ to 3 times longer than wide. See **leaf shape**.

ovoid (L. *ovum*: an egg + Gr. *-oid* f. *-oeides* resembling) A solid object with the outline of an egg.

oxylophil/oxylophile (Gr. *oxy*-, sharp,acid + *phile*, loving) Preferring an acid or humus rich habitat. Synonym **acidophilic**, Similar **calcifuge** and **calciphobe**. Opposite **basophil** and **calciphil**.

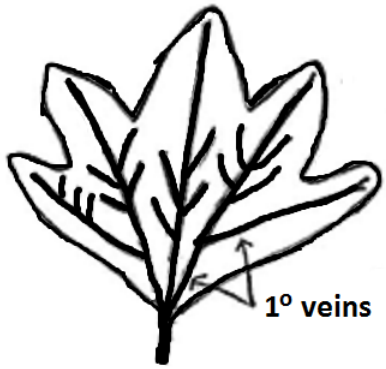
palea (L. *palea*: chaff, the husk of wheat separated in threshing) A chaffy scale. Also in general scales on various parts of ferns hence **paleate** and **paleaceous**.

paleaceous (f. palea) Furnished with scales often chaff-like in texture. See **palea**. Compare **lepidote**.

paleate (f. palea) Clothed with scales. See **palea** and **lepidote**.

Paleozoic Era (Gr. *palaeo- palaios*, ancient + Gr. *zōē* 'life' + -ic) .The geologic time era spanning 540 to 252 million years ago. Includes:- the Cambrian, Ordovician, Silurian, Devonian, Carboniferous and Permian periods. Non-vascular land ("Bryophyte" grade) plants arose in the Ordovician period, the first vascular land plants in the Silurian to Devonian periods of the paleozoic..

palinactinodromous (Gr. *palindromos*, running back again, *palin*, back again, + actinodromous) Actinodromous **leaf venation** (ternate or palmate) pattern but with additional branching above the main point of divergence of the primary veins. (Unusual term)



Palinactinodromous venation
compound actinodromous with a mix of
basal, suprabasal & pedate actinodromous

palmate (L. *palma* ,the palm of the hand) Of a leaf, divided into several leaflets radiating from the same point. Hand-shaped, radiately lobed, or divided. Most ferns follow the **pinnate** pattern.

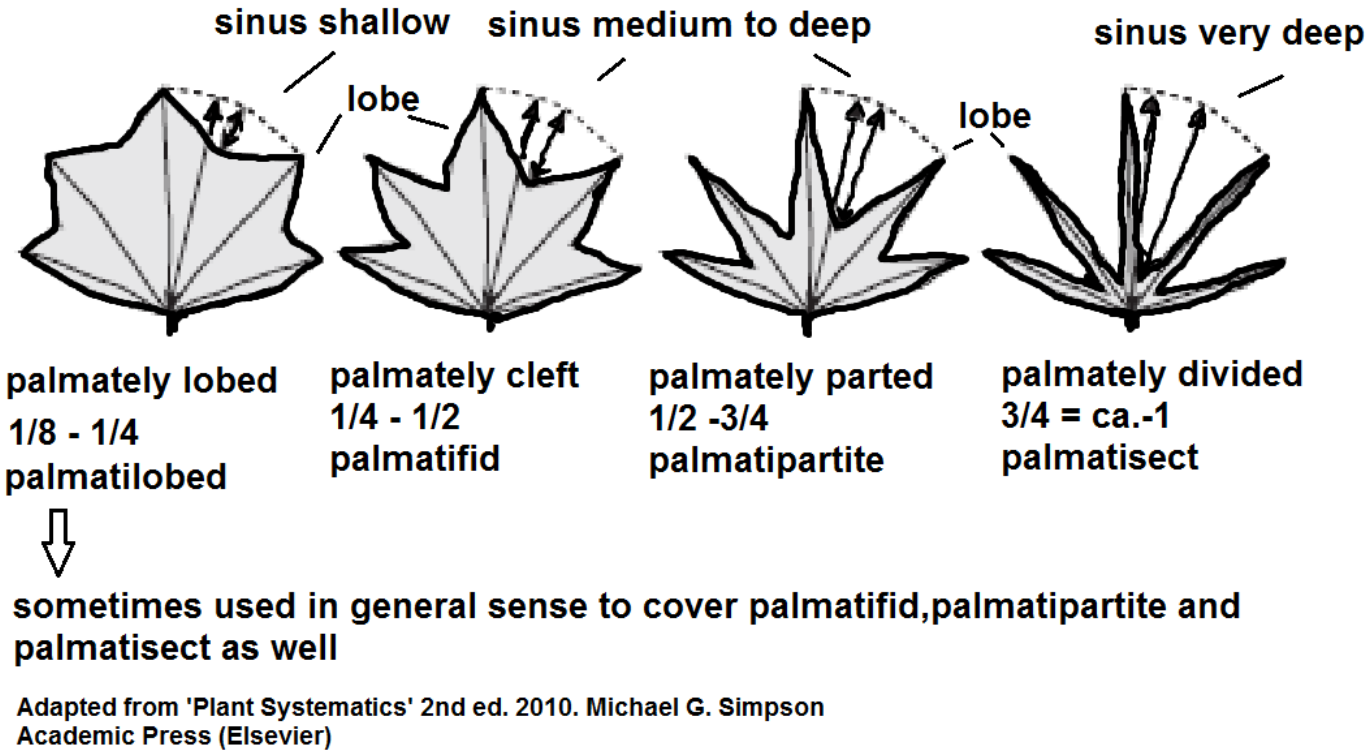


Figure 197 palmate

palmatifid (palmate + -fid L. f. *fidus*, f. *findere* , to split, cleave) Of a leaf, deeply (but not completely) divided into several lobes which arise (almost) at the same level in the palmate pattern. In the broad sense includes **palmately lobed /palmatilobed (**1/8-1/4 sinus depth to base), **palmately cleft** (**palmatifid** strict sense)(1/4 – ½) **palmately parted/palmatipartite** (1/2 – ¾) –the lobes occupying more than half of the leaf.. If more deeply divided that is **palmately divided/palmatisect** (3/4 –ca. 1)- the lobes almost extending to the base.

palmatilobed (palmate + lobed) Lobed with the lobes radiating from a central point like the fingers of a hand. Palmately lobed in general sense. In precise sense with a shallow sinus (1/8 -1/4 sinus depth to base).

palmatipartite (palmate +L. *partire* to divide, from *part-, pars* part.) Palmately parted. Lobed in the hand shape pattern, the lobes occupying more than half of the leaf. Sinus depth ± 1/2 –3/4.

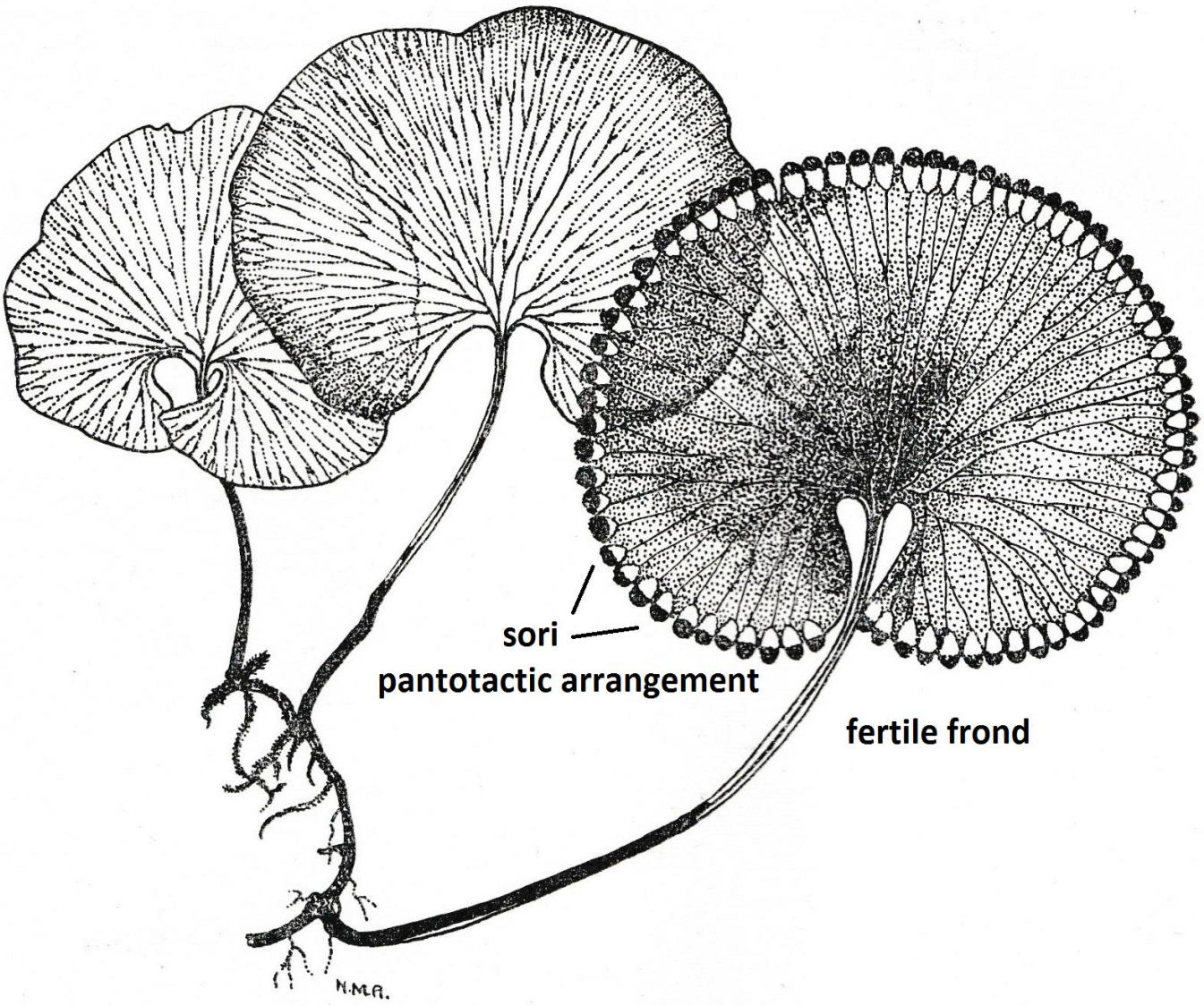
palmatisect (palmate + *sectus*, f. *secare* to cut) Lobed like a hand, the divisions extending nearly to the base. Palmately divided (3/4 – ca. 1 sinus depth). Compare **palmatifid**.

paludicolous (L. *palus*,marsh + *cola* inhabitant f. *colere*, *colereto* to live in a place, to inhabit) A marsh dwelling plant or animal.

palynology (Gr. *palynos* , dust +) The science of the structure of spores (including pollen). Spores and pollen are quite resistant and frequently preserved as fossils, which can be studied by paleobotanists. A **spore** has a single haploid (1n) vegetative cell that in land plants, originates from meiotic division of sporocytes in the sporangium borne by the adult sporophyte, ultimately growing into a gametophyte by mitosis. **Pollen** is similar to a spore but the haploid cell germinates within the spore wall (endospory) to produce a greatly reduced (few-celled) male gametophyte in the seed plants.

panicle (L. *panicula* , a tuft on plants, panicle)) A branched racemose inflorescence; in ferns a loosely arranged cluster of sporangia on a fertile spike as in *Botrychium* spp.

pantotactic (Gr. *pan*, all + *táxis*, I arrange,order) When sori are on nearly all veins of an ultimate branch system. Compare **epitactic** and ***paratactic*.** Tyron suggests these terms are difficult to apply to leaves with an entire to 1-pinnate lamina, and they are redundant to terms for the kinds of branching system.



Kidney fern *Hymenophyllum nephrophyllym* syn. *Trichomanes reniforme*
Artist Nancy M. Adams 'Encyclopedia of New Zealand' 1966
R. E. Owen, Government Printer, Wellington, New Zealand

Figure 198 pantotactic soral arrangement

papilla (L. *papilla* , nipple, f. diminutive of *papula* pimple) a small elongated protuberance on the surface of an organ, usually an extension of one epidermal cell. adj. **papillose**.

papillate (L. *papilla* , nipple, f. diminutive of *papula* pimple) With wart or nipple-like glands,or pimple-like raised areas. Applied to leaf or spore surface for instance e.g. *Botrychium lunaria* spore surface. See **leaf indumentum.**

papillose (L. *papilla* , nipple, f. diminutive of *papula* pimple) Having minute, pimple-like projections on the surface. See **leaf indumentum.**

papyraceaous (L.*papyrus* , papyrus plant from which paper is made) With a texture like parchment.

parallel (L. *parallelus*, lines extending in the same direction and at the same distance) In leaf venation, with primary or secondary veins ± parallel to one another, generally converging at the apex, the ultimate veins transverse. Characteristic of monocotyledons.

parallelodromous (parallel + Gr. *dromos*, running, racecourse) Having the primary veins in a leaf blade arranged approximately parallel to one another, although converging at the base and apex of the leaf. Characteristic of many monocotyledons. Synonym **striate venation**, **parallel venation**.

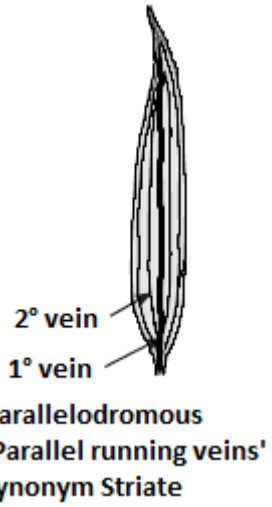


Figure 199 parallelodromous venation

parallelogrammoid (f. parallelogram f. Gr. *parallēl-ógrammon*, a shape "of parallel lines") With 4 sides, the opposite sides parallel.

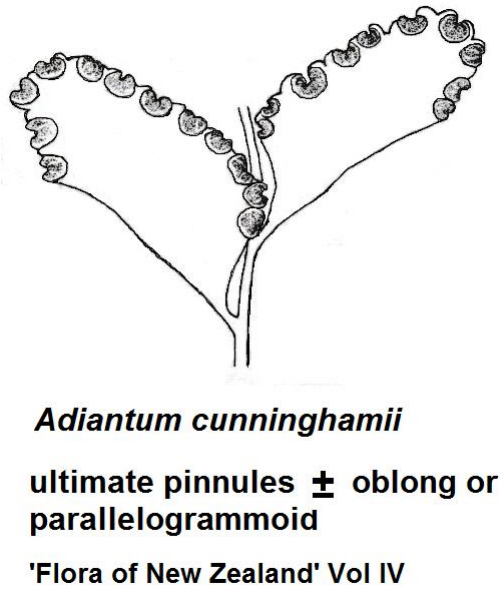


Figure 200 parallelogrammoid

paranema (plural **paranemata**) (Gr. *para*, about, *nēma*, a thread) Sterile filament in the reproductive organs of algae, fungi and ferns.

paraphysate (Gr. *para*- , beside +*physis* , growth +-ate) Bearing paraphyses. Opposite of **non-paraphysate.**

paraphysis (Gr. *para*- , beside +*physis* , growth) Sterile filaments (**paranema**) or hairs borne among sporangia in a sorus: may be simple or branched, pointed, glandular or clubbed pl. Some may represent undeveloped sporangia. **paraphyses.** Soral hairs or filaments if you like.

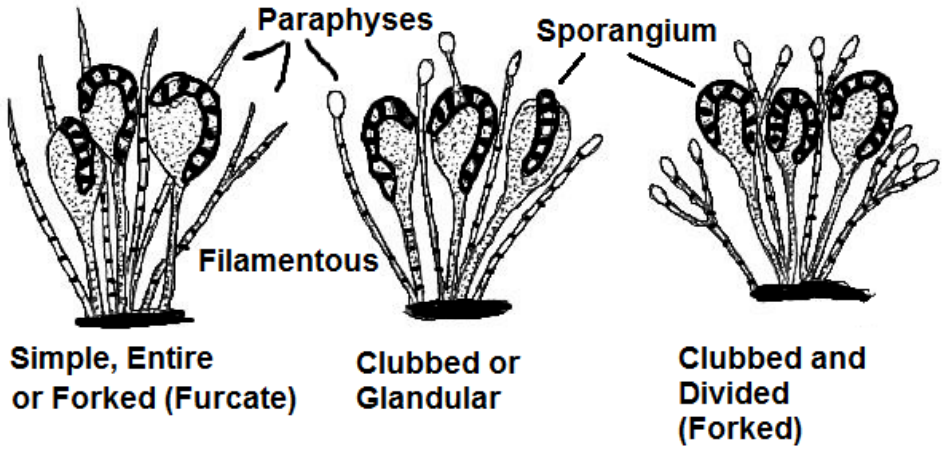


Figure 201 paraphyses

Modified from David L. Jones , "Encyclopedia of Ferns" 1987, Lothian Publishing Co.

paratactic (Gr. *parátaxis*, "placement side by side" f, *pará*, beside + *táxis*, I arrange,order) With **sori** on the basal veins of the ultimate branch system of a lamina with anadromic branching (the first branch of a segment, is given off towards the apex of the lamina, pinna or pinnule). Compare **epitactic** and **pantotactic**. Terms mostly applied to filmy ferns- Hymenophyllaceae . See **soral position**.

parenchyma: (Gr. *parenchyma* to pour in beside f. *para-* beside + *en-* + *chein* to pour) Term derived from an ancient Greek concept of how tissue formed from coagulating blood in a mould . The simplest of three cell types found in plants, the other two are **collenchyma** and **sclerenchyma**. Parenchyma is plant tissue consisting of mature living cells that are relatively unspecialised in function. Cells isodiametric to elongate in shape, possessing a primary cell wall (cellulose) only. Potentially meristematic. If the cells contain chloroplasts the term **chlorenchyma** may be used. The latter are the principal photosynthetic cells in plants. Parenchyma is usually found in the ground tissue: pith or cortex of the stem or roots, and the mesophyll of the leaf.

paripinnate (L. *par*, *paris* , equal + *pinnate*) Also known as **even-pinnate**, pinnately compound without a terminal leaflet, ending in a pair of leaflets. Rare in ferns – Gleicheniaceae have paired leaflets but not in the pinnate pattern. Compare **imparipinnate** or **odd-pinnate**.

parted When the sinus extends (pinnately or palmatly) ½ to ¾ of the distance to the midrib or similar central axis .See: **partite**, **Pinnatipartite** and **palmatipartite**. See **Leaf division**.

partite (L. *partitus*: f. *partio*, I share, part) Divided nearly to the base into lobes or divisions. Similar to **parted**.

pateliform (L.. *pateli*, saucer, plate + form) Plate-like. Can be used to describe scales, or indusia for instance.

patent (L. *pateo*: to lie open, exposed to) Spreading, horizontal; divaricate or divergent orientation.

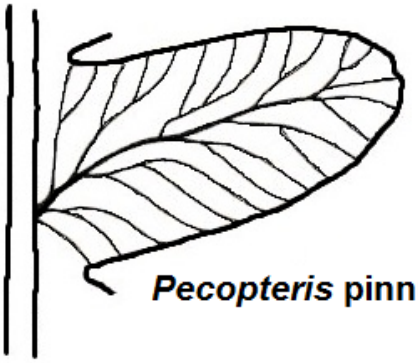
Peat: A mass of partially carbonised plant tissue formed by partial decomposition in water of various plants and especially of mosses of the genus *Sphagnum*, widely found in many parts of the world, varying in consistency from a turf to a slime used as a fertiliser, as stable litter, as a fuel, and for making charcoal. Partially carbonized vegetable matter saturated with water; can be used as a fuel when dried. A type of soil deriving from dead organic material situated in a wet area, where the reduced amount of [[oxygen available in the wet conditions results in the organic material not decomposing as much as it usually would do so in the presence of more oxygen. Used in growing media. Represents an important carbon sink –drainage of peat releases large amounts of carbon (CO_2) to the atmosphere.

P:E Ratio In palynology, the ratio of the **polar dimension** to **equatorial dimension:** the ratio polar to greatest equatorial axis, taking the longer of the two as 8.

pecopteridian venation (f. fossil Seed Fern (Pteridosperm) genus *Pecopteris*) Venation pattern in which the tertiary veins leave the secondary veins in a pinnate arrangement.

Athyrium filix-femina **exhibiting Pecopteridian venation**

'Welsh Ferns a handbook' 1954
H. A. Hyde and A. E. Wade



Pecopteris **pinnule**

'Paleobotany An Introduction to Fossil Plant Biology'
(1981), Thomas N. Taylor, McGraw-Hill inc.

Figure 202 pecopteridian venation (Mettenius, German botanist 1823-1866)

pectinate (L. *pectin* , a comb) Comb-like; deeply divided with the segments narrow and close. See **Leaf margin.**

pectinal vein (L. *pectin* , a comb) Lateral veins that produce abmedial veins (veins facing away from the midvein) almost throughout their length.

pedate (L. *pedatus* footed, from *ped-, pes* foot) Of a palmate or palmately-lobed leaf, having the basal lobes or lateral segments divided again e.g. *Adiantum hispidulum*

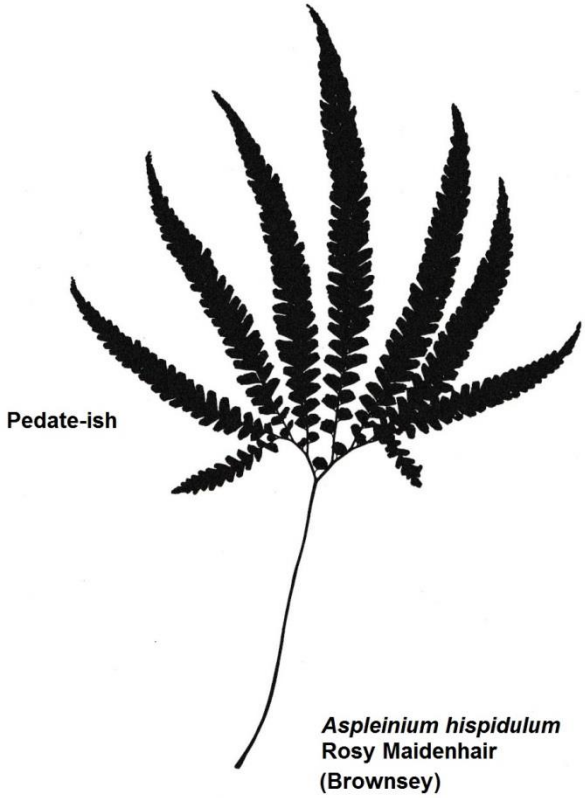


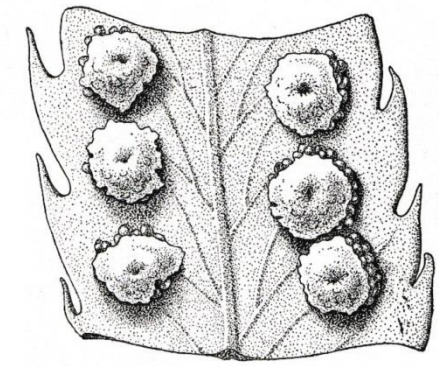
Figure 203 pedate

pedicel (L. *pediculus* , a little foot) In ferns the stalk of a sporangium or a conceptacle; more generally**,** a stalk, usually short and narrow, supporting a gland or other larger structure.

peduncle (L. *pedunculus* a late Latin form of *pediculus*, a lttle foot) In ferns the stalk supporting a sporocarp e.g. in *Marsilea*.

pellucid (L. *pellucio* , transparent, to shine through) Transparent.

peltate (L. *pelta* , shield , f. Gr. *pelte* , shield) Having the stalk attached to the lower surface (hence also basally attached) usually at or near the centre (centrally attached); umbrella-shaped. Hence **peltate indusium** shield-like (round) with the stalk attached near the centre and a **peltate scale** one attached at a point away from the margin. If the stalk is off centre, or one sided the term **eccentric peltate** or **subpeltate** can be applied. The shield ferns such as *Polystichum* and *Lastreopsis* receive that name because of the prominent peltate indusium they possess.



Polystichum sp. Shield fern with peltate indusia

'Textbook of General Botany' 4th ed. 1938
Esther G. Holman & Wilfred Robbins

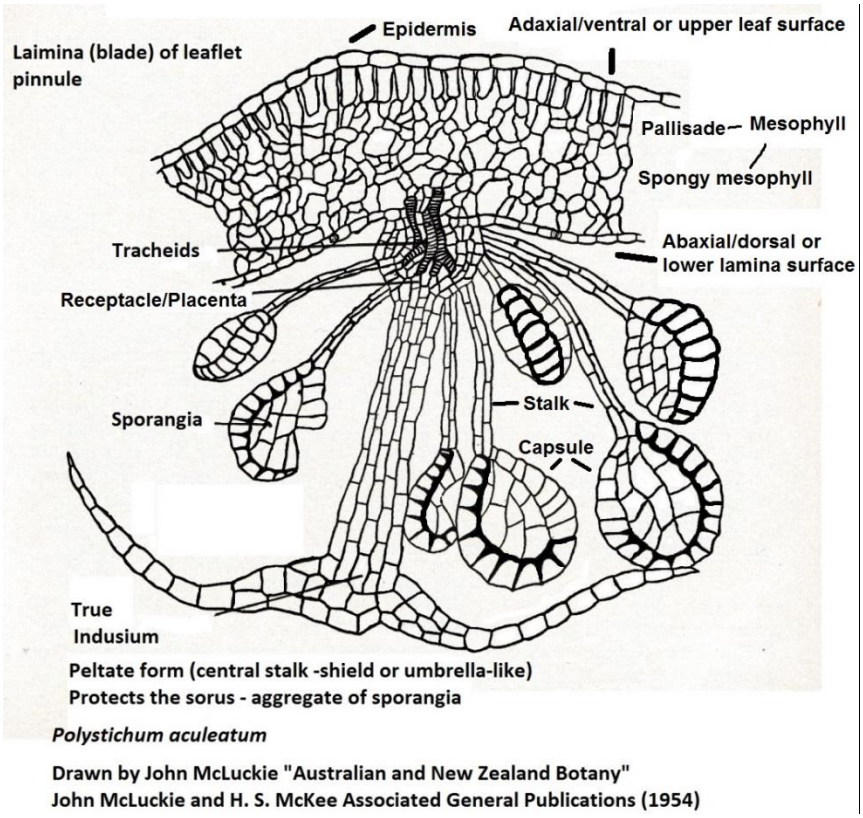


Figure 204 peltate indusium

pendent ((L. *pendo* to hang down) Hanging downwards. Also **pendulous**.

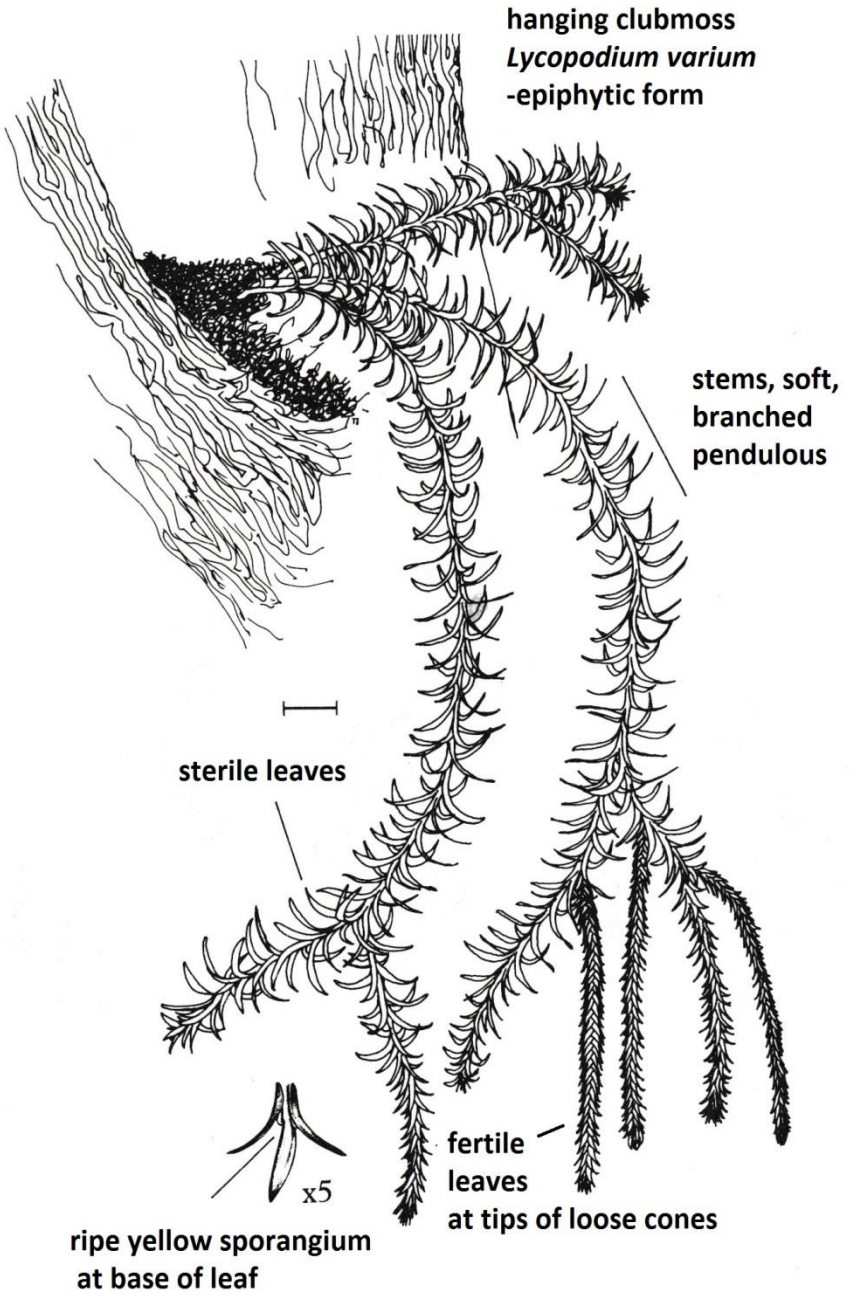


Figure 205 pendent growth form

penninerved (L. *pinna*, a feather + nerve) The veins (nerves) branching pinnately.

pentapinnate (Gr. *penta*, five + pinnate) The frond divided five times pinnately. 5 x pinnate. Synonym **quinquepinnate**. The term **decompound** meaning 'very-compound' could also be used.

percurrent (L. *percurrens*, f. *percurrere*, to run or pass through, f. *per*, through + *currere*, to run) Extending through the entire length, such as from the base to the apex —used of the midrib of a leaf. In leaf venation, when tertiary veins link the secondary veins (or quaternary veins link the tertiary veins) in a ladder-like (**scalariform**) pattern. Compare netlike or reticulate pattern.**Opposite percurrent**: in relation to quaternary veins (4°) – crossing between adjaceant tertiary veins (3°) in parallel paths, without branching and **alternate percurrent** when quaternary veins cross between adjaceant tertiaries with an abrupt offset (an abrupt angular discontinuity).

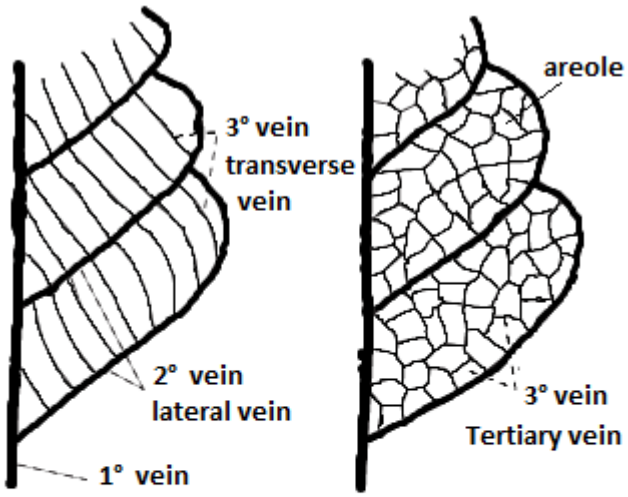


Figure 206 percurrent/scalariform venation and reticulate venation

perennate Maintain a dormant state through the non-growing season. Hence perennating organ.

perennial (Latin *perennis*, f. *per-* throughout + *annus* , year) Living for more than two years. The majority of ferns are perennial. Can be subdivided into short-lived and long-lived perennial, as well as deciduous or evergreen, herbaceous, shrubby (suffrutescent) or arborescent (tree form). Compare **ephemeral**, **annual** and **biennial**.

perfect In leaf venation said if vein branches cover at least two thirds of the leaf blade area (or reach at least two thirds of the distance toward the leaf apex). It is **imperfect** if veins coverage is less than this.

pericostal (Gr. *peri- ,* about, around + costa) Located along and near the costa (mid-rib), e.g. sorus or sporangium located near the costa. See **soral position**.

peridroma pl. **peridromae** (Gr. *peri-* around + *droma* running) The main axis (midrib) of the lamina from the junction of the stipe with the lamina, or lowermost pinna, to the apex. Synonyms: **midrib**, **rachis**, **rhachis**.

perine (*peri-* around + *-ine,* after German *Perinium.* in Latinised form) A thick outer (perisporial) spore wall layer, present in some families and genera of ferns and mosses. Compare **exine**. Synonym **perispore**.

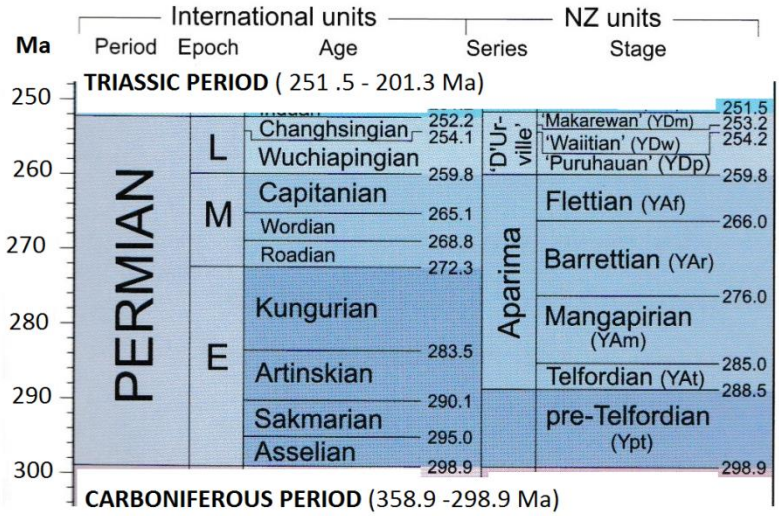
perinium (*peri-* around + *-ine,* after German *Perinium.* in Latinised form) An outer coat of the microspores of certain Lycophytes and ferns.

peripheral fibre strands: Multicellular fibre strands which strengthen the periphery of the leaf in some *Isoetes* species.

perispore (Gr. *peri-* , around + spore) The folded membrane of most spores, forming an ornamental external covering. Synonym **Perine.**

Permian Period (f. the Russian region of Perm, where rocks deposited during this time are particularly well developed) The chronostratigraphic (geological) time period from about 299 -252 (Ma), that followed the Carboniferous Period and was followed by the Triassic Period. Represents the late Paleozoic. Evolving

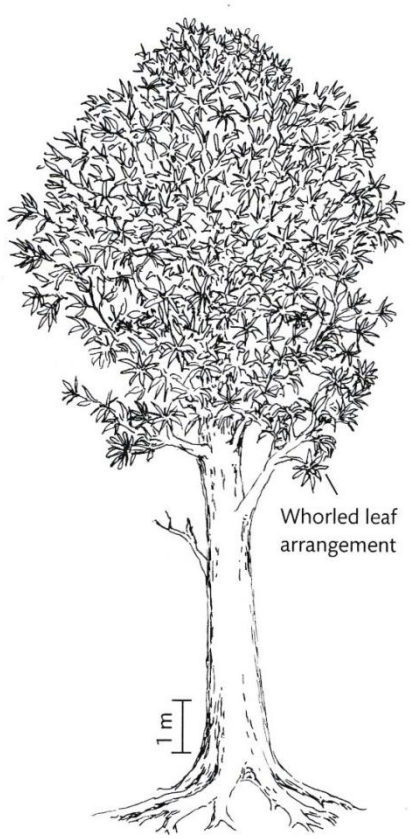
during this time were the cycads, bennettites, ginkos, glossopterids (Gondwana) and other late paleozoic pteridosperms (Angiosperms had yet to evolve from within these Pteridosperm groups) plus the gnetales. Early conifers (voltzialeans from walchian conifers) derived from Cordaites which persisted also existed as did *Calamites* and the last of the progymnosperms (Noeggerathiales) into the early Permian. The Lycopsid trees died out end Carboniferous leaving herbaceous and subarborescent forms to carry the line on. . Marattoid ferns and horsetails were present plus the earliest leptosporangiate ferns (subclass Polypodiidae) Osmundales and Gleicheniaceae . A mass extinction event terminated the Permian Period.

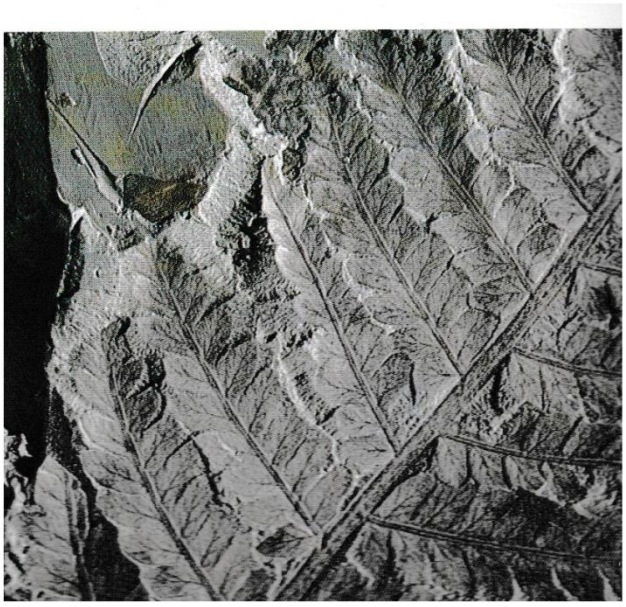


proto- podocarp/araucaria conifer ancestors split late Permian

Permian Period approximately 299-251 million years ago (Ma) E = Early; M = Middle & L = Late

Osmundaceous ferns early leptosporangiate clade appear





***Alethropteris lindleyana* fern foliage, probably the leaf of *Palaeoosmunda* trunks. Speciemen from Tryphinia, Queensland, Late Permian age.**
Mary White "The Greening of Gondwana" 1986. Reed Australia

***Glossopteris* tree Late Paleozoic Pteridosperm**
Gondwanan distribution
Fossil leaves Southland

Diagram from ' The Evolution of Plants' 2nd ed. 2014. K. J Willis & J. C. McElwain
Oxford University Press

persistent (L. *persist* , to continue standing, to persevere) Remaining attached to the plant beyond the expected time of falling. Such as the dead fronds on a tree fern.

petiolate (L. *petiolus* little foot, from *pes* foot) Possessing a petiole.

petiole (L. *petiolus* little foot, from *pes* foot) The stalk of a leaf: in ferns a stipe. *Ophioglossum petiolatum*.

petiolule (L. diminutive of petiole) The stalk of a leaflet. In ferns the leaflet is the **pinna** and the stalk is called the **costa**, for a secondary pinna it's the **costule** and for a tertiary pinna the **costulet**.

petrocolous (Gr. *petros* , rock, stone + L. *cola*, inhabitant f. *colere* or *coloreto*, to live in a place, to inhabit) Living on or in rock. Synonyms: **epilithic**, **lithophyte saxicolous**, **petrophilous**, **rupestral**. Example: Leather-leaf fern *Pyrossia eleagnifolia* which also grows as an epiphyte. See also **chasmophyte**.

petrophilous (Gr. *petros* , rock, stone + *philous*, , love, loving) Rock-loving, growing on rocks. Synonyms **epilithic**, **saxicolous**, **petrocolous**, **rupestral**. Example: Leather-leaf fern *Pyrossia eleagnifolia* which also grows as an epiphyte. See also **chasmophyte**.

pH (power of hydrogen) The measure of acidity or alkalinity of a material . A logarithmic scale is used. 1 is extremely acid and 14 is extremely alkaline, while 7 is neutral.

phanerogams (Gr. *phaneros*, visible, apparent + *gameo*, to marry) An old term for the seed plants (gymnosperms and angiosperms) whose reproduction process was observable (*phaneros*-) to early botanists. Compare **cryptogam.**

phanerophyte (Gr. *phaneros*, visible, apparent + Gr. *phyton*, plant) Danish botanist Raunkier's term for often woody plants with buds perennating more than 25 cm above the surface of the ground. Tree ferns definitely fit this class.

–philous. (Gr. *philus*, love, loving) Suffix used to denote preferring certain conditions or a habitat. Similar to –**colous**. Example **photophilous**.

phloem (Gr. *phloos* , bark) Part of the vascular system of plants concerned with the transport of nutrients, photosynthates, organic compounds and hormones. Tissue composed of sieve cells and companion cells with phloem parenchyma and fibers. Found in the stele and veins. Compare **Xylem**.

photophilous (Gr. *photos*, light + *philus*, loving) A plant preferring to grow in well lit areas. Synonym **heliophyte** or **heliophilous**. Example bracken fern, *Pteridium esculentum* and pig fern, *Paesia scaberula*. Opposite of **sciophilous** or **umbrophile** or **umbraticolous**,

photosynthesis (Gr. *photos*, light + *syn* , together + *tithenai* , place) The conversion of carbon dioxide and water to sugars within green parts of the plant, using chlorophyll and light energy from the sun's rays. Plants that rely on this means, are called photoautotrophs (Light + self feeding) though they do need some additional nutrients and water from the soil. Photosynthetic organs include leaves, stems, thalloid structures such as fern gametophytes, liverworts and hornworts, some roots in part, and some spores.

photosynthetic spores Green spores containing chlorophyll and which can therefore photosynthesize.

phyllome (Gr. *phyllon*, leaf + *oma*- , body f. *soma*) The leaf structures or foliar organs of a plant as a whole i.e. leaves, bracts, scales and floral appendages.

Phyllomophore (phyllome Gr. *phyllon*, leaf + *oma*- , body f. *soma* + *pherien* to carry or bear) Is a structure intermediate between a stem and a leaf. The stipe of an ophioglossoid fern, bearing two blades, one limb of the dichotomy becomes the fertile spike and the other sterile leaf. Hypothetically the fertile segment originates from a modified pair of fertile lateral pinnae (leaflets).

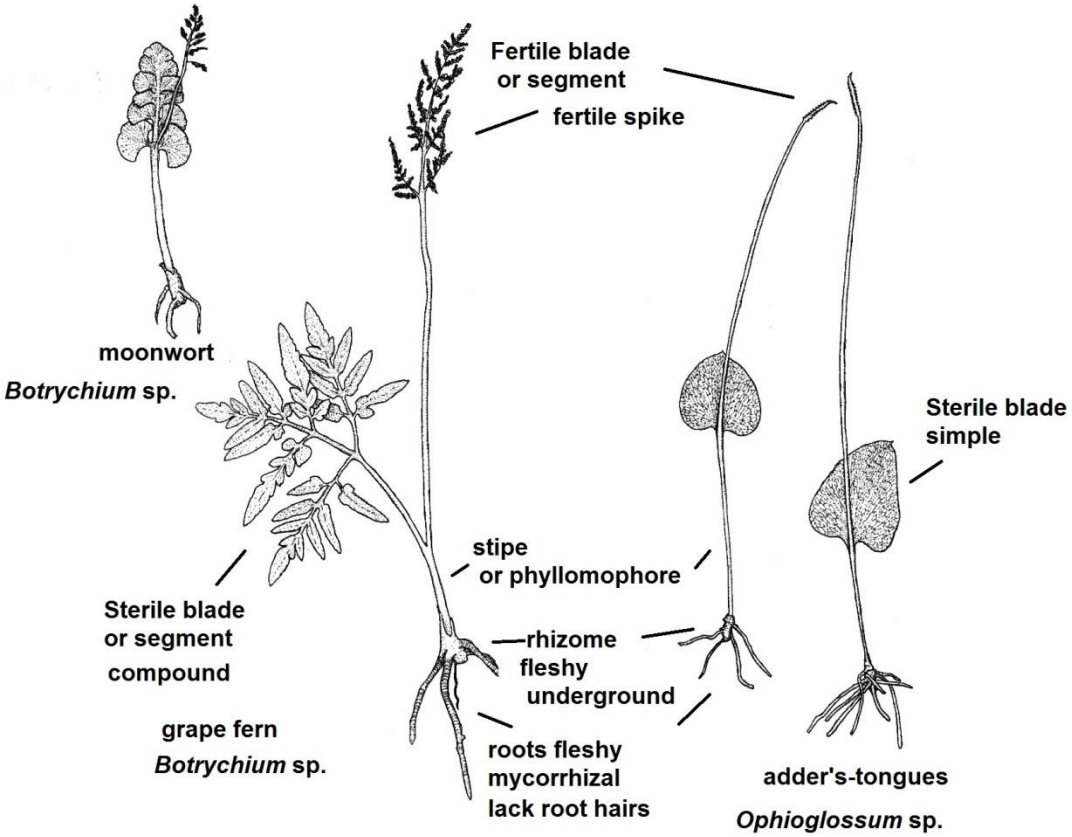


Figure 207 phyllomophore (Ophioglossales)

phyllopodium (Gr. phyll- f. *phyllon*, leaf + L. *-podium* f. Gr. *podion*, diminutive of *pod-*, *pous* foot) (plural phyllopodia) Stump-like extension of the rhizome of some ferns to which the leaves are attached, usually by a distinct abscission layer. When the leaf falls, the phyllopodium remains as a raised scar, a remnant of the petiole.. Example *Zealandia pustulata* subsp. *pustulata*

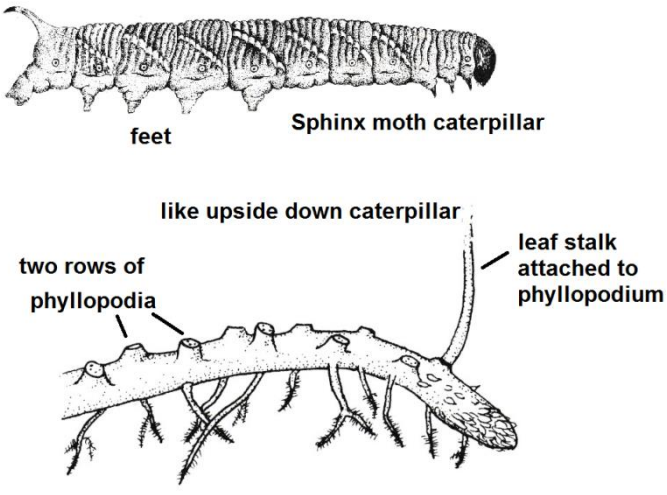
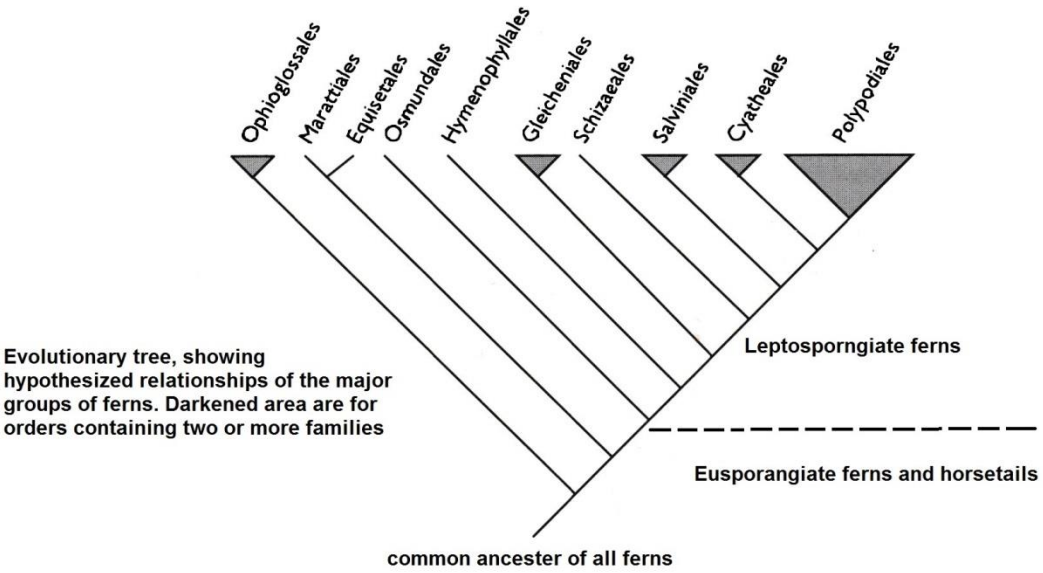


Figure 208 phyllopodium

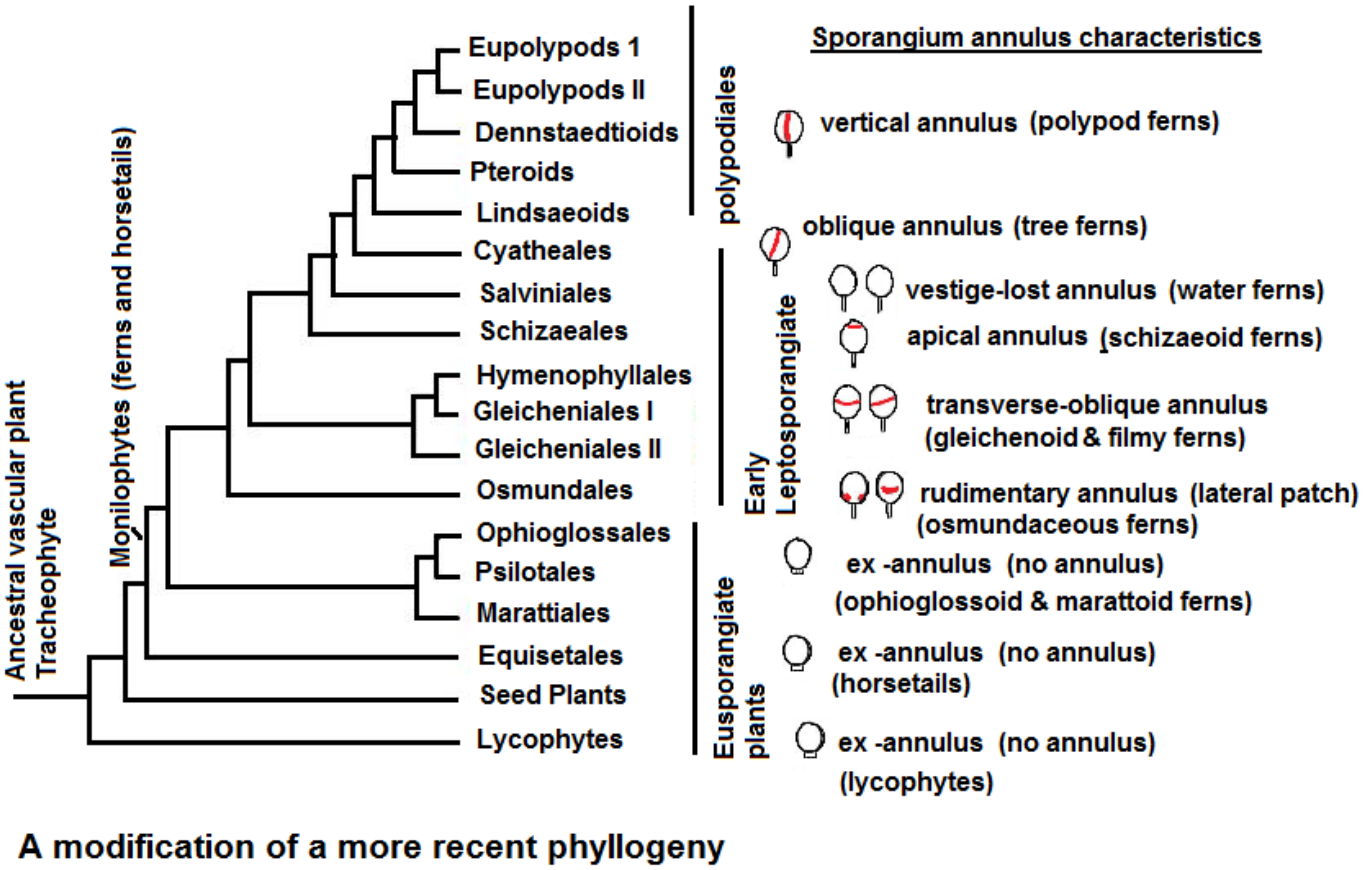
phylogeny (Gr. *phylon* , race or tribe + *genesis*, beginning) The evolutionary history of organisms. See clade.



Evolutionary tree, showing hypothesized relationships of the major groups of ferns. Darkened area are for orders containing two or more families

Modified form ' A Natural History of Ferns' 2004. Moran, Robbin C.. Timber Press

Figure 209 phyllogeny(Moran)



A modification of a more recent phyllogeny

Figure 210 phyllogeny tracheophyte (note position of Equisetales has changed)

phyllotaxy (Gr. *phyll-* f. *phyllon*, leaf + *taxis*, arrangement) Leaf or leaflet arrangement on a stem or axis.

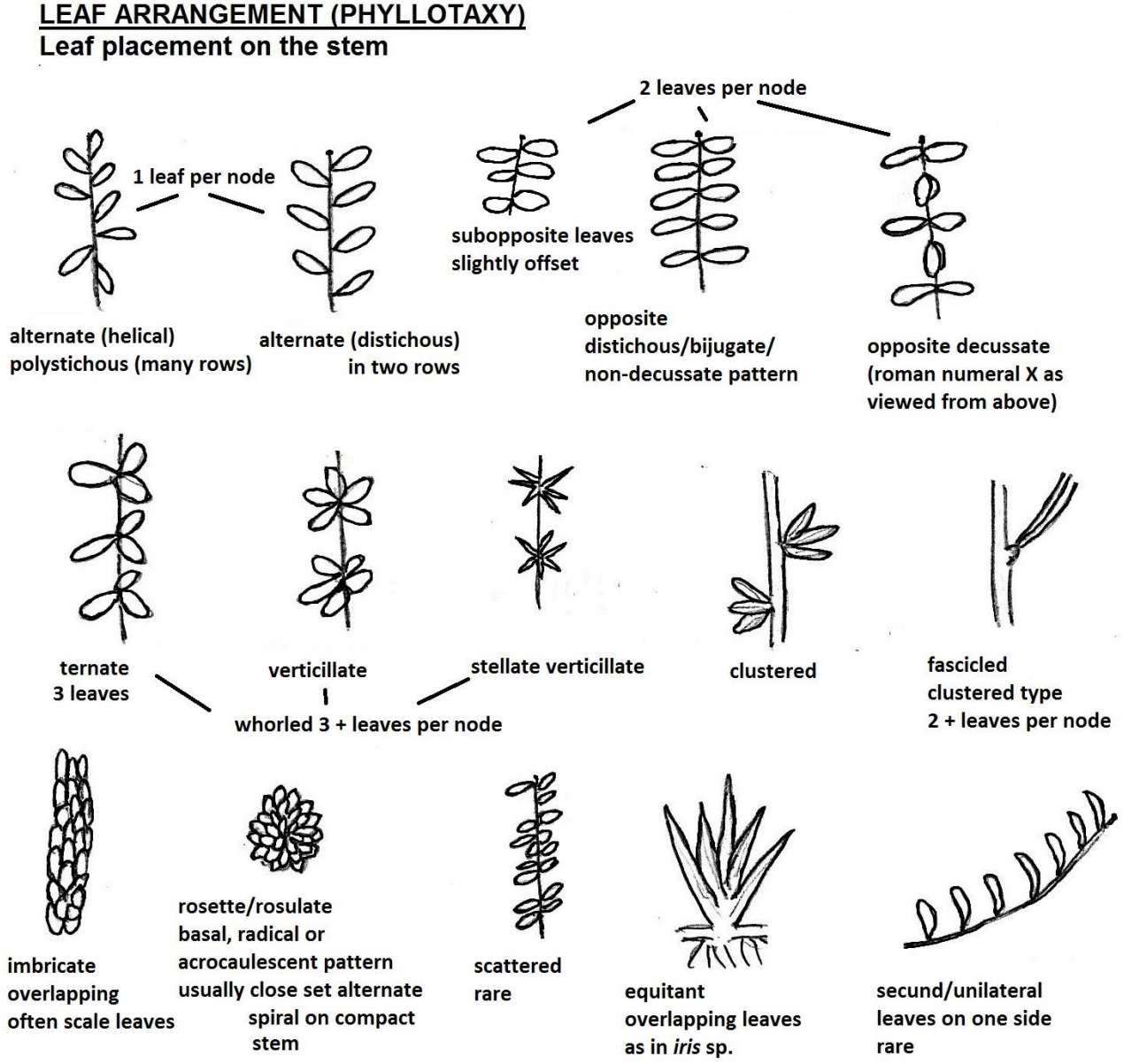


Figure 211 phyllotaxy

phytogeography (Gr. *phytón*, plant + geography) The branch of **biogeography** that studies of the geographical distribution of plants.

pikopiko (Maori) A bud or bulbil, produced vegetatively on the stem or frond of, e.g. *Asplenium bulbiferum* and capable of breaking off and growing independently.

pilate/pileate (L *pileus*, a felt cap shaped like half an egg.) Capped or cap shaped.

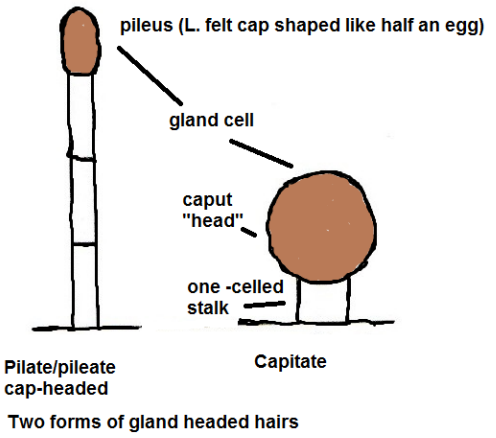


Figure 212 pilate/pileate

pilose (L. *pilo*: to put forth hair, to grow hair) Hairy, the long simple soft hairs, scattered, clearly separated but not sparse. See **leaf hairiness**.

pinna pl. **pinnae** (L. *pinna:* a feather or fin) A primary segment (leaflet or frondlet) of the lamina in a compound leaf. From its arrangement in a feather-like pattern either side of the axis.. Pinnae may be arranged alternately or in opposite to subopposite pairs along the midrib. The pinna may itself be divided once again (bipinnate state) this secondary pinnae is called a **pinnule.** If the secondary pinnae is itself divided (tripinnate condition) this segment is called a **pinnulet**. Some ferns may be up to 8 times pinnate, which exhausts the use of diminutives. The word **decompound** (very compound) covers the greatly or finely divided fronds

pinnate (L. *pinna:* a feather) With two rows (distichous arrangement) of pinnae, pinnules, segments, or veins on either side of an axis. If compound the two rows of leaflets may be opposite or alternate or subopposite. Compare pinnatifid.

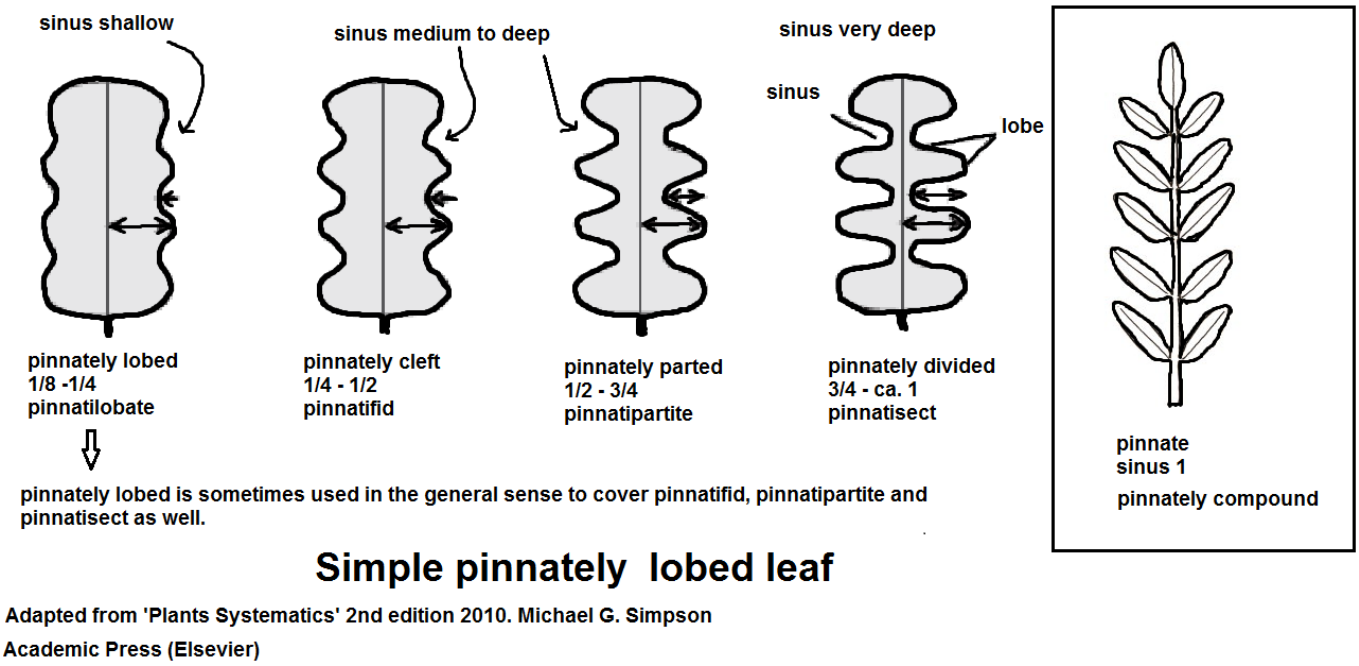


Figure 213 pinnate division

pinnate-pinnatifid Pinnate with the pinnae pinnatifid**.** Synonym **bipinnatifid.** That is the blade is once divided (pinnate) with deeply lobed pinnae (leaflets). Not quite Bipinnate.

pinnate-pinnatilobate Pinnate with the pinnae pinnately lobed. Synonym **bipinnatilobte**.

pinnate-pinnatisect: Pinnate with the pinnae pinnatisect. That is the blade is once divided (pinnate) with very deeply lobed pinnae (3/4 to c. 1 to midvein) more so than pinnate-pinnatifid. Synonym **bipinnatisect**. Not quite Bipinnate.

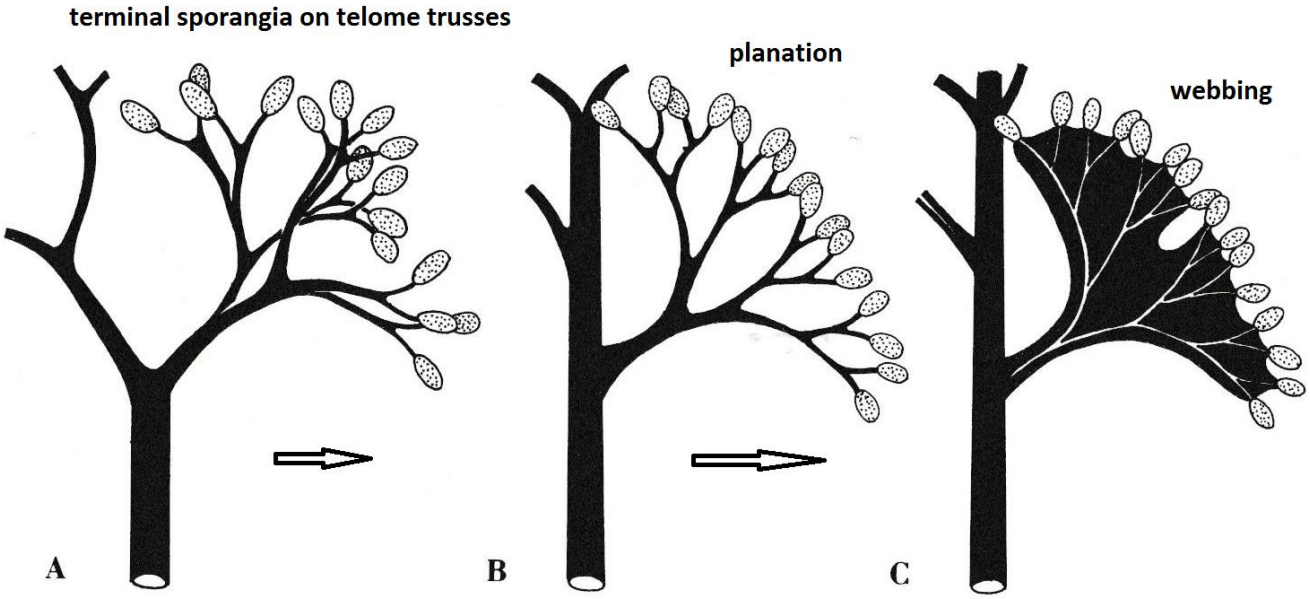
pinnatifid (pinnate + fid : Cut deeply (sinus depth 1/4 to 1/2 distance to midrib) into lobes that are spaced out along the axis in the pinnate pattern. **palmatifid.** , same degree of division, but segments (lobes) radiating from central point, palmate pattern. The distinctions between pinnatilobate, pinnatifid, pinnatipartite and pinnatisect can be somewhat blurred.

pinnatilobate (pinnate + lobate) Having lobes pinnately arranged. Sinus depth 1/8 to 1/4 distance to midrib. The distinctions between pinnatilobate, pinnatifid, pinnatipartite and pinnatisect can be somewhat blurred.

pinnatipartite (pinnate + partite) Once divided with the divisions or sinus ,extending half to two-thirds of the way to the rachis. The distinctions between pinnatilobate, pinnatifid, pinnatipartite and pinnatisect can be somewhat blurred.

pinnatisect: Once divided with the divisions reaching nearly to the rachis (midrib) that is more than three quarters of the way. Not quite bipinnate.The distinctions between pinnatilobate, pinnatifid, pinnatipartite and pinnatisect can be somewhat blurred.

pinnule: (diminutive of pinna) A secondary pinna: the ultimate segment of a frond divided two or more times the secondary pinnae, Some botanists use this term for the ultimate segment of a tripinnate or more divided frond **.** Other botanists substitute the term **pinnulet** for tertiary pinnae or greater.



Hypothetical evolution of the pterophytan (fern) pinnule with marginal sporangia from a primitive axis bearing sterile and fertile telomes.

'Morphology of Plants and Fungi' 1980. Harold C. Bold, Constantine J. Alexopoulos, Theodore Delevoryas. Harper International Edition

Figure 214 pinnule evolution (hypothetical)

pinnulet (diminutive of pinnule) A term for segments of a tripinnate (3-pinnate or higher order frond) another term for pinnule. The midrib is the **costulet**.

pioneer community The organisms that establish themselves on bare ground, rock or sand at the start of a primary succession. Lichens and byrophytes (mosses, liverworts and hornworts) and some higher plants are commonly involved.

pit Of a cell wall, a small hollow or depression.

pitted With numerous small depressions on the surface. Applied for instance to a spore surface.

plagiotropic (Gr. *plagios*, oblique + *tropikos* and *trope* turn) Growing laterally or obliquely, as in most fern rhizomes.

planar (L. *planus*, flat, *planum* level surface) Flattened.

planation (L. *planus*, flat, *planum* level surface) The process of flattening an organ from a three dimensional character – such as the flattening and vascularization of an enation to form the **lycophyll** and flattening of branches followed by webbing to form the **megaphylly** /**euphyll**. See **enation theory** and **telome theory**.

plano-convex (planar + convex) With a flat side and a convex side. Flattened uppermost and curving or arching outwards lower.

plesiomorphic (Gr. *plesio*- ,near, neighbour + *-morphos,* f. *morphe*, shape.) Ancestral state or feature.. A **symplesiomorphy** (*sym* - together + plesiomorphy) is a shared ancestral state among taxa. Compare **apopmorphy** and **synapomorphy**.

pleuricellular or **pluricellur** (L. *pluri*-, many + cellular) Having many cells; used of hairs. Same as **multicellular.**

plicate (L. *plicare* , to fold, bend, curve,) Folded lengthwise into pleats.

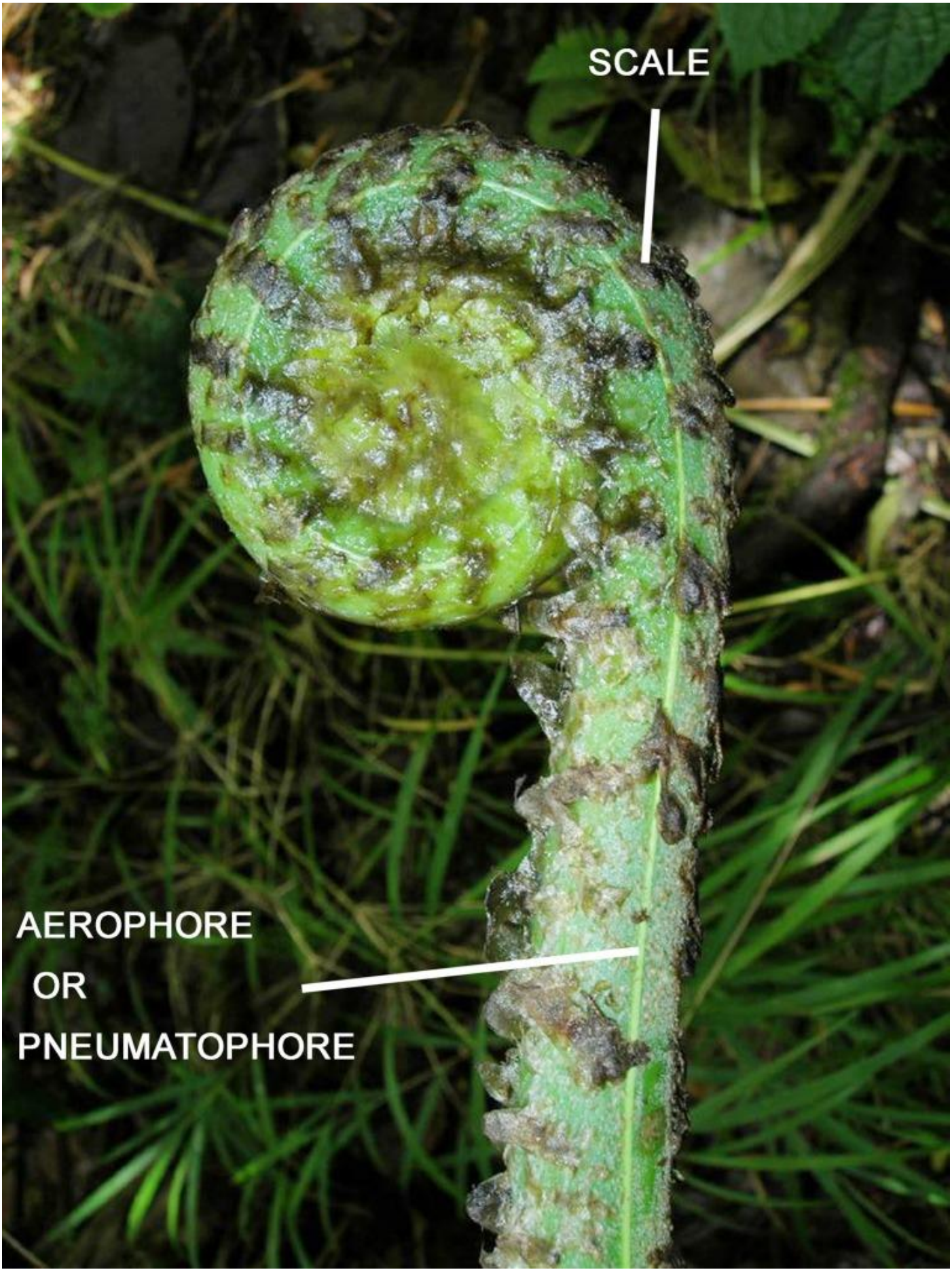
plumose (L. *pluma*: a small soft feather, the downy part of a feather) Feather-like. *Libocedrus plumosa* a conifer.

pluricellur or **pleuricellular** (L. *pluri*-, many + cellular) Having many cells; used of hairs. Same as **multicellular.**

pluricostate (L. *pluri*- , many + costate) With more than one midrib or main vein. Compare **unicostate, uninervous** or **hyphodromous.**.

pluvial (L. *pluvia*l, rain) Pertaining to rain, rainy. another name for a rain-gauge is pluviometer. *Hymenophyllum pluviatile*.

pneumathodes (Gr. *pneumo*, lung, breathe +) Lines, swellings ,bands of pores or aerating tissue, especially prominent along the stipes, rachises, costae or pinnule bases of some leptosporangiate ferns. Also know as **aerophores**. They bear abundant stomates (pores) involved with gas exchange.



Fiddlehead and aerophore (or pneumatophore) of *Pteris livida* (Pteridaceae).

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3761161/figure/F6/

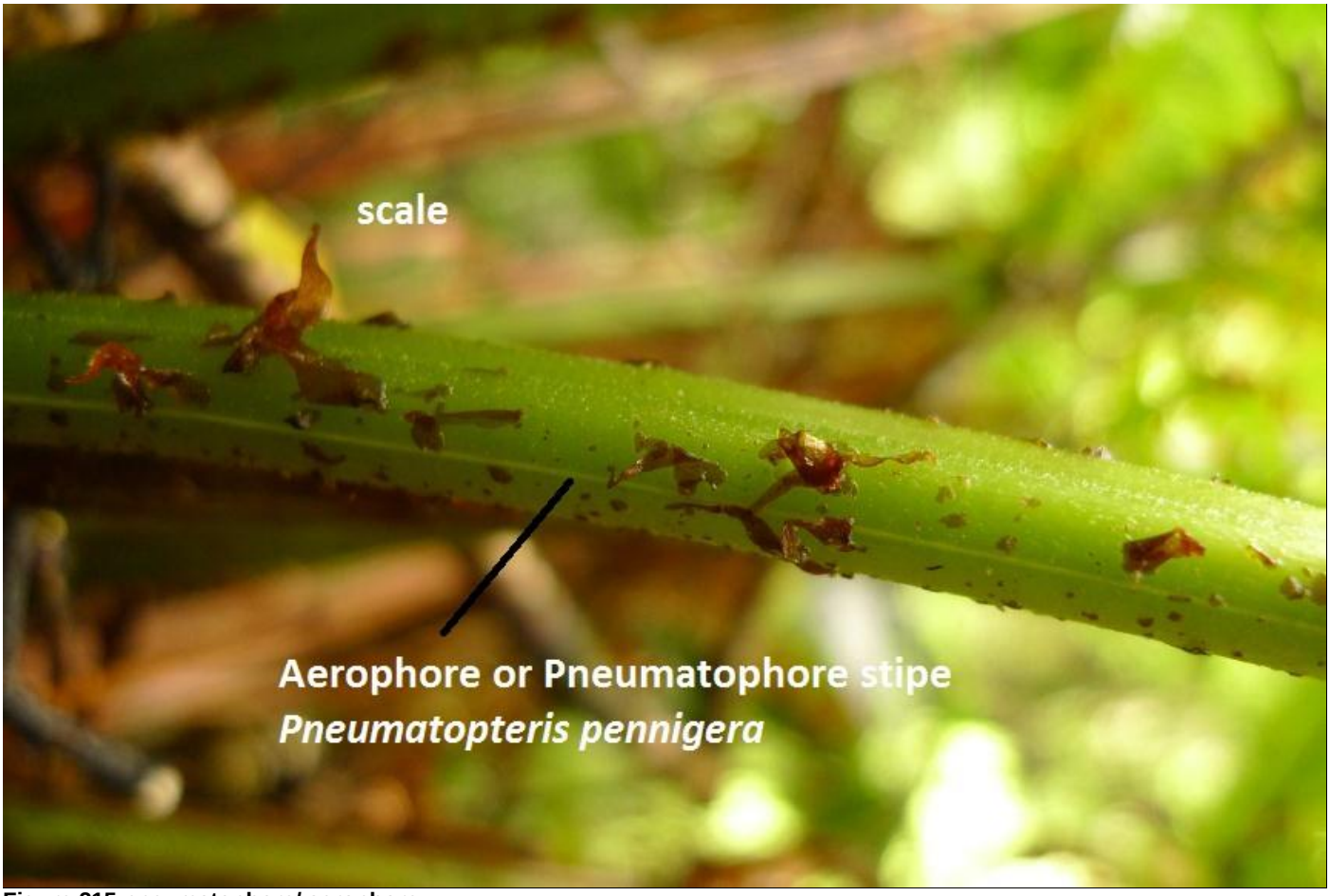


Figure 215 pneumatophore/ aerophore

The genus *Pneumatopteris* derives its name from the Greek *pneuma* (air, wind or breath), and *pteris* (a fern), a reference to the aerophores in some species. New Zealand species *Pneumatopteris pennigera*.

pneumatophores (Gr. *pneumo*, lung, breathe + Gr. *phorus* , bearing, carrying) Wing like protruberances (form of aerophore) found on the petiole bases of some ferns that also have trophopods (enlarged leaf bases).

podocarp forest Forest dominated by species from the conifer family Podocarpacea and the related family Phyllocladaceae. Species include the "big five"; kahikatea, rimu, totara, matai and miro plus celery pines tanekaha and toatoa. Podocarps may also be found intermixed with other species –sharing dominance (canopy layer and emergent) as in a **mixed beech/podocarp/broad-leaf forest** and **kauri/podocarp/broad-leaf forest** (northern). See also **arapod forest**.

poikilohydrous (Gr. *poikilos* variegated + *hydrous* F. *hudor*, water) Said of a plant with leaves that can inroll or shrivel when dry, but which can unfold and reopen when wet.

polar axis (polar + axis) The perpendicular line connecting the poles of a spore.

polar dimension "P" The distance from the proximal to distal end, measured from the equatorial view in trilete spores, or the equatorial longitudinal view in monolete spores.

polar view (polar + view) Spore or pollen grain view at pole; view along axis of symmetry directed towards the centre of the tetrad; view from the proximal or distal end.

pole (L. *polus*, Gr. *polos*, pivot, axis, firmament) Spore or pollen grain viewpoint, one of the extremities of the axis of symmetry that is directed towards the centre of the tetrad.

polygon (Gr. *poly-* , many + *gonos*, angle) Multi-sided shape. Such as when veins anastomose to areoles (leaf tissue surrounded by veins), which may be 3, 4 or 5+ sided.

polymorphic (Gr. *poly-* , many + *-morphos,* f. *morphe*, shape.) Having more than two distinct morphological variants. Compare **monomorphic**, **dimorphic**..

polyphyletic Gr. *polyphylos* , of many tribes, f. *poly-* + *phyle* tribe) A group with several separate lineages, each with a separate common ancestor. The common ancestor of all these lineages is not itself a member of the group. A somewhat, artificial group. Compare **monophyletic.**

polyploid (Gr. *polys*, many + *ploos*, fold) Having more than two of the basic sets of chromosomes in the nucleus. Compare **diploid**, **haploid.** Triploid or greater**.** Adj. polyploidy**.**

polypod ferns (From genus *Polypodium* f. Gr. *polys,* many+ *pous,* foot - referring to the knoblike petiole bases laft after leaf abscission - See **phyllopodium**) Ferns belonging to the Polypodiales- over 8,700 species worldwide in 26 families. In New Zealand ferns of the families: Lindsaeaceae, Pteridaceae, Dennstaediaceae, Aspleniaceae, Athyriaceae, Blechnaceae, Cystopteridaceae, Thelypteridaceae, Davalliaceae, Dryoperidaceae, Nephrolepidaceae,Oleandraceae,Polypodiaceae and Tectariaceae.

Polypodiopsida/Polypodiidae or **Leptosporangiatae** (Polypodiopsida f. genus *Polypodium* f. Gr. *polys,* many+ *pous,* foot - referring to the knoblike petiole bases laft after leaf abscission + taxonomic rank). The leptosporangiate ferns. The majority of ferns. Also known as **Filiopsida** or **Filicales**. Contrast **eusporangiate** ferns. See **leptosporangium, annulus**, **stomium**.

polysporangiates Clade of land plants for which the sporophyte is relatively large (compared to bryophytes) and produces multiple reproductive organs (sporangia) hence the name. The clade includes all the vascular plants or tracheophytes, but some early forms lacked a lignified vasculature and are called prototracheophytes (all extinct) or where semi-lignified the paratracheophtes-Rhyniopsida: *Rhynia gwyne-vaughanii* (all extinct). All the surviving vascular plants and the immediate ancestors of the Lycophyte and fern/horsetail/seed plant clades, class as eutracheophytes or true vascular plants.

polystichous (Gr. *poly-* , many + *-stichos*, f. *stichos* row, line) Arranged in many rows**,** such as leaves in several rows. Compare **distichous.** The genus *Polystichum* from the lines of sori on the pinnules.

primary succession (L. *prime*, first + succession) Succession in which plants colonize surfaces with little or no prior soil development (e.g. lava, sand, landslide, floodplain). New Zealand example. Rangitoto Island lava fields. Contrast **secondary succession**. The initial community of organism is known as the **pioneer community** and as the area develops subsequent communities (seral) are called seres, until a more or less stable mature community is established known as a climax community. It should be noted that primary succession and soil development (pedogenesis) go hand in hand.

primitive Having characteritics similar to or retained unchanged from ancient members of the group. Opposite of advanced or derived. Eusporangiate ferns are considered primitive relative to leptosporangiate ferns for instance. Leptosporangia is an **apomorphy** – derived condition or character state, representing a novelty from the ancestral (**plesiomorphic**) eusporangiate condition. Psilotales, Ophioglossales, Marattiales and Equisitopsida (horsetails) share the ancestral eusporangiate condition so this is a **symplesiomorphy** for this group. Osmundales, Hymenophyllales,Gleicheniales, Schizaeales, Salviniales, Cyatheales and Polypodiales share the leptosporangiate condition so this is a **synapomorphy-** shared derived state for this group.

primofilicales (L. *primus*, first + *filici* , fern) The Primofilcales, an older name for the earliest ferns that first appeared in the middle Devonian and survived until the end of the Paleozoic. Now Class Cladoxylopsida, including subclasses: Cladoxylida, Stauropteridae and Zygopteridae – all extinct. As the name implies probably includes the ancestors of modern ferns.

procumbent (L *pro*: before, earlier, in front of + *cumbi*, to lie, to lie down) Trailing or lying on the ground without rooting at the nodes.

progymnosperms (L *pro*: before, gymnosperms) An extinct Palaeozoic plant group, with fern-like foliage and reproduction – that is by spore either homosporous or heterosporous, but conifer-like trunks. Ancestral to the gymnosperms (seed plants) and sister to the early ferns.

projection (L. *projectura*, a jutting out) Any feature that extends beyond the surface or margin of an organ or body, such as teeth or lobes on a leaf, ornamentation on a spore wall surface and so on. See **exserted**.

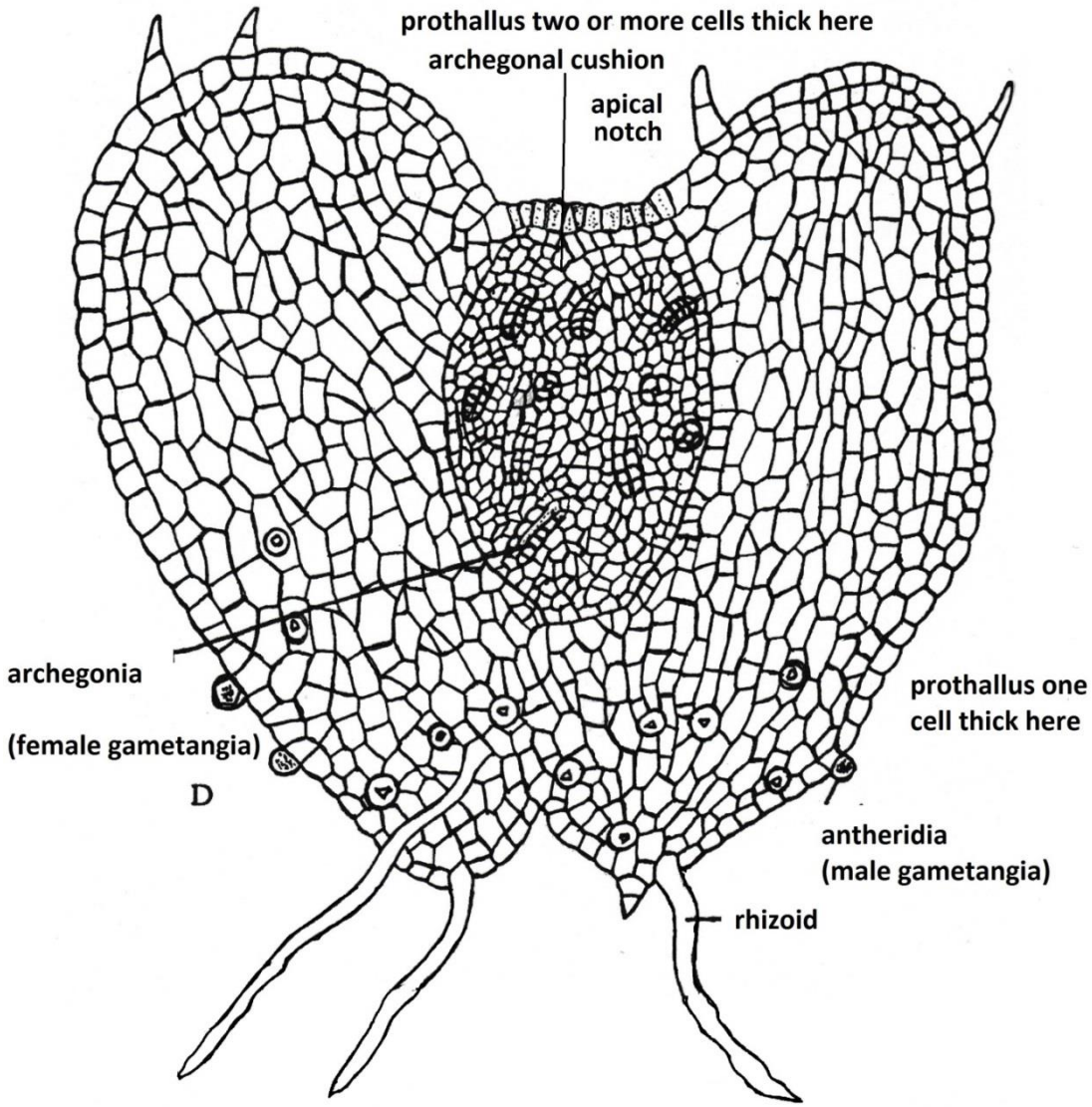
proliferous (L. *proles*, *prolis* , offspring + *ferre*: to bear) Having adventitious leaf buds which produce new plants (plantlets or bulblets). A form of asexual or vegetative propagation in some ferns. *Polystichum proliferum* Mother shield fern, Australian fern, naturalized in places.

propagule ((L.*propago*, layer, runner, cutting, shoot) A body with the capacity to give rise to a new plant, e.g. spore, gemma, bulbil, seed. Similar **disseminule** (L. *seminare* f. *semen* seed), **diaspore**

prostrate (L. *prostratus*, f. *prosternere*, from *pro*- before + *sternere* to spread out, throw down) Lying flat on the ground.

prothallium (**ia**) See **prothallus**

prothallus (Gr. *pro*-, before + *thallus* , sprout) Gametophyte of a fern, fern allie or lycophyte. (plural prothalli) . Thallus is a plant body not divided into discernible stems, roots and leaves, somewhat resembling a thalloid liverwort or hornwort or may be filamentous.. The prothallus when mature produces gametes, male and female sex cells, in structures termed **archegonia** (female) and **antheridia** (male). The gametophyte and the gametes it produces are haploid (1n). Compare **sporophyte**.



Mature prothallus (gametophyte) with thickened archegonial cushion bearing archegonia (female sex organs). Antheridia (male sex organs) are developed outside the cushion, where the prothallus is one cell thick.

Figure 216 mature prothallus fern

protostele (Gr. *pro*: in front, before **+** *stele* pillar) A simple primitive type of **stele** having a solid central vascular core (a cylindrical strand of xylem surrounded by a region of phloem - no pith), with pericycle and endodermis, then cortex external to this.. Four main types of protosteles are recognized:

1. **haplostele** 'Single or simple stele' has a cylindrical vascular core e.g *Gleichenia*, *Selaginella krausiana*,

2. **actinostele** 'ray stele' has radiating arms –stellate or star-shape,so the core is fluted or lobed, phloem occurs in small patches between the radiating arms e.g. *Psilotum*

3. **plectostele** 'pleated stele' a variation of actinostele, has parallel longitudinal plates of xylem alternating with phloem plates. e.g *Lycopodium volubile*.

4. **mixed protostele** has xylem groups scattered amongst the phloem e.g. *Lycopodium cernum*.

5. **polystele** "many" + stele (rare) One with two or more vascular cyclinders embedded in cortex.

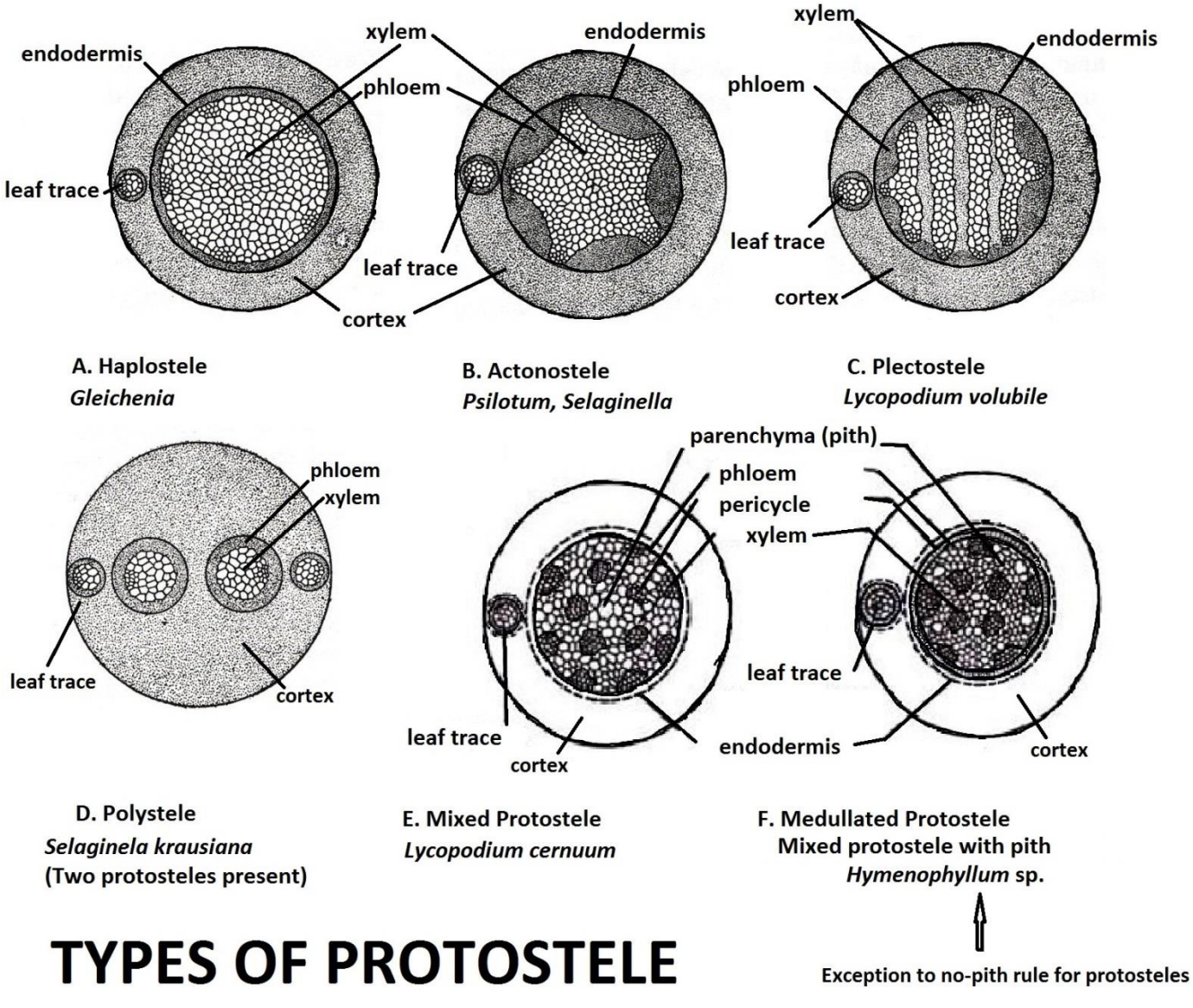


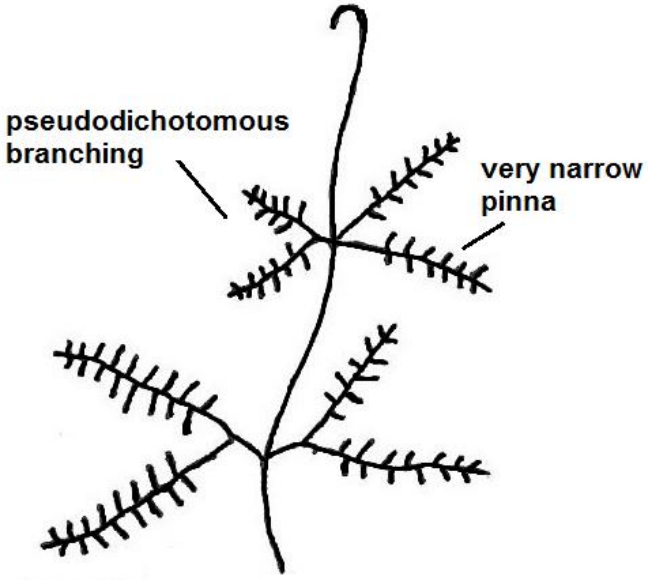
Figure 217 protostele types

protoxylem (Gr. *protos*, first + xylem f. . *xylon* , wood) Referring to the first tracheary elements that develop within a patch of xylem, being typically smaller and with thinner cell walls than the latter formed **metaxylem.** It matures during the elongation of the plant part in which it is found.

protruberance (L. *protuberare*. f. *pro*: in front, before + *tuberare* f. *tuber* , hump) A swelling or lump on the surface. See **epidermal excrescence** and **projection.**

proximal (*proximare* to draw near, from Latin *proximus* next,) Near to the point of origin, the base or point of attachment. Compare **distal**. Palynology, spore or pollen grain side directed towards the centre of the tetrad, the opposite of distal, the part of the spore or pollen grain facing inward in the tetrad.

pseudodichotomous (Gr. *pseudo-* , f. *pseudes*, false + dichotomous).) Appearing as if dichotomous, by continuously dividing ,but really two equal lateral branches in the shape of the letter "Y" with a dormant, terminal bud between, e.g. *Gleichenia* fronds. Division not the result of division of the apical cell.

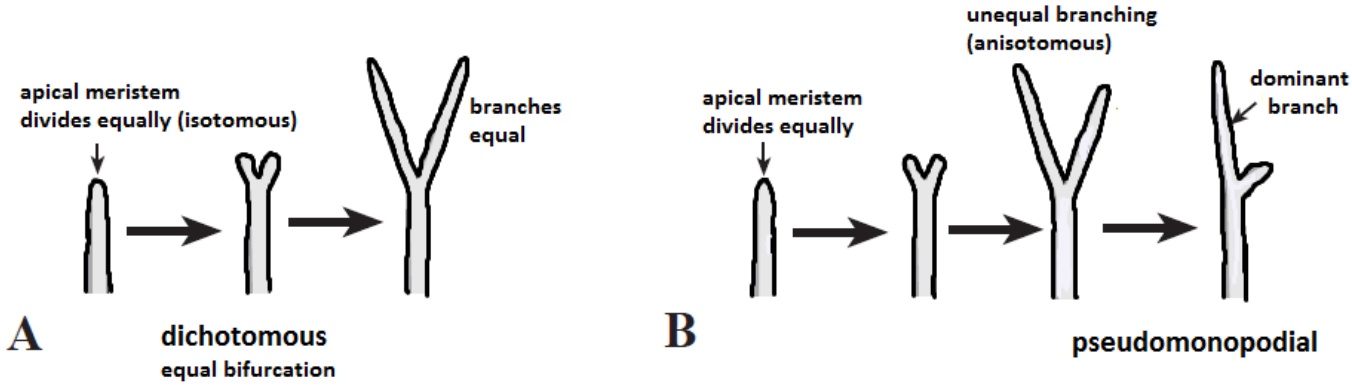


***Gleichenia* sp. Umbrella fern**

Figure 218 pseudodichotomous

pseudoindusium See **false indusium** which is what it means.

pseudomonopodial branching (Gr. *pseudo-* , f. *pseudes*, false +mono, f, *monos* single + L. *podium* f. Gr. *podion*, base f. *pous* foot) A form of dichotomous branching which is extremely unequal (anisotomous) with one daughter axis assuming the upright angle of the parent axis, the other is more divergent appearing as a side branch, and of smaller diameter. It resembles true monopodial branching hence the name. Branching pattern found in *Equisetum*, the extinct, trimerophytes and other Devonian age plants.



Transition from primitive dichotomous (isotomous) apical branching, through anisotomous branching to pseudomonopodial.

Figure 219 pseudomonopodial branching

pseudopeltate (Gr. *pseudo-* , f. *pseudes*, false + peltate) Appearing **peltate** but having a narrow sinus (gap) reaching to the central stalk, e.g. *Dryopteris affinis*. Compare **reniform**.

pseudoserrate (Gr. *pseudo-* , f. *pseudes*, false + serrate) Falsley toothed, a term used for the apparently toothed margins of some rhizome scales.

psilate (Gk. *psil-*, bare, naked +-ate) Lacking ornamentation —used especially of a spore or pollen grain walls. Equivalent to glabrous or smooth for a leaf surface.

Psilotales (Gk. *psil-*, bare, naked referencing leafless stem) The order containing the whisk ferns – primitive eusporangiate ferns represented in New Zealand by *Psilotum nudum* and five species of fork ferns *Tmesipteris* sp.. One family: Psilotaceae and two genera: *Psilotum* and *Tmesipteris*. Allied to the

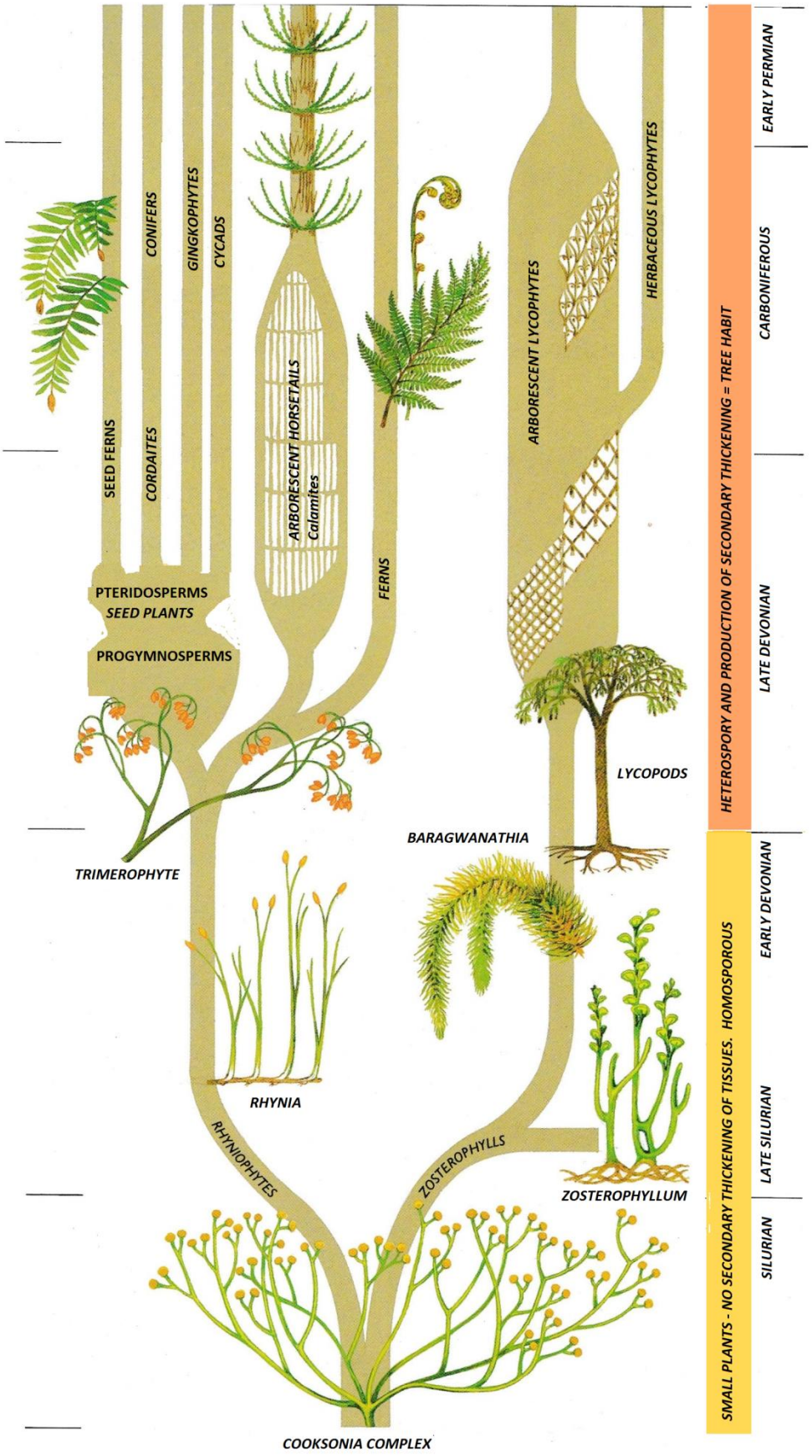
Ophioglossoid ferns and less closely to the non-native horsetails (Equisitopsida). **Marratoid** ferns are also eusporangiate but more distantly related.

Psilotoid (f . genus *Psilotum* + oid, resembling, like) Referring to the whisk and fork ferns *Psilotum* and *Tmesipteris* species, Psilotales, family Psilotaceae.

pteridologist (Greek *pteris* fern + *logos* , discourse) A student of pteridophytes (ferns and lycophytes).

Pteridophyte pl. **Pteridophytes** (Greek *pteris* fern + *phyton ,* plant) The general term for Ferns, and the so called **fern allies** the psilophytes,horsetails and lycophytes, defined by having a life cycle in which the sporophyte and gametophyte generations grow independently of one another, not attached; the sporophyte is large and conspicuous, the gametophyte inconspicuous and ephemeral. They are all vascular spore producing plants, but consist of two separate evolutionary lines: the ferns including the horsetails and whisk ferns versus the lycophytes. So the grouping is polyphyletic or artificial.

FAMILY TREE (PHYLOGENY) OF EARLY LAND PLANTS



Note the early split between the Lycophyte and fern lineages

Diagram modified from'Greening of Gondwana' 1986. White, M. E. (Mary E.). Reed Books Pty Ltd

pteridosperms The seed ferns, fossil seed plants from the paleozoic to mesozoic periods that were gymnosperms, many bore large pinnately compound leaves like fern fronds hence the name. Extant plants the cycads,conifers gingkos, and gnetophytes derived from early forms, angiosperms (flowering plants) from late Mesozoic forms. The ancestor of the pteridosperms was probably a heterosporous progymnosperm (spore bearing plants with fern-like foliage and reproduction and conifer-like trunks).

pteris (Gr. *pteris* fern) Either a prefix: pteris- or pterido- or suffix: –pteris , meaning fern. The Latin equivalent is **filici** hence filicales etc. Also a fern genus *Pteris,* with four native species in New Zealand and two naturalized species.

pteroid fern Species of ferns belonging the the fern family Pteridaceae, includes *Adiantum* spp, *Anogramma* spp., *Cheilanthes* spp.,*Pellaea* spp. , *Pteris* spp. in New Zealand. See **pteris**.

ptyxis (L. *ptyxis*, f. Gr. *ptúxis*, a folding) Pattern of folding and rolling shown by an individual leaf during leaf development. Compare **vernation**.

puberbulent (L. *pubes*: The hair in general) Minutely pubescent. See **leaf hairiness** terms.

puberulous (L. *pubes*: The hair in general) Slightly hairy. See **leaf hairiness** terms.

pubescent (L. *pubes*: The hair in general) Downy, clothed with short soft erect hairs. See **leaf hairiness** terms.

pulvinus, pl. pulvini (L. *pulvinus*: a cushion) An enlarged (swollen) area at the base of stipes, e.g. *Ptisana salicina*.

punctate (L. *punctum ,* point) Marked with dots, points, depressions or translucent glands.

punctiform (L. *punctum ,* point + *form* , shape) Reduced to a mere dot or point, e.g. the sori of *Microsorum punctatum.*

punctulate (L. diminutive of punctate) Minutely dotted.

pup A popular term for a bulbil, plantlet or offset .

pustule (L. *pustule* , a blister) A blister-like prominence, often in which a sorus occurs. adj. **pustulate**. *Microsorum pustulatum*.

pyriform: (L. *pyrus*: pear + *form*, shape) Pear-shaped. *Pilularia novae-zelandiae* – microsporangia pyriform with up to 30 microspores (Flora of N.Z. volume 1).

pyramidal (L. *pyrimidialis*, f. Gr, *puramis*, pyramid) Like a triangular pyramid.

quadrate (L. *quadratus* ,square f. *quattuor* four) Squarish.

quadrifoliar (L. *quadri-* f. *quattuor* four +). Bearing four leaflets arising at the same point, e.g. *Marsilea* leaves one species is called *Marsilea quadrifolia.*

quadripinnate (L. *quadri-* f. *quattuor* four + pinnate). Four times pinnate, 4-pinnate. It has primary, secondary, tertiary and quaternary leaflets. Synonym **tetrapinnate**. See **quaternary leaflet**.

quaternary (L. *quadri-* f. *quattuor* four) The geologic time period from 2.58 million years ago to the present. Includes the Pleistocene and Holocene epochs. The last period of the Cenozoic era. The period is noted for the ice age episodes (glaciations) and the evolution of the genus *Homo* (Humans).

quaternary leaflet (L. *quadri-* f. *quattuor* four + leaflet) A leaflet of the fourth degree; a leaflet of **tertiary leaflet**. This leaflet is either called a **pinnulet** or a **pinnule**. The ultimate leaflet of a **quadripinnate/tetrapinnate** fern.

quinquepinnate. (L. *quinque*, five + pinnate) Frond five times (5 x) pinnate. Synonym **pentapinnate**.

rachides A term used for **rachises.**

rachis pl. **rachises** (Gr. *rachis* ,spine, ridge) A midrib of the lamina, the extension of the stipe (petiole) of the frond i.e. refers to the main axis above the lowermost primary pinna. Also spelled **rhachis.** Synonym **peridroma**. Often the rachis differs from the stipe, both in colour and covering of hairs and scales. The branching of the rachis into secondary pinna (leaflets) results in a change of name for the main vein of the pinna to **costa** (rib).
radial (L. *radialis*, f. *radius* ray) A rhizome having leaves or roots on all sides. A radial stem is often short and erect and is sometimes termed a “root stock”; it may be creeping. The trunk of a tree-fern is a large radial stem.

radially symmetrical With more than two vertical planes of symmetry.

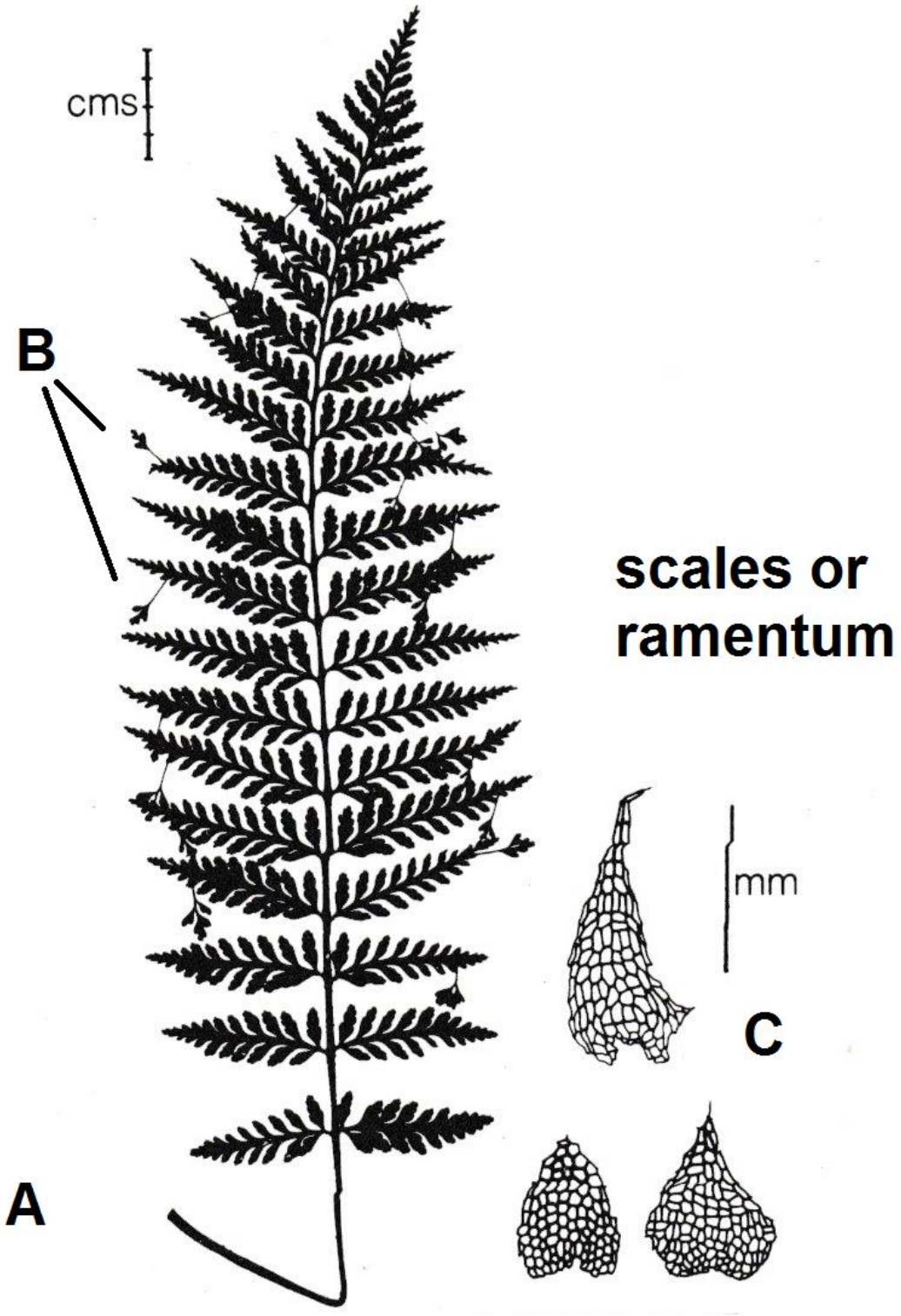
radical (L*. radix*, root) or **basal** With leaves positioned at the base of a stem, arranged in a basal rosette . Compare **cauline** with leaves positioned along the length of the stem and **acrocaulis** with leaves positioned at the apex of the stem as in tree ferns.

radicant (L. *radix* , root) Rooting, a term applied to stems, fronds when they root at the tips, proliferous buds

rain forest Forest that receives a high rainfall of 1500-3000+ mm (or part equivalent from fog) per year; usually lacking a pronounced dry season. Divided into temperate rainforest and tropical rainforest.

rameal sheath. (L. *ramus* , branch + sheath) Leaf sheath on the stem joints, as in *Equisetum.*

ramentum (L. *ramentum*, a shaving) One of the thin dry scales to be found on the stipe, rachis or lamina e.g. *Asplenium bulbiferum* and *A. gracillimun*.



Asplenium bulbiferum **A. frond; B. bulblets; C. stipes scales (ramentum)**

Adapted from 'New Zealand Ferns and Allied Plants' 2000. Patrick J. Brownsey and John C. Smith-Dodsworth Bateman

Figure 220 ramentum *Asplenium*

Figure 221 ramentum *Cyathea medullaris*

ramet (L. *ramus,* branch) A vegetatively produced plant individual that may detach from the gentetically identical parent e.g. the bulbil type asexual reproduction of *Asplenium bulbiferum*. An independent clone. Opposite of **genet** – a sexual produced plant individual that is genetically unique.

random. (branching) With branches arising from buds without relation to leaves.

raphe (Gr. *rhaphe*, seam) The ridge that connects the sporocarp and stem in *Marsilea*.

ray An arm or branch of a stellate hair, e.g. *Pyrossia eleagnifolia*.

receptacle (L. *receptacalum* , store-house) The thickened sporangia- and sometimes paraphysis-bearing tissue on which the sporangia are borne. In the filmy ferns *Hymenophyllum* and *Trichomanes* this is bristle-like; in most other ferns it is flush with the leaf surface or slightly elevated.

recurvation (L. r*ecurvus*: bent back) In **telome theory** one of the evolutionary processes which modifies a telome truss, as possibly occurred in the evolution of the equisitoid sporangiophore.

recurved (L. r*ecurvus*: bent back) Curved downwards towards the base or backwards.

reduced (L. *reducere*, *reductuctum*, to lead back, f. *re*. + *ducere*, to lead) Becoming smaller.

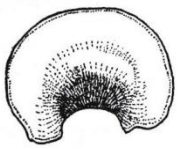
reduction (L. *reducere*, *reductuctum*, to lead back, f. *re*. + *ducere*, to lead) To make smaller. In **telome theory**, an evolutionary process whereby telome trusses are reduced from many to one telome, ending in a **microphyll**/**lycophyll**. This is contrasted with the **enation theory** for the origin of microphylls, which is better supported. Reduction nevertheless is a well known evolutuionary process even if in this case it is incorrect..

reflexed (L. *reflexus*, f. *reflectere* , to bend back). Bent sharply downwards or backwards, turned back on itself – as in the margin of a leaf. In ferns a **reflexed leaf margin** or **leaf lobule margin** may form a **false indusium** –protecting sporangia or sori in some species.

remote (L. *remotus*, f. *removere* , to remove) Distant, far apart, well separated. For instance the spacing of leaves on a stem. Synonym **distant**, compare **approximate**, **confluent**, **connivant**, **contiguous**, **congested**, **close**, **close-set, imbricate**.

renascent (L. *renasci*, reborn) Spring up afresh each year.

reniform: (L. *renes*; the kidneys + *forma* , shape) Kidney-shaped. Crescent-shaped with rounded margins and a central sinus. example *Dryopteris felix-mas*, kidney fern *Trichomanes reniforme*. Applied to leaf and indusial shapes amongst other things. Note also genus *Nephrolepis* means 'kidney scale'.



Nephrolepis cordifolia
reniform indusium
Figure 222 reniform indusium

reticulate (L. *reticulum* , a little net,) Branching and rejoining of veins to form a network. The enclosed area of leaf tissue is the **areole**, pl. **areolae**. Also applied to ornamentation or sculpturing of a spore surface where anastomosing ridges (muri/walls) enclose small more or less irregular spaces (lacunae).

reticulodromous (L. *reticulum* , a little net, + Gr. *dromos,* running, racecourse) (1) Pinnate, **camptodromous**, **leaf venation** pattern in which secondary veins branch into a reticulum toward the margin. Example *Histiopteris incisa* (2) **Actinodromous leaf venation pattern** with three or more primary veins diverging from one point (ternate or palmate pattern) but do not reach the blade margin.

reticulum (L. *reticulum* , a little net) A network, e.g. of veins, where veins meet and cross or join.. adj. **reticulate**. The area of leaf tissue enclosed by the veins is the **areola**. Synonym **net-veined** and **anastomosis**.

retrorse (L. *retrorsus*, f. *retroversus*; f. *retro-* , back + *vertere*, *versum* , to turn). Bent, and pointing away from the apex. Directed downwards or backwards. Compare **antrorse**.

retuse (L. *retusus* , blunted) The apex rounded and notched.

revolute (L. *revolutus ,* to roll back) With the margins rolled backwards**,** the lateral margins inrolled abaxially. Longitudinal posture term, compare **involute**.

rhachis See **rachis** alternative spelling. The midrib of a frond.

rheophyte (Gr. *rheo-* flow, current + *phyton*, plant) A flood resistant plant living between the high and low water levels of rivers.

rhizoid (Greek *rhiza* , root + *oid*- resembling) A thread-like, non-vascularized, unicellular absorbing structure occurring, in the vascular plants, in gametophytes of ferns and some related plants. They have a root-like function,similar to a root hair, they anchor it to the substrate and absorb nutrients.

rhizome (Gr. *rhiza:* a root) The creeping (often underground), climbing or erect stem of a fern, including the erect or vertical trunk or caudex of a tree fern. In other land plants rhizome used in the underground stem sense. The term stolon is then used for an above ground creeping stem and simply stem for an ascending or erect stem. As a stem it bears the fronds of the fern, whereas a true root does not bear leaves. Synonym: **surculum** pl. **surcula**.

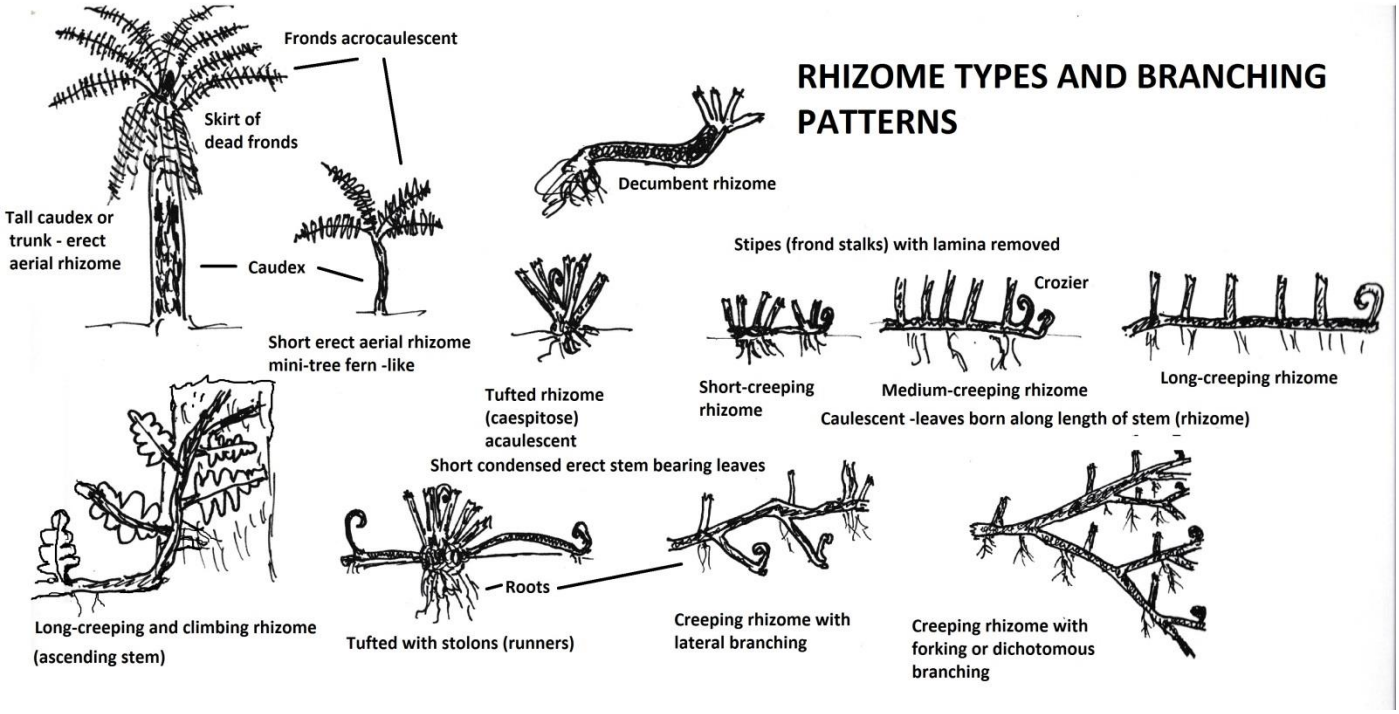


Figure 223 rhizome types and branching

rhizomorph In certain lycophytes (for example, *Isoetes*), a rooting system developed from the first dichotomy of the embryonic shoot (because it originates from shoot tissue, it is not true root). It has the anchoring and absorptive functions of a root but the general morphology and characteristics of aerial shoots. More rhizome than root.

rhizophore: In *Selaginella*, a leafless stem that grows downwards producing adventitious roots or rhizoids.

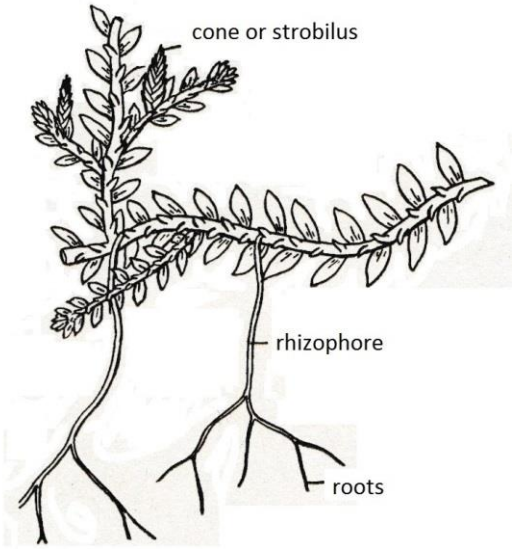
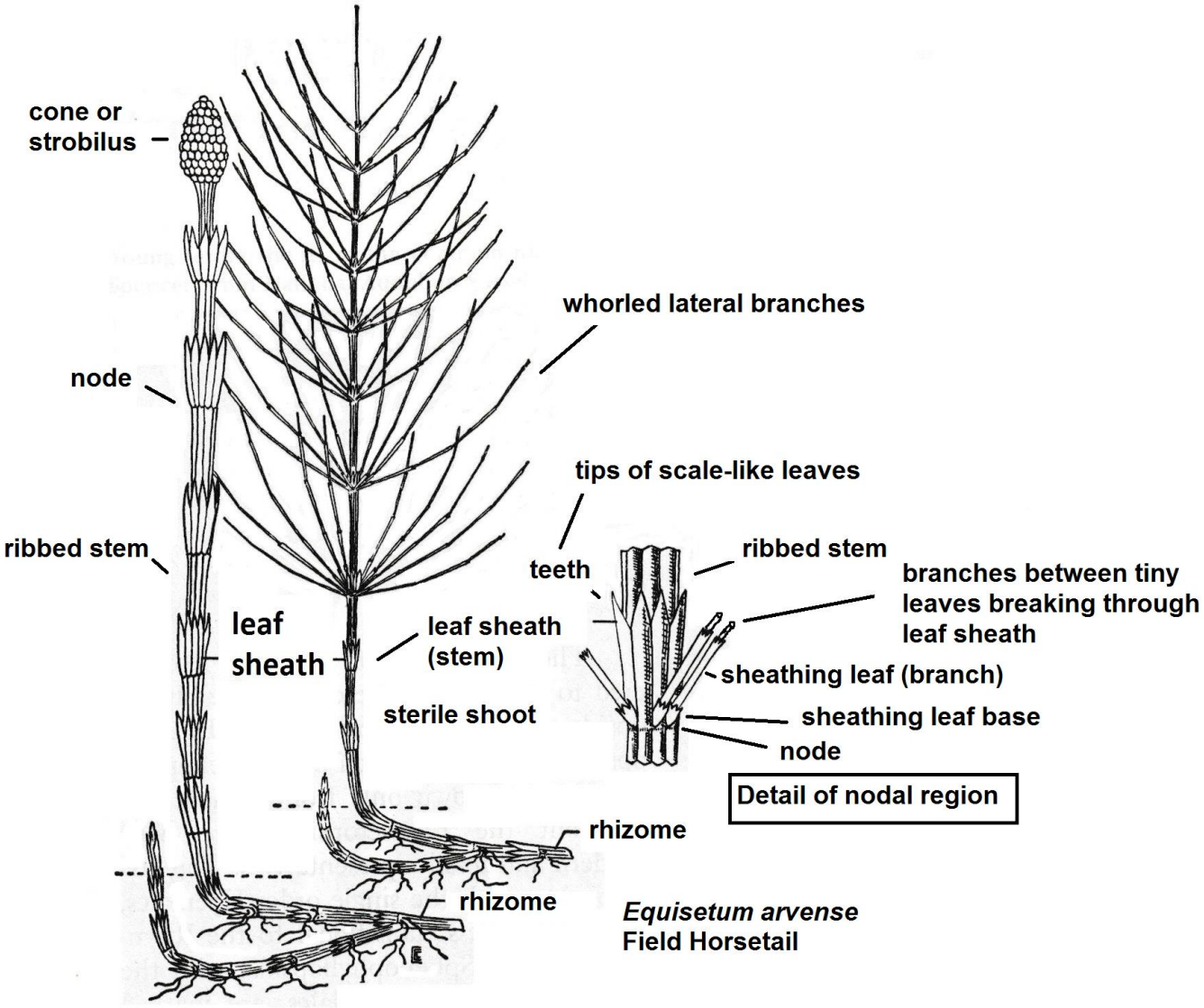


Figure 224 rhizophore *Selaginella*

rhomboid (Gr. *rhombus* a mathematical figure whose four sides and angles are equal) Diamond-shaped and **rhomboidal** diamond-shaped or almost so.

Rhyniophyta or **Rhyniophytina** (from the fossil genus *Rhynia***,** itself named after the Rhynie chert fossil site near the village of Rhynie, Aberdeenshire, Scotland) Primitive, small, early (lower Devonian) vascular plants characterized by naked, dichotomously branched, aerial axes with terminal sporangia. These stems arise from a horizontal, dichotomizing rhizome that bear rhizoids. As currently circumscribed *Rhynia* includes just one species *R. gwynne-vaughnii*. Other genera include, *Huvenia* and *Stockmansella* At one time the Psilophytes were considered to belong here, rather than with the ferns, *Psilotum* does bear an uncanny resemblance to these fossil plants. Rhyniophytes are considered basal to other vascular plant groups. Fossil plants that were similar to Rhyniophytes – polysporangiates, but which lacked vascular tissue such *Horneophyton* and *Aglaophyton* – having water conducting vessels (hydroids) to some mosses have been called protracheophytes. The Rhyniophytes have also been classified as paratracheophytes, having a simpler vascular system- have 'S-type' water-conducting cells, i.e., cells whose walls are thickened but in a much simpler fashion than those of true vascular plants, the eutracheophytes

ribbed With raised longitudinal areas, long raised piece or ridges. Also the lateral veins of a leaf. The terms costa and costule are derived from the Latin for rib, while the midrib of a frond is rhachis from the Greek for spine.



Modified from 'Introductory Botany' 2nd ed., 1971. Cronquist, Arthur. Harper International Edition

Figure 225 ribbed

ridges /ridged Possessing short or long raised areas, such as a stipe or spore surface.

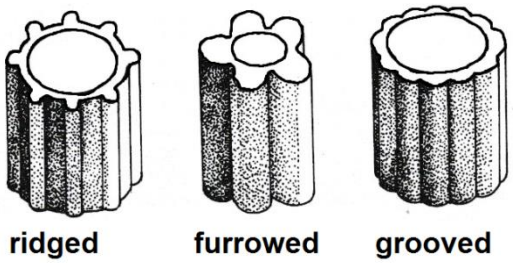


Figure 226 ridges

ring cells Another name for the **annulus.**

riparian (L. *riparius* f. *ripa*, bank, belonging to banks) Growing on riverbanks and streamsides.

root-hair A unicellular protuberance arising from the surface cells of a root. Compare **rhizoid**.

rootstock A swollen root together with the whole or a portion of a very short stem. Another term for rhizome.

rosette (L. *rosula* , little rose) A group of overlapping leaves radiating from the centre.

rosette fern Fern with an ascending or erect, compact rhizome with leaves arranged in a funnel-like rosette (shuttlecock). *Blechnum discolour*. A tree fern is a special case of a rosette-forming fern, with the leaves borne in a acrocaulescent fashion on the trunk.

rostrate (L. *rostrum* , beak of a bird) With a beak like structure.

rounded Round in shape, globose,spherical.

rudimentary (L. *rudis:* in the natural state, rough, raw, wild) Fragmentary, imperfectly developed.

rugose (L. *rugo*: to crease, wrinkle or crumple) Deeply wrinkled. Compare bullate.

rugula pl. **rugulae** (L. *rugo*: to crease, wrinkle or crumple) Spore wall ornamentation. Corrugations, small wrinkled ridges, long and narrow.

rugulate (L. *rugo*: to crease, wrinkle or crumple) Bearing **rugulae**, irregularly distributed wrinkled elements.

rugulose (L. diminutive of rugose) Covered with minute wrinkles.

runner A slender prostrate or arching lateral stem that terminates in a bud which produces leaves and roots. Compare **stolon**.

rupestral (L. *rupes*: a rock) Growing on rocks, cliffs, walls etc. Synonyms: **rupicolous**, **lithophyte, saxicolous**, **petrophilous**, **petrocolous** and **epilithic**. Example: Leather-leaf fern *Pyrossia eleagnifolia* which also grows as an epiphyte. See also **chasmophyte**.

rupicolous (L. *rupes* a rock + L. *cola*, inhabitant f. *colere* or *coloreto*, to live in a place, to inhabit) See **rupestra**l. Example: Leather-leaf fern *Pyrossia eleagnifolia* which also grows as an epiphyte.

saccate (L. *saccus* , sack or bag) With pouched projections or sacs. bag-shaped. The projections appear to be flaccid and hollow, pouched.

sagenoid (Gr. *sagen* , seine , fishing net + *-oid* , resembling) Anastomosing venation with regular areaoles with included veinlets (simple or branched) protruding in all directions, e.g. *Tectaria* spp

sagittate (L *sagittalis* f. L *sagitta*, arrow) Shaped like an arrow head, with the basal lobes pointing downwards. Compare hastate.

saline (Latin *salinus*, from *sal* salt) Salty, brackish. Halophytes (Gr. *hals*, salt, sea + *phyton*, plant) dwell in salty environments.

saprophyte (Gr. *sapros*, rotten, + *phyton*, plant). An organism such as fungi living on dead organic matter and usually lacking chlorophyll. Some of these fungi form a mycorrhizal association with plant roots and some fern and lycophyte gametophytes are totally dependent on the fungi for food and are termed achloromycoheterotrophs. Thus the plant is an indirect saprophyte.

sarmentose (L. *sarmentum* ,twig) Producing long, flexuose runners or stolons

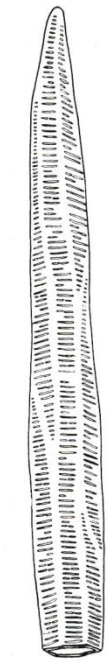
saxicolous (L. *saxum* rock + L. *cola*, inhabitant f. *colere* or *coloreto*, to live in a place, to inhabit) Growing on or among rocks. Synonyms, **rupestral**, **lithophyte**, **petrocolous**, **petrophilous**, **rupicolous**, **epilithic**. Example: Leather-leaf fern *Pyrossia eleagnifolia* which also grows as an epiphyte, *Pteris saxatilis*. See also chasmophyte.

scaberulous (Diminutive of scabrate) slightly or minutely rough to the touch. *Paesia scaberula*. See **leaf hairiness** terms.

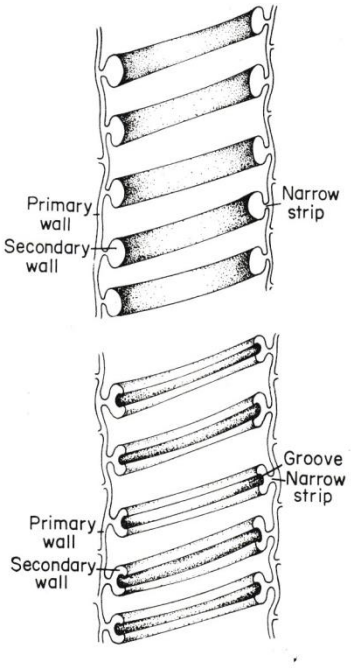
scabrate (L. *scaber*: rough) rough.

scabrous (L. *scaber*: rough) Rough to the touch, due to minute projections. See **leaf hairiness** terms.

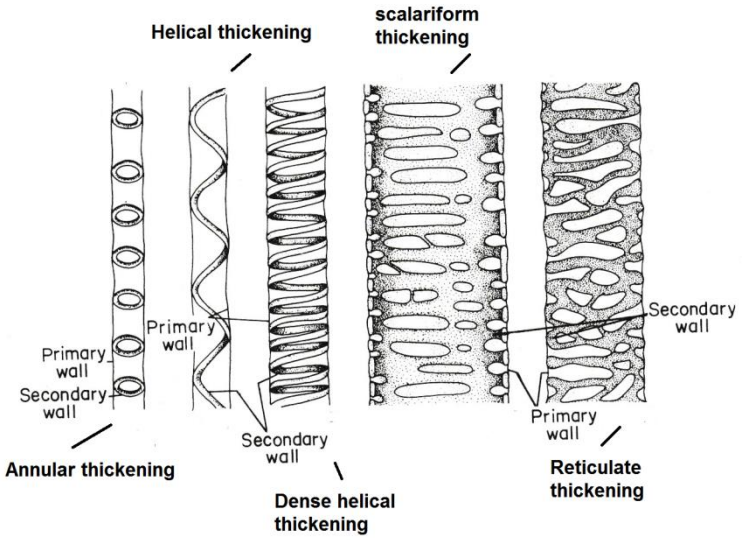
scalariform (L *scala*, ladder + form) Resembling a ladder. Secondary xylem elements possessing parallel bands of lignified thickening or some perforation plates that have several pores separated by parallel bars of tissue.



Tip of tracheid of *Drypteris* with scalariform pitting

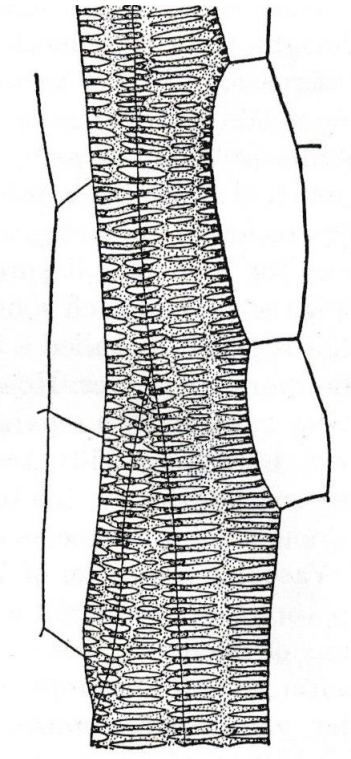


L.S. tracheary element showing helical thickenings and the strips by which they are joined to the primary wall



Different types of secondary wall thickening

(Modified from 'Plant Anatomy' 1982 (3rd ed.) A. Fahn. Pergamon Press)



Scalariform tracheid of
Marsilea vestita
'Cryptogamic Botany' 1955. Smith

Figure 227 scalariform tracheids

scalariform venation When tertiary veins usually link the secondaries in a ladderlike pattern. Synonym **percurrent.** Compare **reticulate** or netlike pattern.

scale 1. A dry thin plate of cells of epidermal origin; one cell thick but two or more cells wide at the base at least; a thin scarious **trichome** which is either flattened,inflated or twisted and variously shaped e.g. hair-like and the margin maybe entire, toothed or fringed. The scale may be attached by the basal edge or at a

point away from the edge (peltate attachment). The scales colouration and markings also distinct –this along with the previous features may be helpful in identification. May be found on rhizomes, stipes or rhachises of many ferns. The term **palea** refers to scales on various parts of ferns particularly if chaffy, hence **paleate**, **paleaceous** while **lepidote** means covered in small scales, **squamate**/**squamose**/**squamous** means scaly;**squamula** is a small scale and **squamulose** –covered in small scales... The covering of scales and hairs is called **indumentum**. 2. Or a vestigial scale-like leaf e.g. *Psilotum* **.** Synonym **ramentum**. Note leaf shape terms can be used to describe scale shapes.

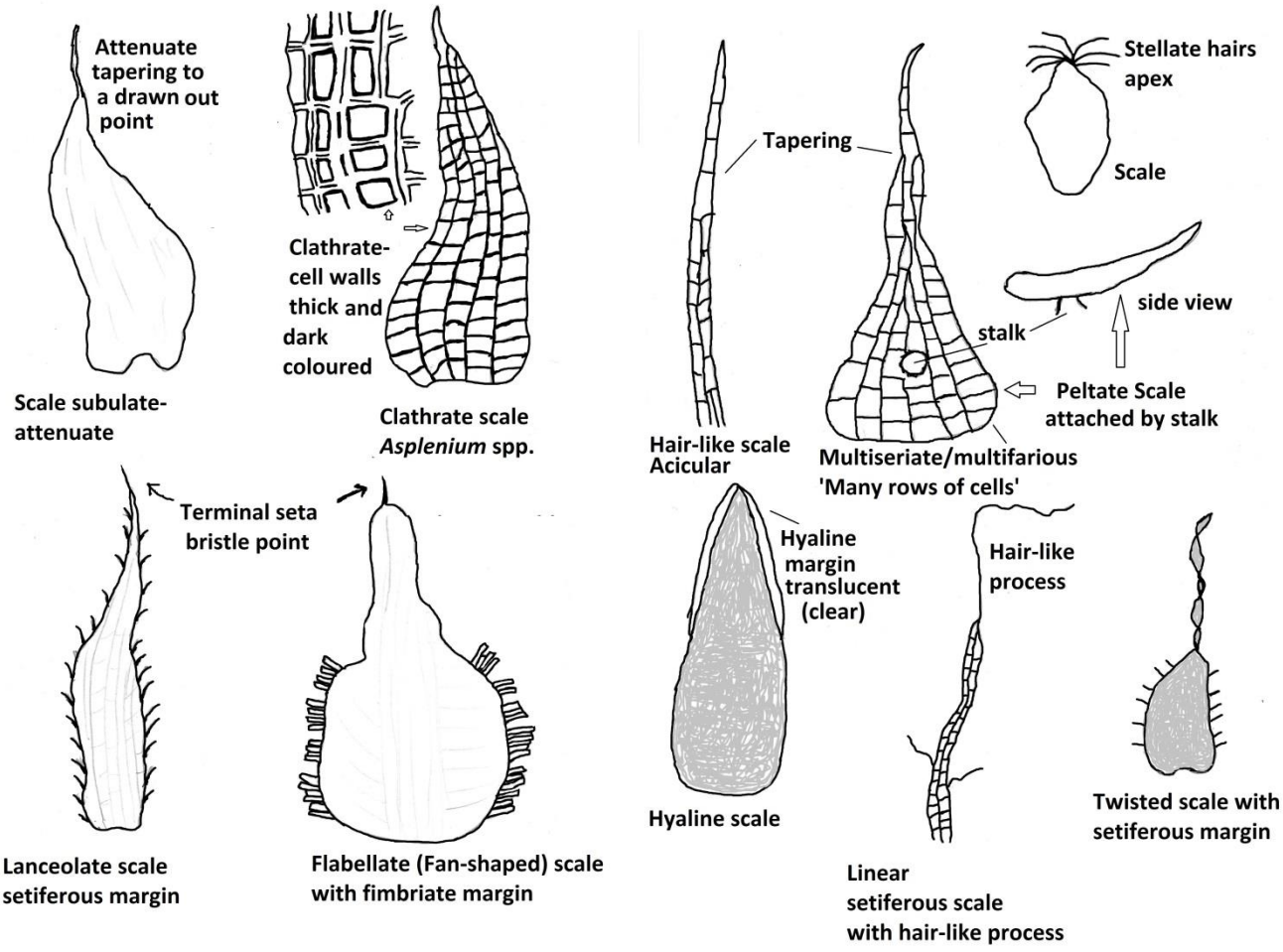


Figure 228 scales

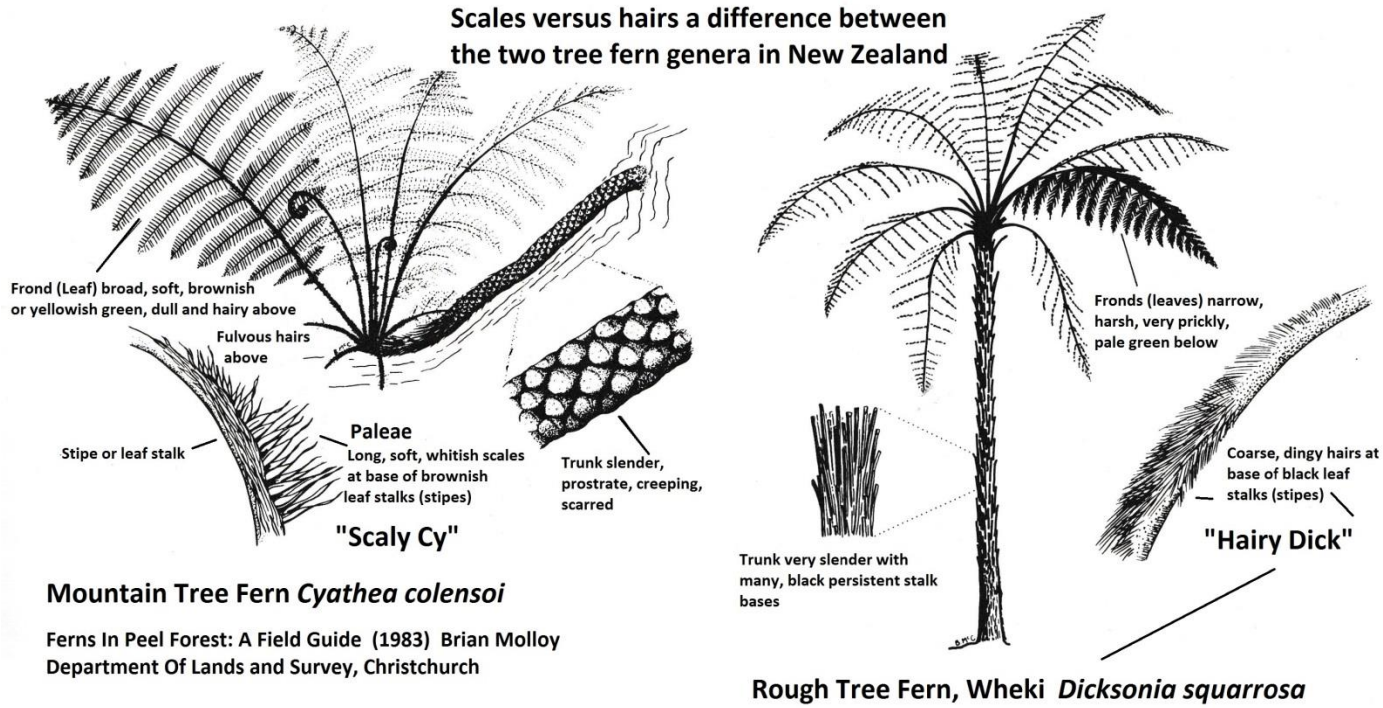


Figure 229 scales versus hairs in tree fern genera

scandent (L. *scandere*: to climb) Climbing on other vegetation for support, e.g. *Phlegmarius volubile* syn. *Lycopodium volubile*, *Lygodium articulatum*, *Dendroconche scandens* syn. *Microsorum scandens*.

scaly Covered in scales, synonyms: **paleate**/**palaceous**(**chaffy)**, **squamate**/**squamose**/**squamous**, and the diminutive **squamulose**, and **lepidote**.

scarious (L. *scariosus,* dry and membranous in texture) Thin, dry and membraneous in texture. *Lycopodium scariosum*.

schizaeoid ferns Ferns in the order Schizaeles familes: Anemiaceae (not in New Zealand), Lygodiaceae (1 species NZ – *Lygodium articulatum*, mangemange) and Schizaeaceae (4 species of *Schizaea* in NZ, comb ferns).

scientific name also known as **botanical name**. The Latinised **binomial** (genus name + specific epithet) by which a species is recognized internationally or a trinomial or greater if subspecies, varieties or forms are involved. Compare **common name**, or **Maori name**. e.g.

Asplenium bulbiferum	Hen and chickens fern	Manamana, Mauku, Mouki, Mouku
Scientific Name	**Common Name**	**Maori name/names**

sciophilous or **skiophilous** (Gr. *skia,* shade + *philous* , love) Said of plants which favour shady conditions. New Zealand examples: *Hymenophyllum atrovirens* and *Leptopteris superba*. Synonym **umbraticolous** or **umbrophile, photophobic.** Compare **heliophile, photophile.**

sclerenchemya (*skleros* , hard + *enchyma* a suffix denoting tissue- see **parenchyma** for etymology) Cells having heavily lignified cell walls, often dead at maturity; or strengthening tissue formed from such. Cell types include fibres and sclerids, sometimes included are the vascular cells or conductive cells such as tracheids and vessel elements of the xylem and the sieve cells or sieve tube members of the phloem (the

phloem cells not lignified but thickened (nacreous thickening). Involved in mechanical support and sometimes conduction (internal transport- if we include xylem and phloem) as well.

sclerenchymatic plates (band) Bands of **sclerenchyma** tissue surrounding each vascular bundle in a tree fern trunk and often in addition a band of sclerenchyma thicker than others, providing a firm cylinder that produces the hard exterior of the trunk and provides the main support for the trunk in tree ferns.

sclerotic (*skleros* , hard) hard and stony.

scrambling fern/lycophyte Fern or clubmoss with leaves of indeterminate growth or dormant leave buds and that spreads across the soil surface and over other low growing vegetation and physical objects..

scutelliform (L. *scutella* , a dish, salver, shaped like an oblong shield f. Gr. *scutum*, shield + *forma* , shape) Shaped like a small shield.

scurf A fine, scaly covering. See **leaf hairiness** terms.

secondary pinna (L. *secundo*: secondly + pinna) The ultimate segments (leaflets) of a bipinnate fern. Also called a **pinnule**.

secondary succession (L. *secundo*: secondly + succession) Succession initiated by the disruption of a previously existing seral or climax community by some major environmental disturbance, leading to a marked change in the stable vegetation community. Secondary succession may occur after a fire or storm, after removal of grazing pressure,or abandonment of cultivated areas. Unlike **primary succession**, a soil is present and relatively intact. Bracken fern *Pteridium esculentum* can be sited as a frequent secondary succession species.

section A taxonomic subgroup of a genus containing closely related species.

seculate (L. f. *sector*, cutter) Sickle shaped, e.g. *Blechnum montanum*. Synonym **falcate**.

seed A ripened ovule, a reproductive unit formed from a fertilized ovule, and comprising an embryo (young sporophyte), food store and protective coat. The resting body in the reproductive cycle of and produced by the seed plants (spermatophytes). Seed differs from spores in many ways (despite the word spore being derived from the Greek for seed) but like spores serves as the dispersal unit. Spores tend to be one-celled. The unripened/unfertilized ovule is multicellular and includes protective and nurturing maternal sporophyte tissue as well as the female gametophyte. The gametophyte is thus retained by and dependent on the sporophyte in the seed plants.In flowering plants the seed is furthermore enclosed or embedded in a fruit, derived from the female parts of the flower – the ovary and sometimes the receptacle as well.

seed ferns The pteridosperms,fossil seed bearing plants,from the late Devonian and Carboniferous to Permian,many of which many bore fern-like leafs (fronds) but produced seeds as well. Class as gymnosperms. evolved from progymnosperms (fern-like plants with conifer like stems). Conifers,cycads, gingkos derived from early Paleozoic forms, angiosperms (flowering plants) from late Mesozoic forms.

seed plants Gymnosperms (for example, pines, gnetophytes,ginkgoes, and cycads) and angiosperms (flowering plants). Vascular plants that produce seeds .Synonym Spermatophyta. The non-seed plants (synonym **cryptogams**) include the ferns, lycophytes and the non-vascular bryophytes which reproduce from spores. Ferns and seed plants share a common ancestry in the extinct trimerophyte clade, the lycophytes seperated earlier and the bryophytes earlier still.

selfing self-fertilization, either **gametophytic selfing** when a sperm fertilizes an egg cell of the same gametophyte or **sporophytic selfing**, when a sperm fertilizes an egg cell of a different gametophyte that developed from spores from the same sporophyte parent. Opposite of **outcrossing**, when a sperm fertilizes an egg cell of another gametophyte that came from a different sporophyte. The resulting offspring are heterozygous in the case of outcrossing and homozygous in the case of selfing.

segment (L. *segmentum* a piece cut off) Each free part of a divided frond. The ultimate leaflets of a frond.

semi-terete (L. *semi-* half + *teres*, *teretis ,* round, cylindrical) Flat on one side, terete on the other. Half-round.

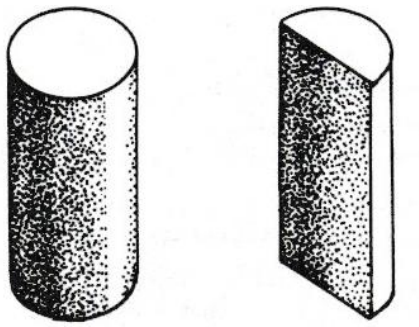


Figure 230 semi-terete

semi-xeric (L. *semi-* half + Gr. xeros , dry), Able to grow in semi-arid conditions.

septate (L *sepes* , a hedge, divider) Divided internally by partitions or cross-walls called **septa**.

septapinnate (L. *septa*, seven + pinnate) With the frond divided seven times. 7 X pinnate.

septum (L *sepes* , a hedge, divider) A partition. pl. **septa**.

sequential. (L. *sequential* f. *sequi*, follow) Said of sorus with the younger sporangia at the apex and the older ones lower down (basipetalous) or the reverse (acropetalous). The sporangia mature in succession indicated by the direction. Contrast **mixed**. Synonym **gradate.**

seral (L. *series*, f. *serere*, to join together, bind) A plant community (**sere**) that is successional, before reaching equilibrium or climax. See **primary succession.**

sere A successional series of plant communities, a stage in a succession. Some seres are named after the starting substrate e.g. lithosere (rock) psamosere (sand as on dunes) hydrosere (water) or initial conditions xerosere (dry soil).

seriate (L. *serere* , to join together) In whorls or apparent whorls.

sericeous (L. *sericus* , silken) Clothed with silky hairs. Synonym **silky**.

serrate (L. *serra*: a saw) Toothed, like a saw blade. With sharp teeth having usually saw-like, sharp, acroscopically directed teeth on the margins. Teeth slightly oblique to the margin – like the edge of a saw. Hence ***serrulate*****,** finely serrate.

serrulate (L. *serra* a saw) Finely or minutely serrate**,** diminutive of **serrate.**

sessile: (L. *sessilis* , pertaining to sitting) Lacking a stalk. Attached directly at the base, sitting directly on the organ or axis to which it is attached. Such as pinnae attached to the rachis or midvein and not having a separate stalk.

seta (L. *seta* , bristle) A stiff hair or bristle. pl. **setae**. A hair-like extension of the leaf, as in homophyllous species of *Selaginella*. Hence *setose*, *setiferous*, having small bristly hairs. Synonym **echina**. Spore wall projection where the trunk does not taper, and the apex is not sharp.

setaceous (L. *seta* , bristle) With the character of bristle. See **leaf hairiness** terms.

setiferous (L. *seta* , bristle + *-ferous* , bearing) Producing or having setae. *Polystichum setiferum*.

setiferous scale (L. *seta* , bristle + *-ferous* , bearing + scale) In tree ferns genus *Cyathea* subgenus *Sphaeropteris* scales at the base of the stipe, that are relatively narrow scales, the cells are similar in shape and orientation (elongate and approximately parallel to the axis) with a number of marginal cells thickened to form short, bristle-like projections or setae. Contrast **flabelloid scale**. See scale (diagram).

setose (L. *setosus*: hair covered) Covered with bristles (**setae**). See **leaf hairiness** terms.

setulate (L. *setosus*: hair covered f. *seta*, bristle) bearing **setae**. See **leaf hairiness** terms.

setulose (diminutive of setose) Covered with small bristly hairs. See **leaf hairiness** terms.

sexine (f. 's' in sculptured, and exine f. *ex-* + *in-* fibrous tissue, from Greek *in-, is* tendon) The outer sculptered part of the exine (exospore) – spore wall layer. in contrast to the **nexine** ('n' from non-sculptured, and exine).

sheath A tubular envelope that clasps the stem, e.g. *Equisetium* spp.

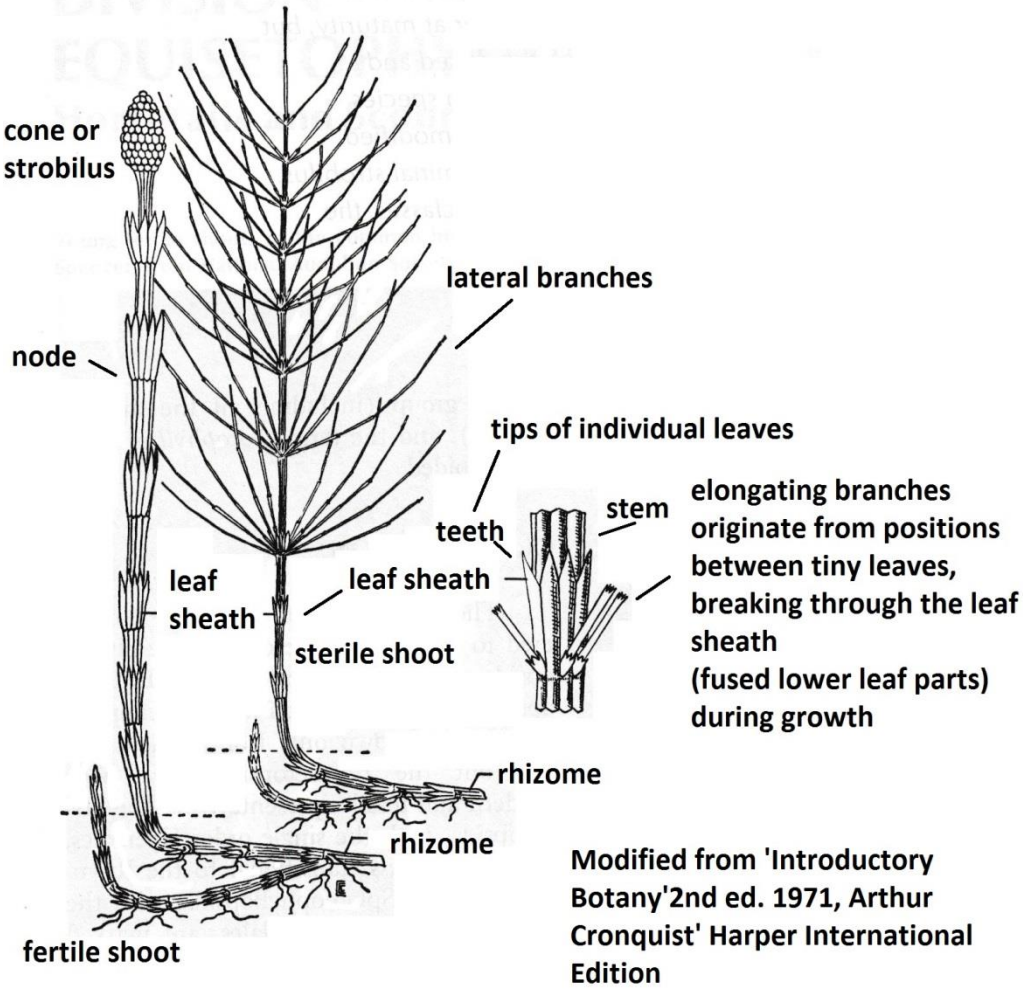


Figure 231 sheath *Equisetum*

shield ferns The shield ferns such as *Polystichum* and *Lastreopsis* receive that common name because of the prominent **peltate** (shield-like) indusium they possess**.**

shield fronds Sterile fronds which envelop the root system of *Platycerium* spp. Synonym **base frond**, **mantle frond**.

shoot A stem plus its leaves and reproductive parts that it bears. Grows from a shoot apical meristem (sam). A bud is a condensed undeveloped shoot.

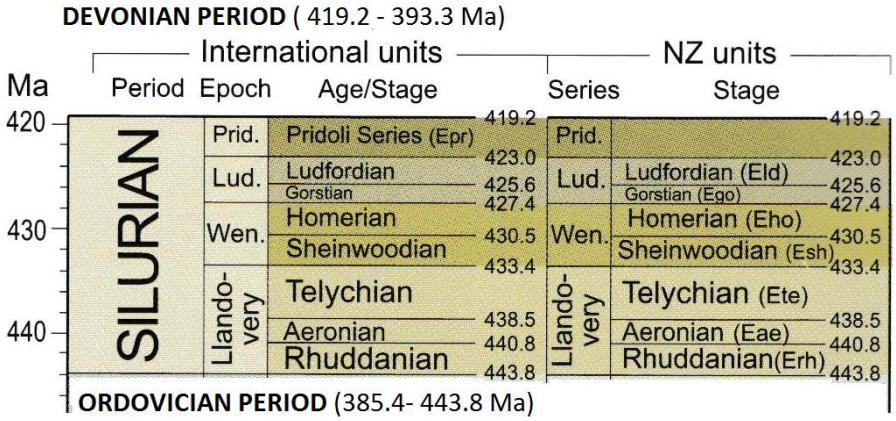
short-creeping rhizome: One that grows horizontally and produces fronds at short intervals. Compare **medium-creeping rhizome**, **long-creeping rhizome**, **caudex** or trunk, **tufted**.

shuttlecock Growth form like a badmington shuttlecock. Rosette type leaf architecture.

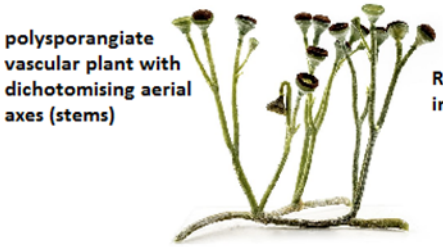
silky With a covering of very fine, lustrous hairs. See **sericeous**.

silvicolous (L. *silva*, woodland + *-cola*, inhabitant) Growing in forests. Synonym **hylophile.** *Polystichum silvaticum*.

Silurian Period (named after a Celtic tribe of Wales, the Silures.) The chronostratigraphic (geological) period from the end of the Ordovician Period, at 443.8 million years ago (Mya), to the beginning of the Devonian Period, 419.2 Mya. During the Wenlock epoch (between 433.4 and 427.4 million years ago), the oldest-known tracheophytes of the genus *Cooksonia*, appear. The complexity of slightly later Gondwana plants like *Baragwanathia*, which resembled a modern clubmoss, indicates a much longer history for vascular plants, extending into the early Silurian or even Ordovician.

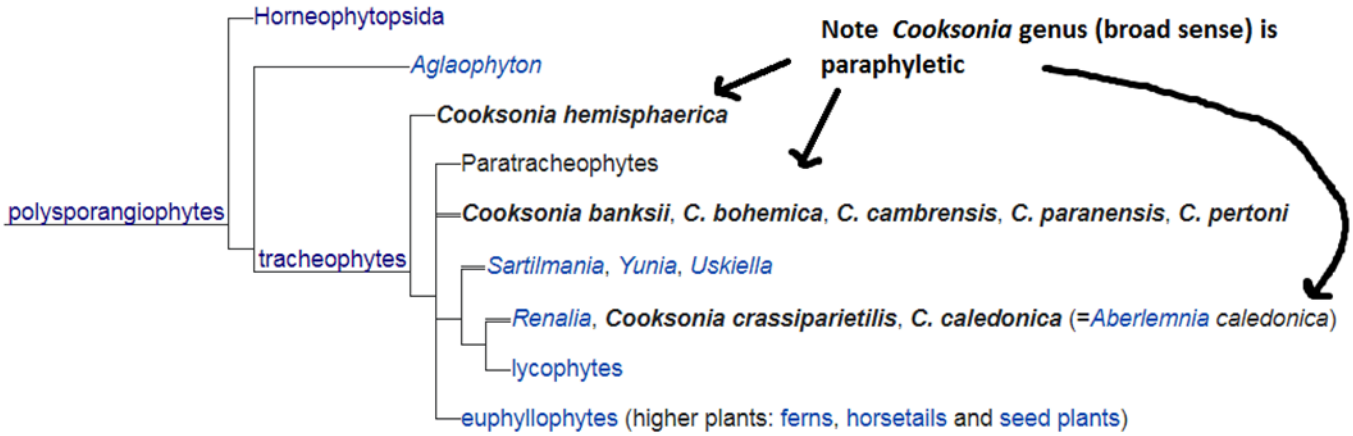


Silurian Period approximately between 444 and 420 million years ago (Ma)



polysporangiate vascular plant with dichotomising aerial axes (stems)

Reconstruction of *Cooksonia* as an independent sporophyte



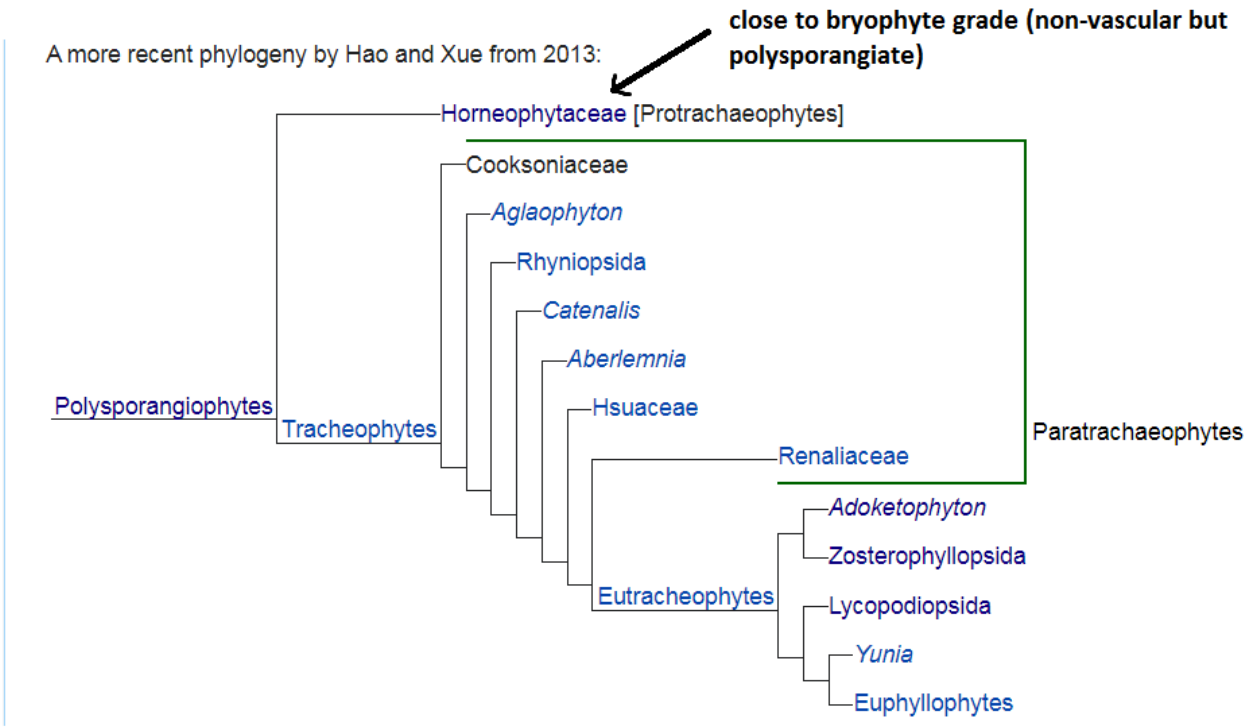
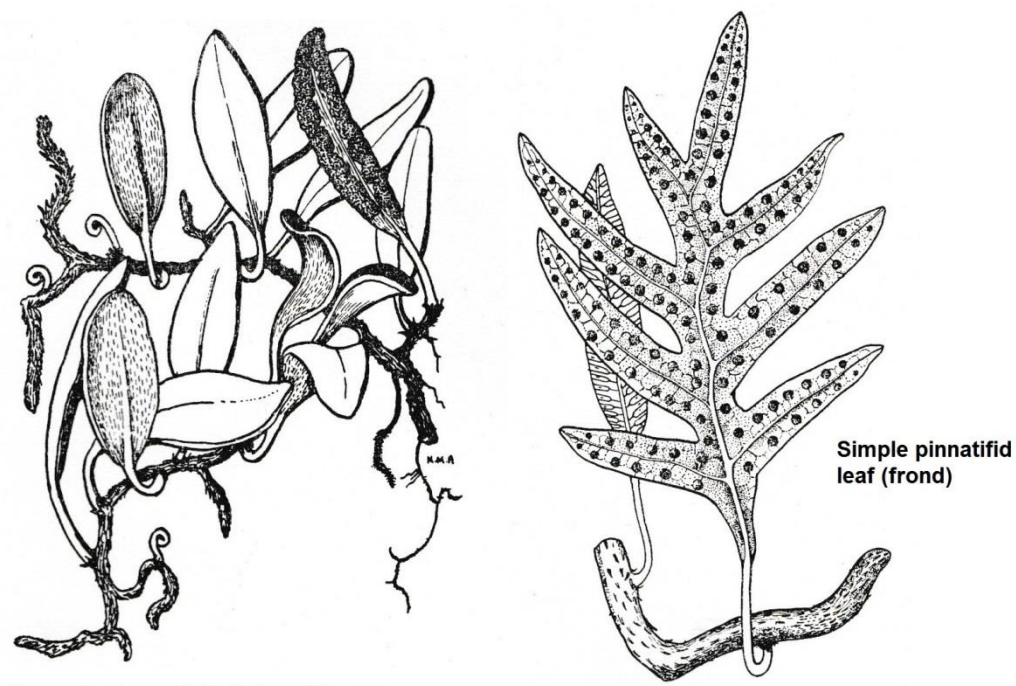


Figure 232 Silurian Period

simple Undivided; of a frond, not divided into leaflets (though it maybe toothed or lobed); of a hair, vein or an inflorescence, not branched. Not compound, or branched. Compare **compound.**



***Pyrossia eleagnifolia* Polypodiaceae**
Simple Leaf - entire
'Encyclopedia of New Zealand' 1966
artist Nancy M. Adams

Zealandia pustultata* subsp. *pustulata
syn. *Microsorum pustulatum*
Phymatosorus diversifolius

Figure 233 simple leaves

sinuate (Shaped like the original Roman Letter C f. Greek letter *sigma*, but now equivalent to English S) Curved or shaped like C, but S will do as well. With the margins strongly wavy.

sinuous (Shaped like the original Roman Letter C f. Greek letter *sigma*, but now equivalent to English S) Changing direction of curvature.

sinus (L. *sinus*: curve, hollow) The cleft, space, recess or gap between lobes or teeth on a margin.

sinus membrane (sinus + membrane) A flap of membraneous tissue occurring in the sinus of some ferns.

siphonostele (Gr. *siphon*, pipe, tube + *stele* , column, post), An arrangement where the tubular, vascular tissue surrounds a central pith. If the xylem is surrounded by an out layer of phloem the term ectophloic (outside phloem) siphonostele is used. If the xylem has an inner and outer layer of phloem the term amphiphloic (both + phloem) siphonostele or **solenostele** is used and if dissected, a **dictyostele**.

sister group The most closely related group in an evolutionary tree; when a branch on an evolutionary tree (cladogram) divides, it forms two sister groups. The two groups share a common ancestor. The ferns and seed plants are considered sister groups, the lycophytes being more distantly related to both. Psilotales are sister to the Ophioglossales, while *Equisetium* is possibly sister to the Marattiales all eusporangiate fern groups.

skiophilous or **sciophilous** or (Gr. *skia,* shade + *philous* , love) Said of plants which favour shady conditions. New Zealand examples: *Hymenophyllum atrovirens* and *Leptopteris superba*. Synonym **umbraticolous** or **umbrophile,photophobic.** Compare **heliophile, photophile.**

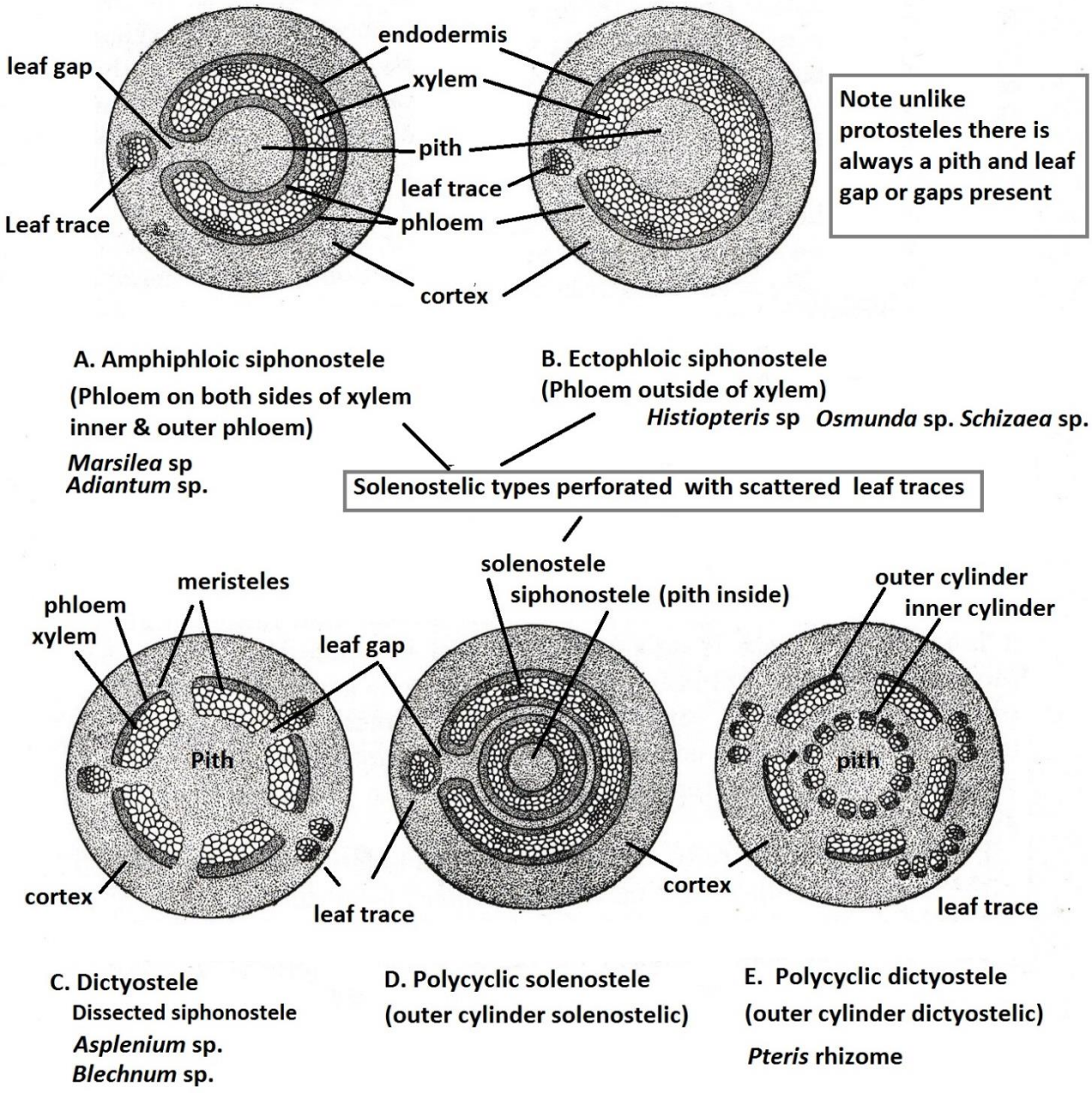
skirt The remains of dead leaves or stipes that are persistent and hang down from the crown of a tree fern trunk e.g. *Cyathea smithii*.

slender Long and thin.

sobol pl **sobole** (L. *soboles, suboles* sprout, shoot, offspring) Archaic term for a shoot originating near the ground; produced by an underground stem that produces roots and buds. A sucker.

soil spore bank The accumulation of spores in the soil profile, not all the spores will be viable though. Similar to the soil seed bank concept.

solenostele (Greek *solen* channel, pipe + *stele* , pillar) Synonym **amphiphloic siphonostele**, a tubular **stele** with both external and internal phloem to the xylem (Gr. *amphi-* both sides + *-phloic,* bark, phloem today).



Siphonostelic (Tube) Types of Steles

A- E Modified from 'Cryptogamic Botany' Vol. II, 1955. Smith Gilbert. McGraw-Hill

Figure 234 solonostelic and siphonostelic stele types

solid shapes (three dimensional)

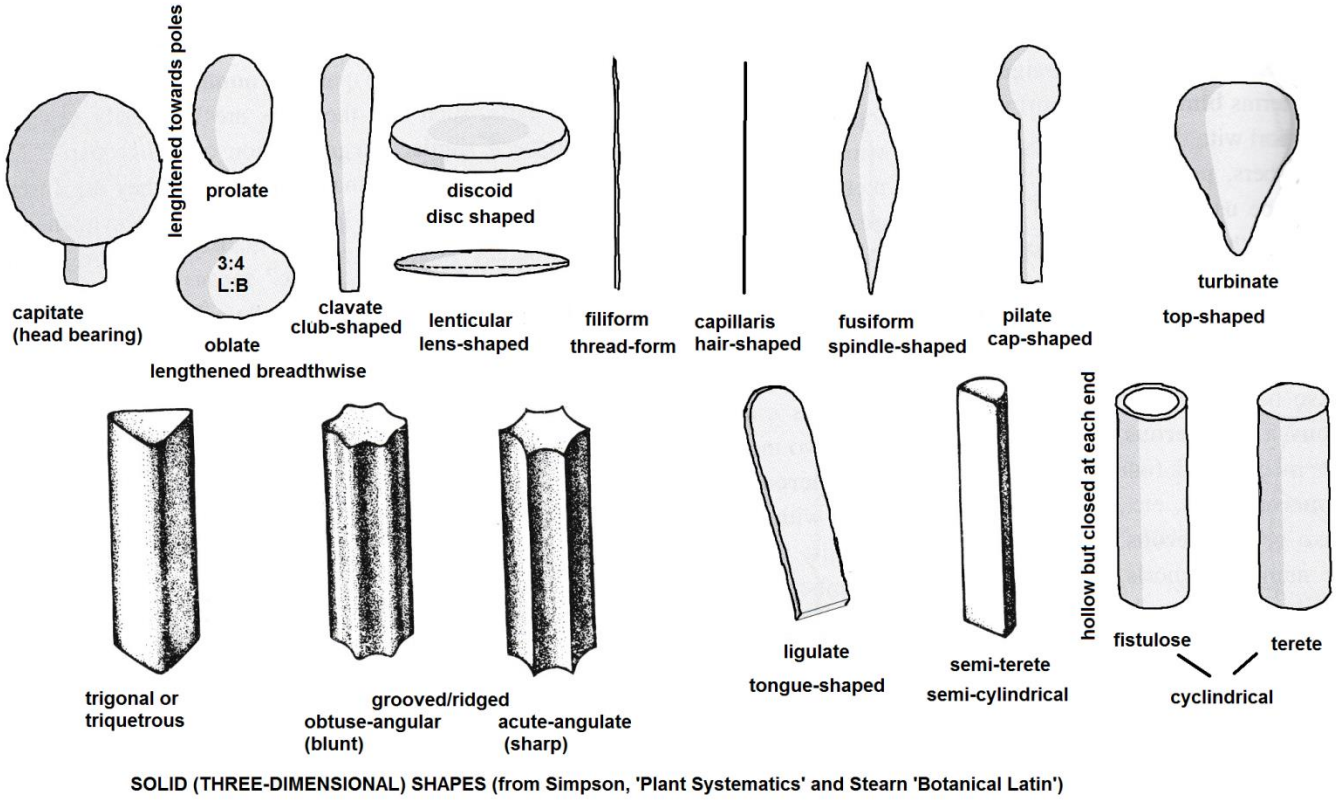


Figure 235 solid shapes

solitary Singly, not in groups.

soligenous (L. *solum* ground + *genesis*, origin) – A wetland such as a swamp, fen or marsh that is nourished by water flowing over or through soil. The water sourced from groundwater or an inflow of surface water. Compare **ombrogenous-** A wetland that is nourished solely by precipitation.

somatic (f. French *somatique* f. Gr. *somatikos*, bodily, f. *soma*, body) All the body cells of an organism except those giving rise to the egg and sperms.

soral flap (Gr. *sorus* , heap + flap) The specialised fertile lobe unique to *Adiantum*. A false indusium.

soral patch The area of the lower surface of the frond where the sporangia of leptosporangiate ferns are concentrated, e.g. *Leptopteris* spp.

soral position The location of the sori on the pinna, pinnules or pinnulets in relation to the midrib (costa) and margin. Also whether located along the veins on one (single-sided sori) or both sides or terminally (at vein tips). The following terms have been applied:-

extramarginal – extending beyond the margin. Protruding marginal sorus.

marginal- at the margin,

surficial – located away from the margin (includes the terms below). In ferns also called **abaxial**

(lower leaf surface) also not embedded or sunk into tissue (not immersed).

superficial -located on the surface. = surficial.

immersed - embedded or sunk into tissue rather than superficial.

submarginal – just behind the margin,

supramedial – nearer the middle (medial position) than the margin.

medial – in the middle, midway between the margin and the costa (costule or costulet).

submedial or inframedial –between medial and pericostal. Nearer the midvein than margin

pericostal – near or at the costa (midrib).

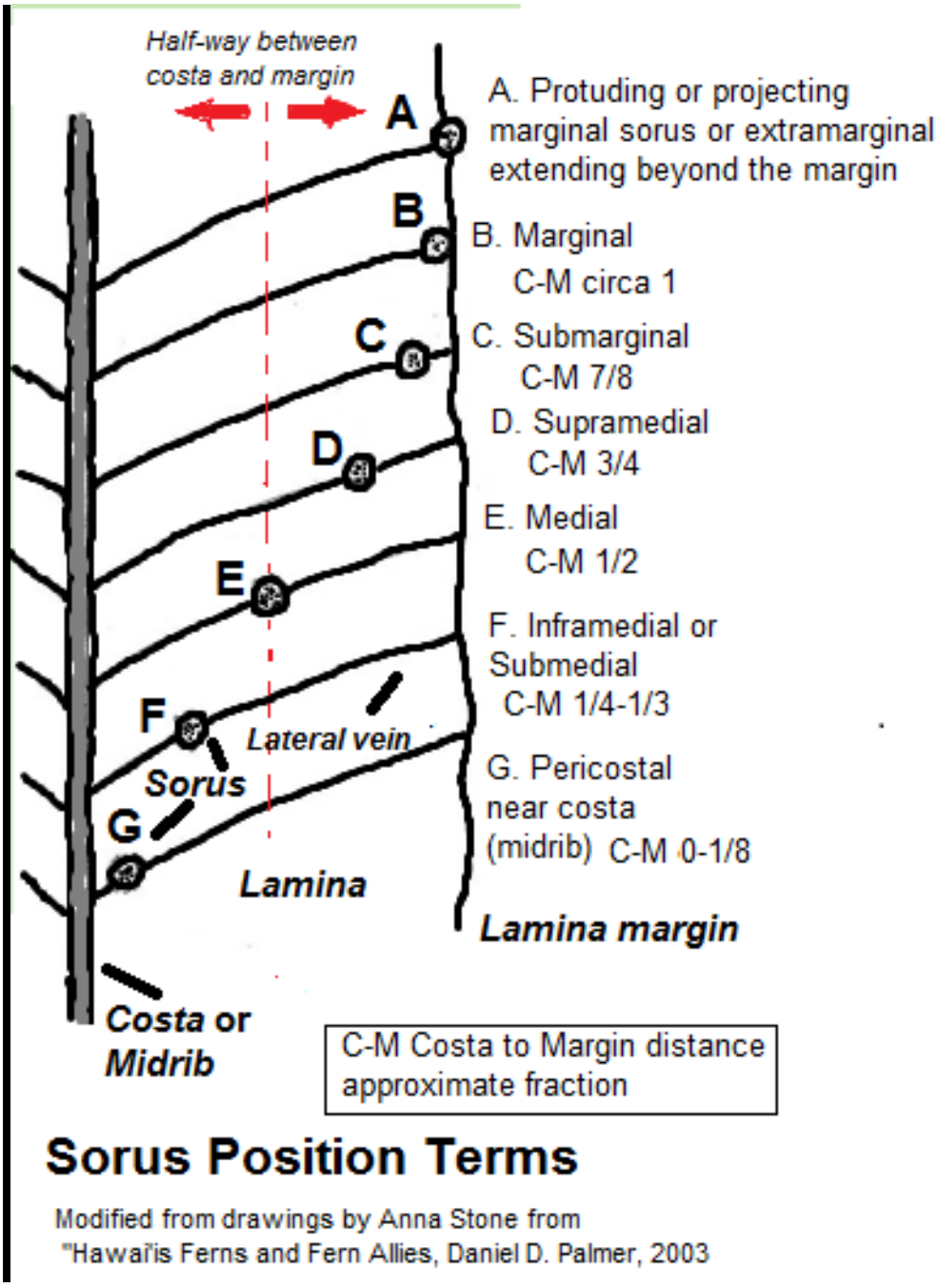
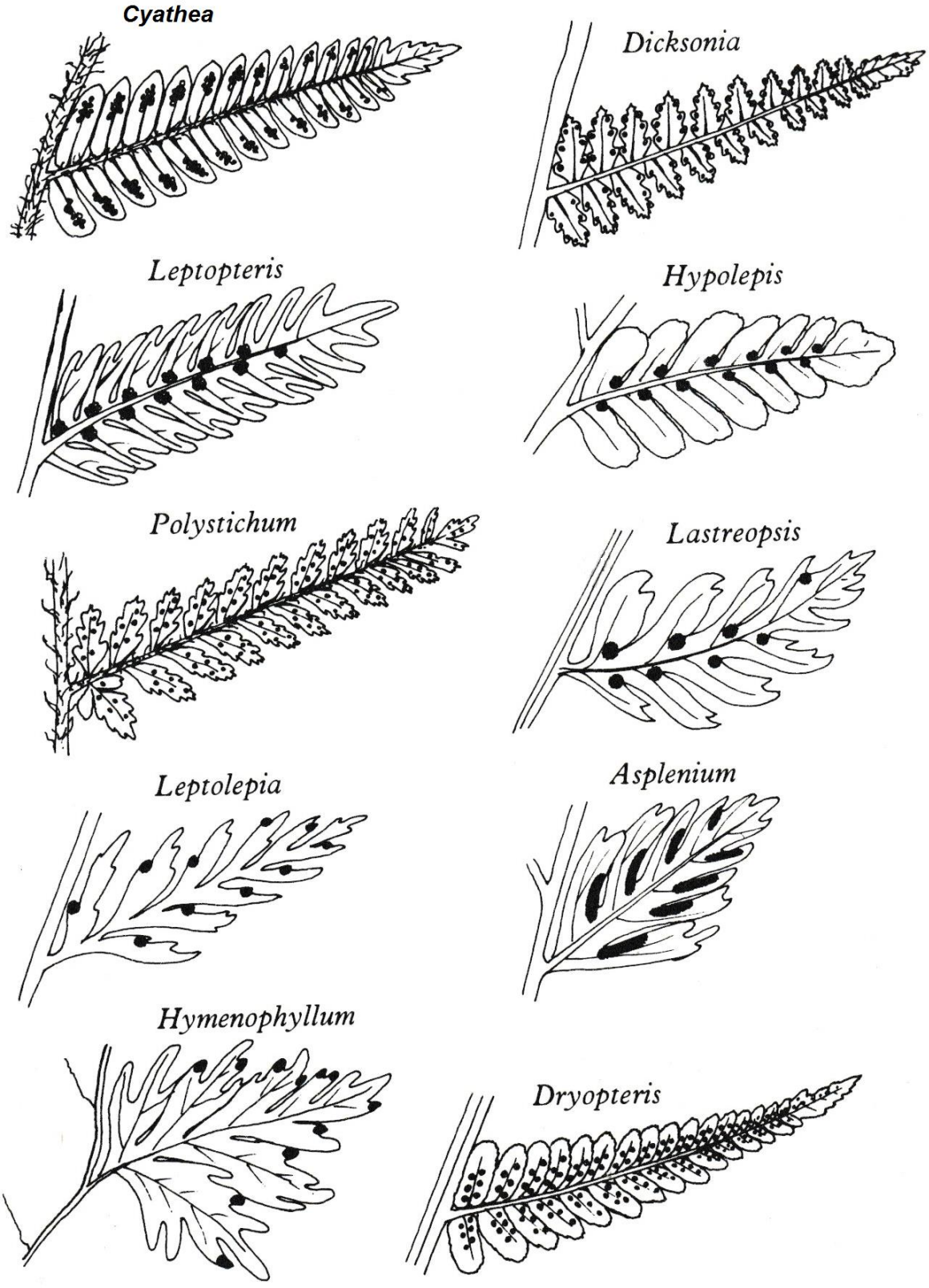


Figure 236 sorus position terms



Arrangment of sori (sporangia clusters) in fern genera represented in Peel Forest

'Ferns in Peel Forest' 1983. Brian Molloy. Dept of Lands and Survey, Christchurch

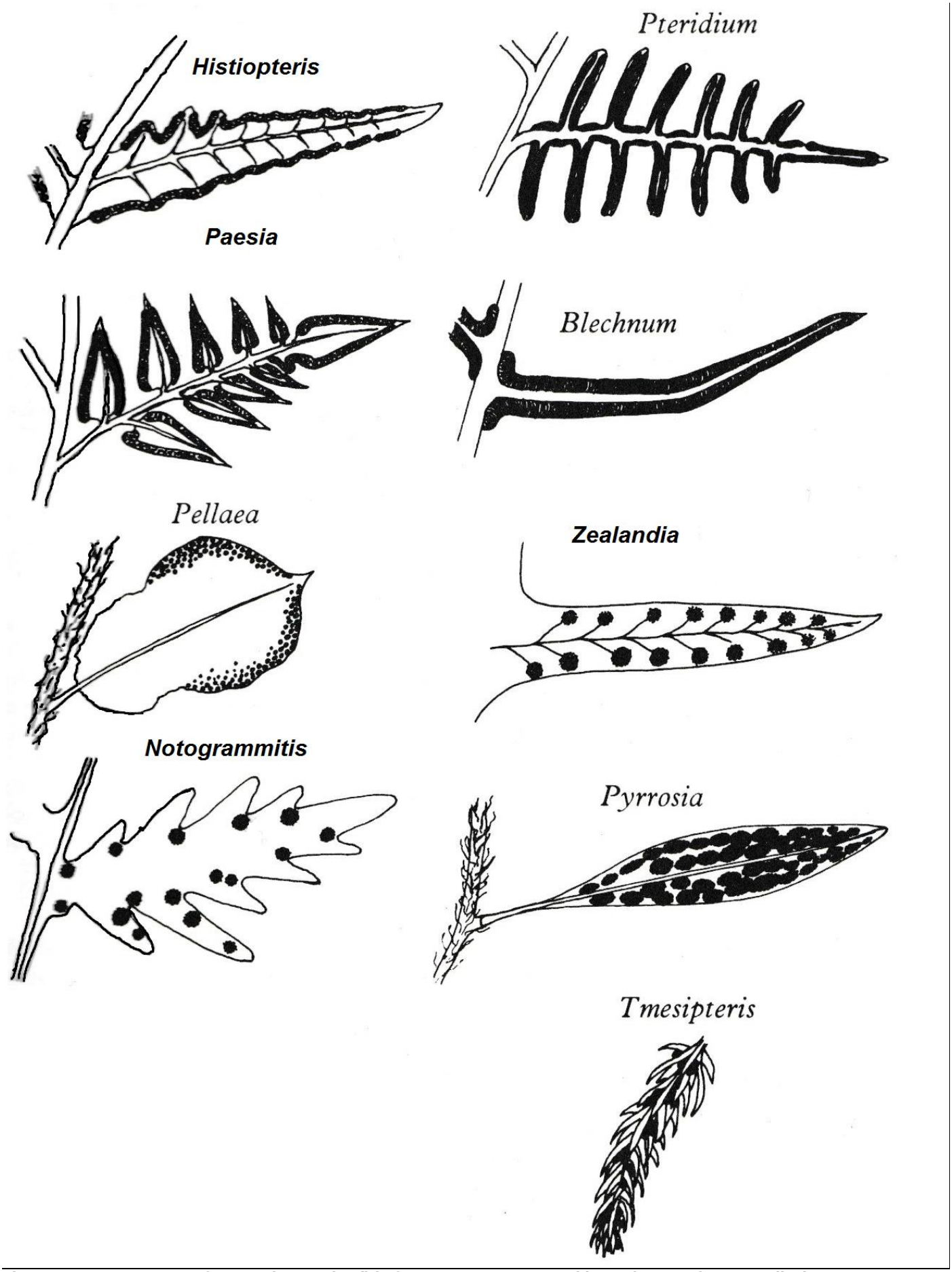
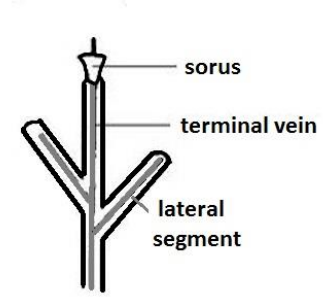


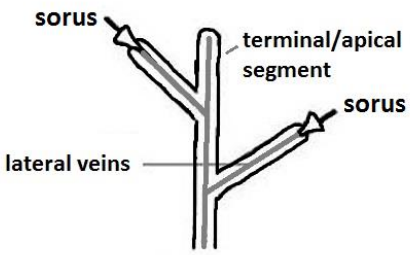
Figure 237 Arrangement of spore clusters (sori) in fern genera represented in Peel Forest (Bryan Molloy)

In addition the terms **epitactic**, **paratactic** and **pantactic** have been applied to the position of sori on the ultimate vein system of filmy ferns.



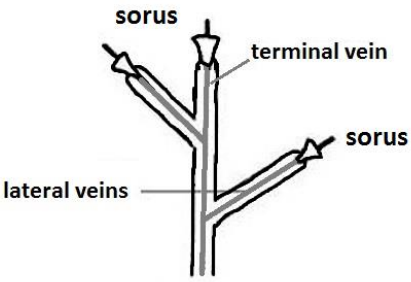
epitactic

When sori are always located on terminal veins of terminal segments in addition to lateral segments, they are epitactic.



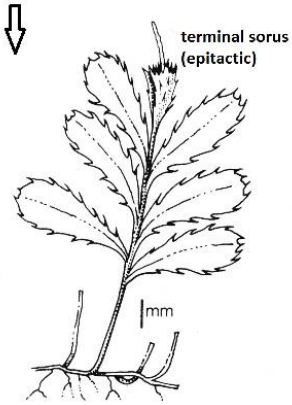
paratactic

When sori are located on terminal veins of lateral segments (rarely on the apical/terminal ones), they are paratactic.

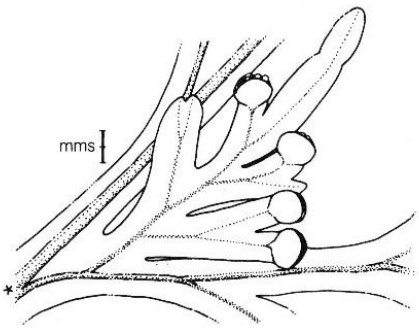


pantotactic

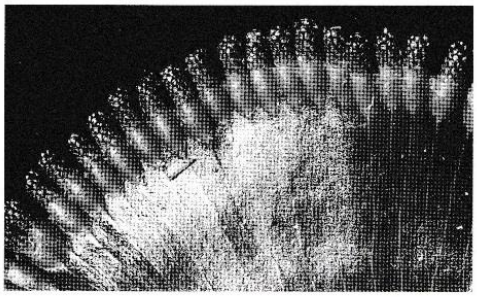
When sori are located almost on all segments or terminal veins, they are pantotactic.



Hymenophyllum minimum **showing toothed lamina segments, terminal sorus and toothed indusial flaps**
Artist Tim Galloway



Hymenophyllum dilitatum
Artist Tim Galloway



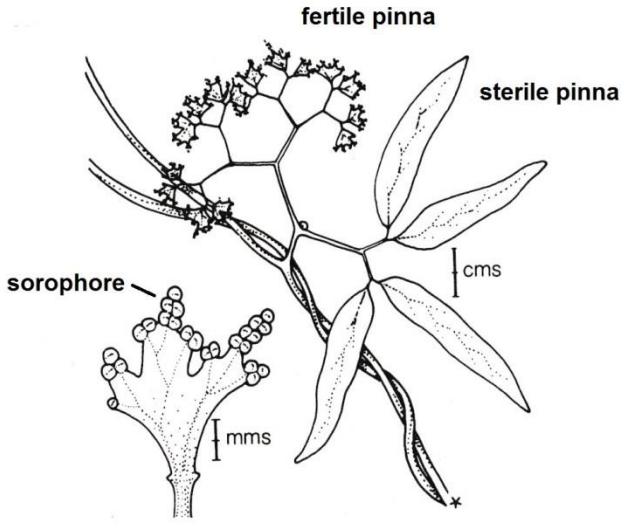
Hymenophyllum nephrophyllum **syn. *Trichomanes reniforme*, with sporarangia emerging from marginal, cup shaped indusia on, long receptacles.**
Patrick Brownsey

Soral Position in the filmy fern family Hymenophyllaceae

Figure 238 special soral position terms

soriferous (Gr. *sorus* , heap + L. *-ferous* , bearing) Bearing **sori**. Compare **acrostichoid**- sporangia singly placed and scattered.

sorophore (Gr. sorus + *-phoros*, bearing) (1.) Specialized outgrowth of a frond margin or segment margin bearing sporangia, e.g. *Lygodium* spp. and (2.) the elongate gelatinous, sporangium-bearing structure (massula) produced when the sporocarps of Marsileaceae open. Different structures but essentially performing the same function – exposing the sporangia for latter spore dispersal.

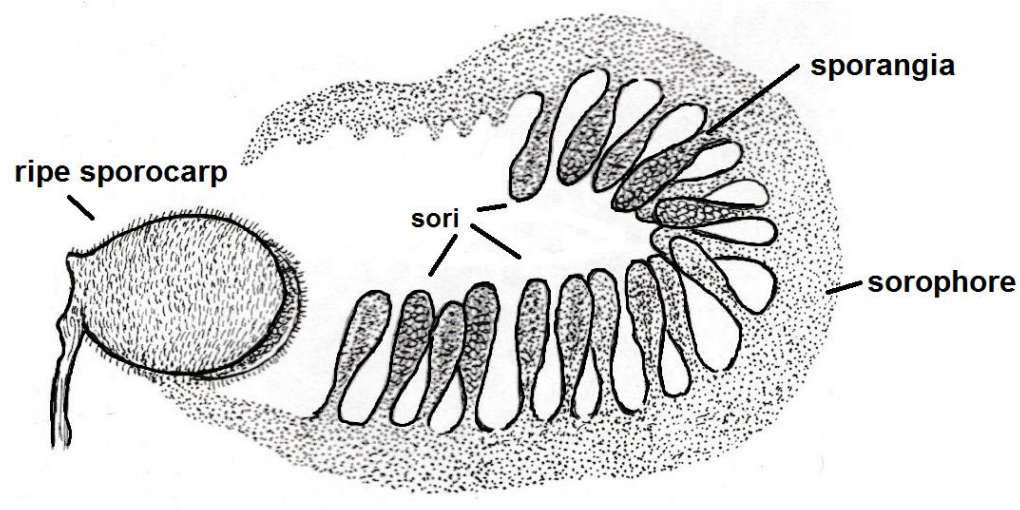


portion of fertile pinna showing sporangia on marginal outgrowths (sorophores)

Lygodium articulatum

Tim Galloway, artist 'New Zealand Ferns and Allied Plants' Brownsey, J. Patrick and Smith-Dodsworth, John C. . David Bateman publisher.

Figure 239 sorophore *Lygodium*

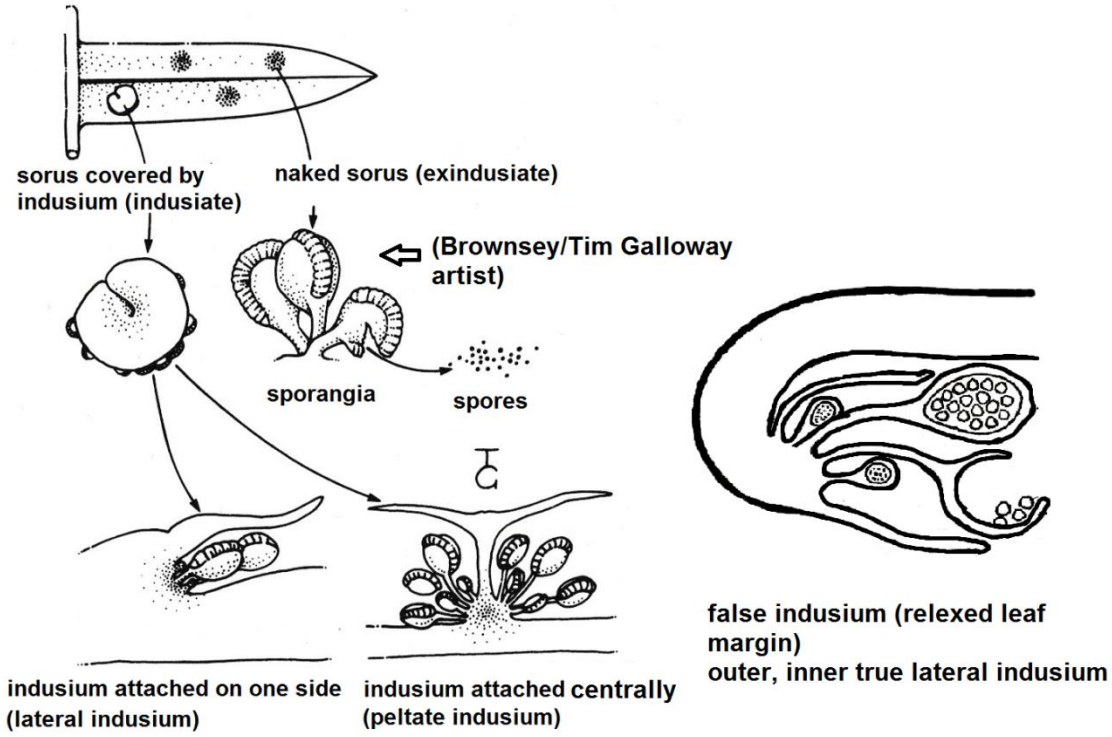


***Marsilea vestita* sporocarp with extruding sorophore - swollen gelatinous structure bearing the sporangia from the sporocarp**

Diagram from 'Plant Classification' 1979. Benson, Lyman. D. C. Heath and Company publishers

Figure 240 sorophore *Marsilea*

sorus (Gr. *sorus* , heap) A cluster of two or more sporangia (spore cases). pl. **sori**. The shape of the sorus and position (see **soral position**) provide features that aid in the identification of ferns. The sorus may be naked (**exindusiate**) or protected by a flap of tissue (true **indusium**), **sporocarp** or reflexed leaf margin (**false indusium**) or both. **Paraphyses** (filaments or hairs) may be present amongst the sporangia (paraphysate) or not (non-paraphysate). In some ferns e.g. Osmundaceae sori and indusia are absent, the sporangia are singly placed or scattered in distribution (See **acrostichoid**.). Similarly the synangia (fused twin or triplet sporangia) of the psilotales does not count as a sorus, nor the synangium of Maratiales Lycophytes lack them as well their sporangia are singly placed in the axil of the sporophyll or born on the upper sporophyll surface (adaxial or ventral position).



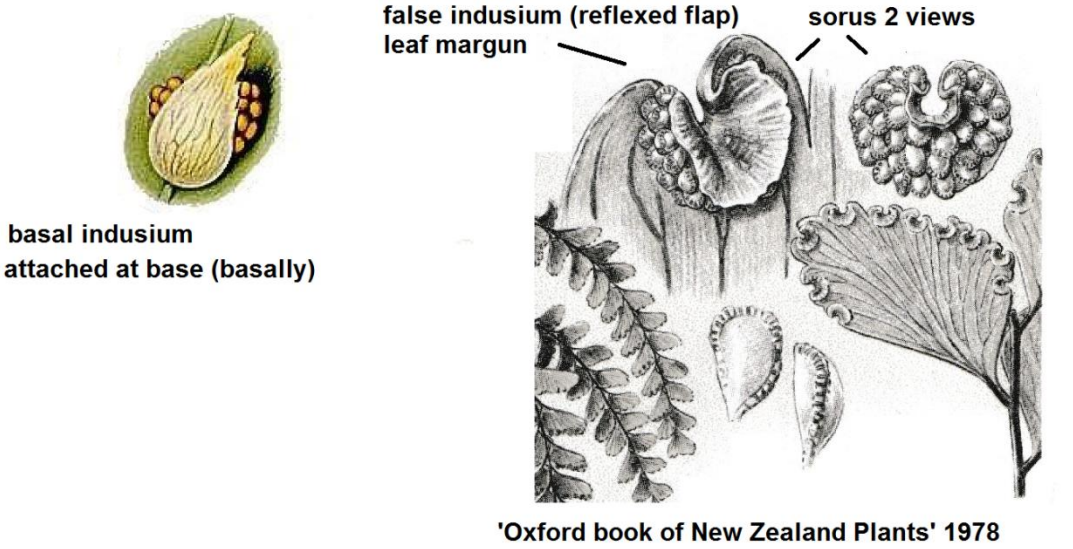


Figure 241 indusium attachment and false indusia

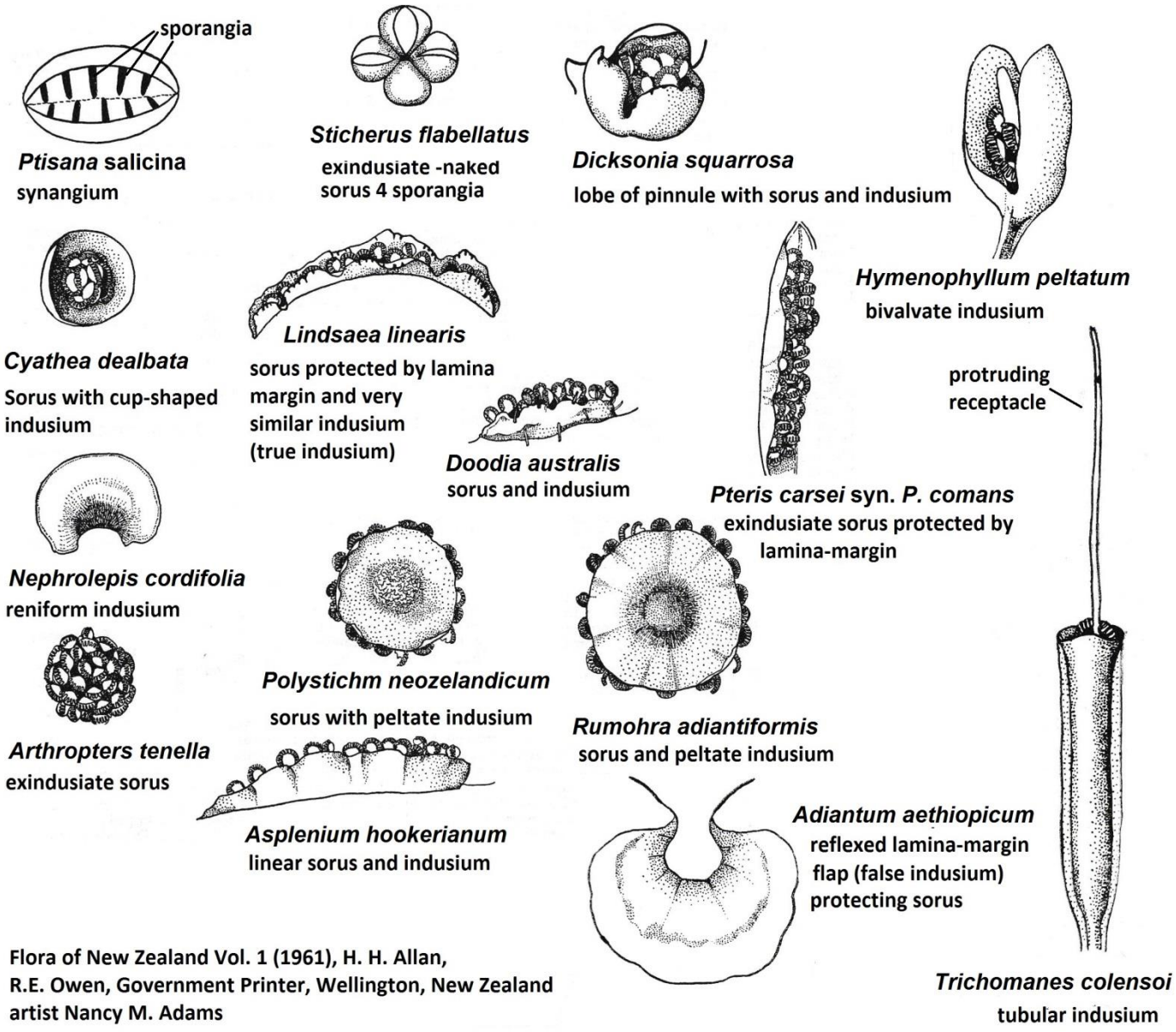


Figure 242 sori and indusia

spathulate (Gk. *Spathe*: a broad blade; & L. *spatula*: spoon like instrument used by druggists and surgeons) Spoon-shaped; broad at the tip and narrowed towards the base.

spatulate (L. *spatula*: spoon like instrument used by druggists and surgeons) Spatula-shaped, narrow at the base and gradually widening distally to a rounded tip.

specialist A plant that is limited to very specific habitat conditions e.g. the filmy fern *Hymenophyllum malingii* habitat:- Montane to subalpine. Epiphytic (rarely rupestral) usually on the dead or dying trunks of kaikawaka (*Libocedrus bidwillii*) but also occasionally found on Hall's totara (*Podocarpus cunninghamii*), rimu (*Dacrydium cupressinum*), *Halocarpus biformis*, beech (*Fuscospora* and *Lophozonia* spp.) and on moss covered boulders, rocks and cliff faces.

speciation In evolution, the biological process by which new species may arise.

species (L. *species*, appearance, form, kind) A taxonomic group of closely related organisms, the individuals usually interbreeding freely and having many characteristics in common; the word is used for both the singular and plural. Abreviation **sp.** single species and **spp.** for more than one species.

species epithet or **specific epithet** (Species + Gr. *epitheton* f. *epi*, upon, + *tithemi*, place) The second word in a species name, following the genus name for example, *filiforme* in *Blechnum filiforme.* The first

name, the genus is capitalised, the specific epithet is always lower case today. Note not to be confused with the species name (binomial) which is both words. This is because the specific epithet can be reused but only for a different genus e.g. *Cyathea colensoi* and *Trichomanes colensoi*. This ensures that the binomial name is unique.

sperm Male gamete, smaller,flagellated and motile compared to the larger, non-motile female gamete (egg). Produced in the **antheridium** on the gametophyte. At fertilization the sperm and egg fuse to form the **zygote**.Synonyms: **spermatozoid**, **antherozoid**.

spermatozoid (Gr. *sperma* ,seed + *-oid*, resembling) A motile, male gamete. Synonyms: **sperm**, **antherozoid**.

sphaereopteroid indusium. (f. genus *Sphaeropteris*, globe fern, f. Gr. *sphaira*, globe + *pteron* wing or fern of some kind, + *-oid*, resembling + indusium) In tree ferns genus *Cyathea*, species where the indusium is rounded and covers the sorus at first. Example *Cyatheae medullaris*. Compare **hemiteloid indusium** and **cyathiform indusium**

Sphenopteridian venation (f. fossil Pteridosperm (Seed Fern) *Sphenopteris* some formerly included in this genus may have been ferns) A type of Ctenopteridian venation (Pinnate pattern) in which the secondaries leave the mid-rib at an acute angle: the secondaries together with acute angled tertiaries run straight to the margin. *Asplenium* species. Classes also as **craspedodromous** venation.

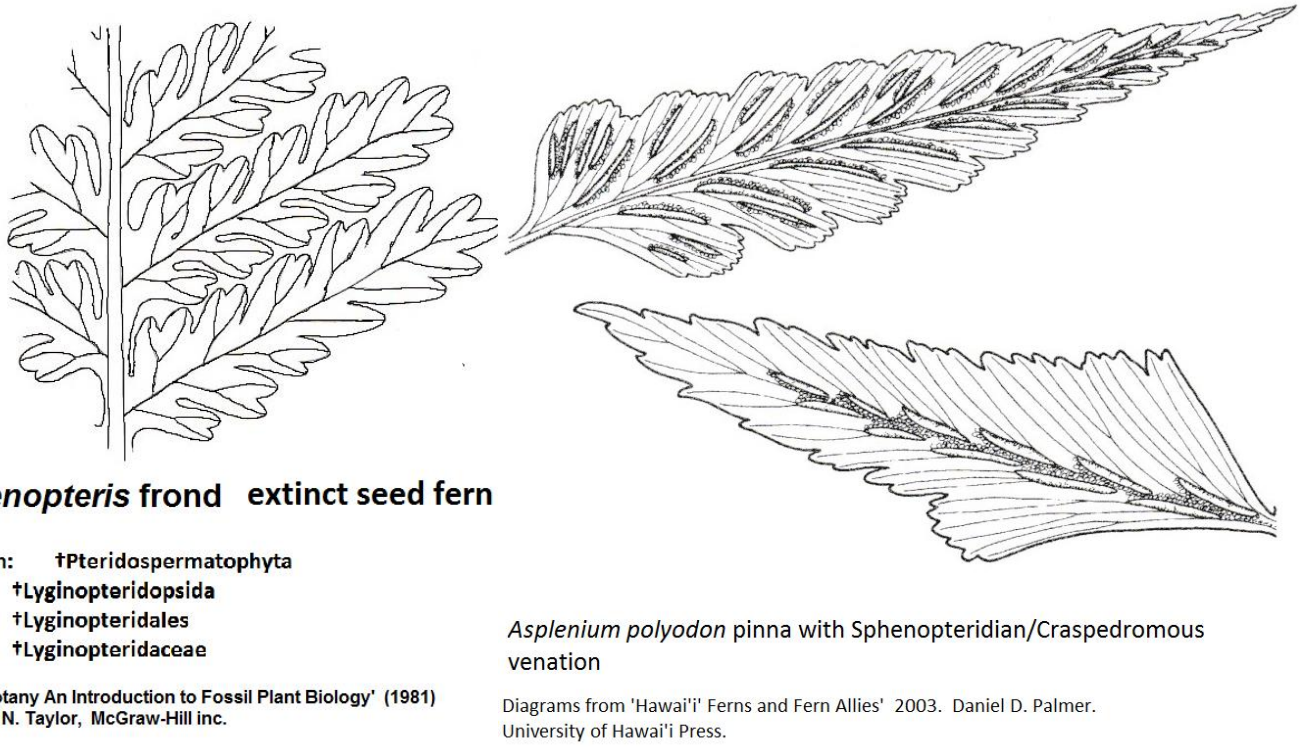
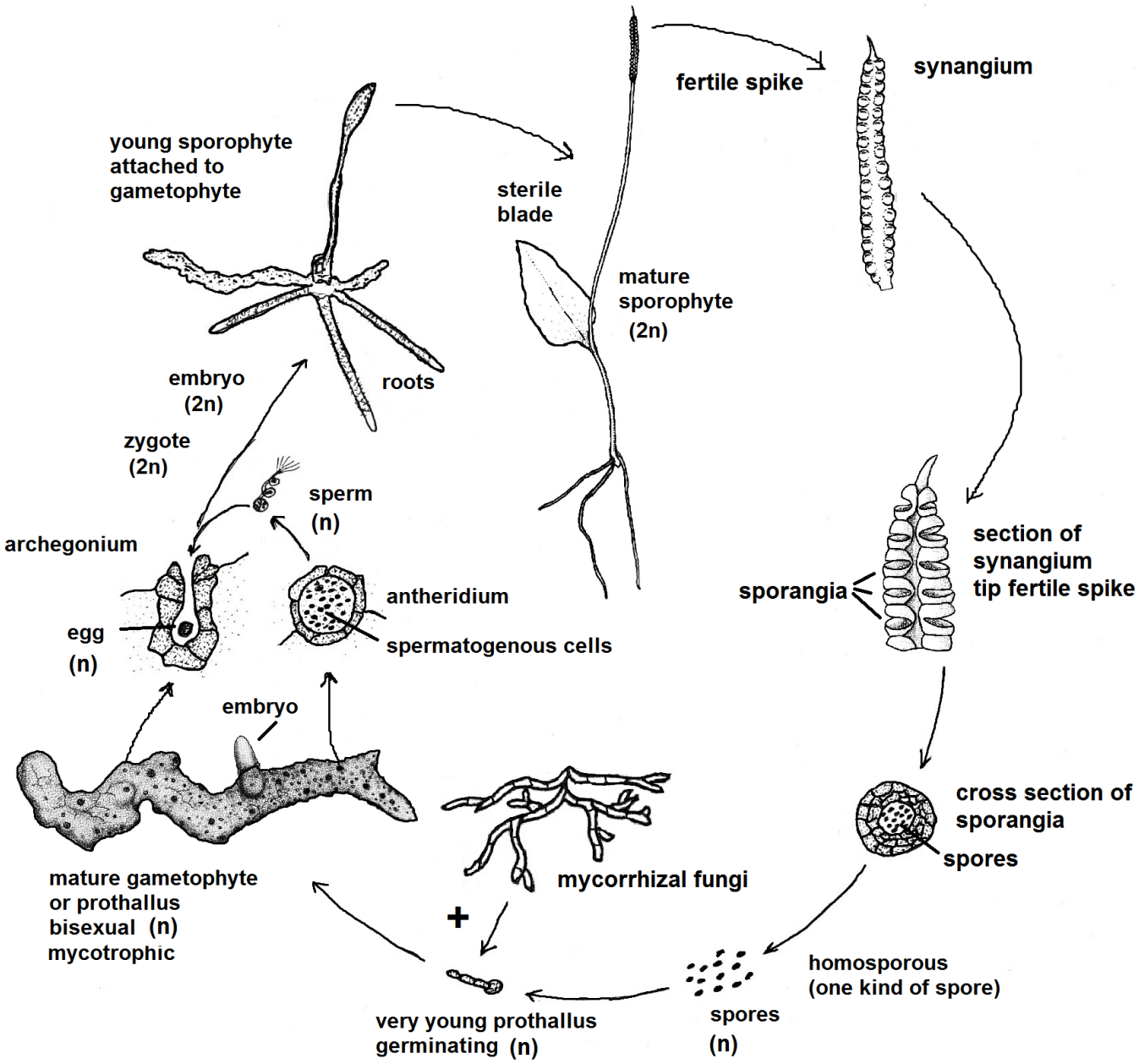


Figure 243 sphenopteridian venation (Mettenius German botanist 1823 -1866)

spicular (L. *spica* , a spike) Spiky.

spiculate (L. *spica* , a spike) With small spine-like projections.

spike An undivided floral axis bearing sessile sporangia, with the younger sporangia at the tip e.g. *Ophioglossum* spp. .



Life cycle of *Ophioglossum*

Euphyllophyta, Monilophyta (ferns), Psilopsida,order Ophioglossales, family Ophioglossaceae

Figure 244 spike *Ophioglossum*

spine (L. *spina*, a thorn) A hard projection with a sharp point, hence **spinose** and **spinescent**.

spinescent Ending in a spine.

spinose Armed with spines.

spinula pl. **spinulae** (diminutive of spine) A small spine; hence *spinulose*, having small spines on the surface. Synonym **spinule.**.

spinulate With fine tapering spine or rod-like projections.

spinule (diminutive of spine) A small spine; hence *spinulose*, having small spines on the surface. Synonym **spinula**.

spiny Possessing spines or spine-like. The Mamaku *Cyathea medullaris* has scales with a spiny margin.

spiral (L. *spira*, a coil) Borne at different levels along the axis, singly and alternately on the rachis or stem, successively, but <180° to the next. A helix ,coiling. See **Fibonacci** & **phyllotaxy**.

sporangiate (Gr. *spora*, seed + *angeion*, a vessel) Bearing spore cases (sporangium).

sporangiophore (sporangium + Gr. *–phore*, f. *phorein*, to bear) The stalk of a sporangium; peltate (shield or umbrella shaped) organ bearing sporangia in the horsetail (*Equisetum*), stobilus or cone.

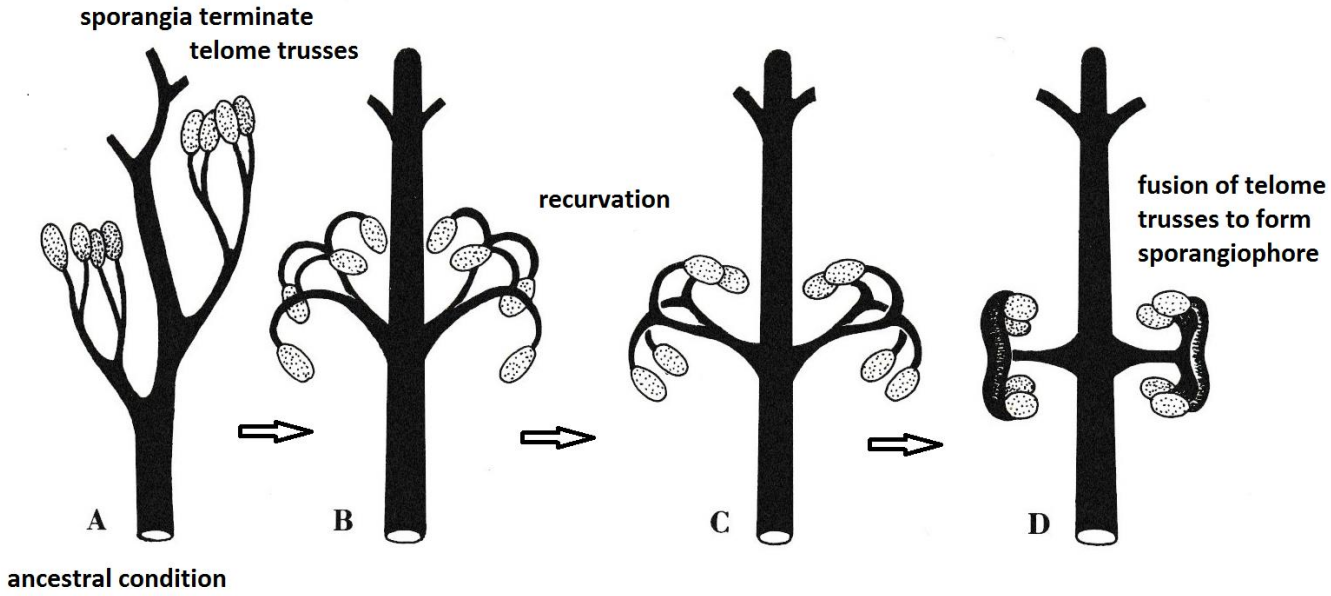


Figure 245 sporangiophore evolution (Equisetum)

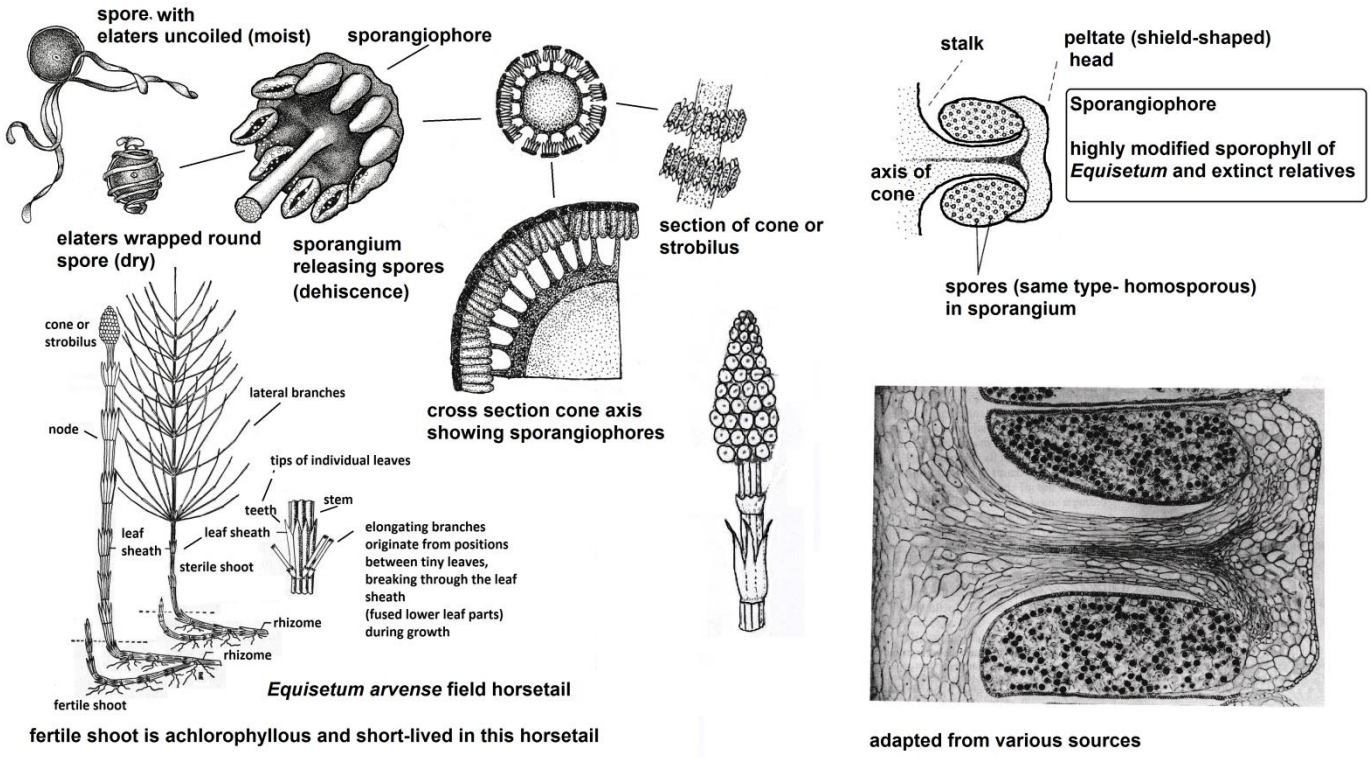


Figure 246 sporangiophore (*Equisetum*)

sporangium *pl.* sporangia. (Gr. *spora*, seed + *angeion*, a vessel) A reproductive structure within which spores are formed. Also known as a **spore case**. The sporangia may themselves be scattered (**acrostichoid**), or aggregated into a **sorus** – clusters of sporangia, or grouped in a cone like structure **strobilus**. In *Psilotum nudum, Tmesipteris* spp. and *Psitania salicina* syn. *Marattia salicina* fused sporangia *(***synangium)** feature.. The sorus may be protected by a flap of tissue **–indusium** (hence indusiate) or not (exindusiate). In water ferns (Salviniales) a modified indusium called a **sporocarp** is found. In most ferns found on the underside of the fertile frond or margin. In Psilotales fused and found on the upper surface of forked leaves. In lycophytes single sporangia are borne on the upper surface of each

fertile leaf, or leaf base (*Isoetes*).See **sorus**, **soral position**, **spore**, **indusium**.

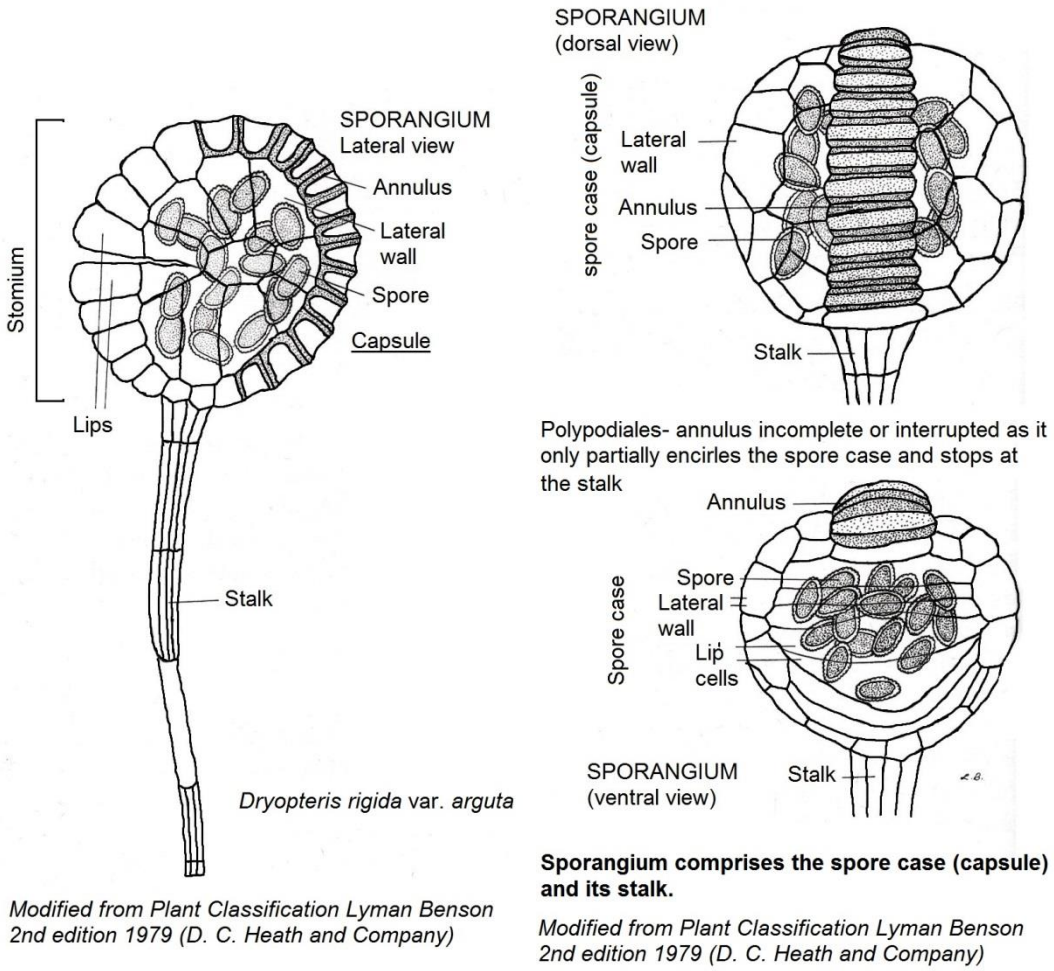


Figure 247 sporangium (Leptosporangiate)

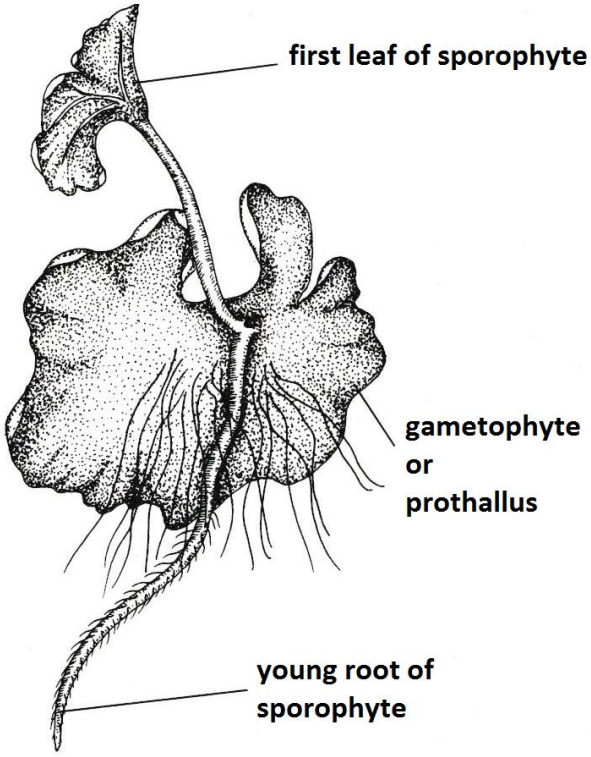
spore (Gr. *spora* , seed) Usually one-celled (unicellular), seldom few-celled sexual or asexual reproductive propagule. In ferns and lycophytes spores are produced in specialized spore cases (sporangia) borne on the underside or margin of the frond (ferns) or the lycophyll leaf axis (sometimes aggregated into a strobilus/cone) of the adult sporophyte . The spores are produced by meiosis (reduction division), so are meiospores, and haploid (1n). The spore represents the start of the gametophyte generation and act as the plants dispersal unit. After release and dispersal by wind or water and reaching a suitable substrate the spore germinates in moist soil and develops as the gametophyte or prothallus by mitosis, so the gametophyte is also haploid (1n). In some heterosporous ferns and lycophytes, the male and female gametophytes develop more or less within the original spore wall –a condition known as **endospory**. The spores are called microspores and megaspores respectively. **Seeds** (mature ovules) in contrast are multicellular,diploid (2n) embryos, protected by surrounding maternal sporophyte tissue .

spore bank The deposition and retention of spores in soil or other substrates. If they remain viable can potentially germinate at some stage. Equivalent to seed bank.

spore capsule The apical part of the sporangium that produces and contains the spores and is born on a stalk.

spore case Sporangium.

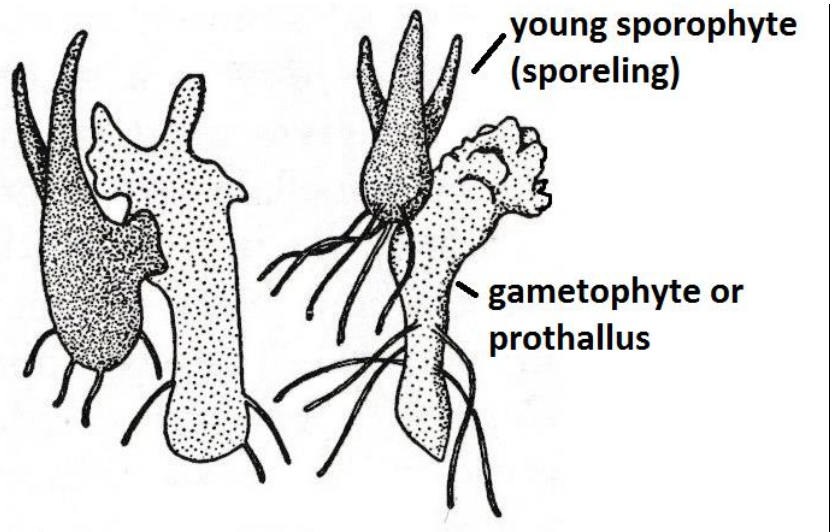
sporeling A very young fern or lycophyte plant (juvenile sporophyte) developing from the prothallus after fertilization. If anything the gametophyte or prothallus has more right to be called a ‘sporeling’ because it develops from the spore.



Young fern sporophyte (sporeling) still attached to the gametophyte but independent of it

Modified from 'The Life of Plants' 1994. Martin Hanson. Longman Paul

Figure 248 sporeling (fern)



Two views *Lycopodium cernuum* young sporophyte

Adapted from Holloway reproduced in 'Cryptogamic Botany: Bryophytes and Pteridophytes' Vol II. 1955. Smith, Gilbert. McGraw Hill.

Figure 249 sporeling (*Lycopodium*)

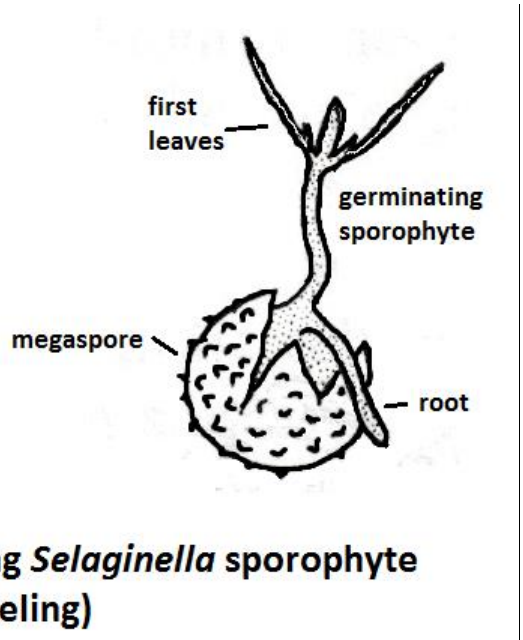


Figure 250 sporeling (*Selaginella*)

spore mother cells The 16 cells in a sporangium which undergo meiosis to produce the spores; each mother cell produces four spores , 64 spores in all in most ferns.

sporiferous (Gr. *spora* , seed + L. *-ferous* , bearing) Bearing spores.

sporocarps (Gr. *spora* , seed + *karpos fruit*) A thick-walled, globular organ containing sporangia embedded in sorophore in heterosporous aquatic ferns e.g. *Pilularia*,*Marsilea, Azolla, and Salvinia* .

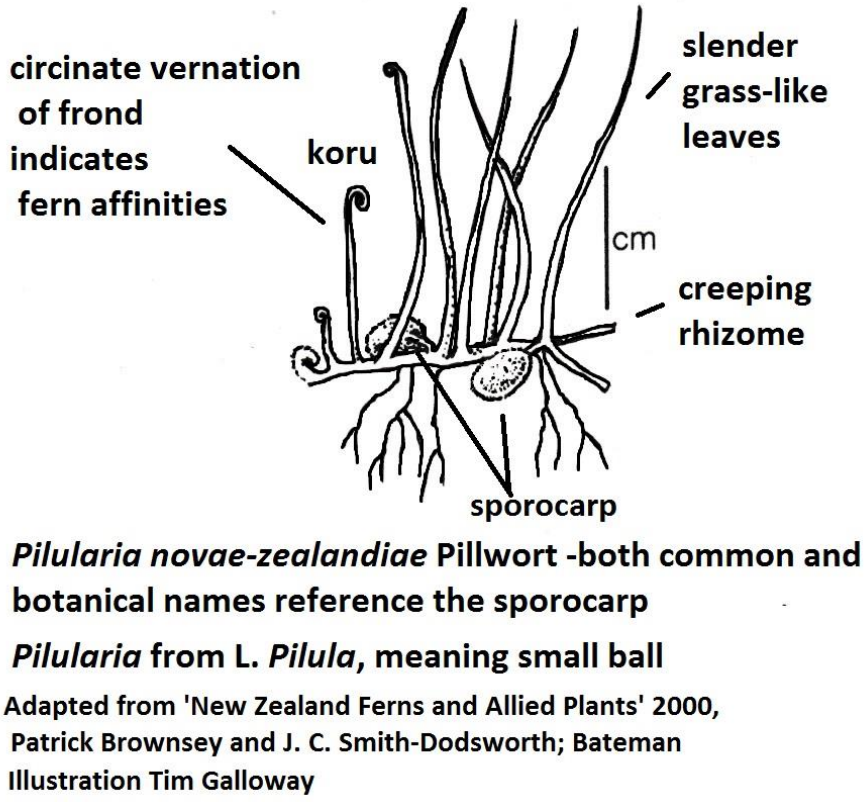


Figure 251 sporocarp (*Pilularia*)

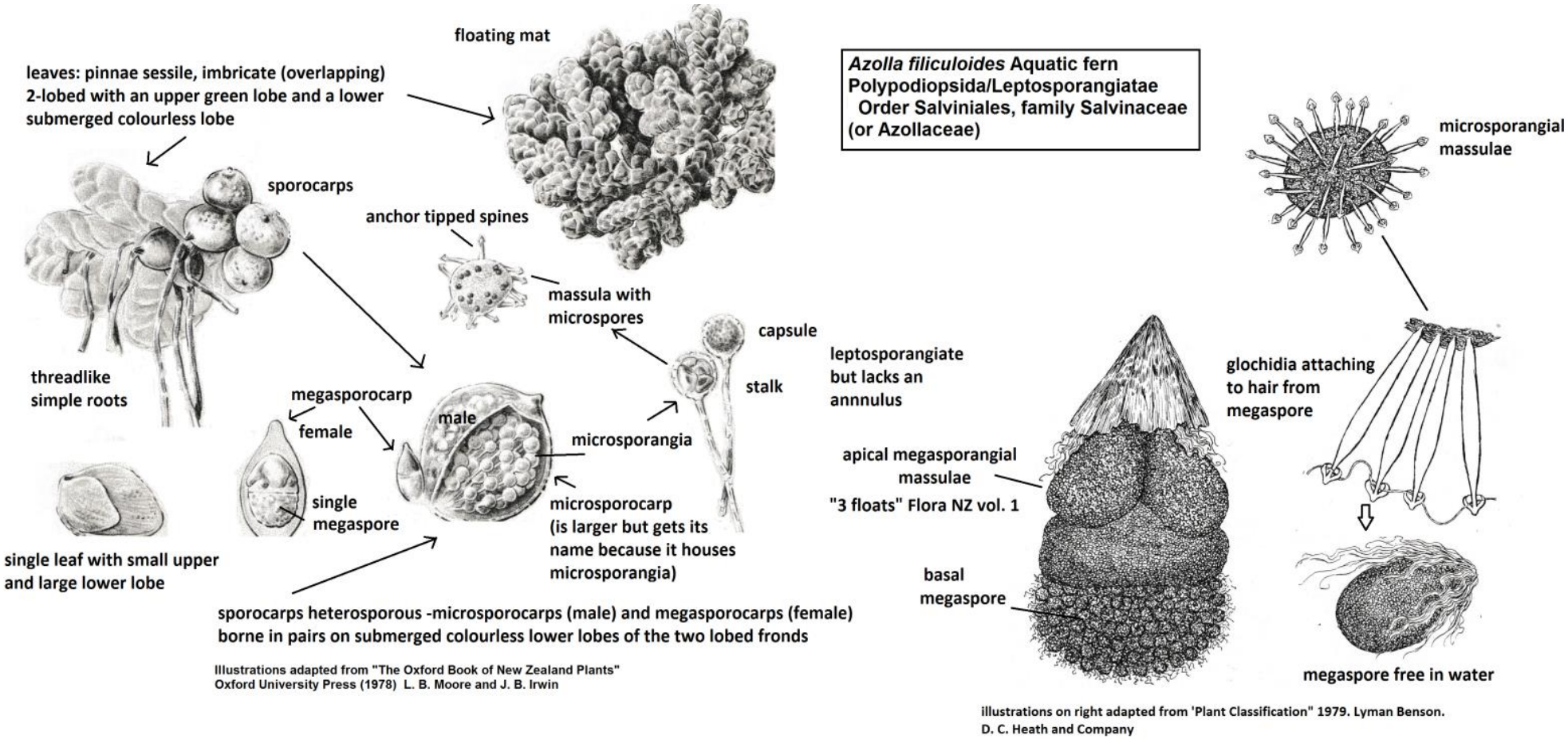


Figure 252 sporocarp (*Azolla*)

sporogenous (Gr. *spora* , seed + *genes* , born, produced) Spore-forming tissue

sporophore (Gr. *spora* , seed + *phorein*, to bear) Sporangium bearing tissue in heterosporous aquatic ferns e.g. *Marsilea, Azolla, and Salvinia* .

sporophyll (Gr. *spora* , seed + Gr. *phyllon* leaf) A spore bearing leaf. A specialised leaf-like organ that bears one or more sporangia. A **fertile frond**. Compare **trophophyll**, sterile frond or vegetative frond

sporophyte (Gr. *spora* , seed + *phyton*, plant) The diploid fern plant or lycophyte which produces dust-like spores (meiospores) when mature.. The asexual generation. The more conspicuous and recognizable plant in the fern or lycophyte life cycle. The sporophyte develops from the zygote (fertilized egg), the gametophyte develops from haploid spores produced by the sporophyte. Compare **gametophyte** or **prothallus.**

sporophyte embryo The sporophyte embryo of ferns and lycophytes posses a well developed foot attaching the embryo to the gametophye, rudiments of a primary root, leaf primordia (sometimes called cotyledons) and a short shoot apex

sporophytic Of the sporophyte generation.

sporopollenin (Gr. *spora* , seed + L. *pollen*, fine flour + in) The chemical coating of the spore wall, (and pollen grain wall). A biopolymer made from carotenoids and carotenoid esters. Decay and chemical erosion resistant. That's why spores fossilize well. Sporopollenin first appears in the zygotes of the land plant ancestors –freshwater green algae the Charophytes.

sporulation (Gr. *spora* , seed) The formation of spores.

spreading Directed outwards from the stem at a rather broad angle; said of leaves.

squamate (L. *squamatus* scaly, f. *squama* , fish or snake scale) or **squamose/squamous** – Scaly. Compare **paleate** and **lepidote**.

squamiform, (L. *squama* , fish or snake scale + form) In the shape of a scale.

squamule L. diminutive of *squama* , scale) A small scale.

squamulose (L. *squamula* diminutive of *squama* , scale) Covered with small, papery scales. See **leaf hairiness** terms.

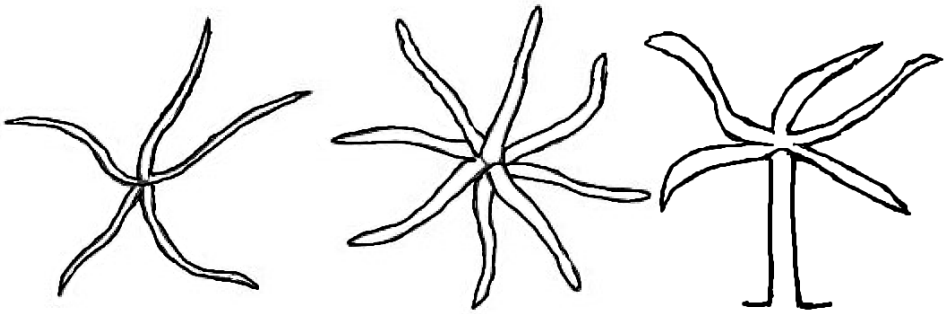
squarrose: (L. *squarrōsus* , scabby) With spreading and divergent scales, projecting points or processes. *Dicksonia squarrosa.*.

stalk A short, supporting axis (e.g., the short, free, basal portion of some pinnae, pinnules , and segments); structure attaching a sporangium to its receptacle; the petiole (**stipe** in ferns) of a leaf or frond.

stalked Joined to an axis with a stalk. Compare **sessile**.

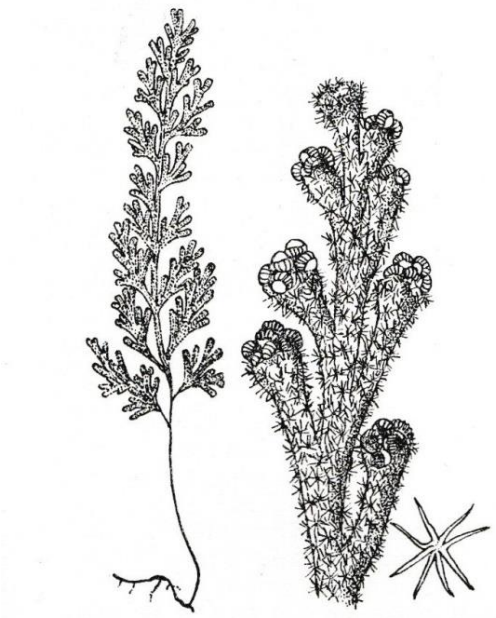
stellar Referring to the stele (vascular cylinder).

stellate (L. *stella ,* star) Star-shaped, as in some scales or hairs with several arms, e.g. *Pyrossia* spp..

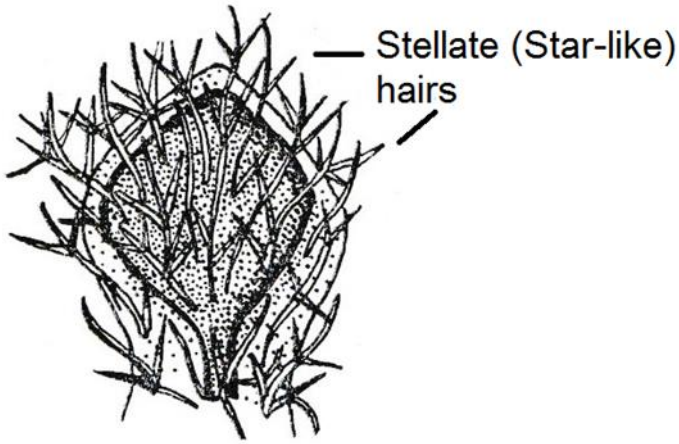


Stellate "Star shaped" Hairs
(Sessile -not stalked)

Stalked and Stellate



Hymenophyllum malingii (*Aptopteris malingii*) sori at tips; stellate (magnified)
(Encyclopedia of New Zealand -artist Nancy M. Adams)



Hymenophyllum peltatum
2-valved indusium bearing stellate hairs.
(Flora of New Zealand Vol. 1)
Nancy M. Adams artist

Figure 253 stellate hairs

stele (Gr. *stele*, pillar or post) The vascular system/vascular cylinder(s) of rhizome, stem, or root. Three main types are found in ferns:-

> **protostele** where the vascular system has a solid core (no pith) – primitive ferns e.g. *Gleichenia* spp..
>
> **siphonostele** or **solenostele** where the stele is tubular- ferns with long creeping rhizomes.
>
> **dictyostele** a complex stele composed of many meristeles (vascular strands) interrupted by leaf gaps, where the vascular trace to a leaf is attached.

stem The ascending axis, above or below ground, which bears leaves (fronds). In ferns and lycophytes, the **rhizome, stolon**, **caudex** or **trunk**. If the the stem creeps above the ground surface it is generally called a stolon, if below ground –a rhizome. With ferns even though the stem may be above ground the term rhizome is often still used. If the stem is erect and aerial it is called a caudex or trunk. See also **stock, surculum** .Contrast **root** the descending axis. The term **shoot** refers to a stem plus its leaves and reproductive structures..

sterile (L. *sterilis* barren) Barren, not producing viable spores. Opposite of **fertile**.

sterile frond Referring to leaves that do not produce sporangia or sori, also known as a **vegetative frond**, **barren frond**, or **trophophyll.** In ferns with dimorphic fronds – sterile and fertile. A purely photosynthetic organ. Compare **fertile frond**.

stipe (L. *stipes ,* log, post, trunk of tree) The leaf stalk or petiole of the fern frond; attaching the frond to the rhizome (stem) changes to **rhachise** where the blade or lamina starts. Compare **rachise** the rest of the midrib where the leaflets (pinnae) are attached.

stipitate (See stipe) Having a stipe (petiloe) or stalk.

stipule (L *stipula* stalk of hay or straw, diminutive of stipe) Fleshy, persistent appendage, paired at both sides of base of a stipe, at least partially covering the stipe base and adjacent rhizome; seen in Marattiacea also the flared leaf bases in *Osmunda* .

stock Another term for the rhizome, the section of the plant from which both the roots and fronds arise.

stolon (L. *stolo*, branch, shoot) An elongate, creeping stem, that intermittently forms new plants and roots along its length. Weki, Rough Tree Fern *Dicksonia squarrosa* spreads vegetatively via stolons. Usually above ground in contrast to **rhizome**.

stoloniferous: (L. *stolo*, branch, shoot + *-ferous* , bearing) Bearing stolons.

stoma pl. **stomata** or **stomates** (Gr. *stoma*, mouth) Minute opening bordered by guard cells in the epidermis of leaves and stem. Air passes through the opening, and most of the plant's water evaporates through the pores (gas exchange).

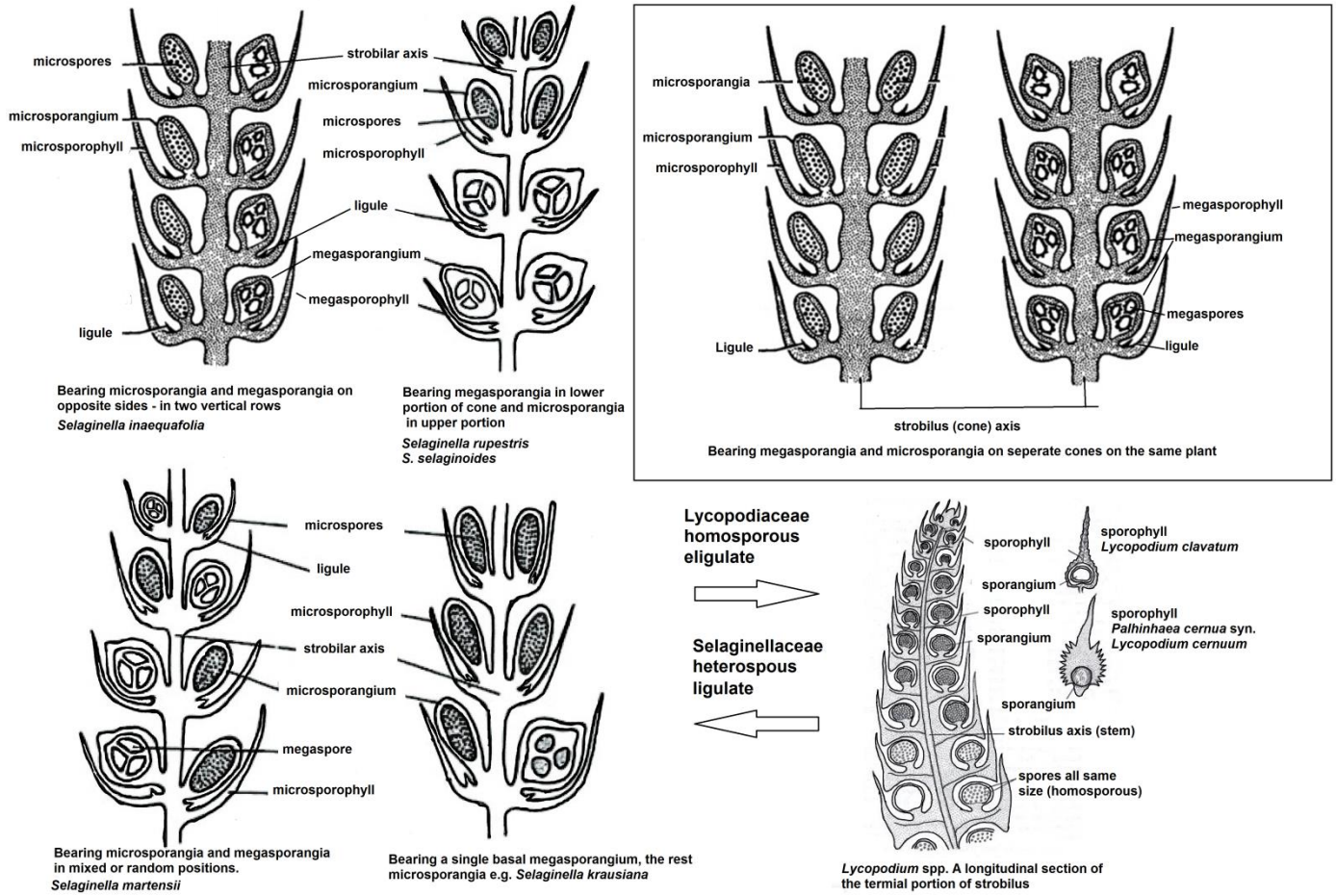
stomium (Gr *stomion*, diminutive of *stoma* mouth) The lip cell region of a sporangium (leptosporangium) with thin walled cells (**lip cells**) associated with the **annulus** where dehiscence occurs and the spores are released.

stramineous (L. *stramen*: straw Straw-coloured, pale yellow.

striate (L. *stria:* groove, furrow) Marked with fine lines or ridges. Grooved. Also a synonym for **parallel** or **parallelodromous** leaf venation.

strigose (L. *strigosus*, f. *striga* row of bristles) With stiff sharp slanting hairs, hair-like scales or bristles.

strobilus (L. *strobilus*, pine cone f. Gr. *strobilos* twisted object, top, pine cone) A cone-like body, as in the Lycopodiaceae, *Equisetum* and Selaginellaceae, consisting of sporophylls (fertile leaves) with sporangia at their bases, borne close together on the axis. pl. **strobili**. Also called cones but distinct from those of conifers.



The position of microsporangia and megasporangia in differnt species of *Selaginella* and a comparisom with *Lycopodium*

(The strobilus or cone bears four rows of sporophylls each subtending a sporangium in its axil. In Longitudinal section, two rows of sporophylls with sporangia , ligule and the central axis are shown)

Figure 254 strobili (*Selaginella* and *Lycopodium*)

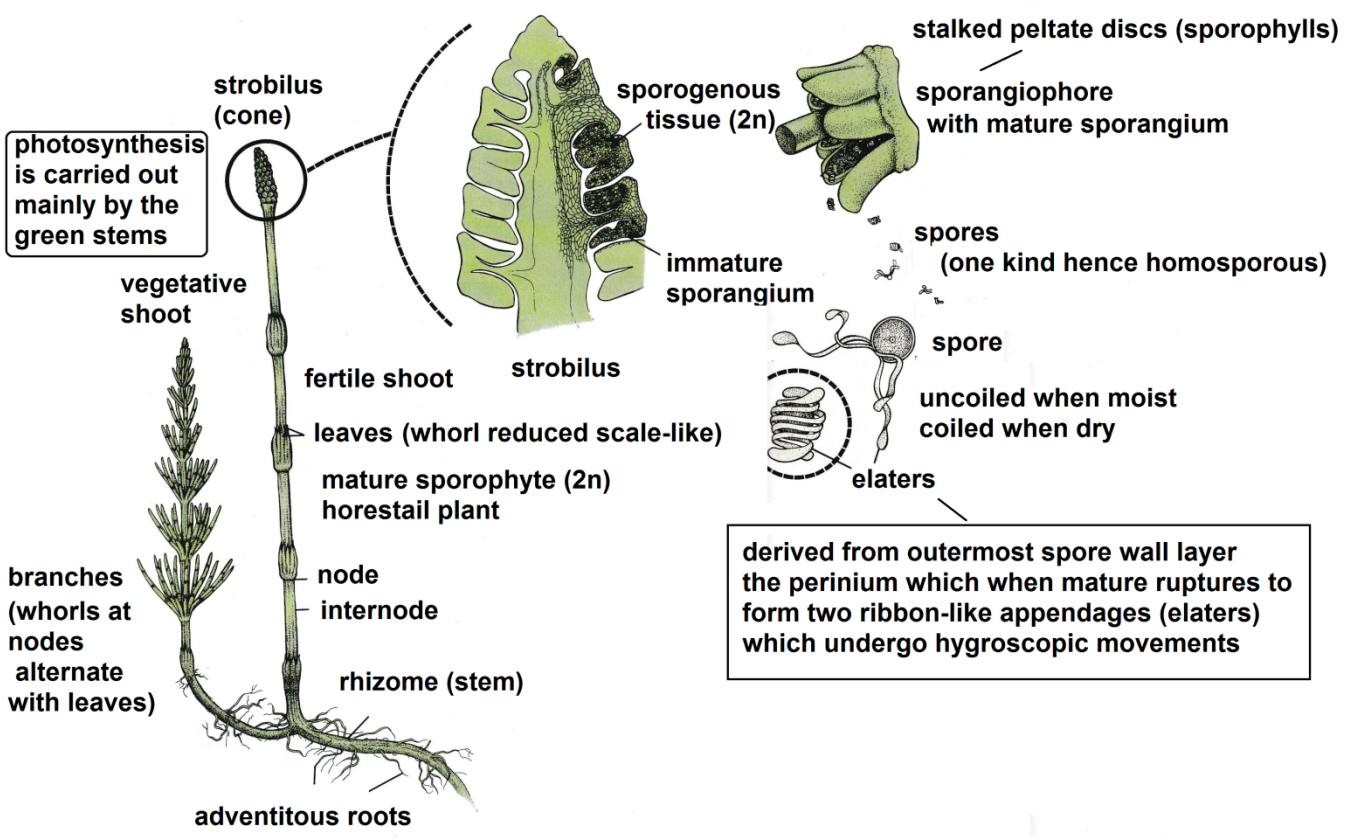


Figure 255 strobilus (*Equisetum*)

sub- (L. *sub-* , under) Prefix meaning under, below, almost, nearly, approaching e.g. submarginal.

subarborescent (L. *sub-* + *arbor*, tree) A term used for ferns which develop small trunks, implying tree-like. Miniature tree fern.

suberose (L. *suberosus*, f. *suber* , cork oak,) Corky. Cork oak is *Quercus suber*.

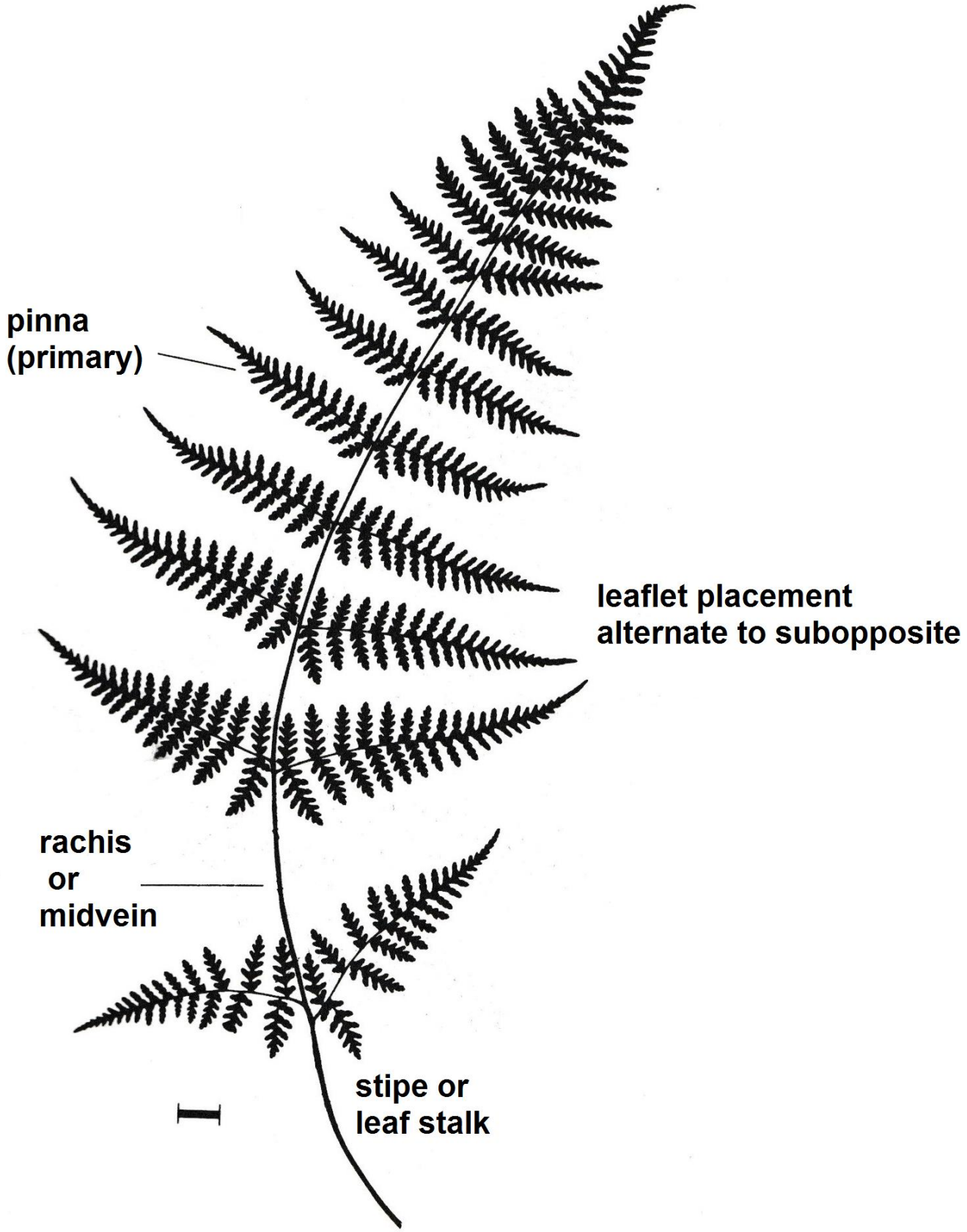
subfamily (sub- + family) A taxonomic group of related genera within a family. Subfamilies have the name ending –oideae. See **classification**.

subgenus (sub- + genus) The taxonomic rank of subgenus, for a group of more closely related species within the genus. Abbreviation subgen. See **classification**.

submarginal (sub- + marginal) Closer to the margin than the midrib. See **soral position**.

submedial (sub- + medial, middle) Near the middle; said of sori that are a little closer to the costa midrib than medial. See **soral position**.

subopposite (sub- + opposite) Nearly but not quite opposite. Slightly alternate.



Sticky pig fern *Hypolepis rufobarbata*
A fern displaying alternate to subopposite leaflet arrangement
(adapted from Brian Molloy)

Figure 256 subopposite

subspecies A taxonomic grouping within a species (see **infraspecific**) used to describe a significant often geographically isolated varient **.** Example *Dicksonia lanata* subsp. *lanata* and *Dicksonia lanata* subsp. *hispida*. Ranked higher than **variety,** or **form**. Abreviation **subsp**. .

substrate (L. *sub-* + *stratum* a spread for a bed) The surface or medium to which a plant is anchored e.g. soil, rock, bark, mud etc.

subtend (L. *sub ,* under + *tendere* , to stretch, extend). To occur immediately below.

subterranean (L *subterraneus*, f. *sub-* + *terra* earth) Occurring below the soil surface. Roots and some rhizomes for instance. Some gametophytes are subterranean and depend on mychorrhizal fungi for nutrition. See **achloromycohetertrophic**.

subulate (L. *subula ,* awl, a tool for making holes in leather) Narrow and tapering gradually to a fine point. Awl-shaped.

succulent (L. *sucus* , juice) Juicy or fleshy.

sucker A shoot arising from the roots or trunk below ground level.

sulcate (L. *sulcare ,* to plough, furrow) Grooved; furrowed. Some stipes or midribs (rachises) are sulcate.

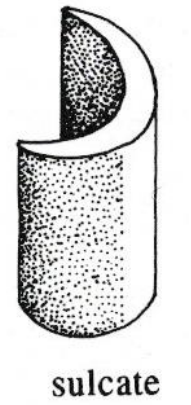


Figure 257 sulcate

sulcus pl. sulculi (L. *sulcare ,* to plough, furrow) A groove or furrow.

superior (L. *super* , above) Situated above another organ. Opposite **inferior**. See example:superior secondary vein below .

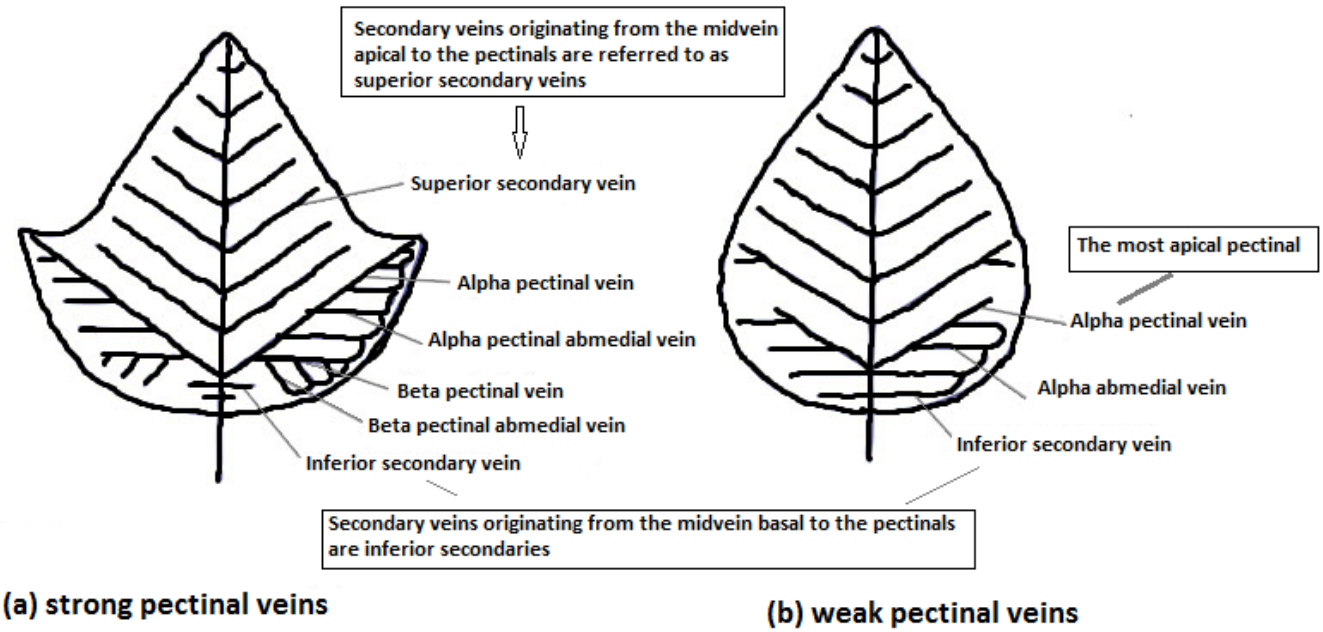


Figure 258 superior term used in relation to venation

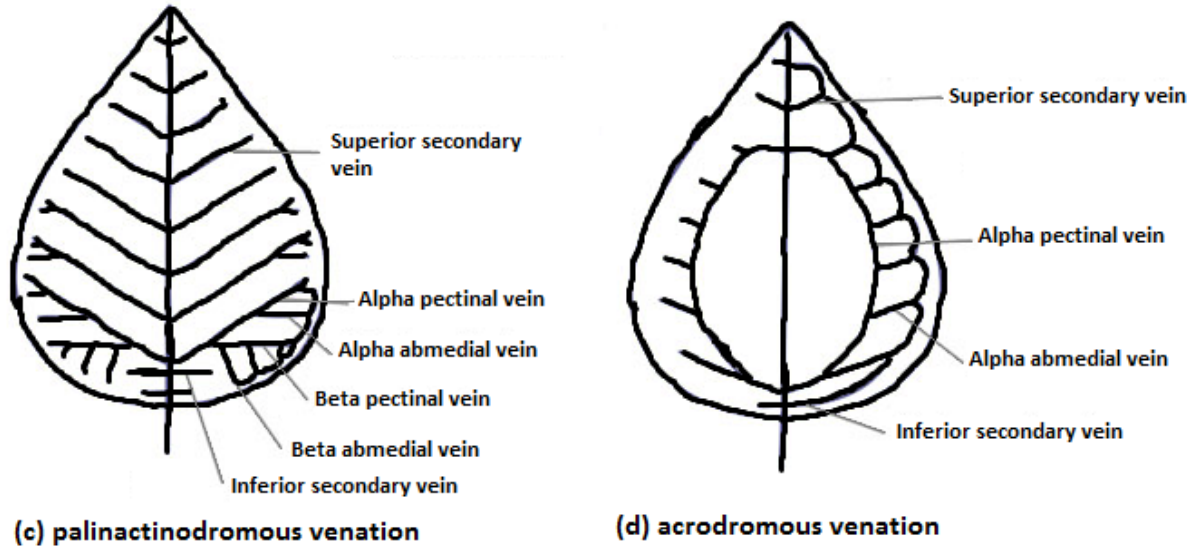
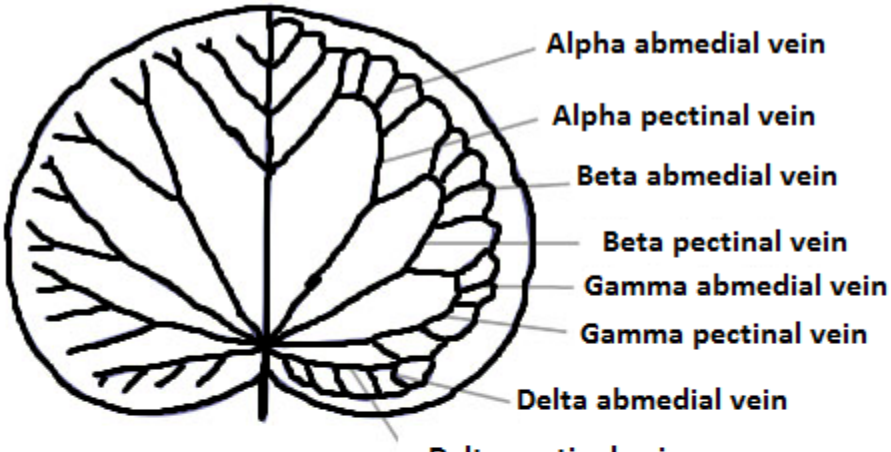


Figure 259 Superior and inferior secondary vein



(e) craspedodromous left and brochiodromous right side

"Pectinal veins: a new concept in terminology for the description of dicotyledonous leaf venation patterns"
ROBERT A. SPICER

Botanical Journal of the Linnean Society, Volume 93, Issue 4, December 1986, Pages 379–388, https://doi.org/10.1111/j.1095-8339.1986.tb01032.x
modified from Arctic Plant Fossils
http://clamp.ibcas.ac.cn/arcticfossils/Systematics3_Venation.html

Figure 260 superior term used in relation to venation

superficial (L. *superficialis*, pertaining to the surface, f. *superficies*,surface, upper side, top,f. *super* "above, over + *facies* form, face) 1. When applied to sori, those arising from the surface, rather than the margin, of a leaf or leaflet - lamina, pinna or pinnule and not embedded or sunken in tissue (immersed) (See **soral position). 2.** Gametophytes that grow on the soil or substrate surface as opposed to underground. Synonym **surficial**.

suprabasal (L. *supra* , above, beyond + basal) Said of primary veins that diverge from a point above the leaf base. Compare basal. See **Leaf Venation**.

supramedial (L. *supra* , above, beyond + medial) Distal to the middle; said of sori that are a little closer to the margin than medial. See **soral position**.

surculum pl. **surcula** (L. *surculus*, twig, sprout) A creeping stem, usually spreading horizontally, e.g. *Microsorum pustulatum,* or short and erect, e.g. *Blechnum discolor*, but sometimes extending above ground as an upright, woody trunk or caudex, e.g. *Cyathea* dealbata. Synonym **rhizome**.

surcurrent (*sur-* , somewhat + *currere* to run, hasten) Regarding leaflet attachment with wings extending from the base of a pinna or segment up the rachis, costa or costule (opposite of **decurrent**). See also **adnate**, **sessile** and **stalked**, the other options.

surficial (surface + *icial* L. f. superficial, under influence from surface) Growing upon the ground – the soil surface. Such as a fern gametophyte also known as **epiterranean,** or **epigeal** and usually photosynthetic.. **Surficial cells** –those at the surface of an organ. **Surficial sori** or **sporangia**, those borne on the leaf surface away from the margin.

swamp Low land that is seasonally flooded; swamps are fertile river-fed freshwaters systems and contain moving water that is well aerated. has more woody plants than a marsh and better drainage than a bog. They are more fertile and less acidic than bogs because inflowing water brings silt, clay and organic matter.

Typical New Zealand swamp plants include raupo (*Typha*), purei (*Carex secta*) and harakeke /flax (*Phormium tenax*). Zonation and succession often leads through Manuka (*Leptospermum scoparium*) to kahikatea (*Dacrycarpus dacrydioides*) swamp forest as soil builds up and drainage improves. **Bogs** on the other hand are rain-fed, and contain stagnant, de-oxygenated water. They are also infertile.

symbiotic (Gr. *syn*, with + *bios* life) Two or more organisms living together to their mutual advantage. A beneficial association of different organisms. See **mycorrhiza a**nd **nitrogen fixation**.

sympatric (Gr*. syn* + *patra* , fatherland) Occupying the same general locality; usually describing ranges of populations of different species. Compare **allopatric.**

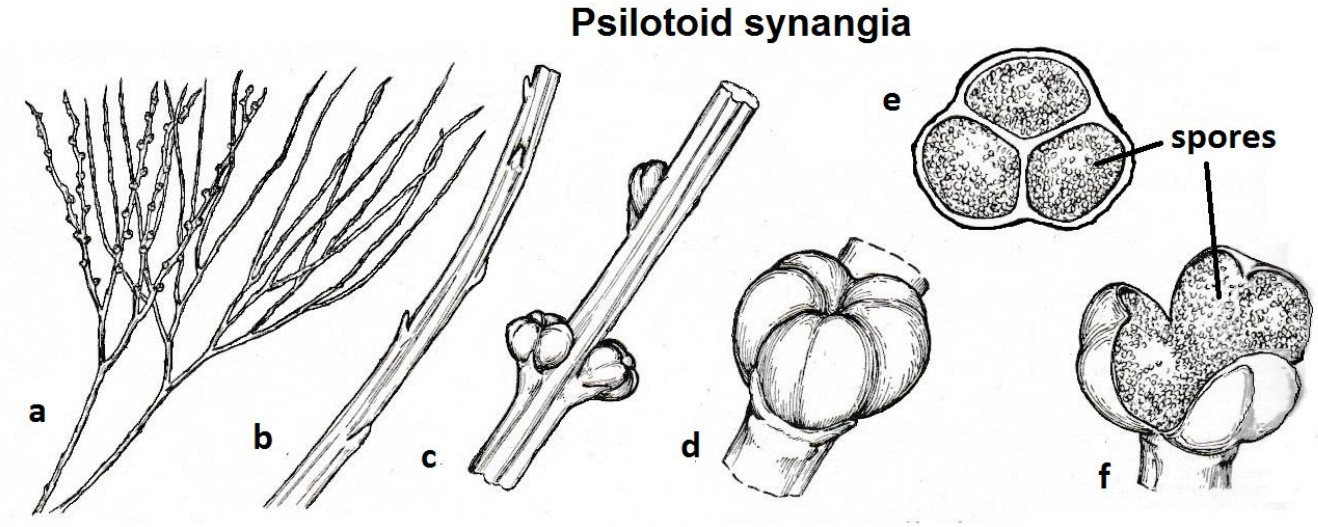
symplesiomorphy (Gr. *syn*- together + plesiomorphy) . Shared ancestral condition (plesiomorphy- *plesio*- near to ancestor)). The eusporangiate ferns share the ancestral state – bearing eusporangia for the Psilotales, Ophioglossales, Marattiales and Equisitopsida (horsetails) this is a **symplesiomorphy** for this group. Osmundales, Hymenophyllales,Gleicheniales, Schizaeales, Salviniales, Cyatheales and Polypodiales share the leptosporangiate condition so this is a **synapomorphy-** shared derived state for this group.

sympodial (Gr. *syn*- + *podion* a little foot, f. *pous* foot**)** Branching pattern with branches more or less equal without a main axis.

Synapomorphy (*syn*- together + apomorphy) Is an **apomorphy** (derived or evolved feature) shared by two or more taxa in whose common ancestor the derived condition arose. Osmundales, Hymenophyllales,Gleicheniales, Schizaeales, Salviniales, Cyatheales and Polypodiales share the leptosporangiate condition a derived feature from the ancestral eusporangiate condition so this is a **synapomorphy-** shared derived state for this group. Psilotales, Ophioglossales, Marattiales and Equisitopsida (horsetails) share the ancestral eusporangiate condition so this is a **symplesiomorphy** for this group.Compare **plesiomorphy** (ancestral state) and **symplesiomorphy** (shared ancestral state).

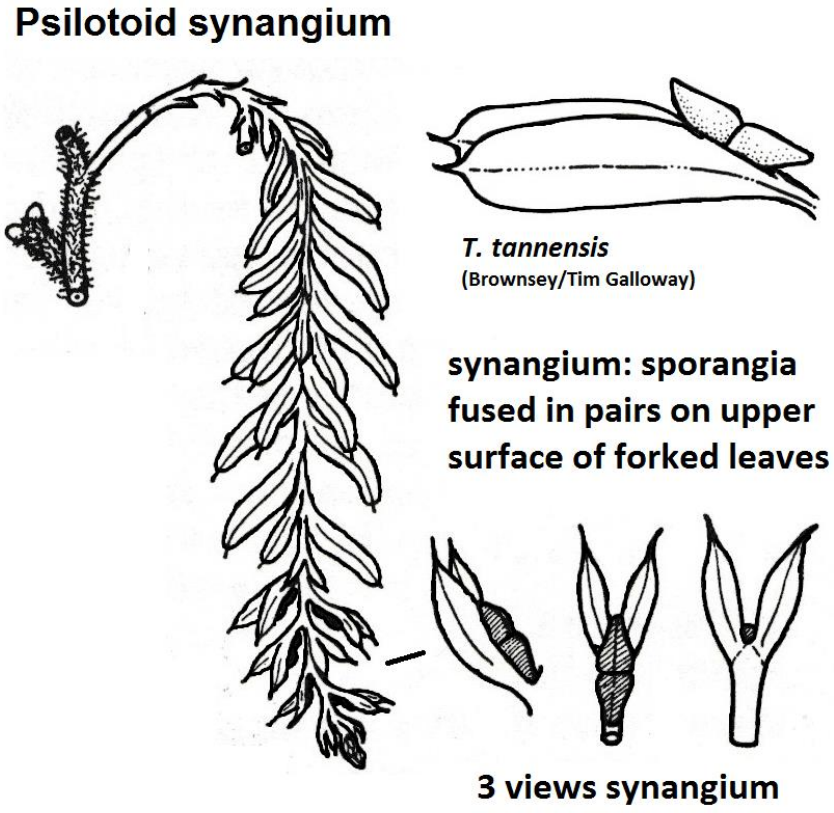
synaptospory (Gr. *syn*- together + L. *aptatus*, *aptus*, fasten, fix + spory) The shedding of spores in small groups or in whole sporangia (spore cases) rather than separately. Found in Cyatheaceae and *Pyrossia* spp. for example.

synangium . pl. **synangia** (Gr. *syn*: together, with + *aggeion* , vessel, bowl) Structure formed by the fusion of sporangia (spore cases) or sori, e.g. in *Psilotum*, *Tmesipteris*, *Ptisana* syn. *Marattia*. Distinct therefore Psilotoid and Marattoid synangia types. Synonym **fused sorus**.



Psilotaceae. *Psilotum nudum*: a, fertile and sterile branches, b, sterile branch portion with leaves (prophylls), c, fertile branch with synangium (3 fused sporangia), d, synangium close up, e, cross-section of synangium, f. synangium with sporangia dehiscing

Modified from 'Taxonomy Of Vascular Plants' 1951. Lawrence, George, H. M.. The McMillan Company



Psilotales. *Tmesipteris tannensis*, synangium with two fused sporangia

Modified from 'The Morphology of Pteridophytes', 1970. Sporne K. R.. Hutchinson University Library

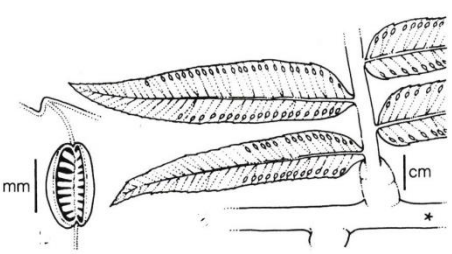
Figure 261 synangium (*Psilotum & Tmesipteris*)

Figure 262 synangium (*Tmesipteris*)

Habit of *Ptisana salicina* syn. *Marattia salicina*, Para or king fern

'A Book of Ferns' 1959. Greta Stevenson. Paul's Book Arcade, Hamilton

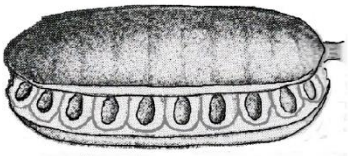
Marattoid synangium



Intramarginal synangia arranged in two rows on fertile secondary pinna

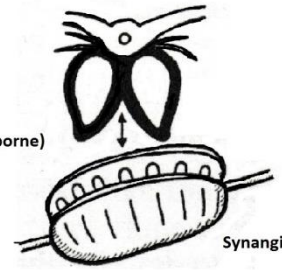
Synangia -boat shaped group of 10- 15 fused sporangia placed near vein endings (Brownsey)

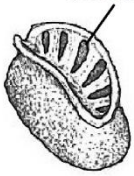
Base of primary pinna swollen at the junction with the rachis



Synangia (fused sorus) variouss views (Bower)

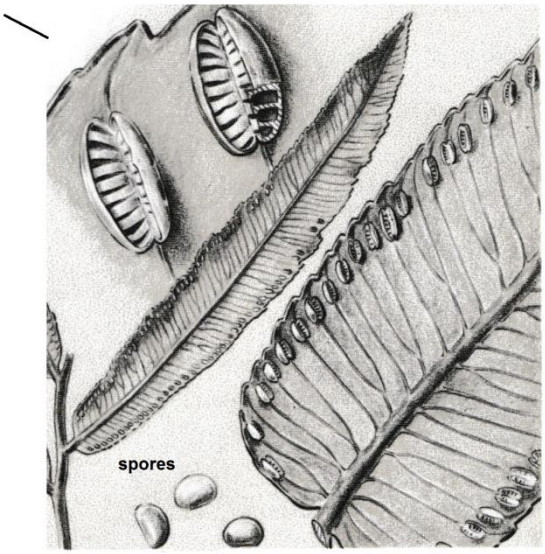
each slit sits atop a sporangia (Moran)





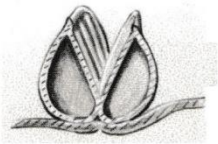
Synangia dehisce in a bivalvate manner

part of pinnule with one old syangium cut through to show compartments



part of frond

base of fertile pinnule



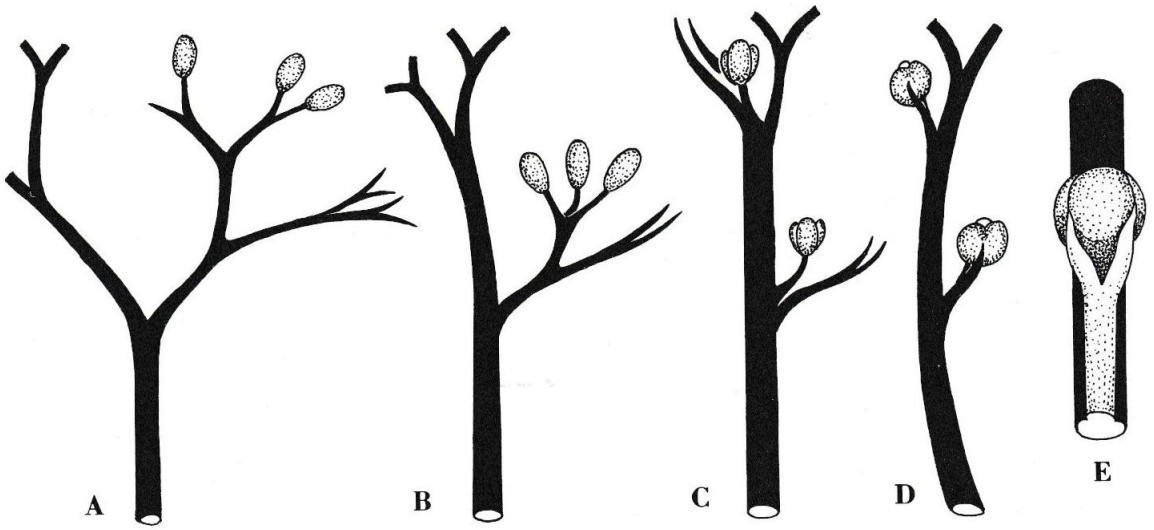
empty synangium cut through

Ptisana (Marattia) salicina
'Oxford Book of New Zealand Plants' 1978.
L. B. Moore & J. B. Irwin
Oxford University Press

Cover photograph: The sporangia of the primitive fern para (*Ptisana salicina* syn.
Marattia salicina) are fused into groups called synangia. Para was once common in the north of New Zealand but it is now in serious decline.
'Plant Conservation Training Module 1. May 2008.
by Iain Reid, John Sawyer and Jeremy Rolfe
Photography by Jeremy Rolfe
Published by the New Zealand Plant Conservation Network in conjunction with Northland Polytechnic.

Introduction to plant life in New Zealand

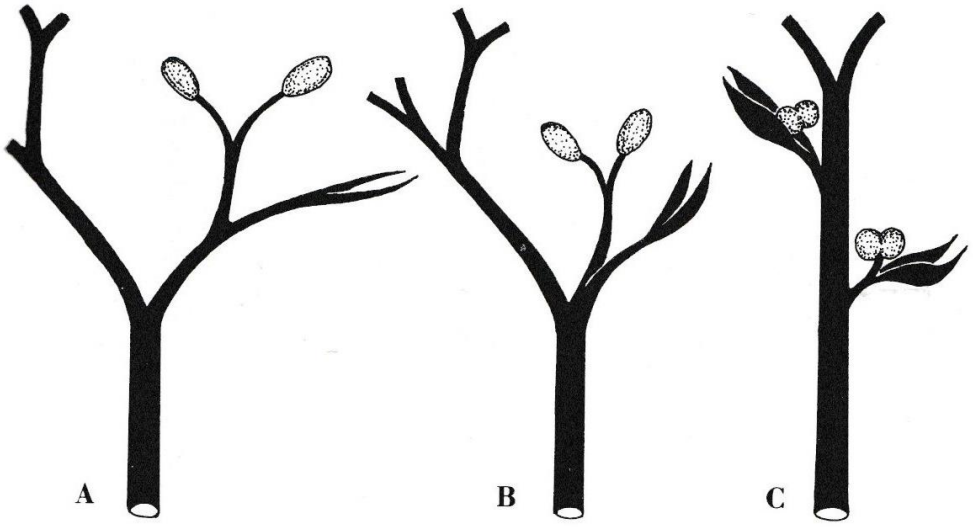
Figure 263 marattoid synangia



Proposed evolutionary steps leading to the develpment of the *Psilotum* type synangium

'Morphology of Plants and Fungi' 1980. Harold C. Bold, Constantine Alexopoulos, Theodore Delevoras. Harper International Edition

Figure 264 synangia evolution (*Psilotum*)



Hypothetical steps in the evolution of the *Tmesipteris* type synangium

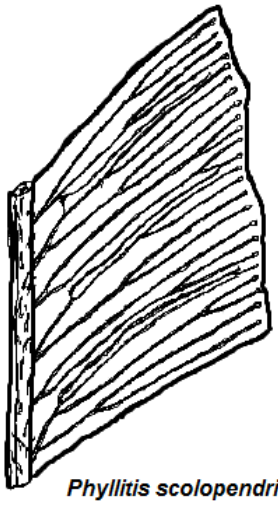
'Morphology of Plants and Fungi' 1980. Harold C. Bold, Constantine Alexopoulos and Theodore Delevoras. Harper International Edition

Figure 265 synangia evolution (*Tmesipteris*)

synonym (Gr. *syn-* together, with + nym f. *onoma*, name). Another name for the same taxon, may be an alternate name to a currently accepted scientific name under a different classification system or an old name now superseded. Abbreviation syn. e.g. *Ptisana salicina* syn. *Marattia salicina*.

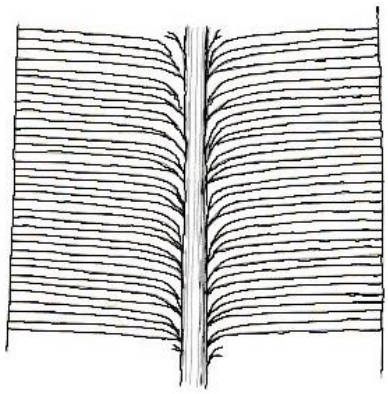
Taenopteridian venation (f. fossil Pteridosperm (Seed Fern) *Taenopteris*) A type of **Ctenopteridian** venation (pinnate pattern) in which the secondary veins leave the mid-rib at approximately right angles and run straight to the margin; any tertiary veins run parallel with the secondaries, then straight to the frond

margin. The short basal curves usually present in the secondaries of this type are ignored.



Phyllitis scolopendrium

Hart's tongue Fern
exotic
Exhibits Taenopteridian venation



Taenopteris

'Paleobotany:
An Introduction to Fossil Plant Biology'
(1981), Thomas N. Taylor, McGraw-Hill Inc.

Figure 266 taenopteridean venation (Mettenius – German botanist 1823 -1866)

tapetum L. *tapete* carpet, tapestry, f. Gr. *tapet-, tapes* carpet)The nutritional fluid which surrounds spores in their developmental stage. A layer of nutritive cells that invests the sporogenous tissue in the sporangium of vascular plants.

tapewormlike Wormlike and segmented; uniseriate with cells separated by clearly marked walls; said of hairs.

taxon pl. **taxa** (Gr. *taxis*, order) A group of plants of the same taxonomic rank, e.g. of the same:- family, genus, species etc.

taxonomy (Gr. *taxis* , arrangement + *nomos*, law) The study of the divisions of life forms into categories.

taxonomic hierarchy The arrangement of taxonomic categories ,clades or monophyletic groups of plants into ranks, with a higher rank inclusive of all lower ranks. Examples family, genus, species, subspecies. See **classification**.

teeth Small projections from the margin of leaf which may be sharp,rounded or blunt, regular or irregular Sinus (recess) less than 1/8th way to midrib S:M. See Figure 267 leaf margins. If the projections are larger they are generally called lobes or segments.

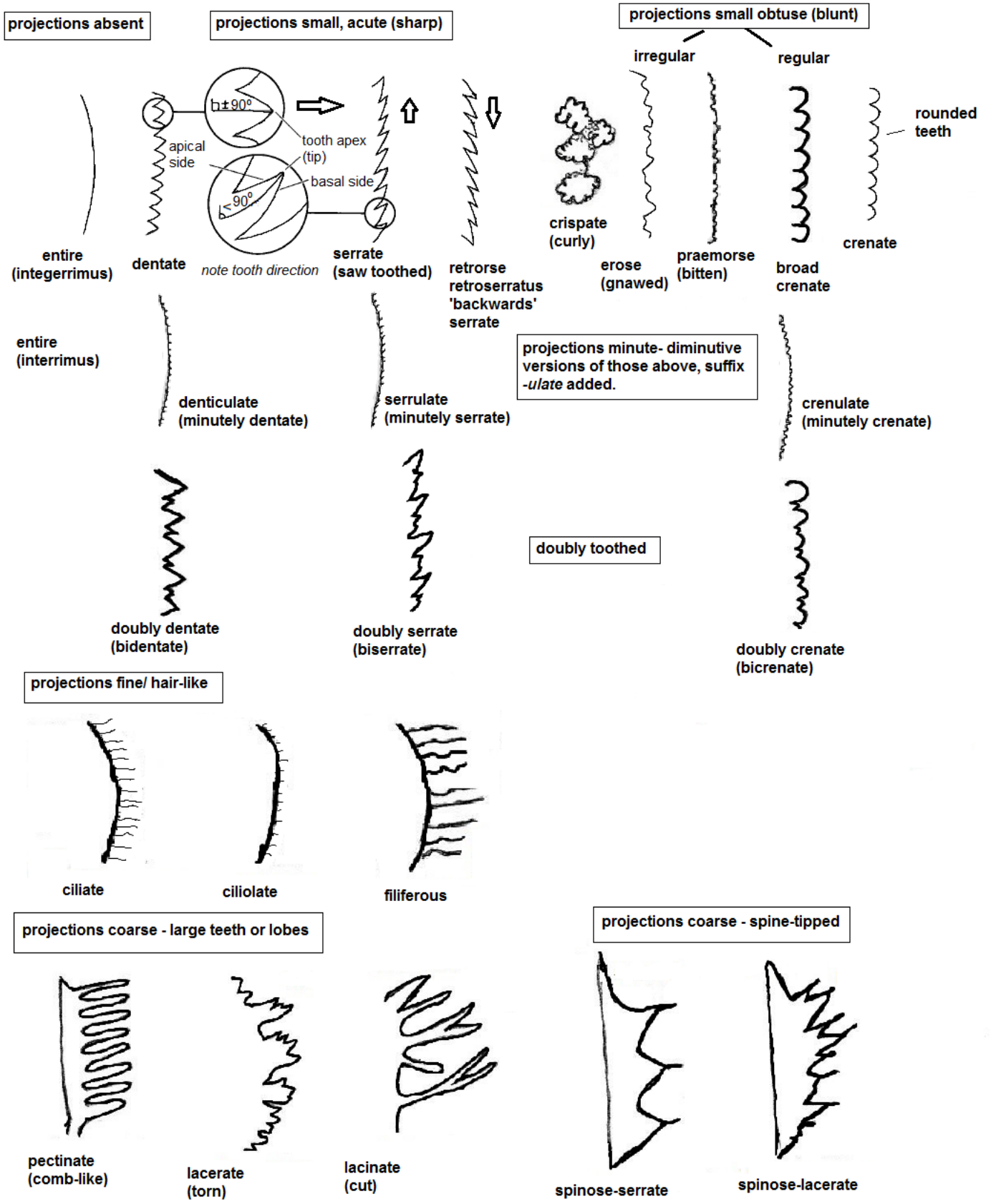
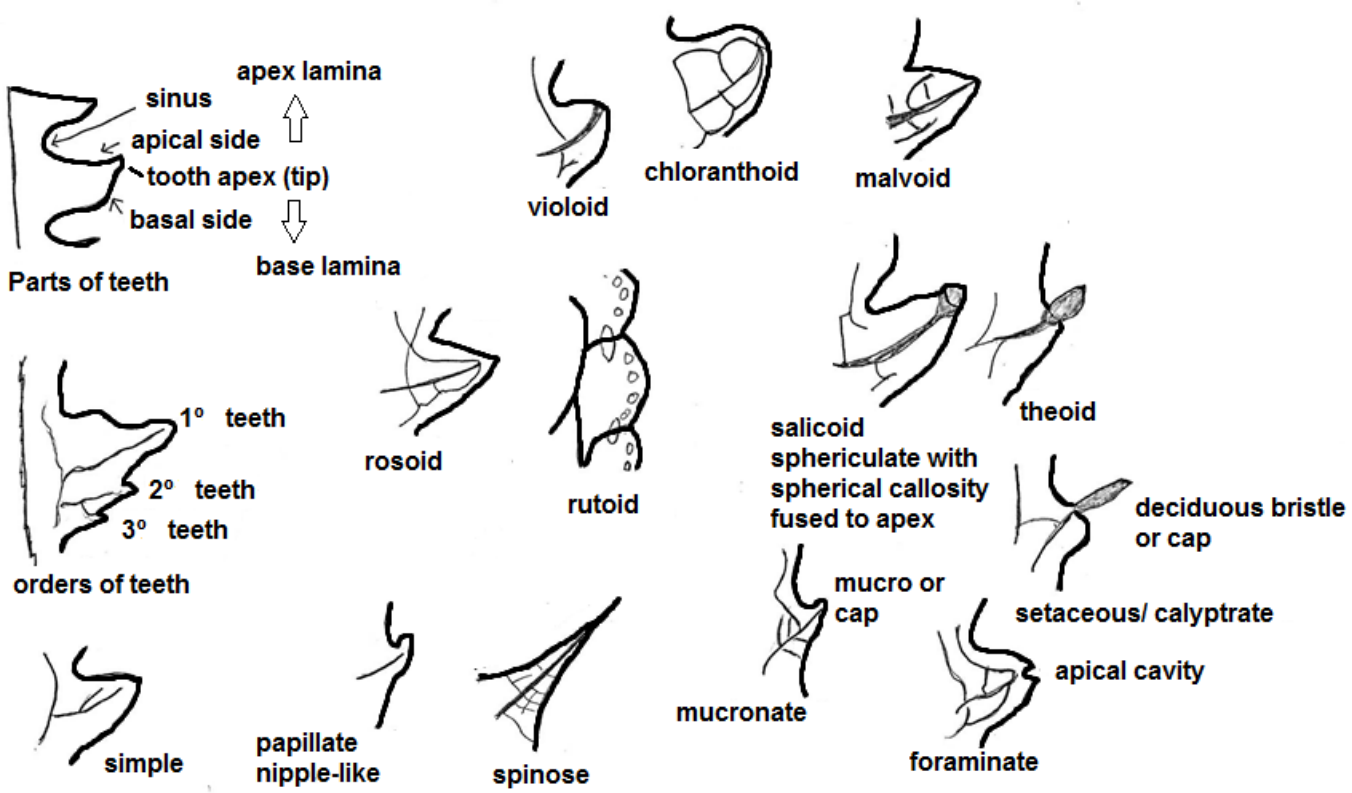


Figure 268 teeth and hair-like projections



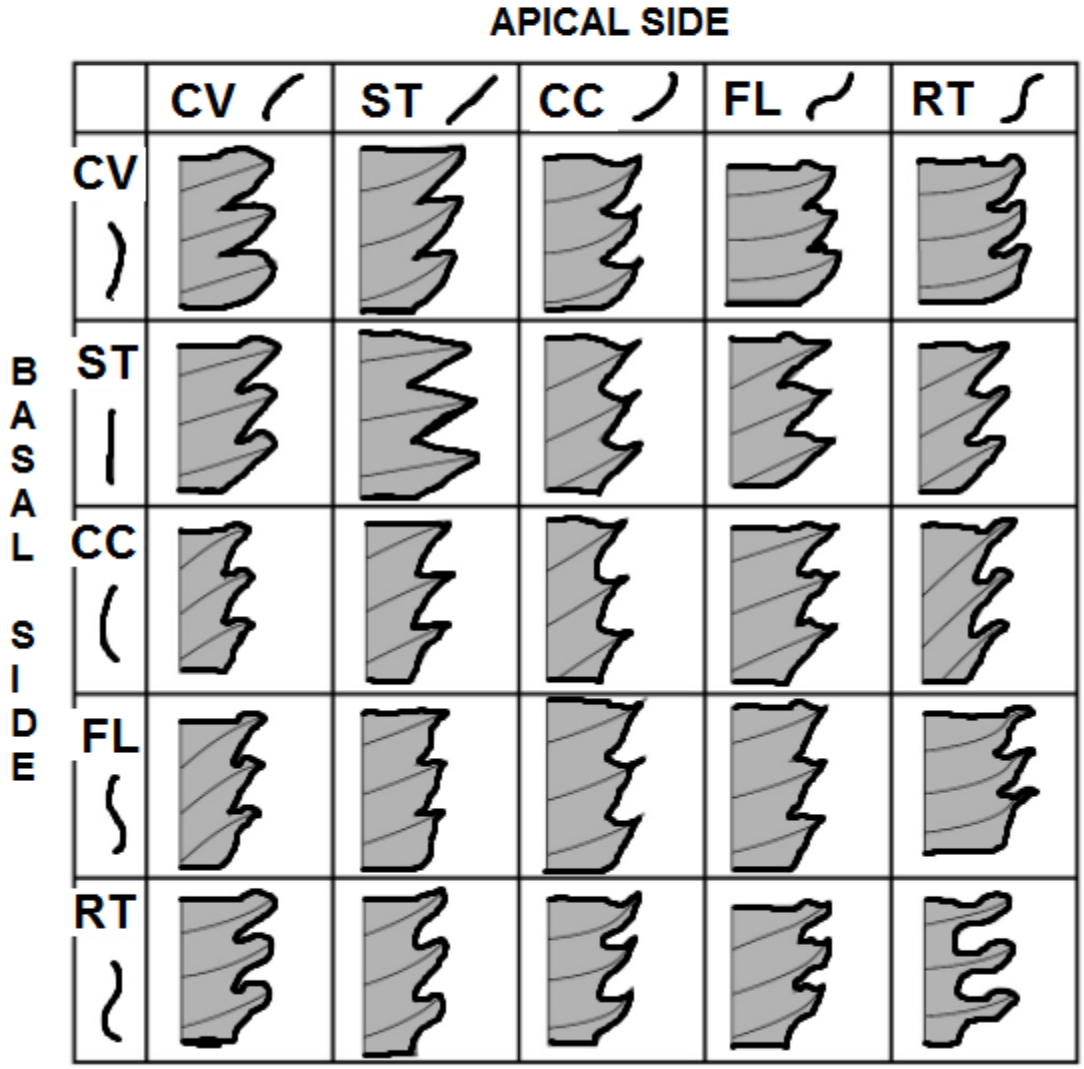
Major tooth types : some based on flowering plant families - hence suffix *-oid*
resembling:
Violaceae, Chloranthaceae, Malvaceae, Rosaceae, Rutaceae, Theaceae, Salicaceae

Figure 269 major tooth types (Judd)

Tooth shape described in terms of the shape of the apical and the basal side. The possible combinations are shown in the chart. The following abbreviations are used

cv (convex) st (straight) cc (concave) fl (flexuose) basally convex & apically concave **rt (retroflexed)** apically convex & basally concave

The apical side is listed first. For example cc/fl would be concave on the apical side and flexuous on the basal side of the tooth. Note that a given leaf can exhibit more than one tooth shape



From 'Manual of Leaf Architecture' 1999. Smithsonian Institute

Figure 270 tooth shapes

temperate Cooler areas of the world. Can be subdivided into warm temperate, cool temperate and cold temperate. The greater part of New Zealand falls into this climate category.

telome (Gr. *telos*, end + *soma*, body) Ancestral branches -terminal segment of a dichotomously branched axis (stem) that may be fertile or sterile. The part of the stem axis that links telomes on a branched sporophyte is termed the **mesome** (G. *meso*-, middle). An aggregation of telomes is termed a telome truss. See **telome theory**. Telome is a hypothetical unit of morphological organization in a primitive vascular plant.

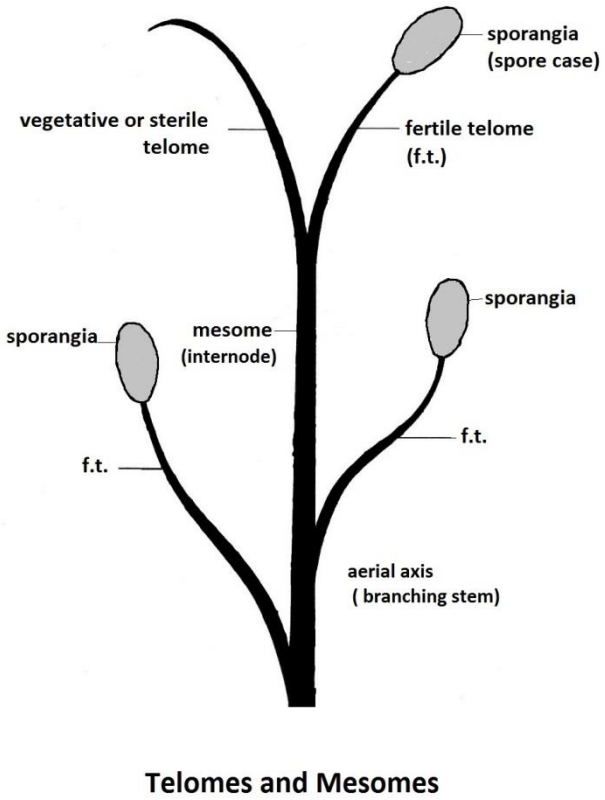


Figure 271 telomes & mesomes

telome theory Theory put forward by W. Zimmermann, to explain the evolution of the euphyll/megaphyll leaf structural type. The earliest vascular plants and their nonvascular relatives (Late Silurian to Devonian age) such as *Cooksonia* and the Rhyniophytes had sporophytes with a leafless aerial stem or axis that exhibited a **dichotomous** branching pattern, whereby the apical meristem splits in two and divides equally to form a forked branching system.. The euphyll leaves accordingly were derived from a three dimensional bifurcating or dichotomous lateral branching system that first underwent , anisotomous (unequal branching) or overtopping whereby one branch becomes reduced in size becoming the lateral branch, the other continues as the vertical axis (**pseudomonopodial** branching pattern) then the subordinated lateral branch becames flattened (planation stage) followed by webbing between lateral telomes (epidermal outgrowths from marginal meristems generating mesophyll tissue) to form the leaf blade. The branched veins indicate the location of former branches. The morphological units are the **telomes** and **mesomes** (internodes) – lengths of stem (axis). The mesome forms the petiole. The telomes are fertile if they bear a terminal sporangium (spore case) and vegetative or sterile if they don't. Aggregations of telomes are called telome trusses. So the lateral telome trusses became the megaphylls or euphylls. Subsequent vascular plants evolved true **monopodial** growth, in which the branching pattern is derived from a single apical meristem.

Modifications of the telome theory with reduction and or recurvation steps have modelled the formation of the *Psilotum* and *Tmesipteris* type synangium, the arthrophytian (horsetail) sporangiophore, the Pterophytan (fern) pinnule, and as an alternative to the **enation theory** for the formation of microphyllous leaf.

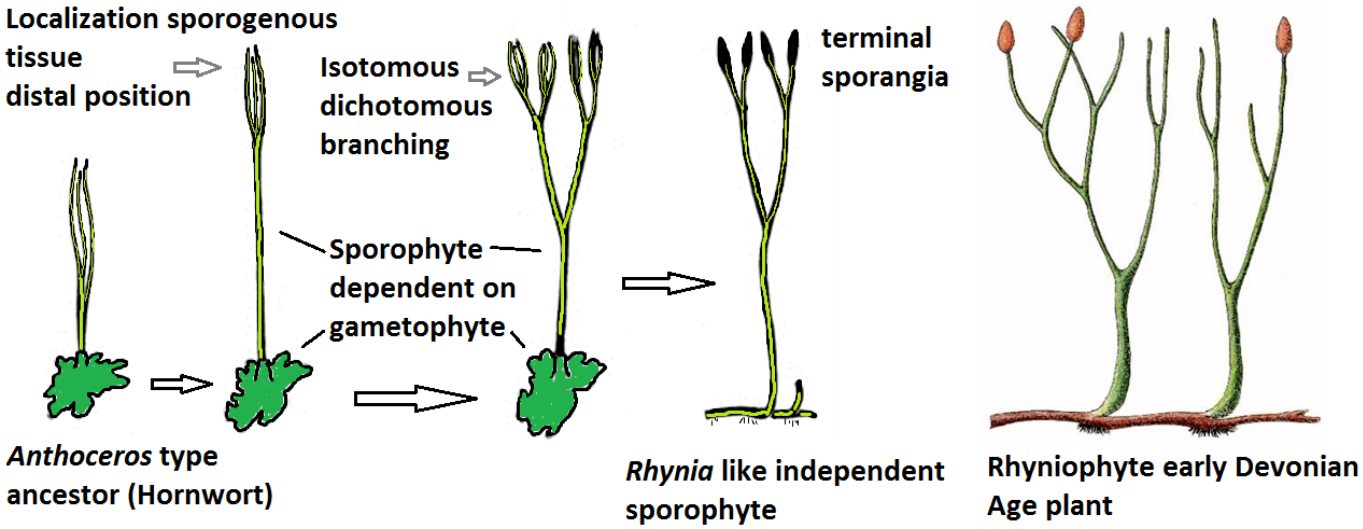


Figure 272 evolution polysporangiate type sporophyte

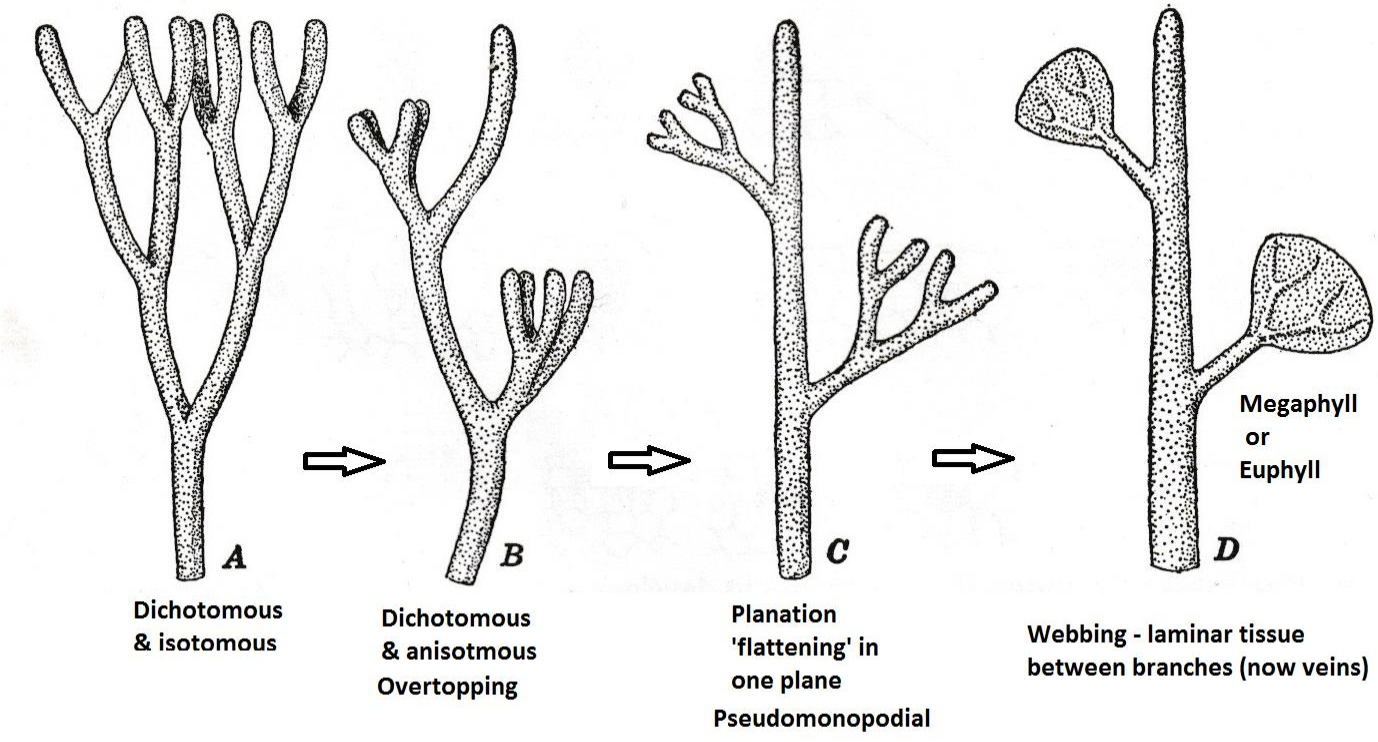


Diagram of the hypothetical evolution of the Megaphyll according to the telome theory (Zimmerman)

Modified from 'Cryptogamic Botany II" 1955. Gilbert Smith. McGraw-Hill Book Company

Figure 273 telome theory

terete (L. *teres*, *teretis* , round, cylindrical) Circular or nearly so in cross section. Opposite of angular. Also known as **cylindrical**. Applied to an axis such as a stem which is cylindrical, smooth, long and gradually tapering e.g. *Pilularia*

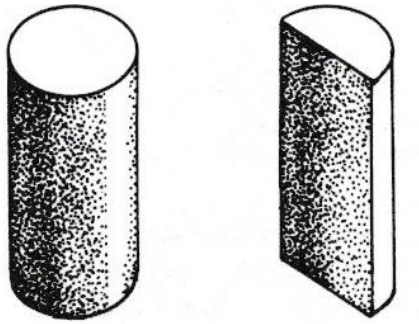


Figure 274 terete/cylindrical

ternate (L. *terni*, *ternus*: three each) in groups of threes, in whorls of three adv. **ternately**

terrestrial (L. *terrestris*, from *terra* land, earth, ground) Growing on the ground; not epiphytes on trees, rocks or aquatic or climbing.. A typical terrestrial fern would be *Blechnum discolour*. Growing on or preferring a soil habitat. Compare aquatic, rupestral, epiphyte. Synonym **terricolous** (L. *terra,* earth + -*colous*, inhabiting).

tertiary leaflet or **tertiaty pinnae** A leaflet of the third degree; a leaflet of a secondary leaflet. This leaflet is either called a **pinnulet** or **pinnule**. The ultimate leaflet of a tripinnate frond.

testiculate (L. *testiculatus*, f. *testiculus* testicle) Testicle-like. Having synangia shaped like a pair of testes, ovoid and solid, *Tmesipteris lanceolata*.

tetrad (Gr. *tetra-* a group of four.) A group of four developing spores, formed by meiotic division of a spore mother cell.

tetrahedral (Gr. *tetra-* four + *-hedral* f. *hédra*, face of a geometrical solid, side). Having four sides.

tetralete (Gr. *tetra-* four +) With four dehiscience fissures, four laesura. Compare, **monolete**, **trilete**, **alete**. Rare, recorded for *Adiantum hispidulum* "**Spore**: trilete occasionally tetralete" (Large, M. F.; Braggins J. E., 1985: Tetralete and trilete spores in *Adiantum hispidulum* Sw. (Adiantaceae) in N.Z. Grana 24: 125-127)

tetrapinnate (Gr. *tetra-* four + pinnate) The frond four times pinnately divided. 4 x pinnate. Synonym **quadripinnate**. Also covered by the term **decompound** ("very compound").

tetraploid (Gr. *tetra-* four + *iodes*, like) Having four of the basic sets of chromosomes in a nucleus. A form of polyploidy. Compare **haploid**, **diploid, triploid** … .

tetrastichous (Gr. *tetra-* four + *stikhos:* rows) Arranged in four regular vertical rows, but not necessarily decussate.

thallus (Gr. *thallos,* a sprout) A plant body not differentiated into leaves, stem and roots. Hence thalloid – resembling a thallus. The **prothallus** or gametophyte of ferns and lycophytes is an example.

thicket (Old English *thiccet* f. thick + et, diminutive suffix) Dense often monospecific vegetation that covers and shades the entire ground, and can deter colonization by other plant species. Thicket-forming ferns include scrambling ferns, some climbing and some erect ferns. *Dicranopteris, Gleichenia, Hypolepis, Sticherus, Lygodium*, *Pteridium esculentum, Dicksonia squarrosa* are examples.

tomentum (L. *tomentum* , wool, hair feather, used as stuffing for cushions) A dense hairy covering of short closely matted hairs. adj. **tomentose**. Similar to **wooly/lanate** and **cottony/gossypinus**.

toothed Of lamina (leaf blade or leaflet) Margins furnished with teeth. See crenate, serrate, and dentate. Opposite of entire or smooth, but not as deeply divided as lobed, parted or divided. Sinus depth less than 1/8 distance margin to midrib or equivalent point. See **Leaf division (lobation) and margins**.

tortuous (L. *tortus* , a twist) Twisted.

trabecula pl **trabeculae** (L. *trabecula*, little beam) In the sporangium cavity of *Isoetes* a series of transverse or slanting plates or bars, strands of sterile tissue (cells), that incompletely divide the interior of the sporangium into blocks of fertile cells. (sporangial trabeculae). In the stele of *Selaginella* sp. highly modified endodermal cells elongated in the direction of the radial axis of the stem and seperated by very large intercellular spaces. As a result the stele appears to be suspended in a very large central cavity. The rbbon-like trabeculae connect the stele to the cortex. (endodermal trabeculae)

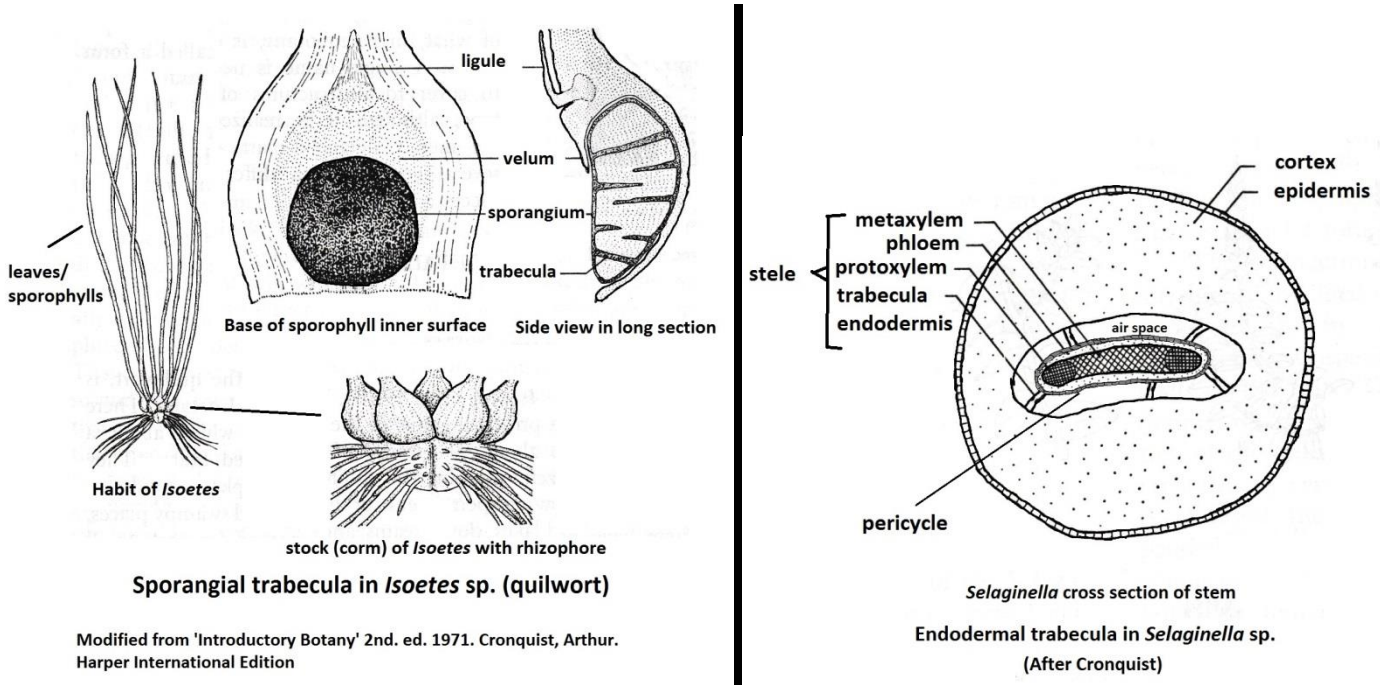
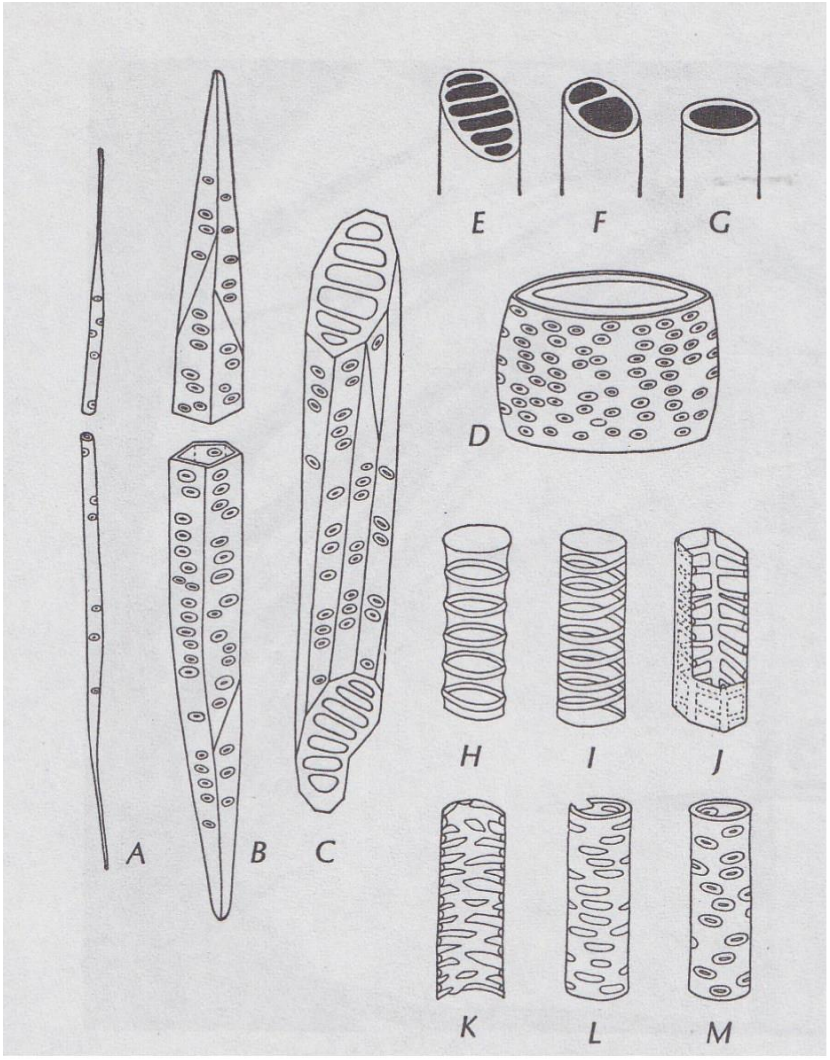


Figure 275 trabecula

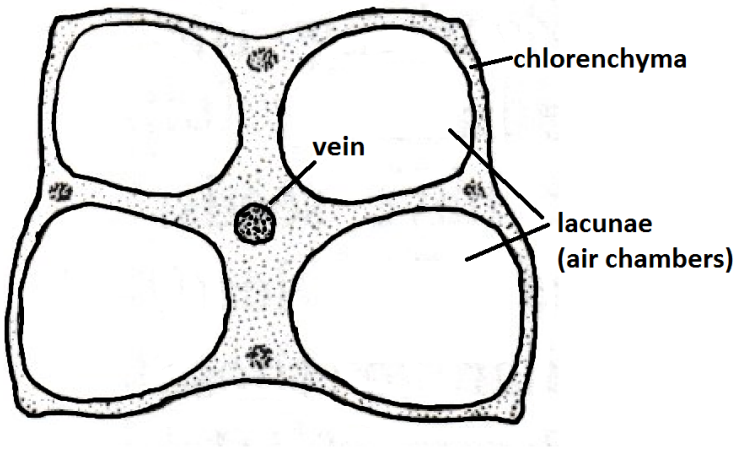
tracheid: (L. *trachea*, tube and Gr. *tracheia* , windpipe) An elongated tapering xylem cell with lignified pitted walls, dead at maturity, adapted for conduction of water and mineral nutrients and for mechanical support. Has closed end walls. The ancestral tracheary element, found in ferns, lycophytes and most gymnosperms in contrast to the more advanced xylem cell the **vessel member**, found in angiosperms and gnetophytes. The vessel member has open perforations in the end wall. Found in vascular xylem tissue and can be classed as **sclerenchyma.**



Xylem cells. *A*, fibre; B, tracheid; C, D, vessel element; E-G segments of vessel elements with progressively less obstructed opening; H-M, types of secondary thickening of xylem cells; H, annular I, spiral, j, scalariform; K, reticulate; L, reticulate-pitted; M, pitted.

Figure 276 tracheids

trans-lacunar diaphragm A plate two or three cells in thickness, perforated by pores, in the leaves of *Isoetes*.



Transverse section of *Isoetes* leaf (microphyll)
(Modified from Cronquist)

Figure 277 trans-lacunar diaphragm *Isoetes*

translucent (L. *trans*- through + *lucere* , to shine) Nearly transparent.

transparent (L. *trans*- through + *parere,*appear +ent) Clear, easily seen through, like glass. Diaphanous (Gr. *dia*, through + *phanes*, showing) *Adiantum diaphanum*.

transpiration The loss of water vapour to the atmosphere mainly through the openings (stomata) in the fronds. Transpiration pull is one of the forces drawing water up the plant body. Evapotranspiration is a combined measure of water loss from an area by evaporation and transpiration.

transverse section (transverse f. *transversus*, f. *trans* , through + *versus* , *transverto*, turn across) A section perpendicular (at right angles) to the longitudinal axis of the plant organ. The horizontal plane to an upright axis. Abbreviation **T.S**. .

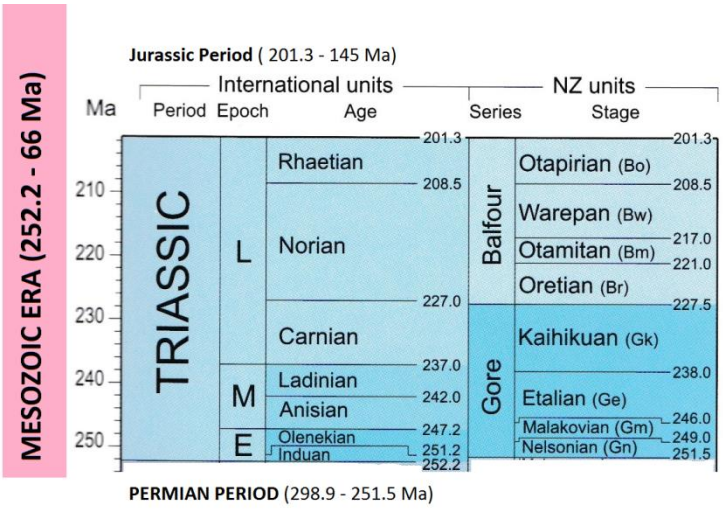
transversely elliptical A spore elliptical in shape when viewed from the pole, in a transverse ellipse, the laesura (tetrad scar) runs parallel with the longest dimension.

transition fern A fern that is homosporous but the adult sporophyte produces separate male and female spores that develop into male and female gametophytes.

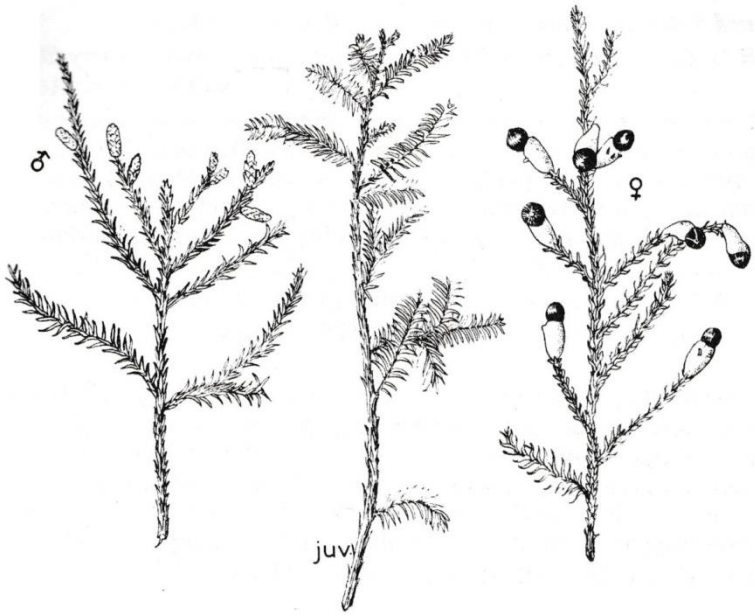
trapezoid (Gr. *trapezion*, little table) Trapezium-shaped, when the sides of a four sided lamina or leaflet are unequal.

triangulate or **triangular** (L. *tri*, three +*angulus*, angle) In the shape of a triangle. *Blechnum triangularifolium*

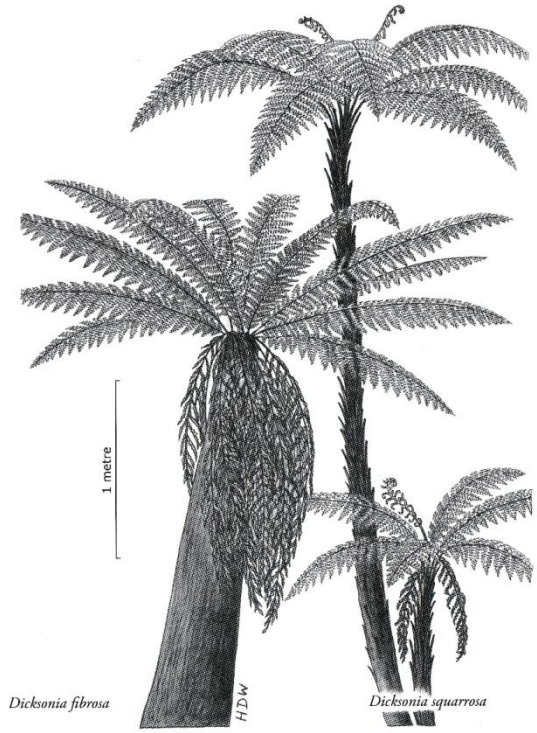
Triassic Period (The Triassic was named in 1834 by Friedrich von Alberti, after a succession of three distinct rock layers (Greek *triás* meaning 'triad') that are widespread in southern Germany: the lower Buntsandstein (colourful sandstone*)*, the middle Muschelkalk (shell-bearing limestone) and the upper Keuper (coloured clay)). The chronostratigraphic (geologic) time period from 252 to 201 million years ago. The Triassic period starts the Mesozoic era. It is preceded by the Permian period (the last period of the Paleozoic) and followed by the Jurassic period.The tree fern family Dicksoniaceae arose in the mid-Triassic. The conifer families Podocarpaceae and Araucariaceae also rose at this time. Archosaurs and their subgroup the Dinosaurs took over as dominant animals from the Permian synapsids and therapsids (Mammal allies and ancestors) following the Permian/Triassic extinction event.. While early mammals evolved during this period.



Triassic Period approximately 252 -201 million years ago



Dacrycarpus dacrydioides **Kahikatea an extant New Zealand podocarp**
'Trees and Shrubs of New Zealand' 1990. A. L. Poole and Nancy M. Adams. DSIR Publishing



Two extant (living) New Zealand tree ferns in the family DIcksoniaceae
'Plant Life on Banks Peninsula' 2013. Hugh D. Wilson. Manuka Press

Part of New Zealand's plant inheritance from Triassic Period or even earlier times.

tribe A taxonomic grouping of similar genera within a family or subfamily. Similar to subfamily and sometimes corresponds to them in some taxonomic systems.

trichome: Gr. *trichoma* growth of hair, f. *trich-, thrix* , hair) An epidermal outgrowth, e.g. a hair (branched or unbranched), scale, hairlike scale, bristle, paraphysis, gland. See **hair**. Bristle ferns -*Trichomanes sp.* , *Lindsaea trichomanoides*.

trichome cover Vestiture with hairs.

trigonous (L. three-cornered) Having three longitudinal angles and three plane faces. Compare **triquetrous**.

trifid (L. *tri ,* three + *findere ,* to split)) Divided into three, more or less equal parts.

trilete (L. *tri* , three + possibly f. + *latus*, side) Of spores, with a three-pronged (triradiate) scar (**laesura**) in the shape of a YScar from separation from tetrad. This trilete or monolete scar functions as an area of weakness which ruptures, allowing germination of the developing gametophyte. The laesura is also known as the **germination fissure**. . Compare **monolete, tetralete** and **alete**.

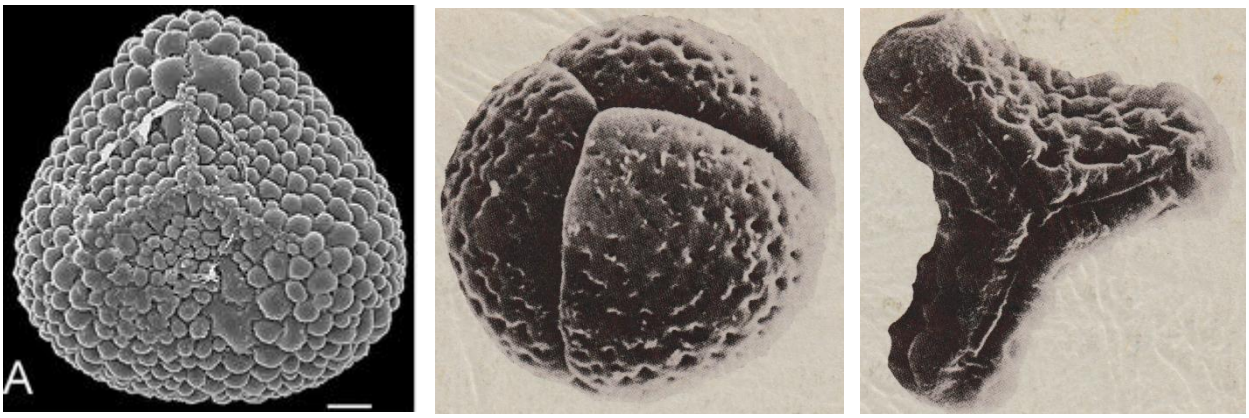


Figure 278 trilete spores

***Lygodium articulatum* –Trilete spore** ***Phlegmarius varius* Trilete spore** ***Dicksonia squarrosa* Trilete triradiate**

syn. *Lycopodium varium*

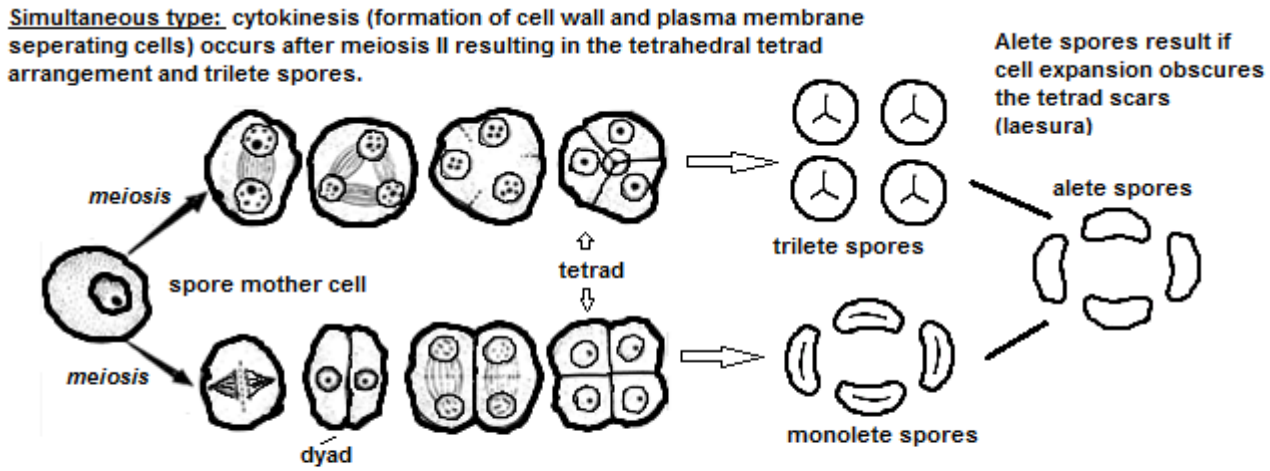


Figure 279 trilete, monolete and alete spore development

trimerous: (L. *tri* , three + Gr. *meros*: parts) Arranged in whorls of three.

tripartite (L. *tri ,* three + *partitus* divided f. *par* , part) Divided into three more or less equal parts, cut nearly to the base. See **partite**, **bipartite**.

tripinnate (L. *tri ,* three + pinnate) The frond divided three times pinnately, 3-pinnate. The ultimate segment (leaflet) or tertiary (3°) pinnae is a **pinnulet** (some authors continue to use the term pinnule for this though).

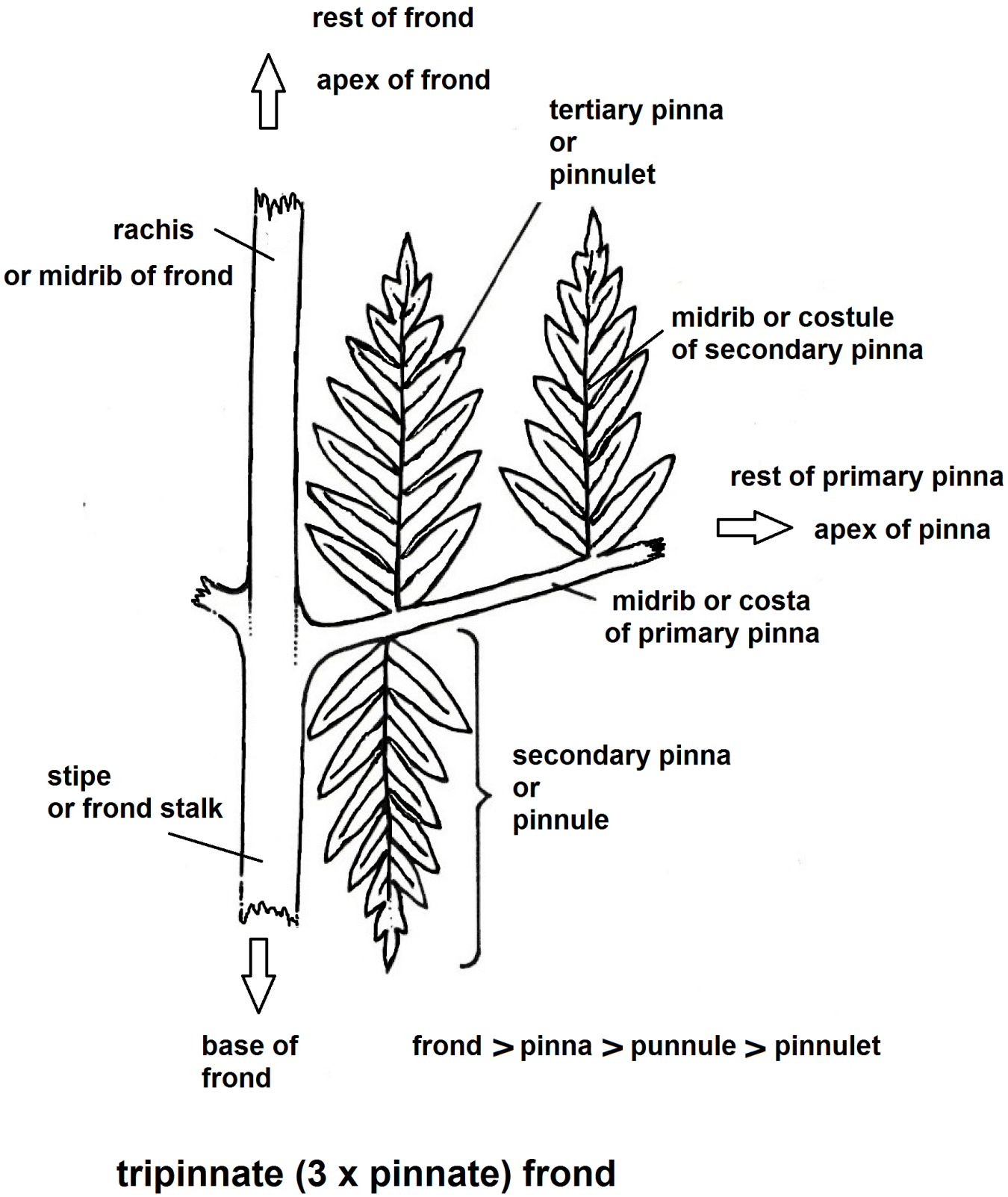


Figure 280 tripinnate

tripinnatifid (L. *tri:* three + pinnate + *-fid* from *findere;* to split) **Bipinnate** (2 x pinnate) with the ultimate segment (leaflet) or **pinnule** partially divided, or deeply notched (-fid). The term tripinnatifid sometimes covers the next two terms.

tripinnatipartite (L. *tri:* three + pinnate + *partitus ,* divided) Bipinnate with the pinnule partially divided, or parted (partite). Sometimes, covered by the term tripinnatifid.

tripinnatisect (L. *tri:* three + pinnate + *sectum*, f. *seco* , to cut) Bipinnate with the pinnule partially but deeply divided, Sometimes, covered by the term tripinnatifid.

triplenerved (L. *tri ,* three + nerved) With three main veins (nerves).

triploid: (L. *tri ,* three. triple + *oides* , like) Polyploid having three of the basic sets of chromosomes in the nucleus. Triploids are either sterile because they produce aborted spores, or fertile because they are apogamous. Compare **diploid**, **haploid.**

triquetrous (L. *triquetrus,* three-cornered) With three prominent, acutely angled ridge and concave faces. *Psilotum nudum (*syn *P. triquetrum)* has triquetrous branchlets

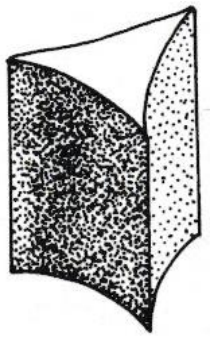


Figure 281 triquetrous

trophopod (Gr. *trophikos*, pertaining to food or nourishment f. *trophe*, food + *podos*, foot) Petiole bases that are swollen, enlarged and starch filled that persist on the rhizome of some fern species. Trophopods that arise from failure to develop (abortion) of a leaf apex have been termed cataphylls (e.g. *Matteuccia struthiopteris)*- a necrotic crozier(koru) is often persistant on the apex of the trophopod in this case. Otherwise trophopods are left on the rhizome following senescence of the distal portion of a fully developed leaf.

trophophyll (Gr. *trophikos*, pertaining to food or nourishment f. *trophe*, food + Gr. *phyllon* leaf) A purely vegetative or sterile frond, one that does not produce spores, instead exists as a photosynthetic (feeding) organ only. In dimorphic ferns species such as *Blechnum*. In monomorphic fern species the sporophyl and trophophyll are combined in one frond type. Synonym **vegetative** ,**barren** or **sterile** frond. Compare **fertile**

frond or **sporophyll.**

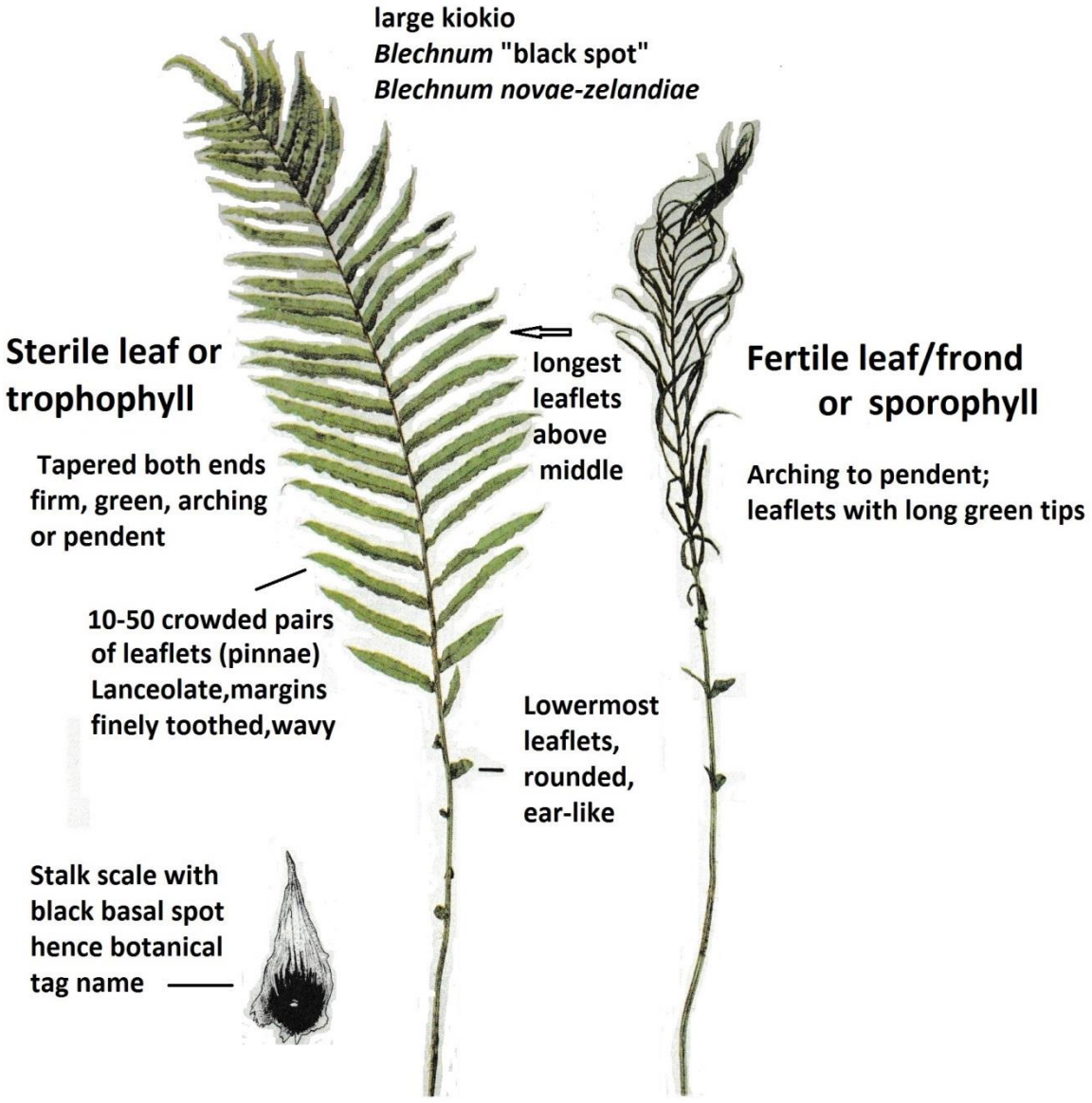


Figure 282 trophophyll

tropical (Gr. *tropikos*, (*kuklos*) *tropic* circle f. *trope*, turning, solstice, (*trepo* , turn)) Warmer or equatorial areas of the world.

truncate (L. *truncare* , to lop) Appearing as if cut off perpendicular to the axis, having the end square or even. Applied to leaf apices or bases for instance. *Fuscospora truncata* hard beech.

trunk The erect, unbranched portion of a tree-like plant such as a tree fern **caudex**.

T.S. transverse section. Compare **C.S**. cross section and **L.S.** longitudinal section.. Term used in microscopy.

tuber (L. *tuber* , bump, hump, swelling) A swollen, often globular underground organ. In ferns, referring to the rounded fleshy stems produced on underground stolons of some species of sword ferns *Nephrolepis*.

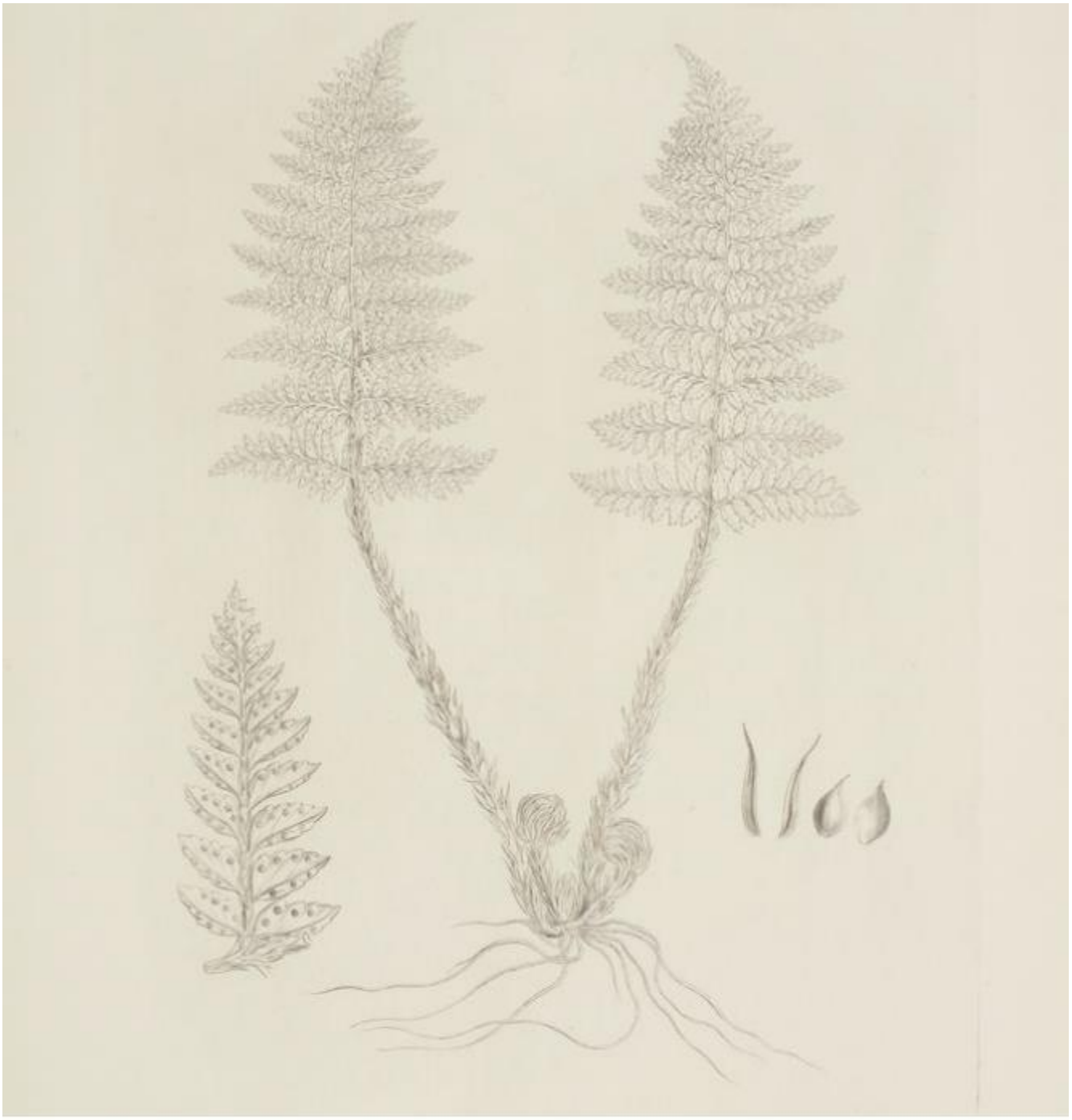
tubercle (L. *tuberculum*, diminutive of *tuber*) A small wart-like outgrowth. Hence **tuberculate**.

tuberculate (L. *tuberculum*, diminutive of *tuber*) Covered with tubercles :knobbly projections or excresences. See **tubercule**. Applied for instance to a spore surface.

tuberculum pl. **tubercula** (L. *tuberculum*, diminutive of *tuber*) Tubers, rounded and irregular knobbly projections.

tubular (L. *tubus* , tube, pipe). Hollow and elongate like a pipe.

tufted Growing in small clumps like a tussock. In Latin *caespitose* f. *caespes*, tuft**. tufted ferns** are those with fronds that arise close together from a compacted more or less woody base. Fern possessing a condensed erect rhizome. Tree ferns are a variant of the tufted form**. Creeping ferns** differ from the tufted in having fronds more or less distantly spaced along an elongated rhizome. A few ferns adopt a habit which is both creeping and tufted. The rhizomes may be short and creeping, with fronds aggregated into short lengths of rhizome so that the plant appears to be made up of seperated tufts. **Hairs** growing closly together in groups (**flocosse**).



***Polystichum richardii* a tufted fern**

Polystichum richardii (Hooker) J. Smith, 1895, United Kingdom, by Sydney Parkinson. Gift of the British Museum, 1895. Te Papa (1992-0035-2353/1941)

Figure 283 tufted fern (growth habit)

tussock grassland Vegetation dominated by grass species with the tussock or caespitose growth form. In New Zealand divided into Tall tussock or snow tussock grassland (colder, drier, but not too dry areas), red tussock grassland (often boggy areas) and short tussock grassland (cold dry eastern sites generally). Herbs and shrubs may grow with them. A similar divide to the Tall grass praire and short grass praire in North America. A rarer grassland type in New Zealand is the sward grassland. There are also a few forest grasses. Spinifex, pingao (a sedge) and introduced marram grass grow on foredunes.

ultimate (L. *ultimare*, come to an end) The final, last, apical, terminal segments that are the last and smallest divisions of a blade. Such as pinna, pinnules or pinnulets on a frond, depending on the degree of leaf division.

unarmed Without spines or prickles. Opposite of armed.

umbraticolous (L. *umbrosus* **,** shady f. *umbra*, shade + *-colous*, inhabiting) Inhabiting shady places. New Zealand examples: *Hymenophyllum atrovirens* and *Leptopteris superba*. Synonym **umbraticolous**, **sciophilous/ skiophilous** and **sciophyte/ skiophyte.** Opposite of **photophilous**/**heliophilous** preferring to grow in well lit sites.

umbrophile (L. *umbrosus*, shady f. *umbra*, shade + Gr. *–philus* , loving.) A plant which favours shady conditions. New Zealand examples: *Hymenophyllum atrovirens* and *Leptopteris superba*. Synonym **umbraticolous**, **sciophilous/ skiophilous** and **sciophyte/ skiophyte**. Opposite of **photophilous**/ **heliophilous** preferring to grow in well lit sites.

unicostate (L *uni*, *unis*: one + *costa*, rib) Leaf venation in which there is only a central midrib and no lateral or secondary veins, e.g. as in lycophytes (the microphyll), psilophytes, equisetophytes, as well as many conifers. Synonym **uninervous**, **hyphodromous**.

undulate (L. *undula*, Diminutive of *unda ,* wave). Wavy and not flat; referring to margins waved in a plane at right angles to the surface. Similar to **sinuate** but up and down.

undulipodium pl. **undulipodia** ((L. *undula*, Diminutive of *unda ,* wave + podium, foot, “wavy foot”) Sperm tale, motile cilia or sperm flagellum. Composed of tubulin and hundreds of other proteins enclosed by an extension of the cell membrane called the undulipodial membrane.

unifarious (L. *uni, unis,*one + *farius*, f. *fariam* ranked in a row or line) In one row equivalent to **uniseriate**. Compare **bifarious**/**biseriate** and **multifarious**/**multiseriate**.

uninervous (L *uni*, *unis*: one + *nervus*, nerve) Leaf venation in which there is only a central midrib and no lateral or secondary veins, e.g. as in lycophytes (microphyll), psilophytes, equisetophytes, as well as many conifers. Synonym **unicostate**, **hyphodromous.**

uniseriate (L *uni*, *unis*: one + *seria* line) Arranged in a single row or series such as cells in a single file; said of multicellular hairs, in which the cells are in a single line. Synonym **unifarious**. Compare **biseriate/bifarious,** and **multiseriate/multifarious.**.

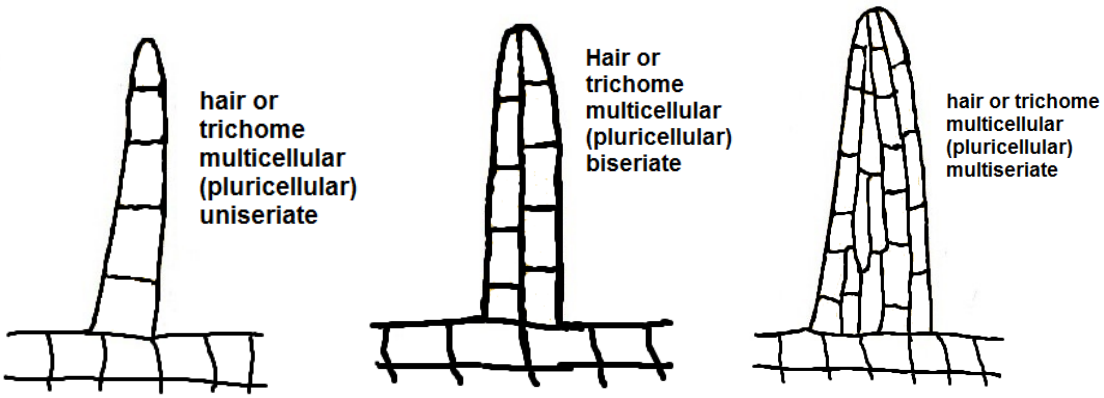


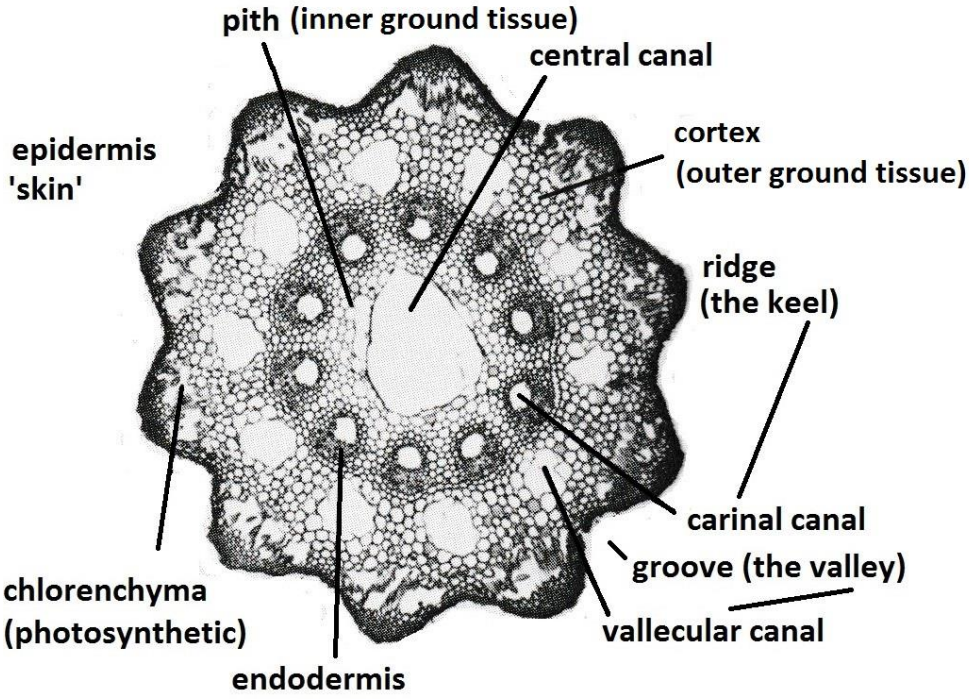
Figure 284 uniseriate,biseriate and multiseriate

united Fused or growing together **. Synangia** for instance are united sori.

unreduced spores Spores that have not had their chromosome number halved (reduced) by meiosis; spores that are 2*n*, not *n*.

urceolate (L. *urceolus* a small jug, vessel.) Urn shaped. Pitcher shaped. Similar to **cyathiform**, or **cupulate**. *Sticherus urceolatus*.

vallecular canal (L. diminutive of *valles, vallis*, valley + canal) A canal beneath a stem groove (the valley), as seen in *Equisetum.* The **carinal canal** is beneath the ridge (keel).



***Equisetum* sp. C.S. stem -note three longitudinal cavities (canals)**

Modified form 'Morphology of Plants and Fungi' 4th ed. 1980
Harold C. Bold, Constantine Alexopoulous, Theodore Delevoras
Harper International Edition

Figure 285 vallecular canal (*Equisetum*)

valve (L. *valvae* , the leaves or folds of a folding door) A lobe of an indusium (involucre) applied to indusial of Hymenophyllaceae (filmy ferns) and Dicksoniaceae. See **bivalvate (2-lipped)**

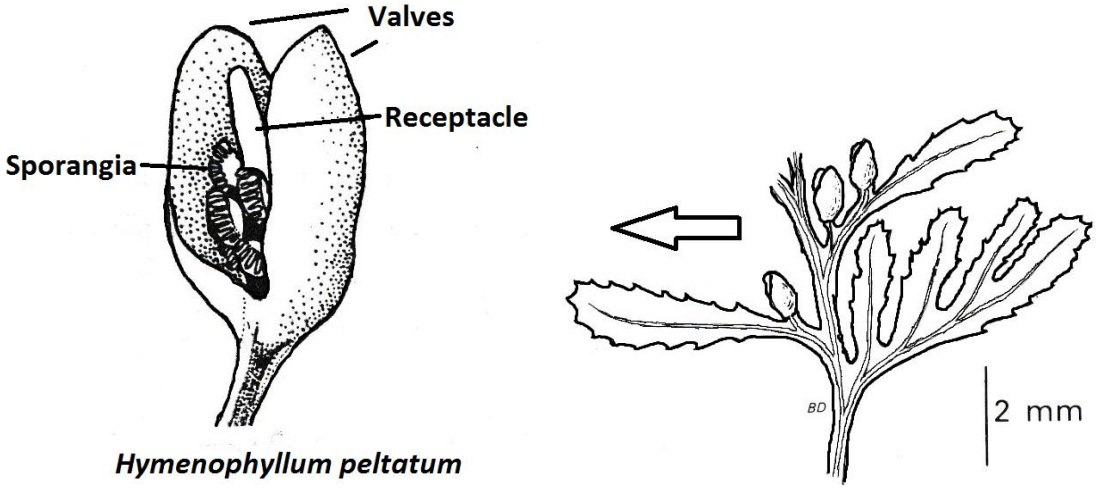
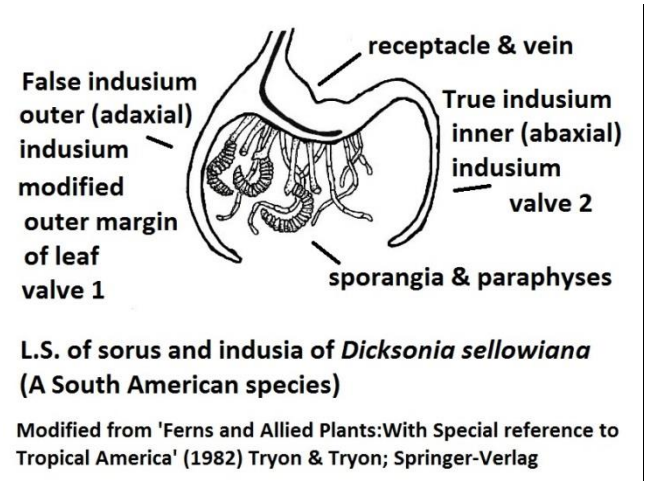


Figure 286 valve (indusium *Hymenophyllum*)



L.S. of sorus and indusia of *Dicksonia sellowiana* (A South American species)

Modified from 'Ferns and Allied Plants:With Special reference to Tropical America' (1982) Tryon & Tryon; Springer-Verlag

Dicksonia sp. tree fern sori with indusia

https://www.flickr.com/photos/gjshepherd/3938743546/in/photostream/

Figure 287 valve (indusium *Dicksonia*)

var. Abbreviation of the taxonomic rank of **variety**, term for a group of more closely related populations within a species. They differ slightly from the species or subspecies they are compared with. Similar to **subspecies**, but of lower rank, but above the rank of **form**. See **infraspecific.**

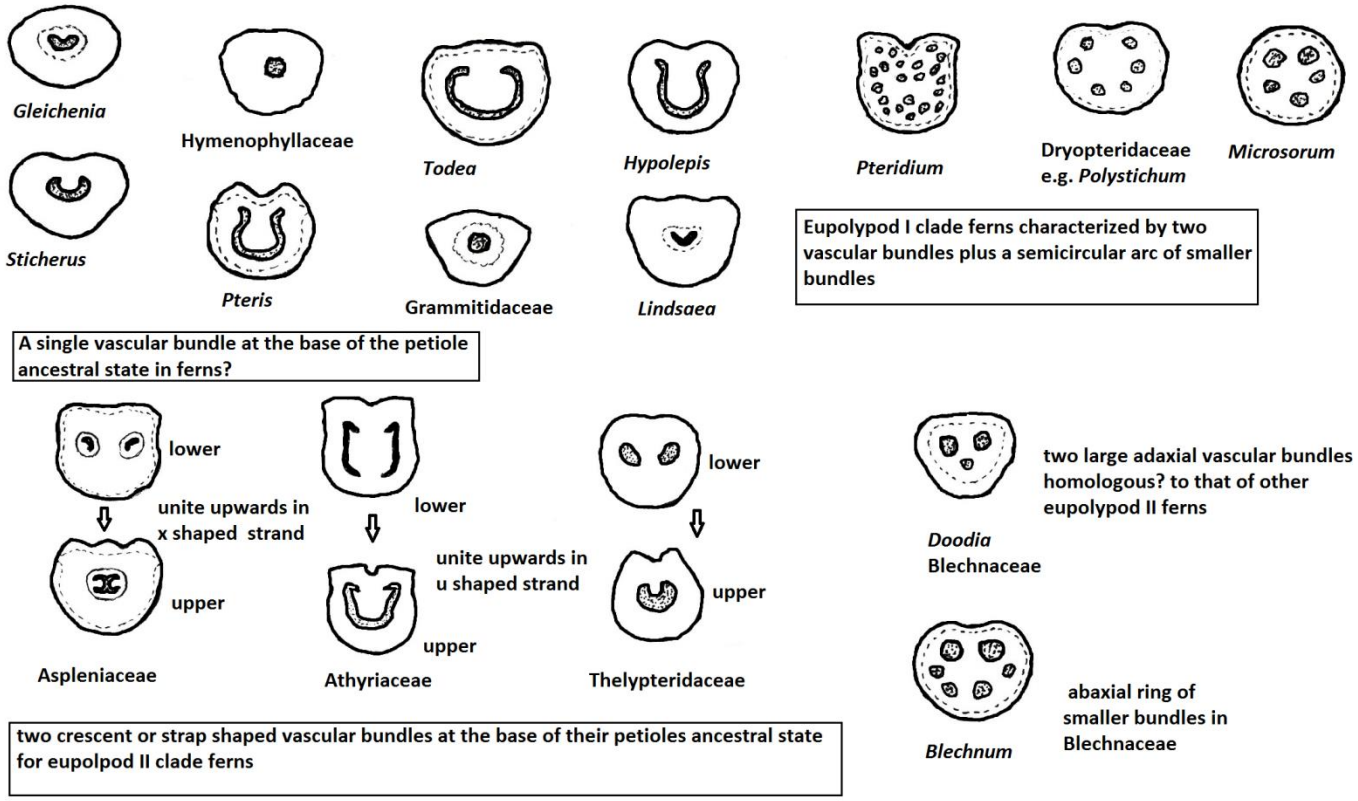
variable (L. *variare*, *-atum*, to vary f. *varius*) Varying in form, habit or colour. *Lycopodium varium*.

variegated (L. *varius ,* diverse, varying) Where the basic colour is broken by areas of another colour.

variety (L. *varietas* , variety) A lesser subdivision of a species; which ranks below subspecies and is therefore a subdivision of subspecies. Abbreviation **var**. .

vascular (L**.** *vascularis,* f. *vasculum* ,small vessel f. *vas* container + *-culum*, diminutive suffix) Having specialized (often woody) conducting elements. The xylem and phloem tissue in plants. Pertaining to the stele, veins(or nerves) in plant morphology.

vascular bundle: Of tissue containing veins or main conducting elements (xylem and phloem) also known as **vascular strand** with associated xylem and phloem tissue. Contains cells that conduct water distally (xylem) and sugars in solution proximally (phloem). See xylem and phloem.



Transverse section (T.S.) of petiole bases of various ferns to show vasculature patterns
Diagrams modified from 'Ferns and Allied Plants of Victoria, Tasmania and South Australia' 1986. Betty D. Duncand and Golda Isaac. Melbourne University Press

Figure 288 vascular bundle patterns in ferns

vascular plants Vascular plants (L. *vasculum* 'duct'), also called tracheophytes or collectively Tracheophyta (Gr. *trakheîa artēría,*windpipe + *phutá* 'plants', form a large group of land plants (c. 300,000 accepted known living species) that have lignified tissues (the **xylem**) for conducting water and minerals throughout the plant. They also have a specialized non-lignified tissue (the **phloem**) to conduct products of photosynthesis. Vascular plants include the clubmosses, horsetails, ferns, gymnosperms (including conifers) and angiosperms (flowering plants). Scientific names for the group include Tracheophyta, Tracheobionta and Equisetopsida *sensu lato*. Some early land plants (the rhyniophytes) had less developed vascular tissue; the term eutracheophyte has been used for all other vascular plants, including all living ones. The temporal range is from late Silurian period c. 425 Ma to the present. The liverworts, mosses and hornworts, collectively the 'bryophytes' are non-vascular land plants. Vascularization occurred in the early Silurian to Devonian period, polysporangiate plants, with some intermediate between the bryophytes and the true tracheophytes (Eutracheophyta). The polysporangiate plants lacking vascular tissue have been termed the 'protracheophyta' (Horneopsida & *Aglaophyton*), those with a simple vascular system (–S-type tracheids) the paratracheophyta (e.g. *Rhynia Gwynne-vaughanii, Stockmansella* & *Huvenia)* and then the eutracheophytes.

vegetation (L. *vegetatio* , growth) The whole plant communities or plant cover of an area.

vegetative (L. *vegetare* , enliven , f. *vegetus*, *vegere*, move, quicken) Asexual development or propagation.

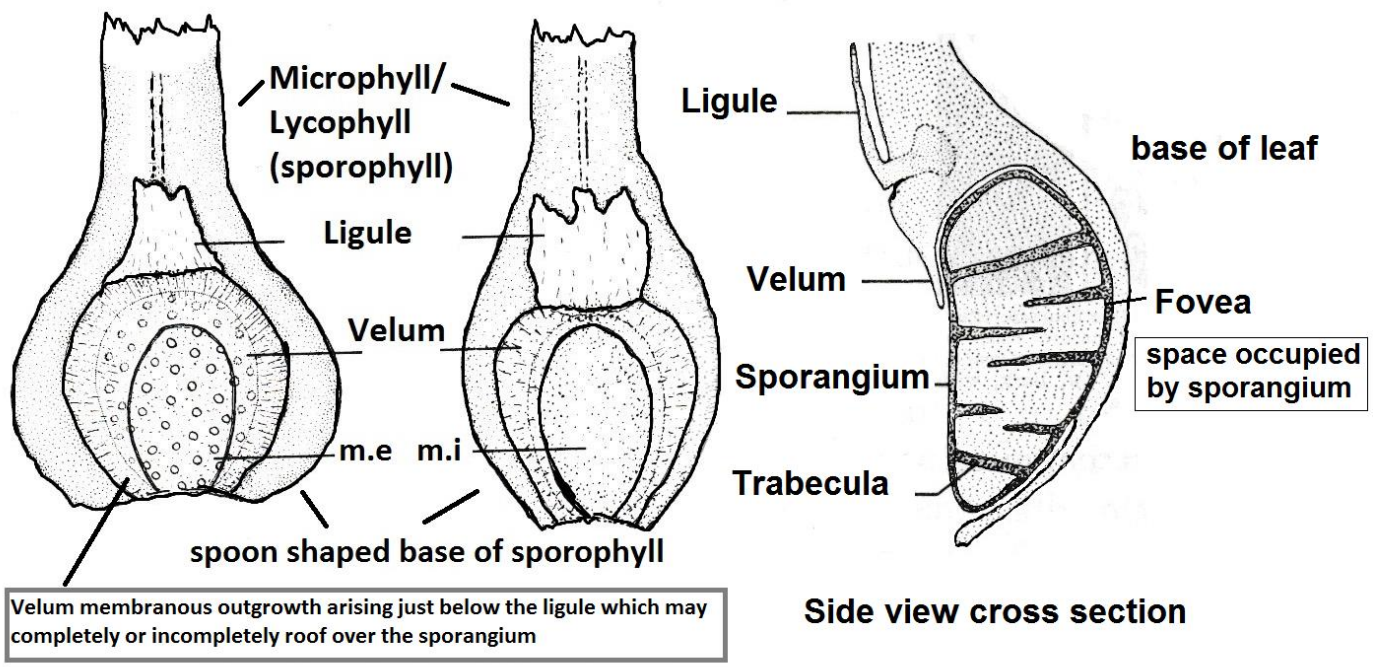
vegetative frond. Frond lacking sporangia. Also known as sterile frond or blade, as opposed to **fertile frond (sporophyll)** or blade in ferns with dimorphic fronds. Synonym **trophophyll** (feeding leaf) or **sterile frond**.

vein (L. *vena* , a vein, blood vessel) A strand of vascular tissue (associated xylem and phloem) in the blade tissue of a frond or part of a frond. Synonym **nerve**. See **venation**.

vein course (dromy) The direction veins take, may be described as straight, convex, sinuous (wavy) or ramified (branching without rejoining) either admedially or exmedially.

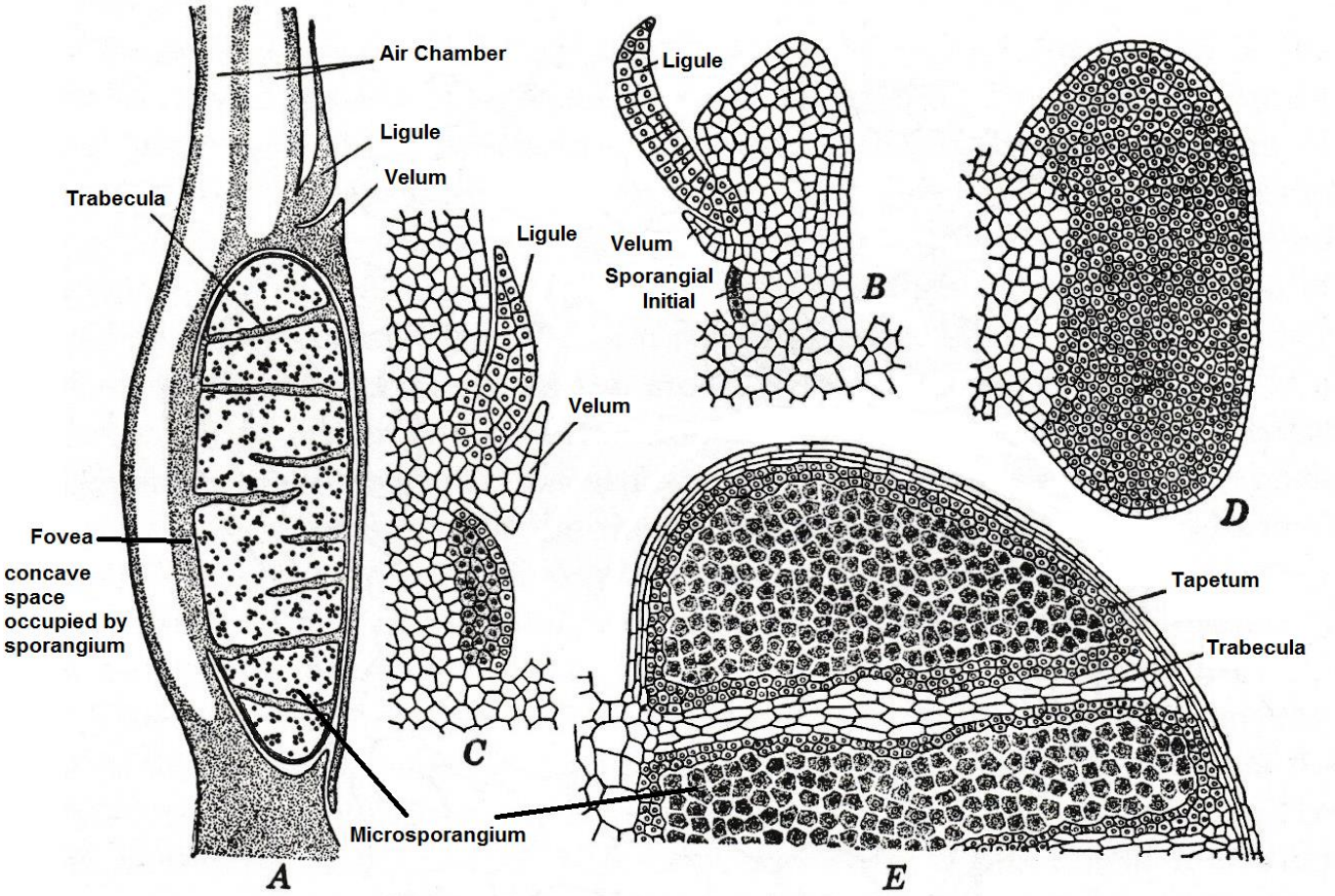
veinlet (diminutive of **vein**) A small or slender vein. **Venule** smaller still.

velum ((L. *velum*, veil) The flap of tiisue that protects sporangia in *Isoetes*. A membranous flap-like envelope which partially or wholly covers the sporangium in cavities (**fovea**) at the base of leaves of *Isoetes*. The velum develops from epidermal cells between the sporangial initials and the ligule.



Isoetes sp. (quilwort) Adaxial view of megasporophyll (left) and microsporophyll (middle) indicating location of the megasporangium (m.e.) and microsporangium (m.i.), **velum** and the minute leaflike flap (tongue) of tissue the **ligule**. On right cross section view from side.

Figure 289 velum (*Isoetes*)



***Isoetes nuttalii* A. Br. A young vertical section of the base of a microsporophyll bearing a mature microsporangium. B a young microsporophyll with the primordium of a microsporangium. C-E, stages in the development of the microsporangia. Early stages in the development of the macro- and microsporangia are alike. Both ligule and velum develop from divisions of epidermal cells. Note in this species the velum almost completely overarches the sporangium, in other species only partially so. Nuttall's quilwort is native to western North America.**

(adapted from 'Cryptogamic Botany' Vol II. 1955. Gilbert Smith. McGraw-Hill International Student Edition)

Figure 290 velum (*Isoetes nuttallii*)

.**velutinous** (L. *velutinus*, f. *velutum* velvet) Covered with fine, soft, spreading hairs; velvet

velvety see **velutinous**

venation (L. *vena* , a vein, blood vessel) The arrangement or pattern of veins in a leaf or frond. Synonym: nervation. *Polyphlebium venosum* syn. *Trichomanes venosum* Veined bristle fern, veined filmy fern.

Venation Pattern terms:- Can get a bit complicated but here are the main terms

abmedial vein A vein directed away from the midvein.

admedial vein A vein directed towards the midvein..

areoles. The spaces formed by a vein network. Synonym **lacuna**

branched veins Free veins that fork or branch but don't unite..Unbranched is simple.

Venation Pattern terms (continued)

dichotomous Where veins branch distally or fork in pairs (bifurcate) of equal size and orientation.

-dromous (Gr. *dromos*, run, race, raceway) Suffix added to the name of the pattern formed by the way the veins run within the lamina (leaf blade). Prefixed by: *acro-*(tip), *actino-* (ray), *campto-, campylo-* (bent, curved), *brochio-(* noose,loop) *clado-* (branched), *reticulo-* (netted), *parallelo-(*parallel), *hypho-*(web) depending on pattern.

false veins. Small vein-like areas of thick-walled cells in the leaves of some lower vascular plants. Not true veins because they lack vascular tissue.

free No veins uniting, or looping to form a network. Maybe simple, forked or branched.

included veinlets. Small veins ending inside areoles. Maybe simple,forked or branched.

midrib The primary vein,in fern terminology **rachis** (frond midrib) **costa** (pinna midrib) **costule** (pinnule midrib) and **costulet** (pinnulet midrib). If **unicostate,hyphodromous** or u**nivervous** it is the only vein.

net Veins uniting, or looping, to form a network. The area enclosed by the veins is the **areole**. Synonym: **anastomosing** or **reticulate**

pectinal A lateral vein that supports a number of subsidiary branches abmedially (veins directed away from the midvein.

penninervous (pinnate + nerve (vein)) Veins running in a pinnate pattern.

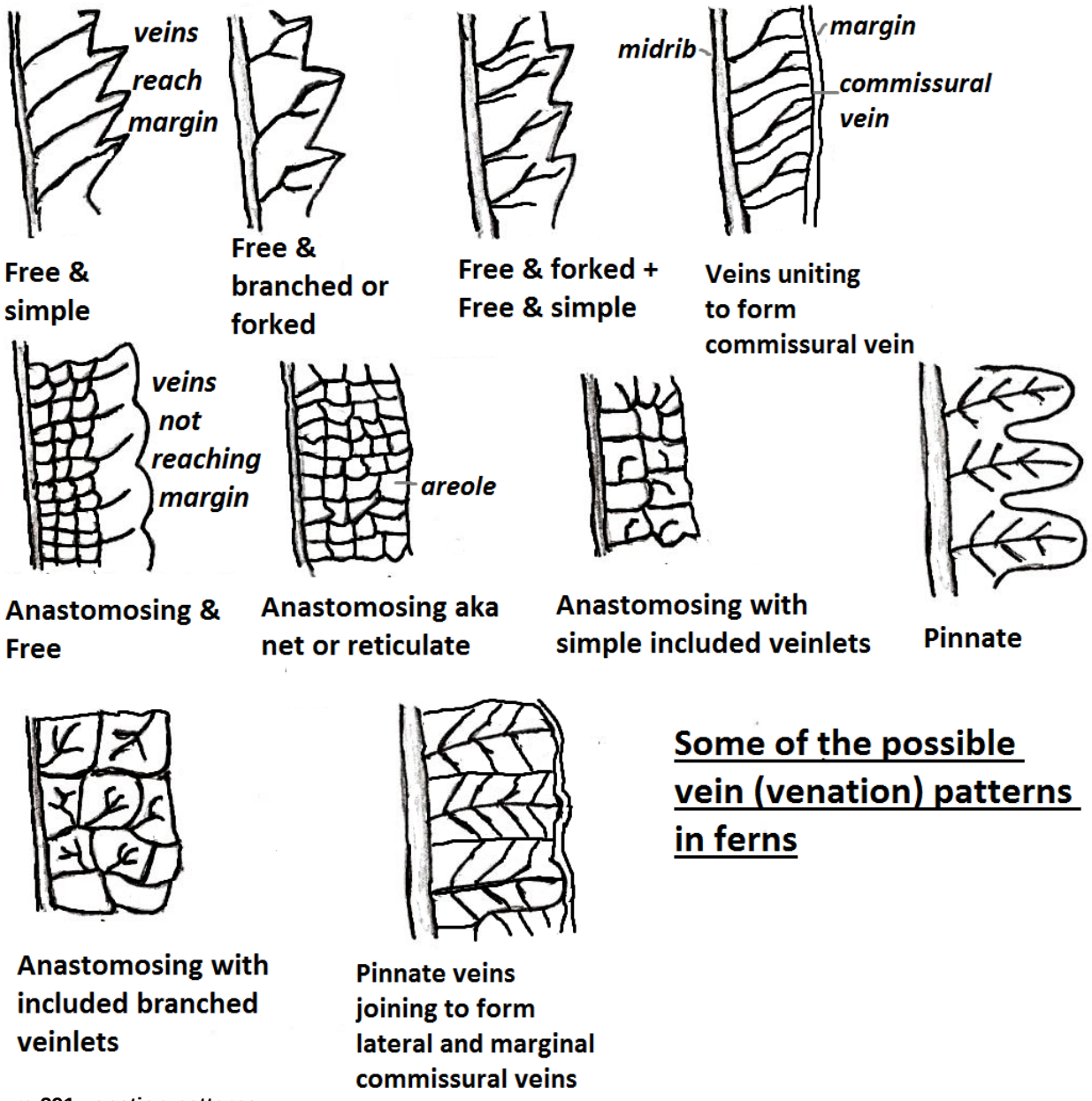
primary vein (1° vein) or **veins** (in actinodromous, palinactinodromous and campylodromous venation) the prominent central vein or midrib of a leaf or leaflet or lobe. In ferns, the rhachis, costa, costule or costulet. If **unicostate**, **uninervous** or **hyphodromous** the only vein present.

secondary vein (2° vein) Vein branching from the primary vein or veins.

tertiary vein (3° vein) Vein branching from secondary veins. Tertiary veins usually link the secondary veins in either a ladderlike (percurrent/scalariform) or netlike (reticulate) pattern.

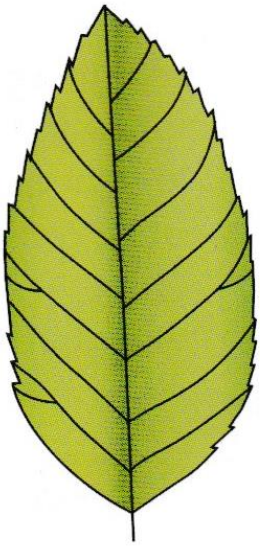
veinlets Secondary or higher order veins.

venules Quaternary (4°veins) or higher order veins.



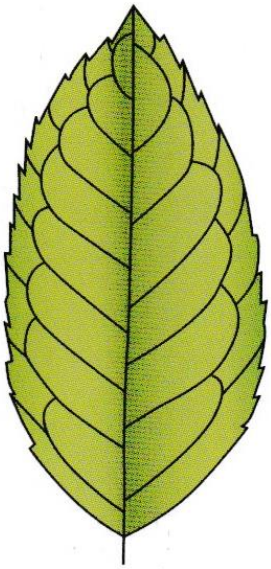
Some of the possible vein (venation) patterns in ferns

Figure 291 venation patterns



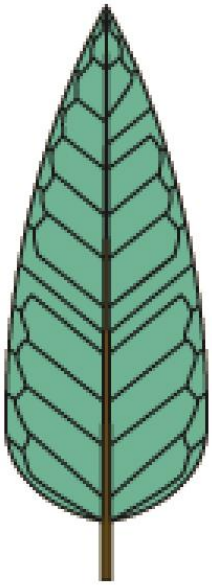
Simple craspedodromous

Secondary veins reach margin and enter teeth



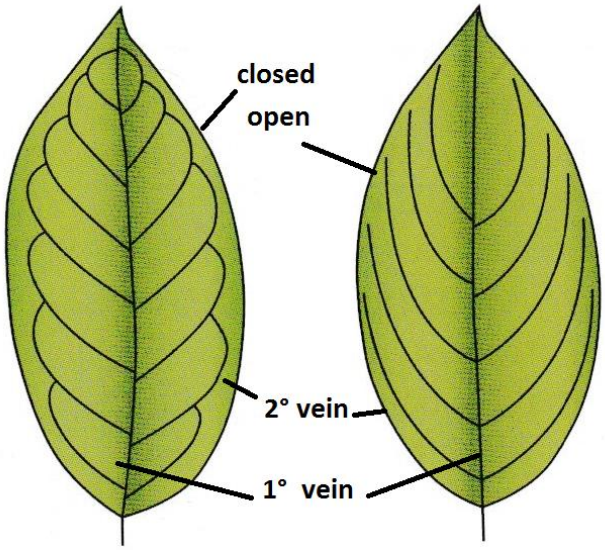
Semicraspedodromous

secondary veins branch, form loops, and reach the margin



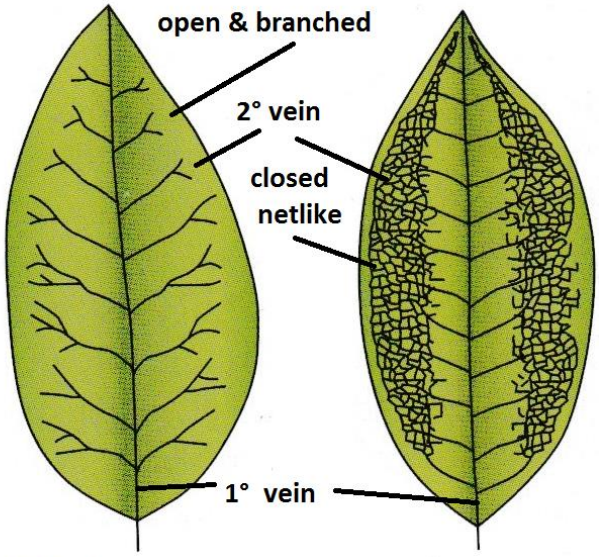
Mixed craspedromous
Simple + semicraspedodromous

Pinnate Craspedodromous Venation



Brochiodromous
Secondary veins form a series of loops (nooses)

Eucamptodromous
Secondary veins arch smoothly toward margin (Arcuate)



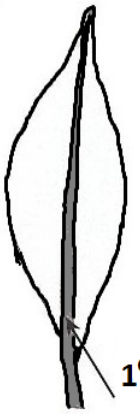
Cladodromous
Secondary veins branch toward margin

Reticulodromous
secondary veins merge into dense reticulum

Pinnate Camptodromous Venation (Secondary veins do not reach margin)

(penninerved = pinnate pattern)

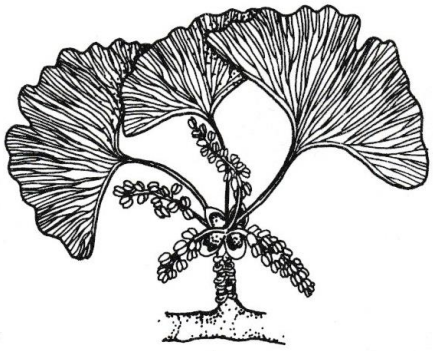
Figure 292 pinnate (craspedodromous & camptodromous) venation patterns



1° vein only

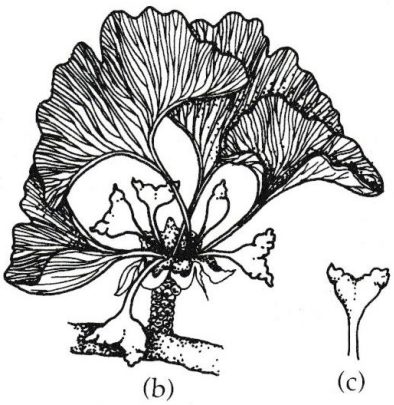
hyphodromous = uninervate

parallelodromous
"parallel running veins"
synonym striate



(a)

Gingko biloba spur shoot with microstrobili
-pollen organs from male tree



(b)

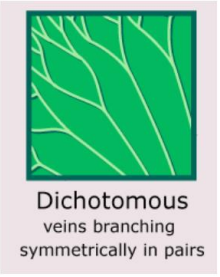
spur shoot with ovules
female tree

(c)

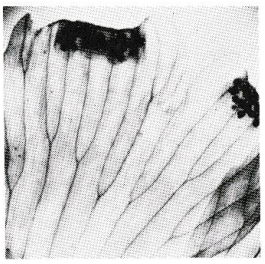
pair of ovules

Gingko biloba is the classic tree exhibiting dichotomous venation

'Contempory Plant Systematics' 1997. Dennis W. Woodland. Andrews University Press



https://upload.wikimedia.org/wikipedia/commons/5/51/Leaf_morphology_no_title.png



Adiantum capillus-veneris. Cleared pinnule; note dichotomous venation and sori with false indusia

Morphology of Plants and Fungi' 1980. Harold C. Bold, Constantine Alexopoulos, Theodore Delevoras. Harper International

dichotomous venation

Figure 293 other venation patterns

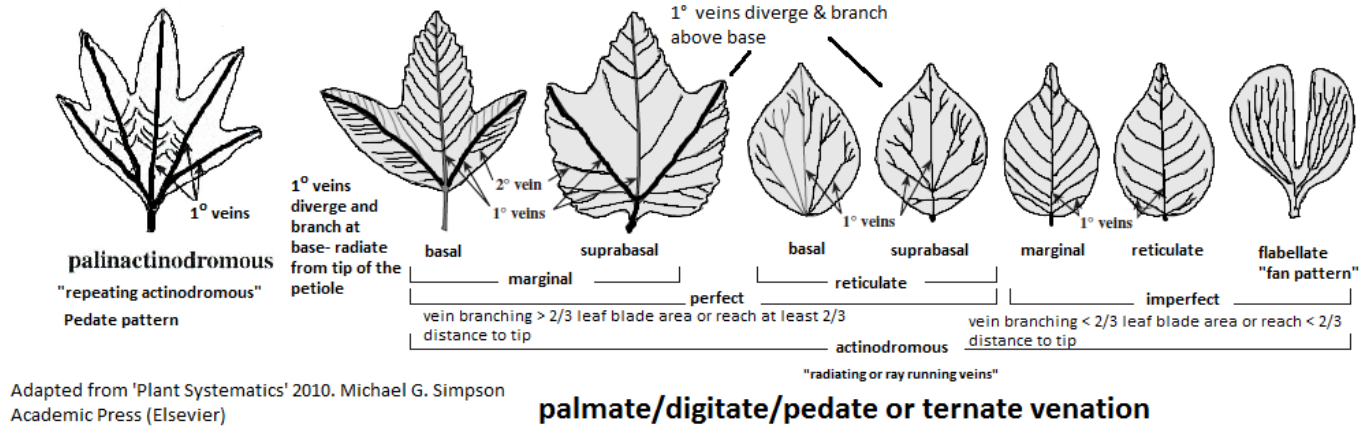


Figure 294 palmate venation patterns

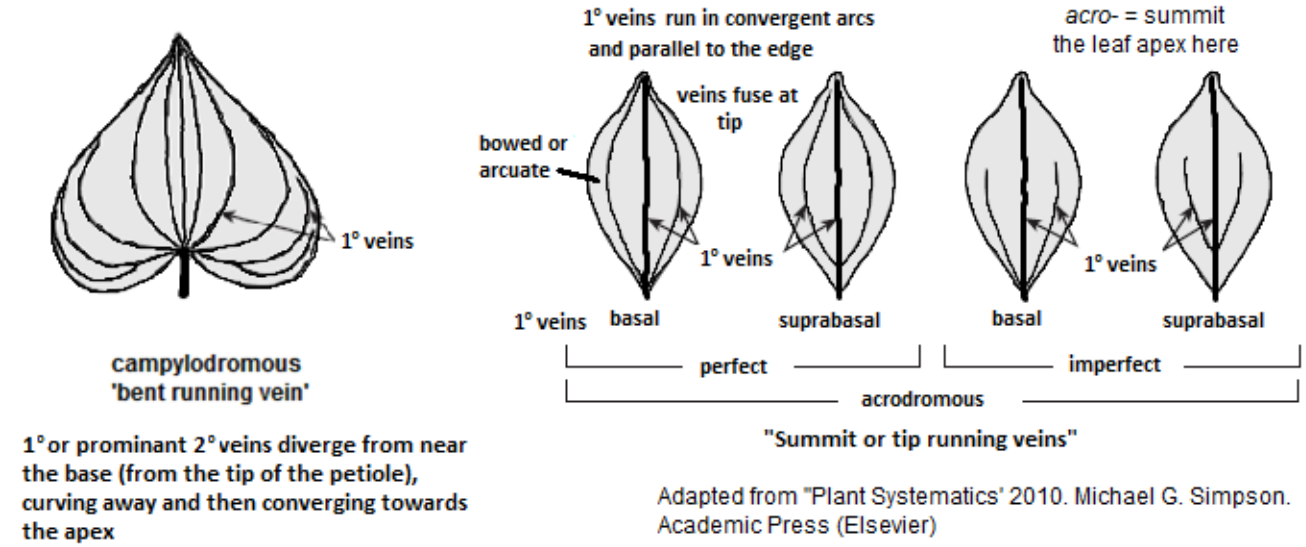
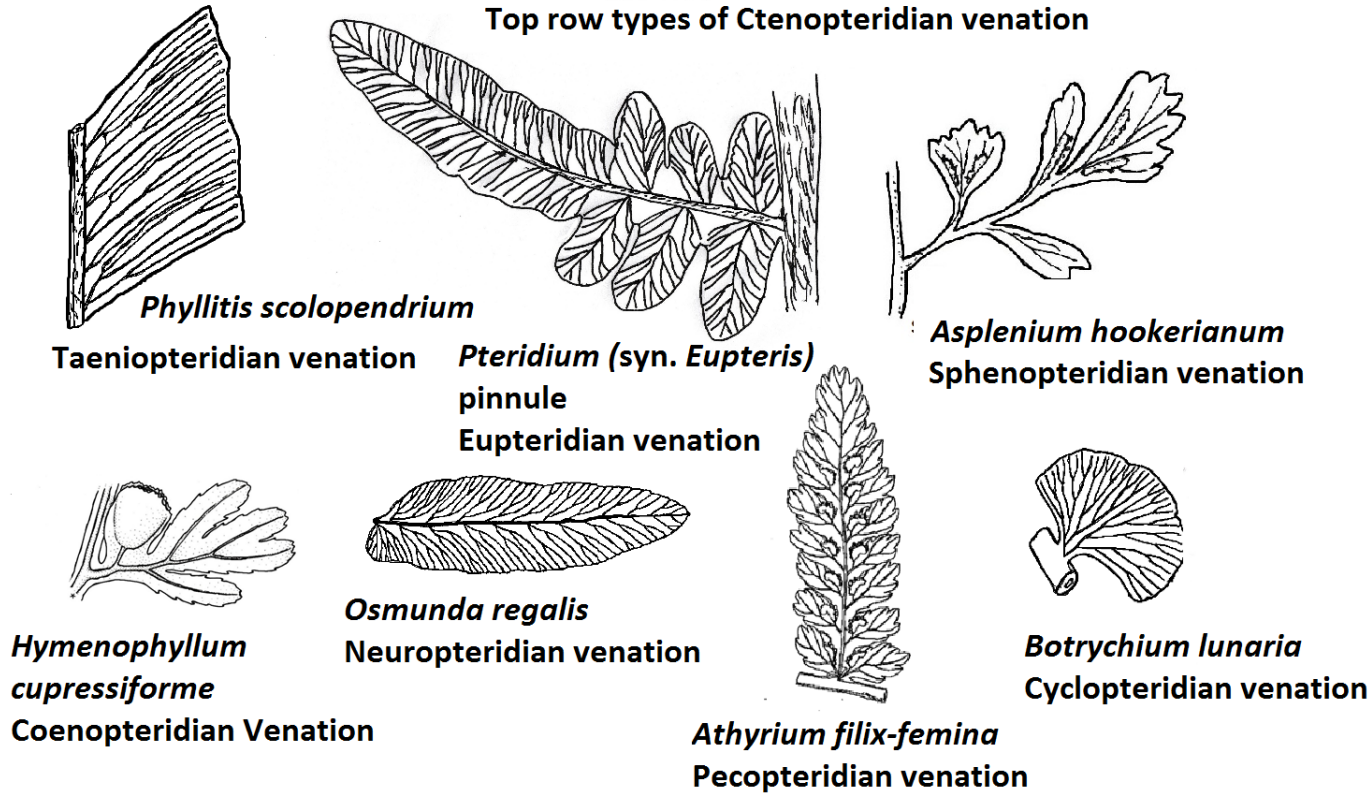


Figure 295 campylodromous & acrodromous venation patterns

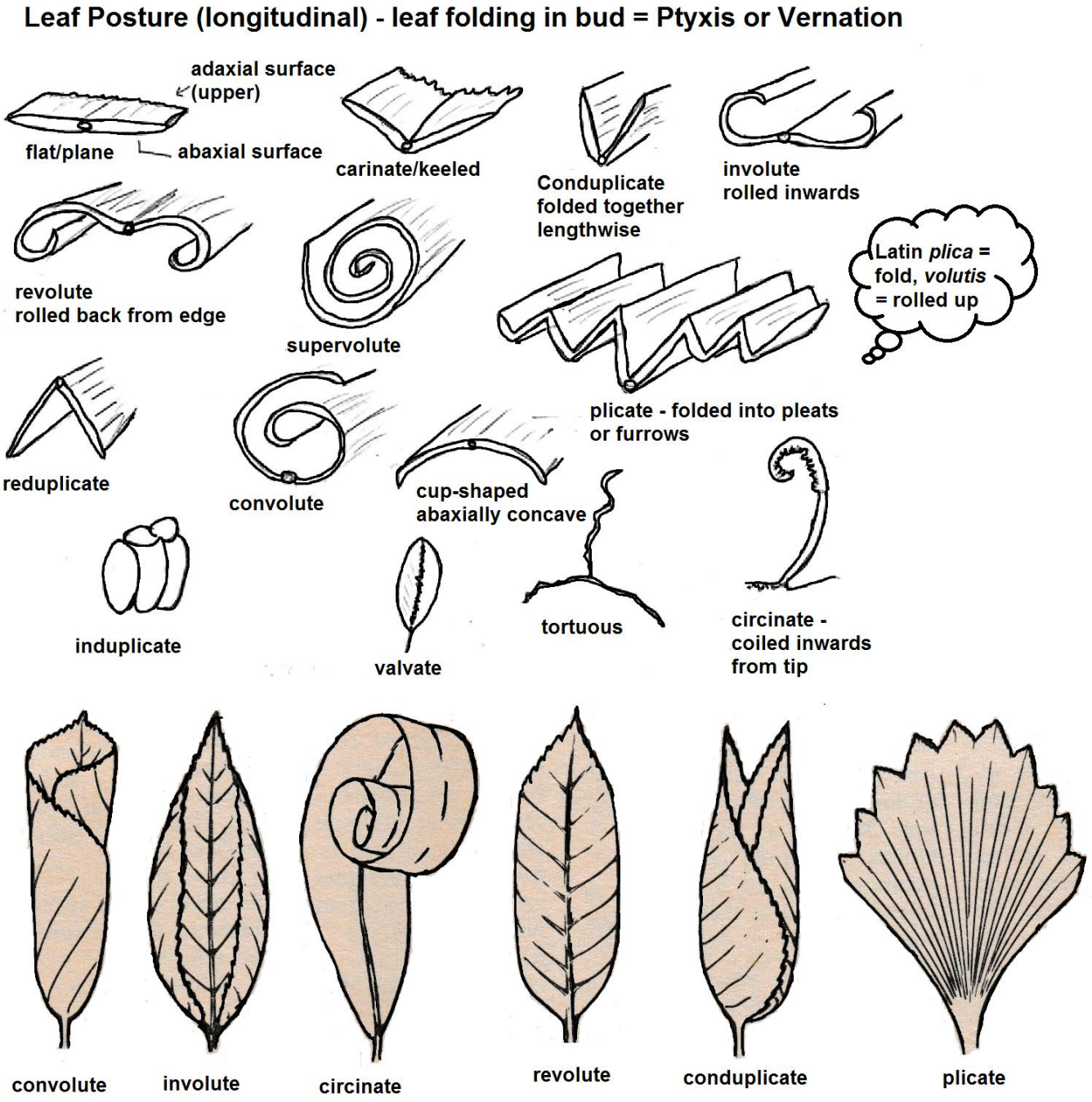


Venation patterns according to the classification system of Mettenius

Named after living ferns: *Coenopteris*, *Ctenopteris*, *Eupteris* (*Pteridium*) and fossil Seed Fern (Pteridosperm) genera: *Taenopteris*, *Sphenopteris*, *Neuropteris*, *Pecopteris* and *Cyclopteris*.

Figure 296 venation patterns (Mettenius –German botanist 1823 1866)

vernation (L. *vernalis* , pertaining to the spring, f. *vernus* , of spring, f. *ver* , spring) The arrangement of the unexpanded leaves in a vegetative bud such as the manner in which the tips of fronds uncoil or unfold in development. Two patterns prevail in ferns:- **circinate vernation** (synonym, crozier, fiddlehead, koru) the common pattern in ferns and **non-circinate vernation**, seen in *Pellaea falcata*, where the young fern blade forms a hook or shepherds crook rather than a coil. In the Ophioglossales the vernation is said to be erect and does not coil. = **Ptyxis** (Gr. *Ptyches*, folds) is the way an individual leaf is folded in bud.



Lower images from 'Penguin Dictionary of Botany' 1984. Penguin Books

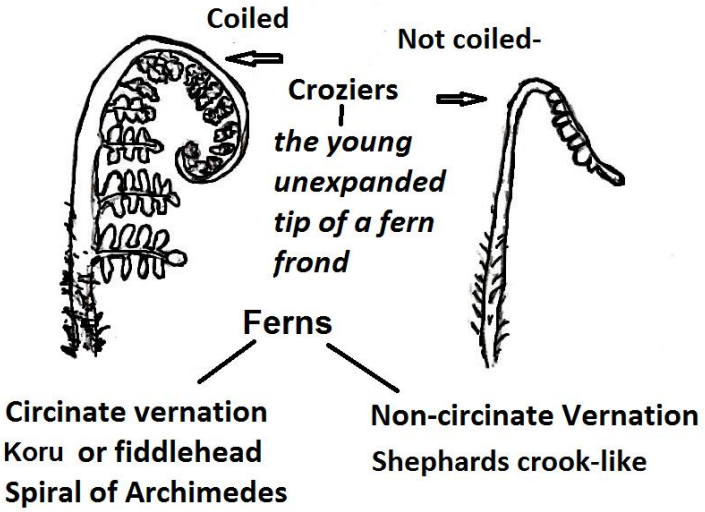


Figure 297 vernation (circinate & non-circinnate)

ventral (L. *ventralis*, f. *venter* belly) The front of an organ; upper surface of a leaf (belly up). Synonym: **adaxial**. The opposite of **dorsal** (back).

vermiculate (L. *vermis* , worm) With worm-like projections.

verruca pl. **verrucae** (L. *verruca* , wart) Wart-like projections regularly distributed (c.f. **tubercula**), broad, more or less isodiametric projections, larger than granulate.

verrucate (L. *verruca* , wart) Warty, with verrucae... In *Anogramma leptophylla* the distal face of the spore is described as verrucate to coarsely tuberculate.

verrucose (L. *verruca* , wart) Covered with wart-like outgrowths, warted.

verticillate (L. *verticillus*, f. *vertex*, eddy, f. *vertere*, turn) Whorled. Three or more leaves at a node.

vesciculose (L. diminutive of *vescica*, bladder, a little bladder) With small bladder-like blistery features.

vestigial (L. *vestigium* , footstep, footprint) Rudimentary, of a relict nature.

vestiture (L. *vestitura* clothing, f. *vestitus* p.p. of *vestio*, to clothe, f. *vestis*, garment) Any covering, but especially hairs. *Polystichum vestitum*.

viable (French vie life, f. L. *vita* , life) Alive and able to germinate. Said of spores.

vicarience (German *vikarirend* , f. *vikarieren* to act as a substitute, f. *Vikar* representative, proxy, f. German *vicar*, f. L. *vicarius* substitute). In biogeography and evolution, when an ancestral population is split into two or more populations by a geologic process, such as continental drift (plate tectonics) or formation of a geographic barrier e.g. the Tasman sea and the Southern Alps in New Zealand's case. See ancient rafters. Compare **dispersal** or **drifters**.

villous (L. *villosus* , hairy, shaggy, rough) Clothed with long soft hairs. Maybe irregularly twisted or curled. Compare **hirsute .** Hairy filmy fern *Hymenophyllum villosum.* see hairiness terms.

vining (L. *vinum*, wine) Climbing by twining of the stems.

viscid (L. *viscidus*, *viscum* 'birdlime', mistletoe.) Sticky or gluey.

viviparous (L. *vivesco* , to become alive + *parere*, bring forth)) Sprouting from a bud while still attached to the parent plant. A form of asexual or vegetative reproduction. See bulbil,

volubile (L. *volubilis* twisting around a support,twinning f. *volvere*, to roll,turn about) Twinning about a support. *Lycopodium volubile*.

whorl (Middle English *wharle*, *whorle*, probably alteration of *whirle*, from *whirlen* to whirl) Three or more leaves at a node. Equals Latin *verticillus*. from whence verticillate.

whorled (English f. whorl) Describing three or more leaves growing at the same level round a stem. Equals Latin *verticillatus* , from whence verticillate.

wig A popular term for the reduced and skeletonized basal pinnae of the fronds of some tree ferns (aphleiae)

wing A membranous flattened border or outgrowth to an axis **,** such as the green laminal tissue down the side of a stipe, rachis, etc. The downwardly continuing base of a decurrent leaf, or the upwardly continuing base of a surcurrent leaf.

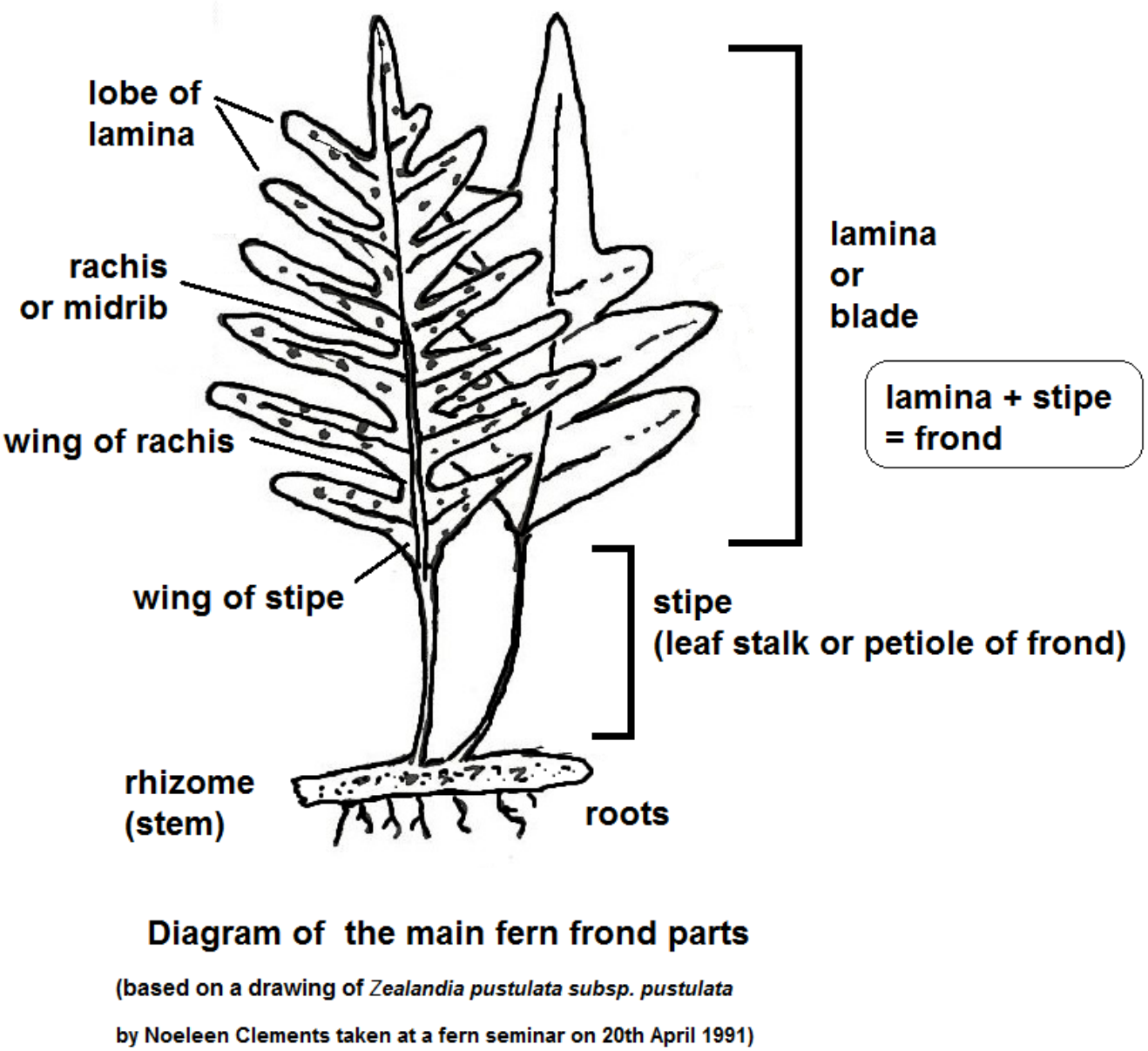


Figure 298 Wing of stipe and wing of rachis (*Zealandia* syn. *Microsorum*)

wings See **ala**.

winged See **alate**.

wooly Bearing,long, soft, matted hairs. Synonym lanate. See hairiness terms.

xeric (Gr. *xeros*, dry) Drought- resistant, able to grow in dry or arid and semi-arid conditions Compare **mesic** and **hydric**.

xeroclinal (Gr. *xeros*, dry + *klinein*, slope, to lean) Growing on the dry side of slopes. Compare **mesoclinal**.

xeromorphic (Gr. *xeros*, dry + *-morphos*, f. *morphe*, shape) Adapted to dry climatic conditions. The morphological and physiological adaptations that enable a plant to grow in dry conditions.

xerophyte (Gr. *xeros*, dry + *phyton*, plant) A drought resistant plant growing in arid or semi-arid climatic conditions or in a situation such as a epiphyte faces subject to dryer conditions. Compare **mesophyte**, **hygrophyte**, **hydrophyte**,

xylem (Gr. *xylon* , wood) The tissue, in a vascular plant, that conducts water and mineral salts distally from the roots to the leaves. The tissue is made up of conducting cells – tracheary elements such as **tracheid**s and or vessel elements, plus associated parenchyma, and sometimes sclerenchyma (fibres). The other vascular tissue is **phloem**. Non- vascular tissue is **ground tissue** (synonym: **fundamental tissue**) and **dermal** (skin) **tissue** the epidermis and bark.

zoochory (Gr. *zoo*, animal + -chore f. *khoreo*, to move) Is dispersal of seed, spores etc by animals (mammals, reptiles, birds, amphibians ,fish and invertebtates such as insects). If inside the animal (typically its gut) it is termed endozoochory (*endo*- inside +zoochory) and if outside ectozoochory (**ecto-** outside +zoochory). Subdivisions of zoochory include by insects –**entomochory**, ants –myremochory. snails & slugs –**gastropodochory,** fish **ichthyochory** and humans- anthropochory or androchory. The other forms of dispersal are physical in nature and include **anemochory** (wind), **autochory** (self), **barachory** or **clitochory** (own weight), **bolochory** (propulsive mechanism), **crystalochory** (glaciers,ice), **hydrochory** (water), **thallasochory** (sea). The extent to which fern or lycophytes spores or other propagules are distributed by animals is largely unknown. In the book 'Gathhering Moss" the author Robin Wall Kimmerer mentions the potential of invertebrates (mites, springtails, slugs …) to carry moss sperm further than the sperm could on its own accord – a few centimeters swimming in water.

Zosterophyllopsida (named after the aquatic flowering plant *Zostera* from a mistaken belief that the two groups were related. David P. Penhallow's generic description of the type genus *Zosterophyllum* refers to "Aquatic plants with creeping stems, from which arise narrow dichotomous branches and narrow linear leaves of the aspect of *Zostera*." Wikipedia) The early vascular plants (Late Silurian Period (420 mya) to Devonian Period), allied to and stem-group lycophytes, forming a sister group to the ancestors of the living lycophytes. The stems of zosterophylls were either smooth or covered with small spines known as enations (precursers of microphylls? see **enation theory**) branched **dichotomously**, and grew at the ends by unrolling, a process known as **circinate vernation**. The stems had a central vascular column in which the **protoxylem** was **exarch**, and the metaxylem developed centripetally. The **sporangia** were kidney-shaped (reniform), with conspicuous lateral dehiscence and were borne laterally in a fertile zone towards the tips of the branches. (Stewart, W.N. & Rothwell, G.W. (1993), *Paleobotany and the evolution of plants* (2nd ed.), Cambridge, UK: Cambridge University Press, ISBN 978-0-521-38294-6)

Zygote (Gr. *zygon*, a yoke) The fertilized egg. The cell formed by the union of two gametes (egg and sperm). The gametes are haploid (1n) cells produced by the gametophyte in ferns and lycophytes. Following fertilization, the resulting cell is diploid (2n) and represents the start of the sporophyte generation.

APPENDIX 1		
CHECKLIST OF NEW ZEALAND FERNS & LYCOPHYTES (endemic, indigenous and naturalized exotics)		
SPECIES (indigenous) or (endemic) or (exotic)	NAME IN BROWNSEY (IF DIFFERENT) 'New Zealand ferns and allied plants' Brownsey, P.J.; Smith-Dodsworth, J.C. 2000: Ed. 2. David Bateman, Auckland.	Common name(s)
LYCOPHYTES: LYCOPODIOPHYTA		
LYCOPODIACEAE Clubmoss family M**ā**tukutuku, Whareatu, Whareatua **,**Tarakupenga		
Austrolycopodium fastigiatum (indigenous)	*Lycopodium fastigiatum*	Alpine clubmoss, Mountain clubmoss
Brownseya serpentina (indigenous)	*Lycopodium serpentinum*	Bog clubmoss
Diphasium scariosum (indigenous)	*Lycopodium scariosum*	Creeping clubmoss

Huperzia australiana (indigenous)	*Lycopodium australianum*	Fir clubmoss
Lateristachys diffusa (indigenous)	*Lycopodium diffusum*	Carpet clubmoss
Lateristachys lateralis (indigenous)	*Lycopodium laterale*	clubmoss
Palhinhaea cernua (indigenous)	*Lycopodium cernuum*	clubmoss
Phlegmariurus varius (indigenous)	*Lycopodium varium*	hanging clubmoss, iwituna, tassel fern,whiri-o-raukatauri
Phylloglossum drummondii (indigenous)	———	annual clubmoss
Pseudodiphasium volubile (indigenous)	*Lycopodium volubile*	climbing clubmoss, hiauea , waikāhu , waewaekoukou,
Pseudolycopodium densum (indigenous)	*Lycopodium deuterodensum*	puakarimu, taramoa, waewaekoukou
ISOETOPSIDA Ligulate lycophytes (synonyms Glossopsida)		
ISOETACEAE Quilwort family		
Isoetes alpina	———	alpine quillwort
Isoetes kirkii	———	quillwort
SELAGINELLACEAE Spikemoss Family		
Selaginella kraussiana (exotic)	———	african clubmoss
Selaginella martensii (exotic)	———	mexican clubmoss
Selaginella moellendorffii (exotic)	———	asian spikemoss

SPECIES	NAME IN BROWNSEY (IF DIFFERENT)	FAMILY
MONILOPHYTES Ferns and Horsetails		
EQUISETACEAE Horsetail family		
Equisetum arvense (exotic)	———	field horsetail
Equisetum fluviatile (exotic)	———	swamp horsetail
Equisetum hyemale (exotic)	———	rough horsetail, scouring rush
PSILIOPSIDA Whisk ferns and Ophioglossoid ferns		
PSILOTACEAE Fork Fern family		
Psilotum nudum (indigenous)	———	skeleton fork fern, whisk fern
Tmesipteris elongata (indigenous)	———	fork fern
Tmesipteris horomaka	New	Banks Peninsula fork fern
Tmesipteris lanceolata (indigenous)	———	fork fern
Tmesipteris sigmatifolia (indigenous)	———	fossil fern, fork fern
Tmesipteris tannensis (indigenous)	———	fork fern

OPHIOGLOSSACEAE Ophioglossoid ferns, Parsley Fern and Adder's tongue fern family		
Ophioglossum coriaceum (indigenous)	———	adder's tongue
Ophioglossum petiolatum (indigenous)	———	stalked adder's tongue fern
Botrychium australe (indigenous)	———	parsley fern, pātōtara ,ti taranaki
Botrychium biforme	———	fine-leaved parsley fern
Botrychium lunaria (indigenous)	———	moonwort
MARATTIOPSIDA Marattoid ferns		
MARATTIACEAE King Fern Family		
Ptisana salicina (indigenous)	*Marattia salicina*	horseshoe fern, king fern, mouku, para, parareka, paratawhiti, tawhiti para, uhi para, uwhi para,
POLYPODIOPSIDA Leptosporangiate ferns synonym **LEPTOSPORANGIATE, FILIOPSIDA, FILICALES**		
OSMUNDACEAE Royal Fern Family		
Leptopteris hymenophylloides (endemic)	———	crêpe fern, heruheru, single crêpe fern,
Leptopteris superba (endemic)	———	crêpe fern, double crepe fern, heruheru, huruhuru o ngāwaewae o paoa , ngutungutu, ngutukākāriki, ngutungutu kiwi, prince of wales feathers, pūniu, pūnui, tētē, tētē kura
Osmunda regalis (exotic)	———	royal fern
Todea barbara (indigenous)	———	hard todea, king fern, royal fern
HYMENOPHYLLACEAE Filmy Fern family, Mauku		
Hymenophyllum armstrongii (endemic)	———	filmy fern
Hymenophyllum australe (endemic)	*Hymenophyllum atrovirens*	filmy fern
Hymenophyllum bivalve (indigenous)	———	filmy fern
Hymenophyllum cupressiforme (indigenous)	———	filmy fern
Hymenophyllum demissum (endemic)	———	drooping filmy fern, Irirangi, piripiri
Hymenophyllum dilatatum (endemic)	———	filmy fern, matua mauku
Hymenophyllum falklandicum (indigenous)	new	filmy fern
Hymenophyllum flabellatum (indigenous)	———	fan-like filmy fern
Hymenophyllum flexuosum (endemic)	———	filmy fern

Hymenophyllum frankliniae (indigenous)	*Hymenophyllum ferrugineum*	rusty filmy fern
Hymenophyllum lyallii (indigenous)	———	filmy fern
Hymenophyllum malingii (endemic)	———	filmy fern
Hymenophyllum minimum (indigenous)	———	filmy fern
Hymenophyllum multifidum (endemic)	———	much-divided filmy fern
Hymenophyllum nephrophyllum (endemic)	*Trichomanes reniforme*	kenehu, kidney fern, konehu, kopakopa, raumanga,raurenga
Hymenophyllum peltatum (indigenous)	———	one-sided filmy fern
Hymenophyllum pluviatile (endemic)	*New*	filmy fern
Hymenophyllum polyanthos (indigenous)	———	cloud filmy fern
Hymenophyllum pulcherrimum (endemic)	———	tufted filmy fern
Hymenophyllum rarum (indigenous)	———	filmy fern
Hymenophyllum revolutum (endemic)	———	filmy fern
Hymenophyllum rufescens (endemic)	———	filmy fern
Hymenophyllum sanguinolentum (indigenous)	———	filmy fern, piripiri
Hymenophyllum scabrum (endemic)	———	rough filmy fern
Hymenophyllum villosum (endemic)	———	hairy filmy fern
Trichomanes caudatum (indigenous)	———	jungle bristle fern (Australia)
Trichomanes colensoi (endemic)	———	bristle fern
Trichomanes elongatum (indigenous)	———	bristle fern
Trichomanes endlicherianum (indigenous)	———	rough bristle fern
Trichomanes humile (indigenous)	———	kermadec (Raoul Island) bristle fern
Trichomanes strictum (indigenous)	———	erect bristle fern
Trichomanes venosum (indigenous)	———	veined bristle fern, veined filmy fern
GLEICHENIACEAE Gleichenoid Ferns, Umbrella fern family		
Dicranopteris linearis (indigenous)	———	thermal umbrella fern
Gleichenia alpina (indigenous)	———	alpine tangle fern
Gleichenia dicarpa (endemic)	———	spider fern**,** swamp umbrella fern, tangle fern, waiwaikāka,

Gleichenia inclusisora (endemic)	———	tangle fern,
Gleichenia microphylla (endemic)	———	carrier tangle fern, parasol fern, waekura, waewae kotuku, waewae matuku, waiwaikāka,
Sticherus cunninghamii (endemic)	———	rarauheriki, raraukeriki, tapuwae kotuku, umbrella fern, waekura,
Sticherus flabellatus var. *flabellatus* (indigenous)	*Gleichenia flabellata*	silky Fan Fern
Sticherus tener (indigenous)	———	umbrella fern
Sticherus urceolatus (indigenous)	———	umbrella fern
LYGODIACEAE Bushmen's Mattress Fern family (sometimes included in Schizaeaceae)		
Lygodium articulatum (endemic)	———	bushman's mattress, hiaue, mākaka, makamaka , mangemange, mangimangi, tarikupenga
SCHIZAEACEAE Schizaoid Ferns, Comb fern family		
Schizaea australis (indigenous)	———	southern comb fern
Schizaea bifida (indigenous)	———	forked comb fern
Schizaea dichotoma (indigenous)	———	fan fern
Schizaea fistulosa (indigenous)	———	comb fern
SALVINNIALES Water ferns		
SALVINIACEAE Water fern family (including AZOLLACEAE)		
Azolla pinnata (exotic)	———	ferny azolla
Azolla rubra (indigenous)	*Azolla filiculoides*	Pacific azolla, azolla, red azolla, Kārerarera, Kārearea, retoreto, returetu
Salvinia molesta (exotic)	———	kariba weed, water fern
MARSILEACEAE Pillwort/Clover fern family		
Marsilea mutica (exotic)	———	four-leaved clover fern, nardoo,
Pilularia novae-hollandiae (indigenous)	*Pilularia novae-zelandiae*	pillwort
CYATHEALES		
Loxsomataceae Loxsoma family		
Loxsoma cunninghamii (endemic)	———	kekakeka, pounamu
DICKSONIACEAE Hairy tree fern family **Loxsoma family**		
Dicksonia fibrosa (endemic)	———	fibrous tree fern, golden tree fern, kuianuipākā, kuripāka , pūnui**,** tūkirunga **,** whekī- kōhunga, wheki- ponga,

Dicksonia lanata subsp. *hispida* (endemic)	_____	stumpy tree fern, tūākura , tuokura,
Dicksonia lanata subsp. *lanata* (endemic)	_____	tūākura, tūōkura, Wooly dwarf tree fern
Dicksonia squarrosa (endemic)	_____	atewekī, brown tree fern, harsh tree fern, pakue, pēhiakura, rough tree fern, tio, tirawa**,** tīronga, urūruwhenua, wekī**,** wheki,
CYATHEACEAE Scaly tree fern family		
Cyathea colensoi (endemic)	_____	creeping tree fern, mountain tree fern, rough tree fern,
Cyathea cooperi (exotic)	_____	australian tree fern
Cyathea cunninghamii (indigenous)	_____	gully tree fern, ponga, pūnui slender tree fern,
Cyathea dealbata (endemic)	_____	kaponga, katote, kātote, ponga, silver fern
Cyathea kermadecensis (endemic)	_____	Kermadec tree fern
Cyathea medullaris (indigenous)	_____	black tree fern, Kākātarahae, Katāta, kōrau, mamaku, pītau,
Cyathea milnei (endemic)	_____	Milne's tree fern
Cyathea smithii (endemic)	_____	katote, kātote, neinei-kura, Smith's tree fern, soft tree fern, whē
POLYPODIALES Polypod ferns		
LINDSAEACEAE lindsaeoid ferns, Necklace fern family		
Lindsaea linearis (indigenous)	_____	screw fern, slender lindsaea
Lindsaea trichomanoides (indigenous)	_____	common lindsaea
Lindsaea viridis	_____	tufted lindsaea
PTERIDACEA Pteroid family		
PTERIDACEAE: Subfamily **Vittarioideae Maidenhair ferns,** tawatawa, huruhuru taipairu, makawe taipairu		
Adiantum aethiopicum (indigenous)	_____	maidenhair, mākaka, true maidenhair
Adiantum capillus-veneris (exotic)	_____	European maidenhair, Venus's hair fern, Virgin's hair
Adiantum cunninghamii (endemic)	_____	common maidenhair, Cunningham's maidenhair
Adiantum diaphanum (indigenous)	_____	small maidenhair, tuberous maidenhair,
Adiantum formosum (indigenous)	_____	giant maidenhair, plumed maidenhair

Adiantum fulvum (endemic)	———	maidenhair
Adiantum hispidulum (indigenous)	———	rosy maidenhair
Adiantum raddianum (exotic)	———	delta maidenhair, american maidenhair
Adiantum viridescens (endemic)	———	maidenhair
PTERIDACEAE : subfamily **Cheilanthoideae**		
Cheilanthes distans (indigenous)	———	woolly cloak fern, woolly rock fern
Cheilanthes lendigera (exotic)	New	
Cheilanthes sieberi subsp*. sieberi* (indigenous)	———	rock fern
Pellaea calidirupium (indigenous)	———	hot rock pellaea
Pellaea falcata (indigenous)	———	sickle fern, australian cliff brake
Pellaea rotundifolia (indigenous)	———	button fern, new zealand cliff brake, round-leaved fern, tarawera
Pellaea viridis (exotic)	———	
PTERIDACEAE: Subfamily **Pteridoideae Brake Ferns**		
Anogramma leptophylla (indigenous)		annual fern, jersey fern
Pteris carsei (endemic)	*Pteris comans*	coastal brake, netted brake
Pteris cretica (exotic)	———	cretan brake
Pteris dentata subsp. *flabellata* (exotic)	———	south african brake, toothed brake
Pteris ensiformis (exotic)	———	slender bracken
Pteris epaleata (indigenous)	New	
Pteris macilenta (endemic)	———	sweet fern
Pteris pacifica (exotic)	———	pacific brake
Pteris saxatilis (indigenous)	———	
Pteris tremula (indigenous)	———	australian bracken, shaking brake,tarawera, tender brake, turawera,
Pteris vittata (exotic)	———	ladder brake, chinese brake
DENNSTAEDTIACEAE Bracken family		
Dennstaedtia davallioides (exotic)	———	lacy ground fern
Dennstaedtia samoensis (exotic)	———	
Histiopteris incisa (indigenous)	———	bat's wing fern, histiopteris, mātātā, water fern,

Hiya distans (indigenous)	*Hypolepis distans*	
Hypolepis amaurorachis (indigenous)	———	southern pig fern, subantartic pig fern, dark rachis pig fern
Hypolepis ambigua (endemic)	———	common hypolepis, rough pig fern
Hypolepis dicksonioides (indigenous)	———	giant hypolepis, giant pig fern, ground fern (Norfolk Island only)
Hypolepis lactea (endemic)	———	milky pig fern
Hypolepis millefolium (endemic)	———	thousand leaved fern
Hypolepis rufobarbata (endemic)	———	sticky pig fern
Leptolepia novae-zelandiae (endemic)	———	lace fern
Microlepia strigosa (exotic)	———	hay-scented fern, lace fern, palapalai, rigid lace fern,
Paesia scaberula (endemic)	———	lace fern, lacy fern, mātātā, pig fern, ring fern, scented fern
Pteridium esculentum (indigenous)	———	bracken fern, bracken, manehu, rārahu, rarauhe, rarauhe-mahuika , tākaha
Sphenomeris chinensis (exotic)	———	
CYSTOPTERIDACEAE Bladder fern family		
Cystopteris fragilis (exotic)	———	brittle bladder fern
Cystopteris tasmanica (indigenous)	———	bladder fern
ASPLENIACEAE Spleenwort fern family petako-pāraharha, petako rauriki		
Asplenium aethiopicum (exotic)	———	african spleenwort
Asplenium appendiculatum subsp*. appendiculatum* (indigenous)	———	ground spleenwort
Asplenium appendiculatum subsp. *maritimum* (endemic)	———	coastal spleenwort
Asplenium bulbiferum (endemic)	———	hen and chicken fern, manamana, mauki, mother fern, mother spleenwort, mouki, mouku, pikopiko,
Asplenium chathamense (endemic)	———	chatham island spleenwort
Asplenium cimmeriorum (endemic)	———	cave spleenwort
Asplenium decurrens (indigenous)	*Asplenium obtusatum* subsp. *northlandicum*	northern shore spleenwort

Asplenium flabellifolium (indigenous)	———	butterfly fern, necklace fern walking fern,
Asplenium flaccidum (indigenous)	———	drooping spleenwort, hanging spleenwort, makawe o Raukatauri, makawe, Nga makawe o raukatauri, Pohutakawa, raukatauri , weeping spleenwort, whekī, whiri-o-raukatauri,
Asplenium gracillimum (indigenous)	———	hen & chicken fern
Asplenium haurakiense (endemic)	———	Hauraki Gulf spleenwort
Asplenium hookerianum var. *colensoi* (endemic)	———	Colenso's spleenwort
Asplenium hookerianum var. *hookerianum* (indigenous)	———	Hooker's spleenwort
Asplenium lamprophyllum (endemic)	———	creeping spleenwort
Asplenium lepidotum (endemic)	new	
Asplenium lyallii (endemic)	———	Lyall's spleenwort
Asplenium oblongifolium (endemic)	———	huruhuruwhenua, pānako**,** paranako, parenako, paretao**,** shining spleenwort, urūruwhenua**,**
Asplenium obtusatum (indigenous)	———	pānako, paranako, parenako, paretao, petako, shore spleenwort,
Asplenium pauperequitum (endemic)	———	poor knights spleenwort,
Asplenium polyodon (indigenous)	———	paretao, peretao, petako, rautaia, sickle spleenwort,
Asplenium richardii (endemic)	———	matua-kaponga, Richard's spleenwort,
Asplenium scleroprium (endemic)	———	southern shore spleenwort
Asplenium shuttleworthianum (indigenous)	———	Shuttleworth's spleenwort
Asplenium subglandulosum (indigenous)	*Pleurosorus rutifolius*	blanket fern
Asplenium trichomanes (indigenous)	———	maidenhair spleenwort
Asplenium trichomanes subsp. *quadrivalens* (indigenous)	———	spleenwort
Asplenium x *lucrosum* (exotic)	———	hybrid Hen & chicken fern
Phyllitis scolopendrium (exotic)	———	hart's tongue fern

BLECHNACEAE Hard fern family		
Austroblechnum banksii (indigenous)	*Blechnum blechnoides*	shore hard fern
Austroblechnum colensoi (endemic)	*Blechnum colensoi*	Colenso's hard fern, peretako, peretao, petako
Austroblechnum durum (endemic)	*Blechnum durum*	hard fern
Austroblechnum lanceolatum (indigenous)	*Blechnum chambersii*	lance fern, nini, rereti
Austroblechnum membranaceum (endemic)	*Blechnum membranaceum*	thin hard fern
Austroblechnum norfolkianum (indigenous)	*Blechnum norfolkianum*	kermadec hard fern
Austroblechnum penna-marina subsp*. alpina* (indigenous)	*Blechnum penna-marina*	alpine hard fern,little hard fern
Blechnum punctulatum (exotic)	New	african hard fern
Cranfillia deltoides (indigenous)	*Blechnum vulcanicum*	korokio, mountain hard fern
Cranfillia fluviatilis (indigenous)	*Blechnum fluviatile*	creek fern, kawakawa, kiwakiwa, kiwikiwi, water fern
Cranfillia nigra (endemic)	*Blechnum nigrum*	black hard fern
Diploblechnum fraseri (indigenous)	*Blechnum fraseri*	miniature tree fern
Doodia aspera Non-resident Native – Vagrant	———	prickly rasp fern
Doodia australis (indigenous)	*Doodia media*	rasp fern, pukupuku
Doodia milnei (endemic)	———	Kermadec rasp fern
Doodia mollis (endemic)	———	moki, mokimoki, mokimoku,mukimuki
Doodia squarrosa (endemic)	———	rasp fern
Icarus filiformis (endemic)	*Blechnum filiforme*	climbing hard fern, pānako, thread fern
Lomaria discolour (endemic)	*Blechnum discolour*	crown fern, petipeti, piupiu, pītau, tāniwhaniwha, turukio
Parablechnum minus (indigenous)	*Blechnum minus*	swamp kiokio
Parablechnum montanum (endemic)	*Blechnum montanum*	dunedin-cass blechnum, mountain kiokio,
Parablechnum novae-zelandiae (endemic)	*Blechnum novae-zelandiae*	blechnum 'black spot', horokio, kiokio, korokio,koropio, moki, mokimoki, palm leaf fern, piupiu, rautao, tupare, tupari,
Parablechnum procerum (endemic)	*Blechnum procerum*	small kiokio

Parablechnum triangularifolium (endemic)	*Blechnum triangularifolium*	kiokio, green bay kiokio
ATHYRIACEAE Lady fern family		
Athyrium filix-femina (exotic)	———————————	lady fern
Athyrium otophorum (exotic)	———————————	Asian lady fern
Deparia petersenii subsp. *congrua* (indigenous)	*Deparia petersenii*	Northern lady fern, small lady fern
Diplazium australe (indigenous)	———————————	large lady fern
DRYOPTERIDACEAE Dryopteroid family , oak fern family, shield ferns		
Arachniodes aristata (indigenous)	———————————	kermadec prickly shield fern
Cyrtomium falcatum (exotic)	———————————	fishtail fern, holly fern, Japanese holly fern
Dryopteris affinis (exotic)	new	golden shield fern, scaly male fern
Dryopteris cycadina (exotic)	———————————	Asian shaggy shield fern
Dryopteris dilatata (exotic)	———————————	broad buckler fern
Dryopteris filix-mas (exotic)		male fern
Dryopteris inaequalis (exotic)	new	african shield fern
Lastreopsis hispida (endemic)	———————————	hairy fern
Lastreopsis velutina (endemic)	———————————	velvet fern
Onoclea sensibilis (exotic)	———————————	sensitive fern, bead fern
Parapolystichum glabellum (endemic)	*Lastreopsis glabella*	smooth shield fern
Parapolystichum kermadecense (endemic)	*Lastreopsis kermadecensis*	raoul island shield fern
Parapolystichum microsorum subsp*. pentangulare* (endemic)	*Lastreopsis microsora*	
Polystichum cystostegium (endemic)	———————————	mountain shield fern
Polystichum lentum (exotic)	———————————	himalayan shield fern
Polystichum neozelandicum subsp*. neozelandicum* (endemic)	*Polystichum richardii* ----------	black shield fern, common shield fern, pikopiko, pīpiko, shore shield fern, tutoke
Polystichum neozelandicum subsp. *zerophyllum* (endemic)	*Polystichum richardii* ----------	black shield fern, common shield fern, pikopiko, , pīpiko shore shield fern, tutoke
Polystichum oculatum	*Polystichum richardii* ----------	black shield fern, common shield

(endemic)		fern, pikopiko, pīpiko, shore shield fern, tutoke ,
Polystichum polyblepharum (exotic)	New ----------	japanese/korean shield fern
Polystichum proliferum (exotic)	————————	australian mother shield fern
Polystichum setiferum cv. *Divisilobium Pulcherrimum* (exotic)	*Polystichum setiferum* ----------	soft shield fern
Polystichum silvaticum (endemic)	————————	shield fern
Polystichum vestitum (endemic)	————————	pītau, prickly shield fern, pūniu, tutoke, pīpiko
Polystichum wawranum (endemic)	*Polystichum richardii* ----------	pikopiko, pīpiko, shore shield fern, tutoke,
Rumohra adiantiformis (indigenous)	————————	florists fern, leathery shield fern
NEPHROLEPIDACEAE Boston fern family		
Nephrolepis brownii (indigenous)	*Nephrolepis hirsutula*	rough sword fern
Nephrolepis cordifolia (exotic)	————————	erect sword fern, tuber ladder fern, tuber sword fern,
Nephrolepis exaltata (exotic)	————————	boston fern, southern sword fern
Nephrolepis flexuosa (indigenous)	New	pacific sword fern
THELYPTERIDACEAE		
Christella dentata (indigenous)	————————	christella, soft fern
Cyclosorus interruptus (indigenous)	————————	swamp shield fern
Macrothelypteris torresiana (indigenous)	————————	sword fern
Pakau pennigera (indigenous)	*Pneumatopteris pennigera*	feather fern, gully fern, pākau , pākauoharoha , piupiu
Thelypteris confluens (indigenous)	————————	Marsh fern, swamp fern, swamp lady fern
TECTARIACEAE (**OLEANDRACEAE** in Brownsey et al)		
Arthropteris tenella (indigenous)	————————	jointed fern
POLYPODIACEAE (Including **GRAMMITIDACEA** in Brownsey et al) Poloypod/polygram family		
Dendroconche scandens (indigenous)	*Microsorum scandens*	Fragrant fern, moki, mokimoki,
Loxogramme dictyopteris (endemic)	*Anarthropteris lanceolata*	lance fern, whare ngārara
Notogrammitis angustifolia subsp. *angustifolia*	*Grammitis magellanica*	strap fern

(indigenous) *Notogrammitis angustifolia* subsp. *nothofageti* (indigenous)	*Grammitis magellanica* subsp. *nothofageti*	strapfern
Notogrammitis billardierei (indigenous)	*Grammitis billardierei*	common strap fern
Notogrammitis ciliata (endemic)	*Grammitis ciliata*	strapfern
Notogrammitis crassior (indigenous)	*Grammitis poeppigiana*	dwarf strap fern
Notogrammitis givenii (endemic)	*Grammitis givenii*	strap fern
Notogrammitis gunnii (indigenous)	*Grammitis gunnii*	strapfern
Notogrammitis heterophylla (endemic)	*Ctenopteris heterophylla*	comb fern, taupeka
Notogrammitis patagonica (indigenous)	*Grammitis patagonica*	strap fern
Notogrammitis pseudociliata (indigenous)	*Grammitis pseudociliata*	strap fern
Notogrammitis rawlingsii (endemic)	*Grammitis rawlingsii*	Rawlings's strap fern
Notogrammitis rigida	*Grammitis rigida*	southern strap fern
Platycerium bifurcatum (exotic)	New	stag horn fern
Polypodium vulgare (exotic)	_____	common polypody
Pyrrosia elaeagnifolia (endemic)	_____	leather-leaf fern, pyrrosia, ota
Zealandia novae-zealandiae (endemic)	*Microsorum novae-zealandiae*	mountain hound's tongue fern
Zealandia pustulata subsp. *pustulata* (indigenous)	*Microsorum pustulatum*	hound's tongue, kōwaewao, kōwaowao, maratata, pāraharaha,raumanga
Record additional species Newly described or found naturalized here		

COMMON NAME (MAORI AND ENGLISH)	SCIENTIFIC (BOTANICAL) NAME
Adder's Tongue	*Ophioglossum coriaceum*
African Clubmoss	*Selaginella kraussiana*
African Hard Fern	*Blechnum punctulatum*
African Shield Fern	*Dryopteris inaequalis*
African Spleenwort	*Asplenium aethiopicum*
Alpine clubmoss	*Austrolycopodium fastigiatum* syn. *Lycopodium fastigiatum*
Alpine Hard Fern	*Austroblechnum penna-marina* subsp*. alpina* syn. *Blechnum penna-marina*
Alpine Quillwort	*Isoetes alpina*
Alpine Tangle Fern	*Gleichenia alpina*
American Maidenhair	*Adiantum raddianum*
Annual Clubmoss	*Phylloglossum drummondii*
Annual Fern	*Anogramma leptophylla*
Asian Lady Fern	*Athyrium otophorum*
Asian Shaggy Shield Fern	*Dryopteris cycadina*
Asian Spikemoss	*Selaginella moellendorffii*
Atewekī	*Dicksonia squarrosa*
Australian Bracken	*Pteris tremula*
Australian Cliff Brake	*Pellaea falcata*
Australian Mother Shield Fern	*Polystichum proliferum*
Australian Tree Fern	*Cyathea cooperi*
Azolla,	*Azolla rubra* syn. *Azolla filiculoides*
Banks Peninsula Fork Fern	*Tmesipteris horomaka*
Bat's Wing Fern	*Histiopteris incisa*
Bead Fern	*Onoclea sensibilis*
Black Hard Fern	*Cranfillia nigra* syn. *Blechnum nigrum*
Black Shield Fern	*Polystichum richardii complex:-* (*P. neozelandicum* subsp. *neozelandicum* , *P. neozelandicum* subsp. *zerophyllum, P. oculatum and P. wawranum*)
Black Tree Fern	*Cyathea medullaris*
Bladder Fern	*Cystopteris tasmanica*
Blanket Fern	*Asplenium subglandulosum* syn. *Pleurosorus rutifolius*
Blechnum 'Black Spot'	*Parablechnum novae-zelandiae* syn. *Blechnum novae-zelandiae*
Bog clubmoss	*Brownseya serpentina* syn. *Lycopodium serpentinum*
Boston Fern	*Nephrolepis exaltata*
Bracken Fern	*Pteridium esculentum*
Bracken	*Pteridium esculentum*
Bristle Fern	*Trichomanes colensoi*
Bristle Fern	*Trichomanes elongatum*
Brittle Bladder Fern	*Cystopteris fragilis*
Broad Buckler Fern	*Dryopteris dilatata*
Brown Tree Fern	*Dicksonia squarrosa*
Bushman's Mattress	*Lygodium articulatum*
Butterfly Fern	*Asplenium flabellifolium*
Button Fern	*Pellaea rotundifolia*
Cape Fern	*Parablechnum novae-zelandiae* syn. *Blechnum novae-zelandiae* (formerly included in *B. capense*)

Carpet clubmoss	*Lateristachys diffusa* syn. *Lycopodium diffusum*
Carrier Tangle Fern	*Gleichenia microphylla*
Cave Spleenwort	*Asplenium cimmeriorum*
Chatham Island Spleenwort	*Asplenium chathamense*
Chinese Brake	*Pteris vittata*
Christella	*Christella dentata*
Climbing Clubmoss	*Pseudodiphasium volubile* syn. *Lycopodium volubile*
Climbing Hard Fern	*Icarus filiformis* syn. *Blechnum filiforme*
Cloud Filmy Fern	*Hymenophyllum polyanthos*
Clubmoss	*Lateristachys lateralis* syn. *Lycopodium laterale*
Clubmoss	*Palhinhaea cernua* syn. *Lycopodium cernuum*
Coastal Brake	*Pteris carsei*
Coastal Spleenwort	*Asplenium appendiculatum* subsp. *maritimum*
Colenso's Hard Fern	*Austroblechnum colensoi* syn. *Blechnum colensoi*
Colenso's Spleenwort	*Asplenium hookerianum* var. *colensoi*
Comb Fern	*Schizaea fistulosa*
Comb Fern	*Notogrammitis heterophylla* syn. *Ctenopteris heterophylla*
Common hypolepis	*Hypolepis ambigua*
Common Lindsaea	*Lindsaea trichomanoides*
Common Maidenhair	*Adiantum cunninghamii*
Common Polypody	*Polypodium vulgare*
Common Shield Fern	*Polystichum richardii complex:-* (*P. neozelandicum* subsp. *neozelandicum, P. neozelandicum* subsp. *zerophyllum P. oculatum and P. wawranum*)
Common Strap Fern	*Notogrammitis billardierei* syn. *Grammitis billardierei*
Creek Fern	*Cranfillia fluviatilis* syn. *Blechnum fluviatile*
Creeping clubmoss	*Diphasium scariosum* syn. *Lycopodium scariosum*
Creeping Tree Fern	*Cyathea colensoi*
Crêpe Fern	*Leptopteris hymenophylloides*
Crêpe Fern	*Leptopteris superba*
Cretan Brake	*Pteris cretica*
Crown Fern	*Lomaria discolour* syn. *Blechnum discolour*
Cunningham's Maidenhair	*Adiantum cunninghamii*
Dark Rachis Pig Fern	*Hypolepis amaurorachis*
Delta Maidenhair	*Adiantum raddianum*
Double Crepe Fern	*Leptopteris superba*
Drooping Filmy Fern	*Hymenophyllum demissum*
Drooping Spleenwort	*Asplenium flaccidum*
Dunedin-Cass Blechnum	*Parablechnum montanum* syn. *Blechnum montanum*
Dwarf Strap Fern	*Notogrammitis crassior* syn. *Grammitis poeppigiana*
Erect Bristle Fern	*Trichomanes strictum*
Erect Sword Fern	*Nephrolepis cordifolia*
European Maidenhair	*Adiantum capillus-veneris*
Fan Fern	*Schizaea dichotoma*
Fan-Like Filmy Fern	*Hymenophyllum flabellatum*
Feather Fern	*Pakau pennigera* syn. *Pneumatopteris pennigera*
Ferny Azolla	*Azolla pinnata*

Fibrous Tree Fern	*Dicksonia fibrossa*
Field Horsetail	*Equisetum arvense*
Filmy Fern	*Hymenophyllum* spp.
Fine-Leaved Parsley Fern	*Botrychium biforme*
Finger Fern	*Notogramma* spp.
Fir clubmoss	*Huperzia australiana* syn. *Lycopodium australianum*
Fishtail Fern	*Cyrtomium falcatum*
Florists Fern	*Rumohra adiantiformis*
Fork Fern	*Tmesipteris* spp.
Forked Comb Fern	*Schizaea bifida*
Fossil Fern	*Tmesipteris sigmatifolia*
Four-Leaved Clover Fern	*Marsilea mutica*
Fragrant Fern	*Dendroconche scandens* syn. *Microsorum scandens*
Giant Hypolepis	*Hypolepis dicksonioides*
Giant Maidenhair	*Adiantum formosum*
Giant Pig Fern	*Hypolepis dicksonioides*
Golden Shield Fern	*Dryopteris affinis*
Golden Tree Fern	*Dicksonia fibrosa*
Green Bay Kiokio	*Parablechnum triangularifolium* syn. *Blechnum triangularifolium*
Ground Fern (Norfolk Island Only)	*Hypolepis dicksonioides*
Ground Spleenwort	*Asplenium appendiculatum* subsp. *appendiculatum* syn. *A. terrestre*
Gully Fern	*Pakau pennigera* syn. *Pneumatopteris pennigera*
Gully Tree Fern	*Cyathea cunninghamii*
Hairy Fern	*Lastreopsis hispida*
Hairy Filmy Fern	*Hymenophyllum villosum*
Hanging Clubmoss	*Phlegmariurus varius* syn. *Lycopodium varium*
Hanging Spleenwort	*Asplenium flaccidum*
Hard Fern	*Austroblechnum durum* syn. *Blechnum durum*
Hard Fern	*Paesia scabeulla*
Hard Todea	*Todea barbara*
Harsh Tree Fern	*Dicksonia squarrosa*
Hart's Tongue Fern	*Phyllitis scolopendrium*
Hauraki Gulf Spleenwort	*Asplenium haurakiense*
Hay Scented Fern	*Microlepia strigosa*
Hen & Chicken Fern	*Asplenium bulbiferum*
Hen And Chicken Fern	*Asplenium gracillimum*
Heruheru	*Leptopteris hymenophylloides*
Heruheru	*Leptopteris superba*
Hiaue	*Pseudodiphasium volubile* syn. *Lycopodium volubile*
Hiaue	*Lygodium articulatum*
Himalayan Shield Fern	*Polystichum lentum*
Histiopteris	*Histiopteris incisa*
Holly Fern	*Cyrtomium falcatum*
Hooker's Spleenwort	*Asplenium hookerianum* var. *hookerianum*
Horokio	*Parablechnum novae-zelandiae syn. Blechnum novae-zelandiae*
Horseshoe Fern	*Ptisana salicina* syn. *Marattia salicina*
Hot Rock Pellaea	*Pellaea calidirupium*

Hound's Tongue	*Zealandia pustulata* subsp. *pustulata* syn. *Microsorum pustulatum*
Huruhuru o ngāwaewae o Paoa	*Leptopteris superba*
Huruhuru taipairu .	*Adiantum* spp
Huruhuruwhenua	*Asplenium oblongifolium*
Hybrid Hen & Chicken Fern	*Asplenium* x *lucrosum*
Irirangi	*Hymenophyllum demissum*
Iwituna	*Phlegmariurus varius* syn. *Lycopodium varium*
Japanese Holly Fern	*Cyrtomium falcatum*
Japanese/Korean Shield Fern	*Polystichum polyblepharum*
Jersey Fern	*Anogramma leptophylla*
Jointed Fern	*Arthropteris tenella*
Jungle Bristle Fern (Australia)	*Trichomanes caudatum*
Kākātarahae	*Cyathea medullaris*
Kaponga	*Cyathea dealbata*
Kārerarera	*Azolla rubra* syn. *A. filiculoides*
Kārearea	*Azolla rubra* syn. *A. filiculoides*
Kariba Weed	*Salvinia molesta*
Katāta	*Cyathea medullaris*
Katote	*Cyathea smithii*
Katote	*Cyathea dealbata*
Kātote	*Cyathea smithii*
Kātote	*Cyathea dealbata*
Kawakawa	*Cranfillia fluviatilis* syn. *Blechnum fluviatile*
Kekakeka	*Loxsoma cunninghamii*
Kenehu	*Hymenophyllum nephrophyllum* syn. *Trichomanes reniforme*
Kermadec (Raoul Island) Bristle Fern	*Trichomanes humile*
Kermadec Hard Fern	*Austroblechnum norfolkianum* syn. *Blechnum norfolkianum*
Kermadec Prickly Shield Fern	*Arachniodes aristata*
Kermadec Rasp Fern	*Doodia milnei*
Kermadec Tree Fern	*Cyathea kermadecensis*
Kidney Fern	*Hymenophyllum nephrophyllum* syn. *Trichomanes reniforme*
King Fern	*Ptisana salicina* syn. *Marattia salicina*
King Fern	*Todea barbara*
Kiokio	*Parablechnum novae-zelandiae* syn. *Blechnum novae-zelandiae* and *P. triangularifolium* syn. *B. triangularifolium*
Kiwakiwa	*Cranfillia fluviatilis* syn. *Blechnum fluviatile*
Kiwikiwi	*Cranfillia fluviatilis* syn. *Blechnum fluviatile*
Konehu	*Hymenophyllum nephrophyllum* syn. *Trichomanes reniforme*
Kopakopa	*Hymenophyllum nephrophyllum* syn. *Trichomanes reniforme*
Kōrau	*Cyathea medullaris*
Korokio	*Cranfillia deltoides* syn. *Blechnum vulcanicum*
Korokio	*Parablechnum novae-zelandiae* syn. *Blechnum novae-zelandiae*
Koropio	*Parablechnum novae-zelandiae* syn. *Blechnum novae-zelandiae*
Koropiu	*Parablechnum novae-zelandiae* syn. *Blechnum novae-zelandiae*
Kōwaewao	*Zealandia pustulata* subsp. *pustulata* syn. *Microsorum pustulatum*
Kōwaowao	*Zealandia pustulata* subsp. *pustulata* syn. *Microsorum pustulatum*
kuianuipākā	*Dicksonia fibrosa*

Kuripāka	*Dicksonia fibrosa*
Lace Fern	*Leptolepia novae-zelandiae*
Lace Fern	*Paesia scaberula*
Lace Fern	*Microlepia strigosa*
Lacy Fern	*Paesia scaberula*
Lacy Ground Fern	*Dennstaedtia davallioides*
Ladder Brake	*Pteris vittata*
Ladder Fern .	*Nephrolepisis* spp
Lady Fern	*Athyrium filix-femina*
Lance Fern	*Austroblechnum lanceolatum* syn. *Blechnum chambersii*
Lance Fern	*Loxogramme dictyopteris* syn. *Anarthropteris lanceolata*
Large Lady Fern	*Diplazium australe*
Leather-Leaf Fern	*Pyrrosia elaeagnifolia*
Leathery Shield Fern	*Rumohra adiantiformis*
Little Hard Fern	*Austroblechnum penna-marina* subsp*. alpina* syn. *Blechnum penna-marina*
Lyall's Spleenwort	*Asplenium lyallii*
Maidenhair	*Adiantum aethiopicum*
Maidenhair	*Adiantum fulvum*
Maidenhair	*Adiantum viridescens*
Maidenhair Fern .	*Adiantum* spp
Maidenhair Spleenwort	*Asplenium trichomanes*
Maidenhair Spleenwort	*Asplenium trichomanes* subsp. *quadrivalens*
Maikuku-moa	*Leptopteris* spp. and *Todea barbara*
Mākaka	*Adiantum aethiopicum*
Mākaka	*Lygodium articulatum*
Makamaka	*Lygodium articulatum*
Makawe	*Asplenium flaccidum*
Makawe o Raukatauri	*Asplenium flaccidum*
Makawe tapairu .	*Adiantum* spp
Male Fern	*Dryopteris filix-mas*
Mamaku,	*Cyathea medullaris*
Manehu	*Pteridium esculentum*
Mangemange	*Lygodium articulatum*
Mangimangi	*Lygodium articulatum*
Maratata	*Zealandia pustulata* subsp. *pustulata* syn. *Microsorum pustulatum*
Marsh Fern	*Thelypteris confluens*
Mātātā	*Histiopteris incisa*
Mātātā	*Paesia scaberula*
Matua-kaponga	*Asplenium richardii*
Matua Mauku	*Hymenophyllum dilatatum*
Mātukutuku	*Lycopodium* spp. (broad sense)
Mexican Clubmoss	*Selaginella martensii*
Milky Pig Fern	*Hypolepis lactea*
Milne's Tree Fern	*Cyathea milnei*
Miniature Tree Fern	*Diploblechnum fraseri* syn. *Blechnum fraseri*
Moki	*Dendroconche scandens* syn. *Microsorum scandens*
Moki	*Doodia mollis*

Moki	*Parablechnum novae-zelandiae* syn. *Blechnum novae-zelandiae* (agg.)
Mokimoki	*Doodia mollis*
Mokimoki	*Dendroconche scandens* syn. *Microsorum scandens*
Mokimoki	*Parablechnum novae-zelandiae* syn. *Blechnum novae-zelandiae* (agg.)
Moonwort	*Botrychium lunaria*
Mother Fern	*Asplenium bulbiferum*
Mother Shield Fern	*Polystichum proliferum*
Mother Spleenwort	*Asplenium bulbiferum*
Mouki	*Asplenium bulbiferum*
Mouku	*Asplenium bulbiferum*
Mouku	*Ptisana salicina* syn. *Marattia salicina*
Mounga	*Asplenium bulbiferum*
Mountain clubmoss	*Austrolycopodium fastigiatum* syn. *Lycopodium fastigiatum*
Mountain Hard Fern	*Cranfillia deltoides* syn. *Blechnum vulcanicum*
Mountain Hound's Tongue Fern	*Zealandia novae-zealandiae* syn. *Microsorum novae-zealandiae*
Mountain Kiokio	*Parablechnum montanum* syn. *Blechnum montanum*
Mountain Shield Fern	*Polystichum cystostegium*
Mountain Tree Fern	*Cyathea colensoi*
Much-Divided Filmy Fern	*Hymenophyllum multifidum*
Mukimuki	*Doodia mollis*
Nardoo	*Marsilea mutica*
Necklace Fern	*Asplenium flabellifolium*
Neinei-kura	*Cyathea smithii*
Netted Brake	*Pteris carsei*
New Zealand Cliff Brake	*Pellaea rotundifolia*
Nga makawe o raukatauri	*Asplenium flaccidum*
Ngutukākāriki	*Leptopteris superba*
Ngutungutu	*Leptopteris superba*
Ngutungutu kiwi	*Leptopteris superba*
Nini	*Austroblechnum lanceolatum* syn. *Blechnum chambersii*
Northern Lady Fern	*Deparia petersenii* subsp. *congrua* syn. *D. petersenii*
Northern Shore Spleenwort	*Asplenium decurrens* syn. *A. obtustaum* subsp. *northlandicum*
One-Sided Filmy Fern	*Hymenophyllum peltatum*
Ota	*Pyrrosia eleagnifolia*
Pacific Azolla	*Azolla rubra* syn. *Azolla filiculoides*
Pacific Brake	*Pteris pacifica*
Pacific Sword Fern	*Nephrolepis flexuosa*
Pākau	*Pakau pennigera* syn. *Pneumatopteris pennigera*
Pākauoharoha	*Pakau pennigera* syn. *Pneumatopteris pennigera*
Pakue	*Dicksonia squarrosa*
Palm Leaf Fern	*Parablechnum novae-zelandiae* syn. *Blechnum novae-zelandiae*
Pānako	*Asplenium oblongifolium*
Pānako	*Asplenium obtusatum*
Pānako	*Icarus filiformis* syn. *Blechnum filiforme*
Palapalai	*Microlepia strigosa*
Para	*Ptisana salicina* syn. *Marattia salicina*
Paraharaha	*Zealandia pustulata* subsp. *pustulata* syn. *Microsorum pustulatum*

Paranako	*Asplenium oblongifolium*
Paranako	*Asplenium obtusatum*
Parasol Fern	*Gleichenia microphylla*
Parenako	*Asplenium oblongifolium*
Parenako	*Asplenium obtusatum*
Paretao	*Asplenium oblongifolium*
Paretao	*Asplenium obtusatum*
Paretao	*Asplenium polyodon*
Paretao	*Austroblechnum colensoi*
Parsley Fern	*Botrychium australe*
Pātōtara	*Dicksonia squarrosa*
Pēhiakura	*Austroblechnum colensoi* syn. *Blechnum colensoi*
Peretako	*Asplenium polyodon*
Peretao	*Austroblechnum colensoi* syn. *Blechnum colensoi*
Peretao	*Asplenium polyodon*
Petako	*Austroblechnum colensoi syn. Blechnum colensoi*
Petako	*Asplenium* spp.
Petako-pāraparaha	*Asplenium spp.*
Petako rauriki	*Lomaria discolour* syn. *Blechnum discolour*
Petipeti	*Paesia scaberula*
Pig Fern	*Asplenium bulbiferum*
Pikopiko	*Polystichum richardii complex:-* (*P. neozelandicum* subsp*. neozelandicum , P. neozelandicum* subsp. *zerophyllum P. oculatum and P. wawranum*).
Pikopiko	*Polystichum vestitum*
Pillwort	*Pilularia novae-hollandiae* syn. *Pilularia novae-zelandiae*
Pīpiko	*Polystichum richardii* complex:- (*P. neozelandicum* subsp*. neozelandicum , P. neozelandicum* subsp. *zerophyllum P. oculatum* and *P. wawranum*)
Pīpiko	*Polystichum vestitum*
Piripiri	*Hymenophyllum demissum*
Piripiri	*Hymenophyllum sanguinolentum*
Piupiu	*Lomaria discolour* syn. *Blechnum discolour*
Pitau	*Cyathea medullaris*
Pitau	*Polystichum neozelandicum* subsp. *zerophyllum*
Piupiu	*Pakau pennigera* syn. *Pneumatopteris pennigera*
Piupiu	*Lomaria discolour* syn. *Blechnum discolour*
Piupiu	*Parablechnum novae-zelandiae* syn. *Blechnum novae-zelandiae*
Plumed Maidenhair	*Adiantum formosum*
Pohutakawa	*Asplenium flaccidum*
Ponga	*Cyathea cunninghamii*
Ponga	*Cyathea dealbata*
Poor Knights Spleenwort	*Asplenium pauperequitum*
Pounamu	*Loxsoma cunninghamii*
Prickly Rasp Fern	*Doodia aspera*
Prickly Shield Fern	*Polystichum vestitum*
Prince Of Wales Feathers	*Leptopteris superba*

Puakarimu	*Pseudolycopodium densum* syn. *Lycopodium deuterodensum*
Pukupuku	*Doodia australis*
Pūniu	*Polystichum vestitum*
Pūniu	*Leptopteris superba*
Pūnui	*Cyathea cunninghamii*
Pūnui	*Dicksonia fibrosa*
Pūnui	*Leptopteris superba*
Pyrrosia	*Pyrrosia elaeagnifolia*
Quillwort	*Isoetes kirkii*
Raoul Island Shield Fern	*Parapolystichum kermadecense* syn. *Lastreopsis kermadecensis*
Rarauhe	*Pteridium esculentum*
Rarauhe-mahuika	*Pteridium esculentum*
Rarauheriki	*Sticherus cunninghamii*
Raraukeriki	*Sticherus cunninghamii*
Rasp Fern	*Doodia australis* syn. *Doodia media*
Raukatauri	*Asplenium flaccidum*
Raumanga	*Hymenophyllum nephrophyllum* syn. *Trichomanes reniforme*
Raumanga	*Zealandia pustulata* subsp. *pustulata* syn. *Microsorum pustulatum*
Raurenga	*Hymenophyllum nephrophyllum* syn. *Trichomanes reniforme*
Rautaia	*Asplenium polyodon*
Rautao	*Parablechnum novae-zelandiae* syn. *Blechnum novae-zelandiae*
Rawlings's Strapfern	*Notogrammitis rawlingsii* syn. *Grammitis rawlingsii*
Red Azolla	*Azolla rubra* syn. *A. filiculoides*
Rereti	*Austroblechnum lanceolatum* syn. *Blechnum chambersii*
Retoreto	*Azolla rubra* syn. *A. filiculoides*
Returetu	*Azolla rubra* syn. *A. filiculoides*
Richard's Spleenwort	*Asplenium richardii*
Rigid Lace Fern	*Microlepia strigosa*
Ring Fern	*Paesia scaberula*
Rock Fern	*Cheilanthes sieberi* subsp. *sieberi*
Rosy Maidenhair	*Adiantum hispidulum*
Rough Filmy Fern	*Hymenophyllum scabrum*
Rough Horsetail	*Equisetum hyemale*
Rough Pig Fern	*Hypolepis ambigua*
Rough Sword Fern	*Nephrolepis brownie* syn. *N. hirsutula*
Rough Tree Fern	*Dicksonia squarrosa*
Rough Tree Fern	*Cyathea colensoi*
Round-Leaved Fern	*Pellaea rotundifolia*
Royal Fern	*Osmunda regalis*
Royal Fern	*Todea barbara*
Rusty Filmy Fern	*Hymenophyllum frankliniae* syn. *H. ferrugineum*
Scaly Male Fern	*Dryopteris affinis*
Scented Fern	*Paesia scaberula*
Scouring Rush	*Equisetum hyemale*
Screw Fern	*Lindsaea linearis*
Sensitive Fern	*Onoclea sensibilis*
Shaking Brake	*Pteris tremula*

Shield Fern	*Parapolystichum* (*Lastreopsis*) and *Polytstichum* spp.
Shield Fern	*Polystichum silvaticum*
Shining Spleenwort	*Asplenium oblongifolium*
Shore Hard Fern	*Austroblechnum banksia* syn. *Blechnum blechnoides*
Shore Shield Fern	*Polystichum richardii* now:- (*P. neozelandicum* subsp*. neozelandicum, P. neozelandicum* subsp. *zerophyllum, P. oculatum* and *P. wawranum*)
Shore Spleenwort	*Asplenium obtusatum*
Shuttleworth's Spleenwort	*Asplenium shuttleworthianum*
Sickle Fern	*Pellaea falcata*
Sickle Spleenwort	*Asplenium pauperequitum*
Silky Fan Fern	*Sticherus flabellatus* var. *flabellatus* syn. *Gleichenia flabellata*
Silver Fern	*Cyathea dealbata*
Silver Tree Fern	*Cyathea dealbata*
Single Crêpe Fern	*Leptopteris hymenophylloides*
Skeleton Fork Fern	*Psilotum nudum*
Slender Bracken	*Pteris ensiformis*
Slender Lindsaea	*Lindsaea linearis*
Slender Tree Fern	*Cyathea cunninghamii*
Small Kiokio	*Parablechnum procerum* syn. *Blechnum procerum*
Small Lady Fern	*Deparia petersenii* subsp. *congrua* syn. *D. petersenii*
Small Maidenhair	*Adiantum diaphanum*
Smith's Tree Fern	*Cyathea smithii*
Smooth Shield Fern	*Parapolystichum glabellum* syn. *Lastreopsis glabella*
Soft Fern	*Christella dentata*
Soft Shield Fern	*Polystichum setiferum* cv. 'Divisilobium Pulcherrimum'
Soft Tree Fern	*Cyathea smithii*
South African Brake	*Pteris dentata* subsp. *flabellata*
Southern Comb Fern	*Schizaea australis*
Southern Pig Fern	*Hypolepis amaurorachis*
Southern Shore Spleenwort	*Asplenium scleroprium*
Southern Strap fern	*Notogrammitis rigida* syn. *Grammitis rigida*
Southern Sword Fern,	*Nephrolepis exaltata*
Spider Fern	*Gleichenia dicarpa*
Spleenwort	*Asplenium trichomanes* subsp. *quadrivalens*
Spleenwort	*Asplenium* spp.
Stag Horn Fern	*Platycerium bifurcatum*
Stalked Adder's Tongue Fern	*Ophioglossum petiolatum*
Sticky Pig Fern	*Hypolepis rufobarbata*
Strap fern	*Notogrammitis* spp. syn. *Grammitis* spp.
Stumpy Tree Fern	*Dicksonia lanata* subsp. *hispida*
Sub- Antarctic Pig Fern	*Hypolepis amaurorachis*
Swamp Horsetail	*Equisetum fluviatile*
Swamp Lady Fern	*Thelypteris confluens*
Swamp Shield Fern	*Cyclosorus interruptus*
Swamp Fern	*Thelypteris confluens*
Swamp Kiokio	*Parablechnum minus* syn. *Blechnum minus*
Swamp Umbrella Fern	*Gleichenia dicarpa*

Sweet Fern	*Pteris macilenta*
Sword Fern	*Macrothelypteris torresiana*
Sword Fern	*Nephrolepsis* spp.
Tāniwhaniwha	*Lomaria discolour* syn. *Blechnum discolour*
Tākaha	*Pteridium esculentum*
Tangle Fern	*Gleichenia dicarpa*
Tangle Fern	*Gleichenia inclusisora*
Tapuwae kotuku	*Sticherus cunninghamii*
Tasmanian Tree Fern	*Dicksonia antarctica*
Tassel Fern	*Phlegmariurus varius* syn. *Lycopodium varium*
Tarakupenga	*Lycopodium* spp. (broad sense)
Taramoa	*Pseudolycopodium densum* syn. *Lycopodium deuterodensum*
Tarawera	*Pellaea rotundifolia*
Tarawera	*Pteris tremula*
Tarikupenga	*Lygodium articulatum*
Taupeka	*Notogrammitis heterophylla* syn. *Ctenopteris heterophylla*
Tawhiti Par	*Ptisana salicina* syn. *Marattia salicina*
Tender Brake	*Pteris tremula*
Tētē	*Leptopteris superba*
Tētē kura	*Leptopteris superba*,shoot of a fern or similar plant
Thermal Umbrella Fern	*Dicranopteris linearis*
Thin hard fern	*Austroblechnum membranaceum*
Thousand Leaved Fern	*Hypolepis millefolium*
Thread Fern	*Icarus filiformis* syn. *Blechnum filiforme*
Tio	*Dicksonia squarrosa*
Tirawa	*Dicksonia squarrosa*
Tīronga	*Dicksonia squarrosa*
Ti taranaki	*Botrychium australe*
Toothed Brake	*Pteris dentata* subsp. *flabellata*
True Maidenhair	*Adiantum aethiopicum*
Tuber Ladder Fern	*Nephrolepis cordifolia*
Tuber Sword Fern	*Nephrolepis cordifolia*
Tuberous Maidenhair	*Adiantum diaphanum*
Tufted Filmy Fern	*Hymenophyllum pulcherrimum*
Tufted Lindsaea	*Lindsaea viridis*
Tūkirunga	*Dicksonia fibrosa*
Tūākura	*Dicksonia lanata*
Tukura	*Dicksonia lanata*
Tukura	*Dicksonia squarrosa*
Tūōkura	*Dicksonia lanata*
Tupare, Tupari	*Parablechnum novae-zelandiae* syn. *Blechnum novae-zelandiae*
Tupari-maunga	*Parablechnum novae-zelandiae* syn. *Blechnum novae-zelandiae*
Turawera	*Pteris tremula*
Turukio	*Lomaria discolour* syn. *Blechnum discolour*
Tutoke	*Polystichum richardii* now :- (*P. neozelandicum* subsp*. neozelandicum, P. neozelandicum* subsp. *zerophyllum , P. oculatum ,* and *P. wawranum*)
Tutoke	*Polystichum vestitum*

Uhi para	*Ptisana salicina* syn. *Marattia salicina*
Uwhi para	*Ptisana salicina* syn. *Marattia salicina*
Umbrella Fern	*Sticherus tener*
Umbrella Fern	*Sticherus urceolatus*
Umbrella Fern	*Sticherus cunninghamii*
Urūruwhenua	*Dicksonia squarrosa*
Urūruwhenua	*Asplenium oblongifolium*
Veined Bristle Fern	*Trichomanes venosum*
Veined Filmy Fern	*Trichomanes venosum*
Velvet Fern	*Lastreopsis velutina*
Venus's Hair Fern	*Adiantum capillus-veneris*
Virgin's hair	*Adiantum capillus-veneris*
Waikāhu	*Pseudodiphasium volubile* syn. *Lycopodium volubile*
Waekura	*Sticherus cunninghamii*
Waiwaikāka	*Gleichenia dicarpa*
Waiwaikāka	*Gleichenia microphylla*
Waiwai kotuku	*Gleichenia microphylla*
Waewaekoukou	*Pseudodiphasium volubile* syn. *Lycopodium volubile*
Waiwai matuku	*Gleichenia microphylla*
Walking Fern	*Asplenium flabellifolium*
Water Fern	*Salvinia molesta*
Water Fern	*Histiopteris incisa*
Water Fern	*Cranfillia fluviatilis* syn. *Blechnum fluviatile*
Weeping Spleenwort	*Asplenium flaccidum*
Wekī	*Dicksonia squarrosa*
Whareatua	*Lycopodium* spp. (broad sense)
Whare Ngārara	*Loxogramme dictyopteris* syn. *Anarthropteris lanceolata*
Whē	*Cyathea smithii*
Wheki	*Dicksonia squarrosa*
Whekī	*Asplenium flaccidum*
Whekī- Kōhunga	*Dicksonia fibrosa*
Whekī -Ponga	*Dicksonia fibrosa*
Whiri-o- Raukatauri	*Asplenium flaccidum*
Whiri-o- Raukatauri	*Phlegmariurus varius* syn. *Lycopodium varium*
Whiri-o- Raukatauri	other ferns
Whisk Fern	*Psilotum nudum*
Woolly Cloak Fern	*Cheilanthes distans*
Woolly Rock Fern	*Cheilanthes distans*
Woolly Dwarf Tree Fern	*Dicksonia lanata* subsp. *lanata*
SOME COMMON NAMES FOR NEW ZEALAND FERN PARTS (MAORI)	
aka-o-tuwhenua	*Pteridium esculentum* rhizome
aka-o-t ūwheunua	*Pteridium esculentum* rhizome
ariki noanoa	*Pteridium esculentum* rhizome
aruhe	*Pteridium esculentum* rhizome

haumia	*Pteridium esculentum* rhizome
haumia roa	*Pteridium esculentum* rhizome
haumia tiketike	*Pteridium esculentum* rhizome
Kakaka	*Pteridium esculentum* stipe (leaf stalk)
koeata	*Pteridium esculentum* young shoot
koru	crosier or fiddlehead, unopened fern frond
kotau	*Pteridium esculentum* young shoot
kōwauwau	*Pteridium esculentum* rhizome
Māhuhu	*Pteridium esculentum* new growth
Māhunu	*Pteridium esculentum* young shoot
Mākaha	*Pteridium esculentum* rhizome
Mākehu	*Pteridium esculentum* new growth
manehau	*Adiantum bulbiferum* shoots
Mārohi	*Pteridium esculentum* rhizome
mātākai-awatea	*Pteridium esculentum* rhizome
Meke	*Pteridium esculentum* rhizome
Miha	*Pteridium esculentum* new growth
mohani	*Pteridium esculentum* rhizome
moheke	*Pteridium esculentum* rhizome
moki	*Pteridium esculentum* new growth
mōnehu	*Pteridium esculentum* fine pubescence or spores on opened fronds
motuhanga	*Pteridium esculentum* meal from rhizome
pakakohi	*Pteridium esculentum* rhizome
peka	*Pteridium esculentum* rhizome
peka a Haumia	*Pteridium esculentum* rhizome
putuputu	*Pteridium esculentum* rhizome
rauaruhe	*Pteridium esculentum* fronds
roi	*Pteridium esculentum* rhizome
tēte kura	shoot of a fern or similar plant
tope	*Pteridium esculentum* fresh growth after a fire

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Timescale card (New Zealand Geological Timescale)
https://www.gns.cri.nz/content/download/7517/40965/file/Timescale_Card_2015_poster.pdf

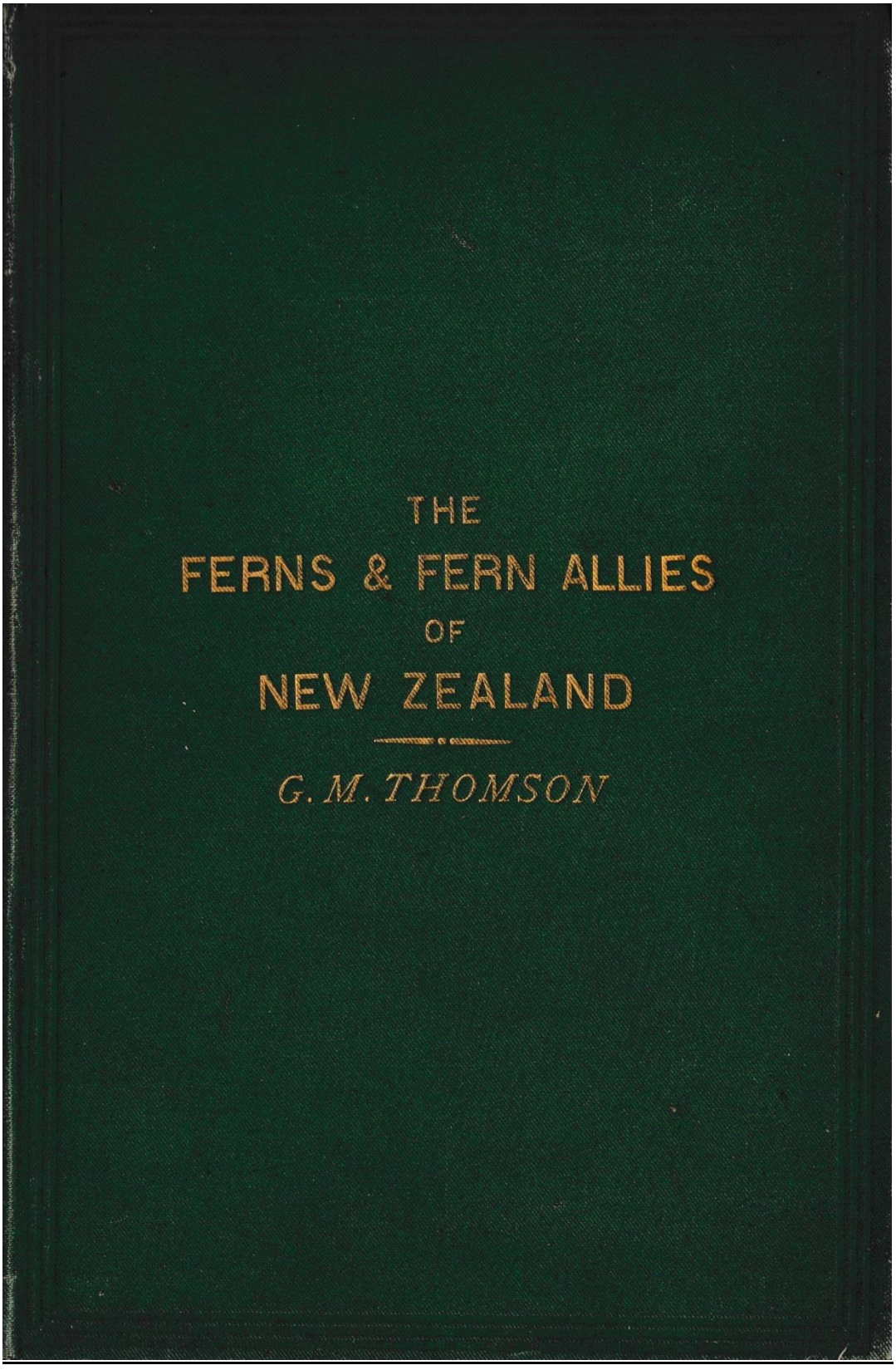

Figure 299 Scanned images form G. M. Thomson's 1882 book on New Zealand Ferns

A. POLYPODIUM BILLARDIERI. B. LOMARIA FLUVIATILIS.
C. ASPLENIUM BULBIFERUM.

All one-fourth the natural size.

THE FERNS AND FERN ALLIES

OF

NEW ZEALAND

With Instructions for their Collection and Hints on their Cultivation

BY

GEORGE M. THOMSON, F.L.S.
SCIENCE TEACHER IN THE DUNEDIN HIGH SCHOOLS

WITH FIVE PLATES

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MELBOURNE, SYDNEY, ADELAIDE, AND BRISBANE
DUNEDIN, N.Z.: HENRY WISE & CO., 108 PRINCES STREET
MDCCCLXXXII

PLATES.

PLATE I.

Fig. 1. *Gleichenia flabellata*, segment of frond (nat. size); *a*, portion of same showing sorus (mag.); *b*, portion of frond of *G. circinata* (nat. size).

Fig. 2. *Cyathea dealbata*, pinnule (nat. size); *a*, portion of same (mag.); *b*, empty involucre (mag.)

Fig. 3. *Hemitelia smithii*, pinnule (nat. size); *a*, portion of same (mag.); *b*, empty involucre (mag.)

Fig. 4. *Alsophila colensoi*, pinnule (nat. size); *a*, capsule (mag.)

Fig. 5. *Dicksonia antarctica*, segment of pinnule (mag.); *a*, sorus and involucre (much mag.)

Fig. 6. *Loxsoma cunninghamii*, portion of frond (nat. size); *a*, sorus and involucre (mag.)

Fig. 7. *Hymenophyllum pulcherrimum*, apex of frond (nat. size); *a*, fragment of same (mag.); *b*, involucre with one valve removed (mag.)

Fig. 8. *Trichomanes venosum*, frond (nat. size); *a*, sorus and involucre (mag.)

Fig. 9. *Davallia novæ-zælandiæ*, apex of frond (nat. size); *a*, portion of pinnule (mag.)

PLATE II.

Fig. 1. *Cystopteris fragilis*, portion of frond; *a*, sorus with involucre turned back; *b*, involucre in position covering the sorus (all mag.)

Fig. 2. *Lindsaya viridis*, portion of frond (nat. size); *a*, *L. linearis*, portion of frond (nat. size); *b*, segment of same, showing sori with the involucre turned back (mag.)

Fig. 3. *Adiantum æthiopicum*, portion of frond (nat. size); *a*, involucre turned back, showing the sorus placed upon it (mag.)

Fig. 4. *Hypolepis millefolium*, portion of frond (nat. size); *a*, *H. distans*, pinnule (mag.)

Fig. 5. *Cheilanthes tenuifolia*, pinna (mag.); *a*, sorus with the marginal involucre turned back (much mag.)

Fig. 6. *Pellæa rotundifolia*, portion of frond (nat. size); pinna (mag.)

Fig. 7. *Pteris macilenta*, pinnule (nat. size); *a*, *P. incisa*, pinnule (nat. size).

Fig. 8. *Lomaria banksii*, portion of sterile frond (nat. size); *a*, portion of fertile frond (nat. size); *b*, back of same (mag.)

Fig. 9. *Doodia media*, pinnæ (nat. size); *a*, portion of same (mag.)

PLATE III.

Fig. 1. *Asplenium flabellifolium*, portion of frond (nat. size).

Fig. 2. *Asplenium flaccidum*, portion of frond (mag.)

Fig. 3. *Aspidium capense*, portion of frond (nat. size); *a*, sorus covered with shield-like involucre (mag.)

Fig. 4. *Nephrodium velutinum*, portion of frond (slightly mag.); *a*, *N. hispidum*, portion of frond (nat. size); *b*, segment of same (mag.)

Fig. 5. *Nephrolepis cordifolia*, fertile pinna (slightly mag.); *a*, sorus (mag.)

Fig. 6. *Polypodium pennigerum*, pinna (nat. size).

Fig. 7. *Polypodium billardieri*, apex of frond (nat. size).

Fig. 8. *Notochlæna distans*, apex of frond (nat. size); *a*, pinnules showing sori (much mag.)

Fig. 9. *Gymnogramme leptophylla*, portion of frond (mag.); *a*, *G. pozoi*, portion of frond (nat. size).

Fig. 10. *Todea barbara*, pinnules (nat. size); *a*, portion of same (mag.); *b*, capsule (much mag.)

Fig. 11. *Schizæa dichotoma*, apex of frond (nat. size); *a*, *S. fistulosa*, apex of fertile frond (mag.)

PLATE IV.

Fig. 1. *Lygodium articulatum*, portion of fertile frond (nat. size); *a*, pinnule (mag.)

Fig. 2. *Marattia fraxinea*, portion of pinna (nat. size); *a*, one of the receptacles open (mag.)

Fig. 3. *Ophioglossum vulgatum*, frond (nat. size); *a*, capsules (mag.)

Fig. 4. *Botrychium ternatum*, fertile and sterile fronds (reduced); *a*, portion of fertile frond (mag.)

Fig. 5. *Phylloglossum drummondii* (nat. size); *a*, spike (mag.)

Fig. 6. *Lycopodium volubile*, fertile and sterile branches (nat. size); *a*, spore (much mag.)

Fig. 7. *Tmesipteris forsteri*, portion of frond (nat. size); capsule after opening (mag.)

Fig. 8. *Psilotum triquetrum*, portion of frond (nat. size); *a*, capsules (mag.)

Plate I.

Plate II.

G.M.T. del

Plate III.

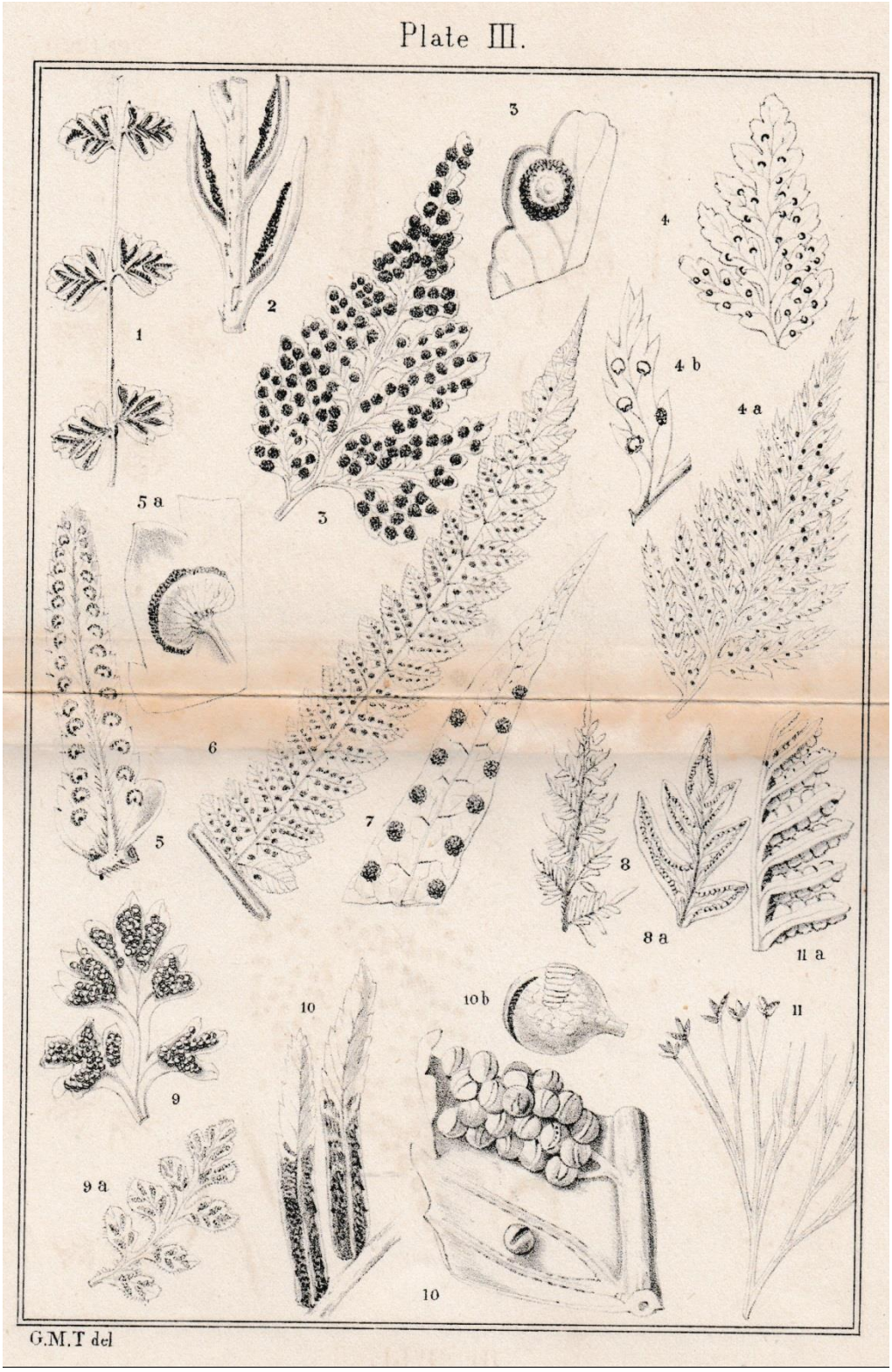


Plate IV.
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