

## Illustrated Pollen Terms

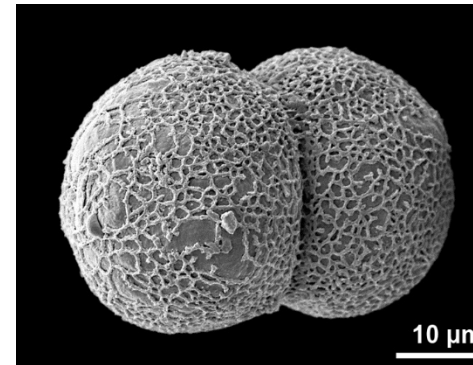
This is an illustrated guide for *PalDat* authors for submitting data. The terms are grouped according the “Diagnosis” page in the *PalDat* submission process. Within a section (e.g., pollen unit), the terms are grouped alphabetically. Terms included in the submission process, are highlighted and written in bold. The SEM micrographs usually represent the turgescient (hydrated) state of recent pollen and the LM micrographs usually show acetolysed recent or fossil pollen. Exceptions are specified in the picture legend. For more information on pollen terminology, please see our book: Halbritter et al. 20018. Illustrated Pollen Terminology. Second Edition, Springer Open.

### shape, size and apertures (pollen unit, aperture, polarity and shape)

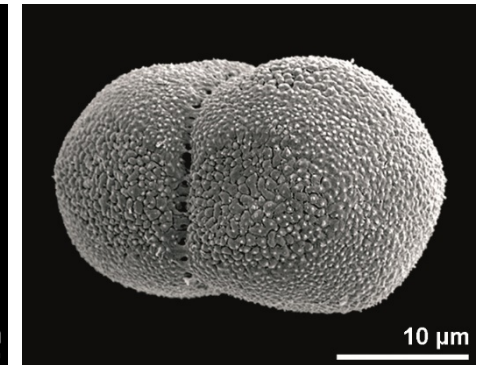
#### pollen unit

**pollen unit** morphological unit of mature pollen grains (e.g., monad, tetrad)

**dyad** dispersal unit of two pollen grains



*Scheuchzeria palustris*

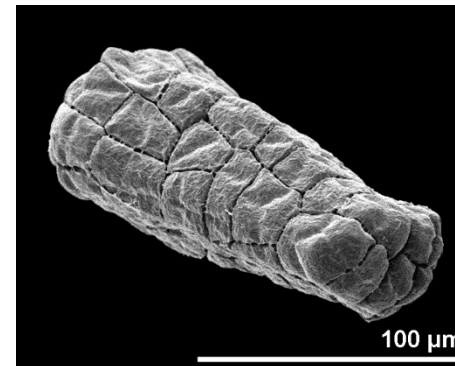


*Zeylanidium subulatum*

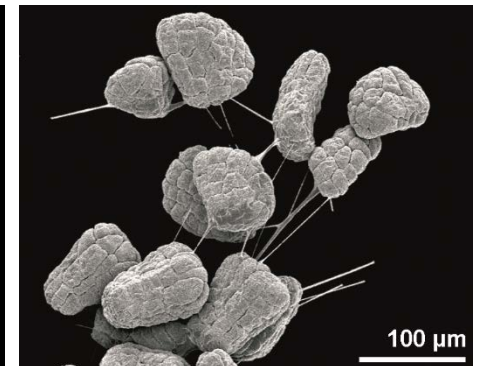
**massula**  
(lat., pl. massulae)

unit of more than 4 pollen grains but less than the locular content of a theca

*Comment: in angiosperms only used for Orchidaceae with sectile “pollinia”*



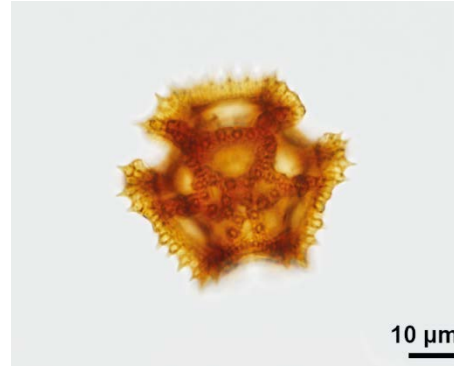
*Platanthera bifolia*



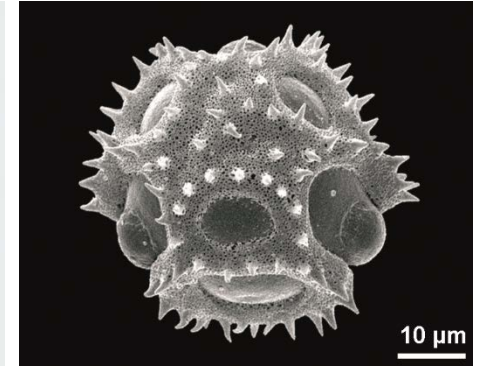
*Nigritella rhellicani*

**monad**

unit consisting of a single pollen grain



*Tragopogon orientalis*

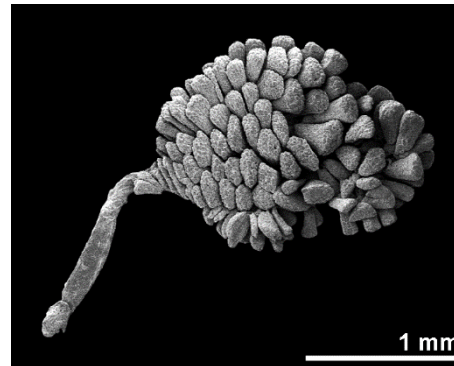


*Tragopogon orientalis*

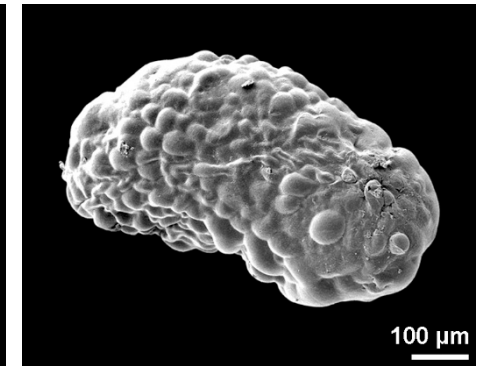
**pollinium**  
(lat., pl. pollinia)

unit of a more or less interconnected  
loculiform pollen mass

*Comment: loculi may be subdivided by  
septae, thus resulting in more than 2  
"pollinia"*



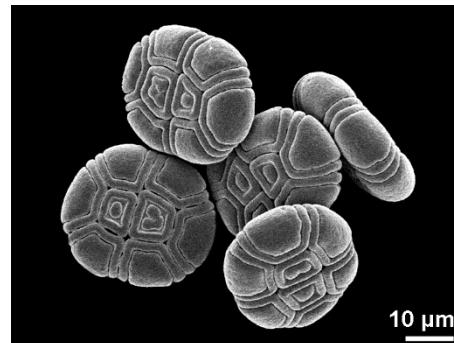
*Anteriorchis coriophora*



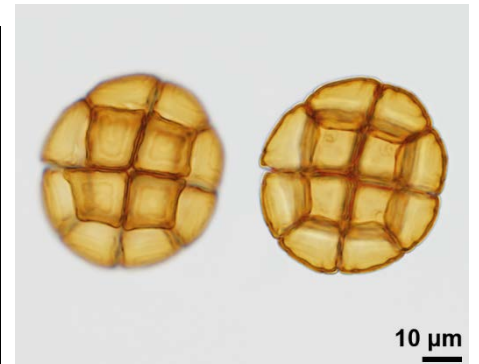
*Stephanotis floribunda*

**polyad**

unit of more than 4 pollen grains



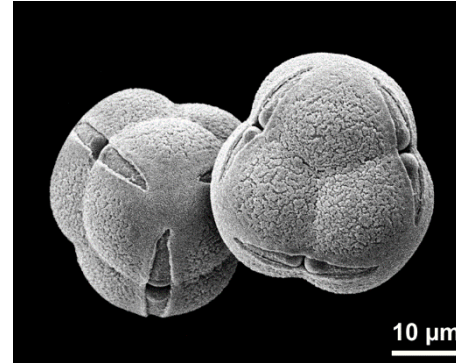
*Acacia myrtifolia*



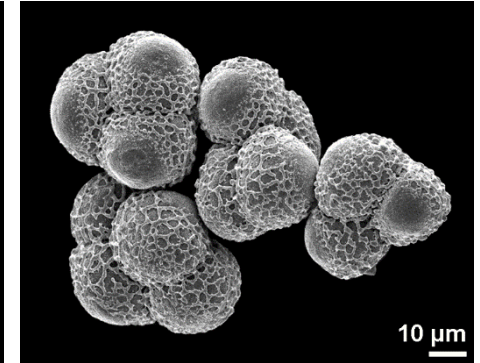
*Acacia sp.*

**tetrad**

unit of 4 pollen grains



*Erica herbacea*



*Epipactis helleborine*

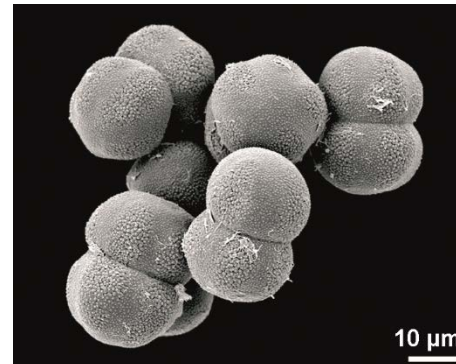
**dispersal unit and peculiarities**

**dispersal unit**

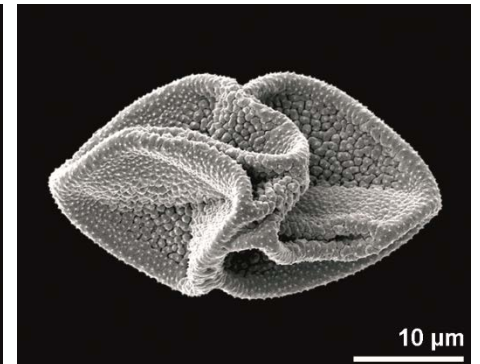
unit in which pollen is dispersed (e.g., monad, tetrad, pollinarium)

**dyad**

dispersal unit of two pollen grains



*Polypleurum stylosum*



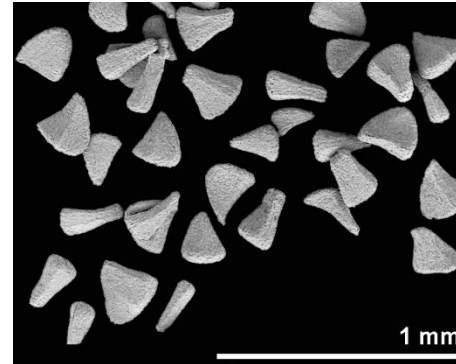
*Polypleurum stylosum* (acetolysed)

**massula**

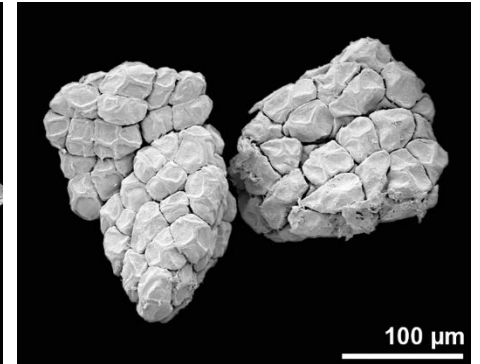
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unit of more than 4 pollen grains but less than the locular content of a theca

*Comment: in angiosperms only used for Orchidaceae with sectile "pollinia"*



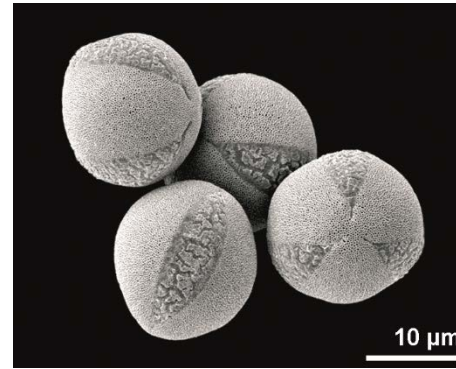
*Orchis italica*



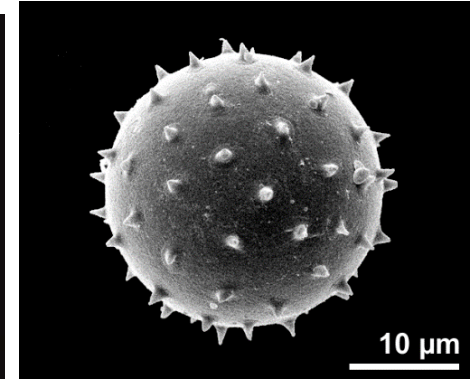
*Epipogium aphyllum*

**monad**

unit consisting of a single pollen grain



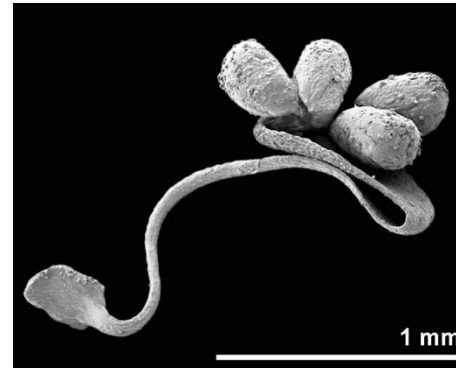
*Lamium galeobdolon*



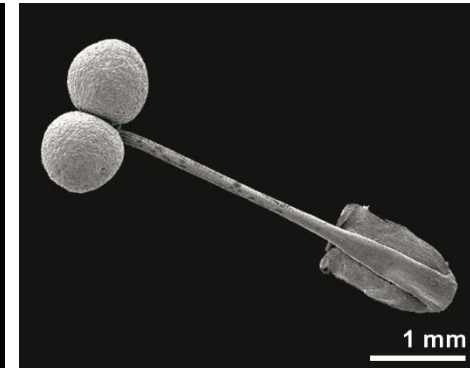
*Alocasia brisbanensis*

**pollinarium**  
(lat., pl. pollinaria)

dispersal unit of pollinium (or pollinia) plus secretions and/or tissues that aid in the removal of the structure from the flower



*Ornithocephalus myrticola*

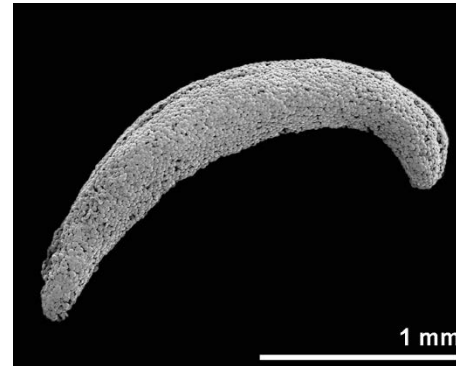


*Aerides multiflora*

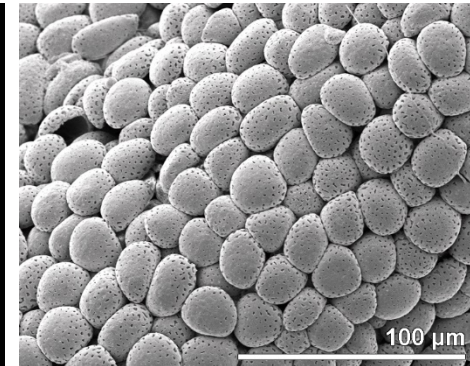
**pollinium**  
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unit of a more or less interconnected loculiform pollen mass

*Comment: loculi may be subdivided by septae, thus resulting in more than 2 "pollinia"*



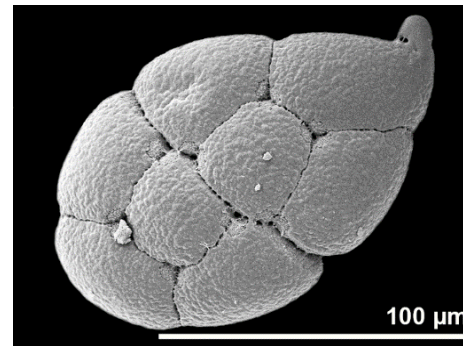
*Cephalanthera longifolia*, pollinium and detail of pollinium



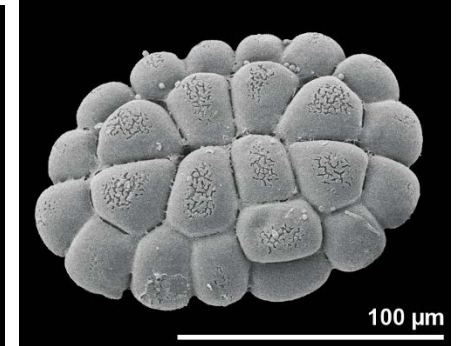


**polyad**

unit of more than 4 pollen grains



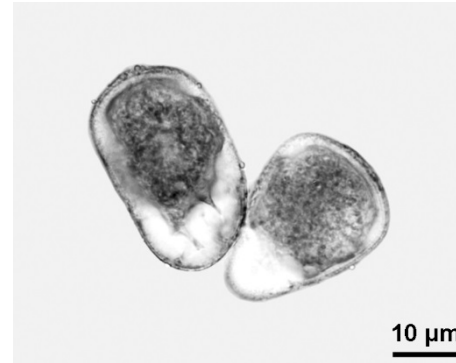
*Calliandra emarginata*



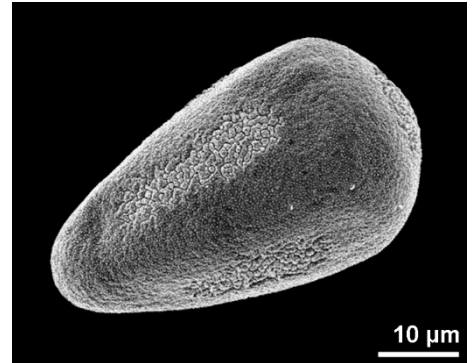
*Albizia saman*

**pseudomonad**

unit of a permanent tetrad with 3 rudimentary pollen grains



*Carex* sp. (hydrated, LM)



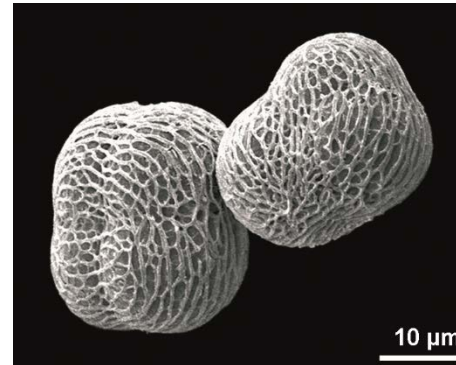
*Schoenoplectus lacustris*

tetra-

prefix meaning four

**tetrad**

unit of 4 pollen grains



*Chlorospatha ceronii*

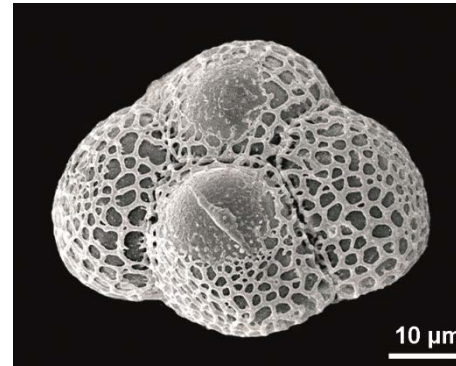


*Erica tetralix*

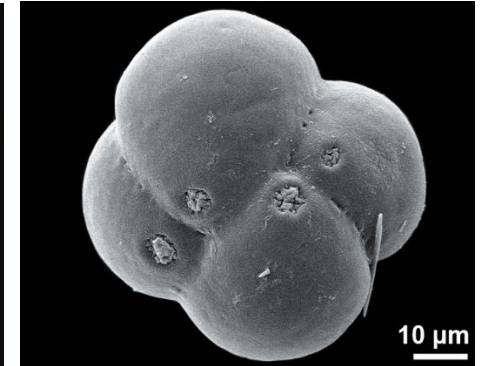
**tetrad decussate**

unit of 4 pollen grains arranged in 2 pairs in 2 different planes

*Comment: these tetrads are a consequence of successive cytokinesis; without systematic relevance*



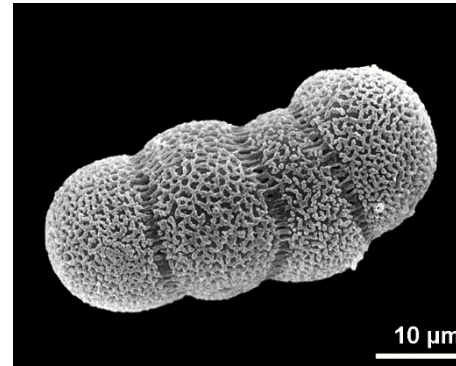
*Neottia nidus-avis*



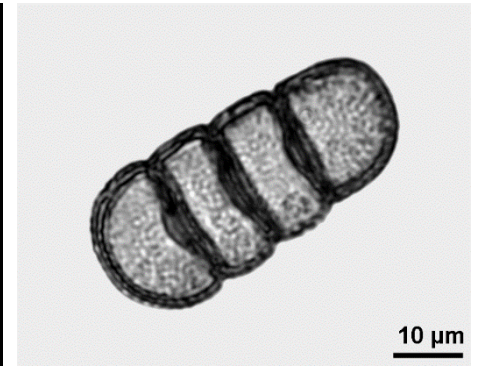
*Androlepis skinneri*

**tetrad linear**

special case of tetrad planar



*Typha latifolia*



*Typha latifolia*

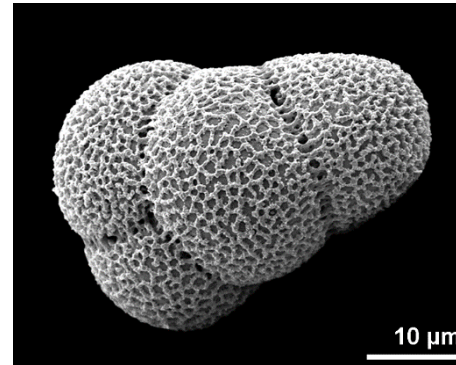
**tetrad planar**

unit of 4 pollen grains arranged in one plane; can be: tetragonal, T-shaped, linear

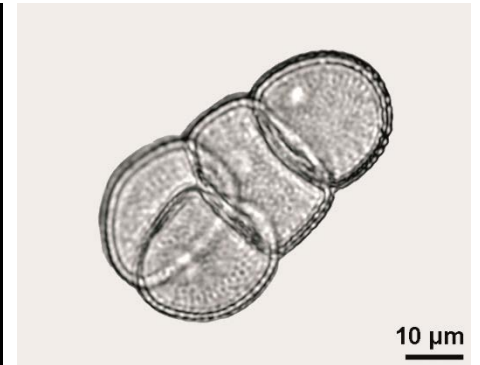
*Comment: these tetrads are a consequence of successive cytokinesis; without systematic relevance*

**tetrad T-shaped**

special case of tetrad planar



*Typha latifolia*



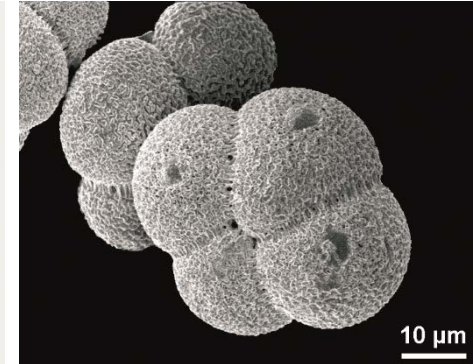
*Typha latifolia*

**tetrad tetragonal**

special case of tetrad planar



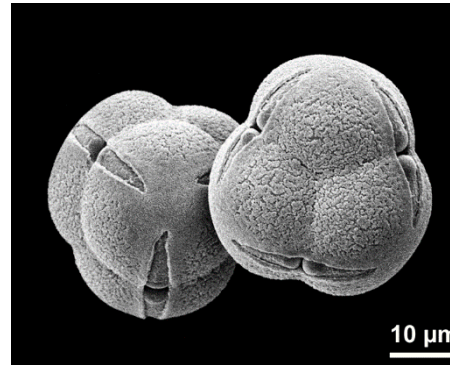
*Typha latifolia*



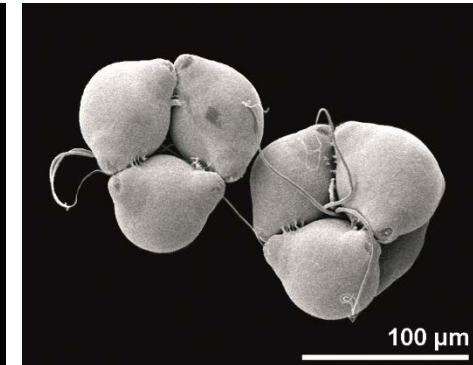
*Typha latifolia* (acetolysed)

**tetrad tetrahedral**

unit of 4 pollen grains in which the centers of the grains define a tetrahedron



*Erica herbacea*



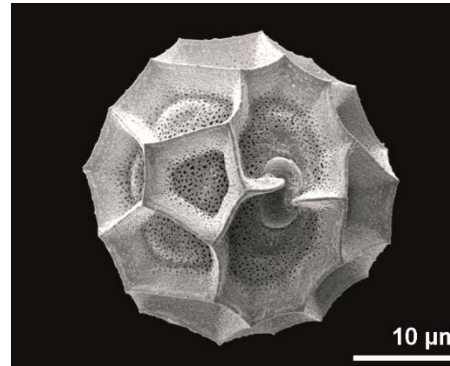
*Epilobium parviflorum*

**pollen class**

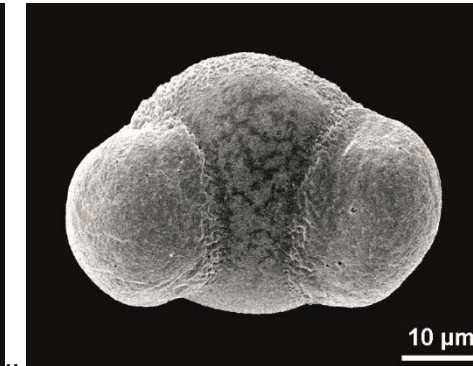
**pollen class**

artificial grouping of pollen grains that share one or more distinctive characters; see also: pollen type

examples are e.g., clypeate, **colpate**, colporate, dyad, **inaperturate**, **lophate**, plicate, polyad, porate, **saccate**, spiraperturate, sulcate, synaperturate, tetrad, ulcerate

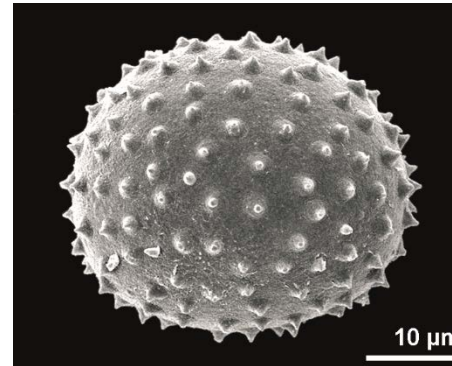


lophate, *Gazania* sp.

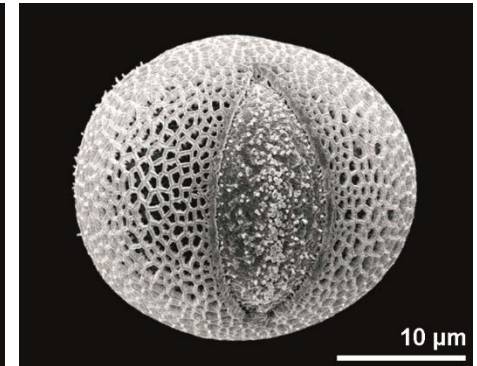


saccate, *Pinus mugo*





inaperturate, *Sauromatum venosum*



colpate, *Corylopsis glabrescens*

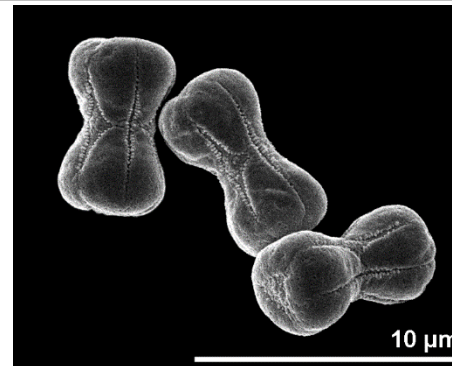
pollen type

term categorizing pollen grains; often used in connection with a distinct taxon

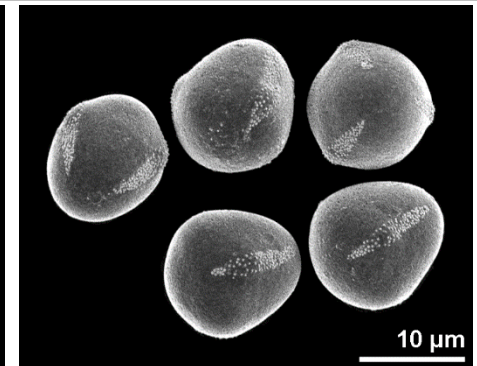
**size (pollen unit)**

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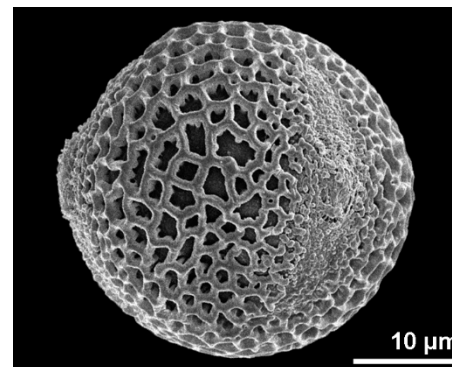
*Comment: we recommend the size categories very small (<10 µm), small (10–25 µm), medium (26–50 µm), large (51–100 µm) and very large (>100 µm)*



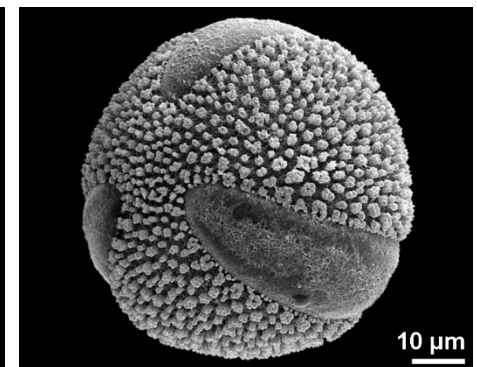
very small sized, *Myosotis palustris*



small sized, *Alkanna orientalis*

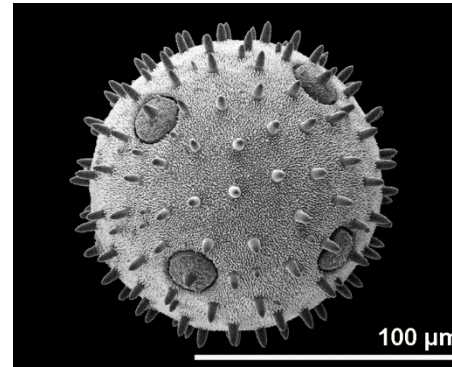


medium sized, *Syringa vulgaris*

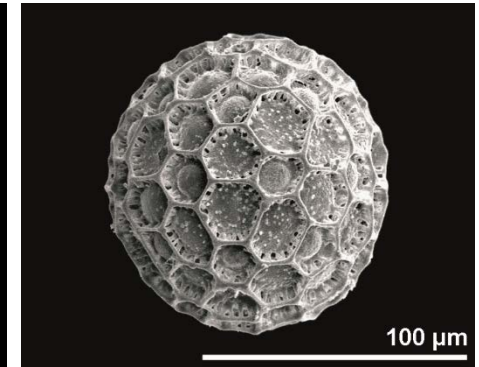


large sized, *Plumbago auriculata*





very large sized, *Cucurbita pepo*



very large sized, *Cobaea scandens*

**size of hydrated pollen (LM)**

**size of hydrated pollen (LM)**

The size to be measured relates to the longest axis of a pollen grain in optical cross-section

*Comment: ornamentation elements not included; usually, as many measurements as there are apertures per pollen grain are conducted on 10 pollen grains for a representative size range.*

**shortest / longest polar axis in equatorial view (LM)**

The size to be measured is the shortest / longest polar axis in optical cross-section

*Comment: Usually, as many measurements as there are apertures per pollen grain are conducted on 10 pollen grains for a representative size range.*



*Heracleum sp.*



*Ailanthus sp.*

**shortest / longest diameter in equatorial or polar view (LM)**

The size to be measured is the shortest / longest diameter in optical cross-section in polar view, or the equatorial diameter in optical cross-section in equatorial view (see picture *Heracleum sp.*).



*Silphium perfoliatum* (polar view)

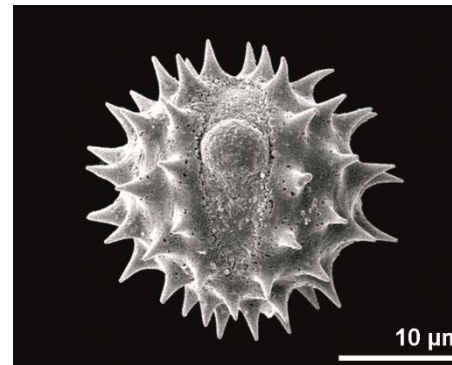


*Heracleum sp.* (equatorial view)

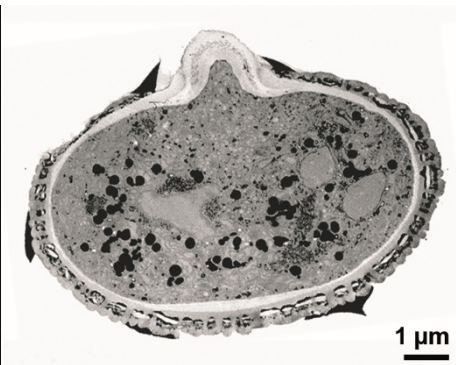
**aperture**

**aperture**

a region of the pollen wall that differs significantly from its surroundings in morphology and/or anatomy, presumed to function usually as germination site and to play a role in harmomegathy



*Eupatorium cannabinum* (3-colporate)

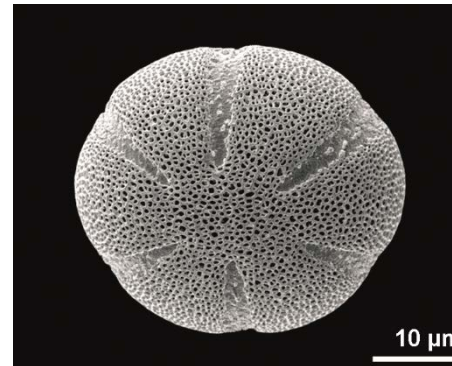


*Apium nodiflorum* (3-colporate)

**aperturate**

pollen grain with one or more apertures

*Antonym: inaperturate*



*Clinopodium vulgare* (6-colpate)



*Acinos alpinus* (6-colpate)

**ektoaperture**

outer part of a compound aperture

**ekto-**

prefix meaning outer

**endoaperture**

inner part of a compound aperture

**endo-**

prefix meaning inner

**compound aperture**

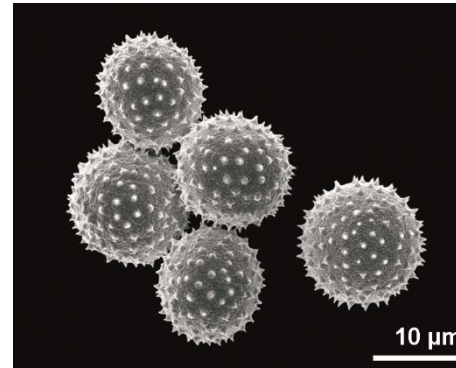
aperture with two or more components that are situated in more than one wall layer, e.g., colporus

aperture number

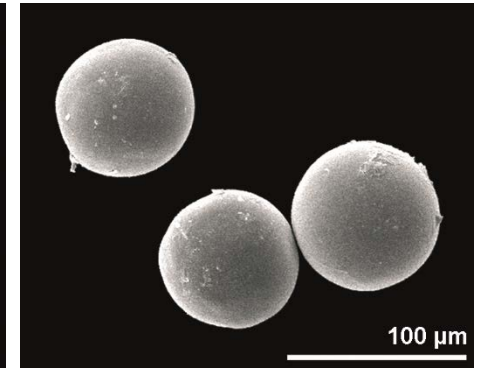
none  
(inaperturate)

pollen grain without distinct apertures;  
see also: omniaperturate

*Antonym: aperturate*



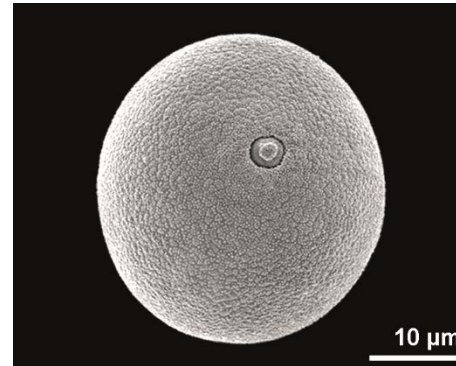
*Pinellia ternata*



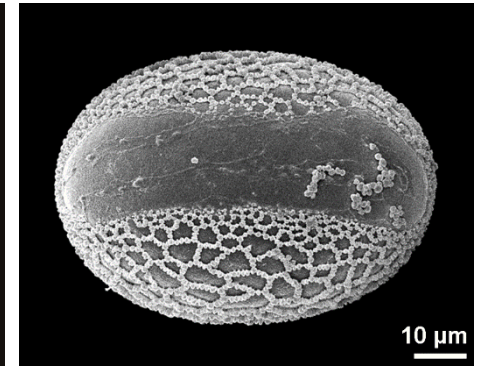
*Hedychium gardnerianum*

1  
(monoaperturate)

pollen grain with 1 aperture (e.g., ulcus,  
sulcus, ring-like aperture, leptoma)



*Phleum pratense* (ulcus)



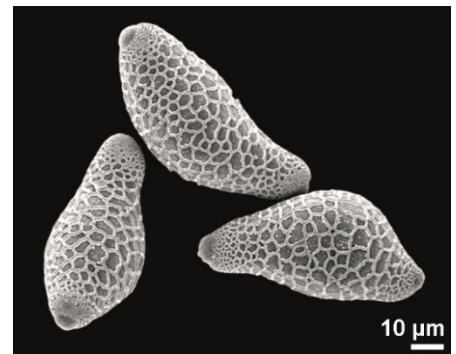
*Lilium martagon* (sulcus)

mono-

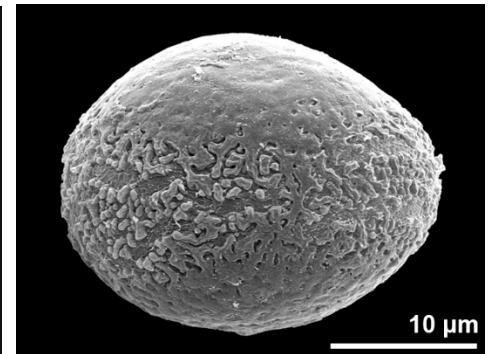
prefix meaning one

2  
(diaperturate)

pollen grain with 2 apertures (e.g.,  
diporate, disulcate)



*Quesnelia Augusto-Coburgii*



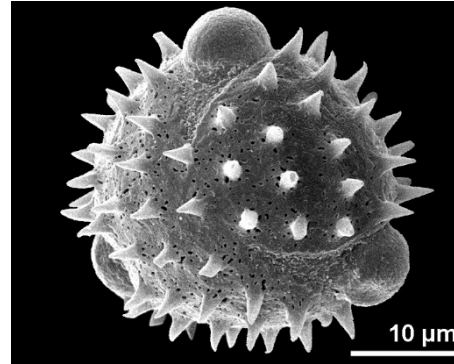
*Calla palustris*

di-

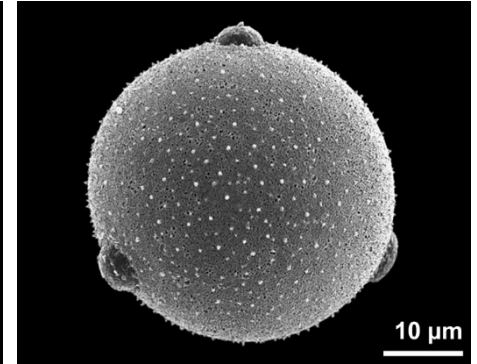
prefix meaning two

3  
(triaperturate)

pollen grain with 3 apertures (e.g.,  
tricolporate, triporate)



*Antennaria dioica*



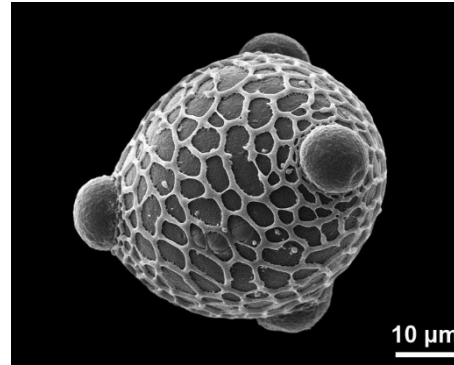
*Campanula saxatilis*

tri-

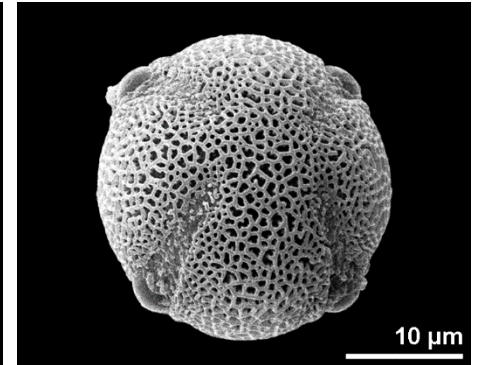
prefix meaning three

4  
(tetraaperturate)

pollen grain with 4 apertures (e.g.,  
tetraporate, tetracolporate)



*Aechmea tomentosa*



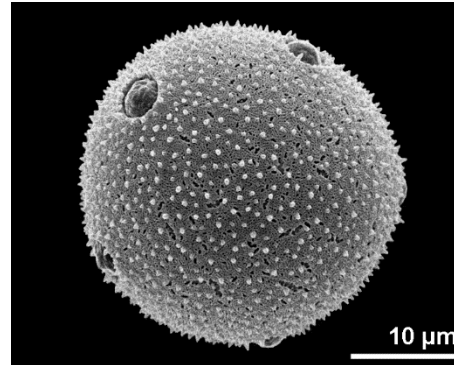
*Poncirus trifoliata*

tetra-

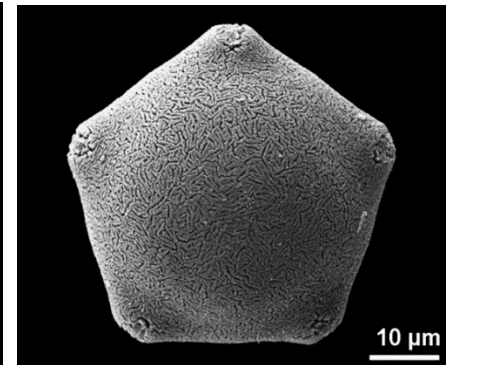
prefix meaning four

5  
(pentaaperturate)

pollen grain with 5 apertures (e.g.,  
pentaporate, pentacolate)



*Legousia speculum-veneris*



*Mendoncia albida*

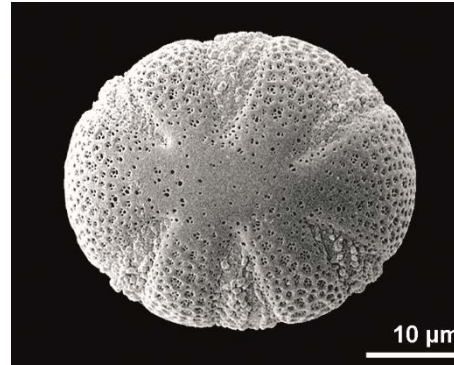


penta-

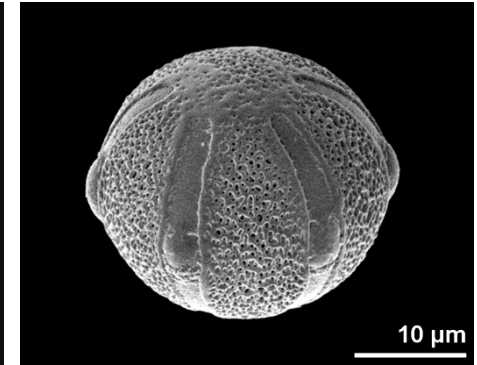
prefix meaning five

**6**  
(hexaaperturate)

pollen grain with 6 apertures (e.g., hexacolpate, hexacolporate, hexaporate)



*Salvia austriaca*



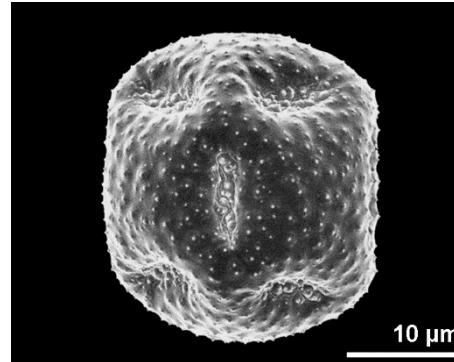
*Pinguicula ehlersiae*

hexa-

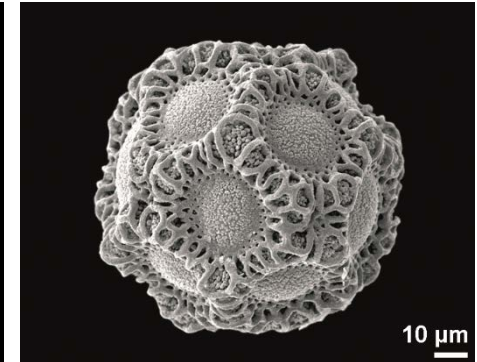
prefix meaning six

**>6**  
(pantoaperturate,  
stephanoaperturate)

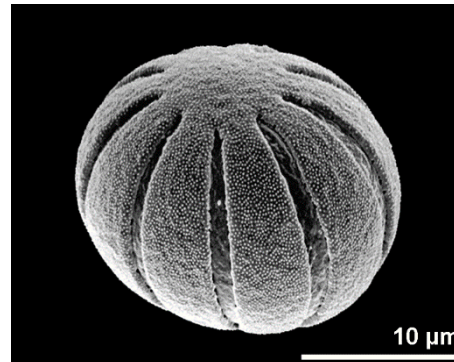
pollen grain with more than 6 apertures  
(e.g., pantocolpate, pantoporate,  
stephanocolpate, stephanocolporate)



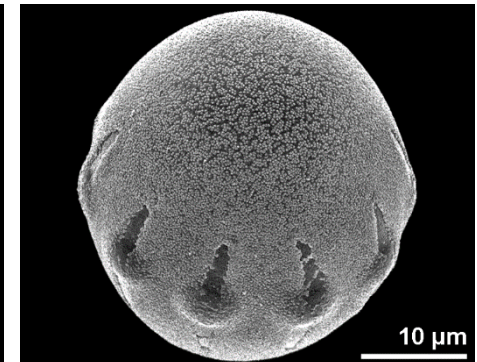
*Ranunculus lanuginosus* (pantocolpate)



*Opuntia phaeacantha* (pantoporate)



*Sherardia arvensis*  
(stephanocolpate)

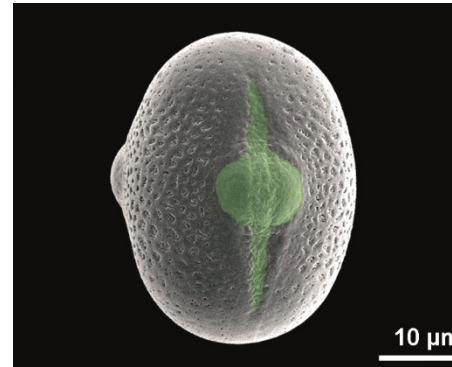


*Symphytum caucasicum*  
(stephanocolporate)

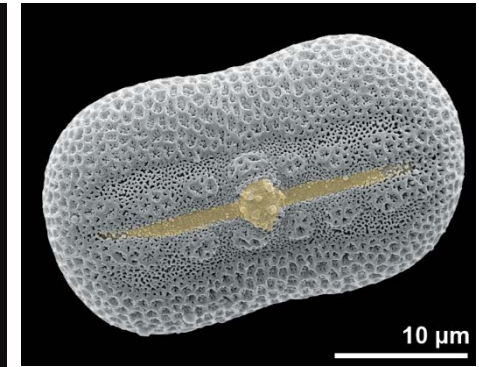
**aperture type**

**colporus**  
(lat., pl. colpori)

compound aperture composed of a colpus (ektoaperture) combined with an endoaperture of variable size and shape



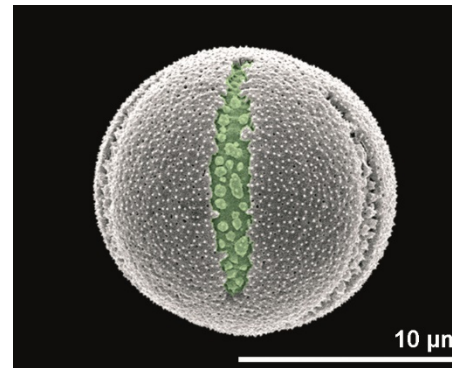
*Lathyrus vernus*



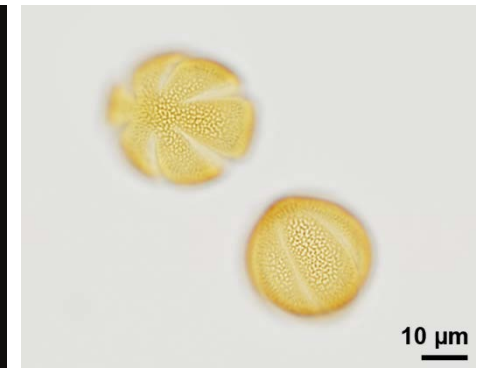
*Justicia procumbens*

**colpus**  
(lat., pl. colpi)

elongated aperture (length/width ratio > 2)  
situated at the equator or globally distributed



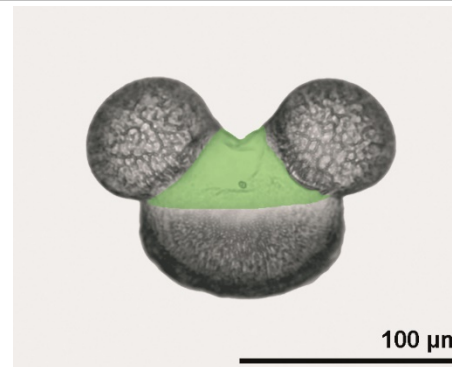
*Crucjata laevipes*



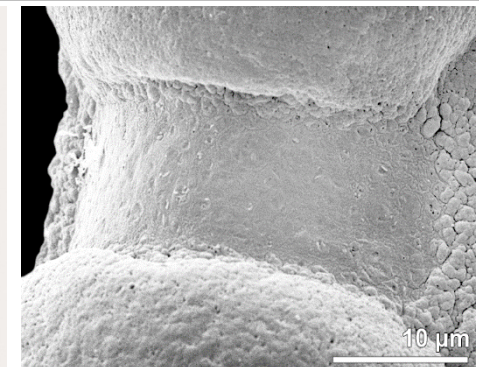
*Origanum vulgare*

**leptoma**  
(gr., pl. leptomata)

thinning of the pollen wall on the distal face in conifers, presumed to function as germination area



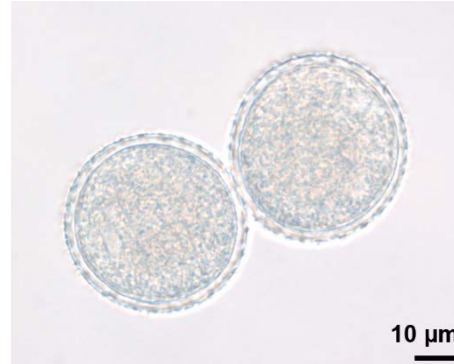
*Abies* sp. (fossil, acetolysed pollen)



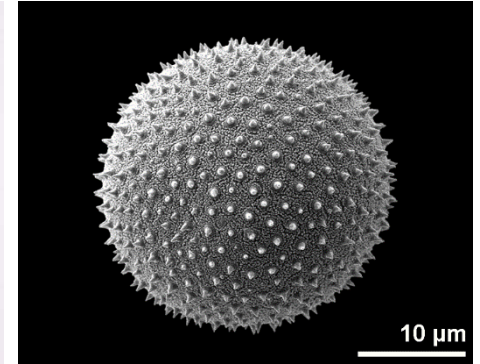
*Pinus strobus*

**no aperture**  
(inaperturate)

pollen grain without distinct apertures  
see also: omniaperturate  
*Antonym: aperturate*



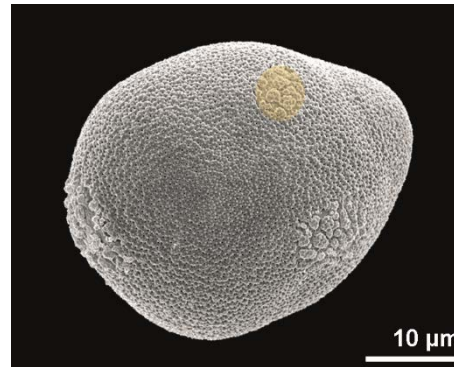
*Alocasia odora* (hydrated, LM)



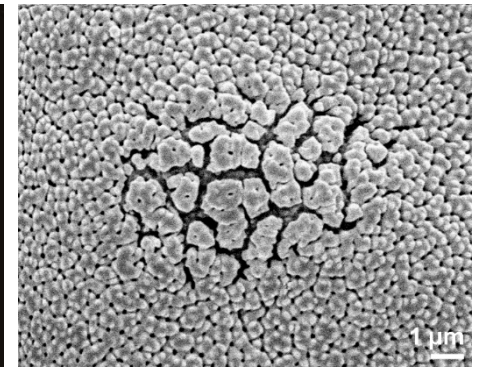
*Phoebe shearerii*

**poroid**

indistinct circular or elliptic aperture



*Carex remota*

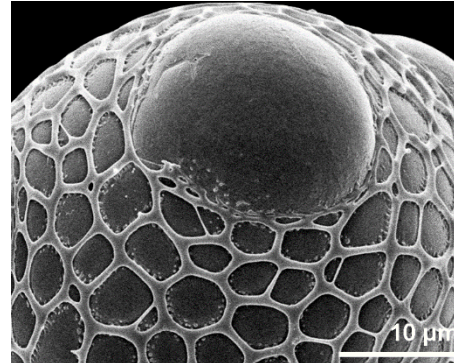


*Scirpus sylvaticus*

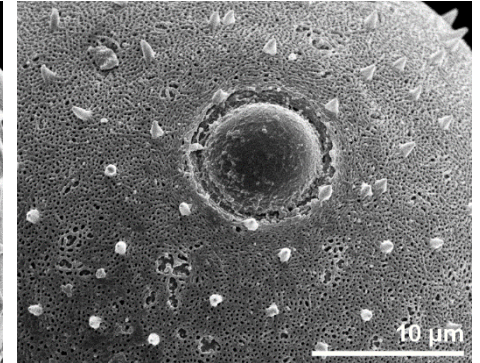
**porus**

(lat., pl. pori; engl. pore, engl., pl. pores)

more or less circular aperture; pori located at the equator or regularly spread over the pollen grain



*Aechmea azurea*

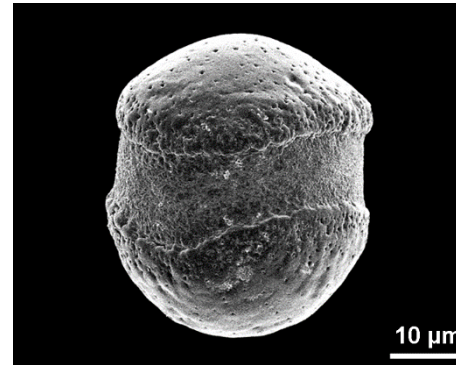


*Campanula rapunculoides*



**ring-like aperture**

circumferential aperture (situated more or less equatorially or, rarely, meridionally)



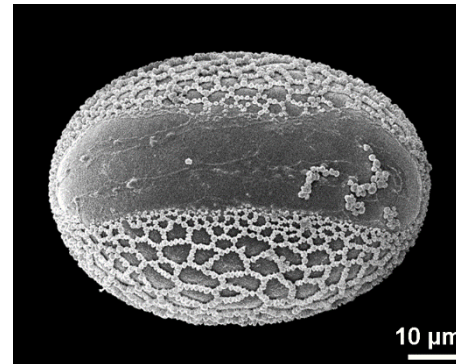
*Gonatopus angustus* (equatorial)



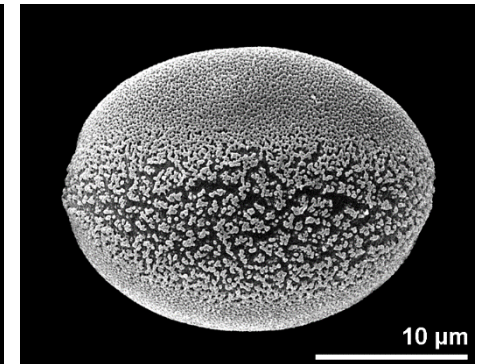
*Gonatopus bovinii* (hydrated, LM)

**sulcus**  
(lat., pl. sulci)

elongated aperture located distally



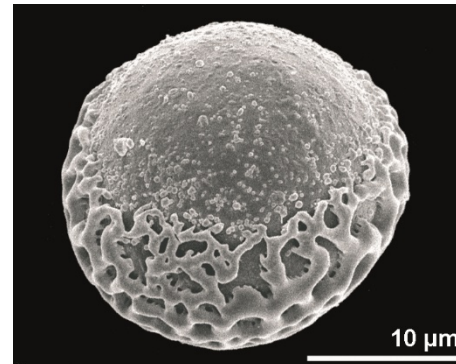
*Lilium martagon*



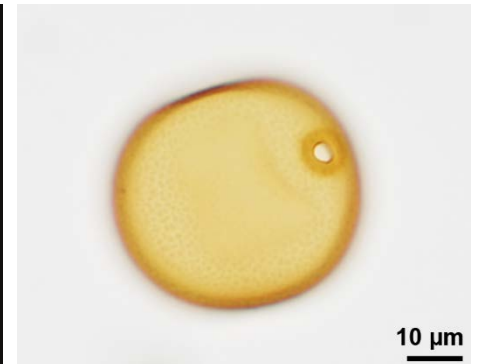
*Galanthus nivalis*

**ulcus**  
(lat., pl. ulci)

more or less circular aperture located distally



*Cephalanthera longifolia*



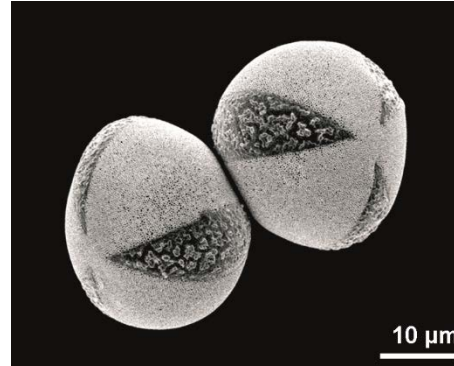
Poaceae



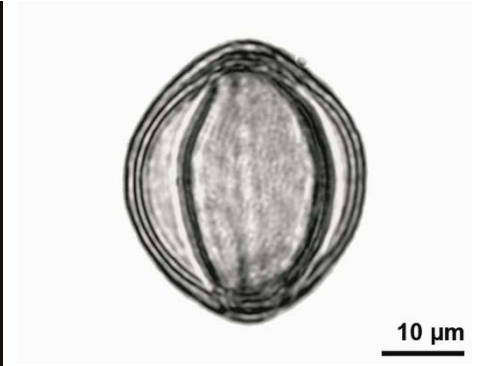
aperture condition

colpate

pollen grain with colpi



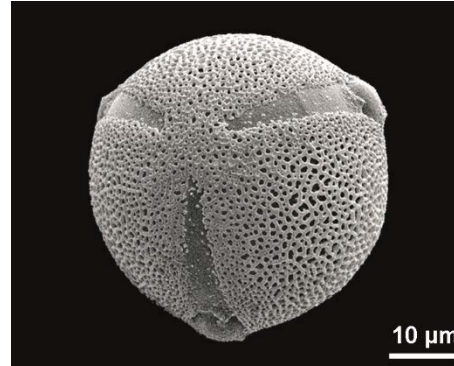
*Lamium maculatum*



*Acer* sp. (fossil)

colporate

pollen grain with colpi



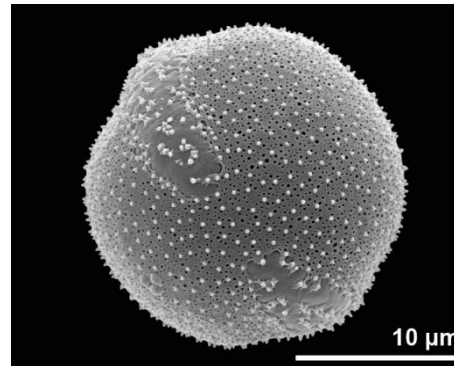
*Cistus creticus*



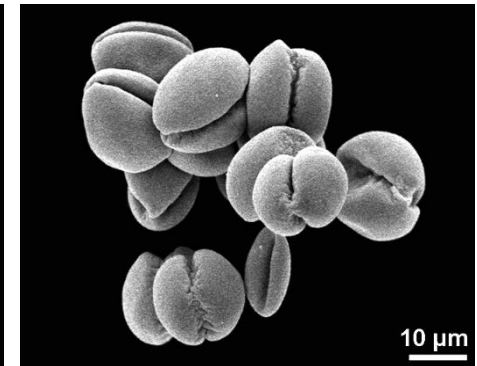
Fabaceae

dicolpate

pollen grains with two colpi



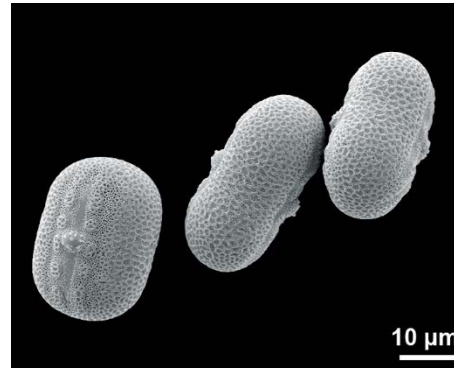
*Hypecoum imberbe*



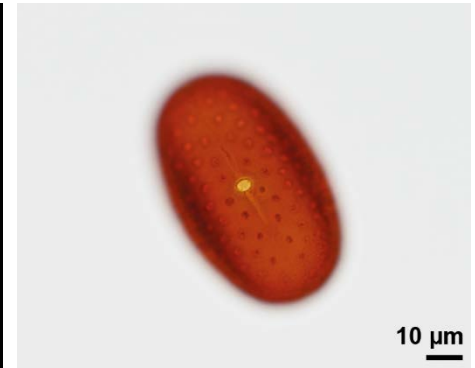
*Pedicularis elongata*

**dicolporate**

pollen grains with two colpi



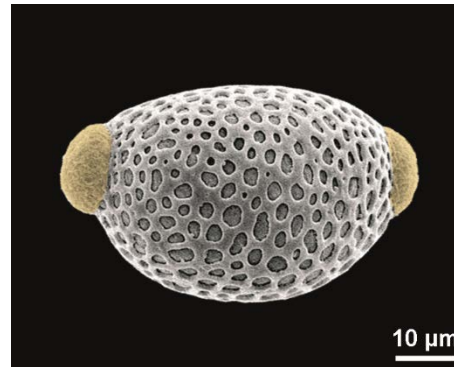
*Justicia procumbens*



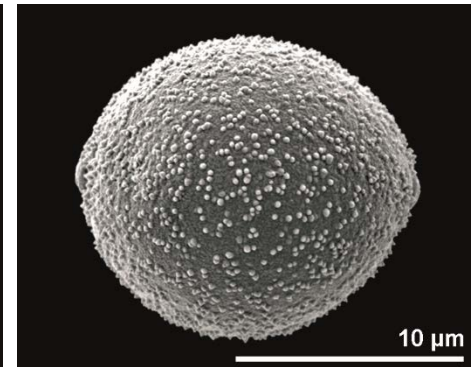
*Justicia carnea*

**diporate**

pollen grains with two pori



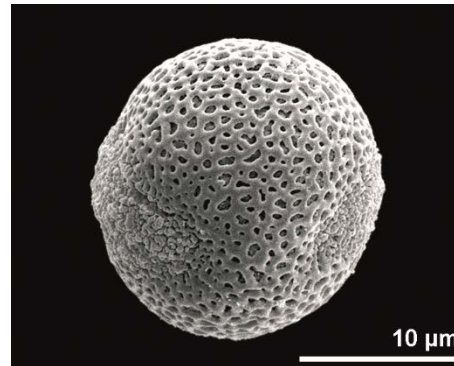
*Aechmea allenii*



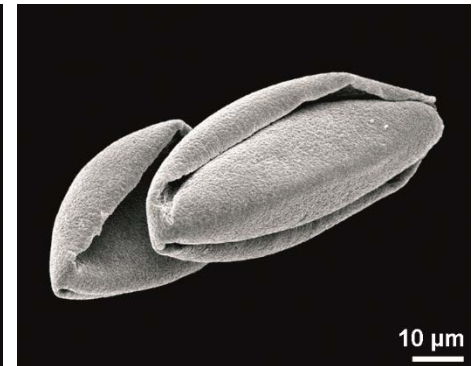
*Broussonetia papyrifera*

**disulcate**

pollen grain with two sulci



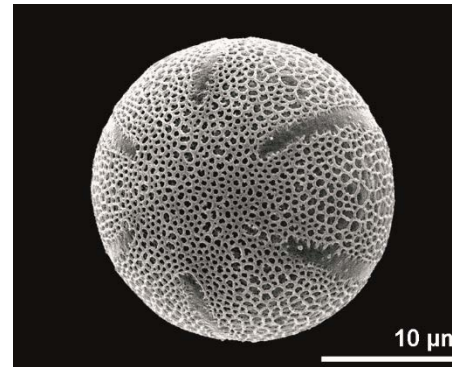
*Tofieldia calyculata*



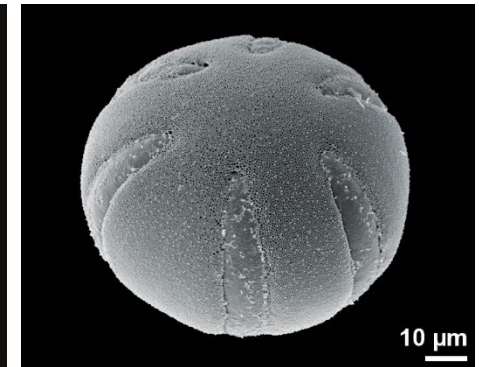
*Eichhornia crassipes* (dry pollen)

**hexacolpate**

pollen grain with 6 colpi



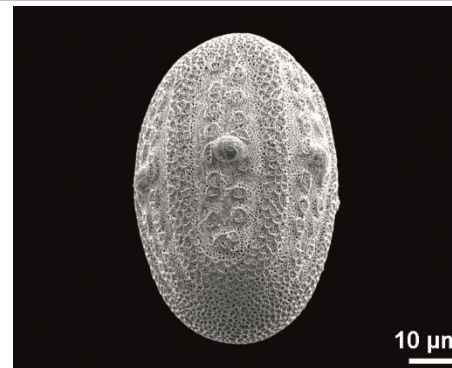
*Primula veris*



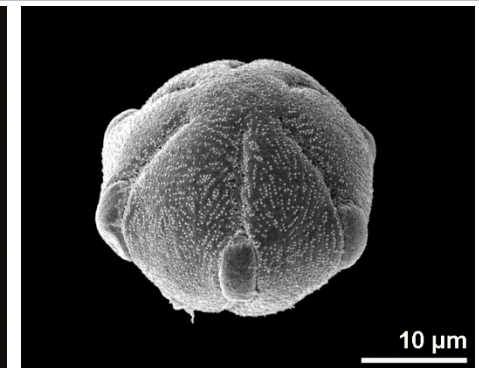
*Merremia umbellata*

**hexacolporate**

pollen grain with 6 colpi



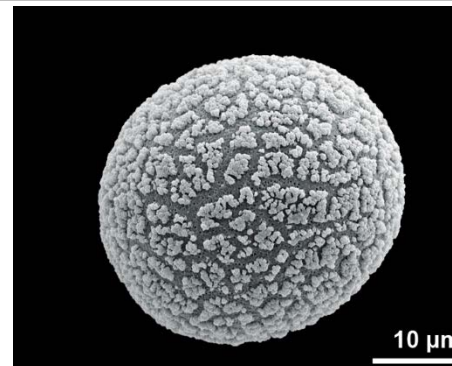
*Justicia menesii*



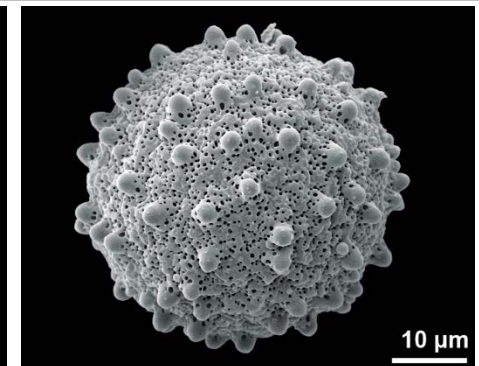
*Sanguisorba officinalis*

**inaperturate**

pollen grain without distinct apertures



*Trillium chloropetalum*



*Aristolochia arborea*

panto-

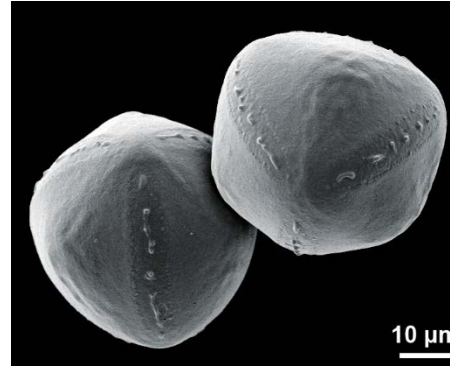
prefix for global

**pantoaperturate**

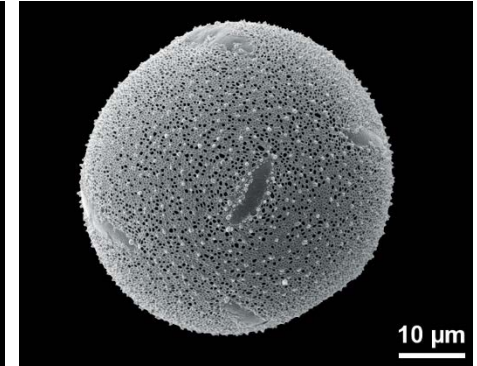
pollen grain with apertures distributed more or less regularly over the surface: pantocolpate, pantocolporate, pantoporate

**pantocolpate**

pollen grain with colpi distributed more or less regularly over the surface



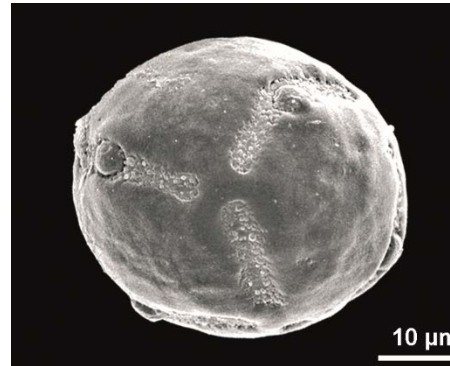
*Sarcocapnos* sp. (panto(6)colpate)



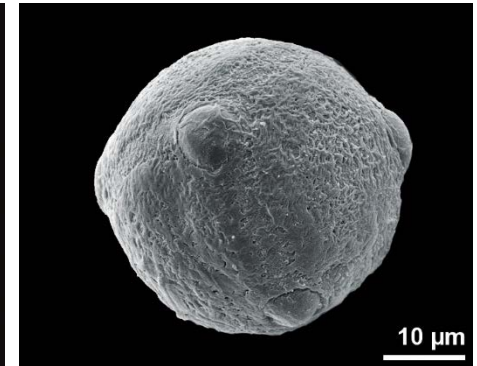
*Maripa nicaraguensis*

**pantocolporate**

pollen grain with colpi distributed more or less regularly over the surface



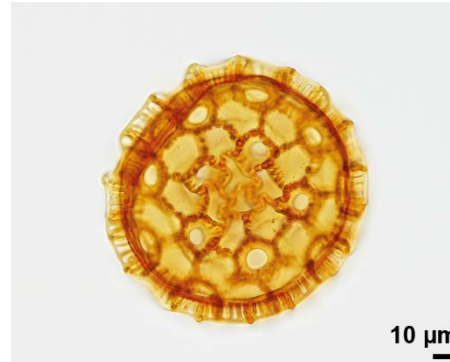
*Banisteria argentea*



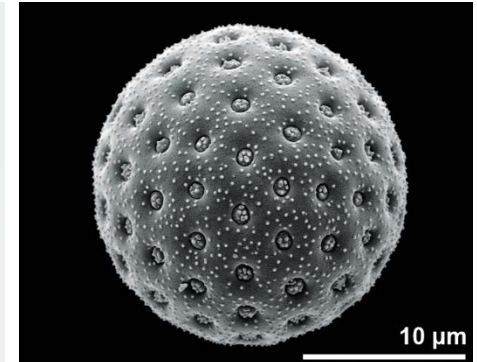
*Stigmaphyllon lindenianum*

**pantoporate**

pollen grain with pori distributed more or less regularly over the surface



*Cobaea scandens*



*Dysphania ambrosioides*

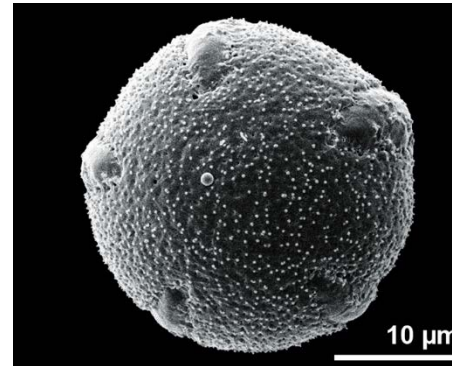
**pentaaperturate**

pollen grain with 5 apertures: pentacolpate, pentacolporate, pentaporate

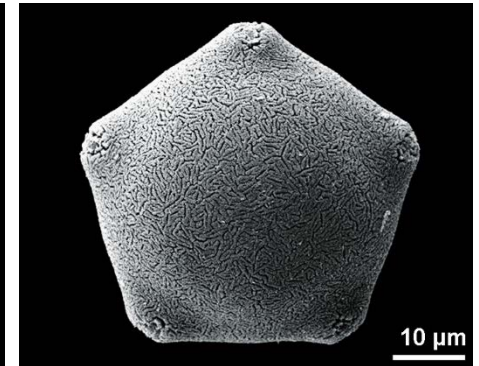


**pentacolpate**

pollen grain with 5 colpi



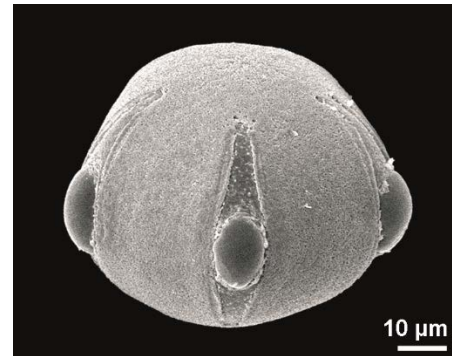
*Didymaea mexicana*



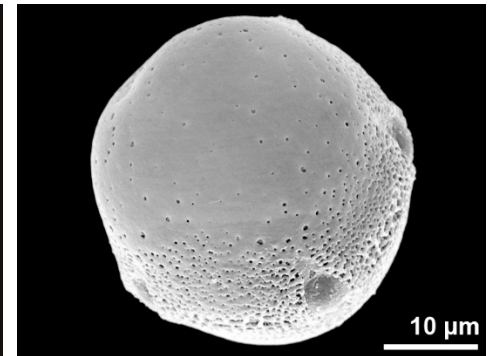
*Mendoncia albida*

**pentacolporate**

pollen grain with 5 colpi



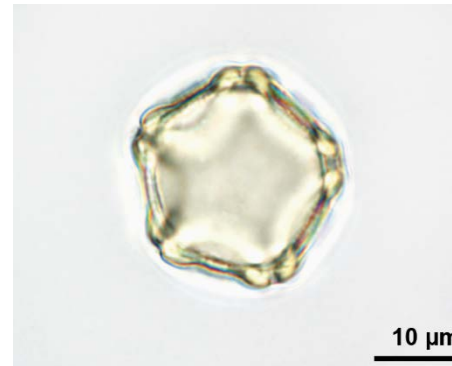
*Viola arvensis*



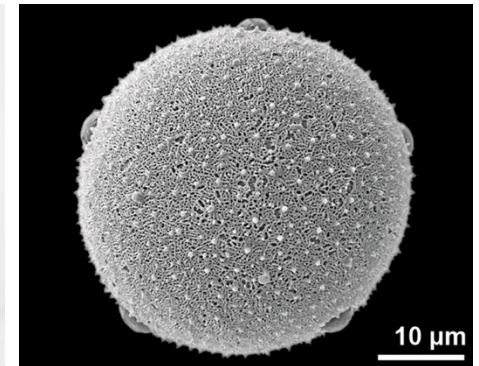
*Pulmonaria australis*

**pentaporate**

pollen grain with 5 pori



*Alnus glutinosa*



*Campanula garganica*

**polychotomosulcate**

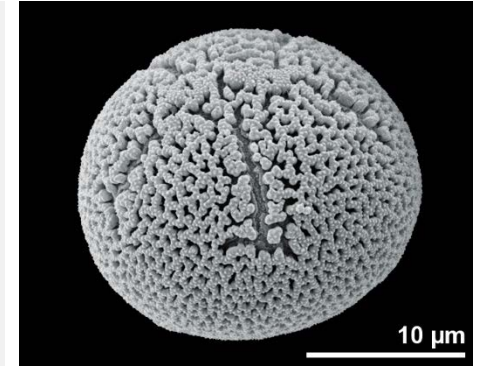
pollen grain with a polychotomosulcus

polychotomosulcus

sulcus with more than three arms



10 μm



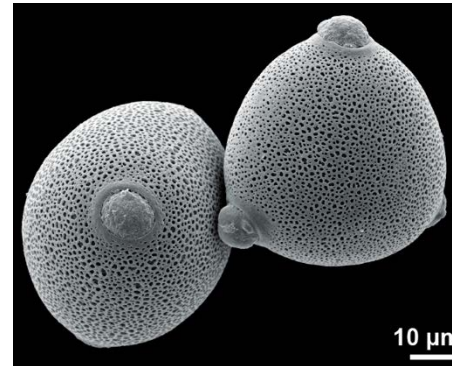
10 μm

*Hedyosmum scabarrinum*

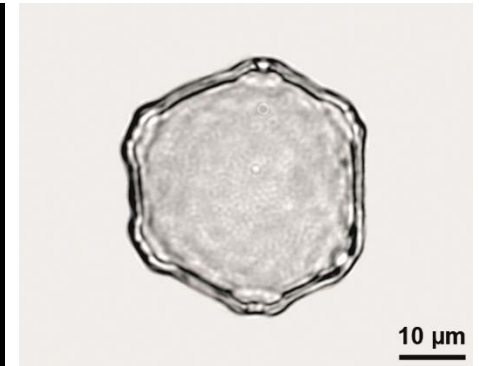
*Hedyosmum scabarrinum*

**porate**

pollen grain with pori



10 μm



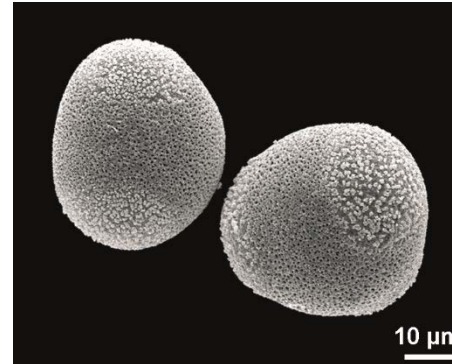
10 μm

*Cucumis melo*

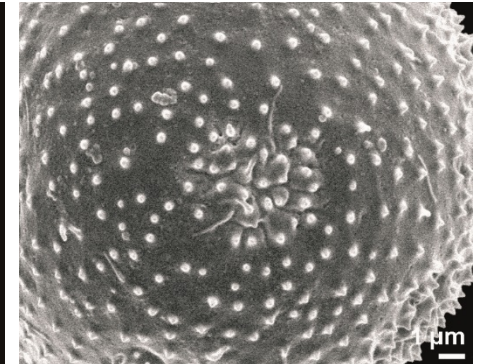
*Pterocarya* sp. (fossil)

**poroidate**

pollen grain with poroids



10 μm



1 μm

*Cercidiphyllum japonicum*

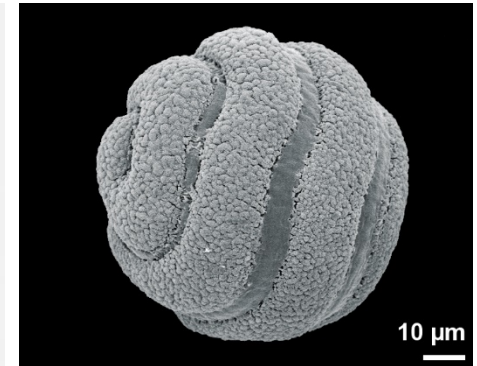
*Caldesia parnassifolia*

**spiraperturate**

pollen grain with one or more spiral aperture(s)



*Thunbergia alata*



*Thunbergia laurifolia*

**spiral aperture**

elongated, coiled aperture

**stephanoaperturate**

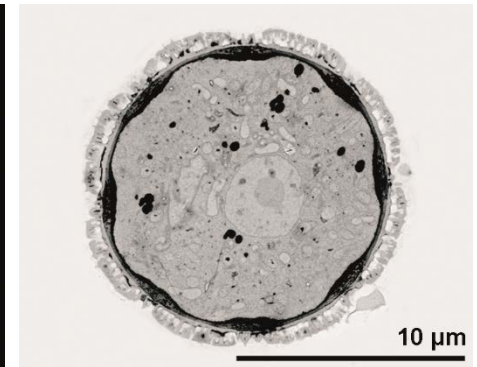
apertures situated at the equator (term usually used for 6 or more apertures); see also: stephanocolpate, stephanocolporate, stephanoporate

**stephanocolpate**

colpi situated at the equator (term usually used for 6 or more apertures);



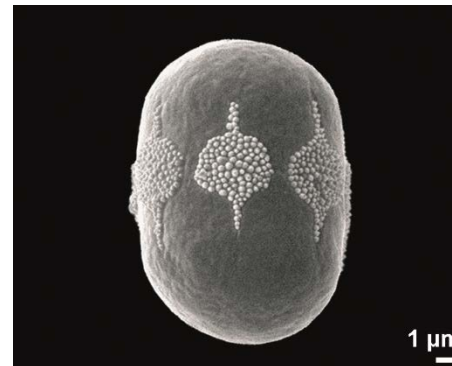
*Sherardia arvensis*



*Galium odoratum* (cross section, TEM)

**stephanocolporate**

colpori situated at the equator (term usually used for 6 or more apertures);



*Buglossoides arvensis*

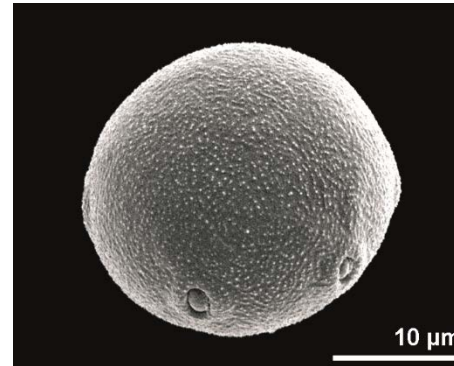


*Utricularia vulgaris*

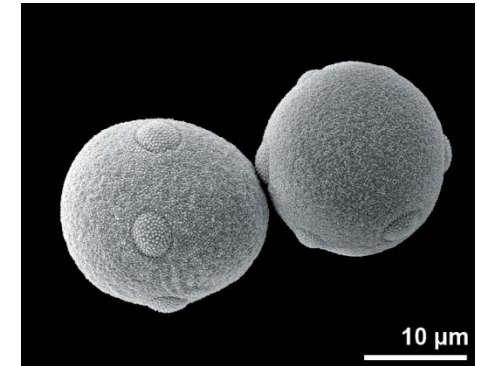


**stephanoporate**

pori situated at the equator (term usually used for 6 or more apertures);



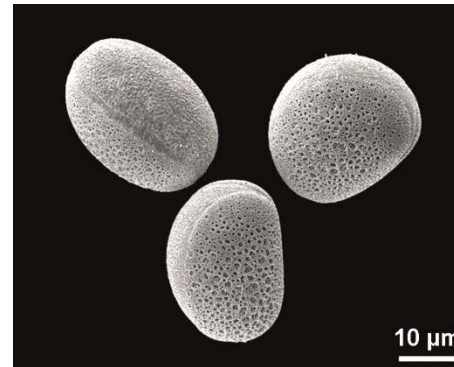
*Alnus viridis*



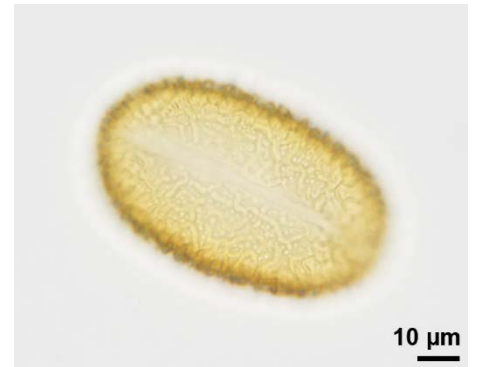
*Paramoltkia doerfleri*

**sulcate**

elongated aperture located distally



*Lachenalia aloides*



*Iris domestica*

syn-

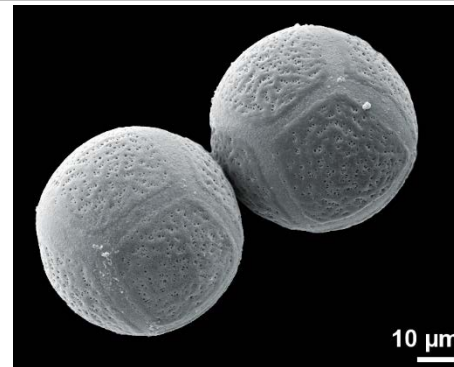
prefix for together

synaperturate

pollen grain with anastomosing apertures: syncolpate, syncolporate

**syncolpate**

pollen grain with anastomosing colpi



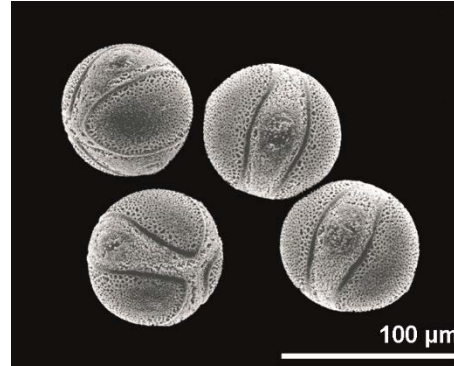
*Pseudofumaria* sp. (panto(syn)colpate)



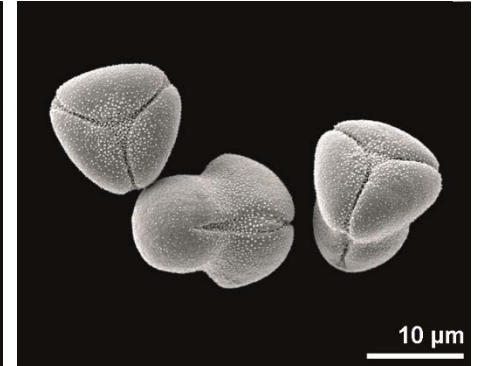
*Barringtonia asiatica* (dry pollen)

**syncolporate**

pollen grain with anastomosing colpi



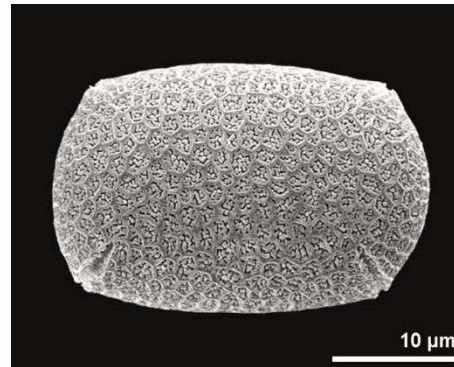
*Cassia pulcherrima*



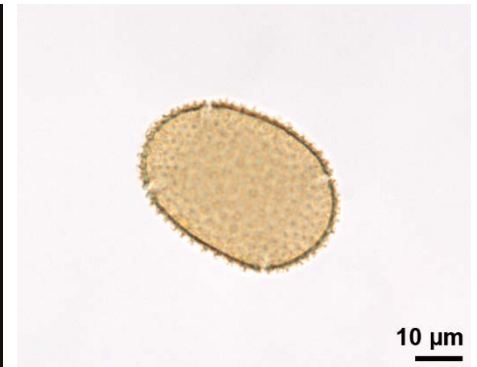
*Onosma visianii*

**tetracolpate**

pollen grain with 4 colpi



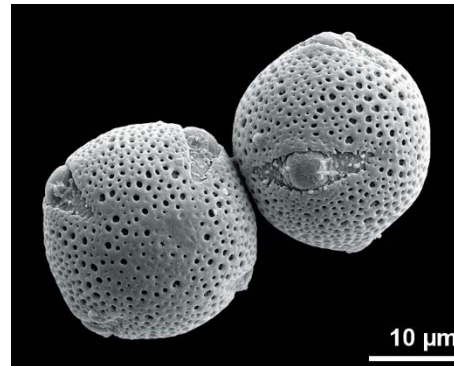
*Impatiens glandulifera*



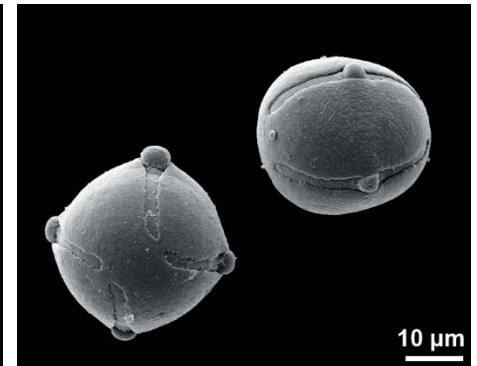
*Impatiens parviflora*

**tetracolporate**

pollen grain with 4 colpi



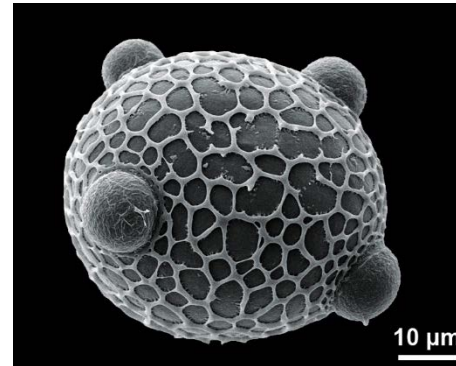
*Cistus swinglei*



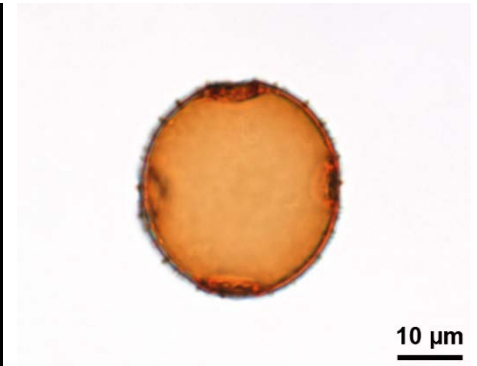
*Ganlisea violacea*

**tetraporate**

pollen grain with 4 pori



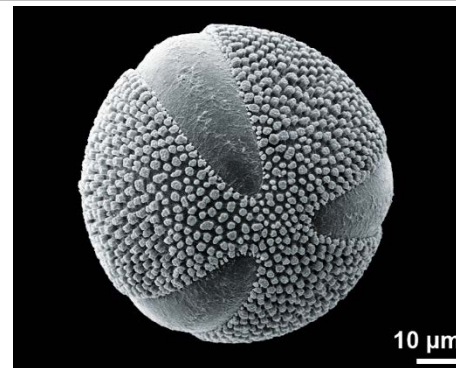
*Aechmea tomentosa*



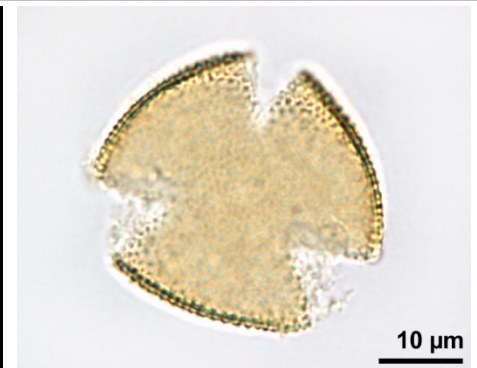
*Phyteuma spicatum*

**tricolpate**

pollen grain with 3 colpi



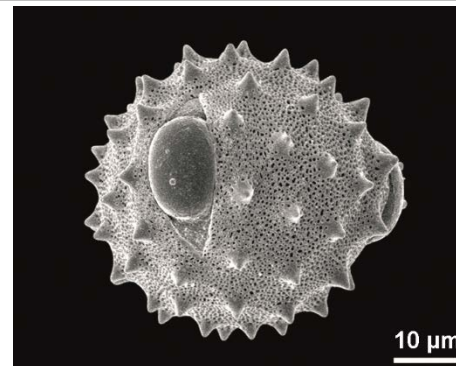
*Ceratostigma plumbaginoides*



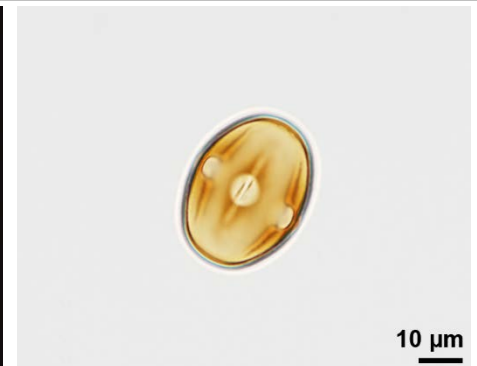
*Fraxinus* sp.

**tricolporate**

pollen grain with 3 colpi



*Cirsium oleraceum*

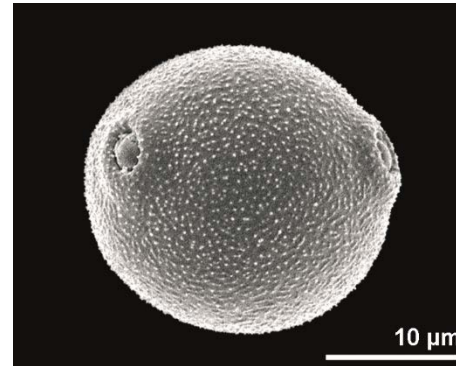


*Lathyrus sylvestris*



**triporate**

pollen grain with 3 pori



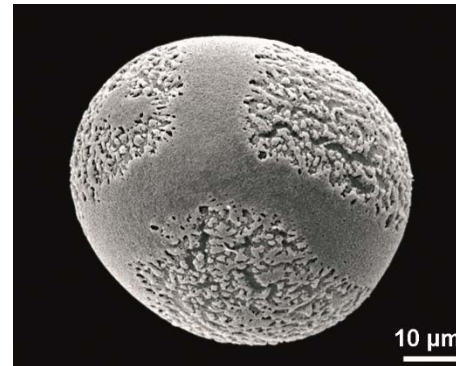
*Betula pendula*



*Betula humilis*

**trisulcate**

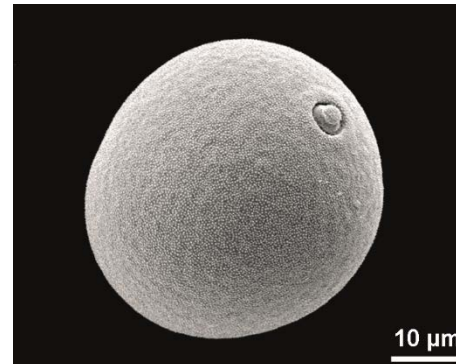
pollen grain with 3 sulci  
(rare feature)



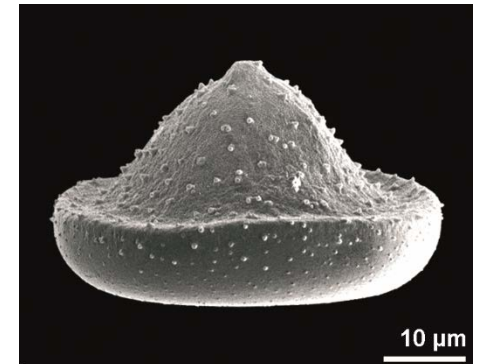
*Tulipa kaufmanniana* (usually sulcate)

**ulcerate**

pollen grain with an ulcer



*Bromus erectus*

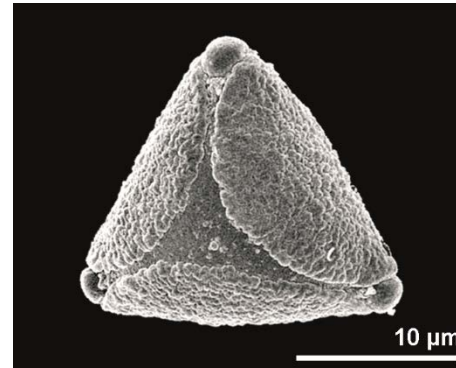


*Heliconia* sp. (dry pollen)

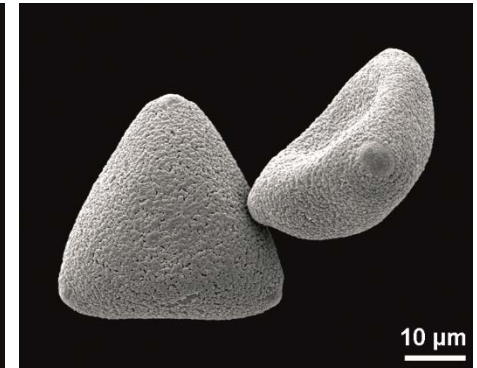
**aperture peculiarities**

**angulaperturate**

pollen grain with an angular outline where the apertures are located at the angles  
*Antonym: planaperturate*



*Callistemon coccineus*



*Leucadendron brunoides*

**annulus**

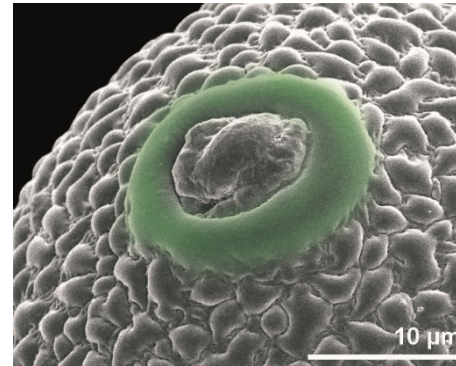
(lat. pl. annuli)

ring like wall thickening surrounding a porus or ulcus

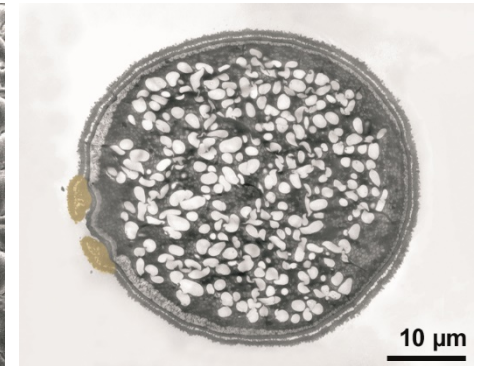
*Comment: "anulus" orthographical variant of "annulus"*

**annulate**

pollen grain with an annulus or annuli



*Trichosanthes anguina*

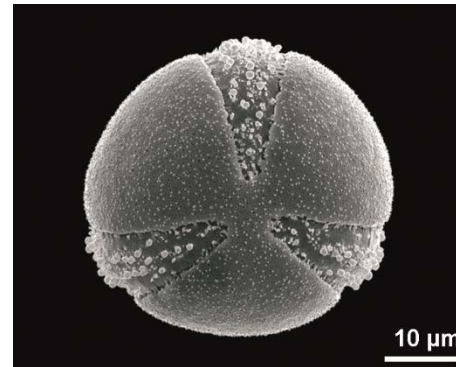


*Triticum aestivum*

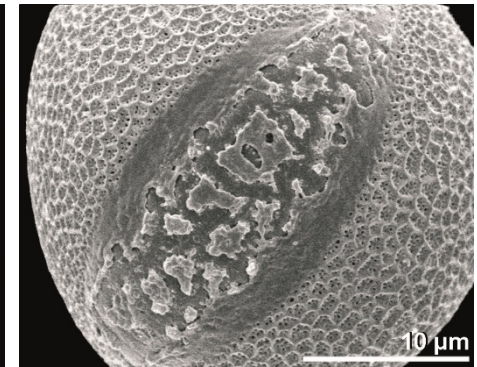
**aperture membrane**

exine layer covering an aperture; aperture membrane (colpus or porus membrane) can be psilate or ornamented

**aperture membrane ornamented**

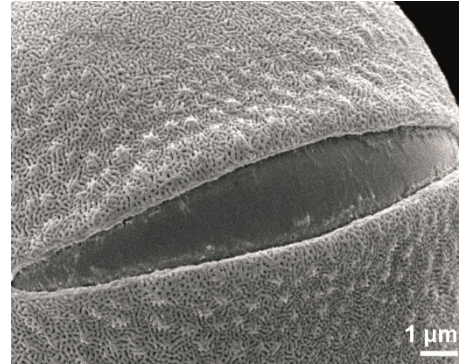


*Convolvulus tricolor*

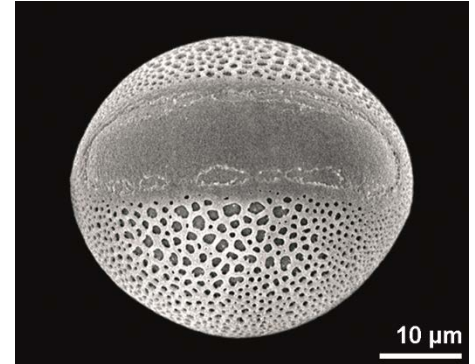


*Galeopsis tetrahit*

aperture membrane psilate



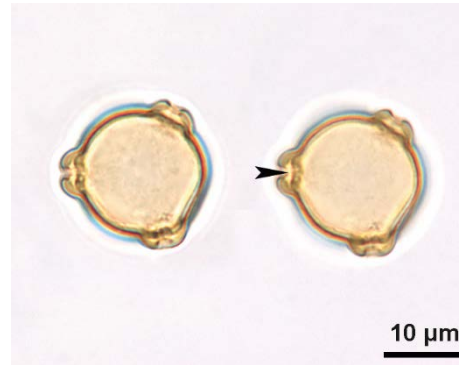
*Melampyrum subalpinum*



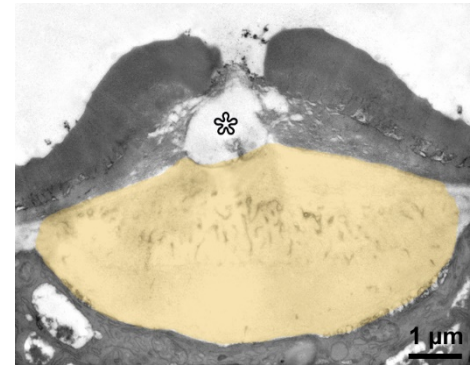
*Doryanthes palmeri*

**atrium**  
(lat., pl. atria)

space between diverging exine layers  
within the aperture

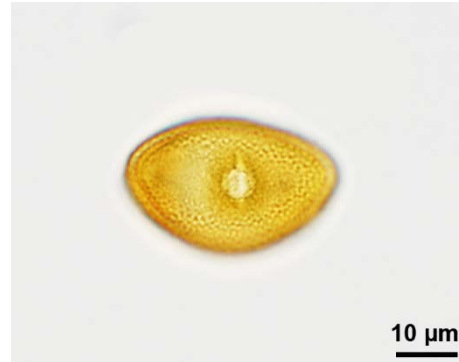


*Betula* sp., atrium (arrowhead and asterisk) and oncus (colored)

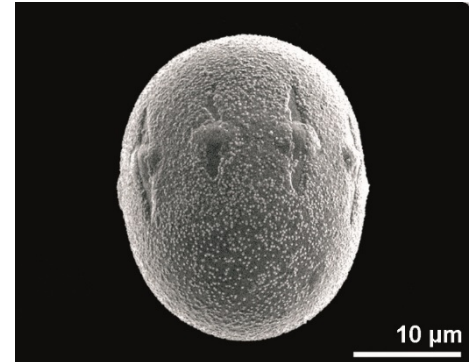


**brevicolporus**  
brevicolporate

pollen grain with brevicolpi  
pollen grain with brevicolpori



*Tilia platyphyllos*

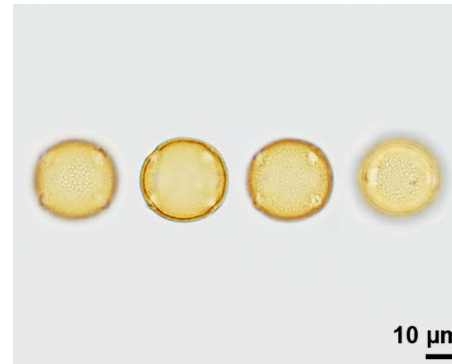


*Symphytum orientale*

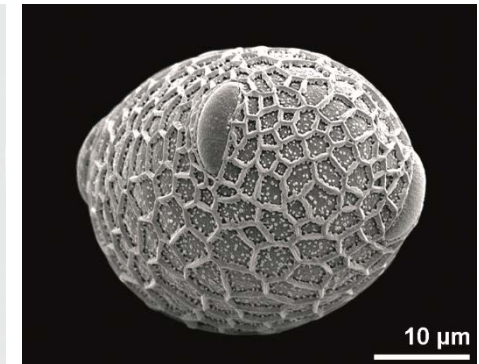


**brevicolpus**  
brevicolpate

pollen grain with brevicolpori  
pollen grain with brevicolpi



*Pistacia* sp.



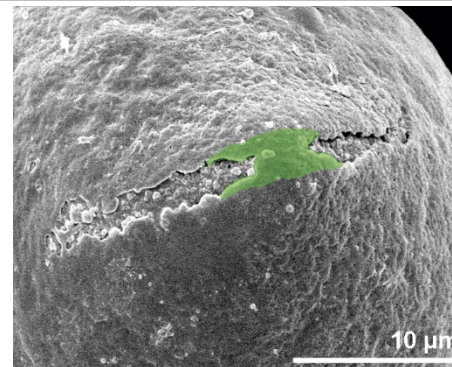
*Impatiens columbaria*

brevi-

prefix meaning short

**bridge**

exine connection(s) between the margins  
of an aperture



*Elaeagnus angustifolia*

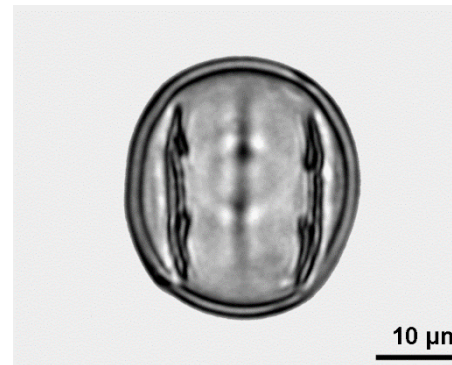


*Malus baccata*

**colporoidate**

used for light microscopy only, describing  
compound apertures composed of a  
colpus (ektoaperture) with an indistinct  
endoaperture

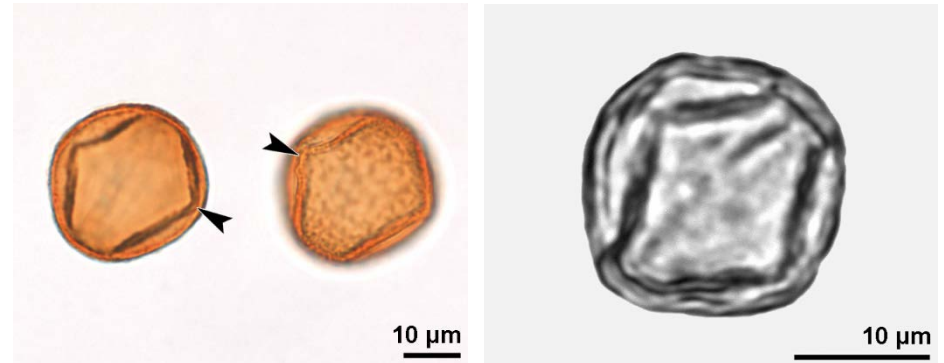
*Comment: Is a rare character, e.g., for  
deciduous Quercus pollen.*



*Eucommia* sp. (fossil)

**geniculum**  
(pl. genicula)

colpus buckled in the equatorial region

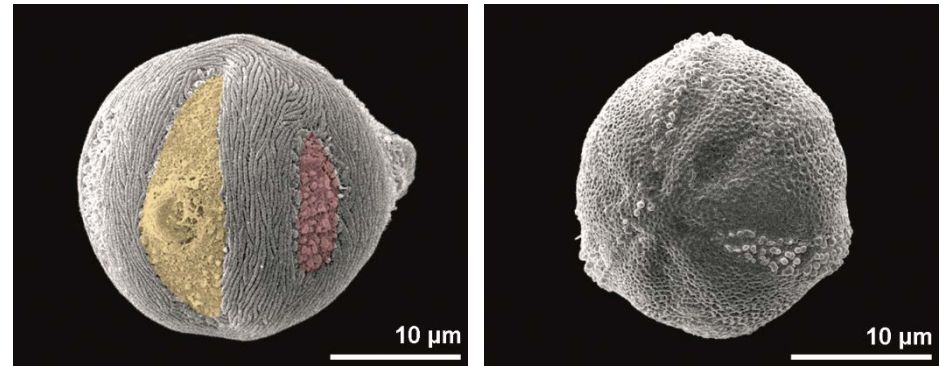


recent (left) and fossil (right) pollen of *Quercus* with geniculum (arrowheads)

**heteroaperturate**

pollen grain with different types of apertures; only one type presumed to function as germination site

*Comment: unfortunately the term "heterocolpate" is commonly incorrectly used for pollen grains with alternating colpi and colpi, but "heterocolpate" means two different types of colpi; therefore we prefer the more general term "heteroaperturate"*



*Lythrum hyssopifolia*, aperture (yellow) *Phacelia tanacetifolia*

hetero-

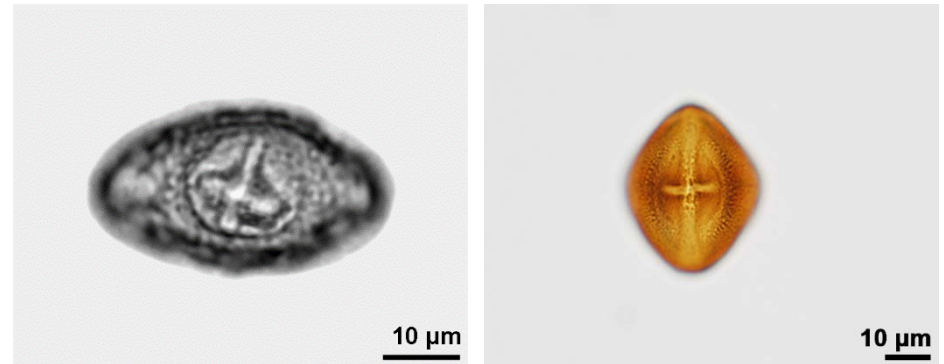
prefix meaning different

endoaperture

inner part of a compound aperture elongated equatorially (lalongate) or meridionally (lolongate)

**lalongate**

endoaperture elongated equatorially

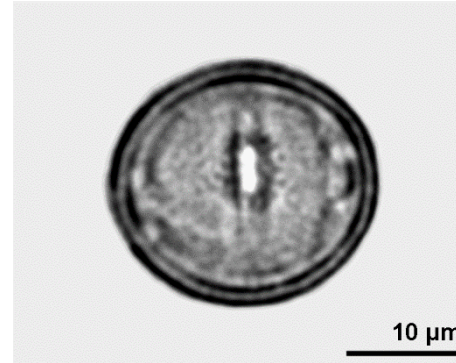


*Symplocos sp.* (fossil)

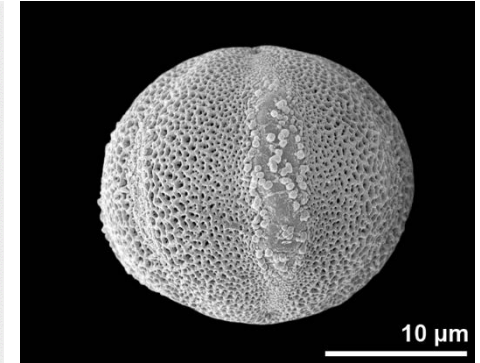
*Dictamnus albus*

**lolongate**

endoaperture elongated meridionally



*Rumex* sp. (fossil)  
colporus (colporate, lolongate porus)

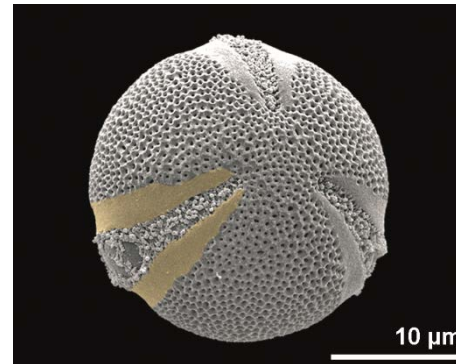


*Phacelia* sp. (heteroaperturate,  
lolongate porus)

**margo**

(lat., pl. margines)

exine area with different ornamentation  
bordering a colpus/colporus



*Discocleidion rufescens*

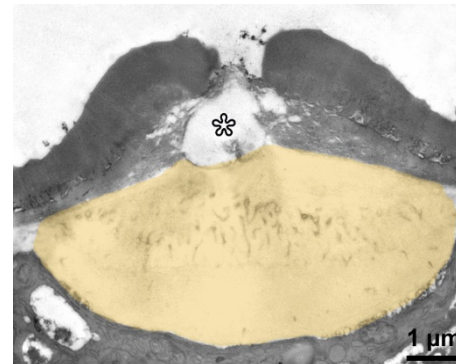


*Euphorbia peplus*

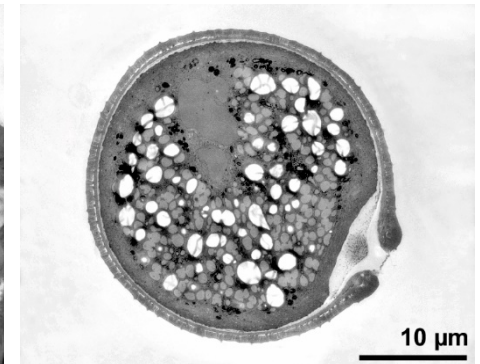
**oncus**

(lat., pl. onci)

lens-shaped body located beneath the  
aperture, not resistant to acetolysis



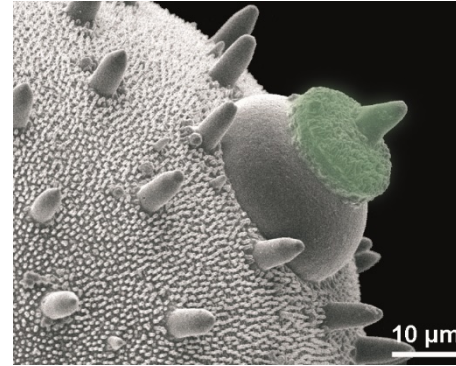
*Betula humilis*; oncus (colored) and atrium (asterisk)



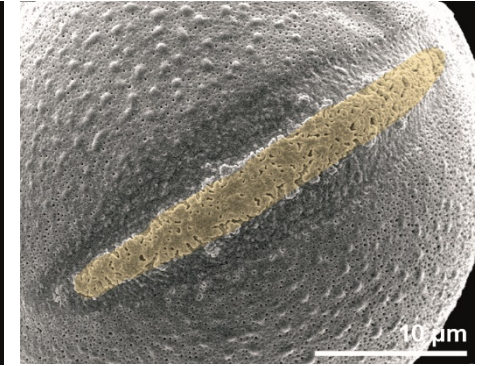


**operculum**  
(lat., pl. opercula)  
operculate

distinctly delimited exine structure  
covering an aperture  
aperture with operculum



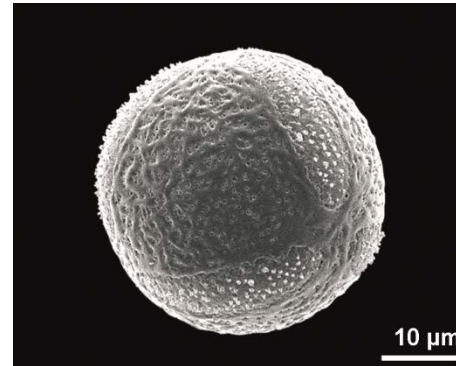
*Cucurbita pepo*



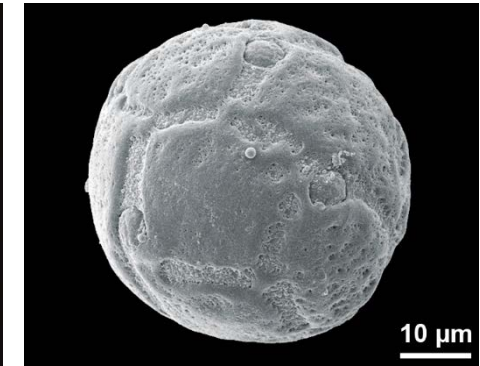
*Teucrium pyrenaicum*

**pantoaperturate**

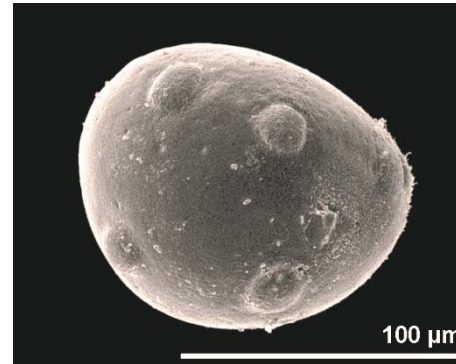
pollen grain with apertures distributed  
more or less regularly over the surface:  
pantocolpate, pantocolporate,  
pantoporate



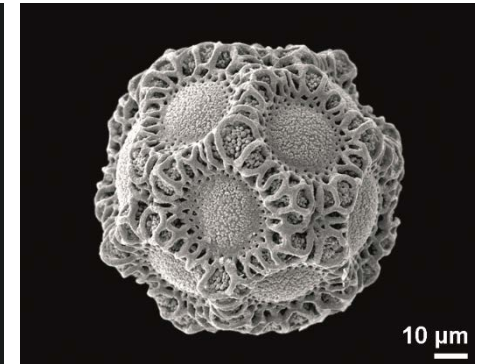
pantocolpate, *Corydalis cava*



pantocolporate, *Malpighia glabra*



pantoporate, *Costus barbatus*



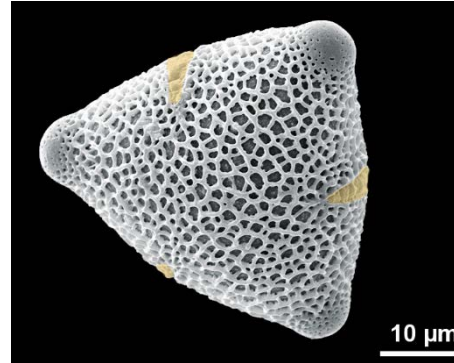
pantoporate, *Opuntia phaeacantha*

panto-

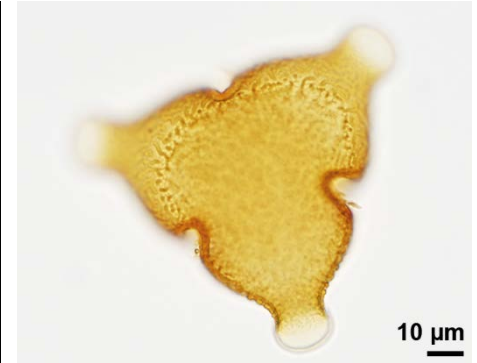
prefix for global

**planaperturate**

pollen grain with an angular outline, where the apertures are situated between the angles  
*Antonym: angulaperturate*



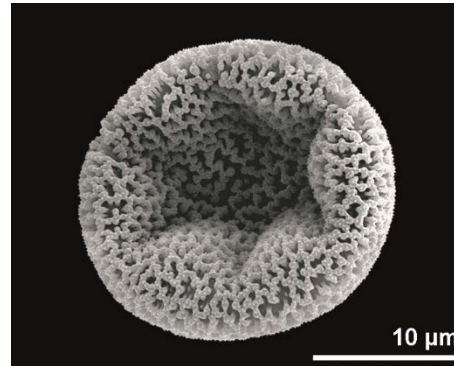
*Pachira quinata*



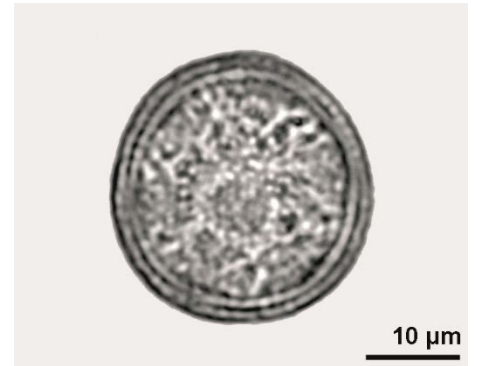
*Pachira sessilis*

**polychotomosulcus**

sulcus with more than three arms



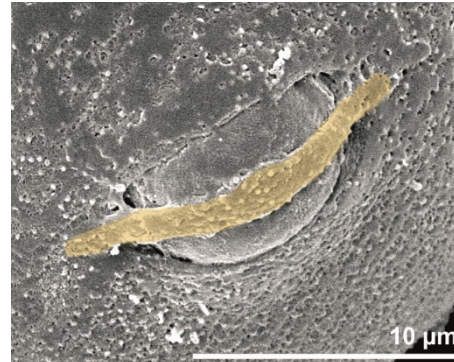
*Hedyosmum goudotianum*



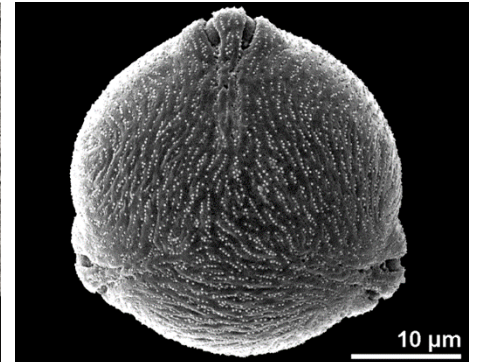
*Hedyosmum goudotianum*

**pontoperculum**  
(lat., pl. pontopercula)  
pontoperculate

elongated operculum linked to the ends of the aperture  
aperture with a pontoperculum



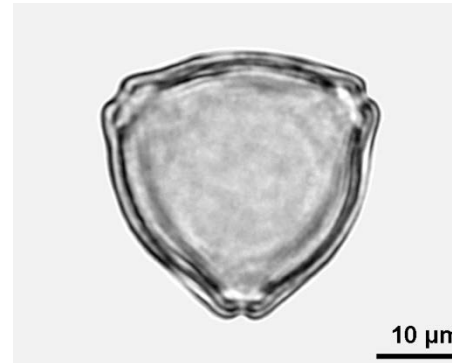
*Sanguisorba cretica*



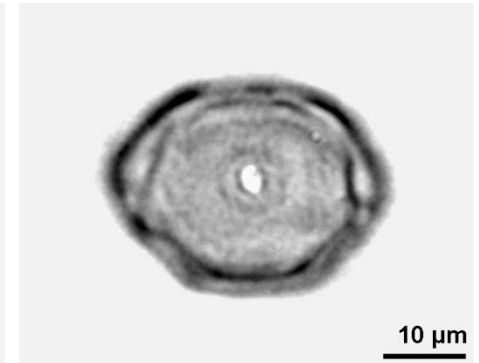
*Sanguisorba minor*

**pororate**

pollen grain with compound apertures composed of a circular “ektoporus” and “endoporus”



*Corylus* sp.(fossil, polar view)



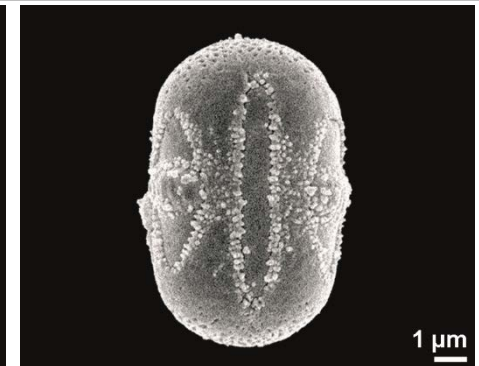
*Corylus* sp. (fossil, equatorial view)

**pseudocolpus**

colpus in a heteroaperturate pollen grain, presumed not to function as germination site



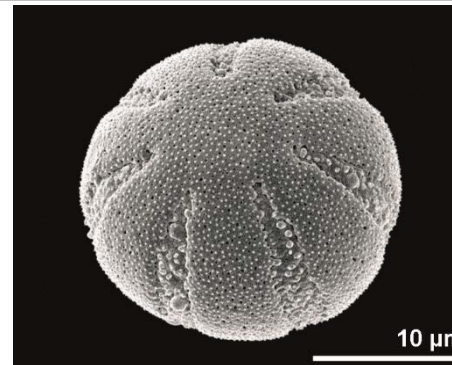
*Lythrum salicaria*



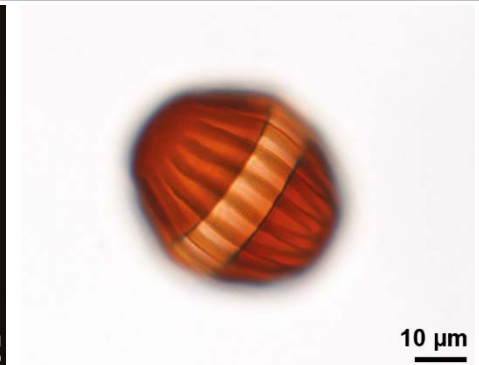
*Asperugo procumbens*

**stephanoporturate**

apertures situated at the equator (term usually used for 6 or more apertures); see also: stephanocolpate, stephanocolporate, stephanoporate



*Galium glaucum* (colpate)

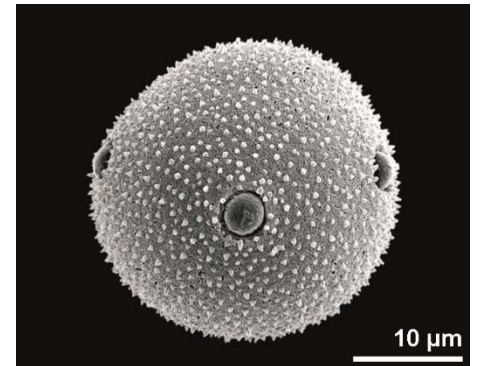


*Polygala myrtifolia* (colporate)





*Borago officinalis* (colporate)



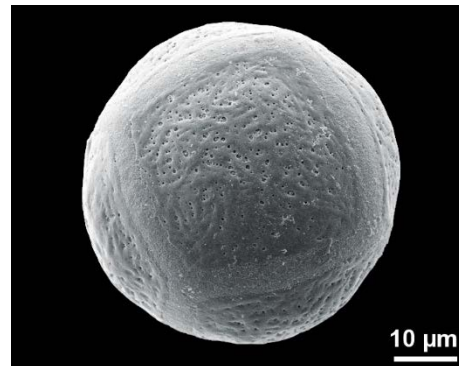
*Legousia speculum-veneris* (porate)

stephano-

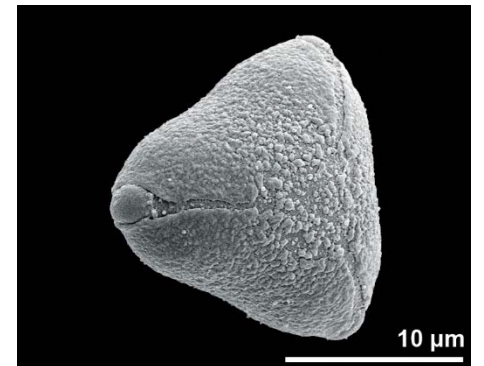
prefix meaning equatorially situated

**synaperturate**

pollen grain with anastomosing apertures:  
syncolpate, syncolporate



*Pseudofumaria lutea* (syncolpate)



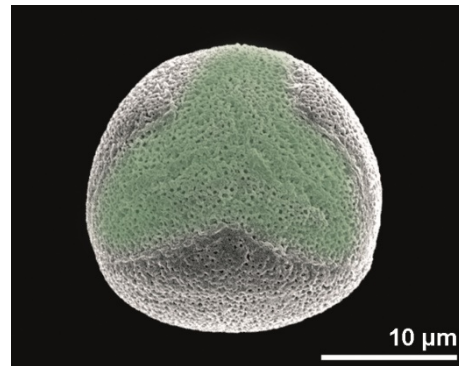
*Myrtus communis* (syncolporate)

**trichotomosulcus**

3-radiate sulcus

trichotomosulcate

pollen grain with a trichotomosulcus



*Dianella tasmanica*



**Areaceae** (fossil)

**polarity and shape**

**polarity**

**polarity** orientation of the proximal and distal pole of a pollen grain resulting from tetrad stage

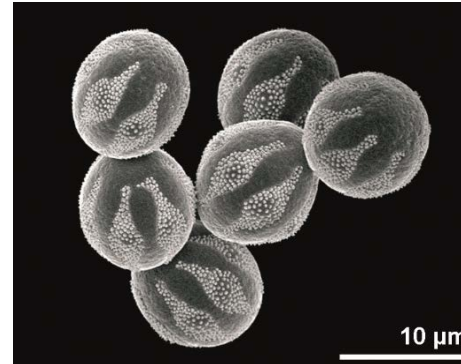
distal directing away from the center of a tetrad (deduced from tetrad stage)

proximal pollen face/pole/side directing towards the center of the tetrad (deduced from tetrad stage); *Antonym: distal*

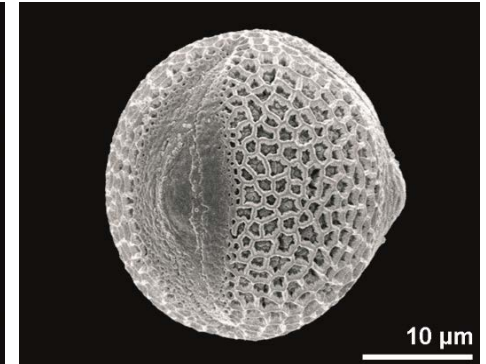
meridian imaginary line on the pollen surface connecting proximal and distal poles

**isopolar** pollen grain with identical proximal and distal faces

*Antonym: heteropolar*



*Moltkia petraea*

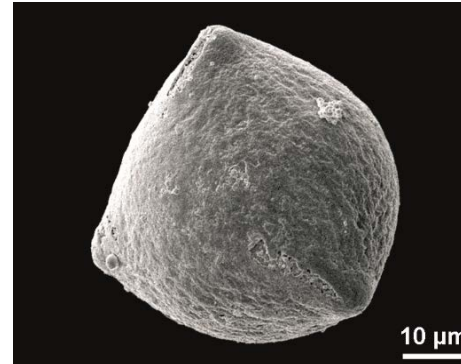


*Viburnum tinus*

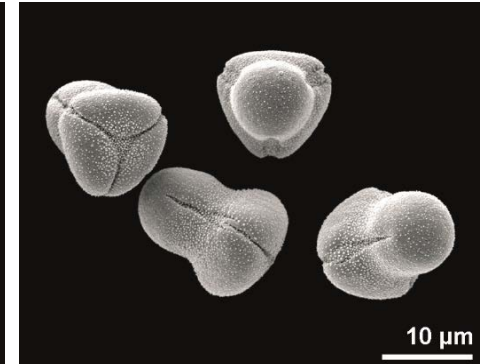
**heteropolar**

pollen grain with different proximal and distal faces

*Antonym: isopolar*



*Elaeagnus angustifolia*



*Onosma visianii* (dry pollen)

pole outermost proximal and/or distal point of a pollen grain

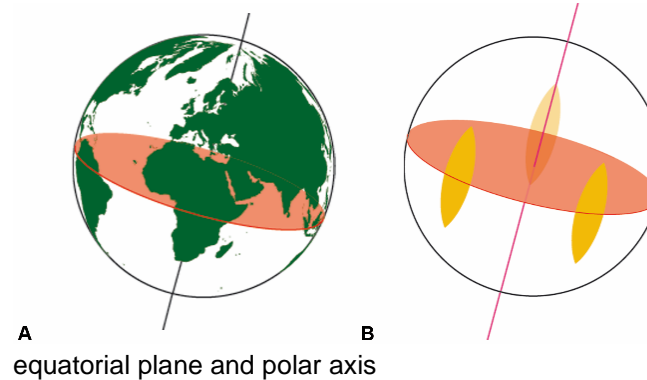
polar area region at and around the pole(s)

*Comment: the term "apocolpium" is often used for polar area, but "polar area" is the more general term independent of the aperture type*

**P/E-ratio**

**P/E-ratio**

refers to the length of the polar axis between the two poles compared to the equatorial diameter (in hydrated and dry condition)



equator imaginary line encircling a pollen grain between the proximal and distal poles

equatorial preposition indicating a region on the pollen surface

equatorial view view of a pollen grain where the equator is directed towards the observer

equatorial plane imaginary plane at the equator, perpendicular to the polar axis

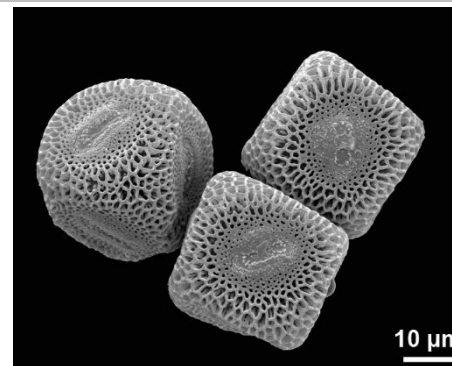
equatorial diameter diameter of a pollen grain at the equator

polar axis imaginary line between the proximal and the distal pole of a pollen grain

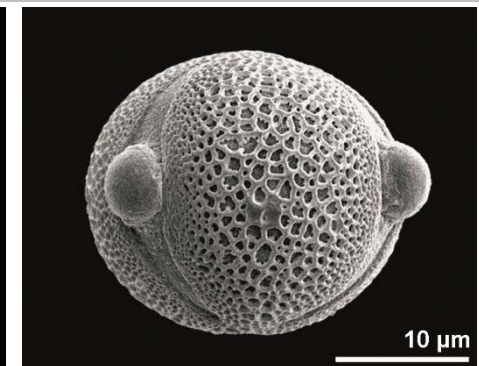
polar view view of a pollen grain in which the pole is directed towards the observer

**isodiametric** pollen grain with a polar axis equal to the equatorial diameter

*Comment: a general term, used in palynology describing e.g., "shape"*



*Basella alba*



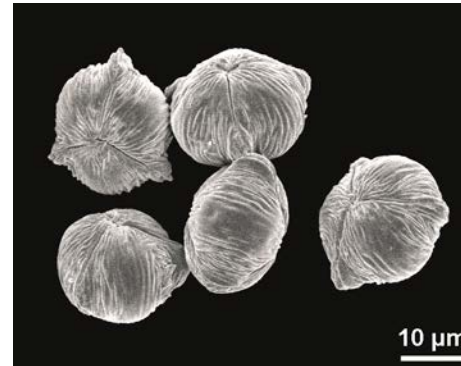
*Parnassia palustris*



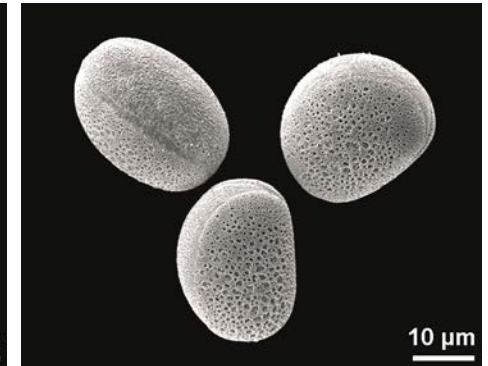
**oblate**

pollen grain with a polar axis shorter than the equatorial diameter

*Antonym: prolate*



*Cuphea purpurea*

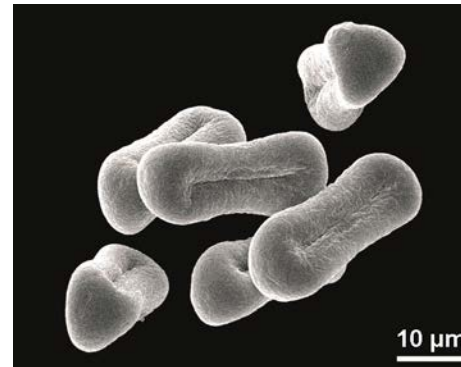


*Lachenalia aloides*

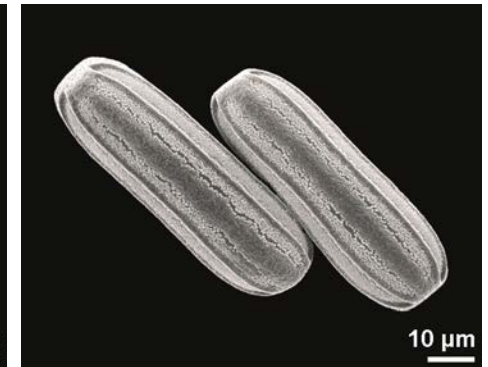
**prolate**

pollen grain with a polar axis longer than the equatorial diameter

*Antonym: oblate*



*Torilis arvensis* (dry pollen)



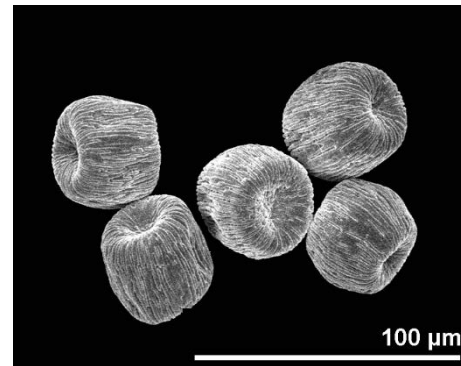
*Crossandra flava*

**Shape (pollen in hydrated and dry condition)**

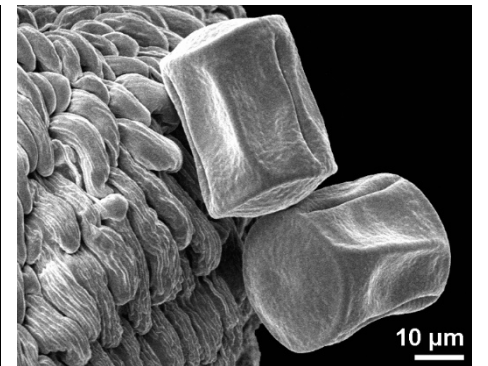
**shape**

3-dimensional form of a pollen grain in relation to the P/E ratio

**barrel-shaped**

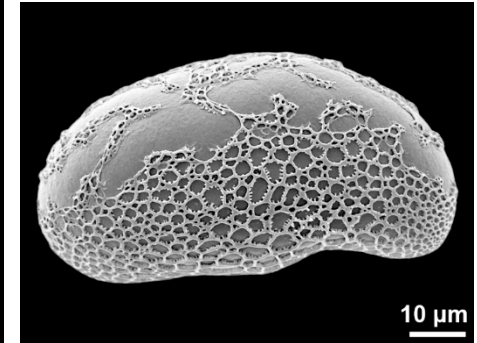
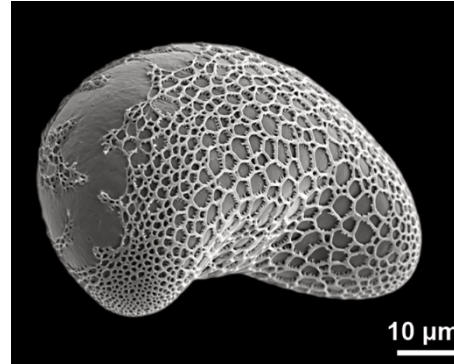


*Brugmansia suaveolens* (dry pollen)



*Anthyllis vulneraria* (dry pollen)

bean-shaped



*Billbergia pyramidalis*

*Billbergia pyramidalis*

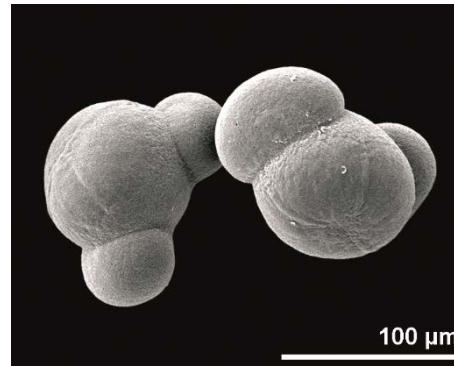
bisaccate

pollen grain with two sacchi

*Comment: nomen conservandum*

bi-

prefix for two



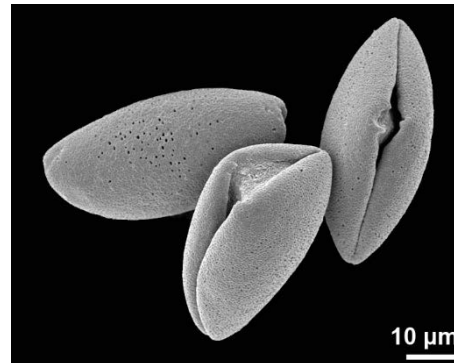
*Abies nordmanniana*



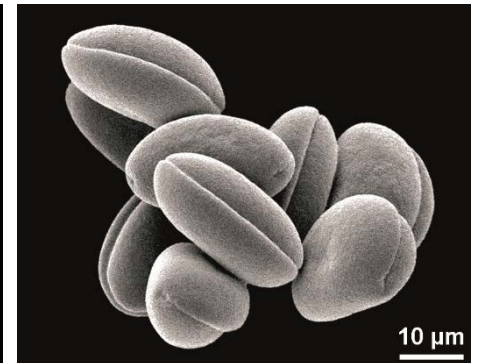
*Pinus mugo*

boat-shaped

characteristic shape of sulcate pollen grains in dry condition as a consequence of harmomegathy

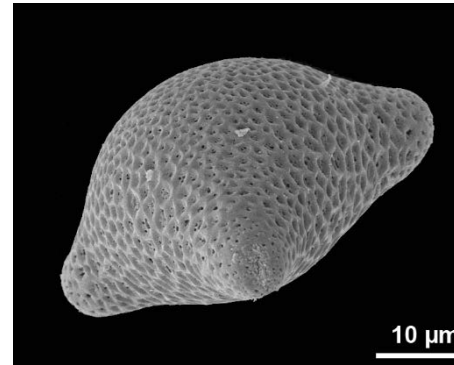


*Hyacinthoides italica* (dry pollen)

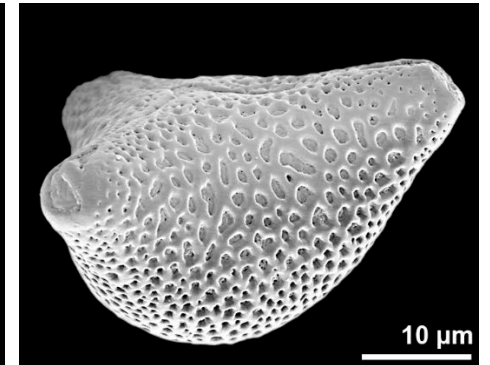


*Galanthus nivalis* (dry pollen)

convex triangular

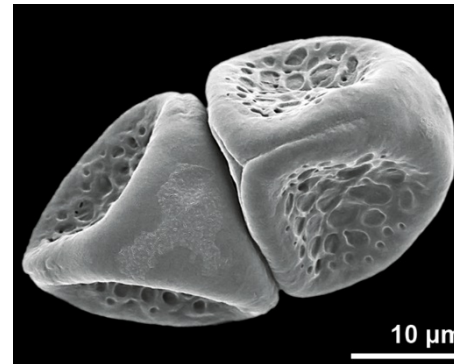


*Cardiospermum halicacabum*

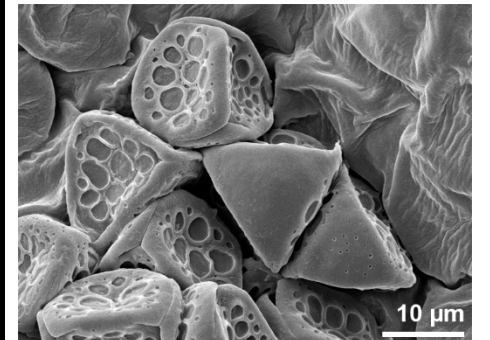


*Cardiospermum corindum*

convex triangular pyramid

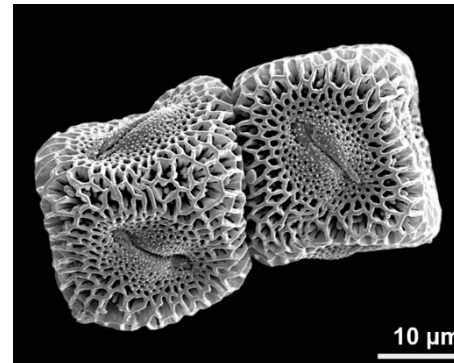


*Thesium dollineri* (dry pollen)

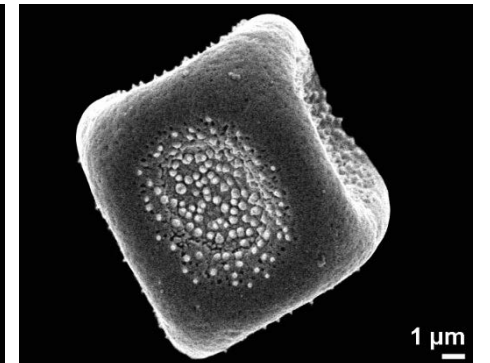


*Thesium bergeri* (dry pollen)

cubical



*Basella alba* (dry pollen)

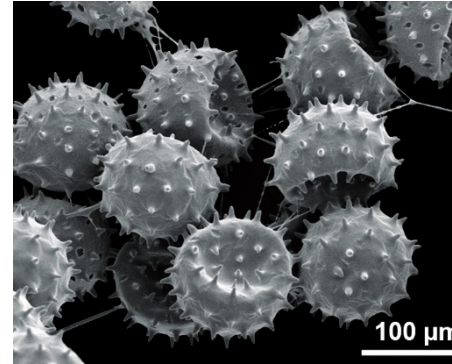


*Herniaria glabra* (dry pollen)

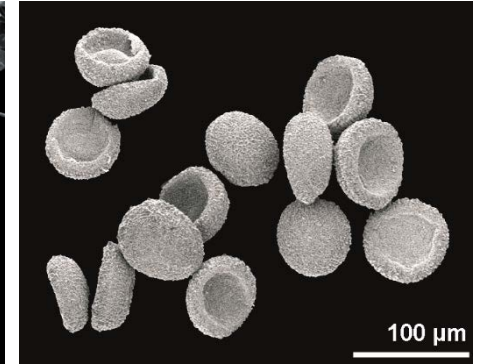


**cup-shaped**

characteristic shape of pollen grains in dry condition as a consequence of harmomegathy

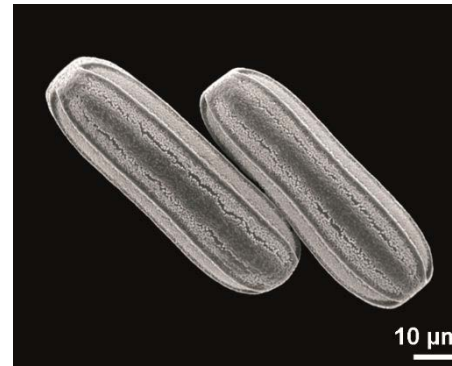


*Hibiscus schizopetalus* (dry pollen)

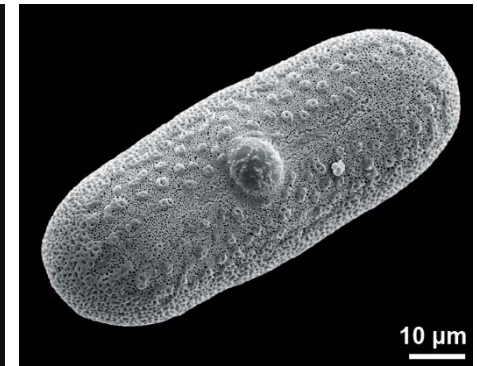


*Tsuga canadensis*

**cylindric**

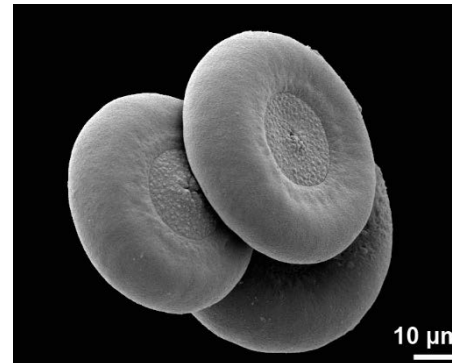


*Crossandra flava*

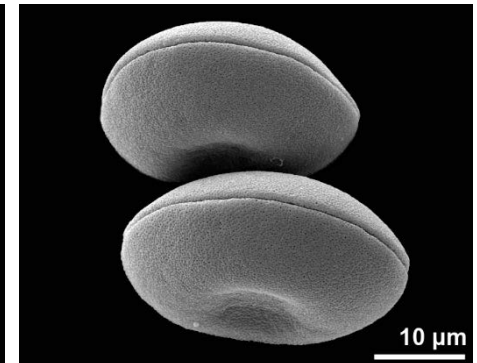


*Justicia carnea*

**disc-shaped**

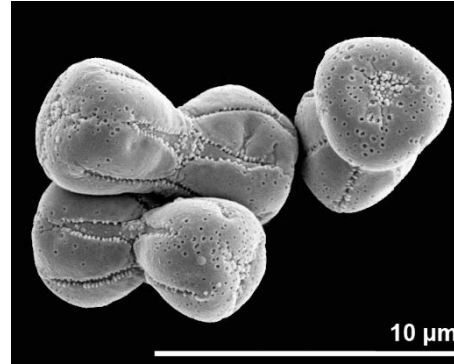


*Whitfieldia laterita* (dry pollen)

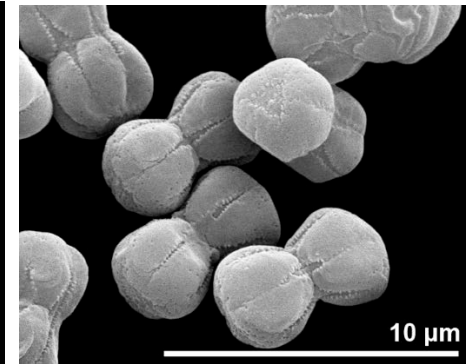


*Pedicularis portenschlagii* (dry pollen)

**dumbbell-shaped**



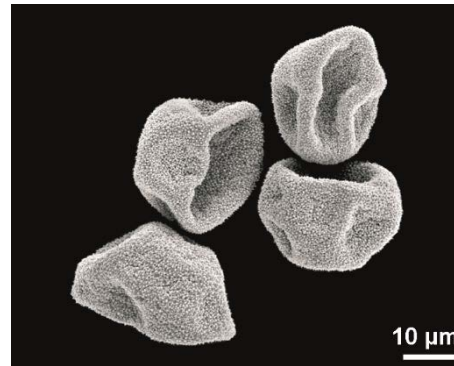
*Myosotis alpestris* (dry pollen)



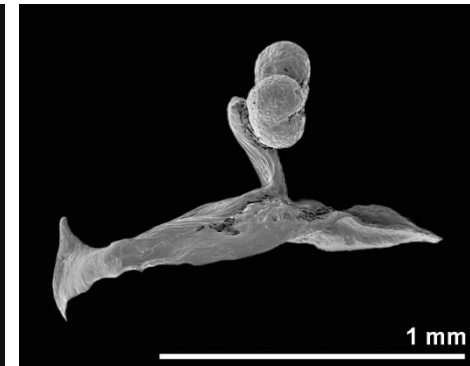
*Myosotis nemorosa* (dry pollen)

**irregular**

*Comment: a general term, used in palynology describing e.g., "outline", "shape"*

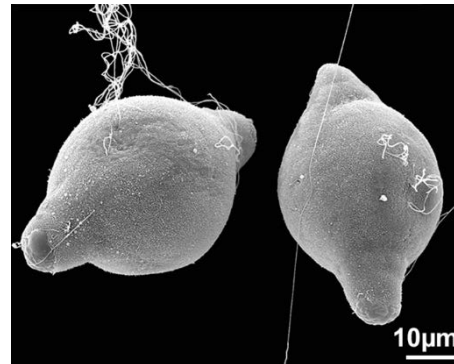


*Populus alba* (dry pollen)

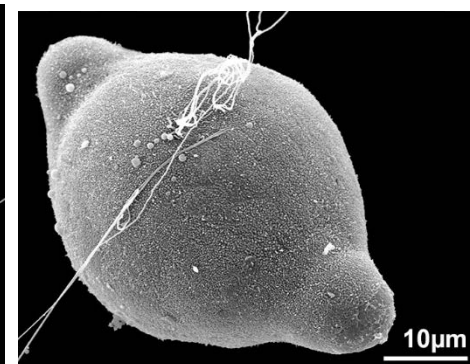


*Schoenorchis fragrans*

**lemon-shaped**

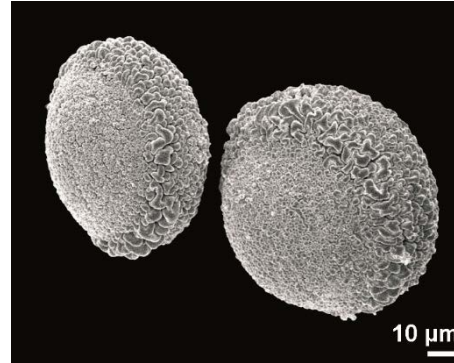


*Fuchsia paniculata*

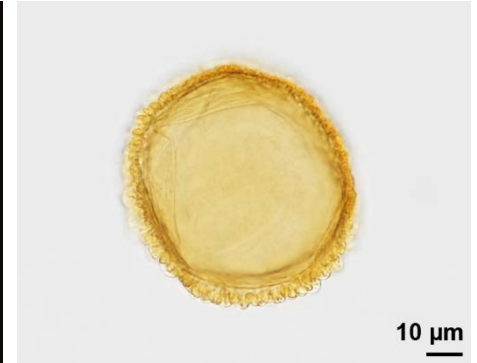


*Fuchsia paniculata*

monosaccate

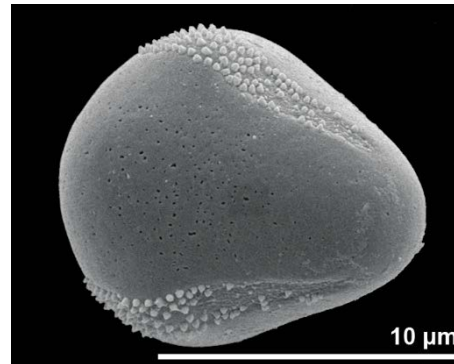


*Tsuga canadensis*

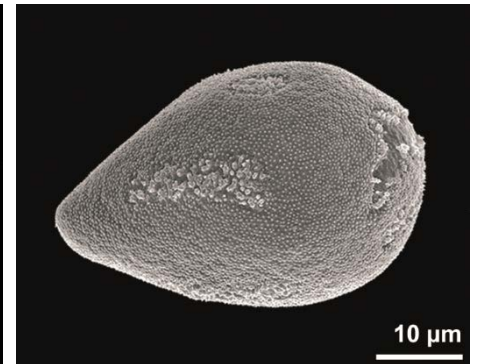


*Tsuga canadensis*

pear-shaped

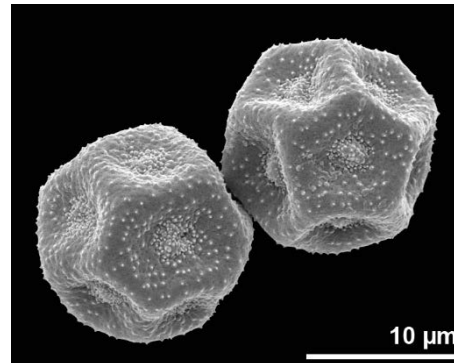


*Alkanna corcyrensis*

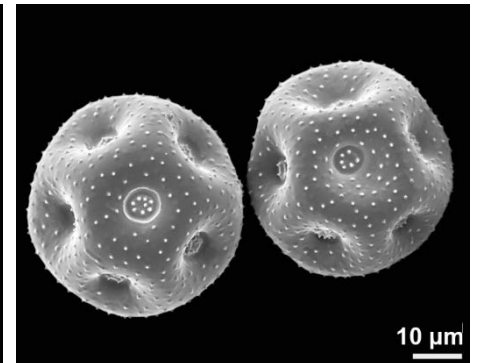


*Cyperus longus*

polygonal



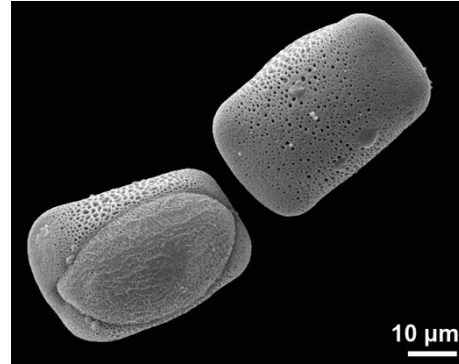
*Paronychia polygonifolia* (dry pollen)



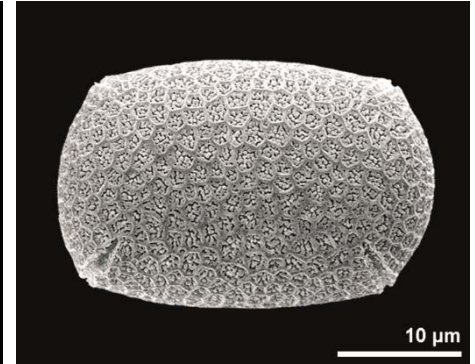
*Dianthus tergestinus* (dry pollen)



rounded cuboid



*Eremurus robustus*



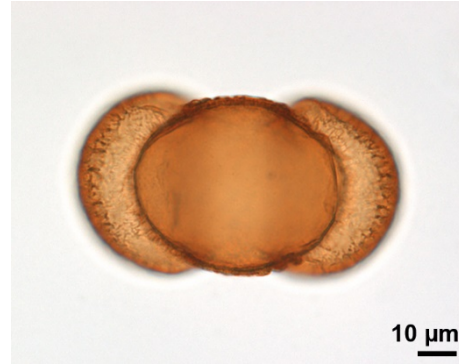
*Impatiens glandulifera*

saccate

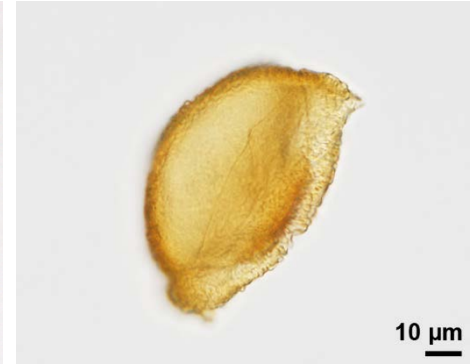
pollen grain with one or more air sacs

saccus  
(lat., pl. sacci)

exinous expansion forming an air sac



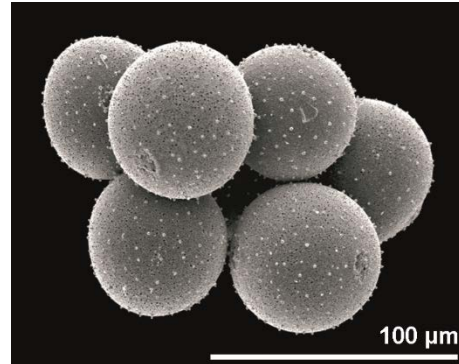
*Pinus cembra*



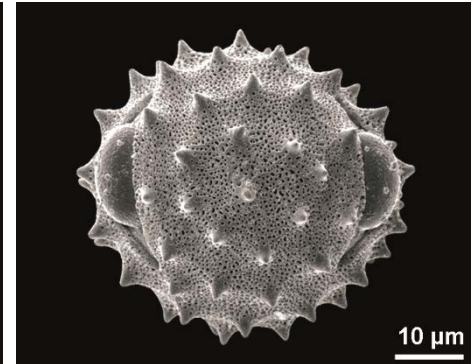
*Tsuga canadensis*

spheroidal

*Comment: a general term, used in palynology describing e.g., "shape"*

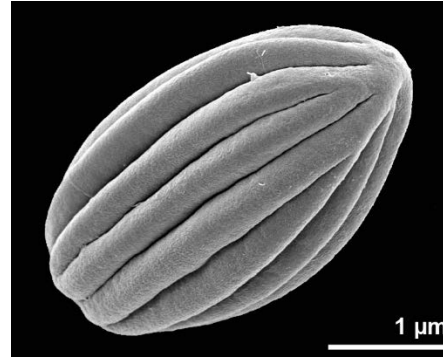


*Adansonia gregorii*

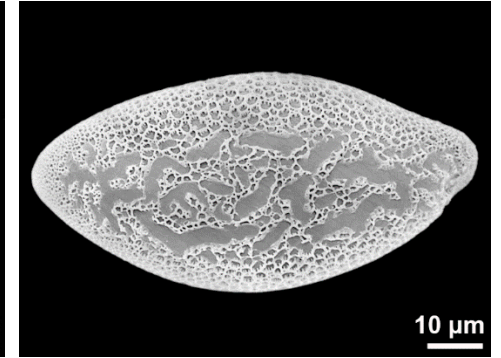


*Cirsium oleraceum*

spindle-shaped

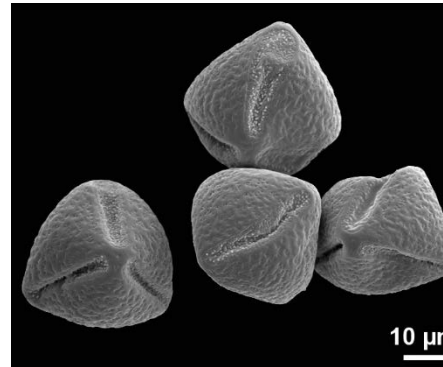


*Ephedra foeminea* (dry pollen)

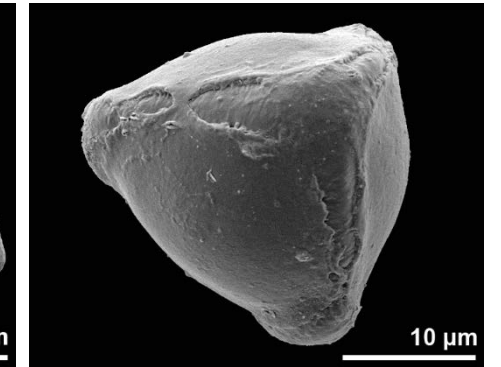


*Billbergia amoena*

triangular pyramid

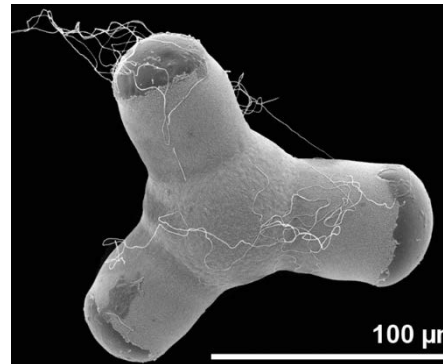


*Corydalis cheilanthifolia* (dry pollen)

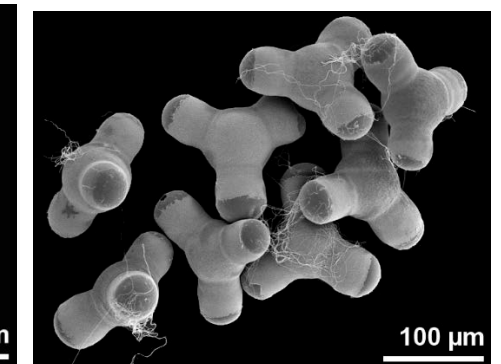


*Schoepfia schreberi*

triangular star



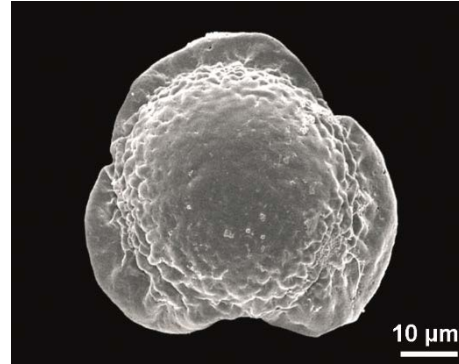
*Clarkia unguiculata*



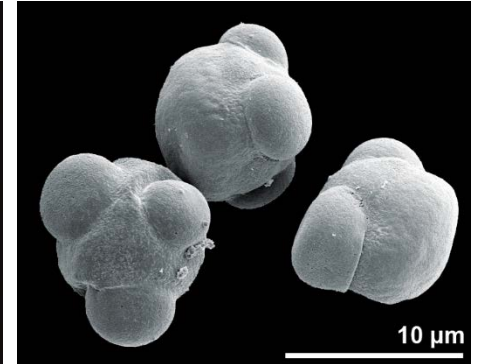
*Clarkia unguiculata*

trisaccate

pollen grain with three sacci

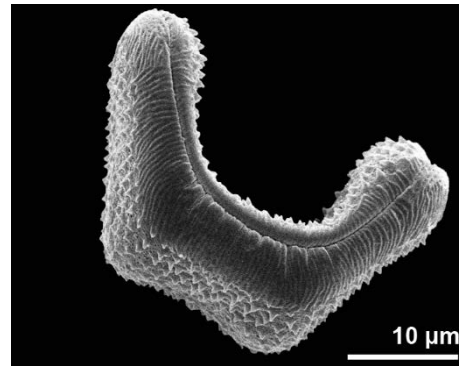


*Dacrycarpus dacrydioides*

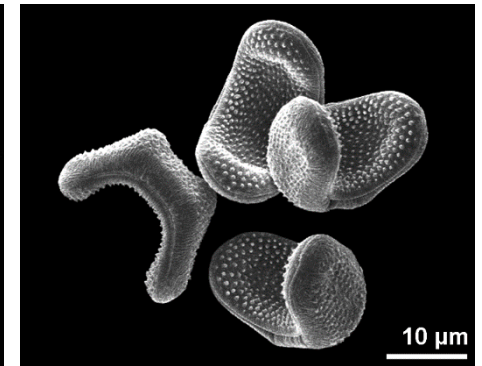


*Abies concolor*

u-shaped

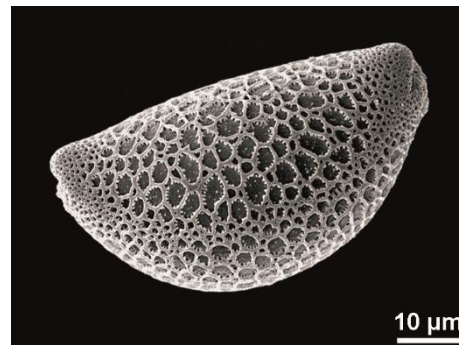


*Limnanthes douglasii* (dry pollen)

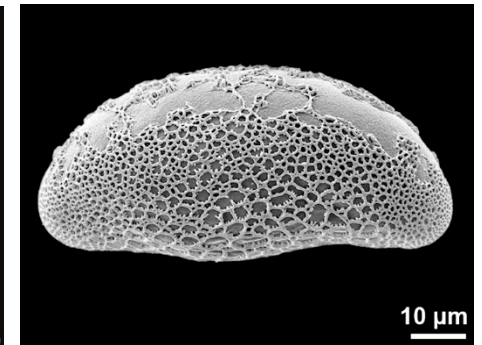


*Limnanthes douglasii* (dry pollen)

wedge-shaped



*Aechmea drakeana*



*Billbergia iridifolia*



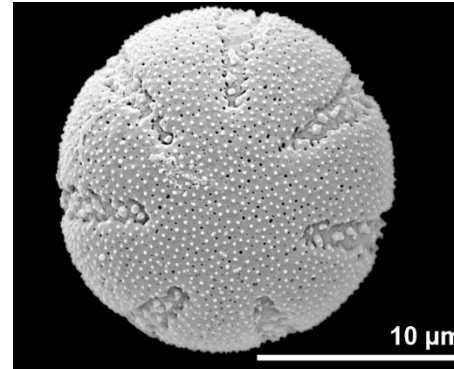
**outline in polar view (pollen in hydrated and dry condition)**

**outline**

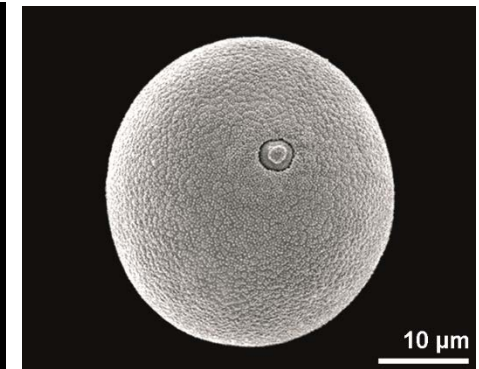
describes the contour of pollen grains in polar and/or equatorial view e.g., circular, elliptic, triangular, quadrangular, polygonal, irregular, lobate; see also: amb

**circular**

*Comment: a general term, used in palynology describing e.g., "outline"*



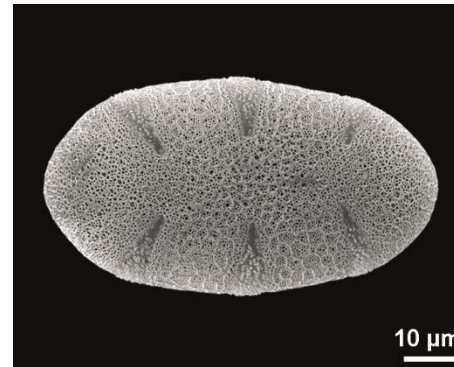
*Galium verum*



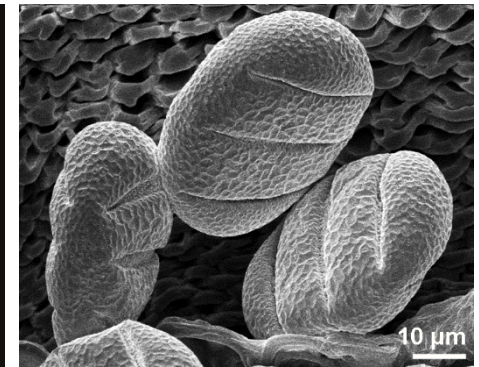
*Phleum pratense*

**elliptic**

*Comment: a general term, used in palynology describing e.g., "outline"*



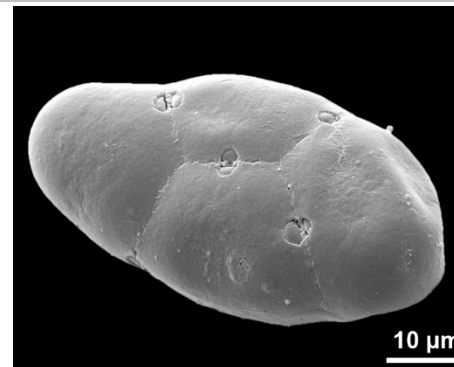
*Salvia coccinea*



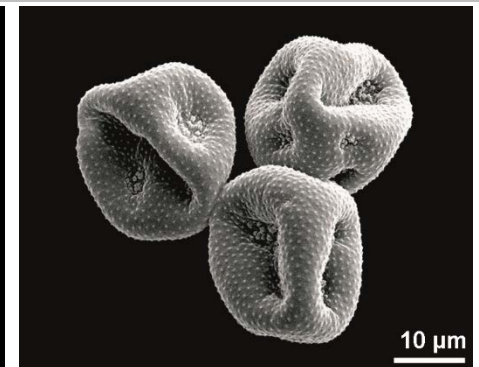
*Salvia coccinea* (dry pollen)

**irregular**

*Comment: a general term, used in palynology describing e.g., "outline", "shape"*



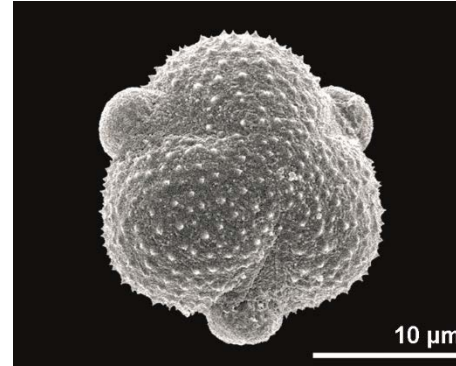
*Periploca gracilis* (tetrad)



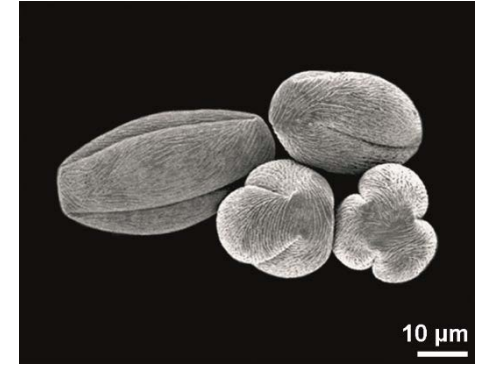
*Thalictrum minus* (dry pollen)

**lobate**

outline in polar view of a pollen grain with bulged interapertural areas (mainly in dry pollen grains)



*Artemisia pontica*



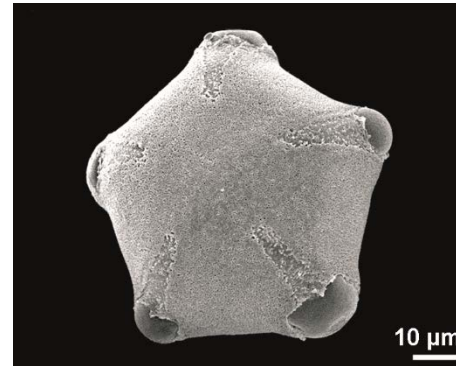
*Acer pseudoplatanus* (dry pollen)

**polygonal**

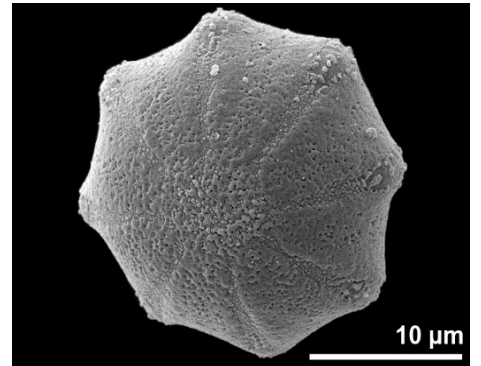
Comment: a general term, used in palynology describing e.g., "outline", "shape"

poly-

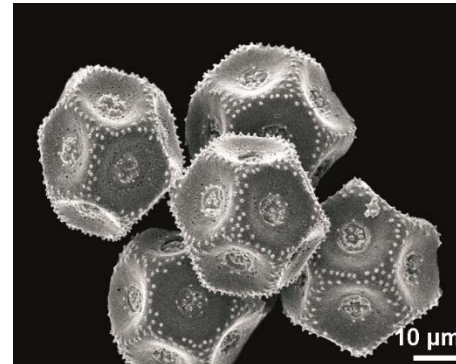
prefix for many



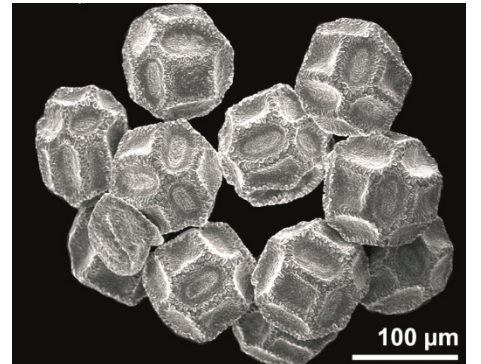
*Viola arvensis*



*Sarracenia alata*



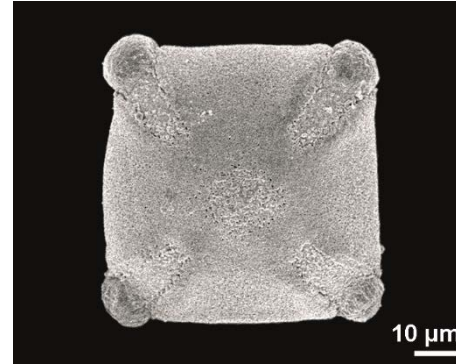
*Stellaria holostea* (dry pollen)



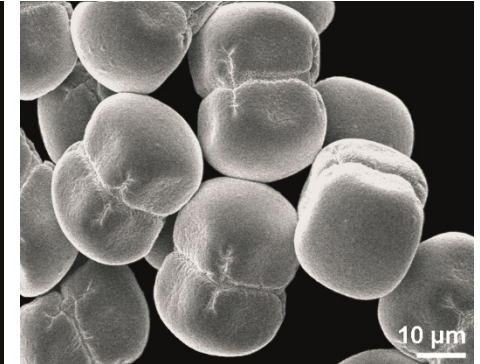
*Opuntia basilaris* (dry pollen)

**quadrangular**

*Comment: a general term, used in palynology describing e.g., "outline"*



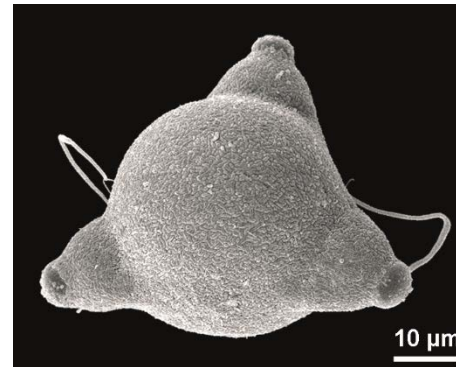
*Viola tricolor*



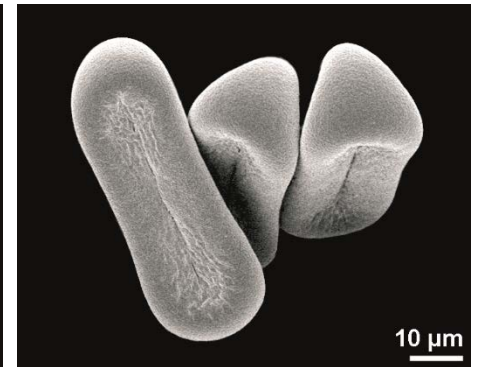
*Anchusa officinalis* (dry pollen)

**triangular**

*Comment: a general term, used in palynology describing e.g., "outline"*

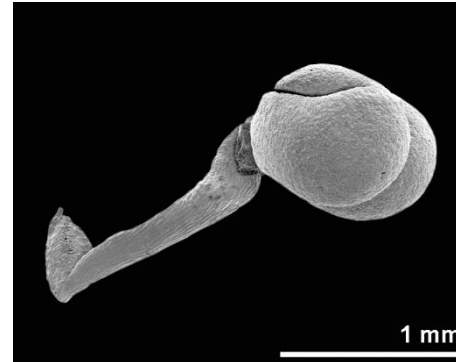


*Circaea lutetiana*

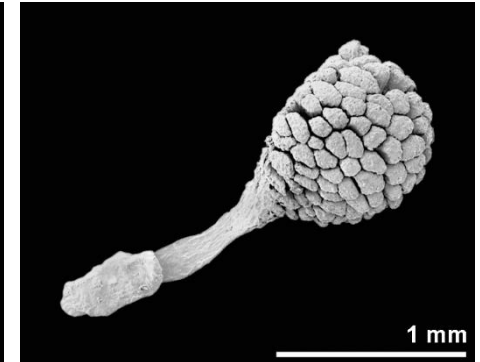


*Orlaya grandiflora* (dry pollen)

**no suitable term**



*Oncidium maizaefolium*



*Steveniella satyrioides*



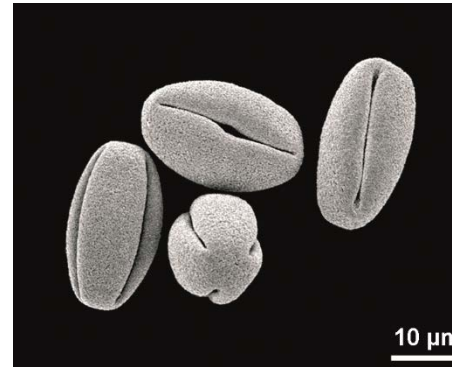
**infoldings (dry pollen)**

**infoldings**

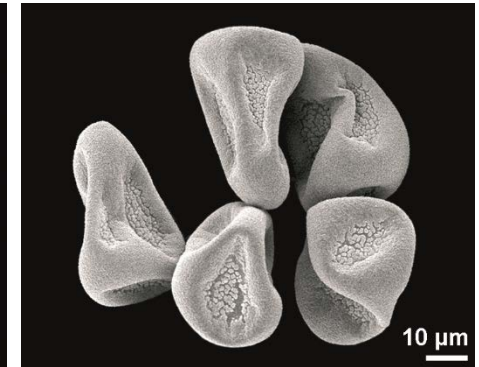
consequence of harmomegathy in dry condition, e.g., boat-shaped, cup-shaped, irregularly infolded (harmomegathy: mechanism permitting changes in shape and size of the pollen grain due to varying hydration status)

**aperture(s) sunken**

characteristic shape of pollen grains in dry condition as a consequence of harmomegathy



*Orthilia secunda* (dry pollen)



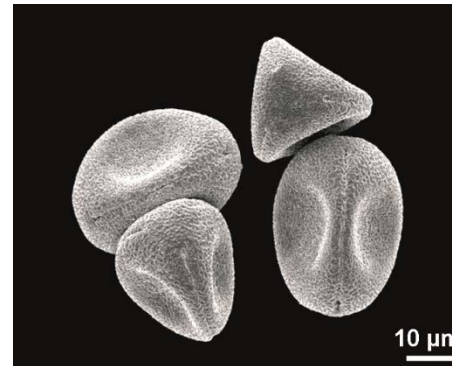
*Carex alba* (dry pollen)

**interapertural area sunken**

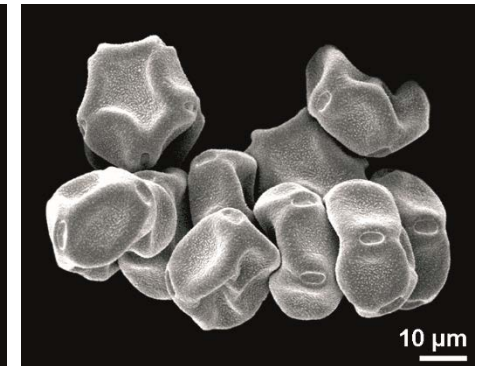
characteristic shape of pollen grains in dry condition as a consequence of harmomegathy

**interapertural area**

region between apertures



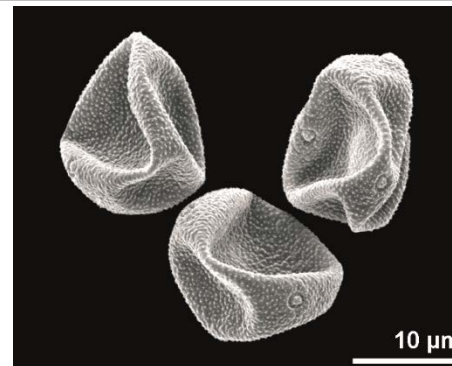
*Odontites luteus*



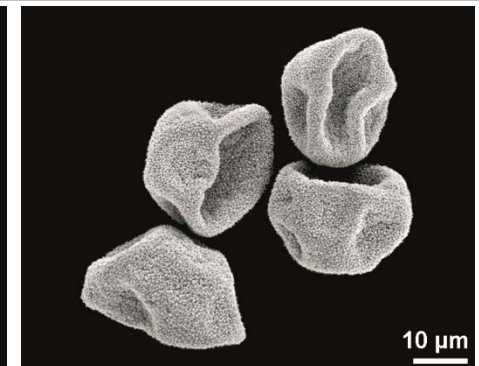
*Alnus glutinosa*

**irregularly infolded**

aperture(s) and/or interapertural area(s) sunken

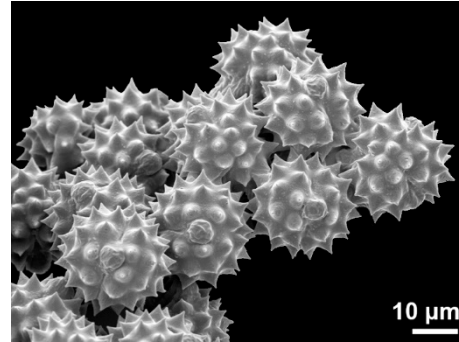


*Urtica dioica*

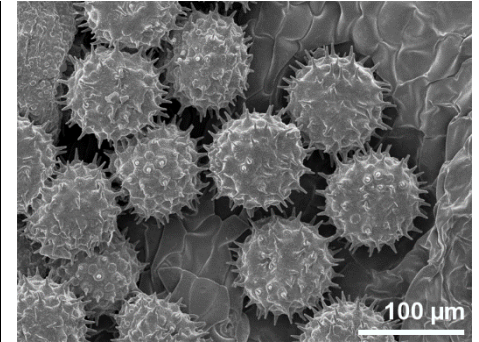


*Populus alba*

not infolded

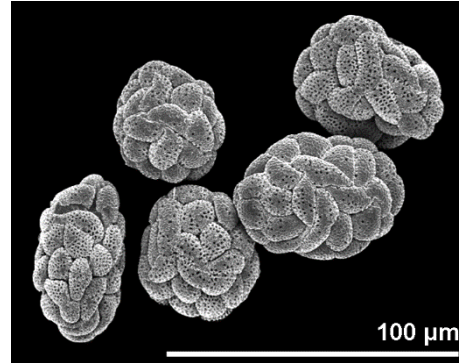


*Achillea abrotanoides*

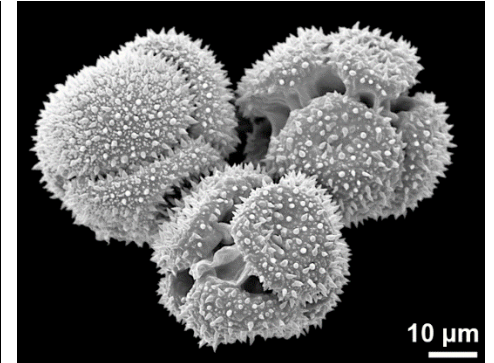


*Argyreia nervosa*

no suitable term



*Catalpa bungei*



*Drosera rotundifolia*

**dominant orientation (LM)**

**polar**

polar view; view of a pollen grain in which the pole is directed towards the observer



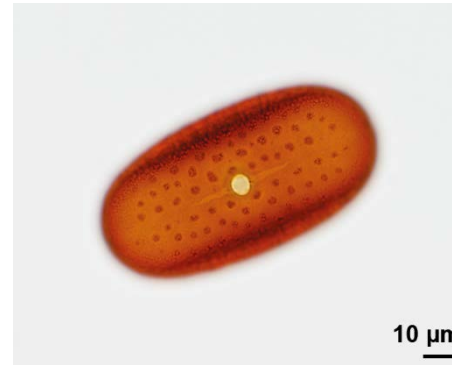
*Impatiens parviflora*



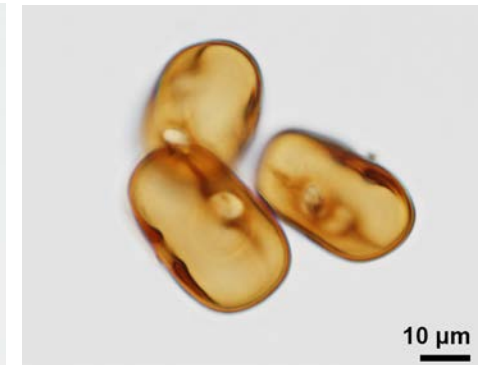
*Tilia tomentosa*

**equatorial**

equatorial view; view of a pollen grain where the equator is directed towards the observer



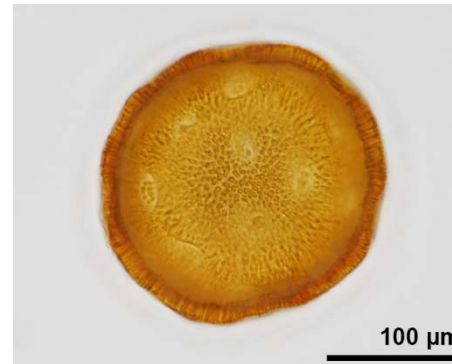
*Justicia carnea*



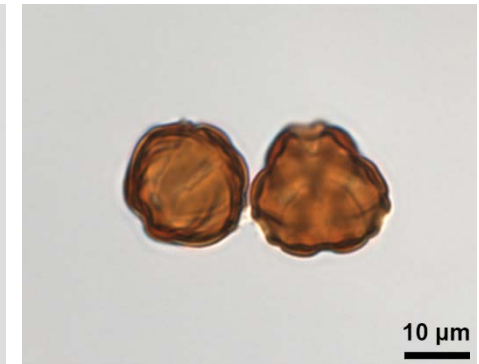
*Lathyrus pratensis*

**oblique**

oblique view; view of a pollen grain neither in polar nor in equatorial view



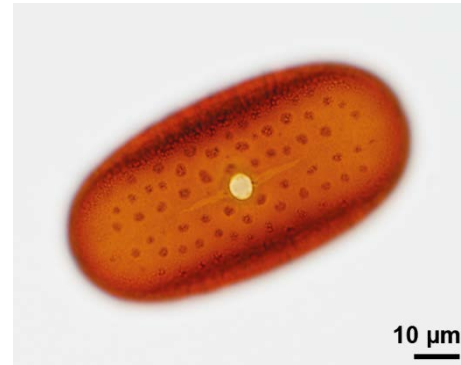
*Calystegia sepium*



*Lythrum salicaria*

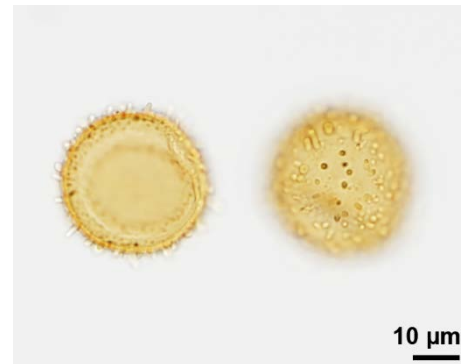
**ornamentation and structure (LM, SEM, TEM and peculiarities)**

<b>ornamentation</b>	applied in palynology to surface features
structure	the stratification of a pollen wall
sculpture	ornamentation elements on the pollen surface, e.g., echini, bacula, clavae, verrucae
<b>LM</b>	light microscope
<b>ornamentation LM</b>	surface features, that can be described up to the resolution limit of the light microscope (LM)
<b>areolate</b>	pollen wall with areolae



*Justicia cranea*

<b>baculate</b>	pollen wall with bacula longer and/or wider than 1 µm
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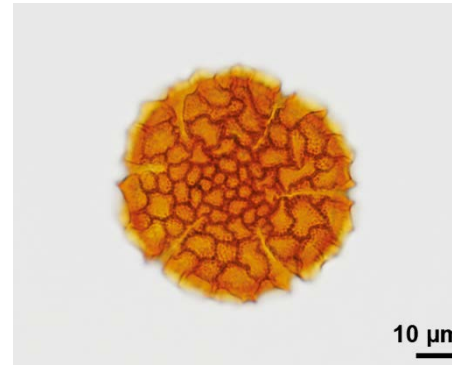


*Nymphaea alba*

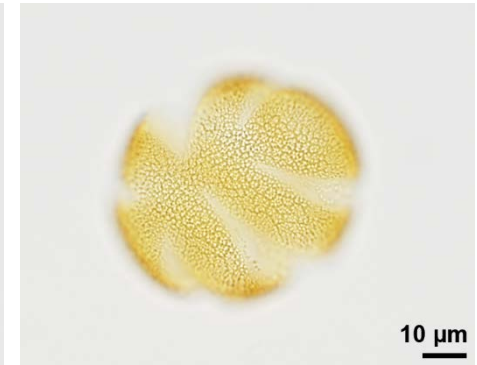


**bireticulate**

reticulate ornamentation, where the lumina of the coarse-meshed reticulum are filled by a fine-meshed reticulum



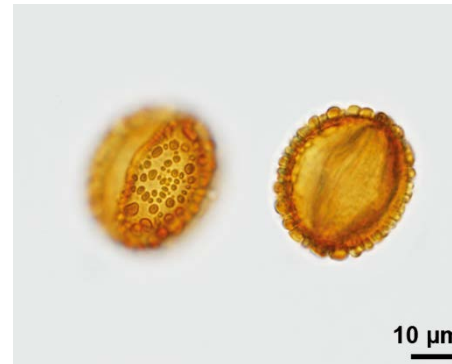
*Ocimum basilicum*



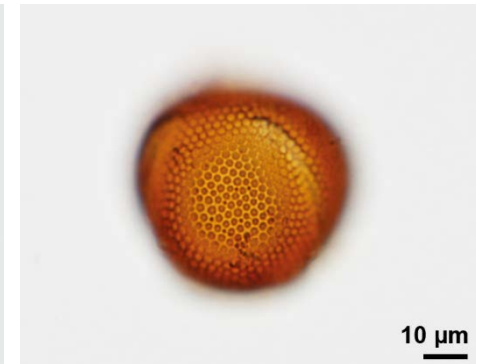
*Salvia hians*

**clavate**

pollen wall with clavae longer and/or wider than 1 µm



*Ilex* sp.



*Linum* sp.

**clypeate**

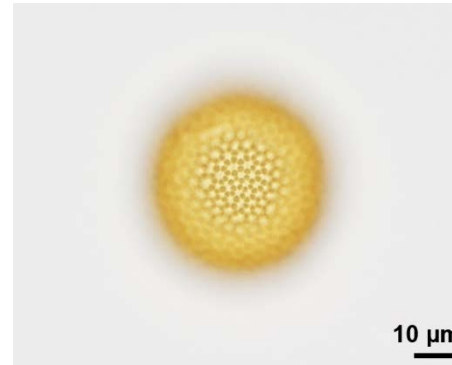
pollen wall with clavae longer and/or wider than 1 µm



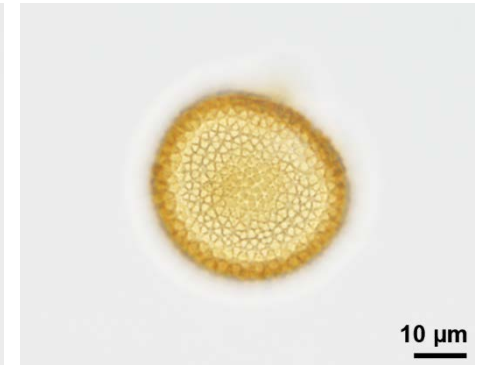
*Proboscidea fragrans*

**croton pattern**

special type of reticulum cristatum formed by regularly arranged suprasculpture elements on muri



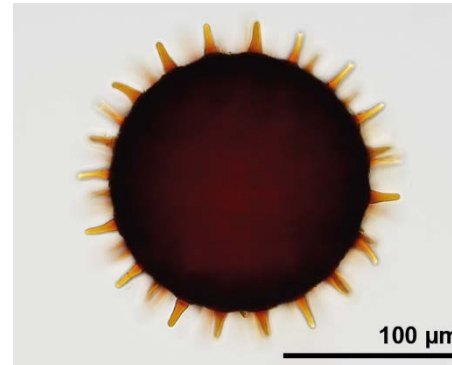
*Croton triqueter*



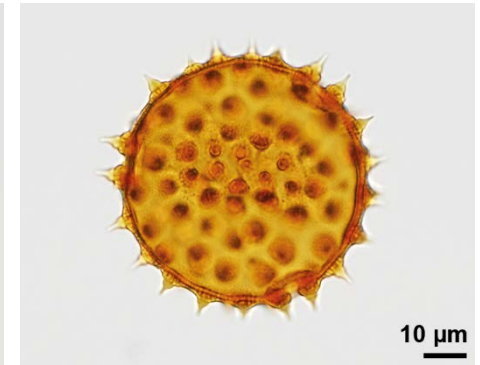
*Garcia nutans*

**echinate**

pollen wall with echini longer and/or wider than 1 μm



*Pavonia multiflora*



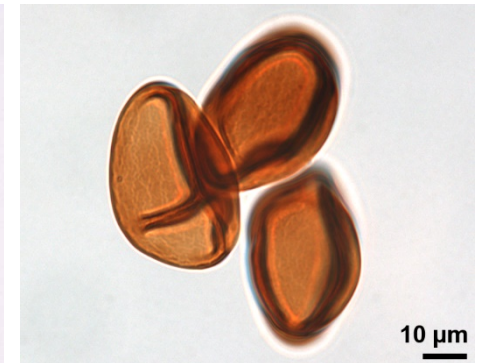
*Abutilon megapotamicum*

**fossulate**

pollen wall with fossulae



*Amorphophallus palawanensis*



*Amorphophallus asterostigmatus*

**foveolate**

pollen wall with foveolae



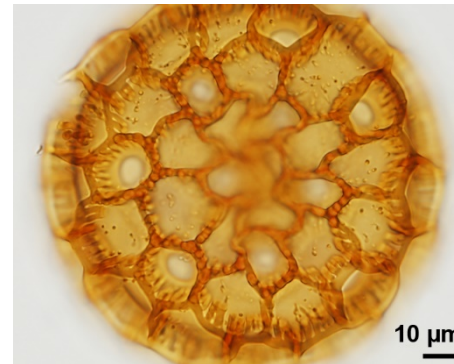
*Bellevalia ciliate*



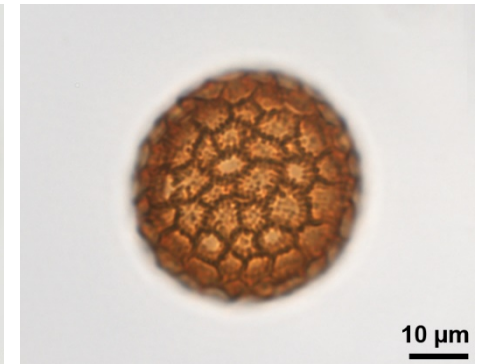
*Muscari* sp.

**free-standing columellae**

columellae not covered by a tectum in semitectate pollen grains



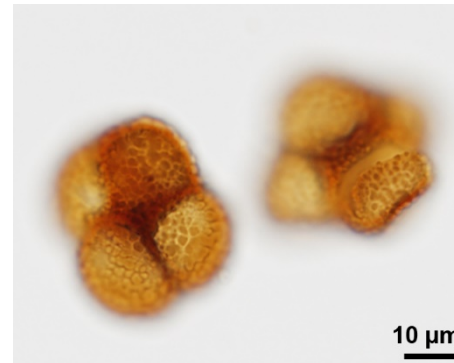
*Cobaea scandens*



*Persicaria lapathifolia*

**gemmate**

pollen wall with gemmae more than 1 µm in diameter



*Calluna vulgaris*

**granulate**

pollen wall with granula

*Comment: not to be confused with "granular", which is a feature of the pollen wall structure*



*Quercus pubescens*

**heterobrochate**

reticulate pollen wall with lumina of different sizes

*Antonym: homobrochate*



*Bessera elegans*



*Plectranthus floribundus*

**homobrochate**

reticulate pollen wall with lumina of uniform size

*Antonym: heterobrochate*



*Impatiens parviflora*

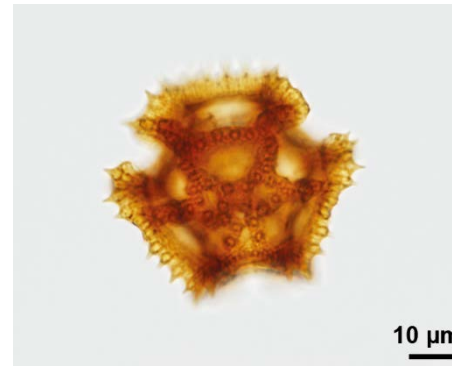


*Lavandula sp.*

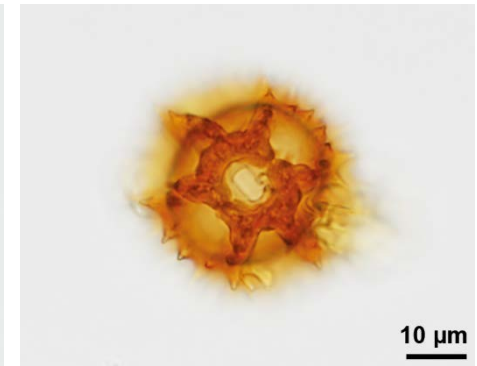


**lophate**

pollen wall with coarse meshed pattern formed by lophae and lacunae



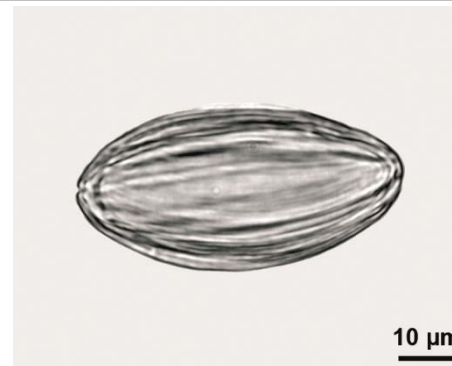
*Tragopogon orientalis*



*Prenanthes purpurea*

**plicate**

pollen wall with plicae



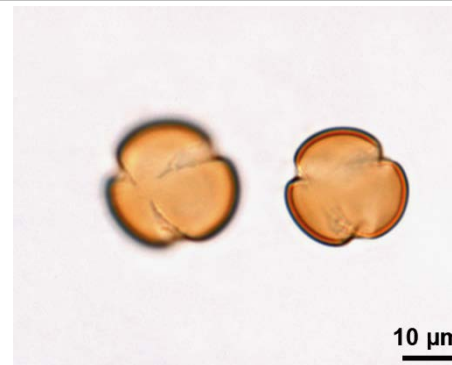
*Ephedra* sp.



*Spathiphyllum minor* (hydrated pollen)

**psilate**

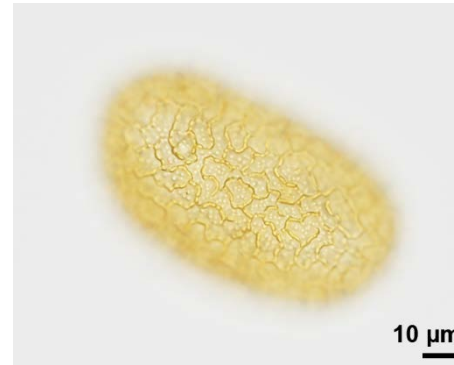
pollen wall with smooth surface



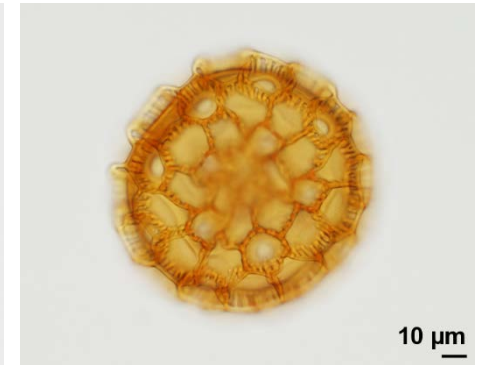
*Lamium album*

**reticulate**

pollen wall with reticulum



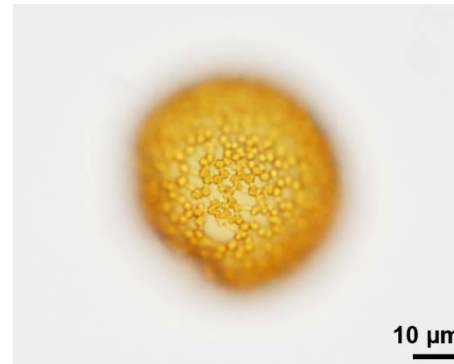
*Iris domestica*



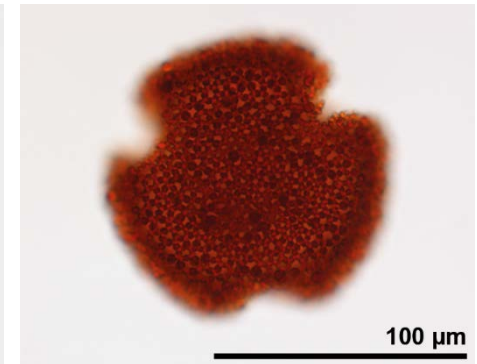
*Cobaea scandens*

**reticulum cristatum**

special type of reticulum; muri with prominent suprasculpture



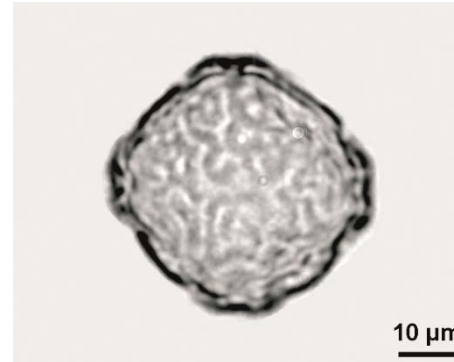
*Phaleria capitata*



*Geranium pratense*

**rugulate**

pollen wall with rugulae



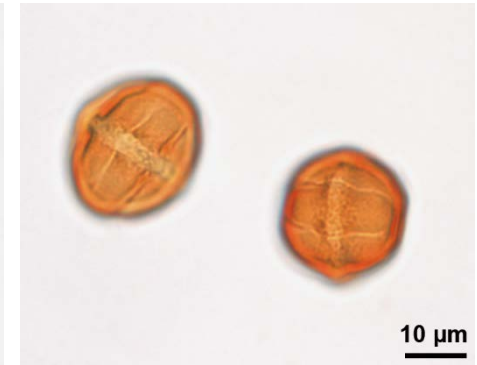
*Zelkova* sp. (fossil)

**scabrate**

term used for light microscopy only, describing minute sculpture elements of undefined shape and of a size close to the resolution limit of the light microscope



*Betula humilis*



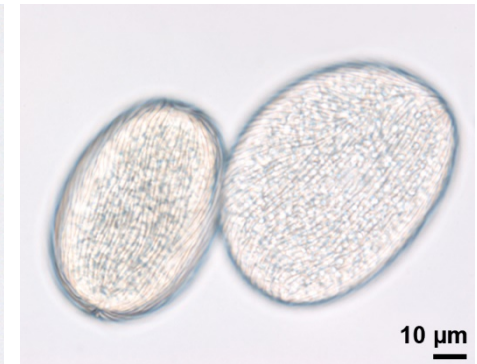
*Sanguisorba officinalis*

**striate**

pollen wall with striae



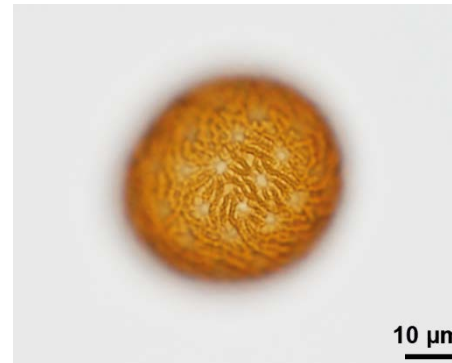
*Acer pseudoplatanus*



*Amorphophallus interruptus* (hydrated)

**striato-reticulate**

ornamentation intermediate between striate and reticulate



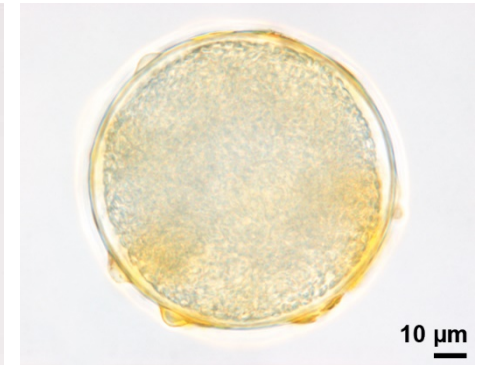
*Polemonium caeruleum*

**verrucate**

pollen wall with verrucae



*Corydalis cava*



*Amorphophallus stuhlmannii*

**nexine. sexine**

**nexine**

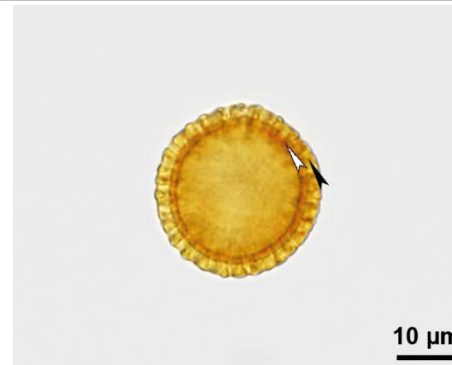
term used for light microscopy, describing the inner, unstructured layer of the exine

**sexine**

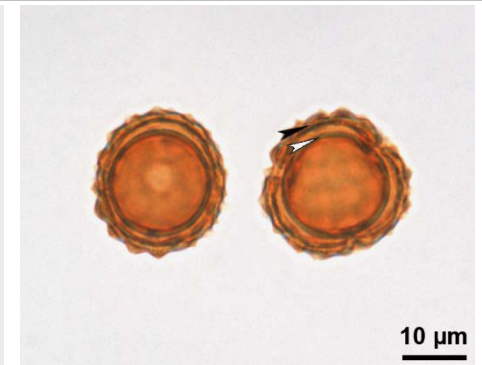
term used for light microscopy, describing the structured/sculptured outer layer of the exine

**present or absent**

sexine (black arrow)  
nexine (white arrow)



*Ligustrum vulgare*



*Xanthium saccharatum*



**SEM**

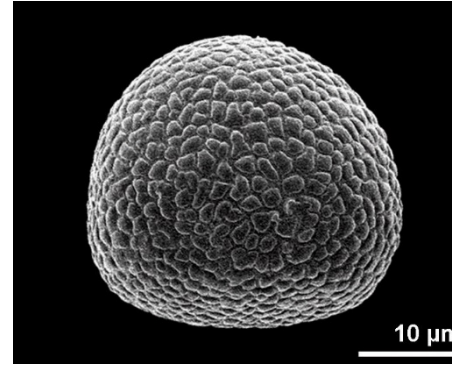
scanning electron microscope

**ornamentation SEM**

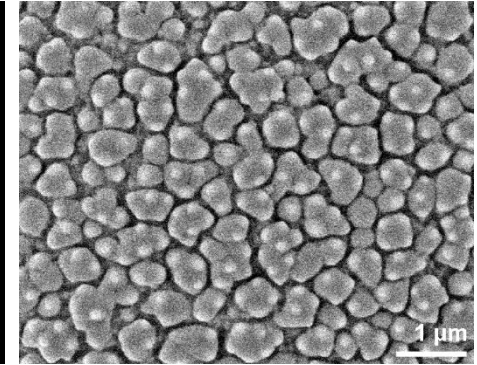
surface features, that can be described up to the resolution limit of the SEM

**areolate**

pollen wall with areolae



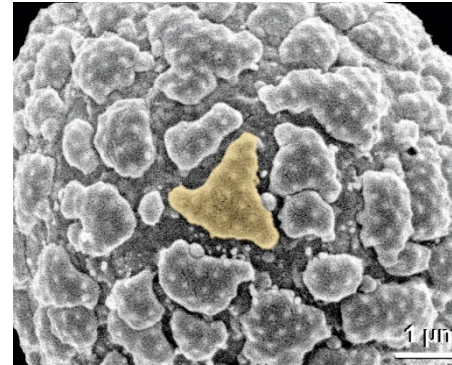
*Dracunculus vulgaris*



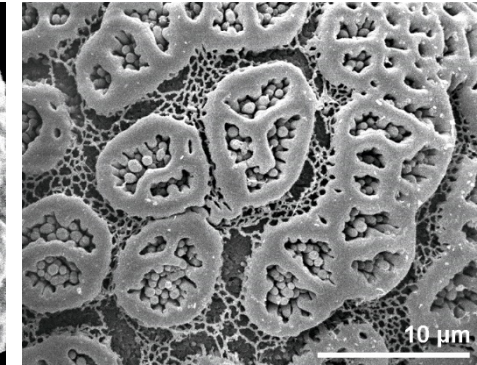
*Cynodon dactylon*

areola  
(lat., pl. areolae)

insular ornamentation element



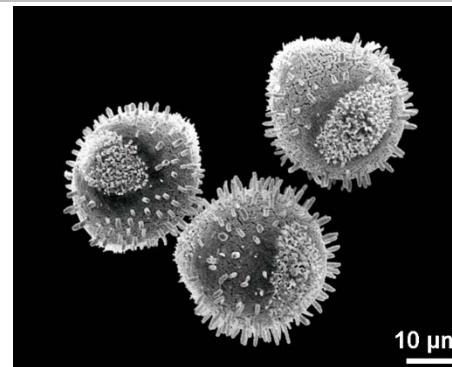
*Peperomia rubella*



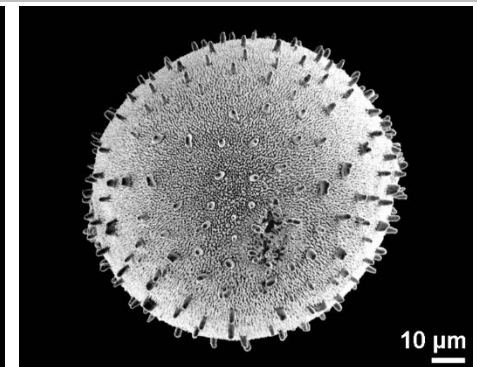
*Poikilacanthus macranthus*

**baculate**

pollen wall with bacula longer and/or wider than 1 μm



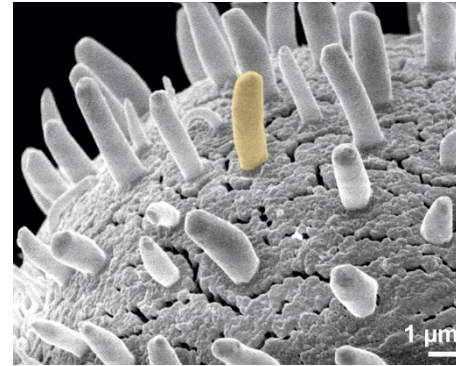
*Viscum laxum*



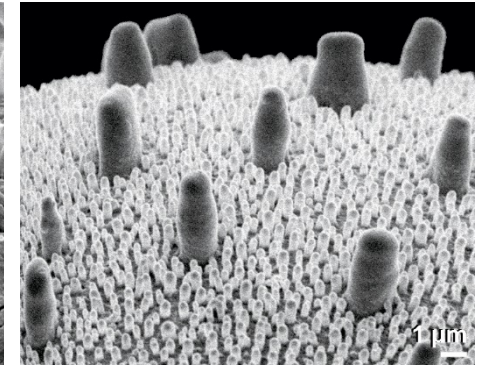
*Erythrochiton brasiliensis*

baculum  
(lat., pl. bacula)

rod-like, free standing element (never pointed)



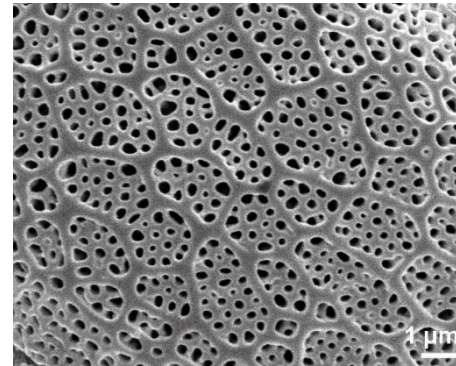
*Viscum laxum*



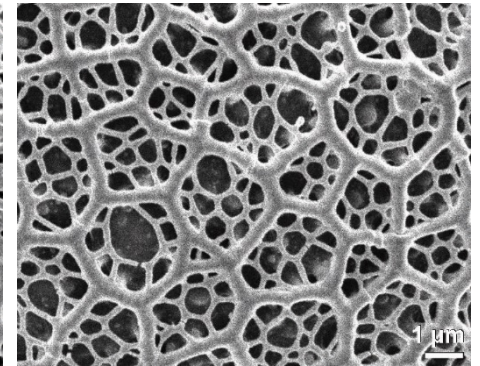
*Erythrochiton brasiliensis*

**bireticate**

reticulate ornamentation, where the lumina of the coarse-meshed reticulum are filled by a fine-meshed reticulum



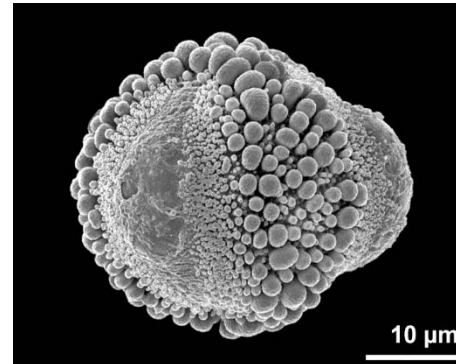
*Prunella grandiflora*



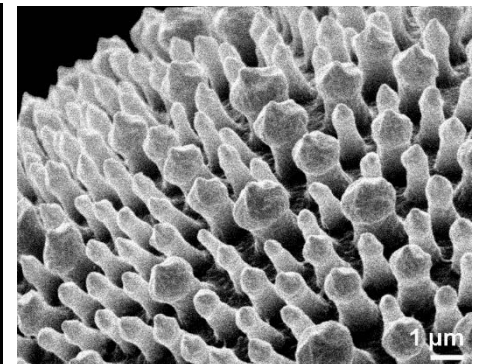
*Salvia argentea*

**clavate**

pollen wall with clavae longer and/or wider than 1 μm



*Ilex aquifolium*



*Linum flavum*

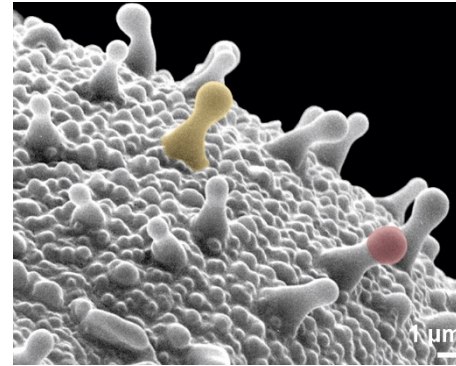


clava  
(lat., pl. clavae)

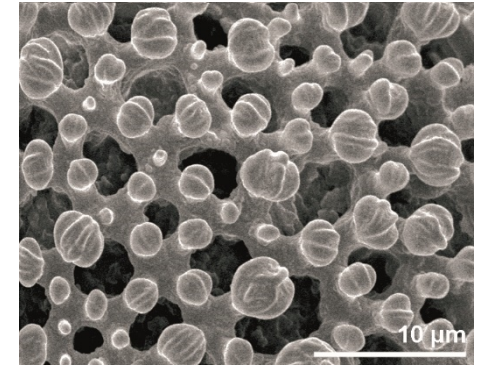
club-shaped element

caput  
(lat., pl. capita)

distal part of a clava  
(colored red)



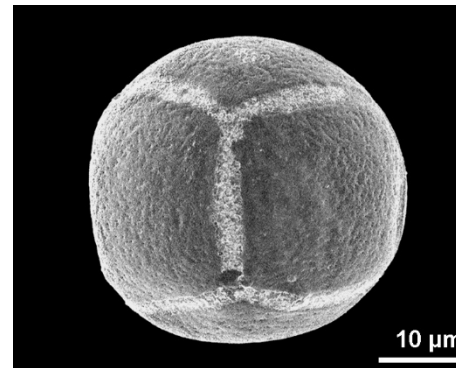
*Iris alata* (clava colored yellow)



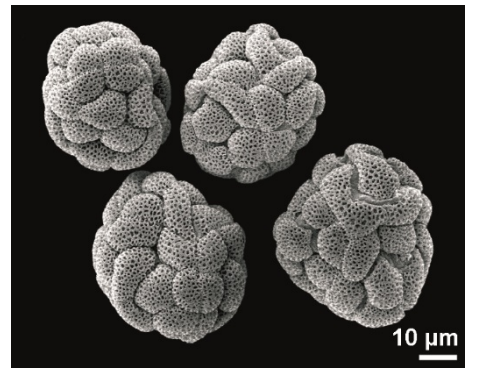
*Geranium pratense*

**clypeate**

pollen wall with clavae longer and/or wider than 1 μm



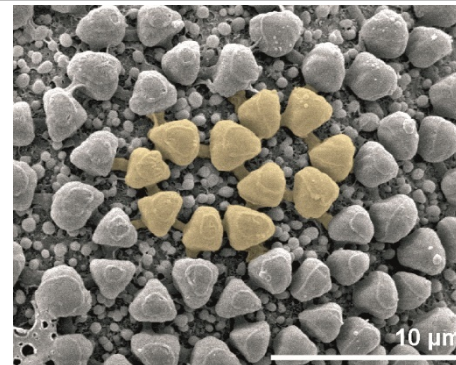
*Corydalis lutea*



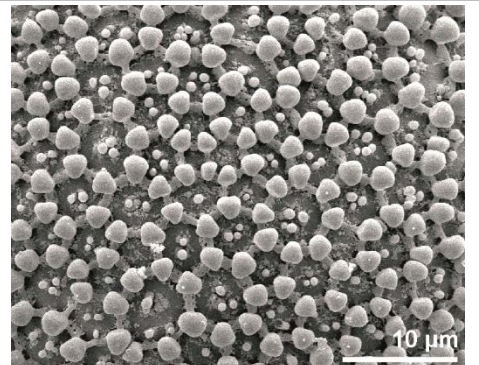
*Catalpa bignonioides* (tetrads, dry pollen)

**croton pattern**

special type of reticulum cristatum formed by regularly arranged suprasculpture elements on muri



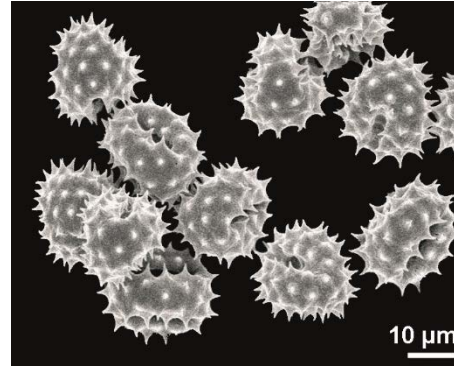
*Croton triquetrus*



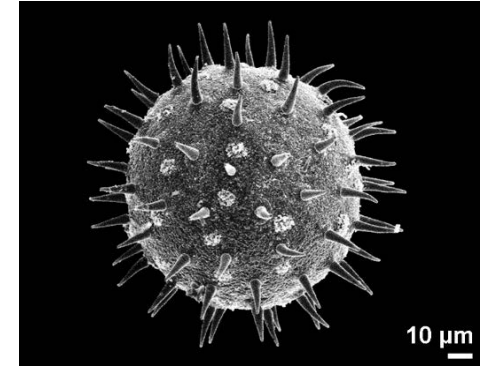
*Jatropha podagrica*

**echinate**

pollen wall with echini longer and/or wider than 1  $\mu\text{m}$



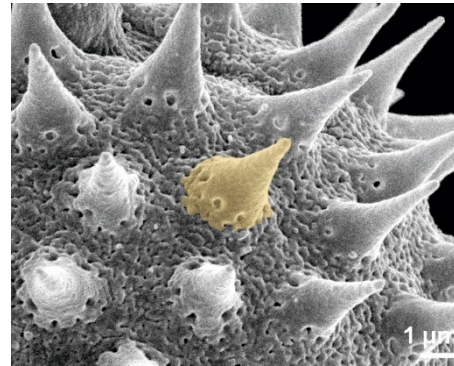
*Bellis perennis* (dry pollen)



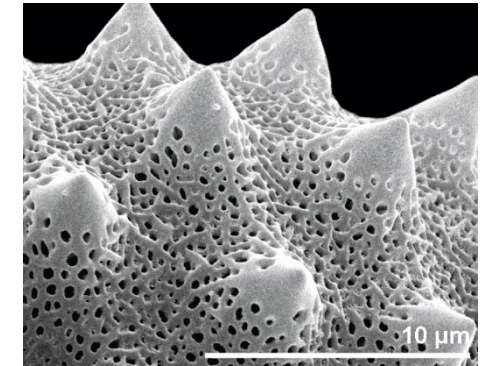
*Hibiscus trionum*

echinus  
(lat., pl. echini)

pointed ornamentation element  
Comment: the plural "echinae" is linguistically incorrect



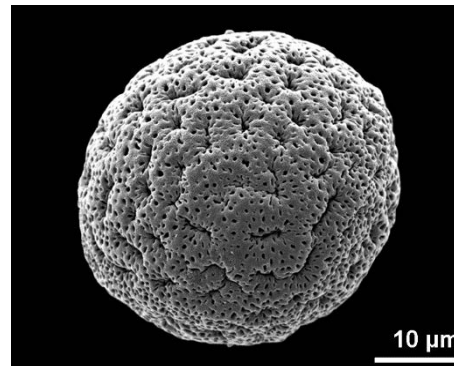
*Galinsoga ciliata*



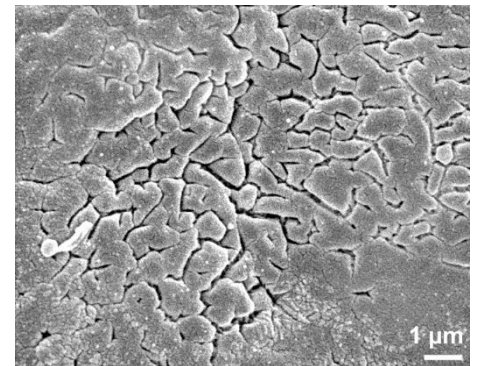
*Carduus acanthoides*

**fossulate**

pollen wall with fossulae



*Aristolochia manshuriensis*

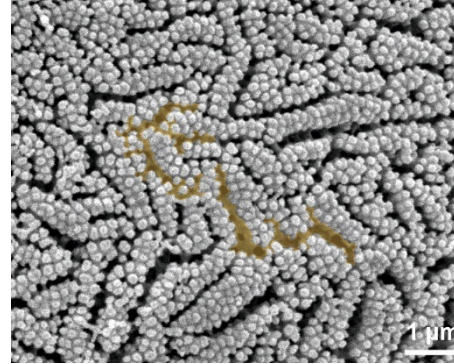


*Rhododendron hirsutum*

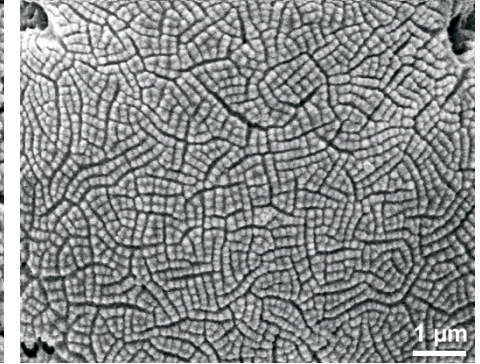


fossula  
(pl. fossulae)

irregular shaped groove



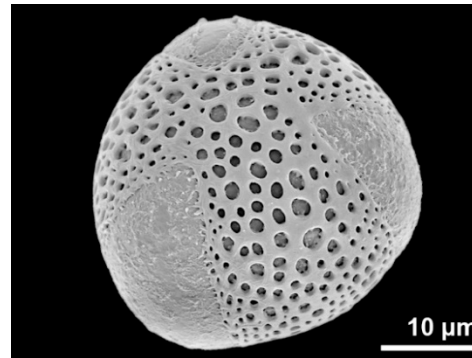
*Mendoncia albida*



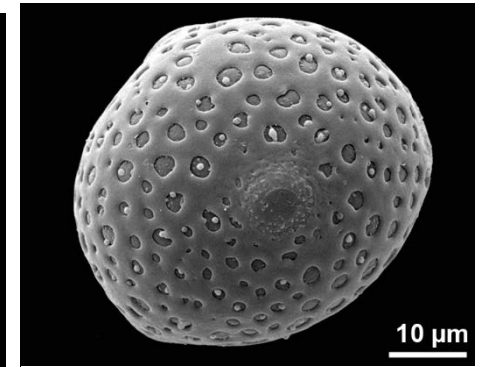
*Erica herbacea*

**foveolate**

pollen wall with foveolae



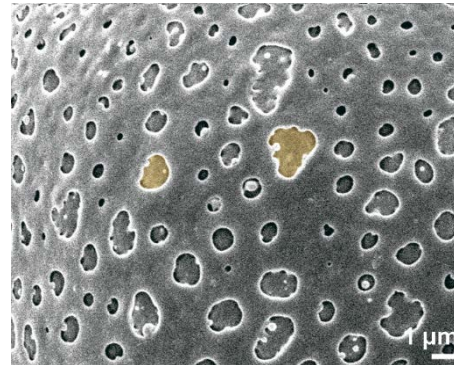
*Averrhoa bilimbi*



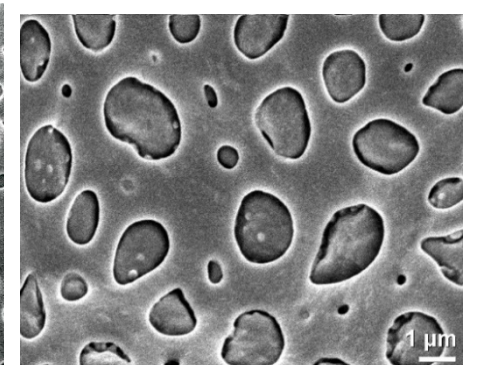
*Aechmea ampla*

foveola  
(pl. foveolae)

roundish lumen more than 1 μm in diameter; distance between two adjacent lumina larger than their diameter



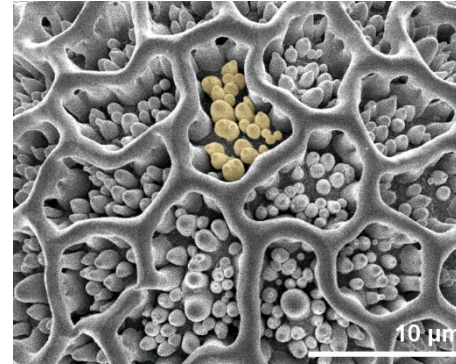
*Streptocalyx poeppigii*



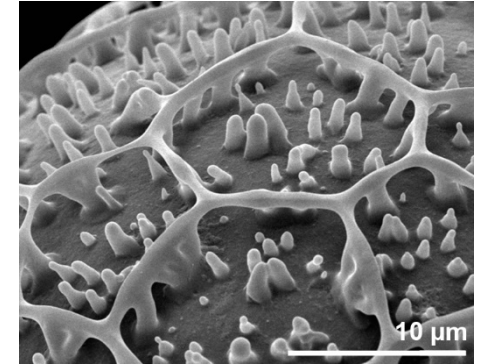
*Canistrum camacaense*

**free-standing columellae**

columellae not covered by a tectum in semitectate pollen grains



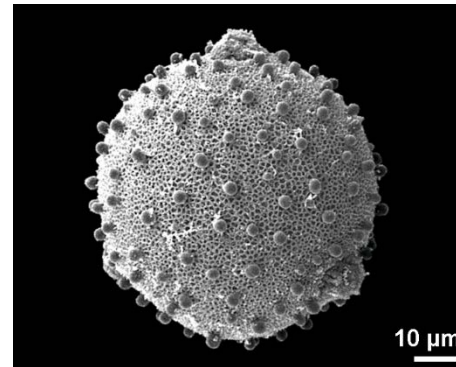
*Dipteracanthus devosianus*



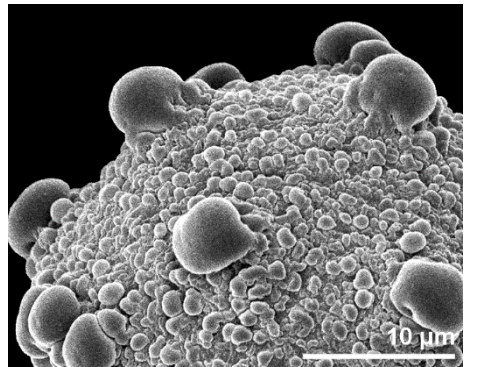
*Ruellia devosiana*

**gemmate**

pollen wall with gemmae more than 1 μm in diameter



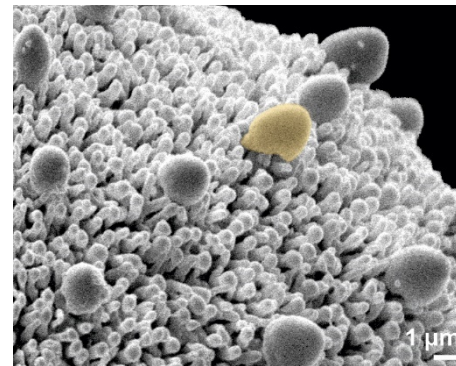
*Cephalopentandra ecirrhosa*



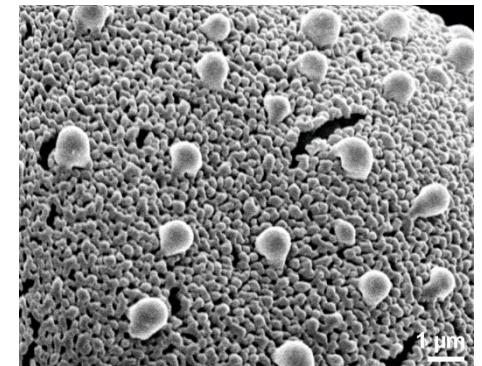
*Stenandrium dulce*

gemma  
(lat., pl. gemmae)

globular ornamentation element



*Dionaea muscipula*



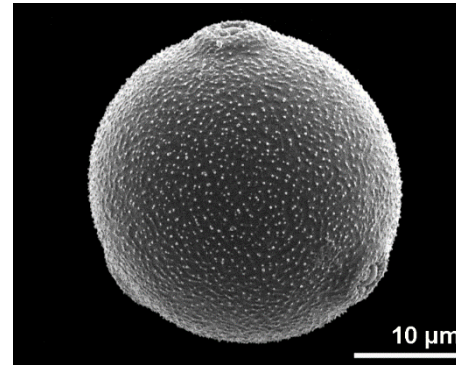
*Asarum europaeum*



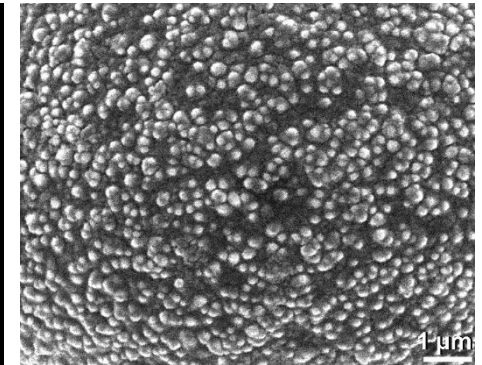
**granulate**

pollen wall with granula

*Comment: not to be confused with "granular", which is a feature of the pollen wall structure*



*Betula humilis*

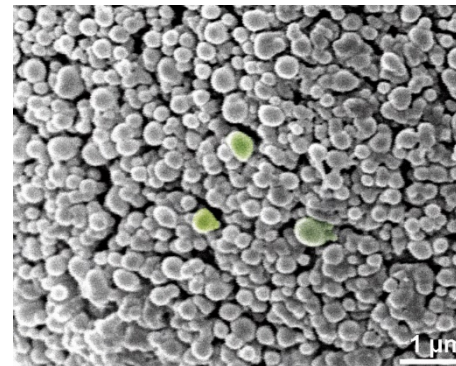


*Humulus lupulus*

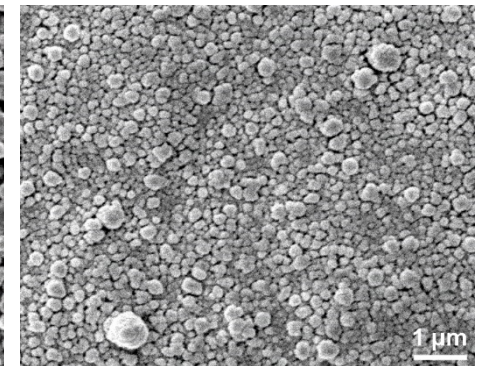
**granulum**  
(lat., pl. granula)

sculpture element of different/indefinable shape, equal or smaller than 0,1 µm in diameter (hard to outline)

*Comment: only applicable if sculpture element cannot be defined more precisely by improved microscopic resolution*



*Rhapsidophora africana*

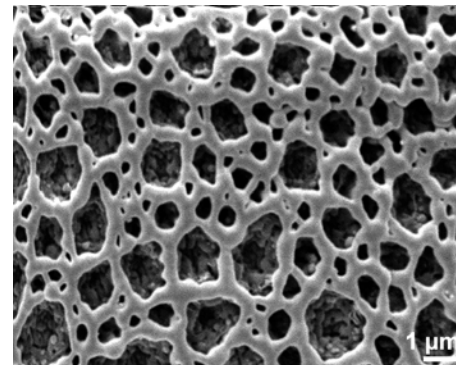


*Larix decidua*

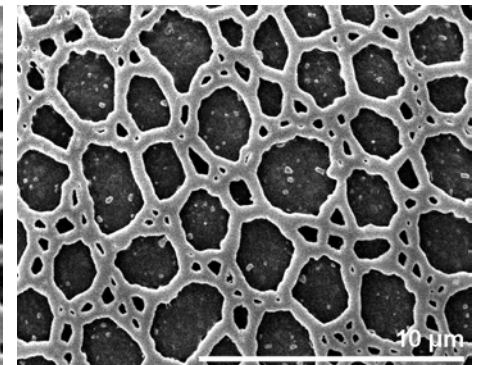
**heterobrochate**

reticulate pollen wall with lumina of different sizes

*Antonym: homobrochate*



*Anthericum ramosum*

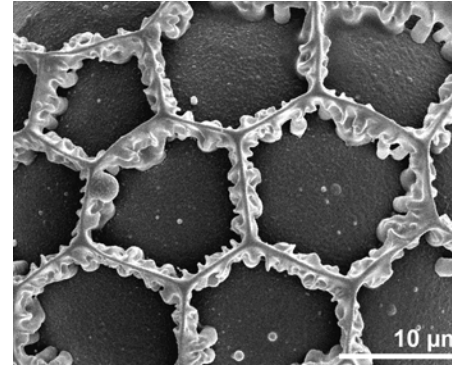


*Fritillaria meleagris*

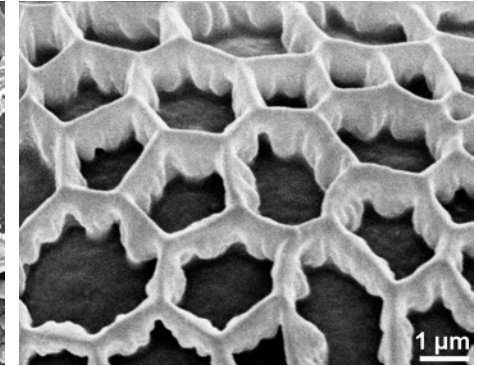
**homobrochate**

reticulate pollen wall with lumina of uniform size

*Antonym: heterobrochate*



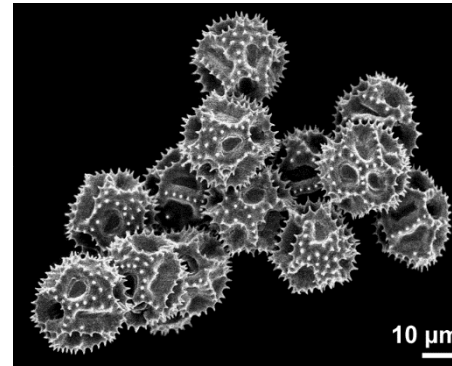
*Ruellia graecizans*



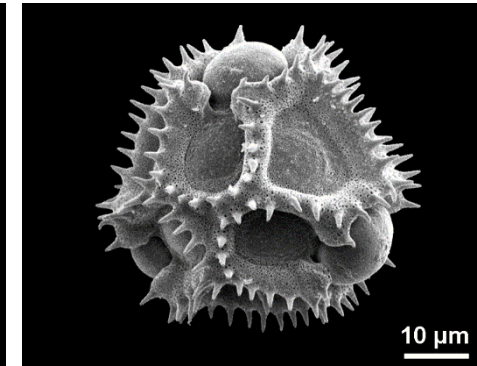
*Abeliophyllum distichum*

**lophate**

pollen wall with coarse meshed pattern formed by lophae and lacunae



*Hieracium hoppeanum* (dry pollen)



*Cichorium intybus*

lophae  
(lat., sing. lophae)

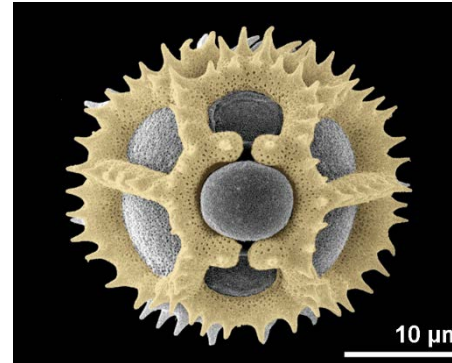
massive exine ridges

lacuna  
(lat., pl. lacunae)

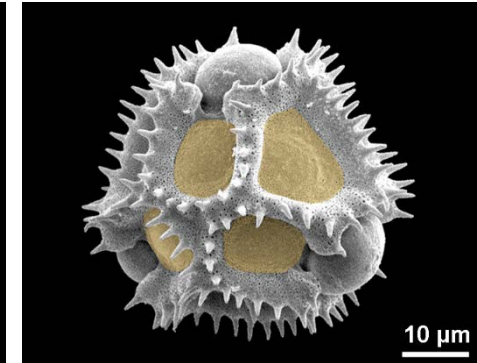
depressed area surrounded by ridges (lophae) in lophate pollen grains

lumen  
(lat., pl. lumina)

space enclosed by muri in reticulate pollen grains



*Leontodon saxatilis* (lophae colored)



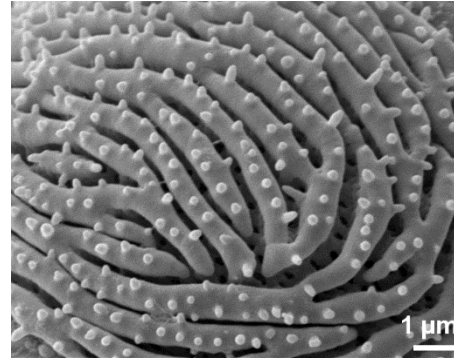
*Cichorium intybus* (lacunae colored)



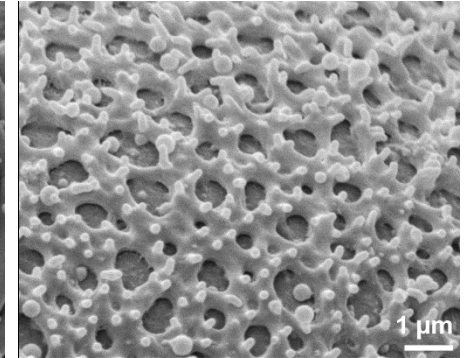
micro-

prefix for small; features between 1-0,5  $\mu\text{m}$ : microbaculate, microclavate, microechinate, microgemmate, microrugulate, microreticulate, microverrucate; not used in combination with striate and foveolate

**microbaculate**

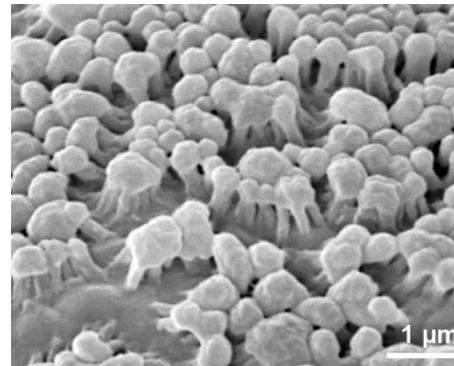


*Saxifraga androsacea*

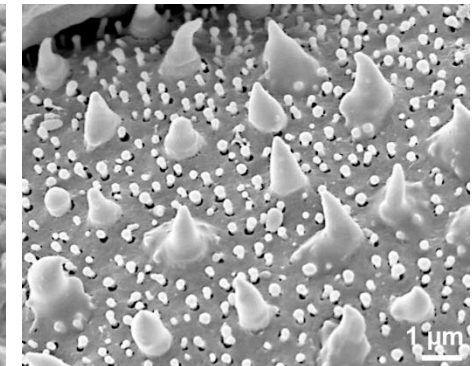


*Pistacia lentiscus*

**microclavate**

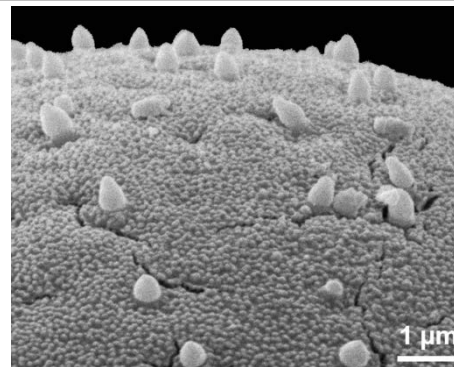


*Callisia fragrans*

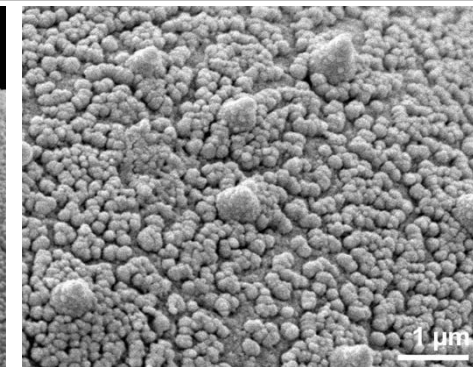


*Drosera aliciae*

**microechinate**

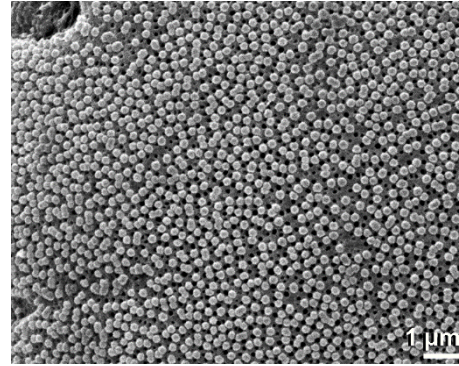


*Heloniopsis kiwanoii*

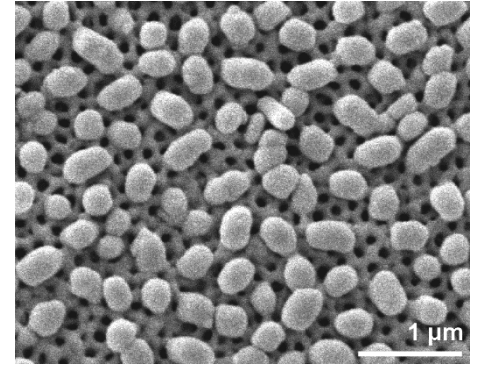


*Trillium grandiflorum*

microgemmate

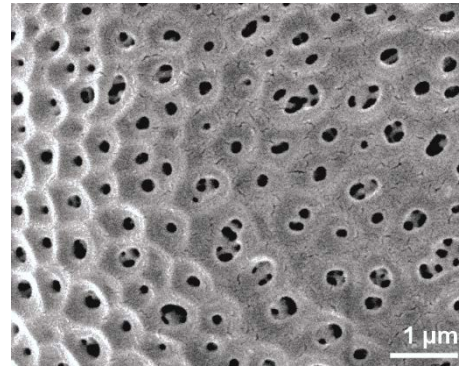


*Borago officinalis*

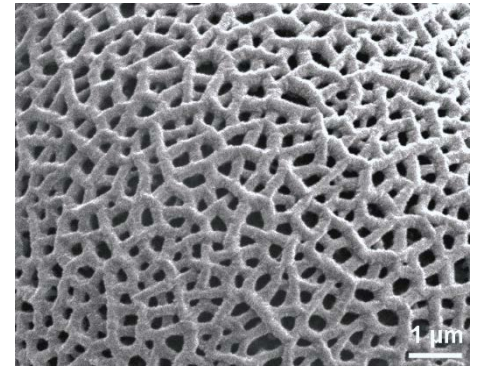


*Epilobium fleischeri*

microreticulate

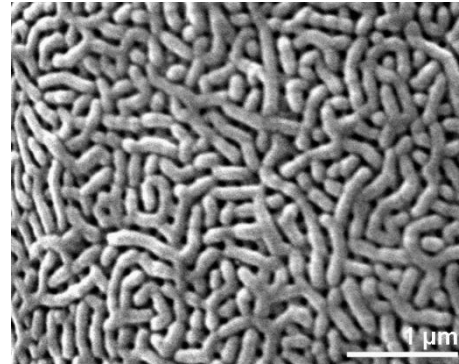


*Cytisus nigricans*

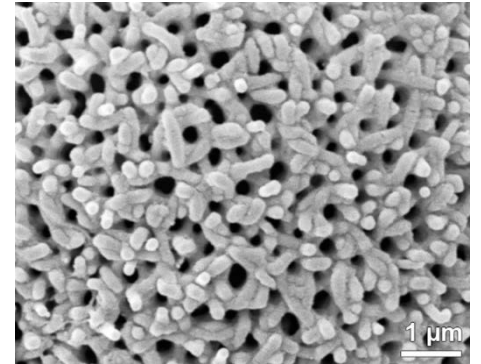


*Reseda luteola*

microrugulate

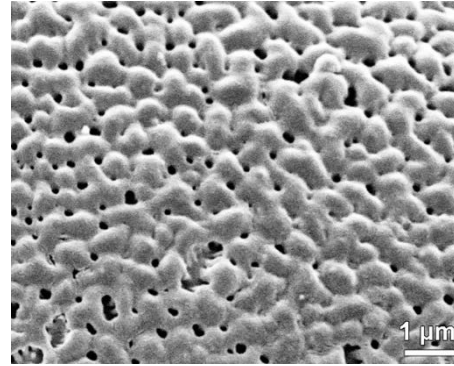


*Melampyrum pratense*

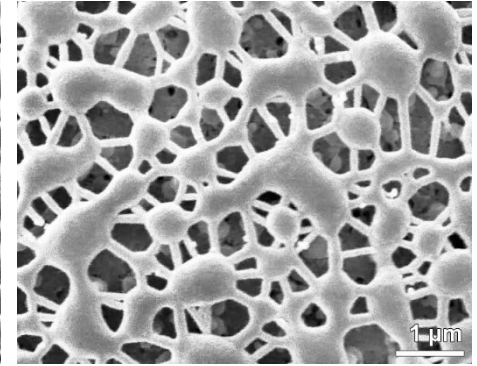


*Polyscias filicifolia*

microverrucate

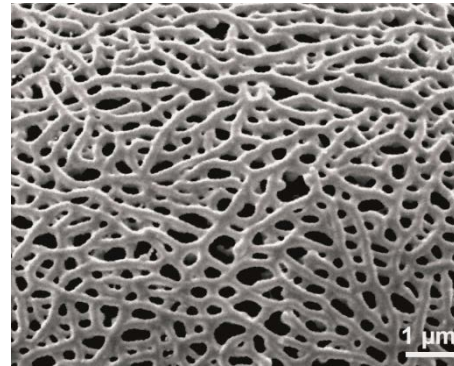


*Tradescantia spathacea*

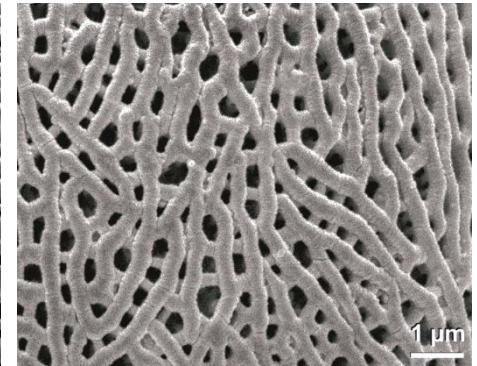


*Aspidistra locii*

striato-microreticulate



*Veronica prostrata*

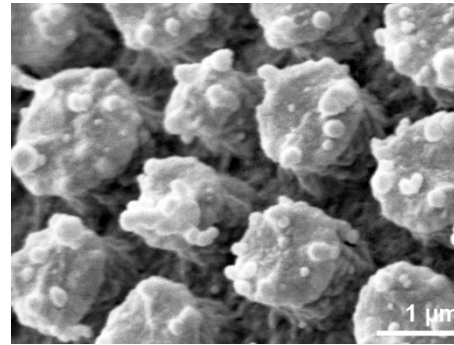


*Ptelea trifoliata*

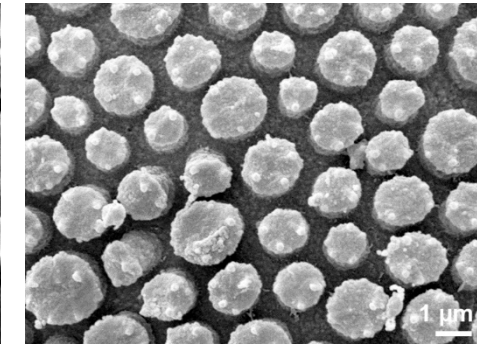
nano-

prefix for very small, features between 0.5 - 0.1 µm: nanobaculate, nanoclavate, nanoechinate, nanogemmate, nanorugulate, nanoreticulate, nanoverrucate; not used in combination with striate and foveolate

nanobaculate



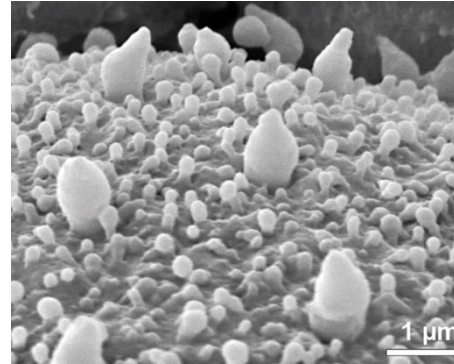
*Linum campanulatum*



*Linum campanulatum*

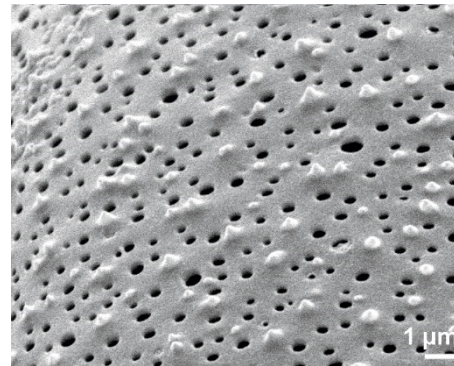


nanoclavate

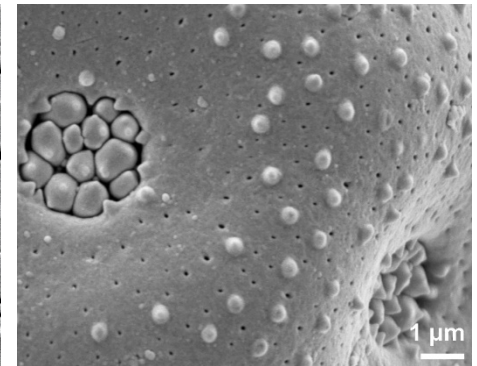


*Drosera binata*

nanoechinate

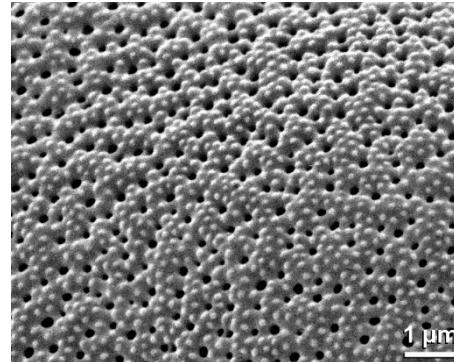


*Babiana ecklonii*

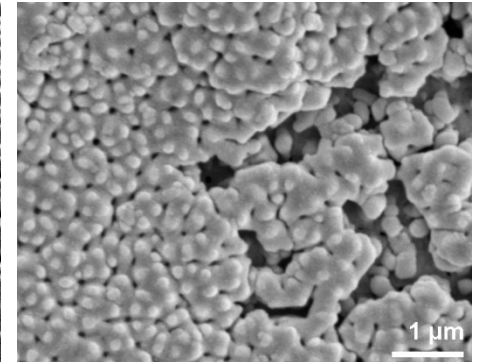


Caryophyllaceae (fossil)

nanogemmate



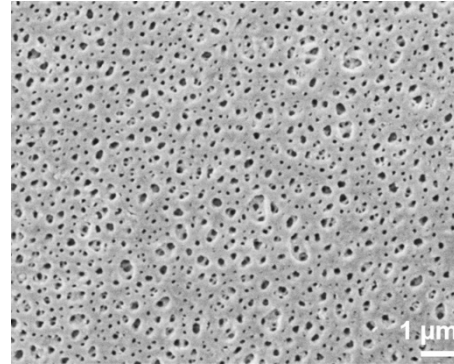
*Carex filiformis*



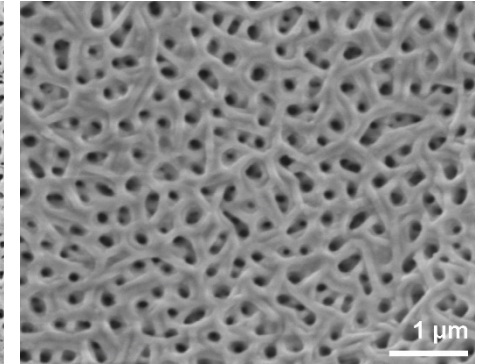
Cyperaceae (fossil)



**nanoreticulate**

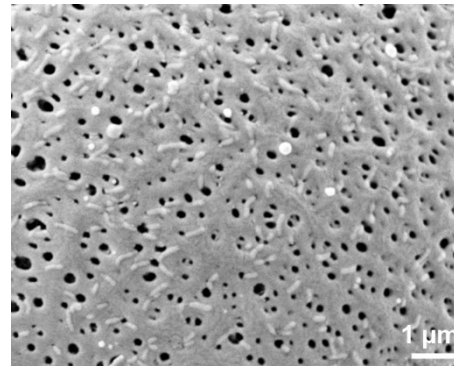


*Viola calcarata*

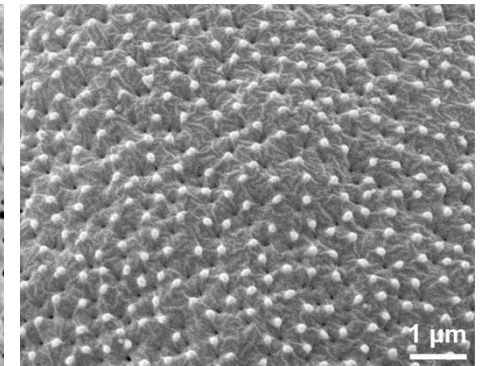


*Tilia* sp. (fossil)

**nanorugulate**

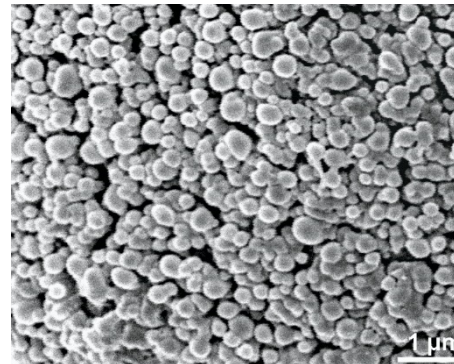


*Heliohebe raoulii*

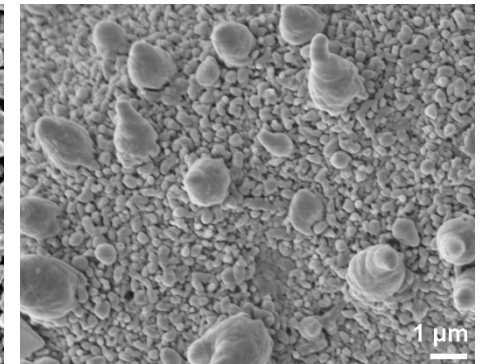


*Haloragis erecta*

**nanoverrucate**



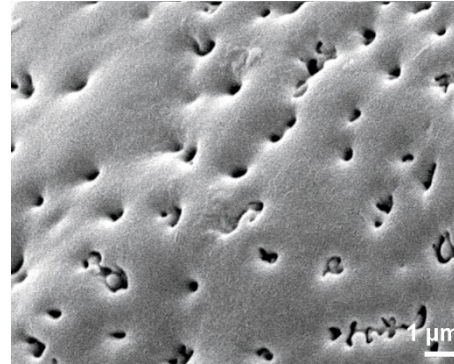
*Rhabdophora africana*



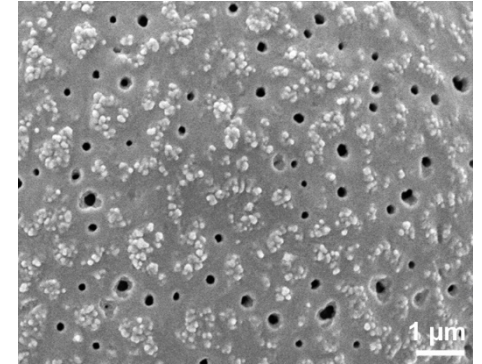
*Caprifoliaceae* (fossil)

**perforate**

pollen wall with holes less than 1  $\mu\text{m}$  in diameter



*Gonatopus angustus*



*Tetragonia tetragonoides*

**plicate**

pollen wall with plicae

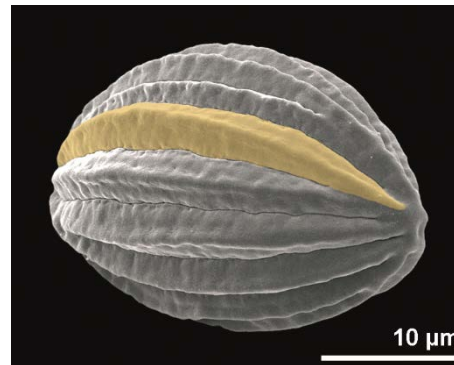


*Hemigraphis primulaefolia*

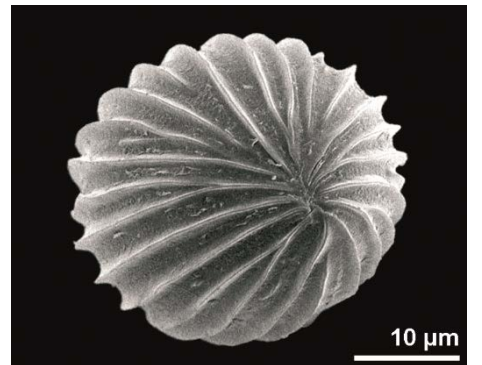


*Spathiphyllum cannifolium*

plicae  
(lat., sing. plica)



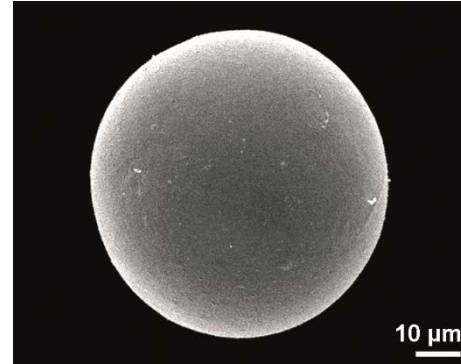
*Ephedra distachya*



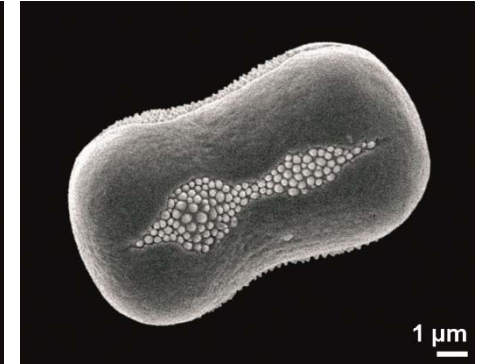
*Pistia stratiotes*

**psilate**

pollen wall with smooth surface



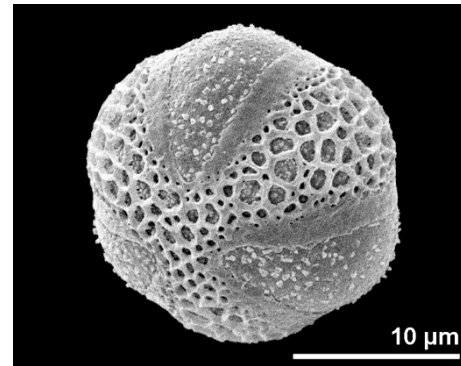
*Hedychium gardnerianum*



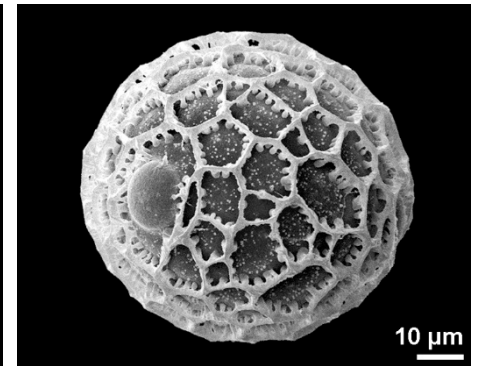
*Lithospermum officinale*

**reticulate**

pollen wall with reticulum



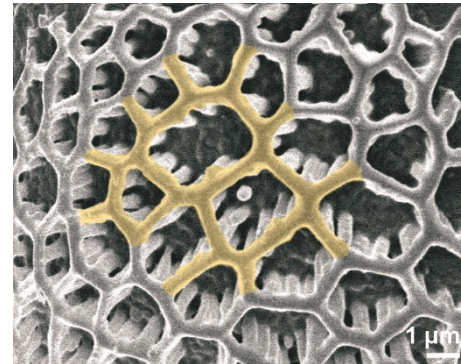
*Salix daphnoides*



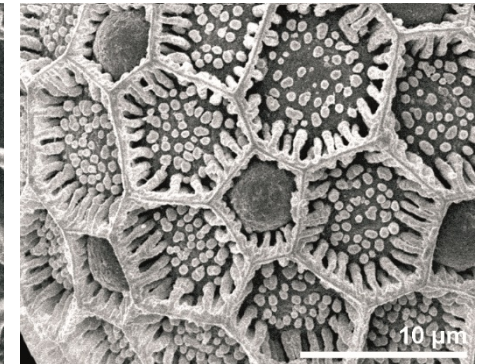
*Razisea citrina*

reticulum  
(lat. pl. reticula)

network like pattern consisting of muri  
and lumina



*Cardamine pratensis*



*Persicaria mitis*



**lumen**  
(lat., pl. lumina)

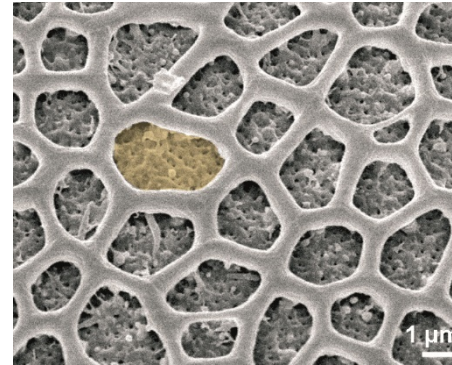
space enclosed by muri in reticulate pollen grains

**brochus**  
(lat., pl. brochi)

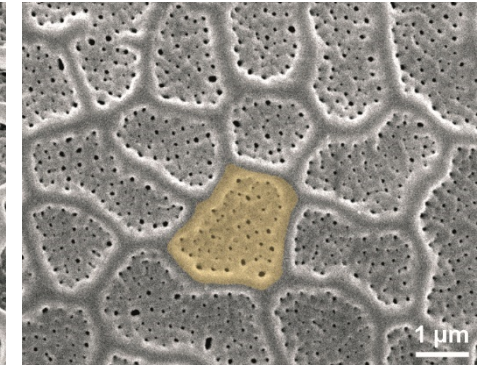
mesh of a reticulum consisting of one lumen and the adjoining half of the muri

**muri**  
(lat. sing. murus)

ornamentation elements forming the meshes in a reticulum



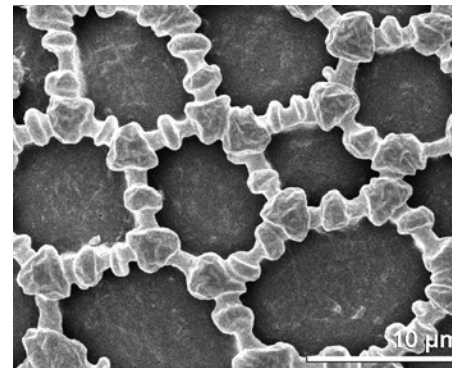
*Luffa cylindrica* (lumen colored)



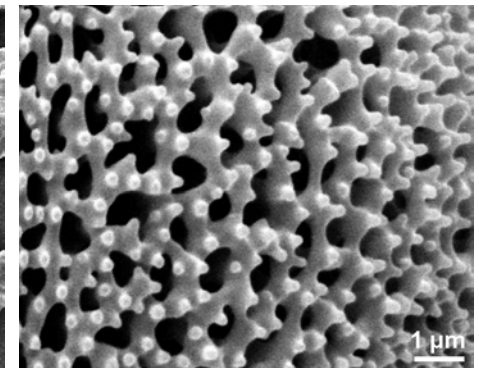
*Physostegia virginiana* (brochus colored)

**reticulum cristatum**

special type of reticulum; muri with prominent suprasculpture



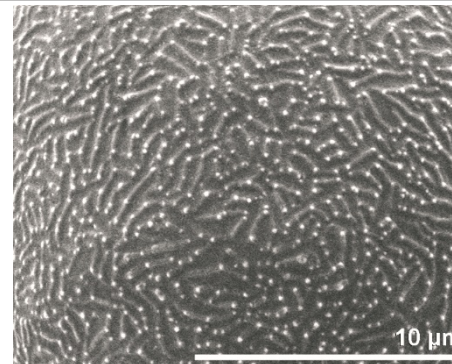
*Lilium candidum*



*Mercurialis perennis*

**rugulate**

pollen wall with rugulae



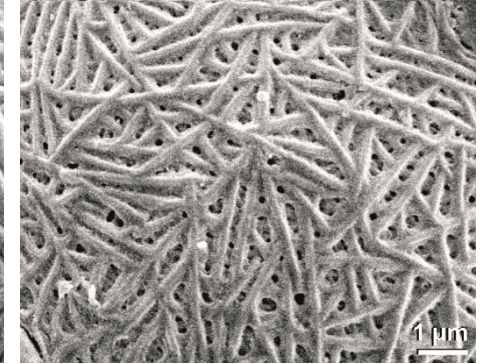
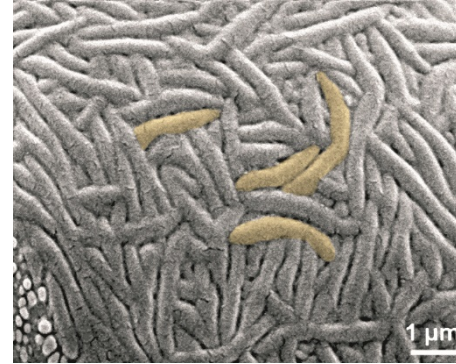
*Carpinus betulus*



*Carpinus betulus*

rugulae  
(lat., sing. rugula)

elongated ornamentation elements  
irregularly arranged

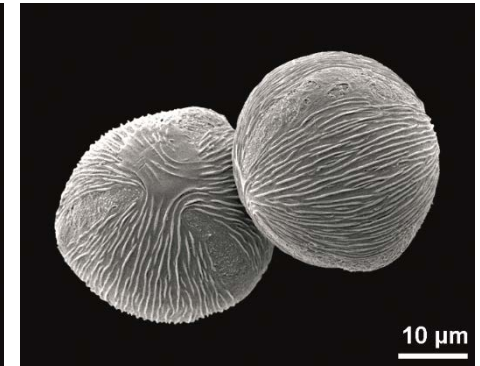
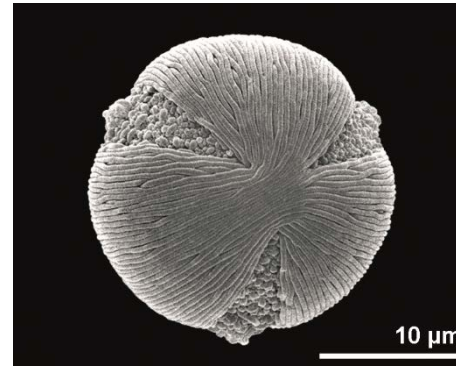


*Securigera varia*

*Sedum acre*

**striate**

pollen wall with striae



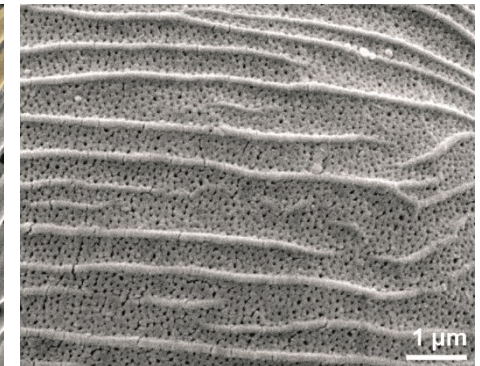
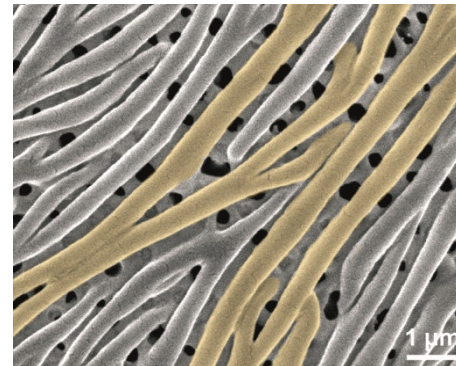
*Neoalsomitra sarcophylla*

*Geum reptans*

striae  
(lat., sing. stria)

elongated ornamentation elements  
separated by grooves parallelly arranged

*Comment: the term "striae" is used  
inconsistently in the literature; we use the  
term for the elevated elements and not for  
the grooves*



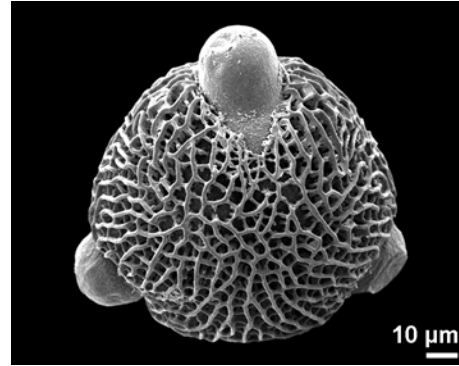
*Acer pseudoplatanus*

*Potentilla inclinata*

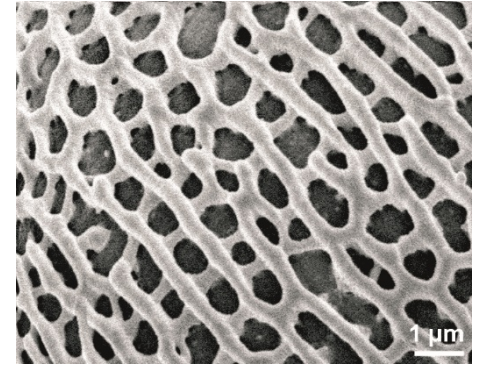


**striato-reticulate**

ornamentation intermediate between striate and reticulate



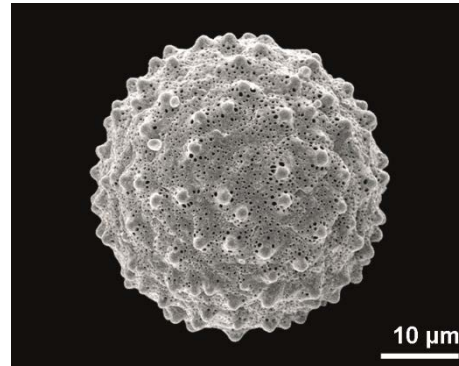
*Pelargonium ferulaceum*



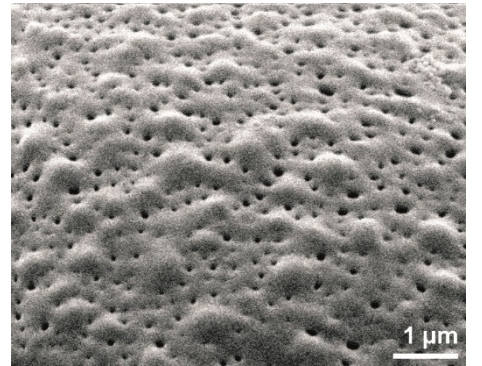
*Solandra longiflora*

**verrucate**

pollen wall with verrucae



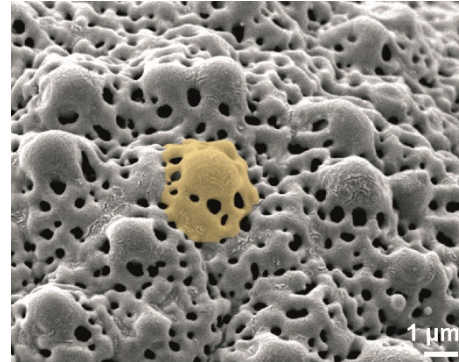
*Aristolochia tricaudata*



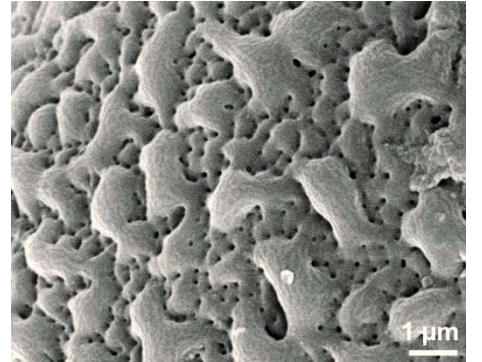
*Teucrium chamaedrys*

verruca  
(lat., pl. verrucae)

wart-like element broader than high



*Aristolochia arborea*



*Cyanastrum cordifolium*

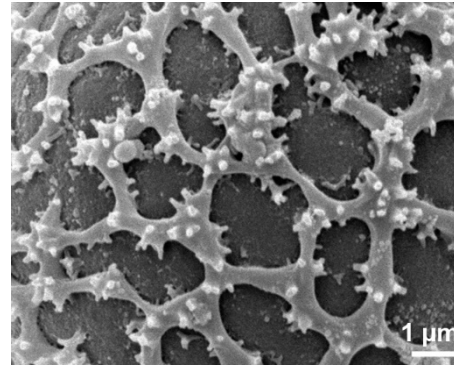


**suprasculpture SEM**

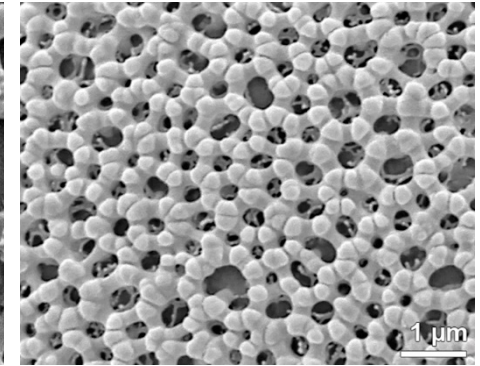
see: *ornamentation SEM*

**suprasculpture**

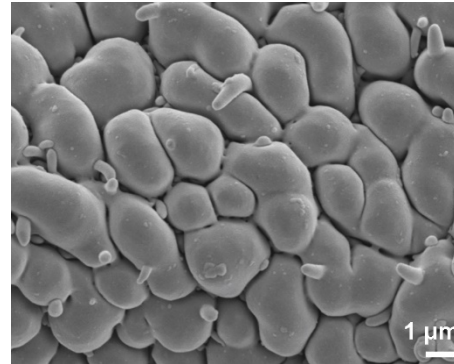
secondary sculpture elements positioned on the primary sculpture of the pollen surface



*Anthurium gracile*, microechinate



*Parentucellia latifolia*, microgemmate



*Tsuga* sp. (fossil), echinate, baculate



*Coffea arabica*, rugulate, microrugulate

supra-

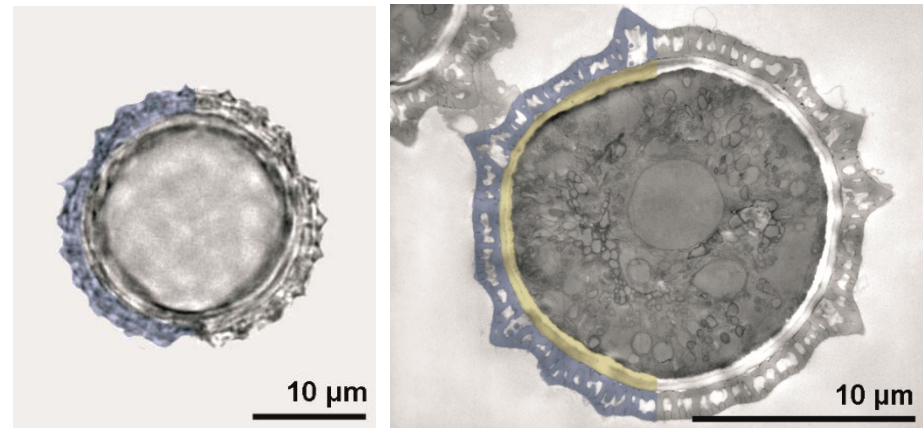
prefix for above

TEM

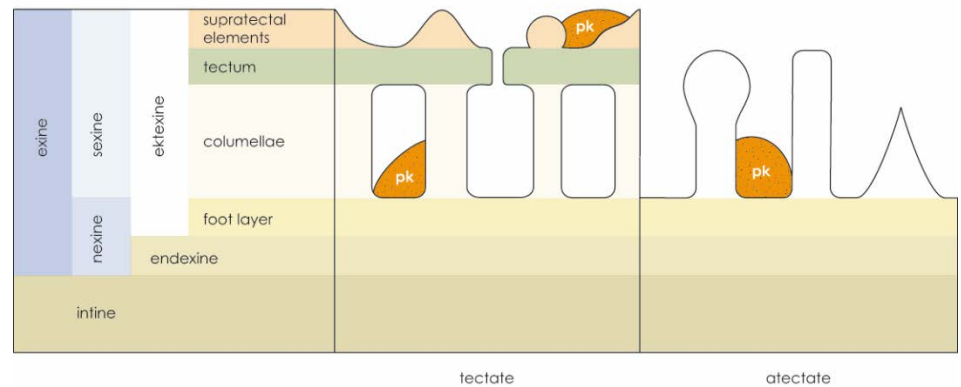
transmission electron microscope

pollen wall

layer(s) enclosing the cytoplasm of a pollen grain



*Ambrosia artemisiifolia*, exine (blue), intine (yellow)



**exine**

outer layer of the pollen wall, usually resistant to acetolysis

**ektexine**

outer layer of an exine

**ekto-**

prefix meaning outer

**endo-**

prefix meaning inner

**tectum**

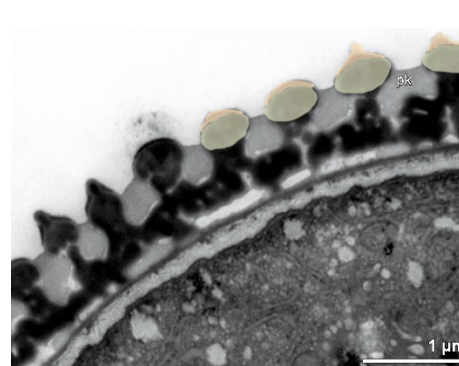
**tectum**

outer more or less continuous ektexine layer; tectum condition can be eutectate or semitectate

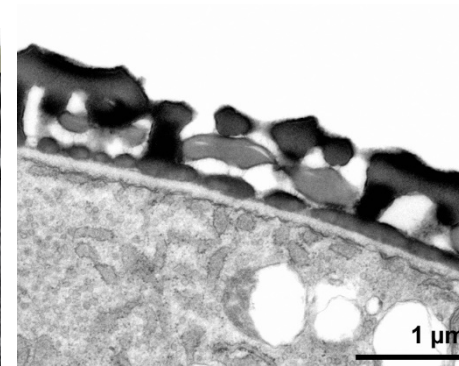
**tectate**

pollen grain with a tectum (tectum and suprasculpture colored)

*Antonym: atectate*



*Saxifraga scardica*

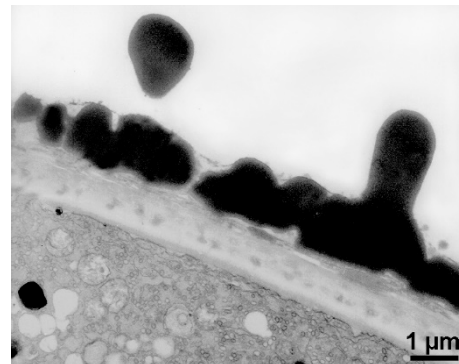


*Galeopsis tetrahit*

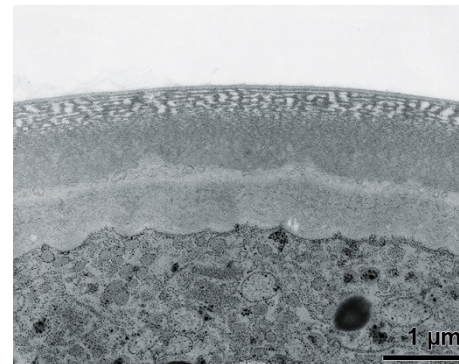
**atectate**

pollen grain lacking a tectum

*Antonym: "tectate"*



*Iris pumila*

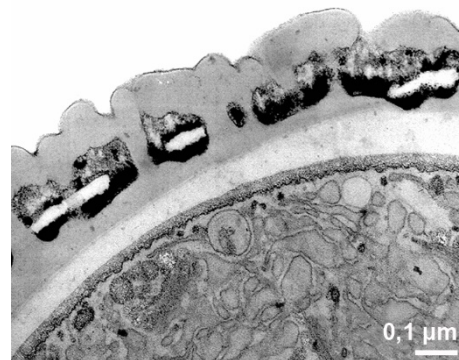


*Spathicarpa sagittifolia*

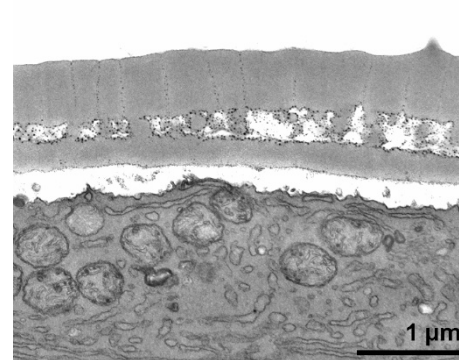
**eutectate**

pollen grain with a predominantly continuous tectum

*Antonym: semitectate*



*Apium nodiflorum*

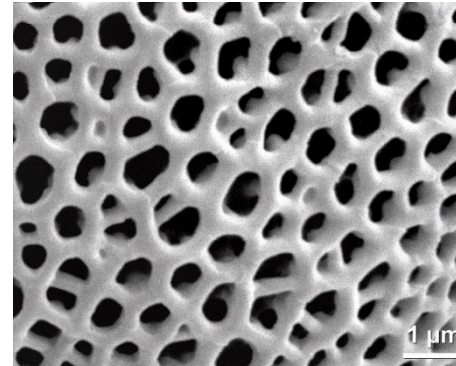


*Corylus avellana*

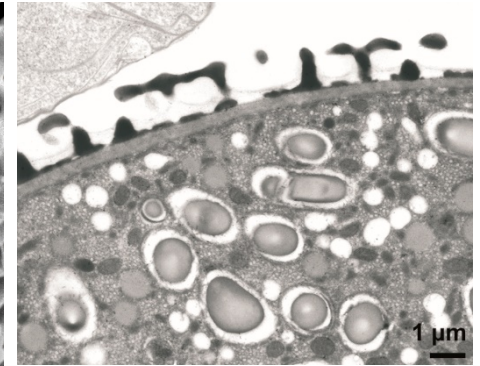


semitectate

pollen grain with a discontinuous tectum



*Acinos alpinus*



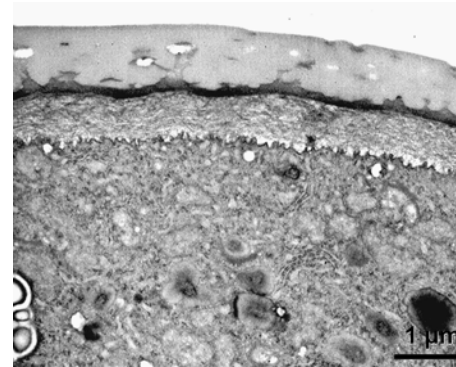
*Acinos alpinus*

**infratectum**

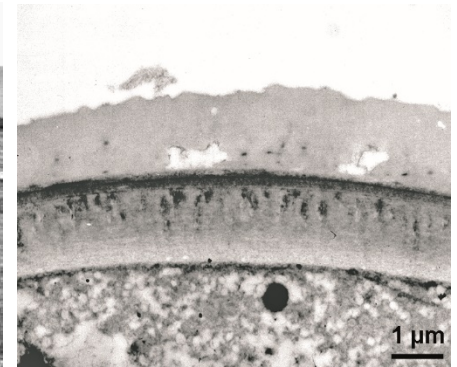
**infratectum**

layer between tectum and foot layer or endexine (if foot layer is absent); infratectum can be alveolate, columellate, granular or absent

**absent**



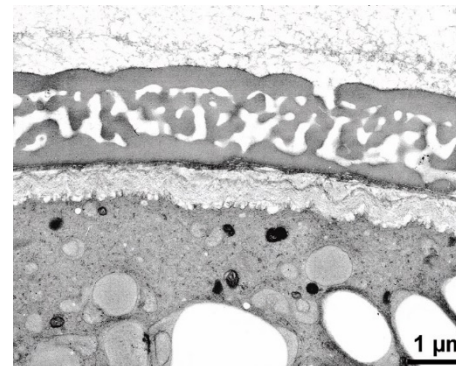
*Mahonia aquifolium*



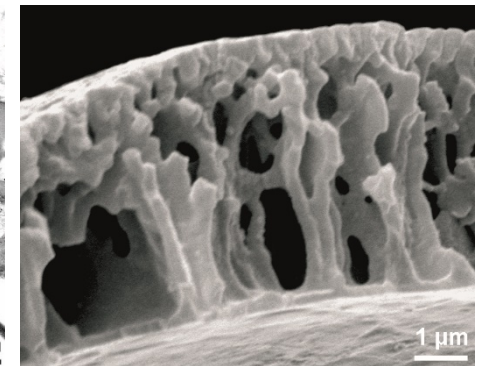
*Dieffenbachia humilis*

**alveolate**

infratectum with compartments of irregular size and shape



*Gonatopus angustus*



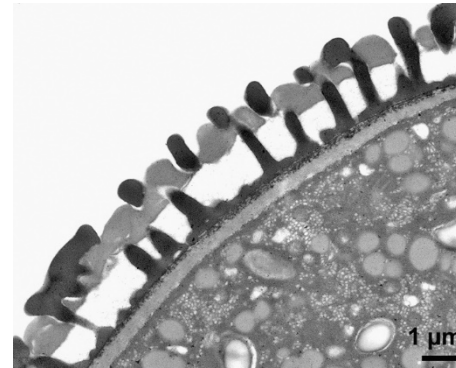
*Abies* sp. (fractured pollen wall)

alveolus  
(lat., pl. alveoli)

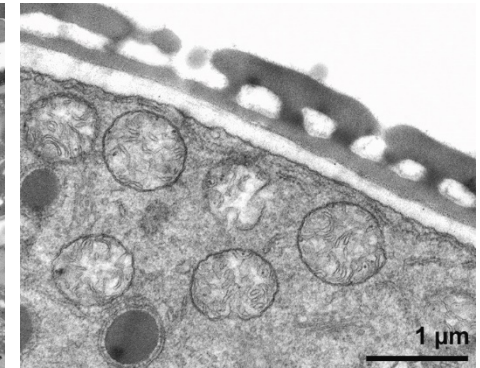
compartment(s) of irregular size and shape

**columellate**

infratectum with columellae



*Mentha aquatica*



*Microrrhinum minus*

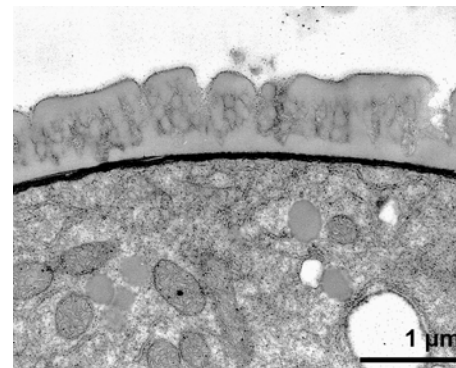
columella  
(lat., pl. columellae)

rod-like structure element, supporting a tectum

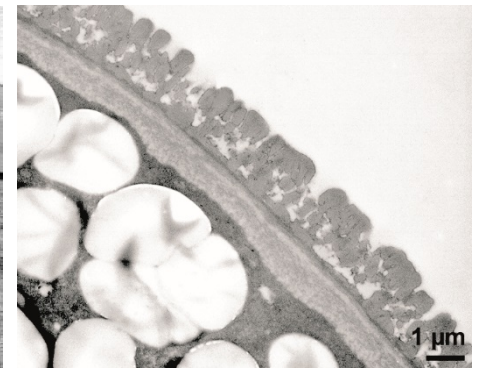
**granular**

infratectum composed of granula, cluster of granula or elements of different size and shape (never solid and rod-like)

*Comment: not to be confused with "granulate", which is a type of ornamentation*



*Amydrium medium*



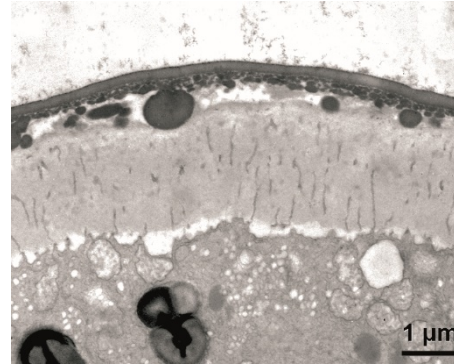
*Viola tricolor*

**foot layer**

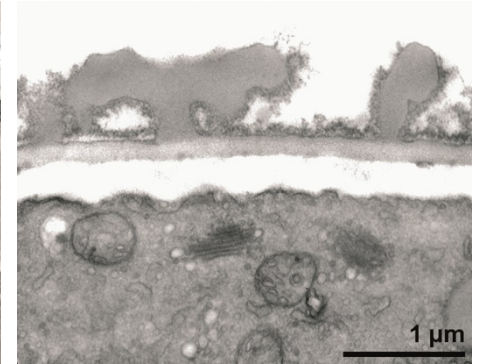
**foot layer**

inner layer of an ectexine that can be continuous, discontinuous, perforated or absent

absent

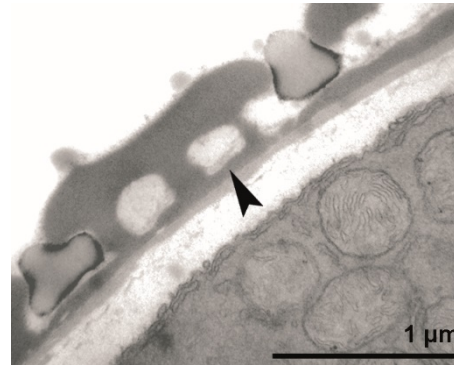


*Pachypodium succulentum*

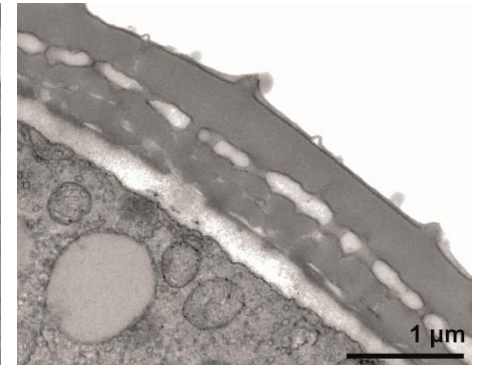


*Fraxinus excelsior*

continuous

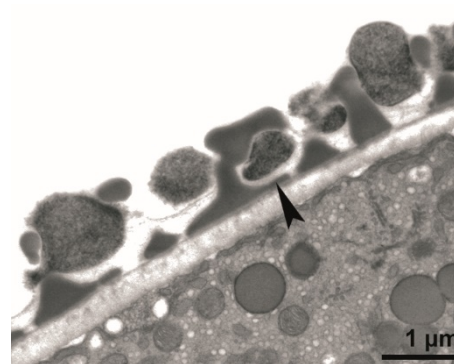


*Microrrhinum minus*

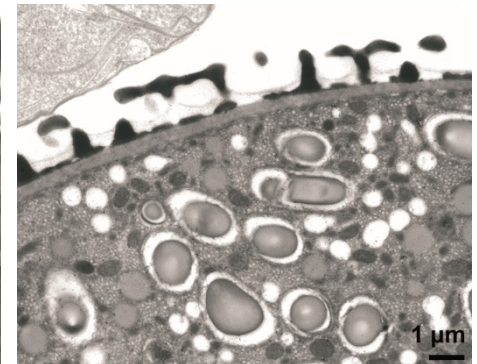


*Plantago maritima*

discontinuous



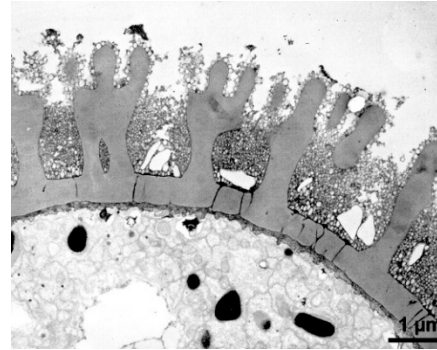
*Clinopodium vulgare*



*Acinos alpinus*



perforate



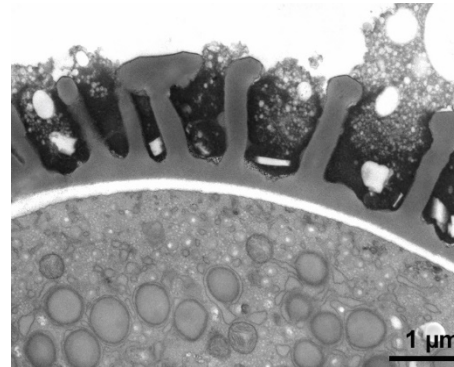
*Geranium robertianum*

endexine

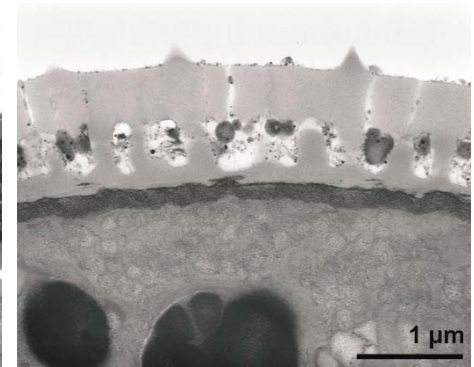
endexine

distinct exine layer between ectexine and intine; endexine can be compact, spongy or lamellar as well as continuous, discontinuous, absent or in aperture only; *Comment: the endexine can be monolayered or bilayered; characteristic for the endexine is the increasing thickness close to the aperture*

absent

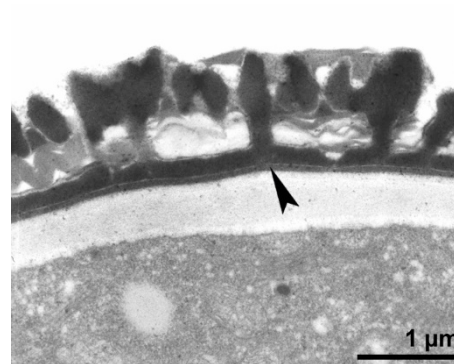


*Brassica napus*

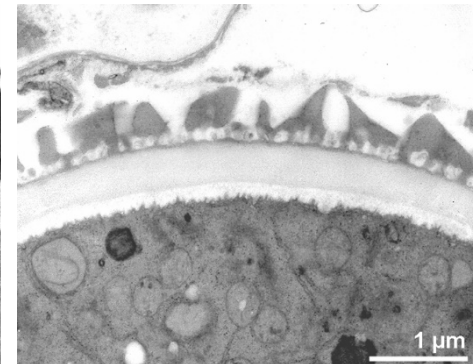


*Chenopodium album*

compact-continuous

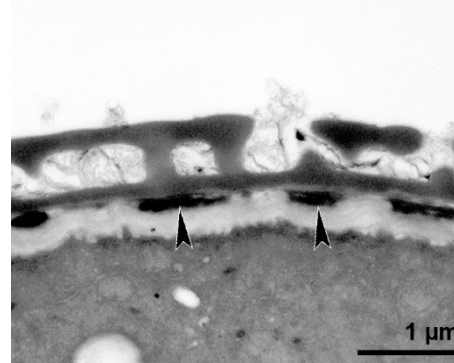


*Odontites luteus*

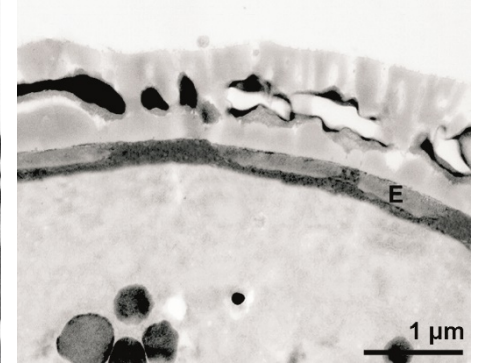


*Androsace maxima*

compact-discontinuous

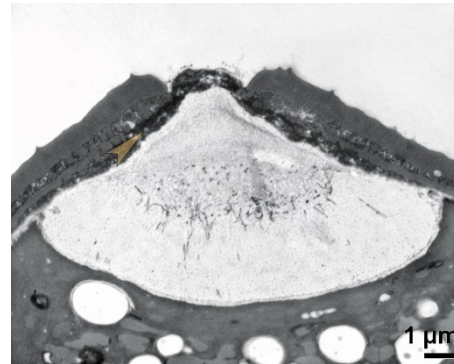


*Glaucium flavum*

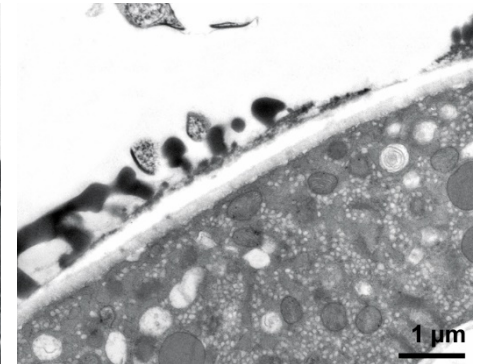


*Ranunculus trichophyllos*

in aperture only

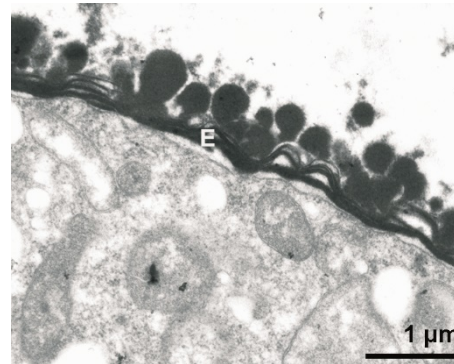


*Corylus avellana*

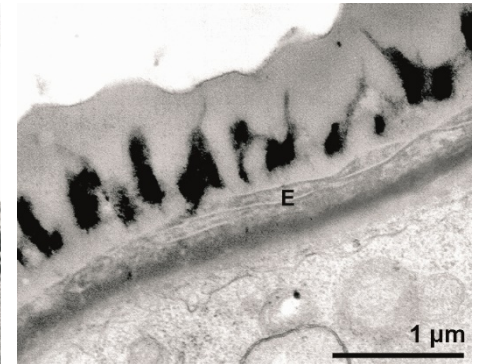


*Acinos alpinus*

lamellar-continuous



*Orobanche hederæ*

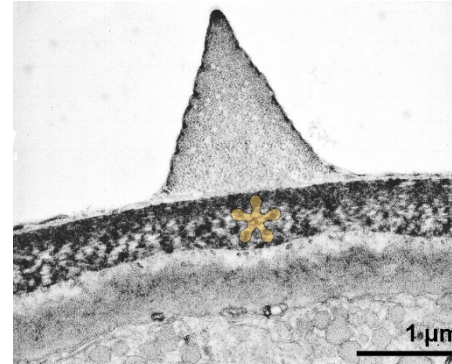


*Thalictrum flavum*

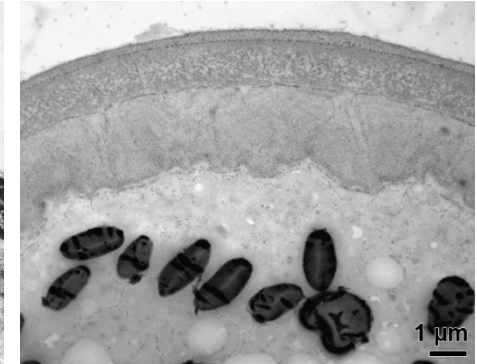
lamellar-discontinuous

has not been observed so far

spongy-continuous



*Pistia stratiotes*



*Amorphophallus mossambicensis*

spongy-discontinuous

has not been observed so far

**intine**

**intine**

part of the pollen wall next to the cytoplasm, mainly consisting of polysaccharides; the intine can be monolayered or bilayered; see also "ektintine" and "endintine"

*Comment: characteristic for a monolayered intine is the increasing thickness in the aperture region and that it becomes bilayered (ektintine and endintine)*

endintine

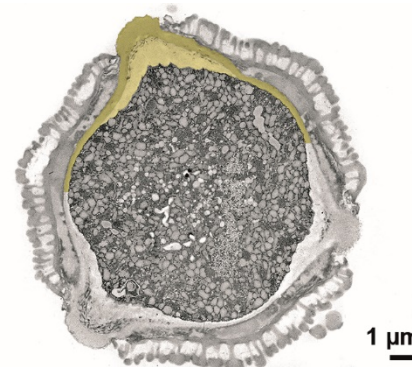
inner layer of the intine which is adjacent to the cytoplasm

ektintine

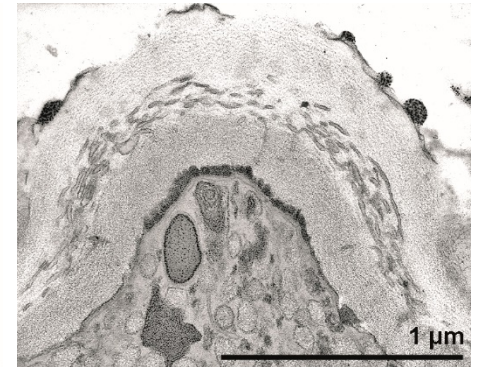
the outer layer of the intine which is adjacent to the exine

**bilayered intine**

ektintine with channels, endintine homogenous



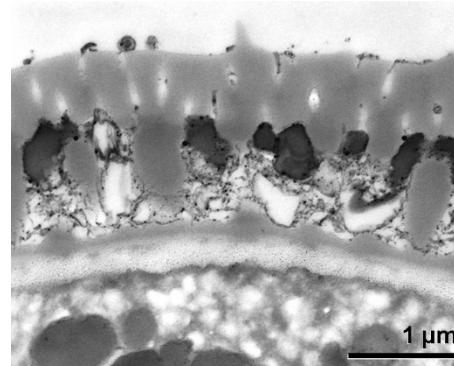
*Apium nodiflorum* (intine colored)



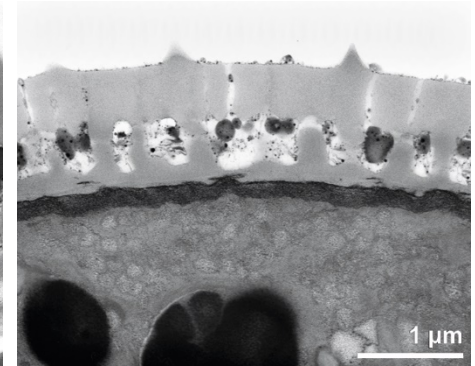
*Apium nodiflorum*



monolayered intine



*Atriplex tatarica*



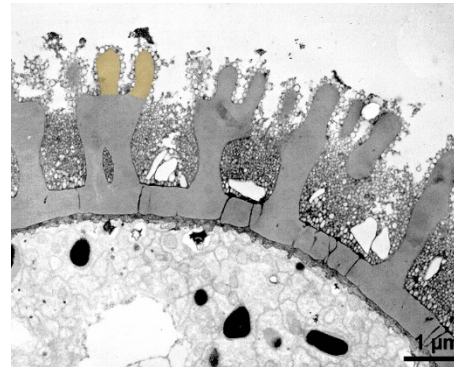
*Cenopodium album*

supratectal element

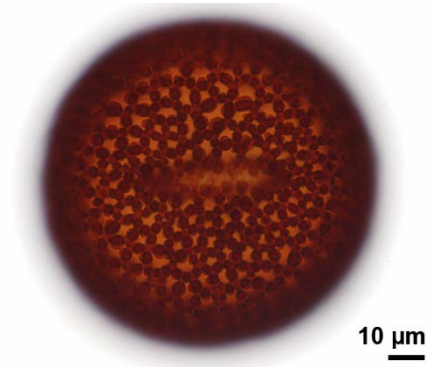
supratectal element

sculpture element positioned on top of the tectum

*Comment: can only be defined in cross section of a pollen wall, see also "suprasculpture"*



*Geranium robertianum* (clavae colored)



*Geranium robertianum*

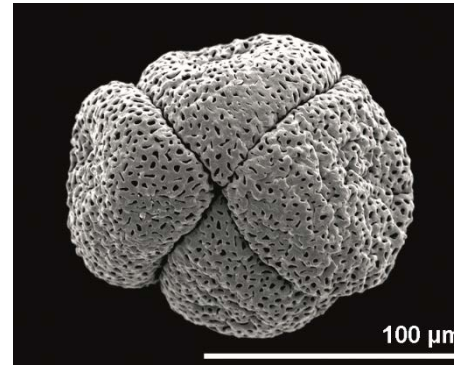
peculiarities

wall peculiarities

acalymmate

dyads, tetrads and polyads covered by a exine envelope which is discontinuous at the junctions between the monads

*Antonym: calymmate*



*Asimina triloba*



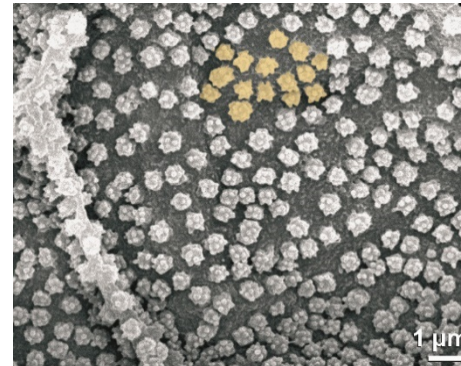
*Asimina triloba*

adhering Ubisch bodies  
(engl., pl. Ubisch bodies)

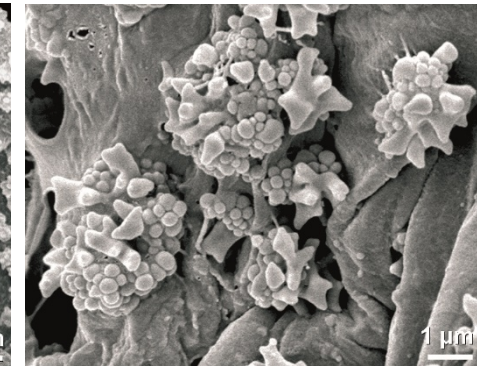
polymorphic sporopollenin-element produced by the tapetum

*Comment: the "Ubisch body" is named after Gerta von Ubisch, who described these bodies for the first time*

Ubisch bodies (colored) on locule wall (inner anther wall)

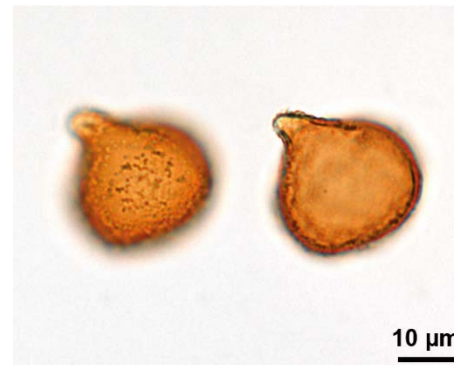


*Trisetum flavescens* (locule wall)

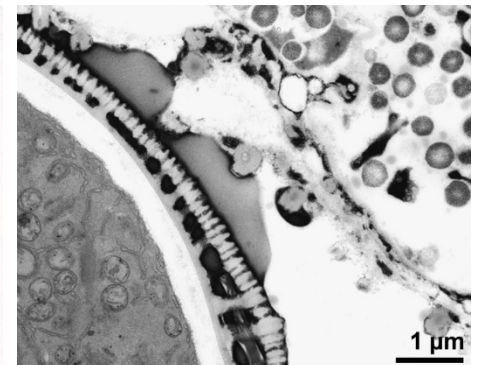


*Stellaria graminea* (locule wall)

Ubisch bodies attached to pollen surface (*Metasequoia*)



*Metasequoia glyptostroboides*



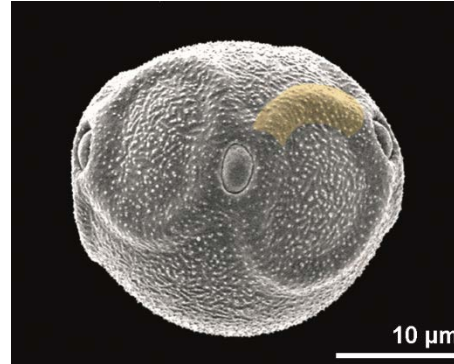
*Melampyrum nemorosum*

**arcus**  
(lat., pl. arcus)

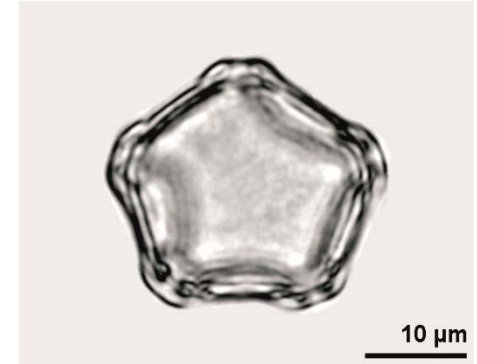
curved wall thickening interconnecting  
apertures

arcuate

pollen grain with arcus



*Alnus glutinosa*

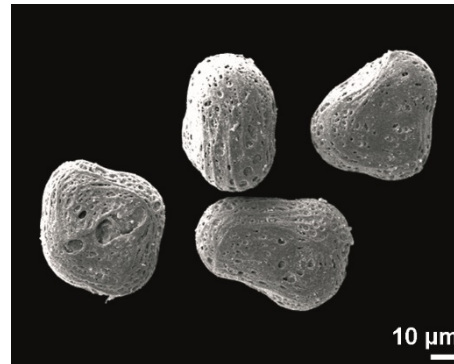


*Alnus* sp.

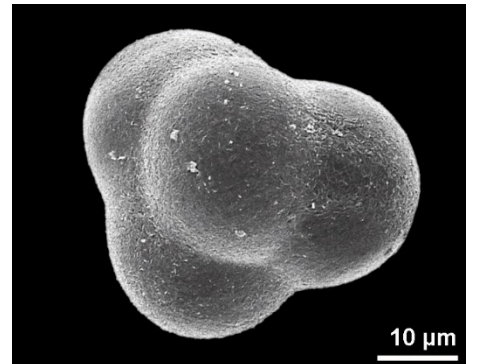
**calymmate**

dyads, tetrads and polyads covered by a  
continuous exine envelope

*Antonym: acalymmate*



*Chlorospatha kolbii* (tetrads)



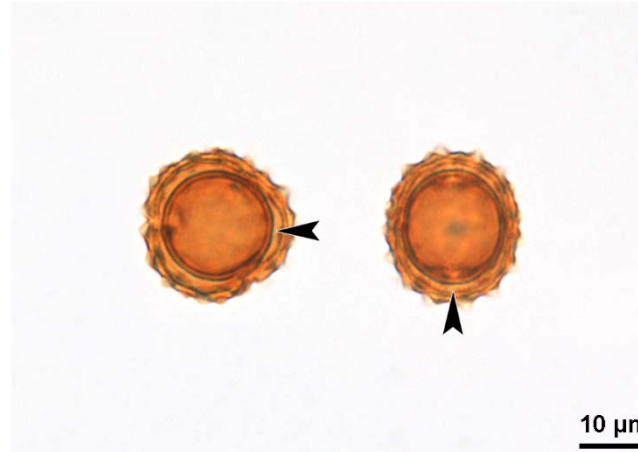
*Chlorospatha dodsonii* (tetrad)

**caveate**

pollen wall with caveae

cavea  
(lat., pl. caveae)

cavity between the sexine and nexine in  
the interapertural area



*Xanthium spinosum*

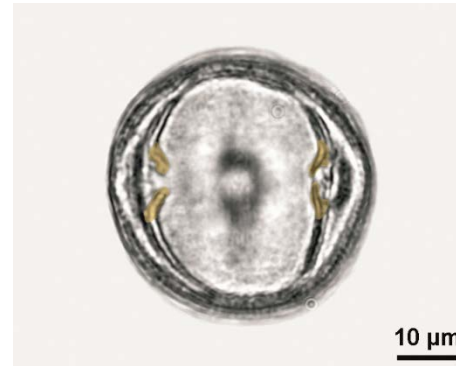


**costa**  
(lat., pl. costae)

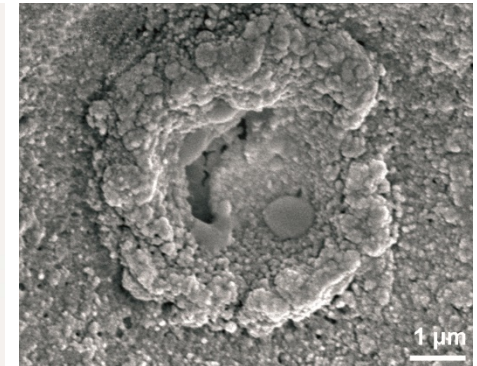
thickening of the nexine/endexine bordering an endoaperture

costate

pollen grain with costae



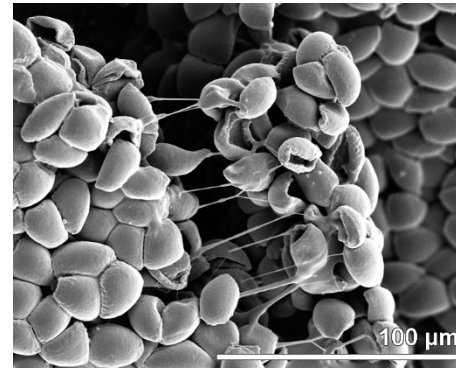
*Nyssa* sp. (costa colored)



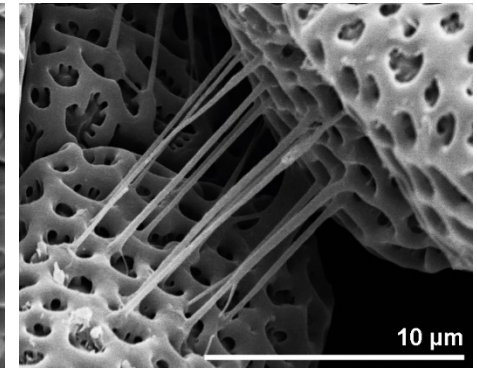
*Austrobuxus nitidus*

**elastoviscin**

highly elastic, not acetolysis resistant substance in Orchidaceae, which interconnects the subunits (monads, tetrads or massulae) of a pollinium and builds up the caudicles



*Caladenia latifolia*



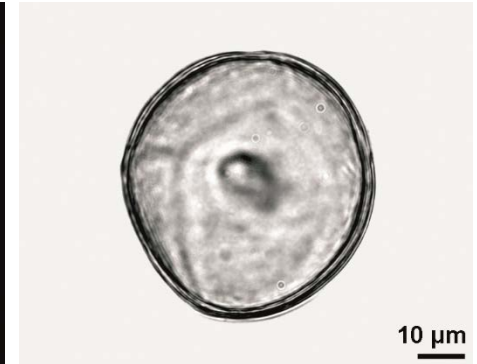
*Spiranthes spiralis*

**impression mark**

a linear or Y-shaped mark on the proximal polar area of a pollen grain retained from the tetrad stage



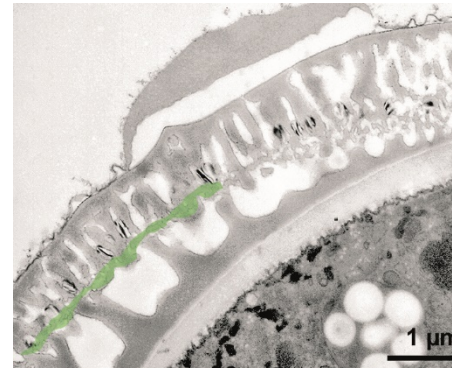
*Larix* sp. (fossil)



*Larix* sp. (fossil)

**internal tectum**

additional more or less continuous layer within the infratectum



*Centaurea cyanus*

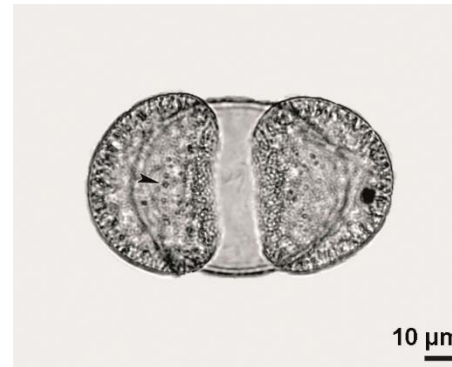


*Agrimonia eupatoria*

**nodulum**

(lat., pl. nodula)

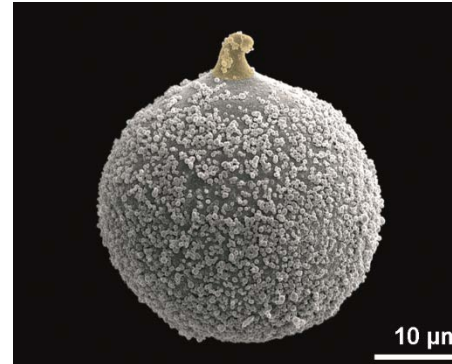
small body located on the nexine of the central saccus area



*Pinus* subgenus *Pinus*, nodula (arrowhead)

**papilla**

small protuberance typical for Taxodioideae pollen located distally



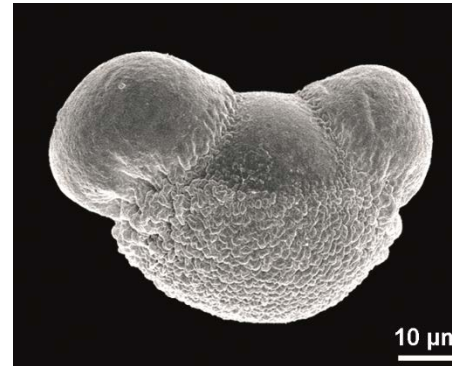
*Cryptomeria* sp. (fossil; papilla colored) *Cryptomeria* sp. (fossil)

**pluricolumellate**

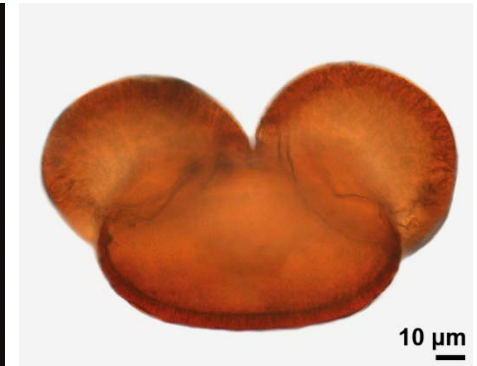
reticulate pollen wall with more than one row of columellae beneath a murus

**saccus**  
(lat., pl. sacci)

exinous expansion forming an air sac



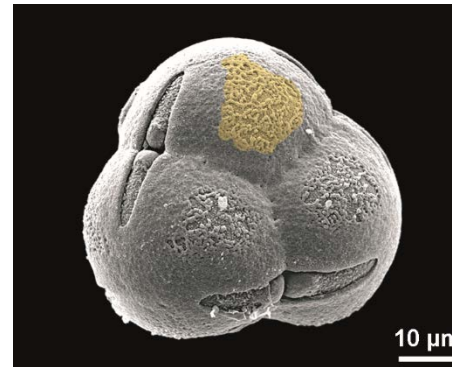
*Pinus mugo*



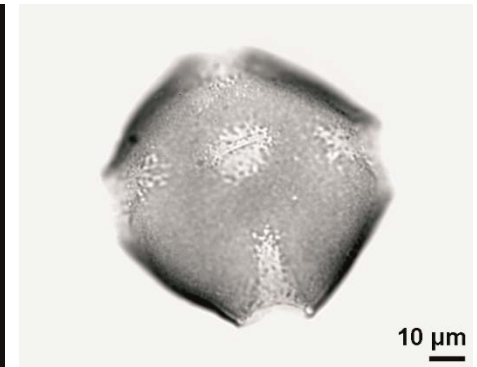
*Abies cephalonica*

**tenuitas**  
(lat., pl. tenuitates)

general term for a thinning of the pollen wall



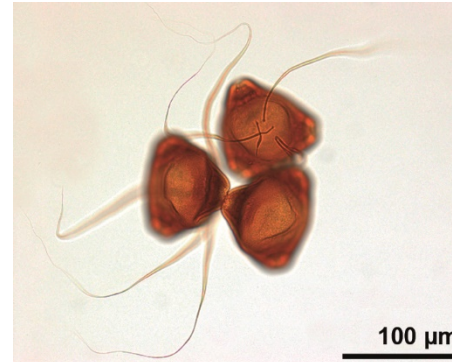
*Agapetes variegata* (tenuitas colored)



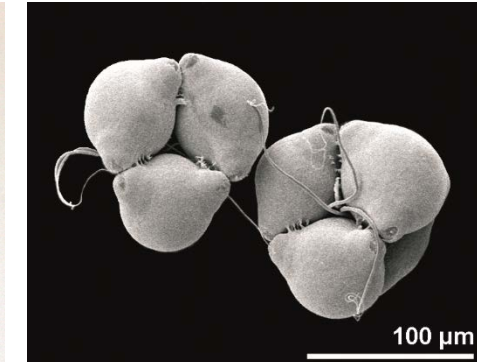
*Viola tricolor*

**viscin threads**

acetolysis resistant threads arising from the exine



*Epilobium angustifolium* (tetrad)



*Epilobium parviflorum* (tetrads)



**miscellaneous**

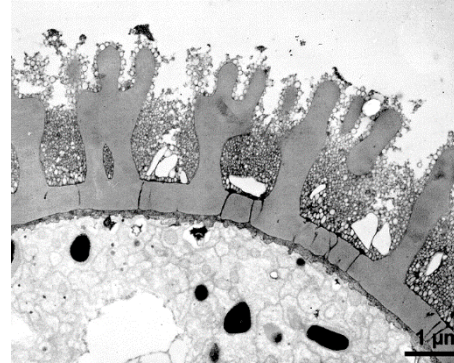
**pollen coating**

**pollen coating**

general term applied to organic compounds usually produced by the tapetum, located on the exine and/or in exine cavities; see also: pollenkitt, tryphine, primexine matrix

**pollen coating vesicles**

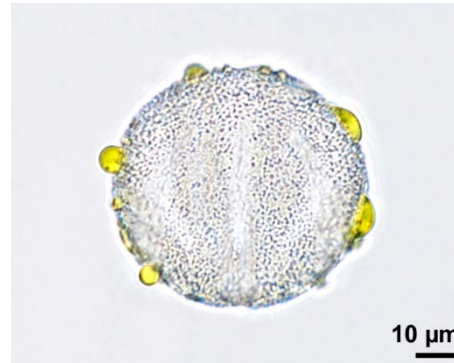
tapetum derived vesicles covering the perforated footlayer in mature pollen grains in e.g. *Geranium* and *Pelargonium*



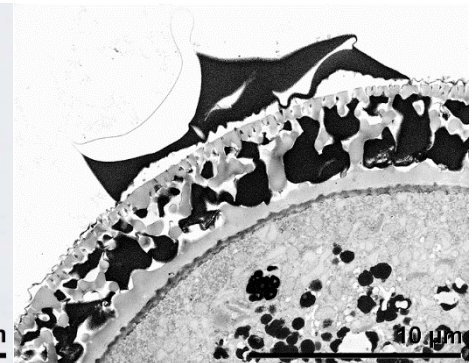
*Geranium* sp.

**pollenkitt**

pollen coating consisting of sticky substances, mainly lipids



*Salvia nemorosa*



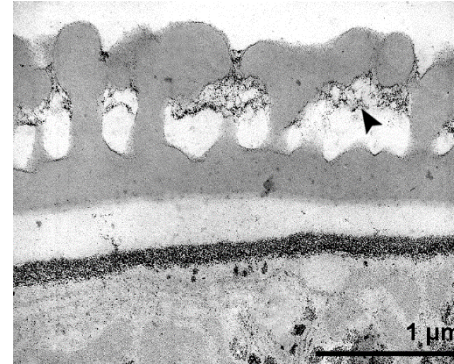
*Nigella arvensis*

**primexine matrix**

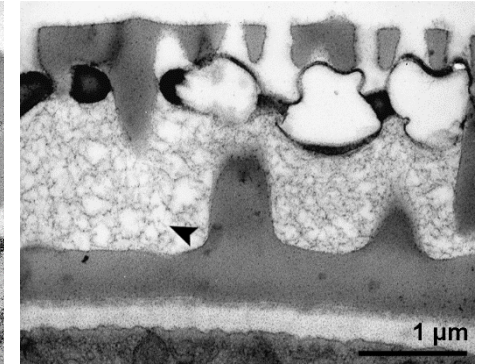
pollen coatings consisting of primexine remnants in mature pollen grains

**primexine**

polysaccharidic layer formed during early developmental stage wherein the later exine structures are preformed



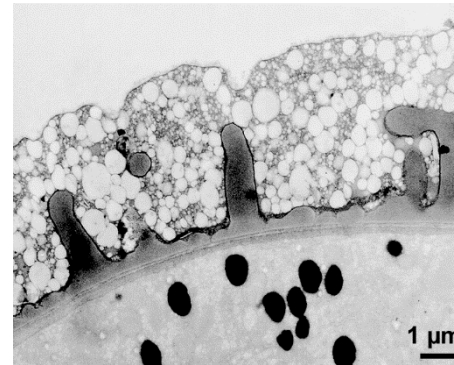
*Apium nodiflorum*



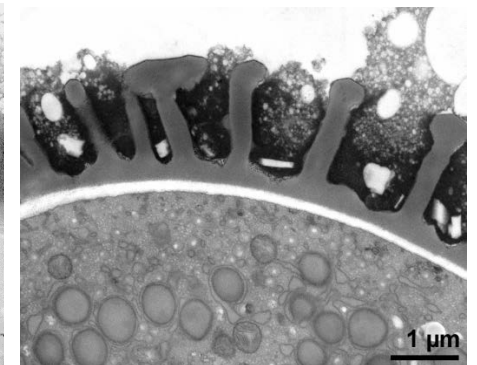
*Convolvulus tricolor*

**tryphine**

pollen coating consisting mainly of lipids mixed with membrane remnants



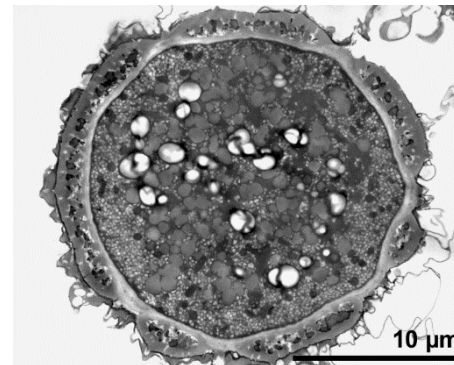
*Sinapis alba*



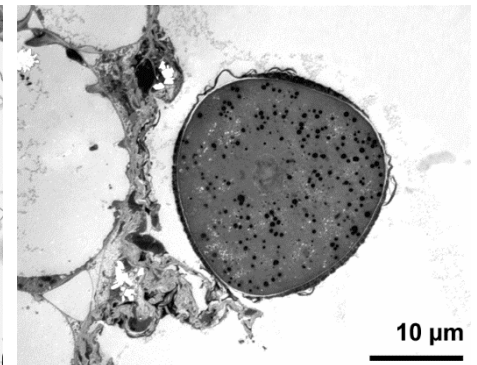
*Brassica napus*

**reserves in cytoplasm**

**lipids**

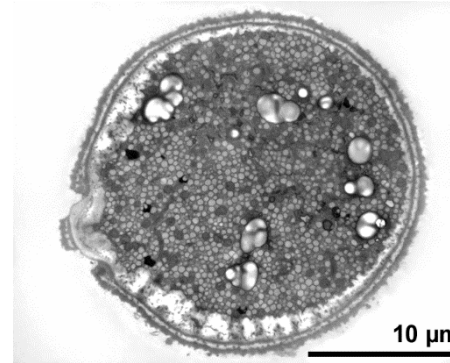


*Chenopodium hybridum*

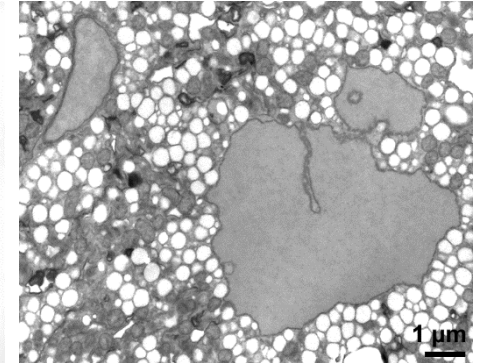


*Ajuga reptans*

polysaccharide vesicles

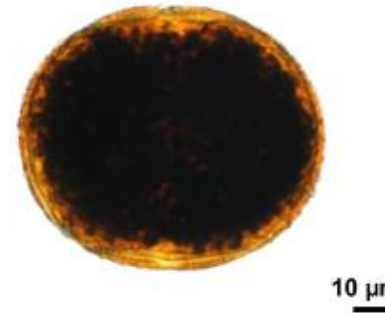


*Poa angustifolia*

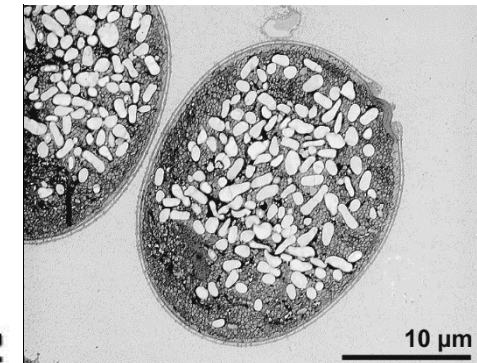


*Bromus inermis*

starch



*Acinos alpinus* (potassium iodine, LM)



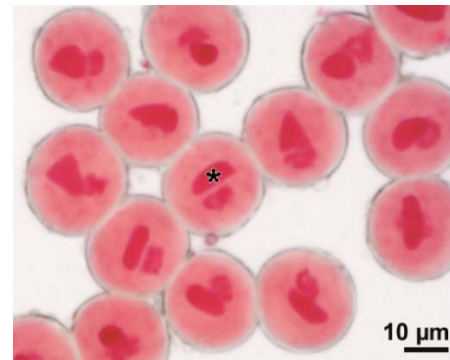
*Lolium perenne*

cell number

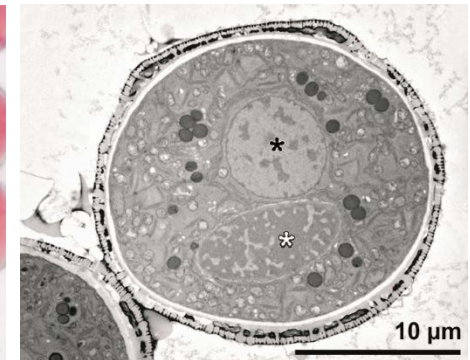
2-celled

binucleate pollen (vegetative cell/nucleus and generative cell/nucleus)

generative nucleus stains intensive red using acetocarmine



*Melampyrum nemorosum*



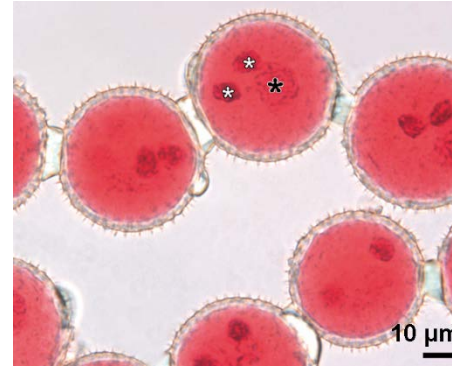
*Melampyrum nemorosum*



**3-celled**

trinucleate pollen (vegetative cell/nucleus and two sperm cells = male gametes)

sperm nuclei (white asterisks) stain intensive red using acetocarmine



*Filarum manserichense*



*Zantedeschia aetiopica*

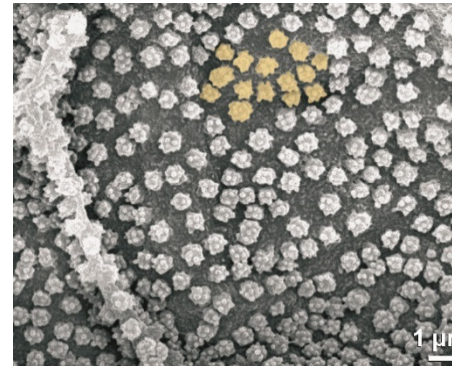
**Ubisch bodies**

**Ubisch bodies**

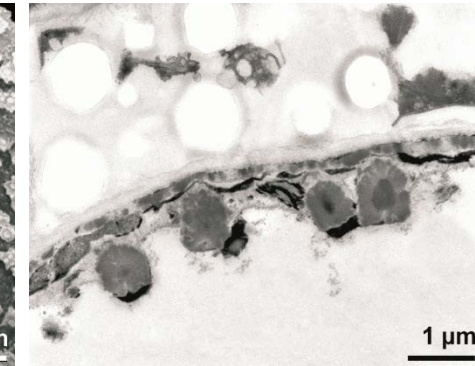
(engl., pl. Ubisch bodies)

polymorphic sporopollenin-element produced by the tapetum

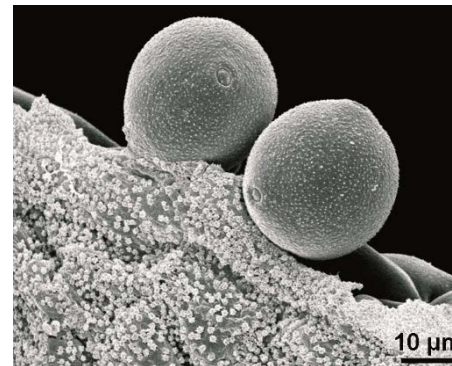
*Comment: the "Ubisch body" is named after Gerta von Ubisch, who described these bodies for the first time; the term "orbicule" implies a globular element; therefore we recommend the term "Ubisch body", as these are polymorphic*



*Trisetum flavescens* (locule wall)



*Odontites luteus*



*Corylus avellana*



*Sauromatum venosum*