Divisio of Gymnosperms.

General characteristics, biology of reproduction.

Plan

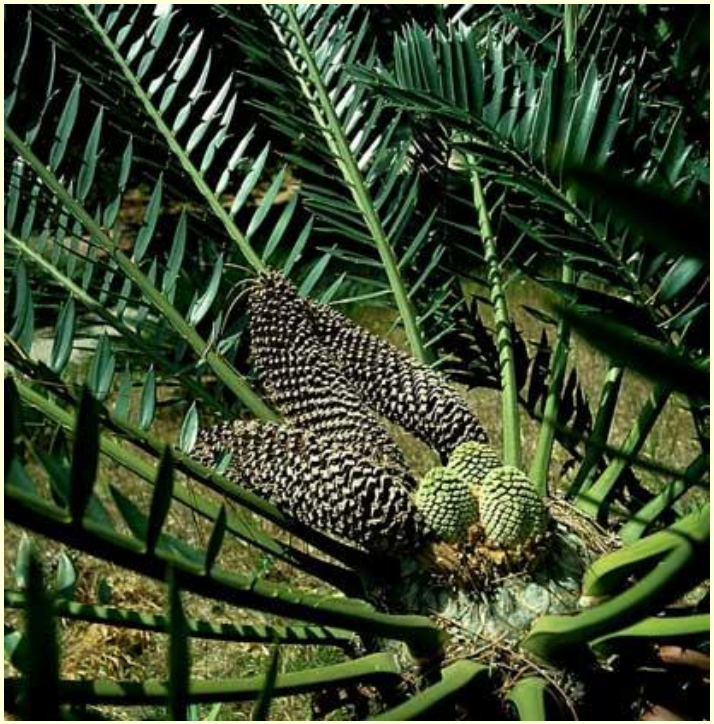
Seed plants.

1.The emergence of the seed and its biological significance.
2.Peculiarities of the development cycle of seed plants.

The Divisio of Gymnosperms.

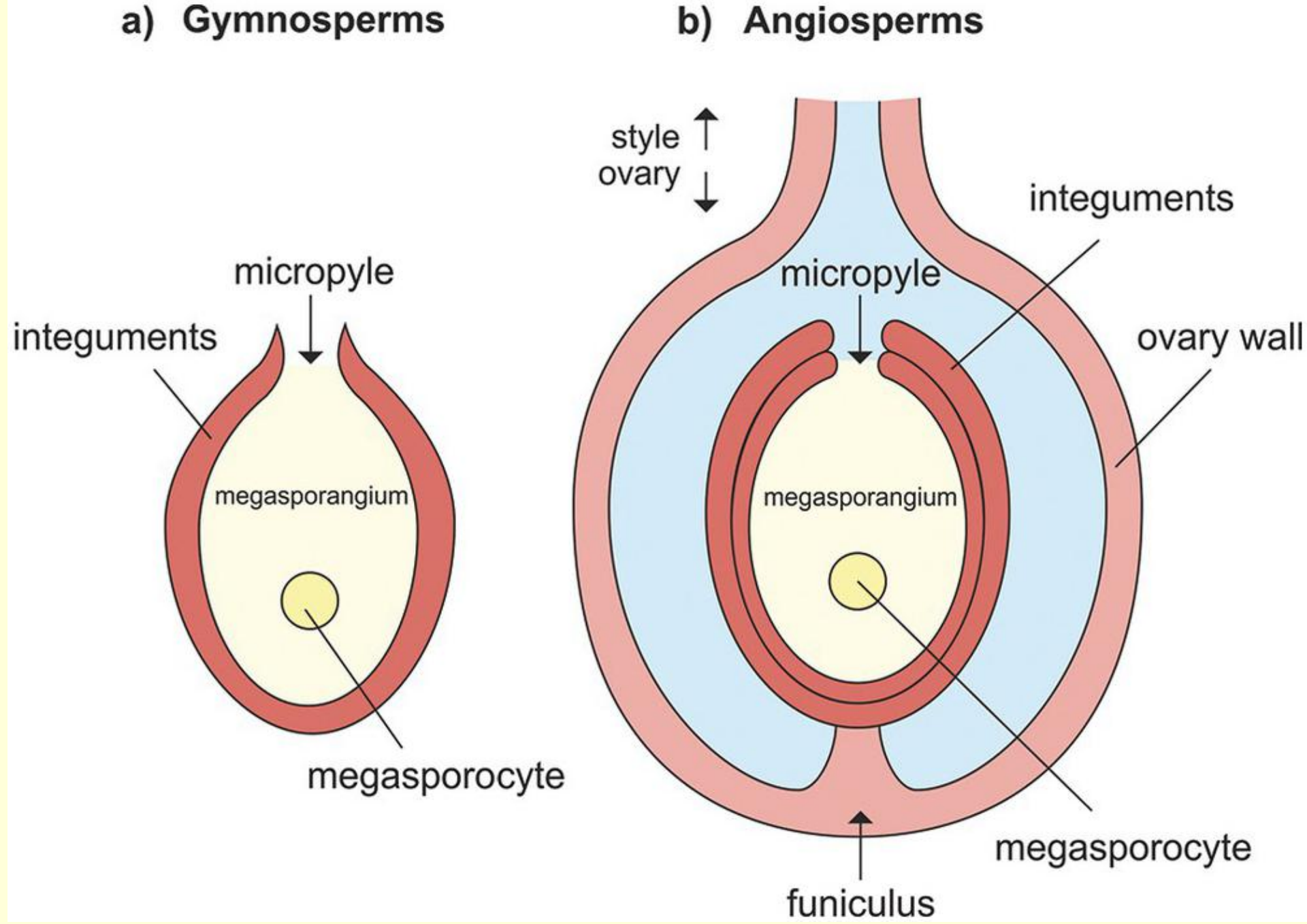
3. General characteristics of Gymnosperms.
4. Life cycle of Gymnosperms using the example of Scots Pine (Pinus sylvestris)
5. Classification of Gymnosperms. Biodiversity of Gymnosperms
6. Importance in medicine and national economy.

Seed plants (Spermatophytes)

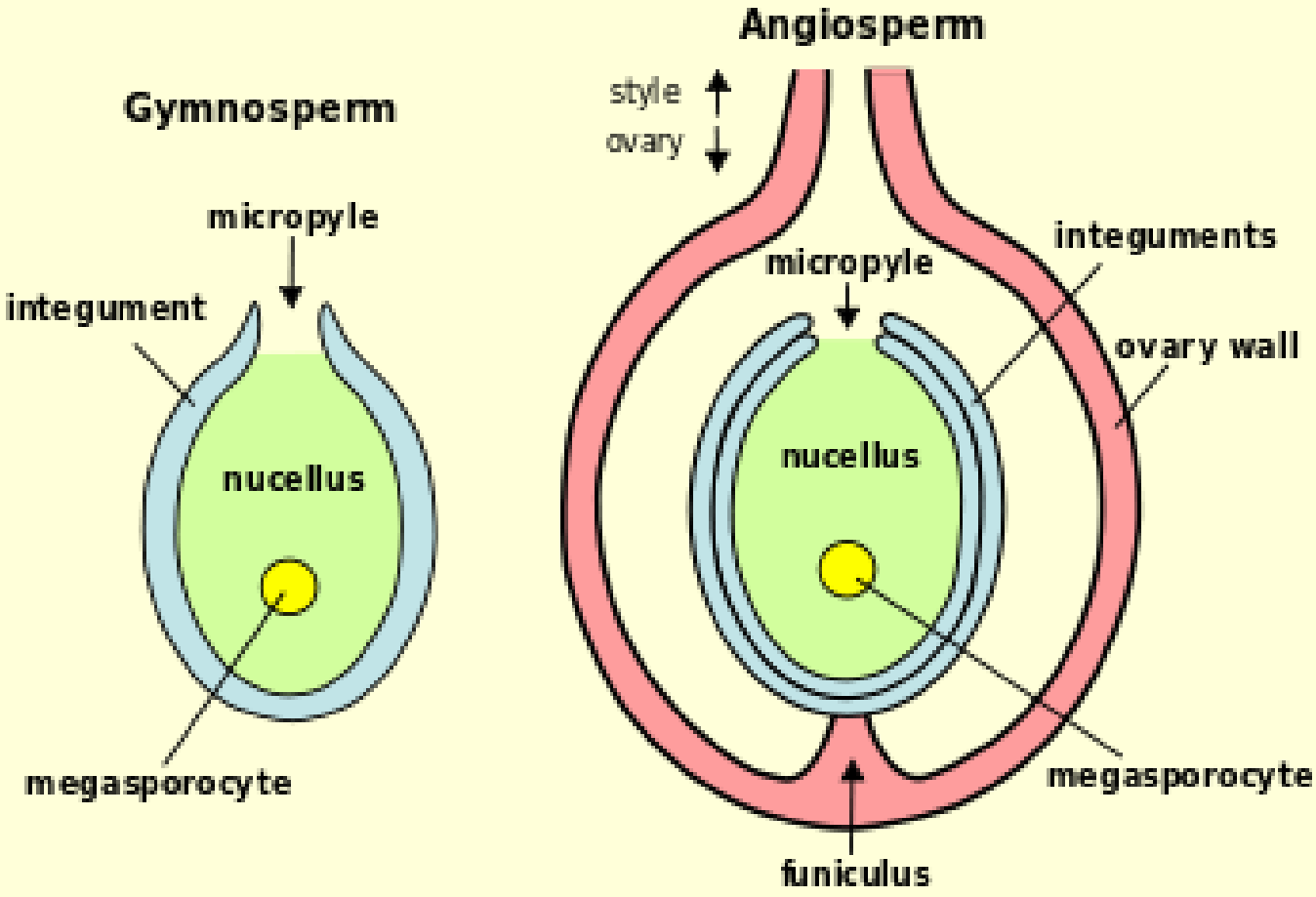


Seed plants (or spermatophytes) are referred to the subkingdom of higher plants. Currently, they dominate in the vegetation cover of the our planet. This group includes two divisions, **the Gymnosperms** and **the Angiosperms**.

They are distinguished from all other higher plants by the presence of a seed. The appearance of the seed is a major aromorphosis and probably one of the factors that determined the dominance of seed plants in the modern flora of the Earth. The reason for this is simple - the seed promotes survival.


a) Gymnosperms
micropyle
integuments
megasporangium
megasporocyte
b) Angiosperms
style
ovary
integuments
micropyle
ovary wall
megasporangium
megasporocyte
funiculus

The megasporangium of seminal plants is fleshy and is called the nucellus. In seed plants, it is covered with one or two additional layers of tissue - integuments.



Ovulus of seeds plants

- The sexual process in seeds plants is not dependent on the moisrty environment and does not require dripping-liquid water.

- Megagametophytes do not leave the megaspore and megasporangia shells and are more reliably protected from adverse environmental influences than in spore plants.

- The forming embryo is also reliably protected by megasporangium and megagametophyte shells and can use nutrients not only of the gametophyte, but also of the adult sporophyte.

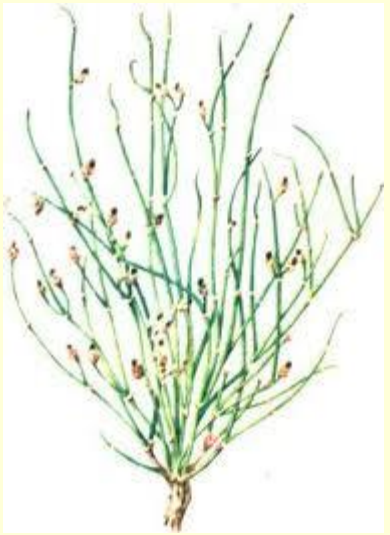
- After a seed is formed, it can remain dormant for a long time without losing its viability.

- When the seed germinates, the embryo (young sporophyte) lives for some time using the reserve of nutrients accumulated in the seed, and this allows it to depend less on the nutrient properties of the substrate during the first stage of life. All this indicates the great adaptability of seed plants to the conditions of existence.

The development of the female gametophyte, fertilization, and the initial stages of sporophyte (embryo) development take place inside the ovule and the seed.

Unlike spore plants, the unit of reproduction and propagation in the seed plants is not a spore but a seed.

The Division of Gymnosperms (Pinophyta or Gymnospermae)

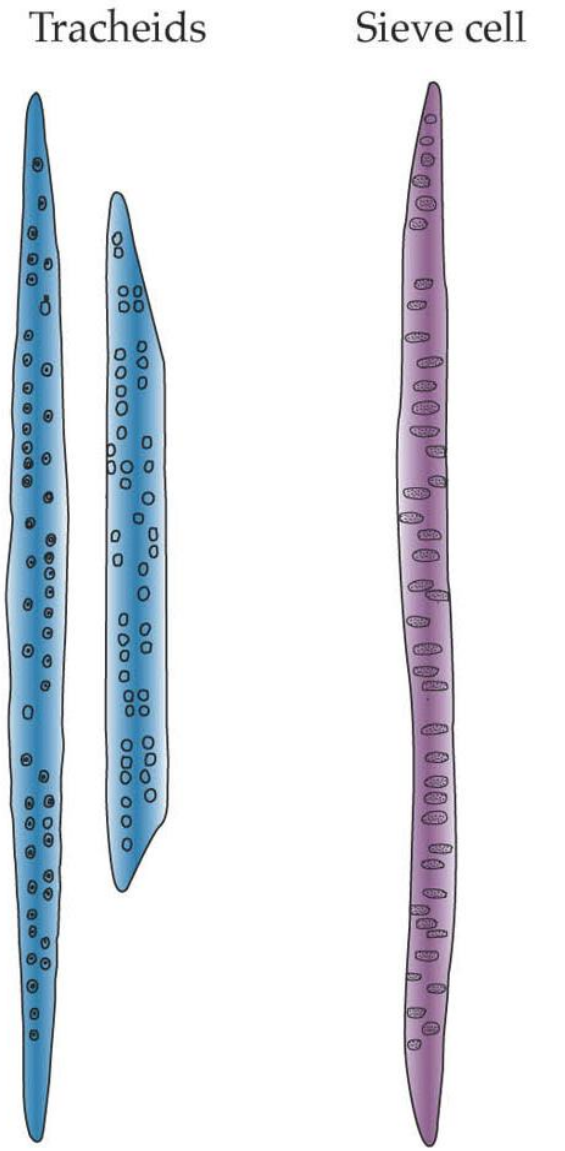


The name of the division suggests a general peculiarity in the structure of Gymnosperms: ovules and seeds are located openly on the surface of sporophylls or similar structures (i.e. "naked").

Most Gymnosperms have micro- and megasporophylls aggregated into strobils, which are collections of sporophylls on the axis isolated from the vegetative part of the shoot.

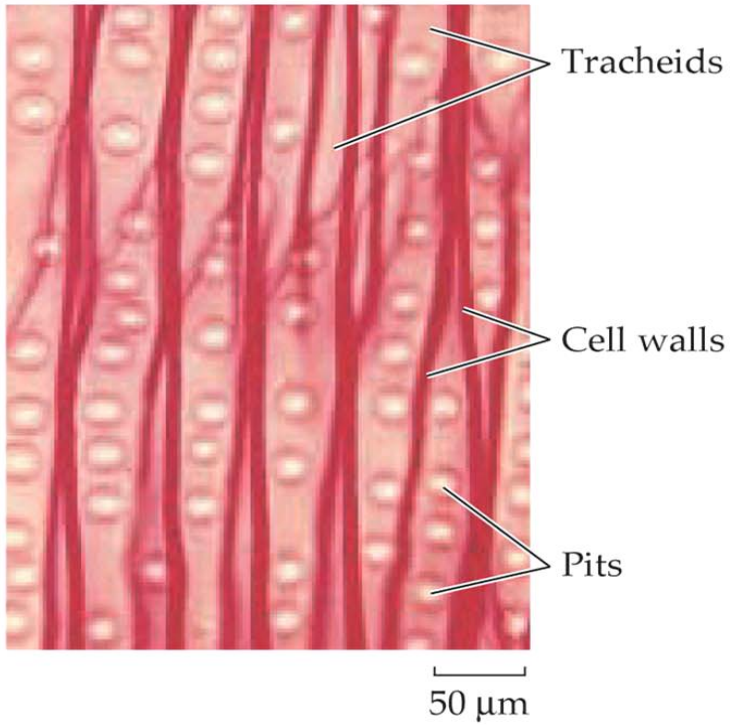
Strobils with megasporophylls are called megastrobils. Those with microsporophylls are called microstrobils. In other words, a strobilus is a spore-bearing shoot - a stem with spore-bearing leaves (sporophylls).

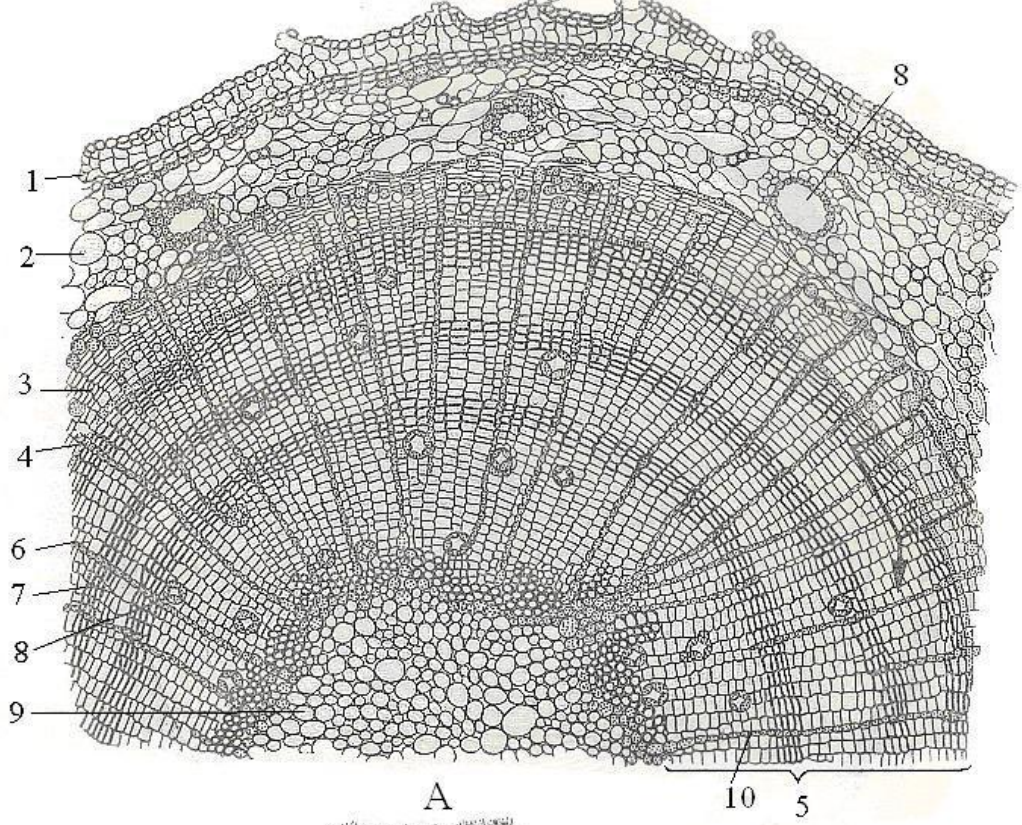
The structure of mega- and microstrobils is different and depends on the systematic belonging of the plant.

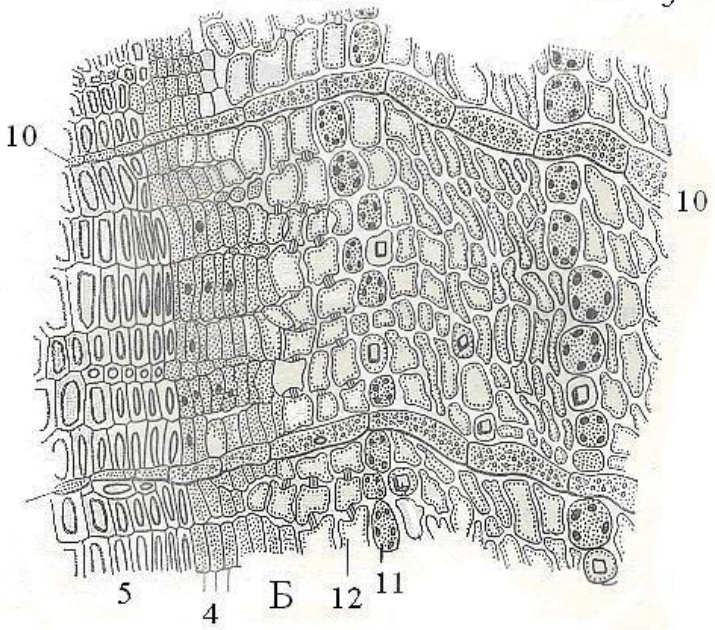


LIFE: THE SCIENCE OF BIOLOGY, Seventh Edition, Figure 35.10 Ev

- The anatomical structure of gymnosperms is characterized by secondary growth in thickness due to cambium activity. The primary cortex consists of a homogeneous parenchyma. Mechanical tissues are absent. The phloem consists of sieve cells (without companion cells), the xylem only of tracheids. Resin passages are often (but far from always) present in the bark and wood.

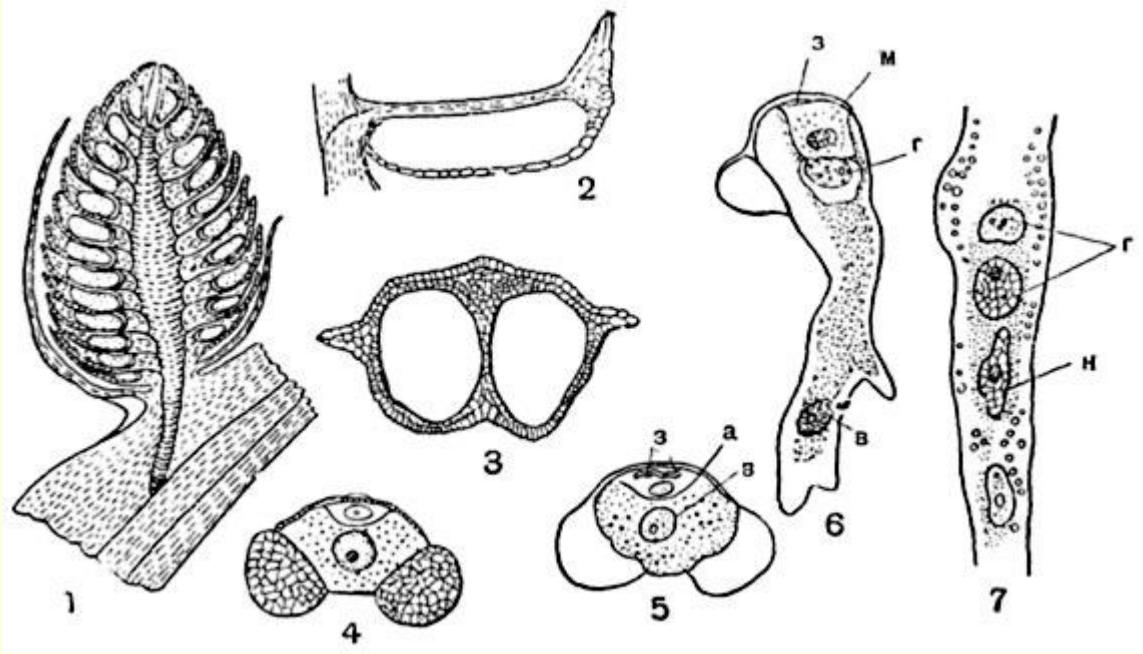




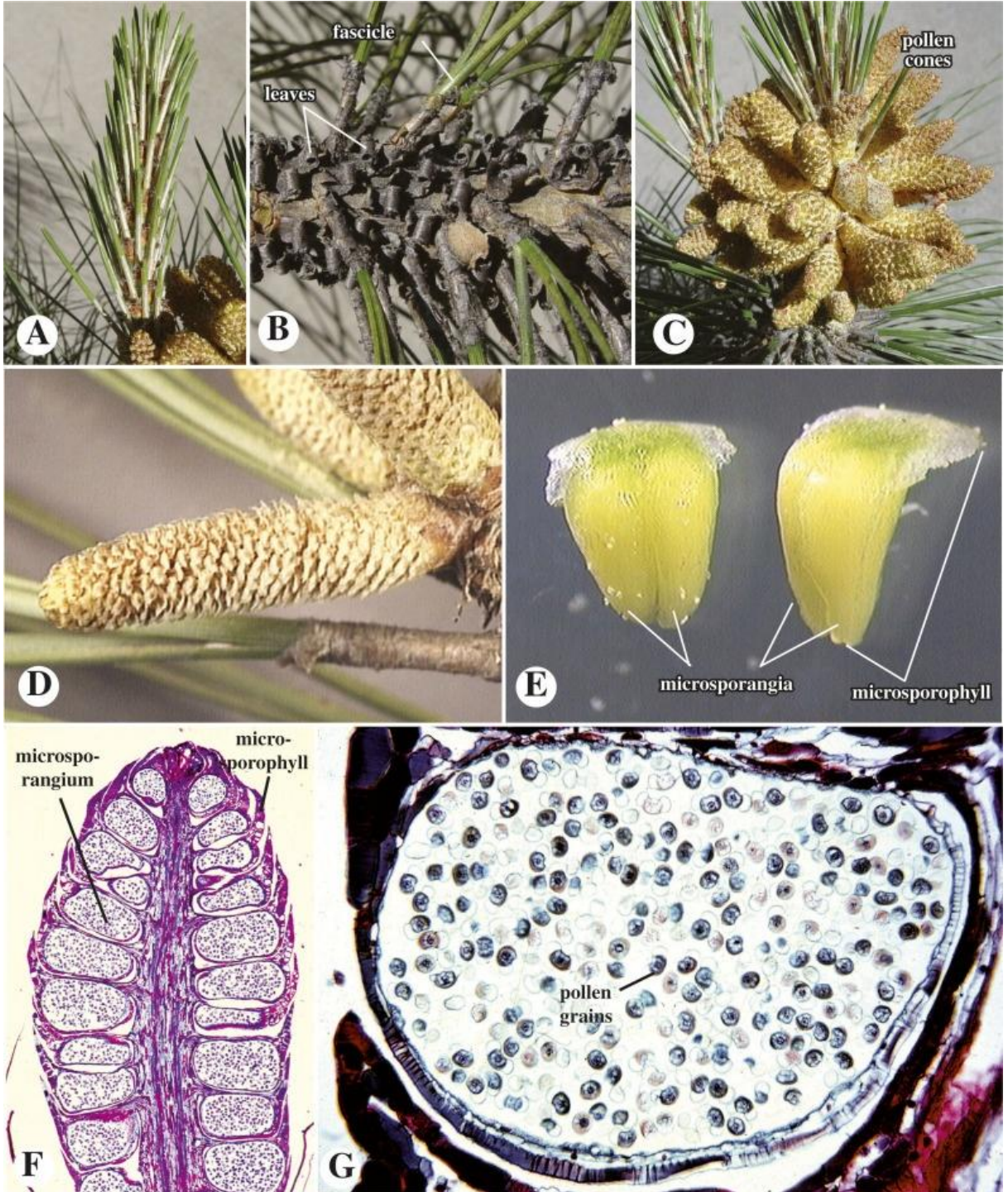


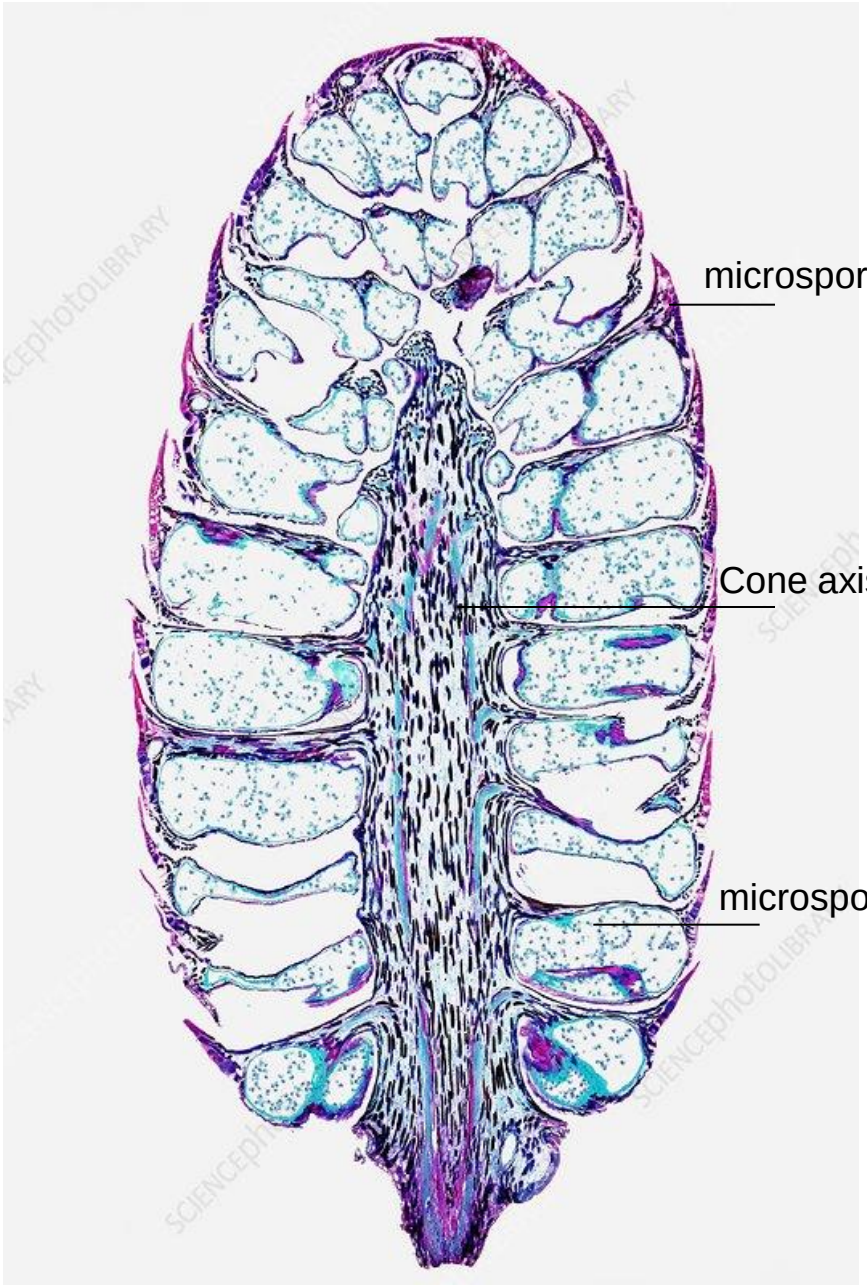
Pine (Pinus sylvestris) stem in cross section:A - part of the cross section; B - phloem and cambium, with adjacent xylem tracheids. 1 - periderm, 2 - primary cortex parenchyma, 3 - phloem, 4 - cambium, 5 - xylem, 6 - spring tracheids, 7 - autumn tracheids, 8 - resin passage, 9 - pith, 10 - pith ray, 11 - bast parenchyma, 12 - sieve tube.

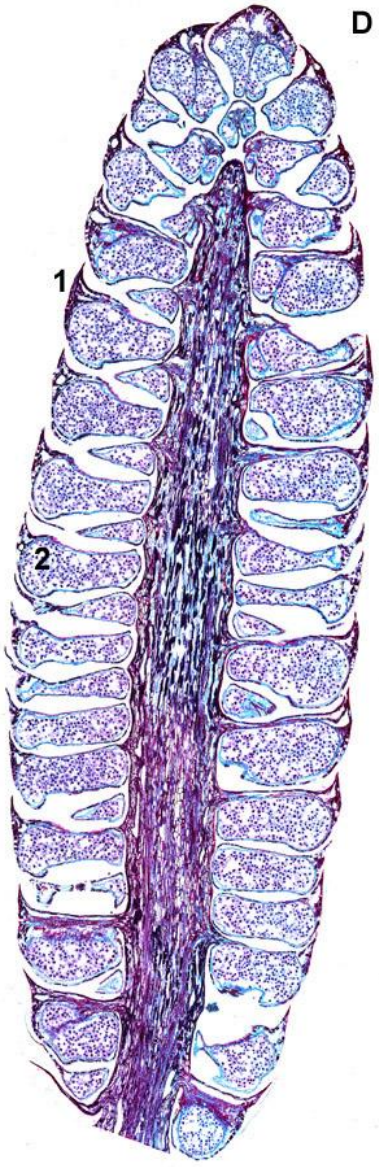
Pinus sylvestris

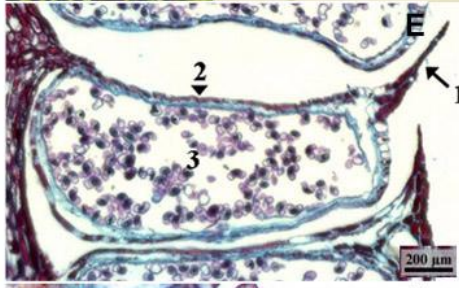


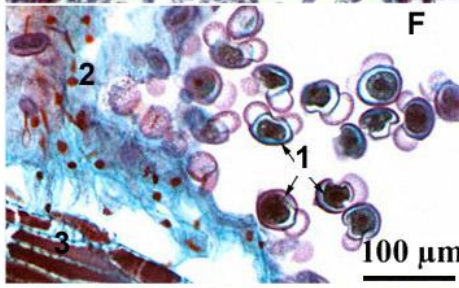
*1 - longitudinal section of male cone; 2 and 3 - longitudinal (2) and transverse (3) sections of microsporophyll (contents of microsporangia not shown); 4 - antheridium; 5 and 6 - sprouting of antheridium; 7 - end of pollen tube (in spruce): **з** - rests of bud; а - antheridial cell; **в** - vegetative nucleus of pollen tube; **н** - antheridial pedicle cell (in Fig. 7 - its nucleus); **г** - generative cell (sperm cells in Fig. 7).*

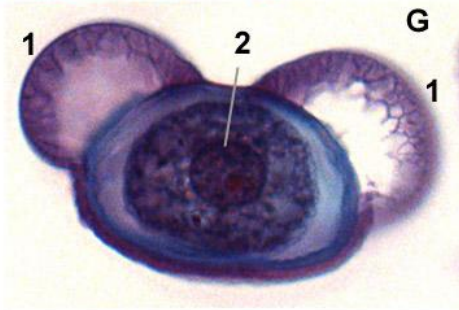

A
fascicle
leaves
B
pollen cones
C
D
microsporangia
microsporophyll
E
microspo-rangium
micro-sporophyll
F
pollen grains
G

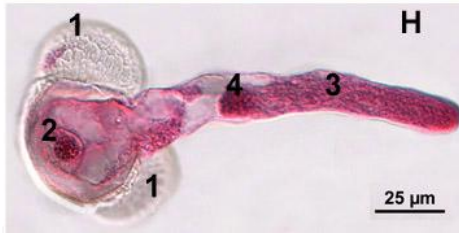






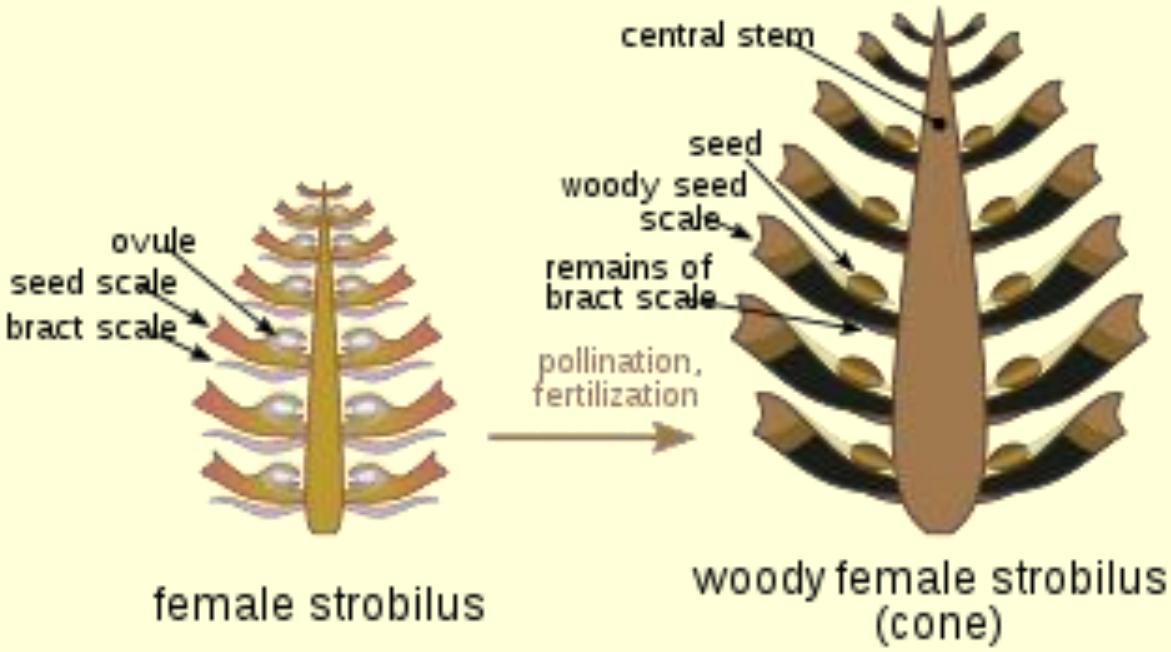


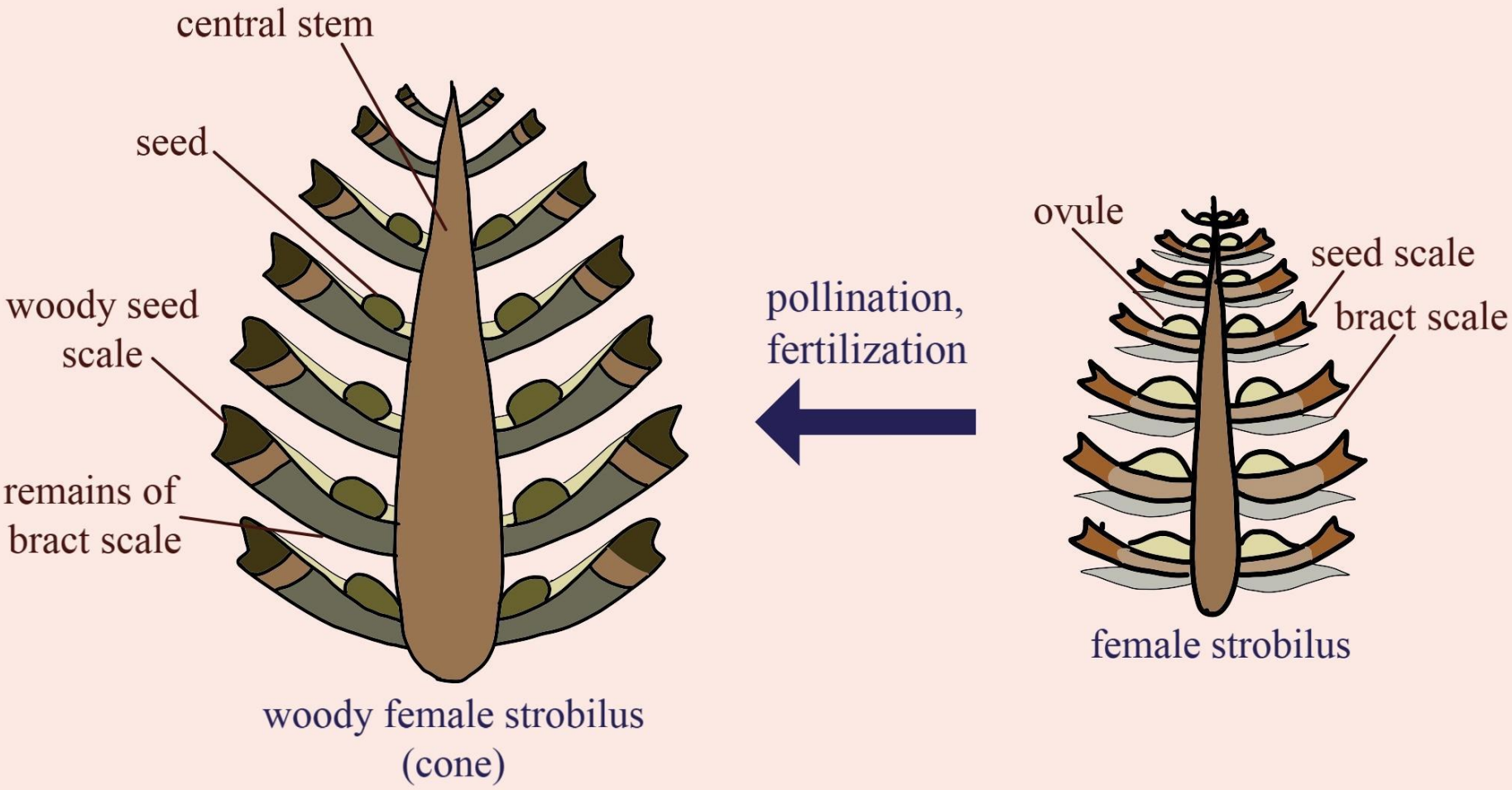




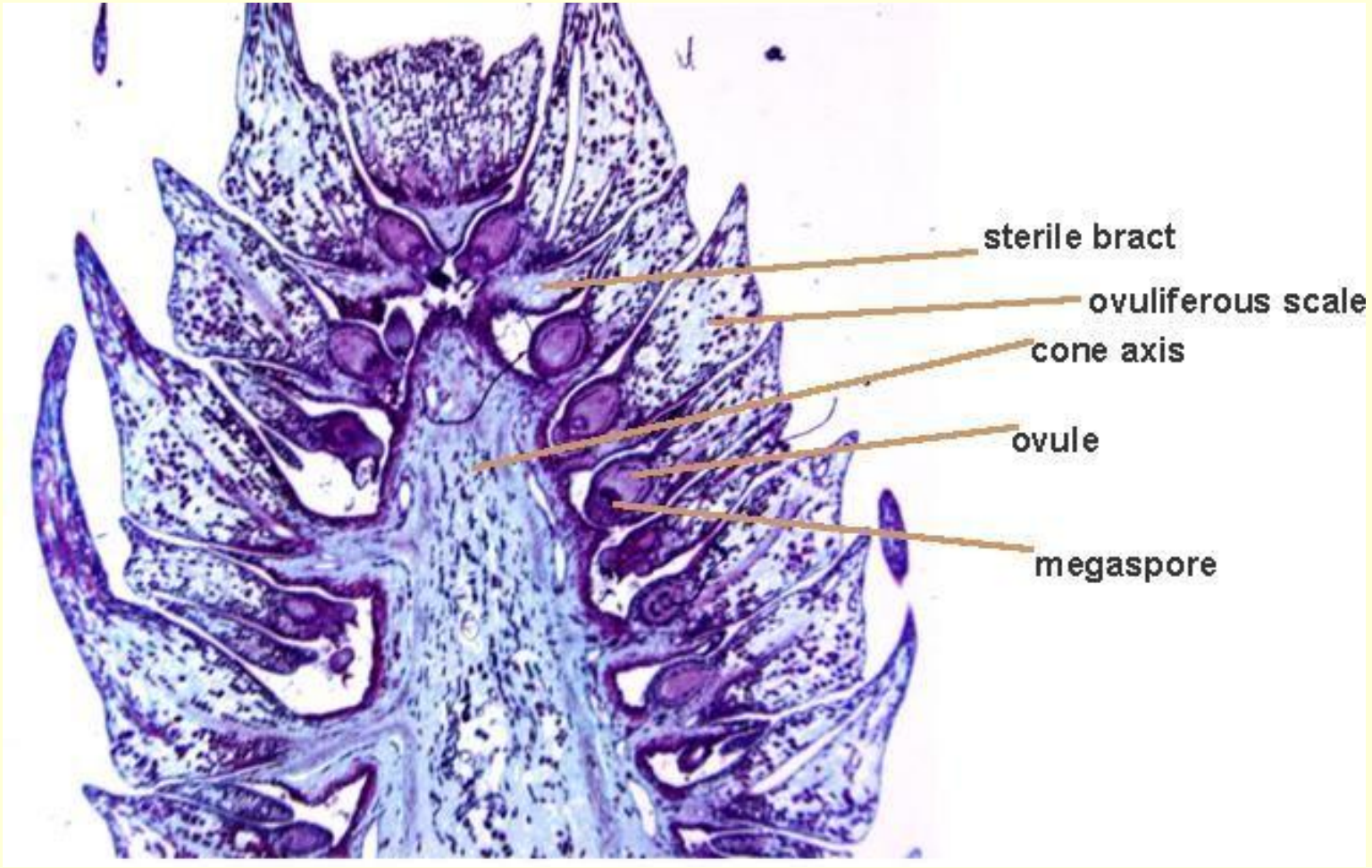
Microstrobils (pollen cone) of pine through microscope

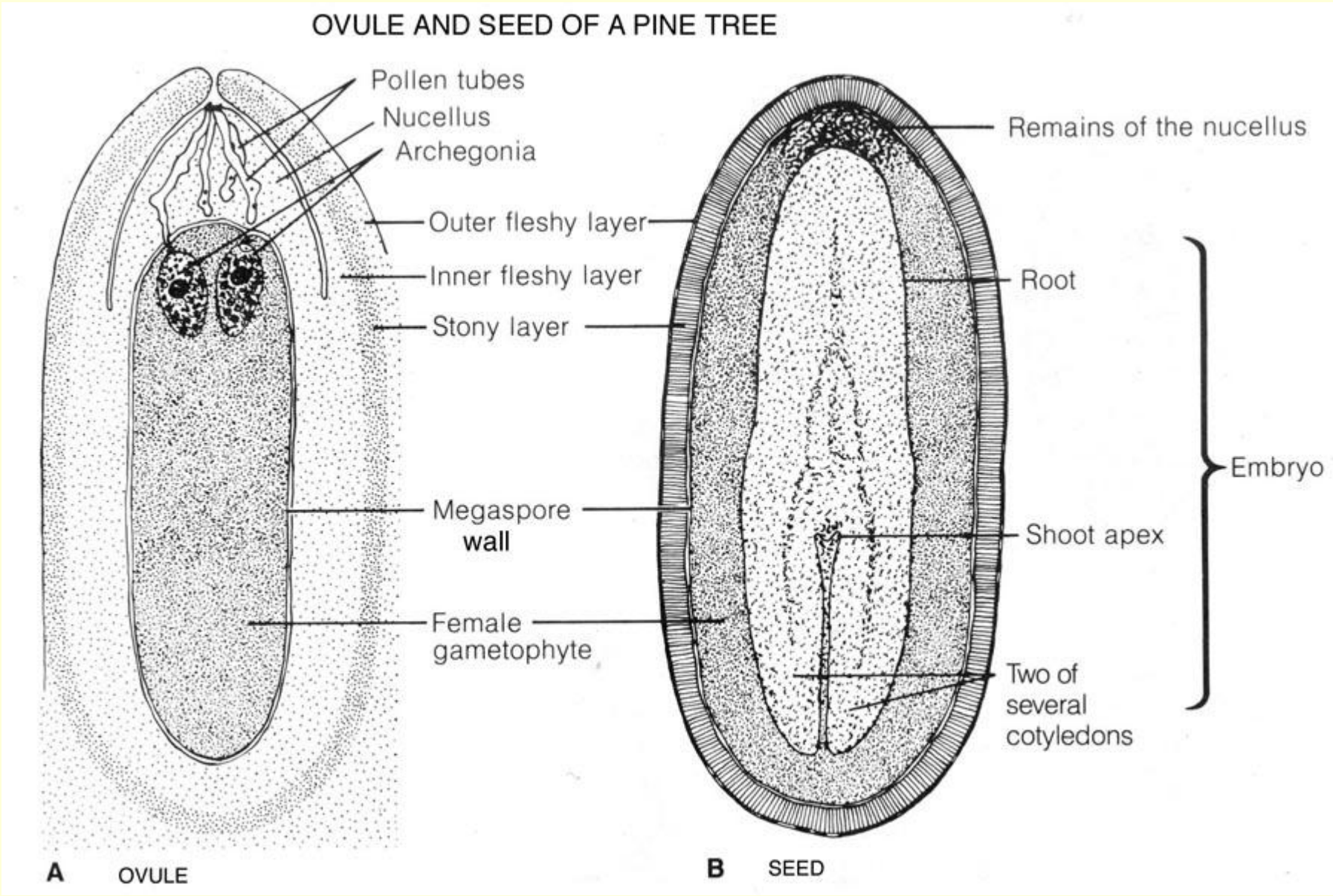
Megastrobils are collected in female cones (Ovulate cone)

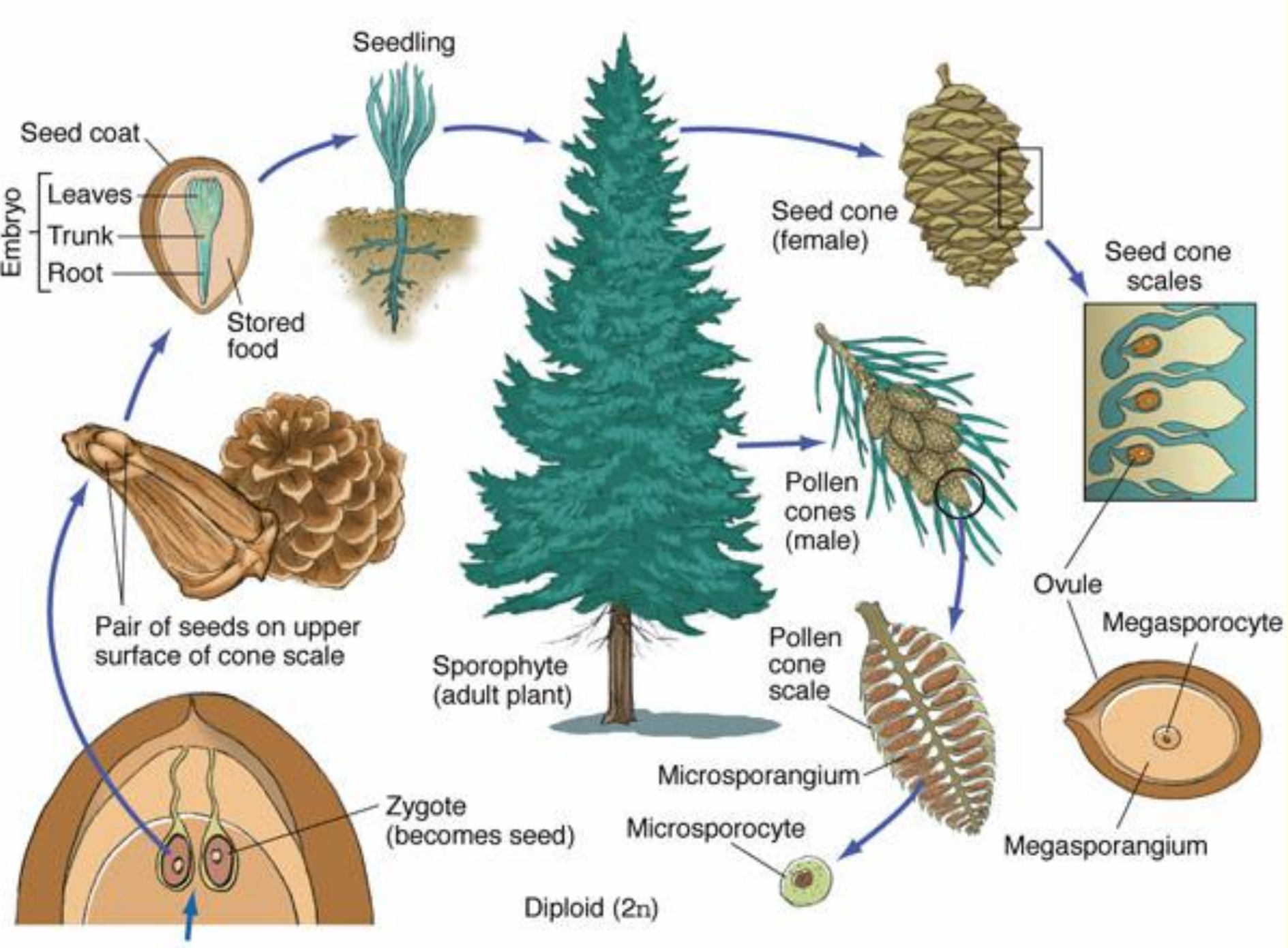


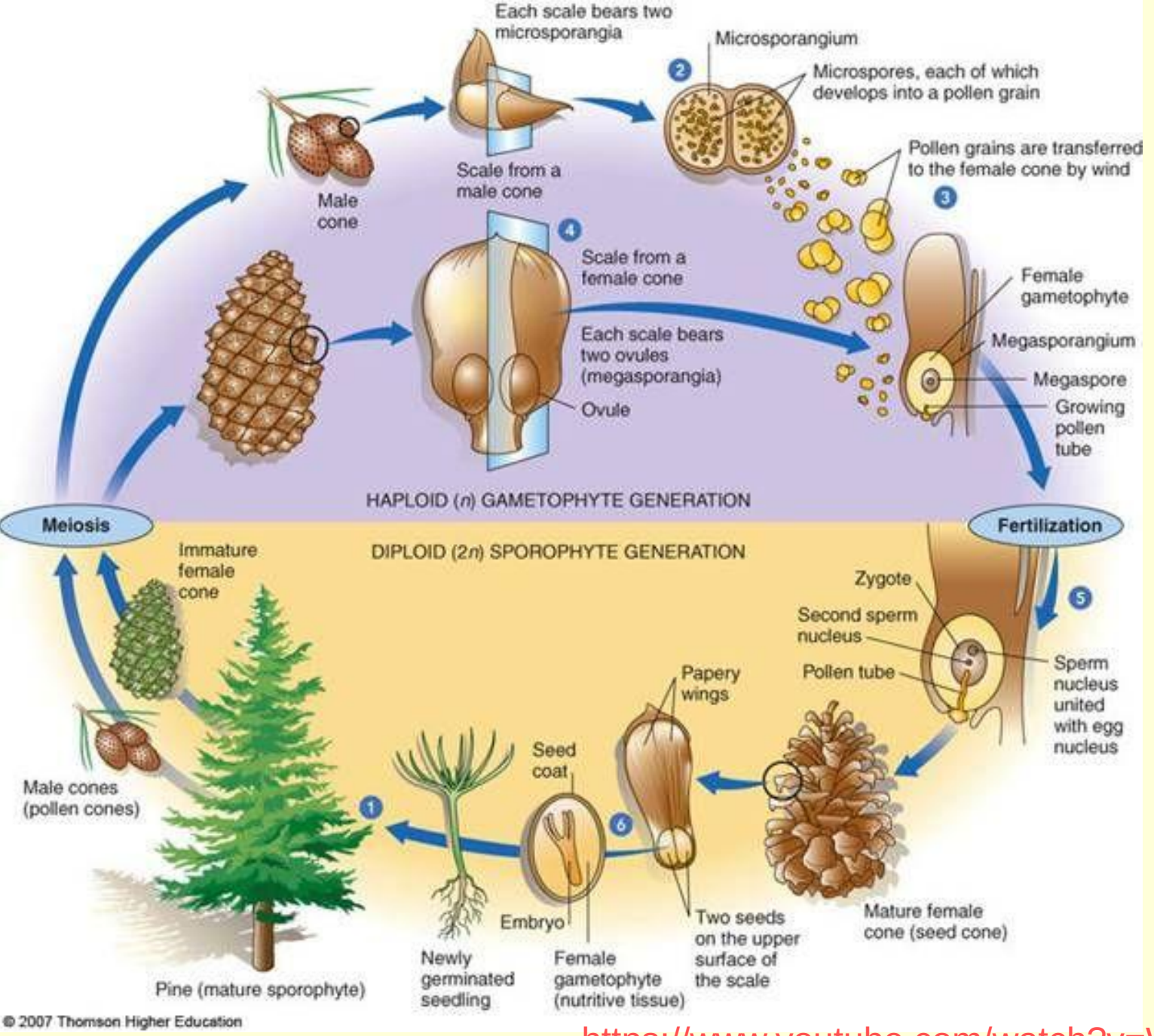


Female cone of *Pinus*


sterile bract
ovuliferous scale
cone axis
ovule
megaspore


OVULE AND SEED OF A PINE TREE
Pollen tubes
Nucellus
Archegonia
Outer fleshy layer
Inner fleshy layer
Stony layer
Megaspore wall
Female gametophyte
Remains of the nucellus
Root
Shoot apex
Two of several cotyledons
Embryo
A OVULE
B SEED


Seedling
Seed coat
Embryo
Leaves
Trunk
Root
Stored food
Seed cone (female)
Seed cone scales
Pollen cones (male)
Ovule
Megasporocyte
Pair of seeds on upper surface of cone scale
Sporophyte (adult plant)
Pollen cone scale
Microsporangium
Zygote (becomes seed)
Microsporocyte
Megasporangium
Diploid (2n)



https://www.youtube.com/watch?v=WqGhmkYXcdM

Gymnosperms are divided into six classes, of which 2 are extinct and 4 are now living.

1. Pteridospermatophyta (or "seed ferns" or "Pteridospermatopsida" (Lyginopteridopsida, Pteridospermae)
2. Cycadops (Cycadopsida)
3. Bennettites (Bennettitopsida)
4. Gneticidae (Gnetopsida)
5. Ginkgopsida
6. Conifers (Pinopsida).

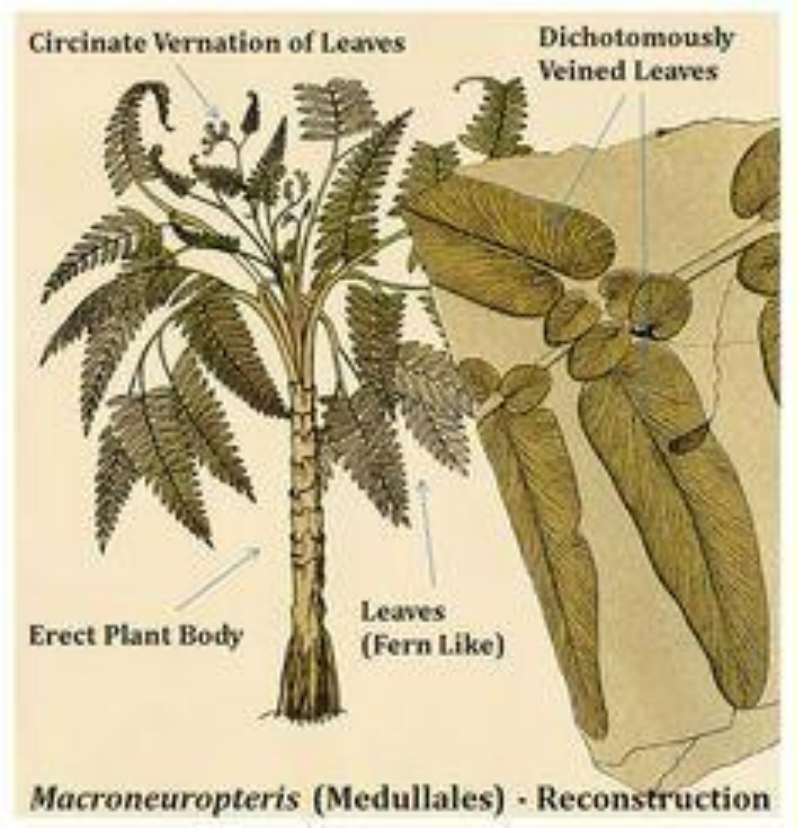
The class Pteridospermatophyta (or "seed ferns" or "Pteridosper-matopsida" (Lyginopteridopsida, Pteridospermae)

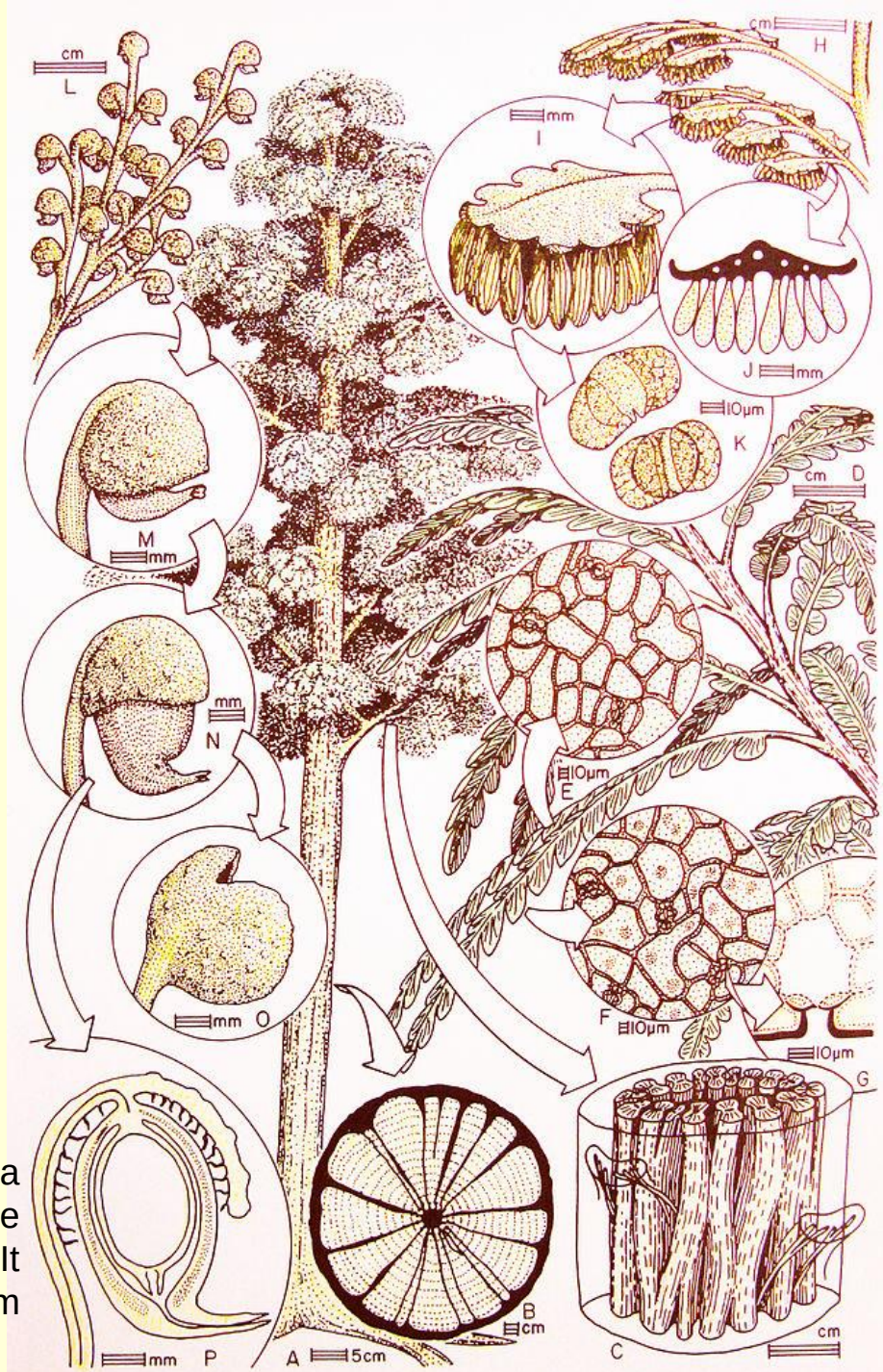
PTERIDOSPERMALES

Neuropteris

Alethopteris

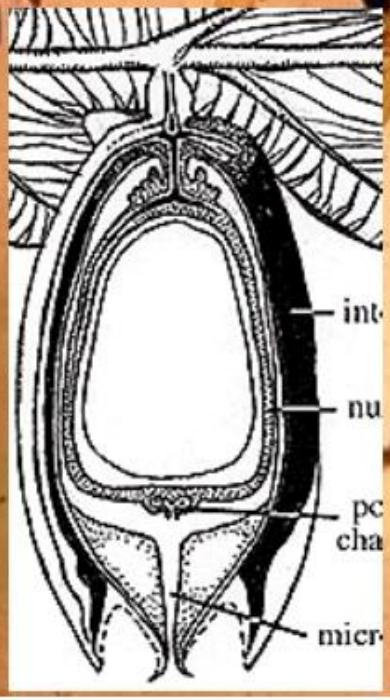
Lyginopteris

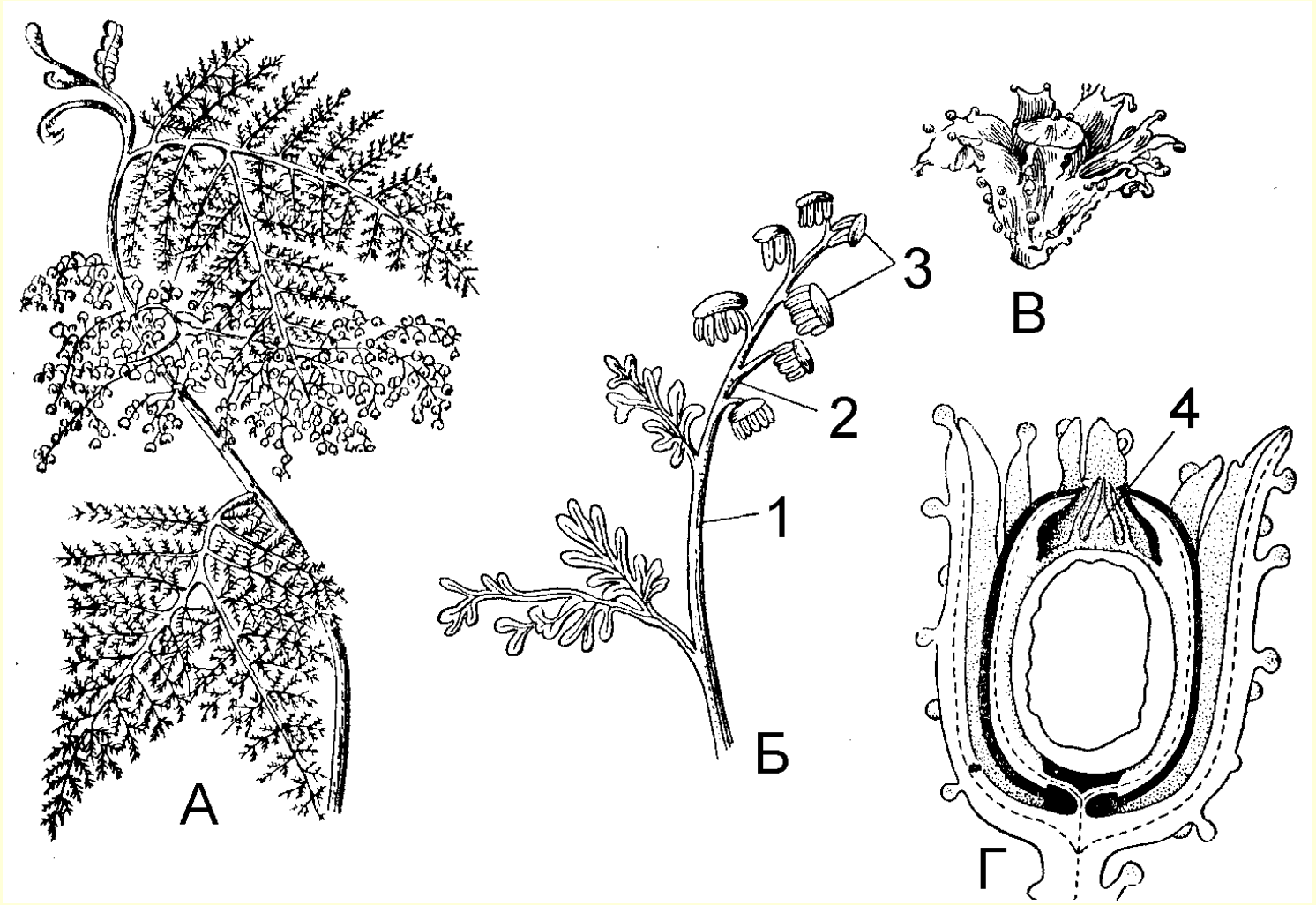




Umkomasia macleanii is an ovulate structure of a seed fern (Pteridospermatophyta and the nominate genus of Family Umkomasiaceae. It was first described by Hamshaw Thomas from the Umkomaas locality of South Africa

Reconstructions of seed fern seeds

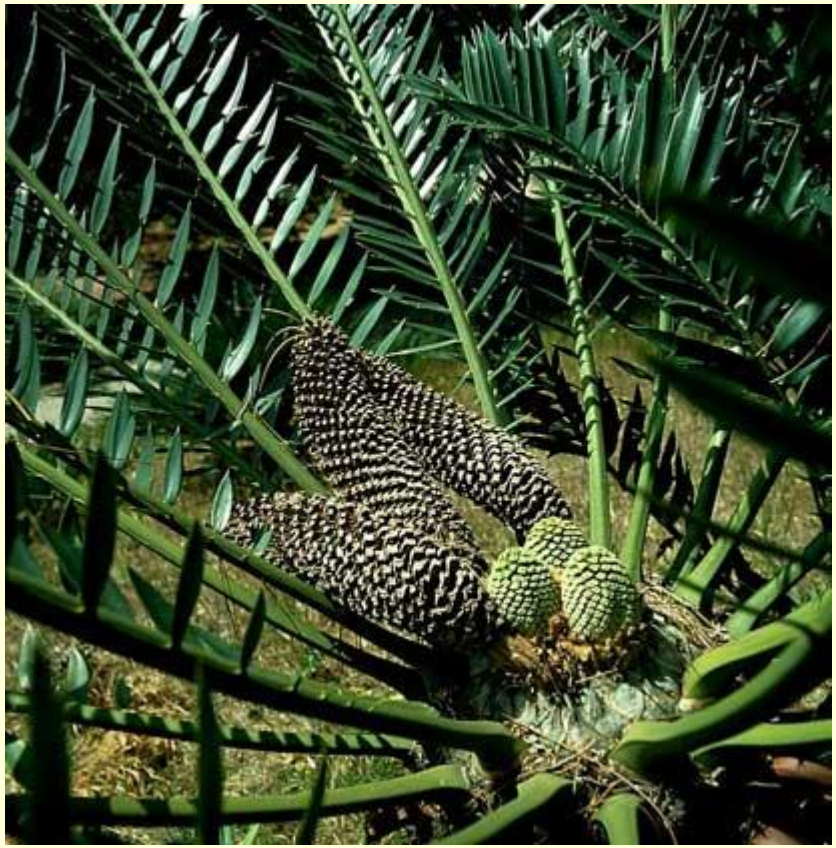


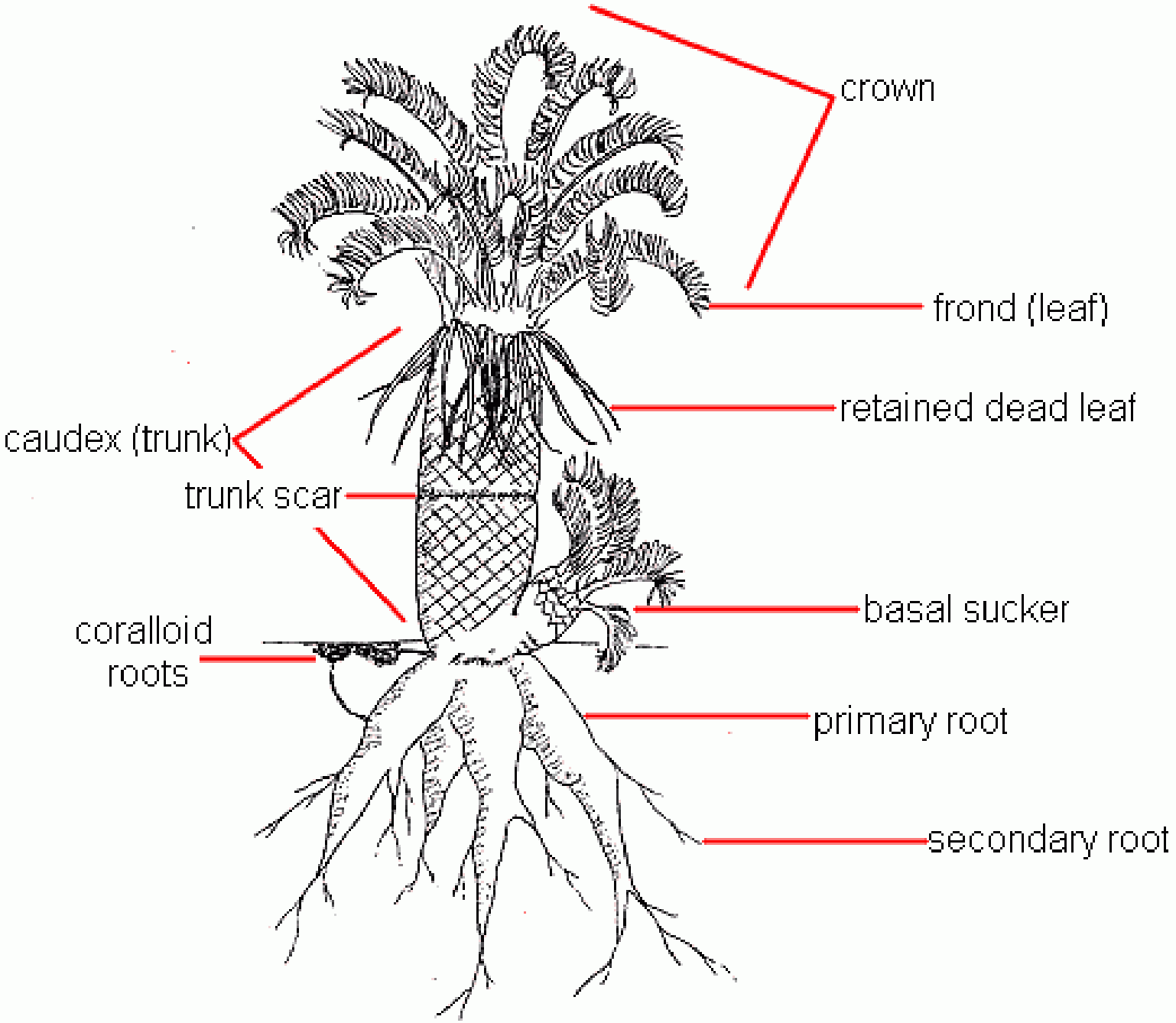


Seed fern - Calymmatotheca hoenighausi

А - general view (part of the plant); Б - reproductive shoot (microsporophylls); В - ovule (outside covered by mucus); Г - longitudinal section through ovule and mucus: 1 - vegetative part of the shoot, 2 - reproductive part, 3 - sporangia.

The class of Cycads (Cycadopsida)




crown
frond (leaf)
retained dead leaf
caudex (trunk)
trunk scar
basal sucker
coralloid roots
primary root
secondary root

Zamia latifolia

Cycas revoluta

Encephalartos sp.

Encephalartos sp.

Encephalartos sp.

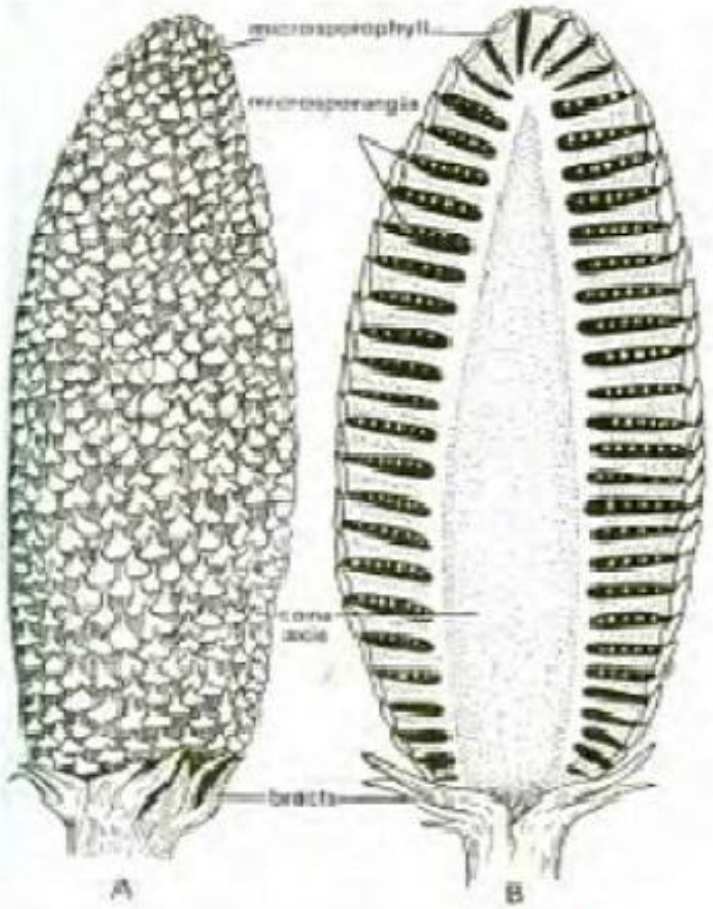
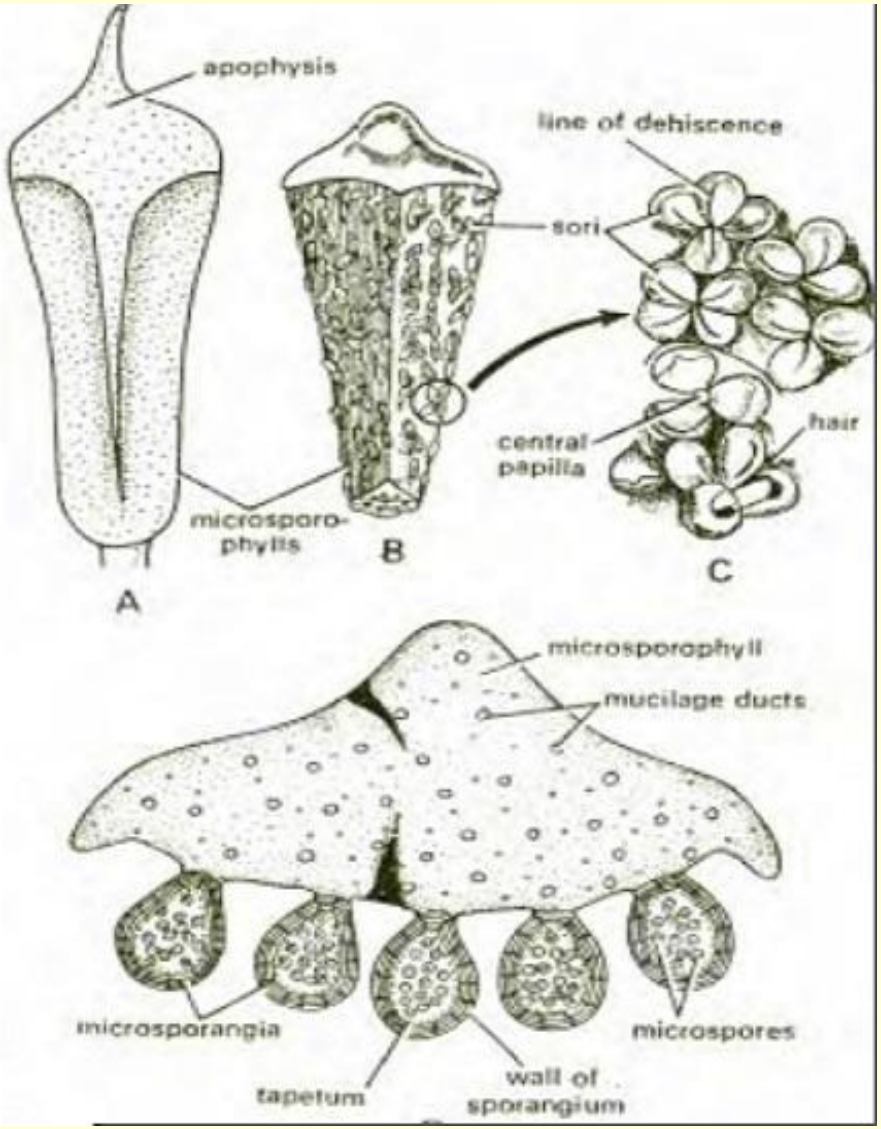
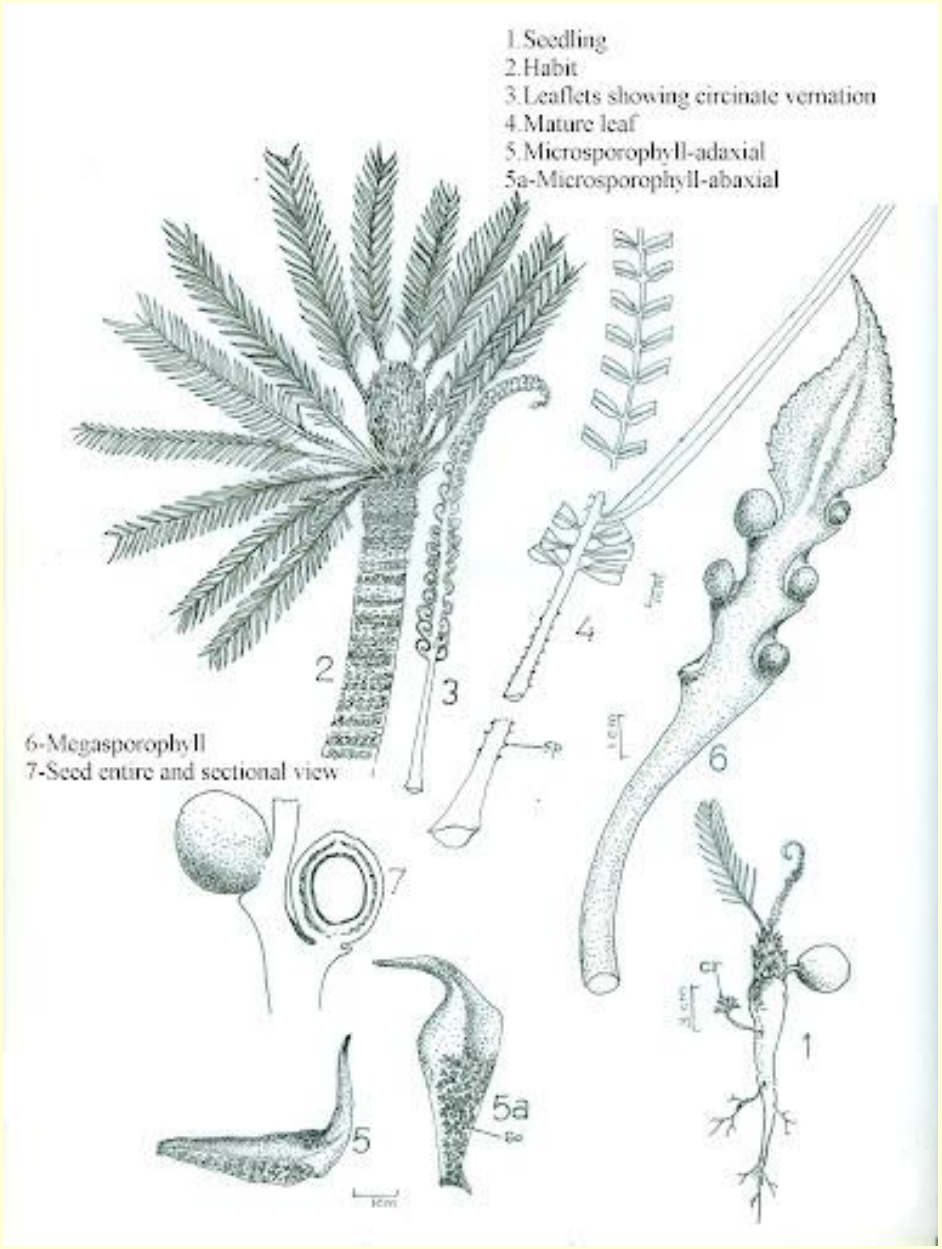
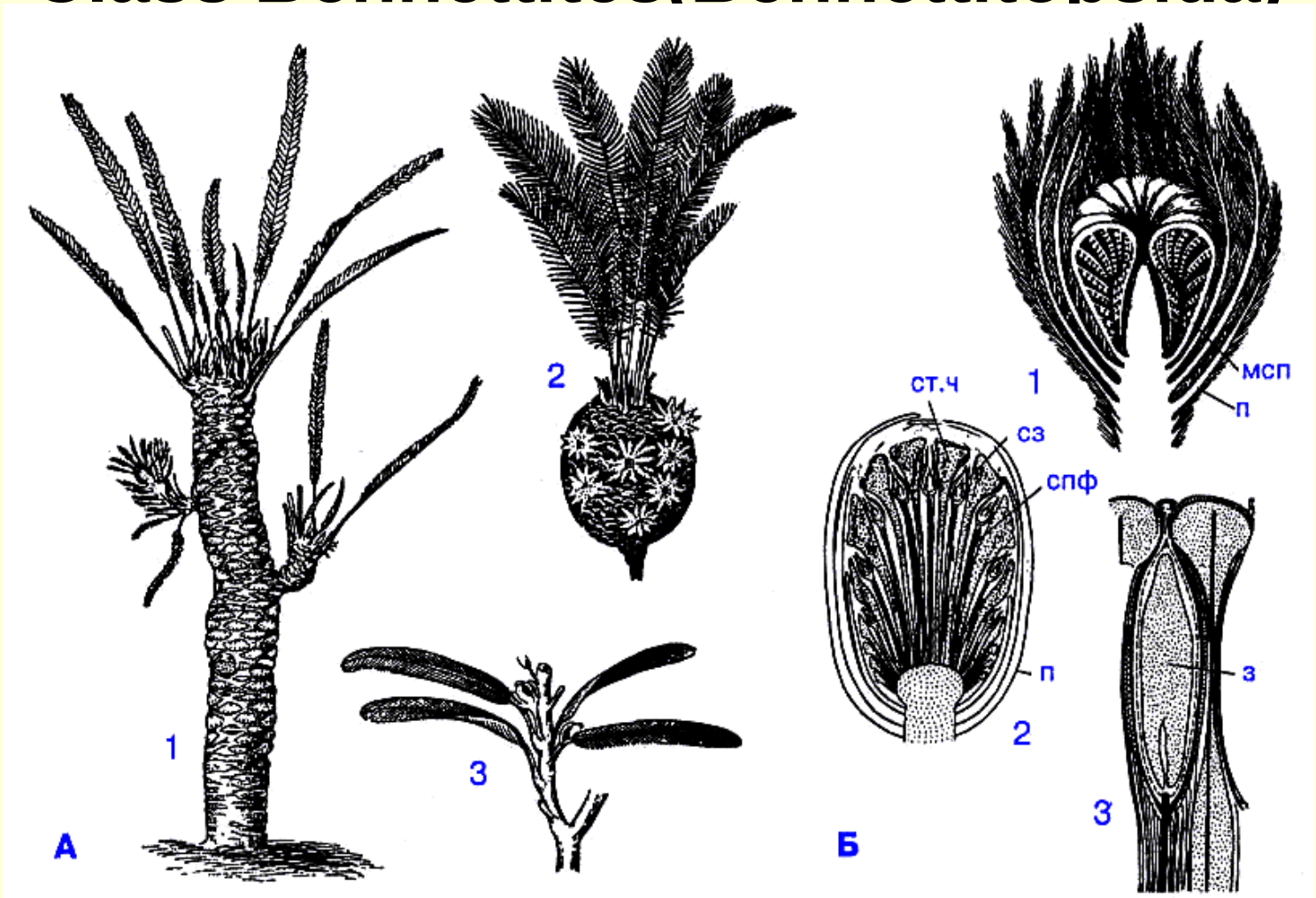


Fig. Microsporophyll
A. Entire, cone B. longitudinal section

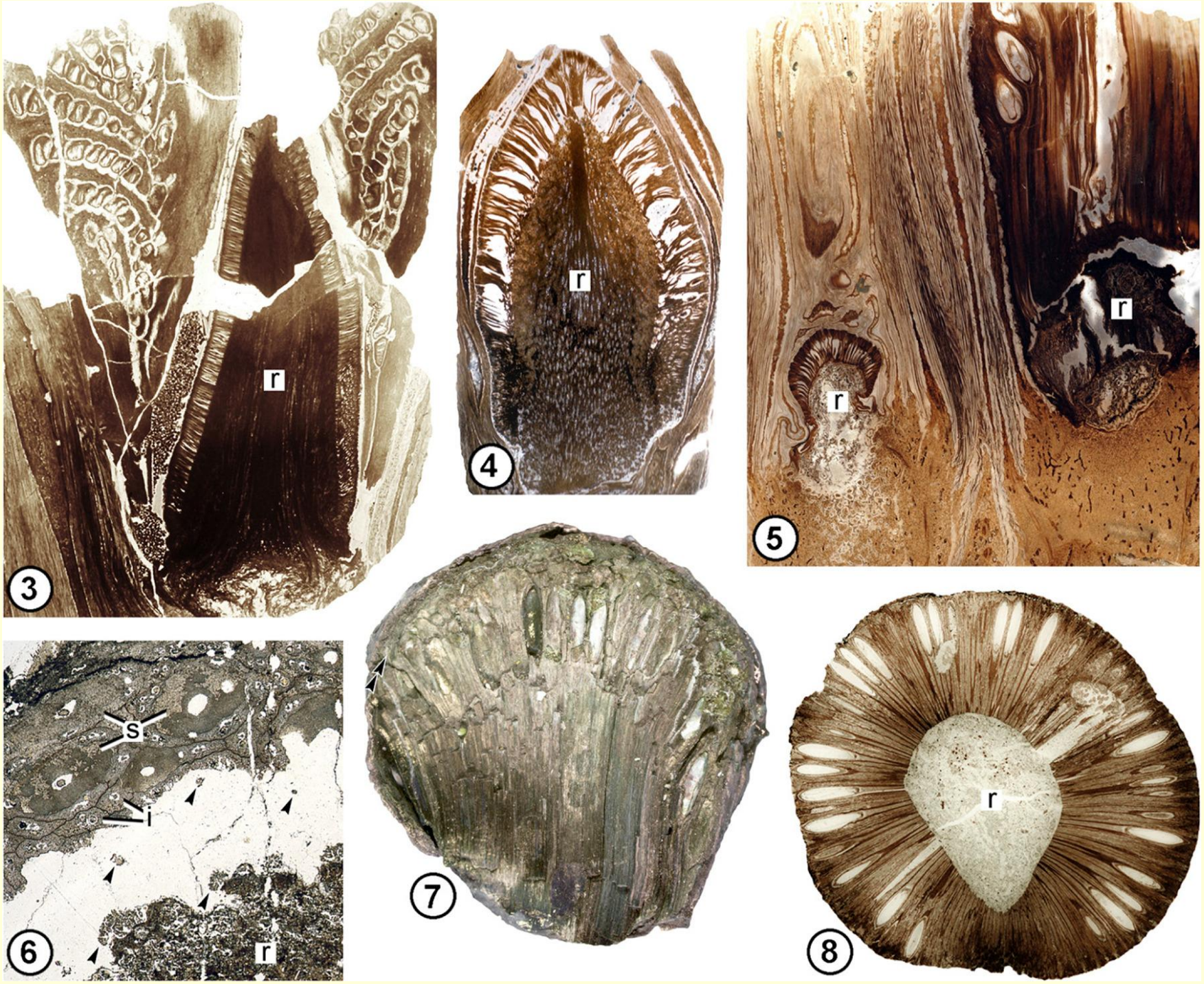



1.Seedling
2.Habit
3.Leaflets showing circinate vernation
4.Mature leaf
5.Microsporophyll-adaxial
5a-Microsporophyll-abaxial
6-Megasporophyll
7-Seed entire and sectional view
1
2
3
4
5
5a
6
7

Class Bennettites(Bennettitopsida)



А - reconstruction:1 - Williamsonia; 2 - Cycadeoidea;3 - Williamsoniella ;Б - Reproductive organs:1 - incision through strobilus of cicatodeoidea; 2 - incision through female part of strobilus; мсп - microsporophyll; п - periant; спф - megasporangiophor сз - ovule; ст.ч – bract scale; 3 - longitudinal incision through the seed; з - embryo.


r
3
r
4
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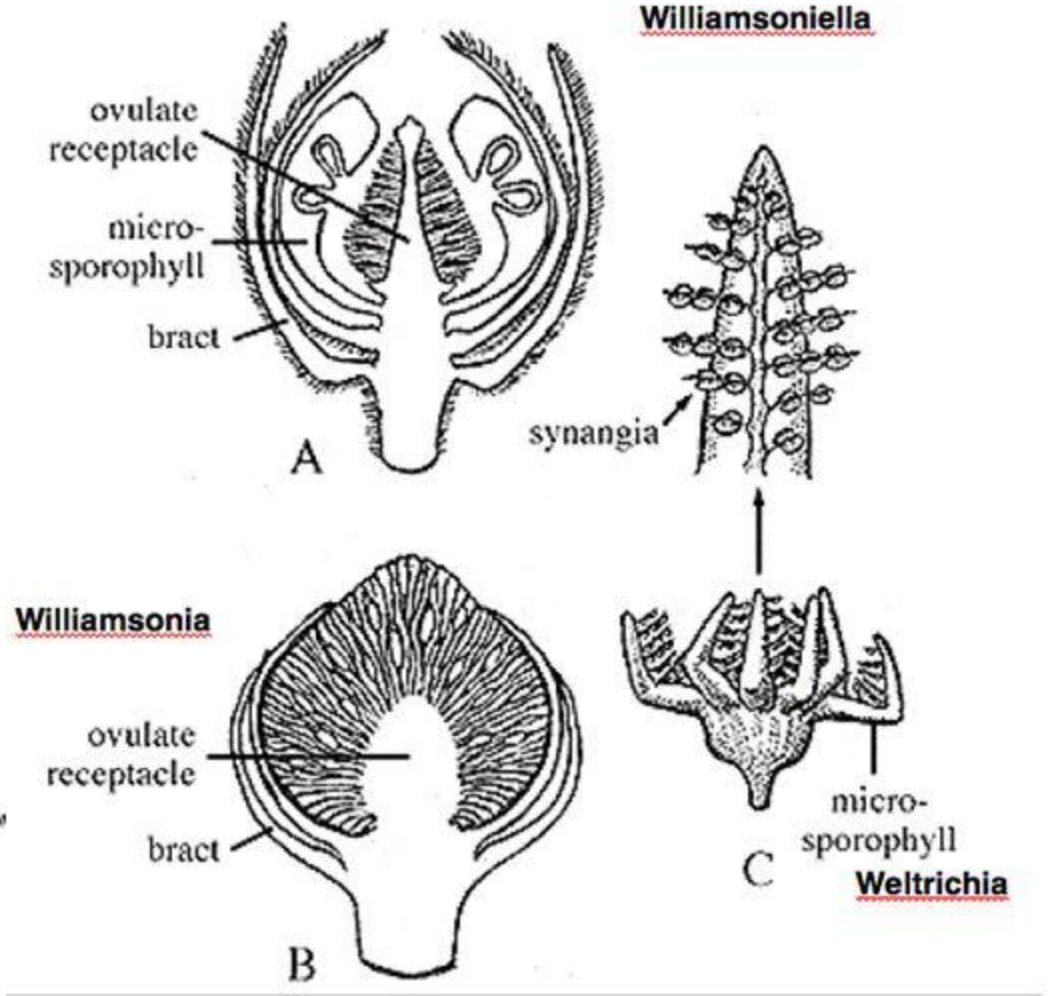
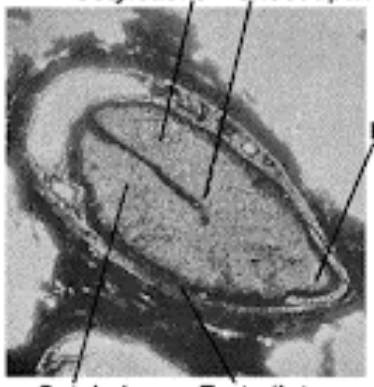
r
5
s
i
r
6
7
r
8

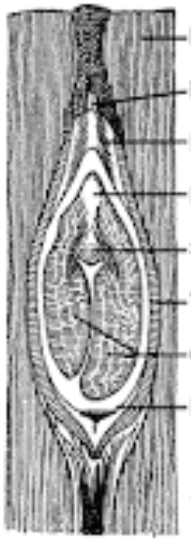
Bennetitales: *Williamsonia*



Bennettitales (cycadeoids): Fossil seeds of extinct gymnosperms

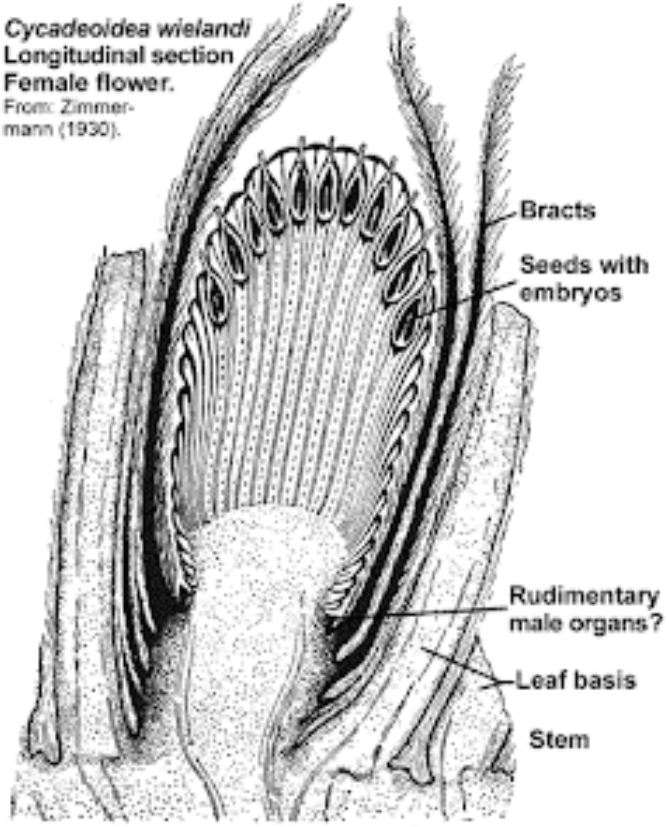


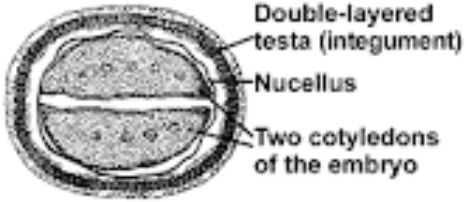
***Bennettites gibsonianus* seed section.**
From: D. H. Scott (1909) Studies in Fossil Botany, Vol. II, Spermatophyta, Adam and Charles Black, London. Photograph: Dr. Bousfield; S. Coll. 351.



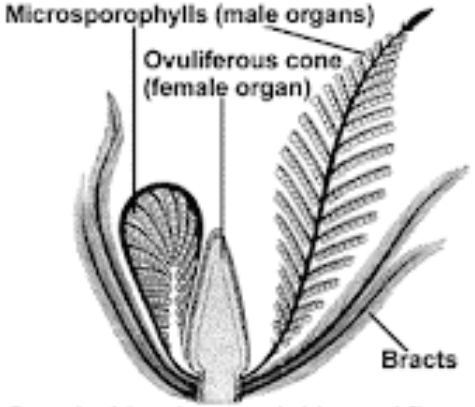
***Cycadeoidea gibsoniana* seed section.**
From: A. Engler (1926) Die natürlichen Pflanzenfamilien, Vol. 13, Gymnospermae, Verlag von Wilhelm Engelmann, Leipzig. Drawing: Solms-Laubach.

Cycadeoidea wielandi
Longitudinal section
Female flower.
From: Zimmermann (1930).





***Bennettites gibsonianus* seed section.**
Transverse section of a seed. Note the vascular bundles in the cotyledons. From: D. H. Scott (1909).



***Cycadeoidea dacotensis* bisexual flower.**
From: W. Zimmermann (1930) Die Phylogenie der Pflanzen. Verlag von Gustav Fischer, Jena. Drawing: Wieland.

The Gnetophytes class (Gnetopsida)

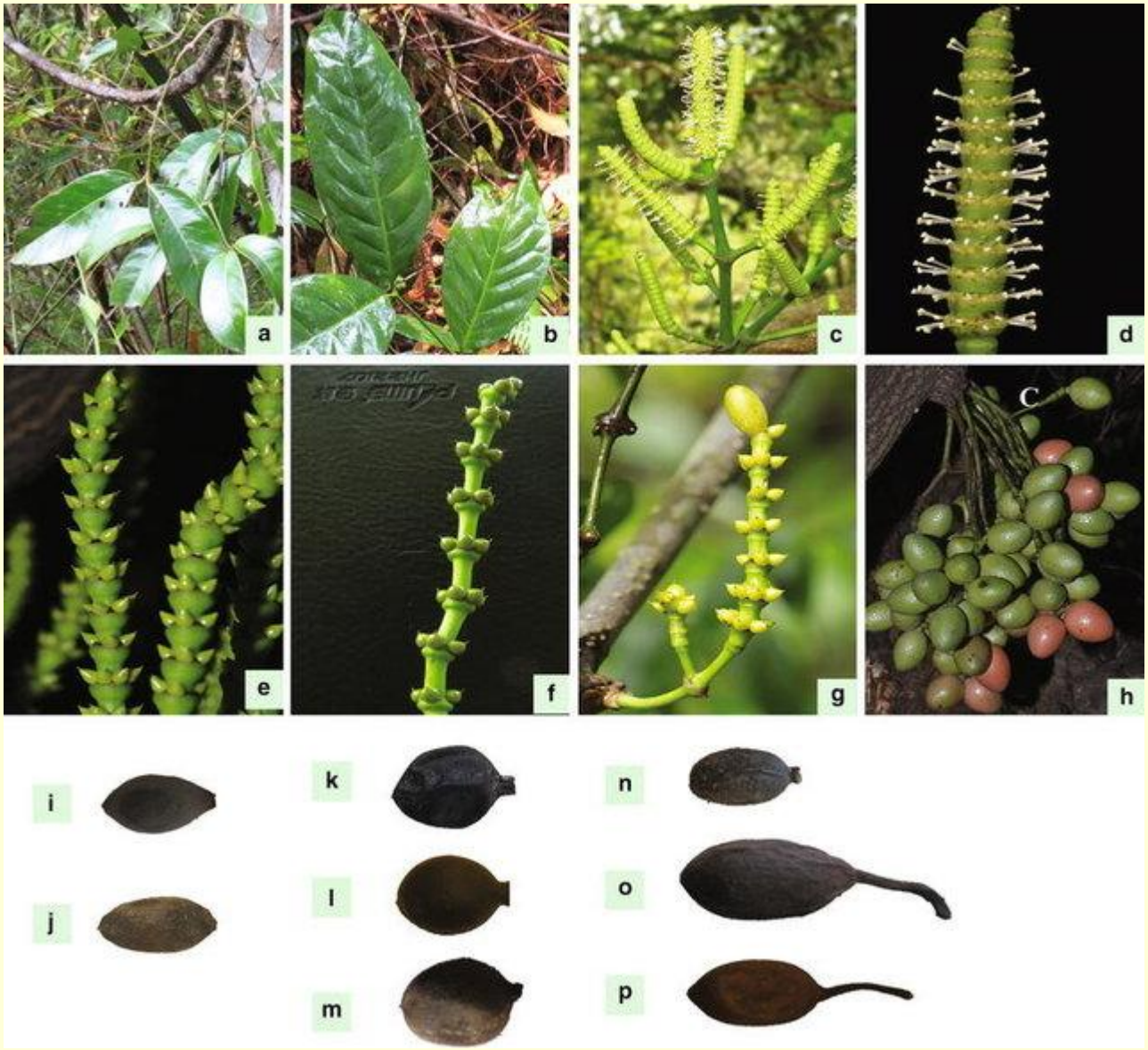
Welwitschia

Ephedra

Gnetum gnemon

Male cone

The female cones



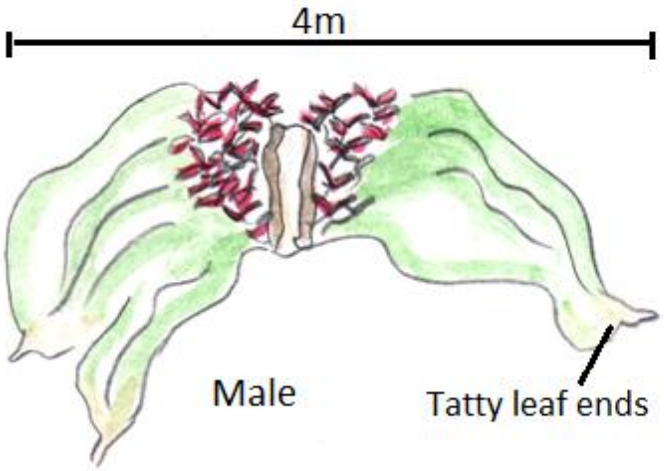
Vegetative and reproductive morphology of Chinese Gnetum.a Leaves and branches of G. parvifolium. b Leaves of G.luofuense. c Male spikes of G. montanum.d A male spike of G. luofuense (=G. hainanense). e Female spikes of G. luofuense (=G. hainanense). f A female spike of G. catasphaericum. g A female spike of G. parvifolium with a developing seed. h Seeds of G. luofuense (=G. hainanense) in clusters. Seeds of Chinese lianoid Gnetum.iG. parvifolium. jG. formosum. kG. catasphaericum.lG. montanum. m–nG. pendulum. o, pG. luofuense (=G. hainanense).Photographs by C. Hou, J. Lau and X.J. Zeng

Welwitschia mirabilis

Female cones in flower

Male cones in flower

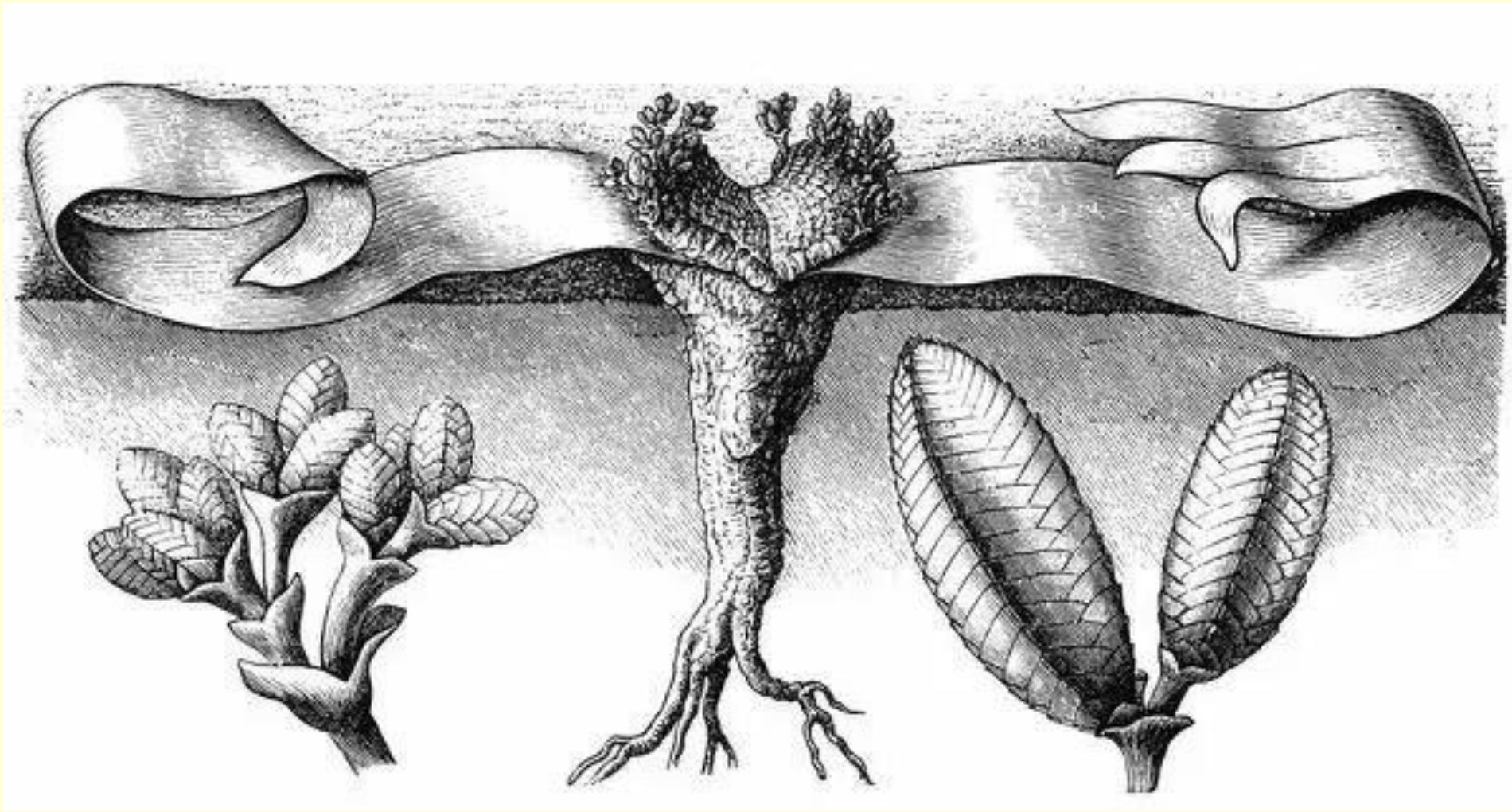
Young Welwitschia



Male cone

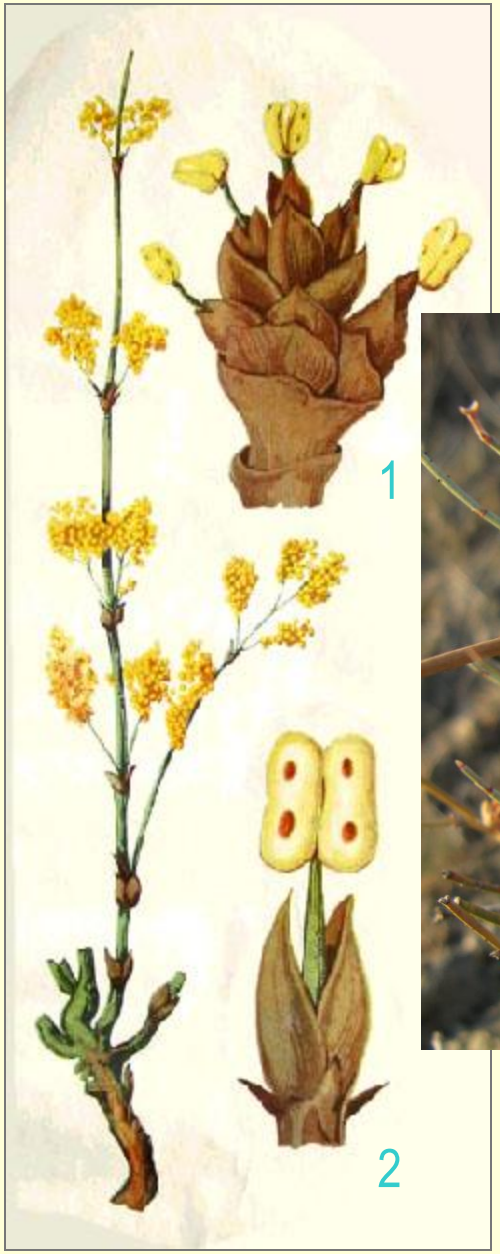
Female

Female cone




JennyGeis Thue-Nilsen

Ephedra distachya



Male plant

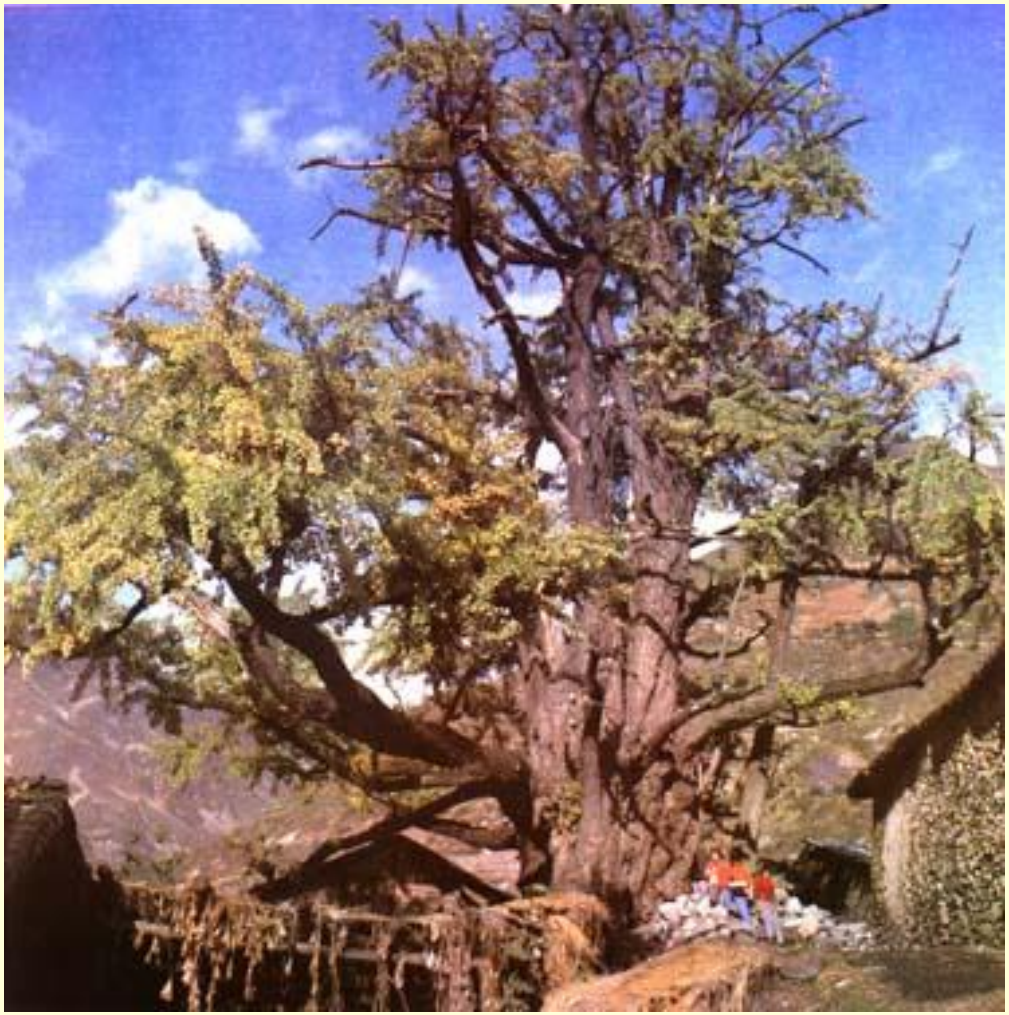
Female plant

Male strobilus

Female strobilus

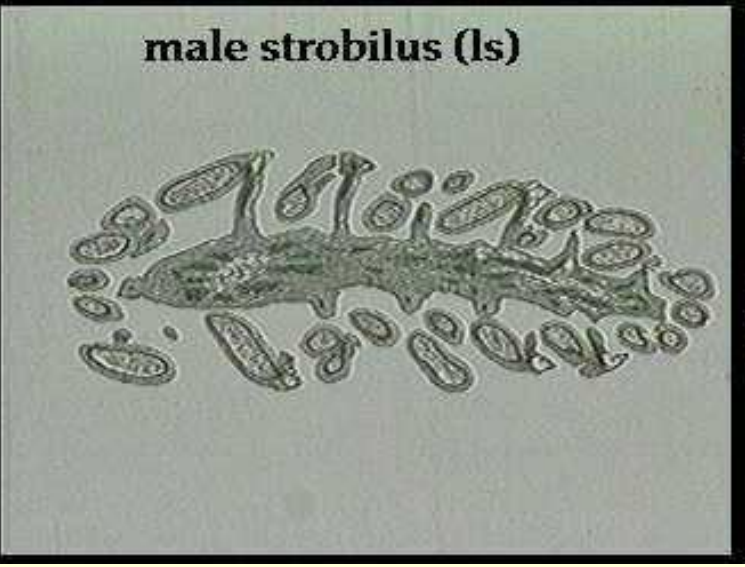
Class Ginkgoopsida

Ginkgo biloba

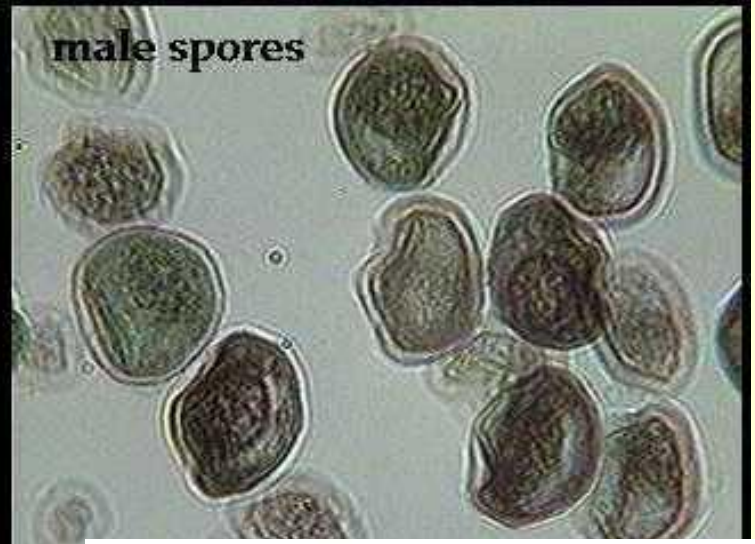


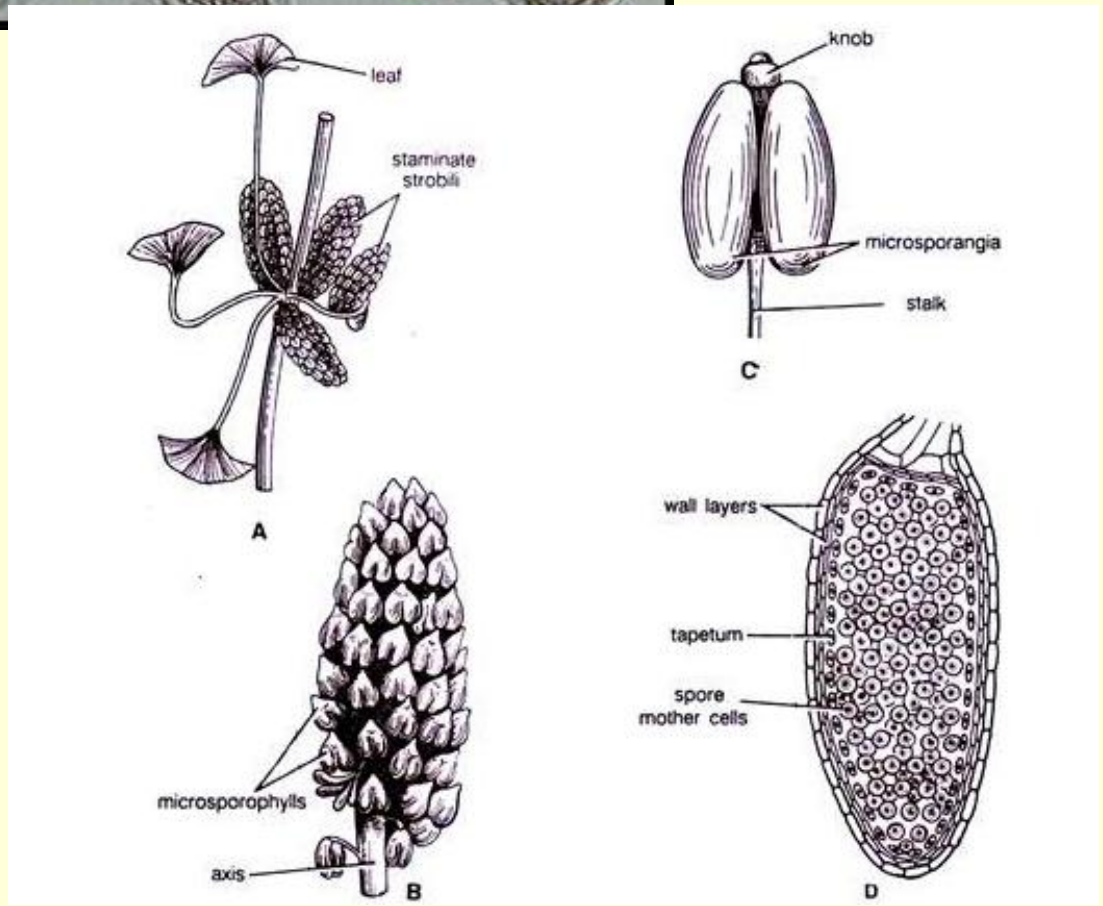
Male ctrobilus

male strobilus (ls)

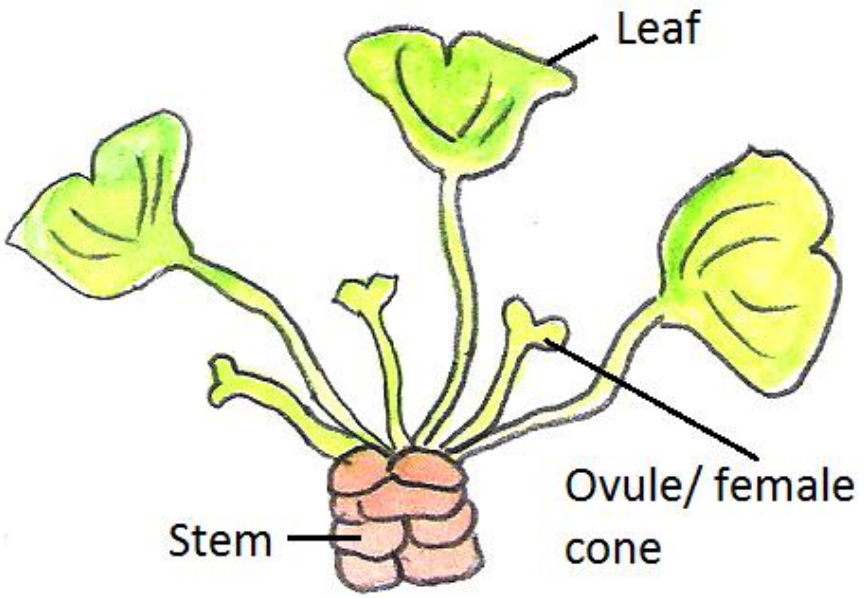


male spores

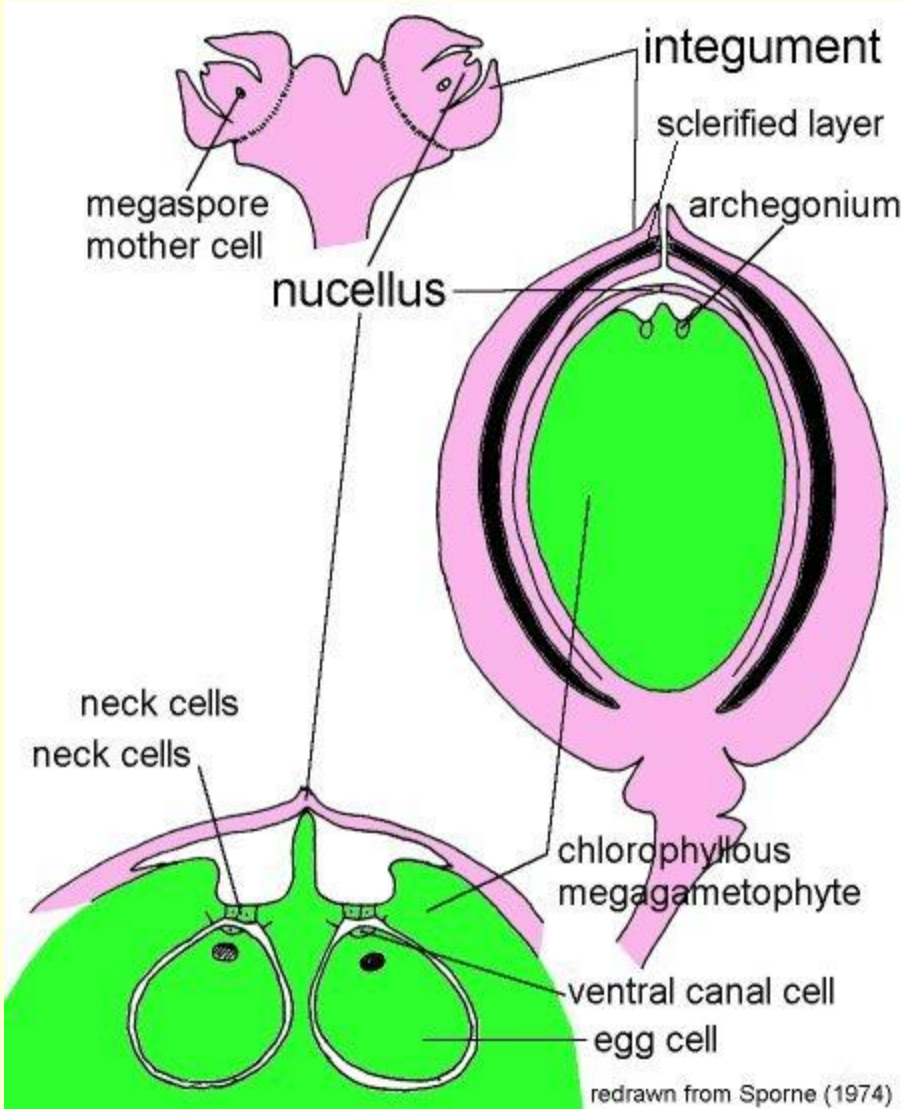




Female strobilus



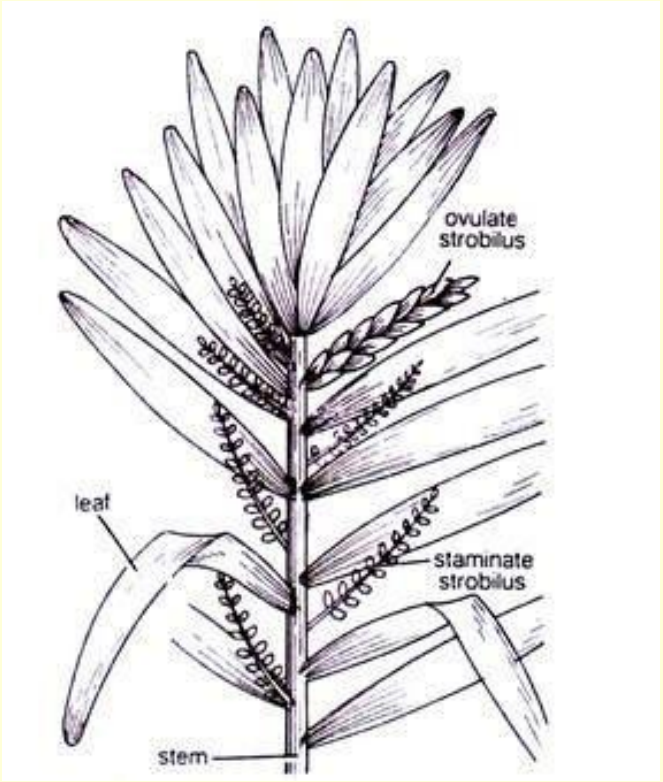
Embryo of ginkgo

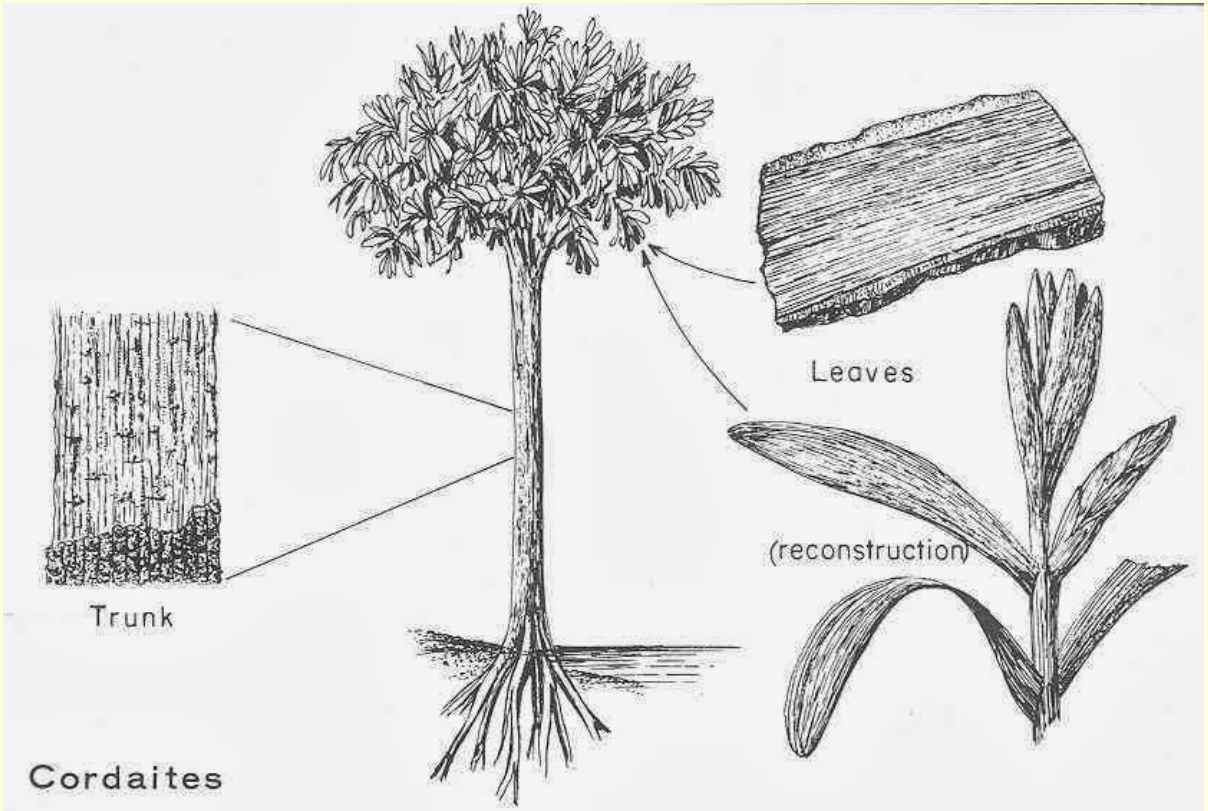


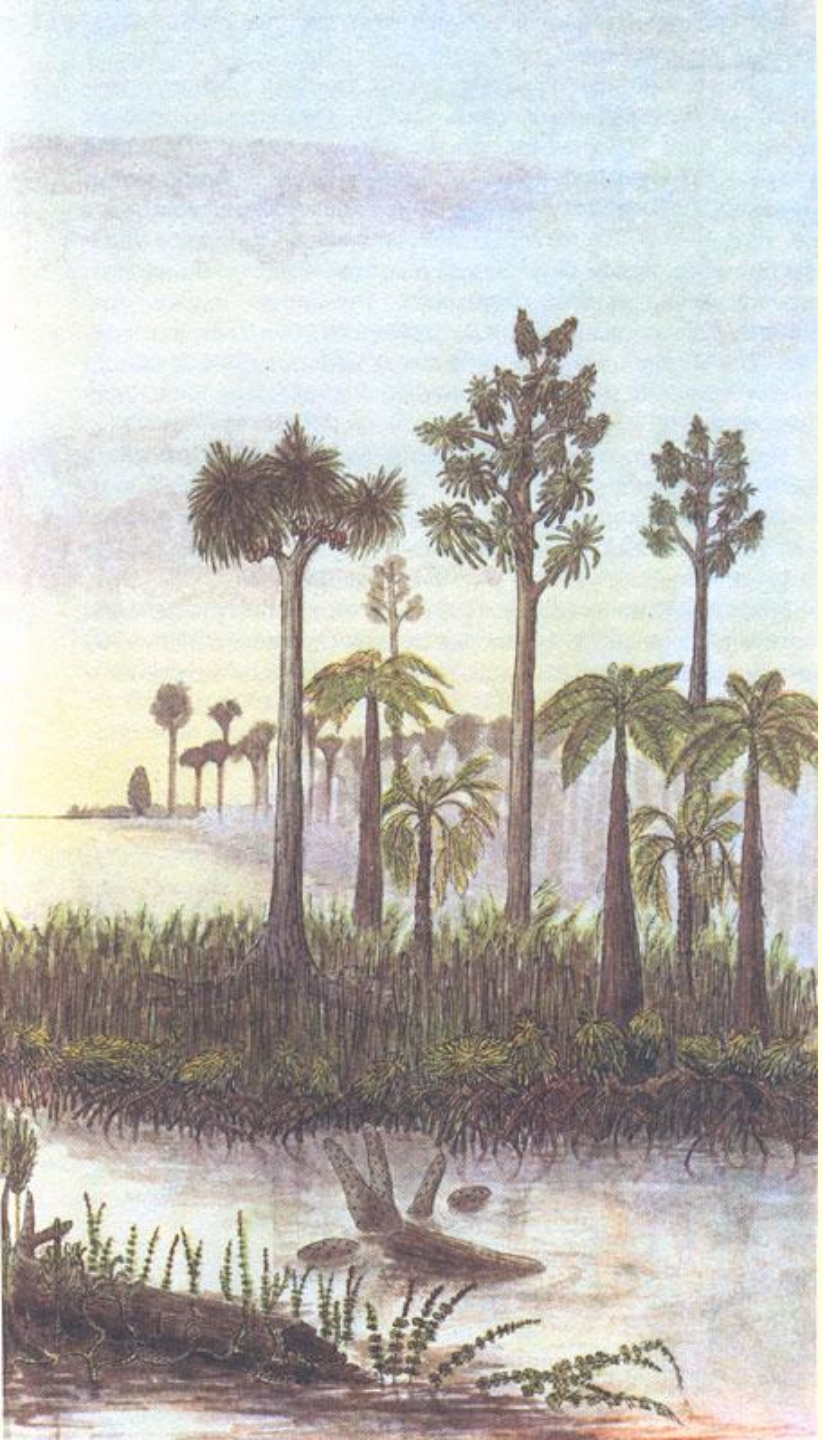
Ginkgo Fossils

Class Conifers - Pinopsida

Subclass **Subclass Cordaites (Cordaitidae)** (Cordaitidae)





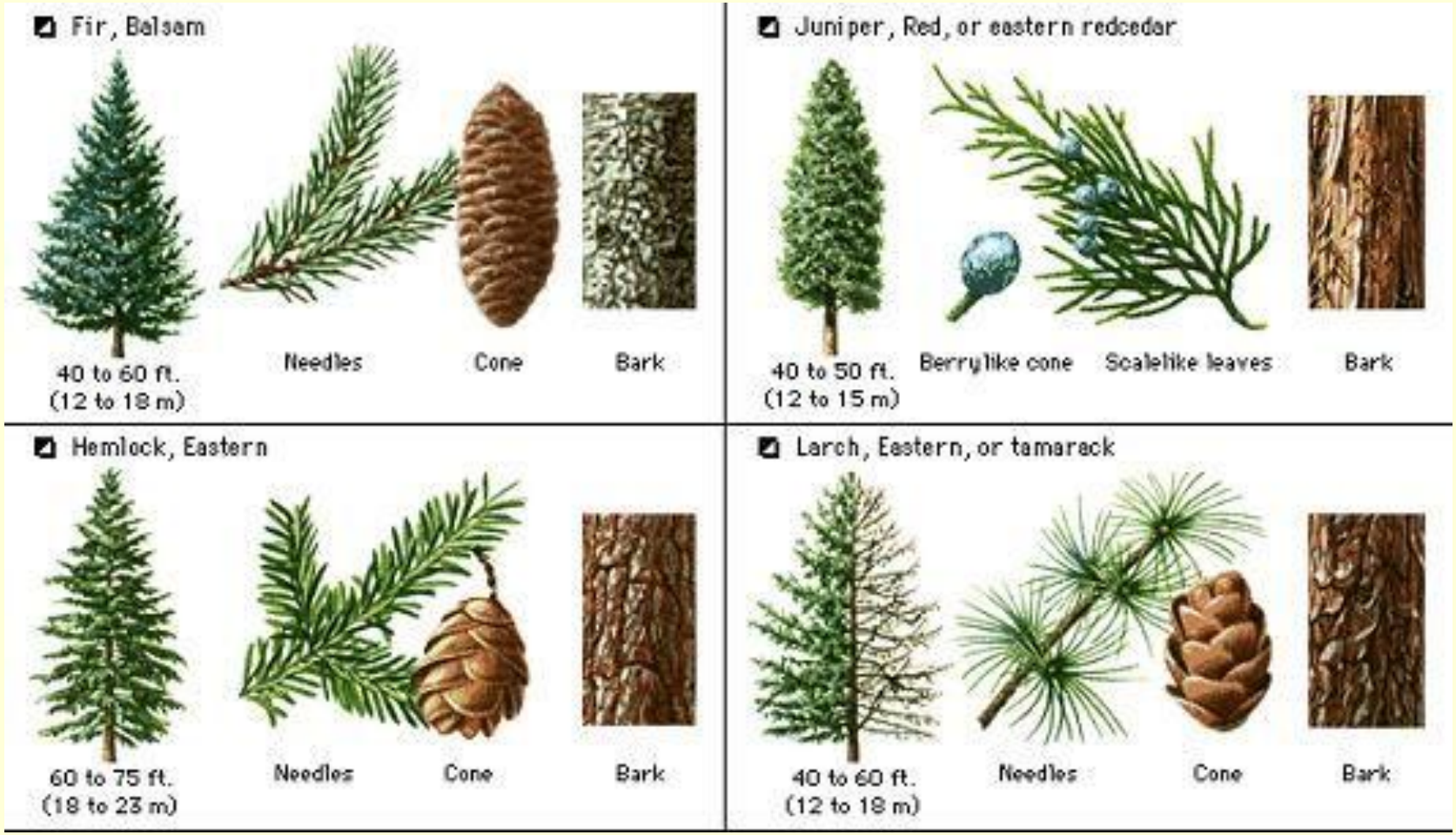


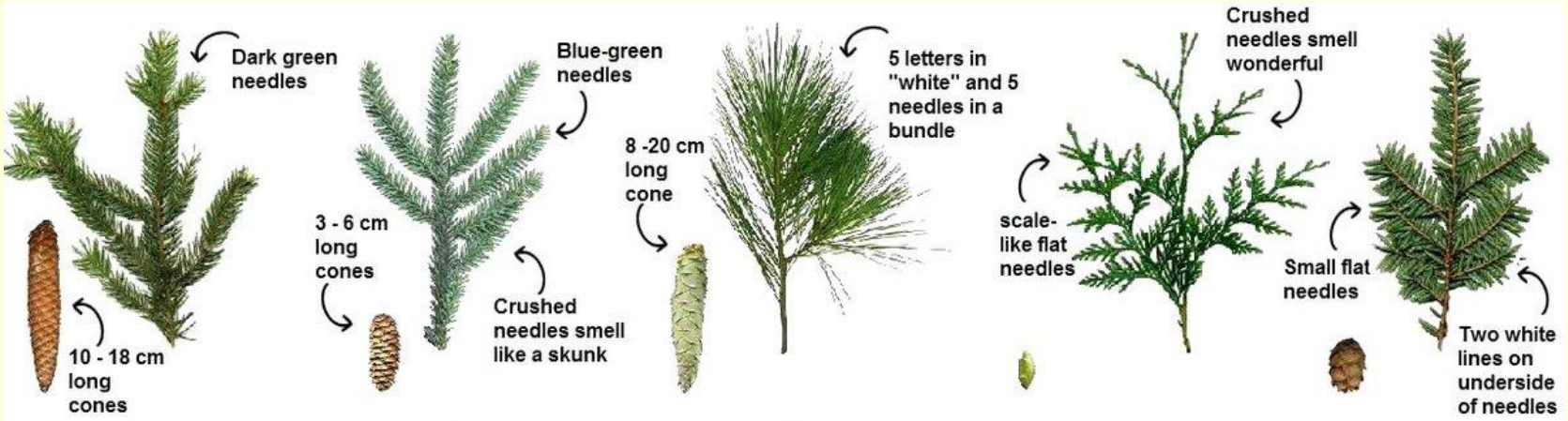
Cordaites fossils


1 cm

Subclass Conifers - Pinidae

Coniferous Trees


Fir, Balsam
40 to 60 ft.
(12 to 18 m)
Needles
Cone
Bark
Juniper, Red, or eastern redcedar
40 to 50 ft.
(12 to 15 m)
Berrylike cone
Scalelike leaves
Bark
Hemlock, Eastern
60 to 75 ft.
(18 to 23 m)
Needles
Cone
Bark
Larch, Eastern, or tamarack
40 to 60 ft.
(12 to 18 m)
Needles
Cone
Bark


Dark green needles
10 - 18 cm long cones
Norway Spruce
Blue-green needles
3 - 6 cm long cones
Crushed needles smell like a skunk
White Spruce
8 -20 cm long cone
5 letters in "white" and 5 needles in a bundle
Eastern White Pine
Crushed needles smell wonderful
scale-like flat needles
Eastern White Cedar
Small flat needles
Two white lines on underside of needles
Eastern Hemlock


Atlas Cedarwood


Siberian Fir


Scotch Pine


Black Spruce


Cypress


Juniper Berry

https://www.youtube.com/watch?v=KBhP_YPYyU4

https://opened.cuny.edu/courseware/lesson/736/overview

https://www.youtube.com/watch?v=xFR__T5H6_E

https://www.youtube.com/watch?v=exJ21G0Dpa0

https://www.youtube.com/watch?v=752YhVLYWro

https://www.youtube.com/watch?v=Fa7mjzEgTAQ

https://www.youtube.com/watch?v=P84i1bRoNhY