

GYMNOSPERMS

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➤ Gnetum

Introduction

Gymnosperms :

- naked seed producing vascular plants.
- include conifers, cycads, ginkgo (The "LIVING FOSSIL" plant) & gnetales.
- seeds develop on the surface of scale like appendages of cones/strobili.
- more advanced than ferns as they produce seeds and in their case the sporophytic generation dominates over the gametophytic counterpart.



Origin

- ❖ There are about 700 to 900 **extant*** species of Gymnosperms.
(Note: **Extant**- term refers to taxa still found to be living.)

- ❖ Gymnosperms originated in **late carboniferous period**.

- ❖ They are considered to be the result of **genome duplication event** which took place around **319 Mya**.

The **fossils** of **Pro-gymnosperms**, belonging to **late Devonian period** around **383 Mya**, exhibit some characters found in the gymnosperms.

- ❖ By the end of the **Palaeozoic era**, they replaced most of the **ferns** becoming the **dominant vegetation** of the **Mesozoic era**.
- ❖ The **end of Mesozoic era** marked start of their **extinction**.

The Diversity

- ❑ Conifers - the most abundant extant groups of gymnosperms with 6-8 families, 65-70 genera, 600-630 species.
- ❑ Cycads - the second most abundant group with 130 species.
- ❑ Gnetales - comprises of 70-80 species including those of *Gnetum*, *Ephedra*, a single *Welwitschia mirabilis* species.
- ❑ Ginkgo is the only living fossil of gymnosperms having single species.

GENERAL CHARACTERISTIC FEATURES

Some characteristic features of gymnosperms are:

- ✓ Their **Seeds** lack outer covering or **shell**.
- ✓ They are **heterosporous**; such that : **Microspores** (male spores) develop to **Pollen grains**
Megaspore (female spore) develop to **Ovule**
- ✓ They bear **cones** and characterised with **absence of fruits**.
- ✓ They depend upon **Anemophily** for pollination.
- ✓ Adult plant body is **Sporophytic**; and is **perennial**, **woody** and **evergreen**.
- ✓ Conifers show **monopodial growth** as the **axis grows taller** the diameter increases as a result of **secondary growth**, example ***S. sempervirens***.

MODERN CLASSIFICATION OF GYMNOSPERMS



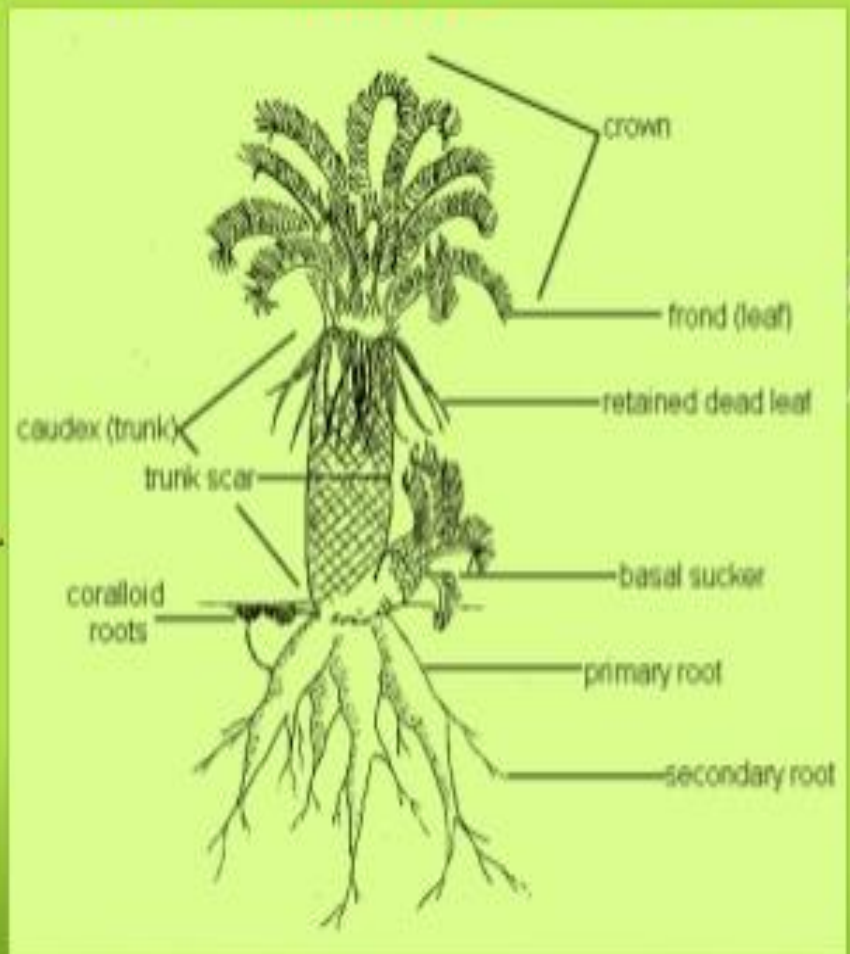
Cycadales and **Ginkgoales** include living members which have long fossil history and are thus regarded as "living fossils", example G.biloba.

Coniferales include abies, **taxus**, **pinus**. The **gnetales** represented by **3 genera** example **gnetum**, **ephedra** and Welwitschia mirabilis.

CYCADOPHYTA : CYCADS

Cycads : Dioecious

- Originated in **Carboniferous period** from seed ferns i.e. **Cycadofilicales** & were **dominant veg.** during **Mesozoic era.**
- Include 11 genera & 100 species; mostly **woody** with **monoxylic trunk** except ***Zamia pygmaea***.
- **Stem/Caudex** : unbranched with leaf scars
- **Leaves/Frond**: pinnately compound, arranged in **whorls**; found in **crown/apex region of stem.**
- **Roots** are coralloid type with primary & secondary divisions.
- **Microsporophyll** form **male strobili.**
- **Megasporophyll** form **female strobili.**



Cycus



Male Cones (Microsporophylls)



Female Cones (Megasporophylls)



Anatomy of Cycus: a. Coralloid roots

Anatomy -Root

Coralloid Roots

- ❑ Has additional algal zone in the cortex
- ❑ Cells of algal zone palisade like and form the middle cortex

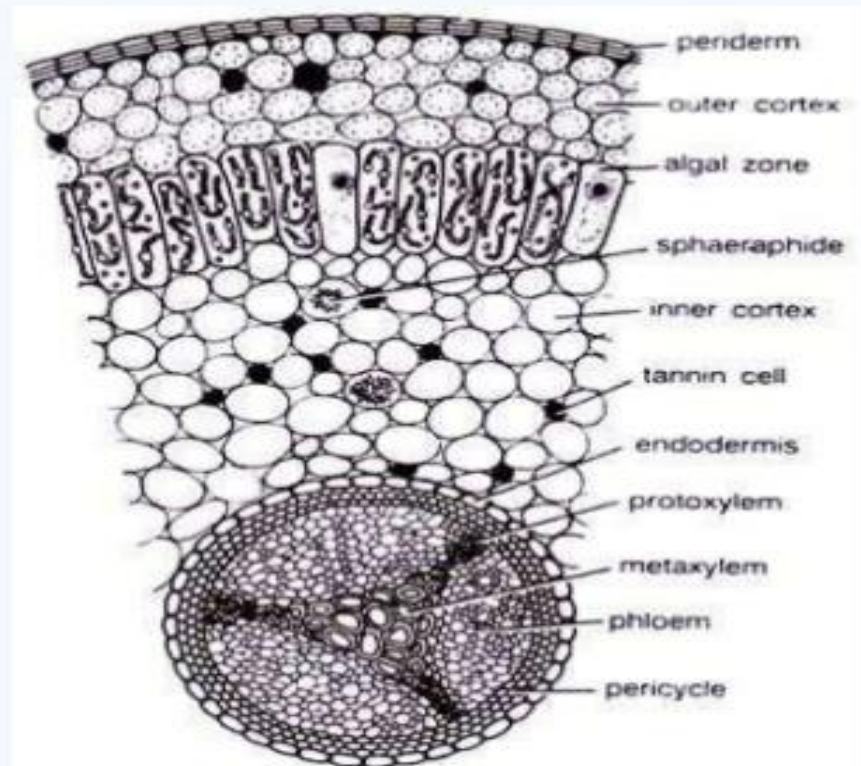


Fig. 8.18. *Cycas revoluta* T.S. coralloid root.

T.S. of Root

Root

Anatomy

- ❑ Young root shows typical structure like that of a dicotyledonous root
- ❑ Outer most layer , epiblema , encloses the parenchymatous cortex interspersed with tannin cells and mucilage canals
- ❑ Endodermis with casparian thickenings
- ❑ Pericycle is multilayered with thin cell shaving starch grains
- ❑ Vascular tissue within is typically radial
- ❑ Roots usually diarch to tetraarch , rarely polyarch
- ❑ Vessels absent in vascular tissue
- ❑ Pith reduced or absent

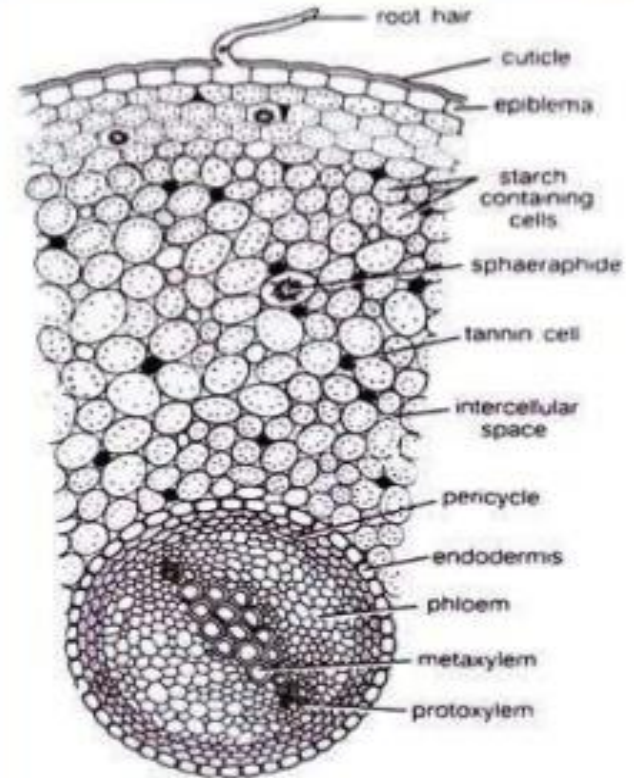


Fig. 8.16. *Cycas revoluta* T.S. normal root (Young)

T.S. of stem

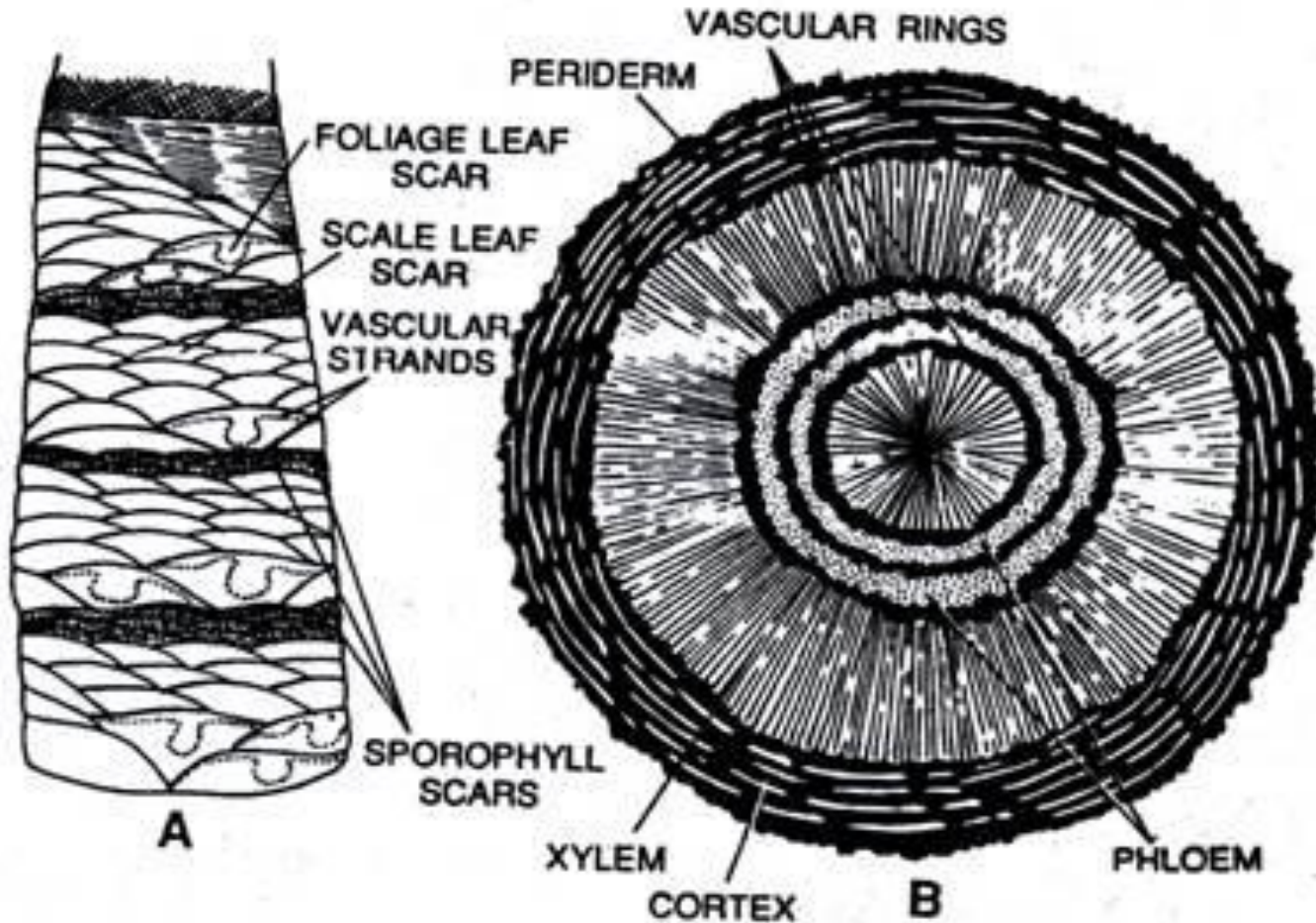


Fig. 3.19. *Cycas revoluta*. A, an old trunk showing different kinds of scars; B, transverse section of an old stem showing polyxylic condition.

T.S. of rachis

Anatomy –Rachis

Rachis of Cycas

- ❑ Woody and thick
- ❑ Hypodermis sclerenchymatous
- ❑ Characteristic feature is omega shaped (Ω) outline of the numerous vascular bundles
- ❑ Each bundle has sclerenchymatous bundle sheath and is open , collateral.

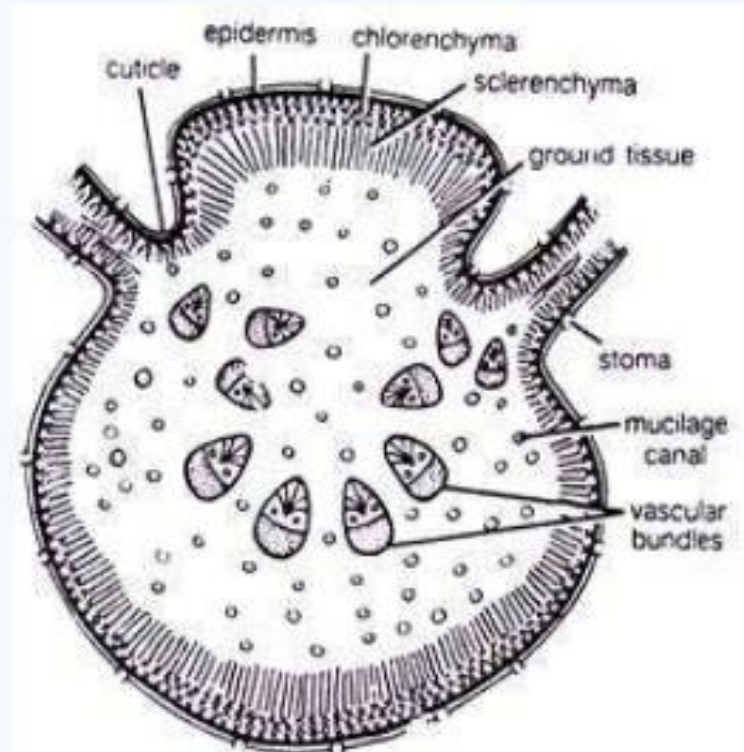
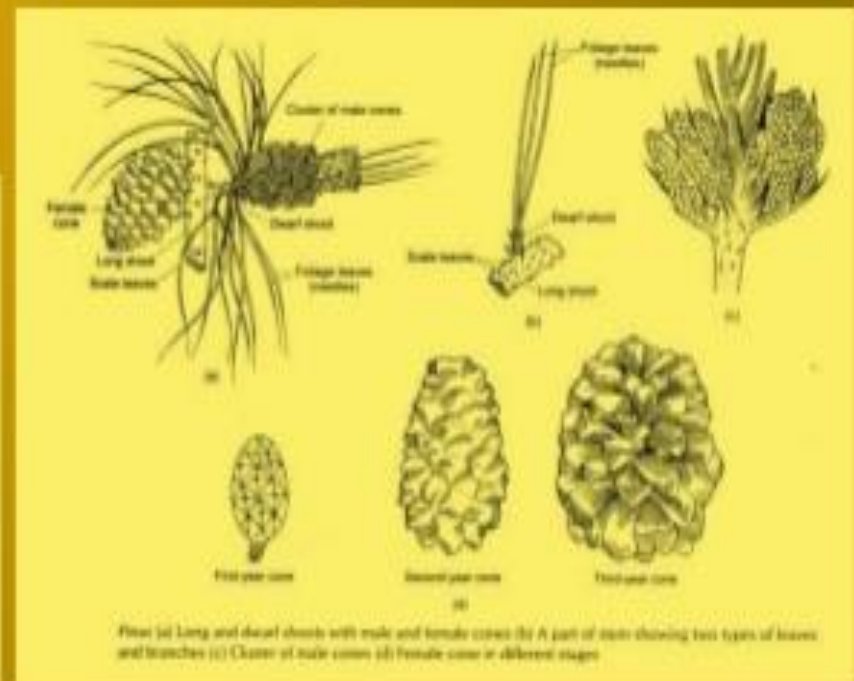
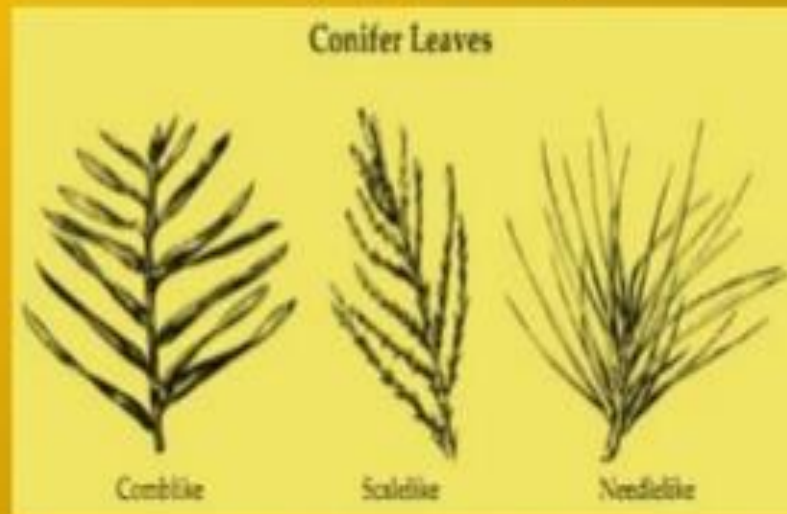


Fig. 8.25. Cycas. T.S. rachis (diagrammatic).

CONIFEROPHYTA: CONIFERS

- Largest division of gymnosperms including **pinus, yews, spruce, junipers, cedars**, etc.
- Most diverse with **588** extant species; both **economically/medicinally** important.
- They are **long, branched** and evergreen trees with **dimorphic branches**.
- Leaves: may be **comb-like, scale-like, needle-like**; mostly linear.
- Wood usually pycnoxylic characterised by presence of **resin canals**.
- **Microsporophylls** and megasporophylls form compact cones; that are **distinguishable**.
- Male Gametes -non motile; found in ♂ cone
- Fertilization – Siphonogamous type.



Pinus : Habit



Pinus : Leaves



Pinus : Male cones



Pinus : Male cones bursting



Pinus : Male cones bursting



Pinus : Female cones





Pinus : T.S.of Needle

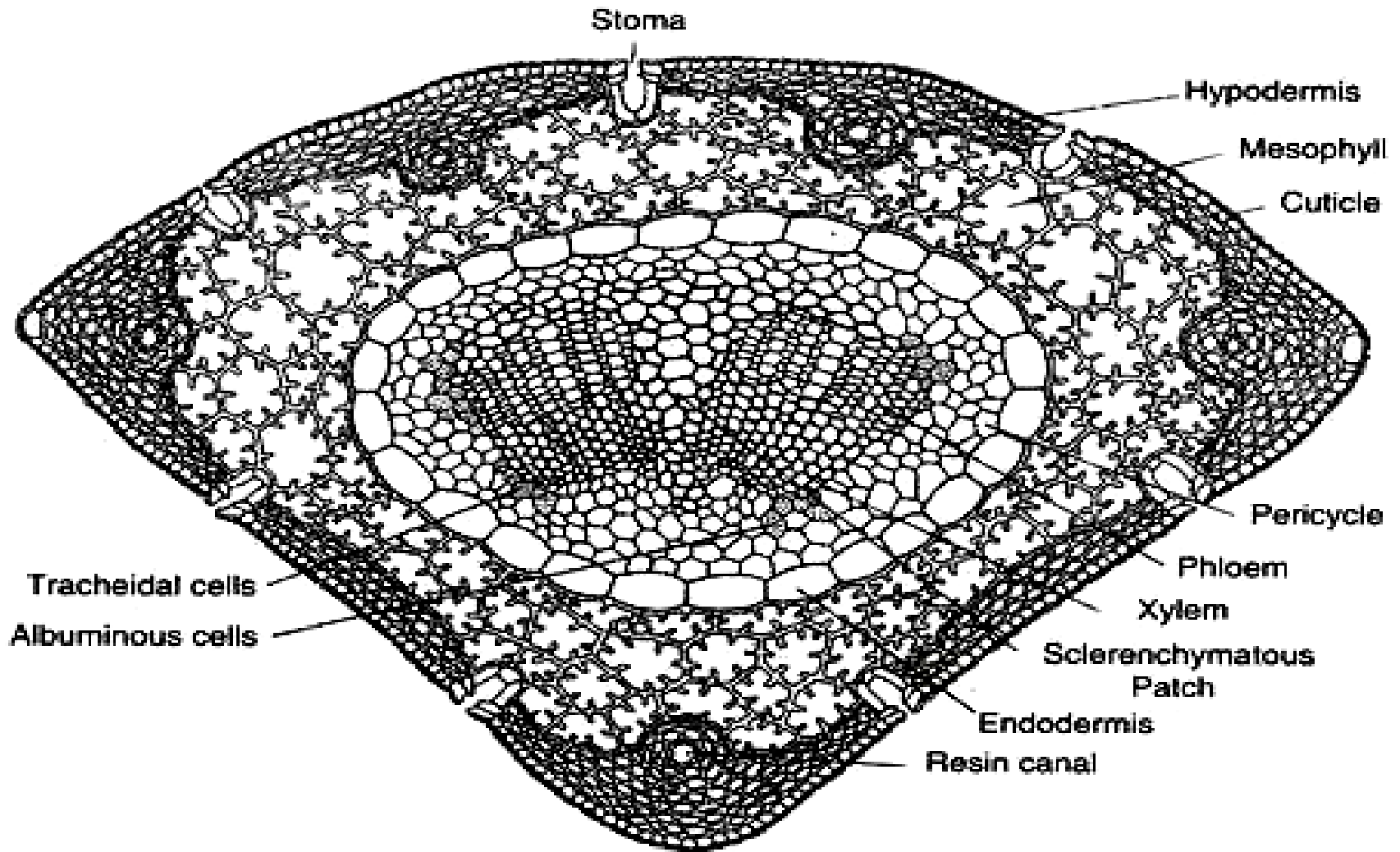
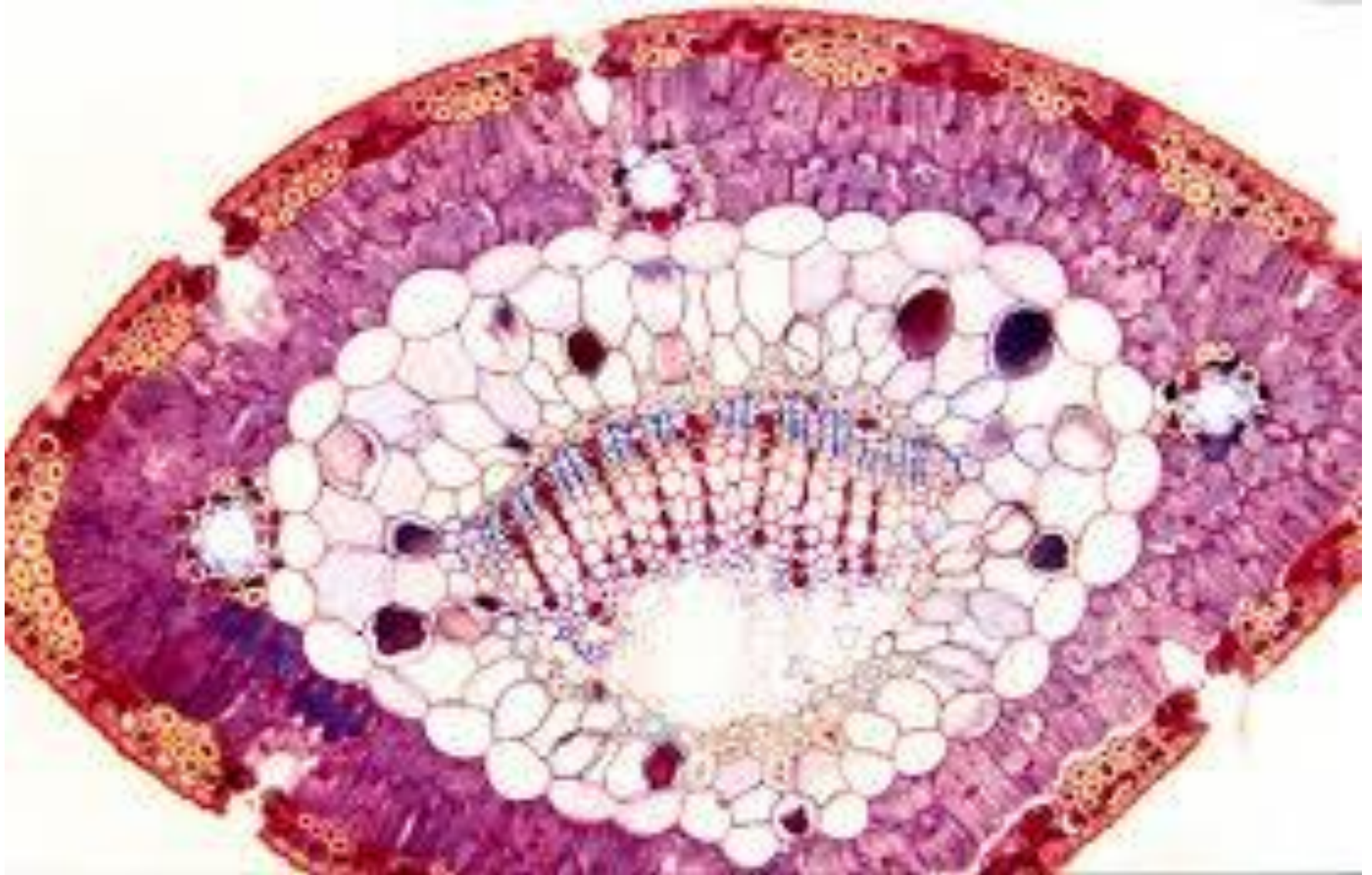


Fig. 8.36. T.S. of *Pinus* needle.

Pinus : T.S.of Needle stained



Pinus : T.S.of root

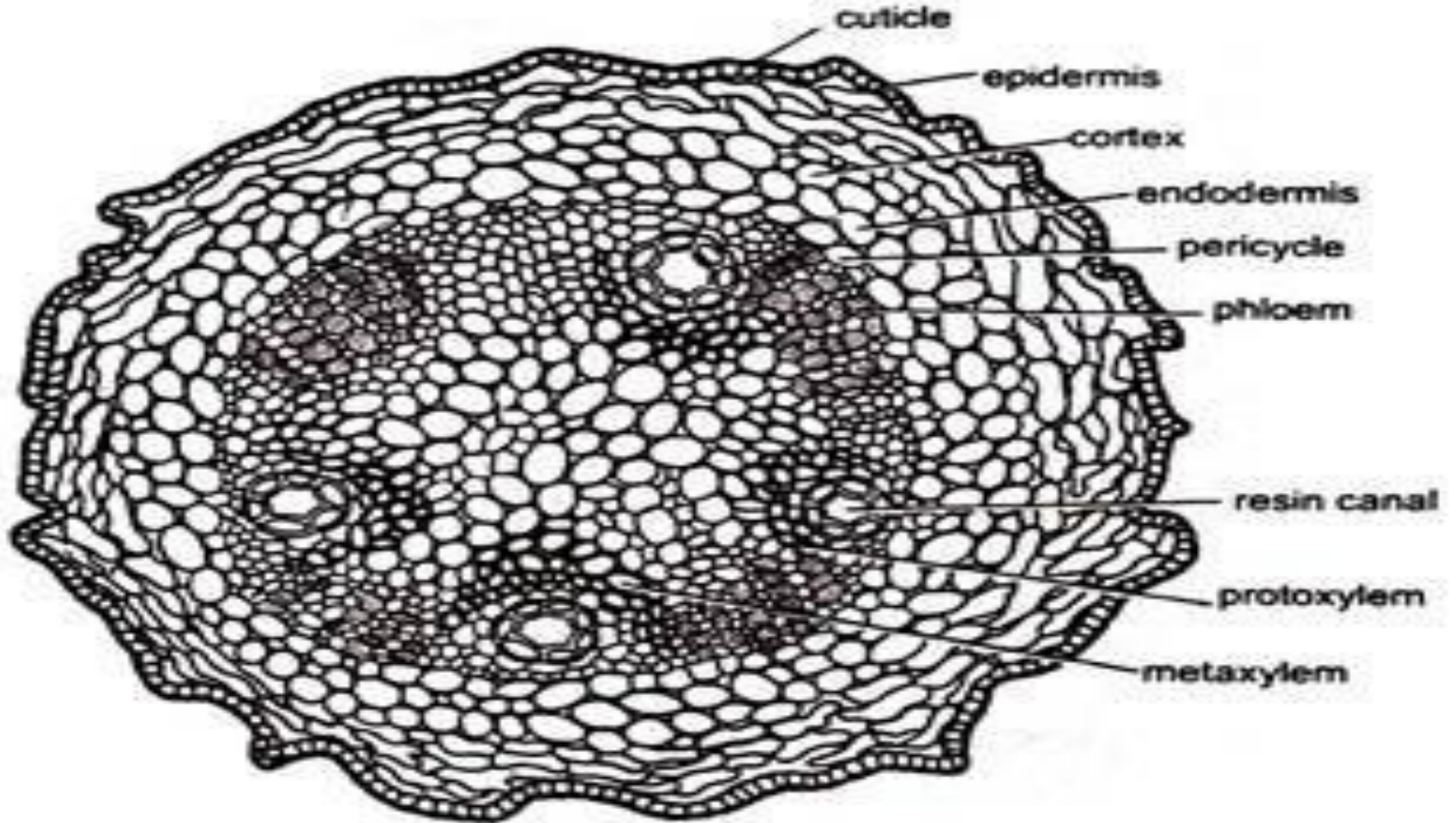
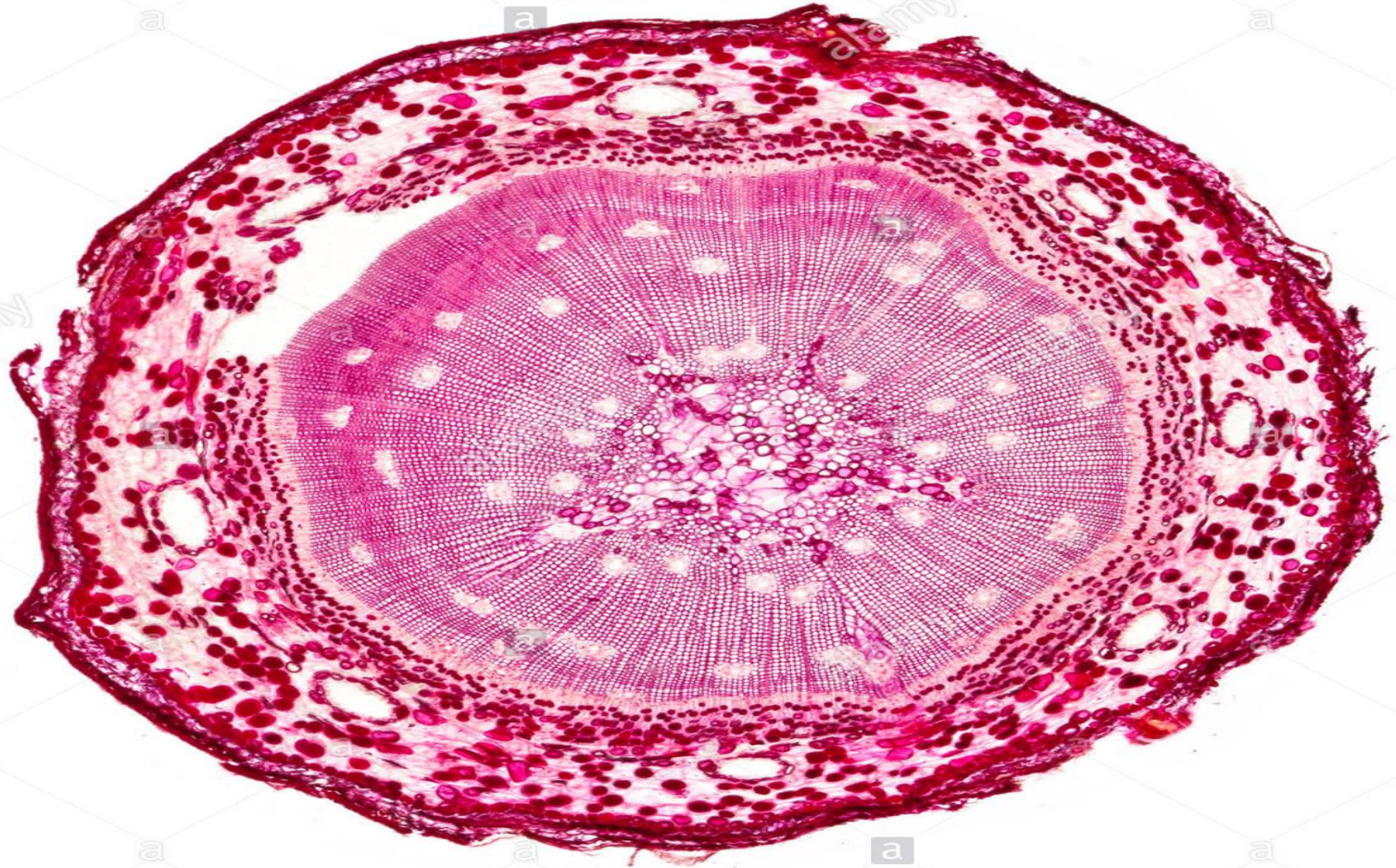
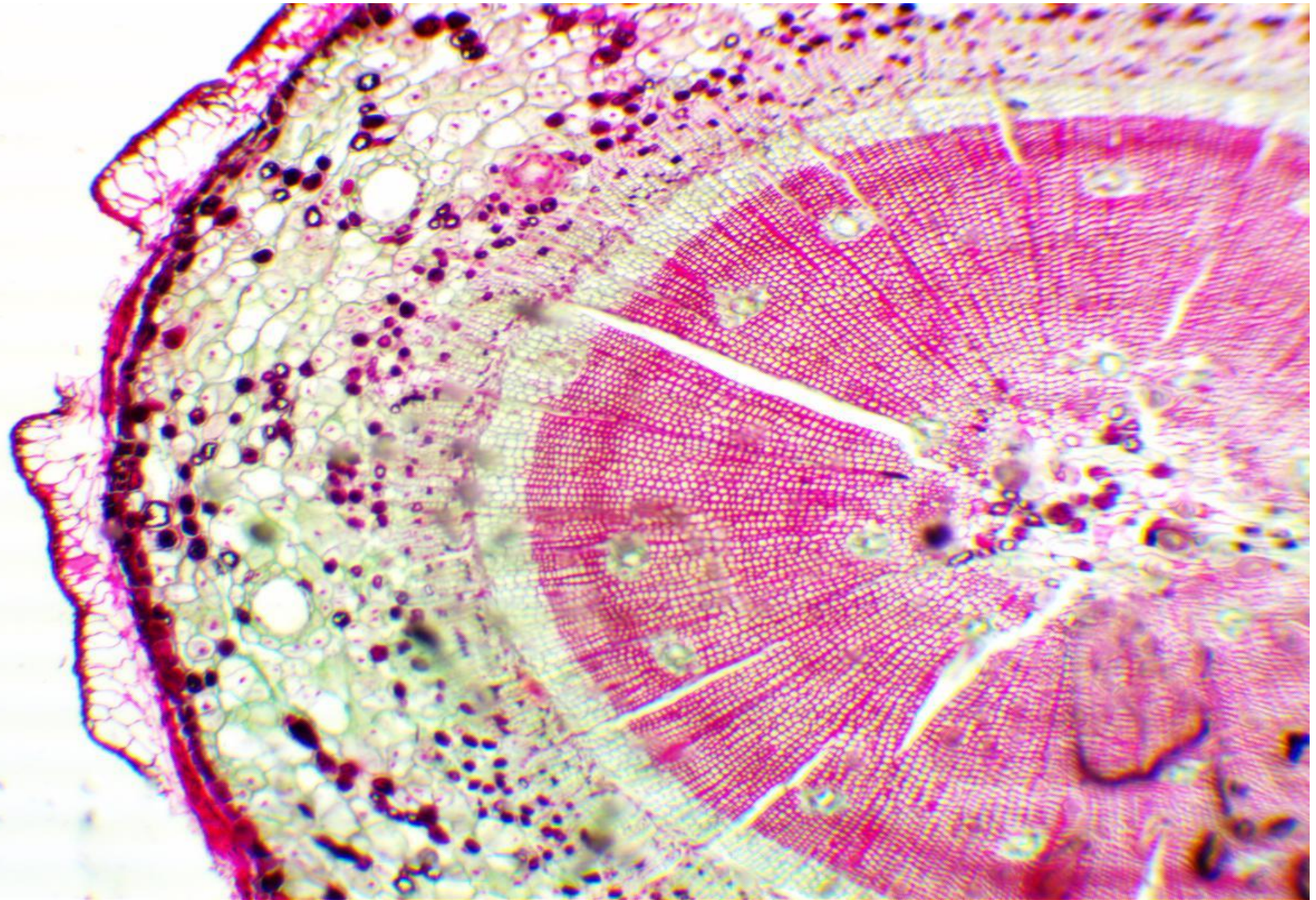


Fig. 29. Pinus. T.S. young root (diagrammatic).

Pinus : T.S.of stem



Pinus : T.S.of stem (enlarged)



GINKGOPHYTA : GINKGO

Ginkgo biloba : MAIDEN HAIR TREE

- ❖ Only living species of Ginkgophyta; thus also k/a "living fossil."
- ❖ First ancestor dated Permian Era; although originated in Jurassic period.
- ❖ First discovered in South East China, preserved in a sacred garden.
- ❖ Leaves: Fan-shaped, varied morphology – deep lobed (notched) to unlobed, parallel veins; exhibiting open dichotomous venation.
- ❖ Dioecious; Male Trees with stalked pollen sacs together at leaf base
Female Trees with pair of naked ovules at end of long stalk.
- ❖ G. biloba along with Cycads are only living seed plants with flagellated male gametes.
- ❖ Rotting fruit produce foul smell due to production butyric acid.



Fig. 10.4. *Ginkgo biloba*. A long shoot bearing deeply lobed leaves.

Ginkgo : Habit



Ginkgo : Leaves



Ginkgo biloba 'Mariken'

Ginkgo : Leaves (enlarged)



Ginkgo : Seeds



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Ginkgo : Seeds



Ginkgo : Seeds (ripend)

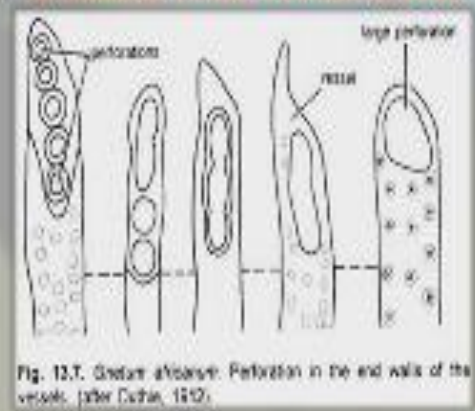


GNETOPHYTA : GNETALES

Gnetales:

- Include three extant genus: Ephedra (65 species), Gnetum (28 species), Welwitschia mirabilis
- Speciality : Presence of Tracheids and Vessel Elements in xylem tissue
Presence of Sieve tubes and Companion cells in phloem tissue.
- Leaves are broad like those found in angiosperms.
- Mostly dioecious; males gametes are non motile unlike cycads and ginkgo.
- Pollination by entomophily in Gnetum and Welwitschia mirabilis.
- In Welwitschia, a flower like structure is found on male cones.
- Nectar produced on cone tip instead of flowers.

ANGIOSPERMIC CHARACTER



Gnetum : Habit



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Gnetum : Male Cones



Gnetum : Male Cones



Gnetum : Male Cones



Gnetum : Male Cones (Enlarged)



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Gnetum : Female Cones



Gnetum : Female Cones (Enlarged)



Gnetum : Habit



Gnetum : Seeds



Gnetum : Seeds



Gnetum : Seeds



Gnetum : Seeds



Gnetum : Seeds



Gnetum : T.S. of Root

Anatomy Of Gnetum

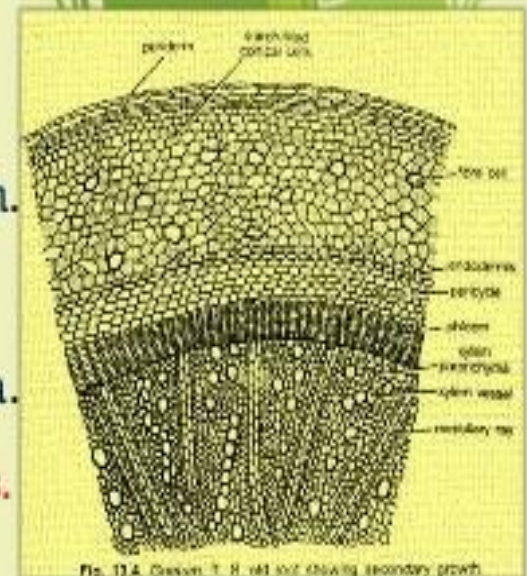
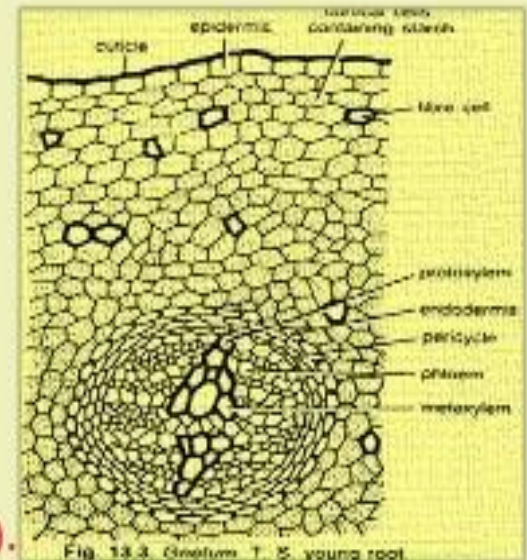
(a) Roots

In Young Roots :

- 1) **Layers** of starch filled **cortical cells**.
- 2) **4-6** layers of **pericycle**; **primary xylem** visible.
- 3) **Roots** may be **Di-arch** and **Ex-arch** (Angiospermic Ch.).

In Older Roots :

- 1) **Primary xylem** indistinguishable due to 2ndry growth.
- 2) Consists of **tracheids**, **vessels** & **xylem parenchyma**.
- 3) **Phloem** consists of **sieve tubes** & **phloem parenchyma**.
- 4) "Bars of Sanio" present in **tracheids**; absent in **vessels**.



Gnetum : T.S. of Stem

b) Stem

In Young Stem : 1) Resembles typical Dicot Stem.

2) **Sunken Stomata** Present.

3) Cortex : i) 1st few layers – Chlorenchymatous cells.

ii) 2nd few layers – Parenchymatous cells.

iii) 3rd few layers – Sclerenchymatous cells.

4) Endodermis & **Pericycle** indistinguishable.

5) Vascular Bundles **Conjoint**, Collateral Open & End-arch in a ring.

Xylem : Comprises Tracheids & Xylem Vessels.

Phloem : Comprises Sieve cells & Phloem Parenchyma.

In Old Stem : 1) Primary Cambium short-lived.

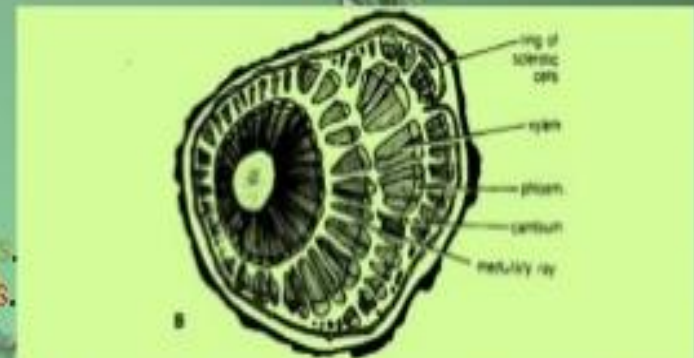
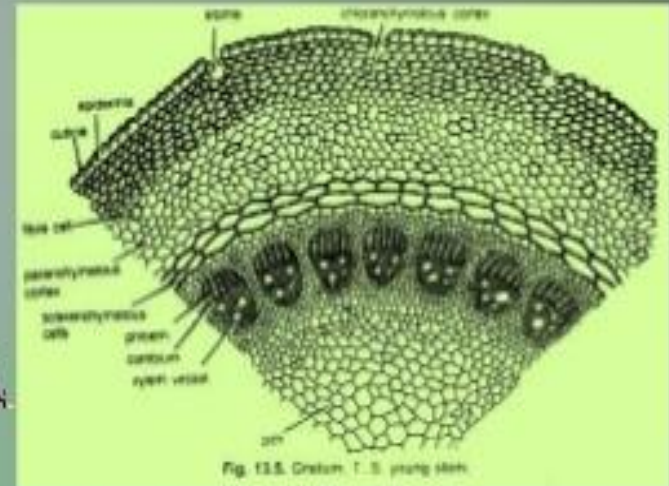
2) **Sclerotic cells** present.

3) 2nd **ary cambium** in diff. parts of cortex form rings.

4) 2nd **ary wood** comprises tracheids & vessels.

5) Phloem **Sieve cells** have oblique, **perforated sieve plates**.

6) Medullary Rays consist of **Polygonal Parenchyma cells**.



Gnetum : T.S. of Leaves

c) Leaves

- They resemble dicot leaves with cuticularised epidermis, stomata on both side except on veins.
- Mesophylls differentiated into single layered palisade, well-developed spongy parenchyma.
- Stone cells & latex tubes present in mid-rib regions.
- Vascular bundles : i) arch/curve form in mid-rib region.

ii) conjoint, collateral type.

iii) Xylem: tracheids, vessels & xylem parenchyma.

iv) Phloem: sieve cells & phloem parenchyma.

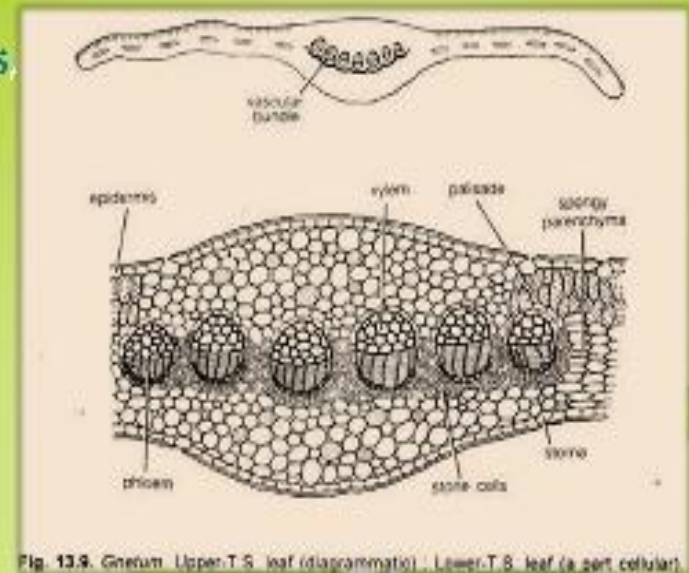


Fig. 13.9. Gnetum. Upper-T.S. leaf (diagrammatic) - Lower-T.S. leaf (a part cellular).

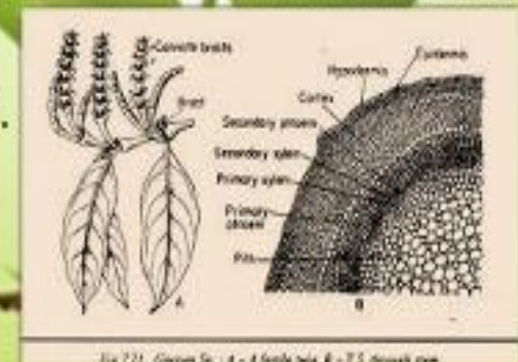


Fig. 221. Gnetum sp. - A - Forked stem, 4 - 7.5 dm long stem.

Gnetum : L.S. of Ovule

Reproduction In Gnetum

- **Gnetum** Dioecious; cones/strobili reproductive structure.
- Cones : i) Cone axis with 2 opposite bracts.
 - ii) flower like structure in collars, formed of bracts.
- ✓ Male Cone: i) Flowers arranged alternatively in definite rings.
 - ii) Each flower contains 2 coherent bracts form perianth.
 - iii) At maturity, stalk elongates such that anther comes out of perianth sheath.
- ✓ Female Cone: i) 4-10 ovules above collars.
 - ii) Ovule consists of nucellus surrounded by 3 envelopes.
 - iii) Nucellus consists of central mass of cells.
 - iv) Inner envelope elongates to form micropylar tube.
 - v) Stomata, sclereids & lactiferous cells formed in other 2 envelopes.
 - vi) Ovule is atropous. Angiospermic Character.

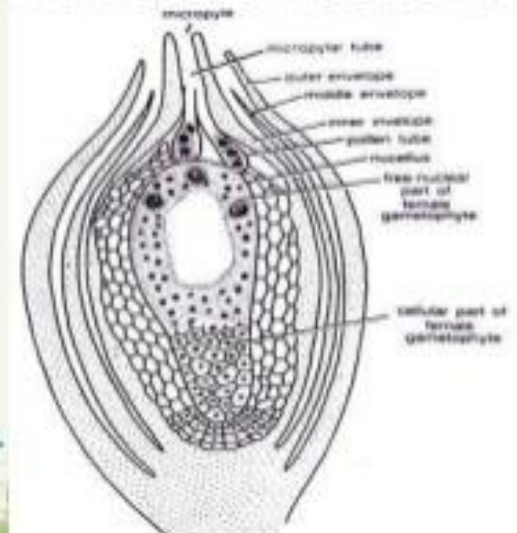
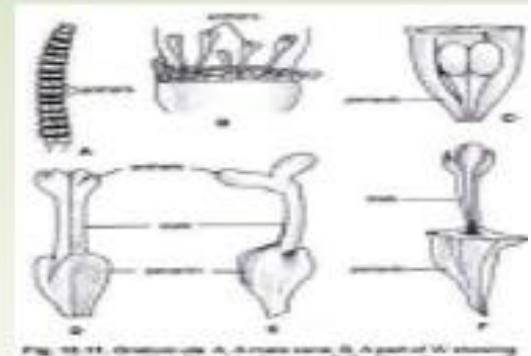


Fig. 13.16. Gnetum. L.S. ovule.

THANK YOU

