

Cycas







Sago Palm  
*Cycas revoluta*



## Systematic Position

Division - Cycadophyta

Class - Cycadopsida

Order - Cycadales

Family- Cycadaceae

- ❑ *Cycas* is the most widely distributed genus of the order Cycadales. There are about 20 species which occurs in wild state in China, Japan, Australia, Africa, Burma and India.
- ❑ Four species of *Cycas* – *C. circinalis* , *C. pectinata*, *C. rumphii* and *C. beddomei* – occurs in natural state in India, Chiefly in Assam, Orissa, Meghalya, Andaman and Nicobar Islands, karnataka and Tamil Nadu. *C. revoluta* and *C. siamensis* are widely grown in gardens.

# Habit

- The plants are short or medium sized trees which look like palms.
- The plant body is a diploid sporophyte which is divided into root, stem and leaves.
- The trunk is covered with persistent leaf bases
- The stem is usually unbranched and it bears a crown of leaves at the tip.

# Habitat

- It grows under xerophytic conditions in exposed hill slopes and places where water is scarce.
- Several species are cultivated in gardens.



## Root

- ❖ The primary root persists and form a tap root system.
- ❖ The main tap root may be long or short and thick.

## Coralloid root

- ❖ Several lateral roots grow vertically upward just below the ground level.
- ❖ They are nodular, profusely branched, dichotomously divided and swollen at the tips and are called coralloid roots
- ❖ the secondary vascular tissue is absent or poorly developed
- ❖ The cortex is wider in comparison with the normal root
- ❖ there is a green algal zone in the middle of the cortex which has radially elongated, large, thin-walled cells with large intercellular spaces occupied by algae.
  - ❖ The algae help the plant in nitrogen fixation.

Certain roots in Cycads grow  
toward the soil surface

Corralloid  
Roots









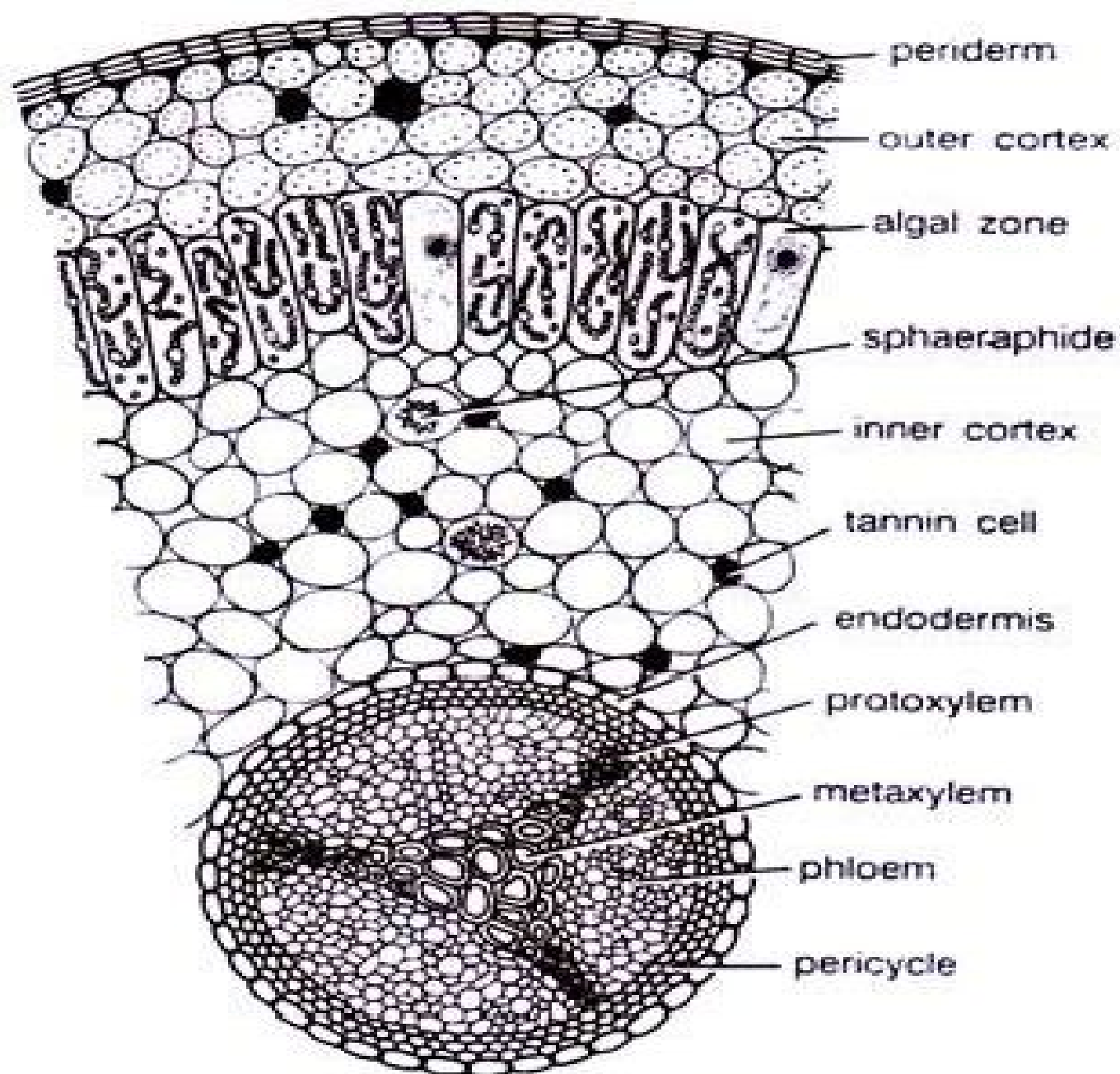


Fig. 8.18. *Cycas revoluta*. T.S. coralloid root.



# Leaves

✓ Two types

1. Foliage leaves - green, large, pinnately compound and stout with a spiny petiole and large, strong rachis. The young leaves are with circinate vernation.
2. Scale leaves - These are dry, brown coloured, somewhat triangular with pointed end. They are present at the apex of the stem in order to protect the young foliage leaves.



## **Rachis of Cycas**

**The outline of transverse section is rhomboidal in the basal region of the rachis, biconvex in the middle cambium and roughly cylindrical at the tip region or at the apex of the rachis. Two arms of the bases of leaflets are present on the rachis, one on each side.**

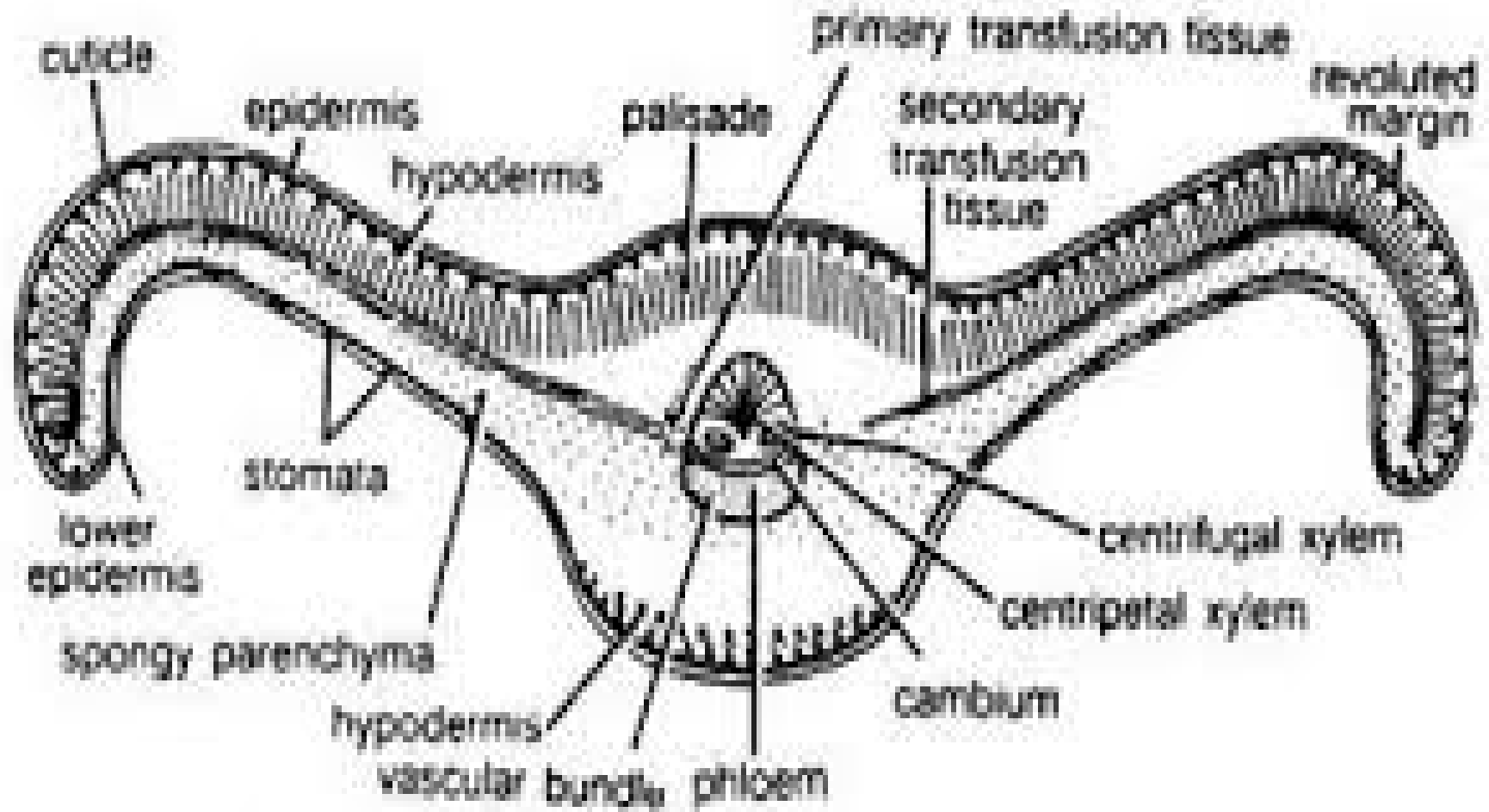
**In T.S. the rachis reveals the following structures from outside within:**

- ✓ **Epidermis is the outermost layer of the rachis consisting of thick-walled cells. It is heavily circularized. On its upper as well as lower sides are present irregularly distributed sunken stomata.**
- ✓ **Hypodermis is present below the epidermis. It is differentiated into outer 2-3 layers of chlorophyll-containing thin-walled cells of chlorenchyma and inner 4-6 layers of thick-walled lignified cells of sclerenchyma. Sclerenchyma is poorly-developed on the lateral sides. It is also seen intermixed with chlorenchyma.**
- ✓ **Ground tissue is a large region consisting of thin-walled, parenchymatous cells. Many mucilaginous canals and vascular bundles are present in this region.**

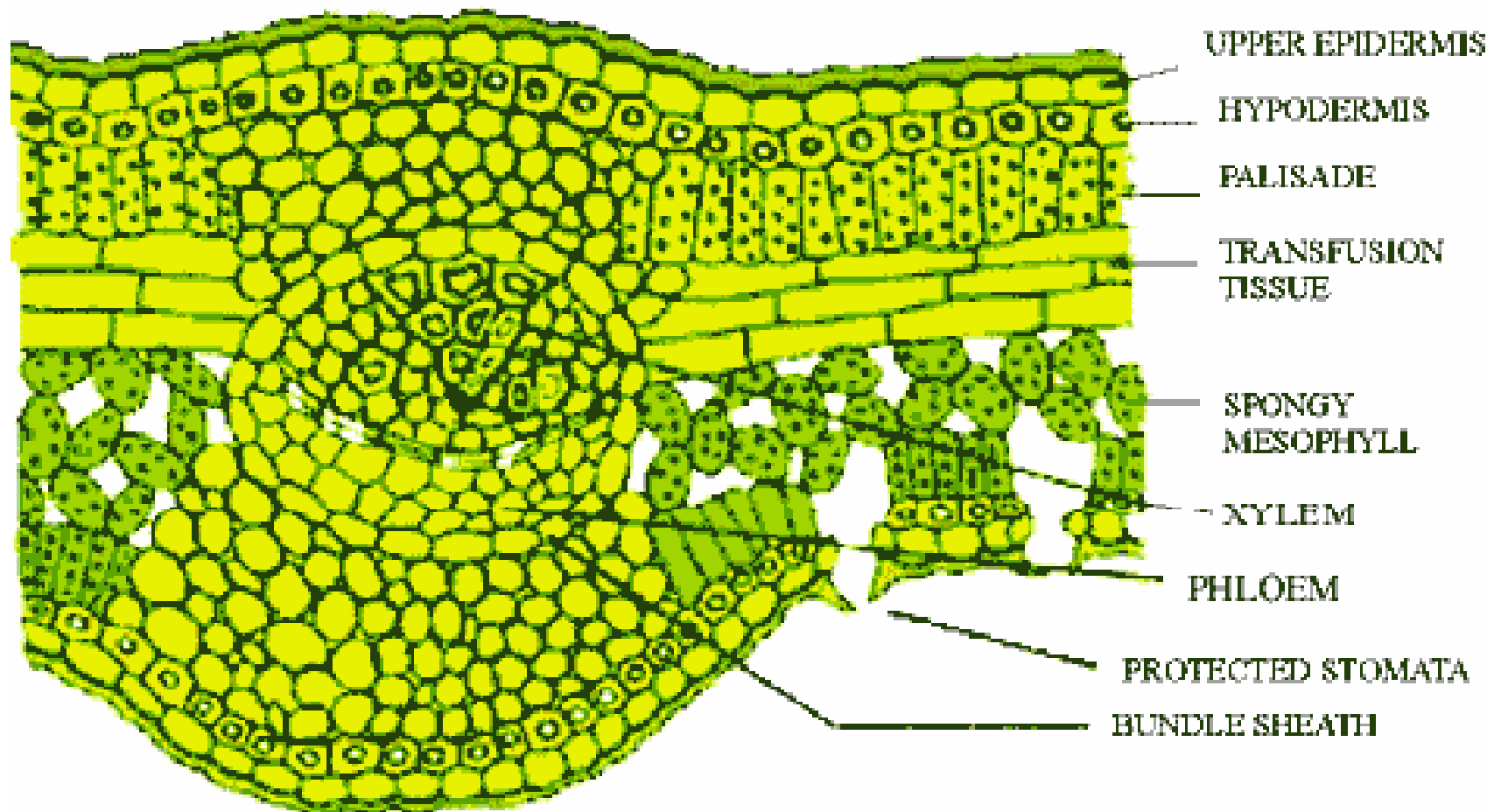


## Leaflet of Cycas

- ❖ Cycas leaflets are large, tough, thick and leathery. In a vertical section the leaflet is differentiated into a swollen midrib portion and two lateral wings.
- ❖ Epidermis is the outermost layer consisting of thick-walled cells. It is surrounded by a thick layer of cuticle. Upper epidermis is a continuous layer while the continuity of the lower epidermis is broken by many sunken stomata.
- ❖ Hypodermis is sclerenchymatous and present below the epidermis. It is absent below the lower epidermis but in the midrib region it is several-celled thick.
- ❖ Mesophyll is well-developed and remains differentiated into palisade and spongy parenchyma. A continuous layer of palisade is present below the sclerenchymatous hypodermis. Its cells are radially elongated and filled with chloroplasts.







- Spongy parenchyma is present only in the wings, directly above the lower epidermis. Its cells are oval, filled with chloroplasts, and loosely arranged having many air-filled intercellular spaces.
- Transfusion tissue consists of two small groups of short and wide tracheid-like cells with reticulate thickenings or bordered pits on their walls.
- Vascular bundle is one, and present in the midrib region of the leaflet. It is conjoint, collateral, open and diploxylic. The triangular centrifugal xylem is well-developed with endarch protoxylem. It is represented by two or sometimes more small groups on either side of the protoxylem.
- Phloem is arc-shaped and remains separated by cambium. Phloem consists of sieve tubes and phloem parenchyma. Companion cells are absent. The portion of the midrib in between the palisade layer and lower hypodermal region is filled with parenchymatous cells.



- ❖ Vascular bundles are arranged in the shape of an inverted Greek letter Omega ( $\Omega$ ) .
- ❖ Towards the tip of the rachis the bundles are arranged in C-shaped manner and their number is comparatively less.
- ❖ Each vascular bundle remains surrounded by a bundle sheath.
- ❖ It is conjoint, collateral and open.
- ❖ The xylem in each vascular bundle is present towards inner side. It consists of tracheids and xylem parenchyma. Cambium separates the xylem from the phloem. Vessels are absent.
- ❖ The vascular bundles are diploxylic, i.e. consists of two types of xylem viz. centripetal xylem and centrifugal xylem. Phloem, present towards the outer side of the vascular bundle, consists of sieve tubes and phloem parenchyma. Companion cells are absent.

# REPRODUCTION

## All Cycads are Dioecious



Pollen Cone

- Individual plants produce either pollen cones or seed cones



Seed Cone

Male and female sex organs are borne on separate plants *Cycas revoluta*

# Cycads produce pollen and seeds in cones



- Cones develop at apex of stem





## **MALE CONE:**

- It is large, conical, compact, solitary and shortly stalked.
- It is terminal in position.
- There is a cone axis at the centre.
- Several perpendicularly attached micro sporophylls are arranged around the cone axis.









## MICROSPOROPHYLLS:

- They are flat, leaf-like, woody, brown in colour with narrow base and expanded upper portion.
- The upper expanded portion becomes pointed and is called **apophysis**.
- Narrow base is attached to the cone axis with a short stalk.
- Each microsporophyll has two surfaces - an adaxial or upper and an abaxial or lower surface.
- On the abaxial surface, thousands of **microsporangia** in the middle region in the groups of 3-5 are present.
- Each group is called a **SORUS**.
- Many hair like, soft structures are present between the sori.
- Many pollen grains or microspores are present in each microsporangium.
- Many mucilaginous canals and vascular bundles are present in the microsporophylls.

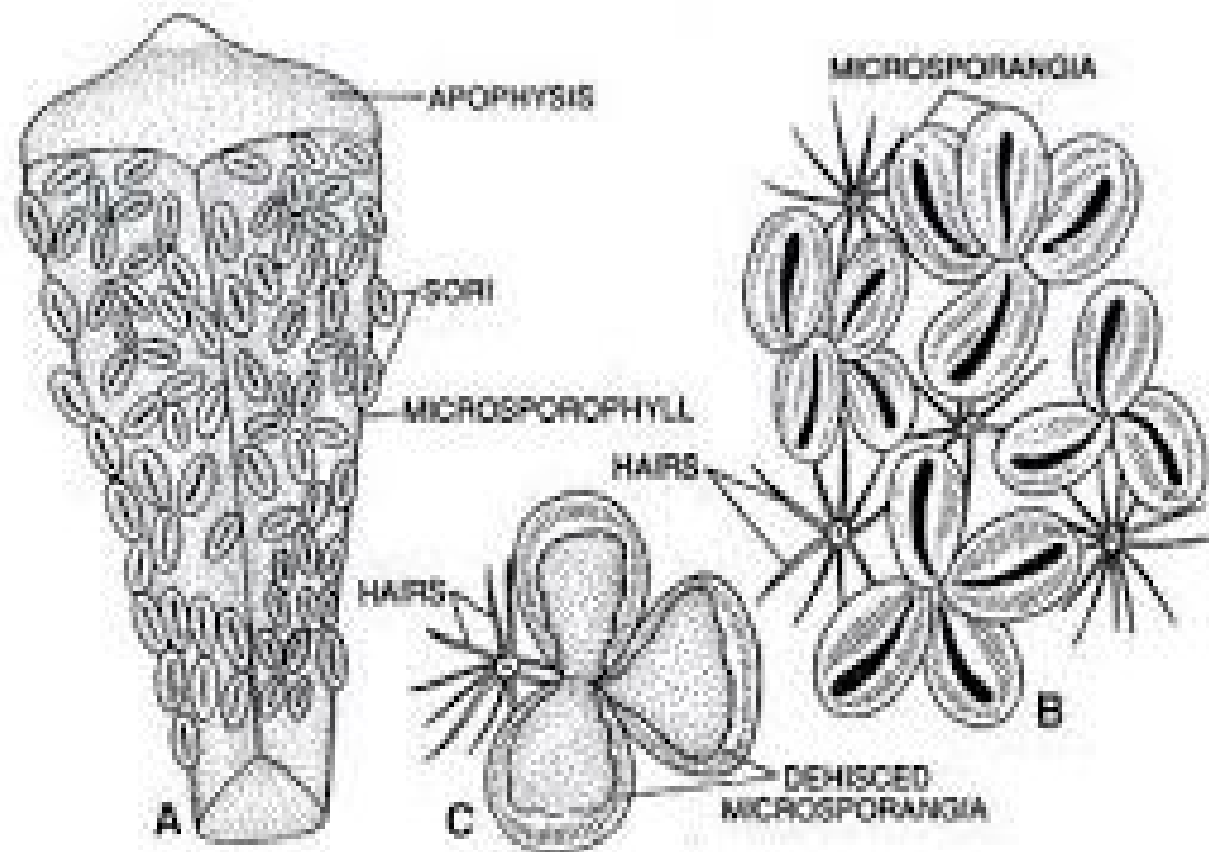
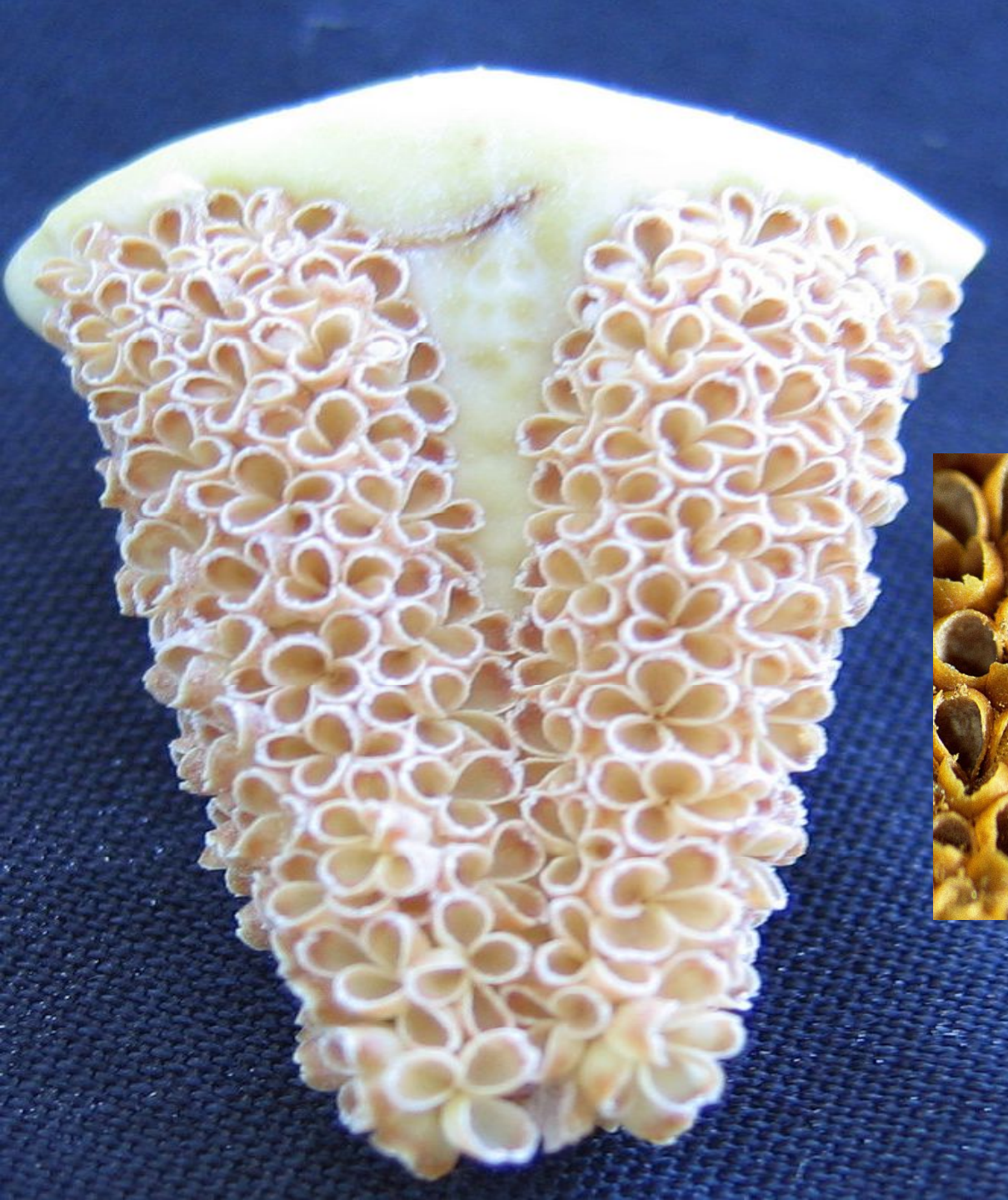


Fig. 3.27. *Cycas*. A, microsporophyll; B, microsporangia; C, dehiscent microsporangia.



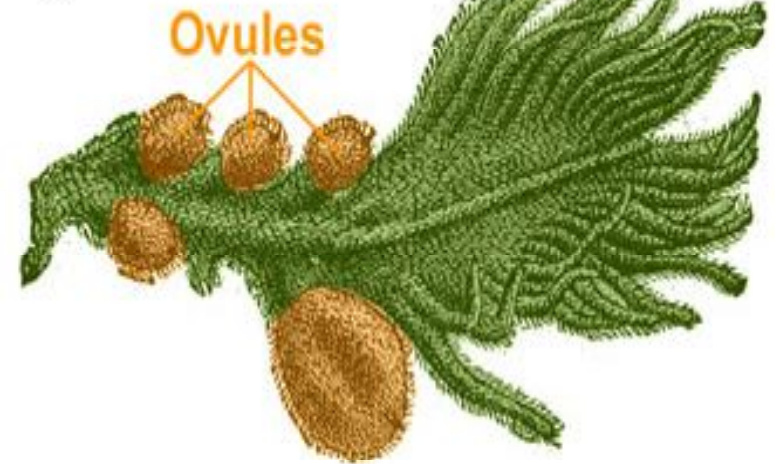


## **MEGASPOROPHYLLS:**

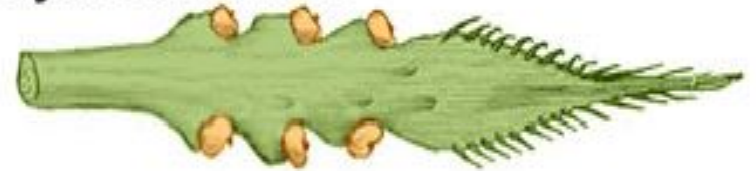
- ✓ **The female reproductive organs are present in the form of megasporophylls.**
- ✓ **Many megasporophylls are spirally arranged at the apex of the trunk.**
- ✓ **Each one is a flat body with an upper leafy portion, middle ovule bearing portion and proximal petiole.**
- ✓ **The middle part is wider than petiole and bears ovules(2-12) in two rows.**
- ✓ **They are green when young but at maturity they are orange or red coloured.**



***Cycas revolta***



***Cycas circinalis***



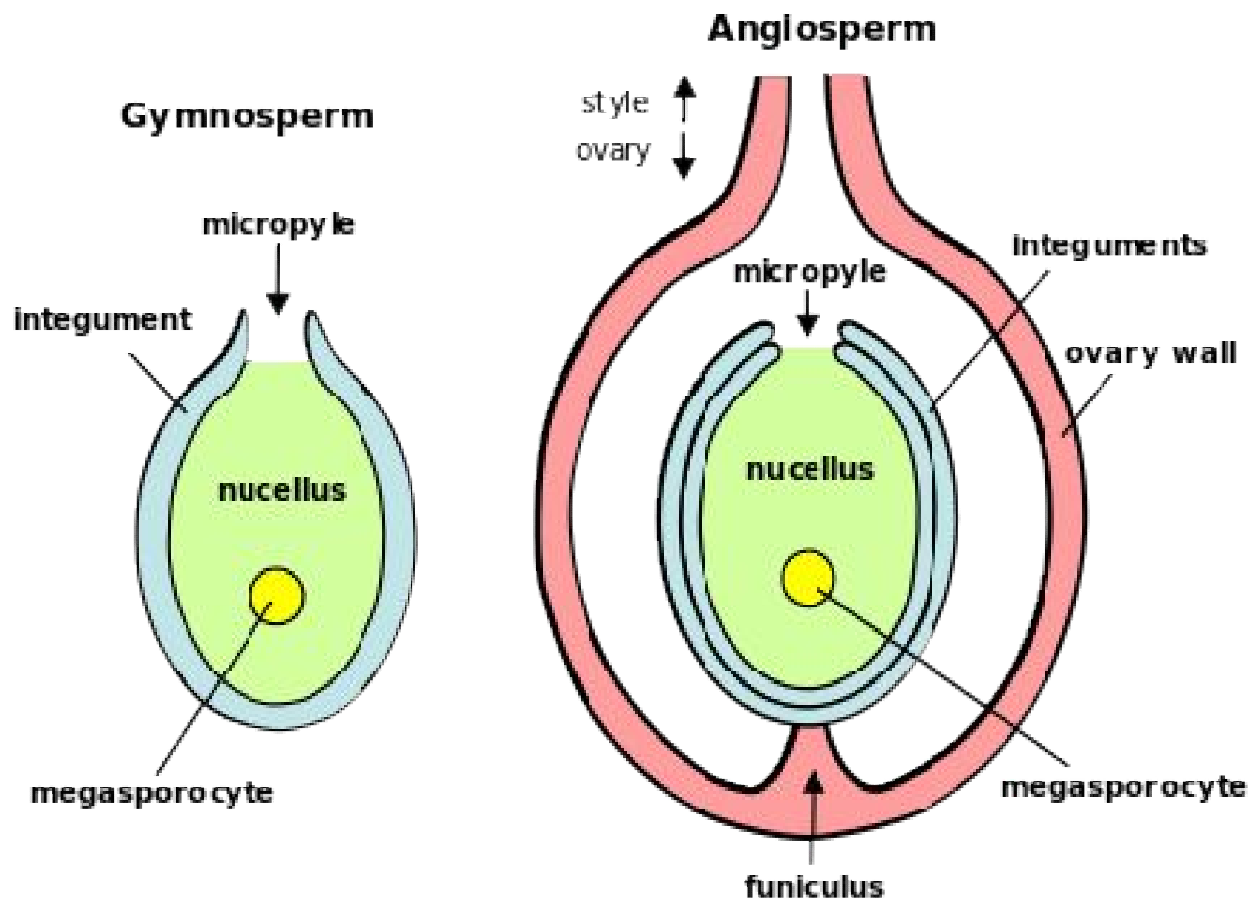
***Cycas normanbyana***



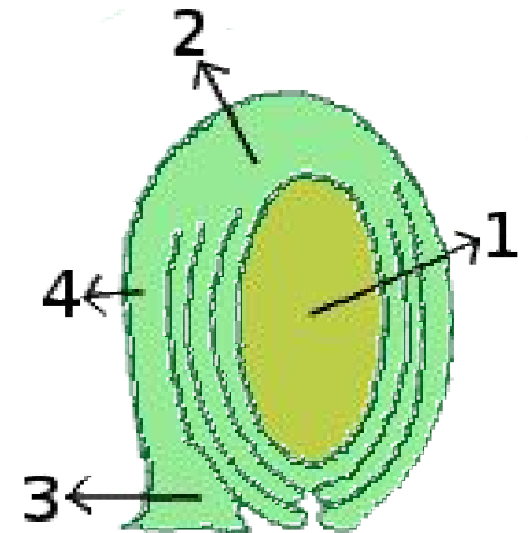
## OVULE:

- ☐ It is orthotropous, unitegmic and shortly stalked.
- ☐ The single integument is very thick and covers the ovule from all sides except a mouth like opening at the top called micropyle.
- ☐ The integument consists of three layers – outer green fleshy (SARCOTESTA), middle yellow stony (SCLEROTESTA) and inner fleshy.
- ☐ Certain cells at the top of nucellus dissolve and form a cavity called pollen chamber to receive pollens.
- ☐ There is an archegonial chamber just below the pollen chamber which has 3-6 archegonia.
- ☐ In the nucellus, only one cell called the megaspore mother cell enlarges and divides to form four haploid megaspores.
- ☐ Out of the four, only one is functional and it is the first cell of the female gametophyte.





orthotropous ovule - a completely straight ovule with the micropyle at the apex



Anatropous ovule

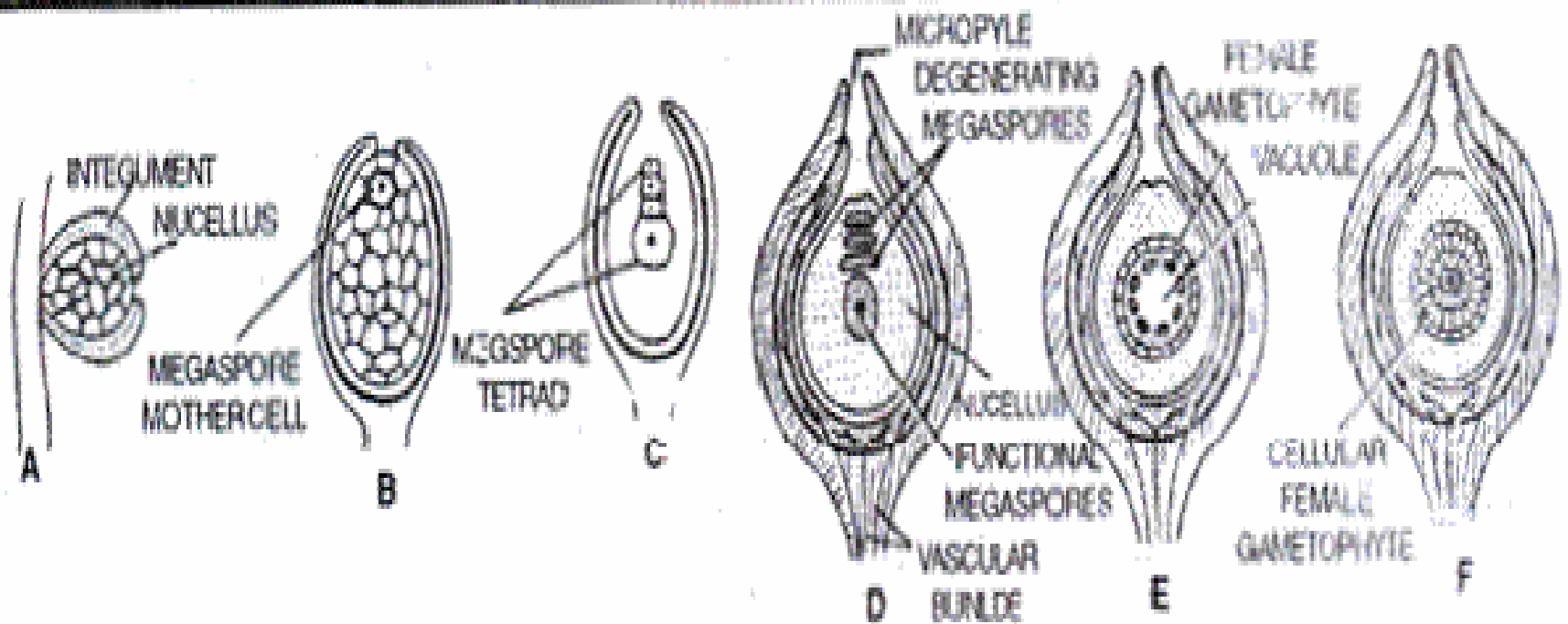


Figure 9.10 Development of female gametophyte of *Cycas* within ovule. A. Ovule in early stage, C. Appearance of megaspore mother cell, C. Megaspore mother cell divides reductionally to form four megaspores, D. Three megaspores degenerate, one remain functional, E to J. Development of female gametophyte and archegonia, K. Mature ovule.

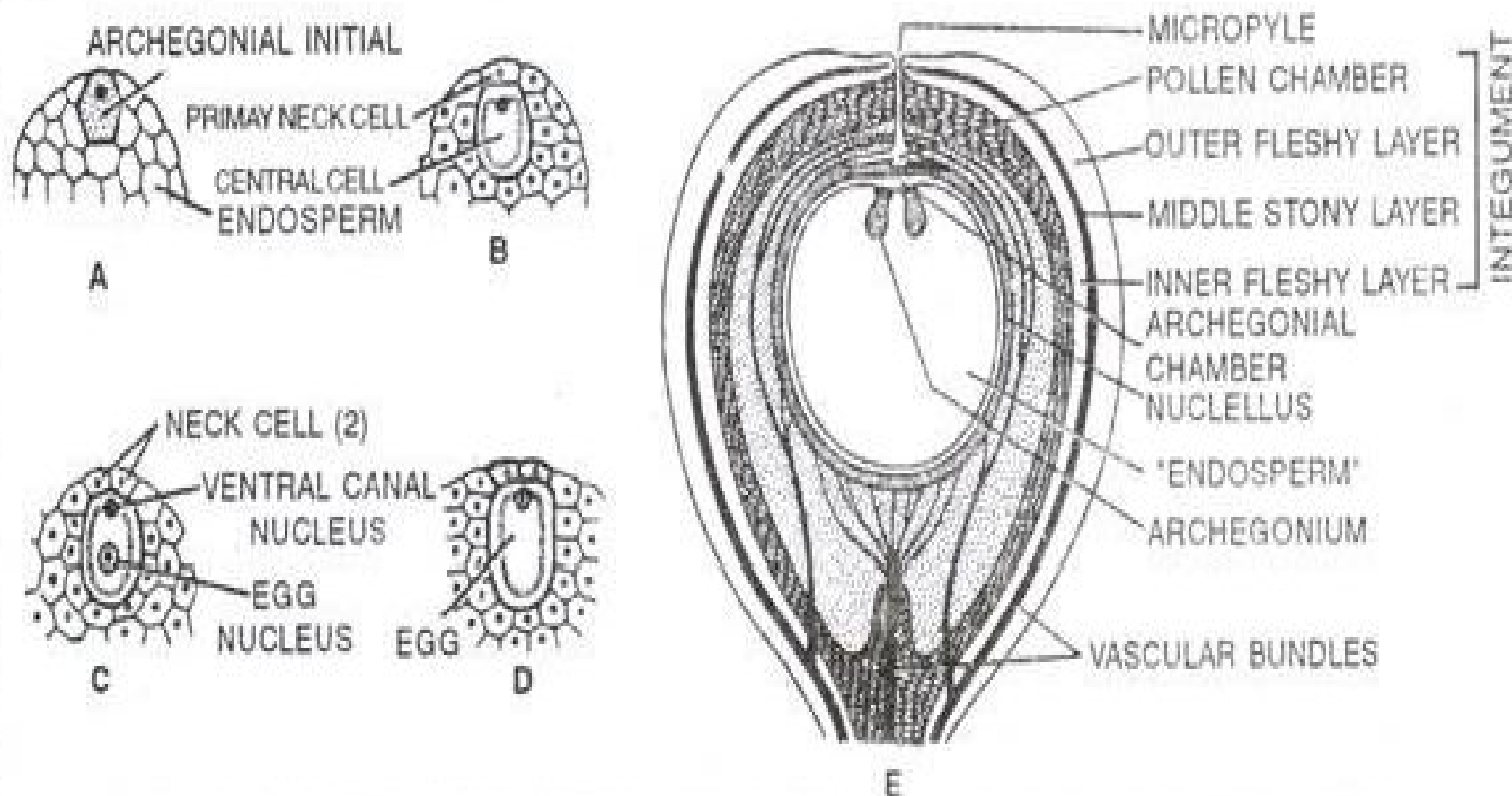


Figure 9.11 A-D. *Cycas*. Development of archegonium, E. V.S. of a mature *Cycas* ovule



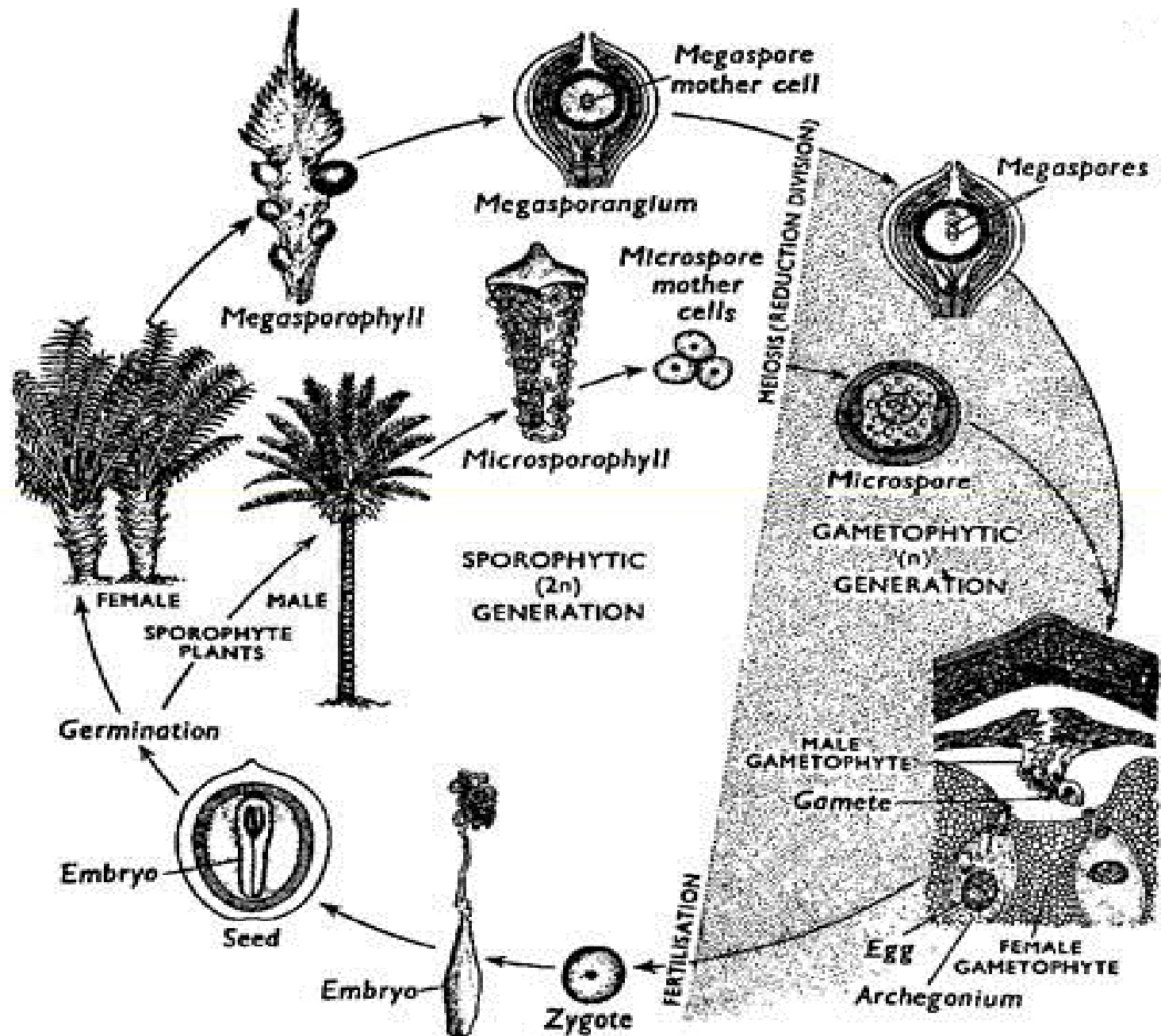
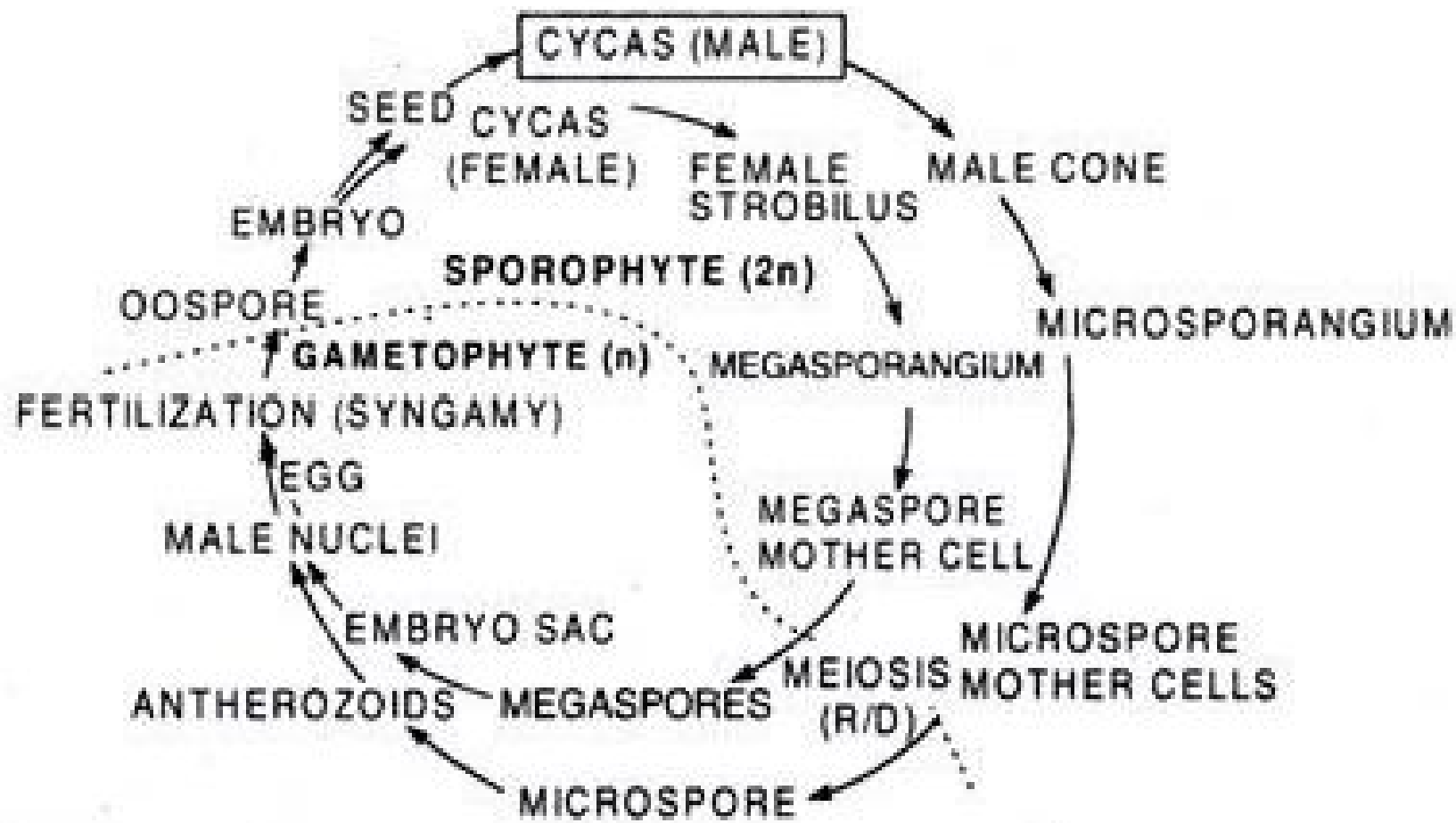


Fig. 1.24 : Life cycle of *Cycas*



**Fig. 3.52. Cycas. Graphic life-cycle.**

## Life Cycle of Cycas

- The plant body is a diploid sporophyte ( $2n$ ).
- The male plant bears male strobilus with several microsporophylls that contain 1000s of microsporangia.
- Haploid microspores are formed as a result of meiosis in microspore mother cell of microsporangia.
- Each microspore develops into male gametophyte that produces male gametes.
- The female plant bears megasporophylls which contain 2-6 ovules in two rows.
- Due to meiosis in the megaspore mother cell of the ovule, the female gametophyte is formed.
- 2-6 archegonia are formed each of which contains an egg.
- Pollination and fertilisation occurs resulting in the formation of a diploid zygote which develops into a seed.