

Gymnosperm

Ephedra sp.

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Classification

Kingdom: Plantae

Division: Gnetophyta

Class: Gnetopsida

Order: Ephedrales

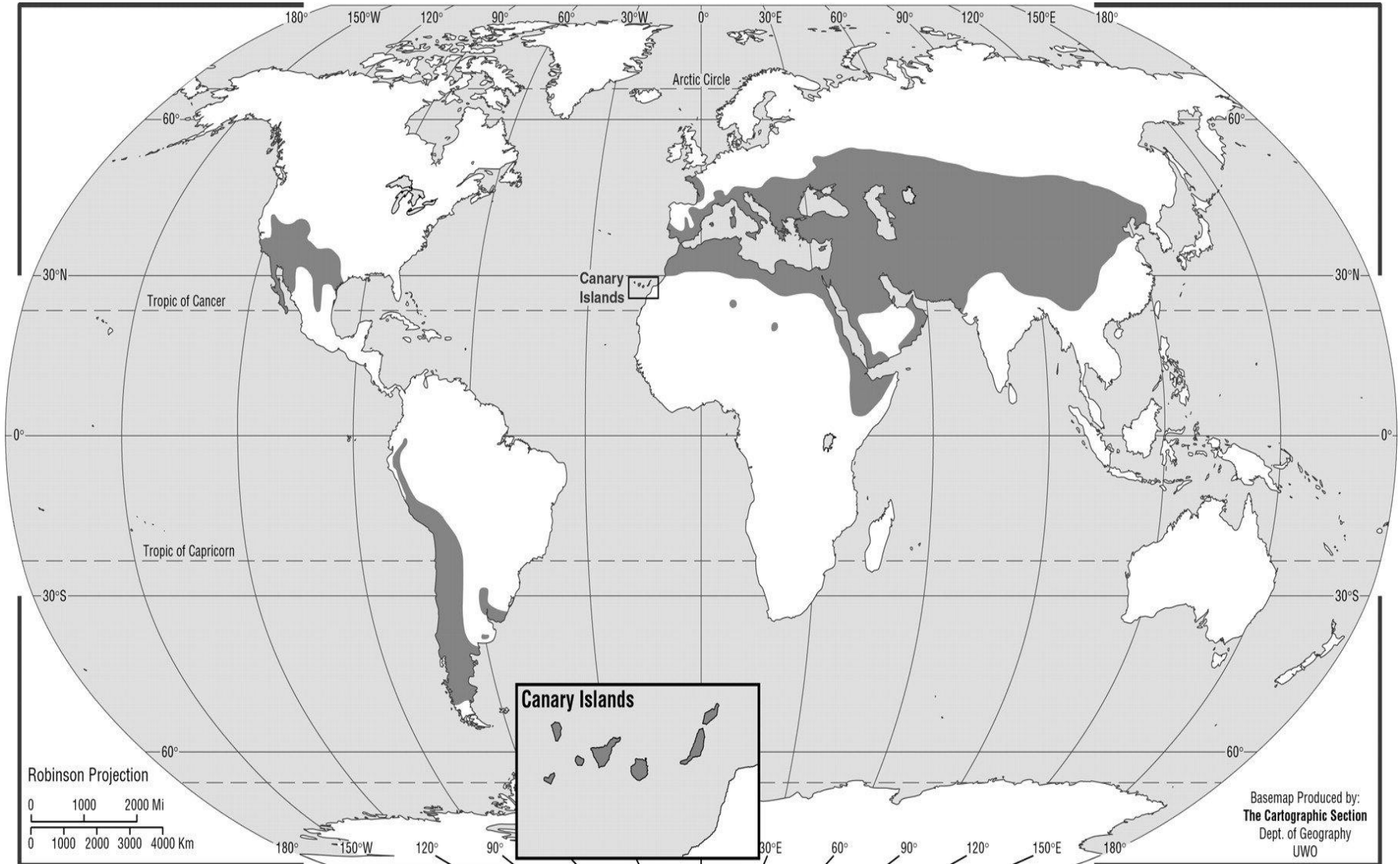
Family: Ephedraceae

Genus: *Ephedra L.*



Ephedra sp.

World Distribution of *Ephedra sp.*



Indian species

Six species are recorded in India

E. foliata

E. intermedia var. *tibetica*

E. gerardiana

E. saxatilis var. *sikkimensis*

E. nebrodensis var. *procera*

E. regeliana

External Morphology

External appearance like *Equisetum*.

The internodes are longitudinally ridged & the ridges on the successive internodes alternate

Two types of branch present: a) determinate
b) Indeterminate

Stem: The stem is green, woody, hard, glabrous and much branched. The branches are also green and photosynthetic & arise in the axils of scale leaves. The stem is distinctly jointed and differentiated into nodes and internodes. Hence, the plants are commonly called ‘Jointed fir’.



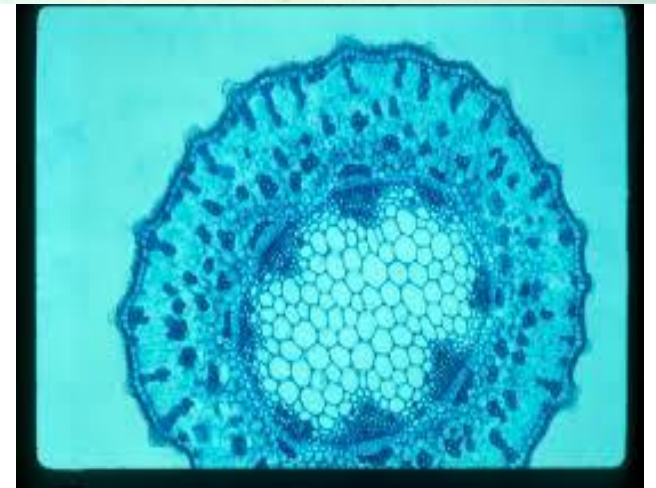
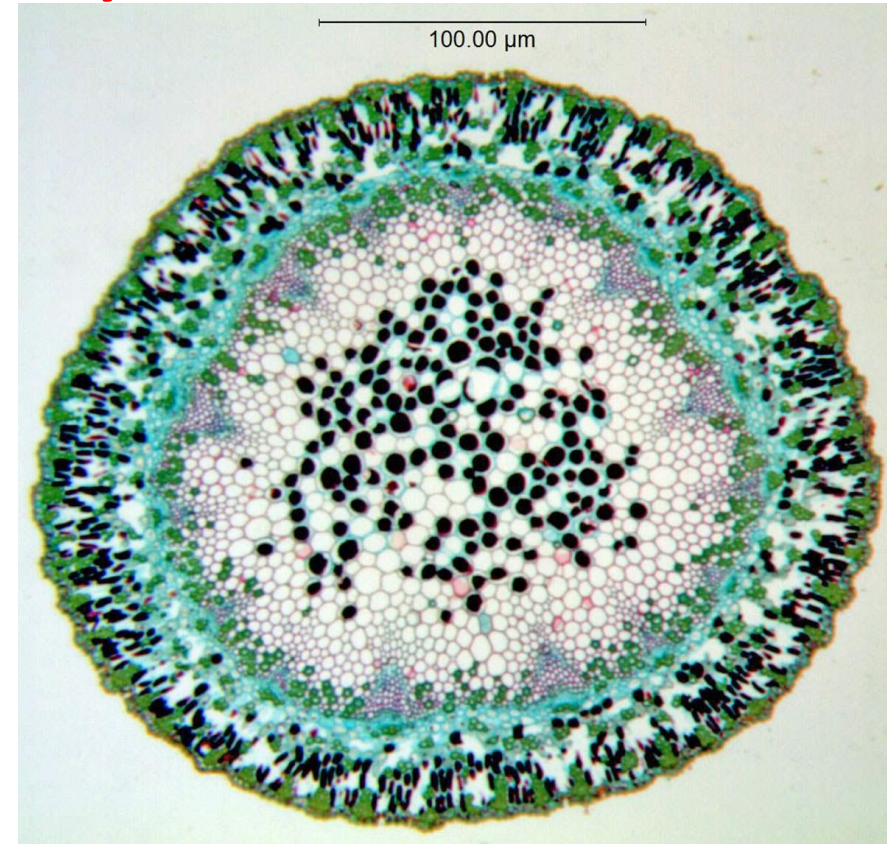
Root: The roots are long branched and deep feeders (tap roots) growing deep into the soil.

Leaves : The leaves are minute , scale like and borne in pairs at each node. The scale leaves bear a bud in their axils. Each leaf is innervated by two un-branched veins that run parallel to each other. As the scale leaves are deciduous & non-photosynthetic , function of photosynthesis is carried out by young green stem.



Anatomy

Stem: wavy outline due to the presence of ridges & furrows. Epidermal cells highly cuticularized except in the region of stomata, which is sunken. Haplocheilic, two guard cell & prominent substomatal cavity, hypodermis present only below the ridges, composed of elongated fibers. Single layer Palisade cells present below the epidermis, then presence of endodermis, sec. growth present, annual ring present, interfascicular cambium present in V.B. two types of cambium cell present **ray and fusiform initials**, tracheids with bordered pit, perforation plates like vessel present. Sec. PH. Contains sieve cells, parenchyma with albuminous cell, rays.



Leaf: Reduced & Membranous, oval outline(T.S), epidermis highly cuticularized, stomata sunken & few in number. 2-3 layer of palisade cell present which are oblong, chlorenchymatous & separated by intercellular space. intercellular space filled up by non green spongy cell, 2 vascular trace present in spongy parenchyma cell.

Reproduction

Most of the species are dioecious and bear male and female reproductive organs on different plants. These plants do not show any difference in their vegetative organization and can be recognized only when reproductive structures appear.

Ephedra is heterosporous and produces two different kinds of spores (microspores and megaspores).

Microsporangiate or Male / Staminate Strobilus :

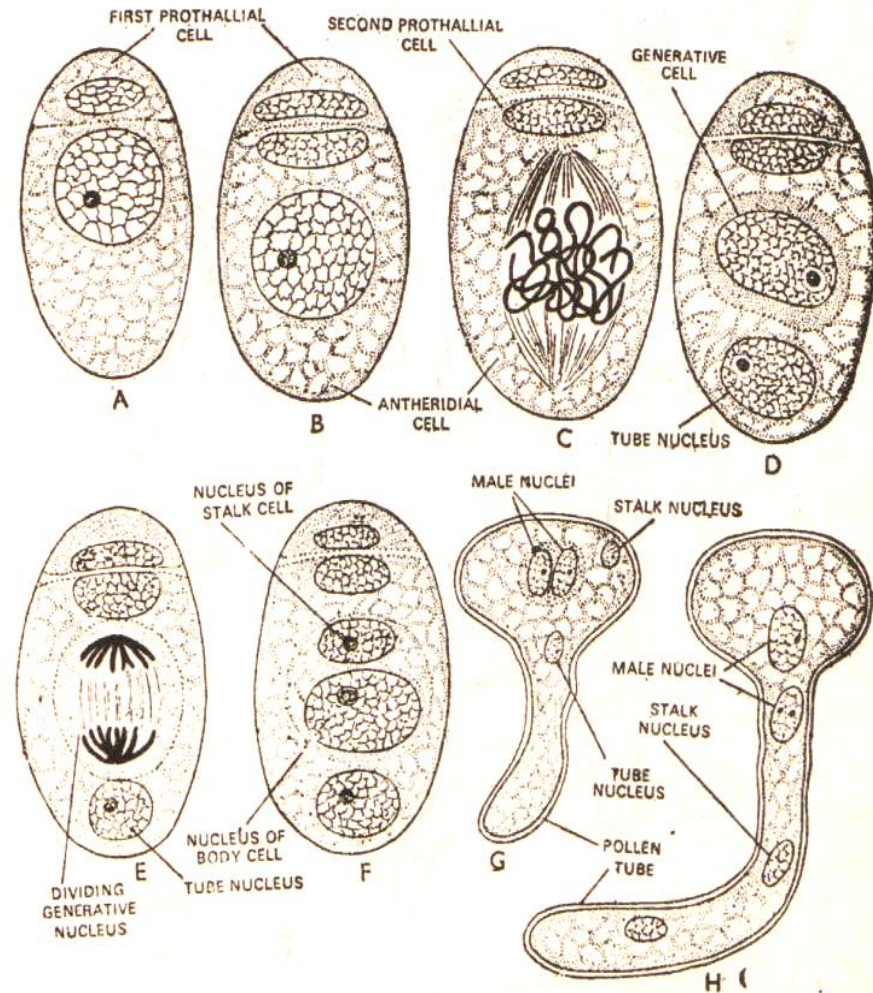
These strobili arise in clusters from the nodes of fertile branches of male plants, in the axils of scale leaves. So, their number at the nodes depend on the number of scale leaves. Each strobilus has a central axis that bears two to eight pairs of decussately arranged simple, broad and cupped bracts. The lower one or two pairs of bracts are sterile whereas the upper ones are fertile.



Each male flower arise in the axil of fertile bract & has an axis called microsporangiophore, which bear 2-8 microsprangia at its tip.

Male Gametophyte

- Microspores are the first cell of male gametophyte & development of male gametophyte starts within the microsporangium.
- Microspore divide obliquely to form a small prothallial cell and a large outer cell.
- Nucleus of large cell divides into two and form secondary prothallial nucleus and an antheridial cell.
- Antheridial cell nucleus divide to form tube nucleus and a generative cell.
- Generative cell divide to form stalk cell and body cell which form two male gametes.



Germination of Microspore and Development of Male Gametophyte

Male gametophyte is released at 5-celled stage.

Pollination is anemophilous
& post pollination changes
occur.



Female / Ovulate Strobilus:

Female strobilus also known as female cone and it is smaller than male strobilus .They are borne in groups of 2-4 at the nodes of female branches. Each female strobilus has a central axis on which about 2-4 pairs of opposite decussate bracts are arranged. Bracts are fused to form cup like cupules.



FEMALE CONE

Female flower

Each female flower is borne in the axil of fertile bracts. It consists of short stalk and terminal Megasporangium.



Megasporangium (Ovule):

Megasporangium consists of centrally located nucellus surrounded by two integuments. The outer integument is cup like and inner integument elongated to form micropylar tube.

Megaspore:

Megaspore is haploid and represents first cell of female gametophyte. It remains embedded within the nucellus of ovule and develops into female gametophyte.

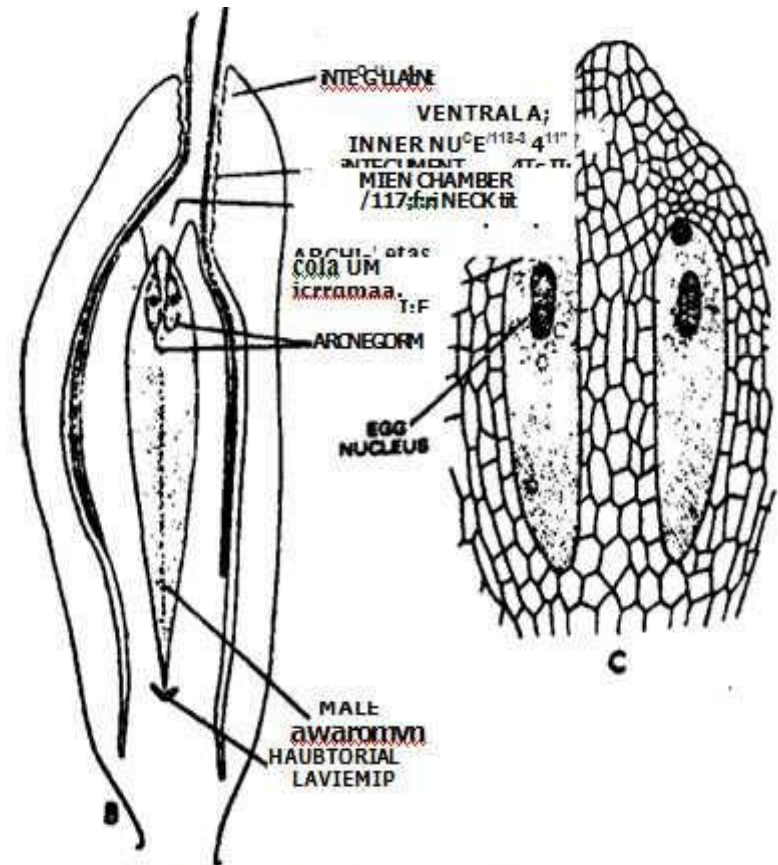
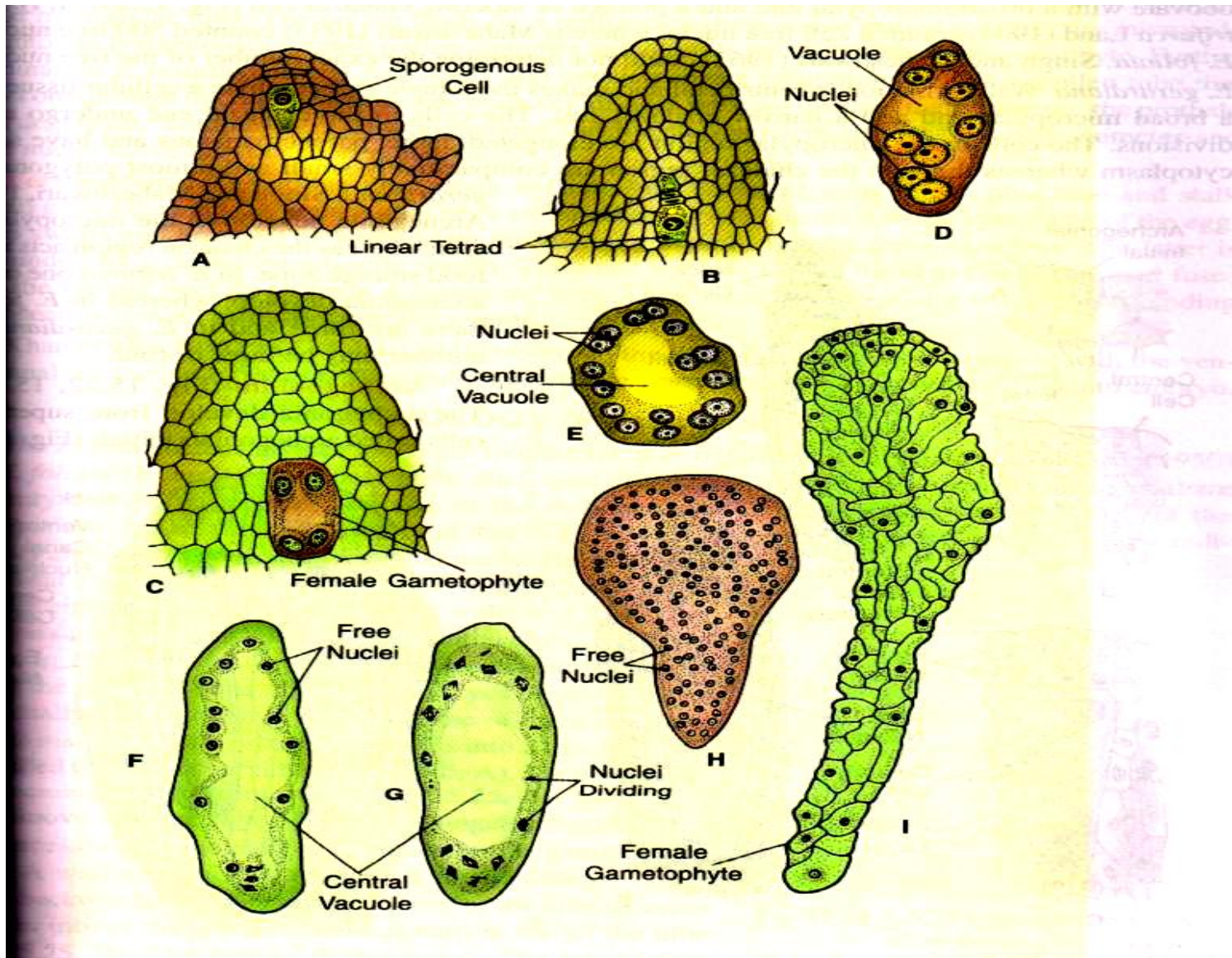


Fig: B-L.S of ovule showing female gametophyte. Cfemale gametophyte showing =begonia

Female Gametophyte

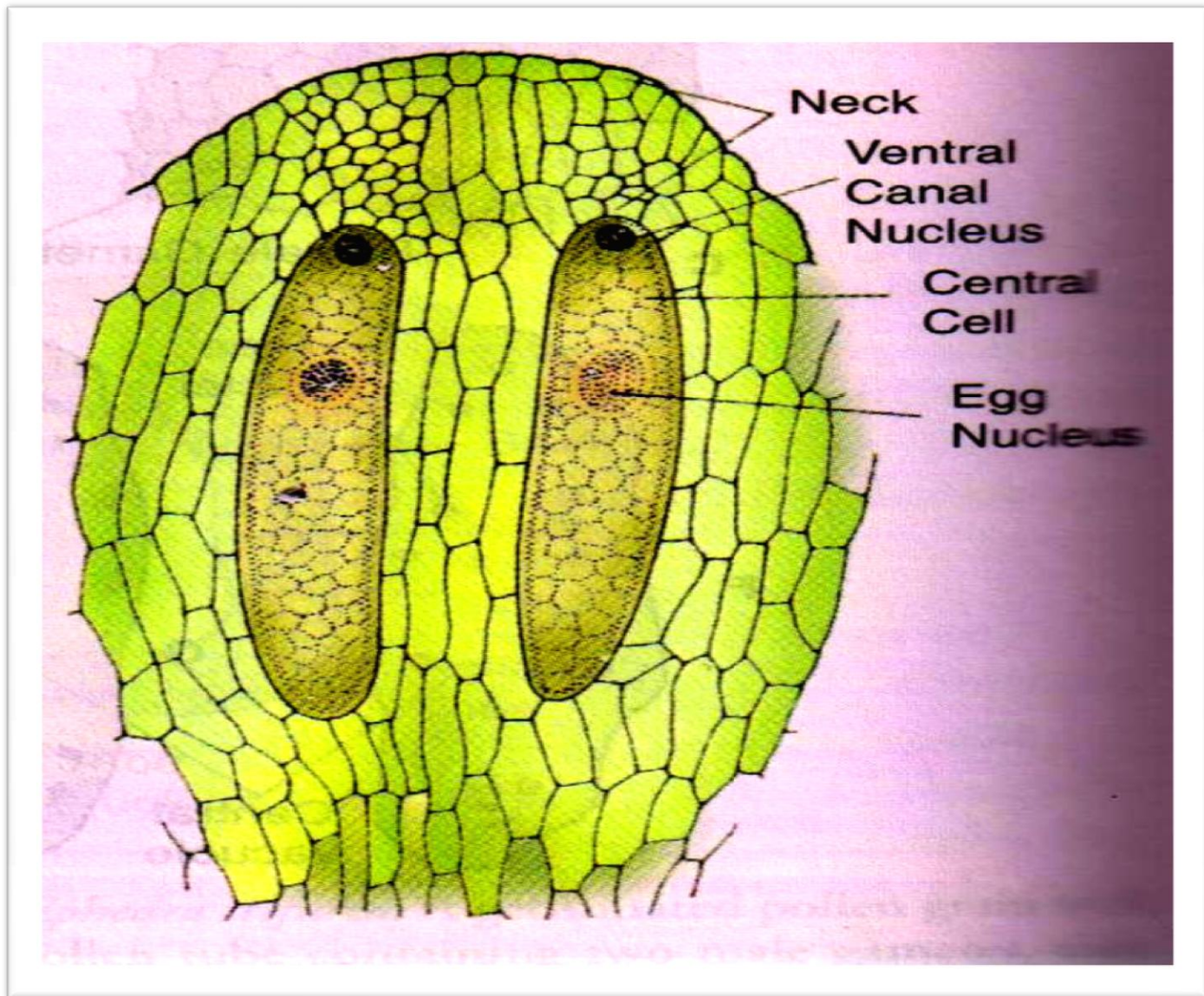
- Megaspore enlarges in size & nucleus divides mitotically to form two nuclei which come to lie at opposite poles.
- Nuclei divide by free nuclear division to form large no. of free nuclei.
- Cell wall formation starts and cellular endosperm or female gametophyte is formed.
- Cells of female gametophyte towards chalazal end store food & those towards micropylar end develop archegonia.



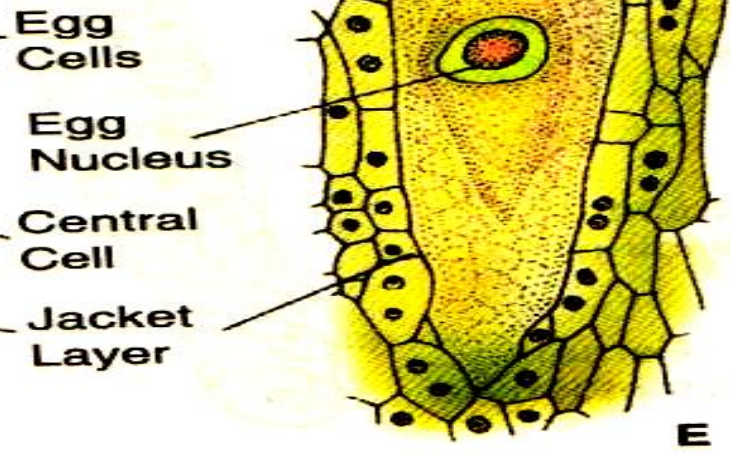
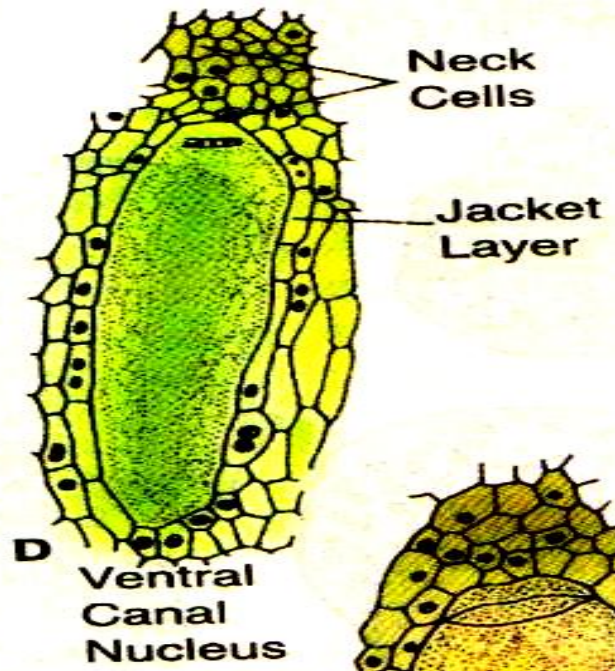
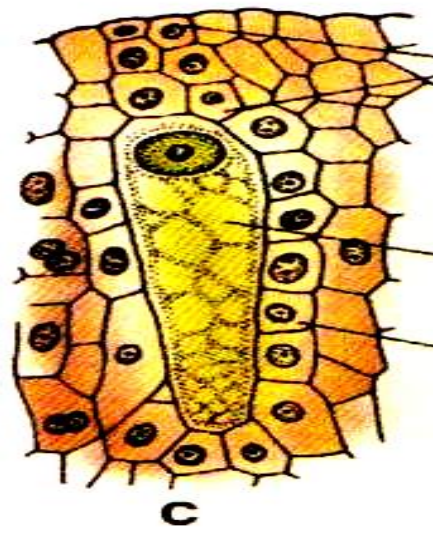
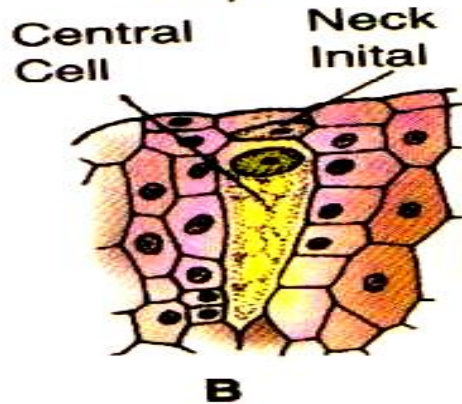
Development of Female Gametophyte

Development of Archegonia

- Each archegonium develops from a single superficial cell (archegonial initial) towards the micropylar end of female gametophyte.
- Archegonial initial divide to form upper primary neck cell & lower central cell.
- Primary neck cell divides repeatedly to form neck having 32 cells arranged in eight tiers.
- Nucleus of central cell divides to form upper ventral canal cell and lower egg nucleus.
- Egg nucleus get surrounded by cytoplasm & develop its own wall and becomes a egg.



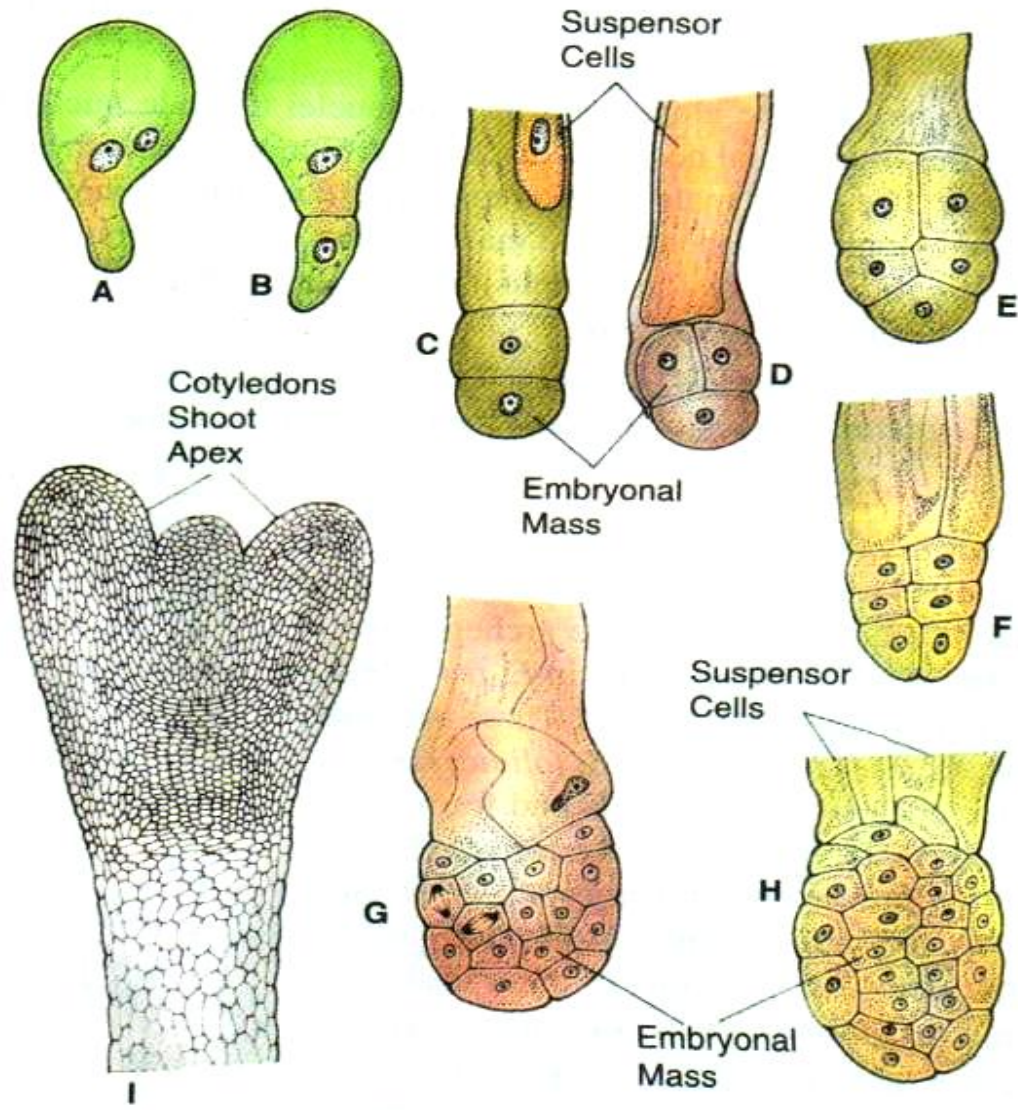
V.S. of Nucellus showing Archegonia



Development of Archegonium

Embryology

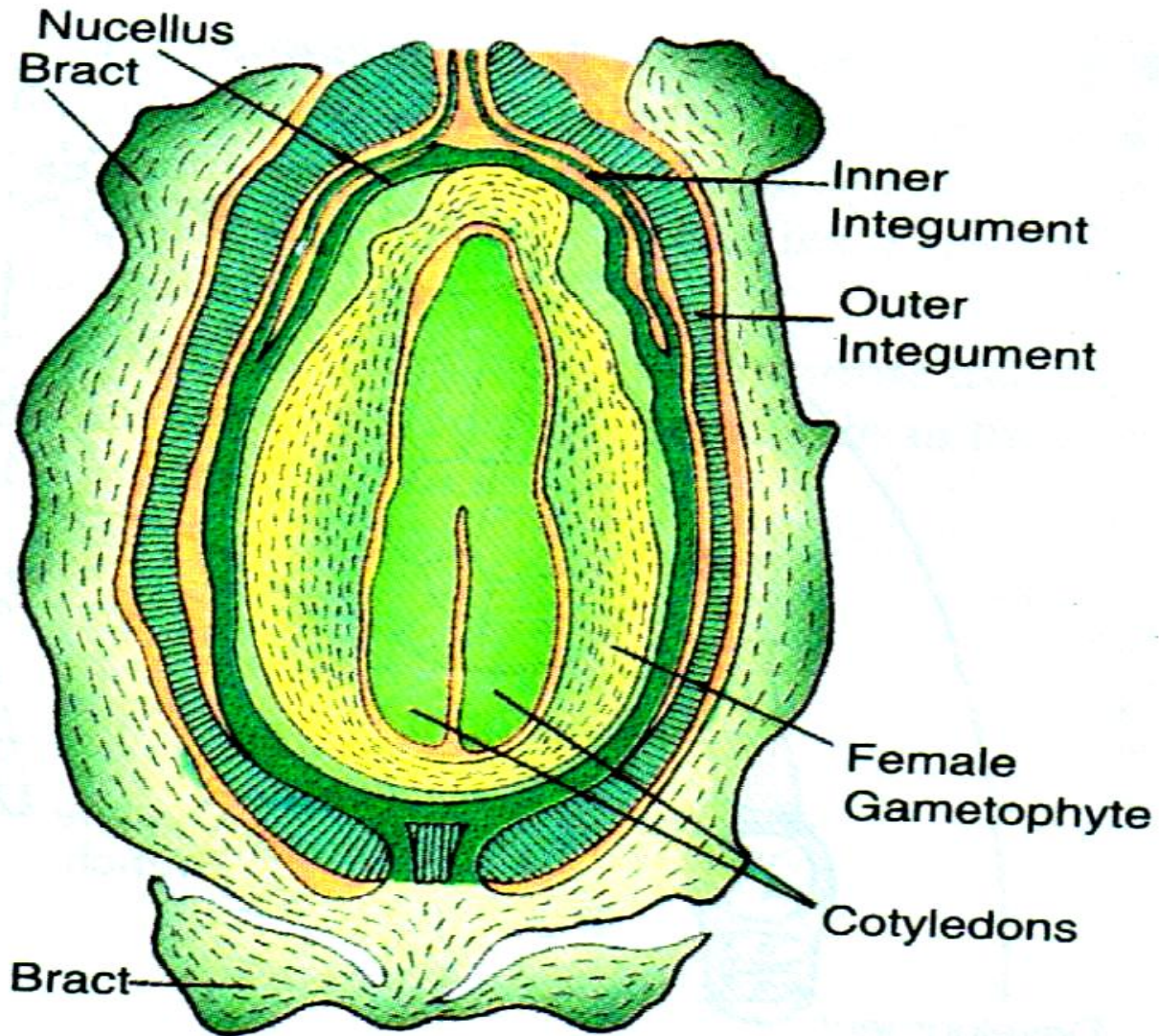
- Cells around the fertilized egg disintegrate, diploid nucleus of zygote forms 8 nuclei after free nuclear division , followed by formation of 8 cells which behave as proembryo.
- Each pro-embryo forms suspensor tube , which at its terminus forms embryonal initial.
- Embryonal initial divides to form a basal and terminal cell. Terminal cell forms proper embryo with two cotyledons, shoot apex and root apex.



Stages in Development of Embryo

Seed

- Ovule after fertilization develops embryos and becomes a seed. The outer integument (perianth) becomes thick and encloses the seed.
- Seed germination is epigeal.



L.S. Of Seed of *Ephedra*

GYMNOSPERM

Gnetum sp.

Classification

Kingdom: Plantae

Division: Gnetophyta

Class: Gnetopsida

Order: Gnetales

Family: Gnetaceae

Genus: *Gnetum* L.



World Distribution of *Gnetum* sp.



Indian species

Five species are recorded in India

G. montanum

G. latifolium var. *macropodum*

var. *funiculare*

G. gnemon var. *griffithii*

var. *brunonianum*

G. ula

G. contractum

Gnetum ula



External Morphology

Stem is cylindrical and branched. Which is arise in the axils of leaves. In climbers branches are two types (long, dwarf). Internodes are present in case of limited growth branches. Jointed stem present in some spp. Node having swollen structure consists of two parts :

- a) one immediately below the node
- b) one immediately above the node

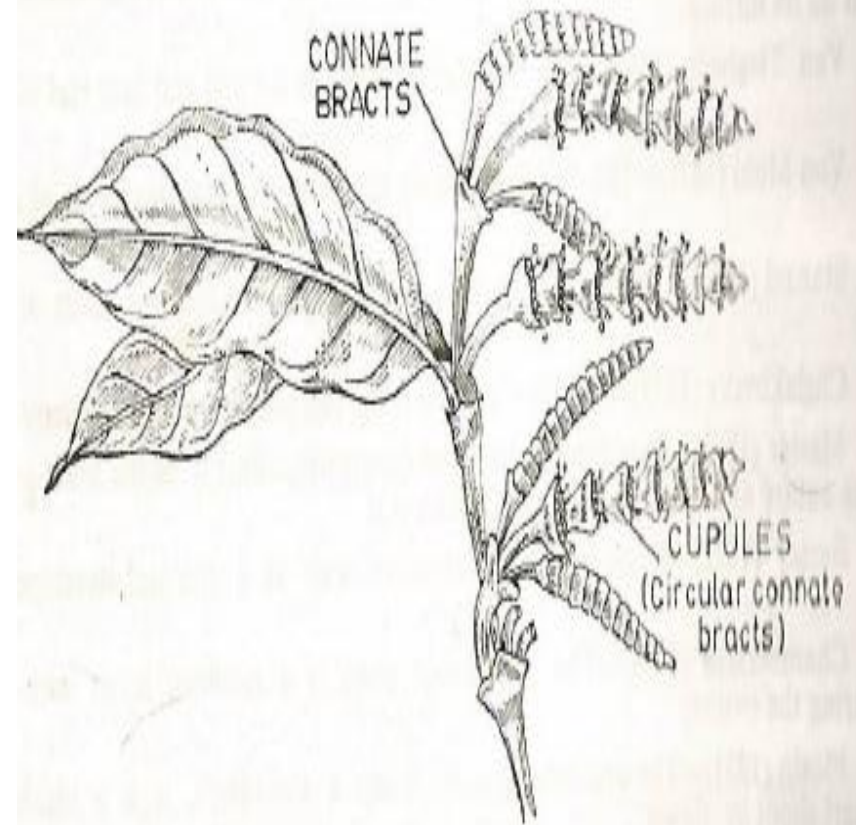


Fig. 3.22—*Gnetum* sp. A portion of the male shoot bearing male strobili.

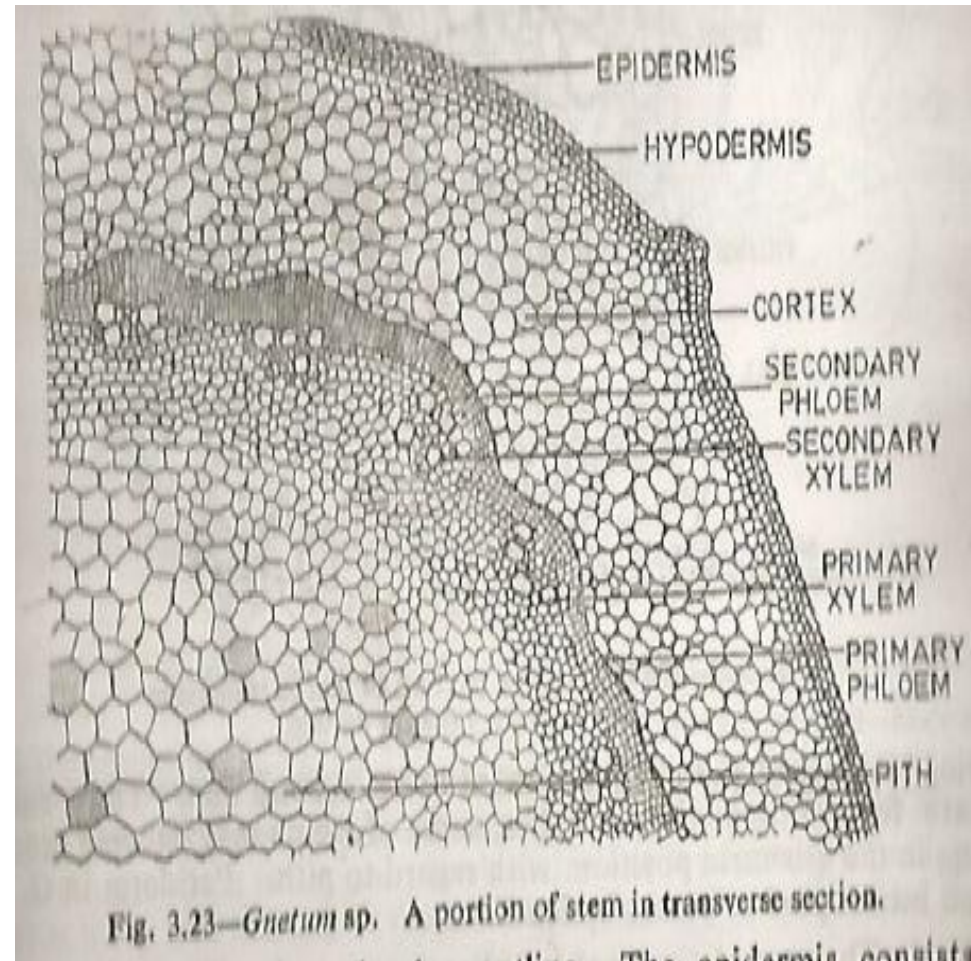
Root: branched normal tap root system.

Leaves: look like dicot leaves, normally one kind and they are borne only on unbranched dwarf shoots (climbing spp.) leaves, simple, exstipulate & shortly petioled. Lamina is oval, large, entire with pinnately reticulate venation. Leaves (9-10) are arranged in opposite decussate pairs on each branch. scale leaves present (incaseof long shoot). Axillary and accessory buds are present.



Internal Morphology

STEM: vasculature look likes dicot. Circular in out line (young stem), epidermis contains single layer of papillate and rectangular cells, with heavy cuticle, stomata present, cortex 12-16 cell layered ,compact, thin. In case of older stem irregular outline, sclerenchymatous zone present in cortex parenchyma cells are lignified, spicular cells present , pit canals present. Pry. V.B. 20-24 in no. ring like arrangement. V.B collateral, open, endarch, broad medullary rays present.



Contd.

Xy. With tracheids & tracheae, Ph. Composed of sieve cells, Ph. parenchyma only. Circular & thin walled parenchymatous pith present.

The stem undergoes sec. growth by the activity of the cambium ring as in typical dicot.

Contd.

Root: diarch, many layered & parenchymatous, cells are large polygonal & filled with starch grain, thick walled fibres also occur among the cortical cells. Epidermis single layer, pericycle multilayered. V.B radial, pry Xy. Very small in amount , sec, Xy. Contains tracheids with bordered pits, Ph. Contains sieve cells and Ph. Parenchyma. Sec. growth normal.

Leaf: T.S. look like dicot leaves, because dorsiventral and reticulate venation. Epidermis with thick cuticularised, stomata present on lower surface, two types of mesophyll tissue present

a) upper palisade (single layer)

b) Lower spongy (multi layer)

Astrosclereids, lignified wall present, fibers & latex tube present. V.B arranged like curve on midrib, V.B. collateral, Endarch.

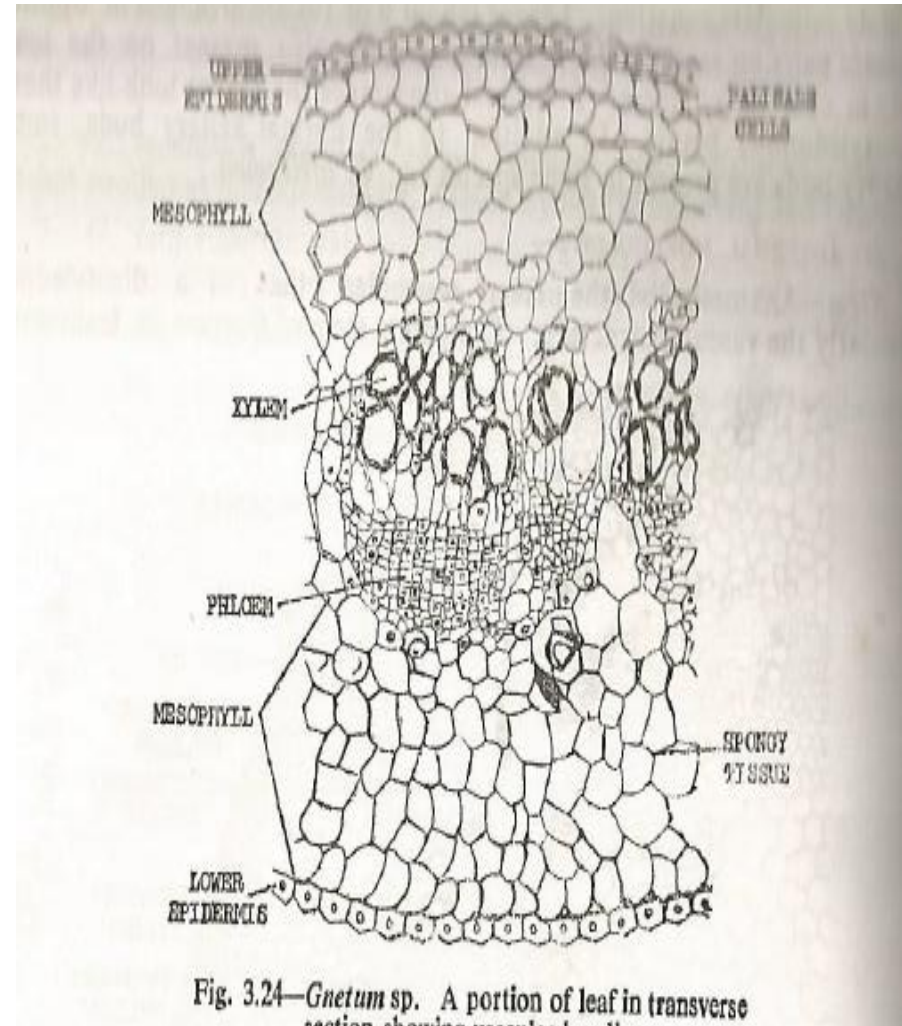


Fig. 3.24—*Gnetum* sp. A portion of leaf in transverse section showing vascular bundle.

Reproductive structure

Dioecious, unisexual flower, male flower as micro & female as megasporophyll, male & female flowers are borne in clusters & axils of leaves, panicle type of inflorescences of angiosperms, perianth present,



Male cone / Inflorescence

Compact, slender axis, up to 6 cm. in length, Inflorescence consists of a stout axis which bears at the base two opposite & connate bracts. collar or cupules present,

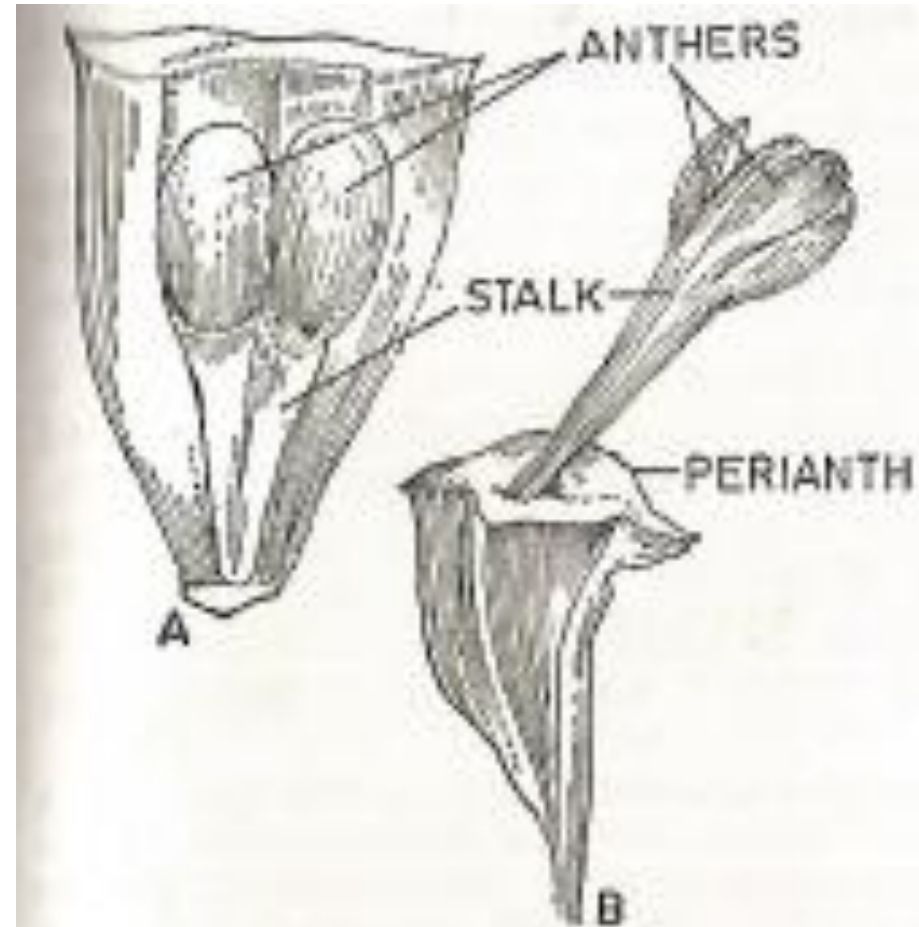


Fig. 3.26—*Gnetum* sp. A—L.s. of a male flower showing two anthers. B—Entire mature flower dehiscent.

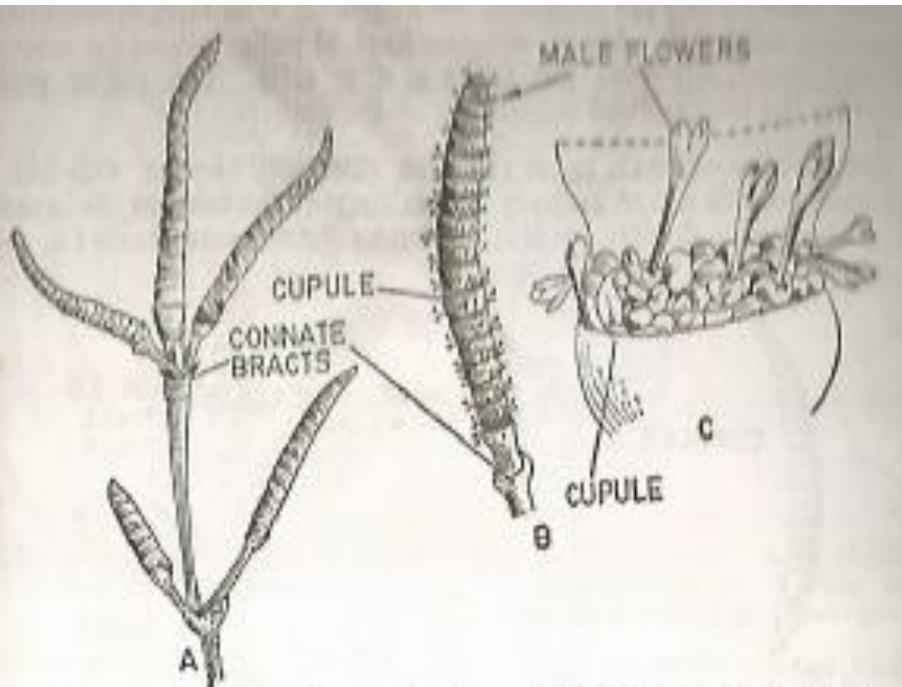


Fig. 3.25—*Gnetum* sp. A—Branch-apex bearing a cluster of male cones. B—Male cone at the time of dehiscence. C—Portion from B enlarged to show the dehiscing male flowers.

Female cone

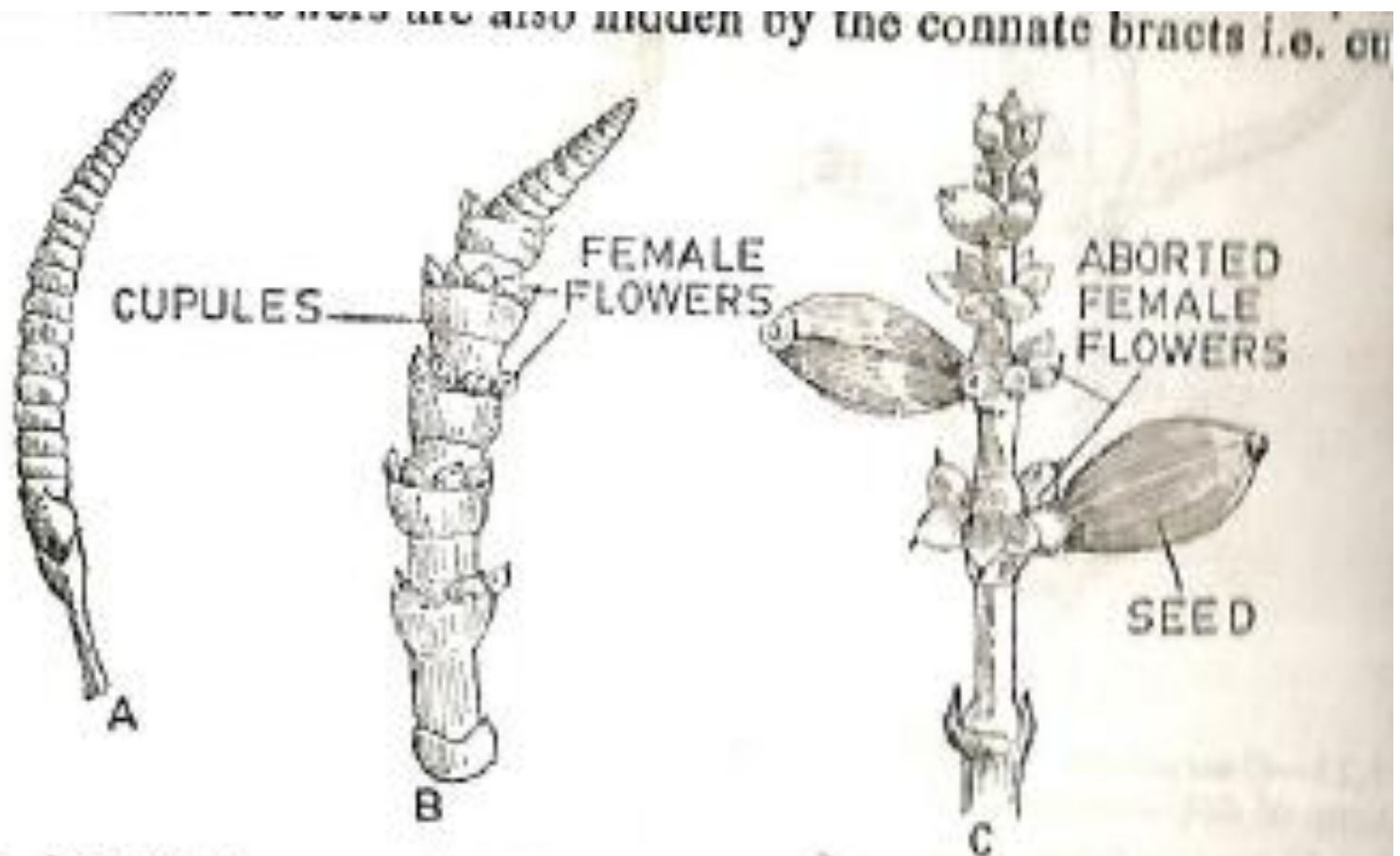


Fig. 3.27—*Gnetum* sp. A—Young female cone. B—Mature female cone showing female flowers (ovules). C—A female cone bearing two seeds and few aborted female flowers (ovules)

L.S. of an ovule

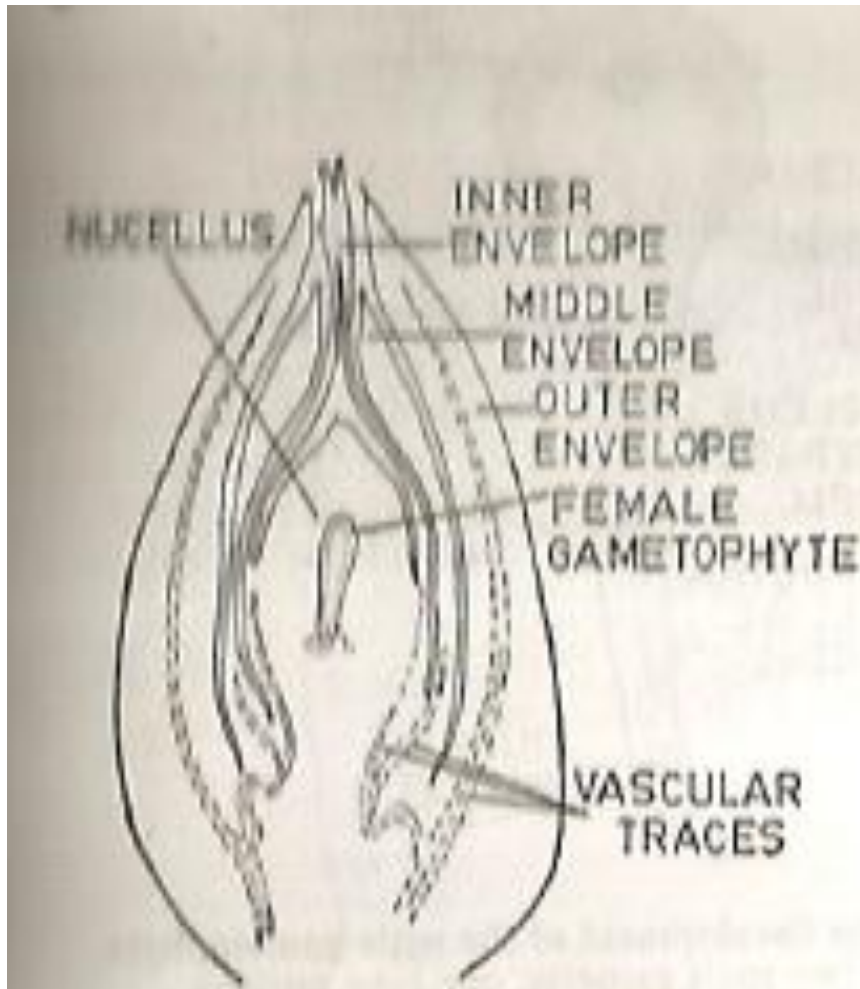


Fig. 3.28—*Gnetum* sp. Median l.s. of an ovule (female flower).

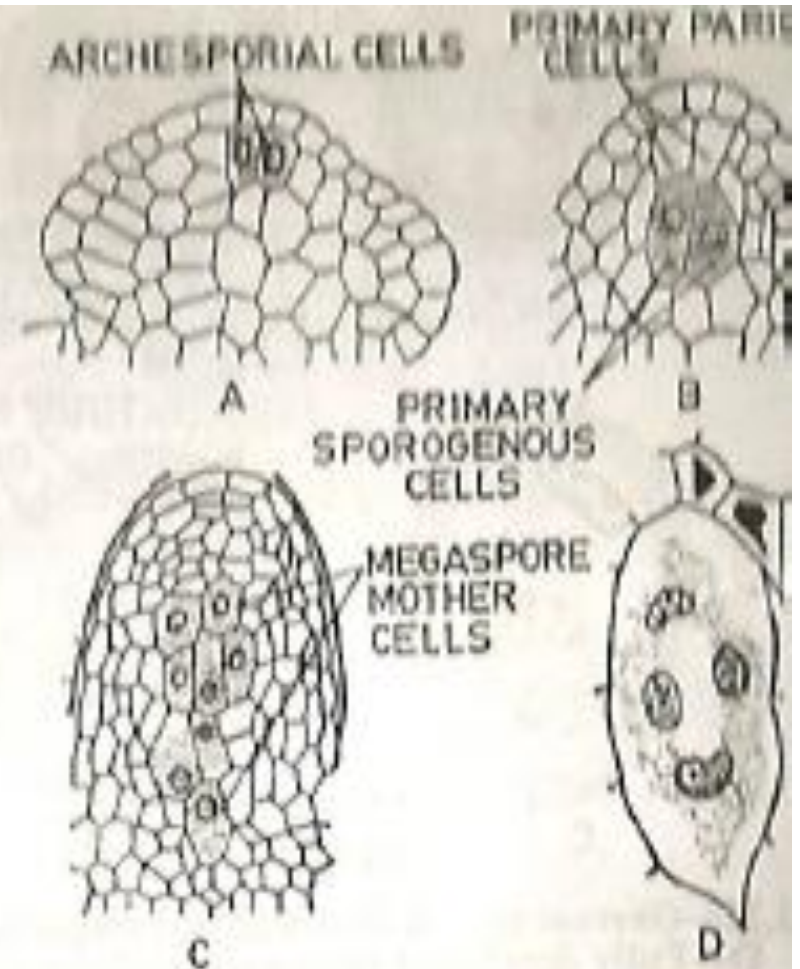


Fig. 3.29—*Gnetum* sp. A-D—Different in megasporogenesis. D—Four functional megaspores within a megaspore mother

Male Gametophyte

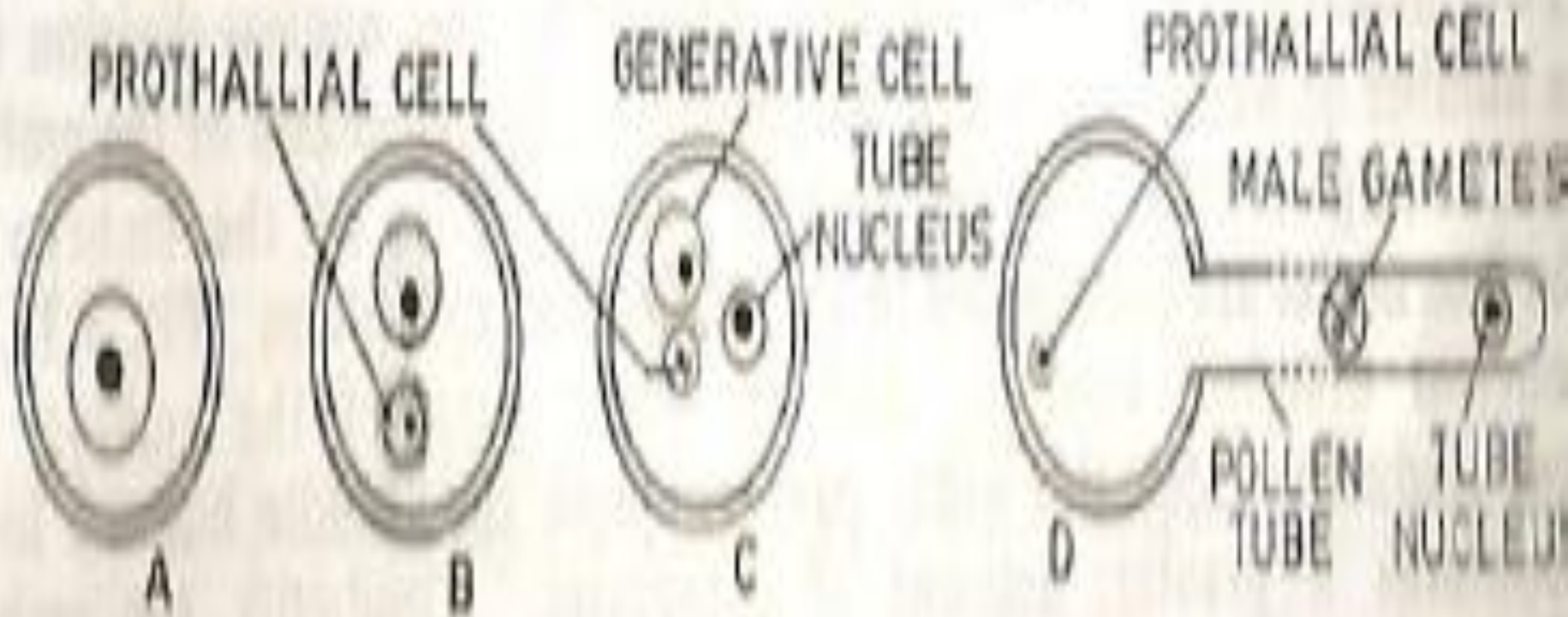
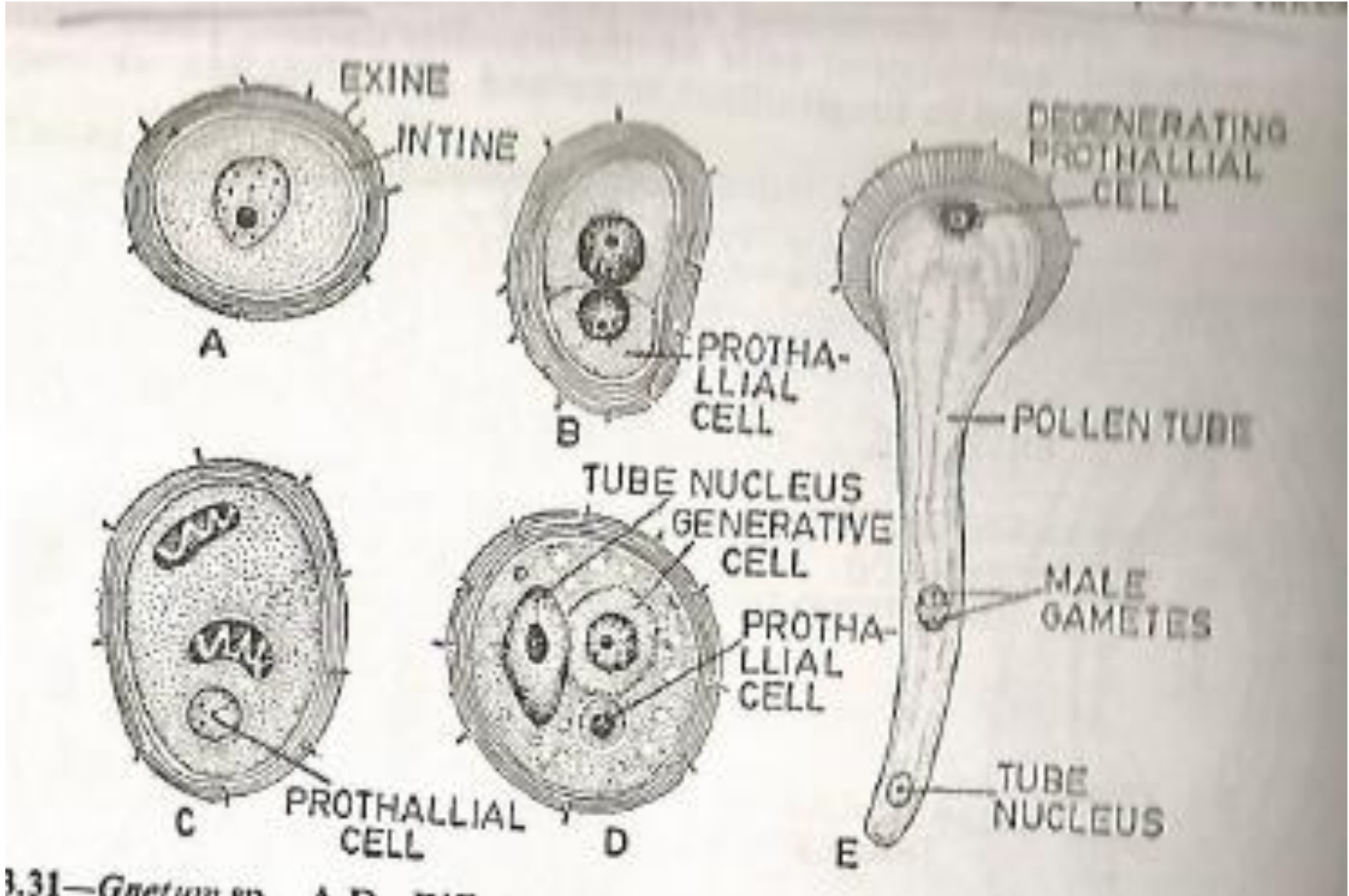
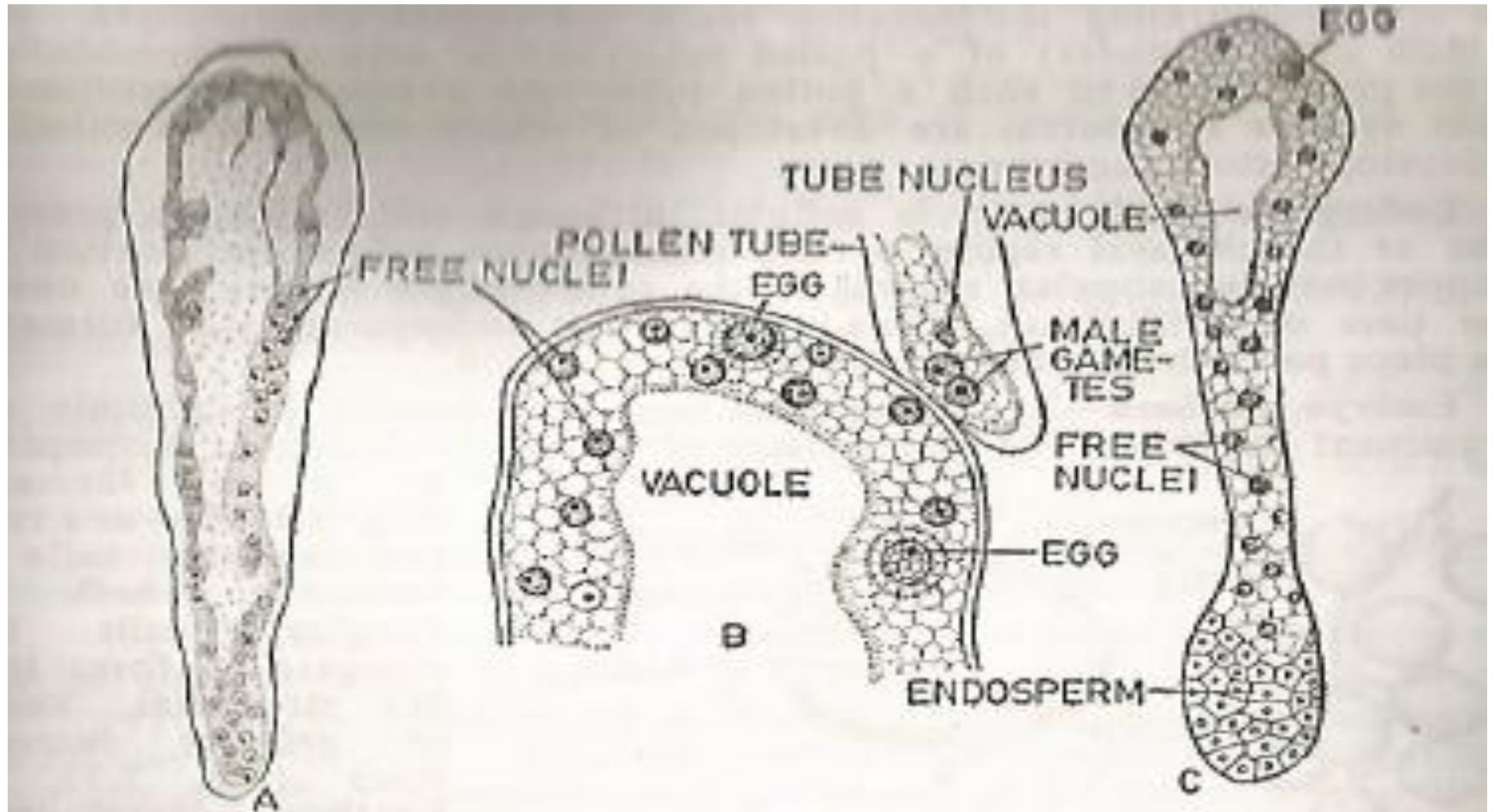


Fig. 3.30—*Gnetum* sp. A-D—Diagrammatic representation of the development of male gametophyte. D—Fully developed male gametophyte with two male gametes, a tube nucleus within pollen tube and a prothallial cell.



3.31—*Gnetum* sp. A. D. ...

Female Gametophyte



3.32 — *Gnetum* sp. A—Female gametophyte in free-nuclear stage. B—Upper part of the female gametophyte showing eggs; a pollen tube containing male gametes is also seen adpressed to the wall of the female gametophyte. C—Later stage of the female gametophyte showing incipient type of endosperm formation before fertilization.

Dev. Of Embryo

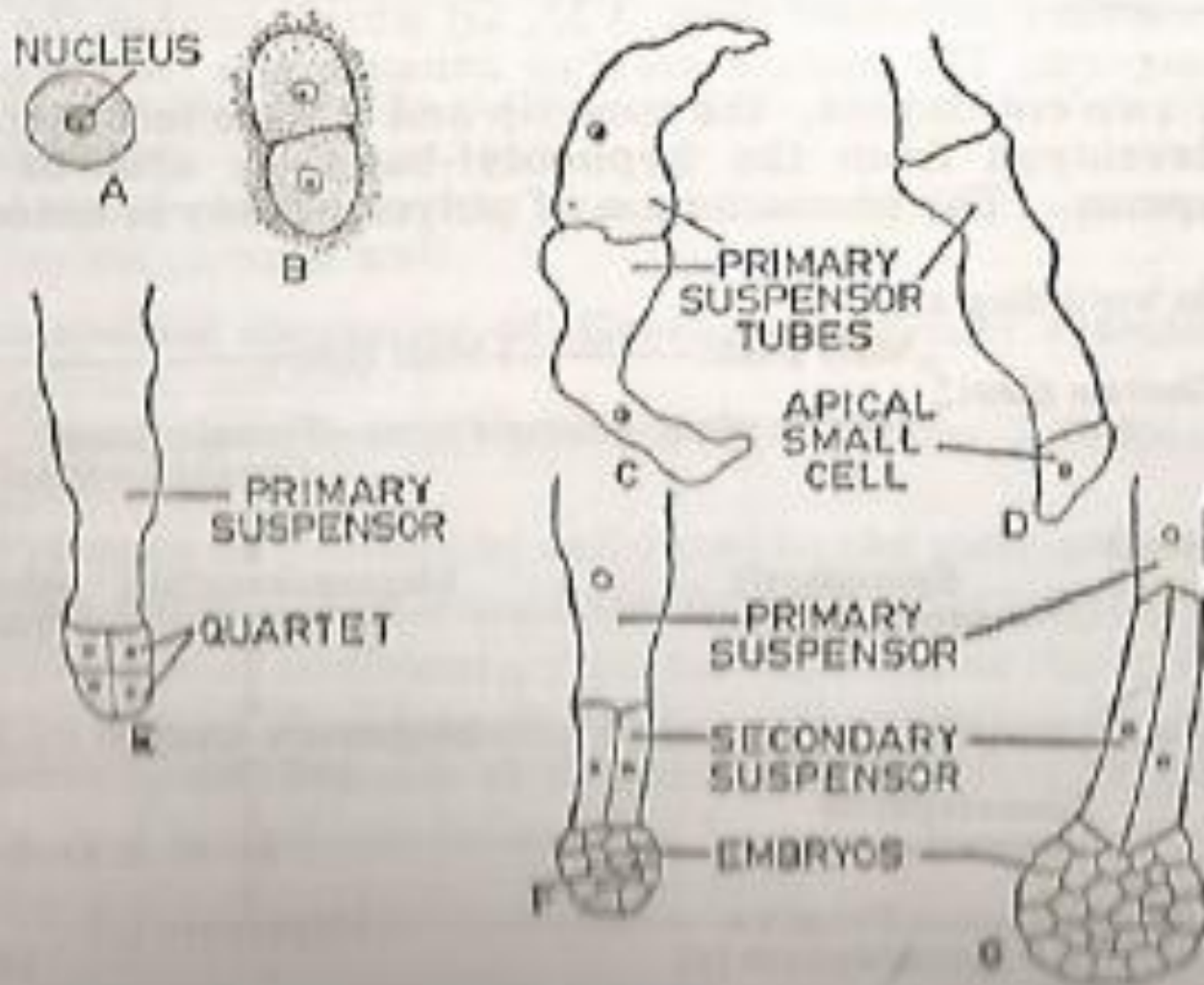


Fig. 1.33—*Gastrum* sp. A—Zygote. B-G—Different stages in the development of emb

Seed

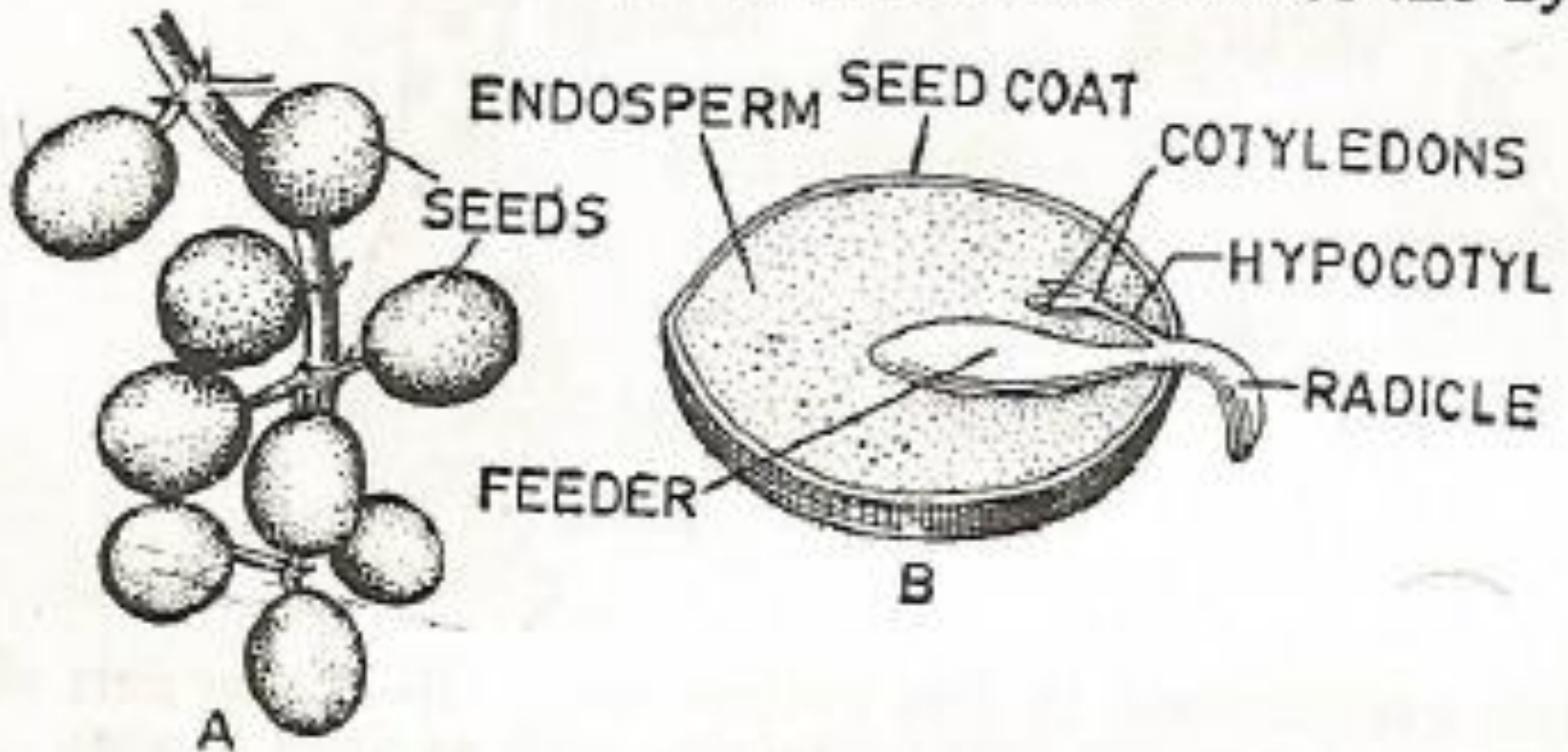
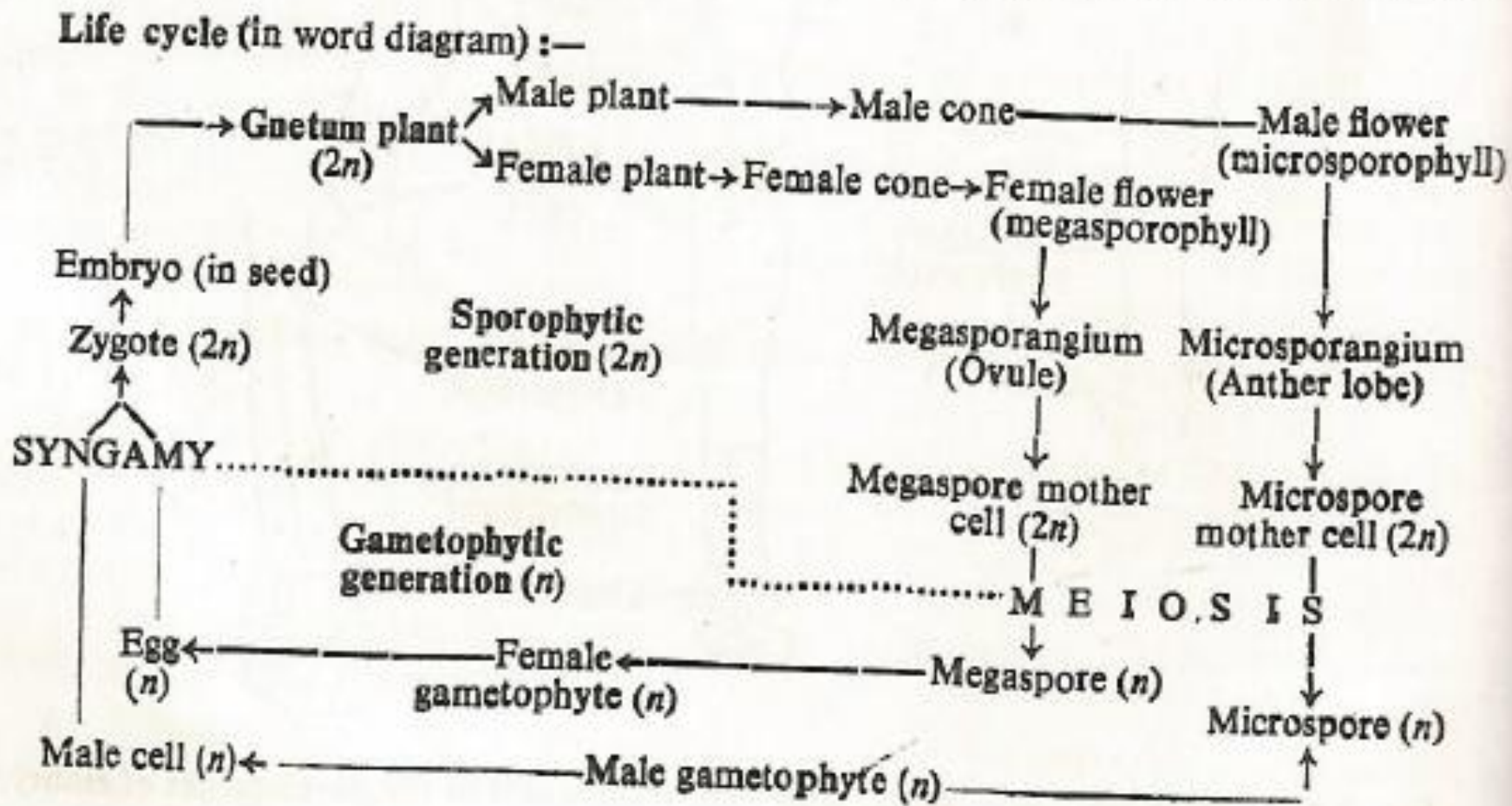


Fig. 3.34—*Gnetum* sp. A—Bunch of seeds. B—L.s. of the seed showing different parts.

Life cycle



- Thanks