**Reproduction of *Cycas***

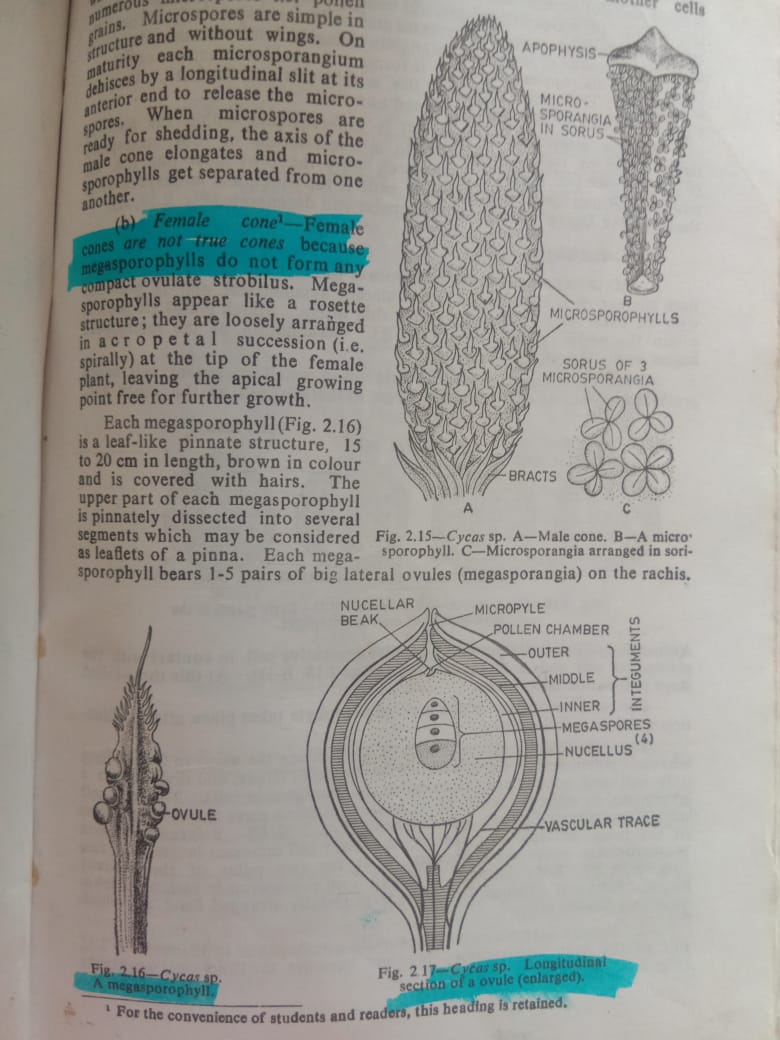
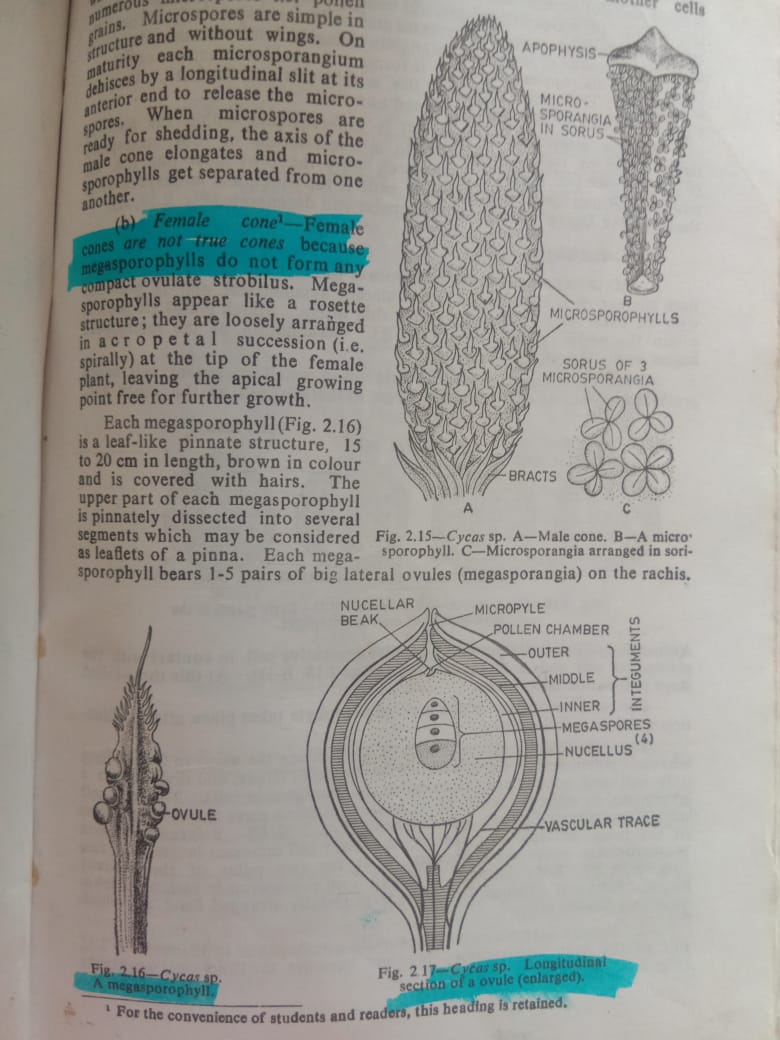
Vegetative reproduction takes place by the help of adventitious buds or bulbils, which commoly arise on trunk.

Cycas plants are dioecious as the male and female flowers (reproductive structure) occur on different plants. Flowers are unisexual and simple, male flowers are represented by microsporophylls (stamens) and female by megaspporophylls (carpels), only microsporophylls are arranged in clusters forming compact cones i.e. strobili. The megasporophylls are loosely arranged and therefore no compact cone formation occurs.

**Male cone**

Male cone is compact structure, cylindrical or ovoid in form and woody in texture. Each cone is very large and upto 50 cm in length. The cone develops singly or a few at the growing apex of the stem but it becomes lateral in position by the growth of lateral bud.

Each cone consists of a central axis upon which several microsporophylls are compactly and spirally arranged in acropetal succession. Each microsporophylls measuring about 3-5 cm long and 12-23 mm wide, is a flattened and wedge-shaped woody structure. The basal narrow part is sterile while the flat distal portion is fertile. Beyond the fertile part of the microsporophylls, there is an expanded sterile part, often called ***apophysis***. On the under surface (i.e. abaxial surface) of the fertile portion numerous microsporangia (pollen sacs or one-lobed anthers) are borne in groups, i.e. in sori. Each sorus contains 3-6 microsporangia. The development of microsporangia is of eusporangiate type. Microsporangia are intermingled with hairs. Each microsporangium is almost sessile, unilocular, oval, sac-like structure. Microsporangium is provided with a multilayered jacket i.e. wall and a tapetum enclosing numerous microspores mother cells which by reduction division form numerous microspores i.e. pollen grains. Microspores are simple in structure and without wings. On maturity each microsporangium dehisces by a longitudinal slit at its anterior end to release the microspores. When microspores are ready for shedding, the axis of the male cone elongates and microsporophylls get separated from one another.

**Female cone**

Female cone are not true cones because megasporophylls do not form any compact ovulate strobilus. Megasporophylls appear like a rosette structure, they are loosly arranged in acropetal succession (i.e. spirally) at the tip of the female plant, leaving the apical growing point free for the further growth.

Each megasporophylls is a leaf-like pinnate structure, 15 -20 cm in length, brown in colour and is covered with hairs. The upper part of each megasporophylls is pinnately dissected into several segments which may be considered as leaflets of pinna. Each megasporophyll bears 1-5 pairs of big lateral ovules (megasporangia) on the rachis.

Each megasporangium i.e. ovule is orthosporous and becomes very large, measuring about 6 cm in length. A mature ovule consists of a massive nucellus surrounded by a thich integument. The integument is three layered e.g. a) outer flesy layer, b) middle stony layer and c) inner flesy layer, often called *sarcotesta*, *sclerotesta* and *endotesta* respectively. The well developed nucellus of the megasporangium remains fused with the integument except at the micropylar end where it forms a beak like structure called nucellar beak. The pollen chamber lies in the nucellar-beak. Vascular supply is noted both in integuments and nucellus.

A single megaspore mother cell is differentiated within the nucellus tissue, which by meiosis gives rise to a linear –tetrad of four megaspores. Out of the four megaspores, only the lowermost one (i.e. the megaspore facing towards the chalazal end) in the functional megaspore while the rest three facing towards micropylar degenerate.

**Pollination**

Pollen grains i.e. microspores are liberated from the microsporangia at the 3-celled stage. In *Cycas* the pollination is anemophilous (wind pollinated). Pollen grains are carried to the pollen chamber of the ovule by wind. At the time of pollination, a drop of mucilage called pollination drop oozes out at the micropylar end of the ovule. The pollen grains which are floating in the air are caught in this drop. As the drops dries up the pollen grains are drawn into the pollen chamber, then due to the further drying up of the pollination drop the pollen chamber is closed.

At the time of pollination pollen grains are directly deposited on the nucellus of the female gametophyte.

**Fertilization**

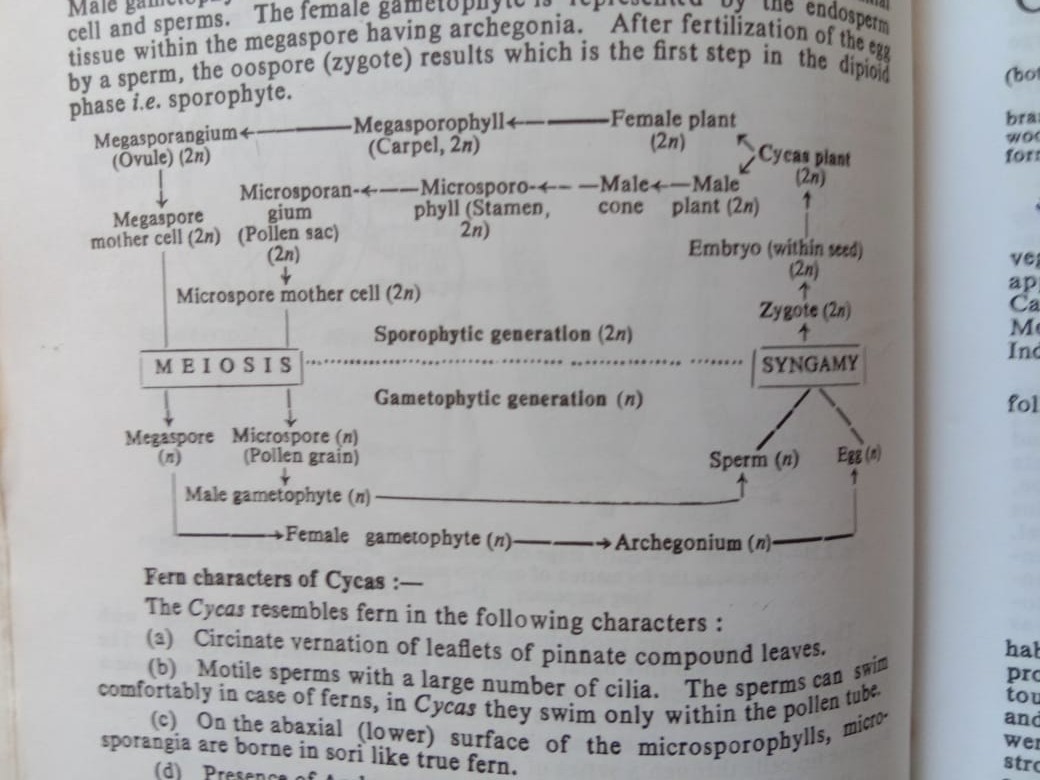
Pollen tube grows towards the archegonium of the female gametophyte. There the end of the pollen tube bursts and discharges its contents into the archegonial chamber. Then motile male cells i.e. sperms swims towards the neck of the archgonium and make their way down to the egg cell. One of the sperms fuses with the egg nucleus i.e. oosphere as a result diplod oospore i.e. **zygote** (***2n***) develops.

**Embryo and seed**

After fertilization the zygote enlarges and its nucleus divides by free nuclear division. In *Cycas*, the embryo is formed from a cellular part of the chalazal end, thus this structure is called proembryo but not an embryo. The mature embryo is straight.

The mature seed of *Cycas* is fleshy, red or orange-brown in colour. The seed is enclosed by a thick seed coat formed from the integument. The straight embryo and the endosperm remain within the testa. The sweet testa and pleasant odour attract birds which helps in dispersal of seeds. The seeds fall to the ground and eventually germinates into a seedlings (young *Cycas* plant).

**Life cycle**- *Cycas* shows a distinctalteration of diploid i.e. sporophytic and haploid gametophytic generations. Plant body represents sporophytic generation while gametophytes (male and female) are very much reduced. Male gametophyte is represented by the pollen tube with persistent prothallial cell and sperms. The female gametophyte is represented by the endosperm tissue within the megaspore having archegonia, the female sex organ. After fertilization of the egg by a sperm, the oospore (zygote) results, which is the first step in the diploid phase i.e. sporophyte.



**Xerophytic characters of *Cycas* leaf**

The xerophytic adaptive feature of cycas leaves are

1. Tough, leathery texture of leaf
2. Strongly cutinized thick walled epidermal layer
3. Greatly thickened hypodermis on both upper and lower epidermis
4. Presence of sunken stomata on the lower epidermis
5. Presence of primary and secondary transfusion tissues.

**Fern characters of *Cycas***

The *Cycas* resembles fern in the following characters

1. Circinate vernation of leaflets of pinnate compound leaves.
2. Motile sperms with larger number of cilia. The sperm can swim comfortably in case of ferns, in *Cycas* they swim only within the pollen tube
3. On abaxial (lower) surface of the microsporophylls, microsporangia are borne in sori like true fern.
4. Presence of archegonia in the female gametophyte.

**Economic Importance**

Leaves of *Cycas* used in making mats. The young succulent shoot and seeds are cooked as vegetables by the people of Assam, Malaya, Indonesia etc. In Japan a type of starch is prepared from the trunk of the *Cycas* plant, this trunk is sold in market as ‘Sago’. Sago can also be obtained from the seeds which contain about 31% starch. In Malabar the flour of seeds known as ‘Indum podi’ is used in the preparation of cakes and porridges. Besides, various species of *Cycas* are planted in gardens for their ornamental value.