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PG - SEM I

26 JANUARY WEDNESDAY

WEEK - 05

FOSSIL CYCADALES.

Introduction: In comparison to the living genera of cycadales the fossil cycads are less in number and therefore have occupied comparatively a small amount of literature. The common fossil Paleocycas integer was described by Florin (1933) from upper Triassic rocks of Sweden. There is ample evidence that true cycads existed contemporaneously with the cycadeoids during the Mesozoic.

Classification:

Sporne (1965) has grouped the fossil cycads in a family - Nilssoniaceae of the order cycadales. But Paleocycas has been kept in cycadaceae.

Nilssoniaceae

- leaves - Nilssonia, Ctenis, Pseudoctenis
- seed bearing organs - Beania.
- Pollen bearing organs - Androstrobus

Cycadaceae

- leaves Bjuvia - Palaeocycas

Foliage of the Fossil cycadales.

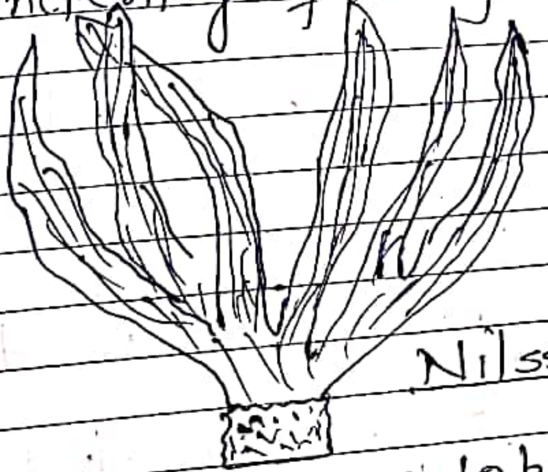
[A] Nilssoniaceae:

Nilssonia: (i) This genus is similar to Pterophyllum (Bennittitales) but the lamina is attached to the upper surface of the rachis.

(ii) Broadly linear up to 40 cm long and 9 cm width.

(iii) Lamina cut in an irregular fashion into (truncate segments) with parallel veins at right angles to the rachis. In some forms the lamina is entire. In some specimens the leaf is dissected only in the upper portion with the lower part entire.

(iv) A ring of subsidiary cells that originated independently of the guard cells.



Nilssonia tenuinervis

(V) Nilssonia appears to be the leaf of a Cycadaceous plant that staminate cones of the Androstrobus type and carpelate cones known as Beania.

(vi) The epidermal structure of the leaf is of the simple type agreeing with the cycadales, Ginkgoales and coniferales.

Ctenis

(i) The leaves assigned to this genus resemble those of recent cycads in that there is a strong rachis bearing broadly attached pinnae with parallel or nearly parallel veins.

(ii) Several veins enter the base of the pinna from the rachis and a characteristic feature is the occurrance of occasional cross connections between them.

(iii) In some species the walls of the epidermal cells are wavy.

Pseudoctenis resembles Ctenis but differ in the ... connections.

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(ii) It agrees microscopically with Pterophyllum
(iii) The stomata are of the Nilssonia type, although in Pseudoctenis spectabilis they are often transversely oriented.

Doratophyllum

(i) This genus has been segregated from Taeniopteris on account of the Cycadean type of stomata present.
(ii) The leaf is oblong-lanceolate and the lamina arises from the sides of the mid-rib distinguish-ing it from Nilssonia.
(iii) The veins fork occasionally. ~~however~~
(iv) Doratophyllum is known only from Sweden and Eastern Greenland.

Macrotaeniopteris

(i) This genus possess non-Bennettitalean epidermal cells and stomata.
(ii) Its main characteristic is its size.
(iii) The leaf is long-obovate with an entire margin. Some leaves are as much as 33 cm broad. but complete leaves are seldom if ever found.
(iv) Restorations of Macrotaeniopteris magnifoliage from the Triassic of Pennsylvania show a group of simple leaves arising from ground presumably attached to a rhizome some attached a height of approximately 1 meter.

[B] Cycadaceae

Paleocycas

(i) The leaf genus of this fossil cycad is known as Bjuvia ~~simplex~~ simplex.

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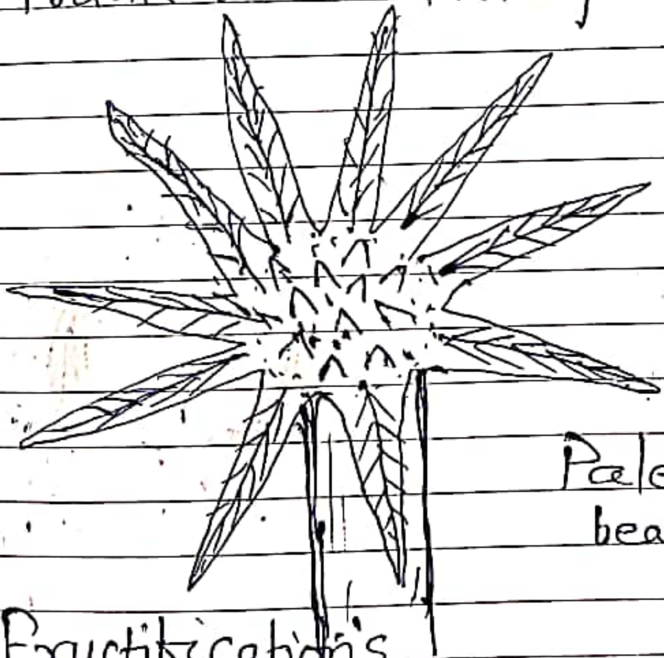
(II) The leaves were large, about 1 metre long & 20 cm broad and had a simple lamina rather like that of a banana.

(III) The leaves were arranged in a crown at the apex of a stout trunk with a loose aggregation of seed bearing structures in the centre. According to Harris, the manner in which the leaves were borne on the trunk is not known because the trunk is completely unknown.



Paleocycas integer bearing leaves (Bjuvia simplex)

Fructifications

There are several mesozoic cone types that have been attributed to the cycadales. Some important ones are as follows:

Androstrobus

(I) This cone genus had long been suspected as being the staminate fructification of some unidentified Mesozoic cycad, but it is satisfactorily proved after the discovery of some additional specimens eg- Androstrobus manis, Androstrobus wonnacottii.

(II) A. manis is a cone about 5 cm long and 2 cm in diameter.

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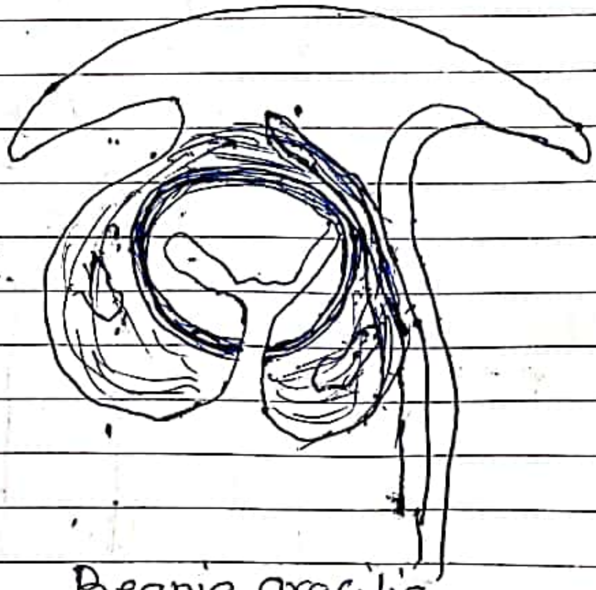
(iii) The spirally arranged microsporophylls consists of a horizontal portion which widens rapidly from the point of attachment and a distal part which forms a broad rhomboidal scale.

(iv) The fairly large, finger shaped microsporangia are attached to the lower surface and appear to be arranged in cluster. with the dehiscence apertures facing each other.

(v) The Pollen grains are oval which are about 36 by 26 microns in length and breath respective

Reconstruction of Androstrobus manis.



Beania gracilis.
L.S. of megasporophyll & ovule.

(VI) Androstrobus wannacotti is similar to A. manis the essential differences being its smaller size and the square rather than rhomboidal terminal bract of the microsporophyll.

(VII) Recent investigation have demonstrated the remain of Pollen grains inside the micropyle.

Resemblance with Staminate cones of recent cycads:

(i) General structure Plan.
(ii) Thick wall of the microsporangia
(iii) Presence of cuticle lining the inner Cavity.
(iv) The stomata on the microsporophylls are ~~clear~~ characteristically cycadean.

Beania

(i) The structure of this ovulate cone is Clearly revealed in some recently discovered specimen of Beania gracilis from Jurrasic of Yorkshire.

(ii) The cone is a loose spike that some times attained a length of 10 cm.
(iii) The seed stalks are spirally arranged at right angles to the axis.
(iv) The apex is peltate and on the surface facing the axis are two sessile seeds on each side of the stalk.
(v) The seeds are oval and the largest ones measure about 13 by 16 mm.
(vi) The micropyle is directed away from the base
(vii) The nucellus is surrounded by a two layered integument, the inner one being sclerotic and the outer fleshy.
(viii) There are present a few resin lumps in the fleshy layer of the integument which is a feature not in common with recent cycads.

Affinity - The peltate carpel suggests affinity with Zamia group of recent cycads but in loose structure of the cone is different from any modern genus.

M.Sc.
SEM-II
Dr. Satish (Botany)

MICROSPOROPHYLL AND MICROSPOROGENESIS

The stamens or microsporophylls are the male organs of the flower.

Each stamen consists of three parts; filament, anther and connective.

The filament is the slender stalk of the stamen and the anther is the expanded head borne at the tip of the filament.

Each anther consists of two lobes connected together by a sort of midrib known as connective.

Each lobe of the anther contains two pollensacs or microsporangia. Thus there are four chambers in each anther.

But in many cases there are only two and sometimes even only one.

Within the each pollen-sac or microsporangia shows granular mass of cells called the pollengrains or microspores.

DEVELOPMENT OF STAMEN

During the development of stamen, there is growth in length, width and thickness.

Early development takes place by apical and marginal meristems.

The stamen primordium develops as a crescent shaped projection on the surface of the thalamus.

As the primordium increases in size, the bulging areas show the position of the sporangia.

Anther and microsporangium (Pollensac).

The cross-section of a young anther consists of a homogeneous mass of meristematic cells surrounded by an epidermal layer.

Further growth of the anther makes it four lobed.

Development of microsporangium:

In each lobe a few cells in the hypodermal region becomes differentiated by their large size.

The make the archesporium. There is much variation in the no. of cells of archesporium.

The archesporium consists of two or three cells

The microsporangial initials or the archesporial cells divide periclinally forming a Parietal layer and a Primary sporogenous layer.

The cells of the Primary Parietal layer lying beneath the epidermis divide repeatedly both Periclinally and anticlinally giving rise to three to five concentric layers forming the wall of the young sporangium.

The cells of the Primary Sporogenous layer may either function directly as Pollen mother cell or divide to form a large no. of cells.

The epidermis along with 3 to 5 layers derived from the Primary Parietal layer form the wall of the Sporangium. The cells of the epidermis divides anticlinally only.

The layer next to the epidermis is the endothecium. became radially elongated and form their inner tangential walls. and fibrous bands develop upwards and terminate near the outer wall.

By the development of the fibrous bands of thickening the endothecium becomes hygroscopic and is mainly responsible for the dehiscence of the mature anther.

The cells of the endothecium are thin walled along the line of dehiscence of each anther lobe.

Pollen grains are discharged from the Pollen sacs is called stomium.

On the maturity of the anther a strain is exerted on the stomium due to the loss of water by the cells of the endothecium, with the result the stomium ruptures and the anther dehisces.

Tapetum:

The innermost layer of the wall layers develops into a single layered tapetum.

The cells of the tapetal layer have dense cytoplasm and conspicuous nuclei.

The tapetal nuclei may divide once or more.

The tapetal layer is of great Physiological significance since all the food material entering into the sporogenous tissue diffuse through this layer.

Ultimately the cells of the tapetal layer disorganise.

The tapetum plays an important role in the development of Pollen. They generally stores starch and proteins which are used for the development of Pollen.

Tapetum also transports the nutrients to the inside of the anther locule.

Sporogenous tissue:

The Primary Sporogenous layer cells give rise to the microspore mother cells or Pollen mother cells.

The Sporogenous cells in normal way divide several times meiotically before functioning as Pollen mother cells.

In the beginning of their formation the microspore mother cells remain closely Packed but as the anther enlarges in size, the Pollen sac also increases in size. So the microspore mother cells also enlarge in size, become spherical in shape and get loosely arranged.

Some of the Sporogenous cells are non functional and serve as the food material for the functional microspore mother cells.

MICROSPOROGENESIS:

The microspore mother cells become rounded and loosely arranged.

Although all the mother cells are capable of giving rise to Pollen grains but some of them may degenerate and serve as food material for the remaining cells which give rise to Pollen grains.

Each functional spore mother cell ... microspores or Pollen ...

CARPEL OR MEGASPOROPHYLL AND MEGASPOROGENESIS

Gynoecium or Pistil ~~or carpel~~ is female reproductive whorl of the flower.

It is composed of one or more carpels.

The carpels are modified leaves which bear the ovule and also called the Megasporophylls.

When the Pistil consists of only one carpel, it is known as Simple and when it consists of two or more carpels, the pistil is said to be compound.

The compound pistil may be apocarpous (free carpel) or syncarpous (United carpels)

Each carpel consists of three parts - stigma, style and ovary.

The stigma is the terminal end of the style on which pollen grains fall and is generally knob like and sticky.

The style is the selender projection of the ovary. The surface of the style is smooth or hairy.

The swollen basal part of the pistil which is single and many chambered is known as ovary.

The ovary contains one or more oval egg like bodies known as ovules.

Each ovule contains a large oval cell known as Embryo sac.

The ovary give rise to fruit and ovules to the seeds.

MEGASPORANGIUM:

An ovule or Megasporangium develops from the base of the ovary.

It is generally oval structure and consists of a central mass of tissue, the nucellus or one or two integuments

Each ovule is attached in the Placenta by a small stalk called the funiculus

The place of attachment of the stalk with the main body of the ovule is called hilum.

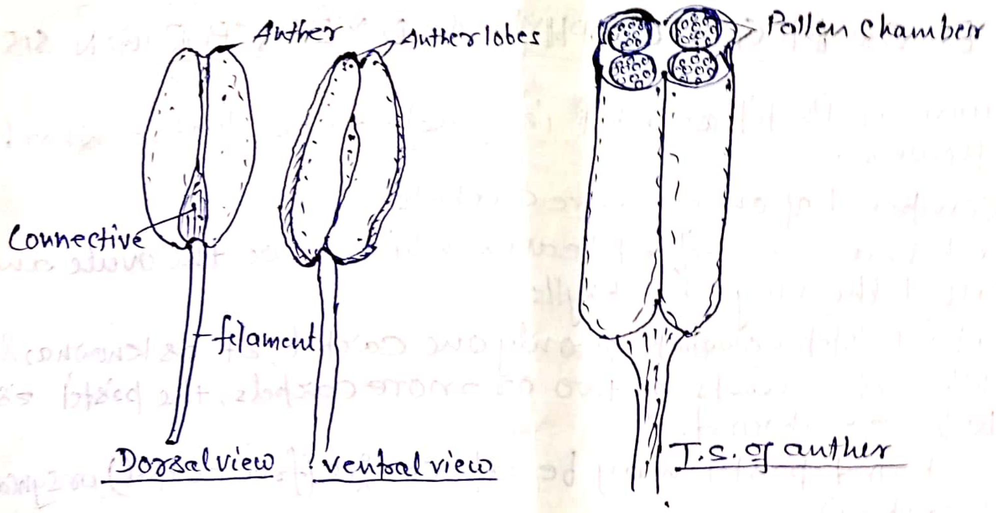
The nucellus makes the main body of the ovule which is made up of Parenchyma tissue.

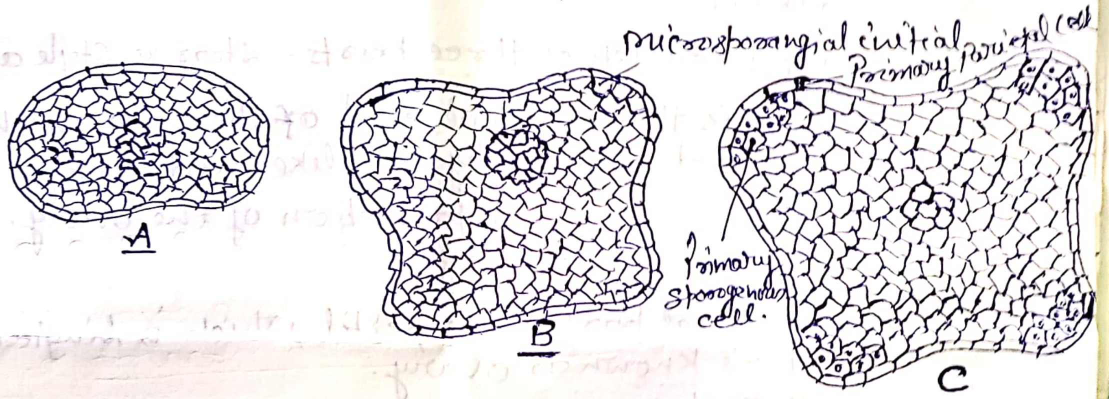
A small opening is left at the apex of the integuments; this is called micropyle.

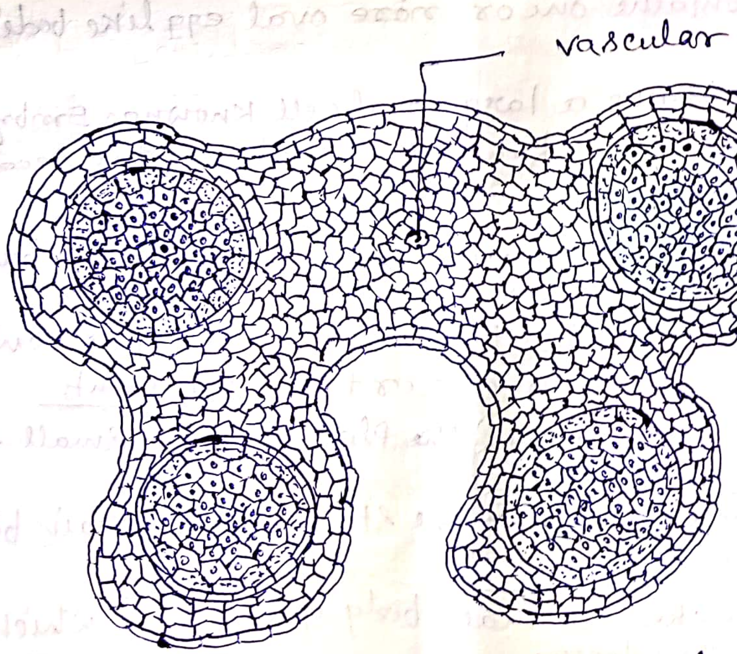
A large oval cell lying embedded in the nucellus towards the micropylar end is the embryo-sac. This makes the most important part of the mature ovule which bears the

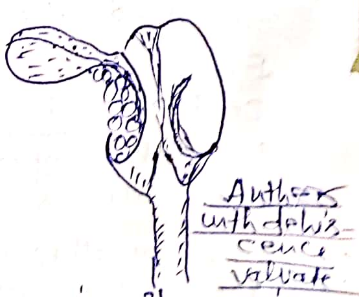
Embryo later on.

The nucleus of ...

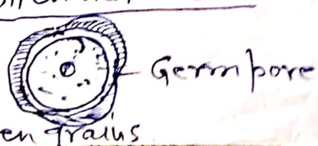








Various stages of the development of microsporangium (Pollen sac) Up to the formation of Pollen mother cells.



... may become functional. In ...

... haustoria like lateral tubes.

The nucleus of each spore mother cell devides twice to form four nuclei, the first division being being the reductional one (i.e meiosis I) and the second division being the ordinary mitotic one (i.e Meiosis II).

Dehiscence of the anther

When the pollen grains mature, they exert some pressure from within on the wall, with the result the anther bursts and sets free the pollen grains.

The dehiscence of anther takes place in four different ways:

Longitudinal, Transverse, Porous, valvular.

Dehiscence of microsporangium:

On the maturation of the anther the middle layers and the tapetum disorganise.

Then the fully developed sporangial wall consists of epidermis and endothelium.

The sterile partition wall between the two pollen sacs disintegrates and the two pollen sacs unite together forming one compartment.

The pollen grains or microspores are released out generally through the stomium.

The Pollen grains

The pollen grains are the male reproductive bodies of a flower, and are contained in the microsporangia

They are minute in size.

Each pollen grain consists of a single cell, possessing two coats - the exine and the intine.

The exine which is provided with spinous out growth and smooth. While the intine is a thin, delicate, layer lying internal to the exine.

The exine possess one or more thin places known as Germ pores.

The pollen tubes make their way through these germ pores when the pollen grains germinate.

The pollen grains germinate on the stigma and each form a slender tube called pollen tube which elongates through the tissue of the Gynoecium carrying the two male gametes in it.

Archesporium and Megaspore formation:

- The archesporium is hypodermal in origin.
- At early stage in the development of the ovule (usually at the time of the initiation of the integumentary primordia) some single cell becomes differentiated at the apex of the nucellus known as Primary archesporal cell.
- It can be distinguished from other neighbouring cells owing to its large size, deeply staining nucleus and dense cytoplasm.
- This primary archesporal cell divides periclinally forming an outer Primary Parietal cell and inner primary sporogenous cell.
- The Primary Parietal cell may divide further several times both by anticlinal and Periclinal divisions forming a variable amount of Parietal tissue.
- The Primary sporogenous cell usually does not divide further and function directly as the megaspore mother cell.
- usually the megaspore mother cell divides meiotically forming a tetrad of four megaspores.
- This usual process of meiotic division is termed as megasporogenesis
- The four megaspores thus formed in an axial row within the nucellus forming a linear tetrad.
- Some times the tetrad may be T-shaped, (inverted, or decussate), Tetrahedral or isobilateral.
- Of the four megaspores, the three upper ones degenerate and appear as dark caps. while the lowest one behave as the functional megaspore.
- The functional megaspore give rise to Embryosac

The other three degenerating megaspores and the neighbouring cells of nucellus absorb.

In certain plants all or any of the four megaspores of tetrad may become functional. In still other cases the megaspore give rise to haustoria like lateral tubes.

Development of ovule:

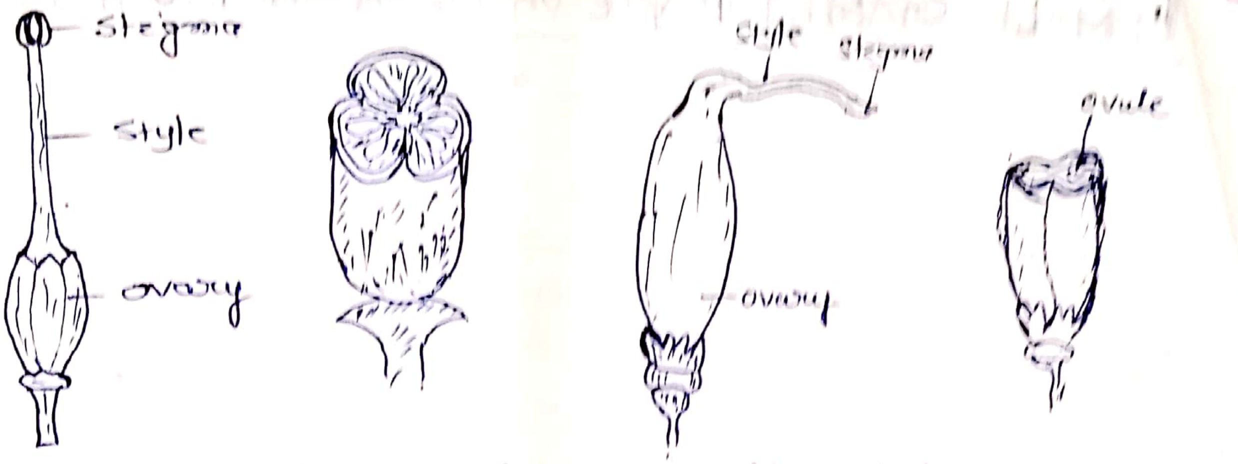
The ovule primordium appears as a small protuberance on surface of the Placenta.
It grows rapidly and develops into a prominent conical structure with rounded tip.
This rounded tip is the forerunner of the nucellus.
It gradually develops into a projecting mass of tissue by the growth and division of its cells.
As the development continues either one or two layers of the tissue develops from the base of the nucellus forming the integuments.
The inner integument developed first and thereafter the outer one develops.
The growth of the integuments is much faster than the nucellus and thus they completely enclose the nucellus except for a narrow opening, the micropyle.
On the basis of the relative position of the micropyle, chalaza and funiculus the mature ovule can be categorized as.
(i) orthotropous or straight
(ii) Anatropous or inverted
(iii) Amphitropous or transverse
(iv) Hemitropous
(v) Campylotropous or curved
(vi) Circinotropous.

Placentation:

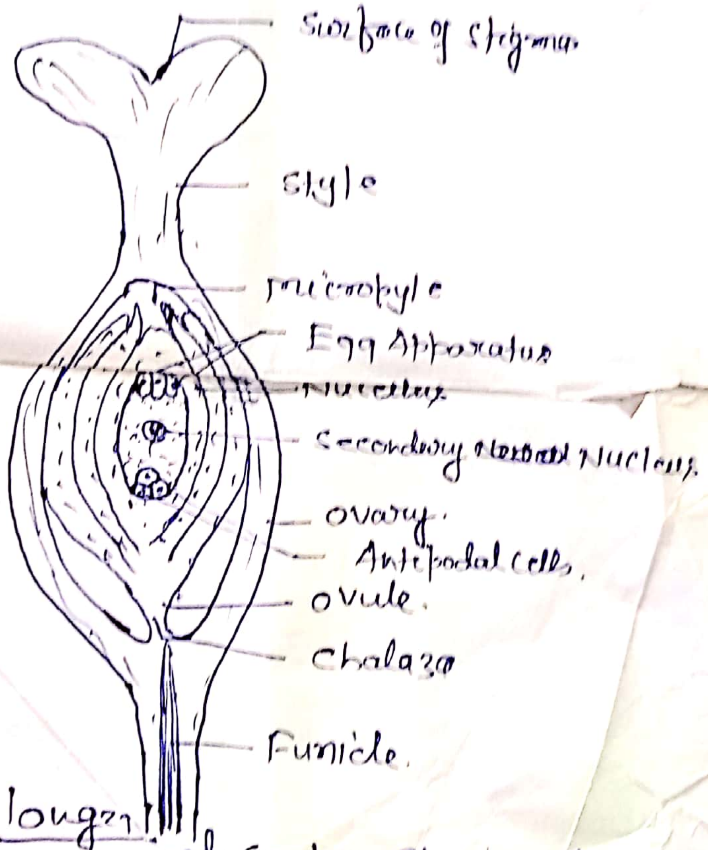
The Placenta is an outgrowth of Parenchymatous tissue in the inner wall of the ovary to which the ovule remain attached.
The Placentae usually develop on the margins of carpels.
The manner in which the Placentae are distributed in the cavity of ovary is known as Placentation.
The origin of an ovule determines the position of the Placenta.
According to Eams (1968) defines that the pattern of ovule arrangement on the carpel constitutes Placentation.

Types of Placentation:

In the simple ovary (one carpel) there is one common type of Placentation known as Marginal.
And in the compound ovary (two or more carpels united together) Placentation may be axile, Parietal, and free central, basal and superficial.



Tricarpellary (syncarpous)   Monocarpellary (apocarpous)



longi... section showing different part of ovule