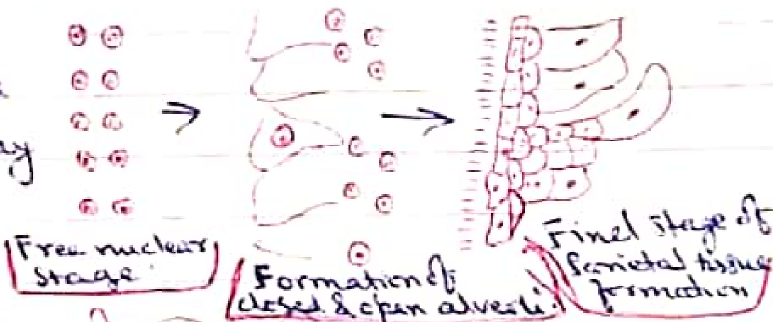
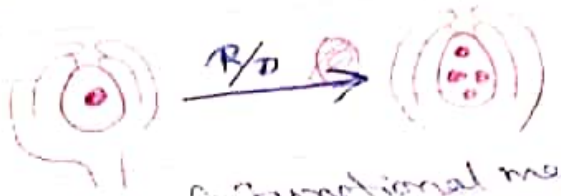
A/c to them at the end of the free nuclear period each of the peripheral nuclei becomes connected by means of secondary spindles. Anticlinal walls then begin to develop centripetally resulting the formation of cell called '<u>Alveoli</u>'. Each alveolus is hexagonal with the inner wall remains open. The ♀ gametophyte at this stage looks like a honey comb, each cavity representing a single alveolus. As the tubular alveoli extend towards the centre of the gametophyte many of them become closed by the devt. of an oblique wall. This triangular cell termed '<u>precociously</u>' closed alveoli by <u>Maheshwari & Singh</u>. The triangular cell as well as the other open alveoli by means of repeated periclinal division from rows of radially arranged cells. As the young cellular gametophytes increases in volume, anticlinal division also occur & the previous regular arrangement of files of cells is lost.

While in majority of gymnosperm parietal tissue is formed in the above way & the ♀ gametophyte is cellular the devt of ♀ gametophyte is distinctive in <u>Welwitschia</u> & <u>Gnetum</u>. In <u>Welwitschia</u> group of nuclei become isolated into compartments by wall formation where as in <u>Gnetum</u> the upper (ie micropylar) end of the gametophyte remains in the free nuclear phase & lies above a basal cellular zone.



<u>Formation of Archegonia</u> :→

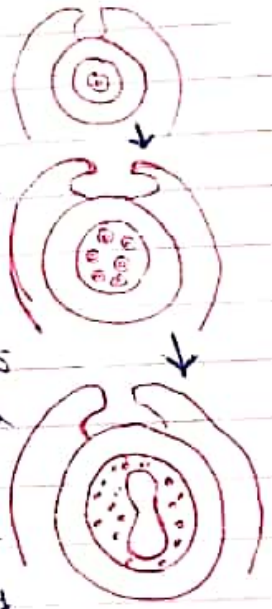
In Gnetum & Welwitschia the meiotic division in the megasporocyte yield four free haploid nuclei forming a coenomegaspore & the 4 nuclei are functional.



Thus in the formation of functional megaspore it is apparent that while the 4 gametophyte of most gymnosperms exhibit a monosporic development those of Gnetum & Welwitschia shows a tetrasporic development like some of Angiosperms.

Free nuclear division:-

The functional megaspore first undergoes an overall enlargement followed by a series of synchronised free nuclear divisions. Numerous nuclei that are formed during this stage in dev. became arranged in the peripheral layer of cytoplasm due to the formation of a large central vacuole.



The no. of free nuclei developed during this step is extremely variable in the different groups of gymnosperm. Even in the same genus considerable variations is noted. The minimum nuclei formation so far reported takes place in Taxus baccata (128) & maximum in Ginkgo-biloba (8,000).

Parietal tissue formation:-

The method of formation of tissue from the coenocitic stage developed as a result of free nuclear division appears to be more or less uniform as mentioned by Maheshwary & Singh (1967).

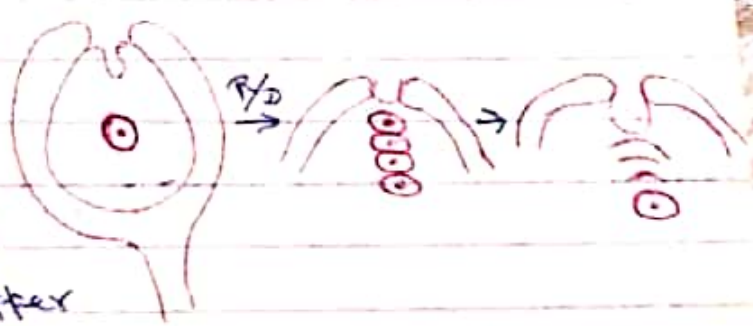
Female Gametophyte in Gymnosperm

The female gametophyte of gymnosperm initiate with the formation of megaspore by the reduction division of megaspore mother cell within the megasporangium. Further development of the gametophyte taken place within the megaspore wall inside the megasporangium. Thus the female gametophyte of gymnosperm is completely endoscopic in nature & completes its dev. & retain permanently within the megasporangium.

The general pattern of dev. is more or less uniform in the diff. groups of gymnosperm & exhibits commonness in free nuclear division of the megaspore nucleus, formation of perietal tissue & final growth of the gametophyte with the formation of egg cells mostly inside the archegonium. The details of the formation along with significant variations are as follows: —

Formation of Functional megaspore :-

In most gymnosperm a single megaspore mother cell develops within the nucellus of ovule which undergoes meiotic to form a linear tetrad. The three upper megaspore degenerate & the lowermost megaspore enlarges & becomes the functional megaspore.



Maheshwari & Singh (1967) reported that a row of three rather than four cells is produced during megasporogenesis in some cycad genera. In this case the uppermost cell in the series is an undivided dyad cell and the two cells below it are megaspores derived from the division of the lower dyad cell. However in such cases also the lowermost megaspore is functional &

The extreme stage in this progressive series of changes among gymnosperm is illustrated by Gnetum in which eggs are matured at the stage of free nuclear division, a cond^n. very much akin to that found ~~in~~ in Angiosperm.

② Elimination of ventral canal cell:-

The gymnosperms are distinguished from pteridophyte by the complete elimination of neck canal cells & this tendencies to supress all of the axial row except the egg continues among gymnosperm, thus the general tendencies of archegonia among gymnosperm is to eliminate the ventral canal cell.

A distinctly walled ventral canal cell is found only among the members of Pinaceae & Ginkgo. In other form the wall has disappeared & the ventral canal cell is represented by a free nucleus. In certain forms even this nucleus may disappeared & of course there is no trace of it when the archegonia are eliminated.

CONCLUSION:-

By the evalution of above discussion, conclusion may be drawin that archegonia in gymnosperm is hynerygms of pistil of angiosperms. Although, developmental pattern of female gametophyte are more or less same in gymnosperms & angiosperms. The development of gametophytes in gymnosperms plants vary significantly.

Among the Gametophyte archegonia develop only in Ephedra. The female gametophyte tissue of Ephedra is differentiated into a micropylar region with large elongated prothallial cells. Archegonia develop in the micropylar region whereas as the chalazal region acts as food storage zone. The no of archegonia may be 1 or 2. as in E. britannica 3 in E. foliata, 3-4 in E. geradiana.

Evolutionary tendencies in the ♀ Gametophyte

The ♀ gametophyte of gymnosperm exhibits a progressive series of changes which is significant because it leads towards the Angiospermic cond". The general dev. pattern of the ♀ gametophyte of gymnosperm is quite uniform & resemble very much to that occurs in heterosporous pteridophyte. In both the groups the sequence of events in the dev. process is more or less same. The only difference is in orientation, maturation & structure of sex organs. In these characters different groups of gymnosperm exhibit evolutionary trends in following directions:—

(1) Early maturation of eggs:

The general tendencies which run through gymnosperm as a whole is to mature the eggs earlier & earlier in the ontogeny of gametophyte. In the most primitive cond" of gametophyte as in the case of Cycadales & Ginkgoales the eggs do not appear until the endosperm is nearly full grown. Among the Coniferales similar cond". prevails in Cephalotaxaceae. most advanced cond". in this regard is exhibited by Taxus where the archegonium initial is differentiated as soon as wall formation has taken place. The next stage is illustrated [illegible] in which eggs are

Certain individual superficial cell of the gametophyte usually those near its micropylar end, gives rise to archegonia. However in Gnetum & Welwitschia the archegonia formation is completely suppressed. In Gnetum one or more of the free nuclei at the micropylar end of the female gametophyte function as female gamete. In Welwitschia a few of the multinucleate cells at the micropylar end of the gametophyte develop long tubes termed archegonial sac tubes which grow upward & meet the downwardly growing tubes. The common wall at point of contact of archegonial sac tube & pollen tube each of 2 nuclei behaves as potential egg nucleus but one of them is fertilized by 1 gamete.

All living gymnosperm with the exception of Gnetum & Welwitschia are thus archegoniate plants.

No. & Position of archegonia:-

The no of archegonia formation is extremely variable in the diff. genera, even within the 2 or more species of gymnosperms.