Palynology

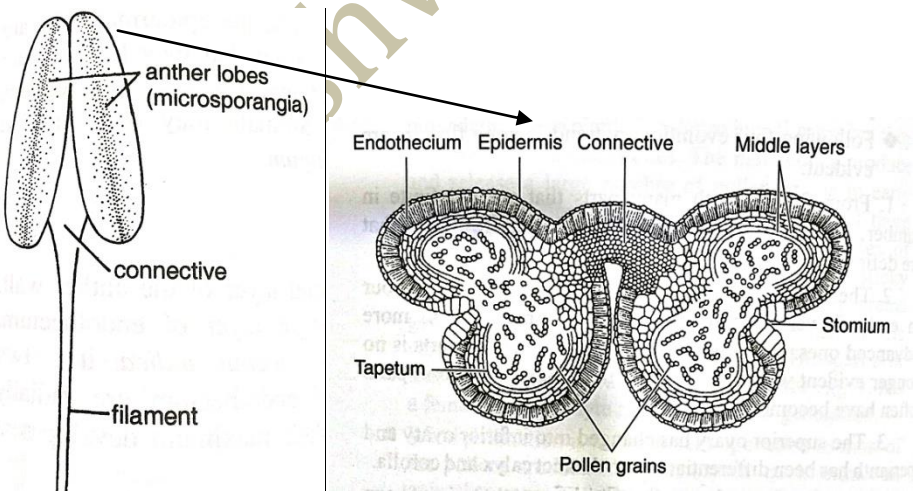
Palynology = (Greek meaning: Paluno= Dust, Logy= Study)

Study of pollen grains or microspores is called Palynology, a term given by **Hyde** and **Williams (1944).** Palynology is having following sub-branches:

1. **Geopalynology:** study of fossils pollen grains. eg. Pollens are used in finding age of rocks.
2. **Aeropalynology:** study of pollens found in air or atmosphere, pollens present in air cause different types of allergies like **hay fever** and **asthama** and are called Aeroallergens.
3. **Iatropalynology:** study of pollen in criminology and medical aspects, place of crime can be judged by study of microspores or pollens collected from dirt under shoes, clothes and nails etc.
4. **Melittopalynology:** study of pollens in honey, with the purpose of identifying the source plant used by bees in the production of honey.

In angiosperms, the main plant body is sporophyte (2n) which is differentiated in root, stem and leaves. In reproductive phase, flowers are produced; a typical flower is having 4 main parts (like Sepals, petals, stamens, carpels etc).

Androecium: it is male reproductive part of flower and its units are **Stamens**, a stamen is having anther, filament and connective as its parts. **Anther** is fertile part in which microspores or pollens are produced.



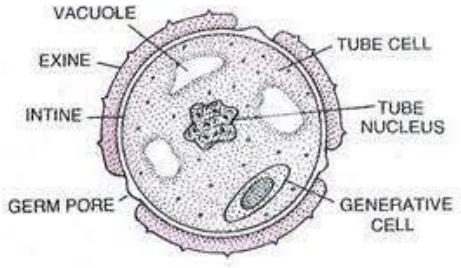
Stamen T.S. of Anther

- Pollen grains or microspores are formed inside anther, which is the fertile portion of stamen or microsporophyll and formation of microspores or pollen is called microsporogenesis.

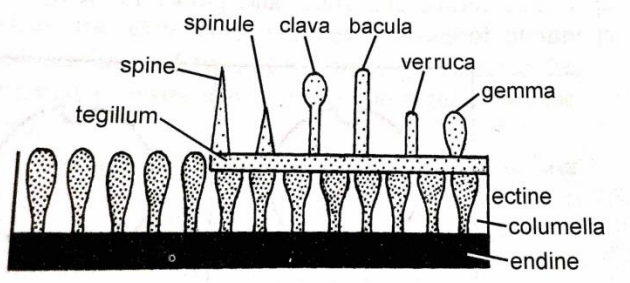
- Anther is having a column of sterile tissue called connective and on either side of this connective is a anther lobe.
- Each anther lobe is usually having 2 chambers or pollen sacs called **microsporangia** and thus generally there are 4 microsporangia per anther.
- Detailed structure of Anther in a T.S. shows the following Structure-
    1. Parietal layers or wall layers of anther
    2. Pollen chambers or microsporangia having sporogenous tissue or archesporial tissue.

Development

- Primary sporogenous cells give rise to **microspore mother cells** or pollen mother cell (MMC or PMC). Each MMC on reduction division gives to 4 microspores or pollens and this formation of pollens and its formation of microspore or pollens are called microsporogenesis.
- Each pollen is having a two layered wall. Outer layer is thick, tough, cuticularized called **Exine,** which is chiefly composed of a material called **Sporopollenin.** It is highly resistant to biological and physical decomposition (i.e., can withstand extreme environment conditions like temperature, acid, bases etc.) due to which pollens are preserved for a long time in fossils. The exine is heterogenous layer consisting of two distinct layers; outer layer is known as **sexine** and and inner **nexine**. Sexine is made of radially arranged rod like elements, the **columellae**; the upper fused parts of the columellae form a roof, known as **tectum** (tegillum). Inner layer is thin, delicate and smooth called **intine**, which is made of **Pectocellulose**.
- The pattern of sculpturing is often directly related to the distribution and arrangement of columellae in the sexine. A sexine without sculpturing (Smooth) said to be **psilate.** Some important sculpturing pattern are **reticulate** (net like), **foveolate** (pitted), **fossulate** (elongated grooves), **irregular pits** or vermiculate.
- In some species the exine bears outgrowths of various types. The exine with small and inconspicuous outgrowths is termed as **granulose**, with rod-shaped projections as **baculate**, club shaped projections as **clavate**, long conical spines as **spinulose** or with short spines as **spinululose.**



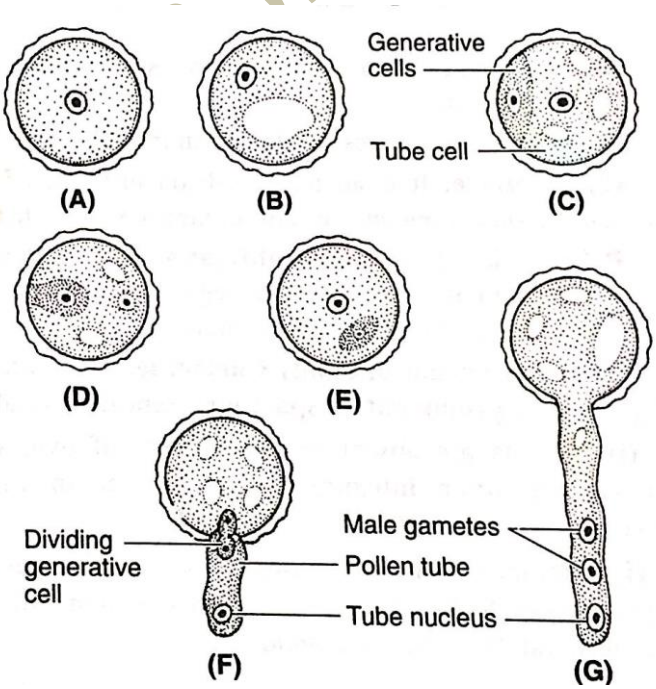
Structure of Pollen



Fine structure of Pollen wall

Development of male Gametophyte or Microgametogenesis or Pollen grains-

1. Microspore or pollen is the beginning (or first cell) of male gametophytic generation.
2. Development of male gametophyte is uniform in all angiosperms. Here, the microspore undergoes only two mitotic divisions and thus fully developed male gametophyte in angiosperms is very very simple and reduced i.e., only 3-nucleated structure and is dependent upon sporophyte.
3. Recently formed microspore is having dense cytoplasm without vacuoles and a centrally located haploid nucleus. As it matures, many small vacuoles develop in this cytoplasm which unites to form a large central vacuole, due to which nucleus is pushed to one side. Nucleus of microspore now divides mitotically in two nuclei, one is larger called **vegetative** or **tube nucleus** and second is smaller called **generative nucleus.** These two nuclei are now separated by wall and thus 2 cells are now formed separated by wall and thus 2 cells are now formed in a microspore, i.e., **smaller generative cell** and **larger vegetative cell**.
4. The pollen is shed from anther at this two celled stage i.e., pollination occurs at 2 celled stage of pollen.
5. The smaller generative cell now separates from the wall and becomes spindle-shaped which now lies freely in larger vegetative cell. This pollen with pollen tube (having 3 nuclei) is fully developed male gametophyte in angiosperms.



Stages in development of male gametophyte in Angiosperms

Pollen viability

Pollen viability refers to the ability of the pollen to perform its function of delivering male gametes to the embryo sac. This functional property of the pollen after their release from the anther varies greatly from species to species and its quality is assessed on the basis of its viability. Pollen viability is an index of its quality and vigour. Pollen viability varies between minutes and years, and which primarily depends on the taxonomic status of the plant and on the abiotic environmental conditions. In order to maintain the viability and fertilizing ability of the pollen for a long period of time special storage conditions are needed. Long lived pollen (six months to a year), eg- Ginkgoaceae, Pinaceae, Arecaceae, Saxifragaceae, Rosaceae, Fabaceae, Anacardiaceae, Vitaceae and Primulaceae. Pollen with a medium life span (approximately 1-3 months), eg- Liliaceae, Amaryllidaceae, Salicaceae, Ranunculaceae, Brassicaceae, Rutaceae, Scrophulariaceae, and Solanaceae. Short lived pollen (from few minutes to a couple of days), eg- Alismataceae, Poaceae, Cyperaceae, Commelinaceae and Juncaceae.

Factors affecting pollen viability-

- **Pollen Cytology:** There exists a close relation between the cytology of pollen and its viability. Studies on pollen morphology and physiology have shown that the binucleate and trinucleate pollen grains show differences in their physiological and structural characters at the time of pollen dispersal. The two celled pollen grains have a longer life span because of their more resistant wall structure, low plasma water content and reduced metabolic activity, whereas the trinucleate pollen grains are short-lived due to their less resistant wall and high moisture content, which can easily be lost by desiccation. This trinucleate pollen has a high rate of metabolism, respiring two to three times more than the binucleate pollen.

- **Humidity and temperature-** Pollen viability is greatly affected by temperature and Humidity. Grass pollen, for example, is very short lived and remains viable only for few minutes to few hours. Some species pollen viable for several years.

  Environmental factors especially humidity and temperature greatly affects pollen viability. This relationship have been investigated by many authors and it transpired that pollen of majority of the species retained viability best at low relative air humidities (0%-30% RH) and temperature (between 0 and 10 °C). In most of the cases it is possible to standardize the conditions (low temperature and/or low humidity) for extending pollen viability of two celled taxa.