Meristem

Specific area in plants, of more or less continuous cell or tissue initiation is called meristem. Cell or tissue initiation results in growth which can be manifested by (a) increase in no. of cells or (b) differentiation of cells into tissues. There are two types of cells, (i) Permanent -donot dividing & (ii) meristematic having capacity of division. A meristem constitute meristematic cells but it is important to note that "All meristem constitute meristematic cells". But all meristematic cells are not meristem".

For example the apices of stem & the cambium are the region of continuous tissue initiation, hence called meristem & constitute meristematic cells developing xylem & phloem are meristematic tissues, for they form some new cells & are mature but they are not meristem. Regular cells in mature tissue, such as primary cortex of stems may divide. Such cells are meristematic, but neither they nor the tissue, which they are a part constitute a meristem.

The cells of meristem differ from those of

2. Mass, Plate & rib meristem:- They are distinguished on the basis of planes of growth:-

Mass - growth in three planes. eg - zygote.
Plate - growth in two planes. eg - leaf epidermis.
Rib - growth in one plane - (also called file meristem).

(B) Based on history:-

1. Primary meristem.
2. Secondary meristem.

1. Primary meristem:- → Primary meristem are those that built up the fundamental part of the plant. It posses promeristem from embryonic stage. Example of this type are apices of stems & roots & primordia of leaves.

2. Secondary meristem:- → Secondary meristems arise as new meristems, in tissues which are not embryonic. The cork cambium is an example of secondary meristem. It adds to the plant body forming supplementary bodies.

(C) Based on position:-

1. Apical meristem.
2. Intercalary meristem.
3. Lateral meristem.

1. Apical meristem:- They lies at the apices of axis & of the appendages such as tips of roots & stems, & often of the leaves & are called growing points. It actively adds in the length of the organs growth is maintained by one or more apical initials which maintain their individuality & position & may be terminal or sub-terminal.

portion of apical meristem separated by layers of permanent tissues (Wardlow - 1952). They may be intercalal or basal in position - latter is become wholly transformed into permanent tissue.

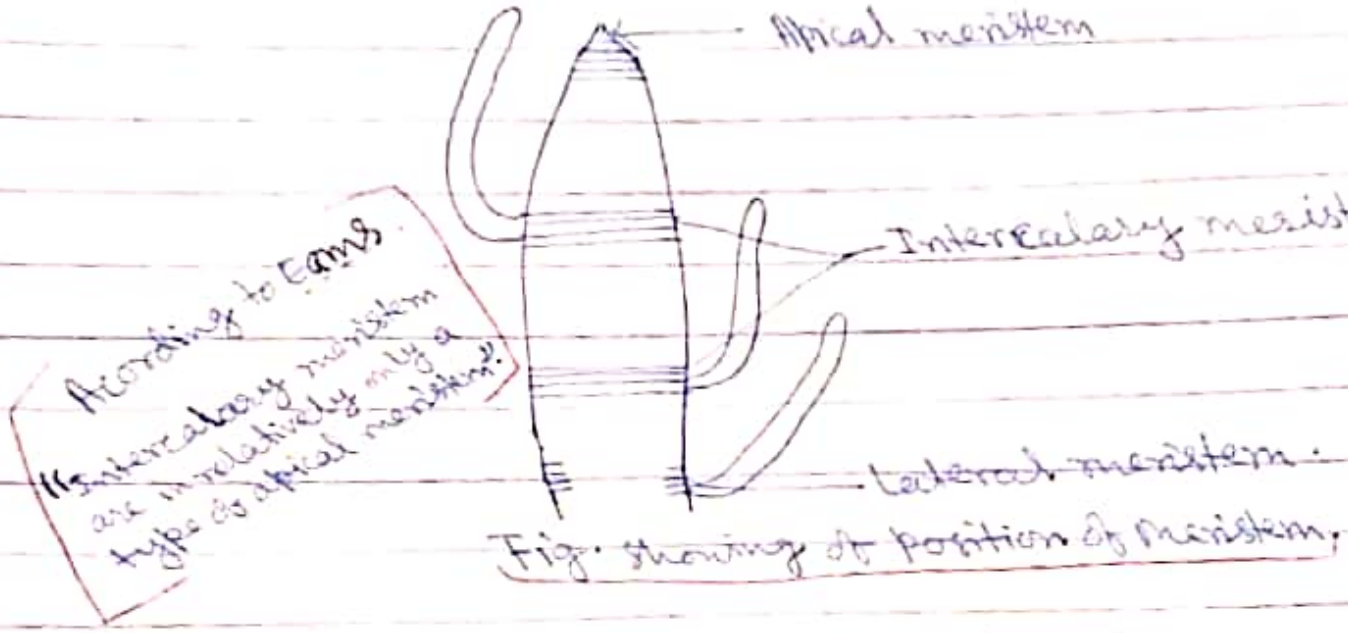


Fig. showing of position of meristem.

According to Esau - The intercalary meristem should be used to designate an actively growing primary tissue region, somewhat removed from the apical meristem. They are not of the same rank as the apical & lateral eg - Equisetum.

3. Lateral meristem :→ Lateral meristems are composed of initials that divide chiefly in one plane (periclinally) & increase the diameter of an organ. They add to existing tissue or build new tissues. The cambium & cork cambium are example of this type.

(D). On the basis of function :→

Based on function Haberlandt (1901) divided primary meristem into three types. — According to their function a system of classification was proposed by Haberlandt. He suggested that the primary meristem can be distinguished into three tissues : —

called Tunica & Corpus. The tunica is the outer zone & is consisted of one or more layers of cells. & the corpus is the central one, a mass of cells, concerned by tunica. The two regions may be easily distinguished from each other because of their differences in structure & appearance due to varying rates & the method of growth. The cells of tunica are smaller & divided anticlinally, thus increase in area. The corpus cells are larger & divide in various planes & thus an irregular mass of cells are formed & the mass of cells increases in volume. The tunica may be single or multilayered & covers the central core of massive corpus. The no. of initials also vary very much. In higher plants like angiosperms these two regions (Tunica & Corpus) are quite independent & arise from different initials. Now this is an established fact that they are quite independent in origin.

In spite of many controversies & interpretation the tunica-corpus theory explains the apical growth to some extent in the shoot of angiosperms.

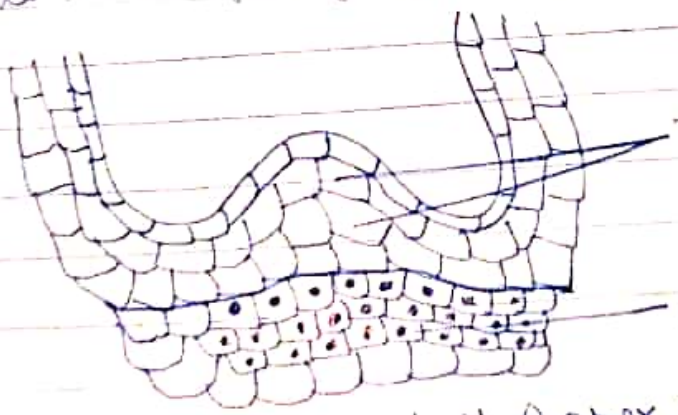


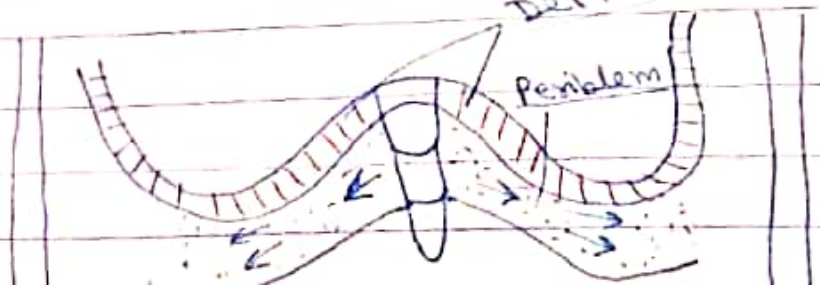
Fig. Diagram L.S. through shoot apex showing thin layered tunica & a mass of corpus.

Shoot apex:→

Terminal part of the shoot which is immediately above the youngest leaf primordium is called shoot apex. It is the region of continuous cell or tissue initiation that give rise to lateral organs like leaves.

this theory, the more or less distinct regions of the apex were called histogen, that is, tissue builders. The histogen used plerome - a central core, dermatogen - a uniseriate external layer, the periblem - the region between the plerome & dermatogen. Plerome gives rise to entire vascular cylinder ending pith, dermatogen gives rise to epidermis, periblem gives rise to all tissues lying between the epidermis & vascular cylinder eg - cortex & endodermis.

Recent experiments have shown, however, there is no distinct relationship between the development of the histogen & various regions of the plants body & segmentation of apical meristem.



vascular tissues. It [illegible]
cells very near to the Central region. In [illegible]
each procambium appears as a broad group of cells in
the ground or fundamental meristem, but in longitudinal
section, the cells are to be seen long & slender.

(c) Ground meristem:- The ground meristem develops into ground tissues & pith. The cells of this region are large, thin walled, living & isodiametric. In later stage they became differentiated into hypodermis, cortex, endodermis, pericycle, pith rays & pith.

Theories of structural development & differentiation:-

The differentiation in meristems brings about in cellular organization & structural segregation with regions distinguishable by -

(a) The no. & position of initiating cells.
(b) The plane of div^n & consequent arrangement.
(c) Size, shape & contents of cells.
(d) The rate of maturation.

Several theories dealing with the methods of origin & their histological & morphological significance have been proposed.

1. The apical cell theory:-

In 1759 Wolff recognised the [illegible]

They are of different shape & sizes. In majority of angiosperms & Gymnosperms it is low-ended, but in few angiosperms eg- Drimys & Hibiscus syriacus, it is concave. The time that lapses between two successive initiation of two leaves or pairs is termed as plastochron. Size of the shoot apex greatly vary among Spermatophytes. It is 90 μ in some grasses & usually varies between 130 - 200 μ in dicots. In Banana it is 280 μ, in palms it may be 500 - 600 μ (Bake - 1941), Cutler (1957), Fahn et al (1967) in the Gymnosperms the variation were still great.

Gifford (1954) has summerised various theories of development of shoot apex, which are: —

1. Apical cell theory
2. Histogen cell theory:
3. Tunica - corpus theory:

There are other theories that have been put forth to explain the apical organization of the shoot. Dermen (1947) put forwards his histogenic layer concept, he did not name any distinct layer, of the apical meristem. He did not believes in any terminology & named the different layers of apical meristem as L_1, L_2, L_3 & so on. These layers were recognised on the basis of their origin.

This concept has **no** support.

Popham & Charm (1950) propounded their mantle core concept. They used the term mantle for the outer dome shaped layer, that covers the central part called the core. This is just a substitute of terminology ~~of tunica~~ Tunica & core for corpus.

These authors recognized three distinct regions in the apical meristem. These were designated as Anneau initial or the peripheral active zone, Meristeme d'attente or the waiting meristem, that becomes active during only formation of inflorescence or terminal flower, & the central region or the meristem medullaire.

Newman (1961) put forth his concept. he recognised three types of shoot apices.

1. Monoplex :→ found in ferns & fern allies. The shoot apex may have one or more cells that divide only by walls parallel with the inclined walls of the stem.

2. Simplex :→ type is found in gymnosperms & consists of one or more initial cells arranged in a single layer. These cells divide by anticlinal & periclinal walls.

3. Duplex :→ type of stem apex is formed in Angiosperms & consists at least two successive layers. The surface layer has cells that divide only in an anticlinal manner. The cells of the inner layer can divide in more than one plane.

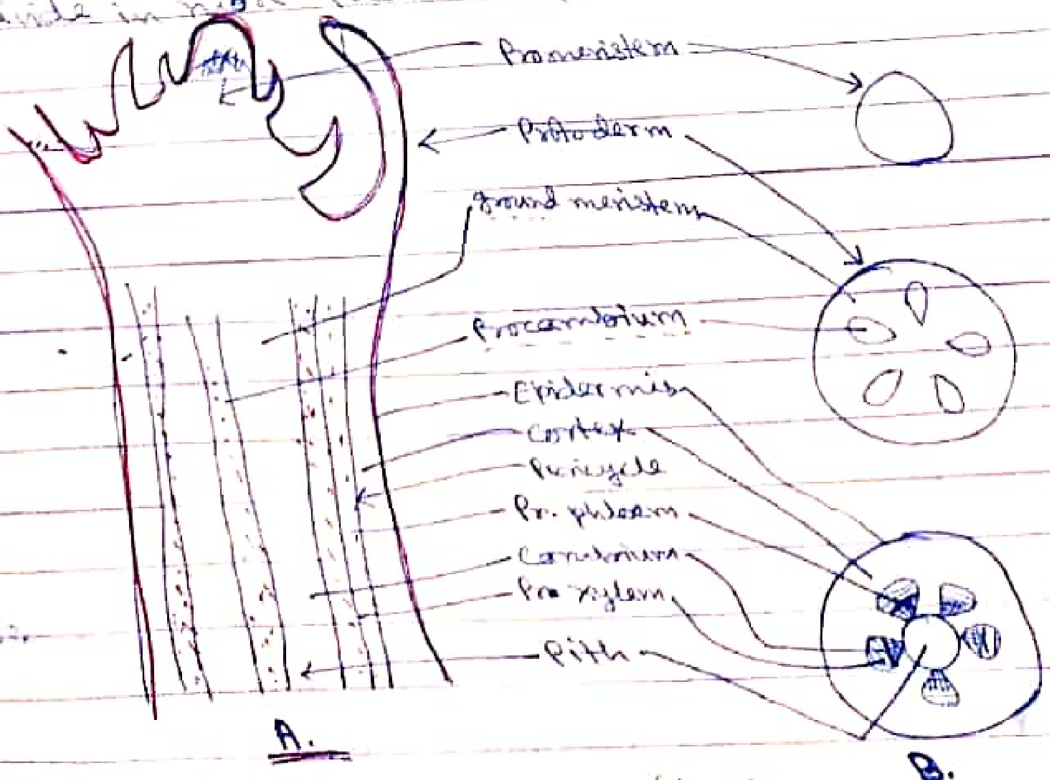


Fig. A- meristem in Stem (L.S.).
B- meristem in Stem (T.S.)

· apical cell

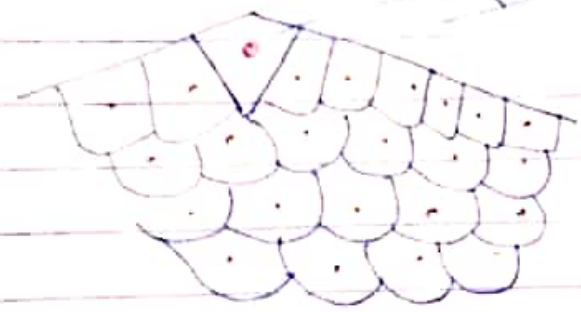


Fig- Apical cell in a rhizome of a fern.

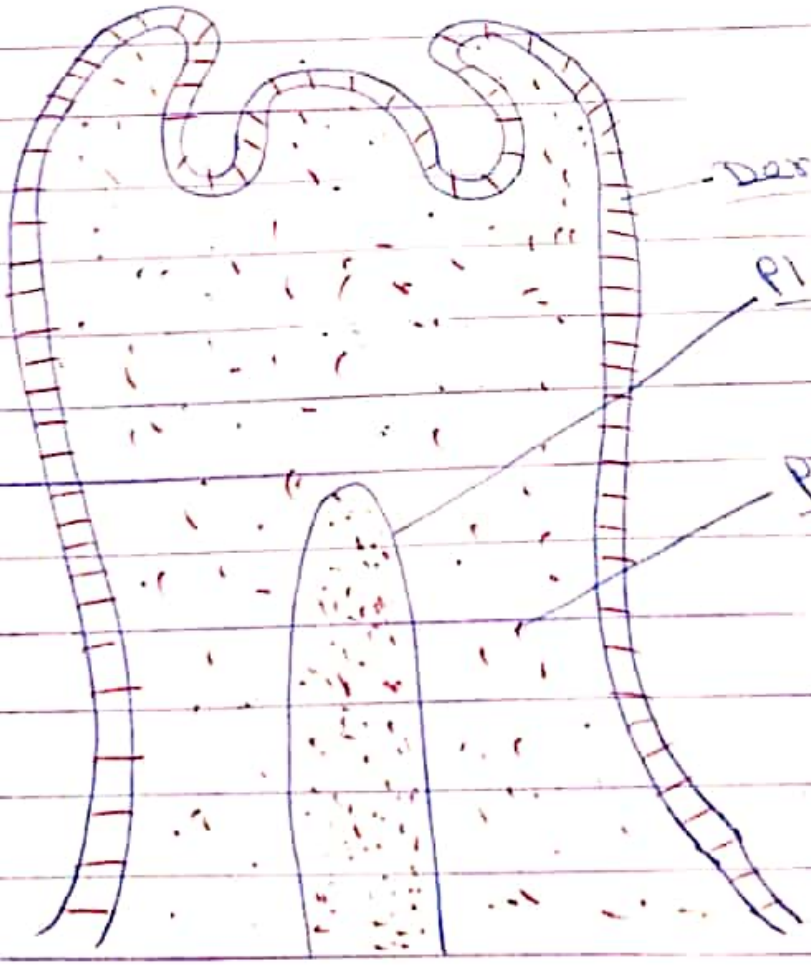


Fig- Histogenic layer concept (diagramatic)