

PRIMARY STRUCTURES OF ROOT

Primary Structures of Sunflower (Dicot) Root:

The roots of sunflower are tap roots. The tap root of Sunflower is circular in outline in transverse section (T.S.). It shows following primary internal structures such as

1. Epidermis
2. Cortex
3. Endodermis
4. Stele

Epidermis:

The root epidermis is also called as epiblema or rhizodermis or piliferous layer. It is outer most protective layer of the root. It is composed of a single layer of thin walled, compactly arranged barrel shaped cells. It bears many hairs called the root hairs on outer surface.

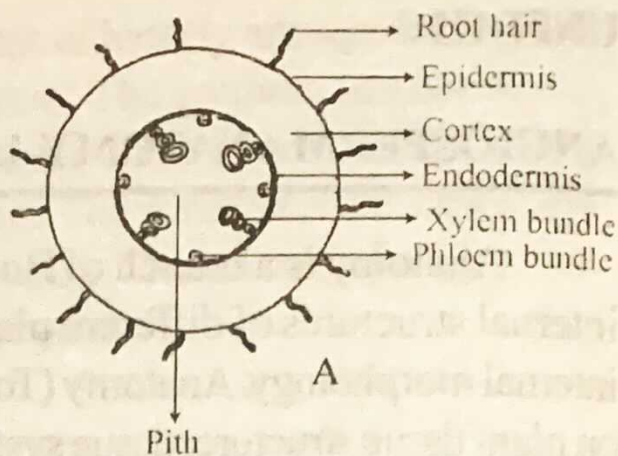
Cortex:

It is present just below the epidermis. It is composed of many layers of thin walled rounded or oval, homogenous parenchymatous cells with intercellular spaces.

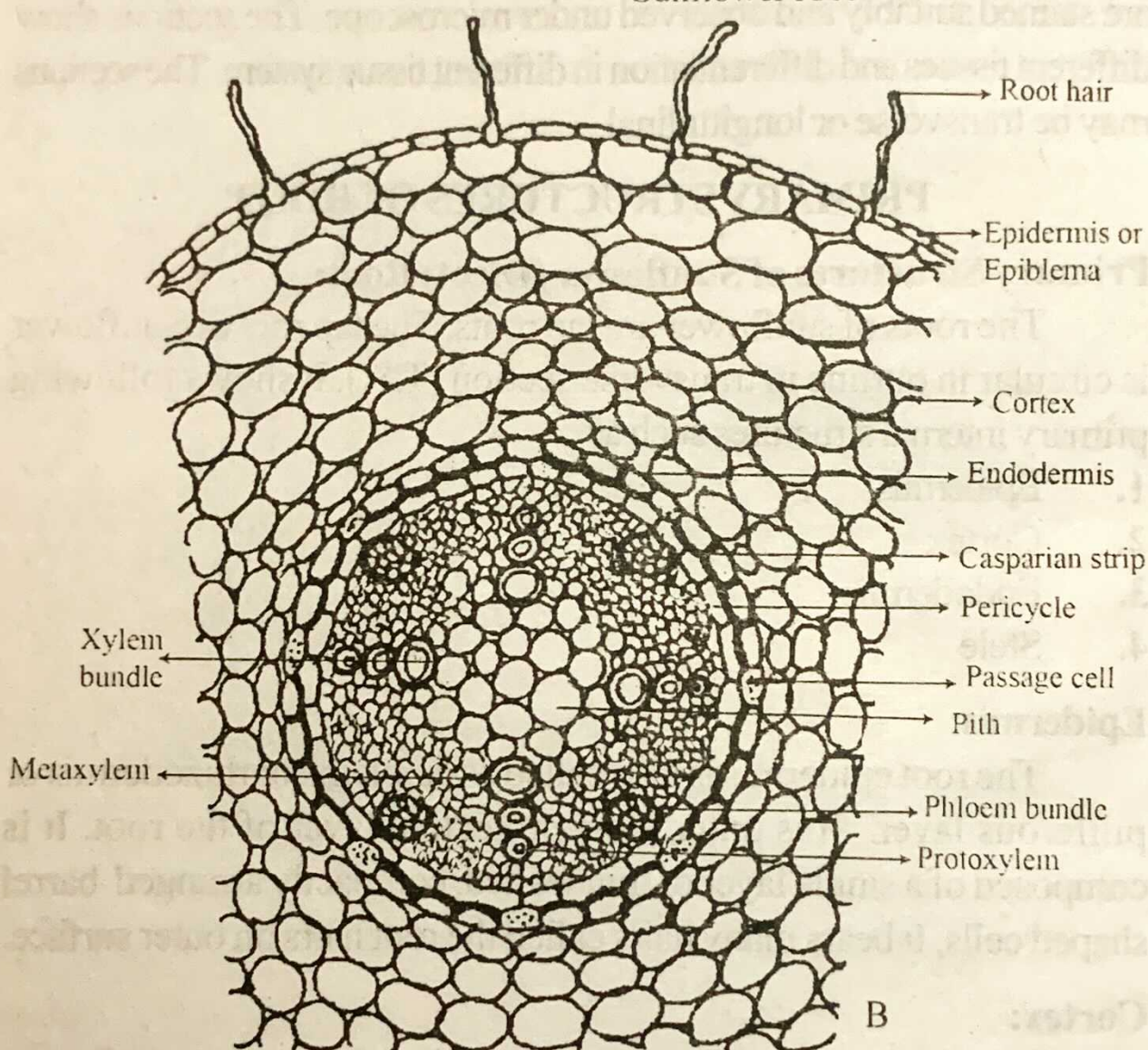
Endodermis:

It is the innermost layer of the cortex. It is composed of a single

layer of compactly arranged barrel shaped cells. Inner surface of radial walls of the endodermal cells is thickened due to the deposition of suberin like substance. The thickened radial walls appear in the form of strips called the Casparian strips named after **Casparay** who first noted the strips. The casparian



Diagrammatic T.S. of Sunflower root



A sector of T.S. of Sunflower root showing cellular details

Fig.3.1 (A-B). T.S. of Sunflower root

strips appear dot like in T.S. The cells of the endodermis opposite to the protoxylem are thin walled and without casparian strips. These cells are called as the passage cells.

Stele:

It is present just below the endodermis. It is made up of pericycle, vascular bundles, conjunctive tissues and pith.

Pericycle:

It is outer most layer of the stele. It is present just below the endodermis. It is made up of a single layer of thin walled parenchyma. It is 2-3 layered just opposite to the protoxylem.

Vascular bundles (VBs):

Vascular bundles are present just below the pericycle. They are composed of xylem and phloem. They are radial, tetrach and exarch. (Radial - xylem and phloem lie on different radii; Tetrach - VBs. with four xylem and phloem bundles alternating with each other; Exarch - Protoxylem towards outside and metaxylem towards inside)

Conjunctive tissue:

A parenchymatous tissue which is present in between the xylem and phloem of the radial vascular bundles is called as conjunctive tissue.

Pith:

It is innermost part of the stele. It is made up of very few, thin walled parenchymatous cells. It occupies very small area in the centre of the stele.

Primary Structures of Maize (Monocot) Root:

In maize the roots are adventitious. The adventitious root of Maize is circular in outline in T.S. It shows following primary internal structures such as

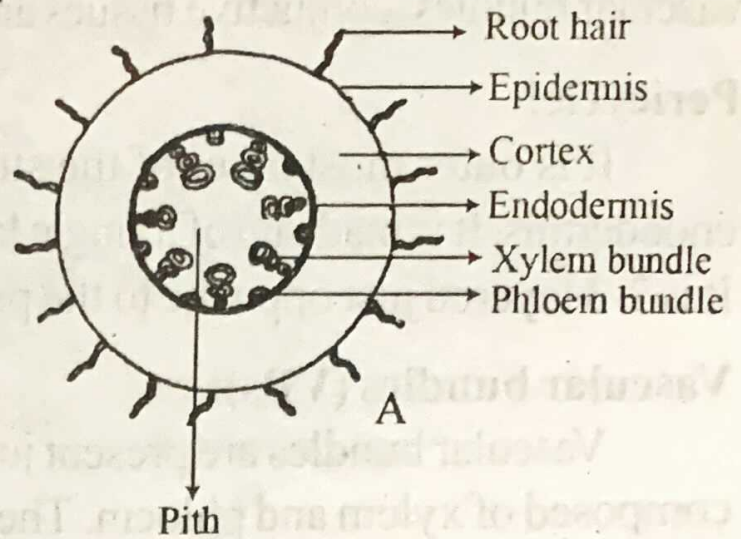
1. Epidermis
2. Cortex
3. Endodermis
4. Stele

Epidermis:

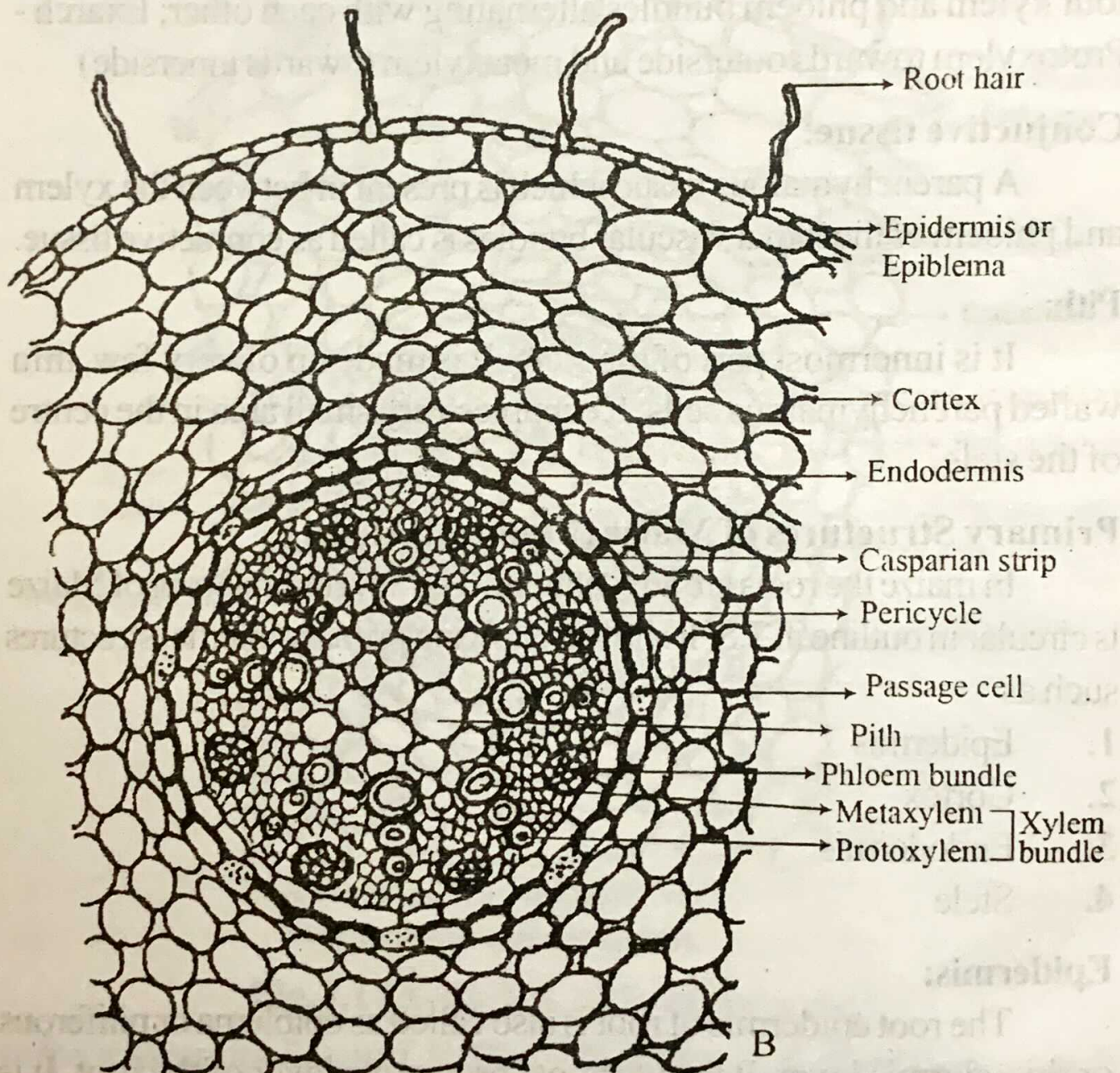
The root epidermis of root is also called as epiblema or piliferous or rhizodermis layer. It is outermost protective layer of the root. It is composed of a single layer of thin walled, compactly arranged, barrel shaped cells. It bears many hairs called the root hairs on outer surface.

Cortex:

It is present just below the epidermis. It is composed of many layers of thin walled, rounded or oval shaped, homogenous, living parenchyma with intercellular spaces.



Diagrammatic T.S. of Maize root



A sector of T.S. of Maize root showing cellular details

Endodermis:

It is the innermost layer of the cortex. It is composed of a single layer of compactly arranged barrel shaped cells. Inner surface of radial walls of the endodermal cells is thickened due to the deposition of suberin like substance. The thickened radial walls appear in the form of strips called the Casparian strips named after **Casparay** who first noted the strips. The casparian strips appear dot like in T.S. The cells of the endodermis opposite to the protoxylem are thin walled and without casparian strips. These cells are called as the passage cells.

Stele:

It is present below the endodermis. It is composed of pericycle, vascular bundles, conjunctive tissues and pith.

Pericycle:

It is outer most layer of the stele. It is present just below the endodermis. It is made up of a single layer of thin walled parenchyma. It is 2-3 layered just opposite to the protoxylem.

Vascular bundles (VBs):

The vascular bundles are present just below the pericycle. They are composed of xylem and phloem. They are radial, polyarch and exarch. (Radial - xylem and phloem lie on different radii; Polyarch - VBs with many xylem and phloem bundles alternating with each other; Exarch - Protoxylem towards outside and metaxylem towards innerside)

Conjunctive tissue:

A parenchymatous tissue which is present in between the xylem and phloem of the radial vascular bundles is called as conjunctive tissue.

Pith:

It is innermost part of the stele. It is made up of very few, thin walled parenchymatous cells. It occupies very small area in the centre of the stele.

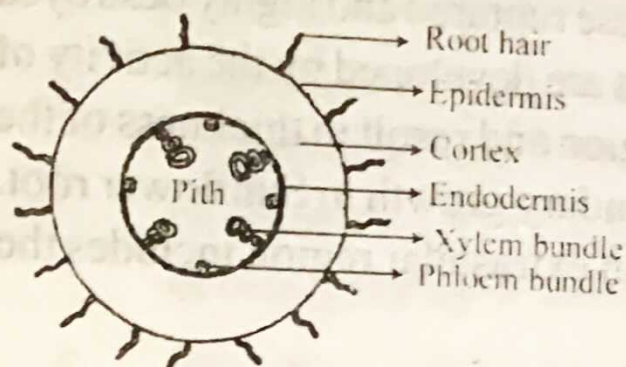
Secondary Growth in Sunflower (Dicot) Root:

The Sunflower stem shows secondary growth in stelar and extra stelar regions.

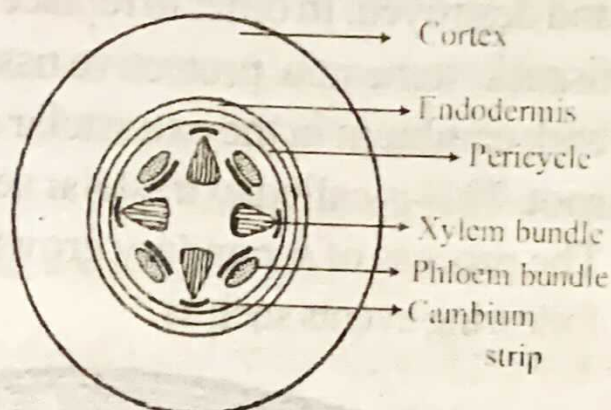
Secondary growth in stelar region of the root:

The process of secondary growth in the stelar region of Sunflower root includes the following events such as

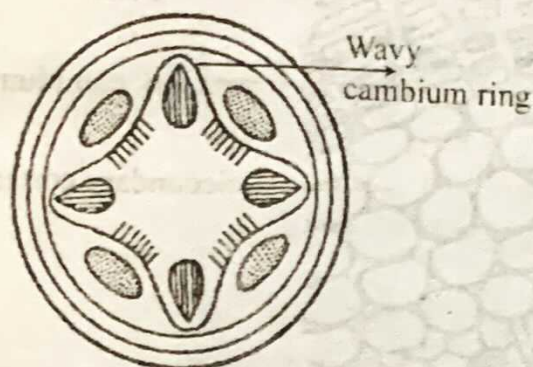
1. There is a single ring of four radial, exarch, closed vascular bundles inside the stele. Very soon some cells of the conjunctive become meristematic and form a strip called the cambium strip. At the same time cells of pericycle outside of each xylem bundles become meristematic and form a strip called the cambium strip.
2. The cambium strips grow on both sides and finally join together and form a wavy cambium ring.
3. All the xylem bundles now remain inside the cambium ring and the phloem bundles outside the cambium ring.
4. By further growth the wavy cambium ring becomes circular in outline.
5. The cells of cambium ring divide and redivide tangentially and result into the formation and addition of new cells to both external and internal sides of the cambium ring.
6. The new cells produced on outside of the cambium ring are differentiated into secondary phloem.
7. The new cells produced on inner side of the cambium ring are differentiated into secondary xylem.
8. The cambium ring is more active on innerside than the outside. Therefore secondary xylem is formed in large amount as compared to the secondary phloem. The secondary xylem is composed of large vessels, tracheids, little xylem fibre and well developed xylem parenchyma.



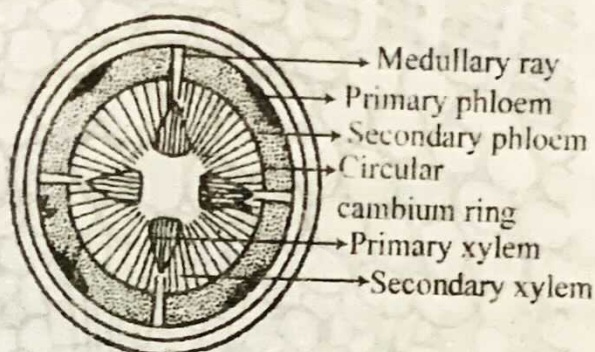
Diagrammatic T.S. of Sunflower root showing primary structures



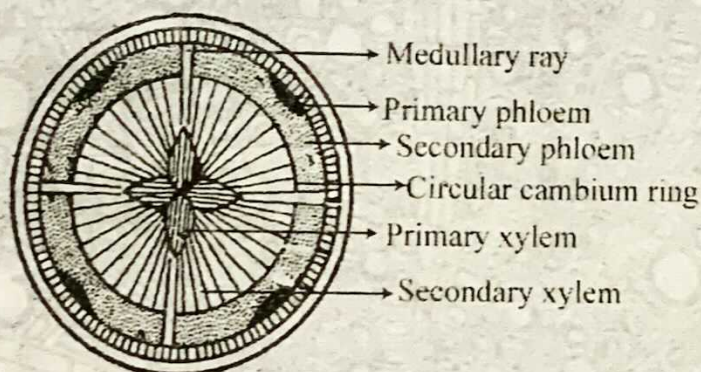
Diagrammatic T.S. of Sunflower root showing cambium strips



Diagrammatic T.S. of Sunflower root showing Wavy cambium ring



Diagrammatic T.S. of Sunflower root showing Circular cambium ring



Diagrammatic T.S. of Sunflower root showing complete secondary growth

Fig.4.5 (A-E). Diagrammatic T.S. of Sunflower root showing different stages of secondary growth.

Secondary growth in extra stelar region of the root:

The secondary phloem and xylem produced in the stelar region of the stem exert great pressure on the extrastelar region (which is made up of endodermis, cortex and epidermis). Due to this pressure the epidermis ruptures here and there. Similarly the cortex also ruptures

and destroyed. In order to replace these ruptured and highly destroyed tissues, some new protective tissues are developed by the activity of cork cambium in the extrastelar region and result in thickness of the root. This is called extrastelar secondary growth in Sunflower root. The process of secondary growth in extrastelar region includes the following events such as

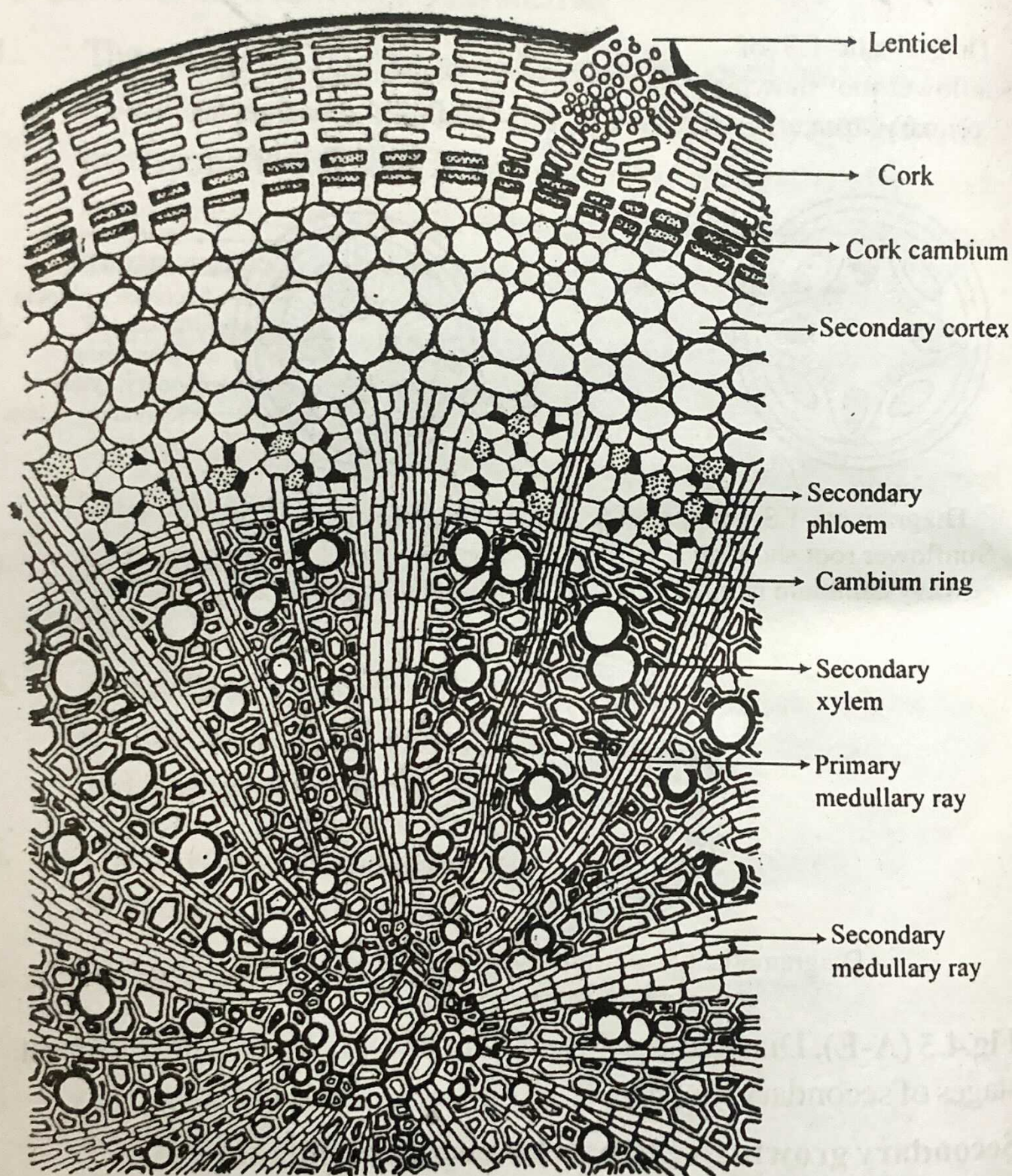


Fig.4.6. A sector of T.S. of Sunflower root showing cellular details after complete secondary growth.

1. The cells of pericycle become meristematic and function as the

cambium ring called the cork cambium or phellogen.

2. The cells of cork cambium divide and redivide and produce new cells on inner side. These cells give rise to secondary cortex or phelloderm. The secondary cortex cells are thin walled, rounded or oval, parenchymatous and with intercellular spaces.
3. The cells of cork cambium divide and redivide and produced new cells on the outer side in radial rows. These radial rows with narrow and rectangular cells together called as the cork or phellem.
4. The ruptured epidermis, cork and secondary cortex together is called as Bark.
5. The cork cambium at certain places produces very small thin walled parechymatous cells on the outside below the ruptured epidermis. This region is called as lenticel or air pore which brings about the exchange of gases.