PRIMARY STRUCTURES OF STEM

Primary Structures of Sunflower (Dicot) Stem:

The Sunflower stem is circular in outline in T.S. The T.S. of stem shows following primary internal structures such as

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

Epidermis:

It is outermost protective layer of the stem. It is made up of a single layer of compactly arranged tubular or barrel shaped cells. It has thick cutical and many hairs on the outer surface. The hairs are called epidermal hairs.

Cortex:

It is present just below the epidermis. It is differentiated into hypodermis, general cortex and endodermis.

Hypodermis:

It is present just below the epidermis. It is made up of 2-3 layers of collenchymatous cells.

General cortex:

It is present below the hypodermis. It is made up of 2-3 layers of parenchymatous, rounded or oval cells with intercellular spaces. These cells store large amount of food material.Resin ducts are also present here and there in the general cortex.

Endodermis:

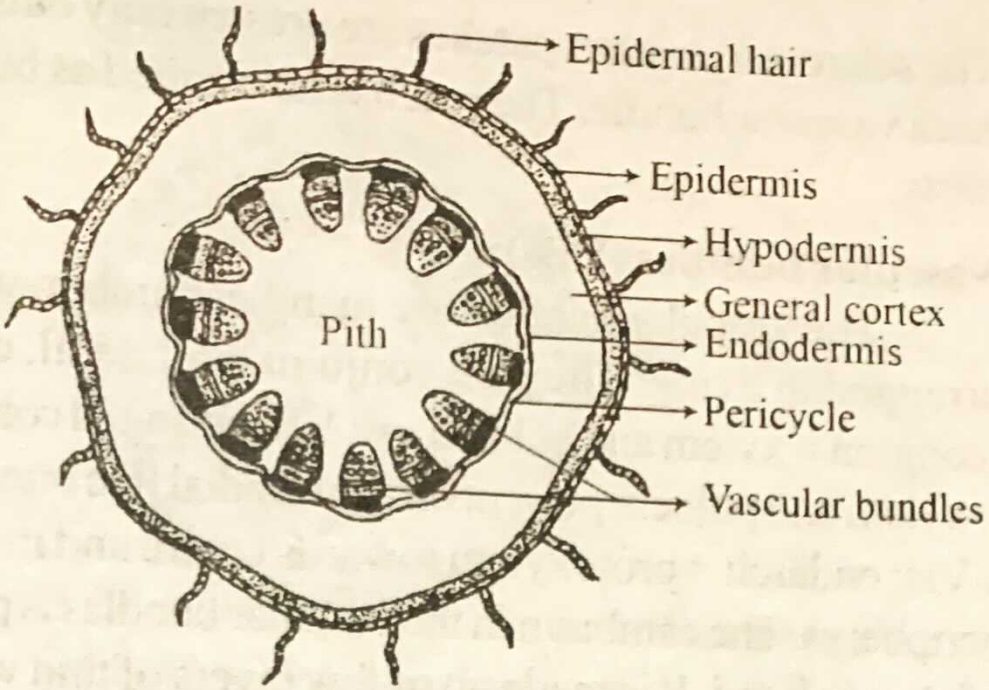
It is innermost layer of the cortex. It is made up of a single layer of compactly arranged barrel shaped cells. These cells store large amount of food material in the form of starch. Hence the endodermis is also called as starch sheath.

Stele:

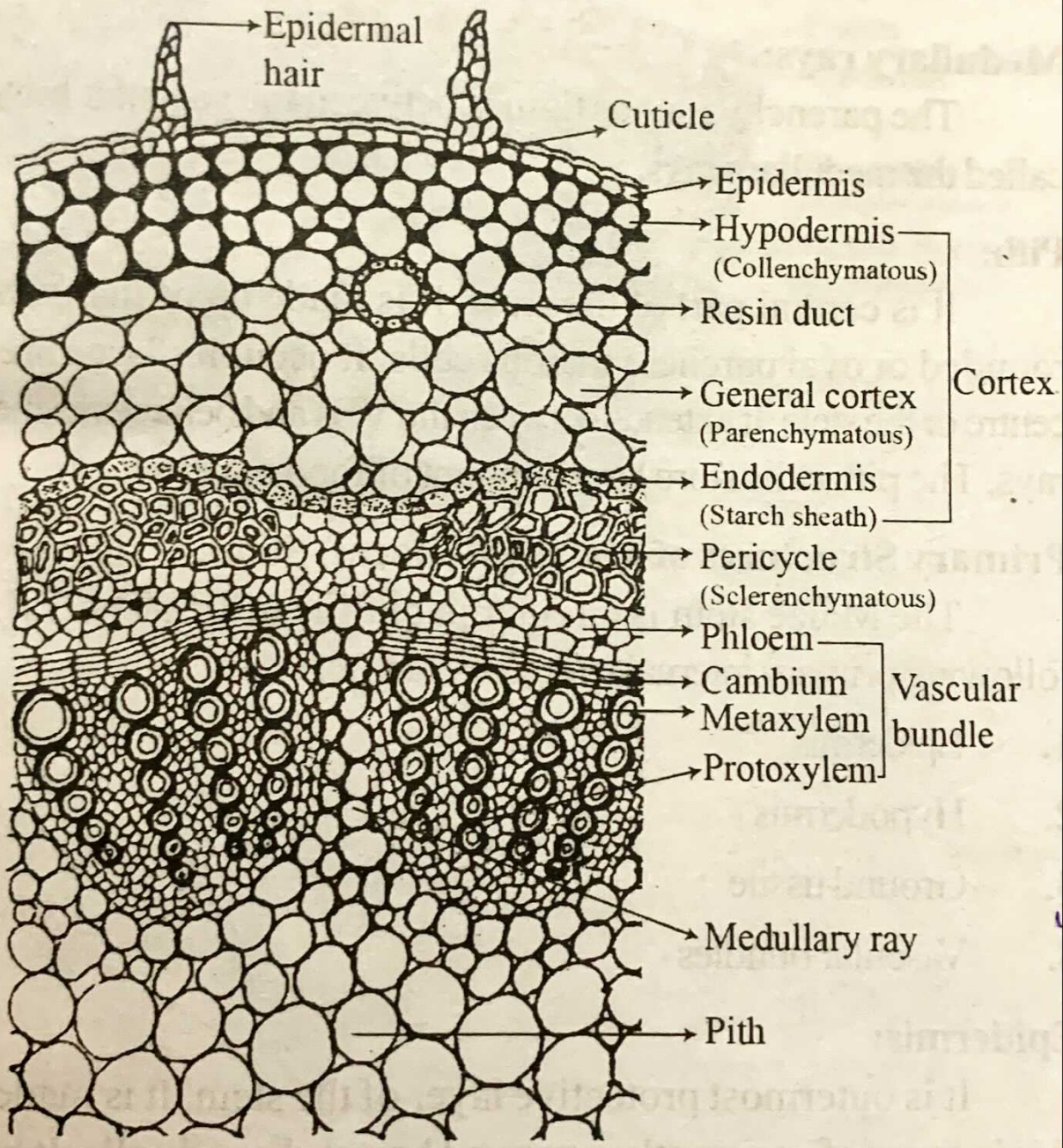
It is present below the endodermis. It is composed of pericycle, vascular bundle, medullary rays and pith.

Pericycle:

It is present just below the endodermis. It is made up of 2-3 layers of sclerenchymatous patches.



Diagramatic T.S. of Sunflower stem



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

The sclerenchymatous patches are present only outside the phloem in each vascular bundle. The patch is also called as bundle caps or hard basts.

Vascular bundles (VBs):

The vascular bundles are many in number, wedge shaped and arranged in a ring. They are conjoint, collateral, open and endarch (conjoint = xylem and phloem in a VB. arranged compactly; collateral = xylem and phloem present on same radial line one above the other in a VB; endarch = protoxylem towards centre and metaxylem towards periphery). The cambium in the vascular bundles is present in the form of strip or band. It is made up of few layers of thin walled rectangular or brick shaped meristematic cells.

Medullary rays:

The parenchymatous tissues between the vascular bundles are called the medullary rays.

Pith:

It is central part of the stele. It is made up of many layers of rounded or oval parenchymatous cells. It occupies large area in the centre of the stele. It extends between the VBs and behaves as medullary rays. The pith cells store large amount of food material.

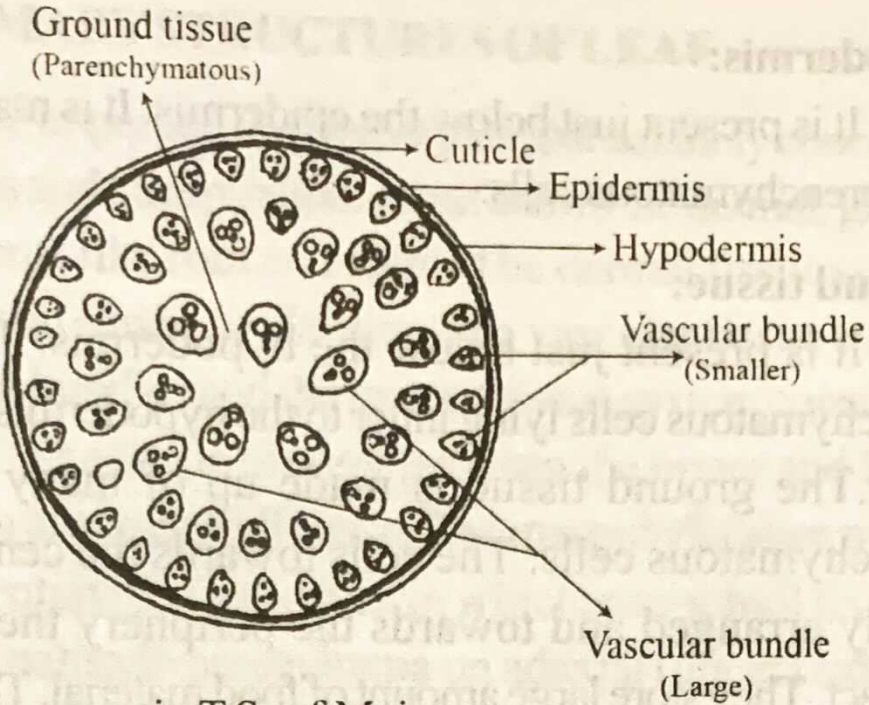
Primary Structures of Maize (Monocot) Stem:

The Maize stem is circular in outline in T.S. The T.S. shows following primary internal structures such as

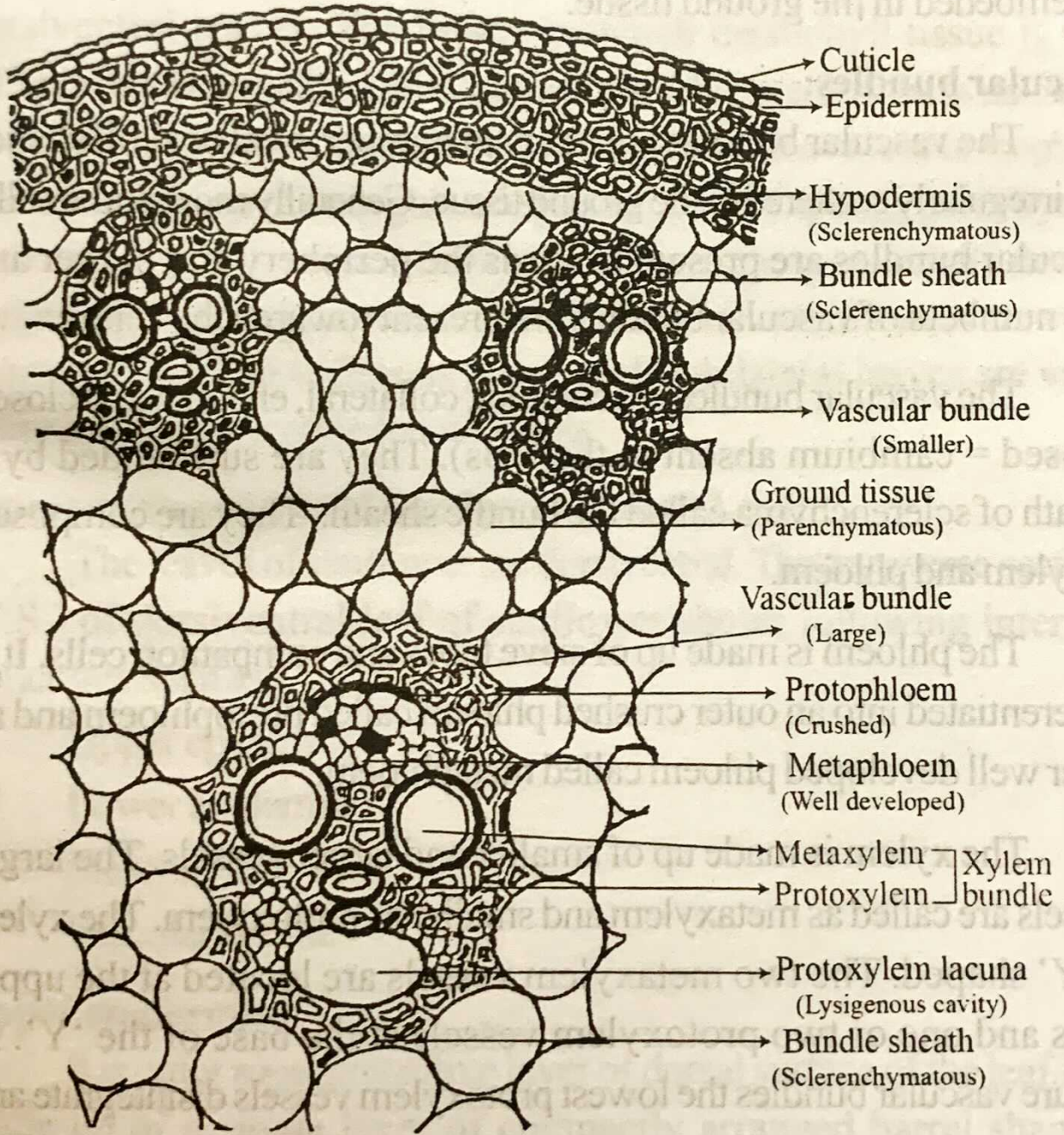
1. Epidermis
2. Hypodermis
3. Ground tissue
4. Vascular bundles

Epidermis:

It is outermost protective layer of the stem. It is made up of a single layer of compactly arranged barrel shaped cells. It has thick cutical on the outer surface.



Diagramatic T.S. of Maize stem



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

Hypodermis:

It is present just below the epidermis. It is made up of 2-3 layers of sclerenchymatous cells.

Ground tissue:

It is present just below the hypodermis. The entire mass of parenchymatous cells lying inner to the hypodermis is called as ground tissue.The ground tissue is made up of many layers of similar parenchymatous cells. The cells towards the centre are bigger and loosely arranged and towards the periphery they are smaller and compact. They store large amount of food material. The vascular bundles are embeded in the ground tissue.

Vascular bundles:

The vascular bundles are many in number, oval or skull shaped and irregularly scattered in the ground tissue. Generally more and smaller vascular bundles are present towards the periphery and bigger and less numbers of vascular bundles are present towards the centre.

The vascular bundles are conjoint, collateral, endarch and closed (closed = cambium absent in the VBs). They are surrounded by a sheath of sclerenchyma called the bundle sheath. They are composed of xylem and phloem.

The phloem is made up of sieve tubes and companion cells. It is differentiated into an outer crushed phloem called protophloem and an inner well developed phloem called metaphloem.

The xylem is made up of smaller and larger vessels. The larger vessels are called as metaxylem and smaller as protoxylem. The xylem is 'Y' shaped. The two metaxylem vessels are located at the upper arms and one or two protoxylem vessels at the base of the 'Y'. In mature vascular bundles the lowest protoxylem vessels disintegrate and form a cavity known as protoxylem lacuna or lysigenous cavity.The lysigenous cavity is filled with water hence it is also called as water cavity.

SECONDARY GROWTH

Secondary Growth in Sunflower (Dicot) Stem:

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

Secondary growth in stelar region of the stem:

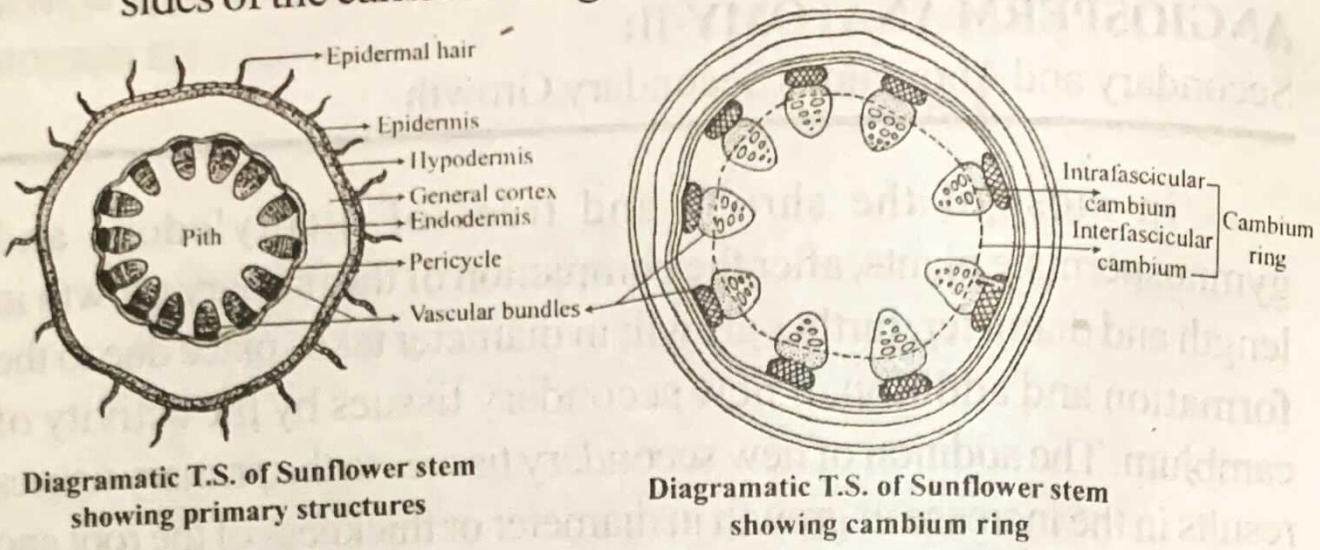
The process of secondary growth in the stelar region of Sunflower stem involves the following events such as

1. There is a single ring of open vascular bundles inside the stele. The cambium of the vascular bundles is called intrafascicular cambium (fascicle = bundle) very soon some cells of the primary medullary rays become meristematic and form a strip between the vascular bundles called the interfascicular cambium.

2. The interfascicular cambium grows on both sides and finally joins to the intrafascicular cambium. It results into the formation of a complete ring called the cambium ring.

3. The cambium ring is meristematic and few layered. 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.



Diagramatic T.S. of Sunflower stem showing primary structures

Diagramatic T.S. of Sunflower stem showing cambium ring

Fig.4.1 (A-B). Diagramatic T.S. of Sunflower stem showing primary structures and cambium ring.

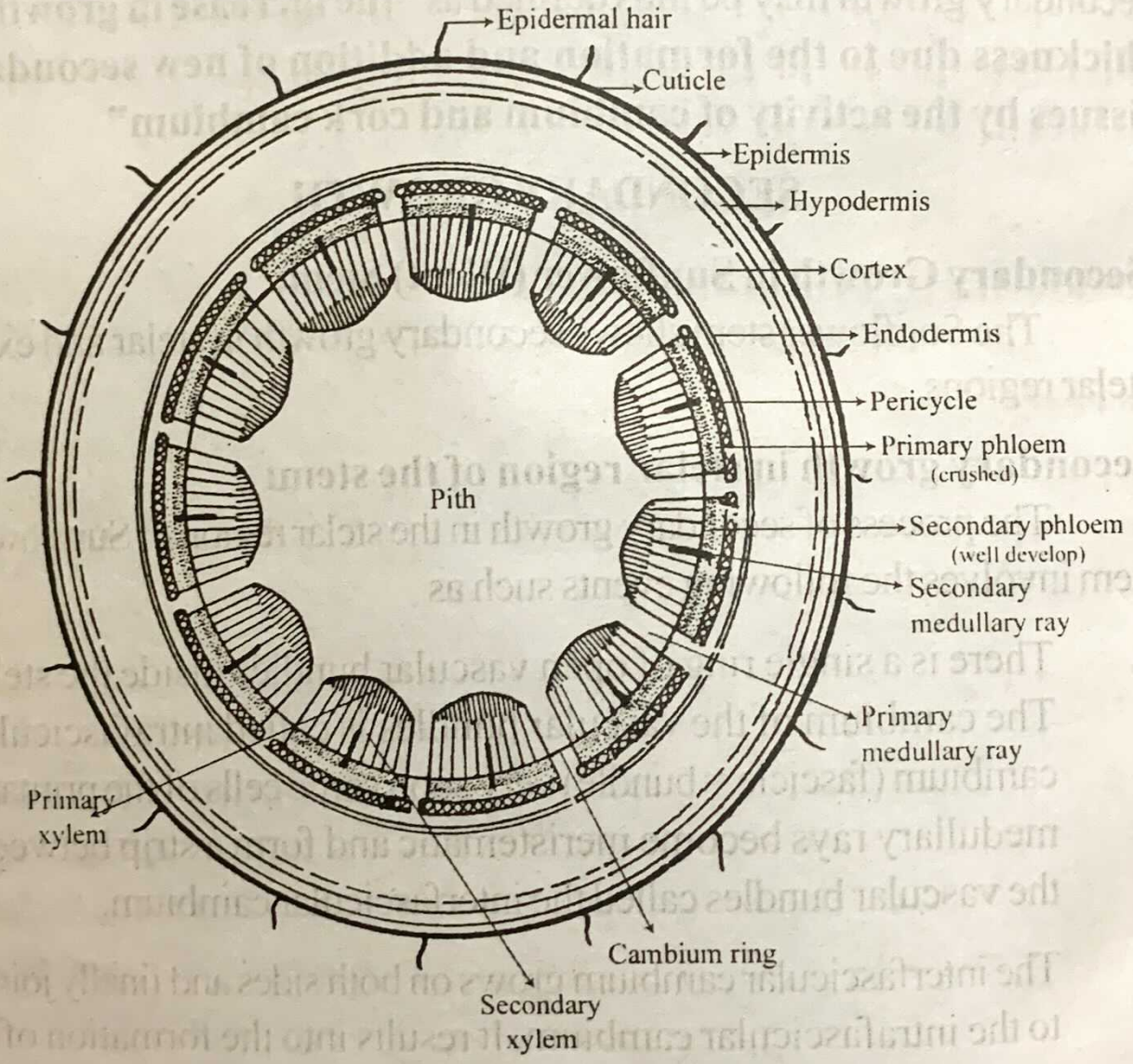


Fig.4.2. Diagramatic T.S. of Sunflower stem showing secondary growth in stelar region.

4. The new cells produce on outer side of he cambium ring are

gradually differentiated into a new tissue called the secondary phloem. The secondary phloem is composed of sieve tubes, companion cells, phloem parenchyma and an abundant amount of phloem sclerenchyma.

5. The new cells produced on innerside of the cambium ring are gradually differentiated into a new tissue called the secondary xylem or wood. Cambium ring is more active on inner side than outerside. Therefore secondary xylem is formed in large amount as compared to the secondary phloem. The secondary xylem is composed of vessels, tracheids, xylem parenchyma and large amount of xylem sclerenchyma.

6. Some new cells produced on inner side of the cambium ring here and there in the secondary xylem differentiated into parenchymatous cells which form the secondary medullary rays.

7. Due to the addition of new secondary tissues the primary xylem of the vascular bundle pushed towards the centre of the stem and the primary phloem pushed towards the periphery and finally gets crushed against the pericycle.

Secondary growth in extra stelar region of the stem:

The secondary phloem and xylem produced in the stelar region of the stem exert great pressure on the extrastelar region (which is made up endodermis, cortex, hypodermis and epidermis). Due to this pressure the epidermis ruptures here and there. The hypodermis gets flattened tangentially. Similarly the cortex also gets affected. In order to replace these ruptured and highly affected tissues, some new protective tissues are developed by the activity of cork cambium in the extrastealar region and result into growth in thickness of the stem. This is called extrastelar secondary growth in the Sunflower stem.

The process of secondary growth in extra stelar region includes following events such as

1. Some outer layers of hypodermis become meristematic and form a cambium ring called the cork cambium or phellogen.

2. The cork canmbium divides and redivides and produces new cells on inner side. These cells are thin walled, green and give rise to a new cortex called the secondary cortex or phelloderm.

3. The cork cambium produces new cells to the outer side in radial rows. These cells are narrow and rectangular in shape. Very soon these cells become dead and impermiable to water due to the deposition of suberin. The suberin deposited layers of these cells together called as the cork or phellem.

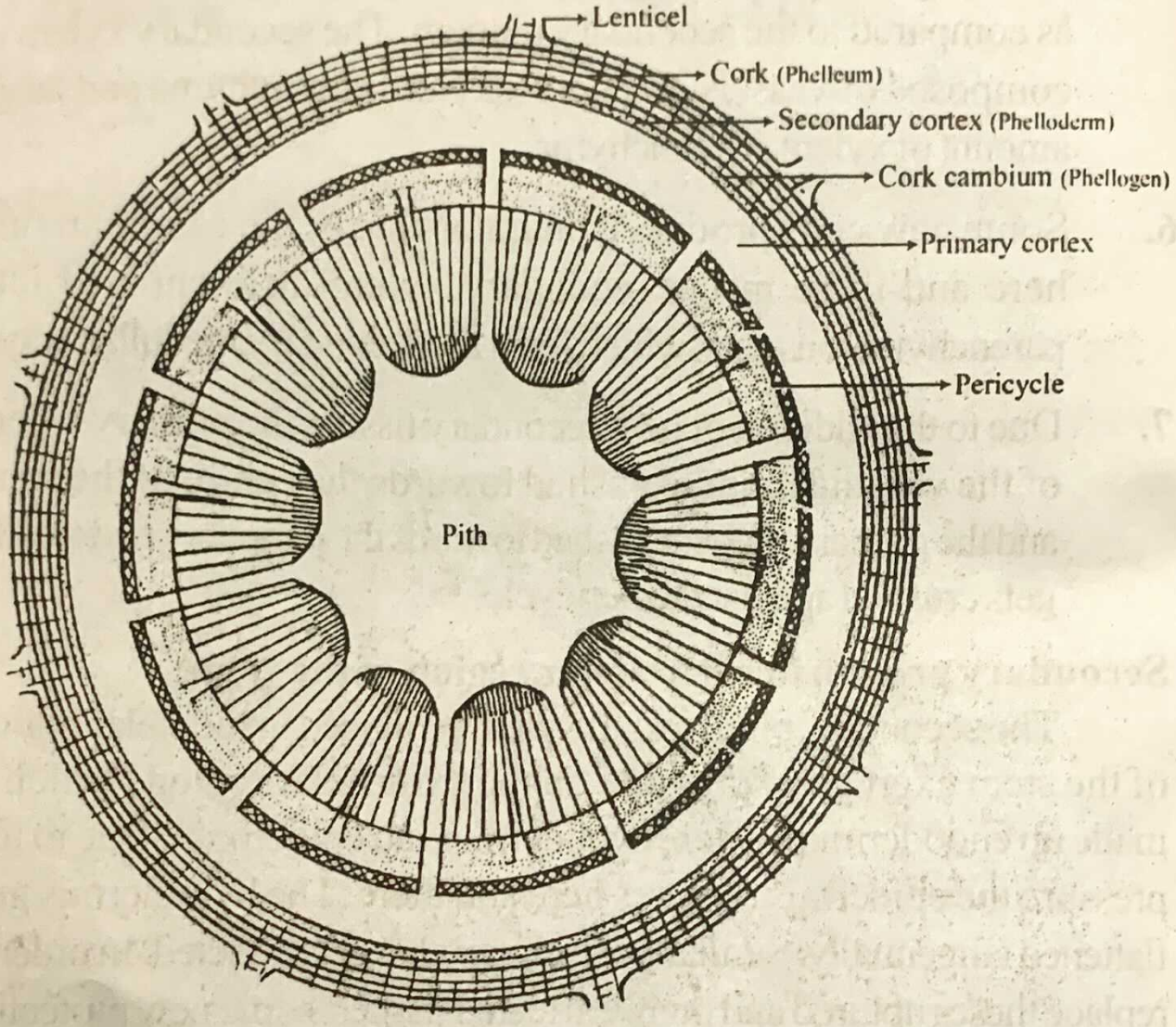


Fig.4.3. Diagramatic T.S. of Sunflower stem showing complete secondary growth.

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 parenchymatous cells on the outer side below the ruptured epidermis. This region is called as Lenticel or air pore which brings about the exchange of gases.

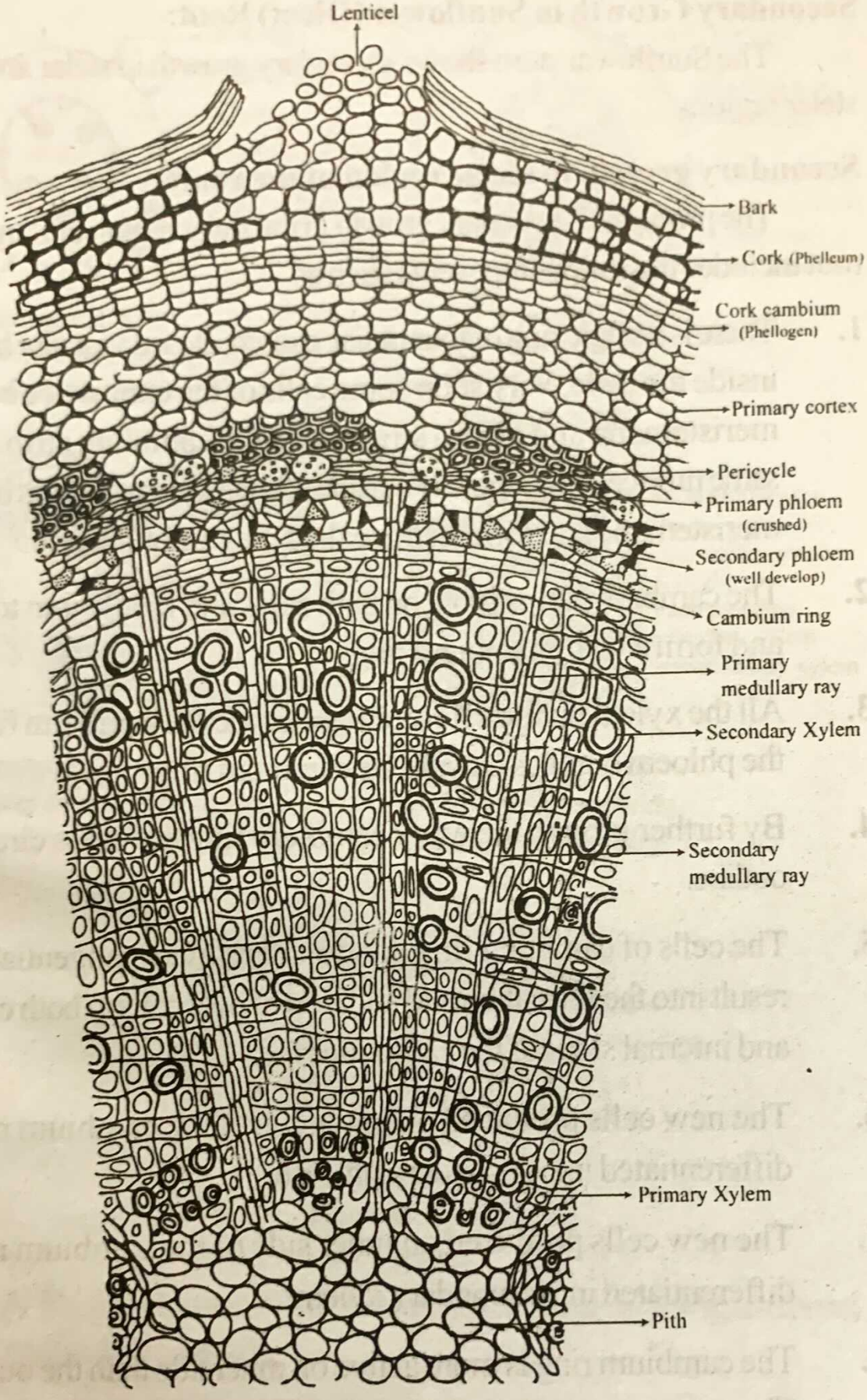


Fig.4.4. Sectors of T.S. of Sunflower stem showing cellular details after complete secondary growth.