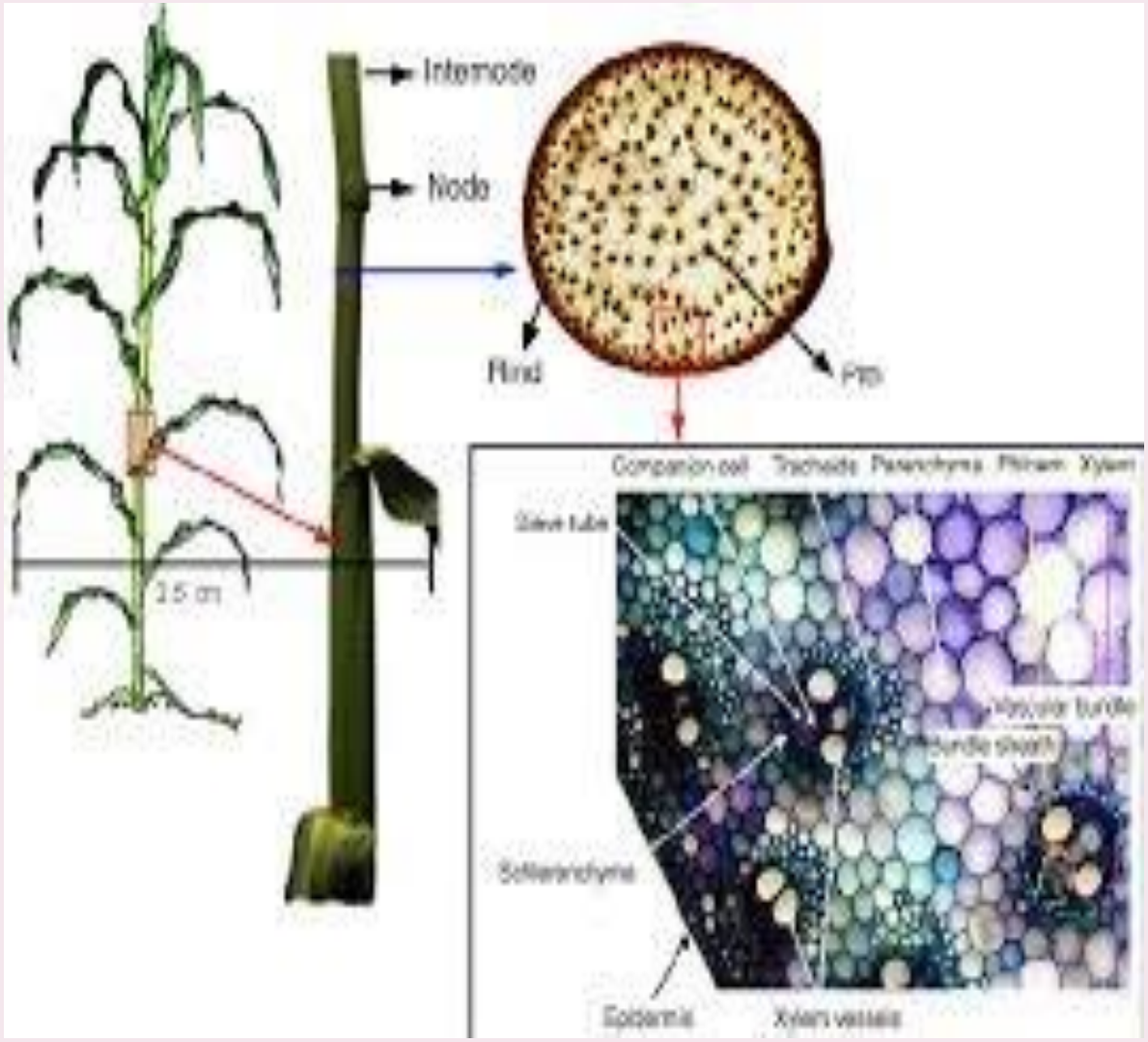
Common Anomalous Structures that Occur in Dicot Stems | Plants



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1. Occurrence of Scattered Vascular Bundles in Dicotyledonous Stem:

Normally the vascular bundles, in the dicotyledonous stem, are arranged more or less in a ring. The followings are a few variations where the vascular bundles are more or less irregularly scattered in the parenchymatous ground tissue of the stem: Ex. Thalictrum (Ranunculaceae), Podophyllum peltatum (Podophyllaceae), Papaver orientale and P. somniferum (Papaveraceae), Bougainvillea (Nyctaginaceae), Piper betle and Peperomia langsdorfii (Piperaceae), Nymphaea (Nymphaeaceae) et

2. Occurrence of Vascular Bundles Arranged in a Ring in Monocotyledonous Stem :

In monocot stems the stele is atactostele, i.e. the vascular bundles are scattered in the ground tissue. But the followings are the exceptions where the vascular bundles are arranged more or less in one or two rings. Ex. Coix, Triticum, Oryza (Poaceae), Tamus communis (Dioscoreaceae) etc.

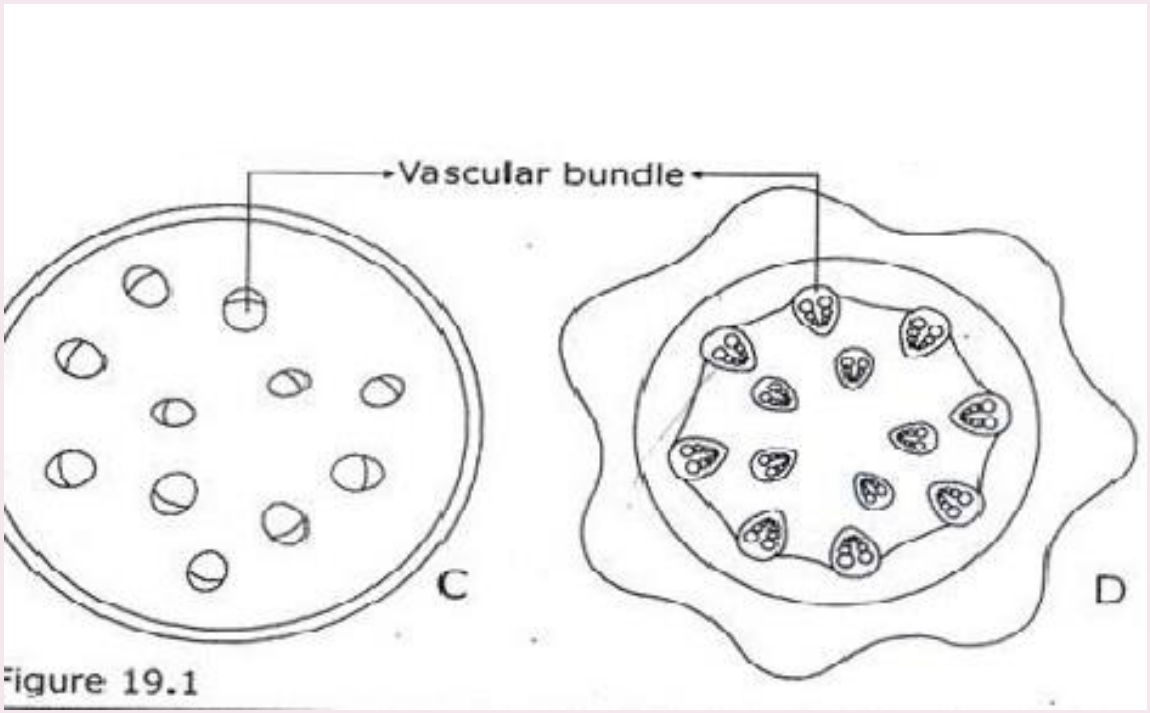


Figure 19.1

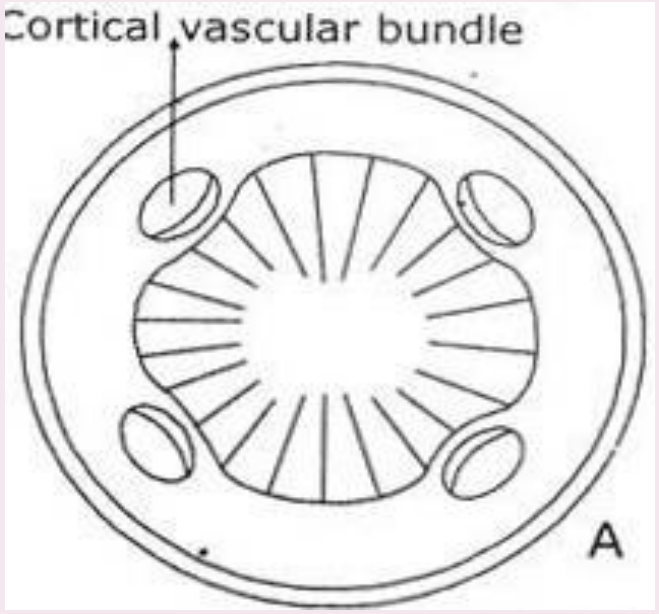
C. Cross-section of the stem of *Peperomia langsdorfii* (dicot) showing scattered vascular bundles (diagrammatic).
D. Cross-section of the stem of *Tamus communis* (monocot) showing two rings of vascular bundle (diagrammatic).

Occurrence of Cortical Bundles (Fig. 19.1A):

In dicotyledonous stem the vascular bundles occur in the stele. But there are some dicotyledonous stems where accessory vascular bundles are found in the cortex of stem in addition to stelar bundles.

The vascular bundle, which runs through the cortex independent of the ring of bundles present in the stele, is referred to as cortical bundles. In most species cortical bundles are leaf trace bundles. Metcalfe and Chalk (1950) listed thirty-seven families where cortical bundle occurs.

Nyctanthes arbortristis (Oleaceae) where four inversely oriented cortical vascular bundles occur with external xylem and internal phloem and these bundles are not directly connected with the main axial ring and in some genera of Rutaceae and Polygonaceae etc.



4. Occurrence of Medullary Bundle:

The supplementary bundle, which occurs in the pith of dicotyledonous stem in addition to the normal ring of bundles, is referred to as medullary bundles **Metcalfe and Chalk (1950) reported thirty-seven families where medullary bundles occur and a few examples are mentioned below:**

Acanthus (Acanthaceae) where collateral and inversely oriented medullary bundles occur; Achyranthes aspera (Amaranthaceae) with two medullary bundles at internode and Cyathula prostrata with four medullary bundles; Obione portulacoides, Atriplex hortensis (Chenopodiaceae); Crepis, Dahlia, Lactuca, Sonchus (Compositae); Greenovia, Echeveria (Crassulaceae); Raphanus sativus (Cruciferae); Anthocleista (Potaliaceae); Bougainvillea, Mirabilis longiflora, Neea, Pisonia (Nyctaginaceae); Apium, Eryngium, Oenanthe (Umbelliferae) etc.

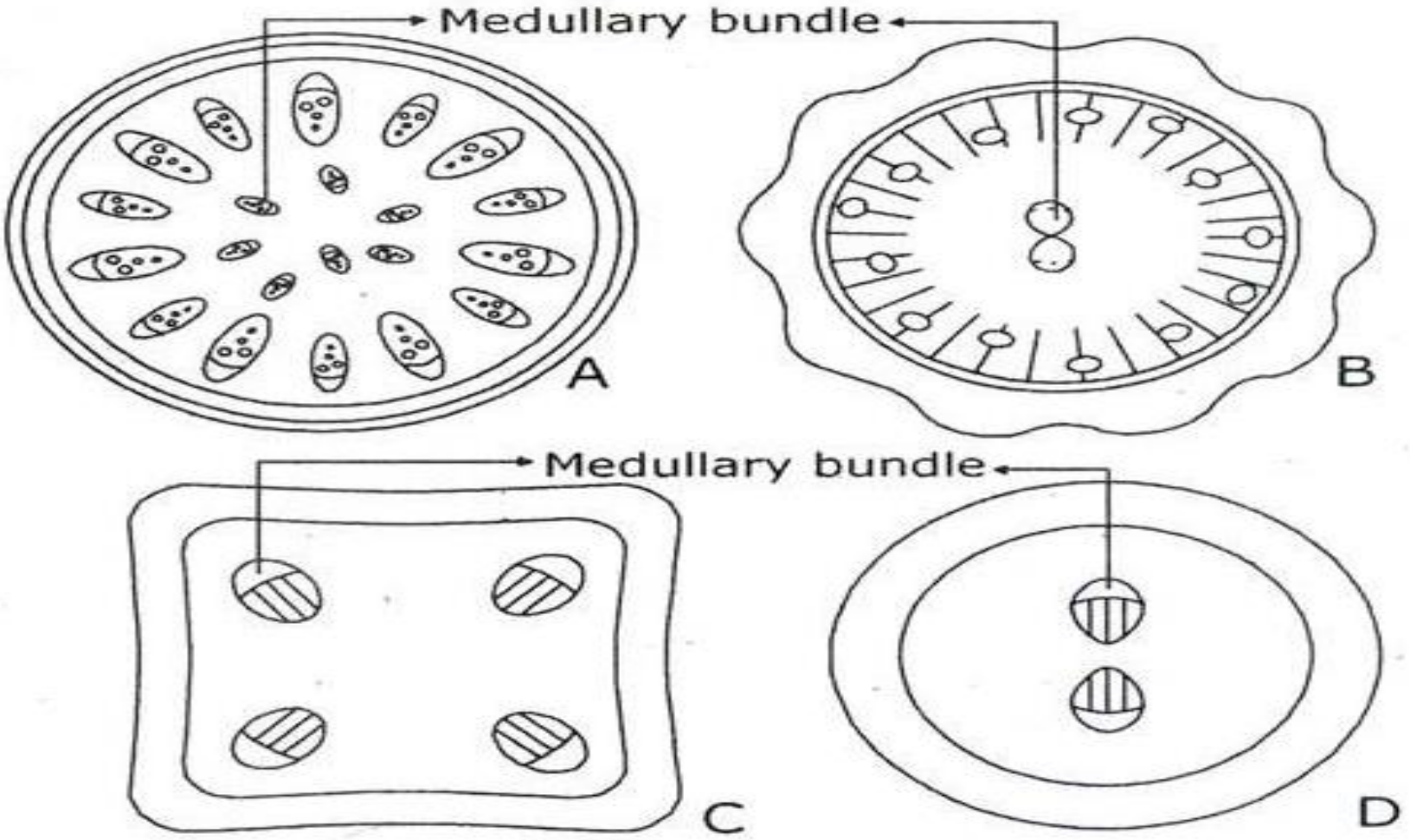


Figure 19.2

Diagrammatic figures showing medullary bundles: A. in the stem of *Aralia* B. in the stem of *Achyranthes aspera*, C. in the inflorescence axis of *Achyranthes coynei* and D. in the young stem of *Bougainvillea*

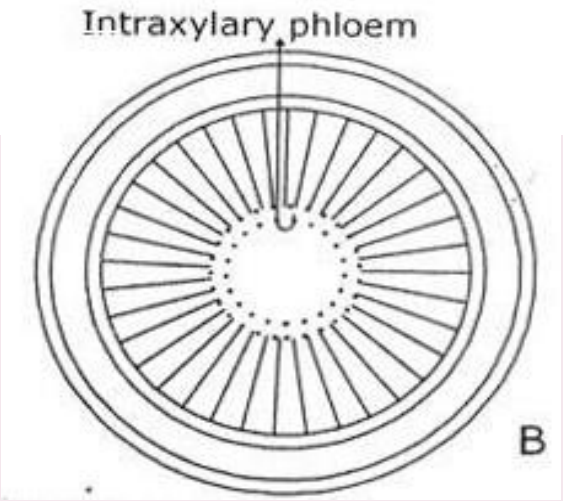
5. Occurrence of Internal Bundles:

The supplementary bundles, which occur below the normal ring of bundles and above the medullary bundles, are referred to as internal bundle. These bundles are not so deeply situated in the pith to be classified as medullary bundles. Ex. Rumex crispus, R. orientalis etc.

6. Occurrence of Internal Phloem or Intraxylary (Perimedidlary, Medullary) Phloem:

The phloem that occurs at the margin of pith in the form of a continuous cylinder or strands is referred to as intraxylary phloem or internal phloem. It is also known as medullary phloem due to its occurrence at the margin of pith.

Metcalfe and chalk (1950) reported the presence of internal phloem in twenty-seven families and a few examples are mentioned below: Wrightia, Vinca, Thevetia, Landolphia (Apocynaceae); Calotropis (Asclepiadaceae); Convolvulus, Ipomoea, Evolvulus (Convolvulaceae); Acanthus, Barleria (Acanthaceae); Solanum, Nicotiana (Solanaceae) etc.



8. Occurrence of Polystele in Dicotyledons:

Usually the stele of dicotyledonous stem is monostele, i.e. the vascular bundles are arranged more or less in a ring and lie within an endodermis. But variations occur when each vascular strand becomes completely enclosed by an endodermis.As a result the stele becomes polystele. Ex. Nymphaea (Nymphaeaceae); Parnassia palustris (Parnassiaceae) whose nodes are polystelic; Dianthera americana where seven steles occur and each stele is represented by a vascular strand, which is completely enclosed by an endodermis.One stele is situated at the centre and the remaining six steles are arranged towards the periphery of stem. Polystelic condition is also reported from Justicia. The stolons of Gunneraceae exhibit polystele. The fruit stalks of Malvaceae, Meliaceae, Moraceae, Sterculiaceae and Theaceae are also polystelic.

Absence of Vessels in Angiosperm:

The xylem of angiosperms is characterized by the presence of vessels. Exceptions are noted in families Tetracentraceae (Tetracentron), Trochodendraceae (Trochodendron) and Winteraceae (Drimys, Pseudoivintera, Bubbia, Zygogynum) where vessels are absent. rately at alternate radii. In this species there is a diarch xylem plate and phloem is situated on both sides.

9. Occurrence of Separate Xylem and Phloem Bundles:

Usually the two vascular tissues xylem and phloem occur together to form bundles. In abnormal cases bundles consisting of either xylem or phloem strands only occur in addition to the normal bundles. In Cuscuta fully developed phloem occurs interspersed between other normal collateral bundles.

Incomplete bundles consisting of phloem only are observed in Rumex crispus, Ricinus communis, Xanthium strumarium, Antigonon leptopus, Achxjranthes aspera, Mirabilisjalapa etc., Maheswari (1930).

In Boerhaavia diffusa incomplete bundles are formed as a result of centripetal differentiation of phloem from procambium cells (Maheswari). In these procambium cells xylem is not formed on the inner side, instead the innermost undifferentiated cells divide tangentially to form cambium.

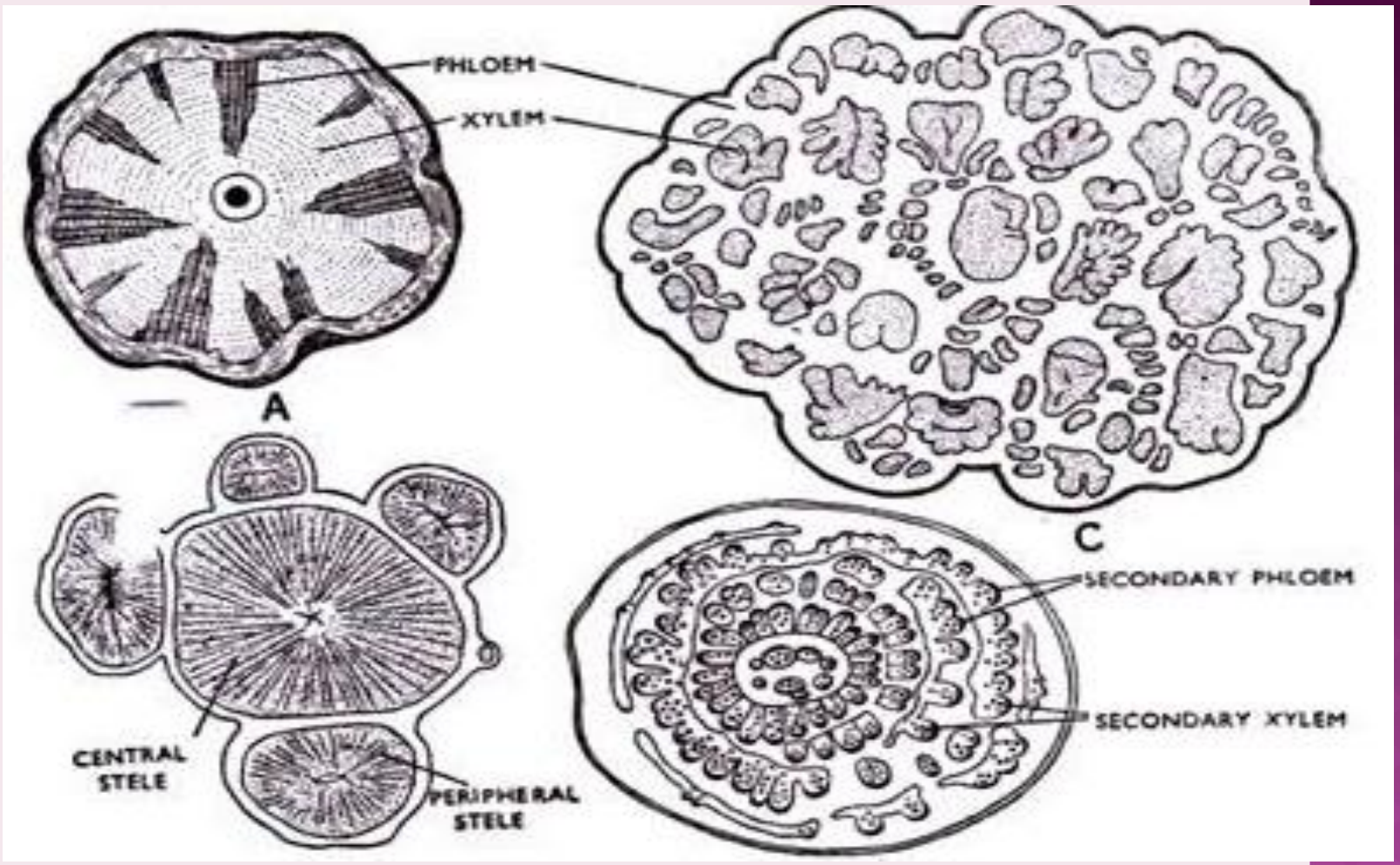
In Utricularia and Polypompholyx the two vascular tissues are not associated in bundles; instead they lie in alternate strands attached to a ring of sclerenchyma, consisting of fibres only. The two vascular tissues of Circaeaster agrestis stem like that of the main root lie sepa

A brief review of a few types is given here:

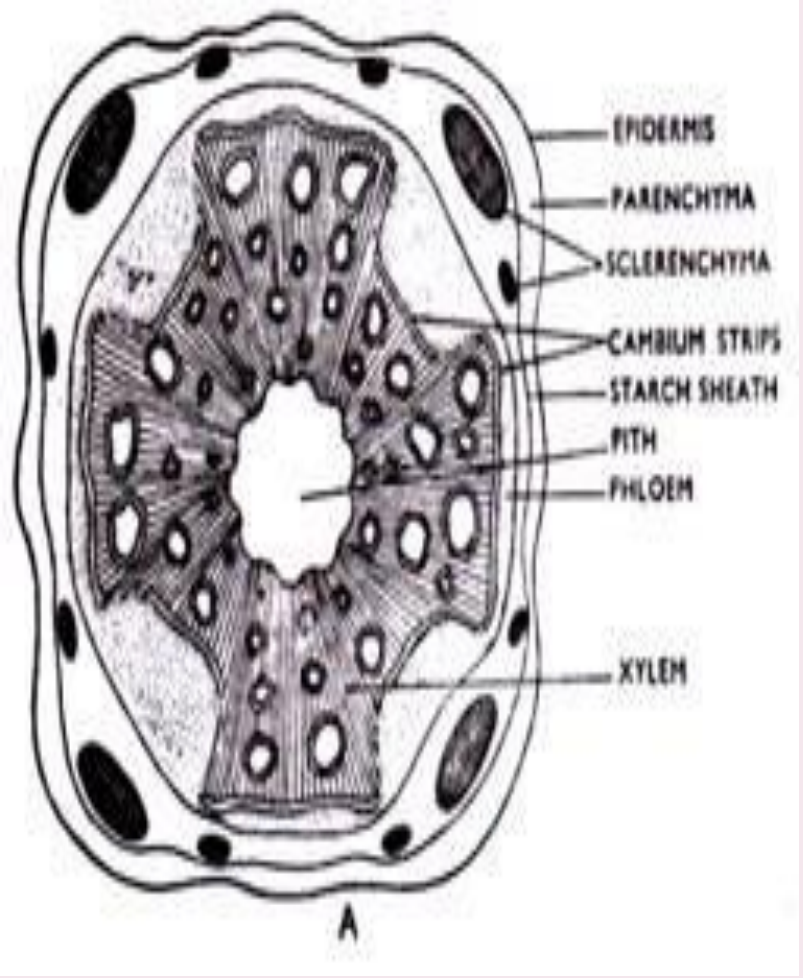
In some stem as in Bignonia and other members of family Bignoniaceae, the cambium is normal in disposition and activity to begin with, but it soon cuts off different proportions of xylem and phloem in different points.

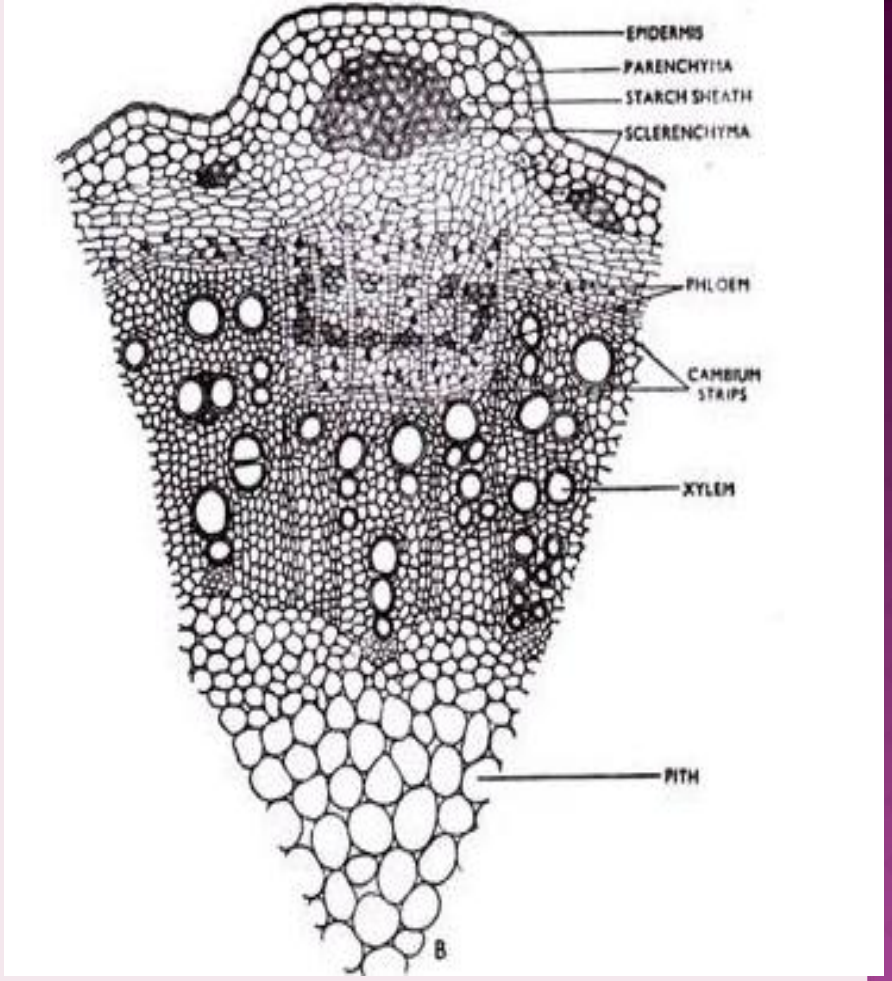
At four points arranged in form of a cross, formation of secondary xylem is reduced and that of secondary phloem correspondingly increased. As a result the woody cylinder appears to have four longitudinal grooves which become increasingly deeper with secondary growth.

The cambium breaks up into a number of strips, widest ones occurring opposite the four projecting ridges of wood and the narrow ones at the bases of the grooves. As a result peculiar structure with ridged and furrowed xylem cylinder (Figs. 648A & 649) is formed. Deeply ridged vascular cylinder is formed in some plants due to the fact that the cambium produces only ray parenchyma cells at some points.



Anomalous stem structures. A. In *Bignonia*. B. In *Serjania*. C. In *Bauhinia*. D. In *Boerhaavia*.



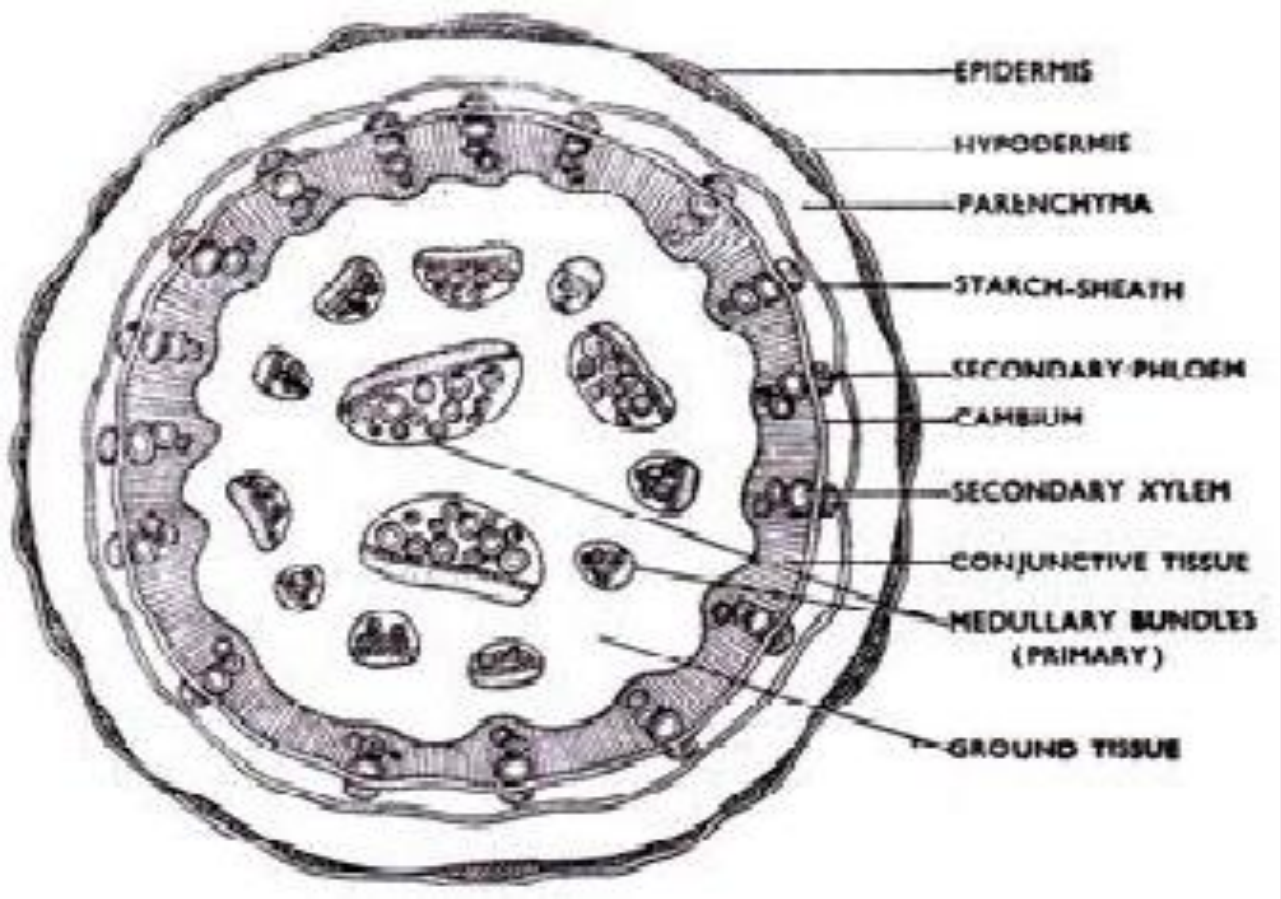


Stem of *Bignonia* sp. with anomalous structures. A. T.s. of stem (diagrammatic). B. Magnified view of a part showing tissues.

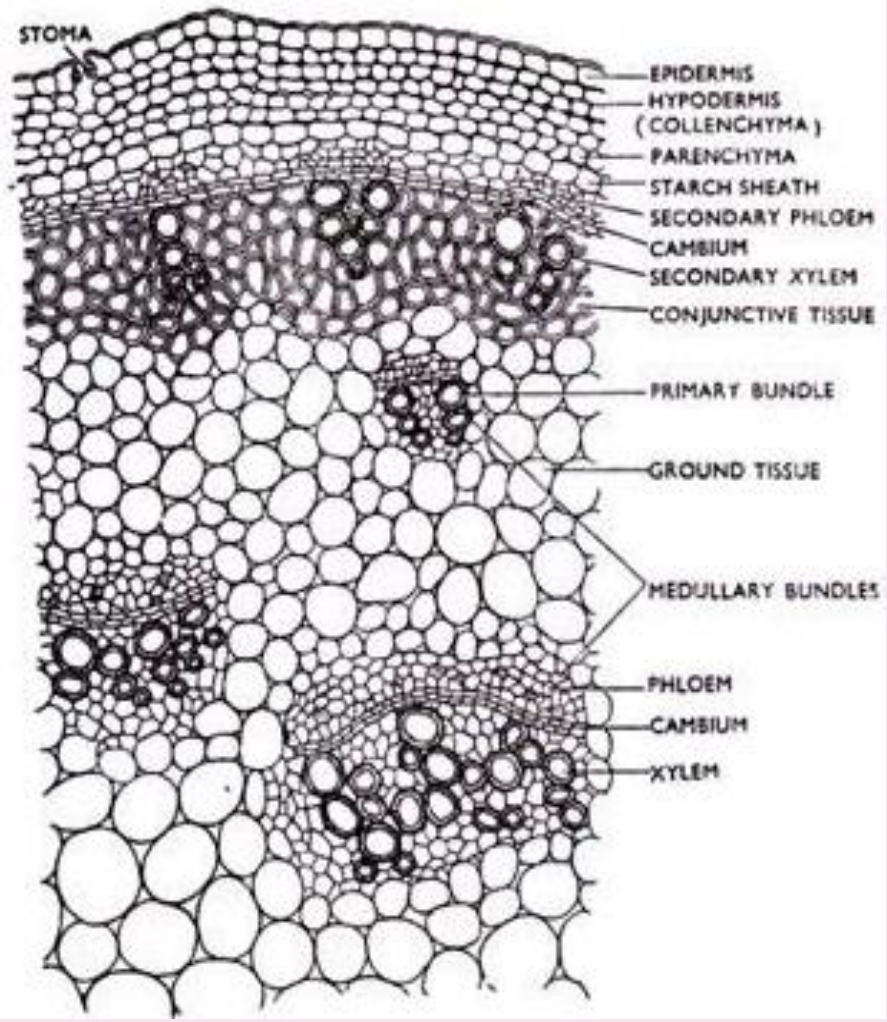
In the families Nyctaginaceae, Amaranthaceae, Chenopodiaccae, etc., anomalous structures are formed in rather different ways. The vascular bundles normally appear either in a ring or they remain irregularly scattered in the ground tissues (medullary bundles). They are as usual collateral ones with fascicular cambium.

Cambial activities continue in the individual bundles for some time and soon cease. So secondary growth is rather limited. Secondary cambium arises on the outer side of the bundles. This cambium cuts off secondary bundles on the inner side, which remain embedded in a non-vascular tissue, known as conjunctive tissue.

It consists of either thin-walled parenchyma or thick-walled lignified elongate cells. The parenchyma cells undergo gradual lignification and thus become thick-walled. The cambium produces very little tissue on the outer side. The secondary bundles may be irregularly scattered or may remain arranged in concentric, rings.



Transverse section of stem of *Boerhaavia* sp. (diagrammatic).

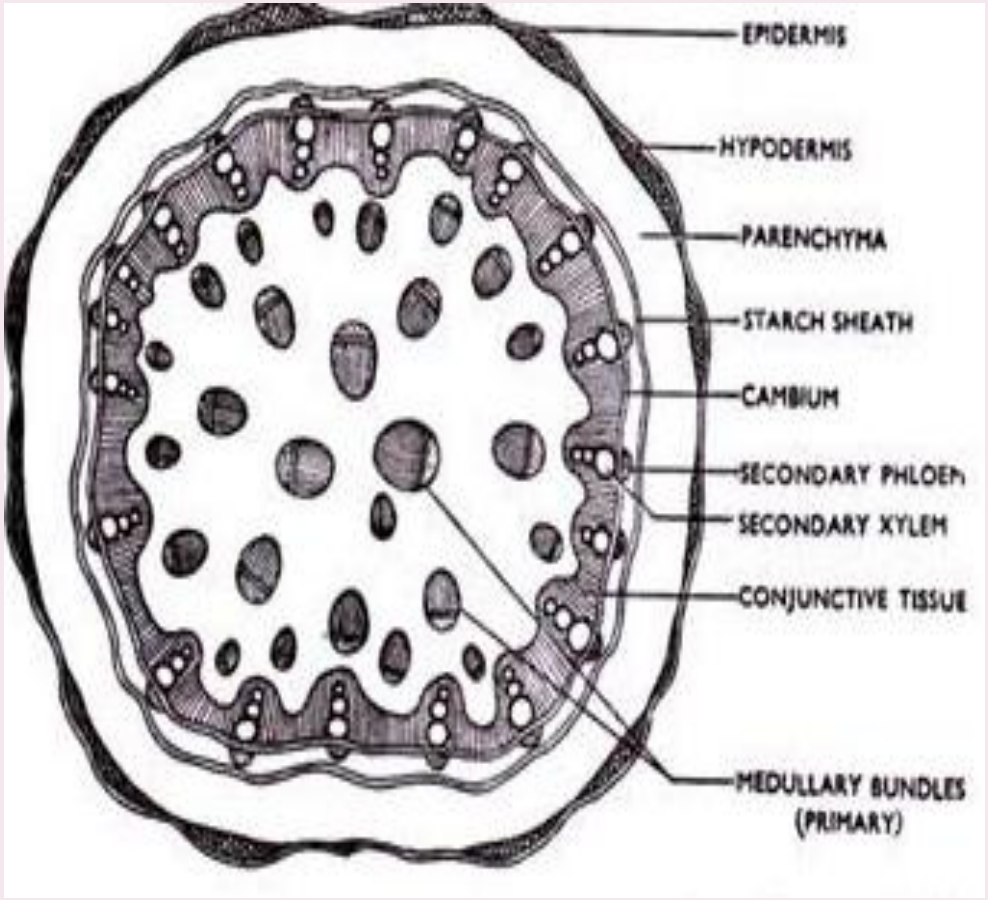


Transverse section of stem of *Boerhaavia* sp. (diagrammatic).

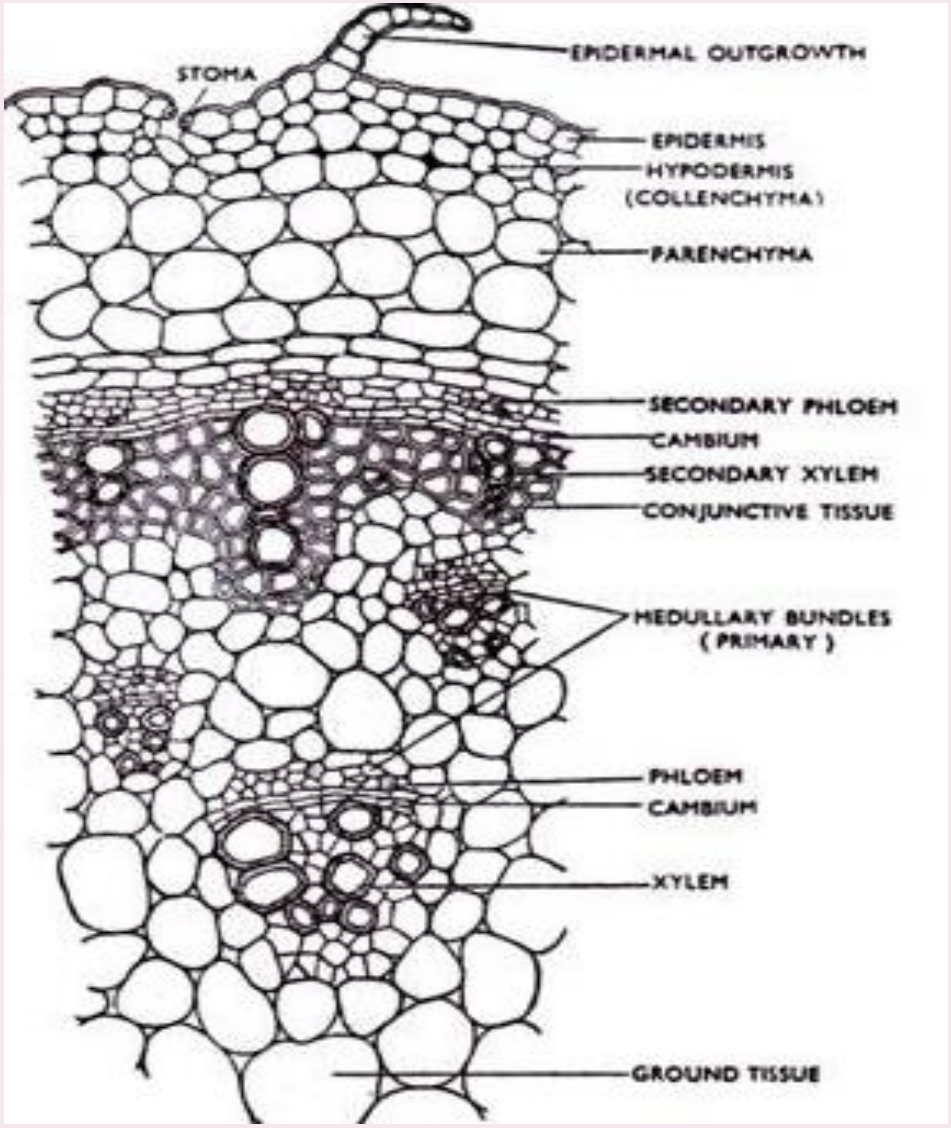
Secondary increase in thickness is due firstly to the formation of a continuous cambium cylinder in the outer ring. These cells form secondary xylem and secondary phloem in the fascicular region and lignified conjunctive tissue in the inter-fascicular region.

The activities of this cambium decline soon and a new cambium arise in the parenchyma outside fact, passing through the pericycle. In this manner other cambia may arise outside producing a few growth rings. The newly-formed bundles remain embedded in hard lignified conjunctive tissue. Scanty secondary phloem is formed outside opposite to the xylem vessels.

The stem of Mirabilis jalapa of the same family is rather quadrangular in outline. It more or less resembles that of Boerhaavia, but the medullary bundles are more numerous. Those occurring towards periphery are smaller in size and more crowded, whereas those at the central region are larger and more spaced out.

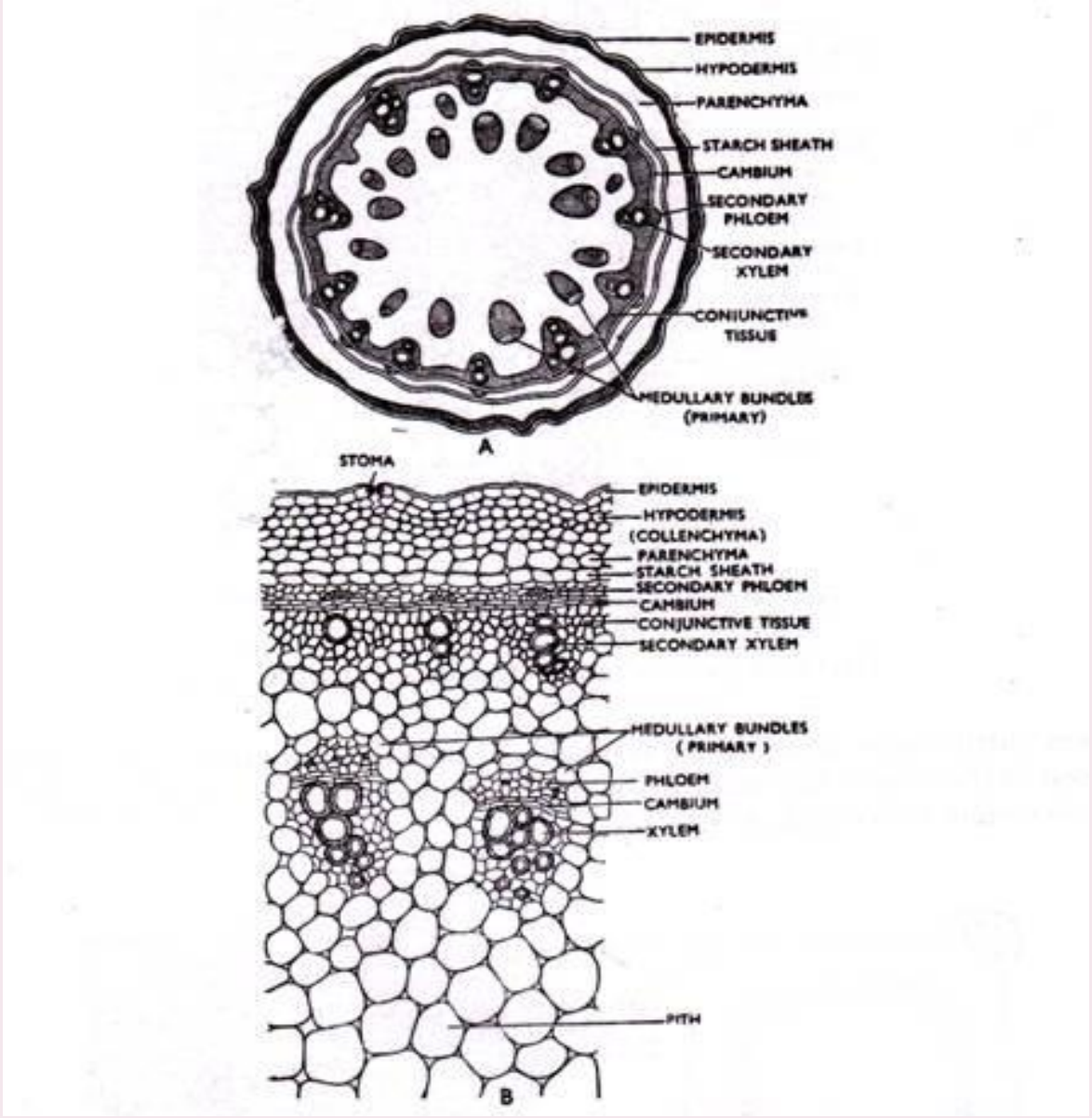


Secondary growth is initiated by the formation of secondary cambium originating in the same manner as in **Boerhaavia**. This cambium cuts off secondary tissues, usually secondary xylem elements on the inner side which remain embedded in the conjunctive tissue. Secondary phloem elements are occasionally formed. The cambium produces very little secondary tissues on the outer side.


STOMA
EPIDERMAL OUTGROWTH
EPIDERMIS
HYPODERMIS
(COLLENCHYMA)
PARENCHYMA
SECONDARY PHLOEM
CAMBIUM
SECONDARY XYLEM
CONJUNCTIVE TISSUE
MEDULLARY BUNDLES
(PRIMARY)
PHLOEM
CAMBIUM
XYLEM
GROUND TISSUE

Amaranthaceae also shows anomalous secondary growth. The transverse section is more or less circular in outline with uniseriate epidermis. The ground tissues are well-differentiated. Collenchyma cells occur in the hypodermal region interrupted by chlorophyll-containing parenchyma cells here and there.

The vascular bundles are medullary ones. They are large in number and remain scattered in the pith. The bundles are collateral and open. Cambial activity is confined to the individual bundles, and it ceases soon. Secondary growth occurs due to development of a new meristem— the secondary cambium outside the stele. The cambium cuts off similar bundles with xylem on the inner side and phloem on the outer side. The secondary bundles remain embedded in thin-walled conjunctive tissue, which is wavy in outline on the inner side.

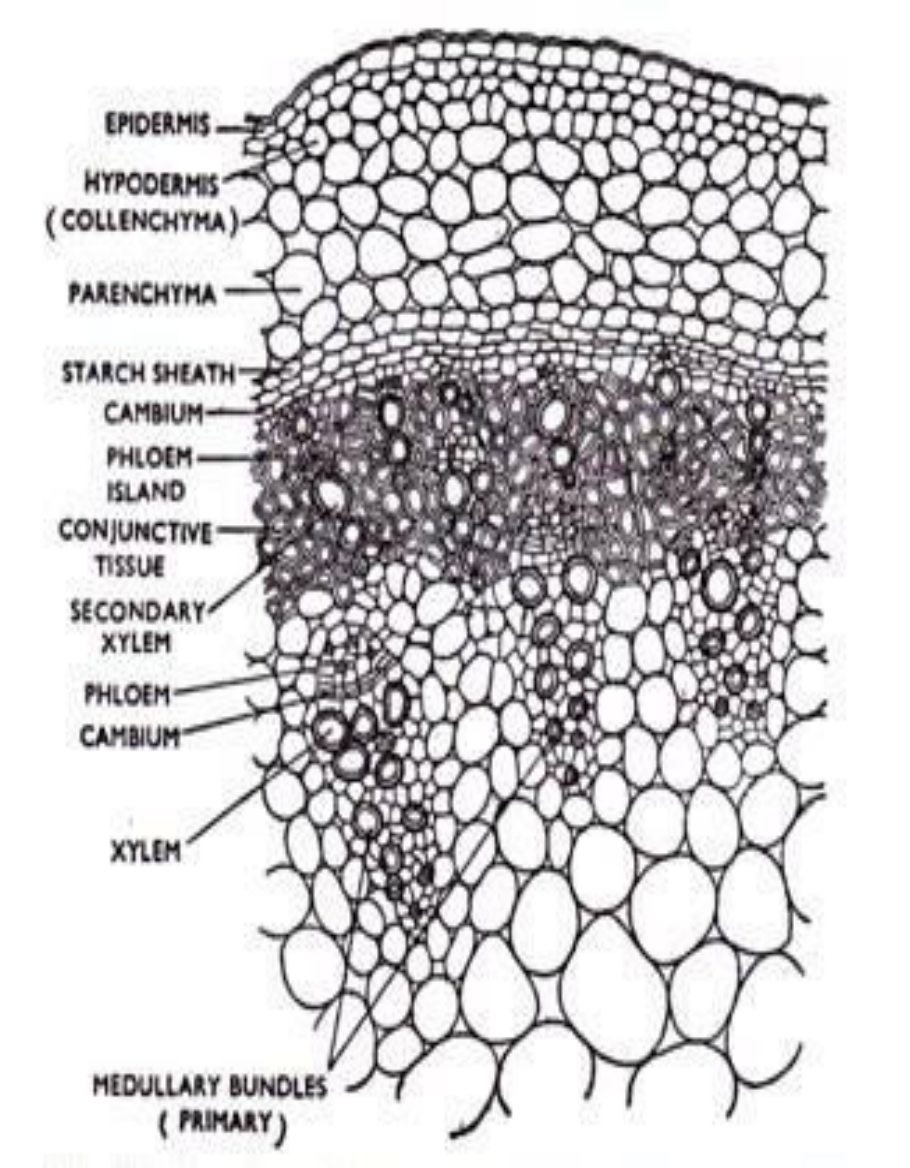


Stem of *Amaranthus* with anomalous structure. A. T.s. of stem (diagrammatic). B. Magnified view of a part showing the tissues.

In the stem **of Chenopodium album** of family Chenopodiaceae there is a concentric ring of primary bundles (medullary) which are collateral open ones. They grow in thickness to some extent and then a peculiar anomalous secondary increase ensues when concentric zones of collateral vascular bundles arise from successive rings or arcs of secondary cambium originating in the pericycle or phloem.

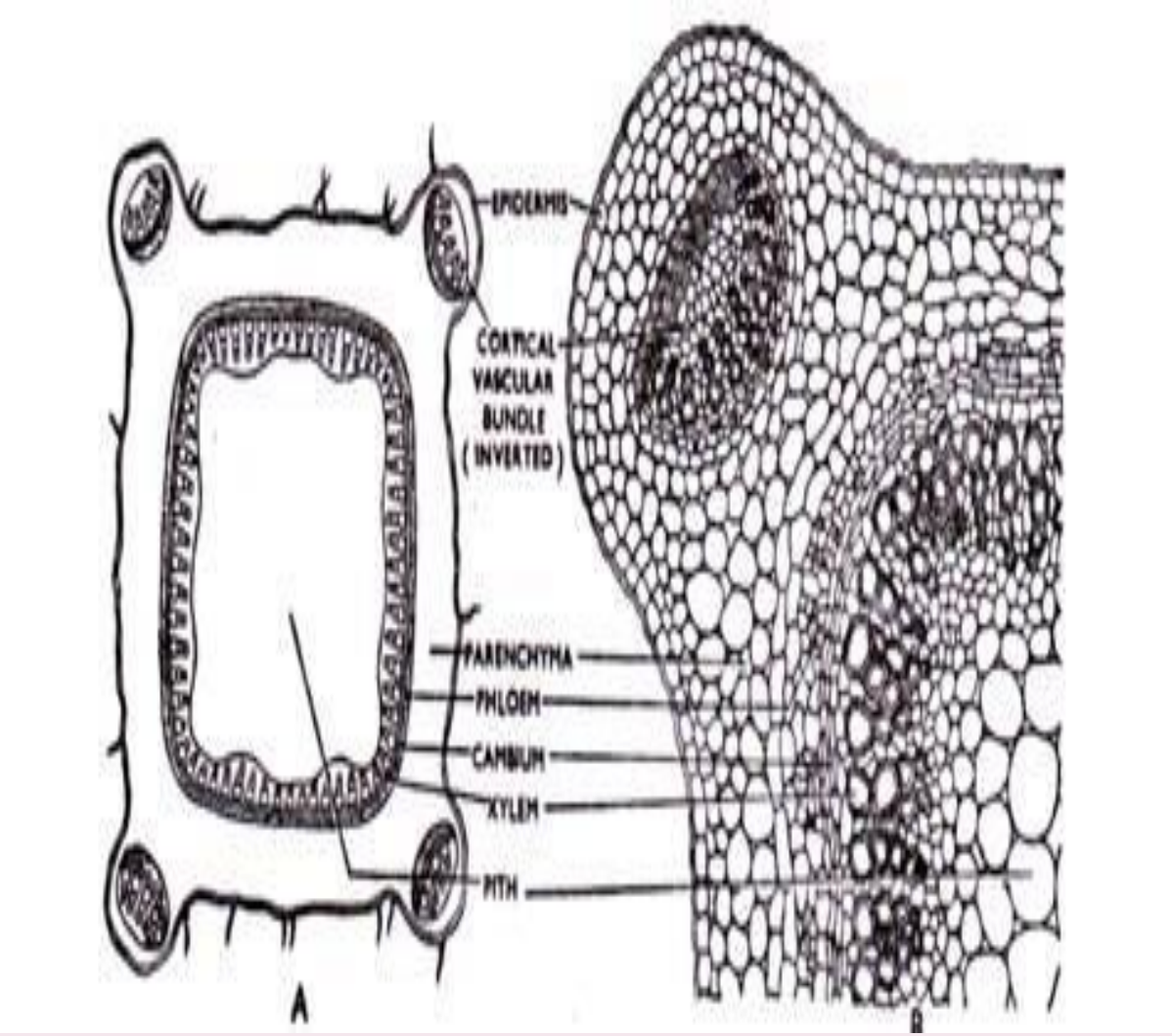
Conjunctive tissues with lignified walls are also formed by the secondary cambium in which the bundles remain embedded. A very interesting feature is the occurrence of isolated strands of phloem, called phloem islands, buried in the secondary xylem.

It becomes possible because phloem patches arise centrifugally as usual, and then short arcs of secondary meristem develop on their outer side, which go on producing normal tissues, resulting in the complete enclosure of the phloem patches.



T.S. of Chenopodium Stem

In the stem of **Nyctanthes** of the family Oleaceae (apart from normal vascular bundles occurring in more or less a ring, there are four cortical bundles at the ridged portions of the stem. These bundles are inverted. They are obviously leaf trace bundles. The central vascular bundles are rather compact collateral open ones with intervening patches of parenchyma in form of rays.


EPIDERMIS
CORTICAL
VASCULAR
BUNDLE
(INVERTED)
PARENCHYMA
PHLOEM
CAMBIUM
XYLEM
PITH
A
B

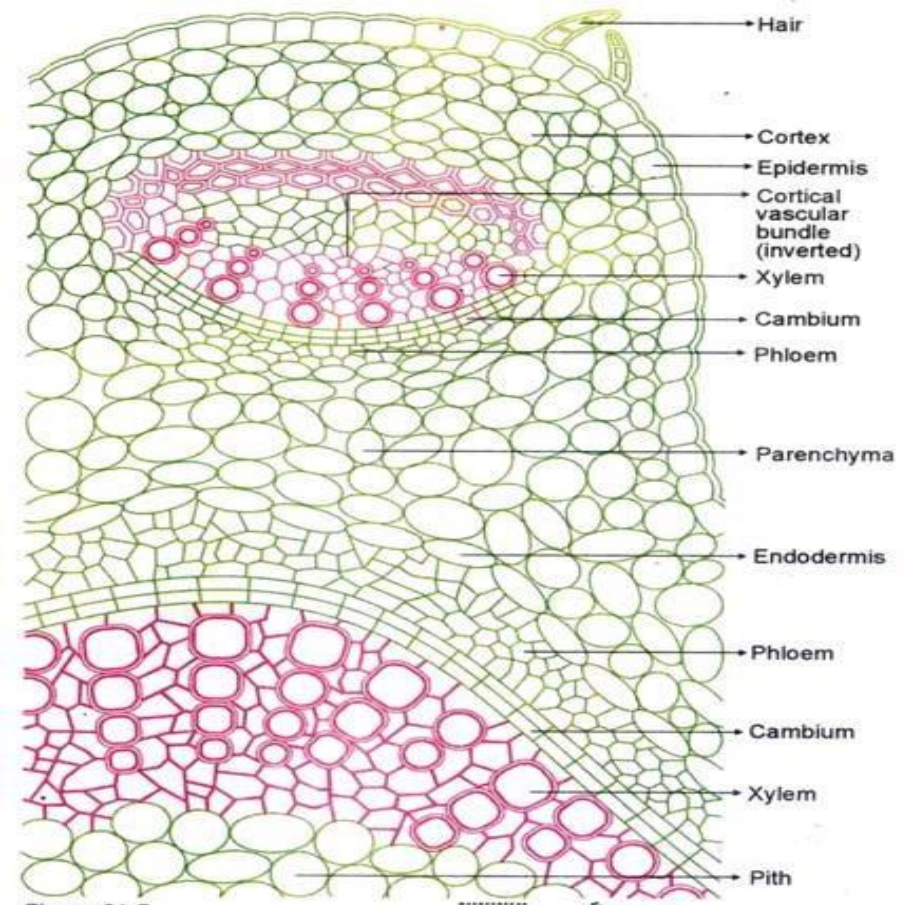
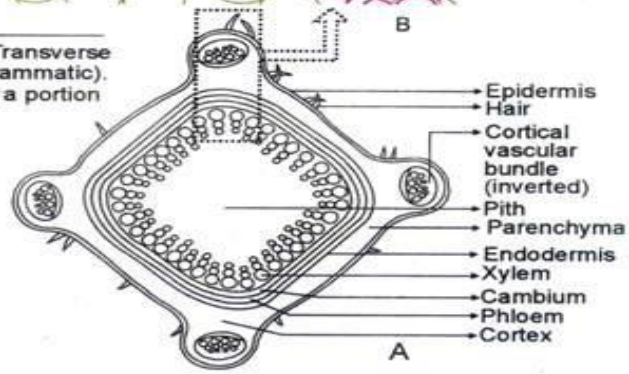


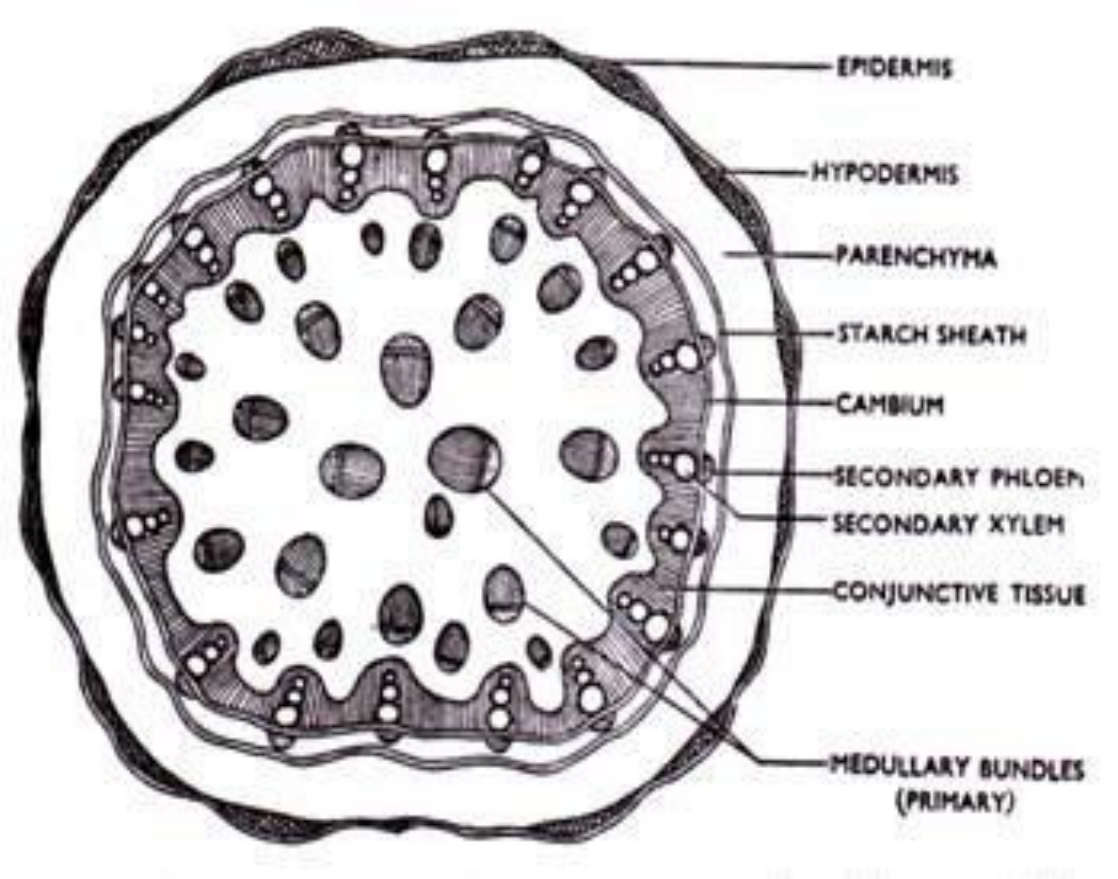
Figure 31.5

Nyctanthes stem. A. Transverse section of stem (diagrammatic). B. Cellular drawing of a portion of A.



The stem of **Mirabilis jalapa** of the same family is rather quadrangular in outline. It more or less resembles that of Boerhaavia, but the medullary bundles are more numerous. Those occurring towards periphery are smaller in size and more crowded, whereas those at the central region are larger and more spaced out (Fig. 654).

Secondary growth is initiated by the formation of secondary cambium originating in the same manner as in Boerhaavia. This cambium cuts off secondary tissues, usually secondary xylem elements on the inner side which remain embedded in the conjunctive tissue. Secondary phloem elements are occasionally formed. The cambium produces very little secondary tissues on the outer side.



T.S. stem of Mirabilis jalapa

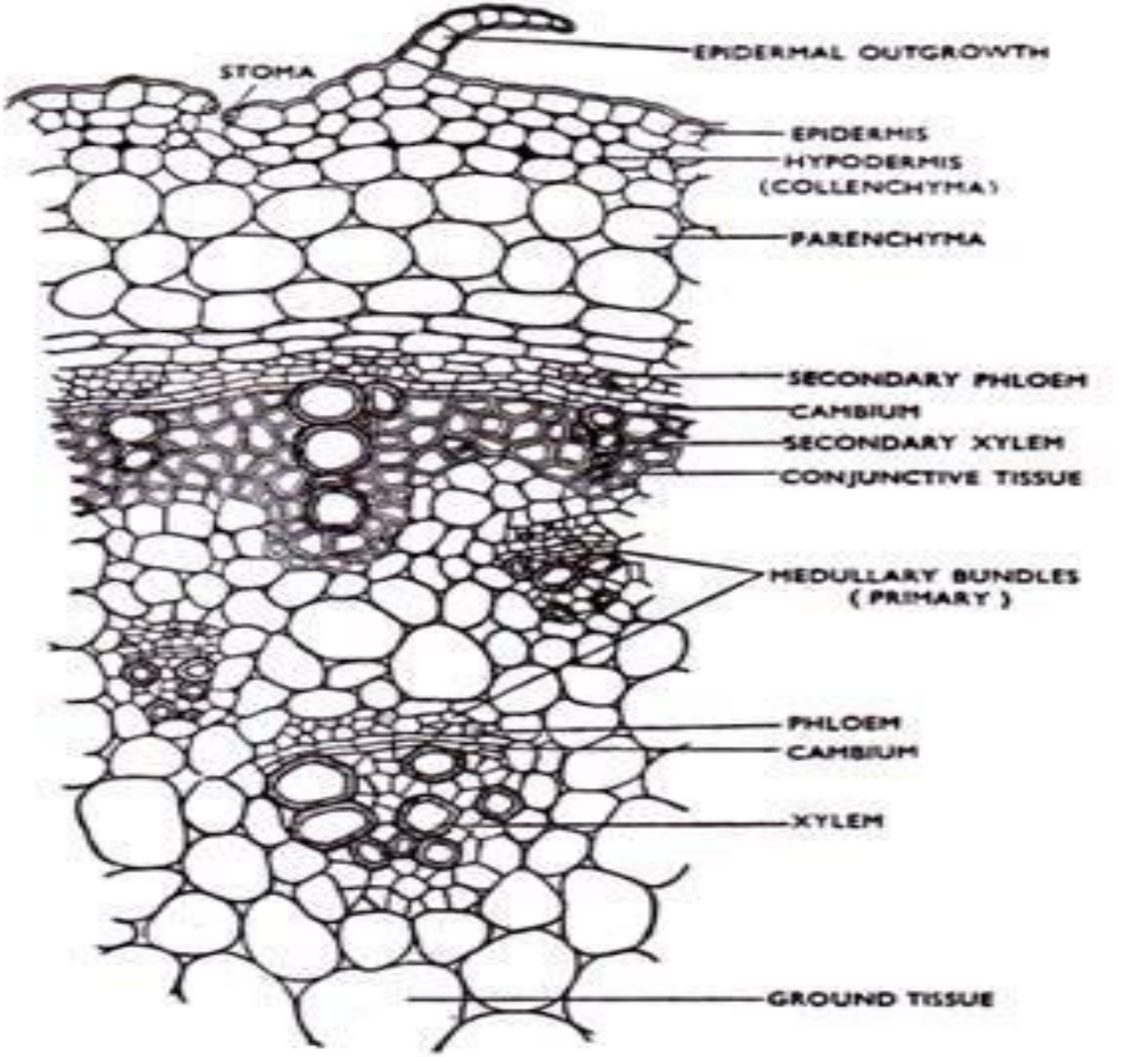


FIG. 655. A portion of stem of *Mirabilis jalapa* in transverse section.


THANKS
FOR
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