Cycas sp

Order : **Cycadales**
Family : **Cycadaceae**
Type : **Cycas Linn.**

Distribution and General Characters of Common Indian Species

This chapter is devoted to the life history of *Cycas* the only representative of the family met within India. Only six species of *Cycas* grow wild in India. These are :

1. *Cycas circinalis* L. (plate I). It is widely distributed in the dry deciduous forests of Southern India. Sago is extracted from its stem and seeds.

2. Cycas beddomei

3. Cycas pectinata

4. Cycas rumphii

5. Cycas siamensis

6. Cycas revolute

General Morphology

The plant, which belongs to the sporophytic generation, is differ entiated into root, stem and leaves. The stem in the young plants, is stout, almost tuberous and subterranean, the top bear ing a crown of spirally arranged leaves. The growth is very slow but it lives to a great

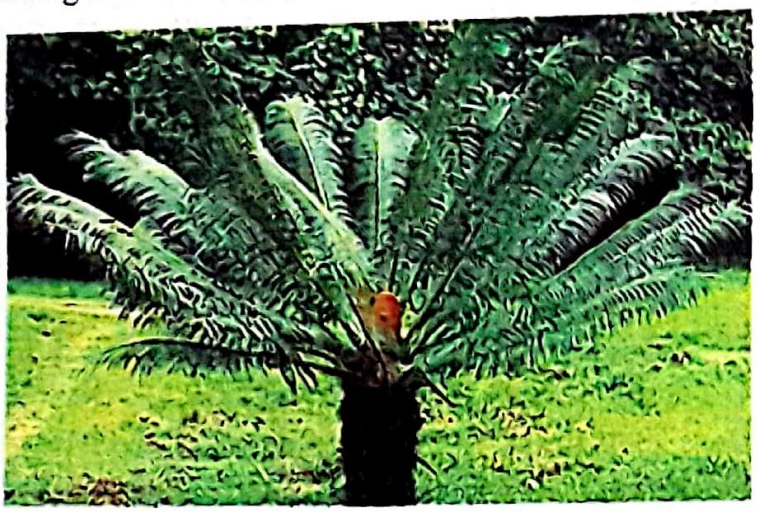

Plate I : Plants of *Cycas circinalis*

Plate II : *Cycas revoluta.*

age. In the course of time the stem builds up into an aerial thick columnar normally unbranched trunk from the summit of which arises a crown of large fern-like leaves (Plate III). It resembles in its appearance the tree ferns or some palms. The older parts of the stem are covered with an armour of persistent woody leaf bases. They closely cover the stem and fortify it. The stem bears adventitious buds at the base. They are large and are covered with scales. They are often called the **bulbils** and serve as a means of vegetative propagation (Plate IV). The leaves are of two kinds :— They are arranged in close spiral succession alternating with each other. The alternating clusters of persistent leaf bases of foliage and scale leaves are of different thickness and give the stem a rugged appearance. The scale leaves are brown and are far more numerous than the foliage leaves. They are persistent and protective in function. They cover the stem apex and offer protection to the young foliage leaves. The foliage leaves are large, compound and pinnately divided into many leaflets (Fig. 9.1).

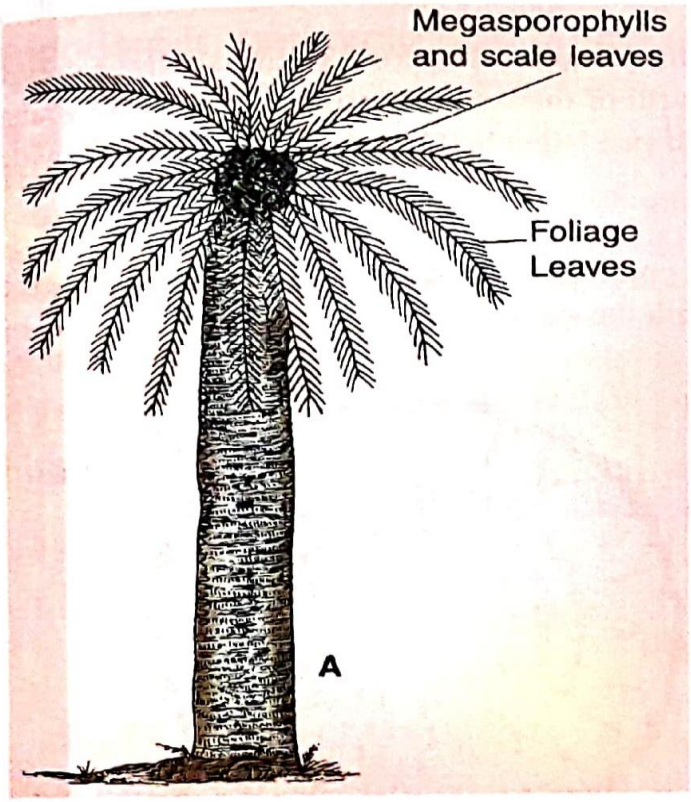

Fig. 9.1. External features of Cycas. *A, C. revoluta; B, C. circinalis.* Note the position of megas porophylls

They are pari-pinnate and the pinnae are closely set on the rachis and are sessile. Some of the lower pinnae may be rather tough and leathery in texture showing their xerophytic nature. The *Cycas* leaves are extensively used for floral decorations. The pinnae are linear in outline with a narrowed structure. The margin is curved downwards and inwards. The revolute margin of the leaflets has given the plant its specific name (*C. revoluta*). Each leaflet is traversed by a single mid-rib. Like the ferns the rachis is incurled and the leaflets are inrolled in the bud condition. The ptyxis is thus of **circinate** type, a new cluster of leaves is formed every year or every second year. In the interval, the succession is kept up by the production of scale leaves.

The primary root persists and forms a **tap-root system**. The main tap root may be long but usually it is short and thick. Some of the lateral roots give out branches which become apo-geotropic, grow vertically upward just below the ground level. They branch repeatedly to form dwarfed dichotomously branched coral-like masses. They are called the **coralloid roots** or **corallorhiza.** They become inhabited by a blue green alga, *Anabaena cycadacearum*. The surface of the coralloid roots is beset with lenticel-like apertures which suggest that they are respiratory in function.

Plate IV : *Cycas revoluta* young leaves.

Pant and Das (1990) have reported the presence of non-coralloid aerial roots in *C. revoluta* and *C. rumphii*. These are positively geotropic adventitious roots and grow out from the lower *sides* of young and old bulbils or leafbases while still attached to that plant. Occasionally these roots are branched. Anatomically these roots are di-to polyarch with wide cortex, mixed parenchymatous pith and scattered xylem elements.

Anatomy of the stem

The stem anatomy is simple and shows certain primitive features. There is a large cortex and pith but a small wood as compared with the girth of the stem. A cross section of the young stem is irregular in outline owing to the presence of persistent leaf bases. It shows the following structures :—

Epidermis

The outer protective layer, the epidermis is discontinuous and ruptured owing to the presence of the persistent leaf bases which completely ensheath the stem.

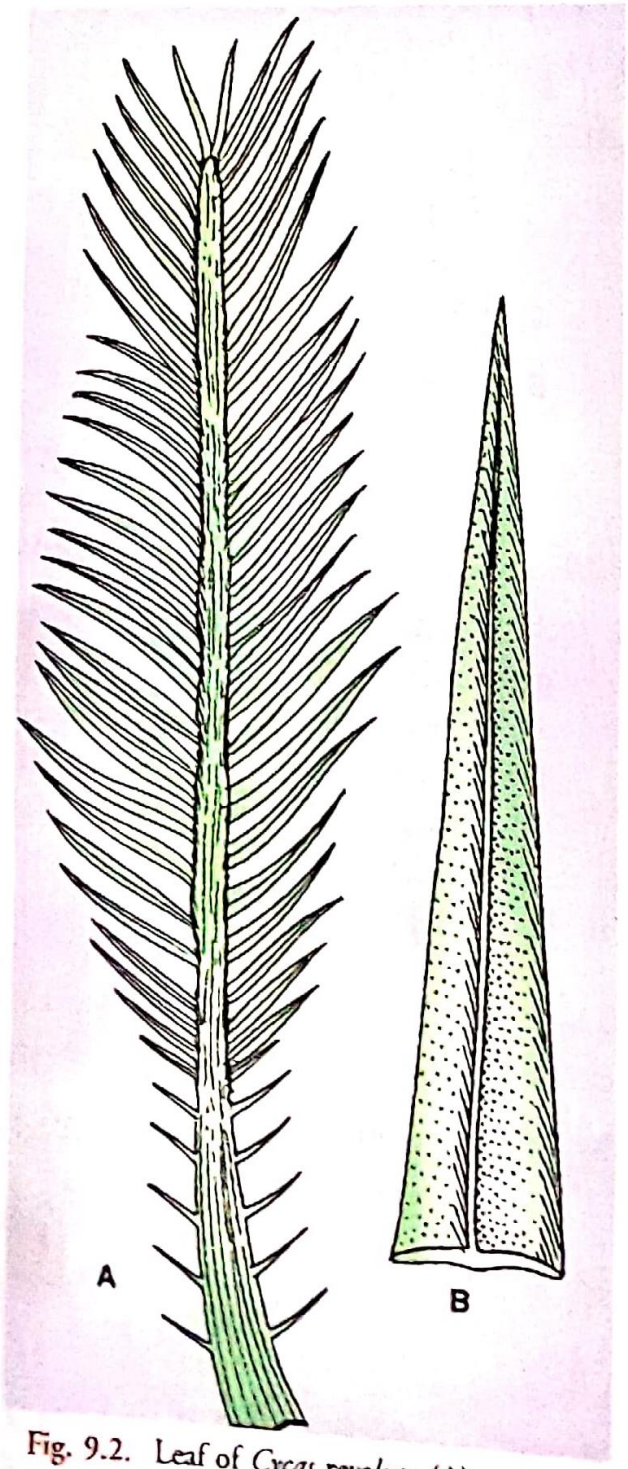

Fig. 9.2. Leaf of *Cycas revoluta* (A) and its leaflet (B).

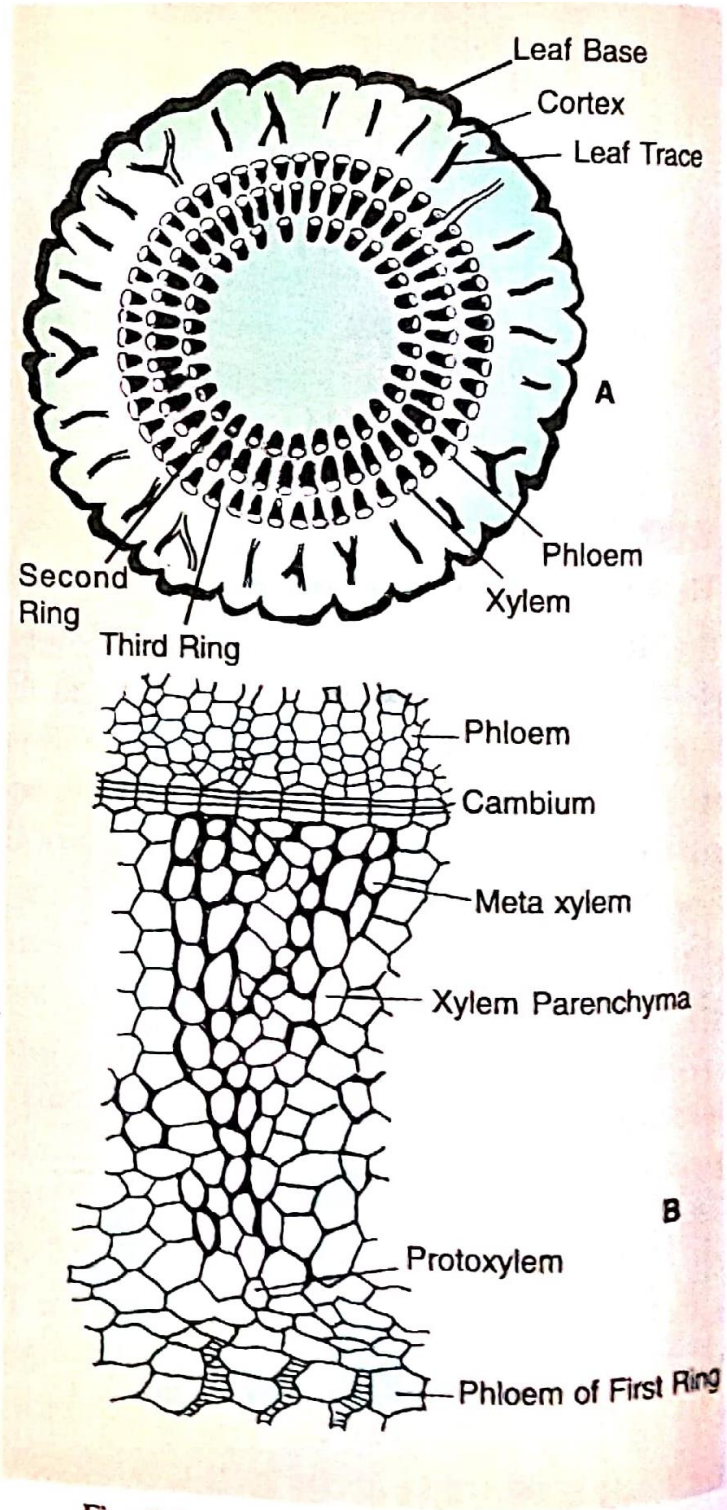

Fig. 9.3. Anatomy of stem of *Cycas revoluta*. A. outline diagram of T.S. stem; B. T.S. of a part of vascular bundle of first ring.

Cortex

It forms the greater bulk even in old stems and consists of thin-walled, parenchymatous cells densely filled with starch grains. Numerous mucilage canals are found in this region. They are connected with the mucilage canals of the pith by medullary rays. The occurrence of peculiar curving leaf traces, the girdles in the cortex, is a striking feature of the stem anatomy of *Cycas*. We shall refer to them in detail afterwards.

Endodermis, pericycle and a narrow vascular cylinder

Endodermis and pericycle are not distinct. The vascular cylinder consists of a primary ring of numerous small closely set vascu lar bundles. The bundles are conjoint, open, collateral and endarch. The xylem consists only of **tracheids** (Fig. 9.3 A) and xylem parenchyma. There are no wood **vessels.** The protoxylem has tracheids with spiral thickenings and the metaxylem with scalariform thickenings and bordered pits in several alternating rows on the radial walls. The phloem contains **sieve tubes** with sieve plates on the oblique end walls, and **phloem parenchyma** (Fig. 9.3 B). There are no companian cells. The primary cambium lies between the phloem and the xylem. It remains active only for a short time, but is succeeded by another, the **secondary cambium** which may arise in the pericycle or the cortex. It also dies. In this way several rings of cambium may be formed.

Medullary rays

There are well developed **medullary** rays between the vascular bundles. They are fairly broad and deep.

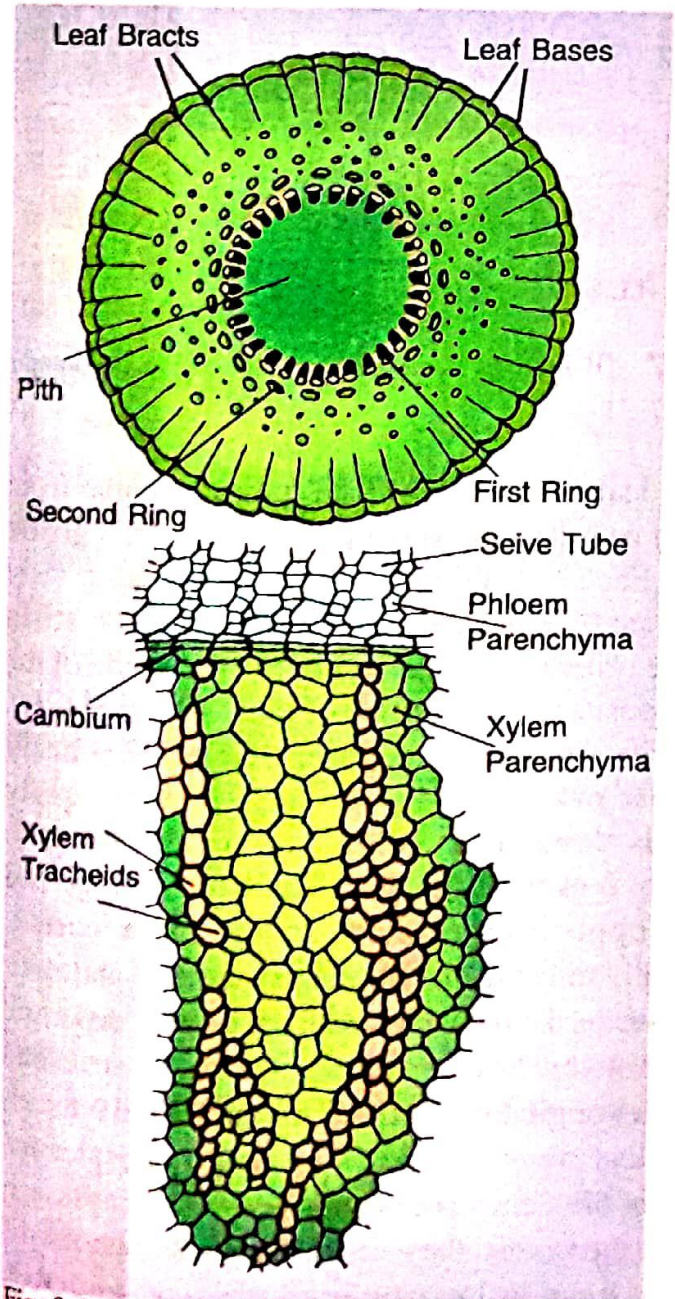

Fig. 9.4. Stem anatomy of *Cycas revoluta.* A. T. S. of stem showing 3 rings of vascular bundles; B, A vascular bundle of secondary ring.

Pith

The pith is large and consists of parenchymatous cells rich in starch. It is traversed by numerous mucilage canals.

Leaf Traces

The vascular supply to the leaves in *Cycas* is peculiar and interesting. The noteworthy feature is

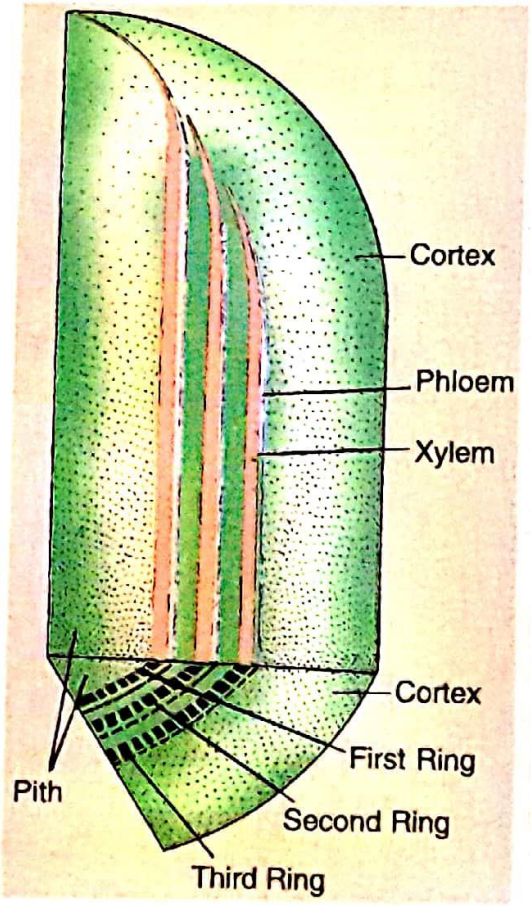

Fig. 9.5. Diagrammatic radial and transverse aspects of stem of *Cycas revoluta* showing concentric rings of vascular bundles.

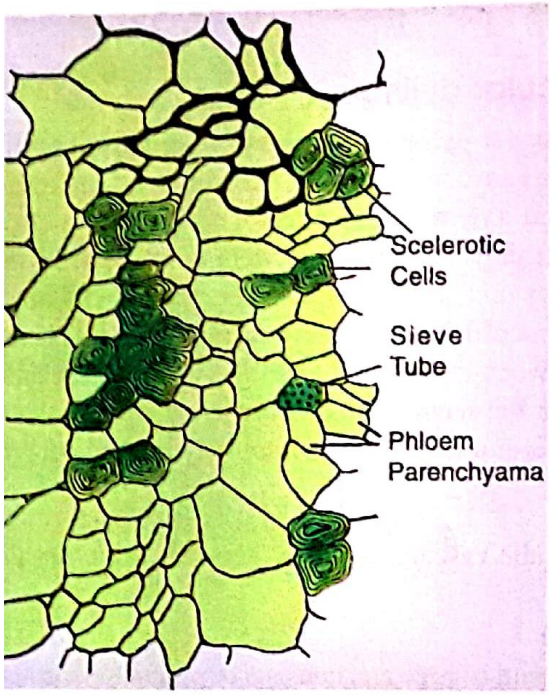

Fig. 9.6 Portion of vascular bundle of stem showing the details of phloem in a T.S.

that the leaf traces do not take a direct course from steles to petiole; as in other plants but form a **girdle system.** Each leaf is supplied by two leaf traces. They are formed by the division of one trace which arises from the primary vascular cylinder on the side of the stem opposite to the insertion of the leaf (Fig. 9.4, B). It takes its origin from the inner edge of the primary xylem. It passes out of the ring, runs obliquely outwards through the cortex and divides into two halves of leaf trace bundles. The latter diverge and run in opposite directions in the outer cortex. Eventually they meet at the base of the leaf and enter the petiole on the opposite side from point of departure from the stele. These converging leaf traces are called the girdles or **girdle bundles.** This girdling of the stem by the leaf traces is a striking and a conspicuous feature of the stem anatomy of *Cycas*. In their passage through the cortex they cross the girdle bundles of the other leaves in their group and are linked by cross connections with each other, with other leaf trace bundles of other leaves in the same group and with

the **radial traces** arising from other points around the vascular ring. The two girdle bundles enter the leaf base and divide repeatedly to form a large number of bundles which are arranged in the horse-shoe (omega) pattern characteristic of the petiole (Fig. 9.7). In the seedling and the cones the girdles are absent. The leaf trace bundles take a direct course from the stele of their destination. The girdles function as supporting structures to the trunks of old plants. The girdle bundles (Fig. 9.7) are collateral with xylem facing inwards. The xylem elements are scalariform as in **ferns** and are centrifugal. The protoxylem is endarch. During their passage up in the petiole, a centripetal mass of xylem appears on the other side of the protoxylem and the centrifugal xylem gradually diminishes. In this way the bundle structure is modified. It consists of a mass of centripetal xylem and a remnant of centrifugal xylem (Fig. 9.8). The latter is separated from the protoxylem by parenchymatous cells. Such bundles are called mesarch. They are characteristic of the ferns. It is a primitive character and indicates the antiquity of the *cycadales*. Presence of two xylem types gives them the name **diploxylic bundles**.

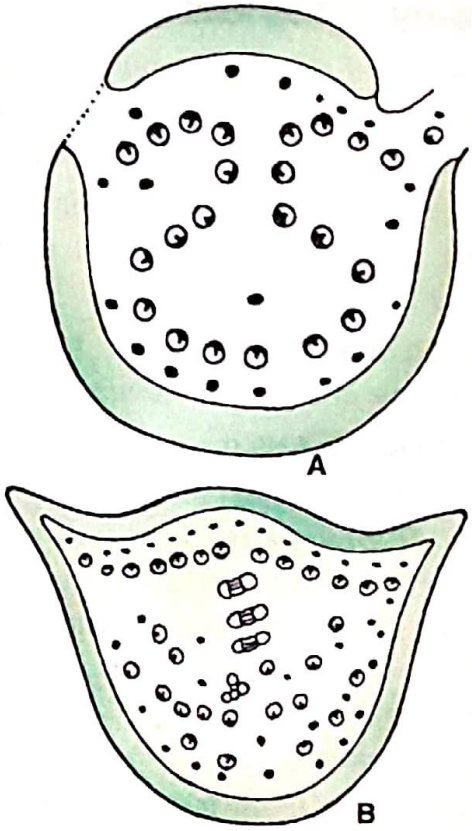

Fig. 9.8. Outline diagrams of petiole of Cycas as seen in a transverse section; they show the omega-like or horse-shoe-like arrangement of the vascular bundles. A. Section cut through the middle region of the petiole. B. Section cut through the base of the petiole.

Secondary growth (Fig. 9.7)

Secondary thickening takes place in the same manner as in the dicotyledonous stem but is not so vigorous. The ring of vascular bundles slowly increases in size radially by means of cambium which forms secondary xylem to the inside and secondary phloem to the outside. As a result a continuous vascular ring is formed. The medullary rays become narrow. The primary cambium then dies and is succeeded by a secondary cambium formed outside the secondary zone derived from the primary cambium. It is formed in the pericycle or the cortex. It forms the second ring of wood concentric with the first. The secondary cambium also perishes and is superseded by a third. It arises outside the second vascular ring. In this way several rings of secondary wood may be formed. The xylem and phloem elements of the rings are normally orientated. Areas of the inverted bundles may occur here and there between the normal rings.

With the formation of the secondary vascular tissues, the outer tissues of the stem are subjected to tangential pressure. Eventually they rupture, but before this take places a special protective tissue the corky periderm is formed outside the cortex by the activity of a special cambium which arises in the outer cortex immediately below the epidermis. This cambium is a secondary meristem. It is called the **phellogen** or **cork cambium.** By repeated division of the phellogen cells a tissue is formed to the exterior. It is the **cork.** It forms the stem surface in the lower part of the very old stem replacing the outer armour of leaf bases.

The anatomy of the stem of *Cycas* presents certain interesting features. They are, the large pith and cortex traversed by numerous mucilage canals, thousands of girdle bundles in the cortex, scanty wood region, short lived primary cambium with well developed broad medullary rays, and several rings of secondary vascular tissue formed by successive rings of cambium formed independently in the cortex or pericycle regions The wood formed is known as *manoxylic*.