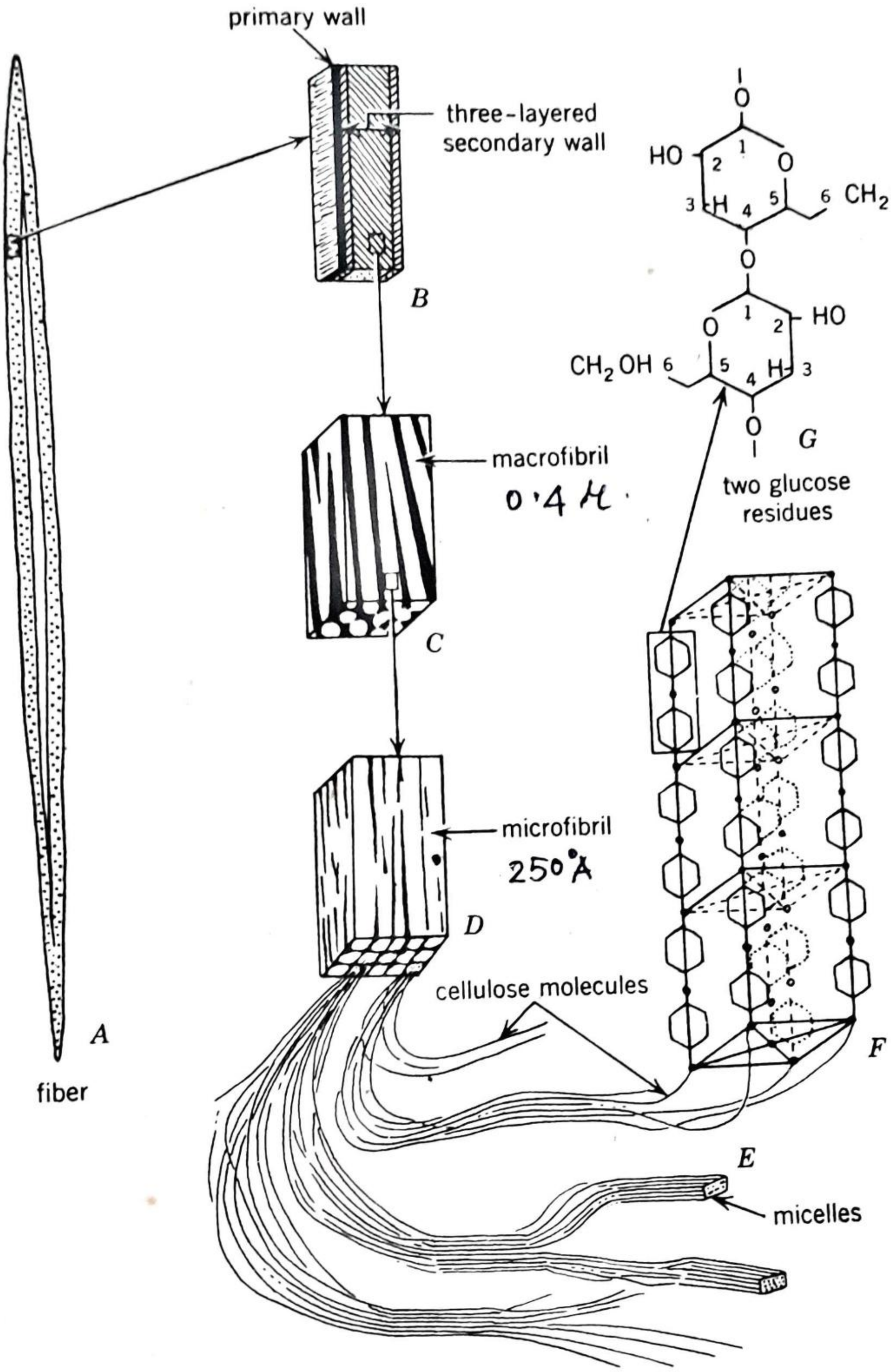


FIG. 3.6. Interpretation of wall structure. Fiber (*A*) has a three-layered secondary wall (*B*). In a fragment of the central layer of this wall (*C*) the macrofibrils (white) consist of numerous microfibrils (white in *D*) of cellulose interspersed by microporosities (black) containing noncellulosic wall materials. Microfibrils consist of bundles of cellulose molecules, partly arranged into orderly three-dimensional lattices, the micelles (*E*). Micelles are crystalline because of regular spacing of glucose residues (*F*). These residues are connected by β-1,

Wyssling, 1959; Roelofsen, [illegible] wall was the main object of study, but with refinement of methods the primary wall also came to be successfully investigated. The particular significance of research on primary walls is that it yields information on the methods of growth of cell walls in surface area.

Structural Elements

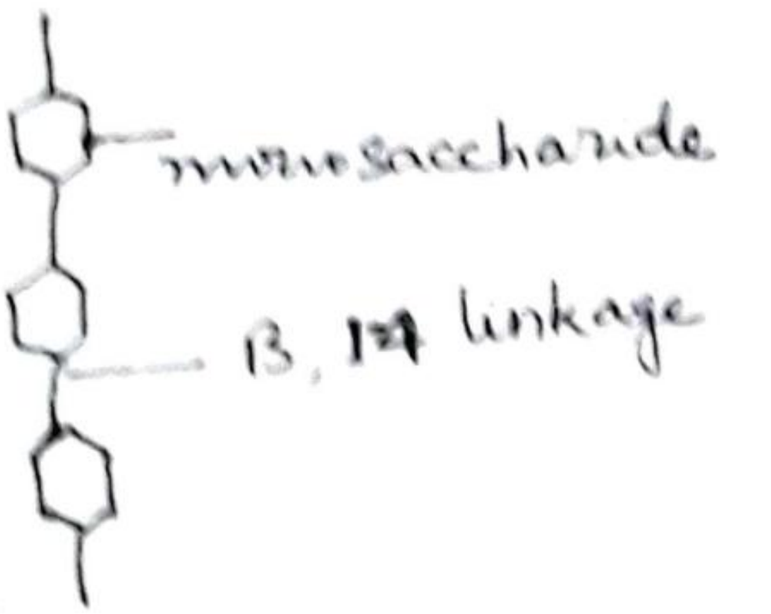
The architecture of cell walls is based on cellulose. As was mentioned previously, cellulose occurs in the form of long chain molecules. These molecules are not dispersed at random in the wall but are combined into bundles of different classes of magnitude ranging from those barely discernible with the electron microscope to those visible with the light microscope. Frey-Wyssling (1959) graphically describes these structural elements and their interrelations on the basis of the secondary wall of the ramie (*Boehmeria*) fiber. One *cellulose molecule* has only 8 Å maximum width and, therefore, has not yet been resolved with the electron microscope. It may be classified as amicroscopic. Cellulose molecules are combined into an *elementary microfibril* that has a widest diameter of 100 Å and is discernible with the electron microscope. It contains 100 cellulose molecules in a transection. Both the cellulose molecules and the elementary fibrils are ribbon-like structures. Elementary fibrils form a bundle called a *microfibril*, which is 250 Å wide and contains 2,000 cellulose molecules in a transection. Electron microscope studies on cell walls are concerned mainly with this unit (fig. 3.6*D*, pl. 13*A*). Microfibrils are combined into *macrofibrils*, 0.4 micron wide and containing 500,000 cellulose molecules in transection. Finally, 2,000,000,000 cellulose molecules make up a transection of the secondary wall of the fiber.

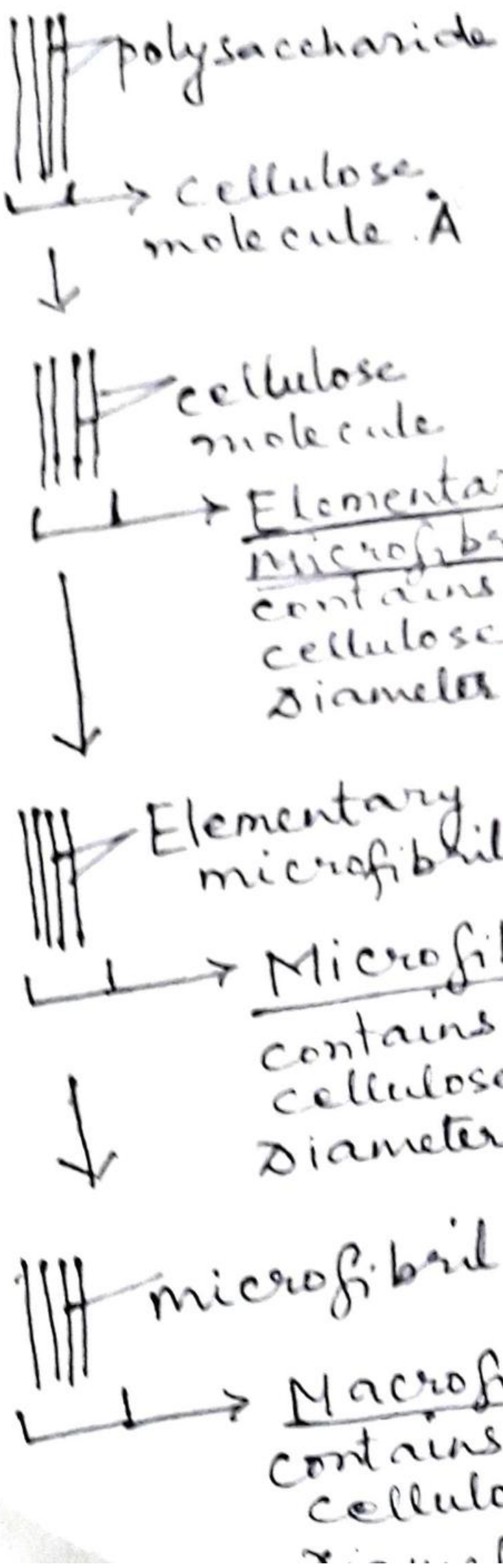
The concept of the elementary fibril is not generally accepted but the existence of units intermediate between the microfibrils and the cellulose molecules is recognized (fig. 3.6*D*). From a morphological aspect the microfibril is used as the basic structural unit of the cell wall (Wardrop, 1962).

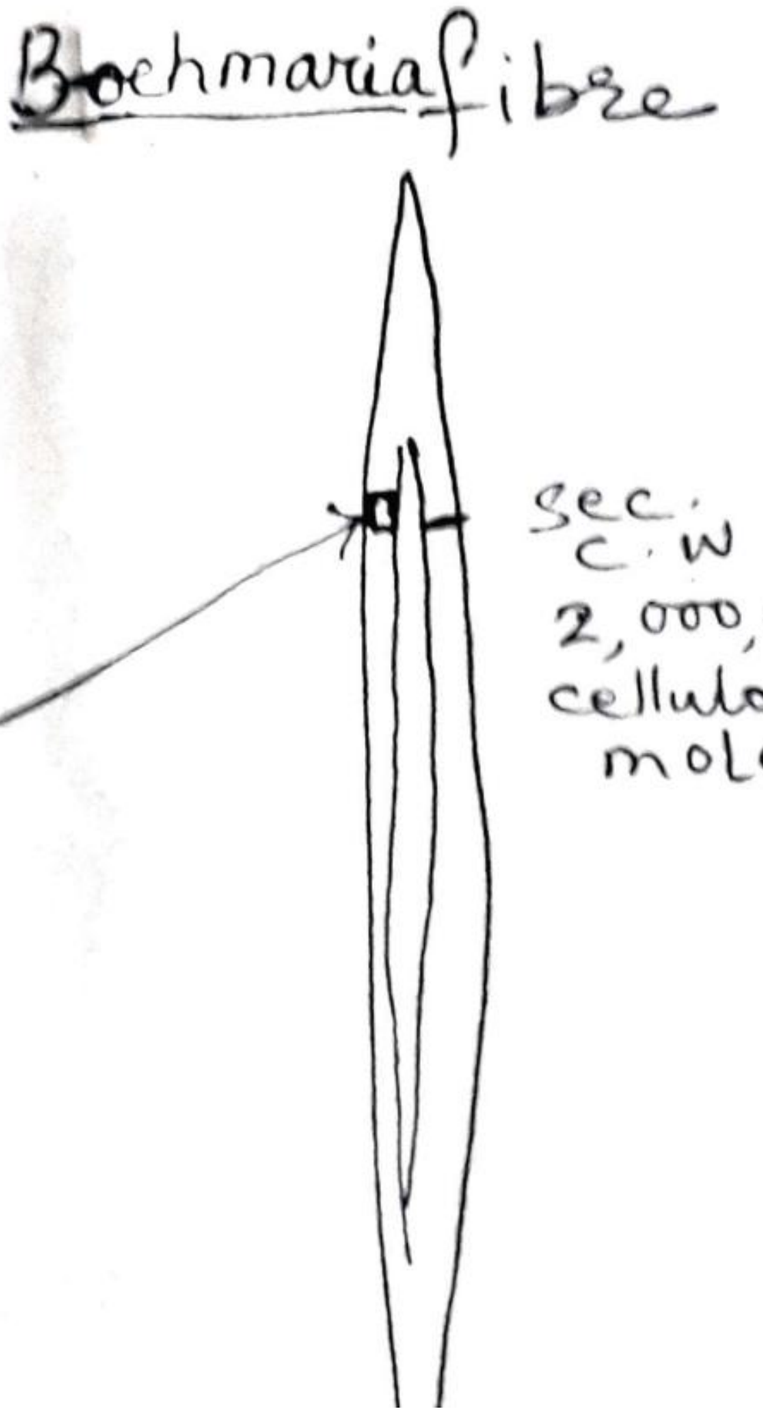
Crystallinity of Cellulose

The crystalline properties of cellulose are a result of an orderly arrange-

Ultra Structure of C.W. after Esau 1964







The Cell wall

Most plant cells have bough and semirigid cell-wall which is non-living in nature. The presence of cell wall in plants differen-
- tiates them from animal cells.

The C.Ws have 3 layers.
1 Primary cell wall.
2 Secondary C.W
3 Middle Lamella.

1 Primary cell wall.
Constituents - cellulose, hemicellulose, polysacch-
-rides.
Physical properties:- Thin and elastic.
Stretches with the growth of cell. Transparent

2. Secondary cell wall.
Constituents - cellulose, hemicellulose.
polysaccharides, lignin, Suberin waxes. Subera
tannins calcium carbonate
Physical properties less flexible and
loses elasticity. Translucent to opaque

3. B. Middle Lamella
Constituents:- Calcium Pectate and
Magnesium pectate
Physical properties - Amorphous.
Homogeneous substance. Opaque