THE HISTOLOGY OF THE STEM AND ROOTS OF HIBISCUS ESCULENTUS, OKRA OR GUMBO

BY

LEONARD NATHANIEL TRACHTE

A THESIS
SUBMITTED FOR THE
DEGREE OF
GRADUATE IN PHARMACY

UNIVERSITY OF WISCONSIN

1924

The Histology of the Stem and Roots of Hibiscus esculentus; Okra or Gumbo

Botany and Geography of the plant.

Hibiscus esculentus L., commonly called okra or gumbo[a], is a tropical annual belonging to the family of Malvaceae, This family includes some important economic plants, of which cotton and okra have the greatest commercial value, and such ornamentals as the abutilons and many species of hibiscus and mallow. The okra plant somewhat resembles that of the cotton, though having much larger and rougher leaves and a thicker stem. Its flowers are similar to those of the cotton in size, shape and color; are always single, there being very little variation between those of different varieties.

The original home of the okra plant is not definitely known, but it is either Africa, the West Indies, or Central America.

Reference to the American seed-trade catalogues will show that okra is entered therein under more than fifty varietal names, the greater number of which are synonyms. The pods have found use throughout the southern states, especially near New Orleans, where the employment of Creole

a. sometimes spelled gombo.

cooks has created a greater demand.

The principal use of okra is in soups and various culinary preparations in which meats form an important factor, as in the so-called gumbo soups, to which the young pods impart an excellent flavor, besides giving a pleasant mucilaginous consistency. The stem and mature pods contain fibre used in the manufacture of paper.

Varieties.

There are three general types of okra, namely, tall green, dwarf green, and lady finger. Each of these is again divided according to the length and color of the pods, making in all six classes or varieties, viz, tall green, long pod; tall green, short pod; dwarf green, short pod; dwarf green, long pod; lady finger, white pod; lady finger, green pod. All variations from these are merely the results of mixtures, no true crosses or hybrids being formed. These mixtures are easily separated and referred to the parent types, and a little attention to selection is necessary in order to keep the varieties pure.

Description of Types.

Tall Green--- Height of plant, four to eight feet; habit of growth, upright, not spreading, sometimes branching near the ground, but all stems erect, leaves large, borne on long petioles; pods in axils of leaves, on short stem; color of pods, green.

Tall green, long pod.--- Pods long, three to five inches when ready for marketing, seven to eleven inches when mature; five-eighths to one and one-fourth inches in diameter; five-to eight-sided.

Tall green, short pod.--- Pods short, one and one half to two inches when ready for marketing, three to five inches when mature; one to two inches in diamter; seven-to eleven-sided.

Dwarf green--- Height of plant, twenty inches to three and one half feet; habit of growth, bushy, spreading from near ground; leaves rather small, on slender petioles; pods green.

Dwarf green, long pod.--- Pods long, two to four inches when ready for marketing, six to ten inches when mature; five-eighths to one and one quarter inches in diameter; five-to eight-sided, tapering to point at blossom end, point usually curved inward toward the stem of the plant; leaves deeply cleft or divided.

Dwarf green, short pod.--- Pods short, one and one half to three inches when ready for marketing, three to six inches when mature; one and one half to two and one half inches in diameter, when fully grown; seven-to twelve-sided; leaves large, almost entire.

Lady Finger,--- Height of plant, about three feet, very much branched and of bushy habit; leaves large, borne on long petioles, the lower ones sometimes more than two feet in length. The entire plant is of a lighter color than either

of the other types. The only distinction between the varieties of this type is found in the color of the pods. Pods four to five inches long when ready for market, six to ten inches when mature; three-fourths to one and one-quarter inches in diameter when mature; slightly seven-to eight-angled; and covered with numerous hairs.

Lady finger, white pod.--- Pods greenish white or nearly white.

Lady finger, green pod.--- Pods pale green, in some cases nearly pure green.

Sections and Drawings.

The plant from which this study was made was two feet high, and nearly smooth. The leaves were from three to five inches long, rounded at the base and coarsely five-lobed. The flowers were yellow and on slender peduncles. The pods were from three to four inches long.

The material used in this study was preserved in commercial alcohol. Sections were cut by the free hand method, soaked in K OH solution to remove starch, and mounted in glycerin. All sketchesand drawings were made free hand.

A cross section of a young root (Plate I) shows a narrow region of cork at the outside, a narrow cortex, a broad phloem region in which are scattered groups of bast-fibres and narrow medullary rays. Inside the cambium is the wood region enclosing a small central pith. A closer study of

these tissues (Plate II) shows the cork to be composed of two or three layers of thin-walled rectangular cells. The cortex consists of four or five rows of large rounded parenchyma cells with intercellular spaces between. These cells contain many large starch grains and an occasional rosette crystal of calcium oxalate. Inside the cortex is the the wide phloem region in which the numerous bast-fibres are located. They are heavy-walled cells and can be easily distinguished. The medulary rays extend into the phloem and are made up of thinner-walled cells than the phloem. They are more or less square cells with numerous pits. Four or five rows of cambium,(Plate III) cells encircle the xylem. They are somewhat rectangular in shape. The xylem is made up of almost round, thick-walled cells with numerous intercellular spaces.

In the lengitudinal section of the young root (Plate IV) the length of the various cells may be seen. Several rows of narrow and somewhat elongated epidermal cells are followed by a wider portion of cortex. The latter contain starch grains and several rosette crystals of calcium oxalate. The cortex cells are somewhat longer and twice as wide as the epdiermal cells. Bast fibres and phloem cells are very long and extremely narrow with shorter and more rectangular cambium cells following. These cambium cells divide the

phloem and xylem, the latter consisting of a wide portion of large, elongated, heavily-pitted cells. Inside the xylem is the pith. These cells are round with many intercellular spaces.

A diagram of a cross section of a young stem (Plate VI) shows a narrow region of epidermis at the outside, a wider portion of cortex, a still wider portion of collenchyma and a very wide portion of phloem, in which groups of bast fibres are present forming an interrupted circle around the xylem. The xylem and pith areas are about the same in width, slightly wider than the phloem. A more complete study, (Plate VII) shows a single layer of epidermis and a lenticel. Four to six rows of oval cells compose the cortex, A wide portion of very thick-walled rounded cells makes up the collenchyma. Just inside the collenchyma are long, closely packed cells among which are the groups of bast fibres. These latter are made up of small, pitted cells in cross section. (Plate VIII) In longitudinal section the bast fibres are elongated with pointed ends. (Plate IX). The cambium cells are very small and only three or four rows are present. The xylem which seems to be a continuation of the phleom, cut off only by the narrow portion of cambium, is made up entirely of small cells in vertical rows. Between the portions of xylem are the medullary rays. Near the phloem the medullary-ray cells are somewhat larger. The longitudinal sections show the length and shape of the bast fibres. The epidermis and cortex cells (Plate IX) are comparatively short. Inside

the cortex are the collenchyma cells being slightly narrower than the cortex but two or three times as long. Large irregular cells with many intercellular spaces compose the greater portion of cortex. The phloem cells are also large but not as large as the cortex cells. The bast fibres are contained in the phloem and are long and narrow with pointed ends. The xylem is composed of vessels and parenchyma (Plate X) most of them being spirally thickened. The pith consists of round cells.

KEY

e------epidermis

c------cork

cc-----cork cambium

co-----cortex

mr-----medulary ray

ph-----phloem

x------xylem

cr-----crystals of calcium oxalate

mc-----mechanical cells

ca-----cambium

bf-----bast fibers

p------pith

l-----lenticel

col----collenchyma

v------vessels

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Plate I

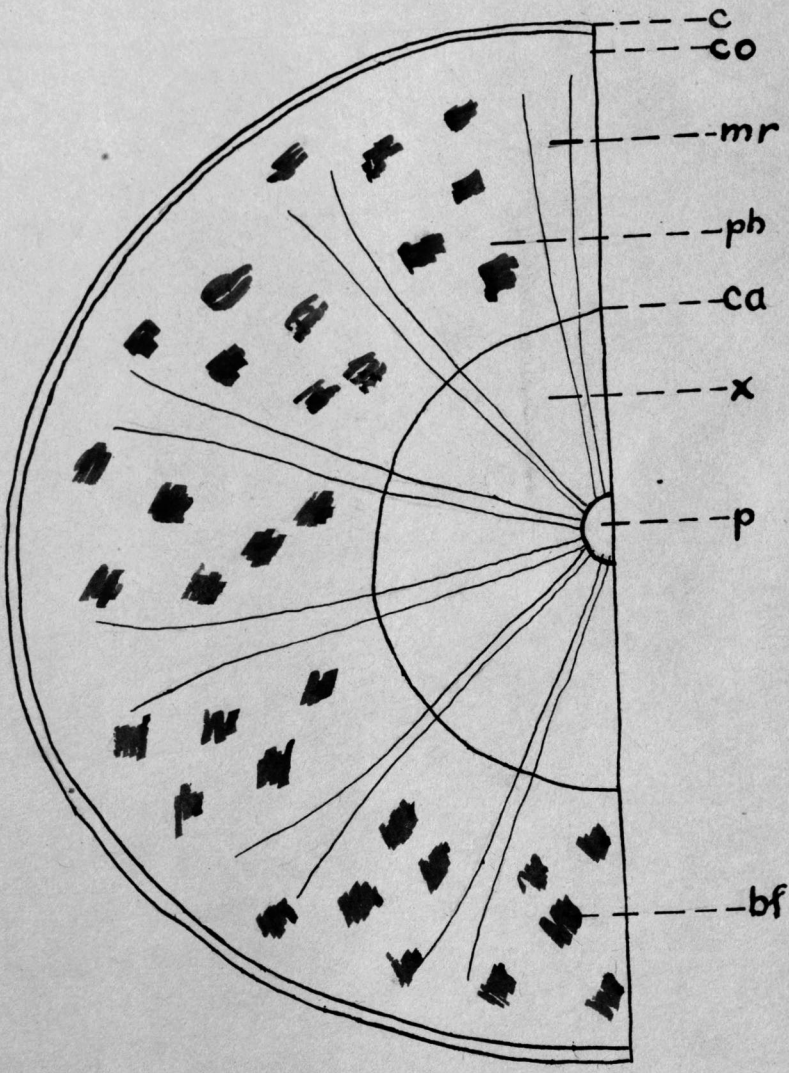
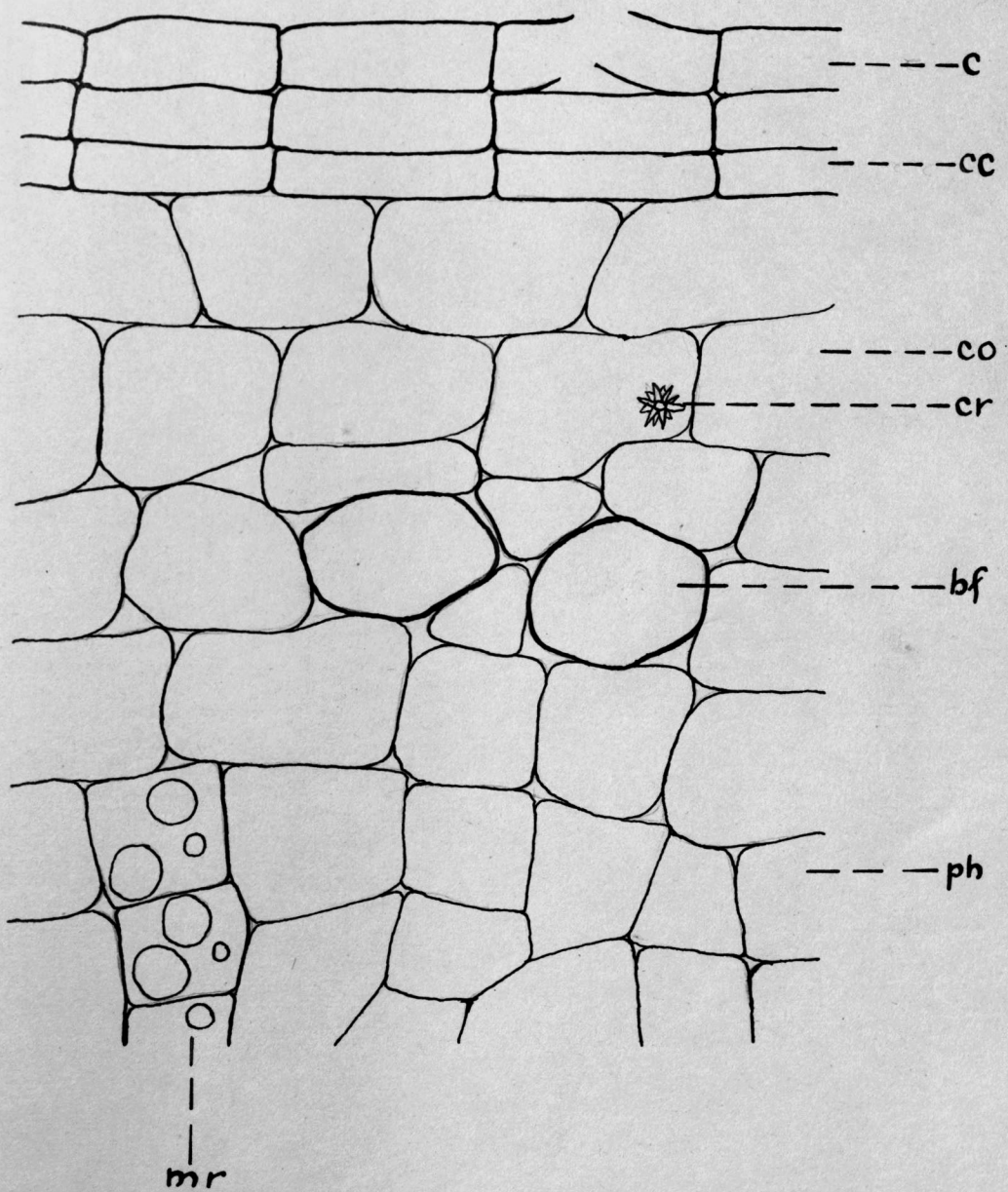


Plate II



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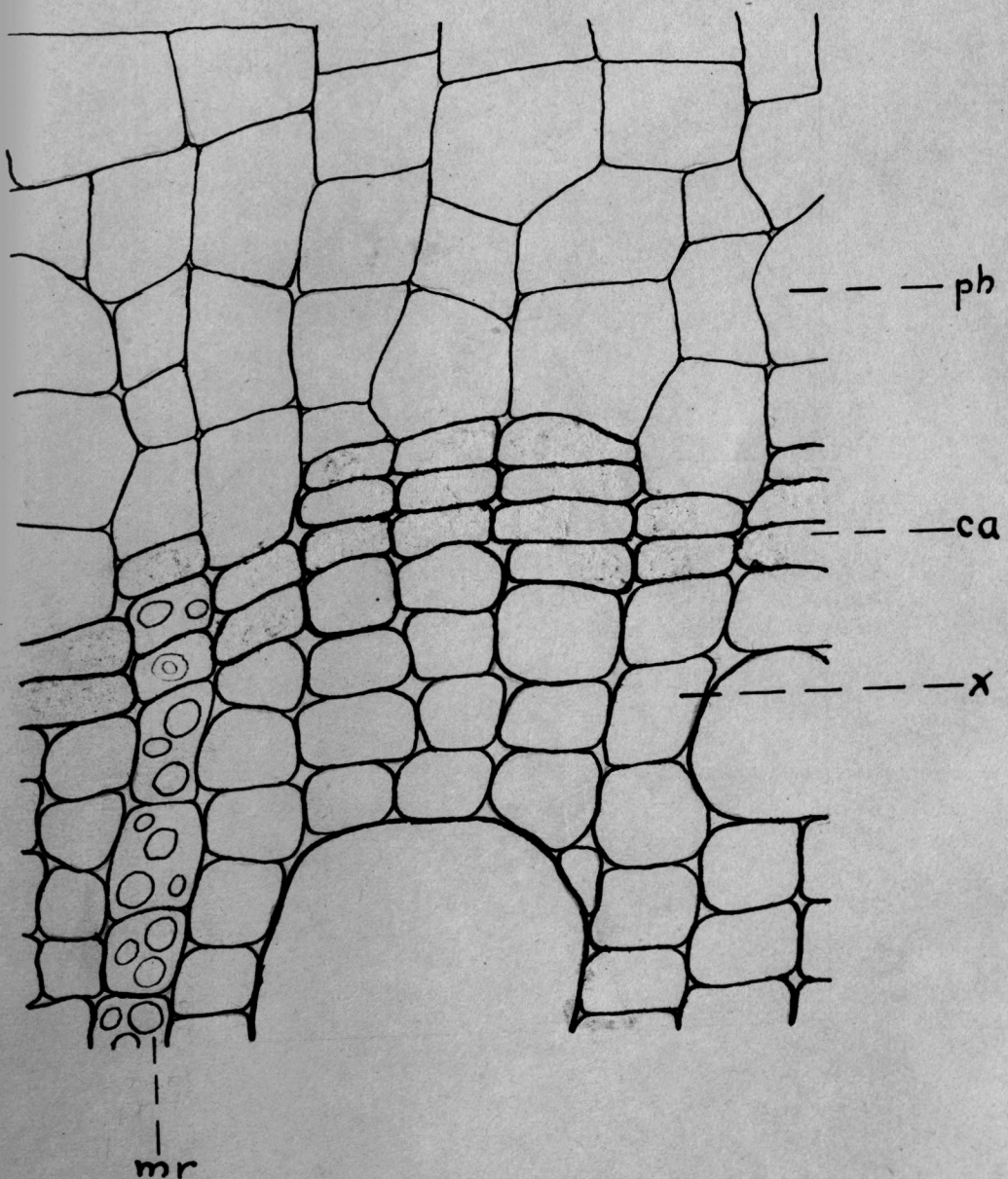


Plate IV

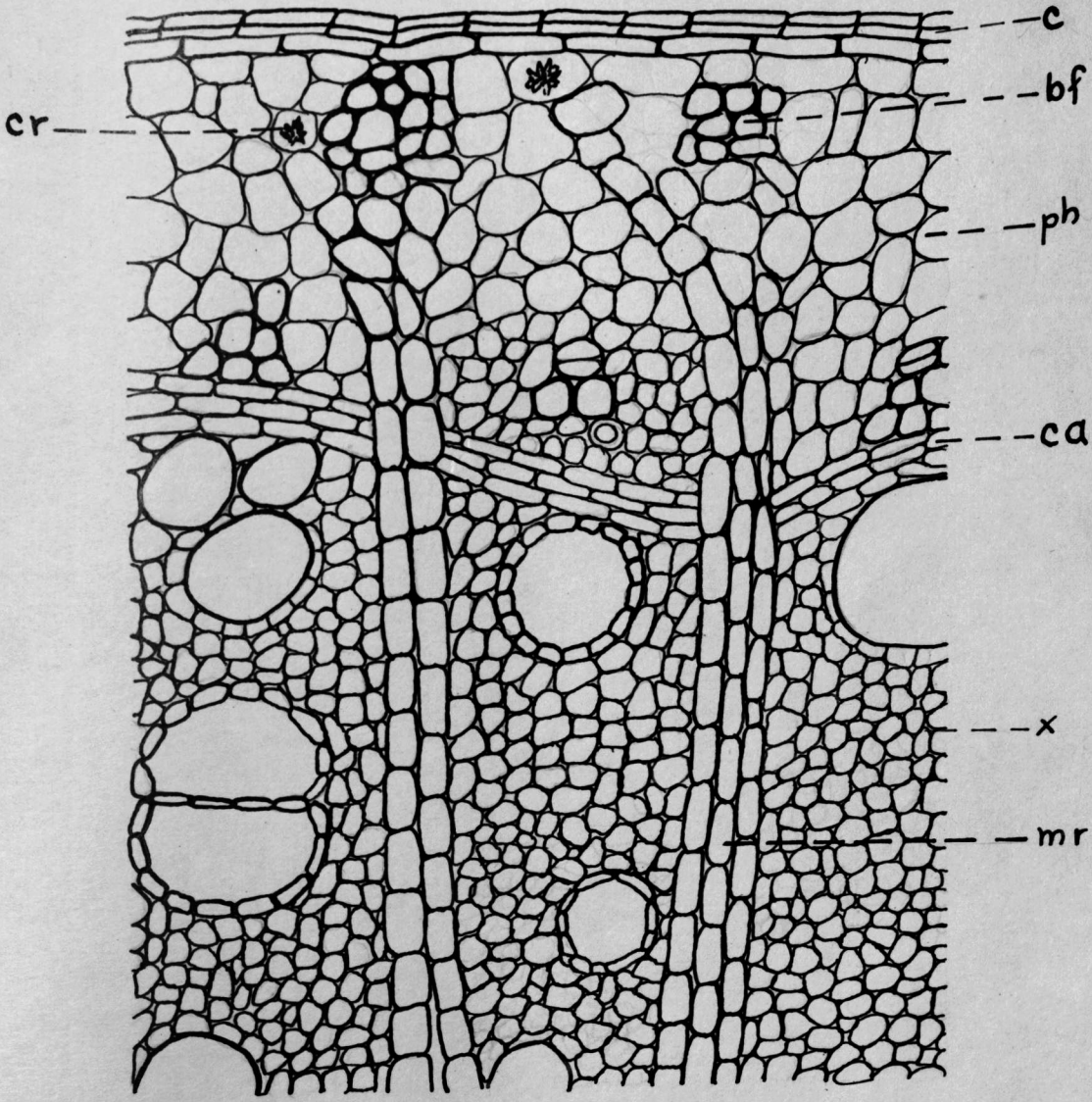


Plate V

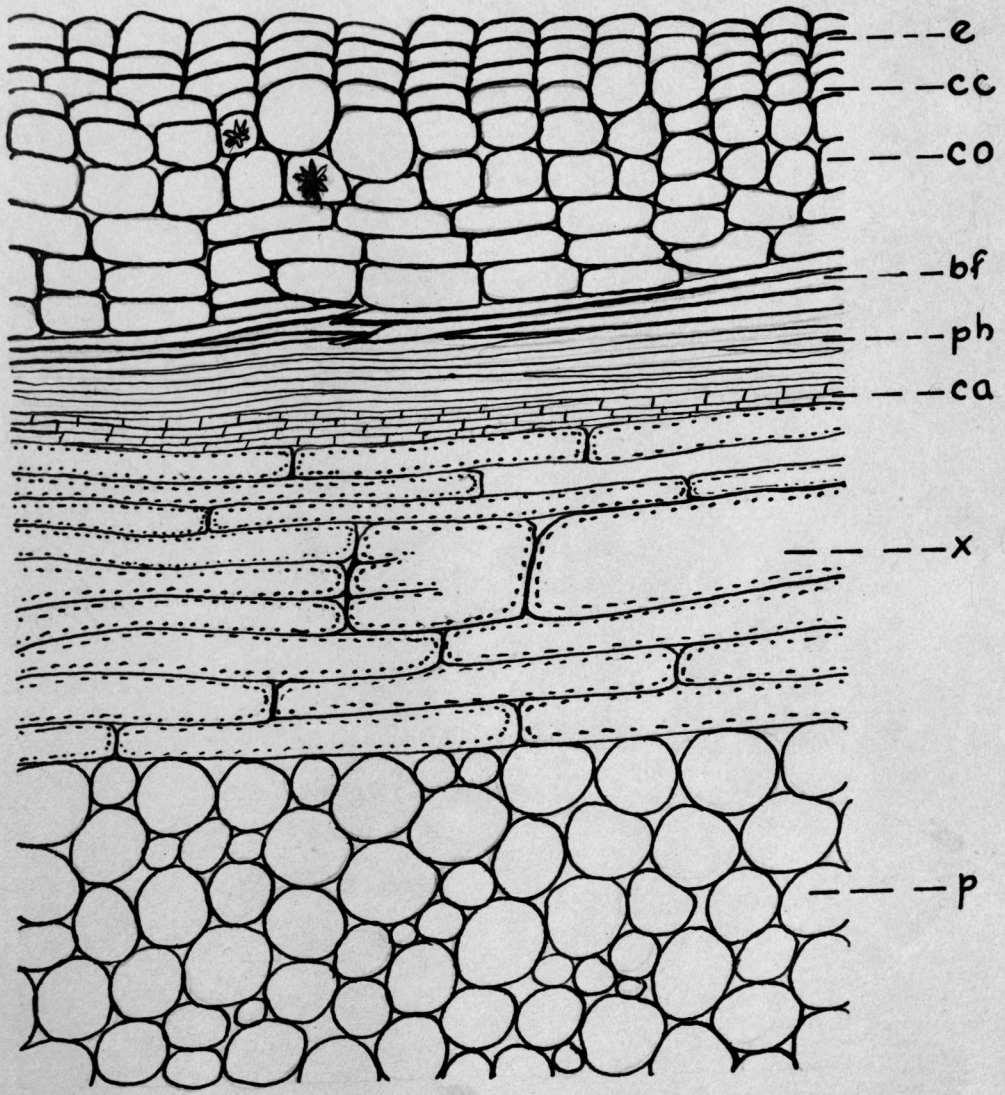


Plate VI

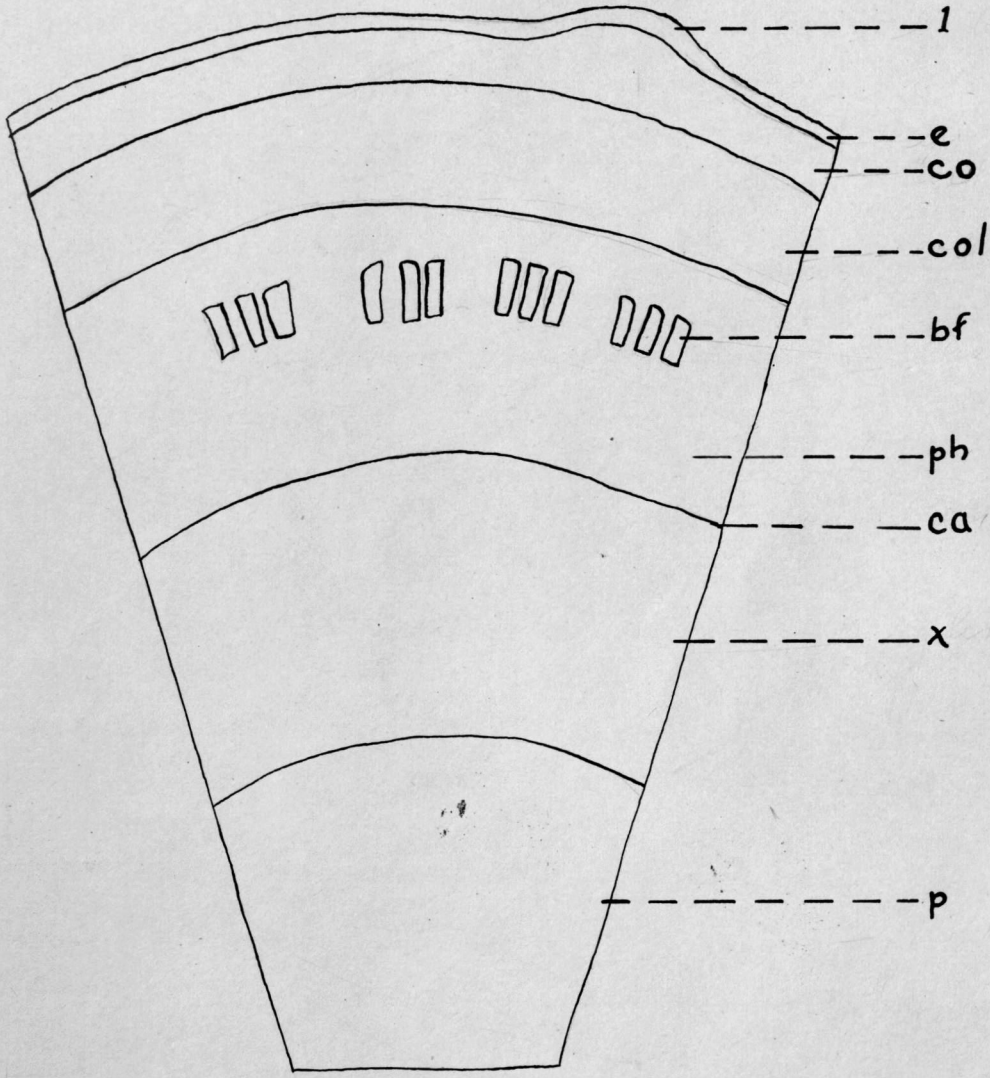


Plate VII

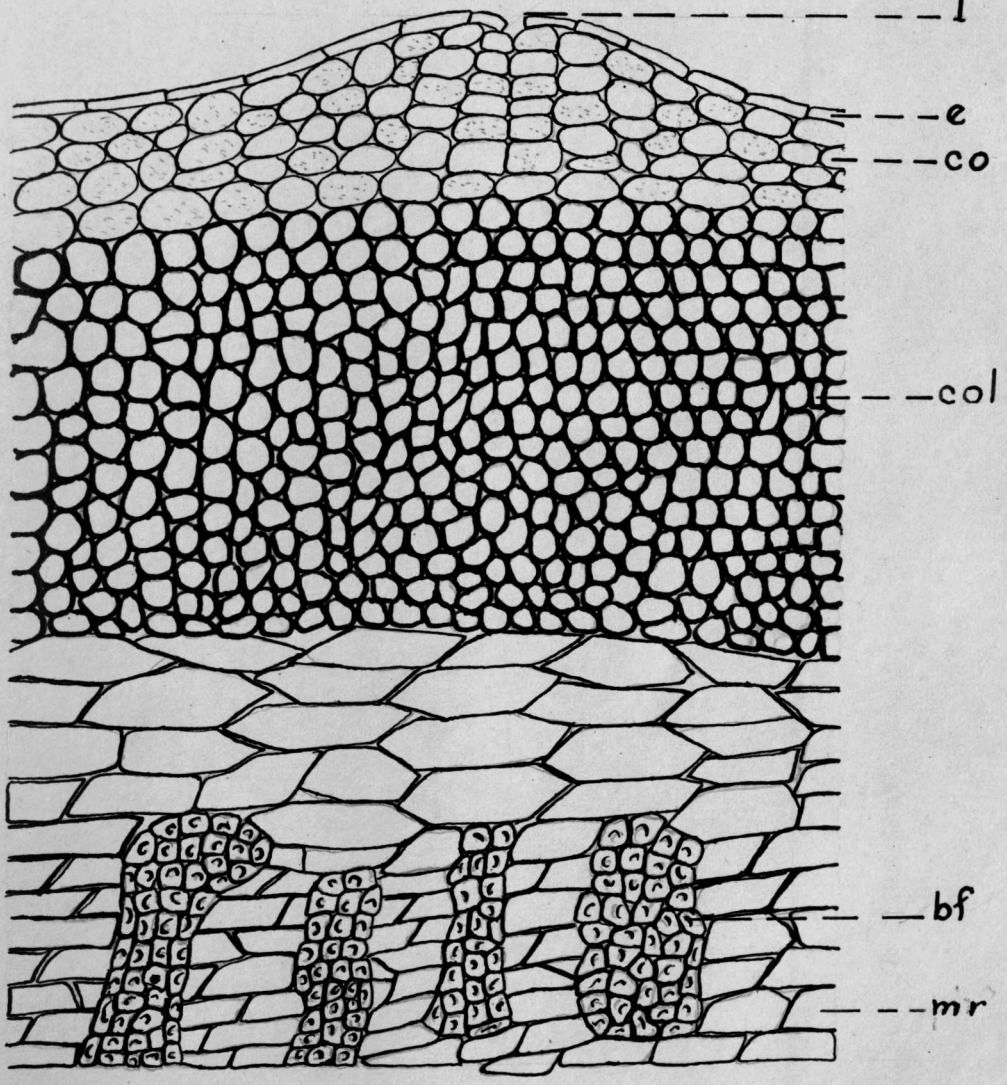


Plate VIII

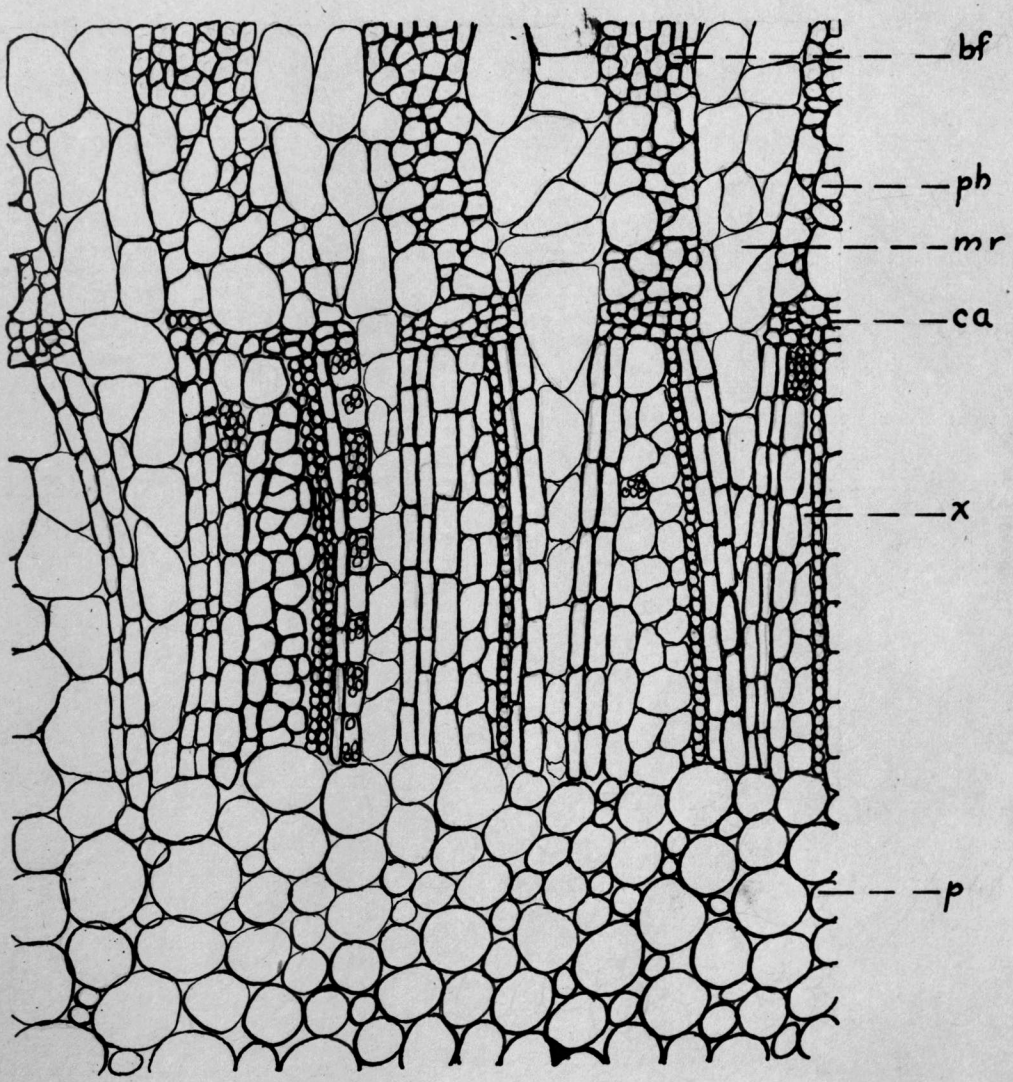


Plate IX

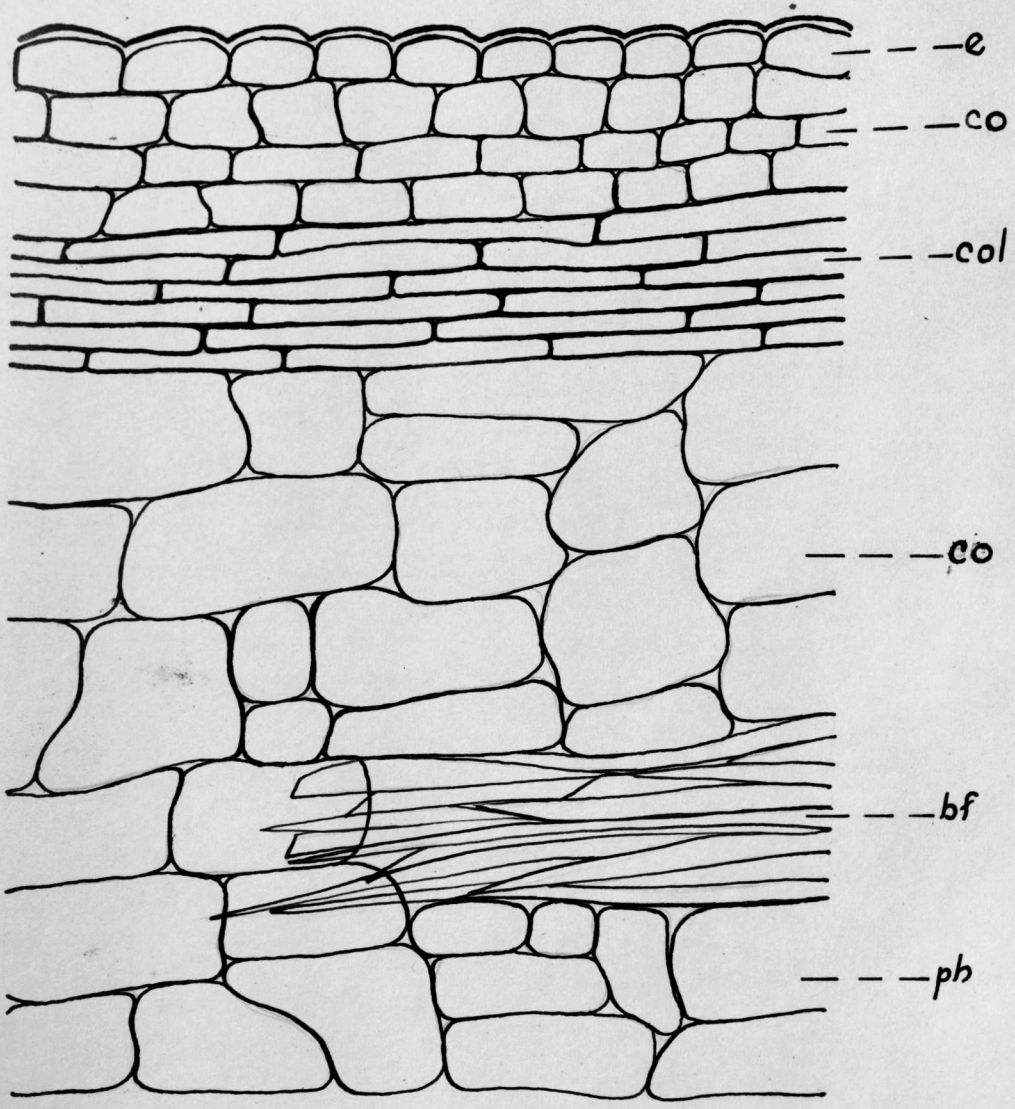
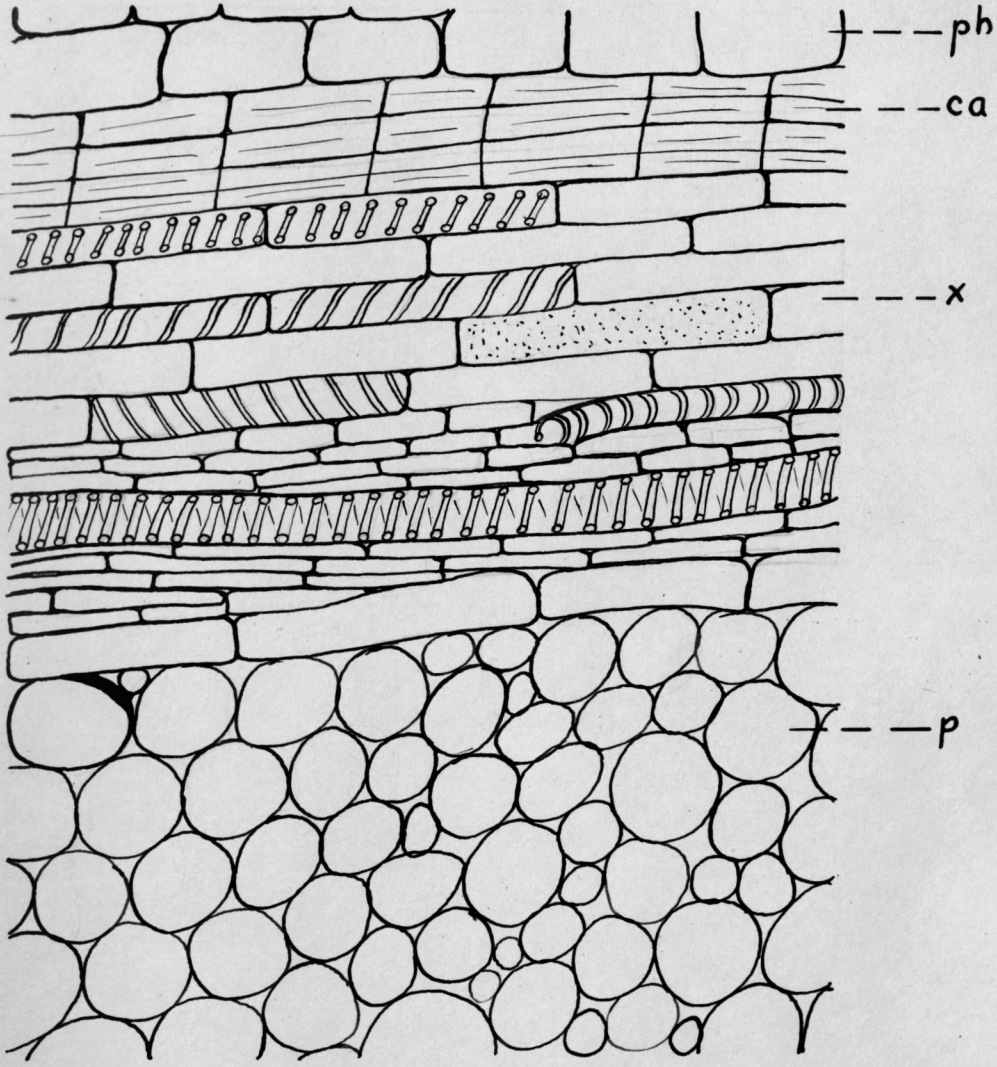


Plate X



APPROVED BY R. H. Denniston

DATE Aug 8, 1924