ANATOMY OF THE ROOT, STEM AND LEAF OF ESCHSCHOLTZIA CALIFORNICA. (CHAM.)

BY

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Eschscholtzia Californica is a schrub(I) from one to one and one-half feet high. Found in California southward through Mexico and South America. In dry rocky soil. Rarely found east of the Rocky Mountains.

In the early summer it blossoms in profusion and covers wide areas. It was first collected by Chamisso, and published by him in 1820, and described as follows: Sepals coherent into a narrow pointed hood, deciduous from within a dilated, top shaped torus. Petals four. Stamens numerous with short filaments and linear anthers. Hoary linear with two nerve-like placentas; style very short; stigmas divided into four to six linear unequal divergent lobes. Capsules elongated, ten nerved, one celled, dehiscent the whole length by two valves, separating from the placental ribs; many seeded. Seeds, globose, reticulate, or rough-tuberculate. Smooth glaucous, slender annuals; with colorless bitter juice, finely dissected alternate petioled leaves, and light bright orange or yellow flowers.

The material used was taken from a first year's plant about one foot in height, grown at Madison, Wisconsin and collected in October 1902.

The Root.

The root examined was fleshy, unbranched about five cm. in length, 0.6 cm. thick, surface smooth with a few short rootlets. The appearance in cross section(Plate I) was whitish and compact, the woody center being somewhat darker than the surrounding tissues. A closer examination shows the cork (C.Plate II) made up of four to five rows of elongated, irregular, thin walled cells, measuring from 15 to 17 μ in the radial direction and from 50 to 100 μ tangentially. The primary cortical parenchyma(Plate II) occupies the space between the cork and the phloem.

The individual cells are quite thin walled, irregular, mostly angular with no definite arrangement and no intercellular spaces; measuring from 89 to 100 μ in both radial and tangential directions, and from 50 to 200 μ in longitudinal direction.(Plate V) The phloem region (Ph.Plate II) is made up of a narrow band of cells just outside the cambium. When treated with zinc-chlor-iodide it is stained a yellowish color. The phloem tissue is made up of phloem parenchyma and sieve cells. The sieve plates were not seen.

The cambium (I.C.Plate III) consists of 1 to 2 rows of irregular cells, measuring from 8 to 27 μ in cross section and forming a continuous circle apparently interrupted where the medullary rays pass through, where the cells seem to be more regular in outline. The medullary rays (M.R.Plates III and IV) consist

of cells of rectangular shape extending nearly to the center of the root. They are from 2 to 4 cels in width and disappear beyond the phloem region.

The wood parenchyma cells (W.Plates III and IV) are small regular, slightly oblong, filling up the space not occupied by the vessels, measuring from 19 to 32 μ in cross section, and from 80 to 100 μ in longitudinal direction. In longitudinal direction the cells are pointed and over-lapping.(Plate V) The vessels are irregular in size, (Plate III) measuring from 10 to 95 μ in diameter and extending to considerable length. The vessels as seen in longitudinal section (Plate VI) are uniform in size and shape, the walls are thick and pitted uniformly scattered through the woody region. The pits are numerous, round in cross section and oblong when seen in longitudinal section.

The Stem.

The stem examined was slightly angular, six sided and hollow; 0.7 cm. in diameter, the inner tissue loose and pithy with the bundles arranged so as to form a circle. Sections were made from a piece 1 cm. in diameter and 5 to 7 1/2 cm. from the root. The large bundles alternate with small bundles, only a few cells separating them. A cross section of the stem shows an epidermis at the outside which consists of 2 rows of regular slightly elongated cells, the outermost row being larger than the inner. The

outer cells of the epidermis measure from 30 to 33 μ tangentially, 17 to 18 μ radially, and 139 μ longitudinally. See Plate IX. The longitudinal tangential walls of the epidermal cells are thicker than the cross walls.

The stomata are numerous in the stem. The tissue directly inside the epidermis is made up of from two to three rows of small thin walled cells which contain chlorophyll. They measure from 14 to 19 μ in tangential direction, 10 to 14 μ radially and 22 μ longitudinally, and appear to be destitute of chlorophyll directly opposite the fibro-vascular bundles.

There is a thin walled tissue between the chlorophyll bearing tissue and the bundles, 1 to 3 cells in thickness, forming a continuous circle or band. Between the bundles is a thick walled pitted tissue. The pits are small and straight. Intercellular spaces are numerous, small and mostly triangular. The cortical parenchyma (C.Plate VII and IX) cells are of irregular outline as seen in cross section but are elongated longitudinally.(C.Plate IX) They are less numerous above the large bundles. They measure from 25 to 40 μ in cross section and about 200 μ in longitudinal direction. The pith makes up about 2/5 of the tissues of the stem. The cells are regular, rounded and measuring as much as 350 μ in length. The intercellular spaces in the pith are mostly triangular.

Plate VIII shows a cross section of a bundle highly magnified. The sclerenchymatous sheath(s.s.) consists of a mass of thick walled angular cells outside the phloem, in some cases equalling the diameter of the remainder of the bundle. It is toward the outside of the bundle and is from 6 to 8 cells thick in the large bundles. Inside this sheath is the phloem region, consisting of the phloem parenchyma and sieve tubes. The sieve tubes measure about 5 μ in diameter and 139 to 150 μ in length as seen in longitudinal radial section(Plate IX) and in longitudinal tangential direction(Plate X). Plate X shows the longitudinal arrangement of the sieve tubes but the sieve plates were not easily seen. The vessels of the bundle in the stem resemble very much the vessels in the root, except that they are not so numerous. The vessels measure 55 μ in diameter and from 450 to 490 μ in length.(Plate IX) The woody parenchyma filling the space around the vessels consists of small thick walled cells of regular oblong shape with no definite arrangement.

The Leaf.

The leaf (Plate XI) is finely dissected, alternate, petioled. The petiole is from 3 to 4 inches in length and as seen in cross section is triangular in outline. The flat surface is toward the stem and opposite to it is a rounded obtuse angle. The two angles adjacent to the flat side are acute and rounded.

There are three bundles in the petiole, a large one in the center made up of phloem and xylem about equally divided, and two small at the corners. The large bundle is surrounded by the mesophyll, which consists of regular shaped angular cells. The epidermis of the petiole consists of one row of cells, strengthened by an additional row at the angles.

Stomata are of frequent occurrence on all sides. Under the epidermis is a band of chlorophyll bearing tissue interrupted at the obtuse angle by thick walled strengthening cells. In the cross section of the leaf (Plate XIII) the epidermis consists of a single row of regular slightly elongated cells, measuring from 30 to 40 μ in tangential direction, (Plates XIII and XV) and 25 to 40 μ in radial direction (Plates XIII and XV).

The cells of the lower epidermis in cross section are about the same as those of the upper. The upper epidermal cells in surface view (Plate XIV) are larger and more irregular than the lower epidermal cells. The cells of the upper epidermis measure from 60 to 100 μ in longitudinal direction and from 40 to 55 μ in cross section. The cells of the lower epidermis measure from 80 to 85 μ in longitudinal and from 45 to 55 μ in cross section. The elongated cells shown in the lower epidermal section are directly over a rib. The stomata are numerous, of nearly uniform size on the upper and lower epidermis. They measure

25 μ in length, 22 μ in width.

The palisade tissue of the leaf consists of several rows of elongated cells measuring 30 μ radially and 16 μ tangentially(Plate XV). The cells are filled with chlorophyll. The spongy parenchyma is filled with chlorophyll and has many intercellular spaces. The bundles of the leaf number from 3 to 5 surrounded by thin walled cells which fill the space inside the parenchyma.

Bibliography.

1.California Geological Survey,Vol.1,p.22.

Explanation of Plates.

I.Cross section of a small root magnified 370 diameters.

II. Cross section of root through the phloem region. Magnified 370 diameters.

III.Cross section of the root showing the Xylem region and the Cambium. Magnified 120 diameters.

IV. Cross section of the root showing the vessels. Magnified 500 diameters.

V. Longitudinal radial section of the tissues of the root outside the woody region. Magnified 120 diameters.

VI.Longitudinal section of the vessels of the root. Magnified 120 diameters.

VII. A cross section of the tissue of the stem. Magnified 120 diameters.

VIII. A cross section of a large bundle of the stem. Magnified 280 diameters.

IX. Longitudinal radial section of the tissues of the stem. Magnified 120 diameters.

X. Longitudinal tangential section of the phloem region of the bundle in stem. Magnified 500 diameters.

XI. Outline drawing of a leaf. Magnified 15 diameters.

XII. Cross section of the petiole of a leaf, magnified 370 diameters.

XIII. Cross section of the leaf. Magnified 280 diameters.

XIV. Surface sections of the upper and lower epidermis of the leaf. Magnified 370 diameters.

XV. Cross section of a part of a leaf. Magnified 500 diameters.

Key to Abbreviations.

C. - Cortex.

B.S. - Bundle Sheath.

I.S. - Intercellular Spaces.

B. - Bundle,

P. - Pith.

V. - Vessels.

W. - Wood.

W.Par. - Wood Parenchyma

Par. - Parenchyma.

M.R. - Medullary rays.

Cam. - Cambium.

Ph.Par. - Phloem parenchyma.

S. - Sieve tubes.

S.S. - Schrenchymatous sheath.

Ep. - Epidermis.

Chlyl.T. - Chlorophyll bearing tissue.

C.Par. - Cortical parenchyma.

Plsd. - Palisade tissue.

Approved.. R. N. Denniston
Asst in Pharmacognosy.

Edward Kremers
Prof of Pharm Chemistry.

May 20, 1903

PLATE. I.

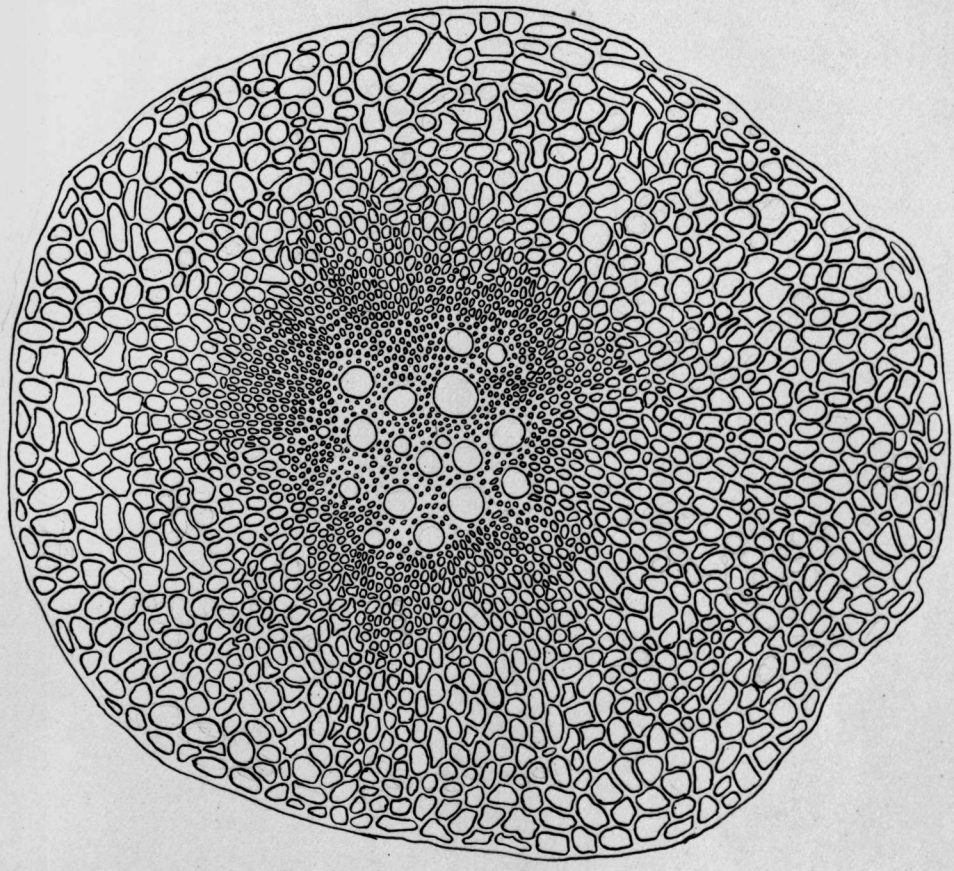
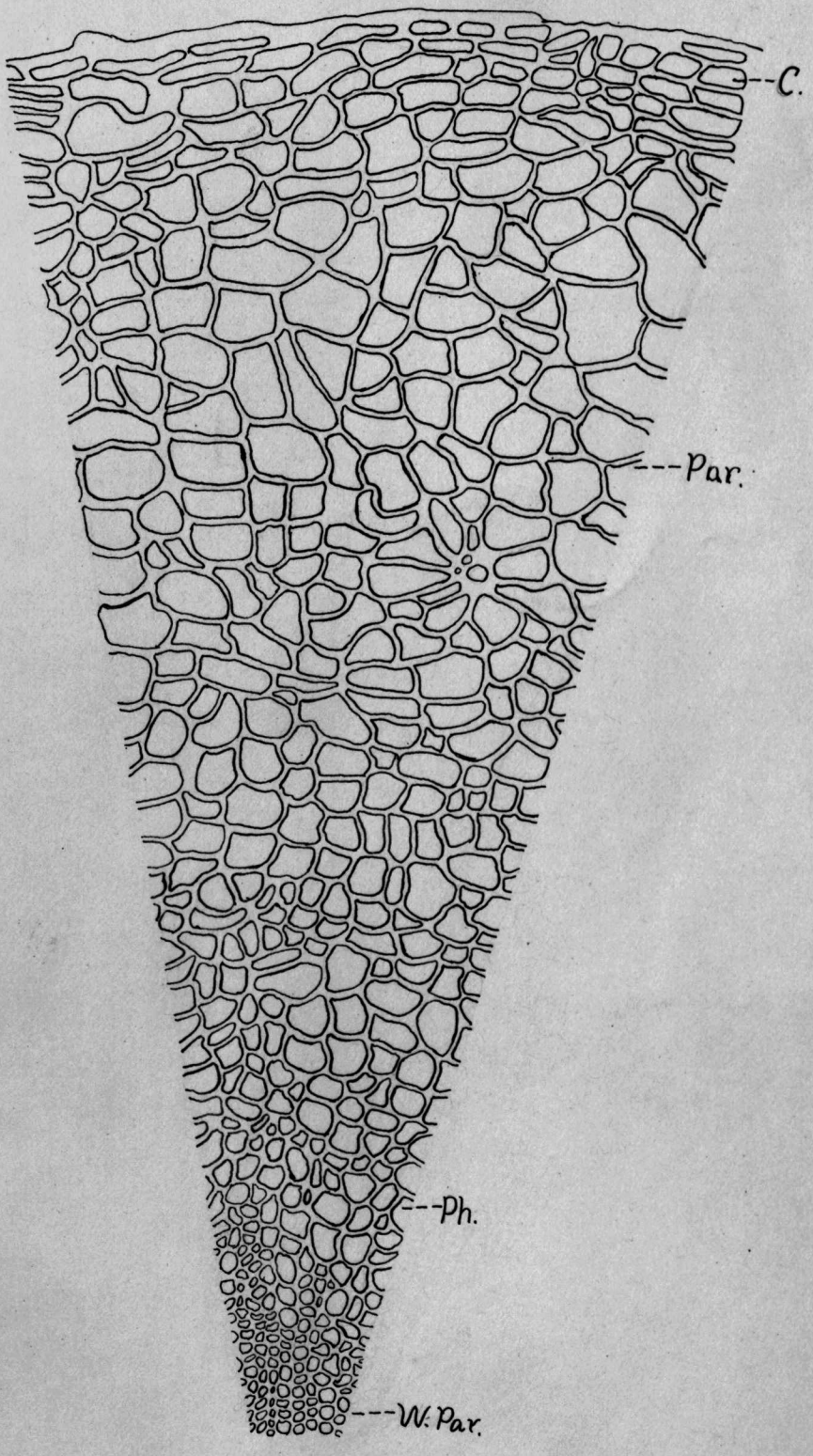


PLATE II



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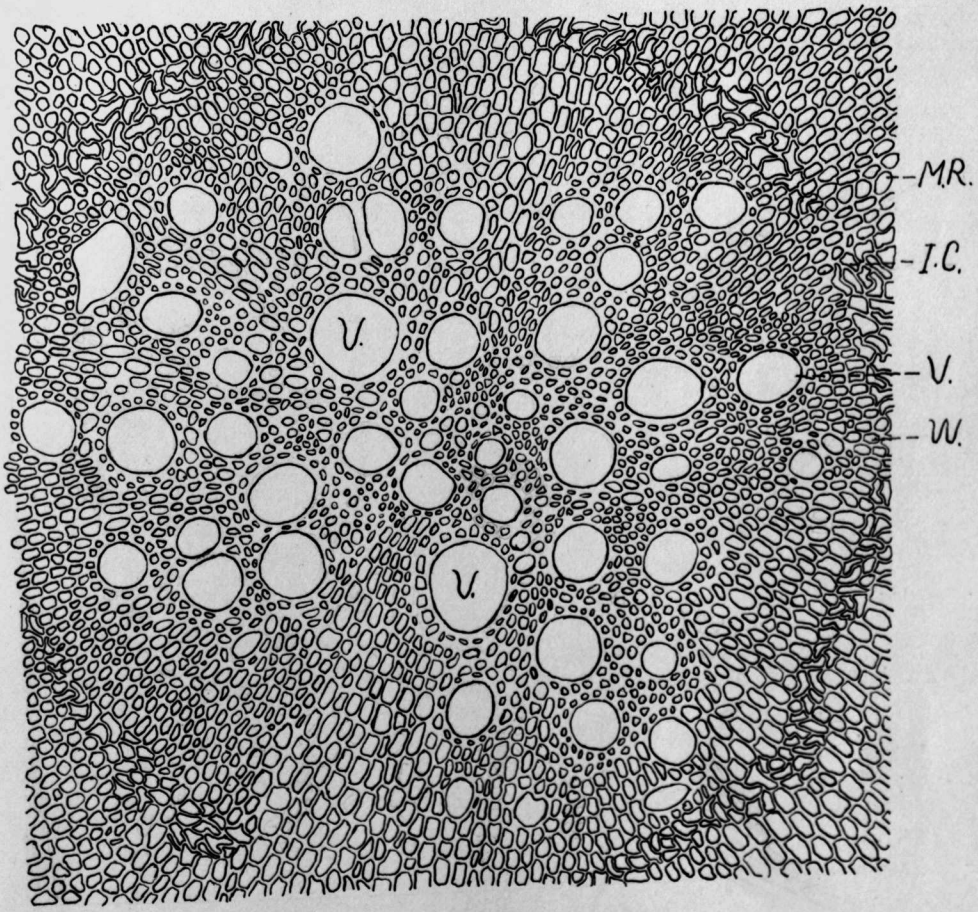

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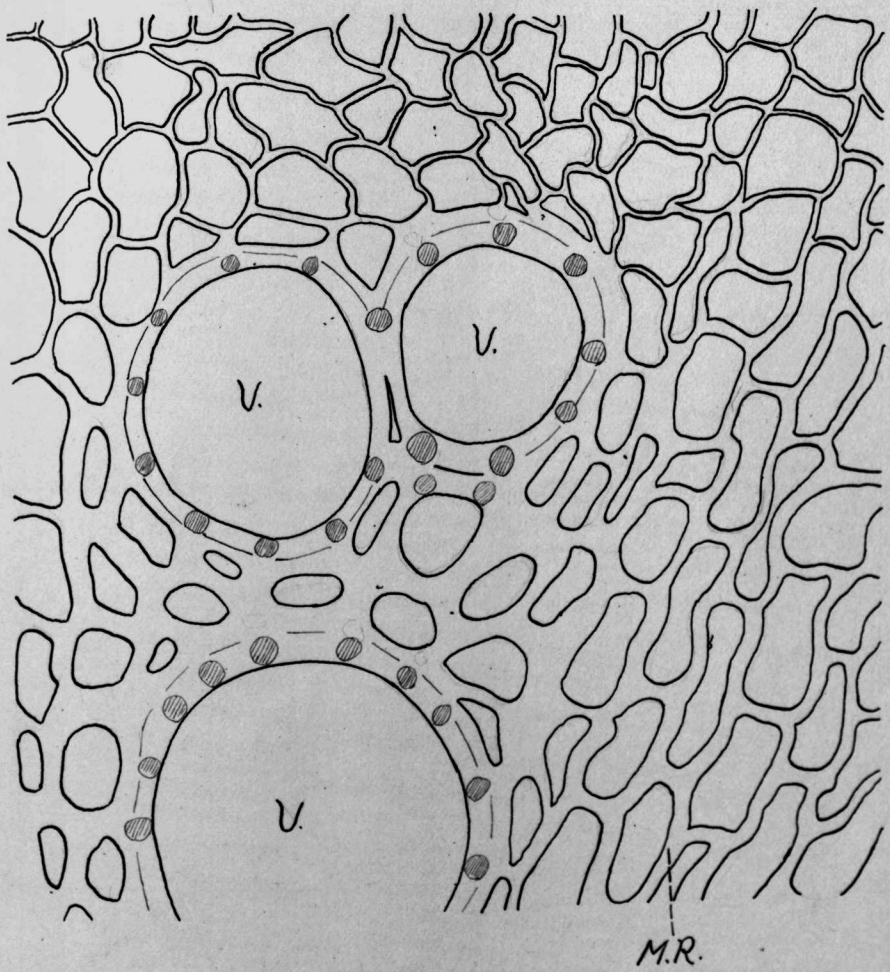

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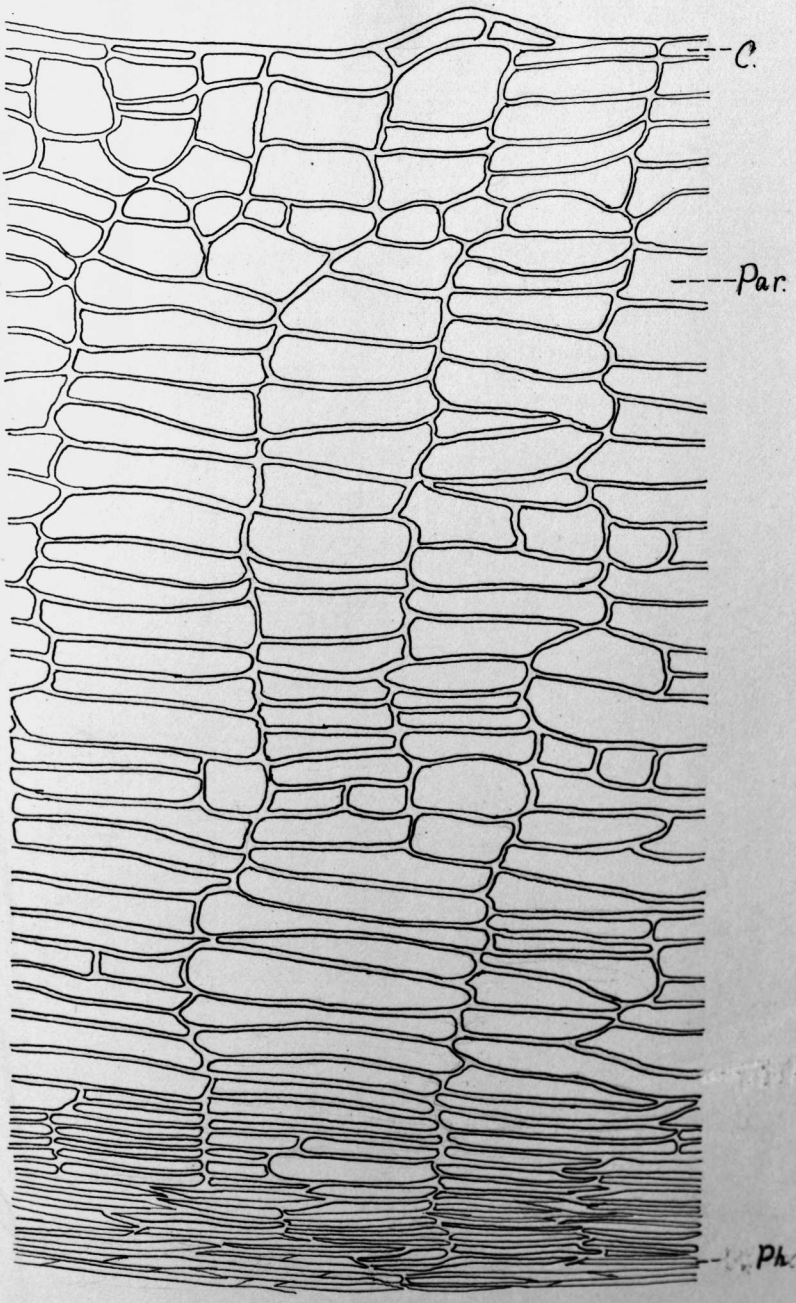

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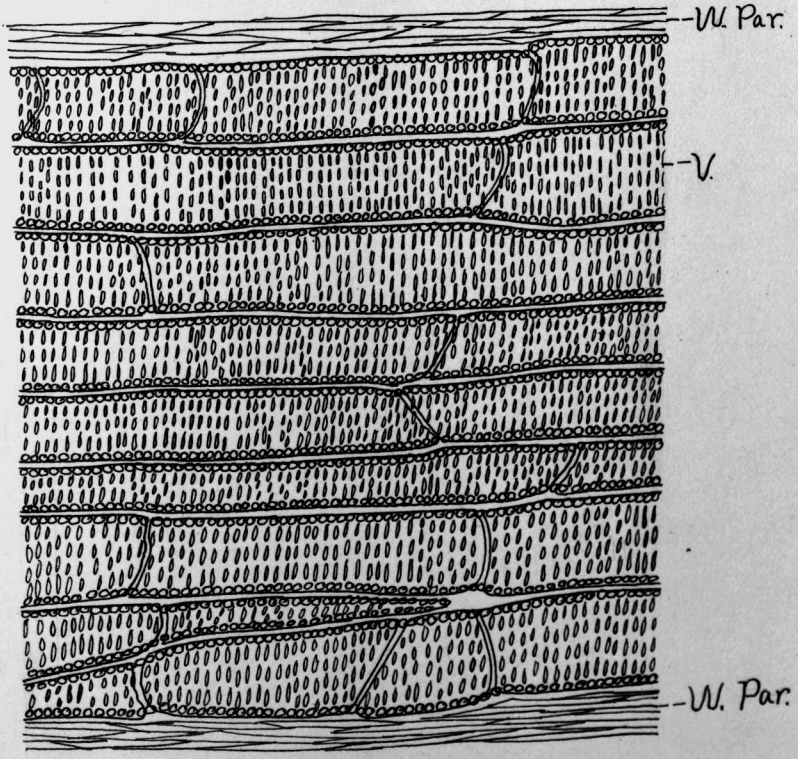

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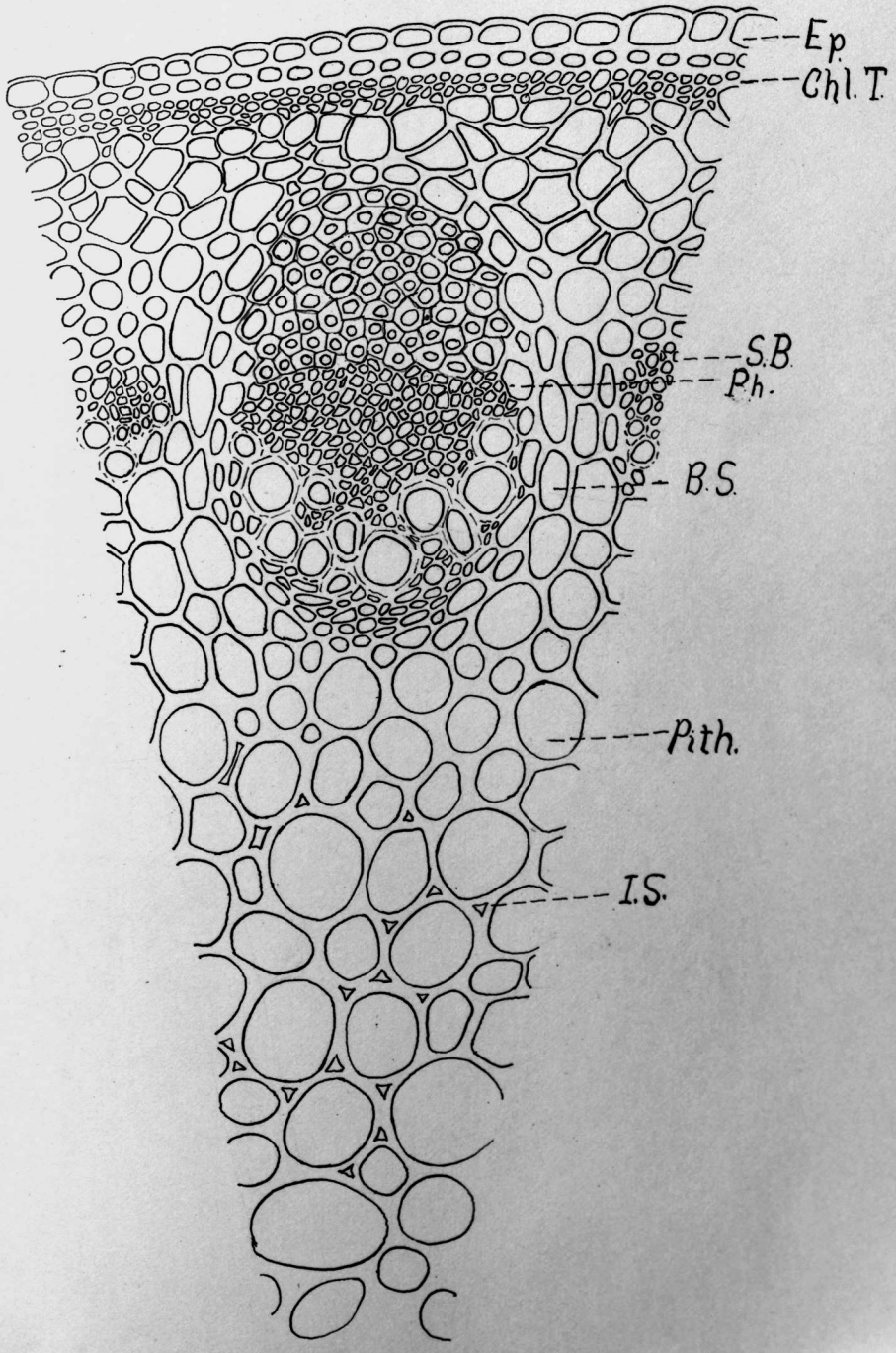

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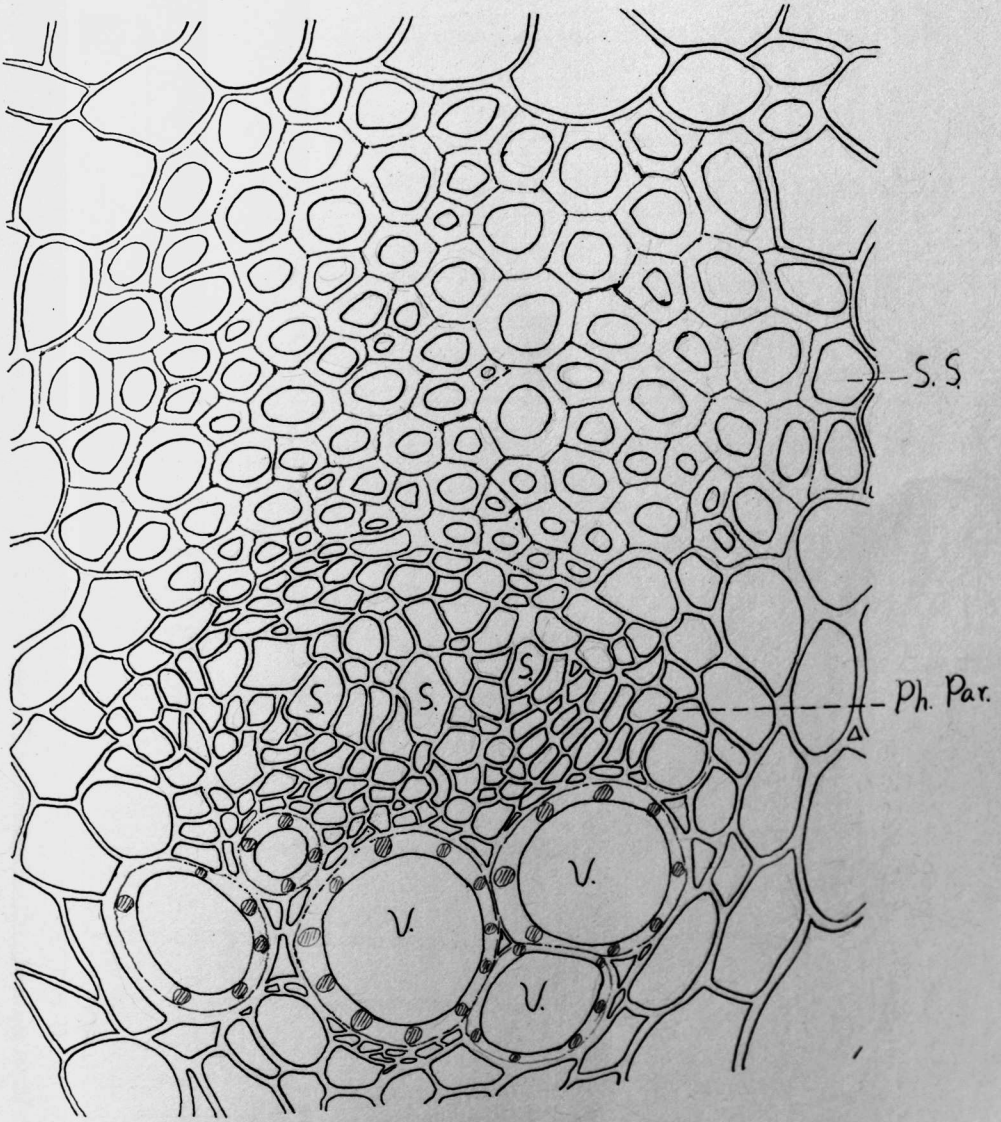

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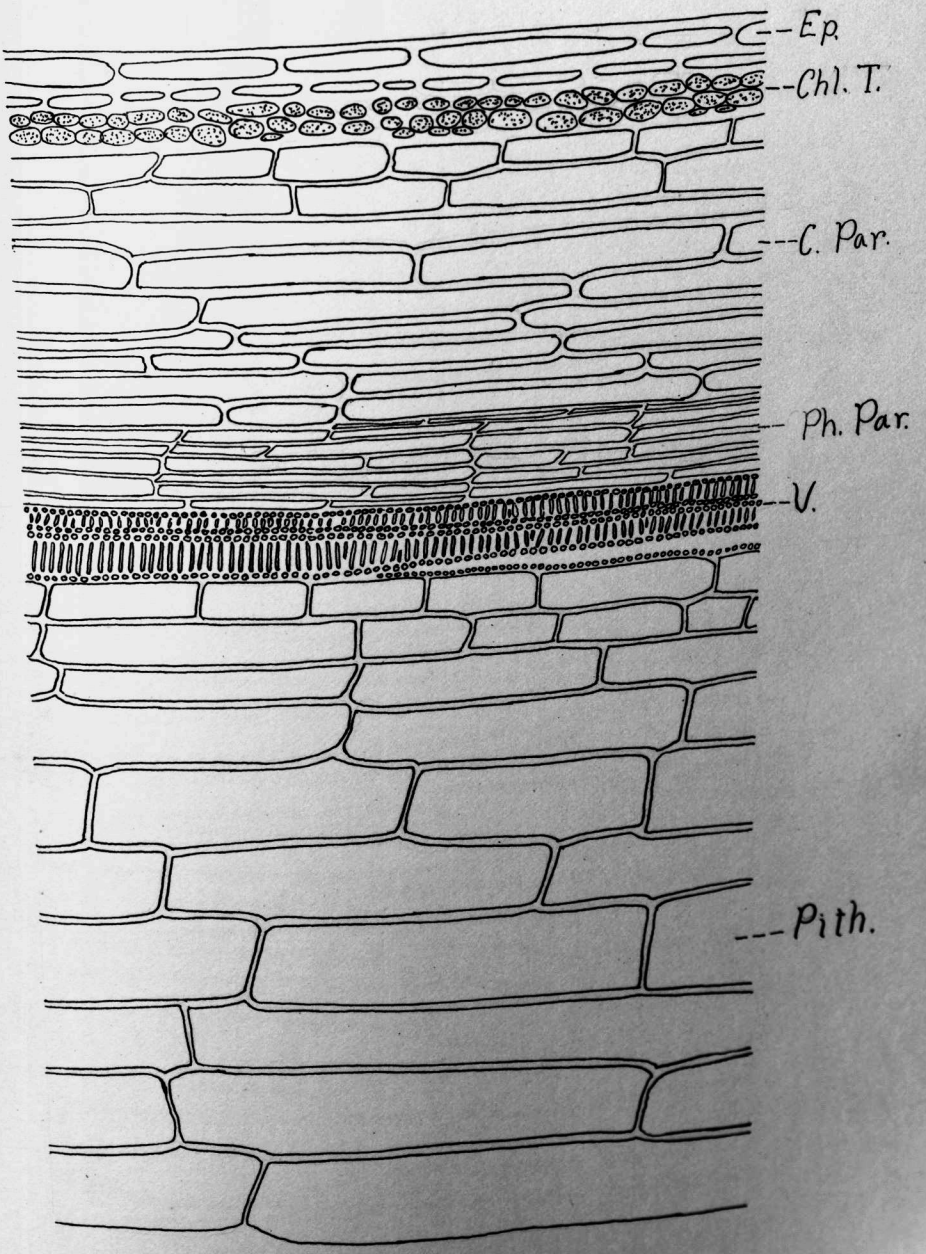
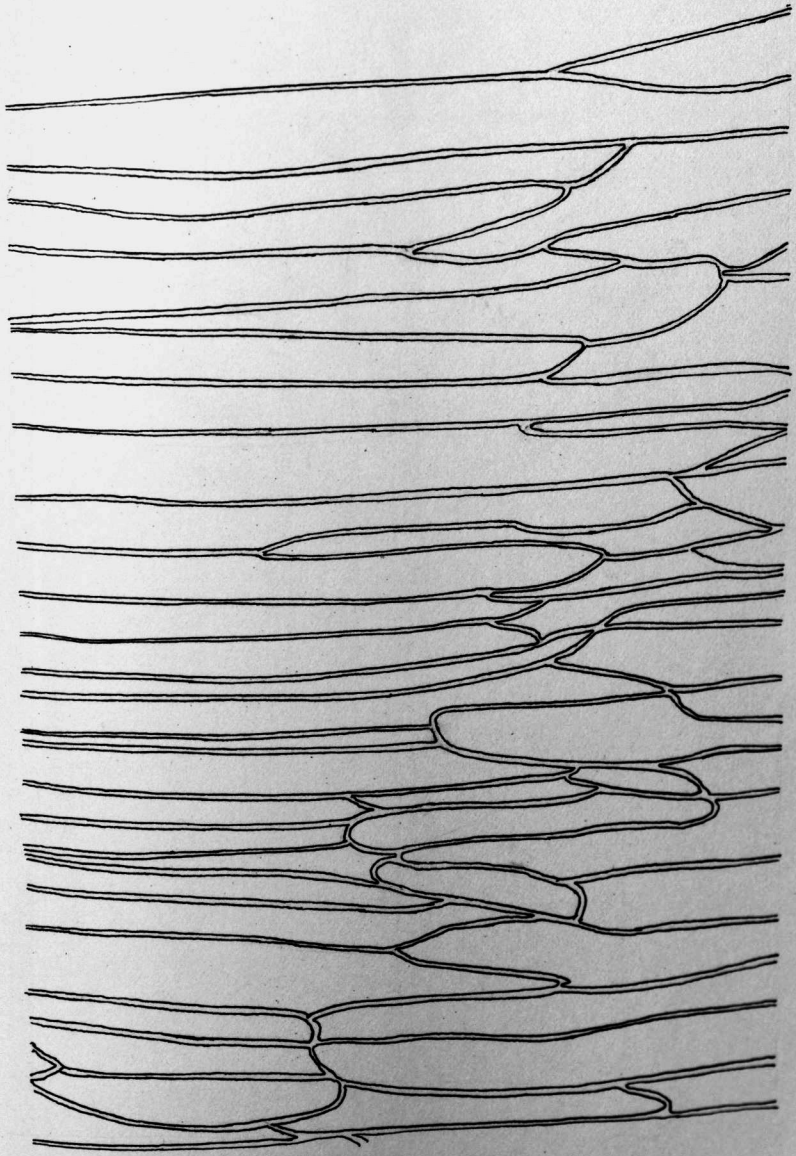


PLATE. X.



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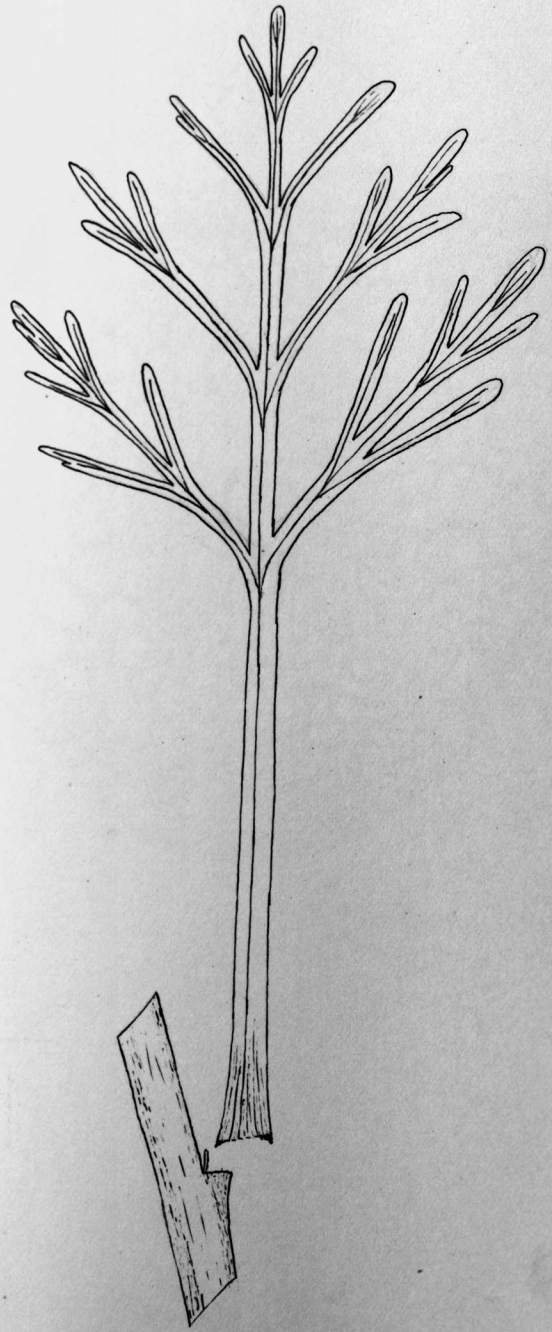

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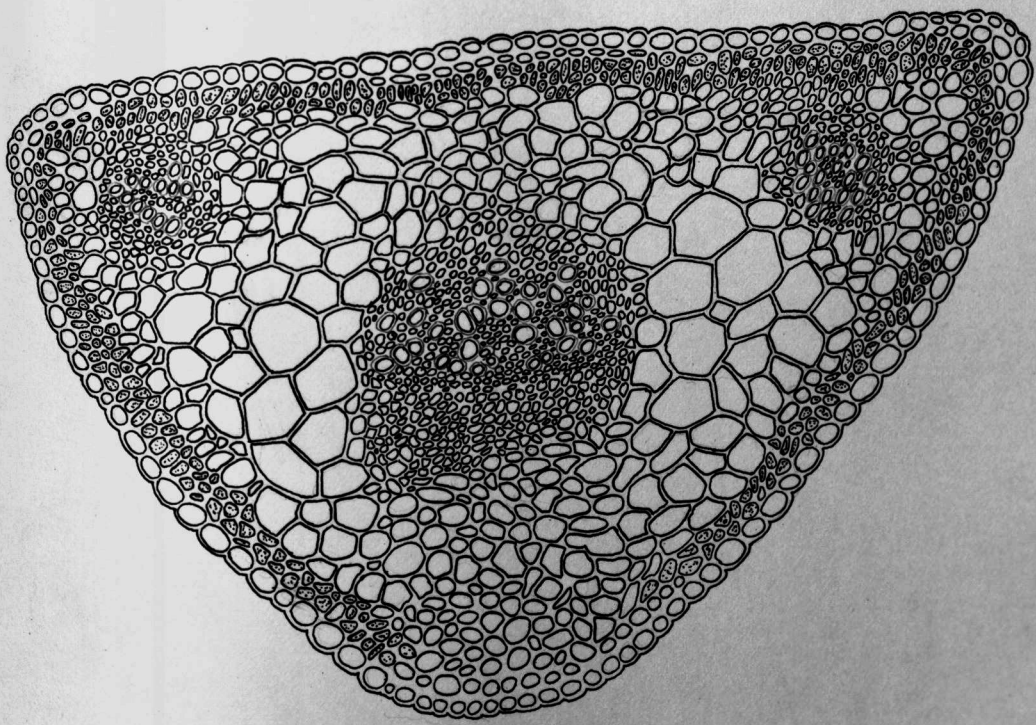

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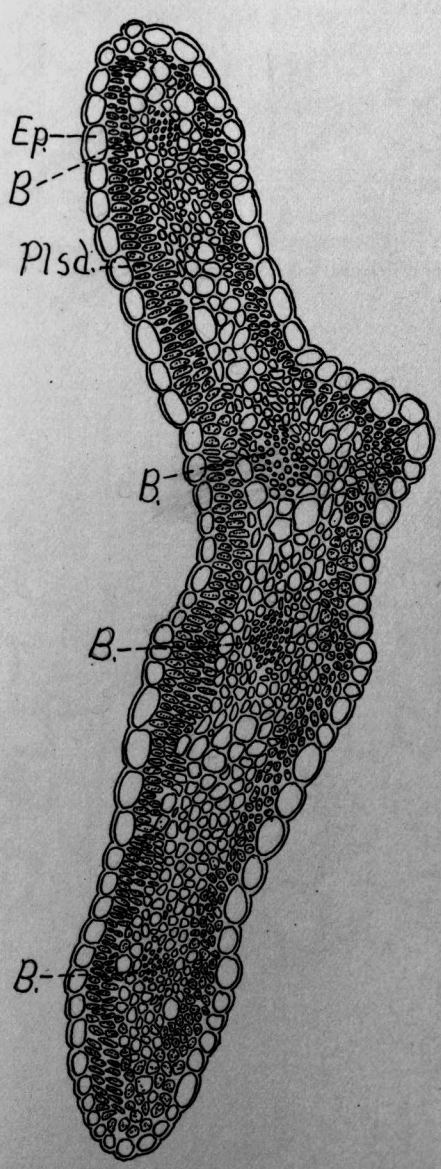

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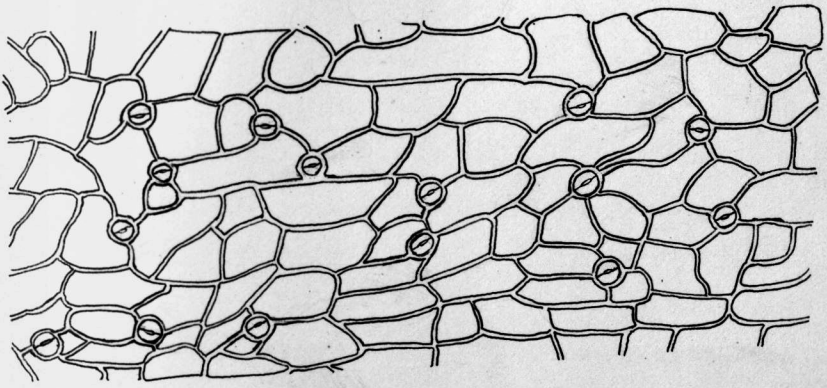

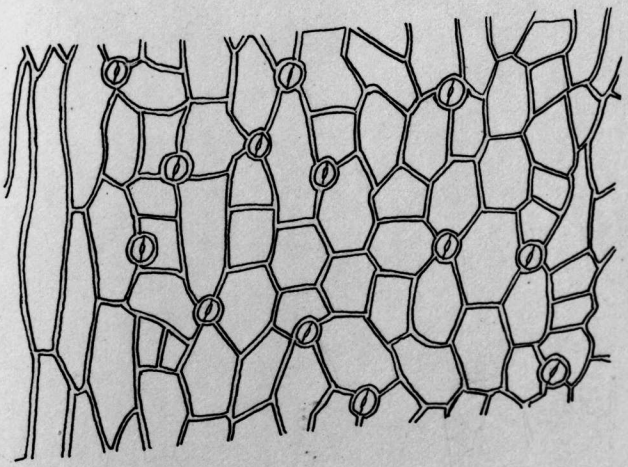

PLATE. XV.