THE STRUCTURE OF THE STEMS OF MYRICA GALE, L. AND MYRICA CERIFERA, L.

(A COMPARATIVE HISTOLOGICAL STUDY)

By

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Myricaceae.

The order Myricaceae(1) or family of Galeworts as now constituted, contains but a small group of plants, generally classified with the Amentaceae. In its botanical relationship it is anomalous being closely allied to several orders.

The genus contains about thirty-five known plants of an aromatic shrubby character, distributed for the most part in temperate regions. At least six species are indigenous to North America. But one species, Myrica Gale is found in the bogs of Northern Europe. This is likewise generally distributed through the middle and northern United States and extends as far north as Alaska. Several species are reported from the West Indies and one from The Andean region of South America. Others are found in Southern Africa, India and China. All medical writers and botanical authorities, even as early as Linnaeus, describe the plants of this genus as useful in the arts and possessing valuable medicinal properties. As yet, they have obtained but little recognition in the practice of the medical profession.

Myrica Gale(4) is the most widely distributed species. Some of its numerous synonyms are Sweet Gale, Meadow Fern, Bog Myrtle, Dutch Myrtle, Willow Myrtle, Bay Brush,

The entire plant is used and also the separated bark. To it is ascribed pectoral, astringent and aromatic properties. The infusion has been also applied externally for the cure of itch and used as a substitute for hops in brewing. The entire plant is useful in dyeing and tanning.

Myrica cerifera(9) is the indigenous species that has attracted the most attention in the United States. Its common names(12) are Wax Myrtle, Wax Berry, Candle Berry, and Bay Berry. The nuts of this species are incrusted with a wax like tallow(16). Myrtle tallow was utilized by the pioneer settlers and we have accounts dating back to the early part of the eighteenth century, of the methods generally adopted by each family to furnish themselves with a supply of this wax for lighting purposes(17).

In South America they are still using this substance, only obtaining it from another member of this family, M.Pubescens.

The bark(18) has attracted some attention but principally among the eclectics and is an ingredient in the so-called "Thomponian Composition powder". To this bark is ascribed stimulant, astringent, antiscorbutic, antisposmodic, sialagogue and errhine properties. It has been extensively used in domestic practice as a vegetable astringent in diarrhoea, and as early as 1804 Dr.Benjamin Smith Barton, then professor of Materia Medica and botany in the University of Pennsylvania called attention to it "as a powerful astringent used with success in diarrhoea" and states "the decoction has also been used with much advantage in dropsical affections, succeeding intermittens and in the treatment of haemorrhage from the uterus, etc." The decoction has also been used as a gargle in inflammation of the throat and as an injection in leucorrhoea. The powdered bark has been applied externally as a stimulant in indolent ulcers.

In large doses it is said to be acrid, drastic and emetic.

The stems of the plant will be the only part to be taken into consideration. They were collected by.Mr.R.H.Denniston at Wood's Holl Mass. July 20,1899 and are from 4mm to 6mm in diameter.

The outer surface of the stems is of a reddish brown color and shows numerous well marked lenticels.

The cut end of the stem exhibits a thin bark, the outer portion of which easily breaks away. The bark is very easily detached from the underlying portions, making it difficult to cut a transverse section without this separation taking place. The layers of the bark are easily distinguished from the wood without the aid of a lens and the medullary rays as they extend out from the pith can easily be detected. The pith region is hardly to be distinguished by the naked eye.

The entire cork region composes about one third of the bark. (C - Plate 1)

The outer cork cells, already described as being easily separated from the later cork, are composed of very thin indefinite but regular cells of a brownish red color. The cork cells lying directly beneath are identical as far as general appearances are concerned only that they are somewhat wider. The cortical parenchyma (C.P.Plate 1) which occupies about the same space as the cork appears somewhat less regular, due to a band of bast fibers and crystal cells(S.C.; B.F. and P.C.O.Plate1).

Hooper(20) calls attention to a remarkable stratum of stone cells existing in the bark of My ica nigrum and Myrica asplenifolia. A simular band existing in M.Gale and M.cerifera would seem to indicate that this is a structural characteristic of the order.

The secondary cortical parenchyma (Ph.Plate 1) together with the bast fibresregion make up the other third of the cortex.

The wood (xy.Plate 1) appears in numerous narrow wedges separated by narrow medullary rays (M.R.Plate L) extending well into the bark.

The spring and fall wood are well marked regions and Plate I shows that the formation of the more open spring wood had not as yet begun for the third year and also that the second years growth exhibits more large vessels than the first.

A small pith region (P. Plate 1) with thickened cell walls and brownish contents appears in the center of the stem and can easily be distinguished from the wood. The cork cells as they appear in a cross section, magnified 265 diameters are flattened tangentially, the outer cells(C.Plate 11) being more compact and filled with a reddish brown content. Their exact outline can barely be distinguished. The length of these cells varies from 33 to 66 μ or about twice that of the younger cork. A small quantity of tannin was found in this region by treating with a solution of ferric chloride.

The younger cork cells(C. Plate 11) are much more clearly

defined in outline, being from 3 to 35μ radially and from 16 to 50μ tangentially, and containing a considerable quantity of tannin. In the outer radial section the outer cork cells appear less compact and much shorter and more clearly defined than in transverse section(C.Plate V) and the gradual increase in size towards the center is noticable. The length varies from 10 to 37μ. The cells of the cork in a longitudinal tangential section(Plate X) are irregular in form. Here and there, scattered throughout the section are numerous cells with dark brown colored contents.

The cells of the cortical parenchyma(C.P.Plate 11) exhibit a vast difference in size, ranging from 6 to 20μ radially and 16 to 73μ tangentially. The cells of the outer row in the collenchyma are considerably smaller than those directly inside and contain little or no cell contents while those comprising the remainder of this region are of various shapes, ranging from the large oblong to the small nearly cylindrical. The large cells as a rule taper somewhat at the ends. The cell walls are moderately thick and along the lower portions of the region will be found occasionally an intercellular space. Tannin is abundant throughout this region, and a small amount of starch is also present. The cells containing the starch are entirely separated from one another, having as many as from two to eight cells between them and a single starch containing cell lying directly above the bast fibre group.(B.F.Plate 11). These cells have about the same general appearance as those surrounding them.

Having about the same position as the starch cells, but

occurring more frequently are the cells containing rosette and prismatic calcium oxalate crystals (R.C. and P.C.O.Plate 11).

In the longitudinal radial section, the cells of the outer cortical (C.P.Plate V) region appears more regular in size, the cell walls are much thicker and occasionally an intercellular space can be detected.

The cells range from 10 to 50 μ in length, some, especially the smaller ones, assuming a cylindrical shape, while the large ones are rounded at the ends.

The rosette crystals (R.C.Plate 11) stand out promenently, the cells that contain them as a rule are separated by intercellular spaces.

The bast fibres (B.F.Plate 11) are white in color and from 6 to 16 μ in diameter with greatly thickened walls showing a distinct concentric stratification. The central cavities are almost obliterated. Associated with the fibre cells, rosette and prismatic calcium oxalate crystals (P.C.O. and R.C.Plate 11) are found together with numerous well defined sclerenchyma cells.

The Brachysclerids shown in (S.C.Plate 11) are found, from 13 to 26 μ radially and from 16 to 66 μ tangentially and occur alternately with the groups of bast fibres; occasionally crystal cells may be seen separating two groups of bast fibres. Each group shows from five to twenty-five fibres.

The stone cells are filled with tannin, the lumen occupies about one half of the cell diameter. In a transverse section

the crystal cells vary but little in size and shape and have a diameter of from 16 to 20 μ . This region in the longitudinal radial section has an entirely different appearance. The bast fibres (B.F.Plate V) showing their immense length, can be easily seen as they gradually taper to an end without any irregularity, and the very narrow cavity running throughout their extent.

The stone cells (S.C.Plate V) forming one continuous concentric band are greatly elongated and are often found to be one half the length of a bast fibre. The crystal cells (R.C.Plate V) appear about the same as in a cross section being from 13 to 20 μ .

In a transverse section of the secondary cortical parenchyma (Ph.Plate 11) we have a less variation in size of the cells, although they vary from 6 to 16 μ radially and from 10 to 40 μ tangentially. The cell contents directly beneath the bast fibre region appear to be more granular than those directly following but upon treating with ferric chloride, the tannin seems to be equally distributed. This test may also aid in showing the breadth of the medullary rays as they extend up into this region as the cells surrounding them are not affected by the ferric chloride. The cell walls in some instances are thicker than in the primary cortical parenchyma while but few intercellular spaces can be found. The shape of the cells resembles that of the primary cortical parenchyma although the majority of the cells are much smaller.

In longitudinal section (Ph.Plate V) the parenchyma cells

are seen to vary in length, ranging from 50 to 200 μ. The color and contents appear the same as in the transverse section .

In a transverse section of the xylem (xy. Plate 111) the numerous narrow medullary rays (m.R. Plate 111) largely filled with tannin are seen to run from the pith to the inner limits of the secondary cortical parenchyma. The area between these rays is occupied towards the interior by large tracheae (T. Plate 111), while towards the cortex region we find thickened wood fibres. In some cases, especially along the outer part, the wood parenchyma elements lie in radial rows. The large vessels are congregated towards the inside of the annual rings (Plate 1).

In transverse sections the wood parenchyma cells are laregly angular and some are rounded at the corners and have a diameter of about 6 to 26 μ. The large wood vessels are from 20 to 36 μ radially and from 6 to 26 μ tangentially. The cell walls are strongly pitted and thickened. The large tracheae vessels and distribution of same can be seen in Plate 1. They are more abundant in the spring wood and in some instances occupy a band around the entire stem, clearly defining the years growth. The medullary rays (M.R. Plate 111) extending through this region may be mentioned here. They extend from pith to cortex and are largely filled with tannin. In transverse sections the cells are rectangular, the longer dimensions lying in the radial direction. They range from 13 to 33 μ radially and tangentially, from 5 to 10 μ. The walls are considerably thickened, in some cases more so than in the surrounding cells. The pitting, although

frequent, is quite as indistinct as in the wood cells.

The fibrous form and pitting of the wood cells can easily be seen in a longitudinal radial section (xy.Plate VI). Some of the cells are elongated, tapering at both ends, others are angular, while both are marked with round X and slit-like pits. In a longitudinal tangential section Plate IX, the pitting and contents is brought out much more clearly than in the views above mentioned. The cell walls are somewhat irregular but show plainly the numerous pits. The smaller cells average about 100 μ in length, while the larger ones average about 300 μ.

Plate VIII, shows longitudinal tangential section of the wood, showing the comparative length of the wood fibres and wood cells. In a longitudinal radial section (M.R.Plate VI) we have either the cells of the medullary rays about square or elongated radially, and varying in size from 13 to 16 μ in width and from 16 to 26 μ in length. The cell walls in this view show the simple pits very plainly, also the very marked thickening.

In the longitudinal tangential section (Plate VIII) through the wood region the rays are seen to be numerous and of about the same width as the average wood cell. An abundance of tannin is found. The cells of the medullary rays vary from 23 to 50 μ in length.

The central pith (P.Plate IV) can easily be distinguished from the wood surrounding it by the well developed cell wall thickening and pitting. The walls are strongly thickened and heavily pitted, the middle lamella can easily be seen. The

cells of the pith region are separated by intercellular spaces at least towards the center. Occasionally a pitted transverse cell wall can be seen. The majority of the pith cells are filled with tannin and mucilage in an amorphous mass, the latter giving the characteristic blue color, upon the addition of a solution of iodine followed with a drop of concentrated sulphuric acid. The diameter of these cells is from 6 to 16 μ. In a longitudinal radial section (Plate VII) these cells appear either square or oblong, having in few cases rounded ends, while the remainder are large and angular. The pitted transverse cell wall can also be seen in some of the cells. This section resembles somewhat that of the medullary rays in longitudinal radial section (M.R.Plate VI) in cell wall and cell contents. The cells range from 23 to 50 μ in length.

Myrica Cerifera.

Myrica cerifera(8) is the indigenous species that has attracted the most attention in the United States.

Their stems are considerably larger than Myrica Gale and range from 5 to 8 mm in diameter. The material used was also collected by Mr.R.H.Denniston at Woods Holl Mass. The stem has a grayish mottled appearance. The outer cork, covered with a paper-like epidermis can readily be separated(C.Plate XII) from the inner bark, when the exposed surface is rugged and admits of being highly polished.(22) The bark (Plate XI) has about the same general appearance as that of M.Gale, while the wood differs only in having the large wood cells distributed throughout the entire xylem (xy.Plate XI), while in M.Gale they are found almost entirely along the spring deposition. The pith region occupies considerably more space as plate XI will show, also showing the cells to be much larger.

In a transverse section(C.Plate II) the outer cork cells have the same massed appearance as in M.Gale while the inner or newer cork cells(C'' Plate XII) are less regular and measure from 2 to 3μ radially and 11 to 33μ tangentially. The color of the cells is reddish brown, deepening as they extend inward to a dark brown. The longitudinal radial section of the cork (C.Plate XVI) is nearly identical with the same section in M. Gale being of about the same length and width and measuring on the average 13 to 36μ.

The cells of the primary cortical parenchyma in a transverse section (C.P.Plate XII) exhibit much thickened cell walls which occasionally are reduced by an intercellular space. Scattered throughout this region we find a few stone cells. Tannin and starch is found abundantly, the latter appearing in small grains and forming an incomplete layer above the bast fibre region. The cells range from 19 to 47μ radially and from 19 to 78μ tangentially.

In a longitudinal radial section (C.P.Plate XVI) the cells are larger, ranging from 29 to 117μ in length. In form they resemble the cells in M.Gale both in transverse and longitudinal section. The bast fibres and stone cells (B.F.& S.C. Plate XIII) form a band similar to those already mentioned in the other Myrica species. In M.Gale we have them forming one distinct band (B.F.& S.C.Plate II) and slightly if at all deviating from it, while in this plant we have the stone cells scattered throughout the primary cortical parenchyma and the bast fibres and occasionally a stone cell mass in the secondary cortical parenchyma. The stone cells and bast fibres have about the same diameter as in M.Gale. The rosette and prismatic calcium oxalate crystal cells (R.C.& P.C.O. Plate XIII) are also found but occur less frequently. In the longitudinal radial section the stone cells (S.C.Plate XVII) appear in one continuous concentric band just as in M.Gale, only differing slightly in that they appear to be elongated radially as well as tangentially, while the same cells in the other species are elongated lengthwise

and are of considerable length. In both transverse (Ph.Plate XIII) and longitudinal radial (Ph.Plate XVII) section the secondary cortical parenchyma resembles the same tissue in M.Gale only that here we occasionally find an isolated stone cell with a mass of bast fibres in this region. A small quantity of starch and tannin is also present. In comparing a transverse section of the wood of these two species we find them almost alike, the only difference being in the tracheae cells of M.Cerifera (T.Plate XIV) being much larger, and varying from 20 to 55 μ radially and from 19 to 40 μ tangentially and the large medullary ray (M.R.Plate XIV) cells containing a considerable quantity of starch. See Plate XIV.

In a longitudinal radial section of these two plants we find no differences, otherwise than those above mentioned. Without the aid of a micrometer this difference would hardly be apparent.

The strongly thickened and heavily pitted cell walls of the pith (Plate XV) show the middle lamella and intercellular spaces separating the cells. This is also like that of M.Gale only that the cells are much larger and contain a considerable quantity of starch and tannin. They are from 22 to 66 μ radially and from 24 to 63 μ tangentially.

In comparing the two species under consideration we find that they have almost the same general structure as well as contents. The outer cork cells are almost exactly alike while in the inner cork we have only a slight irregularity in M.Ceri-

fera. The cells of the wood are somewhat larger in the latter species as are also the medullary rays which contain starch instead of tannin as in M.Gale.

The contents of the pith of the last named species is largely made up of mucilage while here we have starch grains in sufficient quantities to make the cell contents appear as a dark mass when treated with iodine. The pith cells(Plate XV) are considerably larger than those of M.Gale and show distinctly the cell wall thickening and pitting.

ABBREVIATIONS.

C. = Outer cork

C'' = Inner cork

C.P. =Cortical parenchyma

S.C. = Stone cells.

R.C. = Rosette crystals.

P.C.O.=Prismatic calcium oxalate crystals

B.F. = Bast fibres.

Ph. = Phloem or secondary cortical parenchyma.

XY. = Xylem

T. = Tracheae.

M.R. = Medullary rays.

P. = Pith.

EXPLANATION OF PLATES.

Plate I. Diagramatic view of cross section of stem of Myrica Gale. Magnified 55 diameters.

Plate II. Cross section showing details of bark. Magnified 265 diameters.

Plate III. Transverse section of wood and medullary rays. Magnified 265 diameters.

Plate IV. Cross section showing pitting of the pith. Magnified 265 diameters.

Plate V. Longitudinal radial section of bark in detail. Magnified 265 diameters.

Plate VI. Longitudinal radial section of wood showing the pitting of same and large tracheae vessels and medullary rays. Magnified 265 diameters.

Plate VII. Longitudinal radial section showing the pitting of the pith. Magnified 265 diameters.

Plate VIII. Longitudinal tangential section through the wood region. Magnified 100 diameters.

Plate IX. Longitudinal tangential section through the wood showing pitting of wood fibres and medullary rays. Magnified 450 diameters.

Plate X. Longitudinal tangential section of cork. Magnified 450 diameters.

Myrica cerifera.

Plate XI. Diagramatic view of cross section of stem of Myrica cerifera. Magnified 53 diameters.

Plate Xii. View of cork and cortical parenchyma, transverse section. Magnified 265 diameters.

Plate Xiii. View of bast fibres and stone cell band and secondary cortical parenchyma, transverse section. Magnified 265 diameters.

Plate XiV. Cross section through wood, showing the large spring vessels and medullary rays. Magnified 265 diameters.

Plate XV. View of the loose pith and pitting of same transverse section. Magnified 265 diameters.

Plate XVi. View of cork and primary cortical parenchyma. Longitudinal radial section. Magnified 265 diameters.

Plate XVii. Longitudinal radial section showing stone cells and secondary cortical parenchyma. Magnified 265 diameters

All plates were drawn from nature with the aid of the Abbe Camera lucida.

References for Myrica Gale and Myrica cerifera.

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19.Am.Journ.Pharm. 35,p.193

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APPROVED..... R. N. Dennistoun .....

PLATE I.

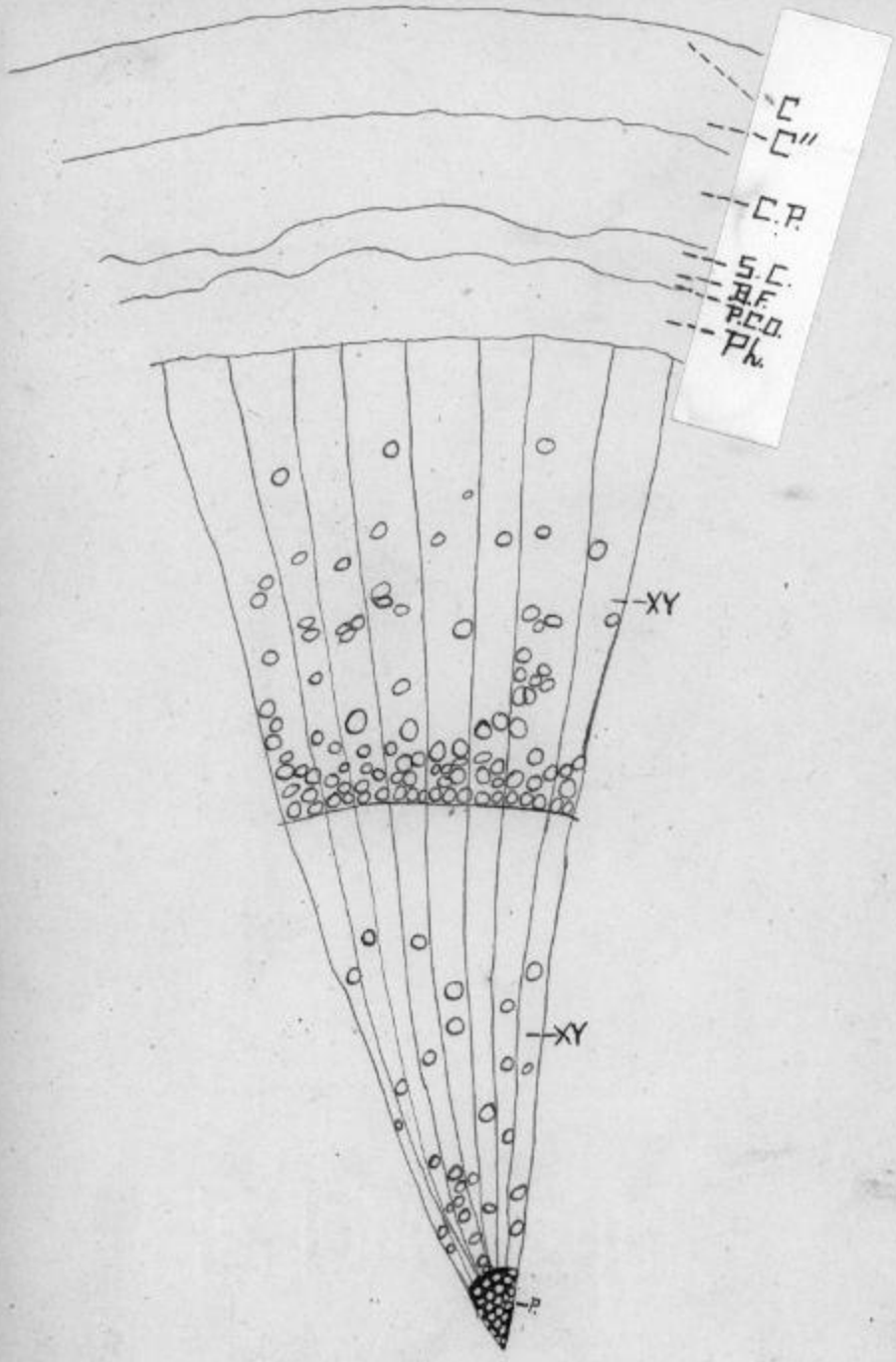
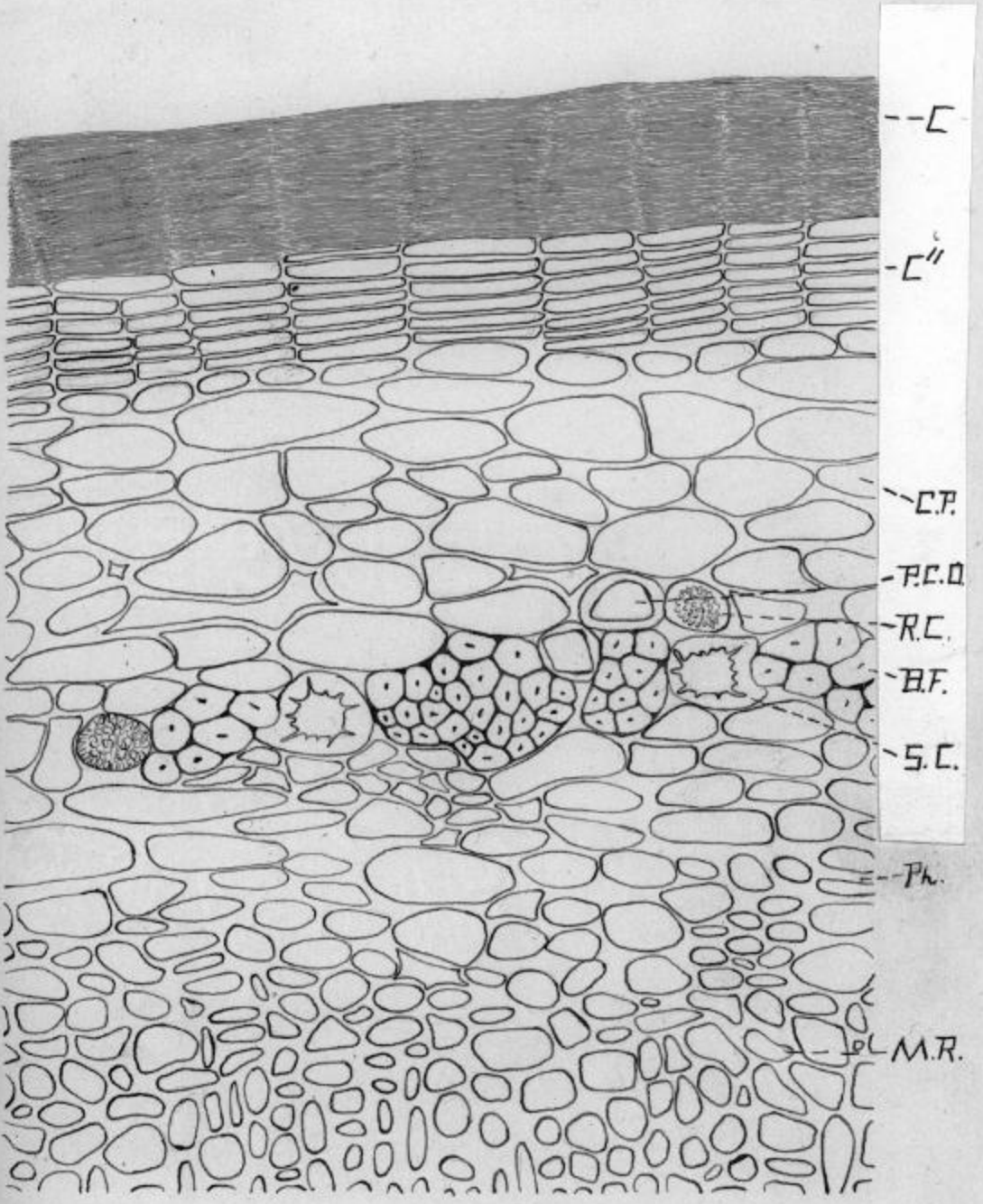


Fig 1

PLATE 2.



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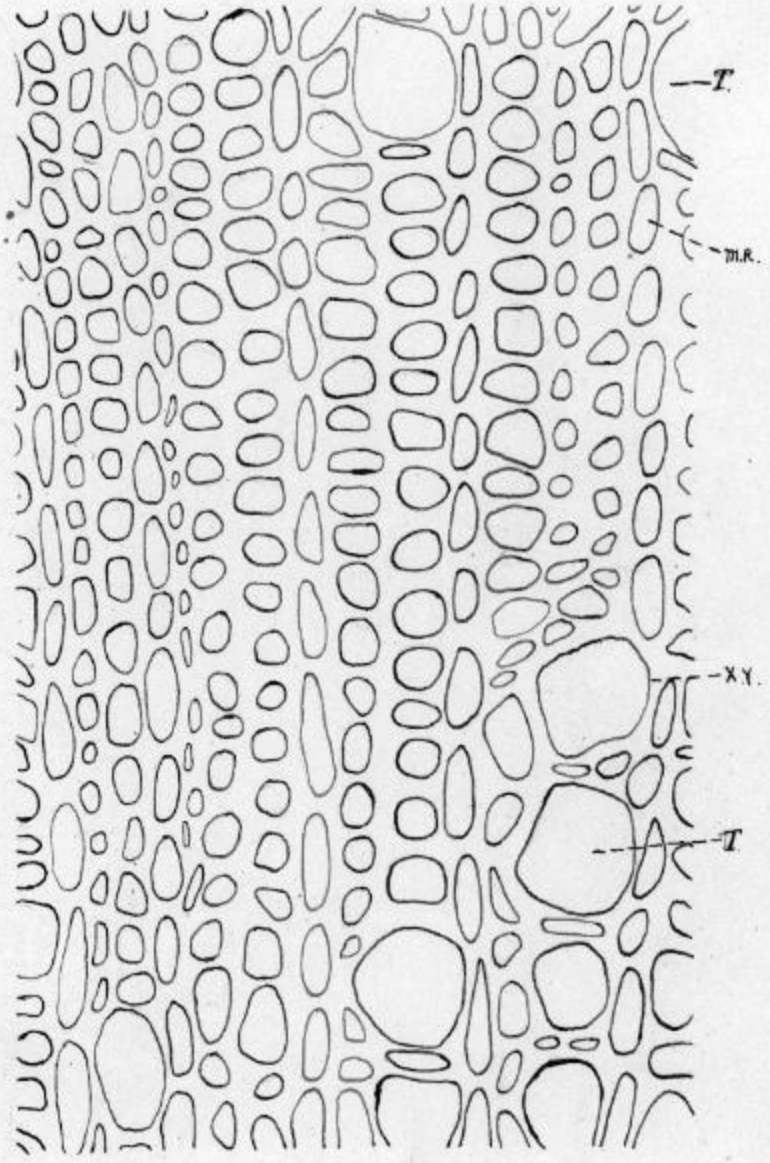

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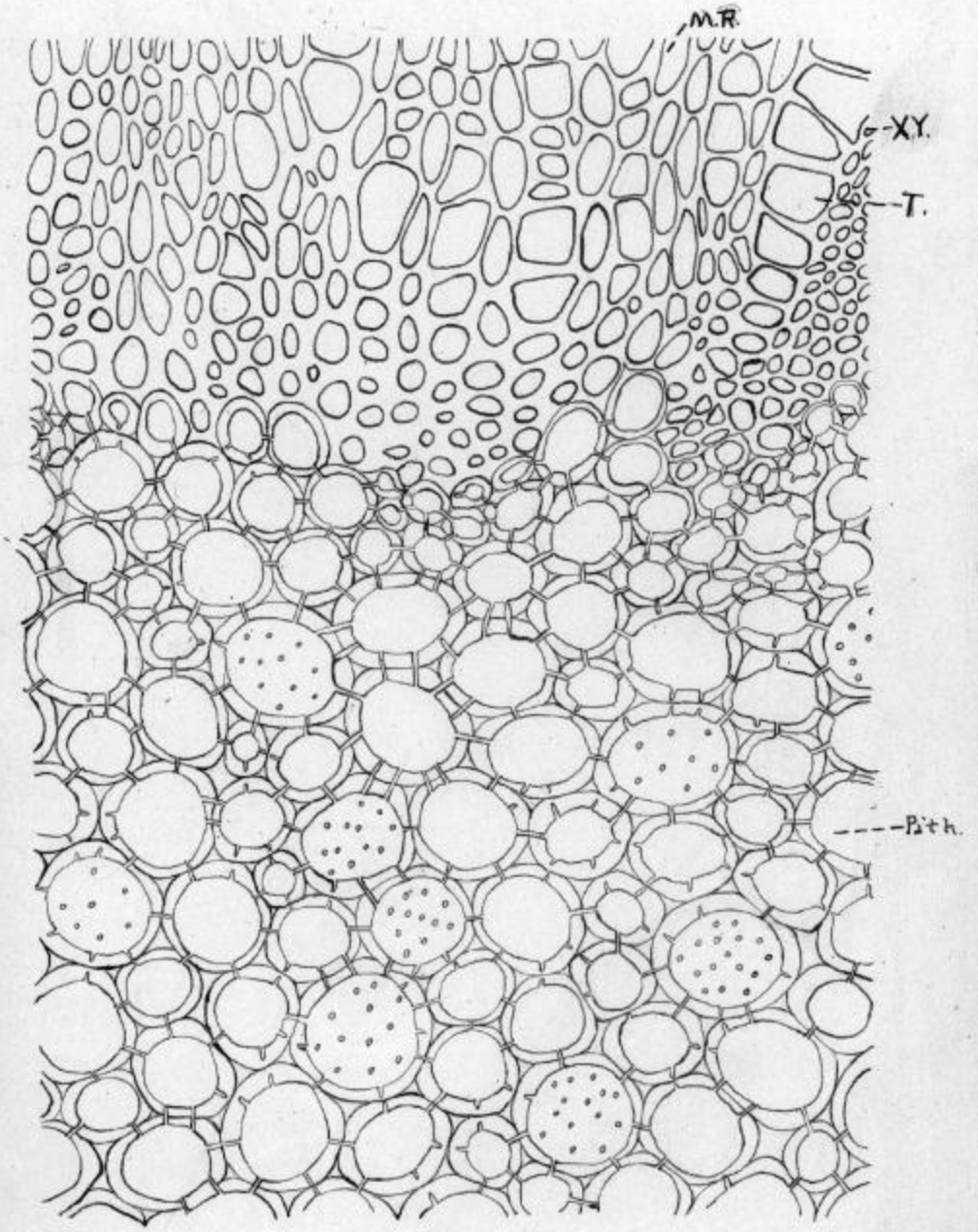

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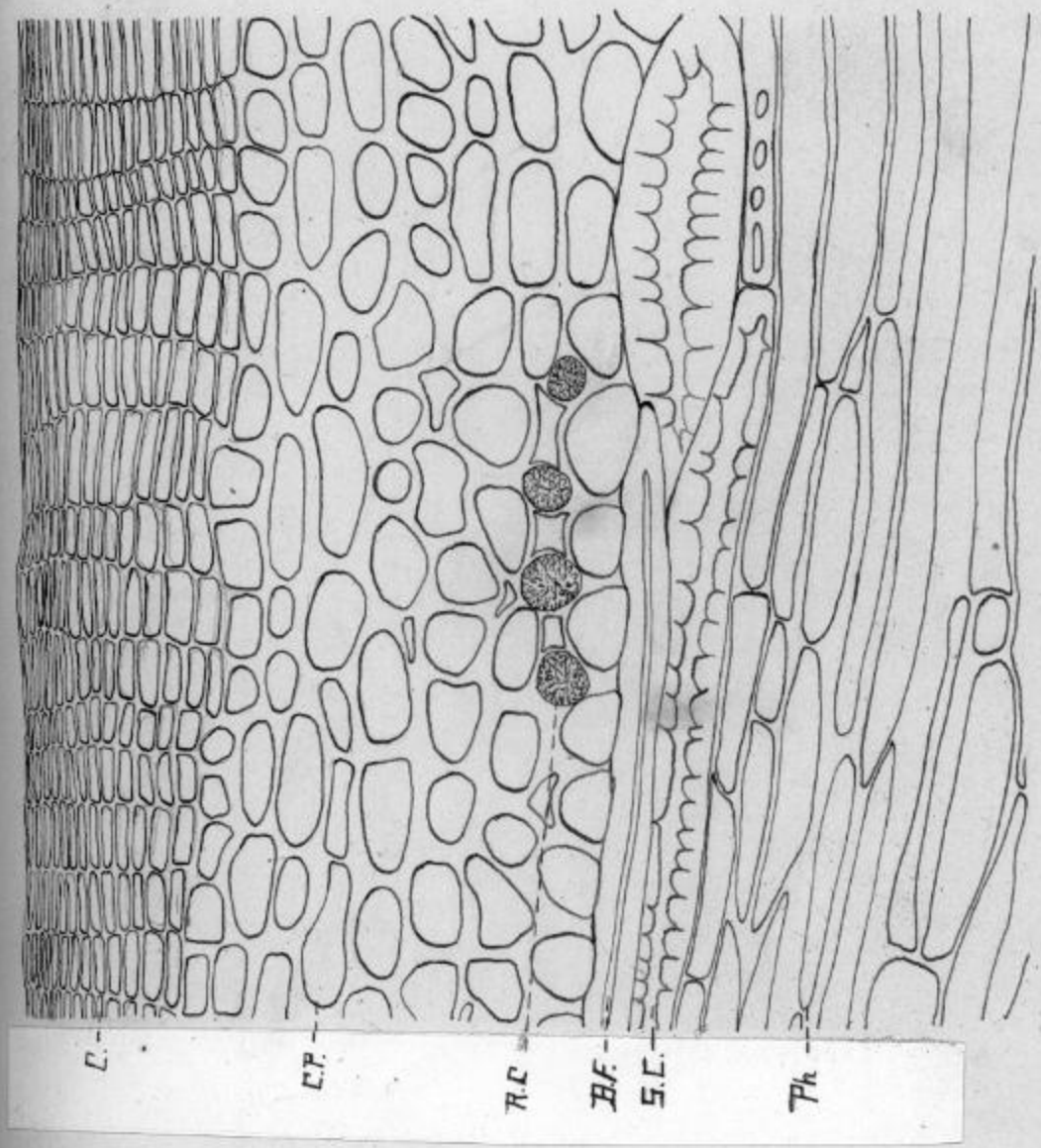
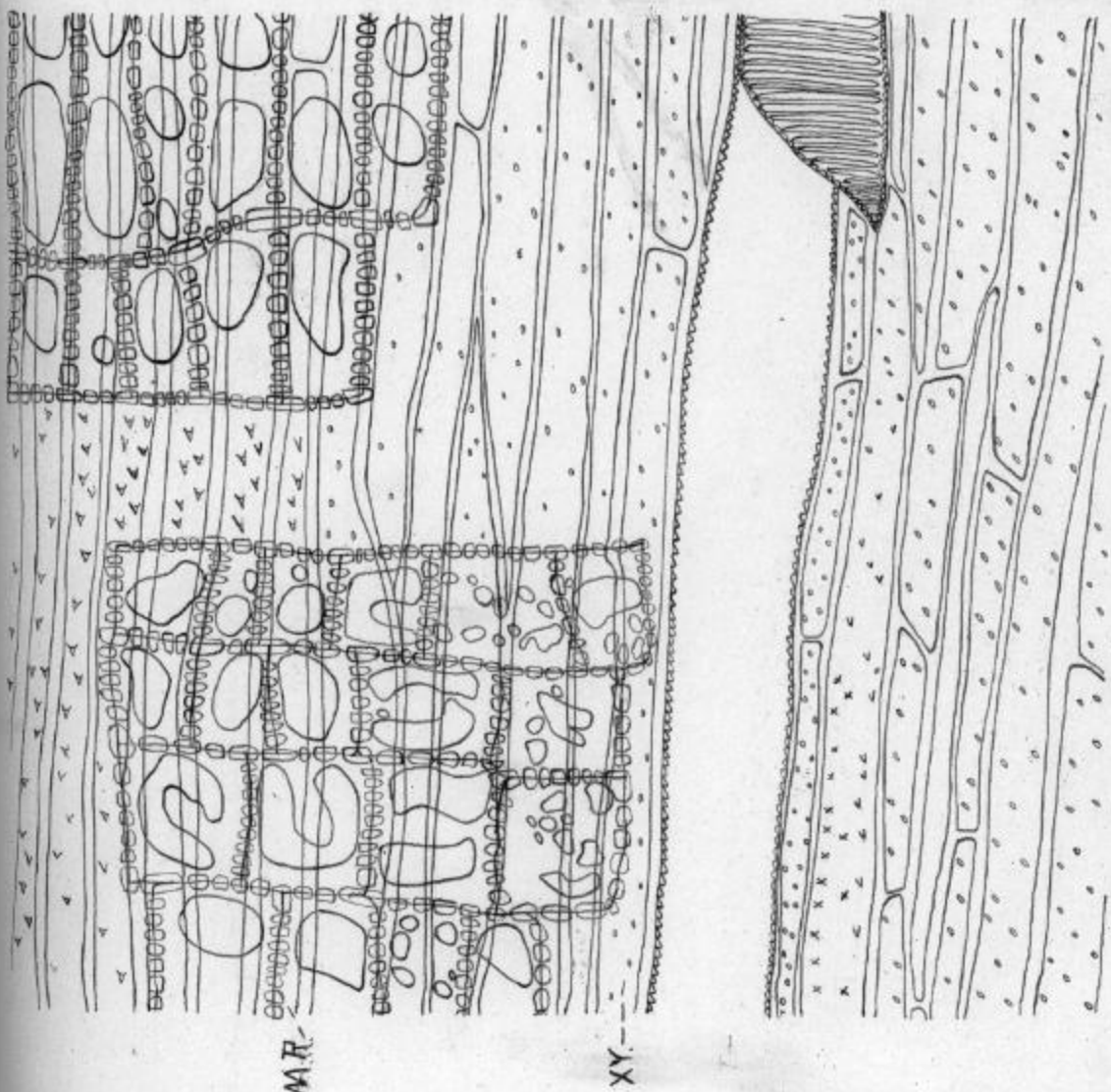


Fig. 4

PLATE 6.



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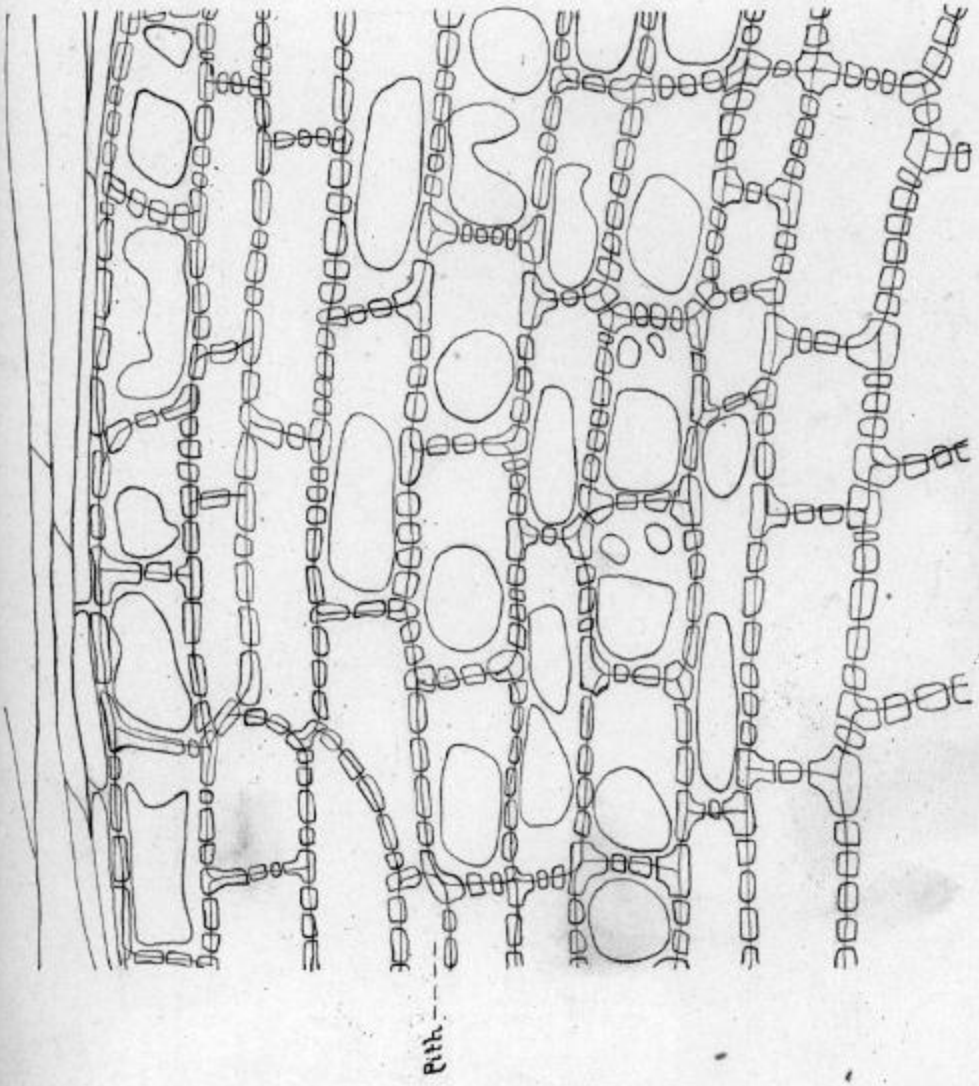

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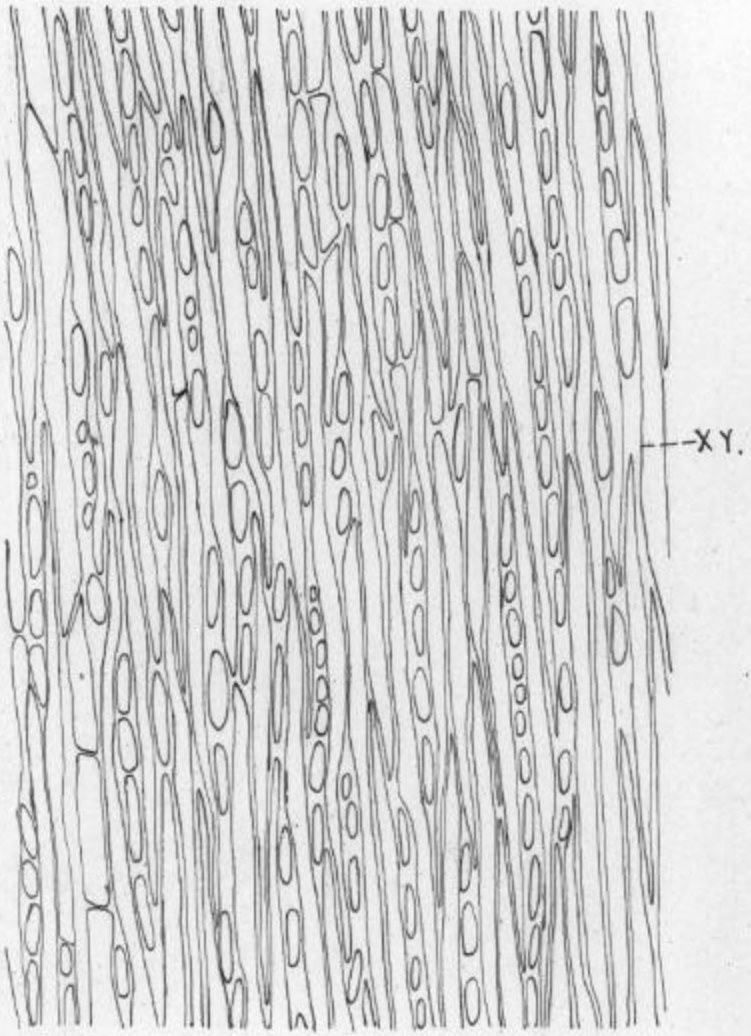

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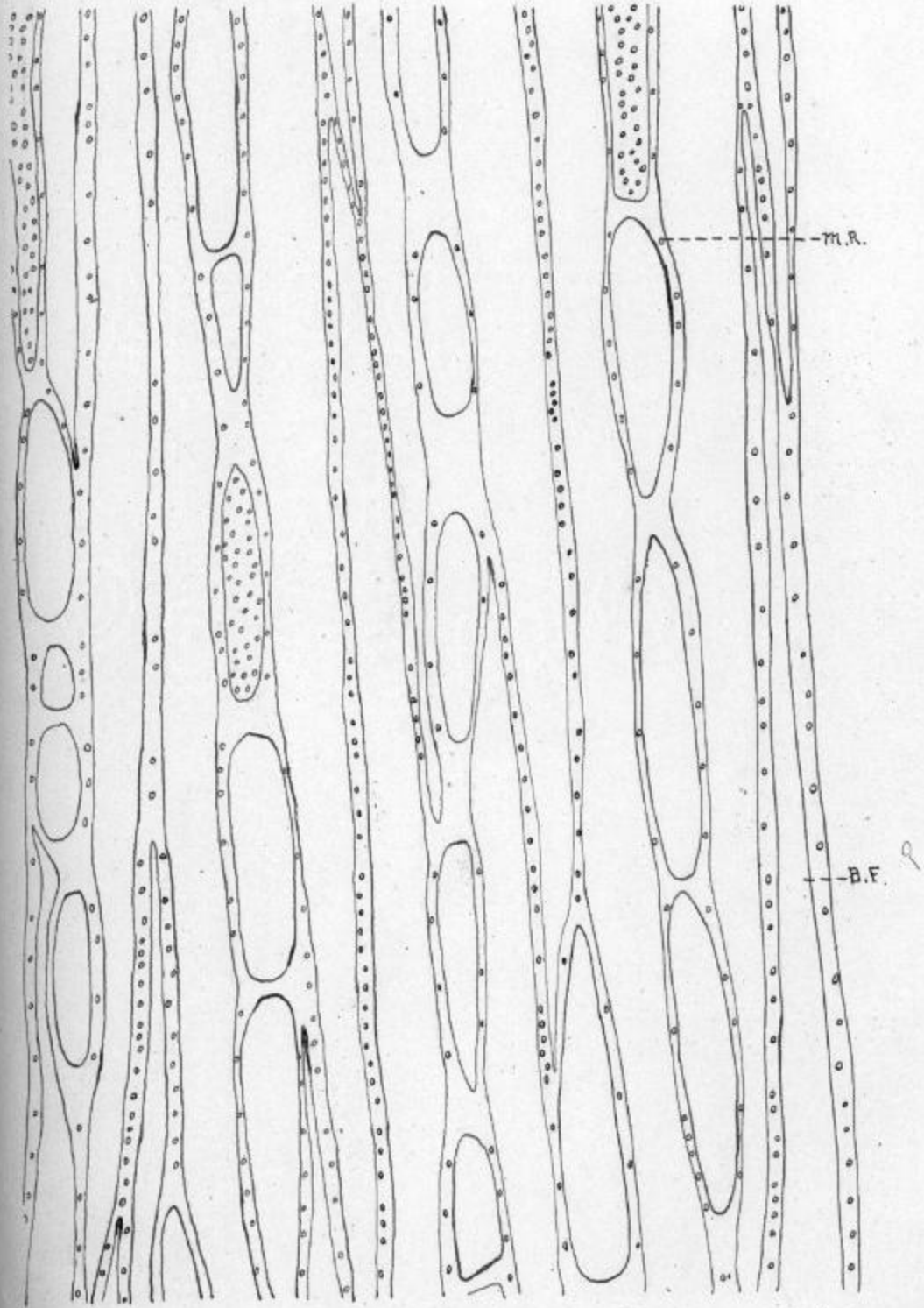

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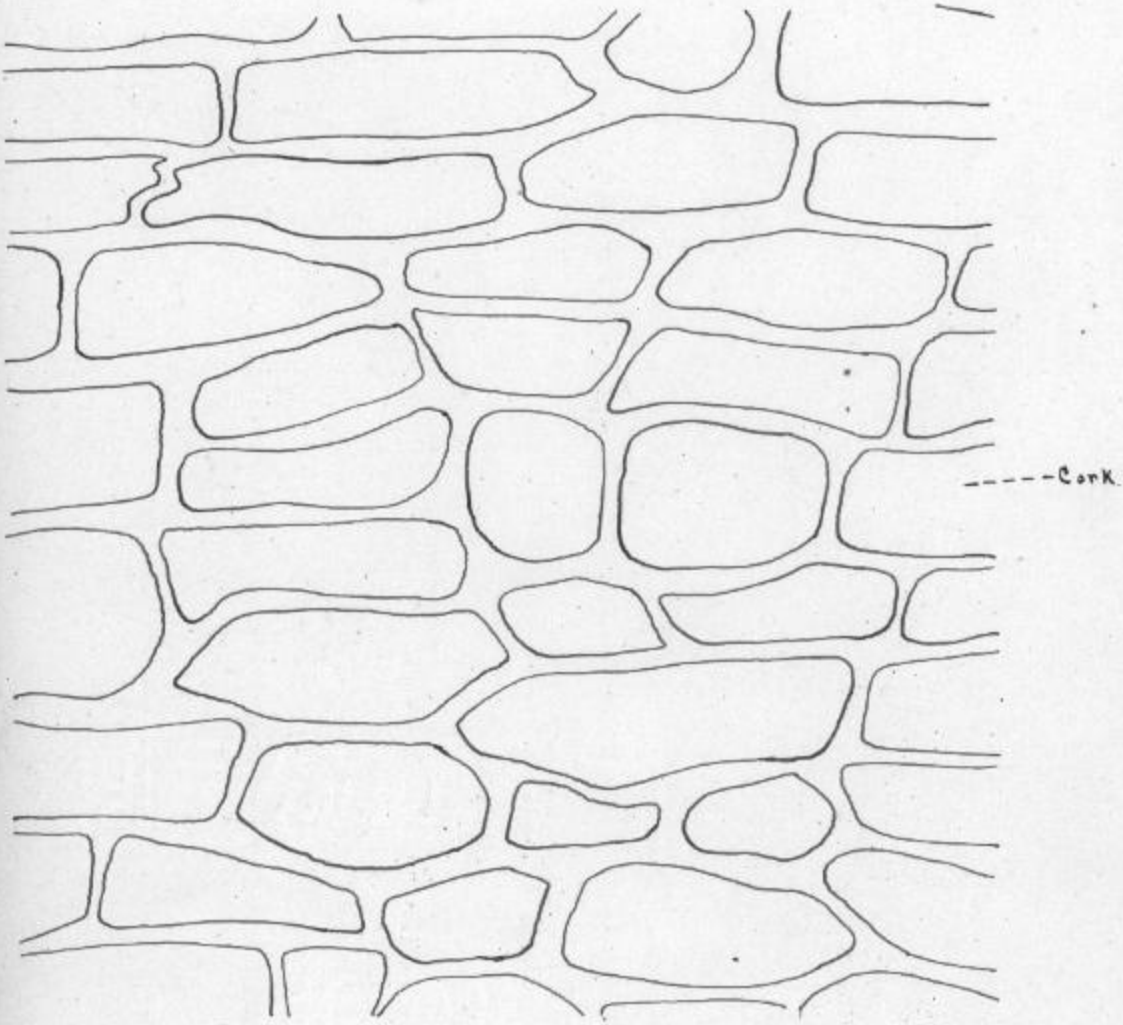

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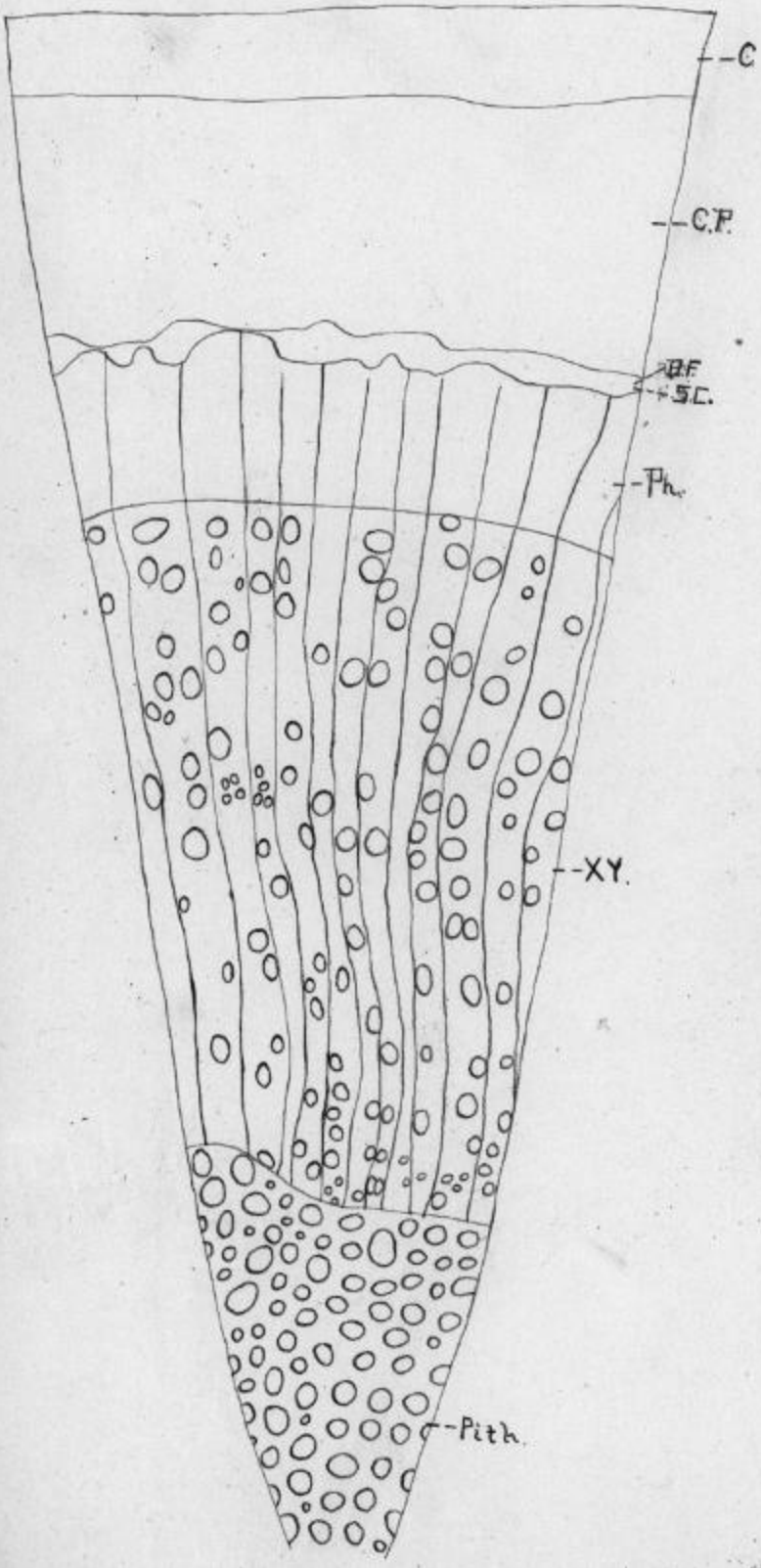
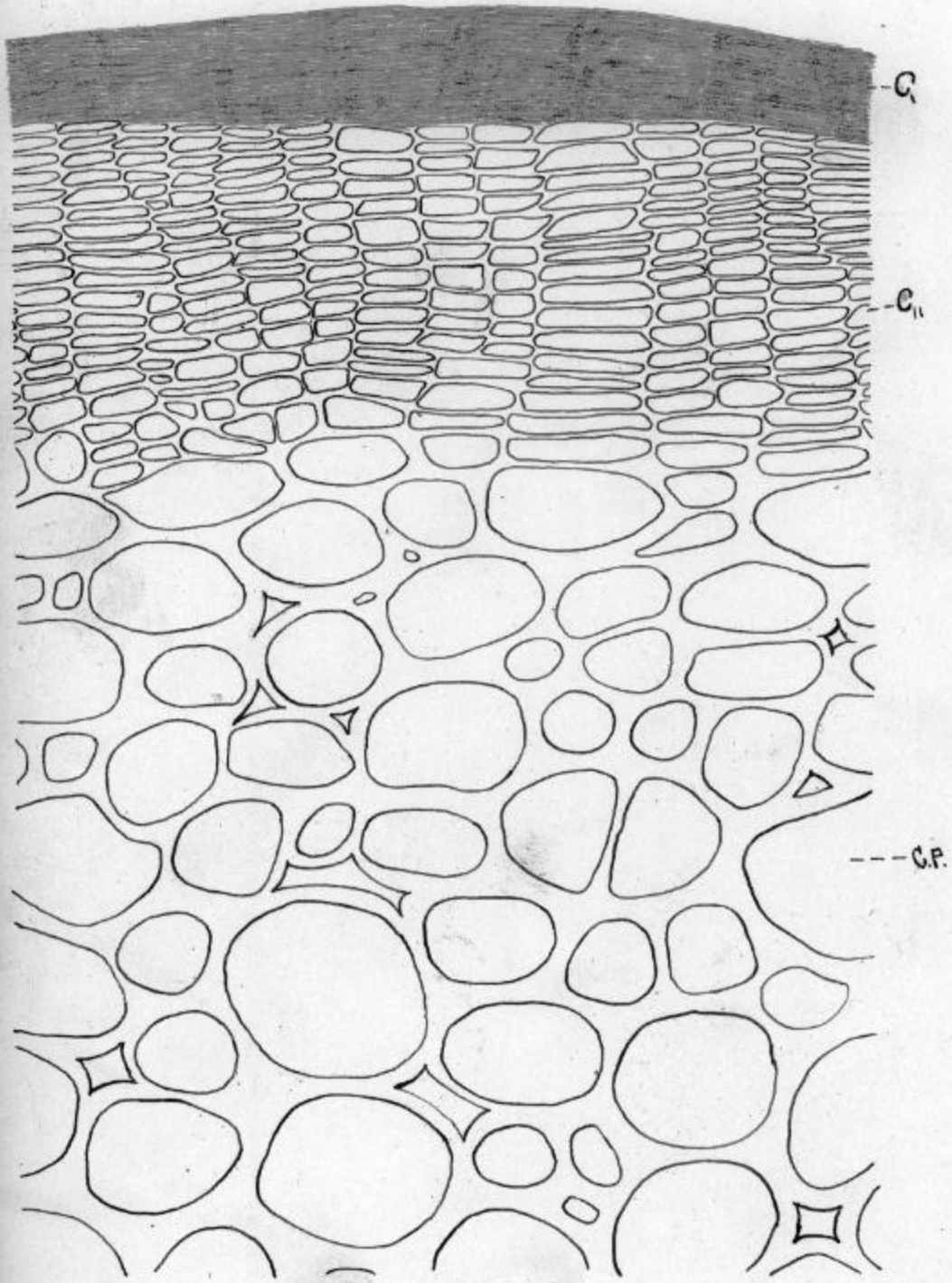


Fig 7

PLATE 12.



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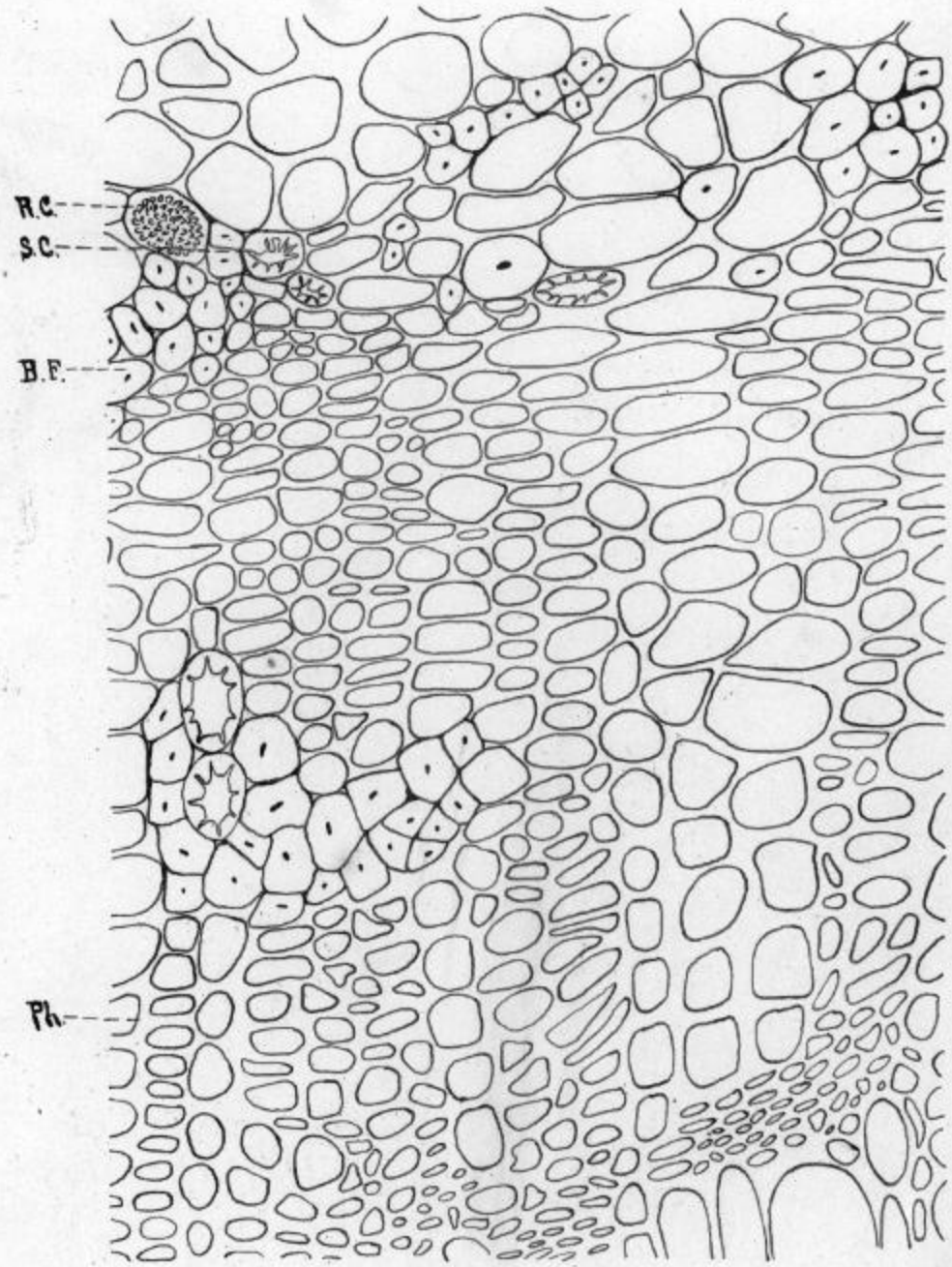

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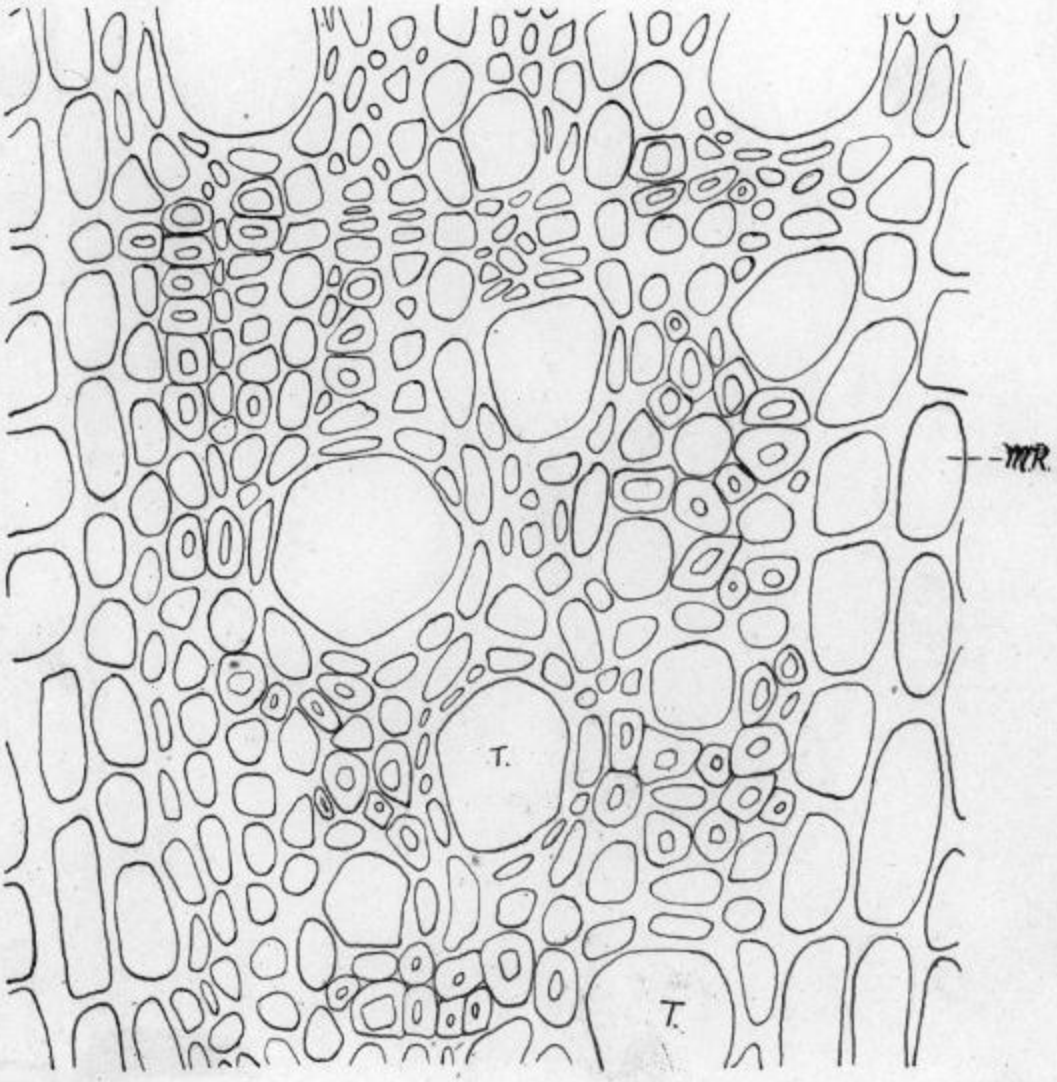

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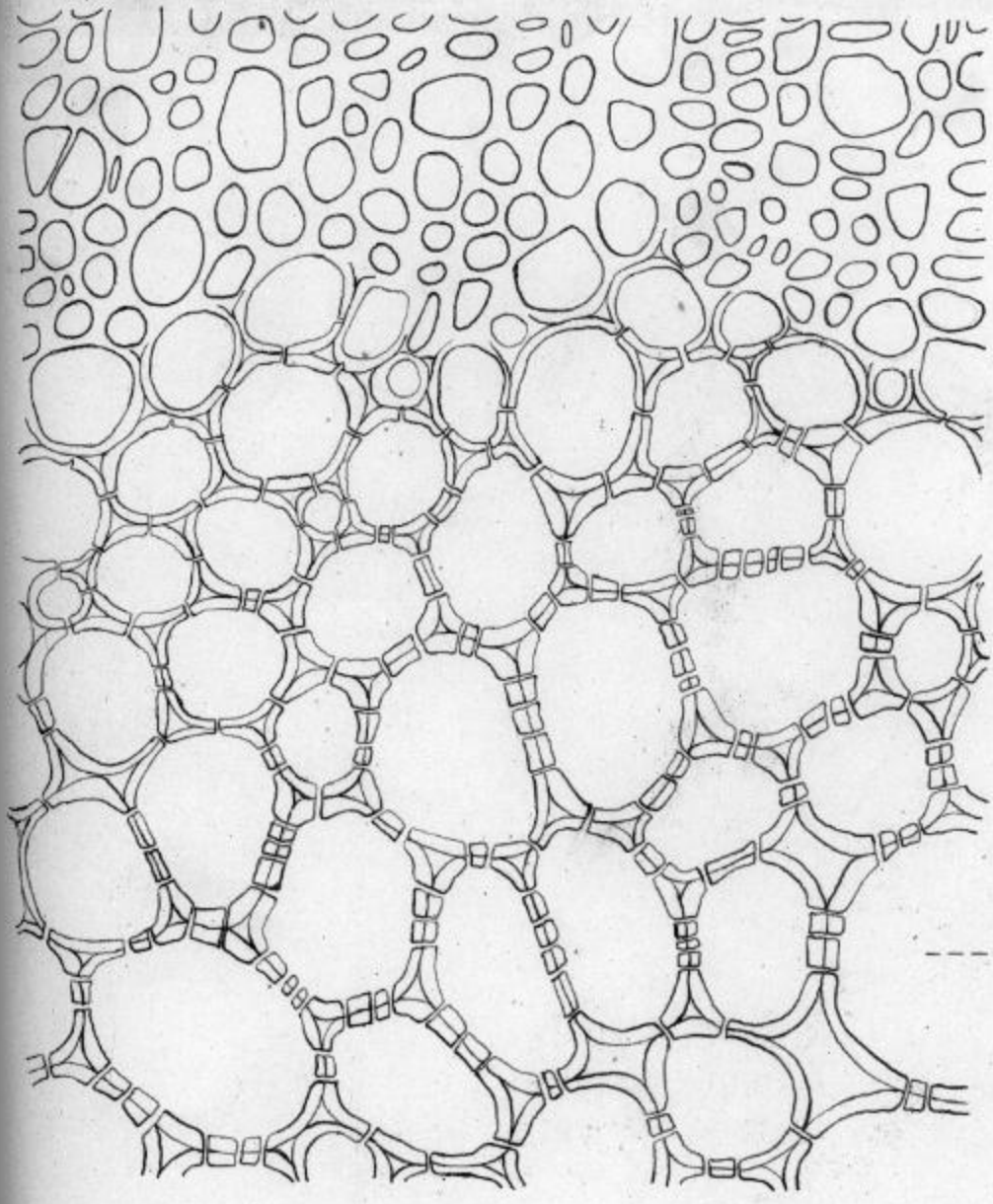

Fig 11

PLATE 16.

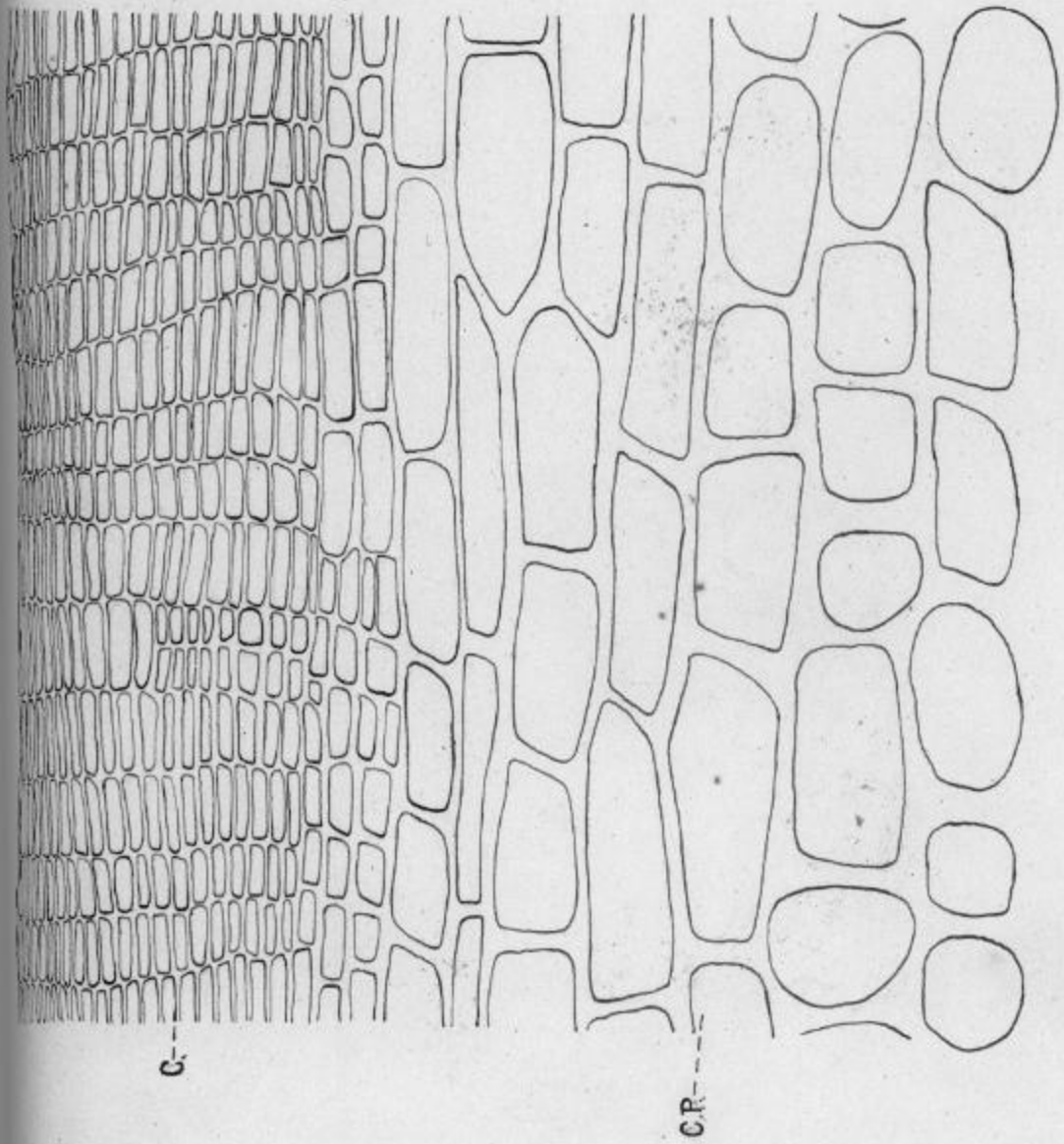

PLATE 17.