

MACRO-AND MICROMORPHOLOGY OF
STERCULIA DIVERSIFOLIA DON CULTIVATED IN EGYPT

Part 1- The Root, Stem and Leaf.

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The macro-and micromorphology of the root, stem and leaf of Sterculia diversifolia Don are studied in order to throw a light on their characters that help in the identification in both entire and powdered forms.

Sterculia diversifolia Don = Brachychiton populneum R. Br., Kurajong, bottle tree is a tropical tree belonging to family Sterculiaceae (1,2,3,4,5). The tree is native to Australia and cultivated in Egypt.

Many species of the genus Sterculia are known to have folkloric medicinal uses; for example leaves are used to relief abdominal pains, diaphoretic, purgative and diuretic. The bark is used as a remedy for dropsy and rheumatism. The fruit is used as astringent and the seed is edible but cause purgation when eaten raw⁶.

Preliminary screening and chemical studies⁷ showed that the leaves, and stems contain flavonoids, the seeds contain alkaloids and are rich in oil content as well as sterols and terpenes.

Material:

Collection was made from plants cultivated in public gardens at Assiut. The plant was identified by the late Prof. Dr. F.Y.Amin, Prof. of Floriculture, Faculty of Agriculture ,

Assiut University. Fresh, as well as, preserved organs were used for this study.

Habitat:

Sterculia diversifolia Don is a street tree up to 15 metres in height. Leaves are variously-shaped, entire or palmately-lobed. The plant is monoecious carrying both male and hermaphrodite flowers. It is propagated by seeds or cutting of the ripened wood. The flowering period is April and May.

1- The Root

Macromorphology:

The root (Fig. 1,A) is a long, cylindrical to fusiform tap root. It reaches about 1-5 metres in length and 15 to 20 cm in diameter near the ground level. Several lateral branches arise from the main one. Externally, it is covered with a dark brown longitudinally striated cork which exposes a whitish interior on exfoliation. It breaks with a splintary laminated fracture in the wood and short, soft in the bark. It is odourless and with a slight bitter taste.

Micromorphology:

A transverse section through the root (Fig. 2,A) is nearly circular, slightly irregular in outline. It shows an outer, narrow bark and a wide, central wood. (The cork is brown surrounding a narrow phelloderm). The pericycle when present is parenchymatous with groups of lignified fibres. The phloem is separated from the xylem by a scanty cambium. The protoxylem is tetra-arch; xylem is wide showing Secondary elements and wide mucilage cavities. Medullary rays are funnel-shaped, bi-to tetraseriate.

The cork: Fig.(2, A & C)

It shows tangentially elongated cells, brown in colour and are slightly lignified. In surface view (Fig. 2, B & C)

they are subrectangular with thin walls and measuring from 35 to 37 microns in length and 20 to 36 microns in width. The cells contain tanniferous substances which stain bluish-green with ferric chloride T.S.

The cortex: (Fig. 2,B)

The secondary cortex is very narrow and formed of 2 to 3 rows of tangentially elongated parenchyma cells with starch granules, simple and compound of 2 to 8 components.

The phloem: (Fig. 2, A, B & C)

The fibres are straight with tapering ends, lignified thin walls, wide lumen and measuring from 340 to 510 microns in length and 20 to 30 microns in width. The soft elements are sieve tubes, companion cells and phloem parenchyma containing starch granules.

The xylem: (Fig. 2, C,d,f)

The vessels are pitted with simple and bordered pits and measure from 35 to 95 microns in diameter. Wood fibres are lignified, somewhat fusiform with tapering ends, thick walls and measure from 190 to 250 microns in length and 15 to 27 microns in width. Wood parenchyma are lignified and pitted in the old root, those of the young one are cellulosic, rectangular with thin walls. Thacheids are narrow with rounded apices, lignified, pitted (simple and bordered) walls and measuring from 60 to 95 microns in length and 10 to 28 microns in width. Medullary ray cells are nonlignified, but shows lignification in the old ones, and elongated. Mucilage cavities are wide mostly lined with narrow, small cells and show stratifications of mucilage which stain red with R.R.

Powdered Root:

The powdered root of Sterculia diversifolia Don is yellowish-brown, odourless and with a slight bitter taste.

It is characterised microscopically by the followings:

- 1- Fragments showing brown, slightly lignified, thin-walled and subrectangular cork cells.
- 2- Fibres of the pericycle with thin, straight and lignified walls, tapering ends and wide lumen.
- 3- Fibres of the wood, which are fusiform, lignified, with thick walls, narrow lumen and tapering ends.
- 4- Vessels, lignified, pitted with simple and bordered pits or spiral and scalariform.
- 5- Tracheids, which are narrow, lignified, pitted with simple and bordered pits and have rounded ends.
- 6- Fragments showing slightly lignified or non-lignified parenchyma which are subrectangular or quadrangular and sometimes slightly pitted.
- 7- Fragments showing few tangentially elongated parenchyma cells of the phelloderm.

II. The Stem

Macromorphology:

The stem (Fig. 3, B) is erect, cylindrical to subcylindrical, solid, up to 10 metres or more in height and 25 to 35 cm in diameter at the ground level. The stem is monopodially branched with internodes measuring about 2 to 6 cm in length. The bark is hardly separated from the wood, showing an outer striated brownish cork and a soft bark. The stem is odourless and nearly tasteless.

Micromorphology:

A transverse section through the young stem (Fig. 3,A) is nearly circular in outline showing an epidermis followed by 2 to 3 rows of a collenchymatous hypodermis. The cortex is parenchymatous showing mucilage cavities arranged in a circle and it is lined internally by a well-defined endodermis. The pericycle is formed of parenchyma alternated with

groups of fibres situated against the vascular bundles. The vascular cylinder is opened by the relatively broad medullary rays. The phloem strands are nearly triangular with the narrowest end towards the exterior and stratified by fibrous bands; each of four to five fibres. The radiating xylem encloses a relatively narrow pith which have mucilage cavities. The phloem and xylem are separated by a narrow cambium.

The cork arises lately and mostly superficially in the subepidermal layer of the old stem.

The epidermis: (Fig. 3,C)

The cells are isodiametric to quadrangular with straight anticlinal walls covered with smooth cuticle and measure from 9 to 14 microns in length and 8 to 12 microns in width and 12 to 13 microns in height. Stomata are rare, ranunculaceous and hairs are absent.

The cork is formed of about 3 to 4 rows of tangentially elongated, thin-walled, slightly lignified cells with brown contents.

The cortical tissue: (Fig. 3,B)

The collenchyma of the hypodermis is rounded and contain chloroplasts. The parenchyma is mostly of tangentially elongated cells containing starch granules which are simple and compound of 2 to 5 components as well as cluster crystals of calcium oxalate measuring up to 40 microns in diameter. Mucilage cavities are similar to those of the root.

The pericycle: (Fig. 3, B & D)

The pericyclic fibres are long, straight with elongated tapering to acute ends, mostly wide lumen and thin, lignified walls. They measure from 500 to 1100 microns in length and 15 to 35 microns in width.

The parenchyma are rounded cells containing cluster crystals of calcium oxalate.

The vascular system: (Fig. 3 A, B & D)

Phloem is formed of sieve tubes, phloem parenchyma and companion cells. Phloem fibres are short, straight with somewhat rounded tips, narrow lumen and lignified, thick walls. They measure from 150 to 530 microns in length and 28 to 45 microns in width.

The primary xylem vessels are lignified, spiral or scalariform measuring up to 45 microns in diameter. Those of the secondary xylem are lignified, pitted with simple and bordered pits and measuring from 35 to 70 microns in diameter. Tracheids are narrow, tapering, pitted and lignified. They measure from 80 to 120 microns in length and 10 to 25 microns in width. Fibres are straight with acute ends, pitted or thick lignified walls and narrow lumen. They measure from 150 to 520 microns in length and 15 to 20 microns in width. Xylem parenchyma are quadrangular, lignified and pitted. Primary medullary rays are wide showing slightly lignified or non-lignified cells. Secondary ones are bi-to tetra-seriate showing lignified, pitted walls.

The parenchyma of the pith is slightly lignified or lignified and pitted in the old stem and the pith contains mucilage cavities as those of the root.

Powdered Stem:

Powdered stem of *Sterculia diversifolia* Don is yellowish-green in colour, odourless and with a slight bitter taste. It is characterised microscopically by the followings:

- 1- Fragments of the epidermal cells of the young stem showing isodiametric to quadrangular cells with straight anticlinal walls, covered with smooth cuticle and showing rare ranunculaceous stomata. Hairs are absent.
- 2- Fragments of the cork from the old stem showing polygonal cells with straight, thin slightly lignified brown cells.

- 3- Fibres of the pericycle with straight, thin lignified walls, wide lumen and acute tapering ends.
- 4- Fibres of the phloem which are short, straight with rounded ends, narrow lumen and somewhat thick walls.
- 5- Wood fibres with straight sometimes pitted lignified walls, narrow lumen, and acute ends.
- 6- Lignified vessels either pitted with simple and bordered pits or spiral and scalariform.
- 7- Fragments showing lignified and pitted parenchyma cells of the xylem.
- 8- Fragments showing rounded parenchyma cells containing starch granules and cluster crystals of calcium oxalate.

III. The Leaf

Macromorphology:

The leaf (Fig. 1 B) is simple, petiolate, exstipulate, coriaceous, alternate, broadly-ovate to oblong - ovate and entire or three, sometimes Five-lobed. The apex is acute, tapering and the venation is reticulate-pinnate. The lamina is glabrous and with a symmetric base.

The fresh leaves are green on the upper surface, pale green on the lower; after drying they become paler. The lamina measures about 5 to 8 cm in length and 3 to 4 cm in width.

The petiole is cylindrical, solid, pale green measuring about 5 cm in length and 1 to 2 mm in diameter.

The leaf is odourless and with a slight bitter taste.

Micromorphology:

A. The lamina:

A transverse section through the lamina (Fig. 4 A) is biconvex, showing a dorsiventral structure with upper palisade of mainly two rows. The latter is interrupted in the midrib region by a mass of hypodermal collenchyma. The vascular system is represented by a large crescent-shaped vascular bundle

accompanied, at its upper side, with other addittive and inverted smaller ones. All the system is surrounded by a pericycle of alternated parenchyma and groups of fibres. A large cavity is present above the vascular system and other one forming an arc below and contain mucilage.

The epidermis:

The upper epidermal cells (Fig. 4 D) are isodiametric with straight anticlinal walls and covered with smooth cuticle. They measure from 17 to 22 microns in length, 15 to 20 microns in width and 11 to 13 microns in height. The marginal cells show beaded anticlinal walls. The upper epidermis shows no stomata or hairs.

The lower epidermal cells (Fig. 4 E) are similar to the upper but smaller in size; measuring from 12 to 15 microns in length, 10 to 13 microns in width and 8 to 10 microns in height. Ranunculaceus stomata surrounded by 4 to 6 epidermal cells are noticed. Hairs are absent.

The cortical tissue: (Fig. 4 C)

The upper and lower collenchyma are formed of 2 to 4 rows of rounded collenchyma cells containing plastids.

The parenchyma is rounded and contain starch granules simple and compound of 2 to 8 components. Those adjacent to the vascular bundles contain cluster crystals of calcium oxalate. Mucilage cavities are similar to those of the root.

The mesophyll: (Fig. 4 B)

The palisade cells are longer in the outer row than the inner. The spongy mesophyll is irregular, with wide intercellular spaces.

The vascular system: (Fig 4 B & 5 D)

The pericyclic fibres are straight with thin lignified walls, wide lumen, pointed apices and measure from 230 to 620 microns in length and 12 to 20 microns in width. Phloem is soft and xylem is radiating showing lignified, pitted, spiral and scalariform vessels.

B- The Petiole:

A transverse section through the petiole (Fig. 5,A) is nearly circular showing an epidermis enclosing a parenchymatous cortex which is traversed by a ring of mucilage cavities. The vascular system is complex and variable. Mostly, it is formed of a circle of closely placed but separate bundles, reaching in number from 4 to 5 and enclosing several accessory medullary bundles in the pith, sometimes these bundles form an almost complete inner ring. Vascular strands in the form of an arc with strongly incurved ends are of frequent occurrence. Sections taken at the lower parts show lignified pitted pith and a large number of medullary bundles with pericycle showing lignified fibres. At the middle region, the pith is wider and the bundles are less in number with much less amount of pericyclic fibres. The peripheral parts of the pith are non-lignified, as well as, the pericycle of the medullary bundles which becomes wider.

The epidermis: (Fig. 5 C)

It is mostly of isodiametric cells showing straight anticlinal walls and covered with smooth cuticle. They measure from 15 to 20 microns in length; 11 to 16 microns in width and 12 to 14 microns in height. Stomata and hairs are not observed.

The cortical tissue: (Fig. 5 B)

The parenchyma is tangentially-elongated to rounded and contain starch granules. Those surrounding the pericycle contain cluster crystals of calcium oxalate.

The pericycle: (Fig. 5, B & D)

The pericyclic fibres are slightly irregular in outline with thin, lignified walls, wide lumen and tapering ends. They measure from 300 to 880 microns in length and 15 to 35 microns in width. The parenchyma contain cluster crystals of calcium oxalate.

The vascular system: (Fig. 5 B & D)

Phloem is soft, of sieve tubes, companion cells and phloem parenchyma. Xylem vessels are lignified and pitted (simple; sometimes bordered). Tracheids are narrow with rounded tips and lignified, pitted walls. Fibres are short, straight with thin walls, wide lumen and tapering ends. They measure from 200 to 520 microns in length and 15 to 30 microns in width. Medullary rays are uni-to bi-seriate and of non-lignified elements.

Powdered Leaf

The powdered leaf of *Sterculia diversifolia* Don is light-green in colour, odourless and with a slight bitter taste. It is characterised microscopically by the following:

- 1- Fragments showing the upper epidermal cells of the lamina which are isodiametric with straight anticlinal walls, covered with smooth cuticle and free from stomata or hairs.
- 2- Fragments showing the lower epidermal cells of the lamina which are isodiametric with straight anticlinal walls and covered with smooth cuticle. The fragments bear ranunculaceous stomata.
- 3- Few fragments showing isodiametric epidermal cells with beaded anticlinal walls.
- 4- Fragments of the mesophyll showing columnar palisade cells and spongy parenchyma.
- 5- Spiral, pitted and scalariform lignified vessels.
- 6- Pericyclic fibres; either straight or slightly irregular with thin, lignified walls, wide lumen and tapering or pointed apices.
- 7- Parenchyma cells, many contain cluster crystals of calcium oxalate as well as minute starch granules.

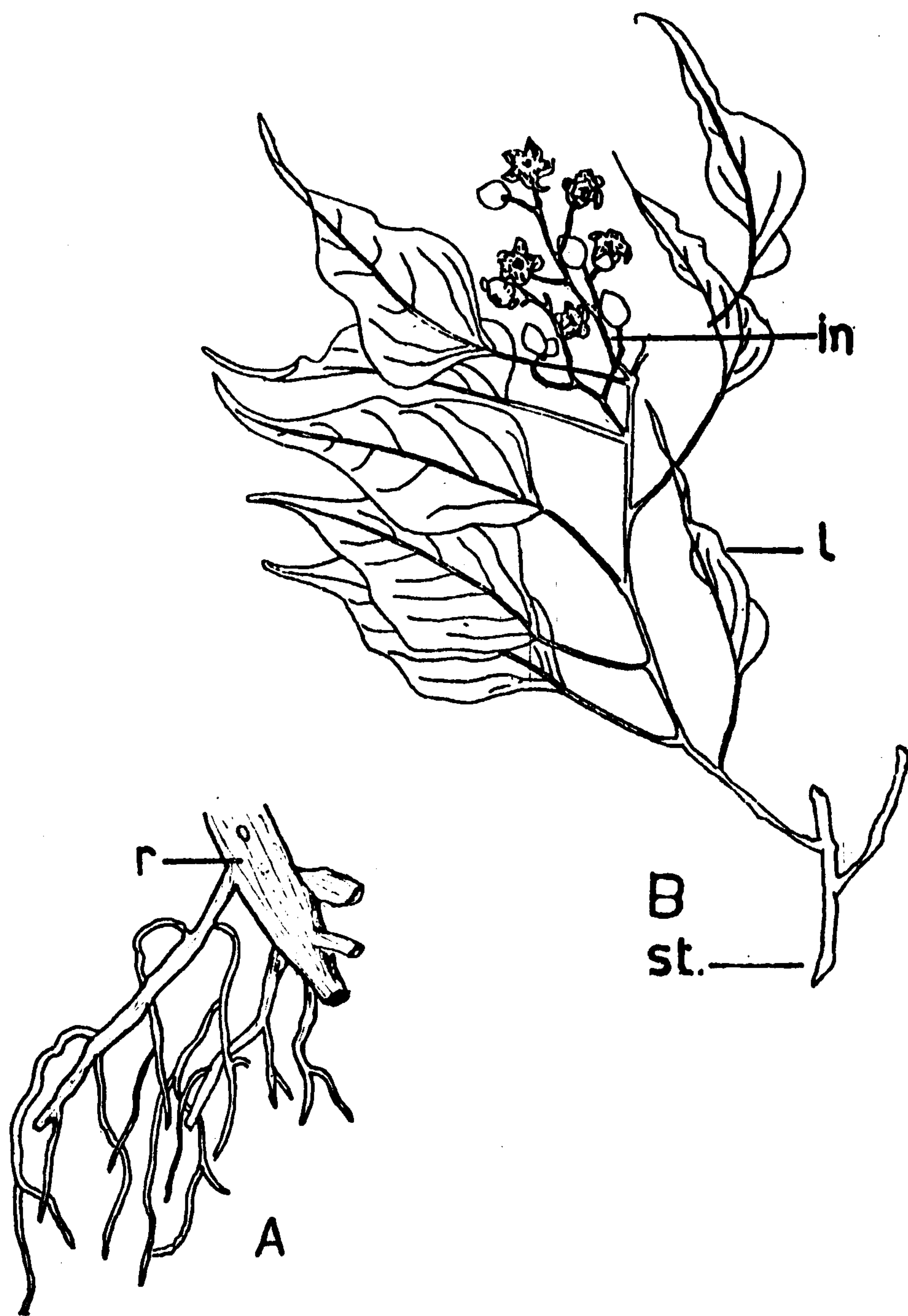


Fig. 1: Sterculia diversifolia Don.

A- Root

X 1/2 (r., root).

B- A flowering branch

X 1/2

(inf., inflorescence; L., leaf; st., stem).

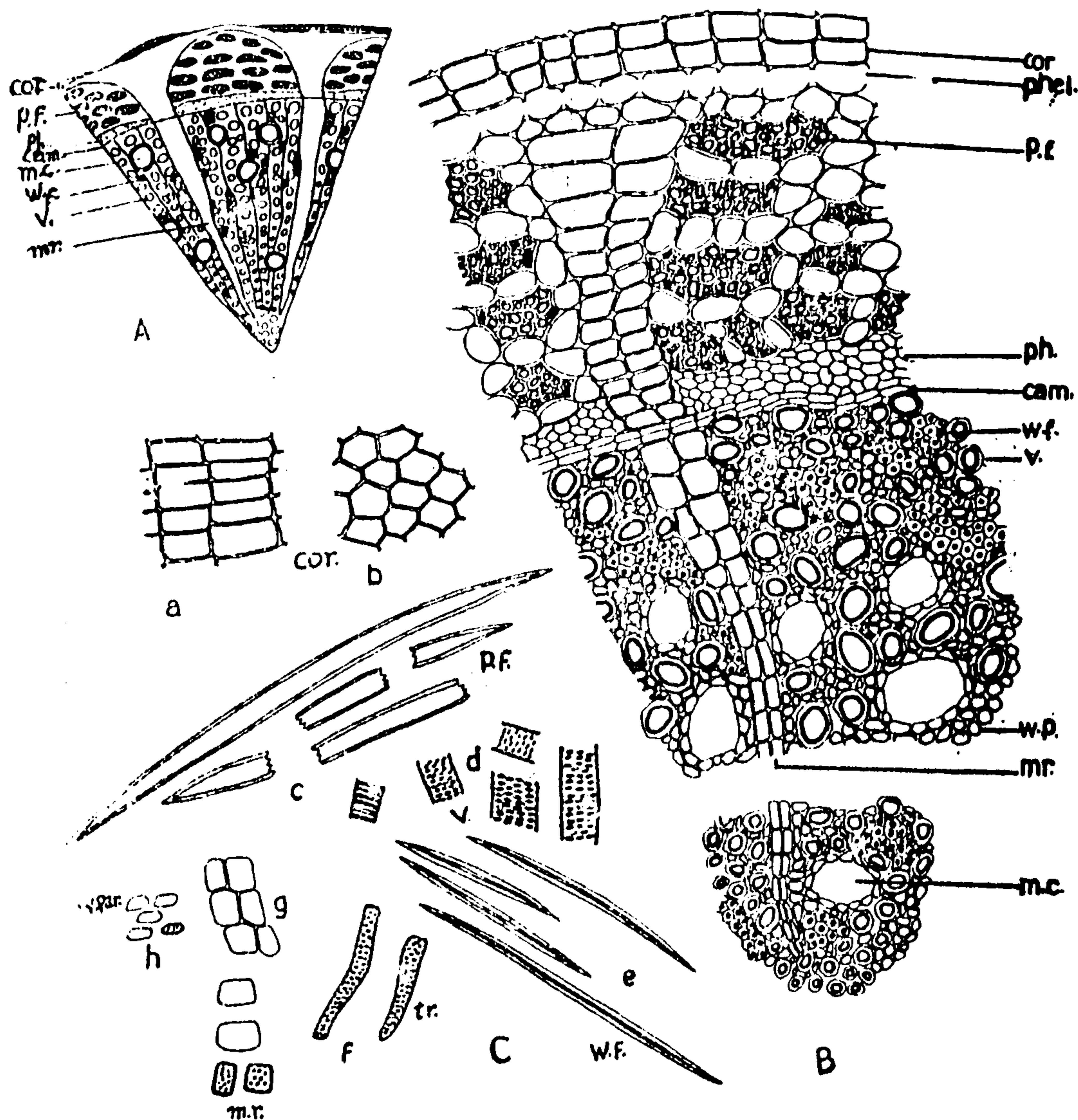


Fig. 2: The root

A- Diagrammatic T.S. of the root	X 20
B- Detailed T.S. of the root	X 108
C- Isolated elements of the root	X 108

(cam., cambium; cor., cork; m.c. mucilage cavity; m.r., medullary ray; p.f., phloem fibres; ph., phloem; phel., phelloderm, tr., tracheids; v., vessels; w.f., wood fibres; w.par., wood parenchyma).

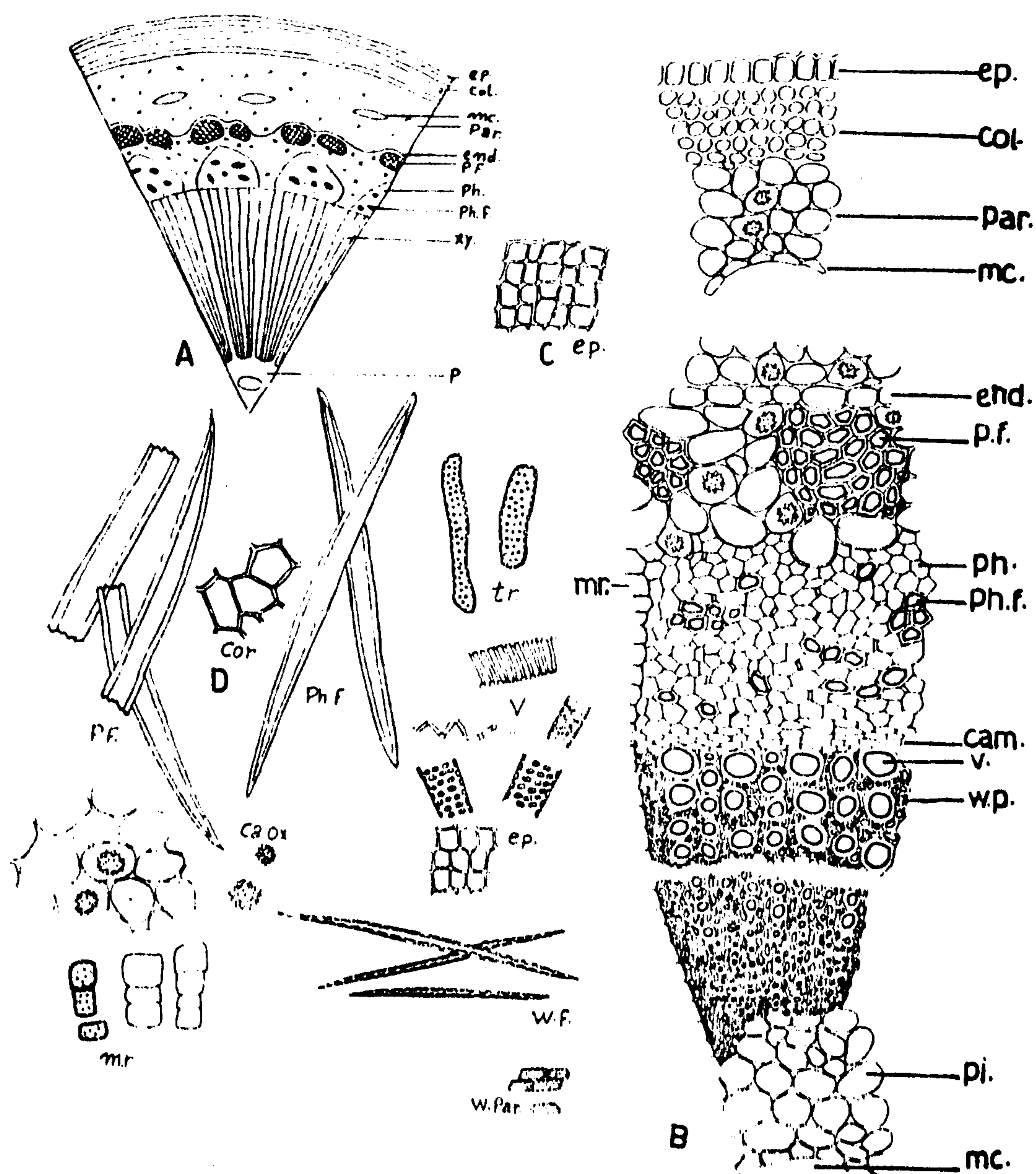


Fig. 3: The stem

- | | |
|------------------------------------|-------|
| A- Diagrammatic T.S. of the stem | X 25 |
| B- Detailed T.S. of the stem | X 150 |
| C- Surface preparation of the stem | X 150 |
| D- Isolated elements of the stem | X 150 |

(cam., cambium; ca . ox., calcium oxalate; col., collenchyma; end., ray; p.f., pericyclic fibres; par., parenchyma; ph., phloem; ph.f., phloem fibres; pi., pith; w.f., wood fibres; w.par., wood parenchyma).

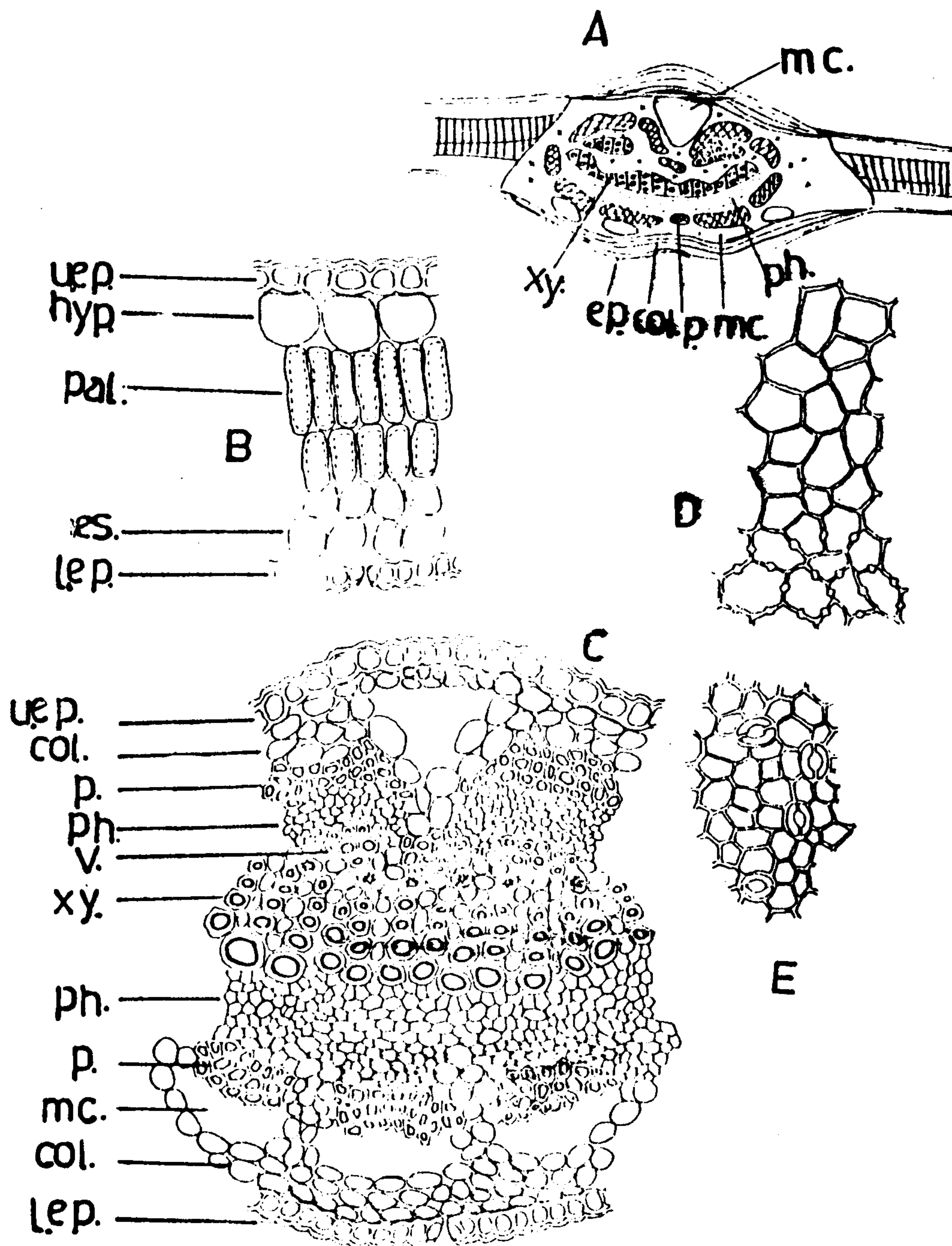


Fig 4: The leaf

- | | | |
|--------|---|-------|
| A- | Diagrammatic T.S. of the leaf | X 48 |
| B- | Detailed T.S. of the lamina | X 270 |
| C- | Detailed T.S. of the midrib | X 144 |
| D & E- | Surface preparations of the upper and lower epidermis | X 270 |

(col., collenchyma; hyp., hypodermis; l.ep., lower epidermis; m.c., mucilage cavity; mes., mesophyll; p., pericycle; pal., palisade; ph., phloem; xy., xylem; v., vessels).

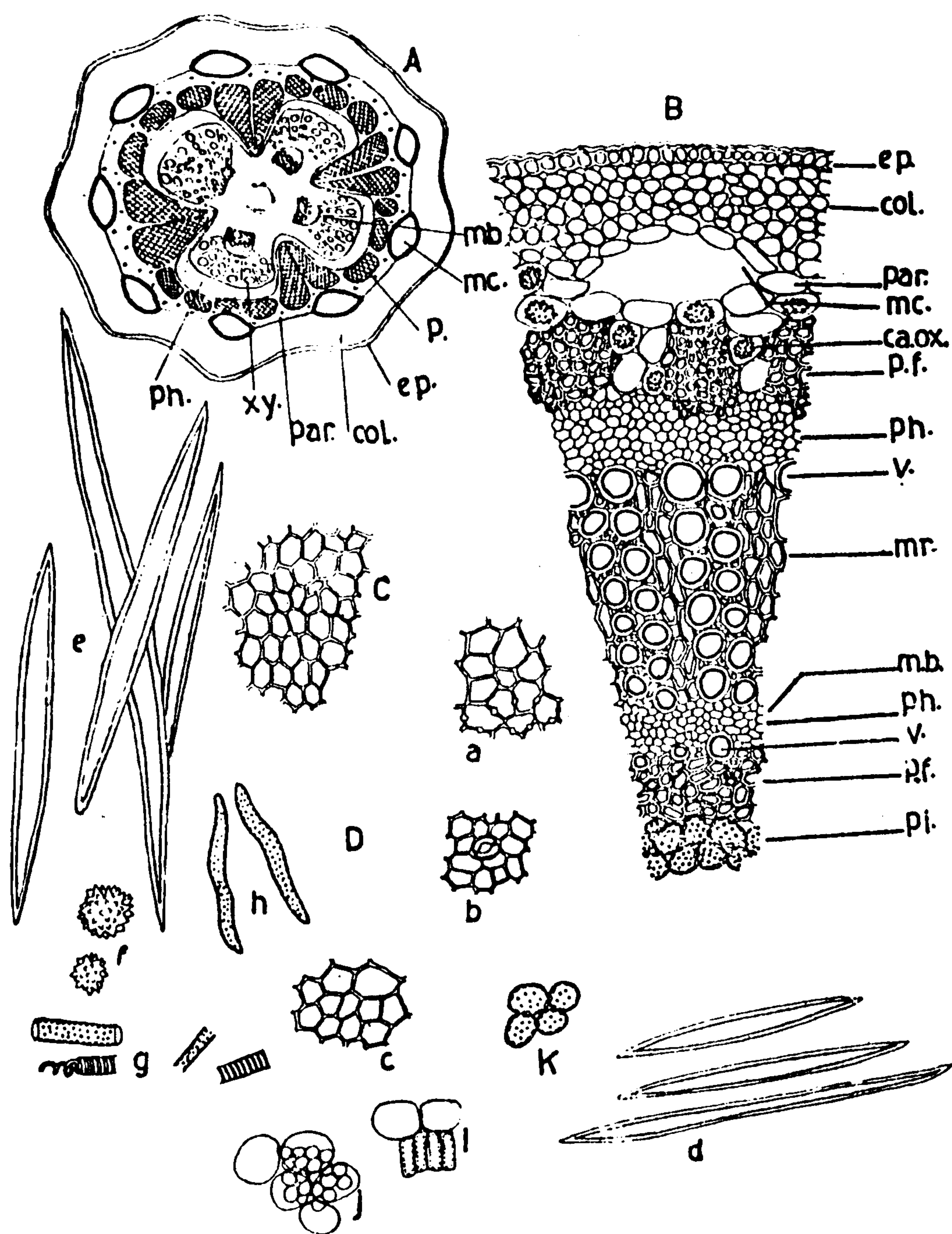


Fig. 5: The leaf

- A- Diagrammatic T.S. of the petiole X 28
 B- Detailed T.S. of the petiole X 162
 C- Surface preparation of the petiole X 162
 D- Isolated elements of the leaf X 162
 (col., collenchyma; ca. ox., calcium oxalate; ep., epidermis;
 m.b., medullary bundles; m.c., mucilage cavity; m.r., medullary ray;
 par., parenchyma; p.f., pericyclic fibres; p., pericycle; ph., phloem;
 v., vessels; xy., xylem).

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الدراسات العيانية والمجهريّة لنبات الستريكيوليا

ديفر سيفوليا دون المنزوع في مصر

الجزء الأول : الجذر والساق والورقة

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يعتبر نبات الستريكيوليا ديفر سيفوليا (بودرة المفريت) أحد أنواع جنس الستريكيوليا المنتمى للعائلة الاستريكيولية وهو عبارة عن أشجار كبيرة غالباً ما تنزع على جانبي الطرق في المدن وكذلك في المنتزهات العامة .

وتشتهر هذه العائلة وكذلك جنس الاستريكيولية بعدة استعمالات طبية كزيت لالام البطن أو مسهل أو مدر للبول وكذلك لعلاج الروماتيزم . وقد أثبت المسح الكيميائي وجود قلويّات ، تربينات أو استيرولات غير مشبعة وفلافونويدات في أجزاء النبات .

وحيث أنه لم يتم من قبل دراسة الصفات المجهريّة والعيانية بالإضافة إلى ما سبق من استعمالات فإنه وجد من الضروري إجراء هذه الدراسة . ويشمل هذا البحث الدراسات العيانية والمجهريّة للجذور والساق والورقة والتي ثبت من خلالها أنه يمكن التعرف على هذه الأجزاء سواءً صحيحة أو على هيئة مسحوق .