

MACRO -AND MICROMORPHOLOGY OF CASSIA SPECTABILIS DC.

PART 1: The Stem and Leaf.

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ABSTRACT

The macro-and micromorphology of the stem and leaf of Cassia spectabilis DC, cultivated in Egypt have been investigated in order to determine the diagnostic features by which each organ could be identified both in the entire and powdered forms.

Cassia spectabilis DC. is a large tree belonging to the family Leguminosae (Fabaceae), subfamily Caesalpinoideae and it is cultivated in Egypt in public gardens for its shade.

The genus Cassia (ancient Greek name) includes 400 species and the majority is native to tropical and subtropical countries¹⁻¹¹. Some species of the genus have wide uses in folk medicine as purgatives, to relief toothache, as a remedy for ophthalmia, venereal diseases and cough¹².

The methanolic extract of Cassia spectabilis DC. exhibited antimicrobial activity against different strains of micro-organisms¹³.

From the genus Cassia, anthraquinones, alkaloids and flavonoids were isolated and studied¹³⁻¹⁷. Now, we are investigating the phytochemistry of Cassia spectabilis DC.

Reviewing the current literature, very little was mentioned about its macromorphology. However, nothing was traced concerning the detailed macro-and micromorphological study of the different organs of Cassia spectabilis DC. hence detailed study was thought to be pertinent due to important situation among other Cassia species.

Material :

The material used in this investigation was obtained from the plant cultivated in Aswan Botanical Island. Identification of the plant was done by Agricultural Engineer Mr. Ali Mousa, the Director of the Island.

Fresh samples as well as samples preserved in ethanol (70%) containing 5% of glycerol were used.

Habitat : Cassia spectabilis DC. is a large tree with monopodial branches and attaining up to 12 meters in height, Leaves are compound, paripinnate. Flowers are bright-yellow, in racemes. The flowering season starts from February to April and from July to September and the Fruiting season in May, June and October. Fruits are long cylindrical pods, dark chocolate brown to almost black in colour and each one contains from 30 - 60 seeds. The latter are oval and greenish-brown in colour.

A. The Stem

Macromorphology : (Fig. 1)

The main stem or trunk is erect, cylindrical, solid, woody, monopodially branched and measuring from 10-13 meters in height and 35-45 cm in diameter near the ground. The terminal and lateral branches are narrower, hairy, green in colour and show short internodes measuring from 2 to 10 cm in length. The terminal young parts of the stem are somewhat smooth and green in

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colour, while the older ones are rough bearing scars of fallen leaves and the bark is hardly separated from the wood. The stem is odourless and with a slight bitter taste.

Micromorphology :

A transverse section through the young stem (Fig. 2 B) is nearly rounded and shows an outer hairy epidermis surrounding a narrow cortical tissue. The latter consists of outer layer of collenchyma cells and inner one of parenchyma cells limited internally by an endodermis. The vascular system is continuous, consists of a soft phloem and a radiating xylem separated by a cambial layer and surrounded by a complete ring of pericyclic fibres. The pith is wide and parenchymatous.

The Epidermis :

It consists of subrectangular cells as shown in transverse section (Fig. 3). In surface view (Fig. 2 A), the cells appear polygonal with straight anticlinal walls, measuring 9-11-12 μ in height, 18-35-51 μ in length, and 11-16-20 μ in width. The cells are covered with thick smooth cuticle. Stomata of the paracytic type are rarely present and trichomes of nonglandular unicellular type are present numerously. They are almost bent or curved with narrow lumina, acute or acuminate apices and covered with warty cuticle. The trichomes measure from 151-192-232 μ in length, 13-17-20 μ in width at the middle part and 20-22-24 μ at the base. Many epidermal cells contain mucilage which stains red with ruthenium red.

The Cortical Tissue : (Fig. 3)

The outer collenchyma region consists of about 3 layers of thick-walled, nearly rounded or ovoid cells. The inner parenchymatous region consists of 4-6 rows of thin-walled cells with

narrow intercellular spaces. These parenchyma cells contain prisms of calcium oxalate, as well as, few minute starch granules and mucilage which stains red with ruthenium red. The endodermis is indistinguishable.

The Vascular System : (Fig. 2 B,3)

The pericyclic fibres are elongated with somewhat regular outline. They possess usually wide lumina, thick lignified striated walls and acute to acuminate apices and measure from 18-24-29 μ in diameter and from 2200-2600-3000 μ in length. The parenchyma cells surrounding the fibres contain prismatic crystals of calcium oxalate forming a crystal sheath. The prisms measure from 9-13-16 μ in length. The phloem is formed of sieve tubes, companion cells and phloem parenchyma free from contents. The xylem vessels are lignified, mainly pitted, reticulate and spiral, and measure from 27-63-93 μ in diameter. Tracheids are elongated with blunt ends, the walls are lignified and show simple pits and they measure from 33-40-47 μ in diameter and 211-225-238 μ in length. Wood fibres are elongated with lignified thick walls, wide lumina and acute to acuminate apices measuring from 22-27-31 μ in diameter, as shown in (Fig. 4). The xylem parenchyma consists of subrectangular lignified pitted cells. Medullary rays are uni-, bi- or multi-seriate formed of elongated subrectangular cells with thick lignified pitted walls.

The Pith : (Fig. 3)

The parenchyma cells of the pith are nearly rounded or oval in shape, mostly with pitted and non-lignified walls, being about 44-94-144 μ in diameter. The cells contain few minute starch granules and prisms of calcium oxalate.

The old stem shows several rows of outer nonlignified cork cells, scattered small groups of phloem fibres, wide region of secondary xylem and a narrower central pith.

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The Powder : (Fig. 4)

The powdered young stem is yellowish-green in colour and possessing a faint odour and a slight bitter taste. It is characterised microscopically by the following features:

- 1- Fragments of the epidermis : with or without paracytic stomata. The cells are nearly polygonal with straight anticlinal walls and covered with smooth cuticle. The fragments bear non-glandular, unicellular hairs which are covered with warty cuticle and have acute or acuminate apices.
- 2- Groups of lignified pericyclic fibres surrounded by crystal sheath with prismatic crystals of calcium oxalate.
- 3- Xylem vessels which are lignified pitted, reticulate and spiral together with lignified tracheids and wood fibres.
- 4- Wood parenchyma and medullary ray cells with thick, pitted and lignified walls.
- 5- Fragments of parenchyma cells of the pith with thin, non-lignified pitted walls containing prismatic crystals of calcium oxalate and minute starch granules.
- 6- Free prisms of calcium oxalate.
- 7- Absence of stone cells.

B. The Leaf

Macromorphology : (Fig. 1).

The leaves are alternate, compound, paripinnate and exstipulate, showing a pulvinus at the base of the leaf rachis. The leaflets are lanceolate with entire margin, mucronate apex, symmetric base and coriaceous texture. Both surfaces are pubescent with small whitish hairs being distinctly visible especially near the veins. They have a dark green upper surface and

a paler lower one. Venation is pinnate, reticulate. The leaflets measure from 6-8 cm. long and about 1.7-2 cm. wide in the middle part. The dry leaves are almost odourless and with unpleasant bitter taste.

The leaf rachis is cylindrical, slender, slightly grooved on the upper side where 2 longitudinal ridges run on the upper side, yellowish-green in colour, pubescent, longitudinally striated bearing from 8 to 15 pairs of leaflets and usually reaching about 25-30 cm. long and 0.5-1.5 in diameter and showing a pulvinus at its base.

Micromorphology :

A-- The Leaflet :

A transverse section through the lamina in the midrib region (Fig. 5 C), is somewhat planoconvex in outline. It shows a dorsiventral structure with a discontinuous palisade. The cortical tissue shows a mass of collenchyma abutting on the upper epidermis and another one on the lower. The vascular system is represented by a large vascular bundle consisting of a wide radiating xylem and a narrow soft phloem. The pericycle is formed of upper smaller arc of lignified fibres and a lower larger one. Both the upper and lower epidermises carry non-glandular hairs. Numerous prismatic crystals of calcium oxalate are scattered in the mesophyll and cortical tissue.

The Upper Epidermis :

It consists of one row of tangentially elongated cells as shown in transverse section. In surface view (Fig. 5 A), the cells appear polygonal, isodiametric or slightly elongated, with more or less straight anticlinal walls, being about 9-11-13 μ in height, 16-32-48 μ in length and about 9-16-22 μ in width. The cells are covered with thick smooth cuticle.

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Numerous stomata of the paracytic type are present, usually surrounded by two cells. The stomata are oval in shape and measure about 9-14-18 μ . long and about 8-11-13 μ . wide. Unicellular, non-glandular trichomes are present, almost bent or curved with narrow lumina and the apices are acute or acuminate. They are covered with warty cuticle and measure about 157-180-193 μ . in length, 13-16-18 μ in width at the middle part and about 20-22-24 μ . at the base. Multicellular, uniseriate, non-glandular trichomes composed of 3-4 cells with acute or acuminate apices are noticed. They are covered with warty cuticle and measure about 511-522-533 μ . in length, 18-20-22 μ . in width at the middle part and about 22-23-24 μ . at the base. They have thin walls and wide lumina. Many epidermal cells contain mucilage which stains red with ruthenium red.

The Lower Epidermis : (Fig. 5B)

It is similar to the upper epidermis in shape and contents but measures about 10-13-16 μ . in height, 13-31-49 μ . in length and 9-16-22 μ . in width.

The Mesophyll : (Fig. 5C,D)

The palisade consists of one row of columnar cells measuring about 27-33-38 μ . in height and 9-11-13 μ . in diameter. The spongy parenchyma are irregular cells of about 8 rows and they contain minute starch granules. Prismatic crystals of calcium oxalate are present specially in the cells surrounding the pericyclic fibres forming crystal sheath. These prisms measure about 9-13-16 μ . in length.

The Cortical Tissues (Fig. 5C,6)

Collenchyma cells are arranged in 3 to 4 rows of nearly rounded or ovoid cells and measure 11-18-24 μ . in width. The Parenchyma surrounding the vascular bundle are rounded to oval

in shape with slightly irregular walls and somewhat wide inter-cellular spaces. They contain minute starch granules and prismatic crystals of calcium oxalate.

The Vascular System : (Fig. 6)

The xylem vessels are lignified pitted, spiral and reticulate, being about 18-35-47 μ . in diameter. The medullary ray cells are subrectangular with non-lignified walls. The phloem consists of thin-walled soft cellulosic elements. The upper mass of pericycle is formed of 6-8 rows of lignified polygonal fibres, while the lower one is formed of 5-7 rows. The fibres are similar to those of the stem and measure about 13-21-29 μ . in diameter and 1800-2150-2500 μ . in length. A layer of collapsed parenchyma consists of 2 to 4 rows present below the upper arc of the pericyclic fibres.

B- The Leaf Rachis :

The transverse section of the leaf rachis (Fig. 7A,B and C) is almost similar to that of the stem with the exception of the presence of two small collateral inverted vascular bundles in the two ridges. The epidermal cells are slightly axially elongated and shows, unicellular and multicellular, uniseriate, non-glandular hairs similar to those of the lamina. The cortical tissue and the vascular system (Fig. 7C) are similar to those of the stem.

The Powder : (Fig. 8).

The powdered leaf is dark green in colour and possessing a faint odour and unpleasant taste. It is characterised microscopically by the following features:

- 1- Fragments of the epidermises of the leaflets showing polygonal, isodiametric cells with straight anticlinal walls. The cells are covered with smooth cuticle. The fragments

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carry stomata of the paracytic type, non-glandular unicellular and multicellular uniseriate hairs covered with warty cuticle, having acute or acuminate apices.

- 2- Fragments of the epidermis of the leaf rachis consisting of polygonal axially elongated cells with straight anticlinal walls and covered with smooth cuticle. The fragments show stomata and hairs.
- 3- Scattered hairs of both unicellular and multicellular types, slightly curved or coiled, with acute or acuminate apices and covered with warty cuticle.
- 4- Fragments of the mesophyll, showing palisade and spongy parenchyma containing prisms of calcium oxalate.
- 5- Lignified pitted, reticulate and spiral xylem vessels as well as tracheids.
- 6- Fibres of the pericycle which are elongated with somewhat straight outline and have thick lignified walls with acute or acuminate apices and surrounded by a crystal sheath of prismatic crystals of calcium oxalate.
- 7- Fragments of parenchyma cells of the pith with pitted thin walls containing prisms of calcium oxalate and minute starch granules.
- 8- Numerous free and scattered prisms of calcium oxalate.

Numerical Values :

- 1- Stomatal index:
 - For upper epidermis : 4.2 to 5.7
 - For lower epidermis : 6.4 to 8.2
- 2- Palisade ratio : 5.25 to 6.25.
- 3- Vein-islet number: 19 to 21.



Fig. 1: Flowering branch of C. spectabilis DC.

X 1/2

Fl., flower; lft., leaflet; pd., pod;

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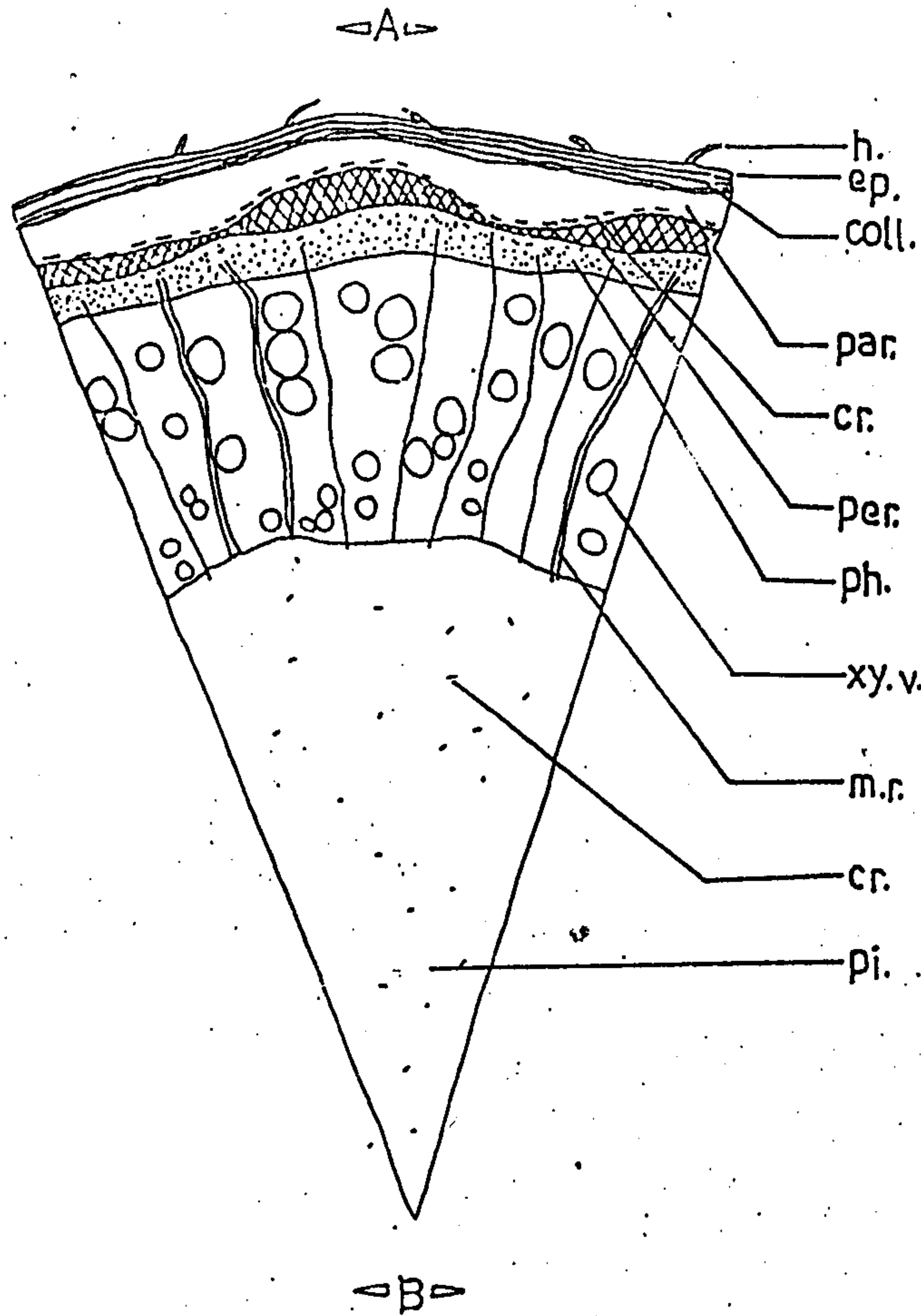
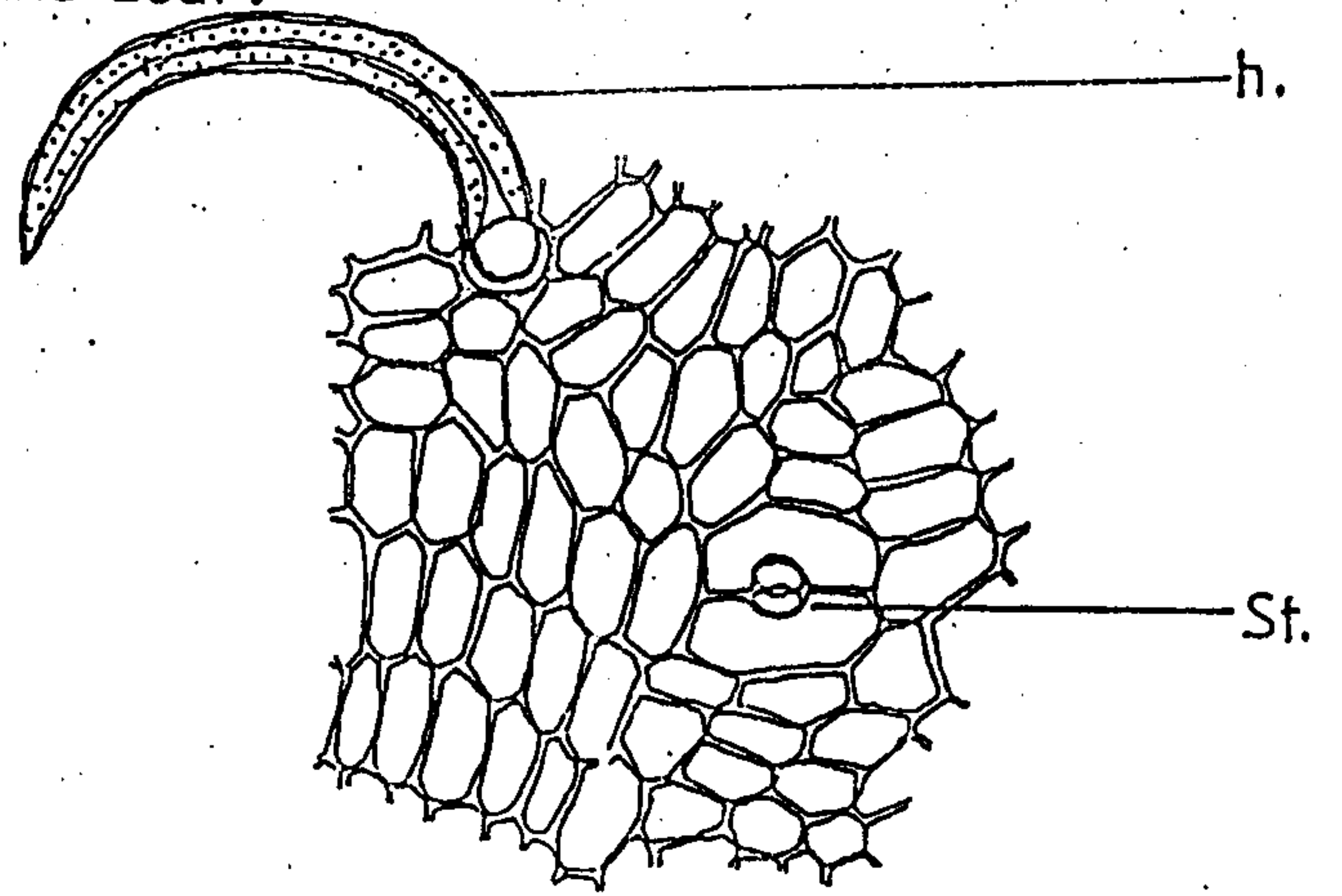


Fig. 2: A- Surface preparation of the stem X 239

B- Diagrammatic T.S. of the stem X 322

coll., collenchyma; cr., crystal of ca.ox.;
ep., epidermis; h., hair; m.r., medullary ray;
par., parenchyma; per., pericycle; ph., phloem;
pi., pith; st., stoma; xy., v., xylem vessel.

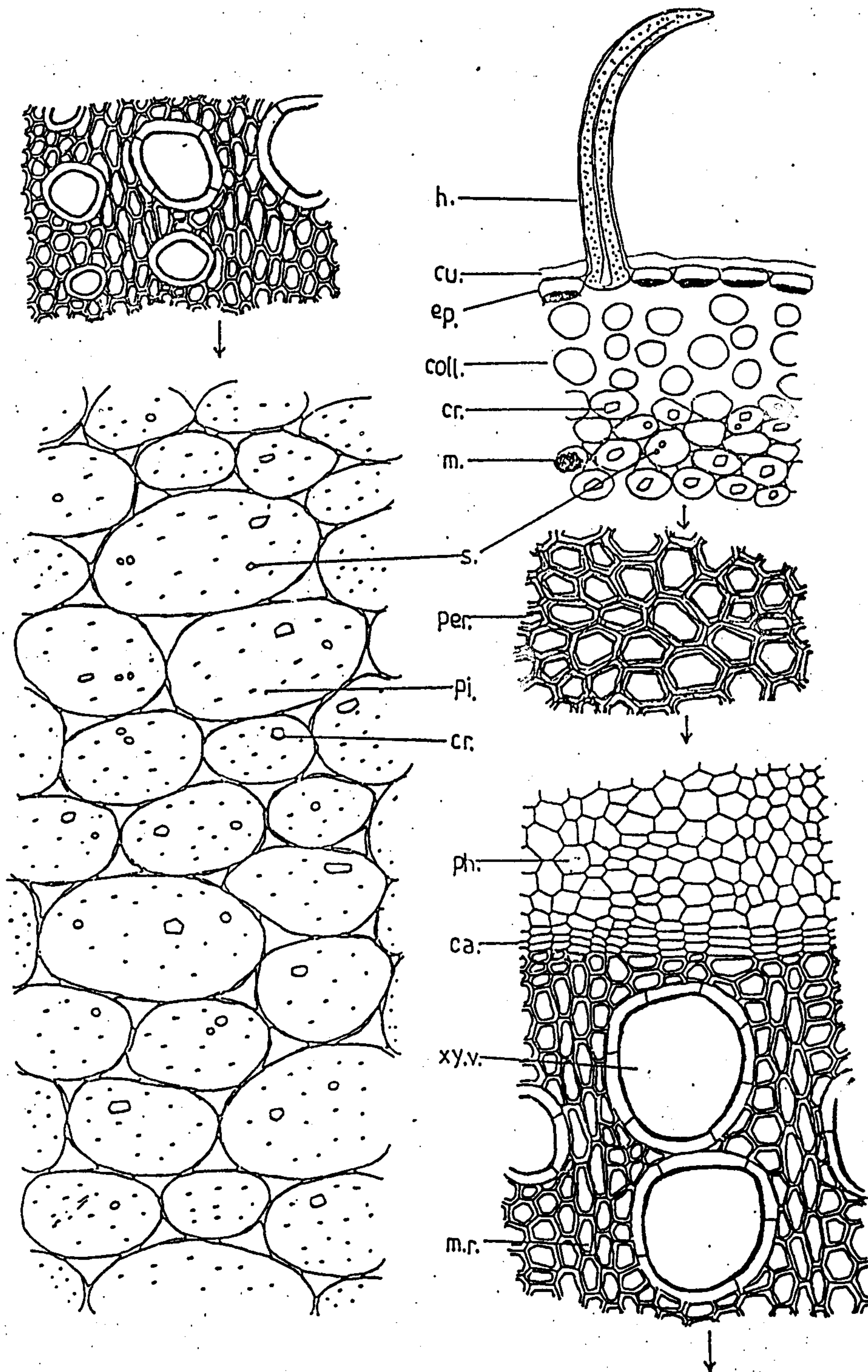


Fig. 3: T.S. Sector of the stem

X 209

ca., cambium; coll., collenchyma; cr., crystal;
of ca.ox.; cu., cuticle; ep., epidermis; h., hair;
m., mucilage; m.r., medullary ray; per., pericycle;
ph., phloem; pi., pith; s., starch granule; xy.v.,
xylem vessel.

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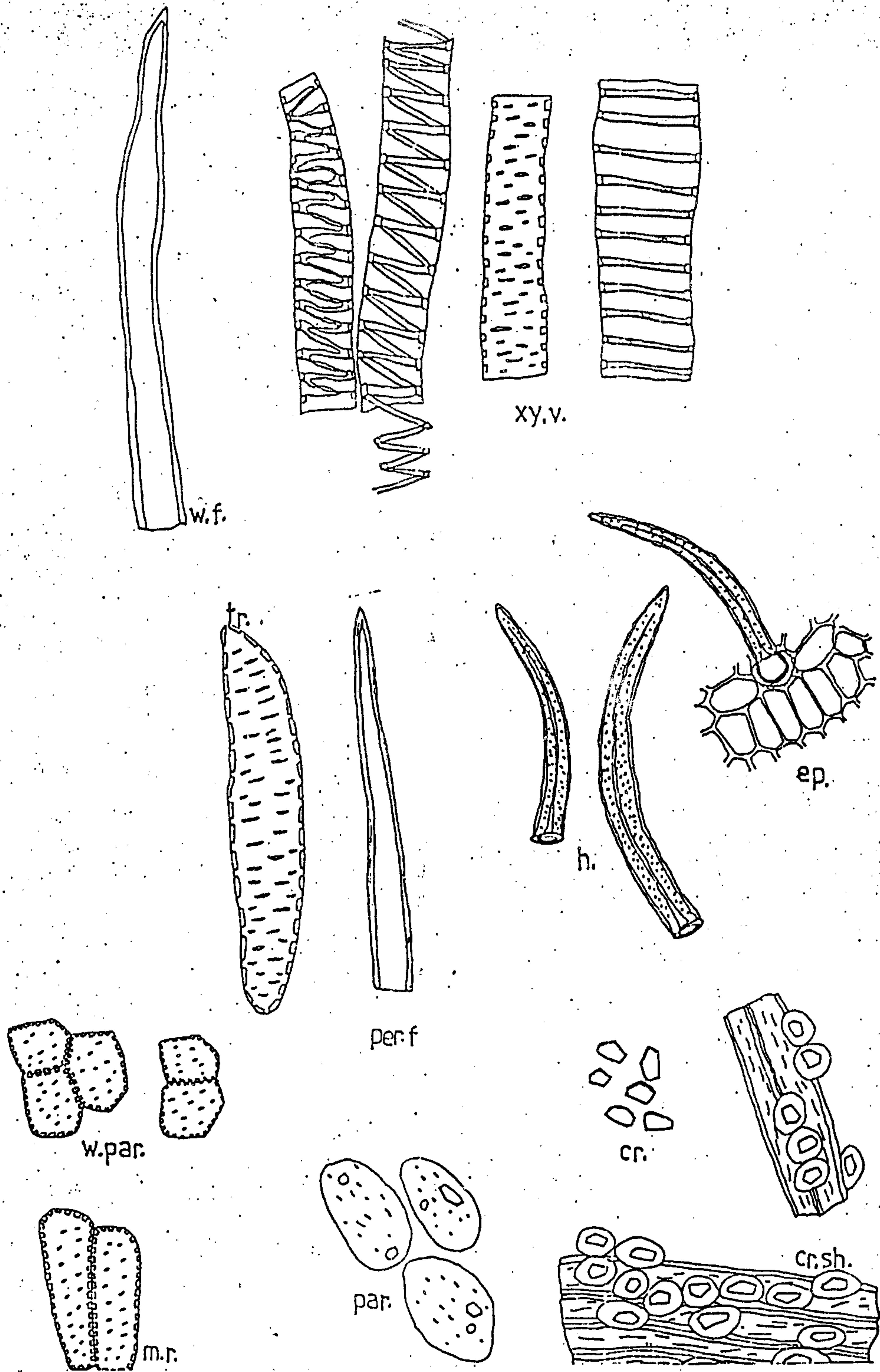


Fig. 4: Powder of the stem X 238

cr., crystal of ca.ox.; cr.sh., crystal sheath;
ep., epidermis; h., hair; m.r., medullary ray;
par., parenchyma; per.f., pericyclic fiber; tr.,
tracheid; w.f., wood fiber; w.par., wood parenchyma;
xy.v., xylem vessel.

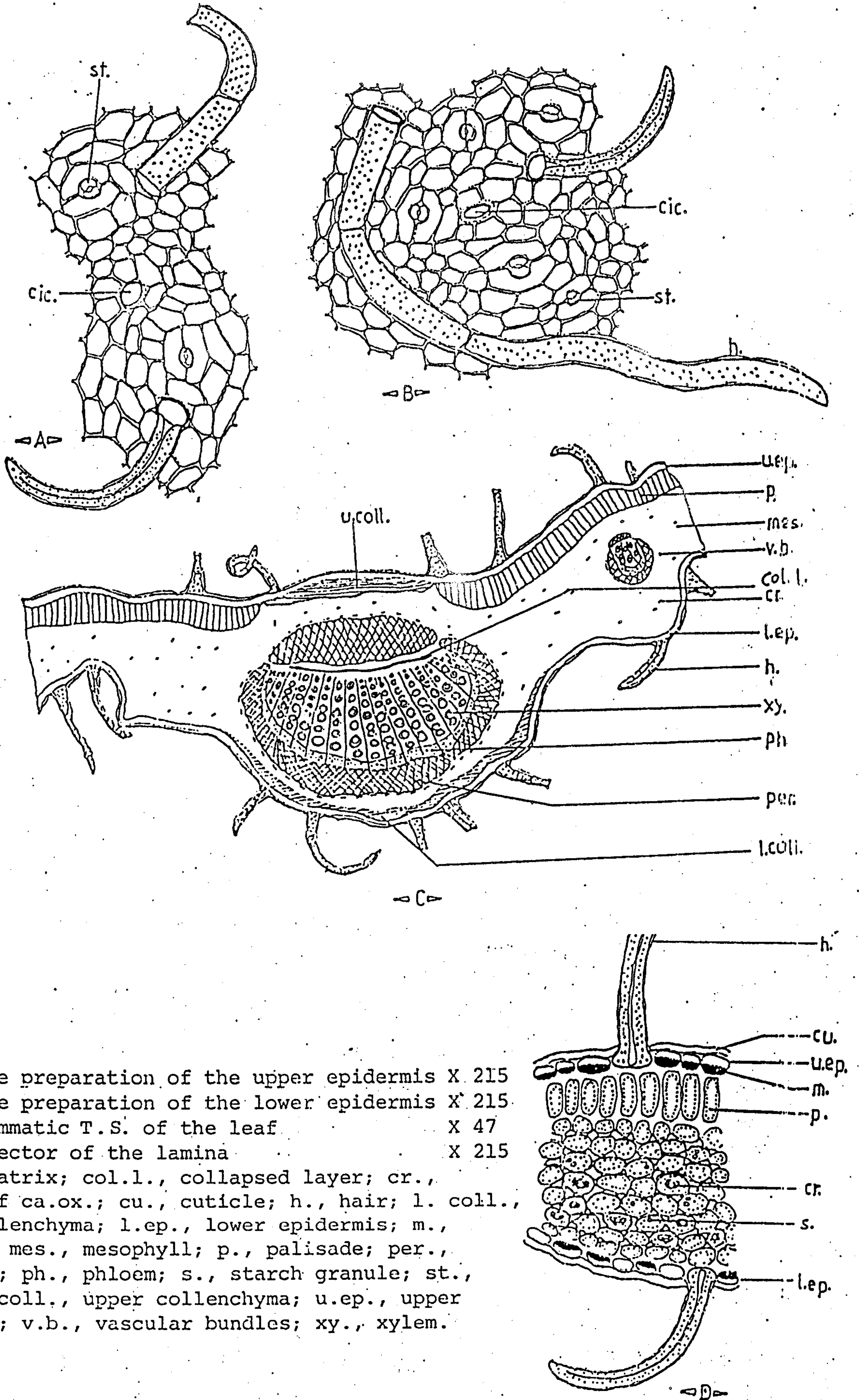
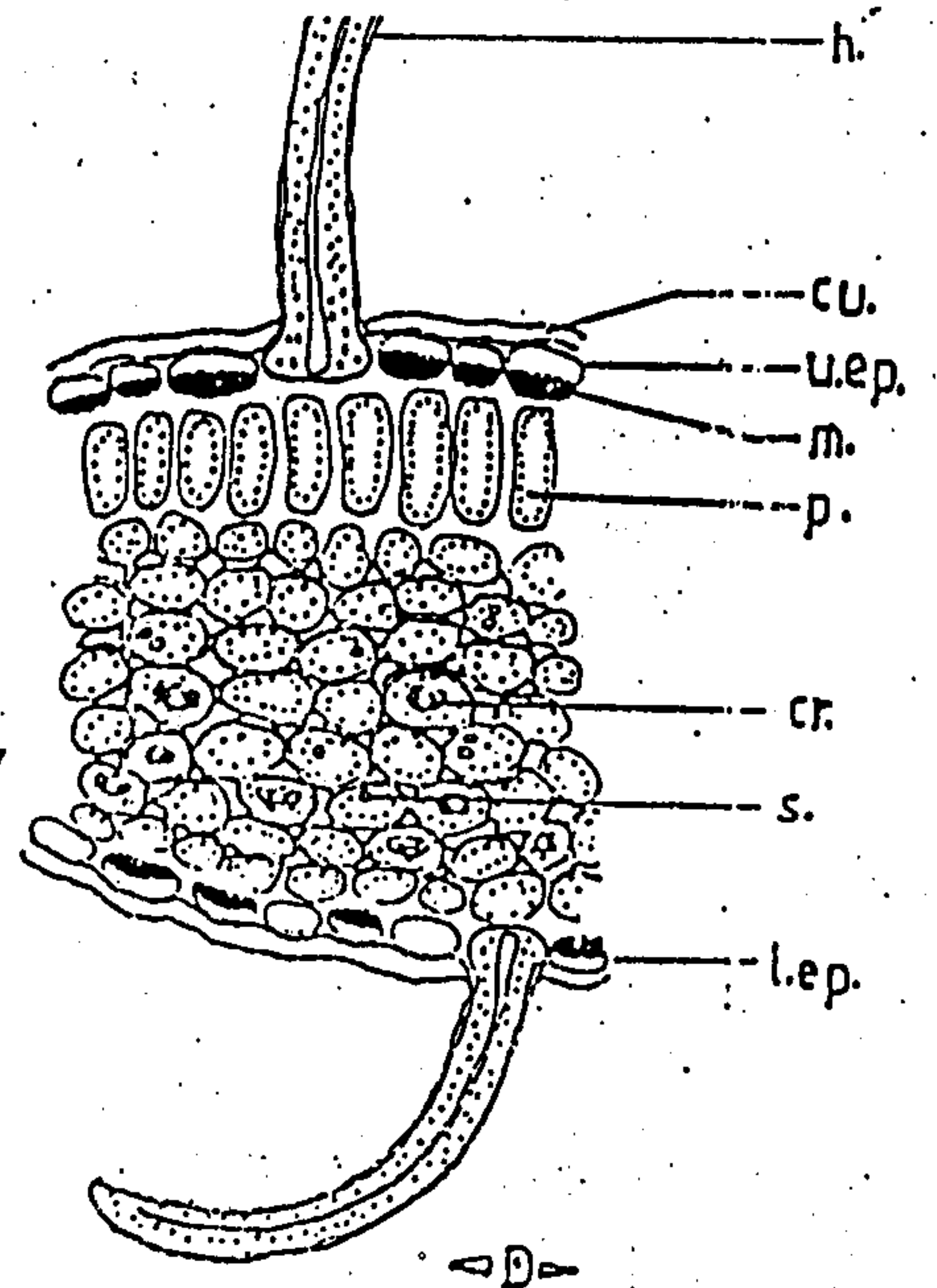


Fig.5: The leaf

- A- Surface preparation of the upper epidermis X 215
 - B- Surface preparation of the lower epidermis X 215
 - C- Diagrammatic T.S. of the leaf X 47
 - D- T.S. sector of the lamina X 215
- cic., cicatrix; col.l., collapsed layer; cr., crystal of ca.ox.; cu., cuticle; h., hair; l. coll., lower collenchyma; l.ep., lower epidermis; m., mucilage; mes., mesophyll; p., palisade; per., pericycle; ph., phloem; s., starch granule; st., stoma; u.coll., upper collenchyma; u.ep., upper epidermis; v.b., vascular bundles; xy., xylem.



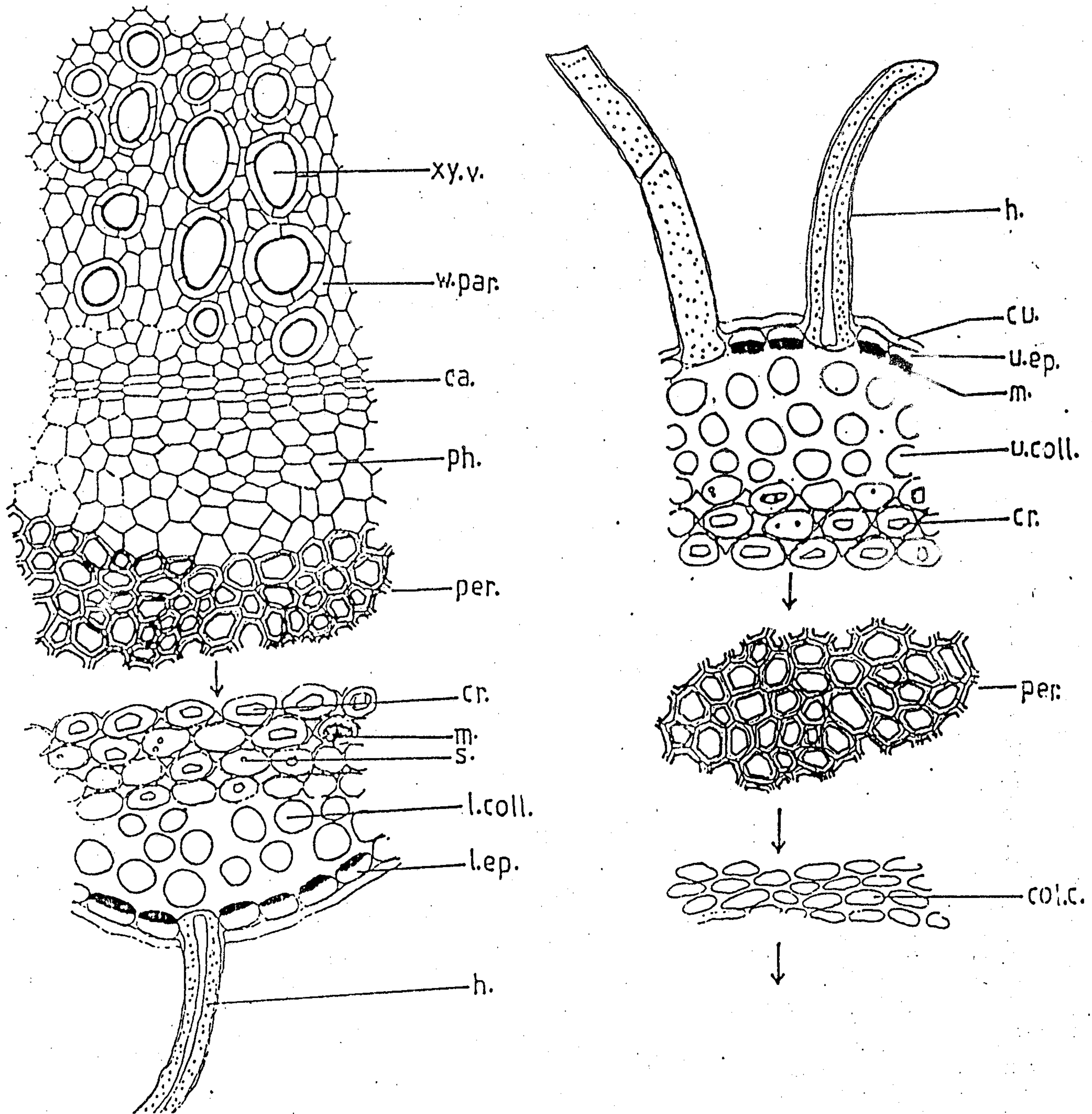


Fig. 6: The leaf

T.S. sector of the midrib

X 282

ca., cambium; col.c, collapsed cells; cr., crystal of ca.ox.; cu., cuticle; h., hair; l.coll., lower collenchyma; l.ep., lower epidermis; m., mucilage; per., pericycle; ph., phloem; s., starch granule; u.coll., upper collenchyma; u.ep., upper epidermis; w.par., wood parenchyma; xy.v., xylem vessel.

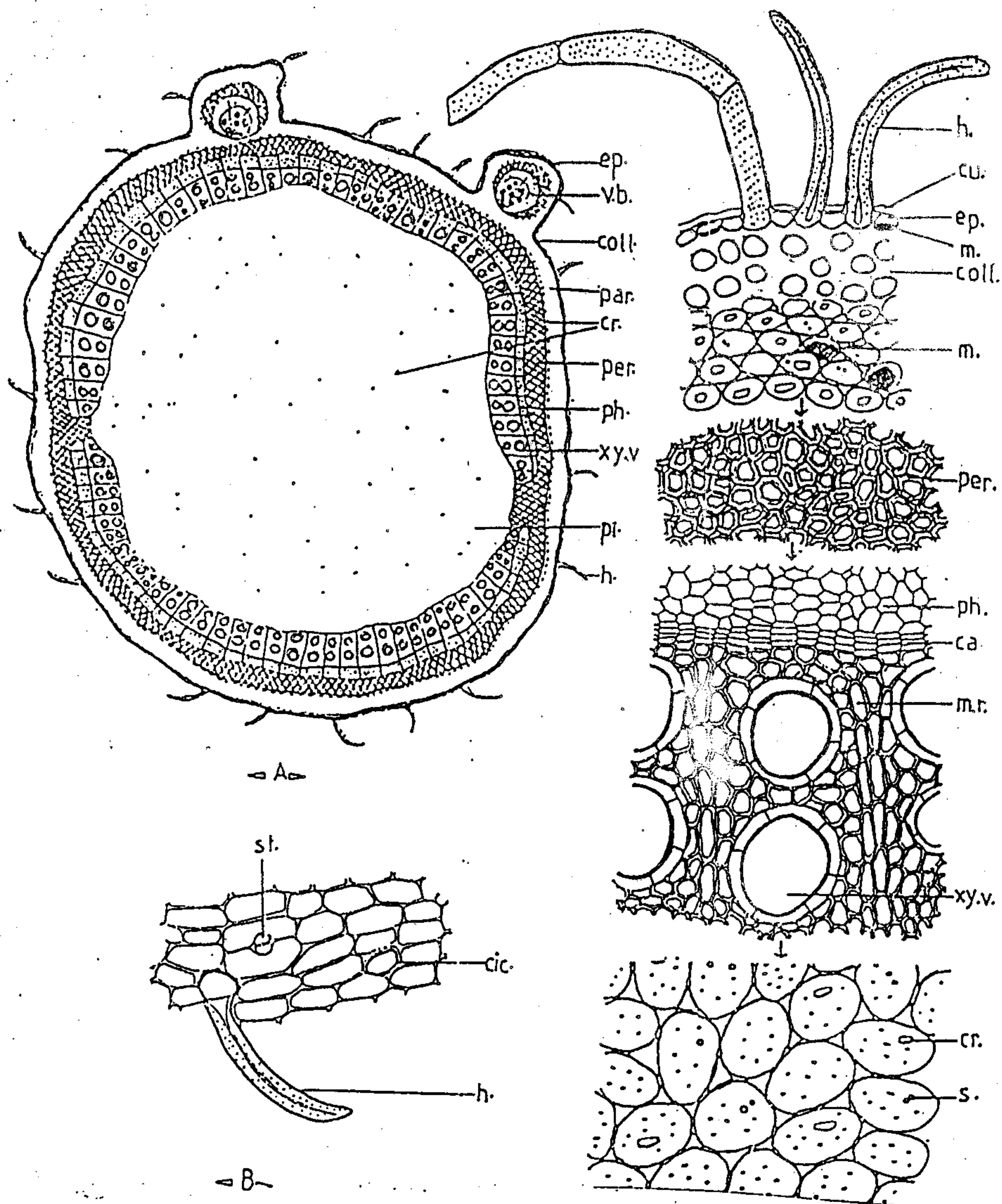


Fig. 7: The leaf rachis

- A- Diagrammatic T.S. of the leaf rachis X 20
 B- Surface preparation of the leaf rachis X 150
 C- T.S. sector of the leaf rachis X 150

ca., cambium; cic., cicatrix; coll., collenchyma;
 cr., crystal of ca.ox.; cu., cuticle; ep., epidermis;
 h., hair; m., mucilage; m.r., medullary ray; par.,
 parenchyma; per., pericycle; ph., phloem; pi.,
 pith.; s., starch granule; st., stoma; v.b., vascular
 bundles; xy.v., xylem vessel.

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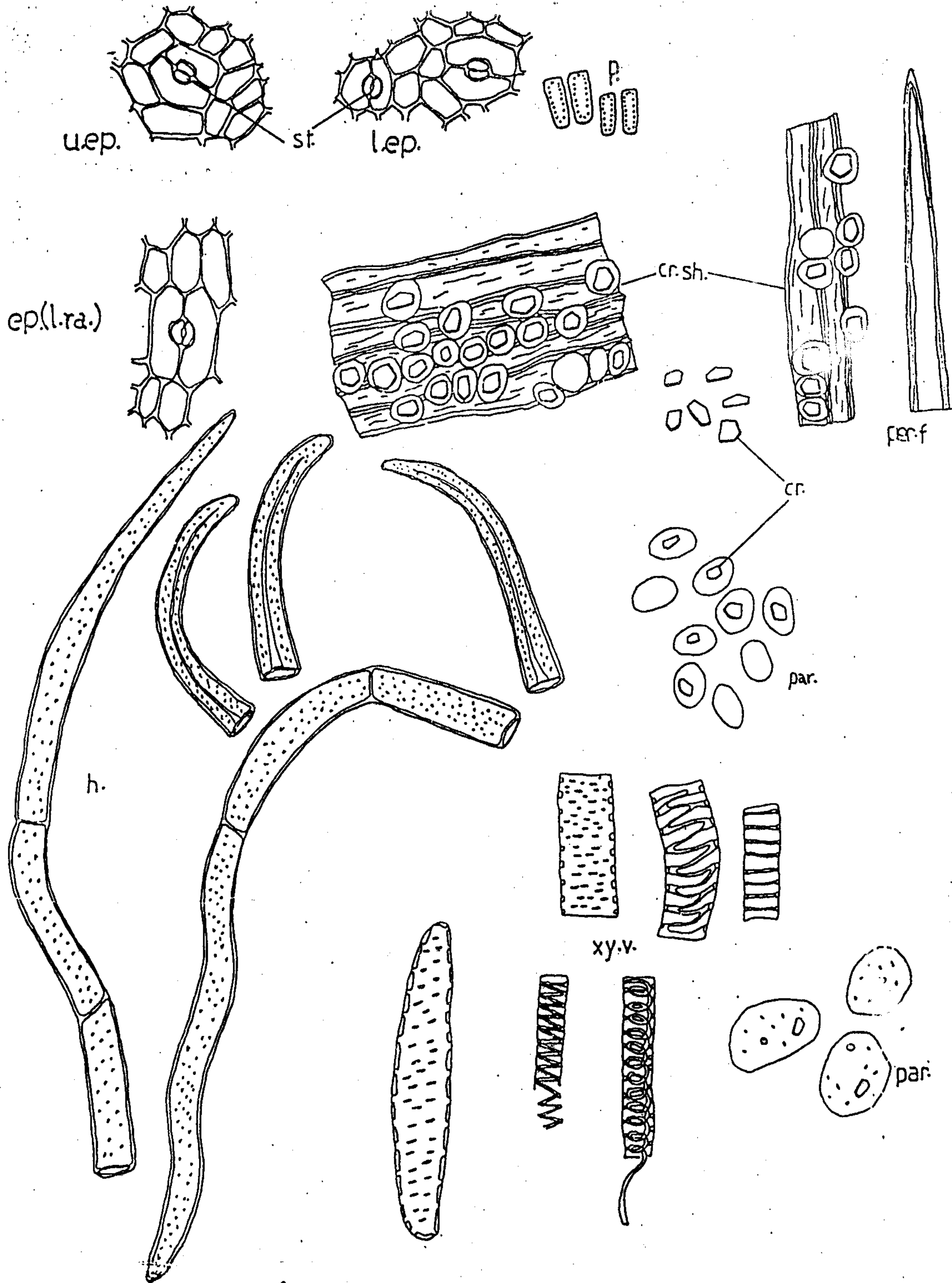


Fig. 8: Powder of the leaf

X 237

cr., crystal of ca.ox.; cr.sh., crystal sheath;
ep.(l.ra.), epidermis of leaf rachis, h., hair; l.ep.,
lower epidermis; p., palisade; par., parenchyma;
per. f., pericyclic fiber; st., stomata; tr.,
tracheid; u.ep., upper epidermis; xy.v., xylem vessels.

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الصفات العيانية والمجهرية لنبسات

كاسيا سيكتابيليس . دى كندول المنزرع فى مصر

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قسم العقاقير - كلية الصيدلة - جامعة أسيوط - أسيوط - مصر

نبات كاسيا سيكتابيليس دى كندول من نباتات المناطق الاستوائية وجوار
الاستوائية التى ادخلت زراعتها فى مصر وينتمى هذا النبات الى الفصيلة البقلية .
ولجنس كاسيا استعمالات طبية عديدة خاصة كملينات نتيجة لاحتوائها على
الانثراكينونات وبعض هذه النباتات يحتوى على المواد الفلافونيدية والقلوانيات
بالاضافة للانثراكينونات وقد وجد أن بعض هذه المركبات لها تأثير فعال ضد
الميكروبات .

لذلك قد روى من المناسب عمل دراسة عقاقيرية نباتية وكيميائية لاستخلاص
المواد الفعالة فى هذا النبات وفى هذا الجزء تم دراسة الصفات العيانية
والمجهرية للساق، والاوراق لامكان التعرف عليها سواء كانت كاملة أو على هيئة
مسحوق .