

MACRO-AND MICROMORPHOLOGY OF TABEBUIA GUAYACAN
HEMSL CULTIVATED IN EGYPT.

PART I: THE STEM AND LEAF

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ABSTRACT

The macro-and micromorphology of the stem and leaf of Tabebuia guayacan Hemsl. cultivated in Egypt at Aswan Botanic garden have been investigated in order to determine the diagnostic features by which each organ could be identified in the entire and powdered forms.

INTRODUCTION

Tabebuia guayacan Hemsl. is a large tree belonging to the Family Bignoniaceae, order Schrophulariales. The species is native to tropical and subtropical countries and is cultivated in Aswan Botanic Garden and other parts of the world as an ornamental plant¹⁻⁴.

Tabebuia guayacan Hemsl. contains several quinones and flavonoids³⁻⁷. Some of these compounds were reported to have antimicrobial and antiviral activities⁸.

Reviewing the current literature, nothing has been reported regarding the macro-and micromorphology of the different organs of Tabebuia guayacan Hemsl. hence detailed study was thought to be pertinent.

EXPERIMENTAL

Material :

The material used in this investigation was obtained from the plant cultivated in Aswan Botanic Garden. Identification of the plant was done by Prof. Dr.N.E.El-Keltawi. Prof. of Horticulture Faculty of Agriculture, Assiut University. Fresh samples as well as samples preserved in ethanol (70%) containing 5% glycerol were used.

Habitat :

Tabebuia guayacan Hemsl. is a large tree with monopodial branching and attaining up to 10 meters in height. It carries opposite decussate compound leaves and yellow bell or funnel shaped flowers. The fruit is a capsule containing numerous seeds.

A-THE STEM

Macromorphology :

The main stem of the plant is erect, cylindrical solid reaching up to 10 meters in height and up to 40 cm in diameter near the ground. The young branches are green to light-green in colour hairy while the older parts are greenish-brown to dark-green with longitudinal fissured and cracked surface. The stem breaks with a fibrous fracture. It has a faint odour and bitter astringent taste.

Micromorphology :

A transverse section in the young stem (Fig.2 A) is round in outline and shows an epidermis followed by a moderately wide cortex showing branched secretory vessels. The pericycle is formed of an alternating groups of lignified fibres and parenchyma. The vascular tissue includes a continuous band of phloem and xylem separated by a zone of cambiform cells and radially traversed by numerous medullary rays and enclosing a wide pith.

A transverse section in the old stem (Fig. 3 A) shows nearly the same structure of the young stem with the difference in the presence of thickened lignified cork instead of the epidermis, the cortex contains large branched secretory structure as well as groups of sclereids. Also small groups of phloem fibres are present in the phloem region.

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The epidermis : (Fig. 2 B) :

The epidermis of the young stem is formed of axially elongated cells with straight anticlinal walls and measure 128-168-208 u in length, 40-48-56 u in width and 56-64-72 u in height.. Non glandular hairs are unicellular or multicellular uniseriat consisting of 2-5 cells, simple occasionally branched covered with smooth and sometimes warty cuticle, measuring 152-352 u in legth and 40-56 u in width near the base. Stomata of anomocytic type are present, surrounded by 4-5 epidermal cells. They are oval or rounded in shape, measuring 48-52-56 u in diameter.

In the transverse section of the old stem (Fig. 3 A) a cork is present which is formed of several rows of thickened lignified and pitted walls ,the inner most layer is somewhat larger cells, cup shape, with only lignified inner and tangential walls, measuring 56-64-72 u in height and 40-44-48 u in width.

In surface view they appear polygonal having somewhat wide lumena and lignified walls.

The cortex : (Fig. 2 C)

The cortex formed of 3-4 rows of thick walled parenchyma cells, containing simple or compound starch granules and prismatic crystals of calcium oxalate. The rest of the cortex is formed of several layers of wide parenchyma surrounded by several secretory structures which forming network like structure arround the cells. These secretory structures contain substances giving yellow colour with KOH soln. (5%) orange with FeCl_3 and brown with iodine solution.

The pericycle : (Fig. 2 C)

The pericycle is formed of 3-4 rows of parenchyma cells interrupted by somewhat large groups of fibres. The fibres are lignified with wide lumena and acuminated apices measuring 24-32-48 u in diameter.

The vascular tissue : (Fig. 2 C)

The vascular tissue is formed of a phloem region and xylem region separated by a zone of cambiform cells. The phloem region is formed

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of sieve elements and phloem parenchyma interrupted by several branched secretory structures, forming network like structure, containing yellowish-brown contents, stained brown with Iodine solution, yellow with KOH soln. and orange with Ferric chloride.

The xylem : (Fig. 2 C)

It is formed of lignified elements including vessels, fibres tracheids and wood parenchyma. The vessels with pitted, scalariform and spiral thickening, measuring 40-56-88 u in diameter. Tracheids are narrow elongated, with pitted lignified walls, measuring 56-64 u in diameter. The wood fibres have lignified walls and wide lumina with blunt to rounded apices, measuring 20-24-32 u in diameter. The wood parenchyma consists of elongated cells with lignified simply pitted walls. The medullary rays are uniseriate, formed of rectangular cells which are thin walled and cellulosic in the phloem region but lignified in the xylem region and having thick, pitted and lignified walls.

The pith : (Fig. 2 C)

The pith is comparatively wide and is composed of rounded parenchyma cells with wide intercellular spaces. In old stem, some cells are pitted and lignified. They contain starch granules which are simple and compound as well as prismatic crystals of calcium oxalate.

The powder: (Fig. 3 C)

The powdered stem is yellowish-green to yellowish-brown in colour, with faint odour and slight bitter astringent taste. The important microscopical features of the powdered stem are :

- 1- Fragments of the epidermal cells from the young stem which are axially elongated with straight anticlinal walls showing anomocytic stomata.
- 2- Non-glandular hairs which are unicellular, or multicellular uniseriate covered with smooth or warty cuticle.
- 3- Fragments of cork cells from the old stem, polygonal in shape with thick lignified walls.

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- 4- Sclereids either isolated or in groups, with thick lignified walls and relatively wide lumen.
- 5- Fragments of lignified pericyclic fibres. wood fibres and phloem fibres with thick walls and relatively wide lumen.
- 6- Fragments of secretory structures containing yellowish contents stained brown with iodine soln., yellow with KOH, and orange with FeCl_3 .
- 7- Fragments of the inner most layer of the cork cells with thick, lignified inner tangential walls.
- 8- Wood vessels, which are lignified with pitted, scalariform and spiral thickenings.
- 9- Wood parenchyma with pitted and lignified walls.
- 10- Fragments of the medullary rays cells, which are elongated parenchyma with pitted and lignified walls.
- 11- Fragments of the pith parenchyma, which are rounded or oval shape containing prismatic crystals of calcium oxalate.

Some of these cells are pitted and lignified.

B-THE LEAF

Macromorphology : (Fig. 1)

The leaves of *Tabebuia guayacan* Hemsl. are opposite decussate exstipulate compound palmate leaf. Each leaf is usually formed of 5-leaflets with a relatively large one in the center. The two basal leaflets are shortly petiolate or nearly sessile, while the other three have long petioles.

Each leaflet is ovate in shape with entire margin, acuminate apex and symmetric base. The venation is pennate reticulate and anastomosing near the margin. The midrib is more prominent on the lower surface. The leaves are green in colour, the upper surface is darker than the lower one. The leaflets measure 5-9 cm in length and 3-5 cm in width at the middle parts.

The petiole is planoconvex in outline, measuring 0.3-3-5 cm in length and 0.2-0.3 mm in diameter.

The leaf rachis is somewhat planoconvex in outline, measuring 9-10-13 cm in length and 0.2-0.3-0.4 mm in diameter.

The leaf has characteristic odour and slight bitter to astringent taste.

Micromorphology : (Fig. 4)

A transverse section in the leaflet appears planoconvex in outline with the midrib prominent on the lower surface. It shows a dorsiventral structure with upper palisade layer formed on one row of cells. Above the palisade, there is a single layer of hypodermal cells. The palisade and the hypodermal cells are not continuous in the midrib region where they are replaced by a subepidermal mass of collenchyma. Another mass of collenchyma is present on the lower part of the midrib. The bundle of the main vein has a central pith surrounded by a continuous ring of xylem, phloem and lignified pericyclic fibres.

The epidermises: (Fig. 4 A,B,C and D)

The upper epidermis is formed of rectangular cells. In surface view, the cells appear as polygonal, isodiametric or slightly elongated measuring 64-72-96 u in length, 24-40-64 u in width and 40-48-56 u in height. The cells are covered with smooth cuticle. Stomata are hardly seen on the upper surface.

The lower epidermis is formed of somewhat square to subrectangular cells, mostly isodiametric with straight anticlinal walls, covered with smooth cuticle and measuring 40-56-72 u in length, 24-40-56 u in width and 24-28-32 u in height. Stomata are more numerous on the lower surface. They are of anomocytic type mainly surrounded by 5-6 cells., Glandular hairs are present on both surfaces but they are numerous on the lower surface. They are formed of unicellular stalk and multicellular head of 8-10-12 radiating cells. The glandular heads measure 104-128-160 u in diameter.

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The non-glandular hairs are present on both surfaces, they are similar to those present on the young stem, but differ in being more frequent, measuring 200-252-360 u in length.

The mesophyll: (Fig. 4 D)

The mesophyll tissue is heterogenous consisting of one layer of large hypodermal cells measuring 48-56-64 u in height and 40-48-60 u in width.

The hypodermis is followed by one layer of the upper palisade which measure 96-108-120 u in length and 24-28-40 u in width.

The spongy tissue consists of 4-6 rows of irregular parenchyma cells with wide intercellular spaces. They contain small starch granules as well as prismatic crystals of calcium oxalate.

The cortical tissues: (Fig. 5)

The cortical tissue shows an upper and lower subepidermal collenchymatous masses, formed of 2-4 rows of cells. The rest of the cortical tissue consists of rounded or oval parenchyma cells containing prisms of calcium oxalate and small starch granules.

The vascular tissue: (Fig. 5)

The pericyclic fibres are lignified with relatively wide lumina and acuminate to acute apices. They measure 32-40-56 u in diameter. The phloem is formed of narrow zone of soft elements, show branched secretory vessels forming network-like structure.

The vessels are lignified, radially arranged having scalariform and spiral thickening rarely pitted measuring 40-72-88 u in diameter.

The wood fibres are lignified, measuring 16-32-48 u in diameter. The wood parenchyma are polygonal, thick walled, pitted and lignified. The pith is formed of rounded parenchyma with wide intercellular spaces, containing prisms of calcium oxalate and small starch granules. Some of these cells are slightly thickened and pitted.

The petiole: (Fig. 6 A)

A transverse section of the petiole, is somewhat rounded in outline showing two small projections on its upper side.

It consists of an epidermis and cortical tissues surrounding the main vascular stele. The epidermis shows glandular and non-glandular hairs similar to those present on the lamina in all aspects. Stomata are rare and similar to that of the leaf.

The epidermis is followed by the cortex which is formed of several layers of collenchyma and parenchyma cells containing starch granules and prisms of calcium oxalate ended by nearly complete ring of lignified pericyclic fibres.

The vascular stele shows a complete ring of xylem and phloem, with central pith, which are similar to those of the leaf in all aspects.

The powder: (Fig. 6 B)

The powdered leaf is light green to yellowish-green in colour, with faint odour and slight bitter and astringent taste. It is characterised microscopically by the followings :

- 1- Fragments of the upper epidermis showing glandular hairs with unicellular stalk and multicellular head with 8-12 radiating cells.
- 2- Fragments of the lower epidermis showing anomocytic stomata surrounded by 5-6 epidermal cells and glandular hairs similar to those present on the upper surface.
- 3- Fragments of non-glandular hairs, unicellular or multicellular uniseriate, simple or branched covered with smooth and sometimes warty cuticle.
- 4- Fragments of lignified pericyclic fibres with wide lumina and acute to acuminate apices.
- 5- Fragments of mesophyll showing palisade cells.
- 6- Prisms of calcium oxalate are scattered in the field.
- 7- Fragments of scalariform and spiral vessels with lignified walls.
- 8- Fragments of secretory vessels which are branched containing yellowish-brown contents.

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Fig.1 Sketch of the branch

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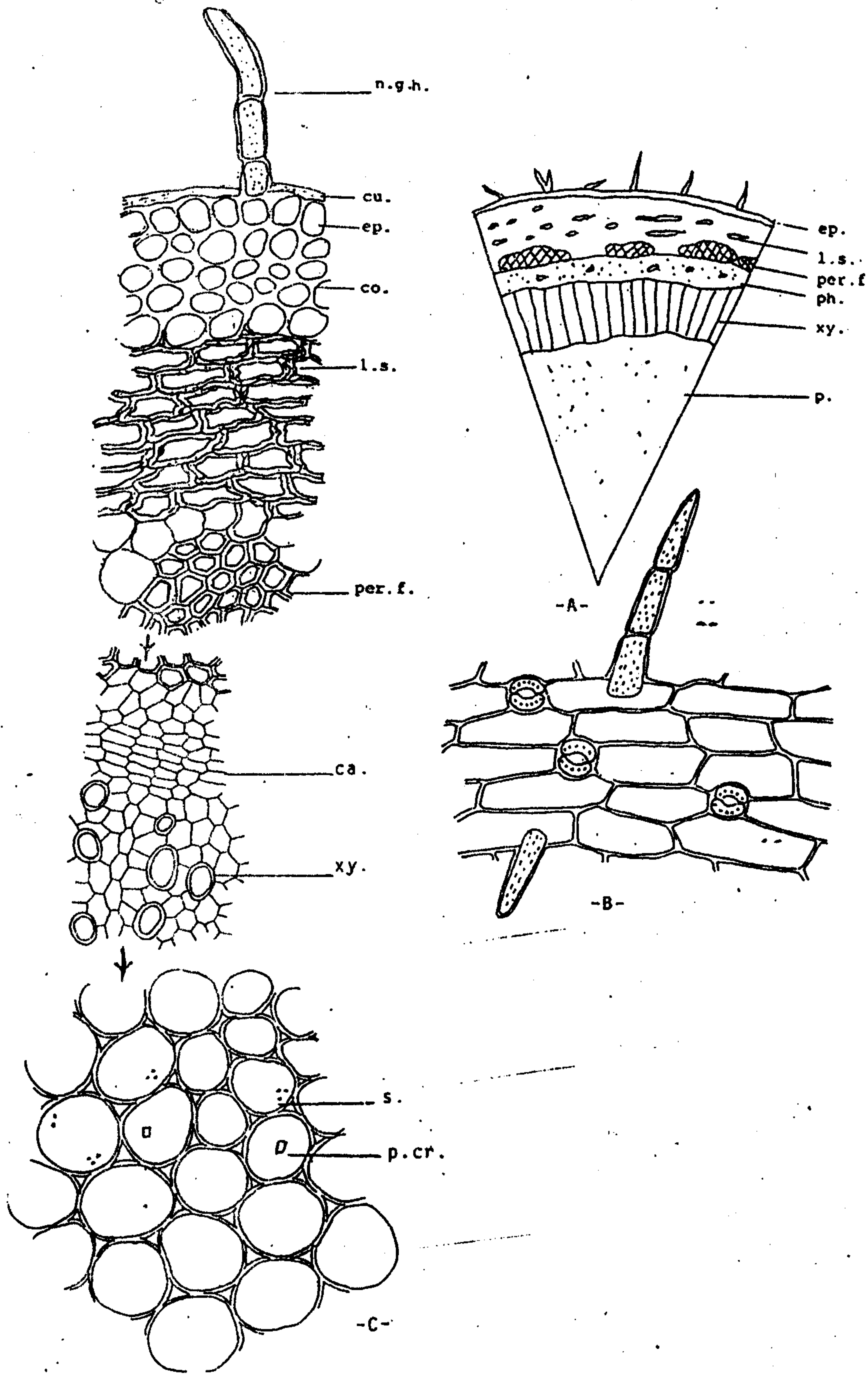


Fig.2 A-Diagramatic T.S.in the young stem X 40
 B-Surface preparation in the young stem X 100
 C-Detailed T.S. in the young stem X 100

ep., epidermis; ca., cambium; col. collenchyma; cu., cuticle;
 p.pith; per.f., pericyclic fibre; p.cr., prismatic crystals of calcium
 oxalate; ph., phloem; l.s., laticeferous structure; n.g.h., non
 glandular hairs; s., starch st., stomata; xy., xylem.

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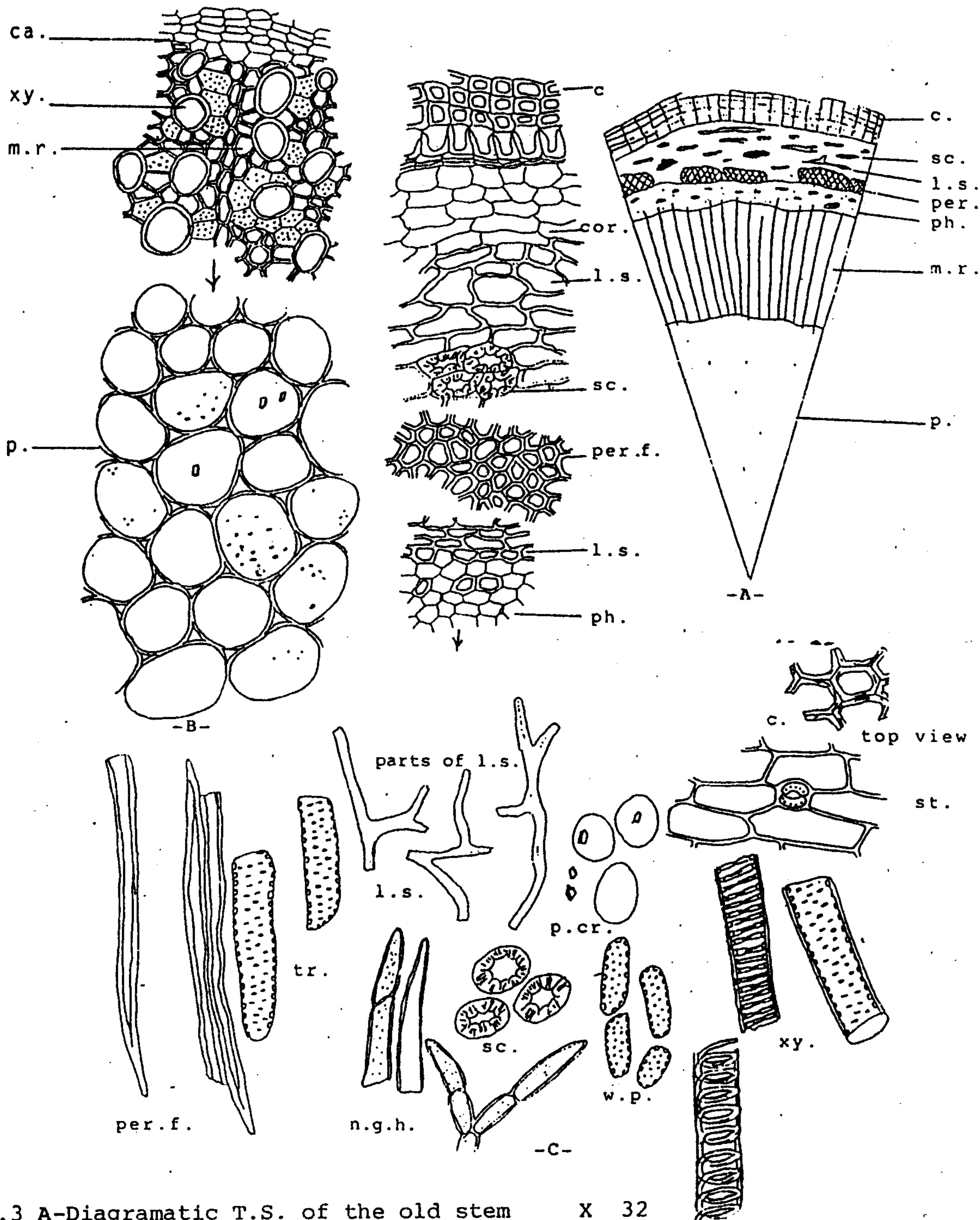


Fig.3 A-Diagrammatic T.S. of the old stem X 32
 B-Detailed T.S. of the old stem X 80
 C-Isolated elements of the stem X 80

c., cork; ca., cambium; cor., cortex; p.pith; per.f., pericyclic fibre;
 p.cr., prismatic crystals of calcium oxalate; ph. phloem I.s., laticiferous
 structure; sc., sclerides; st., stomata.; tr., tracheides; w.p. wood

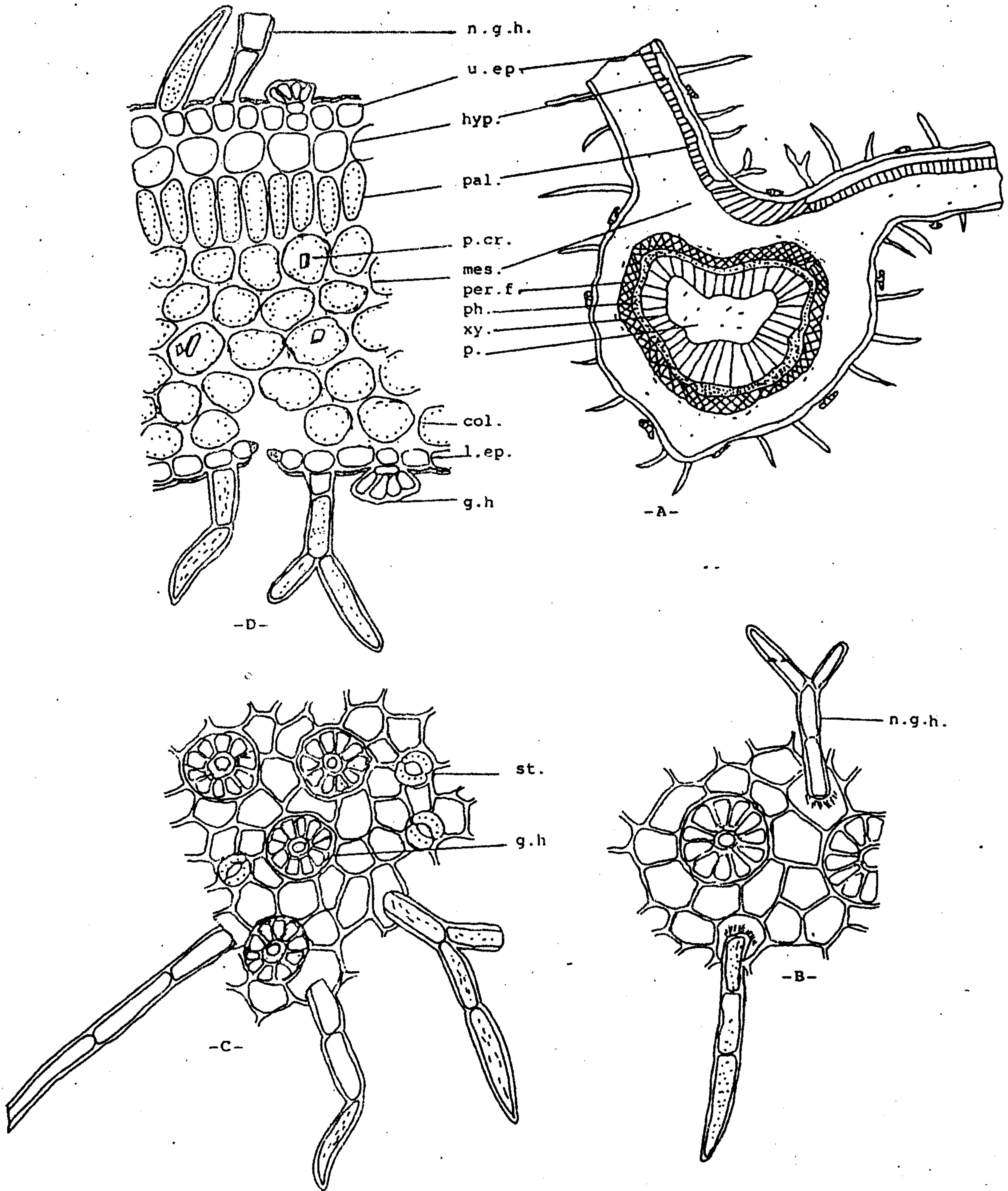


Fig.4 A- Diagrammatic T.S. of the leaflet X 40
 B-Surface preparation of the upper epidermis X 100
 C-Surface preparation of the lower epidermis X 100
 D-Detailed T.S. of the lamina X 100

coll., collenchyma; g.h. glandular hair; hyp., hypodermis.,
 mes., mesophyll; n.g.h., non glandular hair; p.pith;p.al.,palisade;
 per.f.,pericyclic fibre; ph.phloem;p.cr., prismatic crystals of
 calcium oxalate; l.ep., lower epidermis;st., stomata; u.ep.,
 upper epidermis; xy., xylem.

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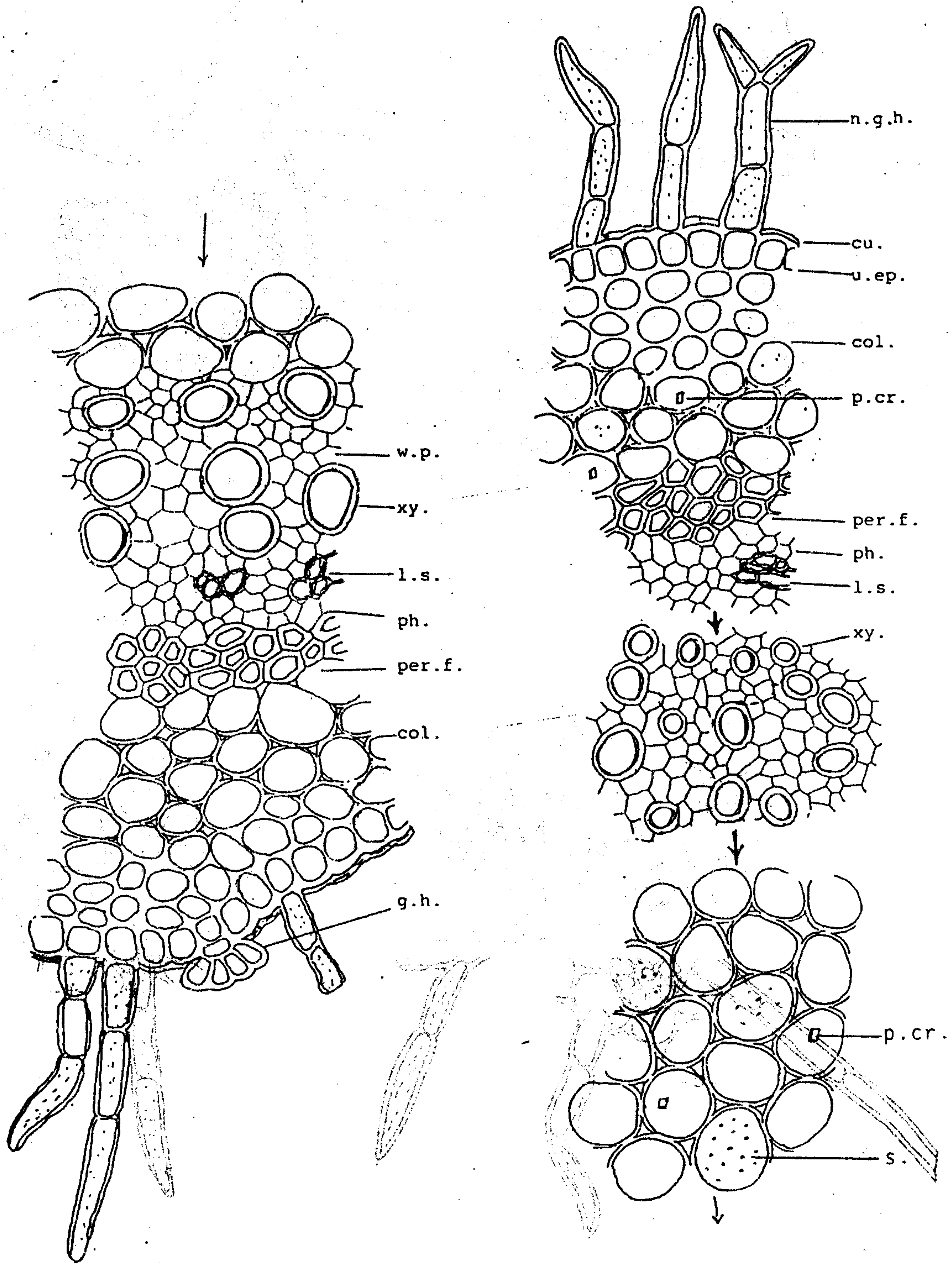


Fig. 5 Detailed T.S. of the midrib
 coll., collenchyma; cu., cuticle; glandular hair; l.ep., lower epidermis; l.s., laticiferous structure; n.g.h., non glandular hair; p.cr., prismatic crystals of calcium oxalate; .p., pith; per.f., pericyclic fibres; ph., phloem; s., starch w.p., wood parenchyma; xy., xylem.

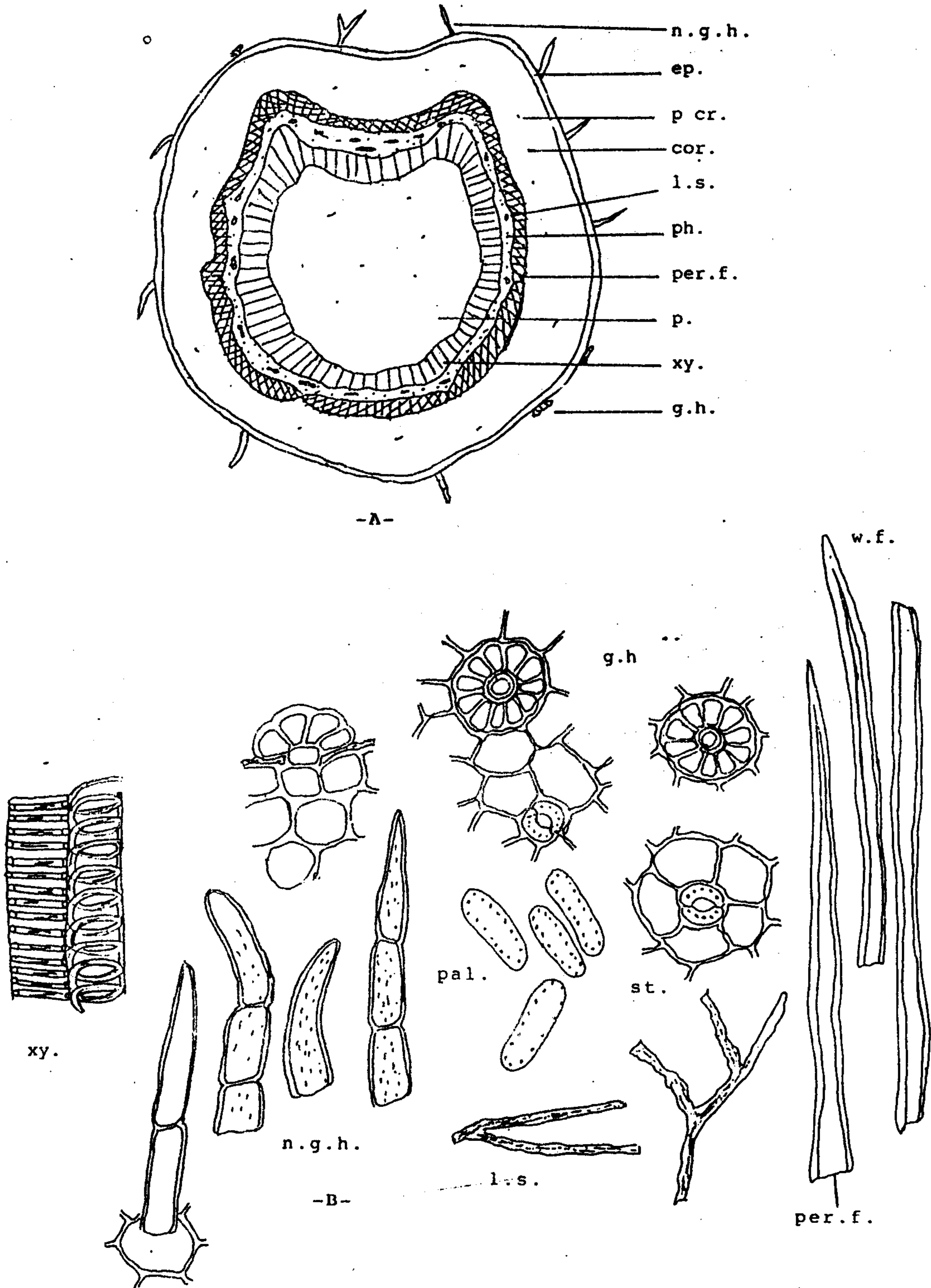


Fig.6 A- Diagramatic T.S., in the petiole X 40
 B- Isolated elements of the leaf X 100

cor., cortex; ep. epidermis; g.h., glandular hair; l.s., laticiferous structure; p., pith; per., pericycle; p.cr., prismatic crystals of calcium oxalate; ph., phloem; per.f., pericycle fibres; pal., palisade; st., stomata xy.; xylem.

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" الصفات العيانية والمجهرية لنبات التابيبا
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