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MACRO-AND MICROMORPHOLOGY STUDY OF SALVIA FARINACEA BENTH. (STEM AND LEAF)

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ABSTRACT

The macro-and micromorphology of the stem and leaf of Salvia farinacea Benth. cultivated in Egypt are presented with the view of determining the diagnostic features by which these organs can be identified both in the entire and powdered forms.

INTRODUCTION

Salvia farinacea Benth. is a perennial herb belonging to family Labiatae[1,2]. It is cultivated as an ornamental plant for its showy violet or deep blue flowers. It has been reported that the term Salvia obtained from the ancient Latin name used by Pliny "Salveo" (means to save or heal)[1]. It has also been reported that the radix of Salvia miltiorrhiza (chinese medicine, Ten-shen) exhibited a nign innibitory activity againstcollagen-induced platlet aggregation[3]. Recently it is reported that genus Salvia na anticarcinogenic activity due to the diterpenequi-

none content[4]. Reviewing the current literature, nothing was traced on both botanical and chemical study on Salvia farinacea Benth. with the exception of very brief notes concerning the morphological characters[1]. It was therefore, necessary to perform a comprehensive study of all vegetative organs of the plant.

The present work deals with the macro-and micromorphology of the stem and leaf of the plant cultivated in Egypt.

EXPERIMENTAL

Materials:

The separated organs of Salvia farinacea Benth. were collected at different stages of growth from plants grown in experimental station, Faculty of Pharmacy, University of Assiut. The identity of the plant was verified by Prof. Dr. M.N. El-Hadidy, Dept. of Botany, Faculty of Science, University of Cairo.

The material used in this study was freshly preserved in alcohol 70% containing 5% glycerin. The powder (No. 36) was prepared from air-dried plants.

MACROMORPHOLOGY

Habitat:

Salvia farinacea Benth. (Fig. 1) is a perennial herb 90 cm high with simple stem.

The leaves are cauline, simple, petiolate, having a crenate margin and acute apex.

The inflorescence is terminal erect with pink to muve flowers. Flowering stage from October to January from each year.

The Stem (Fig. 1) is more or less quadrangular in outline. reaching up to 90 cm in height, 8 to 10 mm in diameter at the ground level and 3 to 6 mm at the middle part. It is monopodially branched and the small branches possess internodes measuring from 3-5 cm in length. The stem is solid, green in colour with pink tinge, slightly pubescent with splintery fracture when dry.

It has a faint characteristic odour and slightly bitter taste.

The Leaf (Fig. 1) is cauline, simple, opposite decussate , exstipulate, petiolate. The lamina is lanceolate to linear-lanceolate and measures 5-12-16 cm in length and 1-2.5-3 cm in width at the widest part. It is usually symmetric at the base, has a crenate margin and acute apex. The surface is pubescent and the upper surface is dark green in colour but the lower one is lighter. Venation is pinnate reticulate. The petiole is short, grooved on the upper side, measures from 1 to 2 cm in length and 0.3 to 0.5 cm in diameter. The leaf possesses a charateristic odour and slight bitter taste.

MICROMORPHOLOGY

The Stem:

A transverse section in the stem (Fig. 2A) is more or less quadrangular in outline.

The epidermis (Fig. 2C) consists of one layer of cells which, in surface view, appear polygonal mainly axially elongated with straight anticlinal walls and covered with moderately thick, finely striated cuticle. Dimensions of the cells are listed in Table 1. No stomata could be detected. Non-glandular and glandular trichomes are present (Fig. 3). The non-glandular trichomes are frequent, they are uniseriate, multicellular formed of 2-6 cells with tapering apices and covered with warty cuticle.

The Glandular Trichomes are of two types:

1- Unicellular head, unicellular or bicellular uniseriate stalk.

2- Labiaceous hairs, each consists of short unicellular stalk and large globular multicellular head, composed of 8 radiating cells and covered with smooth cuticle.

The cortex (Fig. 2B) is comparatively narrow, showing an outer subepidermal collenchyma restricted to the four angles of the stem, and formed of 4-6 rows of thick-walled nearly rounded collenchymatous cells. The remaining of the cortex consists of few rows of large thin-walled parenchymatous cells with large intercellular spaces. They contain abundant starch granules mainly simple, rounded with a central

point-like hilum.

The endodermis (Fig. 2B) is formed of thin-walled parenchymatous cells, containing numerous starch granules and forming a starch sheath.

The pericycle (Fig.2B) consists of interrupted ring of pericyclic fibres separated by thin-walled parenchymatous cells, surrounding the vascular tissue. The fibres are long, having thick lignified walls with irregular outline, wide lumena and having pointed or blunt apices.

The vascular tissue (Fig. 2B) in young stem is formed of four separate collateral vascular bundles opposite to the four angles, but in old one it forms a continuous ring consisting of secondary elements.

The phloem consists of moderately thin-walled cellulosic elements, sieve tubes, companion cells and parenchyma. The cambium zone is formed of 3-5 rows of cellulosic thin-walled cambiform cells. The secondary xylem consists of lignified, thick-walled elements, found in radial rows. The vessels are mainly solitary or in small groups of 2 or 3 and show spiral, scalariform, reticulate and pitted thickenings.

The vessels are accompanied with some tracheids,fibrous tracheids and tracheidal vessels. The wood fibres are abundant, spindle-shaped having lignified straight walls, wide lumena and blunt or tapering ends. The wood parenchyma consists of elongated cells with pitted lignified walls.

The medullary rays are 3 to 6 cells wide. The cells are radially elongated, lignified and pitted in the xylem region but non-lingified in the phloem region. Dimensions are given

in Table 1.

The pith (Fig. 2B) consists of large more or less rounded or polyhedral, thin-walled parenchymatous cells. Parenchymatous cells of the cortex, phloem and pith, as well as the medullary rays contain small rounded starch granules. No calcium oxalate crystals are present.

The Leaf:

A transverse section in the lamina (Fig. 4 A) appears planoconvex in outline in the midrib region. It shows upper and lower epidermses enclosing inbetween a dorsiventral mesophyll which is replaced in the midrib region by the vascular strand and the cortical tissue.

The upper epidermis (Fig. 4 D) is formed of rectangular cells in transverse section and appears polygonal in surface view with straight or sinuous anticlinal walls and moderately thick smooth cuticle. The cells of the lower epidermis are similar to those of the upper one, but differ in that they are smaller in size and the anticlinal walls are more wavy. Cells of the neural region are narrower, subrectangular, axially elongated with thick smooth cuticle. Stomata are distributed on both surfaces, but they are more on the lower one, very rare on the neural region. Stomata are oval, occasionally rounded in shape and are of the diacytic type. Glandular and non-glandular trichomes are present on both surfaces and similar to those of the stem.

The mesophyll (Fig. 4C) is dorsiventral, consisting of 2 rows of columnar, cylindrical palisade cells, and comparatively narrow spongy tissue.

The cortical tissue (Fig. 4 B) consists of an upper and lower subepidermal masses of collenchyma formed of 3-5 rows of cells on both sides. The rest of cortical tissue is formed of almost rounded, large, thin-walled parenchymatous cells.

The vascular tissue (Fig. 4B) in the midrib is represented by a large strand with the xylem to the adaxial side and the and the phloem to the abaxial side.

The phloem is narrow and consists of thin-walled soft cellulosic elements. The xylem (Fig. 4 B) consists of lignified vessels and thin-walled wood parenchyma. The vessels possess pitted, spiral and scalariform thickenings. Medullary rays are formed of 2-4 rows of thin-walled and cellulosic cells. The endodermis (Fig. 4 B) is formed of one layer parenchyma containing starch granules. Dimensions are given in Table 1.

Numerical Values:

1- Stomatal Index

Upper epidermis	:	5.6	to 6.6
Lower epidermis	:	8.3	to 9.2

2- Palisade ratio : 8 to 10

3- Vein-islet number : 8.5 to 9.9

The Petiole:

Appears in transverse section more or less plano-convex in outline and showing a hairy epidermis and comparatively wide cortex (Fig. 6 A).

The epidermis (Fig. 6 C) consists of one row of one cells which appear square or subractangular in transverse section. In surface view the cells are polygonal with nearly straight anticlinal walls. Trichomes are identical with those of the lamena. Dimensions are given in Table 1.

The cortical tissue (Fig. 6B) is formed of large thin-walled parenchyma and 4-6 rows of subepidermal collenchyma.

The vascular strand is crescent-shaped and consists of three or four vascular bundles and two additional lateral bundles is the upper side.

THE POWDER

The Stem(Fig. 3):

Powdered stem is yellowish green to dark green in colour,possesses a slight aromatic odour and slightly bitter taste. It is characterised by:

1- Fragments of polygonal epidermal cells with straight anticlinal walls and thick, finely striated cuticle.

2- Numerous non-glandular trichomes; multicellular (2-6 cells) uniseriate with tapering apices and covered with warty cuticle. Glandular trichomes of Labiaceous type, and few glandular trichomes with unicellular head and stalk of one

or two cells.

3- Fragments of lignified tracheids, having tapering or blunt ends; fibrous tracheids and tracheidal vessels.

4- Fragments of lignified pericyclic fibres, having wide lumena and pointed or blunt apices.

5- Fragments of lignified wood parenchyma and medullary ray cells with pitted lignified walls.

6- Fragments of lignified vessels with spiral, pitted reticulate and scalariform thickening.

The Leaf(Fig. 5):

Powdered leaf is green to dark green in colour, having aromatic odour and a slight bitter taste. It is characterised by:

1- Fragments showing the mesophyll with the palisade and spongy tissue.

2- Fragments of epidermal cells, being polygonal with wavy anticlinal walls, covered with thick, smooth cuticle and showing diacytic stomata.

3- Non-glandular and glandular trichomes similar to those of the stem are present.

4- Fragments of lignified vessels mostly with spiral and pitted thickening.

Table 1: Stem and leaf: Dimensions of cells of different tissues.

	Height	*Width*	*Length*	*Diameter*
Epidermis:				
Stem	11-13-15	15-22-31	22-33-44	
Leaf				
Upper epidermis	13-17-22	20-28-37	31-41-54	
Lower epidermis	11-13-15	15-22-31	15-30-44	
Neural epidermis	13-18-24	13-16-20	37-45-53	
Petiole	15-18-22	15-20-26	24-34-44	
Stomata :				
Leaf		20-22-24	22-24-20	
Non-glandualr trichomes				
Stem		28-33-37	222-355-488	
Leaf		35-43-51	177-344-511	
Glandular trichomes				
1-Unicellular head and uni-or bicellular stalk				
Head				24-30-37
Stalk		8-11-13	11-13-15	
2-Labiaceous hairs				
Head				46-55-64
Pericyclic fibres				
Stem		31-37-44	977-1066-1155	
Vessels				
Stem				44-88-133
Leaf				17-26-35

Table 1: Cont.

	Width	*Length*	*Diameter*
Tracheids			
Stem	20-22-24	122-160-200	
Tracheidal vessels			
Stem	22-24-26	288-320-355	
Fibrous tracheids			
Stem	20-26-33	255-340-433	
Wood fibres			
Stem	26-31-37	488-577-666	
Palisade cells	8-10-13	51-57-64	
Starch			
Stem			8-12-15
Leaf			6-7-8

All measurements are in microns.

Macro-and micromorphology study of Salvia farinacea Benth. (Stem and Leaf)

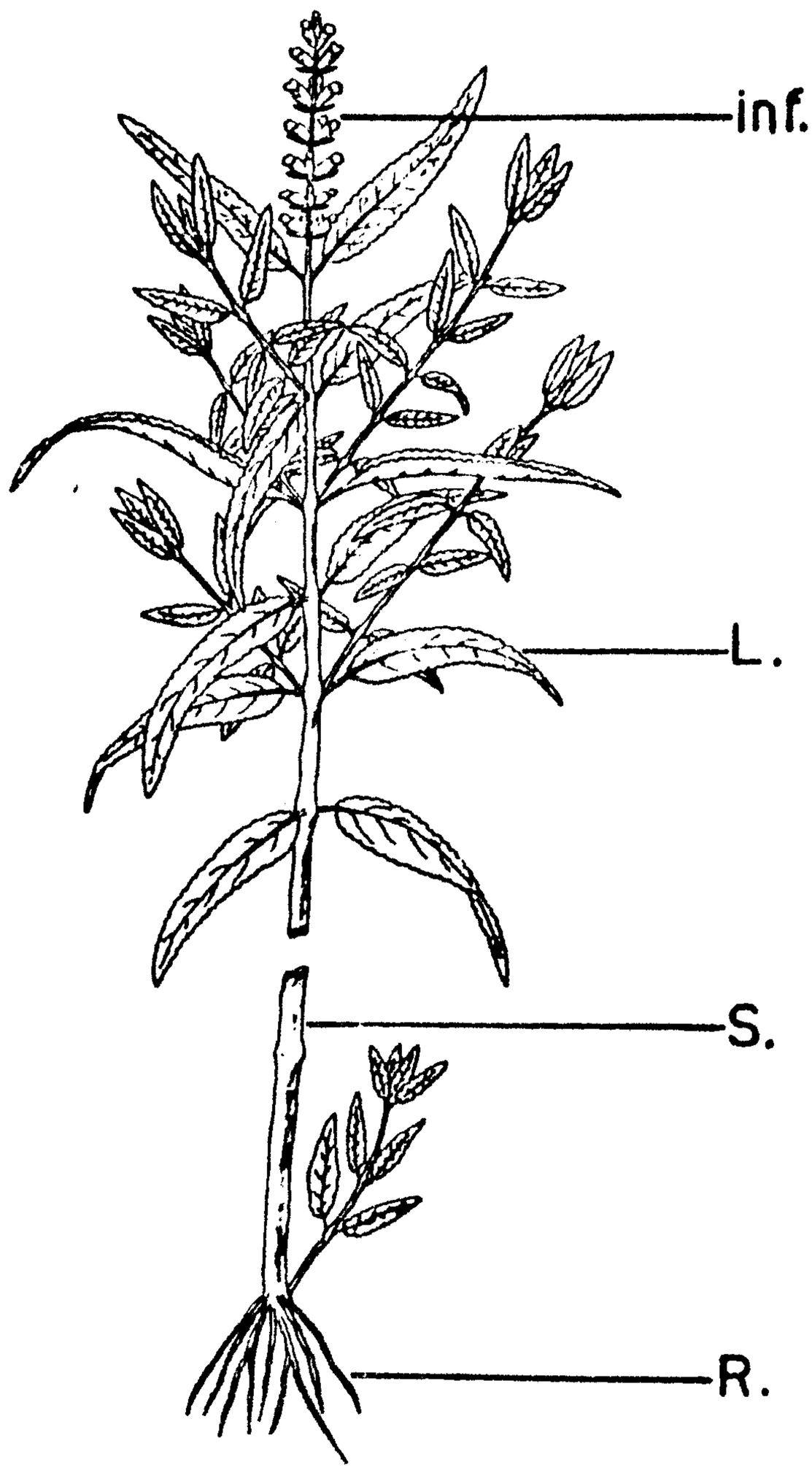


Fig. 1: Sketch of Salvia farinacea Benth X 1/3
inf., inflorescence; l., leaf; r., root; s., stem.

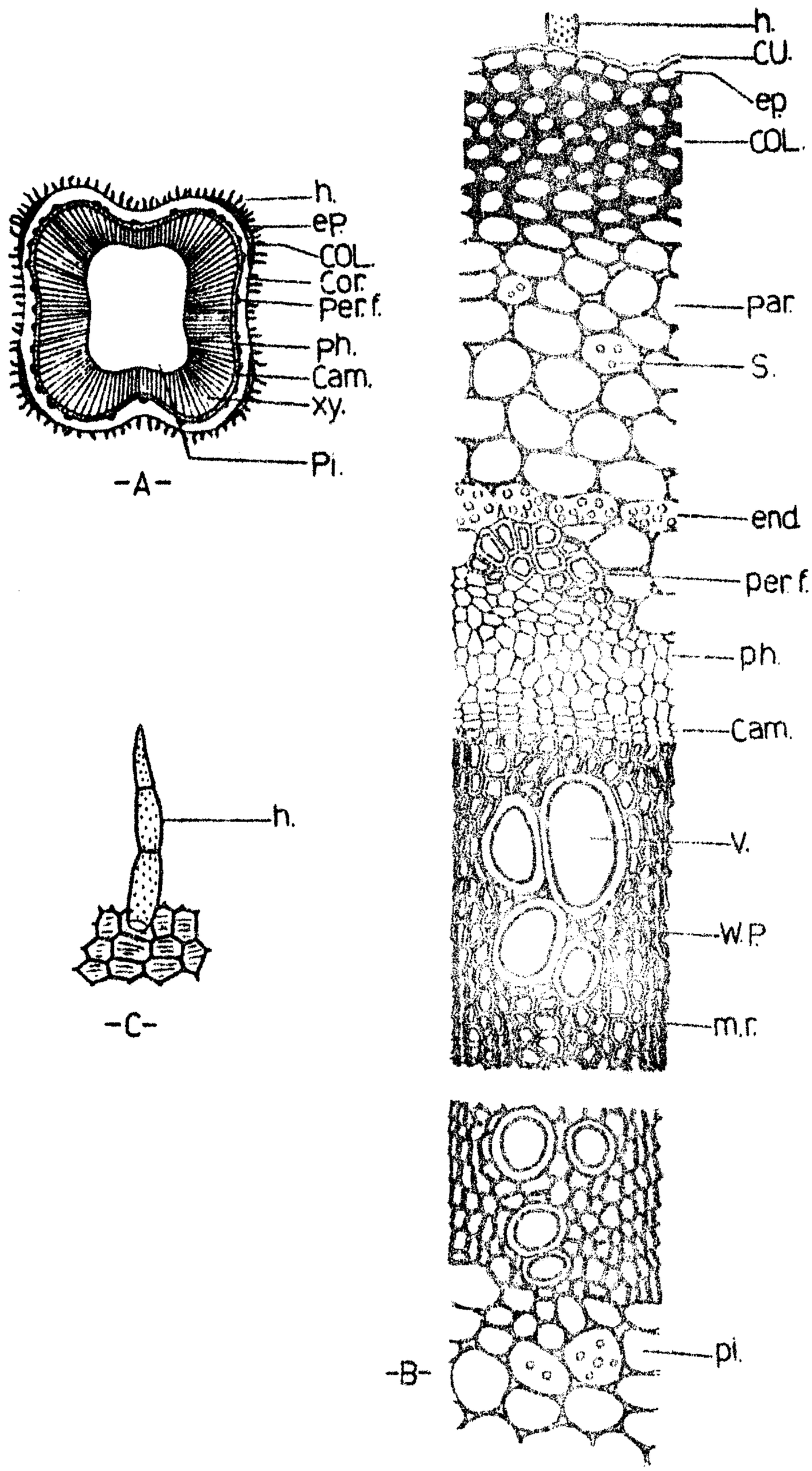


Fig. 2: A- Diagrammatic T.S. in the stem X 5
B- Detailed T.S. X 190
C- Surface preparation X 190
cam., cambium; col., collenchyma; cor., cortex; cu., cuticle; end., endodermis; ep., epidermis; h., hair; m.r., medullary ray; par., parenchyma; per.f., pericyclic fibres; ph., phloem; s., starch; v., vessel; w.p., wood parenchyma; xy., xylem;

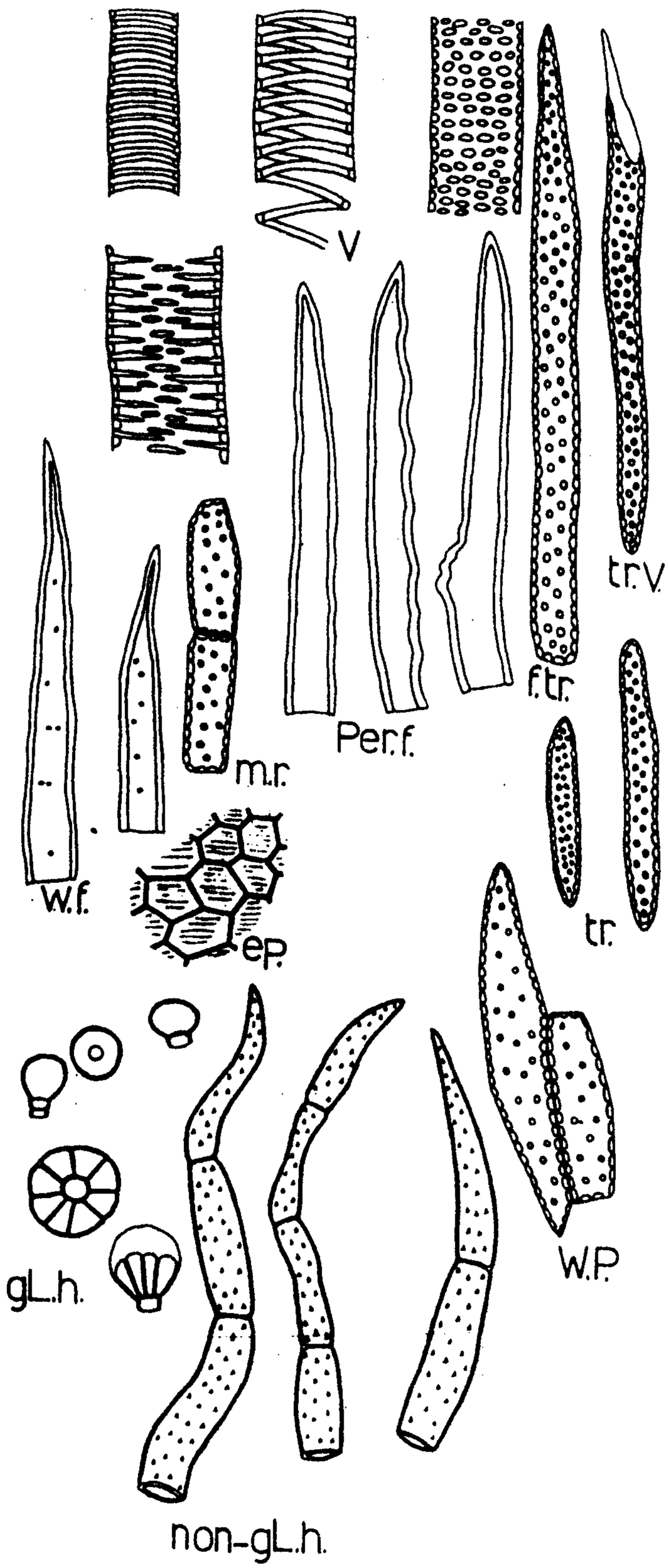


Fig. 3: Isolated elements of the stem X 205
ep., epidermis; f.tr., fibrous tracheids; gl.h., glandular hairs; m.r., medullary ray; non-gl.h., non-glandular hairs; per.f., pericyclic fibres; tr., tracheids; tr.v., tracheidal vessel; v., vessel; w.f., wood fibres; w.p., wood parenchyma.

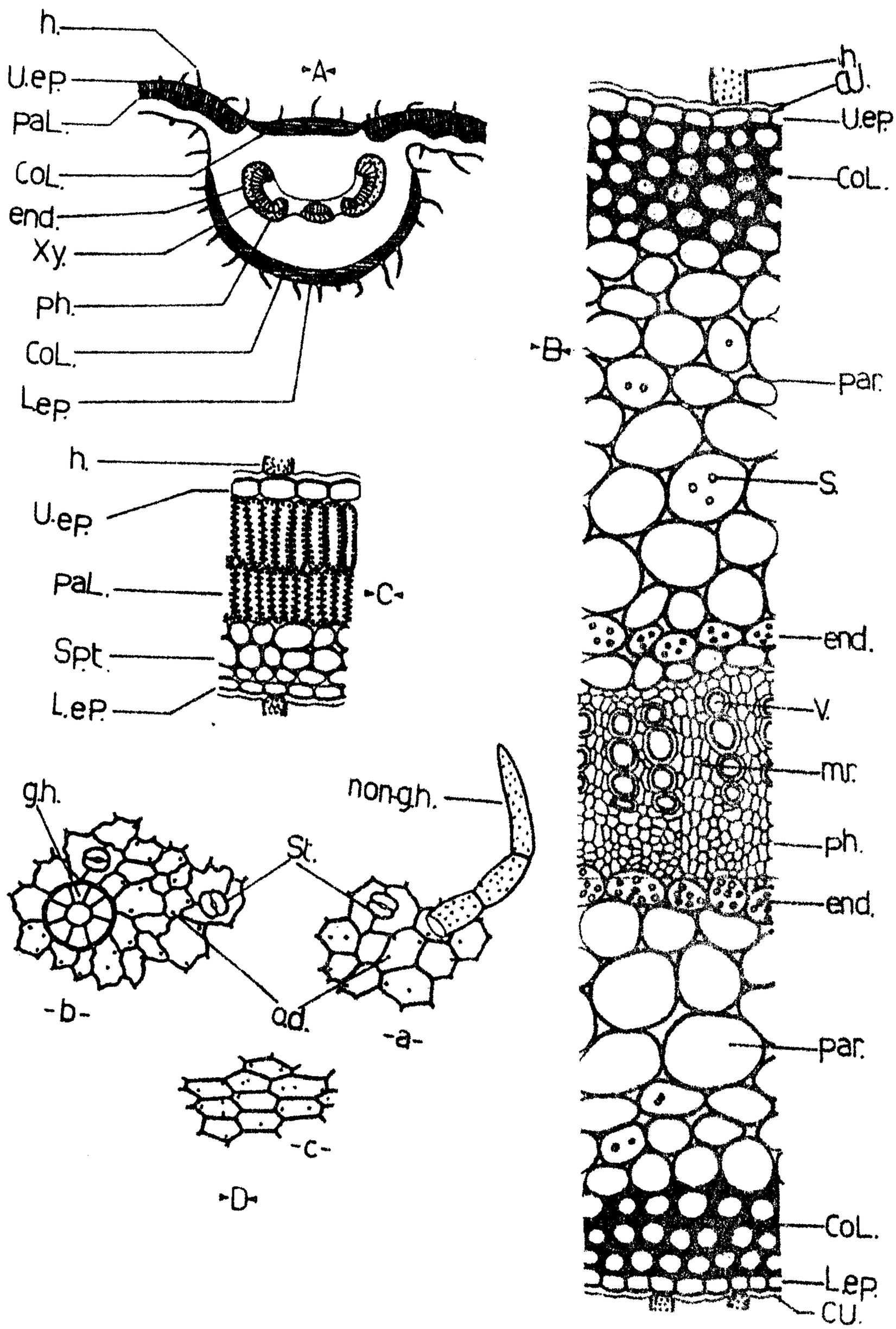


Fig. 4: A- Diagrammatic T.S. of the leaf
B- Detailed T.S. in the midrib
C- Detailed T.S. in part of the lamina
D- Surface preparation
a- Upper epidermis
b- Lower epidermis
c- Neural epidermis

col., collenchyma; cu., cuticle; end., endodermis; g.h., glandular hair; h., hair; l.ep., lower epidermis; m.r., medullary ray; non-g.h., non glandular hair; o.d., oil droplet; pal., palidade; par., parenchyma; ph., phloem; s., starch; sp.t., spongy tissue; st., stomata; u.ep., upper epidermis; v., vessel; xy., xylem.

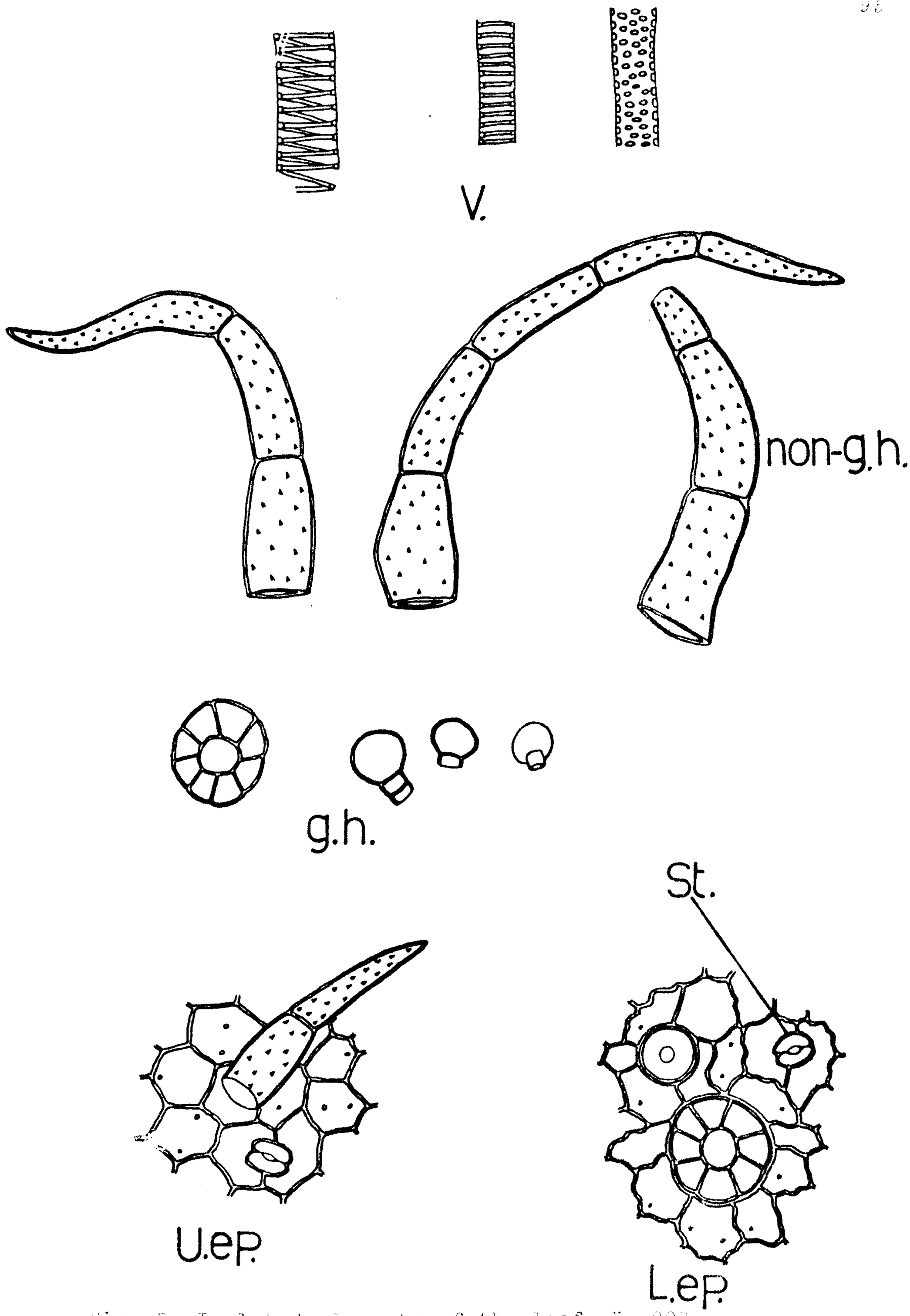
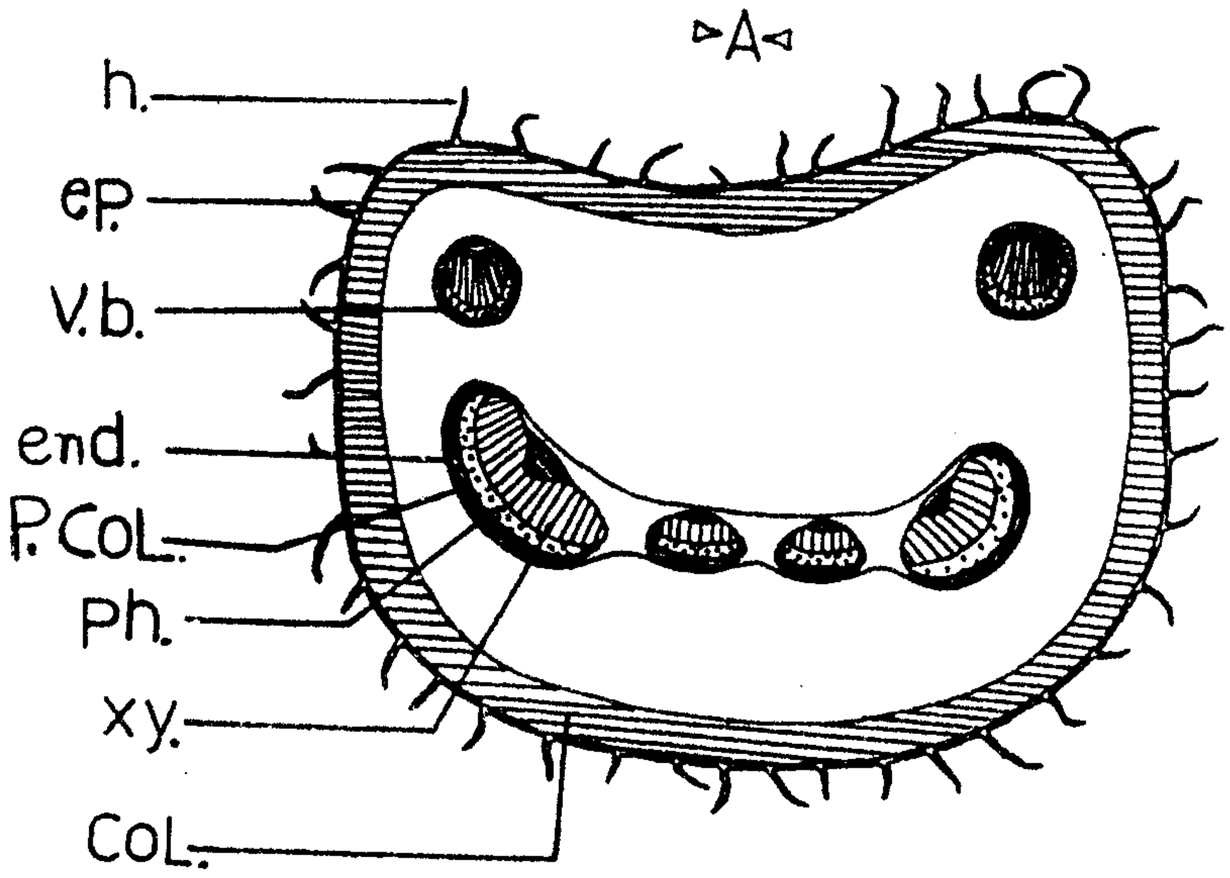
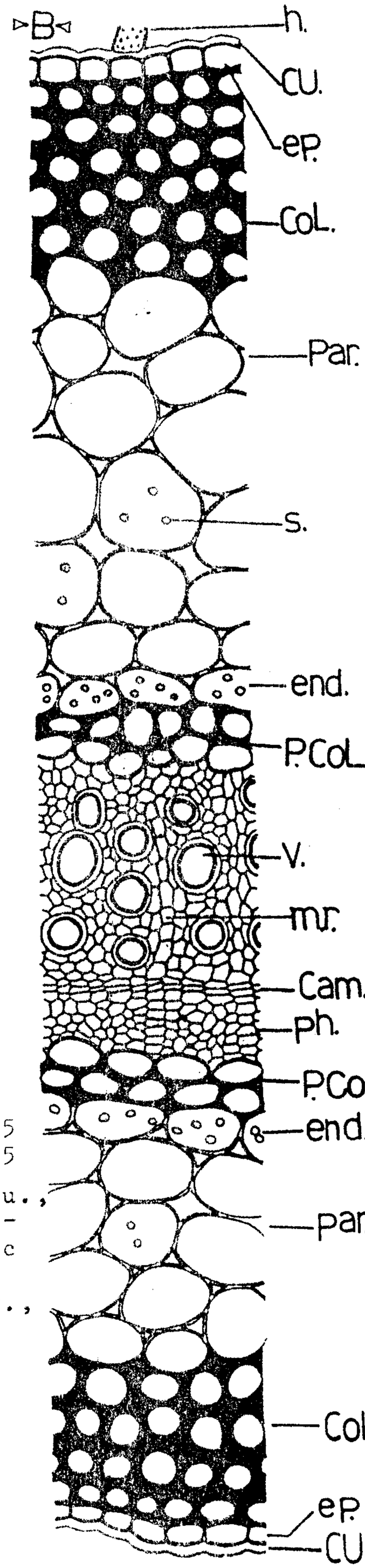


Fig. 5: Isolated elements of the leaf X 293
g.h., glandualr hair; l.ep., lower epidermis; non-g.h., non-glandualr hair; st., stomata; u.ep., upper epidermis; v., vessels.





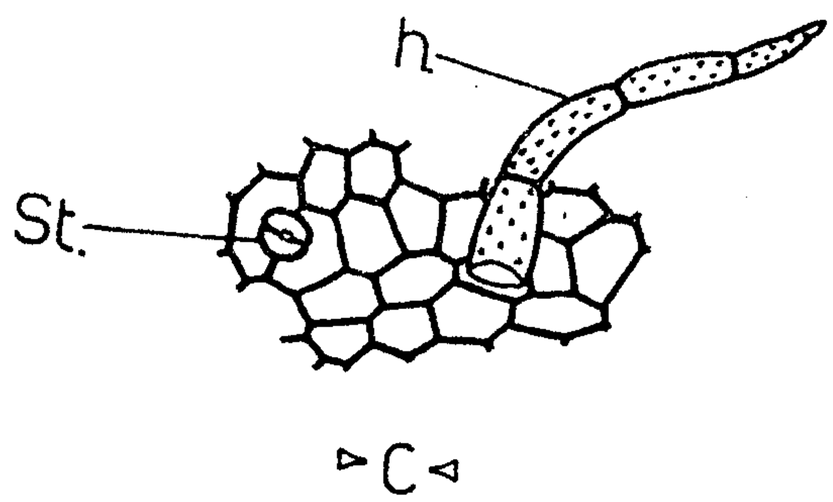


Fig.6: A- Diagrammatic T.S. in the petiole X 22
B- Detailed T.S. X 205
C- Surface preparation X 205

cam., cambium; col., collenchyma; cu., cuticle; end., endodermis; ep., epidermis; h., hair; p.col., pericyclic collenchyma; par., parenchyma; ph., phloem; s., starch; st., stomata; v., vessel; v.b., vascular bundle; xy., xylem.

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الدراسة العيانية والمجهرية لنبات السالفيافارنسيابنثام
(الساق والورقة)

احمدعبد الرحمن على - داود ونيس بشاى - محمد أحمد الشنوانى
ومحمد صلاح كامل
قسم العقاقير - كلية الصيدلة - جامعة اسيوط

نبات السالفيافارنسيا هو من نباتات الزينة التى تزرع فى مصر لجمال أزهارها البنفسجية وينتمى هذا النبات الى العائلة الشفهية . وقد ذكر أن بعض انواع السالفيا لها تأثير ضد مرض السرطان وكذلك بعض امراض الدم.

لذلك روءى انه من المناسب عمل دراسة عقاقيرية ،نباتية وكيميائية لاستخلاص فوائد هذا النبات.

وفى هذا الجزء تم دراسة الصفات العيانية والمجهرية للساق والورقة للتعرف عليها سواء كانت كاملة أو على هيئة مسحوق.

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