

MACRO AND MICROMORPHOLOGY OF CLIVIA MINIATA REGEL
CULTIVATED IN EGYPT.

PART I: The Root, Corm And Leaf

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The macro and micromorphology of roots, corms and leaves of Clivia miniata Regel cultivated in Egypt are given with a view of determining the diagnostic features by which each organ can be identified in the entire and powdered form.

Clivia miniata Regel, is a handsome ornamental perennial herb, belonging to the family Amaryllidaceae¹; usually cultivated in most common and private gardens for its beautiful flowers. C. miniata Regel is known as Scarlet Kaffir-lily miniatum Hook, Himantophyllum miniatum Groenl and Vollata miniata Lindl^{1,2}. The plant is used as antidote for snake-bite, for treatment of febrile conditions and to facilitate delivery at child-birth². Leven et al³⁻⁵ stated that the folkloric use of C. miniata Regel is due to its antiviral activity. Since 1954 up till now at least 9 alkaloids were isolated from C. miniata Regel growing abroad⁶⁻¹⁴. Recently, a new alkaloid clivonidine¹⁵, was isolated by us from C. miniata Regel cultivated in Egypt.

In the present work, the macro as well as micromorphological features of the root, corm and leaf of the plant are illustrated.

Material:

The material was obtained from plants cultivated in the Experimental Station of the Faculty of Pharmacy, Assiut Uni-

versity, Assiut, Egypt. The plant was identified by late Prof. Dr. Vivi Täckholm, Prof. of Taxonomy, Faculty of Science, Cairo University.

Habitat:

Clivia miniata Regel (Fig. 1) is a showy, ornamental perennial herb showing an imperfect bulb. The bulby structure is reduced and the stem of the bulb becomes swollen, modified into the corm, from which arise the foliage leaves and the scap. with flowers. The plant attains a height of 43-45 cm. The aerial portion is composed of the evergreen broad, strap-shaped, long leaves and a flowering axis carrying a large umbel of 10-20 orange to reddish flowers. The underground portion composed of the corm from which arise numerous fleshy adventitious roots. The plant is propagated by divisions or by removal of offsets in February. The flowering period extends from February to May.

A- The Root

Macromorphology:

The roots (Fig. 1) are typically adventitious completely enveloping the corm. They are cylindrical, fleshy and soft penetrating the soil vertically, obliquely and horizontally. They measure from 8-17 cm. in length and 4-6 mm in thickness. Externally, it is dull-yellowish, longitudinally and transversely wrinkled. The dried root breaks with a short fracture exposing a whitish interior. It is odourless and with bitter taste.

Micromorphology:

A transverse section in the root (Fig. 2) is nearly rounded in outline. It shows an outer irregular protective tissue (epidermis and exodermis), a relatively wide parenchymatous cortex limited with a distinct endodermis and surrounding a complete ring of central stele. The stele is surrounded by a parenchymatous pericycle and encloses from 9-18

vascular bundles of alternated arcs of primary xylem and phloem on separated radii. There is a narrow parenchymatous exceptional pith in the center. Typical medullary rays are absent but conducting parenchyma of one or more layers separate the xylem and phloem. Some parenchymatous cells contain mucilage, small starch granules, raphides or isolated acicular crystals of calcium oxalate. In young root, the piliferous layer shows numerous root-hairs.

The epidermis:

It is formed of a single layer (Fig. 3) of square to subrectangular, thin-walled cells with root hairs (piliferous layer). The cells measure from 16-34 microns in width and from 20 to 45 microns in height. Hairs are unicellular and measure from 125 to 140 microns in length. In old stages, some of the epidermal cells become destroyed or rubbed off with its root-hairs and their walls become thickened and suberised.

The exodermis:

It is formed of 3 to 6 rows of irregularly arranged suberised cells. The cells are thickened with thick pitted walls, pits are elongated and thus giving the cells a reticulate appearance. They measure from 17-35 microns in width and 34-50 microns in height.

The cortex:

It is wide and consists of a polygonal isodiametric to rounded thin walled parenchyma. Many cells contain masses of mucilage which stain red with Ruthenium red (T.S). Few small rounded, single and compound (2 to 3 components) starch granules are scattered in some parenchyma and measure from 3-15 microns in diameter. Raphides and acicular crystals of calcium oxalate are of common occurrence and measure about 35-45 microns in length.

The Endodermis:

It is a distinct layer consisting of square to sub-rectangular cells measuring from 25-35 microns in width and 21-41 microns in height.

The stele:

The stele (Fig. 2 and 3) includes about 9-18 alternated arcs of primary xylem and phloem. The pericycle which is parenchymatous marks the outermost rows of the stele. The phloem is well marked, situated near the periphery of the vascular cylinder and consists of sieve tubes and companion cells. The xylem is polyarch, composed of radial groups with the protoxylem towards the periphery of the stele. It comprises wood parenchyma and lignified vessels with spiral and reticulate thickenings and measuring 15 to 40 microns in diameter.

The pith:

The pith is a small central zone formed of thin cellulosic, parenchyma containing few starch granules which are closely identical with those of the cortex in all aspects.

The powder:

Powdered root is dark brown in colour, with a faint odour and a bitter mucilagenous taste. It shows:

- 1- Fragments of brown polygonal, subrectangular cells of epidermis, usually ruptured.
- 2- Fragments of exodermis consisting of irregular cells with suberised pitted walls.
- 3- Parenchymatous cells from the cortex containing minute starch granules, masses of mucilage and acicular crystals or raphides of calcium oxalate.
- 4- Lignified vessels with spiral and reticulate thickenings.

- 5- Few starch granules usually simple and scattered prisms of calcium oxalate in the field.
- 6- Few fragments of unicellular, non-glandular root hairs.

B- The Corm

Macromorphology:

The corm (Fig. 1) is a short, swollen vertical underground stem with shortened internodes. It is covered with brown membranous scale-leaves and bears numerous adventitious roots arising at the nodes. It has a large apical bud and small axillary ones. It varies in size from 3 to 5 cm. in length and 2 to 3 cm. in diameter. The outer surface is rough and dark brown in colour while the interior is white. It is brittle and breaks with short fracture. It has a bitter taste and a faint odour.

Micromorphology:

A transverse section in the corm (Fig.4) is nearly rounded in outline, somewhat irregular with some depressions. The three tissue systems, the epidermal, the fundamental and the vascular, are clearly distinguished. It shows an epidermis which is always intact except in the regions of adventitious roots where the tegumentary tissue consists of an outer zone of irregularly arranged cells produced by the suberisation of the cells of the ground parenchyma and an inner zone of storied cork. The bundles are scattered throughout the ground tissue. They are closed, collateral with the larger ones partially enclosed in a sheath of sclerenchyma. Some of the parenchyma contain starch granules, others contain raphides or acicular crystals of calcium oxalate. Many cells contain mucilagenous masses.

The tegumentary tissue:

In young corm, the epidermal cells are polygonal, isodiametric, sometimes axially elongated with more or less straight anticlinal walls and measure from 15 to 28 microns in height, 20 to 35 microns in width and 35 to 90 microns across. Around the root scars and in old corm the tegumentary tissue consisting usually of irregularly arranged suberised cells derived from the outer layers of the ground tissue forming the metaderm, in addition to few regular layers of storied cork, but no periderm. As a general rule, the storied cork originates, as in most cotyledones, by tangential division of the cells of the ground tissue, but with no cork cambium. Thus, the cork arises without the formation of initial layer or phellogen. The metaderm cells are irregular, polygonal in surface view with thick brownish walls.

The ground tissue:

It consists of ordinary thin-walled parenchymatous cells through which the vascular bundles are scattered, The cells are packed with starch granules which are closely identical with those present in the cortex of the root.

Many cells contain masses of mucilage, others contain bundles of raphides and isolated acicular crystals of calcium oxalate.

The vascular system:

It is represented by numerous closed, collateral vascular bundles traversing the ground tissue (Fig. 4) and widely separated from each other. They are generally more crowded and smaller towards outside but larger in size and fewer in number in the center. Each bundle consists of a group of 3 to 7 lignified vessels and a batch of phloem and enclosed in a sheath of pericycle. The pericycle of the small bundles is parenchymatous but in the large bundles it may show isolated

or small groups of fibres. The pericyclic fibres are lignified with moderately wide lumen, thick walls and acute to rounded apex and measuring from 10 to 20 microns in diameter and 700 to 1000 microns in length. The xylem vessels show spiral, scalariform and pitted thickenings and measure from 10 to 25 microns in diameter. The phloem consists of sieve tubes and companion cells.

The powder:

The powdered corm is buff to brown in colour, having a faint odour and a slightly bitter taste. It shows:

- 1- Fragments of brown, lignified tangentially elongated cells of storied cork.
- 2- Lignified vessels with spiral, reticulate and pitted thickenings.
- 3- Fragments of cortical cells containing starch granules, mucilage masses and acicular crystals of calcium oxalate.
- 4- Few lignified pericyclic fibres with wide lumen.
- 5- Starch granules which are simple or compound with centric hilum.

C- The Foliage Leaf

The macromorphology:

They are simple sessile and radical (Fig. 1), the lamina is broad, linear, strap-shaped with an entire margin and rounded to blunt apex. The leaf measures from 25 to 55 cm. in length and 2.5 to 3.5 cm. in width at the middle portion. The leaves are smooth, dark green in colour on both surfaces. Venation is parallel and the dry leaf is brittle, breaks with short fracture. It has a slight odour and a bitter mucilaginous taste.

The micromorphology:

A transverse section in the lamina (Fig. 5) appears crescent-shaped to concavo-convex, sometime plano-convex in

outline. It shows an upper and a lower epidermises enclosing inbetween the mesophyll. The vascular system is a parallel one being formed of closed collateral vascular bundles embedded in the homogeneous mesophyll. The spongy parenchyma contains few prisms of calcium oxalate, minute starch granules as well as masses of mucilage; the basal part of the foliage leaf shows in addition acicular crystals of calcium oxalate.

The epidermis:

The cells of both the upper and lower epidermises (Fig. 6) are polygonal, mainly axially elongated, subrectangular with straight anticlinal walls and covered with thick smooth cuticle. They measure from 137-250 microns in length, 16 to 41 microns in width and 24 to 38 microns in height. Numerous cells are filled with mucilage.

Stomata are only observed on the lower epidermis and rarely on the upper one. They are of the anomocytic type, usually surrounded by 4 epidermal cells and measuring about 60 to 140 microns in length and 18 to 50 microns in diameter. Epidermal trichomes are absent.

The mesophyll:

It is homogeneous and the palisade is not pronounced. No hypodermal collenchyma are observed. The spongy tissue is formed of several rows of parenchyma with wide intercellular spaces.

The endodermis and cells surrounding it are rounded to subrectangular parenchyma containing starch granules and forming a starch sheath around the vascular bundles. The starch granules are closely identical with those present in the root and corm in all aspects.

Many cells of the mesophyll contain mucilagenous masses or prisms of calcium oxalate. No lacunae are present in the mesophyll between the vascular bundles (C.f. many members of the family Amaryllidaceae).

The vascular system:

It is represented (Fig. 5) by several radially elongated, closed, collateral vascular bundles. Each vascular bundle shows a parenchymatous pericycle surrounding it. The pericycle shows 2 arcs, the upper arc is larger than the lower one but on the other sides of the bundle the pericycle is reduced to one or rarely two rows. The xylem forms a group or a radial row of about 5 to 12 lignified vessels having spiral, rarely annular or scalariform thickenings. The vessels are surrounded by small, thin-walled, non-lignified wood parenchyma. The phloem forms a batch below the xylem elements and is formed of soft cellulosic elements.

The powder:

The powdered leaf is green in colour, having a slight odour and a bitter taste. It shows:

- 1- Fragments of the epidermis with smooth cuticle and straight anticlinal walls. Some fragments show anomocytic stomata and contain mucilage masses.
- 2- Greenish fragments of the mesophyll consisting of thin-walled rounded sometimes oval chlorenchymatous cells.
- 3- Fragments of cortical tissue containing mucilage masses, starch granules and prismatic or acicular crystals of calcium oxalate .
- 4- Vessels with spiral and annular thickenings.
- 5- Absence of trichomes, sclereides, fibres and reticulate vessels.

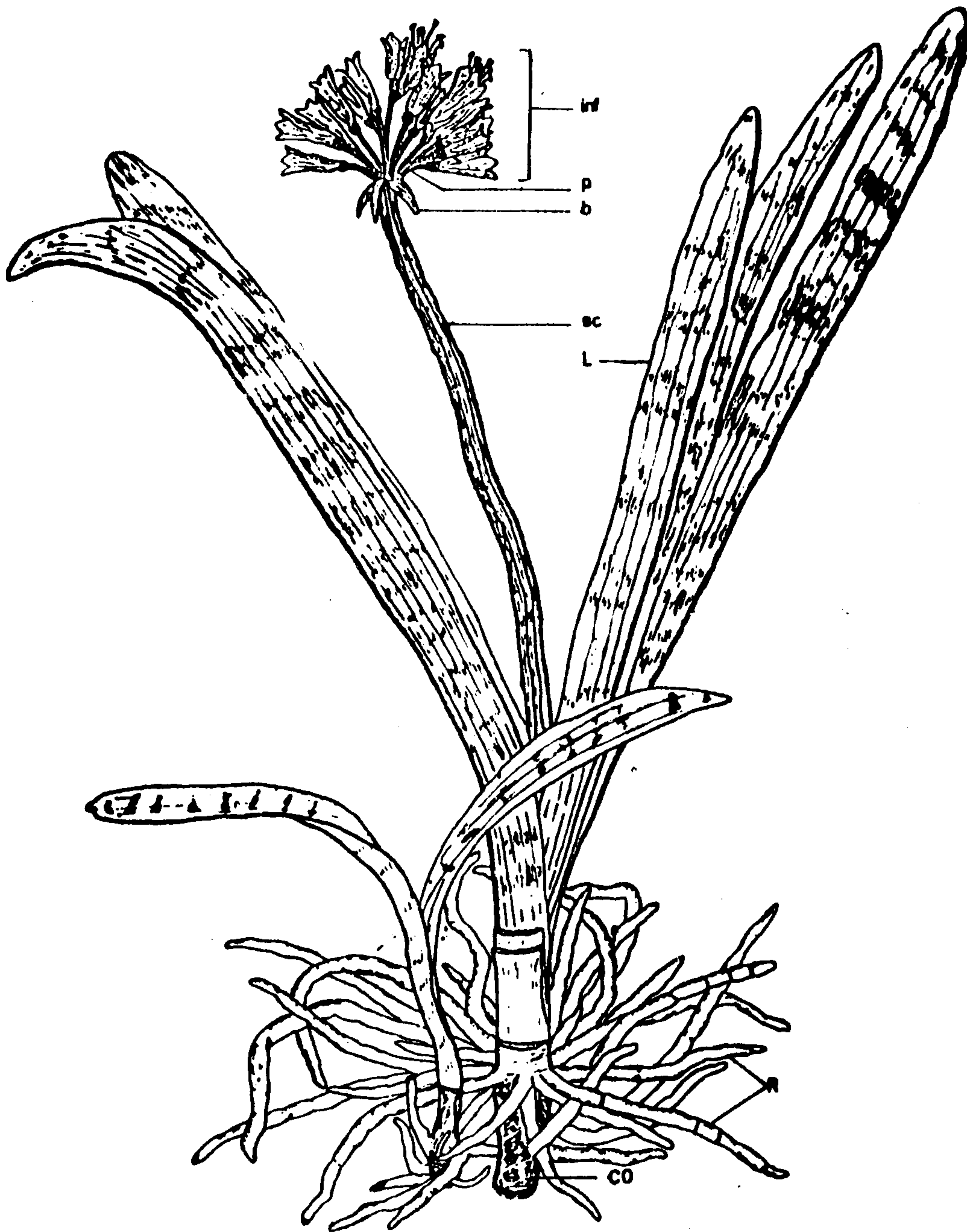


Fig. 1- Sketch of Clivia Miniata Regel

X 1/3

inf., inflorescence; p., pedicel; b., bract; sc., scape;
L., leaf; R., Root; Co., Corm.

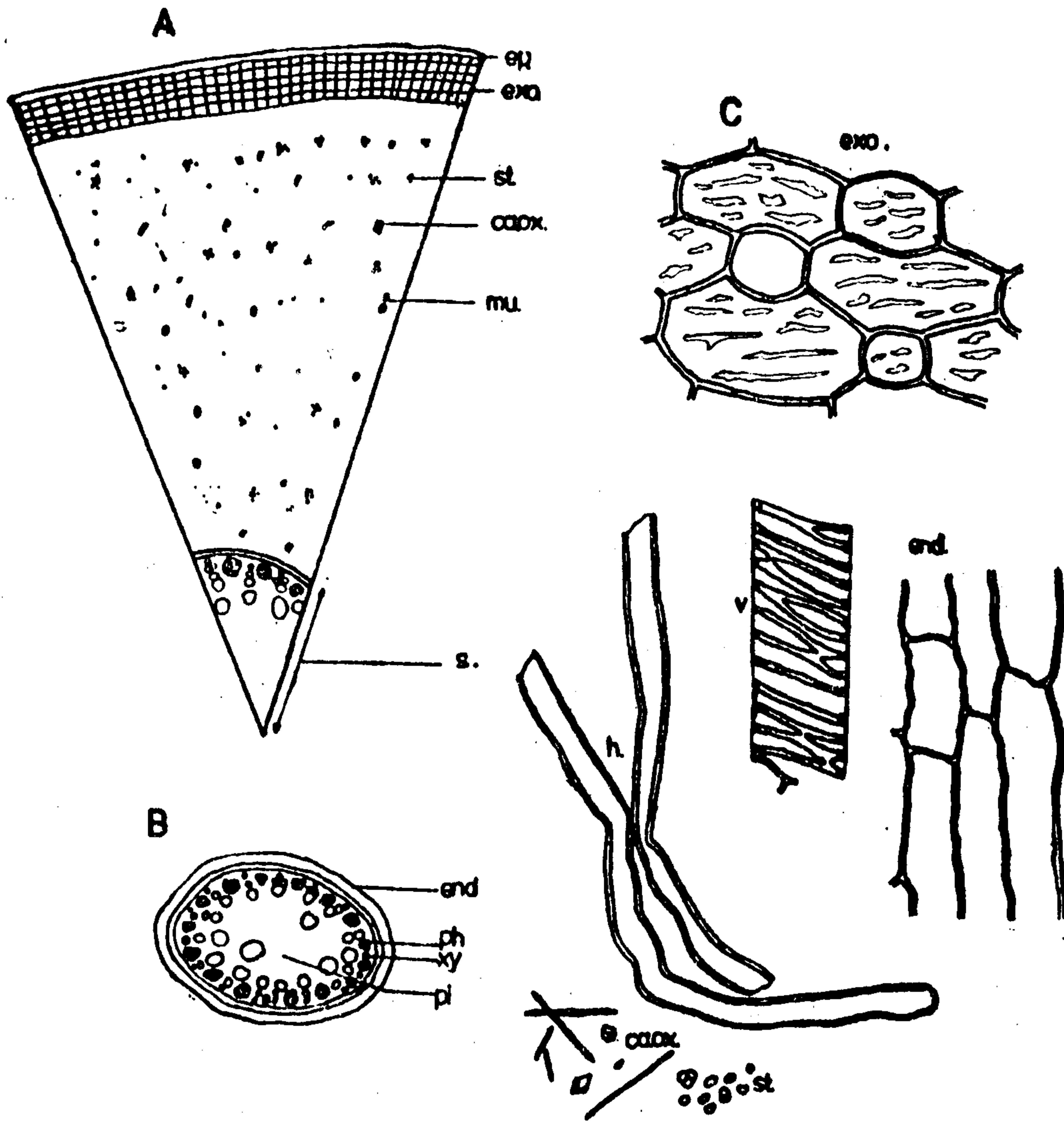


Fig. 2- The Root

- A- Diagrammatic T.S. in the root X 24
- B- Diagrammatic T.S. in the stele X 24
- C- Isolated elements X 135

ep., epidermis; exo., exodermis; st., starch granule; Ca. Ox., calcium oxalate; mu., mucilage; V., vessel; end., endodermis ; ph., phloem; xy., xylem; pi., pith; h., hair; s., stele.

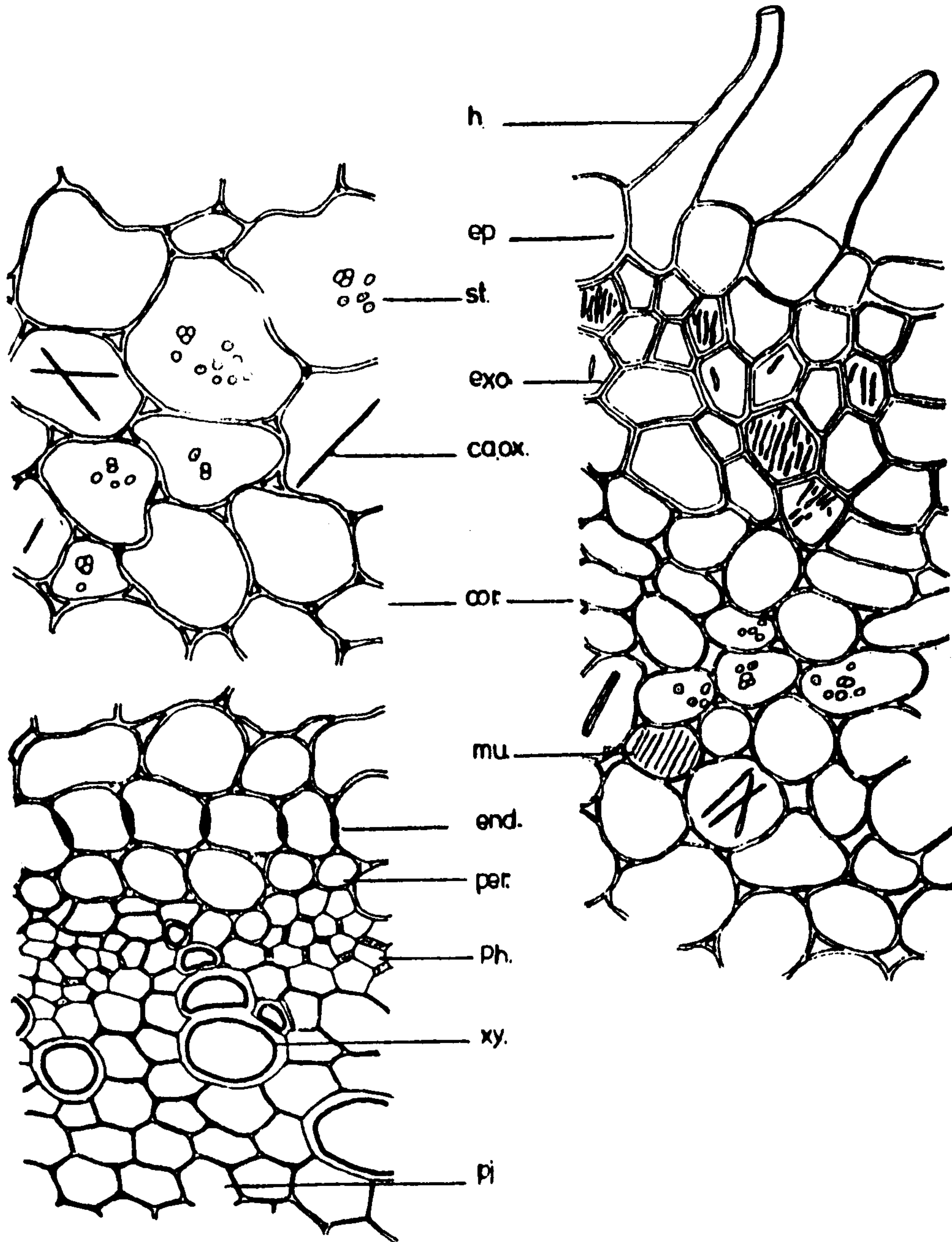


Fig. 3- Detailed T.S. in the root

X 135

h., hair; ep., epidermis; st., starch granule; exo., exodermis;
 Ca. Ox., calcium oxalate; cor., cortex; mu., mucilage; end.,
 endodermis; per., pericycle; ph., phloem; xy., xylem; pi., pith.

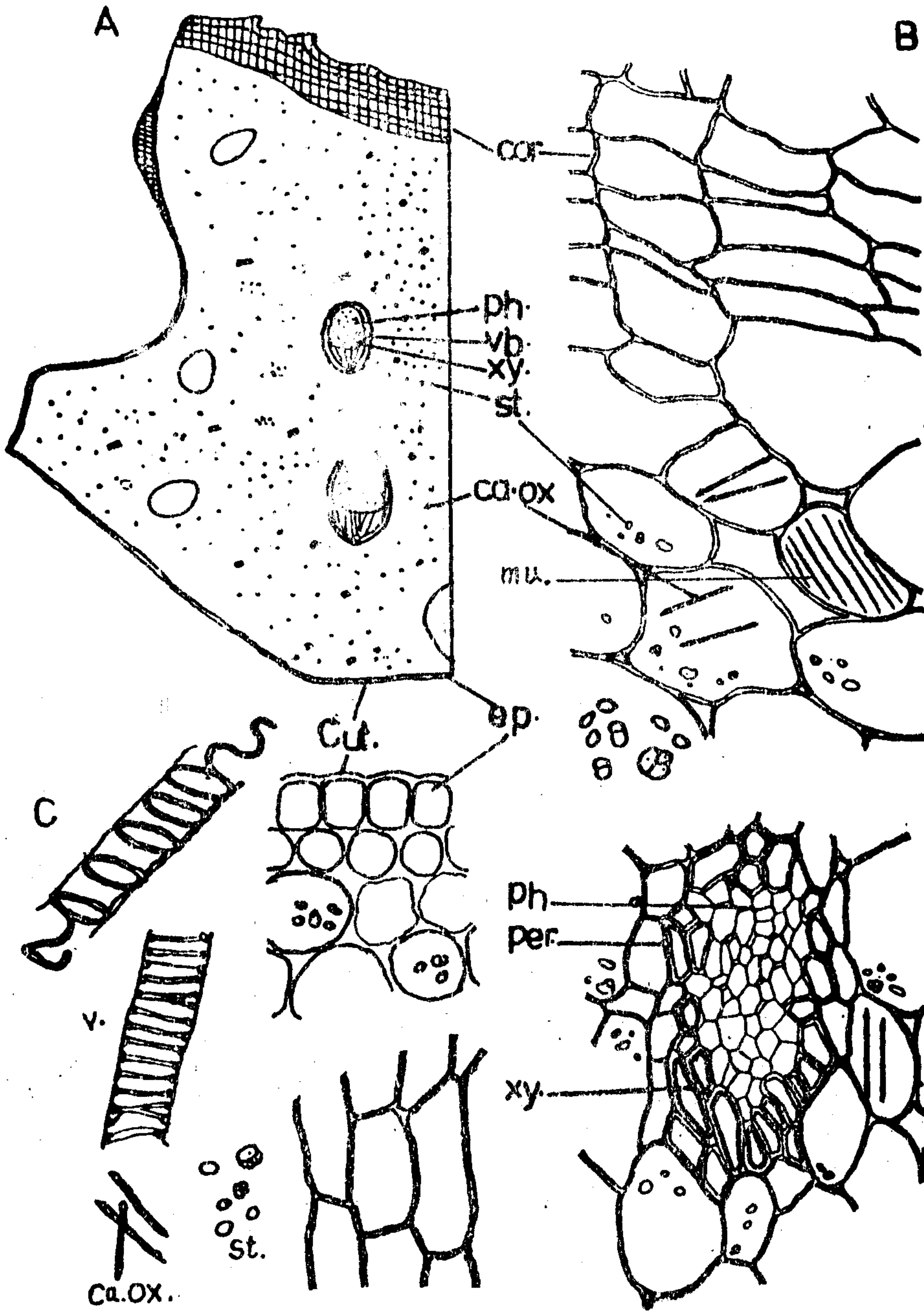


Fig. 4- The Corm
 A- Diagrammatic T.S. in the corm X 36
 B- Detailed T.S. in the corm. X 135
 D- Isolated elements X 135

cor., cork; ph., phloem; v.b., vascular bundle; xy., xylem; st., starch granule; Ca. Ox., Calcium oxalate; ep., epidermis; cut., cuticle; per., pericycle; mu., mucilage.

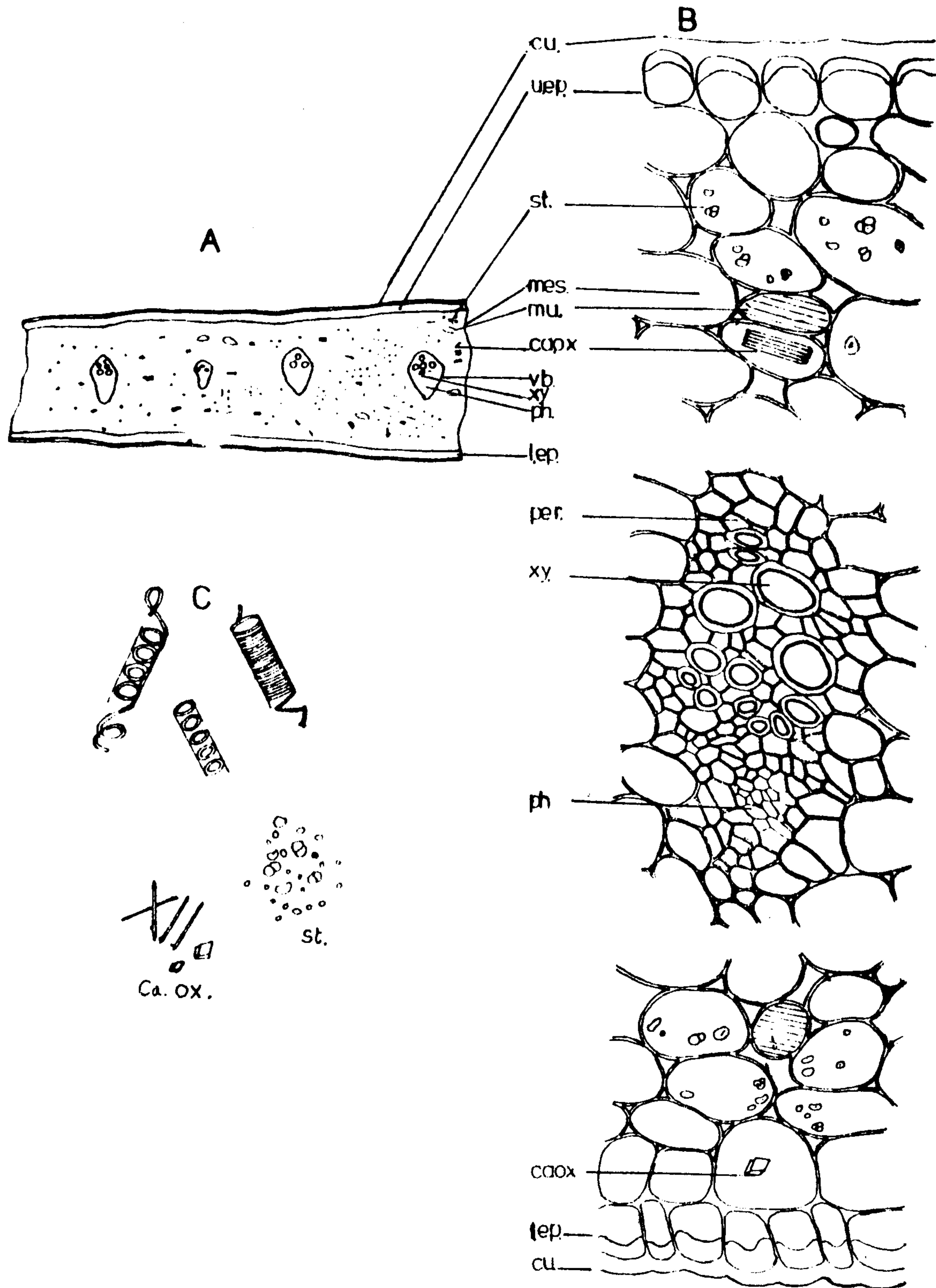


Fig. 5- The Foliage Leaf
 A- Diagrammatic T.S. in the foliage leaf
 B- Detailed T.S. in the foliage leaf
 D- Isolated elements

X 24
 X 135
 X 135

cu., cuticle; u. ep., upper epidermis; st., starch granule;
 mes., mesophyll; Ca. Ox., Calcium oxalate; v. b., vascular bundle;
 xy., xylem; ph., phloem; L. ep., lower epidermis; per., pericycle.

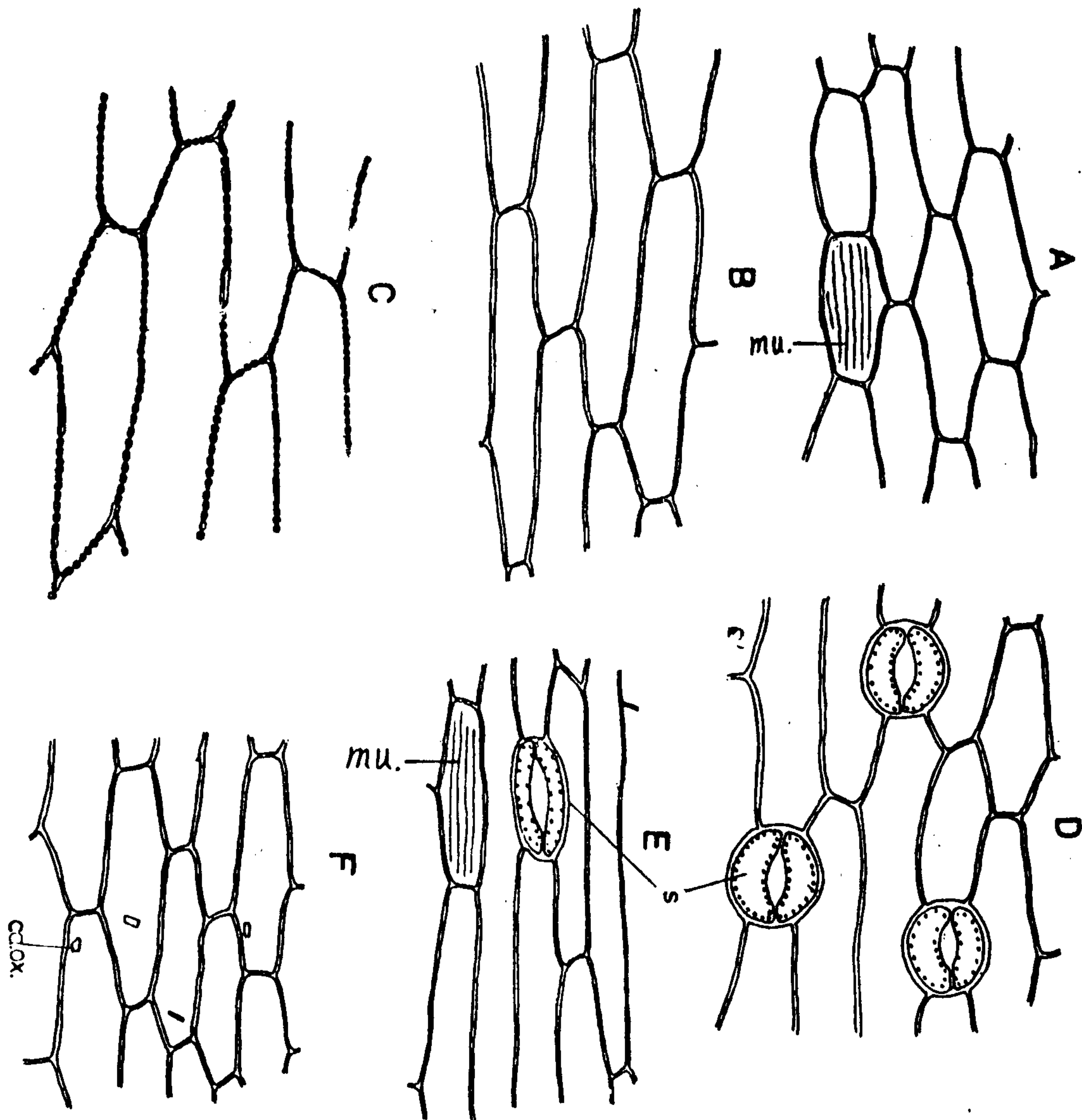


Fig. 6- Surface view of the upper and lower epidermis of the foliage leaf.

A- Apical region of the upper epidermis	X 135
B- Middle region of the upper epidermis	X 135
D- Basal region of the upper epidermis	X 135
C- Apical region of the lower epidermis	X 135
E- Middle region of the lower epidermis	X 135
F- Basal region of the lower epidermis	X 135

Ca. Ox., calcium oxalate; S., stomata; mu., mucilage.

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الصفات العيانية والمجهريّة لنبات الكليفيا منياتا (ريجل)
المنزوع في مصر

الجزء الاول : الجذر والكورمة والورقة

احمد محمد المغازي - احمد عبد الرحمن على - سمير انيس روس - صفا احمد محمد المغازي

نبات الكليفيا منياتا (ريجل) هو احد نباتات الفصيلة المعمرة الدائمة الخضرة ويتبع العائلة النرجسية وترجع اهمية هذه العائلة الى كونها غنية بالمواد الطبيعية ذات المفعول الواسع المدى والتي غالباً ما كانت تستعمل في علاج الاورام الحميدة والخبيثة منذ عهد ابوقسرة وفي السنوات الاخيرة وجد ان بعض نباتات العائلة النرجسية ومن بينها نبات الكليفيا منياتا (ريجل) لها اثر فعال في مقاومة فيروس شلل الاطفال .

يشتمل هذا البحث على دراسة الصفات العيانية والمجهريّة لجذر وكورمة وورقة نبات الكليفيا منياتا (ريجل) الذي ينزوع في جمهورية مصر العربية بهدف التعرف على جذور وكورمات واوراق هذا النبات صحيحة كانت او على هيئته مسحوق .