

MACRO AND MICROMORPHOLOGY OF PANCRATIUM  
SICKENBERGI ASCH. ET SCHWEINF. EX BOISS  
GROWING IN EGYPT

PART I: The Root, Bulb and Leaf

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ABSTRACT

The macro and micromorphology of roots, bulbs and leaves of *Pancratium sickenbergi* Asch. et Schweinf. ex Boiss growing in Egypt are presented with the view of determining the diagnostic features by which each organ can be identified in the entire and powdered form.

INTRODUCTION

*Pancratium sickenbergi* Asch. et Schweinf. ex Boiss (Fam: Amaryllidaceae) is a perennial herb grows wild in Egypt<sup>1</sup>. It is also cultivated in many common and private gardens for its beautiful flowers. The plant is known in arabic as Bosseil, Aysalaan and Batn El-Hayya<sup>1</sup>.

The family Amaryllidaceae has been and still constituting a wide field of investigation in plant chemistry. This is due to the fact that crude preparations obtained from several genera of this family have been used in the treatment of tumours<sup>2</sup>, syphilis, scorfula<sup>3</sup>, piles, jaundice, asthma

and diarrhoeia<sup>4</sup>. Recently a large number of alkaloids have been isolated and identified. Lycorine, which is a common alkaloid in this family was found to exert an antiviral activity against the polyomyelitis virus<sup>5,6,7</sup>.

Pancregium sickenbergi Asch. et Schweinf. ex Boiss. was subjected to several phytochemical investigations. Its alkaloid<sup>8,9,10,11</sup>, protein, lipid and carbohydrates contents were reported<sup>11</sup>.

As regard to the micromorphology of Pancregium sickenbergi Asch. et Schweinf. ex Boiss. nothing could be traced in the literature while very little is known about its macro-morphology<sup>1,12</sup>. In the present work, the macro-as well as, micromorphological features of the root, bulb and leaves of Pancregium sickenbergi Asch. et Schweinf. ex Boiss are presented.

#### Material :

The material was obtained from plants cultivated in the Experimental Station of Medicinal Plants, Faculty of Pharmacy, Assiut University, Assiut, Egypt. The plant was identified by late Prof. Dr. Vivi Tackholm, Prof. of Taxonomy, Faculty of Science, Cairo University.

Fresh material as well as preserved in alcohol 70% containing 5% glycerin were used. For the study of powder, the roots, bulbs and leaves were air dried and powdered (No. 36).

#### Habitat:

Pancregium sickenbergi Asch. et Schweinf. ex Boiss. (Fig.1) is a perennial herb showing a tunicated single bulb and attaining a height of 25-40 cm. The aerial portion is com-

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posed of 3-6, linear, greyish-green, 20-35 cm long, conspicuously spirally twisted leaves and a peduncle, much shorter than the leaves carrying 3-6 flowers in an umbel-like inflorescence. The underground portion is composed of a conical-shaped tunicated bulb and an adventitious fibrous root system attached to the solid disc-like stem of the bulb. The plant flowers in August.

#### A- THE ROOT

##### Macromorphology:

The roots (Fig.1) are typically adventitious completely enveloping the flattened discoid underground stem of the bulb. They are cylindrical, fleshy and soft, penetrating the soil vertically, obliquely and horizontally. They measure from 5-20 cm in length and 0.2-0.4 cm in thickness. From the root arise several lateral fibrous rootlets, which never exceed the main root in diameter or length. The surface of the fresh root is mostly longitudinally, rarely transversely wrinkled. The young roots are white in colour while old ones are pale brown. The dried root breaks with a short fracture exposing a whitish interior. It has a slight odour and mucilaginous, disagreeable acrid and bitter taste.

##### Micromorphology:

A transverse section in the root (Fig. 2, A & B) is nearly rounded in outline. It shows an outer irregular pale brown protective tissue consisting of ruptured epidermis and exodermis, a wide parenchymatous cortex traversed in the upper

region by a layer of collapsed cells and limited with a distinct endodermis which surrounds a complete ring of central small stele. The stele is surrounded by a parenchymatous pericycle which encloses from 8-14 closed vascular bundles of alternated arcs of primary xylem and phloem of separated radii. There is a narrow parenchymatous exceptional pith surrounding the hollow centre. The stele constitutes about  $\frac{1}{5}$  to  $\frac{1}{7}$  of the whole diameter of the root. Typical medullary rays are absent but conducting parenchyma of one or more layers separate the xylem and phloem groups are observed.

The epidermis (Fig. 2,X) consists of a single layer of ruptured brown cells with thickened lignified walls measuring 95-190  $\mu$  in length and 50-90  $\mu$  in width, some of the sub-epidermal parenchyma of the ground tissue become thickened forming the exodermis.

The exodermis (Fig. 2,C) is formed of 3 to 6 rows of irregularly arranged cells with lignified walls. The cells are polygonal, somewhat tangentially elongated, measuring 50-120  $\mu$  in width and 45-80  $\mu$  in height.

The cortex (Fig. 2,C) is comparatively very wide and comprises a broad region of isodiametric, rounded to polygonal thin-walled parenchyma with almost wide intercellular spaces. The outer region of the cortex is traversed by a layer of 5 to 8 rows of tangentially elongated, narrow, thin-walled parenchymatous cells. With the exception of the layer of narrow cells, the majority of the cortical parenchyma are packed with starch granules and many cells contain masses of mucilage which stain red with ruthenium red solution, blue with methylene blue, but do not stain red with corallin soda.

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They give granular precipitate with lead subacetate test solution. The starch granules are mainly simple and some are compound of 2 to 3 components. Simple granules are mostly rounded or oval with a distinct, centric hilum appearing as a point, cleft or radiating fissure. They measure 7-50  $\mu$  in diameter. Raphides as well as isolated single acicular crystals of calcium oxalate are scattered in the parenchyma of the cortex and measure 60-110  $\mu$  in length.

The endodermis (Fig. 2,C) consists of small usually square to subrectangular cells, with lignification on the tangential and radial transverse walls. The cells measure from 30-70  $\mu$  in width and 30-60  $\mu$  in height.

The stele (Fig. 2,B & C) includes about 8-14 alternated arcs of primary xylem and phloem. The pericycle constitutes the outermost one to two rows of the stele. It consists of small, cellulosic, thin-walled parenchyma, free of contents and usually compressed by the xylem groups. The phloem is represented by shining small radial, oval areas consisting of sieve tubes and companion cells. The xylem is polyarch, composed of radial groups with protoxylem towards the periphery of the stele. It comprises wood parenchyma and lignified vessels with annular, spiral, reticulate and scalariform thickenings, measuring 20-150  $\mu$  in diameter.

The pith (Fig. 2, C) is a small zone formed of thin cellulosic parenchyma containing starch which is closely identical with that of the cortex in all aspects. The pith surrounds a hollow centre which measures 100-150  $\mu$  in diameter.

**The Powder (Fig. 2, D, E,F,X):**

Powdered root is light to dark brown in colour, with slight odour and mucilagenous bitter taste. The diagnostic microscopical features of the powdered root are:

- 1- Fragments of brown, polygonal, subrectangular lignified cells of the remaining of epidermis which are almost ruptured.
- 2- Fragments of exodermis with polygonal, usually irregular cells with brown lignified walls.
- 3- Fragments of thin-walled parenchymatous cells from the cortex containing starch granules, masses of mucilage and acicular crystals of calcium oxalate.
- 4- Fragments of lignified vessels with spiral annular, reticulate and scalariform thickening.
- 5- Numerous free starch granules, mainly simple and some are compound of 2 to 3 components and showing a centric hilum.
- 6- Absence of sclereids and fibres.

**B- The Bulb****Macromorphology:**

The bulb (Fig. 1) is single, tunicated and conical to subrectangular in shape. It has an underground portion, embedded in the soil usually at a depth of about 6 cm and a thick long aerial neck. The basal solid disc-like stem carries the fibrous root system, the outer tunics are membranous, scaly and brownish in colour while the inner ones are

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white, fleshy, succulent and having a mucilagenous, bitter acrid taste. The bulb varies from 3.5 to 7 cm in length and 2.5 to 5 cm in diameter at the widest portion. The fleshy scales are broad, ranging from 4 to 9 cm in width and 1 to 2 mm in thickness at the middle region. They are externally marked with fine longitudinal ribs or lines representing the vascular strands. The fleshy scales have yellowish white colour and a mucilagenous, bitter taste.

Micromorphology:

A transverse section through the fleshy scale (Fig. 3 A & B) appears crescent-shaped to concavo-convex, somewhat flattened in outline. It shows an outer and an inner epidermises enclosing in between a homogeneous mesophyll, through which numerous vascular bundles are embedded and forming a single row.

The outer and inner epidermises (Fig. 3, B, C & D) consist of polygonal axially elongated cells, with nearly straight anticlinal walls and covered with smooth thin cuticle. The outer epidermal cells (Fig. 3, B & C) measure 70-170  $\mu$  in length 20-50  $\mu$  in width and 25-50  $\mu$  in height. The inner epidermis (Fig. 3, B & D) measure 60-130  $\mu$  in length, 15-40  $\mu$  in width and 35-65  $\mu$  in height.

The epidermal cells of the outermost scales of the bulb contain red pigments dissolved in the cell sap.

Trichomes and stomata are not observed.

The mesophyll (Fig. 3, B) is homogeneous and consists of several rows of thin-walled polyhedral or rounded parenchyma with wide intercellular spaces. The majority of these cells contain starch granules, mucilage or raphides as well as isolated acicular crystals of calcium oxalate which are closely identical with those of the root in all aspects.

The vascular system (Fig. 3, B & E) is represented by several closed collateral vascular bundles which are devoid of any fibres. Each vascular bundle is surrounded by a parenchymatous pericycle. The xylem consists of non-lignified wood parenchyma and lignified vessels having spiral, rarely annular or scalariform thickening, measuring 50-100  $\mu$  in diameter. The xylem usually forms a group or a radial row of 2-5 vessels. The phloem forms a batch below the xylem elements and is formed of thin walled shining sieve tubes and companion cells.

The Powder (Fig. 3, C,D,E,F,G):

The powdered fleshy scale is yellowish-white in colour with a faint odour and bitter mucilagenous taste. The diagnostic microscopical features are the following:

- 1- Numerous fragments of translucent polyhedral rounded thin walled parenchyma, many of them are packed with starch granules, mucilage and acicular crystals of calcium oxalate.
- 2- Fragments of the epidermis showing polygonal, axially elongated cells with slightly wavy anticlinal walls and covered with smooth cuticle .
- 3- Numerous free starch granules, acicular crystals of calcium oxalate and mucilagenous masses.
- 4- Vessels with spiral, annular and scalariform thickenings.
- 5- Absence of stomata, trichomes, sclereids and fibres.



*Macro and micromorphology of Paneratum sickenbergi* Asch.  
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### C- THE FOLIAGE LEAVES

#### Macromorpnology:

The foliage leaves (Fig. 1) are simple, sessile and possessing an undivided strap-shaped lamina with an entire margin and a blunt apex. The leaf measures 20-35 cm. in length and about 1 to 1.5 cm in width at the middle portion. The fresh foliage leaves are smooth, dark green in colour. The venation is parallel. The dry leaf is brittle and breaks with a short fracture. It has a slight odour and bitter mucilagenous taste.

#### Micromorphology:

A transverse section in the lamina (Fig. 4, A) appears crescent-shaped to concavo-convex in outline. It shows an upper and lower epidermises enclosing in between an isobilateral mesophyll having a single layer of palisade beneath each epidermis. In between the upper and lower palisade is the spongy tissue. The vascular system is parallel, formed of closed collateral vascular bundles embedded in the mesophyll.

The upper and lower epidermises: (Fig. 4, B, D & C) consist of polygonal, axially elongated cells, with nearly straight anticlinal walls and covered with thick smooth cuticle. They measure 290-550  $\mu$  in length, 35-75  $\mu$  in width and 35-75  $\mu$  in height.

The stomata (Fig. 4, C & D) are anomocytic, more frequent on the lower than the upper surface. They are usually oval in shape and measure 65-90  $\mu$  in length and 60-90  $\mu$  in diameter. Trichomes are not observed.

The mesophyll: (Fig. 4, A & B) is isobilateral, consisting of one layer of palisade on both sides and enclosing a comparatively wide chlorenchymatous spongy tissue. Many cells of the spongy tissue contain starch granules, mucilagenous masses or raphides as well as isolated acicular crystals of calcium oxalate which are closely identical with those present in the root and the fleshy scale in all aspects.

The vascular system: (Fig. 4, A, B & E) is represented by several radially elongated, closed, collateral vascular bundles. Each vascular bundle is surrounded by parenchymatous pericycle. 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 20-100  $\mu$  in diameter. The vessels are surrounded by small, thin walled, non-lignified wood parenchyma. The phloem forms a patch below the xylem elements and is formed of soft cellulosic elements.

The Powder (Fig. 4, C, D, E & F):

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

- 1- Fragments of the epidermis showing polygonal, axially elongated cells with nearly straight anticlinal walls. Some fragments show anomocytic stomata.
- 2- Fragments showing the mesophyll with palisade and spongy tissue which contain mucilagenous masses, starch granules and acicular crystals of calcium oxalate.
- 3- Vessels with spiral, annular and scalariform thickenings.
- 4- Numerous free starch granules, acicular crystal of calcium oxalate and mucilagenous masses.
- 5- Absences of trichomes, sclereids and fibres.

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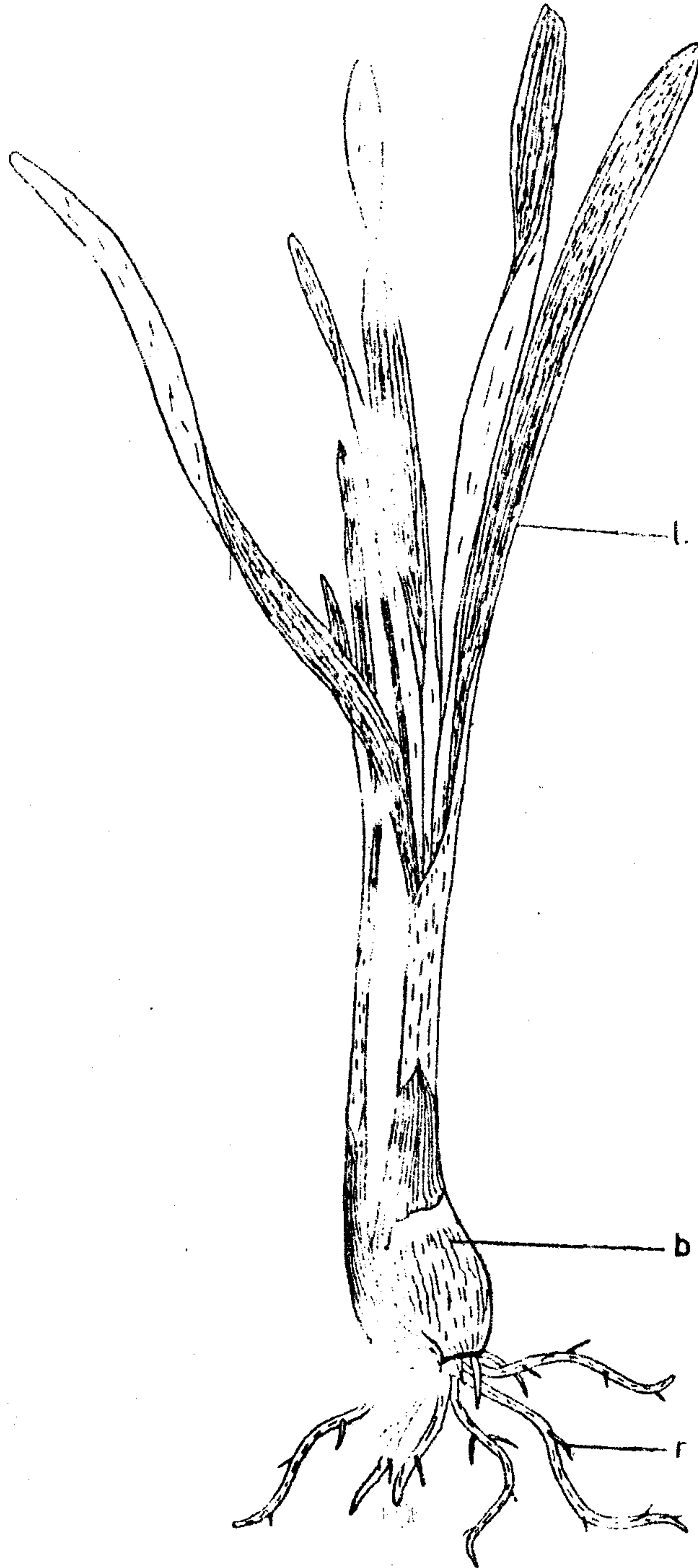


Fig. 1: Sketch of *Panocratium sickenbergi* Asch. et Schweinf. ex Boiss. X 4/5  
b., bulb; l., foliage leaf; r., root.

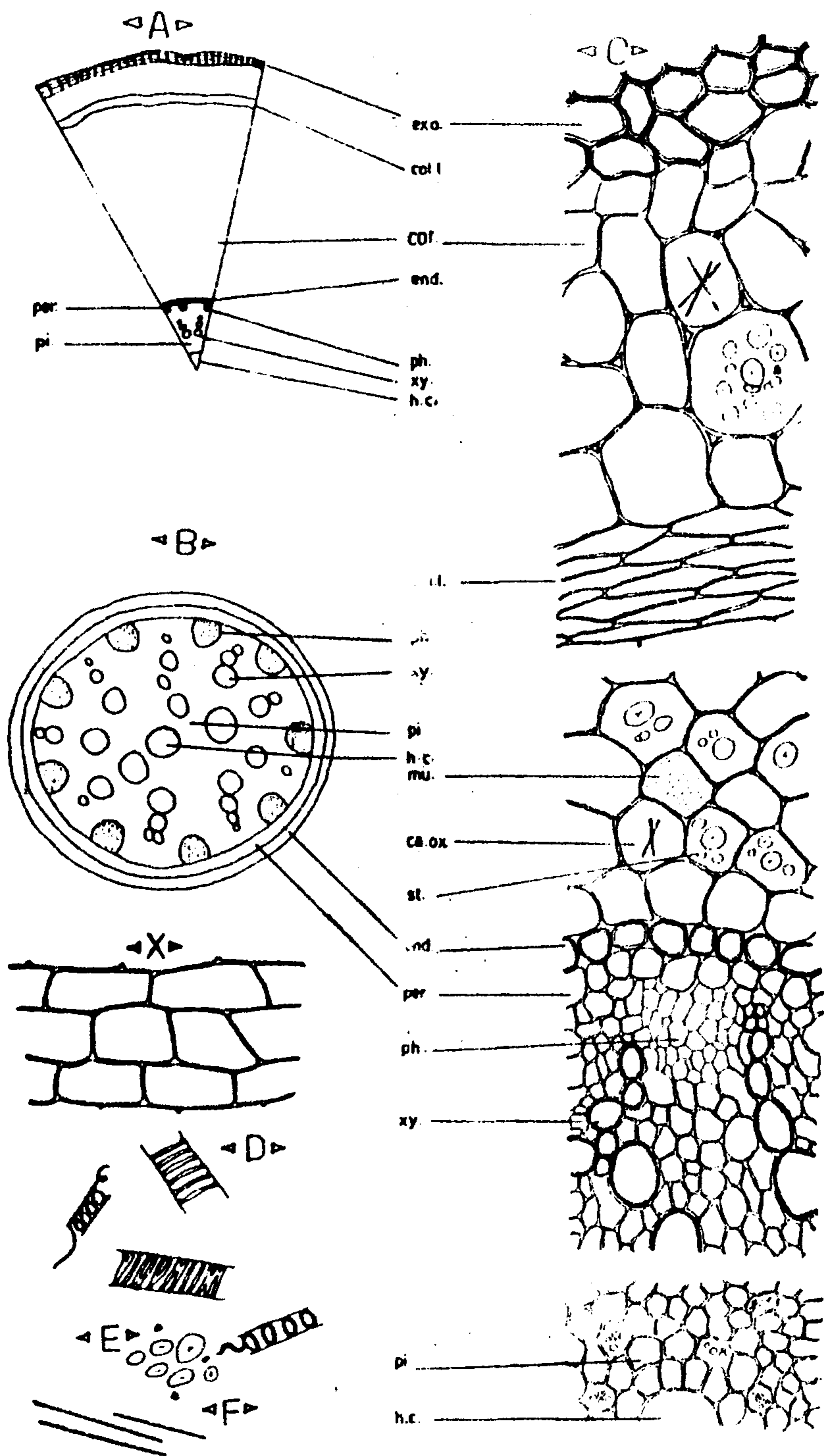


Fig. 2: The Root.

- |                                      |       |
|--------------------------------------|-------|
| A- Diagrammatic T.S. in the root     | X 15  |
| B- Diagrammatic T.S. in the stele    | X 48  |
| C- Detailed T.S. in the root         | X 125 |
| D- Vessels                           | X 125 |
| E- Starch granules                   | X 125 |
| F- Needle crystal of calcium oxalate | X 125 |
| G- Epidermis of the root             | X 125 |

ca.ox., calcium oxalate; col. l., collapsed layer; cor., cortex; exo., exodermis; end., endodermis; h.c., hollow centre; mu., mucilage; per., pericycle; ph., phloem; pi., pith; st., starch granules; xy., xylem.

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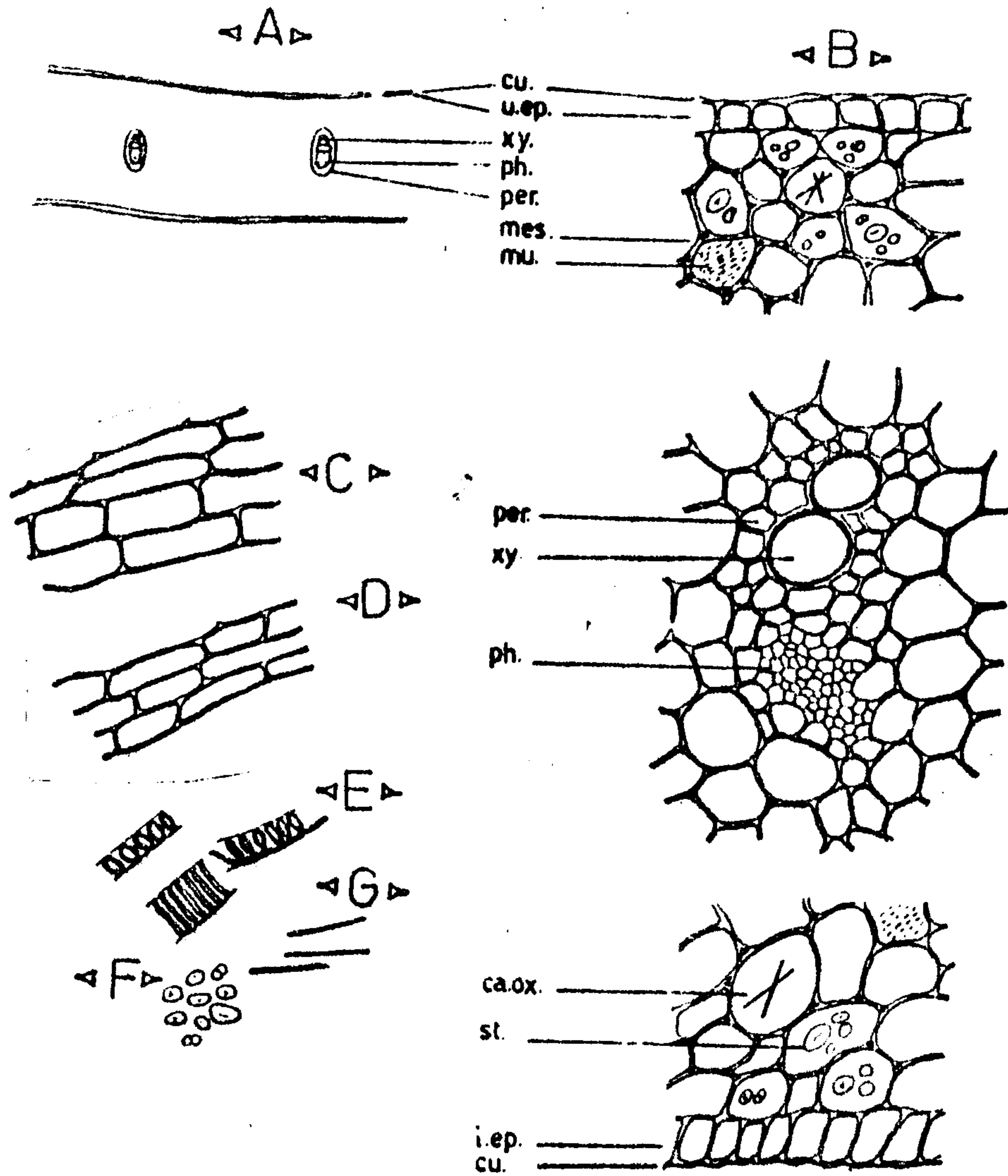


Fig. 3: The Fleshy Scale.

- |    |  |       |
|----|--|-------|
| A- | Diagrammatic T.S. in the fleshy scale. | X 18  |
| B- | Detailed T.S. in the fleshy scale      | X 160 |
| C- | Outer epidermis                        | X 160 |
| D- | Inner epidermis                        | X 160 |
| E- | Vessels                                | X 160 |
| F- | Starch granules                        | X 160 |
| G- | Calcium oxalate                        | X 160 |

ca. ox., calcium oxalate; cu., cuticle; i.ep., inner epidermis; mes., mesophyll; mu., mucilage; per., pericycle; ph., phloem; st., starch granules; u. ep., outer epidermis; xy., xylem.

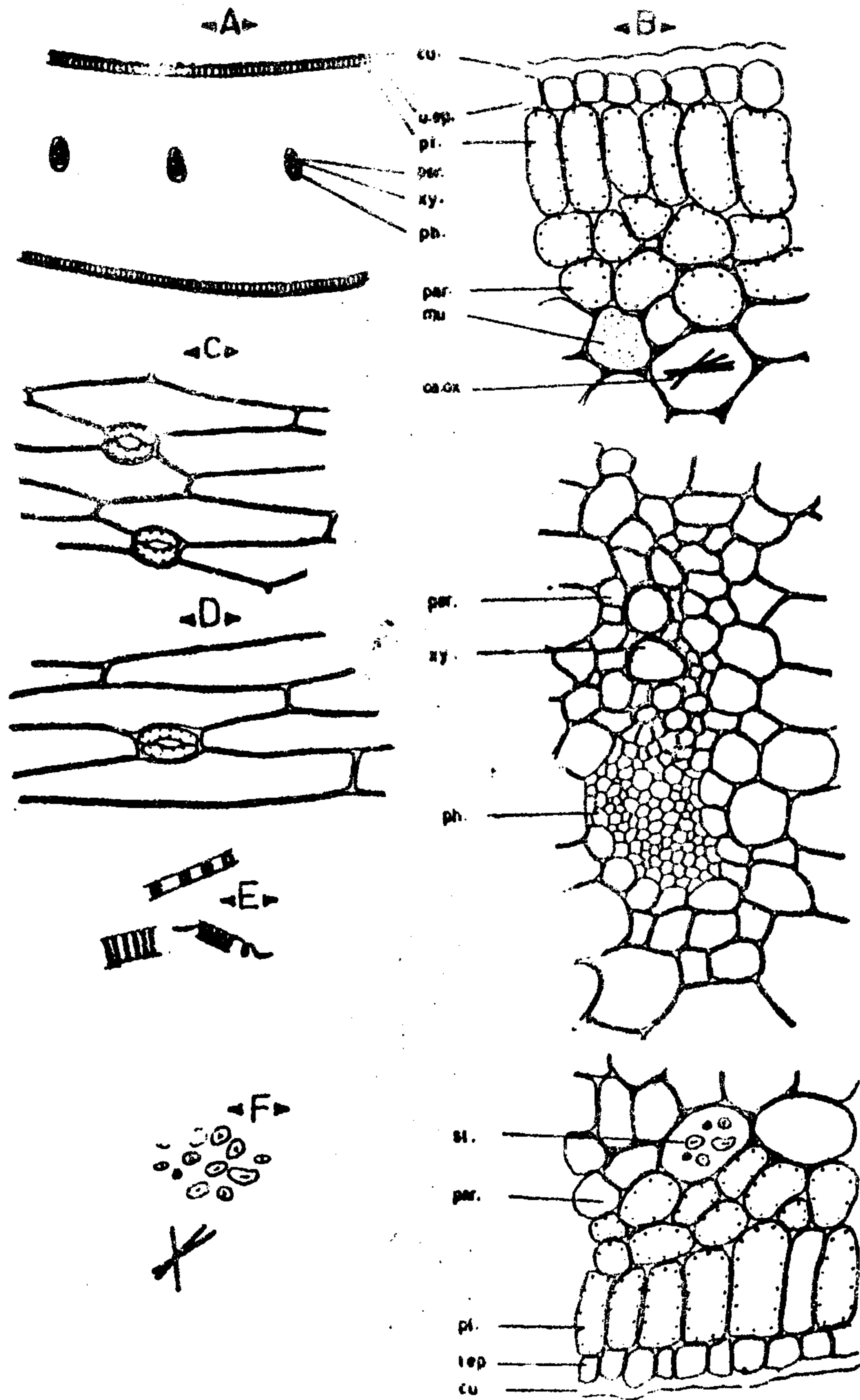


Fig. 4: The Foliage Leaf

- |    |                                       |       |
|----|---------------------------------------|-------|
| A- | Diagrammatic T.S. in the foliage leaf | X 14  |
| B- | Detailed T.S. in the foliage leaf     | X 120 |
| C- | Lower epidermis                       | X 120 |
| D- | Upper epidermis                       | X 120 |
| E- | Vessels                               | X 120 |
| F- | Starch granules and calcium oxalate   | X 120 |

ca. ox., calcium oxalate; cu., cuticle; l. ep., lower epidermis; mu., mucilage; par., parenchyma; per., pericycle; ph., phloem; pl., palisade; st., starch granules; u. ep., upper epidermis; xy., xylem.

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( بانكيرشيم سيكينبرجاي الذي ينمو

في مصر

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العربية حتى يمكن التعرف على هذه الاجزاء الهامة في حالتها  
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