

MACRO AND MICRO-MORPHOLOGY OF SOLANUM PSEUDOCAPSICUM L.  
CULTIVATED IN EGYPT

PART 1 : The Root. Stem and Leaf.

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*The macro and micro-morphology of the root, stem and leaf of Solanum pseudocapsicum L. cultivated in Egypt are presented with view of finding the diagnostic characters for their identification in the entire and powdered forms.*

Solanum pseudocapsicum L.<sup>1</sup> family Solanaceae is a common pot plant prized for its ornamental scarlet-red berries<sup>2</sup>. Preliminary phytochemical examination of this plant proved the presence of steroidal glycoalkaloids, flavonoids, sterols and/or triterpenes, carbohydrates and/or glycosides, tannins and saponins. In general, Solanum species contain steroidal glycoalkaloids<sup>3</sup> of considerable economic importance, since some of which are precursors for steroidal hormones<sup>4</sup> such as cortisone and certain sex hormones, as well as some of these steroids are potent antibacterial<sup>5</sup>, antifungal and antitumor agents<sup>6</sup>. No detailed botanical or phytochemical study is available in the literature, consequently the present work was carried out.

EXPERIMENTAL

Material:

Samples of Solanum pseudocapsicum L. were collected from the Experimental Station of Medicinal Plants of the

Faculty of Pharmacy, Assiut University, Assiut. All samples were collected at the fruiting stage.

### MACROMORPHOLOGY

*Solanum pseudocapsicum* L. is an annual herb, which attains a height of 40-70 cm.

The Root : (Fig. 1 B)

The plant has a tap root of 10-20 cm in length and 1-1.5 cm in diameter at its upper part and bearing numerous cylindrical lateral roots. The root is brownish-grey with longitudinally wrinkled surface. It is flexible and tough to break, exposing a whitish-yellow interior. The root has a slight odour and a slightly bitter taste.

The stem: (Fig. 1 A)

The stem is herbaceous, green to greenish-brown in colour cylindrical, longitudinally wrinkled and solid. It measures from 0.4-1.2 cm in diameter and bearing alternate leaves, the internodes attaining 3-6 cm. in length. The stem is flexible and tough to break exposing a yellow interior. It has a slight odour and a slightly bitter taste.

The Leaf: (Fig. 1 C)

The leaf is ovate-lanceolate, measuring from 3-6 cm in length and 1.5-2.5 cm in width. It is dark green in colour. The lamina is simple, smooth, thin and papery in touch when fresh but brittle when dry. The leaf has an entire or slightly wavy margin, showing an obtuse apex and a symmetric decurrent base. The leaf has a pinnate reticulate venation with 4-5 main lateral veins more prominent on the lower surface. The leaves are exstipulate, having a small slightly winged petioles adnating with the

stem, measuring from 0.3-0.6 cm in length and 1-2 mm. in width. The leaves have a slight odour and a slightly bitter taste.

### MICROMORPHOLOGY

#### A. THE ROOT

A transverse section in the root (Fig 2) is nearly circular in outline, with a bark occupying about one third of its diameter and surrounding a wide central wood.

The cork (Fig 3) is formed of 5-7 rows of brownish-yellow polygonal tangentially elongated cells with equally suberised walls, measuring from 40-50-70  $\mu$  in diameter. The tracheids are fusiform with blunt apices measuring from 200-250-300  $\mu$  in length and from 10-15-20  $\mu$  in diameter. The wood fibres are the main constituent elements of the xylem. They are polygonal with wide lumen and pointed apices, measuring from 400-600-700  $\mu$  in length and from 14-16-20  $\mu$  in diameter. The wood parenchyma are rectangular, usually elongated with slightly thickened, pitted lignified walls and containing few starch granules similar to those of the phelloderm. The primary xylem is diarch and detected only in very young roots. The medullary rays are narrow, mostly uniseriate, rarely biseriate. In the phloem region, they are parenchymatous and somewhat tangentially elongated while in the xylem region, they are polygonal radially elongated with pitted and lignified walls. The cells of the medullary rays contain starch granules similar to those of the phelloderm.

#### Powdered Root:

The powdered root is brownish-yellow in colour with a slight odour and a slightly bitter taste. It is characterised by the presence of the following diagnostic structures.



- 1- Fragments of brownish-yellow cork composed of thick-walled cells which are polygonal in shape.
- 2- Fragments of phelloderm with thin-walled cellulosic parenchymatous cells filled with simple rounded, oval or polygonal starch granules.
- 3- Fragments of wood tissue showing pitted, reticulate, spiral and scalariform vessels and tracheids.
- 4- Fragments of xylem fibres with wide lumen and pointed apices.
- 5- Patches of pitted, lignified medullary rays and wood parenchyma containing starch granules.
- 6- Numerous idioblasts containing microspenoidal crystals of calcium oxalate.

#### B. THE STEM

A transverse section in the stem (Fig 4) is more or less circular in outline showing an epidermis followed by a fairly wide cortex, then an endodermis followed by a pericycle surrounding a continuous ring of vascular tissues, consisting of phloem and secondary xylem with short archs of primary xylem. A parenchymatous Pith with groups of perimedullary phloem at its periphery is present in the centre. Idioblasts of microspenoidal crystals of calcium oxalate are scattered in the cortex and pith, but they are more abundant in the phloem.

The epidermis (Fig. 4 B, C) is formed of polygonal tabular cells, tangentially elongated with straight or slightly curved anticlinal walls covered by a striated cuticle and measure from 30-50-60  $\mu$  in length, 15-18-20  $\mu$  in width and 12-14-16  $\mu$  in height. Stomata are few and of the cruciferous type. They are oval in shape, measuring from 22-24-30  $\mu$  in length and from 18-20-24  $\mu$  in width. Trichomes of the glandular and nonglandular types are present, but

the glandular trichomes are more abundant. Glandular trichomes have a unicellular stalk and 4-6 celled globular or ovoid head. The stalk of the glandular hairs measures from 14-16-20  $\mu$  in length and from 7-8-12  $\mu$  in diameter. The head measures from 22-28-35  $\mu$  in length and 17-22-30  $\mu$  in width. The nonglandular hairs are multicellular, branched or nonbranched. The nonbranched type is multicellular, uniseriate, from 2-7 cells and covered by a smooth cuticle. The branched type is multicellular and the apical cells are conical in shape. The cortex (Fig. 5) is formed of 4-6 rows of collenchyma filled with chloroplasts. The collenchyma is followed by numerous rows of oval thin-walled parenchymatous cells containing few rounded, oval or polygonal simple starch granules and measuring from 3-6-10 in diameter. The innermost layer of the cortex forms a distinct endodermis, consisting of thin-walled cellulosic tangentially elongated cells containing simple starch granules similar to those of the cortex.

The pericycle (Fig. 5) is formed of thin-walled parenchymatous cells interrupted at intervals with isolated lignified fibres, rarely in groups of two or three. They are oval to rounded, with thick stratified lignified walls having a narrow lumen and a tapering apex, measuring from 600-1100-2000  $\mu$  in length and from 15-20-25  $\mu$  in diameter.

The phloem (Fig. 5) is parenchymatous with groups of sieve tissue and numerous idioblasts of microspheoidal crystals of calcium oxalate. Few starch granules are present in the phloem parenchyma.

The secondary xylem (Fig. 5) is lignified formed of vessels, few tracheids, abundant wood fibres and wood parenchyma. The vessels are pitted and measuring from 30-40-70  $\mu$  in diameter. The tracheids are fusiform, pitted, with blunt apices measuring from 200-250-300  $\mu$  in length and from 10-15-20  $\mu$  in diameter. The wood fibres have moderately thick

walls, wide lumen and pointed tips, measuring from 400-500-600  $\mu$  in length and from 10-14-18  $\mu$  in diameter. The wood parenchyma are rectangular, axially elongated with slightly thickened pitted lignified walls and containing few starch granules similar to those of the cortex. These cells measure from 30-40-60  $\mu$  in length and from 12-14-18  $\mu$  in width. The primary xylem is formed of spiral, annular and scalariform lignified vessels accompanied with unlignified wood parenchyma. Both the xylem and phloem are radially traversed by numerous mostly uniseriate, rarely biseriate medullary rays containing starch granules similar to those of the cortex. In the xylem region the cells are polygonal, radially elongated and having moderately thickened, pitted and lignified walls. In the phloem region, the cells are parenchymatous, cellulosic and somewhat tangentially elongated.

The pith (Fig. 5) is wide, parenchymatous showing numerous small groups of perimedullary phloem at its periphery, some of them is accompanied from the inner side by large fibres similar to those of the pericycle. Few simple starch granules and numerous idioblasts of microphenoidal crystals of calcium oxalate similar to those of the cortex are present.

#### Powdered Stem:

The powdered stem is yellowish-green in colour with a faint odour and a slightly bitter taste.

- 1- Abundant fragments of epidermal cells showing cruciferous stomata and covered by a striated cuticle, the anticlinal walls are straight or slightly curved.
- 2- Glandular hairs with unicellular stalk and multicellular globular or ovoid head composed of 4-6 cells and covered by a smooth cuticle.



- 3- Covering trichomes are multicellular branched or nonbranched and covered by a smooth cuticle. Nonbranched trichomes are multicellular uniseriate and composed of 2-7 cells. The apical cells are conical in shape.
- 4- Fragments of collenchymatous cells containing chloroplasts.
- 5- Few large pericyclic fibres usually isolated, with thick lignified walls, with narrow lumen and tapering apex.
- 6- Numerous idioblasts of microspenoidal crystals of calcium oxalate.
- 7- Patches of pitted, lignified medullary ray cells and wood parenchyma.
- 8- Patches of moderately thickened, lignified fibres with wide lumen and pointed tips which may be crossed at right angle by pitted lignified medullary ray cells.
- 9- Fragments of wood tissue showing pitted, scalariform, spiral annular vessels and tracheids.
- 10- Starch granules are simple, rounded, oval or polygonal.

#### C. THE LEAF

The leaf (Fig. 6 A, B) is dorsiventral with a single layer of discontinuous palisade below the upper epidermis. The midrib projects strongly on its lower side and moderately on its upper side, and is traversed by vascular strand formed of an arch of collateral vascular bundles, accompanied on the ventral side by supernumerary strands of perimedullary phloem.

A collenchymatous pericycle and a distinct starch sheath surrounding the vascular strand.

The upper epidermis (Fig. 6 C) is formed of polygonal cells with straight to slightly curved anticlinal walls, covered by a thin smooth cuticle and measure from 30-40-50  $\mu$  in length, 15-17-20  $\mu$  in width and 12-14-16  $\mu$  in height. The lower epidermis (Fig. 6 D) is formed of polygonal cells, with wavy anticlinal walls, covered by a thin smooth cuticle and measuring from 35-45-50  $\mu$  in length, 20-25-30  $\mu$  in width and 12-14-16  $\mu$  in height. Glandular and nonglandular trichomes are present on both surfaces, but they are more abundant on the lower surface. Glandular trichomes are with unicellular stalk and unicellular or multicellular globular head, other trichomes with multicellular uniseriate stalk and unicellular head. Nonglandular trichomes are similar to those of the stem. Cruciferous stomata are found on both epidermises but they are more abundant on the lower epidermis, measuring from 20-22-24  $\mu$  in length, 15-16-18  $\mu$  in width on the upper epidermis and 18-20-22  $\mu$  in length, 14-17-18  $\mu$  in width on the lower epidermis. (Stomatal Index is 11.5-12.1-13.3 for the upper surface and 16.2-17-17.7 for the lower surface. The stomatal Number is 12-14-16 for the upper surface and 18-20-22 for the lower surface).

The mesophyll (Fig. 7) is heterogenous. The palisade is formed of one row of columnar cylindrical compact cells abutting on the upper epidermis, measuring from 40-60-80  $\mu$  in length and 12-14-18  $\mu$  in diameter. The spongy mesophyll is formed of several rows of thin-walled cellulosic rounded to polygonal parenchymatous cells. The palisade ratio is 4-5-6, the vein-islet number is 13-15-18 and veinlet termination number is 9.5-13.25-17.5.

The cortical tissue (Fig. 7) is formed of subepidermal collenchyma followed by large thin-walled, rounded parenchymatous cells. The endodermis (Fig. 7) is formed of subrectangular to oval, thin-walled parenchymatous cells and



containing simple starch granules measuring from 3-6-10  $\mu$  in diameter.

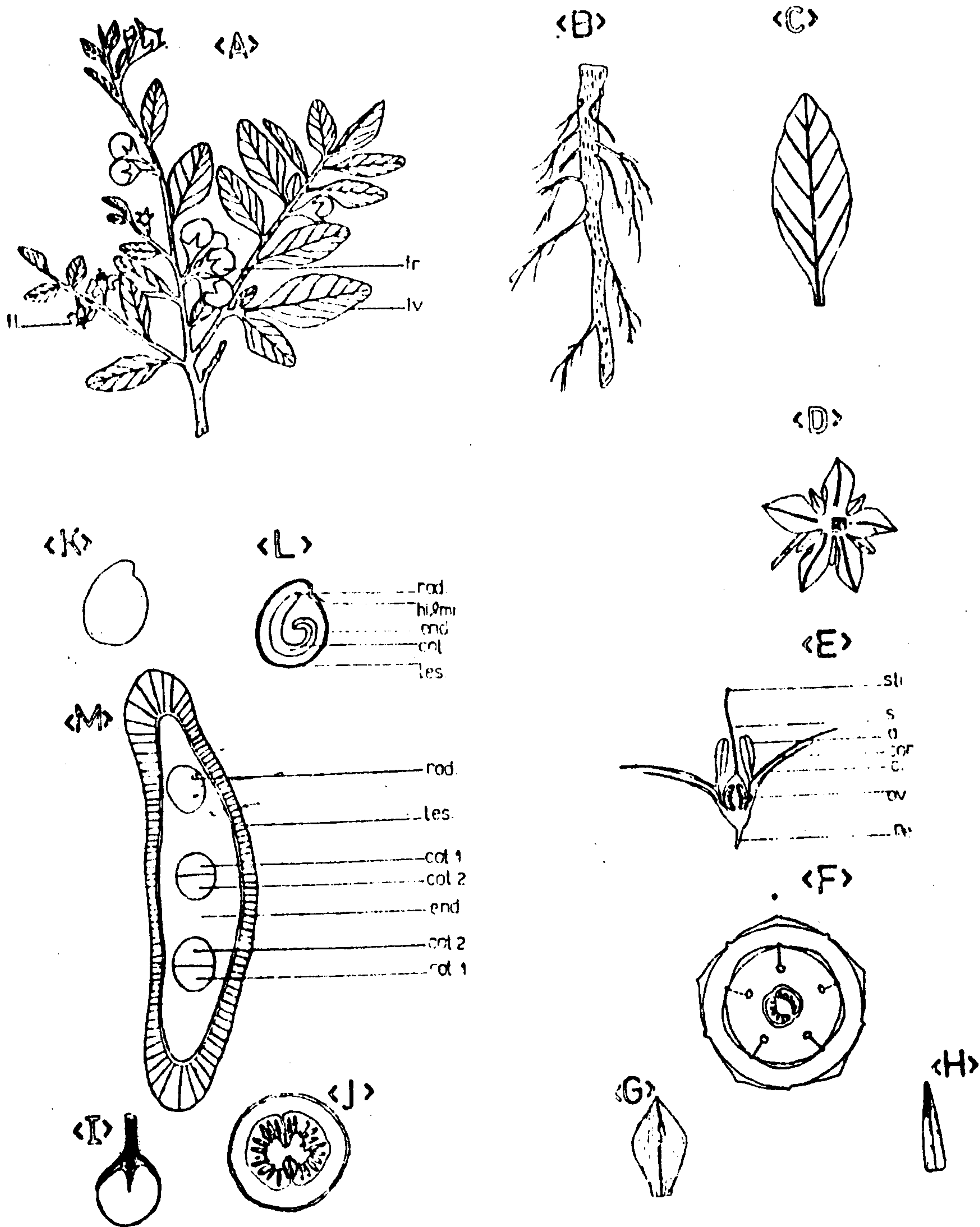
The pericycle(Fig. 7) is formed of collenchymatous cells. The phloem(Fig. 7) consists of thin-walled shining sieve tissue and phloem parenchyma. The xylem consists of several rows of spiral and scalariform lignified vessels measuring from 14-18-22  $\mu$  in diameter with groups of xylem parenchyma.

Idioblasts of microspenoidal crystals of calcium oxalate are abundant in the phloem and scattered in the mesophyll and cortical parenchyma.

Powdered Leaf:

The powdered leaf is dark green in colour with a slight odour and a bitter taste. It is characterised by the following diagnostic structures:

- 1- Abundant fragments of the upper epidermis showing straight to slightly curved anticlinal walls and covered with smooth cuticle.
- 2- Abundant fragments of the lower epidermis with wavy anticlinal walls and covered with smooth cuticle.
- 3- Cruciferous stomata, glandular hairs with unicellular stalk and multicellular head(4-6 cells) and other with unicellular stalk and unicellular globular head. Nonglandular trichomes are similar to those of the stem.
- 4- Fragments of spiral and scalariform vessels.
- 5- Fragments of parenchymatous cells containing simple rounded oval or polygonal starch granules.
- 6- Green fragments of leaves with palisade cells abutting on the upper epidermis.
- 7- Numerous idioblasts of microspenoidal crystals of calcium oxalate.
- 8-

Fig. 1: *Solanum pseudocapsicum* L.

A- Fruiting shoot	X 1
B- Root	X 1
C- Leaf	X 1
D- Flower	X 4
E- Vertical Section of the flower	X 4
F- Floral Diagram	
G- Petal	X 3
H- Sepal	X 4½
I- Fruit	X 1
J- T.cut in the fruit	X 2
K- Seed	X 10
L- L. cut parallel to the flat surface of the seed	X 10
. cut perpendicular to the flat surface of the seed	X 48

fl., flower; fr., fruit; lv., leaf; sti., stigma; s., style; a., anther; cor., corolla; c., calyx; ov., ovule; pe., pedicel; rad., radicle; hi., hilum; mi., micropyle; end., endosperm; cot., cotyledon; tes., testa.

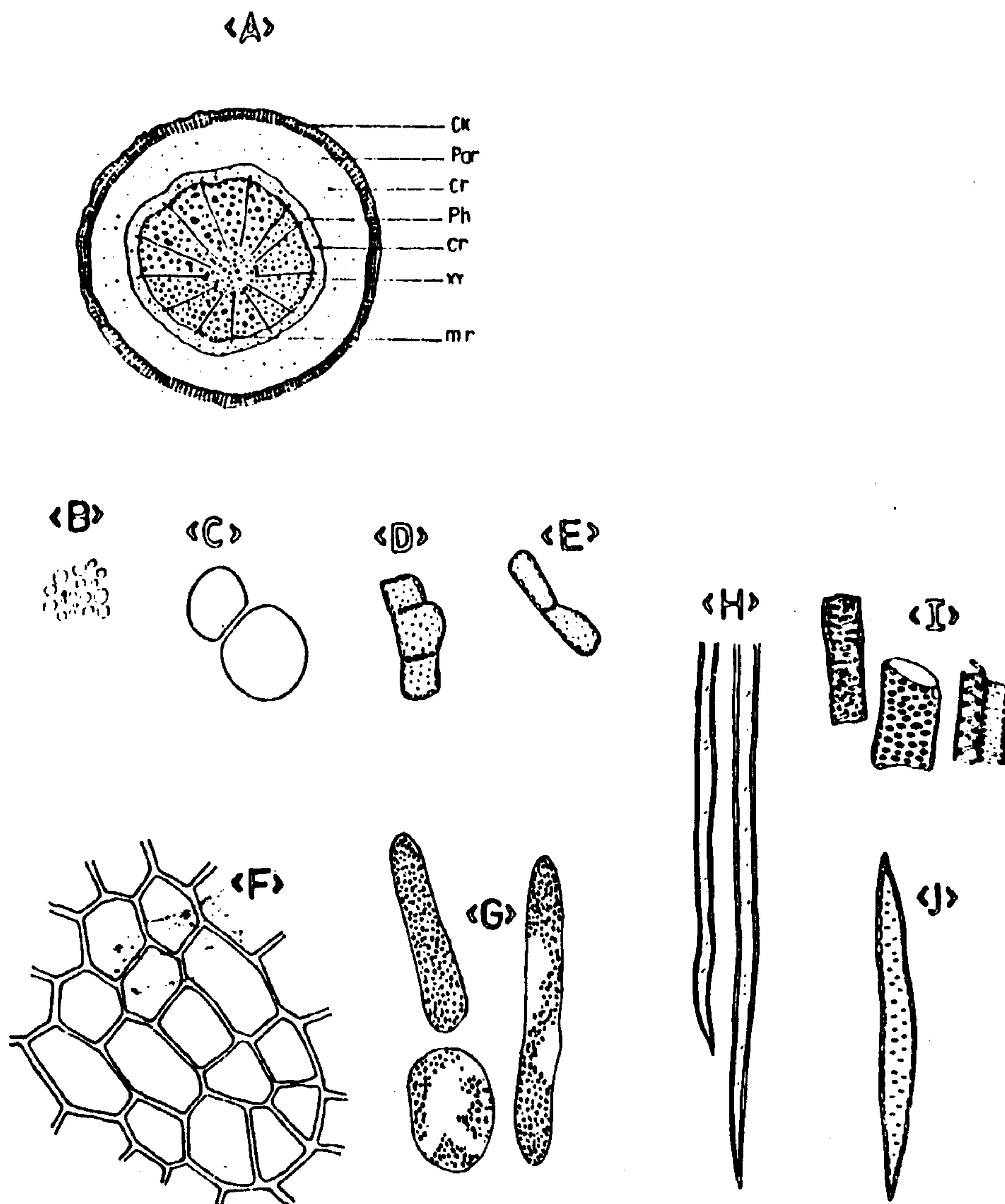


Fig. 2: The Root

A- Diagrammatic T.S. in the root	X 24
B- Starch granules	X 135
C- Parenchyma	X 135
D- Medullary ray	X 135
E- Wood parenchyma	X 135
F- Cork	X 135
G- Idioblasts of microspenoidal crystals of calcium oxalate	X 135
H- Wood fibres	X 135
I- Xylem vessels	X 135
J- Tracheid	X 135

ck., cork; par., parenchyma; cr., idioblasts of microspenoidal  
crystals of calcium oxalate; m.r., medullary ray; xy., xylem; ph.,  
phloem.



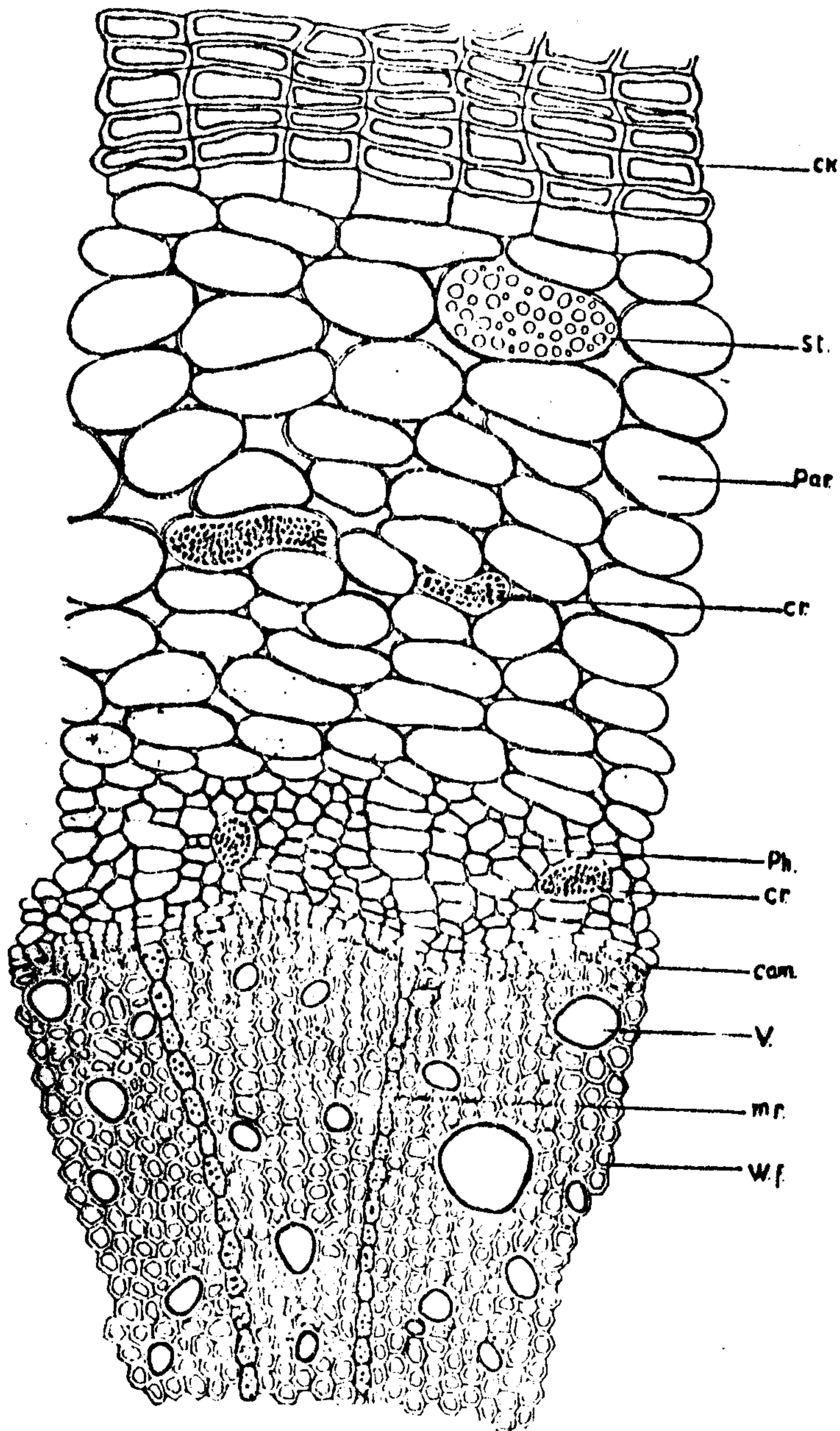


Fig. 3: Detailed T.S. in the root

X 203

ck., cork; st., starch; par., parenchyma; ph., phloem; cam., cambium; v., vessels; w.f., wood fibre; m.r. medullary ray; cr., idioblast of microsphenoidal crystals of calcium oxalate.

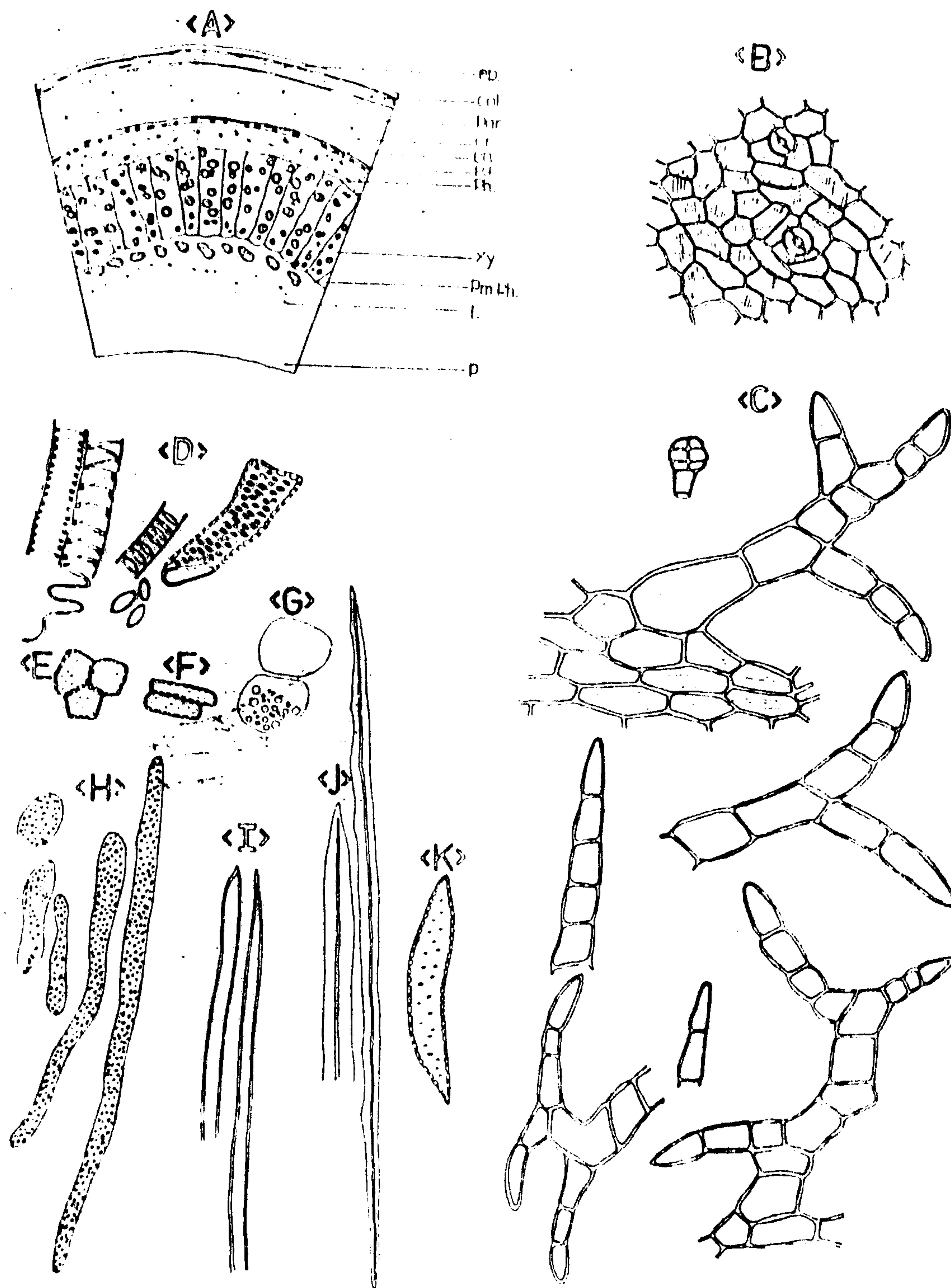
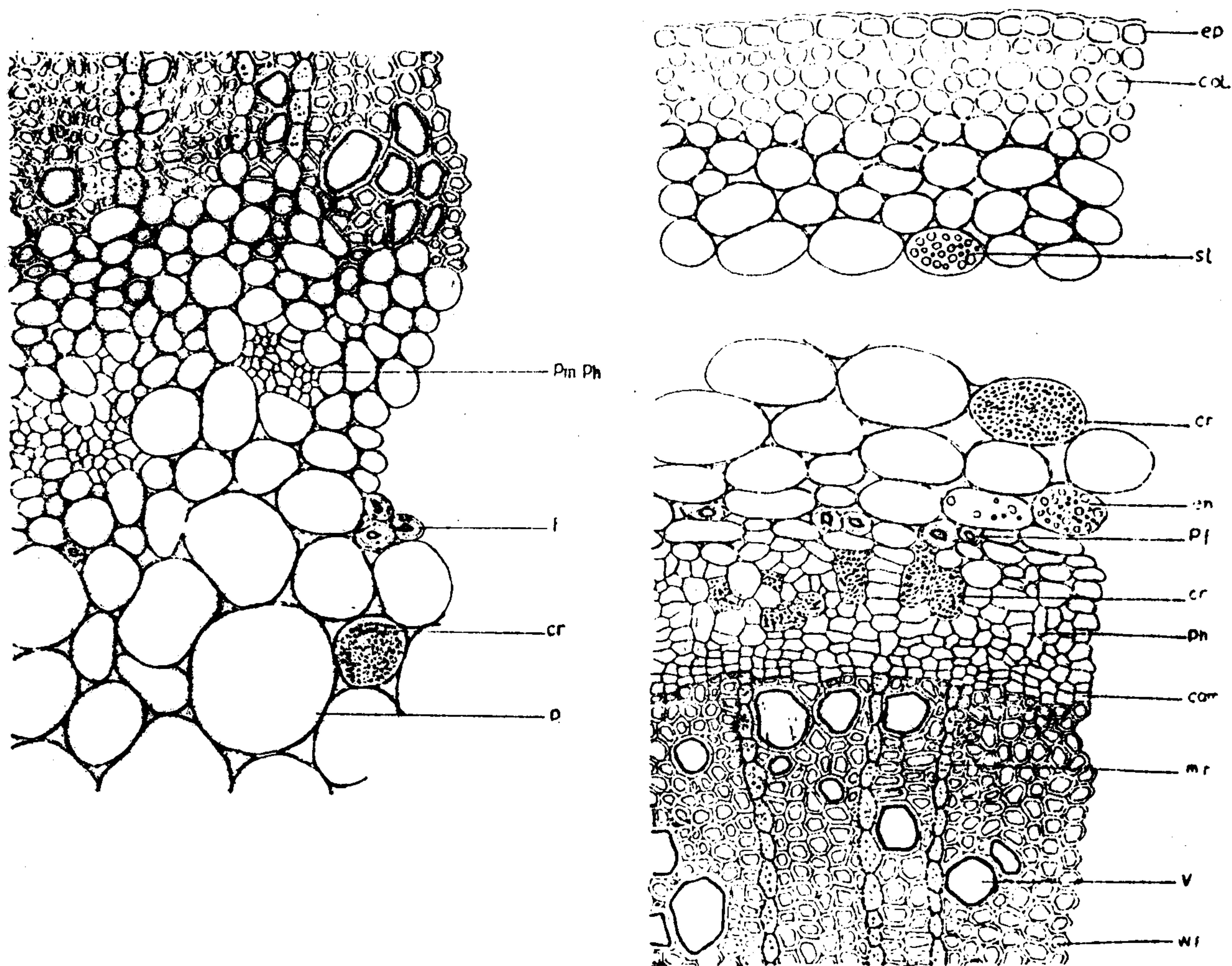


Fig. 4: The Stem

A-	Diagrammatic T.S. in the stem	X 48
B-	Epidermis	X 135
C-	Trichomes	X 135
D-	Vessels	X 135
E-	Medullary ray	X 135
F-	Wood parenchyma	X 135
G-	Parenchyma	X 135
H-	Idioblasts of microspenoidal crystals of calcium oxalate	X 135
I-	Wood fibres	X 135
J-	Pericyclic fibres	X 135
K-	Tracheid	X 135

ep., epidermis; col., collenchyma; par., parenchyma, cn., endo-  
dermis; p.f., pericyclic fibre; xy., xylem; pm.ph., perimedullary  
phloem; f., fibre; p., pith; cr., idioblasts of microspenoidal  
crystals of calcium oxalate.



Fig. 5: Detailed T.S. in the stem

X 270

ep., epidermis; col., collenchyma; st., starch granules; par., parenchyma; en., endodermis; p.f., pericyclic fibre; ph., phloem; cam., cambium; m.r., medullary ray; v., vessels; w.f., wood fibre; f., fibre; pm. ph., perimedullary phloem; p. pith; cr., idioblast of microsphe-noidal crystals of calcium oxalate



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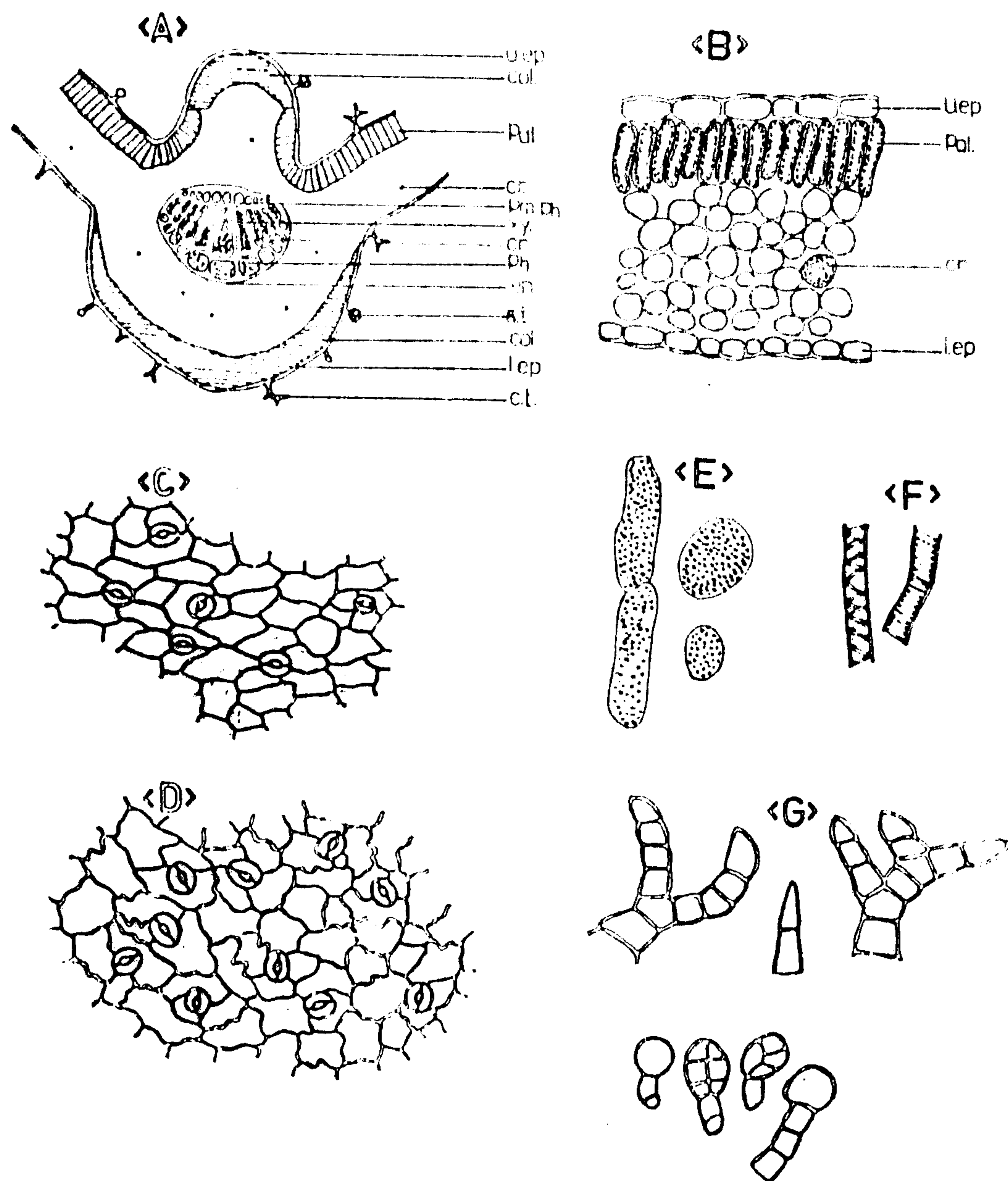


Fig: 6: The Leaf

A-	Diagrammatic T.S. in the leaf	X 24
B-	Detailed T.S. in the lamina	X 135
C-	Upper epidermis	X 135
D-	Lower epidermis	X 135
E-	Idioblasts of microspenoidal crystals of calcium oxalate	X 135
F-	Vessels	X 135
G-	Trichomes	X 135

u.ep., upper epidermis; col., collenchyma; pal., palisade;  
xy., xylem; pm.ph., perimedullary phloem; ph., phloem; en., c.t.,  
covering trichomes; cr., idioblasts of microspenoidal crystals  
of calcium oxalate.

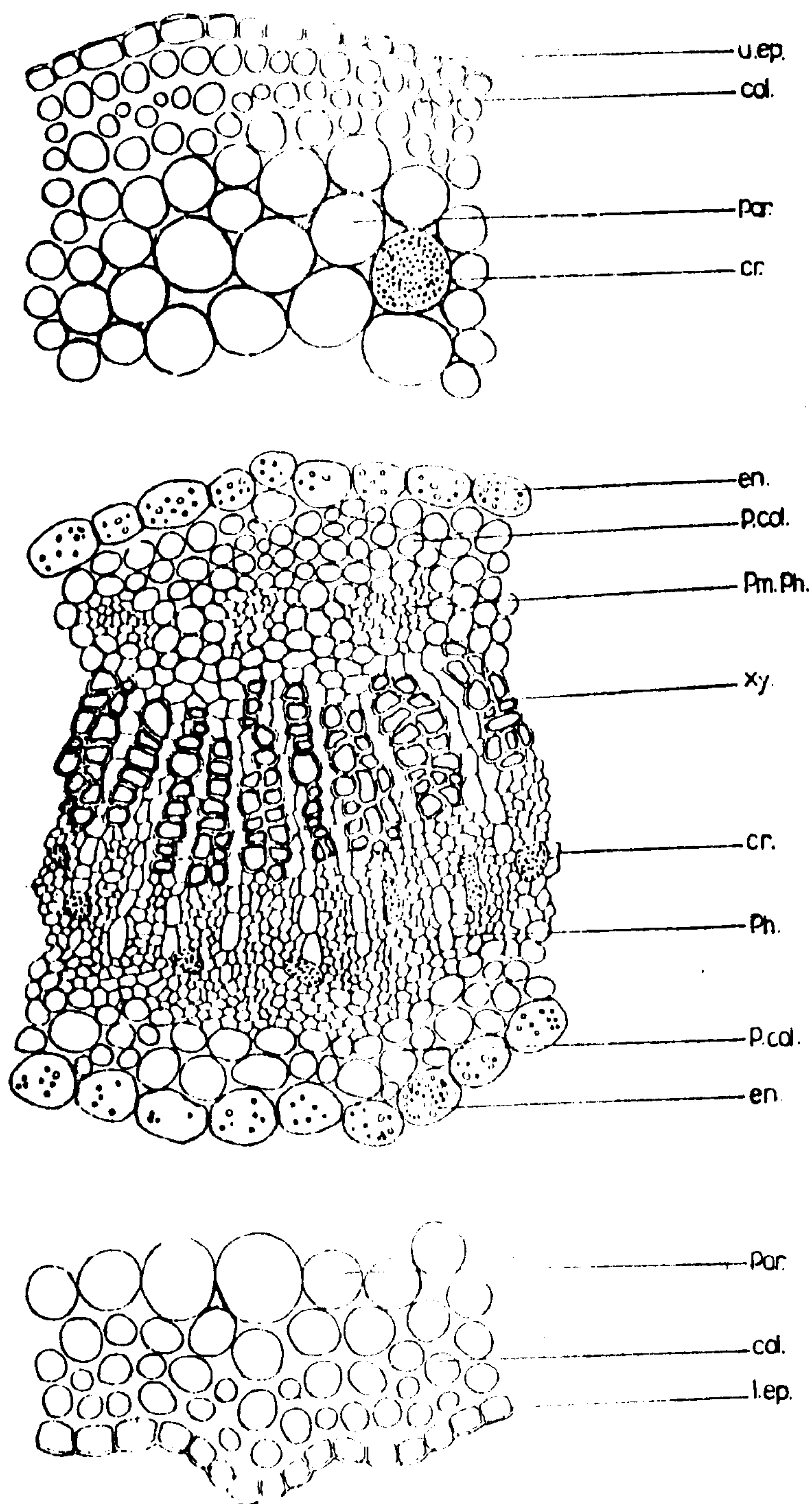


Fig. 7: Detailed T.S, in the midrib

X 270

u. ep., upper epidermis; col., collenchyma; par., parenchyma; en., endodermis; p. col., pericyclic collenchyma; pm. ph., perimedullary phloem, xy., xylem; ph., phloem; l.ep. lower epidermis; cr; idioblast of microsphenoidal crystals of calcium oxalate.

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دراسة بيانية ومجهرية لنبات السولانوم بسودوكابسيكام ( لينيه )

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