

MACRO-AND MICROMORPHOLOGY OF STERCULIA DIVERSIFOLIA  
DON CULTIVATED IN EGYPT

PART II: The Flower Fruit

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*The Flower and fruit of Sterculia diversifolia Don are studied in order to characterise and identify them in both ntire and powdered forms.*

In a previous investigation<sup>1</sup> we have studied the root, stem and leaves of Sterculia diversifolia Don (Brachychiton populneum R. Dr. Kurajong, bottle tree). The following is a trial to complete the study started before.

1- The Flower

Macromorphology:

The flowers (Fig. 1 A) are grouped in pedunculate, axillary panicles. The individual floret is either male or female with an androgynophore. The floret is pedicellate, actinomorphic, hypogenous and pentamerous; petals are absent, sepals are petaloid.

The floral diagrams are shown in (Fig. 1, E, a, b). The flower measures from 15 cm in length and 5 to 12 mm in diameter. The pedicel is green cylindrical, measuring about 1.5 cm in length and 2 mm in diameter.

The flowers have a slight odour and a slight bitter taste.

The petaloid: (Fig. 1 A) is campanulate of five united sepals which are pale-yellow to pale-green with reddish dots. The sepals have pointed ends, traversed by veins and are glabrous. It measures about 7 to 12 mm in length.

The androecium: (Fig. 1,B). The stamens are indefinite in number. The filaments are united, forming a tube; the anthers are two celled, yellow, cylindrical, narrow and measuring about 3 cm. in length and 1 mm in diameter.

The Androgynophore: (Fig. 1,C) The ovary is syncarpous, consisting of 5 free carples united only by their styles and stigma. It is superior formed of 5 oval carples; each carple is unilocular with more than two anatropous ovules arranged on an axile placenta. The styles are united and the ovary is surrounded at its base by a number of bicelled, yellow and sessile anthers.

Micromorphology:

The calyx (Petaloid):

The outer epidermal cells (Fig. 2 D,b) are somewhat isodiametric with straight and beaded anticlinal walls, and covered with smooth cuticle. They measure from 15 to 25 microns in length and 12 to 18 microns in width. Stomata and hairs are absent.

The inner epidermal cells (Fig. 2,D,a) are somewhat isodiametric with straight anticlinal walls and covered with smooth cuticle. They measure from 12 to 22 microns in length and 10 to 17 microns in width. Ranunculaceous stomata are present, but hairs are absent.

The Androecium:

The filament tube: The epidermis (Fig. 2,C) shows axially elongated cells with straight anticlinal walls and covered with smooth cuticle. They measure from 14 to 26 microns in length and 5 to 8 microns in width. Stomata and hairs are absent.

The epidermis of the anther is (Fig. 2 B, b) composed of isodiametric cells with slightly curved anticlinal walls. They measure from 13 to 15 microns in length and 12 to 15 microns in width.

The fibrous layer (Fig. 2 B,a) is formed of isodiametric cells showing bar-like thickenings.

Pollen grains (Fig. 2 B, C) are spherical with smooth exine and pitted surface and show three germ pores situated in furrows. They measure from 28 to 35 microns in diameter.

The androgynophore:

The ovary wall: Shows an epidermis (Fig. 2 E,a) formed of isodiametric cells with straight walls. The epidermis is covered with stellate hairs. Each hair is composed of 10 to 15 cells with acute apices ; measuring from 20 to 25 microns in width and 200 to 450 microns in length.

The epidermal cells of the style (Fig. 2 E,b) are subrectangular with sinuous or wavy anticlinal walls and covered with smooth cuticle. They measure from 30 to 36 microns in length and 15 to 18 microns in width.

The epidermis of the stigma (Fig. 2, E, c) is papillosed. The cells are mainly isodiametric with straight anticlinal walls.

The pedicel:

A transverse section through the pedicel (Fig. 3 A) is more or less circular in outline, showing an epidermis, a cortex and a central stele of 9 to 11 vascular bundles. The pericycle is formed of alternating groups of pericyclic fibres (towards the bundles) and parenchyma.

The epidermis (Fig. 3 C): is formed of isodiametric cells with straight anticlinal walls and covered with smooth cuticle. They measure from 9 to 14 microns in length, 7 to 12 microns in width and 8 to 9 microns in height. Stomata are rare and hairs are absent.

The cortex: (Fig. 3 B)

The cortical parenchyma contain cluster crystals of calcium oxalate. Mucilage cavities are present arranged in a circle and showing stratifications of mucilage which stains red with Ruthenium Red and lined by a row of narrow cells.



The pericycle: (Fig. 3 B & D j)

The fibres are straight with lignified, thin walls, wide lumen and tapering ends. They measure from 400 to 650 microns in length and 12 to 20 microns in width.

The vascular system: (Fig. 3 B & D k)

The vessels are lignified; mainly pitted or spiral.

The pith: (Fig. 3 A & B)

It is parenchymatous, showing a mucilage cavity at its centre as that of the cortex.

POWDERED FLOWER

The powdered flower of Sterculia Diversifolia Don is yellowish green in colour, odourless and with a slight bitter taste. It is characterised microscopically by the followings:

- 1- Fragments showing the outer epidermis of the petaloid with isodiametric cells having straight and beaded anticlinal walls. Stomata and hairs are absent.
- 2- Fragments showing the inner epidermis of the petaloids with straight anticlinal walls, covered with smooth cuticle and bear ranunculaceous stomata.
- 3- Fragments showing axially-elongated cells of the epidermis of the filament tube. The cells have straight anticlinal walls and are covered with smooth cuticle.
- 4- Fragments of the epidermis of the anther with isodiametric cells having slight curved walls and covered with smooth cuticle.
- 5- Fragments of the fibrous layer of the anther with isodiametric cells and bar-like thickenings.
- 6- Scattered pollen grains which are spherical with smooth and pitted exine and show three germ pores.
- 7- Fragments of the epidermis of the ovary with isodiametric cells having straight anticlinal walls covered with smooth cuticle and show stellate hairs.

- 8- Fragments showing subrectangular cells of the epidermis of the style with sinuous or wavy anticlinal walls and covered with smooth cuticle, stellate hairs are present.
- 9- Fragments showing the papillosed cells of the stigma.
- 10- Fragments of the epidermis of the pedicel which are isodiametric with straight anticlinal walls and covered with smooth cuticle.
- 11- Lignified, pitted, scalariform and spiral xylem vessels and pericyclic fibres with lignified, thin walls, wide lumen and tapering ends.
- 12- Fragments showing parenchyma and/or collenchyma cells. Some of them contain cluster crystals of calcium oxalate and parts of the mucilage cavities.

#### The Fruit

##### Macromorphology:

The Fruit (Fig. 1 F) is a woody, stalked follicle, green in colour when unripe, brown after ripening. It is straight with a pointed apex and a smooth reticulated outer surface and a hairy, pale-yellow, inner one. The follicles are grouped in fours or fives and they do not dehisce before ripening. Mature fruits split by longitudinal slits from base to apex exposing yellow seeds. The basal end of each follicle extends as a cylindrical stalk. The fruit measures up to 5 cm in length and 25 mm in diameter. The fruit is odourless with an unpleasant taste.

##### Micromorphology:

###### A. The pericarp.

A transverse section through the pericarp (Fig. A) consists, of an epicarp and endocarp enclosing a parenchymatous mesocarp traversed by vascular bundles and mucilage cavities. The vascular bundles are arranged in two rows, longitudinal and

tangential, alternating with other two rows of mucilage cavities. Sometimes these bundles and cavities are arranged, each, in one row.

The epicarp:

It Consists of isodiametric cells with straight anticlinal walls and covered with smooth cuticle. The cells measure from 10 to 15 microns in length, 9 to 14 microns in width and 11 to 12 microns in height. Stomata of the ranunculaceous type are of frequent occurrence and hairs are absent.

The mesocarp: (Fig. 4 B)

The hypodermis is formed of about two rows of rounded collenchyma, containing colouring matter. The parenchyma is slightly, tangentially elongated to rounded and contain cluster crystals of calcium oxalate, as well as minute starch granules. The vascular bundles show an outer arc of lignified pericyclic fibres and a narrow zone of soft phloem elements surrounding the zylem.

The fibres are straight, with tapering, acute ends and moderately, thick, lignified walls. Xylem consists of vessels which are lignified spiral and pitted, together with lignified pitted and narrow tracheids. Mucilage cavities show stratifications of mucilage which stain red with Ruthenium Red. and lined with narrow cells.

The endocarp: (Fig. 4 B)

It is formed of one row of small cubical cells carrying unicellular spines showing pointed tips and comparatively thin walls and wide lumen. These itching causing spines, measure from 480 to 1200 microns in length and have no contents.

B. The fruit stalk.

A transverse section through the stalk (Fig. 5 A) is nearly circular in outline showing an epidermis followed by a collenchymatous hypodermis of 5 to 8 rows. A diversity in the structure such as that of the leaf petiole<sup>1</sup> is noticed also in the stalk. However, a common one comprising a narrow parenchymatous cortex showing mucilage cavities arranged in a circle and



a circle and a polystylic structure of the vascular system. Cortical vascular bundles as well as medullary ones are present together with the normal vascular cylinder. The latter is opened by the wide medullary rays and shows a wide lignified fibrous pericycle. The phloem is soft and narrow and the xylem is represented by vessels and tracheids.

The epidermis: (Fig. 5 C)

It is formed of somewhat isodiametric cells with straight anticlinal walls. covered with smooth cuticle and measure from 16 to 20 microns in length, 10 to 18 microns in width and 12 to 16 microns in height. Stomata are rare and hairs are absent.

The cortex, (Fig. 5 B)

The collenchyma is rounded and the parenchyma is narrow, tangentially-elongated and contain cluster crystals of calcium oxalate.

The pericycle: (Fig. 5 B & D)

The fibres are straight with more or less thick and lignified walls, wide lumen and tapering ends. They measure from 230 to 720 microns in length and 15 to 35 microns in width.

The vascular system: (Fig. 5 B & D)

The phloem is soft and the xylem vessels are lignified, scariform, spiral and pitted. The pith parenchyma is cellulosic and contain cluster crystals of calcium oxalate.

The Seed

Macromorphology:

The seed (Fig. 6) is ovate or pyramidal with a narrow end extending to a hairy projection and a broader one. The surface shows faint longitudinal striations and carries pointed spines at its lower two thirds. A well-marked raphe is running from base to apex along one of the angles. It measures from 1.2 to 5 cm in length 10 mm broad and 3 mm thick. The seed is odourless and with a bitter unpleasant taste. It has a yellowish-brown surface with dark brown striations.

The yellowish-brown testa encloses a very narrow endosperm and a straight embryo with its two planoconvex cotyledons and a radicle directed towards the narrow end.

#### Micromorphology:

A transverse section through the seed (Fig. 7) shows an outer seed coat of two layers and an inner one. The testa is formed of one row of lignified quadrangular cells followed by a hypodermis of 1 to 3 rows of similar but smaller cells. The innermost layer of the outer seed coat shows rounded cells with wide intercellular spaces. These cells contain clusters of calcium oxalate. The outer integument is formed of two rows of columnar cells, the outer is shorter. These cells are cellulosic, showing minor projections directed upwards. The lower row shows pale transverse false septa.

The endosperm cells are rounded and contain aggregates of amorphous aleurone grains and oil globules.

The embryo cells are rounded to polygonal showing the same contents as those of the endosperm.

#### The epidermis:(Fig. 7, C)

It is formed of polygonal 5-or 6- sided cells with straight anticlinal lignified walls. The cells are covered with thick, smooth cuticle and carry spines similar to those of the endocarp.



### Powdered Fruit

The powdered fruit of *Sterculia diversifolia* Don is yellowish-brown in colour, odourless and with a slight bitter taste. It is characterised microscopically, by the followings:

- 1- Fragments showing the epicarp of the fruit with isodiametric cells having straight anticlinal walls, covered with smooth cuticle and bear run-  
anulaceous stomata.
- 2- Fragments showing parenchyma cells, some contain cluster crystals of calcium oxalate and parts of mucilage cavities.
- 3- Lignified, spiral and pitted xylem vessels together with pitted, tapering tracheids and fibres with thin or thick walls.
- 4- Spines either scattered or attached to the end-  
ocarp and epidermis of the testa. The spines are long with wide lumen and pointed acute tips.
- 5- Fragments showing the epidermal cells of the testa with lignified 5 or 6- sided polygonal lignified cells. The walls are straight and thick and the cells bear spines.
- 6- Fragments showing the columnar cells of the seed coat with their walls bearing minor projections.
- 7- Fragments showing endosperm or embryo cells with oil globules and aleurone grains.

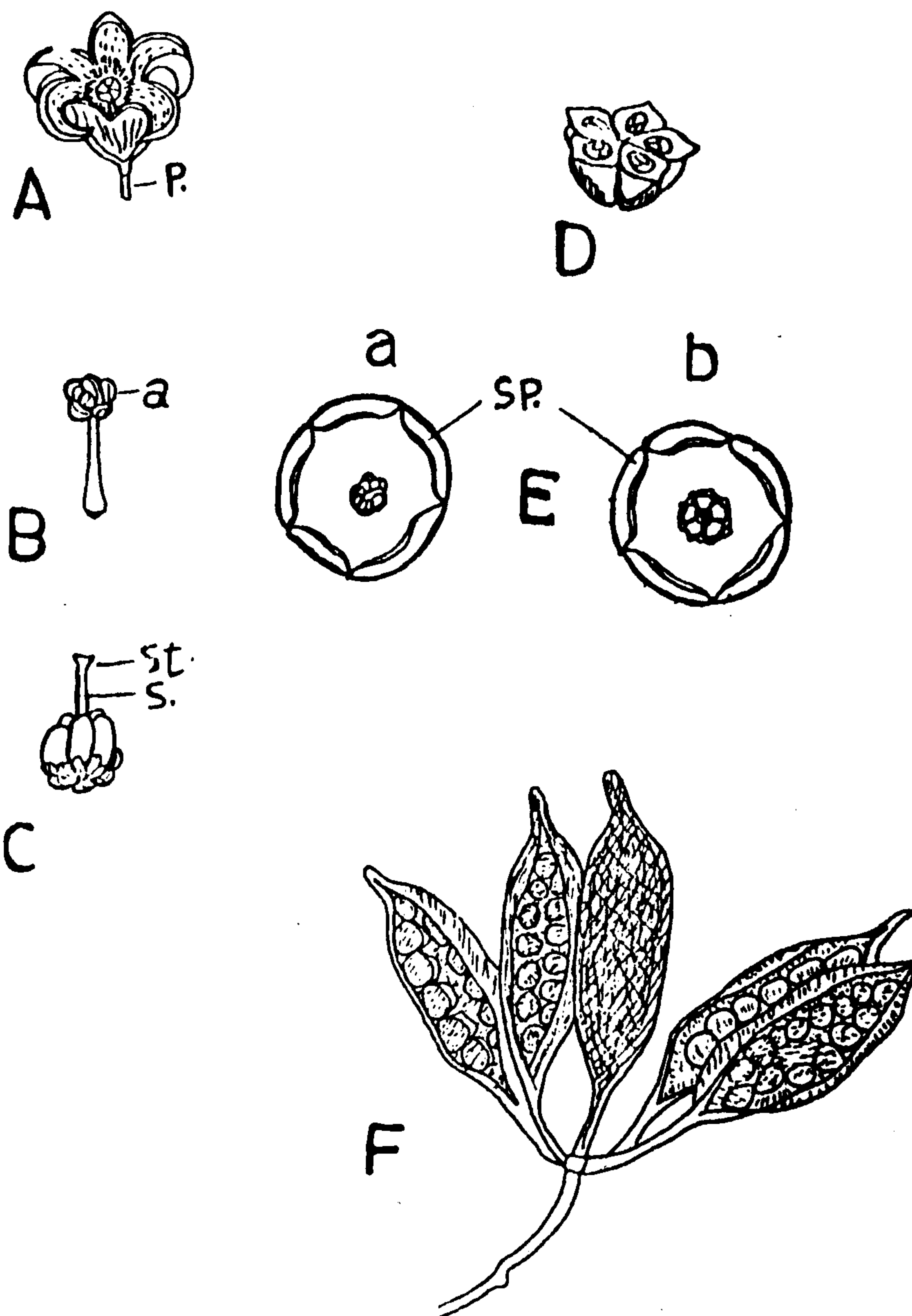


Fig. 1- The flower and fruit

- |                                       |       |
|---------------------------------------|-------|
| A- The floret                         | X 2   |
| B- The androecium                     | X 2   |
| C- The androgynophore                 | X 2.5 |
| D- T. cut of the ovary                | X 20  |
| E- Floral diagrams                    |       |
| a- Male flower                        |       |
| b- Female flower with androgynophore. |       |
| F- The fruit                          | X 1/2 |
- (a., anther; p., pedicel; s., style; sp., sepals; st., stigma).

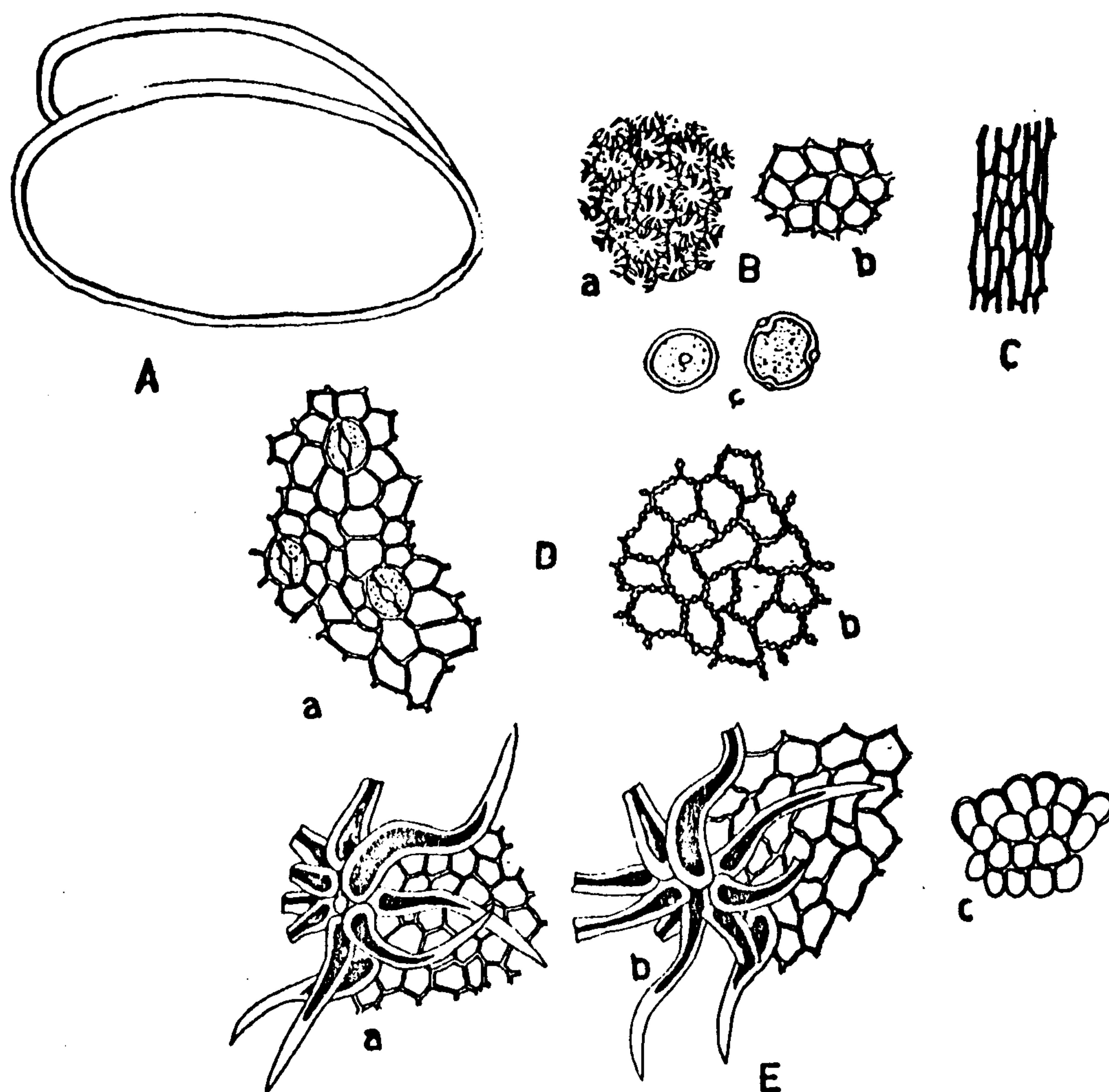


Fig. 2- The florets

- |    |                                |       |
|----|--------------------------------|-------|
| A- | The anther                     | X 50  |
| B- | The androecium                 | X 128 |
| a- | Fibrous layer of the anther    |       |
| b- | Epidermis of the anther,       |       |
| c- | Pollen grains                  |       |
| C- | Epidermis of the filament tube | X 128 |
| D- | The petaloid                   |       |
| a- | Inner epidermis,               |       |
| b- | Outer epidermis                | X 128 |
| E- | The androgynophore             |       |
| a- | Epidermis of the ovary         |       |
| b- | Epidermis of the style         |       |
| c- | Epidermis of the stigma        | X 128 |



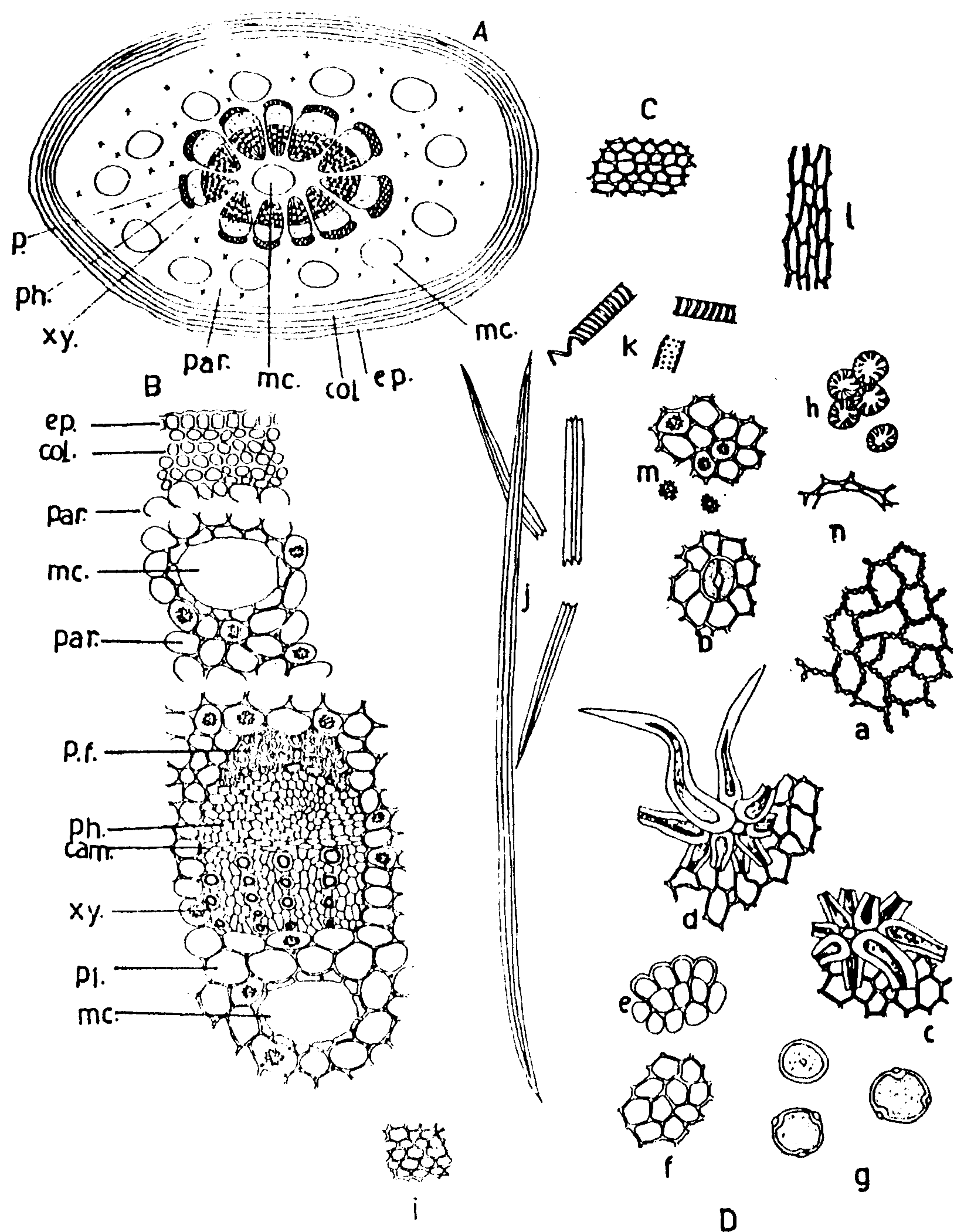


Fig. 3- The flower  
 A- Diagrammatic T.S. of the pedicel X 25  
 B- Detailed T.S. of the pedicel X 150  
 C- Surface preparation of the pedicel X 150  
 D- Isolated elements of the flower X 150

(col., collenchyma; ep., epidermis; p., pericycle; par., parenchyma; p.f. pericyclic fibres; ph., phloem; m.c., mucilage cavity; cam., cambium; pi., pith; xy., xylem).

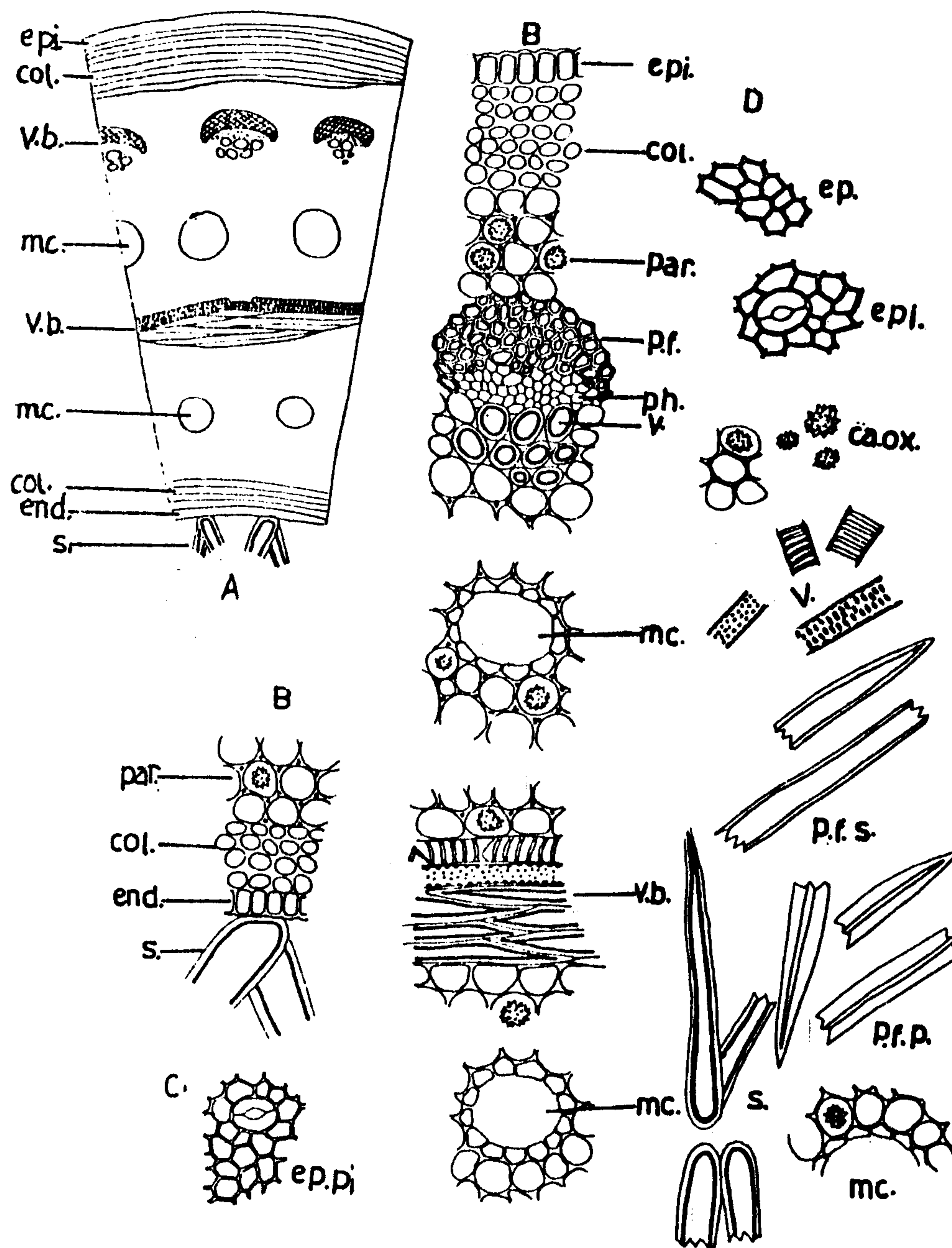


Fig. 4- The pericarp  
A- Diagrammatic T.S. of the pericarp X 25  
B- Detailed T.S. of the pericarp X 150  
C- Surface preparation of the epicarp X 150  
D- Isolated elements of the fruit X 150  
(col., collenchyma; end., endocarp; ep., epidermis; epi., epicarp; m.c., mucilage cavity; p.f.p., pericarpic fibres of pericarp; p.f.s., pericarpic fibres of stalk; s., spines; v.b., vascular bundles).

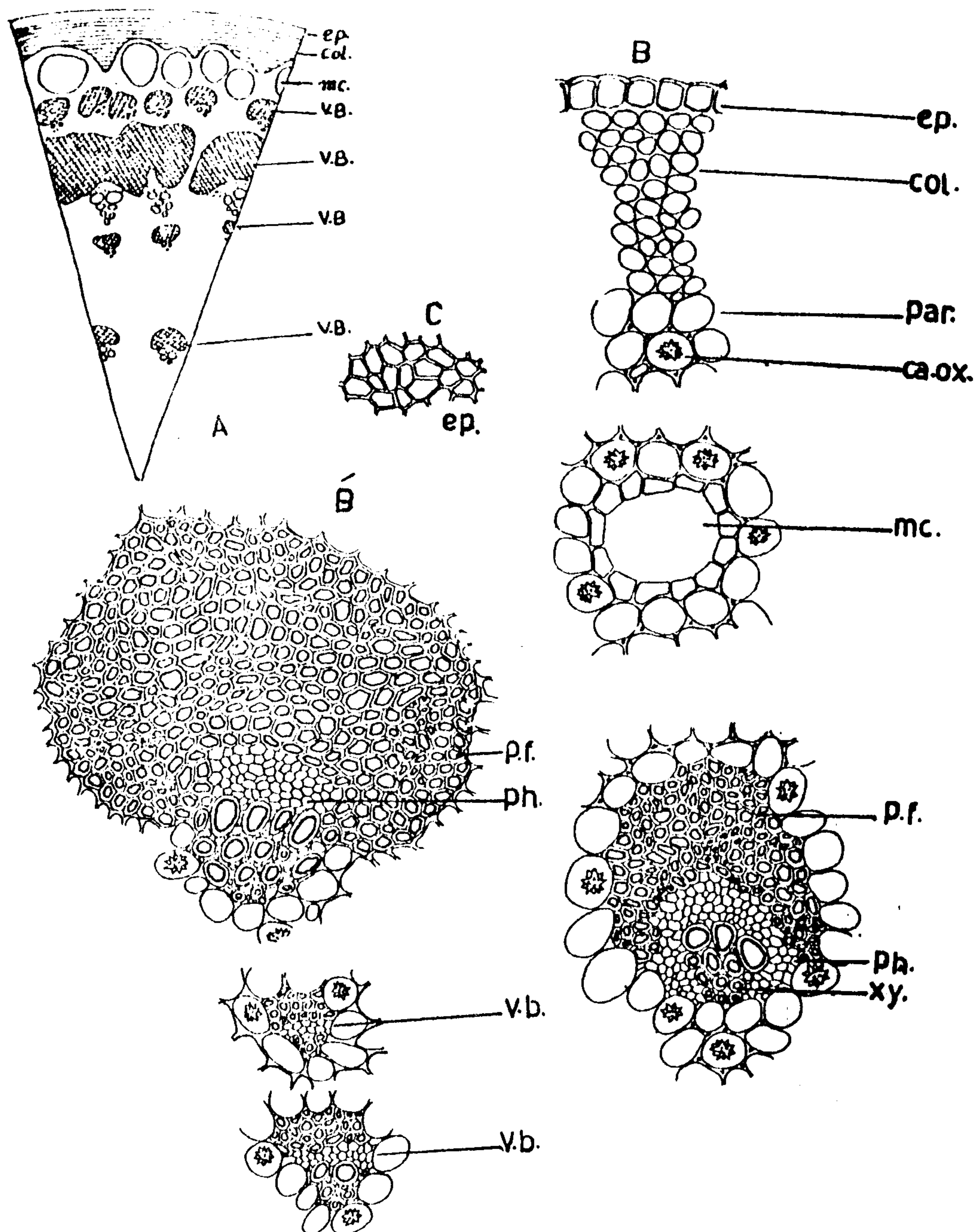


Fig. 5- The fruit stalk

A- Diagrammatic T.S. of the stalk

X 25

B- Detailed T.S. of the stalk

X 150

C- Surface preparation of the stalk

X 150

( col., collenchyma; ca. ox., calcium oxalate; ep., epidermis; m.c., mucilage cavity; par., perenchyma; p.f., pericyclic fibres; ph., phloem; v.b., vascular bundles; xy., xylem).



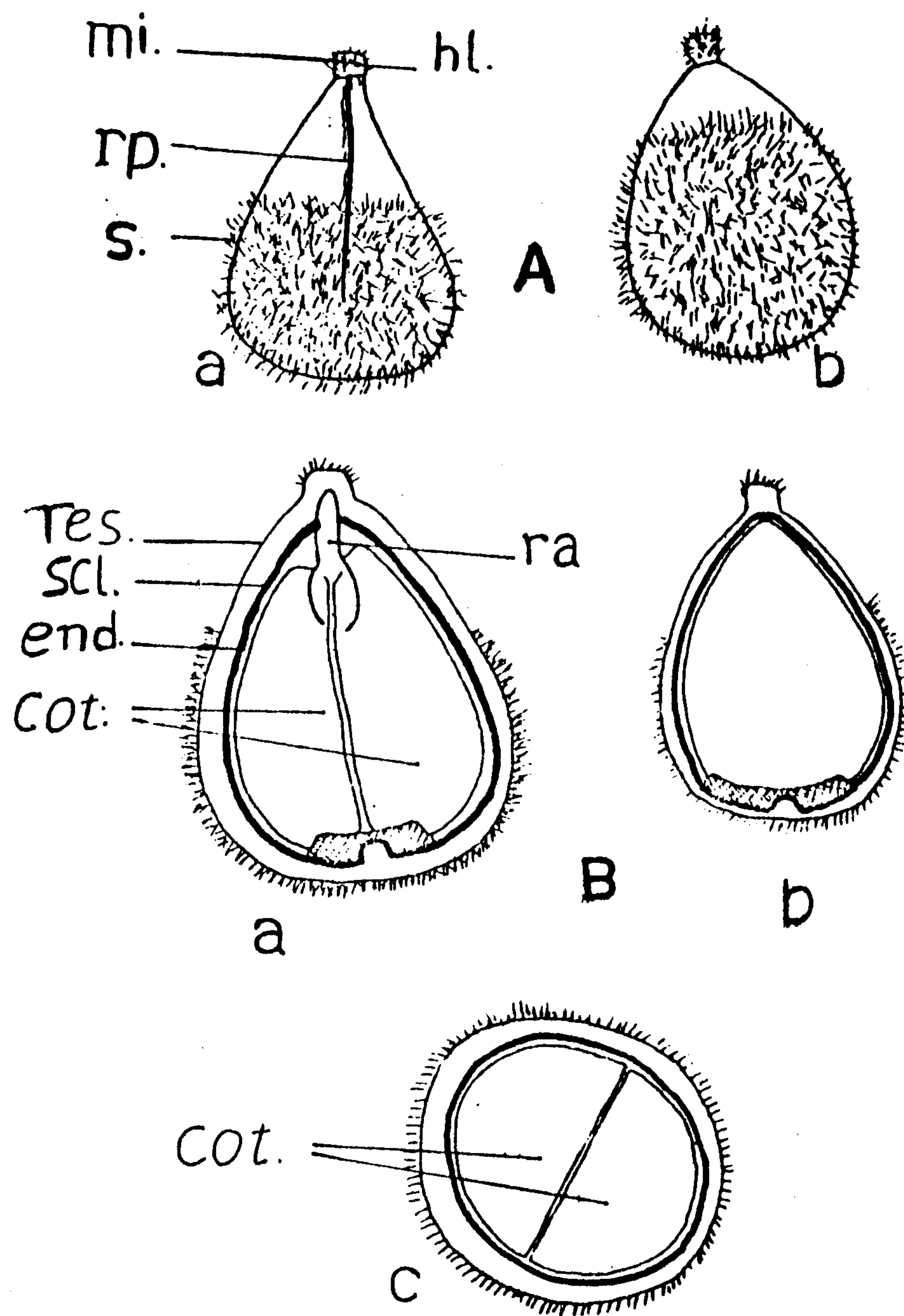


Fig. 6- The seed

A- Dorsal and ventral surfaces

B- Longitudinal cut.

C- Transverse cut.

X 5

(cot., cotyledons; end., endosperm; hl., hilum; mi., micropyle; rp., raphe; tes., testa).

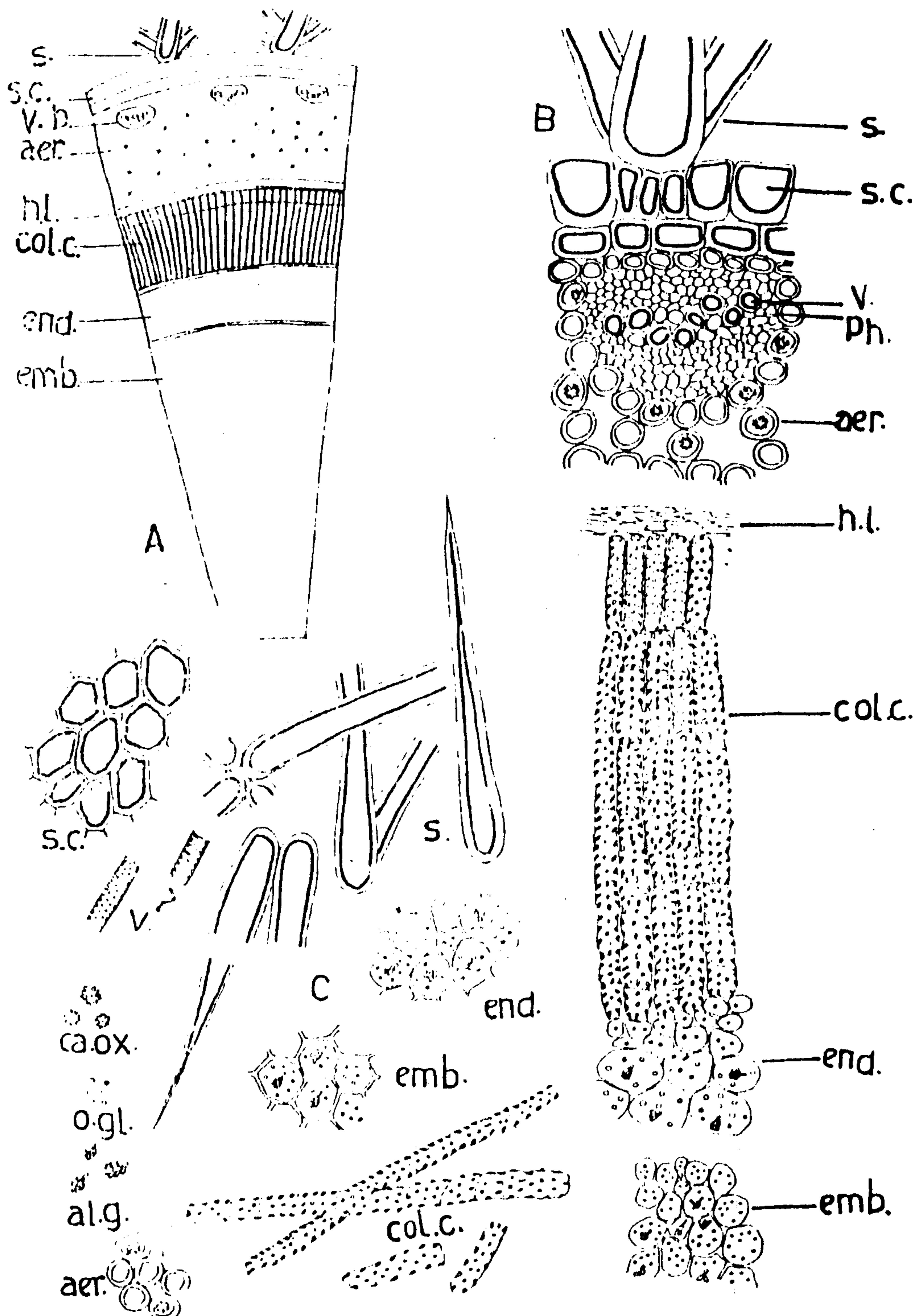


Fig- 7- The seed

A- Diagrammatic T.S. of the seed

X 33

B- Detailed T.S. of the seed

X 190

C- Isolated elements of the seed

X 190

(ca., ox., calcium oxalate; col.c., columnar cells; aer., aerenchyma; aleurone grains; emb., embryo; end., endosperm; hl., hyaline layer; s., spines; s.c., seed coat; o.gl., oil globules; v., vessels; v.b., vascular bundles).

REFERENCES

- 1) S.M.El-Sayyad, A.A.Ali and E.K. Desouky; under  
Publication.

الدراسات الحياتية والمجهريّة لنبات  
الستركيوليا ديفرسيفوليا المنزرع في مصر  
الجزء الثاني - الزهرة والثمرة  
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في بحث سابق قام الباحثون بدراسة الصفات الحياتية والمجهريّة  
لجذر وساق وورقة نبات الستركيوليا ديفرسيفوليا المنزرع  
في مصر

ويشمل هذا البحث على الدراسة الحياتية والمجهريّة لزهرة  
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