

MACRO-AND MICROMORPHOLOGY OF TABEBUIA
PENTAPHYLLA HEMSL. CULTIVATED IN EGYPT.
PART II: THE STEM BARK AND FLOWER

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ABSTRACT

The macro-and micromorphology of the stem bark and flower of Tabebuia pentaphylla Hemsl, cultivated in Aswan botanic garden have been investigated in order to determine the diagnostic features by which each organ could be identified both in the entire and powdered forms.

INTRODUCTION

In a previous paper¹, the macro-and micromorphology of the stem and leaves of Tabebuia pentaphylla Hemsl. was presented. The present work deals with macro-and micromorphology of the stem bark and the flower of the same plant.

A-The Stem Bark

Macromorphology (Fig.1):-

The stem bark of Tabebuia pentaphylla Hemsl. is found in channelled pieces, single or double quills and mainly in flat pieces, measuring 3-5-8 mm in thickness, 2-4-6 cm in width and 10-20 cm. in length.

The outer surface is light-brown to yellowish-brown in colour with irregular longitudinal fissures and transversely cracked surface while the inner surface having yellowish-brown colour, finely longitudinally striated, occasionally with yellowish pieces of wood. The fracture is granular in the outer part and fibrous in the inner one, having faint and characteristic odour, slightly bitter and astringent taste.

Micromorphology:-

T.S. in the stem bark (Fig.2) shows four distinct regions, the cork, the cortex, pericycle and the phloem regions.

The Cork (Fig.3):-

The cork layer is formed of several rows of radially arranged cork cells traversed by some bands of thickened and lignified cork cells. The cork cells are somewhat tangentially elongated, polygonal or subrectangular. They appear polygonal in top view, having straight anticlinal walls containing yellowish-brown contents, measuring 60-74-85 u in length, 27-33-40 u in width and 18-25-33 u in height.

The lignified cork cells band consists of 1-3 rows, these cells are subrectangular in shape having wide lumina and thick lignified walls with simple pits. They measure 57,70,100 u in length, 50-55-60 u in width and 17-26-32 u in height.

The Cortex (Fig.3):-

The phellogen consists of 2-3 rows of thin walled, tangentially elongated or rectangular cells below the cork cells. A well marked phelloderm (secondary cortex) consists of rounded or oval shaped thickened parenchyma cells. The primary cortex which is comparatively wide, consists of thin walled oval or rounded to slightly elongated parenchyma cells measuring 30-49-68 u in diameter. The parenchyma cells of the cortical region containing both starch granules and prisms of calcium oxalate. The starch granules are

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mainly simple and some are compound containing two to many components, each is rounded, ovoid or spherical with centric, point like or branched hilum. The prisms of calcium oxalate are numerous, measuring 10-20-27 u in length. Numerous sclereids are scattered in the cortex either solitary or in groups of 6-20-50 sclereids. The sclereids appear as rounded or tangentially elongated with thick lignified walls with wide and sometimes narrow lumina and simple or branched pits, measuring 46-60-100 in length 30-43-58 u in width and 25-42-55 u in height. Several groups of fibers are scattered in the corticol region, each consists of 3-6-10 fibers.

To the inner side of the cortex, groups of lignified pericyclic fibres separated by parenchyma cells, each group reaching up to 25 fibres. The fibres are characterised with lignified walls, narrow lumina, acute to acuminate apices, pitted and finely striated walls, measuring 700-1300-1900 u in length and 16-28-35 u in diameter. The parenchyma cells surrounding the pericyclic fibres contain prisms of calcium oxalate giving rise to crystal sheath appearance.

The Phloem (Fig.3 and 4):-

The phloem zone is formed of phloem parenchyma, phloem fibres and sieve elements. The phloem parenchyma are rounded to subrectangular in shape, having thin walls, containing both starch granules and prisms of calcium oxalate as those of the cortical parenchyma measuring 10-20-27 u in diameter. The sieve elements are indistinguishable. The phloem fibres present in groups each containing 6-10-14 fibres, each with thick lignified, finely striated walls and narrow lumen with acute to acuminate apex. The fibre groups are surrounded by parenchyma cells containing prisms of calcium oxalate giving rise to crystal sheath appearance. The medullary rays are uniseriate or sometimes biseriate, the cells are elongated polygonal parenchyma filled with starch granules and

prisms of calcium oxalate and measuring 60-75-105 u in length. The phloem region contains branched anastomosing secretory vessels forming network like structure containing yellowish resinous content. The innermost layer of the phloem is formed of rounded to irregular shaped parenchyma in which the medullary rays are indistinguishable and containing small groups of nonlignified phloem fibres.

The Powdered Bark (Fig. 5):-

The powdered bark has yellowish-brown to light brown colour, faint characteristic odour slight bitter and astringent taste. The powder exhibits the following microscopical characters:-

- 1- Fragments of the cork cells with thin nonlignified walls which are polygonal in shape, containing yellowish-brown contents, or with thick lignified walls showing wide lumina
- 2- Fragments of the cortex showing rounded and oval parenchyma cells containing starch granules and prisms of calcium oxalate.
- 3- Fragments of lignified phloem and pericyclic fibres either isolated or in association with parenchyma cells containing prisms of calcium oxalate giving rise to crystal sheath appearance.
- 4- Fragments of sclereids which are either isolated or in groups having thick, pitted, lignified walls and narrow or wide lumina.
- 5- Starch granules which are simple or compound of 2 to more components, each having rounded, ovoid or spherical shape with centric point like or branched hilum, either free or in parenchyma cells.
- 6- Prisms of calcium oxalate scattered in the field.
- 7- Fragments of branched secretory vessels containing yellowish-brown contents forming network like structure.

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B-The Flower

Macromorphology:-

The flower (Fig. 6) is large in size, yellow in colour, usually solitary, terminal or axially at the end of the branches, pedicellate, erect, bell-or funnel-shaped, measuring 6-9 cm in length and 2-4 cm in diameter at the widest part. The flower is zygomorphic, hermaphrodite and having the following floral formula:

$$(\otimes, K(5), C(5), A_4 + 1, G(\underline{2}))$$

The Calyx:-

Is synsepalous, tubular, consists of five green to yellowish-green glabrous, more or less triangular toothed sepals, each measuring 0.8-1.3 cm in length and 4-8 mm in width.

The Corolla:-

Is large, bell-or funnel-shaped, gamopetalous, consists of five yellowish petals, measuring 4-8 cm in length and 2-4 cm in width at the widest part and having characteristic odour.

The Androecium:-

Consists of five epipetalous stamens alternating with the corolla lobes. The two lateral stamens are larger than the anterior ones and the fifth is infertile staminode. The filament having yellowish-brown colour, cylindrical in shape and having dense hairs at the base, measuring 1-1.5 cm in length. The anther lobes are two divergent and dehiscent by a longitudinal slit having yellowish colour, measuring 0.3-0.3 cm in length.

The Gynaecium:-

Consists of a rounded superior ovary, syncarpous, bilocular containing several ovules with axile placenta measuring 0.9-1.0 cm in length and up to 0.5 cm in width. The style is slender measuring 2.3-2.5 cm in length and terminates with two lobed stigma.

The pedicel is green to yellowish-green in colour and glabrous.

The flower has characteristic odour and slightly bitter taste.

Micromorphology of the Flower:-

The Calyx:-

The tissues of the sepals (Fig. 7 A) comprise the lower and upper epidermises enclosing in between a homogeneous mesophyll traversed by several vaso centric vascular bundles.

The Lower Epidermis:-

The lower epidermis of the sepals shows little variations in shape and size of the cells at different regions. The apical region (Fig.7 B) shows isodiametric to slightly elongated cells with straight anticlinal walls covered with smooth cuticle and showing anomocytic stomata surrounded by 5-8 cells, they measure from 20-32-45 u in length and 15-22-32 u in width. The middle region (Fig. 7 C) is similar to those of the apical region but slightly larger in size. They measure from 24-38-50 u in length and 20-27-35 u in width.

The basal region (Fig.7 D) shows similar cells of the apical region in shape but more larger in size measuring 27-40-53 u in length and 23-31-40 u in width.

The lower epidermis of the sepals shows anomocytic stomata surrounded by 5-8 epidermal cells and also glandular hairs of peltate form formed of unicellular or bicellular stalk and multicellular head of 8-15-30 radiating cells. The hairs measure 20-25-30 u in length and 65-80-95 u in diameter.

The Upper Epidermis:-

The upper epidermis of the sepal shows polygonal cells, covered with smooth cuticle and some of them containing one or more prisms of calcium oxalate. The apical region (Fig.7 E)

shows polygonal cells with straight anticlinal walls, measuring 40-53-65 u in length and 16-27-36 u in width. While those of the middle region (Fig.7 F) are more larger, measuring 50-61-27 u in length and 33-41-49 u in width. The basal region (Fig.7 G) is polyhedral in shape containing one or more prisms of calcium oxalate, measuring from 78-90-101 u in length and 50-64-70 u in width.

The Corolla (Fig.8 D) :-

The petals are formed of an inner and outer epidermal cells enclosing in between a homogenous mass of mesophyll traversed by several vasoconcentric vascular bundles.

The Inner Surface:

The apical region (Fig.8 A) is formed of polygonal, isodiametric cells having straight anticlinal walls with papillosed cells measuring 36-46-55 u in length and 27-35-42 u in width.

The middle region (Fig.8 B) shows polygonal cells with circular papillae and faint radiate striations. The cells measure 60-71-82 u in length and 28-39-52 u in width.

The basal region (Fig.8 C) shows polygonal, axially elongated cells with circular papillae, measuring from 70-83-96 u in length and 30-38-48 u in width.

The Outer Surface:-

The cells of the apical part of the outer surface (Fig.8 E) are similar to those of the inner surface, measuring 45-60-80 u in length and 26-34-43 u in width.

The cells of the middle region (Fig.8 F) are isodiametric with straight anticlinal walls, covered with striated cuticle, measuring from 28-53-80 u in length and 26-36-42 u in width and showing unicellular non-glandular hairs.

The basal region (Fig.8 G) is more axially elongated cells covered with striated cuticle, measuring from 85-92-102 u in length

and 26-38-45 u in width. Unicellular or less common bicellular non-glandular hairs are present on the outer epidermis. They are covered with warty cuticle, measuring 180-200-225 u in length.

Micromorphology of the Stamen:-

The anther:-

A transverse section in the anther (Fig.9 A) shows two anther lobes. Each is formed of two pollen sacs in which many pollen grains are present. The pollen grains (Fig.9 B) are spherical in shape with faintly pitted exine and showing three germinial pores, measuring from 52-60-75 u in diameter. In the center of each anther lobe a vaso centric vascular bundle is present formed of central xylem surrounded by phloem. The epidermis of the anther (Fig.9C) is formed of polygonal cells with straight anticlinal and covered with smooth cuticle. They measure 49-89-95 u in length and 18-22-30 u in width. The fibrous layer (Fig.9 D) is formed of lignified isodiametric to slightly elongated cells showing bar-like thickening and measuring 20-26-33 u in diameter, and 39-49-62 u in length.

The filament:-

A transverse section in the basal part of the filament (Fig. 9 E) shows an epidermis, wide cortical tissue and central vascular strand. The epidermis of the filament (Fig.9 F) is formed of rectangular, axially elongated cells having straight anticlinal walls and covered with smooth cuticle. They measure 53-68-82 u in length and 27-36-46 u in width. The epidermal cells at the basal part showed both glandular and non-glandular hairs (Fig.9 G) The glandular one is formed of multicellular, uniseriate stalk of 3-7 cells and multicellular head of 6-12 cells. The hairs measure from 320-405-490 u in length. Non-glandular hairs are multicellular, uniseriate, measuring 300-375-425 u in length.

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Micromorphology of Gynaecium:-

The Ovary:-

T.S. in the ovary (Fig.10 A) is rounded in shape showing an epidermis enclosing a parenchymatous ground tissue containing prismatic crystal of calcium oxalate and traversed by small vascular strands, surrounding two locules in which the ovules are present. The epidermis of the ovary (Fig. 10 B) Showing polygonal cells with straight anticlinal walls, covered with smooth cuticle measuring 16-28-40 u in length and from 14-19-25 u in width. Numerous glandular hairs are shown on the epidermis of the ovary of peltate type while stomata are absent.

The ground tissue consists of several rows of parenchymatous cells which are rounded or ovoid in shape containing prisms of calcium oxalate and separated by small intercellular spaces. The vascular bundle consists of few narrow xylem vessels surrounded by a small zone of phloem elements.

The Style:-

The epidermal cells of the style (Fig.10 C) are rectangular axially elongated with straight anticlinal walls and covered with smooth cuticle. They measure 80-95-110 u in length and from 10-20-24 u in width. Both stomata and trichomes are not observed.

The Stigma:-

The surface of the stigma (Fig.10 D) is papillosed, showing hairy like papillae protruding from each cell of the epidermis. The papillae measure 180-186-250 u in length and from 16-24-32 u in diameter and covered with smooth cuticle.

The Stalk (Pedicel):-

A transverse section in the pedicel (Fig.11 A) is more or less rounded in outline. It consists of an epidermis followed by comparatively wide cortex, vascular bundles and a parenchymatous pith.

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The epidermis (Fig.11 B) consists of polygonal cells with straight anticlinal walls and covered with thick, smooth cuticle. They measure 20-30-33 u in length and 13-19-24 u in width. The stomata are very rare of anomocytic types. Numerous peltate glandular trichomes are present.

The cortex is composed of thin walled ovoid to rounded parenchyma cells containing prisms of calcium oxalate.

The vascular tissue is formed of 15-18 open collateral vascular bundles arranged in a ring, separated from each other by parenchymatous medullary rays.

The pith parenchyma are rounded in shape, containing prisms of calcium oxalate.

The Powdered Flower (Fig.12):-

The powder has yellow to yellowish-brown colour, faint characteristic odour and slightly bitter taste. The diagnostic elements are :-

- 1- Fragments of middle region of outer epidermis of calyx with polyhedral, slightly elongated cells covered with smooth cuticle, showing both glandular hairs and stomata.
- 2- Fragments of the apical region of the outer epidermis of calyx with glandular hairs and stomata.
- 3- Fragments of basal region of the calyx showing polyhedral cells containing one or more small prisms of calcium oxalate.
- 4- Fragments of basal and middle region of inner epidermis of petals with polygonal, axially elongated cells covered with smooth cuticle and showing non glandular hairs.
- 5- Fragments of apical region of the inner and outer epidermis of petals with isodiametric cells having distinct circular papillae.

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- 6- Fragments of basal and middle region of outer epidermis of petals with polyhedral, axially elongated cells, papillosed and showing faint striation.
- 7- Fragments of fibrous layer of anther showing polygonal isodiametric cells with lignified and thickened (bar like thickening) cells.
- 8- Numerous greyish spherical pollen grains.
- 9- Fragments of epidermis of ovary with polygonal isodiametric cells having straight anticlinal walls and showing peltate hairs.
- 10- Fragments of papillosed stigma.
- 11- Fragments of glandular trichomes of two kinds, one formed of unicellular or bicellular stalk and multicellular radiating cells. The other formed of multicellular stalk (3-6 cells) and multicellular head (6-13 cells).
- 12- Fragments of non-glandular trichomes either unicellular or multicellular (3-7 cells).
- 13- Fragments of lignified spiral, pitted annular vessels and tracheids.

REFERENCES

- 1) D.W. Bishay; S.A. Ross; A.M. Abdel-Baky and Z.Z Ibrahim, *Bull. of Pharm Sci., Assiut University*, 10, Part 1, (1987), (in press).

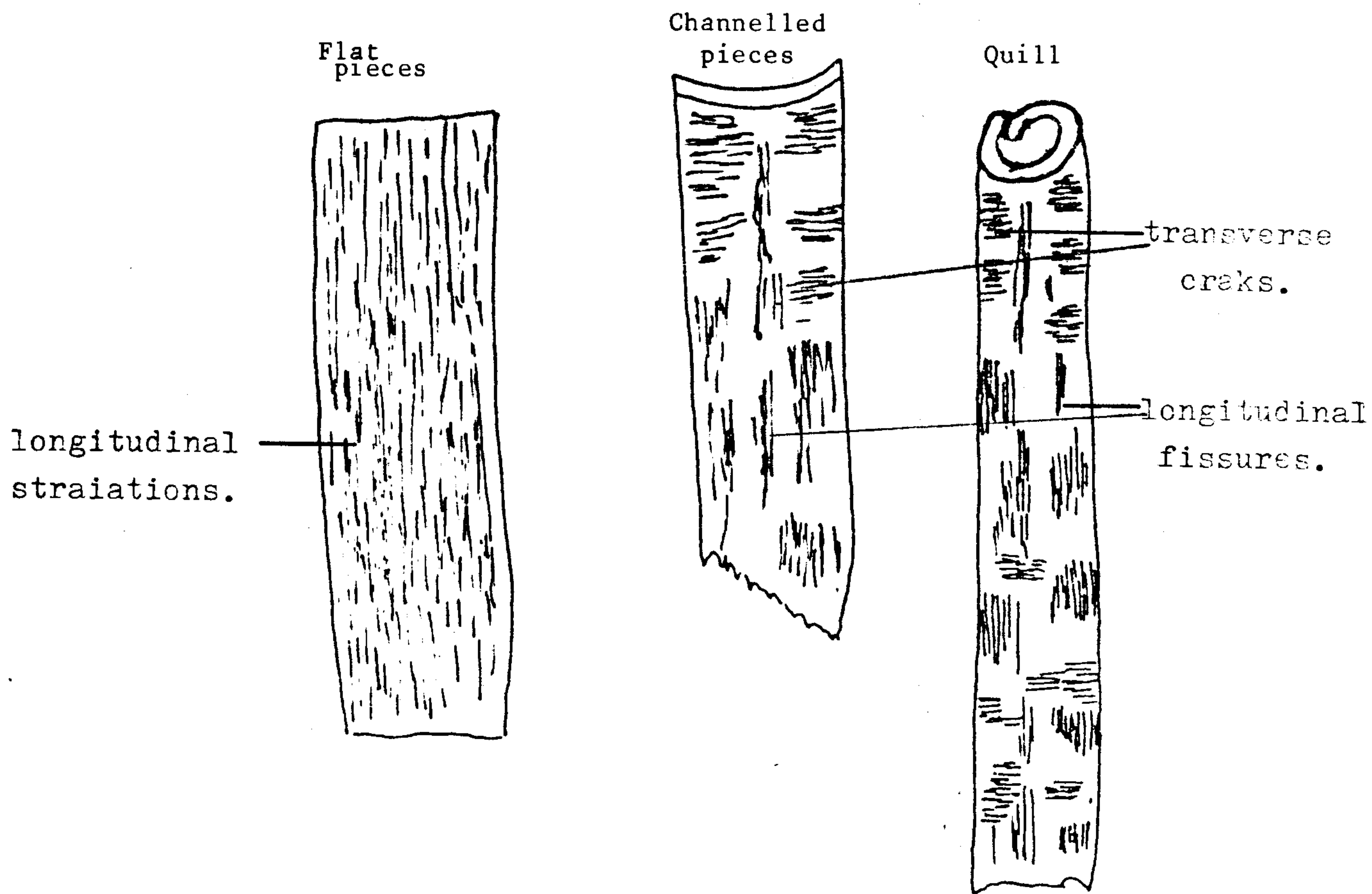
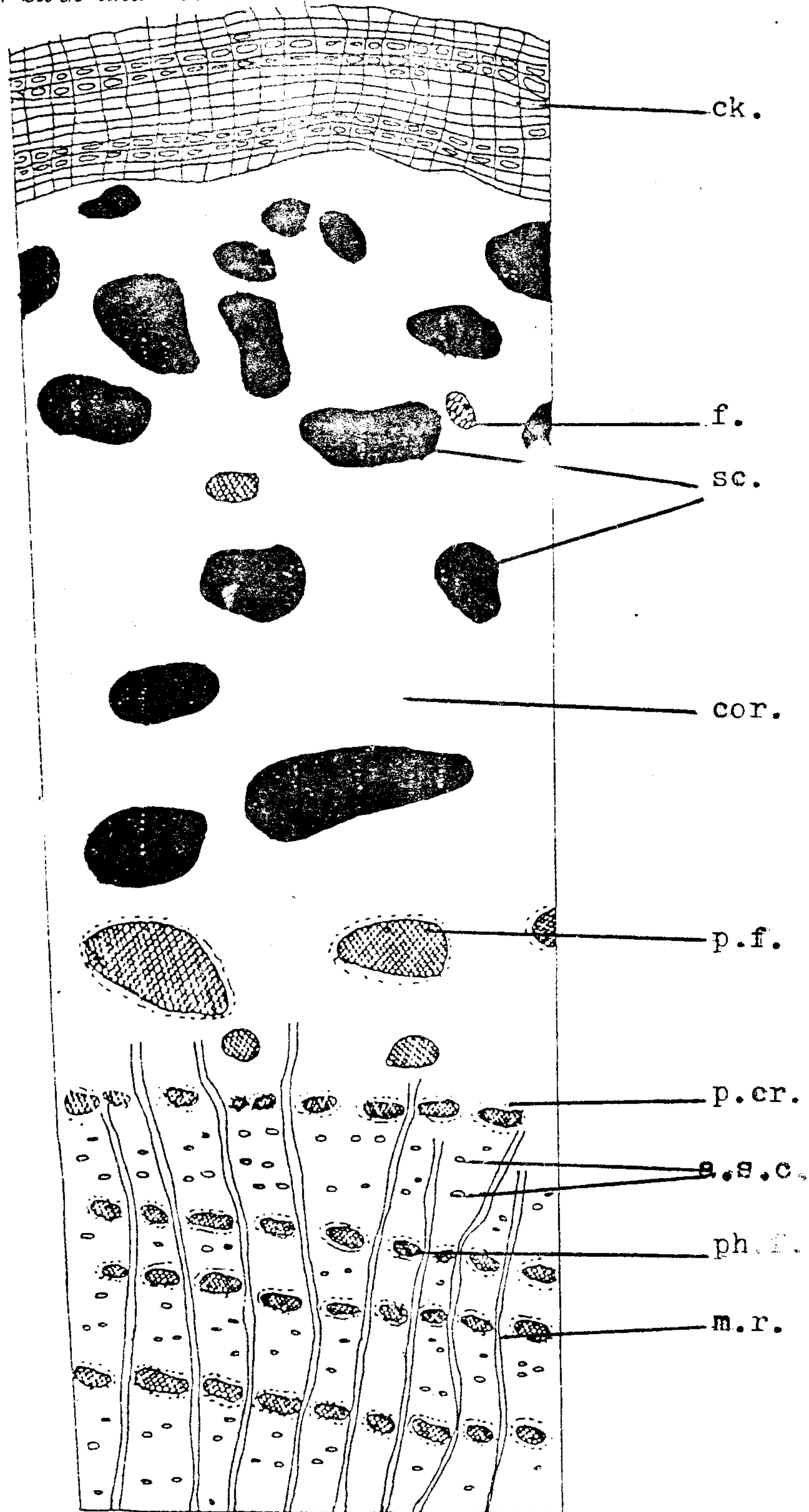


Fig. 1 Sketh of the stem bark

(x $\frac{2}{3}$)

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(x28)

Fig. 2 Diagrammatic T.S. in the stem bark

Ck., cork; cor., cortex; f., fibers; m.r., medullary rays; p.cr., prisms of calcium oxalate; p.f., pericyclic fibres; ph.f., phloem fibers; sc., sclerenchymatous cells; a.s.v., anastomosing secretory vessel.

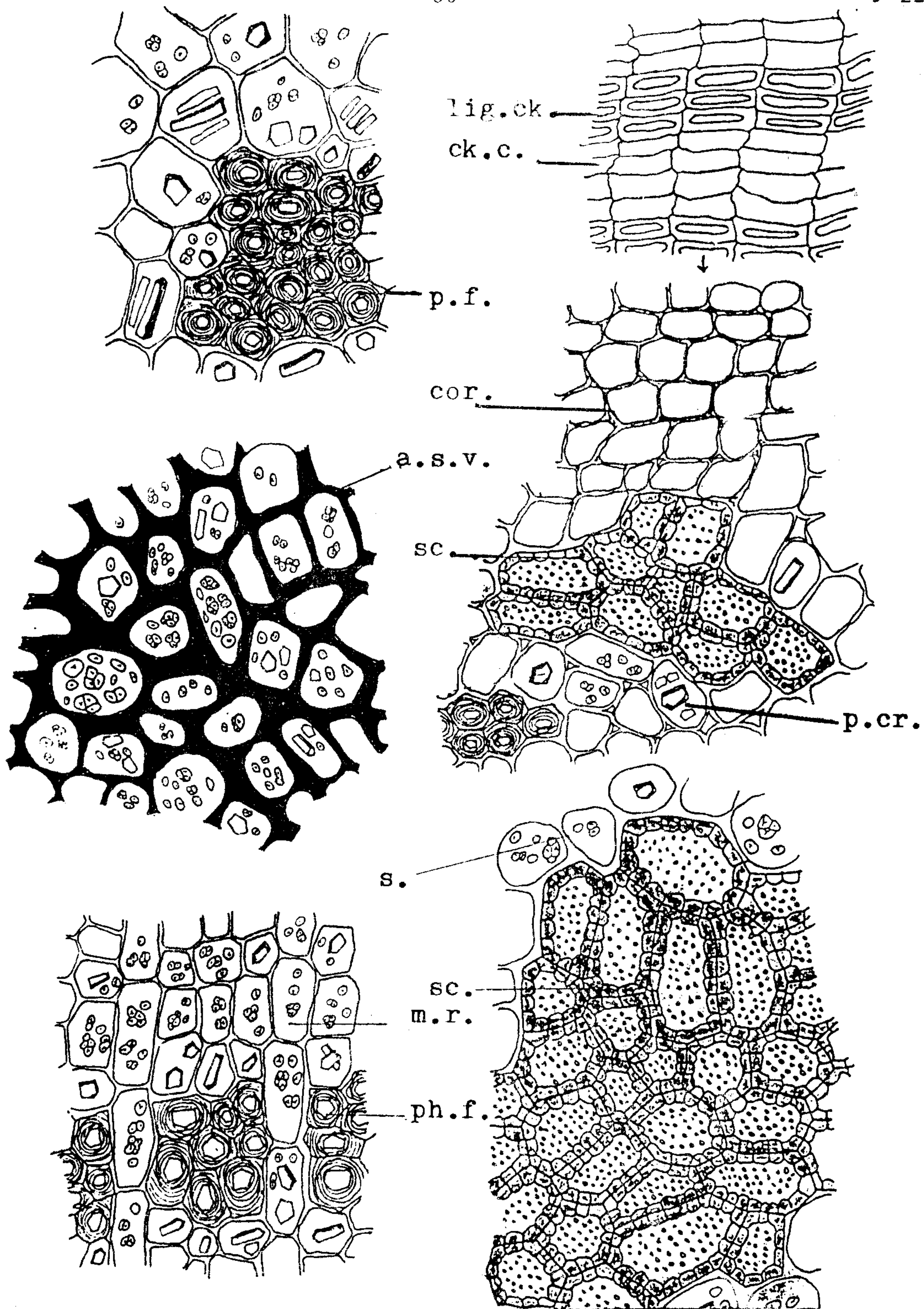


Fig. 3. Detailed T.S. in the stem bark (x 225)
 ck.c, cork cells; lig.ck., lignified cork cells; cor., cortex; m.r. medullary rays; p.f., pericyclic fibres; ph.f., phloem fibers; starch granules; sc., sclerenchymatous cells; a.s.v., anastomosing secretory vessel.

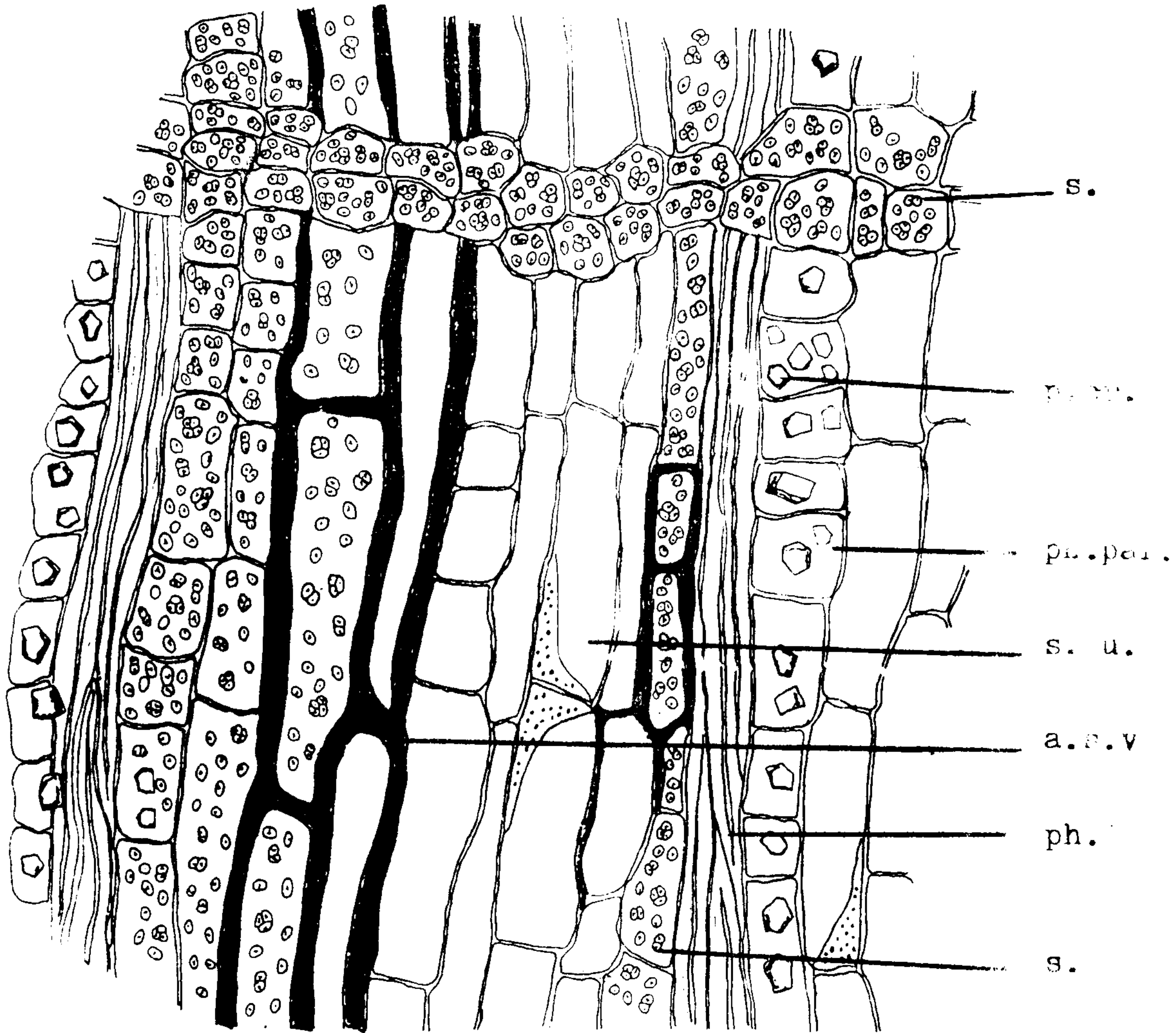


Fig.4. Longitudinal section in the stem bark

(x220)

c.c.,companion cells;

p.cr.,prisms of calcium oxalate ph.f.,phloem fibres;ph.

par.,phloem parenchyma;s.,starch granules;s.tu.,sieve tubes;a.

s.v.anastomosing secretory vessels.

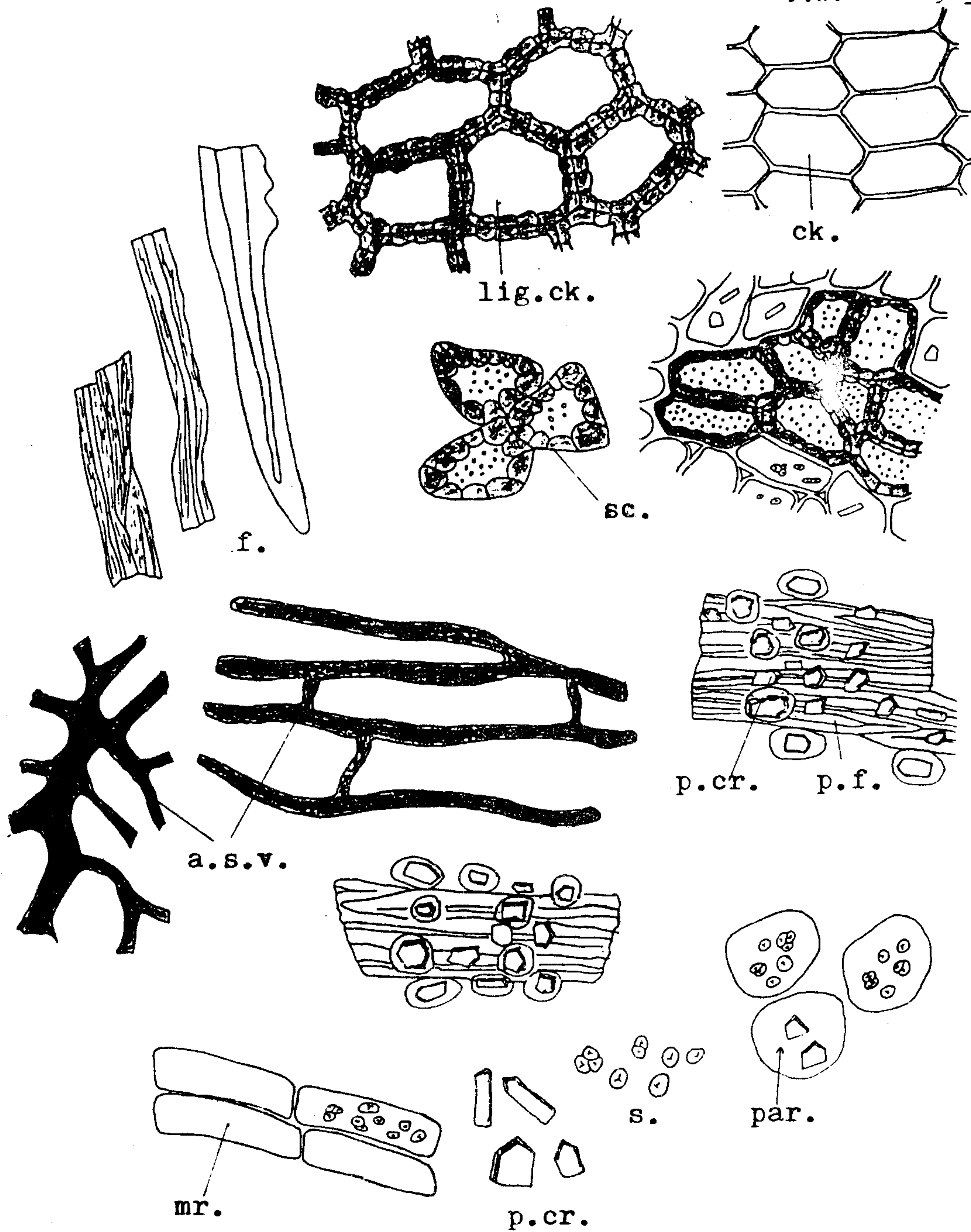
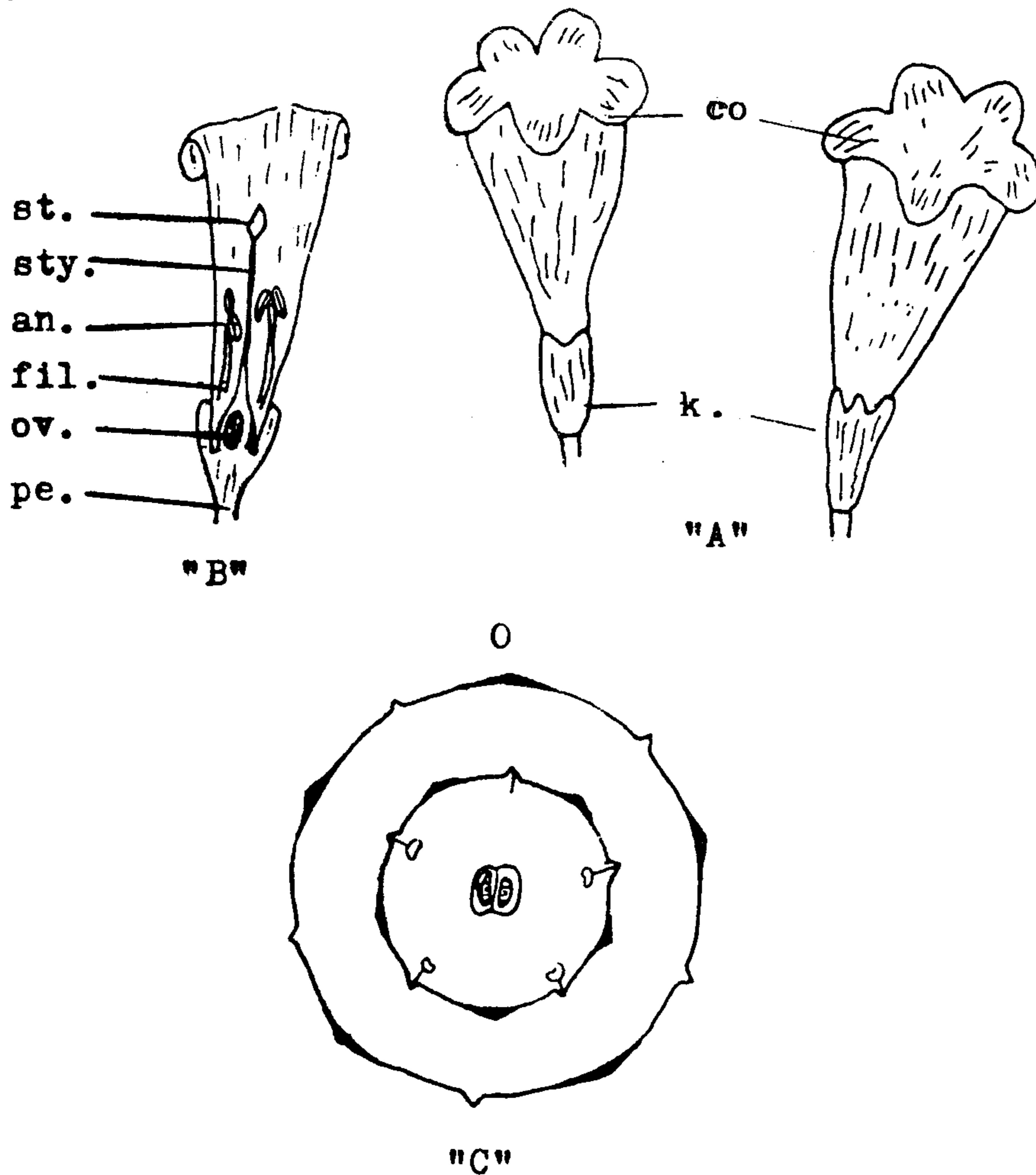


Fig. 5 The powder of the stem bark (x200)
 ck., cork; f., fibre; lig.ck., lignified cork; m.r., medullary ray cells; p.cr., prisms of calcium oxalate; p.f., pericyclic fibres; par., parenchyma; s., starch; sc., scleried; a.s.v. anastomosing secretory vessels.

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♂, ♀. K(5), C(5), A₄₊₁, G(2)

Fig. 6 The flower

A-Macromorphology of the flower

B-L, cut in the flower

C-Floral diagram

an., anther; fil., filament; ov., ovary; pe., pedicel; st., stigma;
sty., style; co., corolla; k., calyx.

(x0.7)

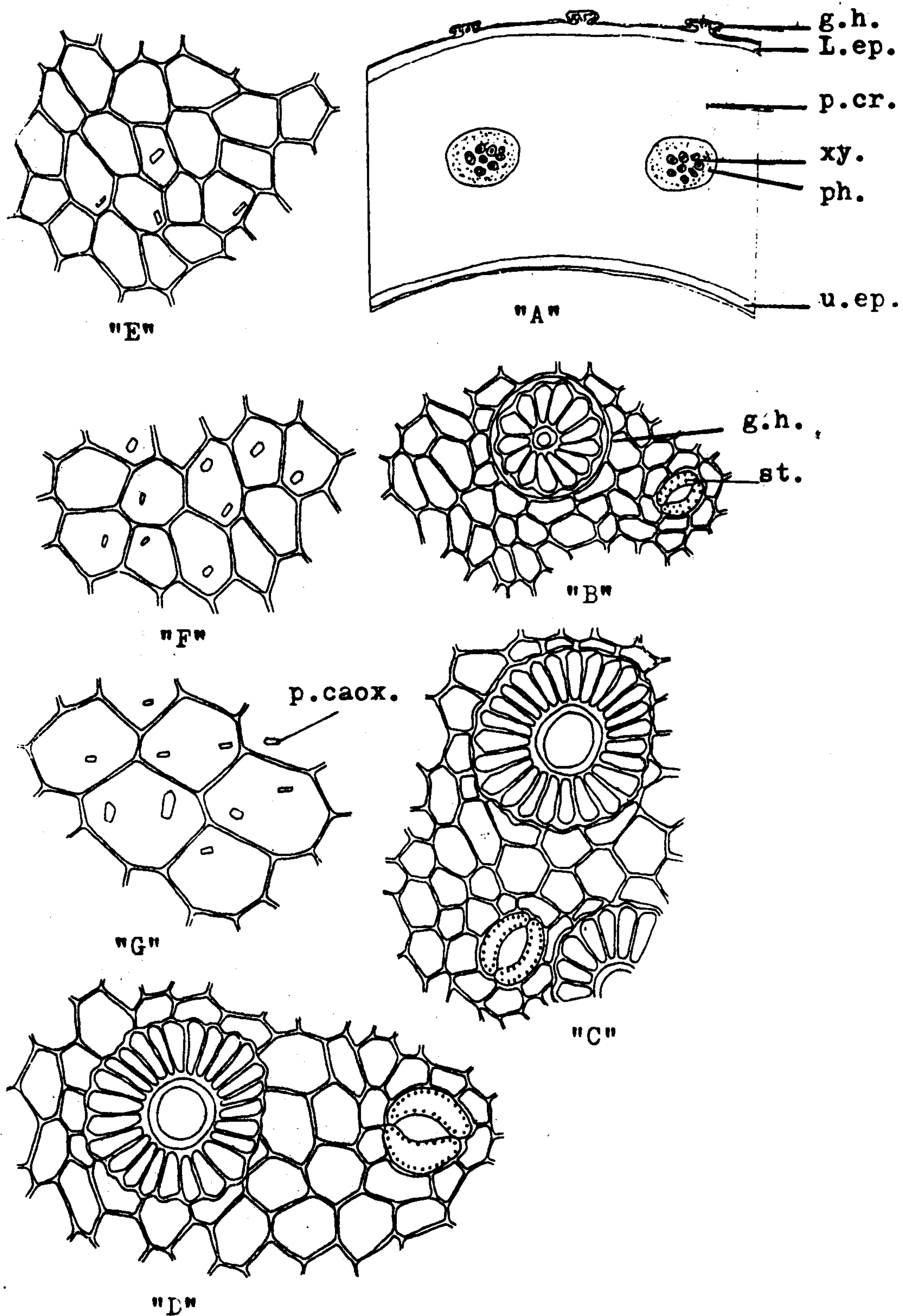


Fig. 7 The sepals, diagrammatic T.S. and surface preparations.

- A- Diagrammatic T.S. in the sepals (x 24)
 The lower epidermis: B- Apical region - C- Middle region (x 210)
 D- Basal region
 The upper epidermis: E- Apical region - F- Middle region (x 210)
 G- Basal region (x 210)
 g.h., glandular hairs; l.ep., lower epidermis; p.cr., prisms of calcium oxalate; ph., phloem; u.ep., upper epidermis; xy., xylem.

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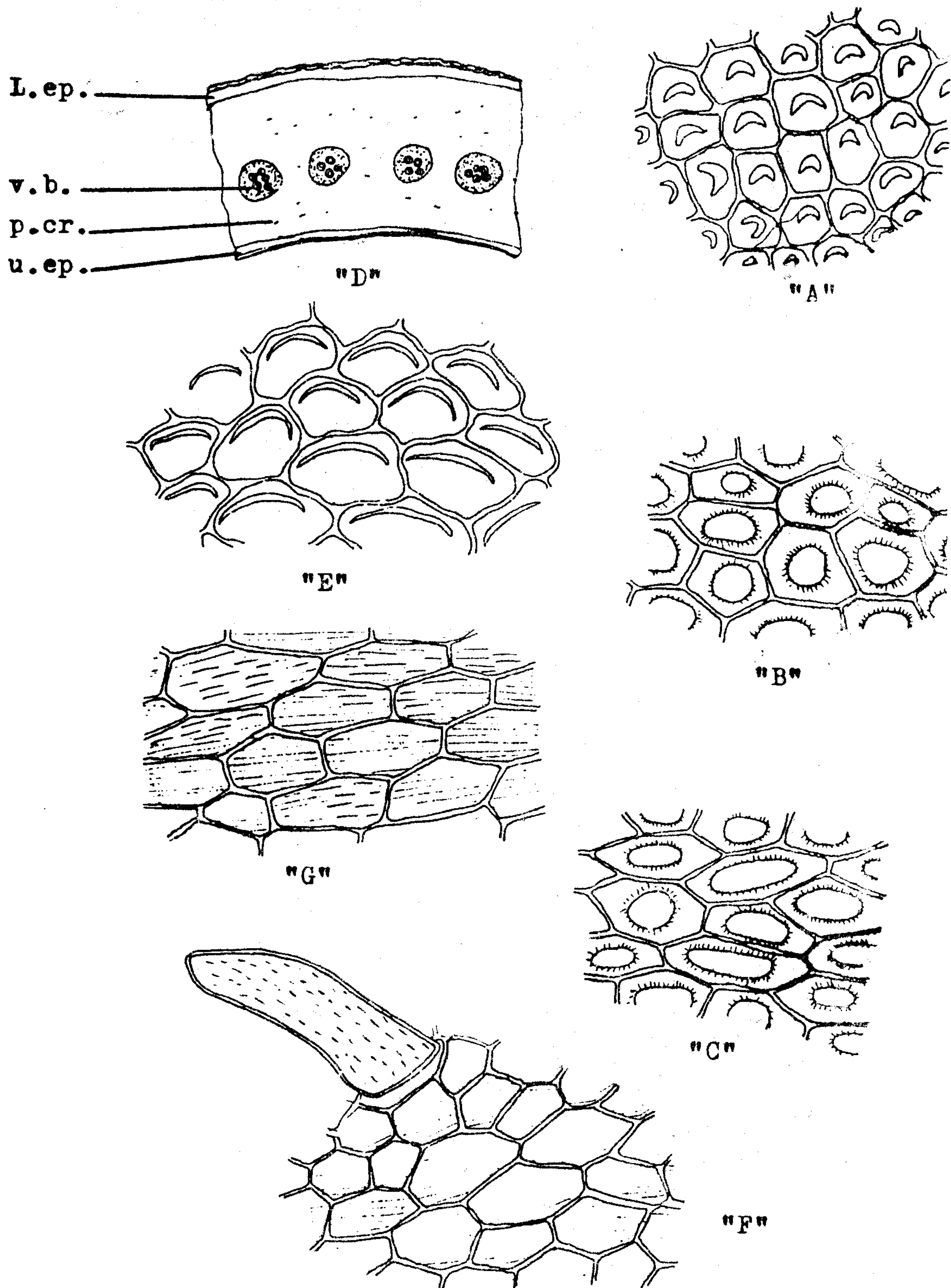


Fig. 8 The petals, diagrammatic T.S. and surface preparations (x33)
The inner surface: B- Middle region. C- Basal region (x200)
D- Diagrammatic T.S. in the petal (x24)
The outer surface E- Apical region F- Middle region (x200)
G- Basal region. (x200)
ep., epidermis; v.b., vascular bundle; p.cr., prisms of calcium oxalate.

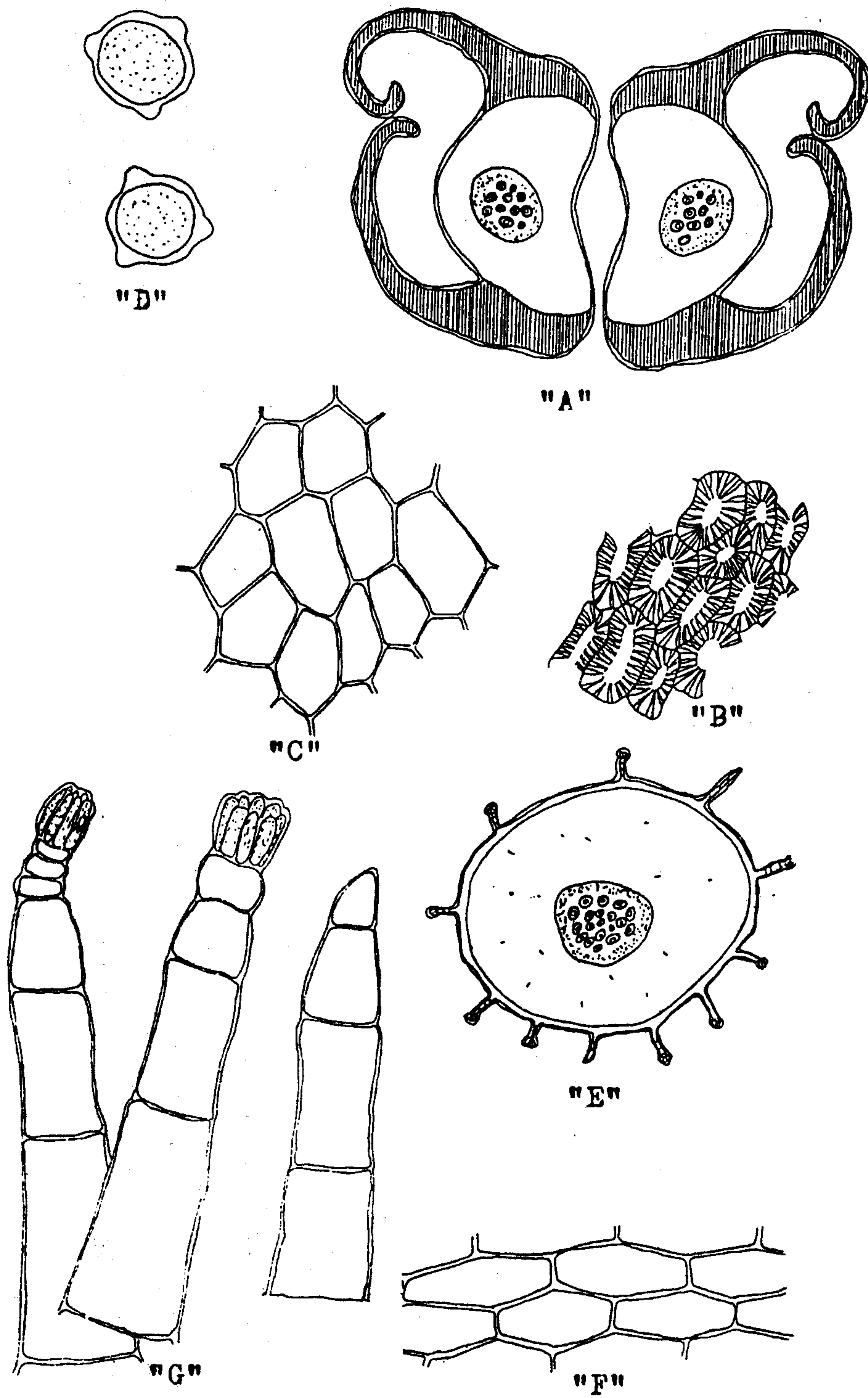


Fig. 9 The androecium

A- Diagrammatic T.S. in the anther

(x 24)

B- Fibrous layer of the anther

(x 208)

C- Epidermis of the anther

(x 208)

D- Pollen grains

(x 200)

E- Diagrammatic T.S. in the basal part of the filament

(x 203)

G- Glandular and non-glandular hairs from the base of filament

(x 140)

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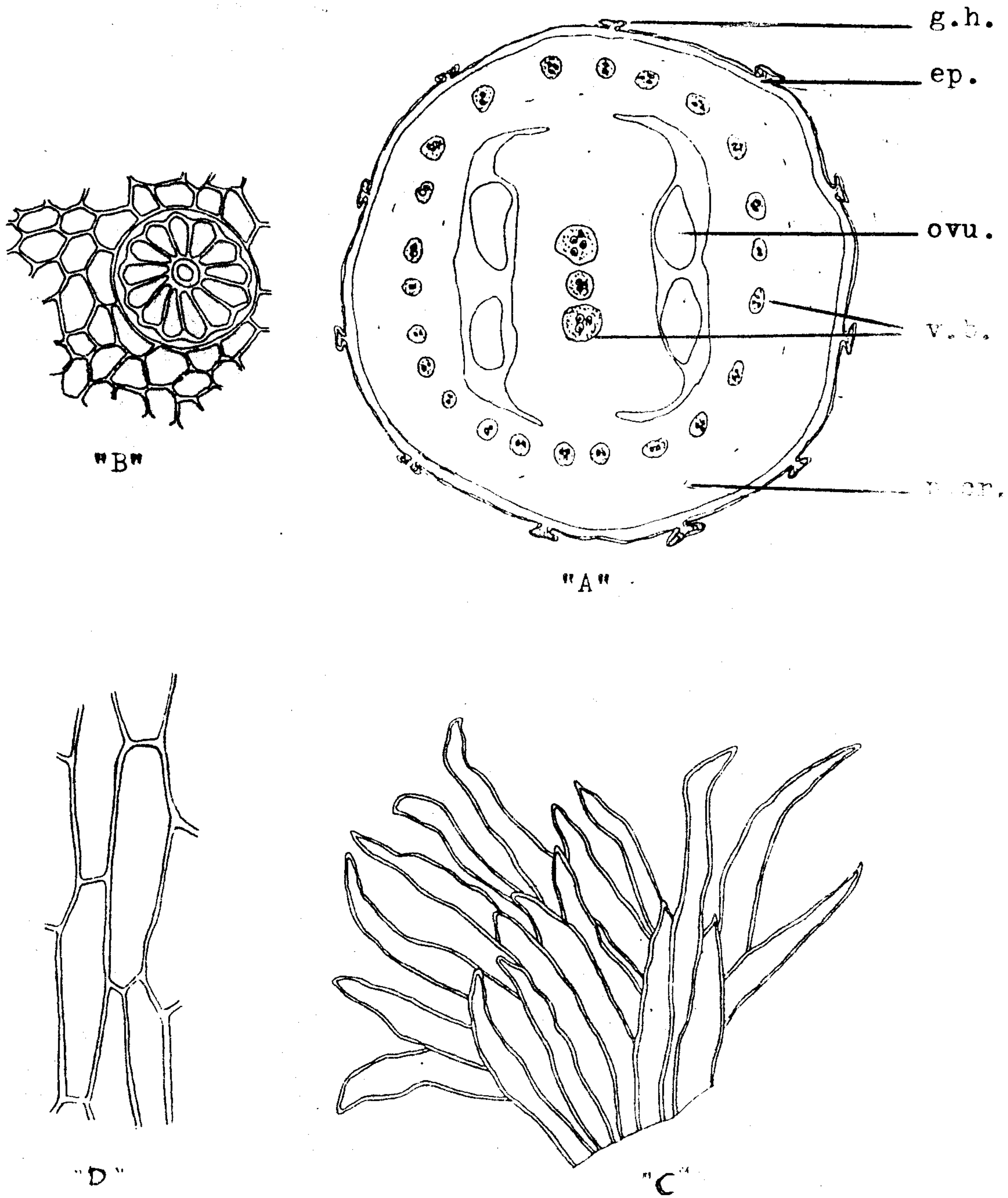


Fig. 10 The gynaecium

A- Diagrammatic T.S. in the ovary

(x 24)

B- Epidermis of the ovary wall

(x 196)

C- The stigma

(x 220)

D- Epidermis of the style

(x 315)

ep., epidermis; g.h., glandular hair; ovu., ovule; p.cr., prisms of calcium oxalate; v.b., vascular bundle.

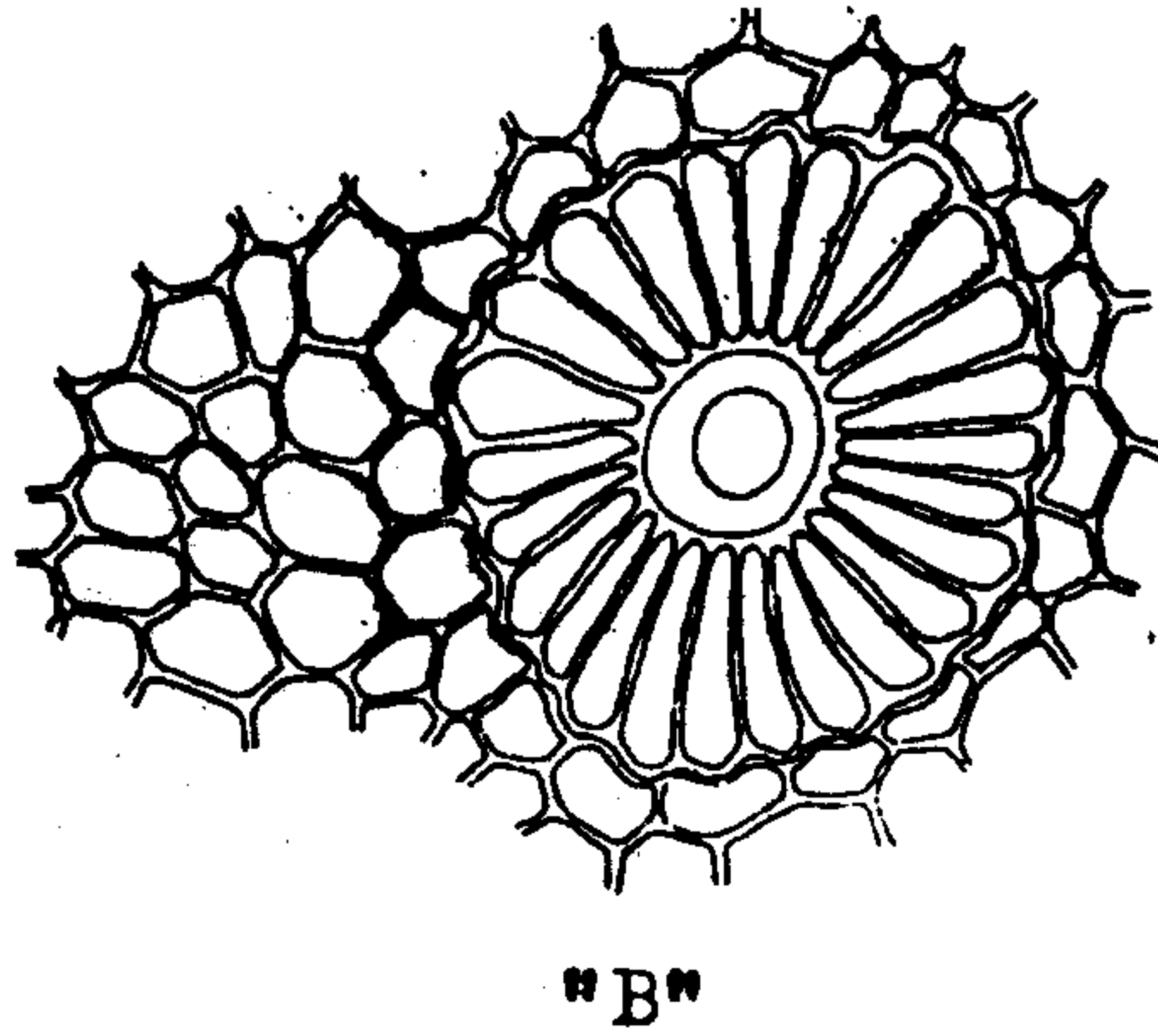
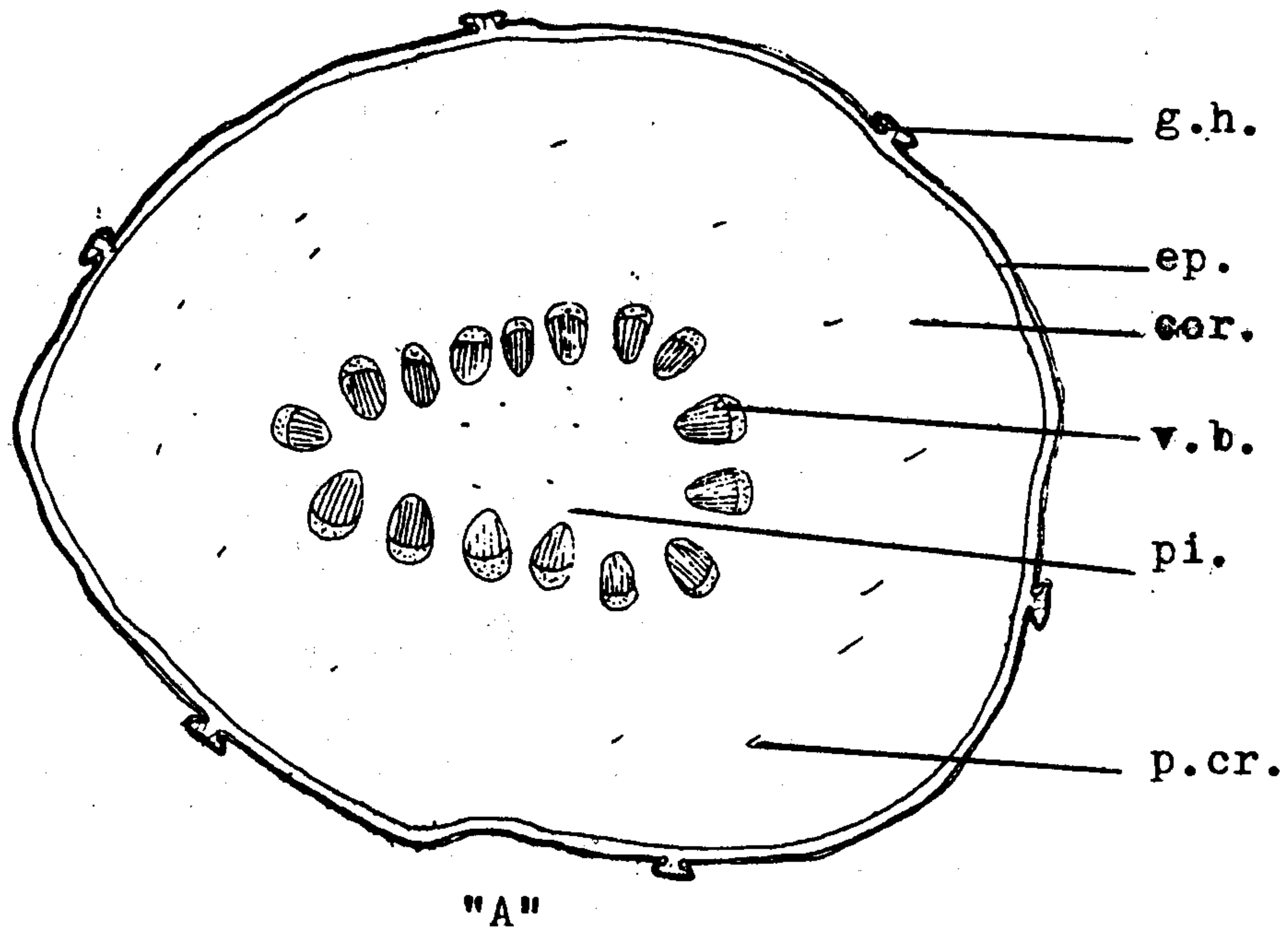


Fig. 11 The pedical

A- Diagrammatic T.S.in the pedicel

(x24)

B- Surface preparation of the pedicel

(x208)

Cor.,cotex;ep.,epidermis;g.h.,glandular hairs;p.cr.,prisms of calcium oxalate;pi.,pith;v.b.,vascular bundle.

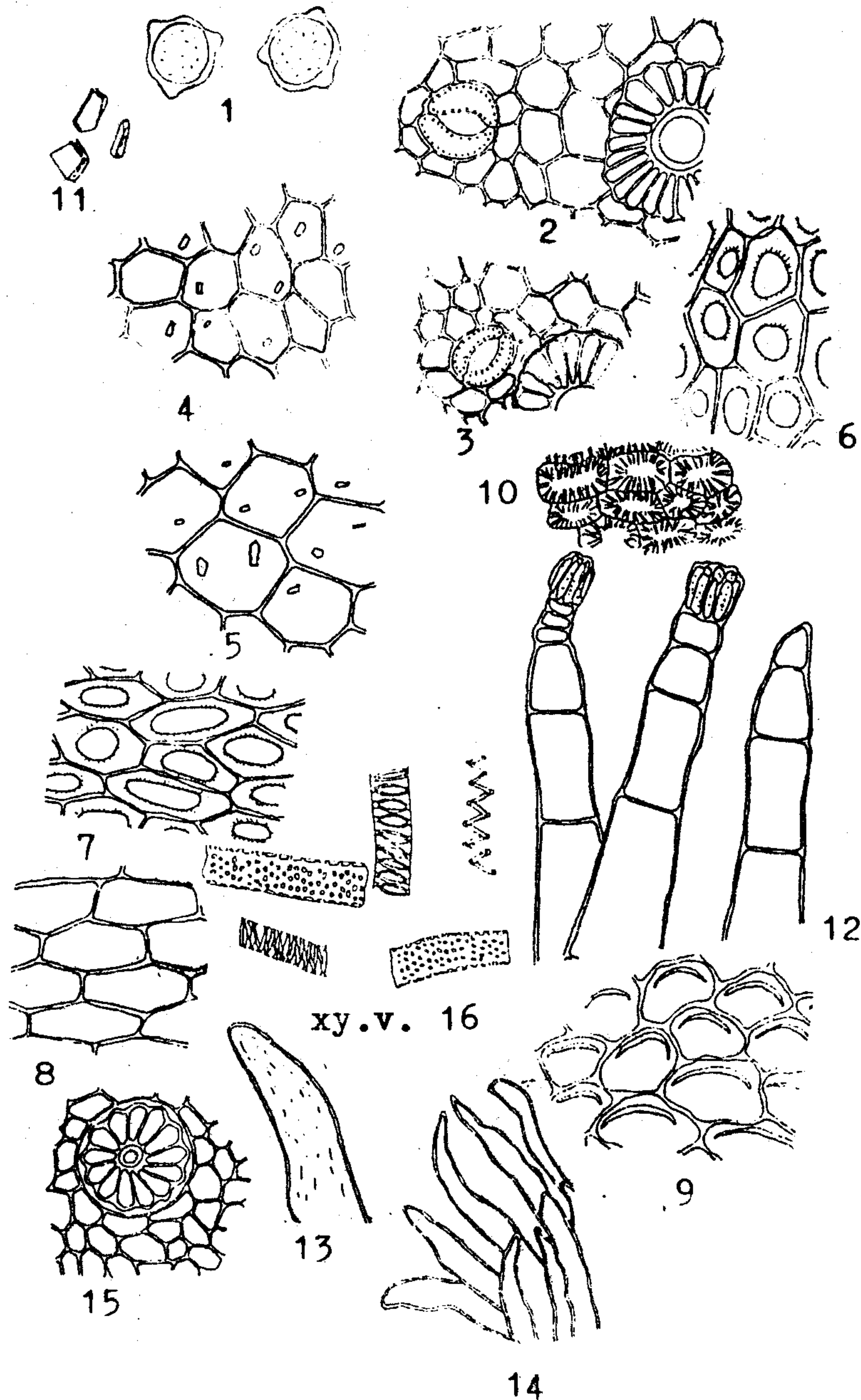


Fig. 12 The powder of the flower

(x168)

- 1- Pollen grains -2- Outer epidermis of the sepals(apical region)
- 3- Outer epidermis of the sepals(basal region)
- 4,5- Inner epidermis of the sepals. 6,7- Outer epidermis of the petals
- 8- Inner epidermis of the petals. 9- Apical region of the petals
- 10- Fibrous layer of the anther 11- Prisms of calcium oxalate
- 12- Glandular and non-glandular hairs from the base of the anther.
- 13- Non-glandular hairs from the inner epidermis of the petals.
- 14- Fragments of papillosed stigma.
- 15- Fragments of epidermis of the ovary
- 16- Lignified spiral, pitted and annular xylem vessels.

الصفات العيانية والمجهريية لنبات التاييبيا

بنتافيللا هيمل المنزرع فى مصر

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الجزء الثانى : القلف والزهره .

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