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MACRO AND MICROMORPHOLOGY OF CASSIA SPECTABILIS.DC. CULTIVATED IN EGYPT.

Part.II. The-Flower, Fruit and Seed.

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ABSTRACT

The macro-and micromorphology of the flower, fruit and seed of Cassia spectabilis DC, cultivated in Egypt 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 paper[1], the macro-and micromorphology of the stem and leaves of Cassia spectabilis DC(Leguminosae, Caesalpiniaceae) were presented. The present work deals with macro-and micromorphology of the flower, fruit and seed of the same plant.

A- The Flower

Macromorphology (Fig. 1 A) :

The flowers are grouped in branched or unbranched, dense , terminal racemes. Each has long straight solid peduncle, 15-25 cm in length and up to 15 mm in diameter, which has a hairy surface and bears more than 12 flowers alternatively arranged.

The flower is pedicellated, abracteate, hermaphrodite, zygomorphic, pentamerous, epigenous with faint odour and bitter taste. It has the following floral formula.

% , ♀ , K 2+3 , C_5 , A_{7+3} , $G\underline{1}$

The Calyx (Fig. 1 C&D) :

It is persistent of 5 sessile free sepals, three are larger, spathulate with rounded apices entire margins and arranged in one whorl in a contorted manner, measuring from 8-10 mm long and 5-7 mm wide. The others are smaller, lanceolate in shape with acute apices and each is situated externally to one side of the flower, measuring from 3-6 mm long and 2-4 mm wide. The calyx is yellowish-brown in colour and its outer surface is hairy.

The Corolla (Fig. 1 E) :

It is composed of 5 bright yellow imbericate petals, each is shortly petiolated, ovate with entire margin and rounded apex and measuring from 6-14 mm long and 5-8 mm wide.

The Androecium (Fig. 1 P&F) :

It consists of 10 free stamens of unequal lengths, 7 of them are larger and arranged in one whorl measuring 6-8 mm long; their anthers from 4-6 mm and 2 mm in width. The other three are smaller, staminode, laterally arranged and measure from 2-4 mm long. The anthers are basifixed yellow in colour.

The Gynaecium (Fig. 1 G) :

It is dark brown in colour, superior, monocarpellary, unilocular and measuresfrom 1-2 cm in length and 2-3 mm in diameter. The ovary is elongated with an elongated style and stigma. The ovules are arranged on a marginal placenta.

The Pedicel (Fig. 1 A) :

It is green, straight, cylindrical and solid, with hairy surface. It measures from 7-20 mm length and 1-3 mm wide.

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Micromorphology :

1- The calyx : A transverse section in the sepal (Fig. 2 A) comprises inner and outer epidermises, enclosing in between a homogeneous parenchymatous mesophyll traversed by numerous vascular bundles.

The inner epidermis (Fig. 2 B) :

The cells are polygonal, somewhat elongated with straight anticlinal walls. They are covered with striated cuticle and measure from 20-35-50 u in length and 12-30-50 u in width. Stomata and trichomes are not observed.

The outer epidermis (Fig. 2 C) :

The cells are polygonal, subrectangular with straight anticlinal walls. The cells are covered with striated cuticle, being 44-56-68 u in length and 16-30-44 u in width. Stomata of the paracytic type are present being 20-22-26 u in length..Non-glandular, unicellular trichomes are abundant, covered with warty cuticle; measuring from 88-244-800 u in length and 18-22-26 u in width at the base.

The mesophyll (Fig. 2 A) :

It is formed of thin-walled parenchyma, containing cluster crystals of calcium oxalate. The vascular bundles consist of soft cellulosic phloem and radiating xylem of lignified vessels.

2-The corolla : A transverse section in the petal (Fig. 3 A) is planoconvex in outline, showing outer and inner epidermises enclosing in between a parenchymatous mesophyll traversed by a main vascular bundle and other smaller ones.

The inner epidermis (Fig. 4 A) :

The cells are polygonal with wavy anticlinal wals, In surface view they have different dimensions according to their positions (Fig. 4 A) ranging from 22-39-56 u in length and 16-28-40 u in width.

The cells are covered with striated cuticle. Stomata and trichomes are not observed.

The outer epidermis (Fig. 4 B) :

They are polygonal with sinuous and wavy anticlinal walls. The cells are papillosed and covered with striated cuticle. They have different dimensions ranging from 20-42-60 u in length and 14-22-40 u in width. Stomata and trichomes are not observed.

The cortical tissue (Fig. 3 B) :

It is formed of thin-walled parenchyma cells containing cluster crystals of calcium oxalate. The vascular bundles are composed mainly of xylem consisting of lignified spiral and scalariform vessels and narrow phloem of soft cellulosic elements.

3- The androecium :

The filament (Fig. 5 E) :

The epidermis of the filament consists of polygonal isodiametric cells with straight anticlinal walls covered with striated cuticle and measure from 15-24-33 u in length and 12-19-26 u in width. Non-glandular unicellular trichomes covered with warty cuticle are also seen.

The anther :

A T.S.through the anther (Fig. 5 A) shows two lobes attached by the connective through which passes a central vascular strand, Each anther lobe is formed of two pollen sacs, containing pollen grains. The anther wall consists of epidermis and fibrous layer. The connective is formed of small thin-walled parenchyma.

The epidermis (Fig. 5 B) consists of polygonal subrectangular cells with somewhat straight anticlinal walls. The cells are papillosed covered with striated cuticle and measure from 18-34-50 u in width and 20-25-30 u in height. Stomata and trichomes are observed.

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The fibrous layer (Fig.5 C&D) is formed of 1-3 rows of lignified cells with bar-like thickened walls. In surface view they are more or less polygonal with beaded walls, measure from 22-34-64 u in length, 18-28-38 u in width and 62-66-70 u in height.

The pollen grains (Fig. 5 F) are pale yellow in colour, spherical with minute pitted exine. Each posseses 3 germ pores and 3 germinal furrows, measure from 35-40-45 u in diameter.

4-The gynaecium :

The ovary :

A T.S.in the ovary (Fig. 6 A) is nearly rounded with an epidermis enclosing a wide ground tissue of parenchyma containing cluster crystals of calcium oxalate and traversed by 5 collateral vascular bundles. The ovary is unilocular and the ovules are attached to marginal placenta.

The epidermis of the ovary (Fig. 6 B) is formed of polygonal, isodiametric cells with straight anticlinal walls and covered with striated cuticle. They measure from 15-19-23 u in length and 10-16-22 u in width. Stomata and trichomes are not observed.

The style (Fig. 6 C) :

It shows an epidermis of polygonal, axially elongated cells with straight anticlinal walls and covered with striated cuticle. they measure from 14-22-30 u in length and 10-15-20 u in width. Stomata and trichomes are not observed.

The stigma (Fig.6 D):

It shows polygonal epidermal cells with straight anticlinal walls. They measure from 15-21-27 u in length and 10-18-26 u in width. The cells are covered with striated cuticle. Elongated papillae are present near the tip of the stigma.

5- The pedicel : A T.S. through the pedicel (Fig. 7 A) is more or less rounded in outline. It has an outer epidermis surrounding a cortical tissue which consists of an outer collenchymatous layer and an inner parenchymatous one. The epidermis is covered with a large number of trichomes (Fig.7 B). The innermost layer of the cortex (endodermis) is indistinguishable. The vascular system is surrounded by a complete ring of pericyclic fibres of about 6-9 rows which are accompanied by a crystal sheath with prismatic crystals of calcium oxalate (Fig. 7 C). The phloem is formed of soft cellulosic elements. Stomata are not observed.

The xylem region (Fig. 7 A&C) is radiating and protruding in the pith. It is formed of lignified spiral vessels, non-lignified wood parenchyma and uni-bi-or multiseriate medullary rays.

The phloem and xylem are separated by a cambial zone of 2-4 rows. The central pith is wide and parenchymatous, containing prisms and clusters of calcium oxalate.

THE POWDERED FLOWER

The powdered flower is yellowish-brown in colour with characteristic odour and bitter taste. Microscopically, the powder is characterised by the following features (Fig. 8) :

1- Fragments from the epidermis of the calyx, showing polygonal elongated cells with straight anticlinal walls and covered with striated cuticle. Fragments of the outer epidermis carrying stomata of the paracytic type and non-glandular unicellular trichomes.

2- Fragments from the outer epidermis of corolla showing papillosed, plygonal cells with sinuous walls and covered with striated cuticle.

3- Fragments from the inner epidermal cells of the corolla which are polygonal and covered with striated cuticle.

4- Fragments from the epidermal cells of the anthers which are papillosed and covered with striated cuticle.

5- Fragments from the fibrous layer of anthers which are polygonal with beaded lignified walls and showing bar-like thickenings.

6- Numerous spherical pollen grains, with pitted exine. Each one possesses 3 germ pores and 3 germinal furrows.

7- Fragments from the epidermis of stigma, which are polygonal cells, covered with striated cuticle and showing elongated papillae.

8- Lignified spiral and scalariform xylem vessels.

9- Scattered prisms and cluster crystals of calcium oxalate.

10- Groups of lignified pericyclic fibres, with thick walls, wide lumina surrounded by crystal sheath containing prismatic crystals of calcium oxalate.

11- Numerous non-glandular, unicellular trichomes of different dimensions. They are curved and covered with warty cuticle with acuminate apices.

12- Absence of stone cells.

B. THE FRUIT

Macromorphology (Fig. 9) :

It is a stalked, dry, indehiscent pod. It is straight or slightly curved, cylindrical and constricted crosswise forming one-seeded joints and containing up to 30 seeds. The surface is wrinkled, finely striated traversely. The distal end is rounded and bear a small curved point marking the position of style, while the proximal end is extended as a short brown stalk. The pericarp is thick and hard. The fruits measure from 25-40 cm in length and 1-1.5 cm in diameter. It has a characteristic odour and bitter taste.

Micromorphology of the fruit :

1- The pericarp :

A T.S. through the pericarp (Fig. 10) shows an outer epicarp

of one layer and an inner sclerenchymatous endocarp enclosing a wide mesocarp. The latter consists of parenchyma traversed at the outer region by a layer of sclerenchyma in which several collateral vascular bundles are embedded.

The epicarp (Fig. 11) :

It is formed of a single layer of subrectangular cells. In surface view (Fig.10 A), the cells are polygonal, with straight anticlinnal walls and covered with smooth cuticle. They measure from 14 -17-20 u in height, 16-24-32 u in length and 8-14-20 u in width. Stomata and trichomes are not observed.

The mesocarp (Fig. 11) :

The outer layer consists of 6-8 rows of tangentially elongated, thin-walled parenchyma cells containing clusters of calcium oxalate. The inner parenchymatous layers are isodiametric and towards the endocarp they are more radially elongated The sclerenchyma consists of oval cells with narrow radiating lumina and thick lignified walls, measuring 20-32-44 u in width and 66-161-256 u in length.

The vascular bundle (Fig.10) consists of narrow zone of soft cellulosic phloem and inner xylem consists of lignified vessels. It shows an upper arc of lignified pericyclic fibres accompanied with crystal sheath containing prismatic crystals of calcium oxalate.

The endocarp (Fig. 11) :

Consists of oval or subrectangular sclereids with lignified walls and narrow radiating lumina. They measure about 22-32-42 u in width and 66-161-256 u in length.

THE POWDERED FRUIT

The dried powdered pericarp is brown in colour with a slight characteristic odour and a bitter taste. Microscopically, it is characterized by the following (Fig. 12):

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1- Fragments of the epicarp, consisting of polygonal cells with straight anticlinal walls and covered with smooth cuticle.

2- Fragments of the mesocarpal parenchyma which are elongated, containing prisms and clusters of calcium oxalate.

3- Numerous lignified sclereids, with thick walls and narrow radiating lumina.

4- Fragments of pericyclic fibres with thick lignified walls and narrow lumina.

5- Fragments of lignified spiral and scalariform xylem vessels.

6- Numerous free and scattered prisms and clusters of calcium oxalate.

7- Absence of trichomes.

C. THE SEED

Macromorphology (Fig. 9 C) : The seed is oval, flattened, greenish-yellow in colour. It has a narrow end containing the hilum and micropyle. The surface is smooth with a well-marked raphe on one of the flat surfaces. The seed is odourless with bitter taste. It measures from 4-6 mm in length and from 2-4 mm in width. A transverse cut of the seed (Fig. 9 D&E) shows two planoconvex, yellowish fleshy cotyledons surrounded by a whitish oily endosperm and a thick seed coat. The radicle is short and pointed towards the micropyle. The seed is of albuminous type.

Micromorphology of the seed (Fig. 13 A) :

A T.S. in the seed is more or less oval in cross section. The testa shows an outer epidermis accompanied with hypodermal layer. The middle zone is homogeneous of 6-8 rows of thick-walled parenchyma. It is followed by an inner layer similar to the hypodermis and a hyaline collapsed layer. The testa encloses a narrow oily endosperm in which the dicotyledonous embryo is embedded.

The epidermis (Fig. 13 B) :

It is formed of one row of radially elongated cells. They are closely packed with thickened cellulosic non-lignified walls and narrow lumina forming a palisade-like layer. The epidermis is covered with thick cuticle. In surface view (Fig. 13 B), the cells appear polygonal with slightly wavy walls and narrow radiating lumina. They measure from 82-88-94 u in height, 17-22-27 u in length and 8-12-16 u in width.

The hypodermis, middle layer and inner layer (Fig.13 B) :

The hypodermis is formed of cells, slightly constricted at their middle part, showing a narrow outer end and a wide basal one. In top or basal view (Fig. 14 B) they appear polygonal each with a central rounded area representing the narrow end of the cell. They posses thickened cellulosic walls.

The middle zone is composed of several rows of slightly compressed parenchyma, oval in shape with thick non-lignified walls, they are free from any contents.

The inner layer of the seed coat is formed of cells similar to those of the hypodermal layer but smaller in size.

The endosperm (Fig.13 B) :

It consists of isodiametric hexagonal cells with thick cellulosic slightly beaded walls, measuring from 54-74-94 u in length and 22-44-66 u in width. They contain fixed oil droplets which stain red with Sudan III, granular protein contents staining yellow with picric acid and mucilage which stains red with Ruthenium red.

The embryo (Fig. 13 B):-

The cotyledon is formed of upper and lower epidermises which are somewhat square in shape, enclosing inbetween elongated palisade-like cells, becoming more or less isodiametric towards the inners. They measure 60-69-78 u in length, 9-11-13 u in width at the outer part, 22-28-34 u in length and 12-16-20 u in width at the inner part. They contain fixed oil globules and granular protein.

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THE POWDERED SEED

It is pale greenish-brown in colour, having a faint odour and disagreeable bitter taste. Microscopically, it is characterised by the following features (Fig. 14):

1- Fragments from the palisade-like cells of the testa, which appear in side view, radially elongated with thickened cellulosic, non-lignified walls. In top and basal views , they appear polygonal with slightly wavy anticlinal walls, and narrow radiating lumina.

2- Numerous cells from the hypodermis which are oval or rounded and slightly constricted at the middle part. The cells possess thickened cellulosic walls. Some appear in top or basal view as polygonal cells with a central rounded area.

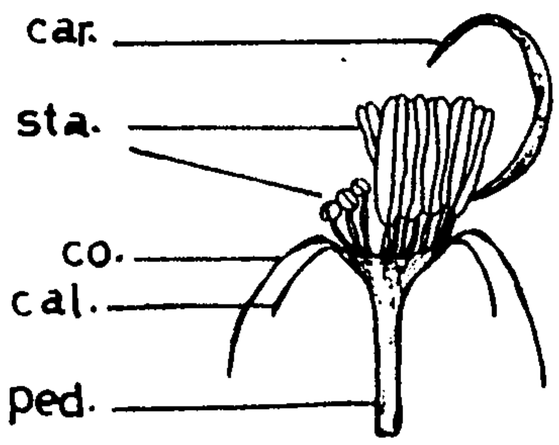
3- Fragments of oval parenchyma of the middle zone with thick non-lignified walls.

4- Fragments of the endosperm showing polygonal, isodiametric cells with thick cellulosic, beaded walls and containing oil droplets, protein granules and mucilage.

5- Fragments of palisade-like cells of the embryo, containing oil droplets and protein granules.

6- Spiral and scalariform lignified xylem vessels from the raphé.

-A-



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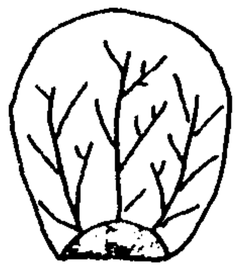

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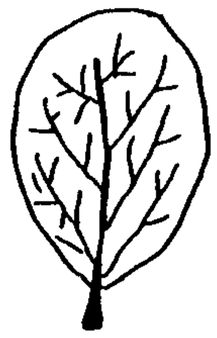

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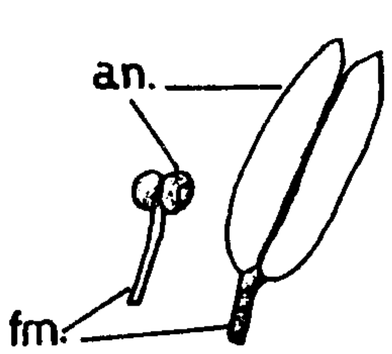

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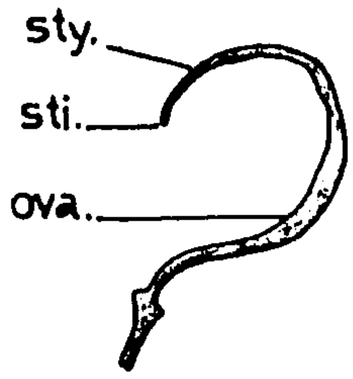

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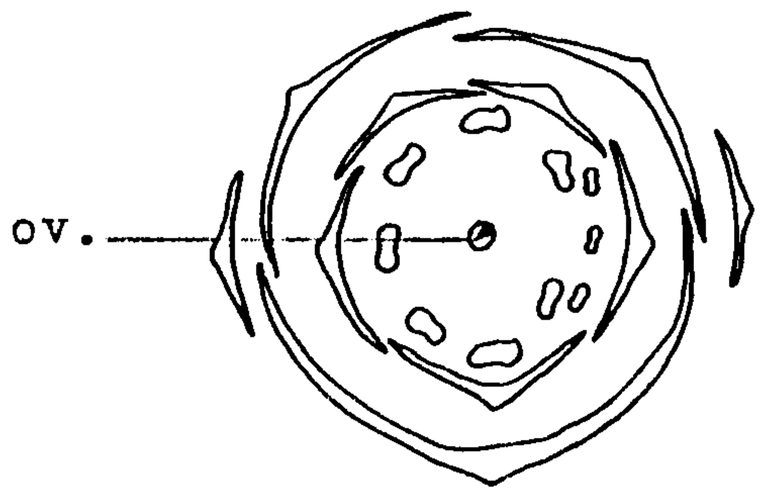

-H-

Fig.1: A-The Inflorescence X 1.5
B-Opened flower X 1.5
C & D-Sepals X 2.8
E-Petal X 2 F-Stamens X 4
G-Carpel X 2 H-Floral diagram

an.,anther;cal.,calyx;car.,carpel;co.,corolla;fl.,flower;fm.,filament
ova.,ovary;ped.,pedicel;sta.,stamen;sti.,stigma;sty.,style.ov.,ovule

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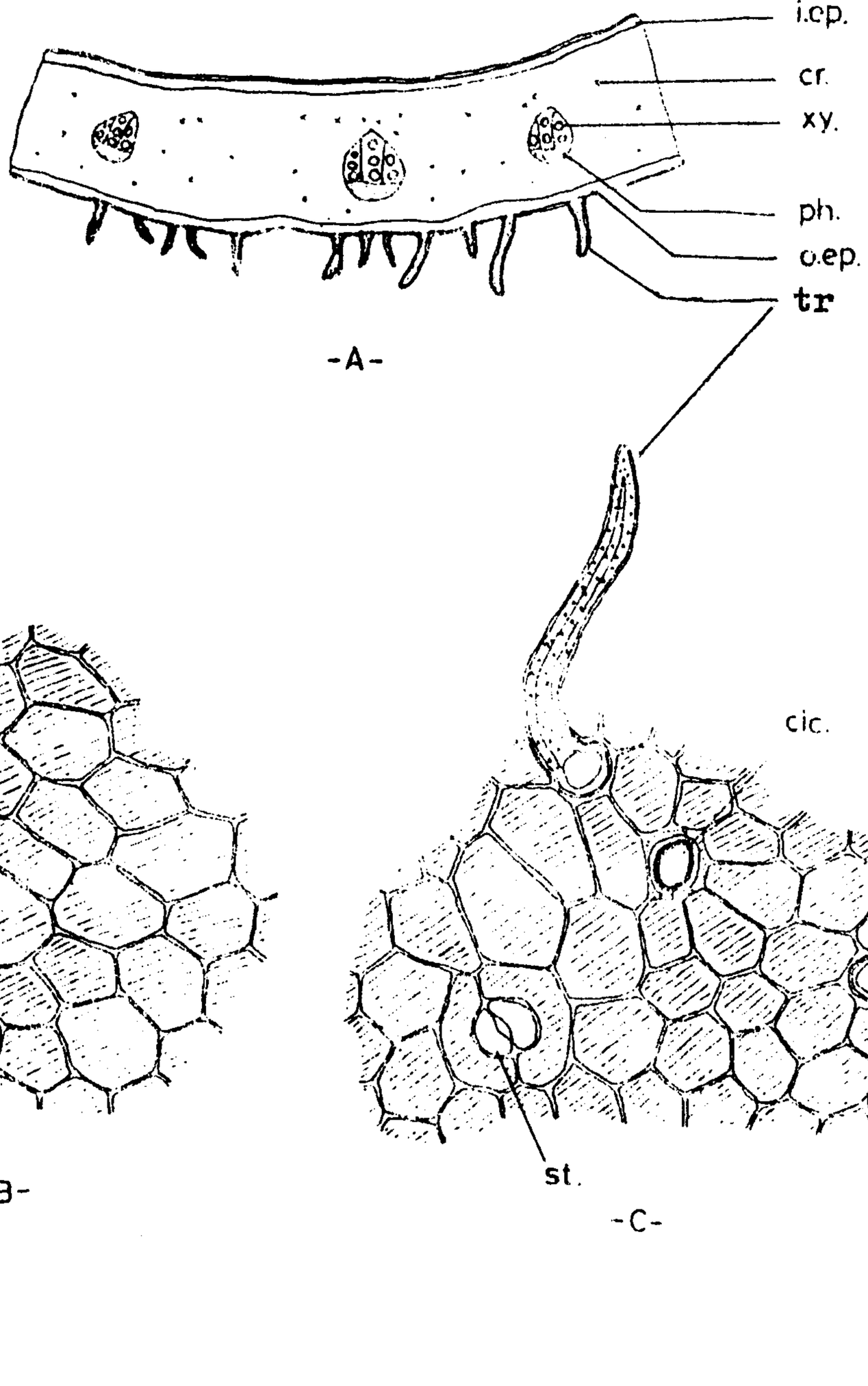

Fig. 2: The Calyx

A-Diagrammtic T.S.in the calyx X 68

B-Inner epidermis X 268

C-Outer epidermis X 268

cic.,cicatrix;cr.,crystal of ca.ox.;i.ep.,inner epidermis;o.ep.,outer epidermis;ph.,phloem;st.,stomata;tr.,trichome;xy.,xylem.

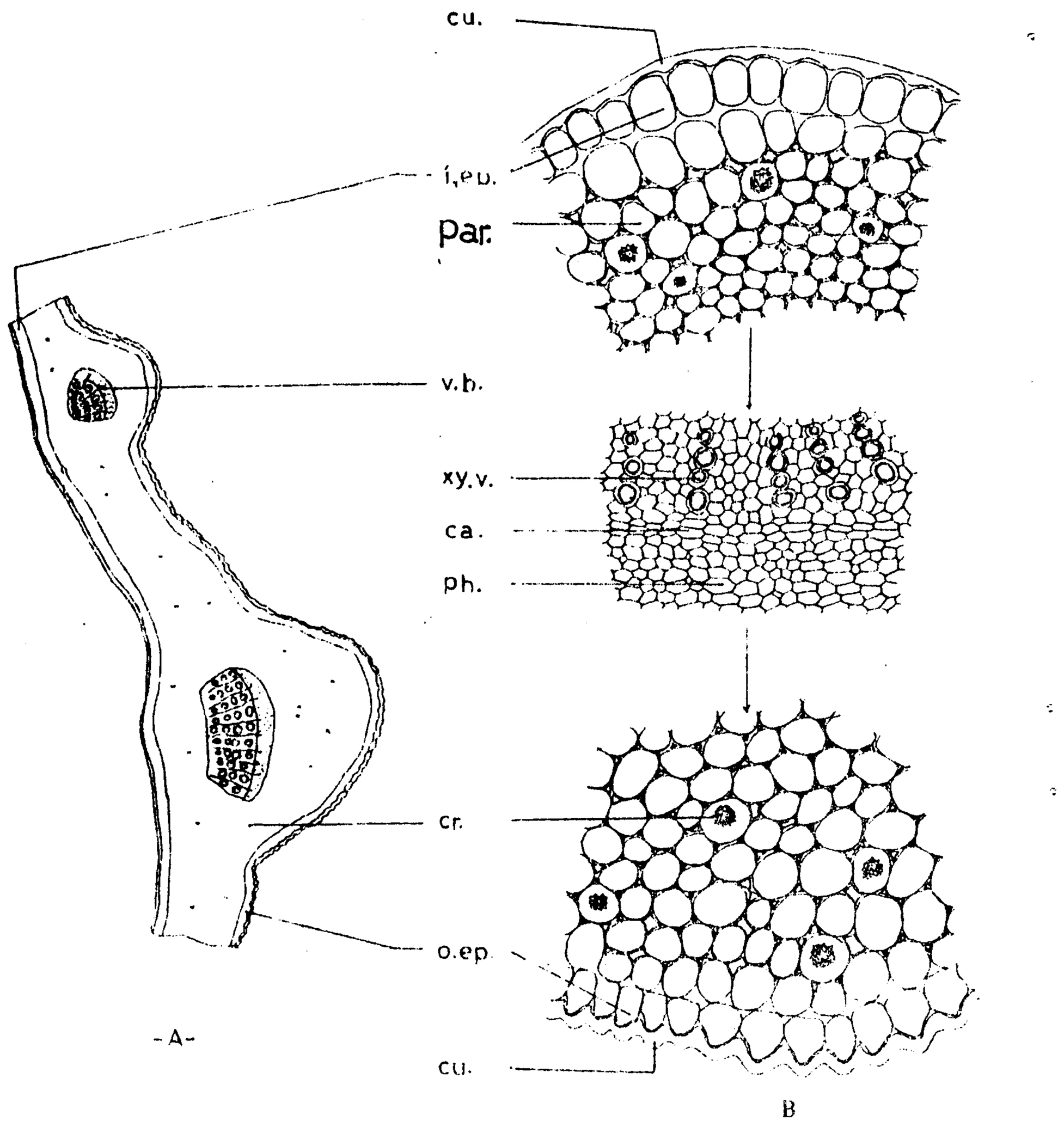

Fig. 3: A-Diagrammatic T.S.in the corolla X 68
B-T.S.sector in the corolla X 268
ca.,cambium;cr.,crystals of ca.ox.;cu.,cuticle;i.ep.,inner epidermis
o.ep.,outer epidermis;par.,parenchyma;ph.,phloem;v.b.,vascular bundle
xy.v.,xylem vessel.

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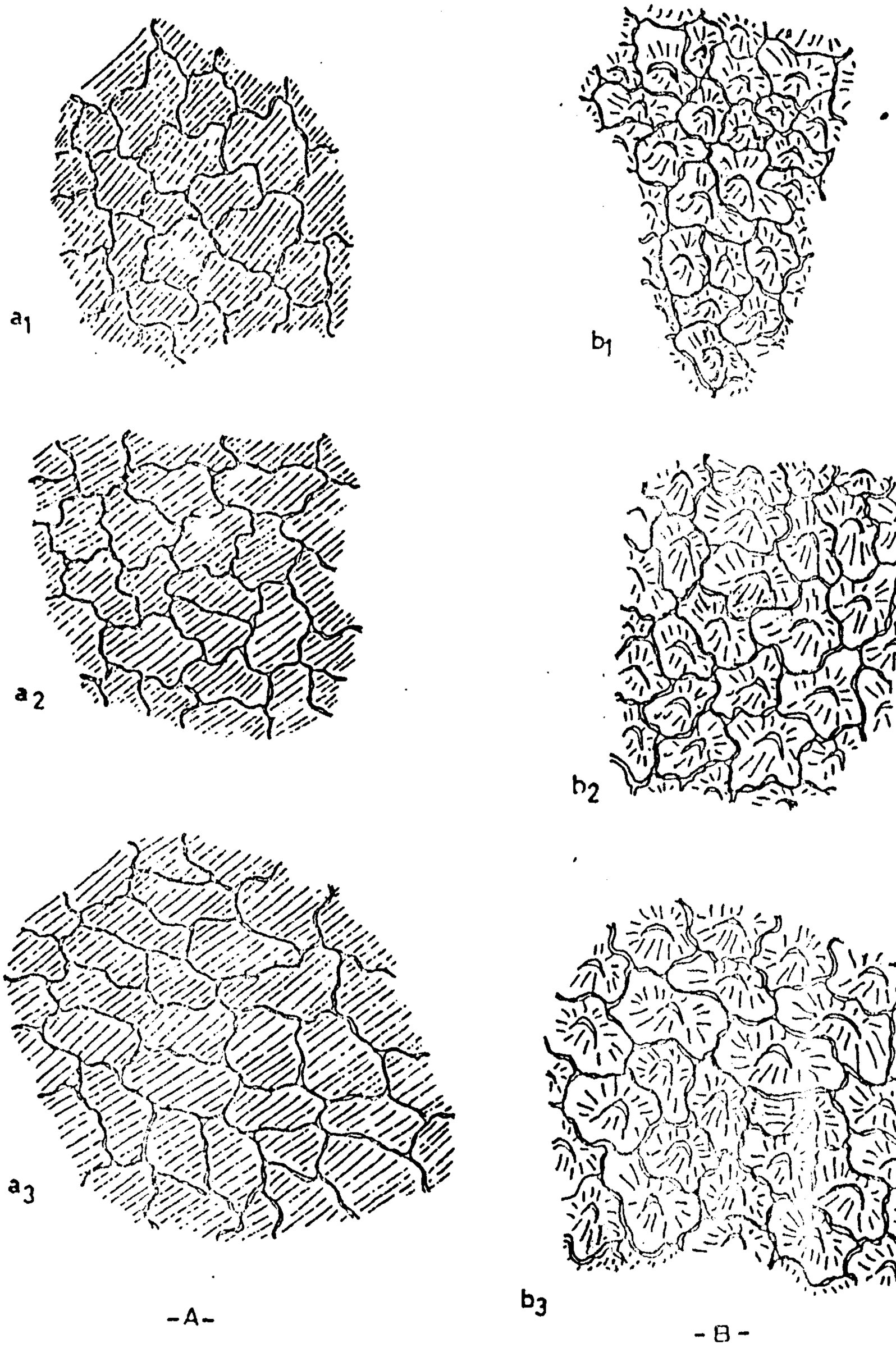


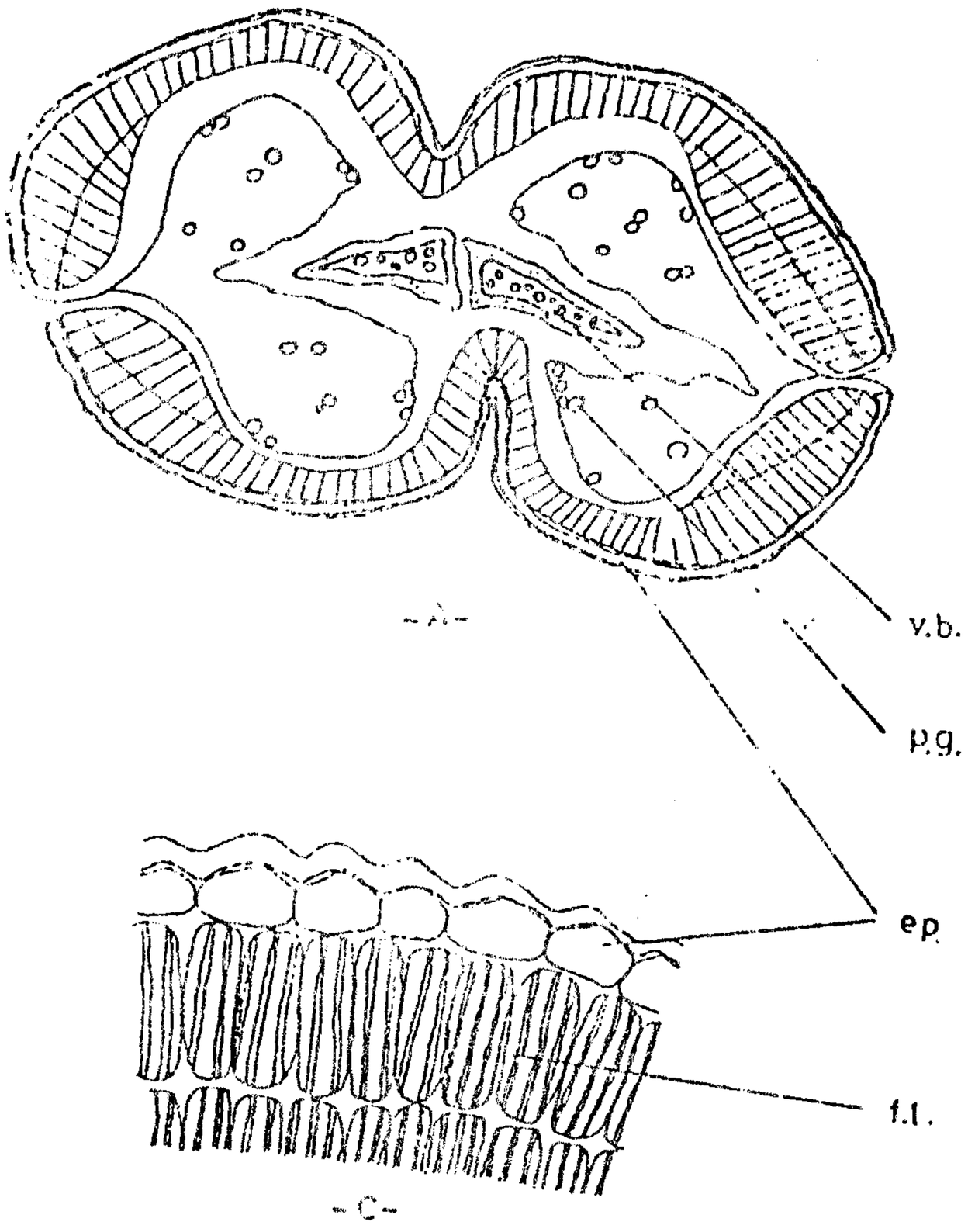
Fig. 4: The Corolla

A-Inner epidermis:

a_1-Upper part X 299 a_2-Middle par X 299 a_3-Lowerpart X 299

B-Outer epidermis:

b_1-Upper part X 299 b_2-Middle part X 299 b_3-Lower part X 299



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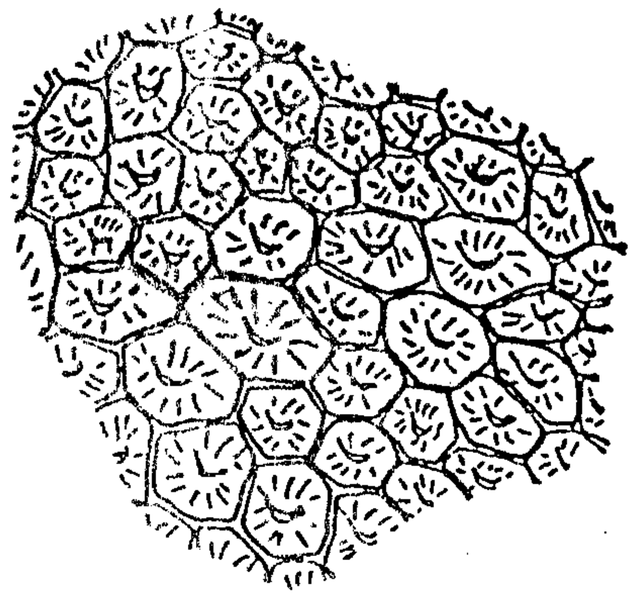

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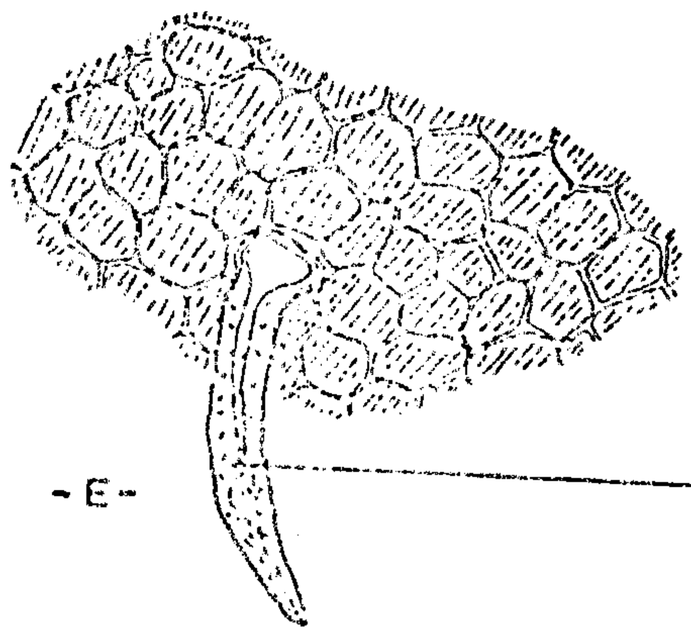

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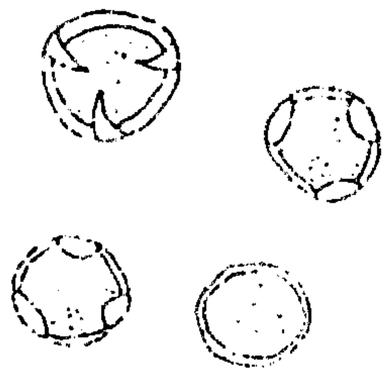

-F-

Fig.5 : The androecium
A-Diagramatic T.S.in the fertile anther X 33
B-Surface preparation in the anther X 268
C-T.S.sector in the anther X 268
D-Fibrous layer of the anther X 268
E-Surface preparation in the filament X 268
F-Pollen grain X 268
ep.,epidermis;f.l.,fibrous layer of the anther;p.g.,pollen grains;tr.,trichomes;v.b.,vascular bundles

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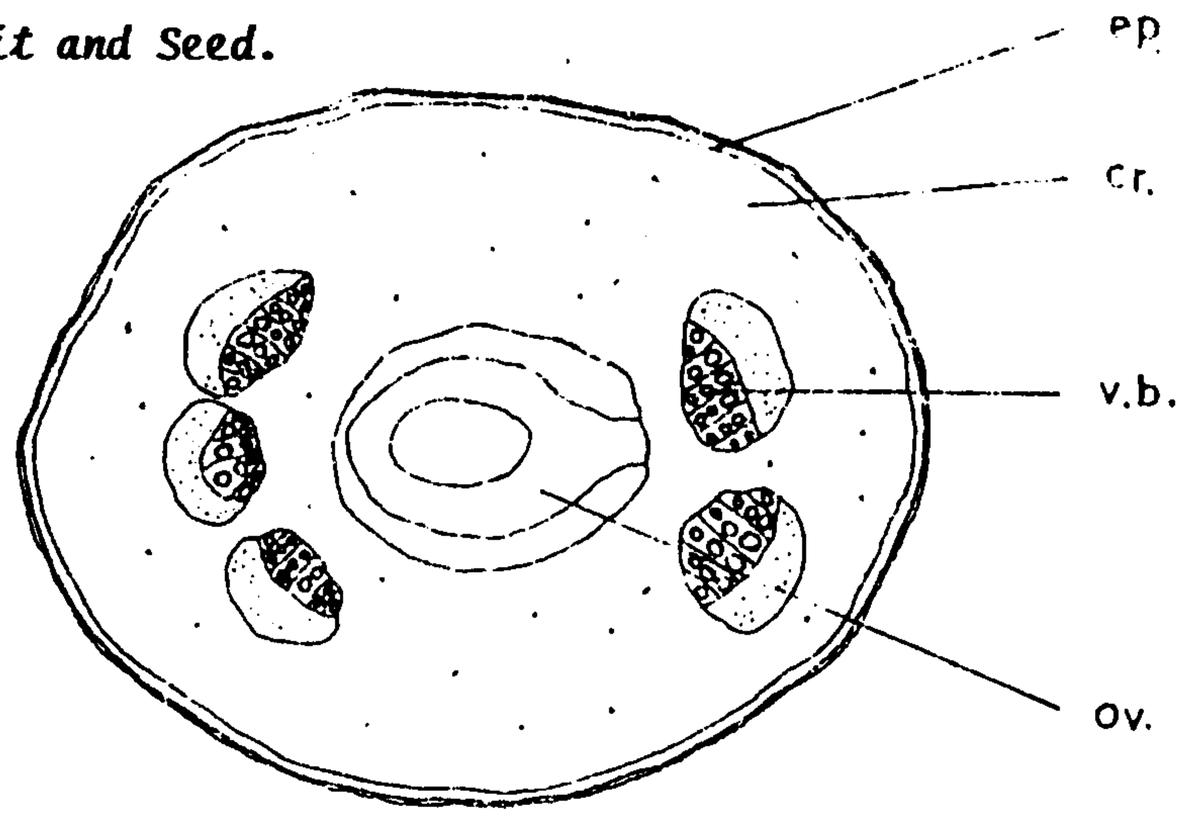

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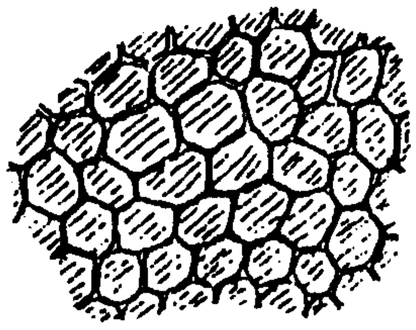

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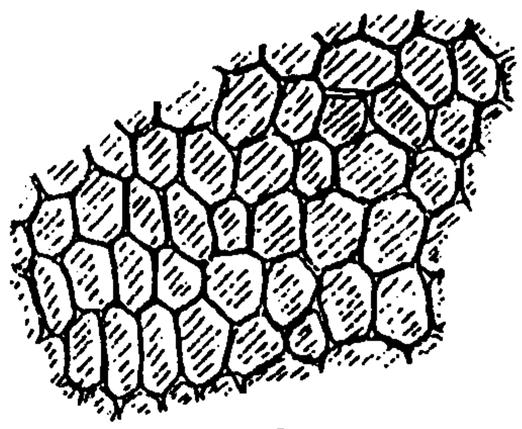

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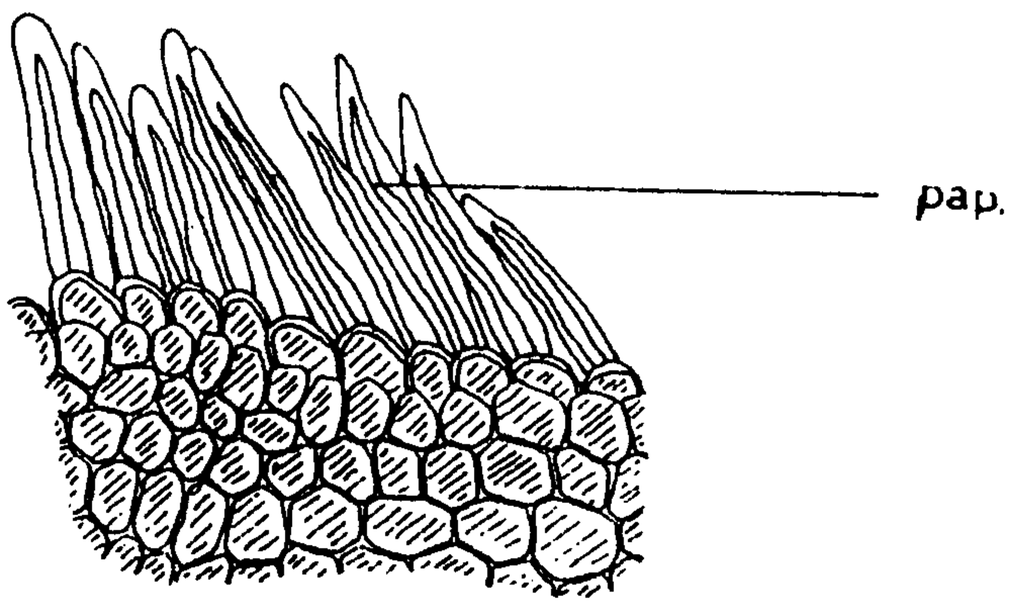

- D -

Fig.6 :The Gynaecium

A-Diagrammatic T.S.in the ovary X 68
B-Surface preparation in the ovary X 268
C-Surface preparation in the style X 268
D-Surface preparation in the stigma X 268

cr.,crystals of ca.ox.;ep.,epidermis;ov.,ovules;pap.,papillae;v.b., vascular bundle.

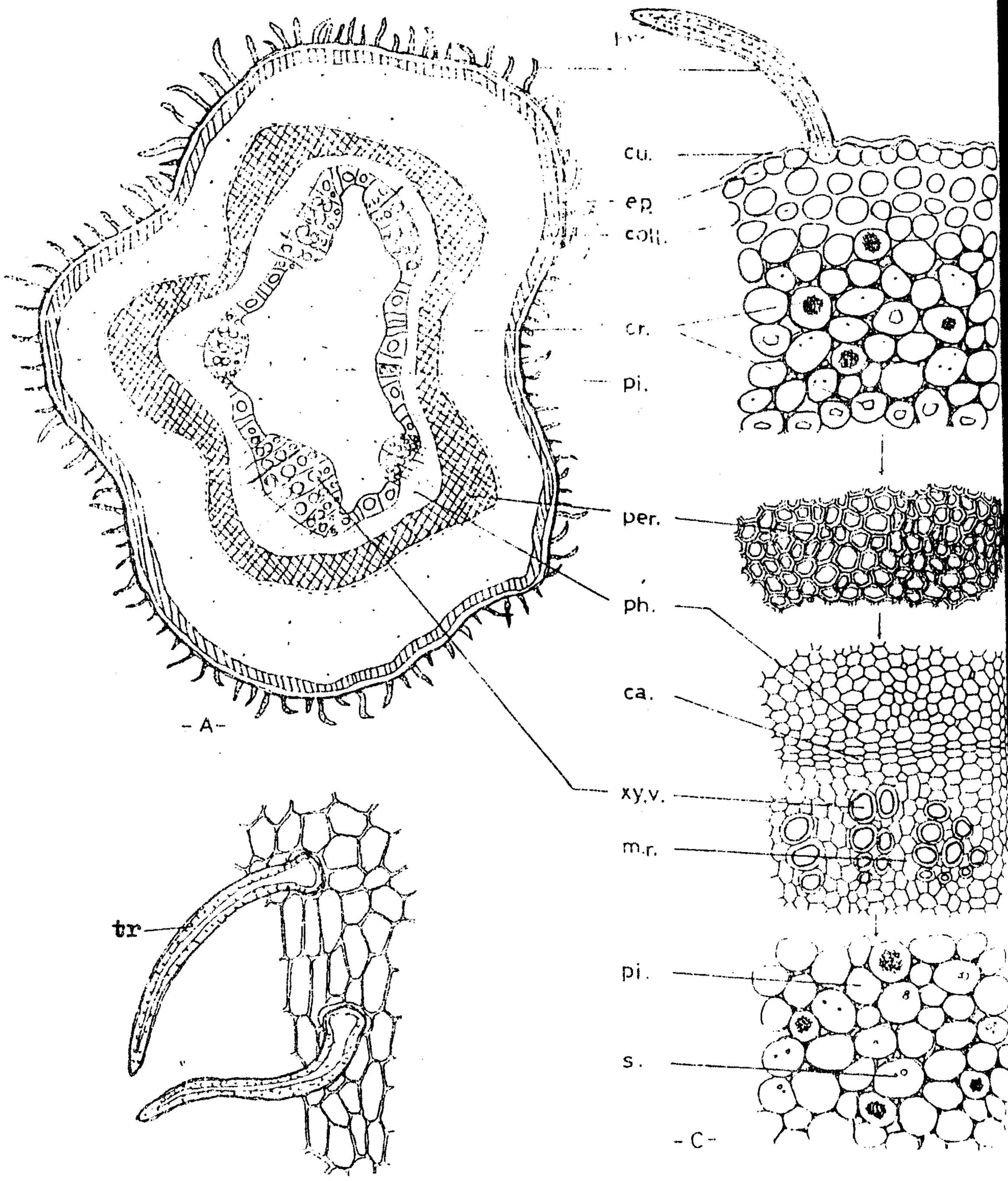

Fig. 7: The Pedicel

A-Diagrammtic T.S. in the pedicel X 68

B-Surface preparation in the pedicel X 268

C-T.S. sector in the pedicel X 268

ca., cambium; coll., collenchyma; cr., crystals of ca.ox.; cu., cuticle; ep., epidermis m.r., medullary ray; per., pericycle; ph., phloem; pi., pith; s., starch granule; tr., trichome; xy.v., xylem vessels.

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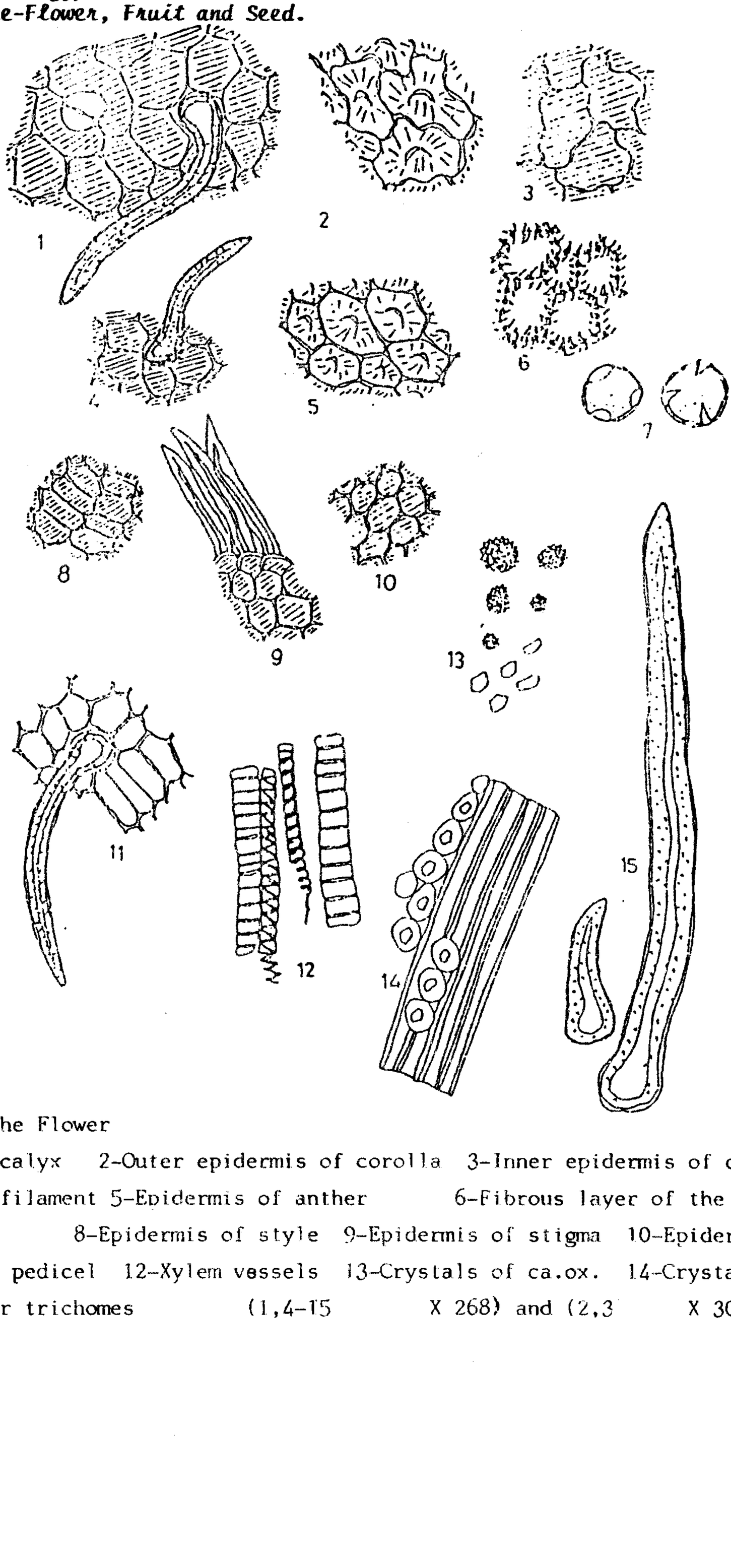

Fig. 8 :Powder of the Flower

1-Epidermis of calyx 2-Outer epidermis of corolla 3-Inner epidermis of corolla
4-Epidermis of filament 5-Epidermis of anther 6-Fibrous layer of the anther
7-Pollen grains 8-Epidermis of style 9-Epidermis of stigma 10-Epidermis of ovary
11-Epidermis of pedicel 12-Xylem vessels 13-Crystals of ca.ox. 14-Crystal sheath
15-Non-glandular trichomes (1,4-15 X 268) and (2,3 X 305).

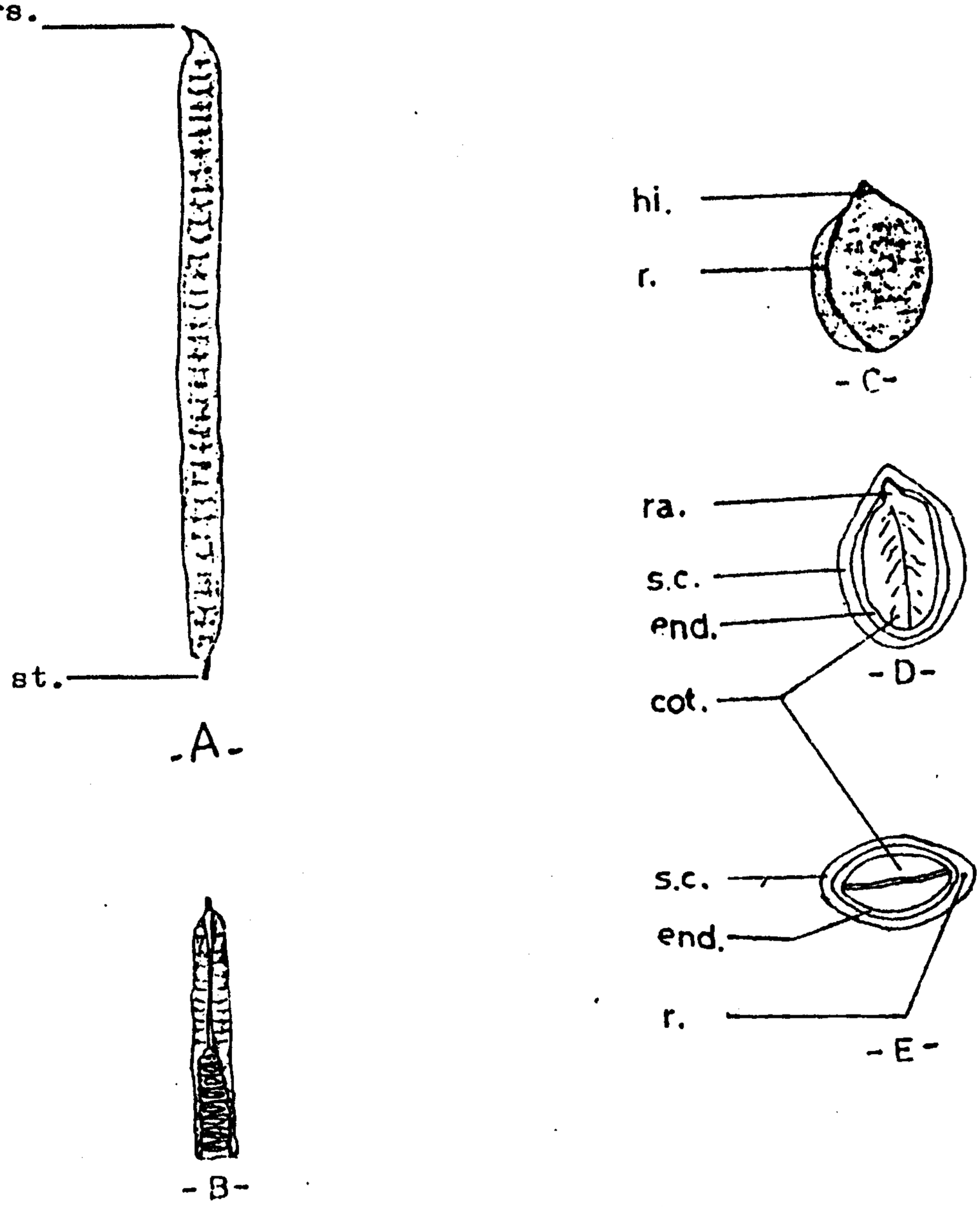

Fig. 9 The Fruit

A--Entire legume X 1/4 C-the seed X 4

B-Opened legume X 1/4 D-L.s in the seed X 4

E-T.S.in the seed X 4

cot.,cotyledon;end.,endosperm;hi.,hilum;e.,raphe;ra.,radicle;s.c., seed coat.; **rs.,remaining of style. st.,stigma.**

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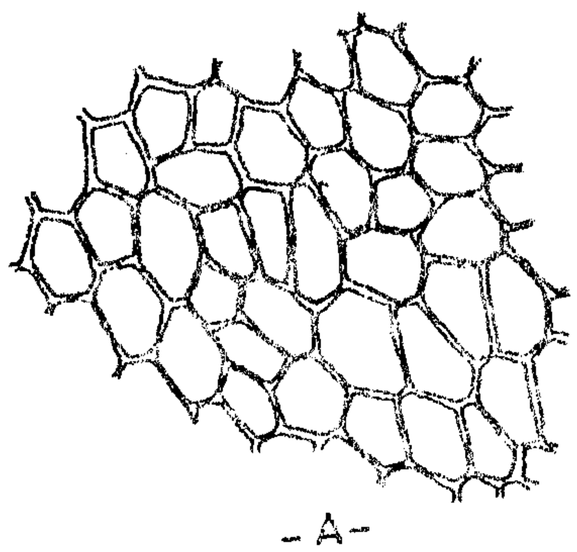
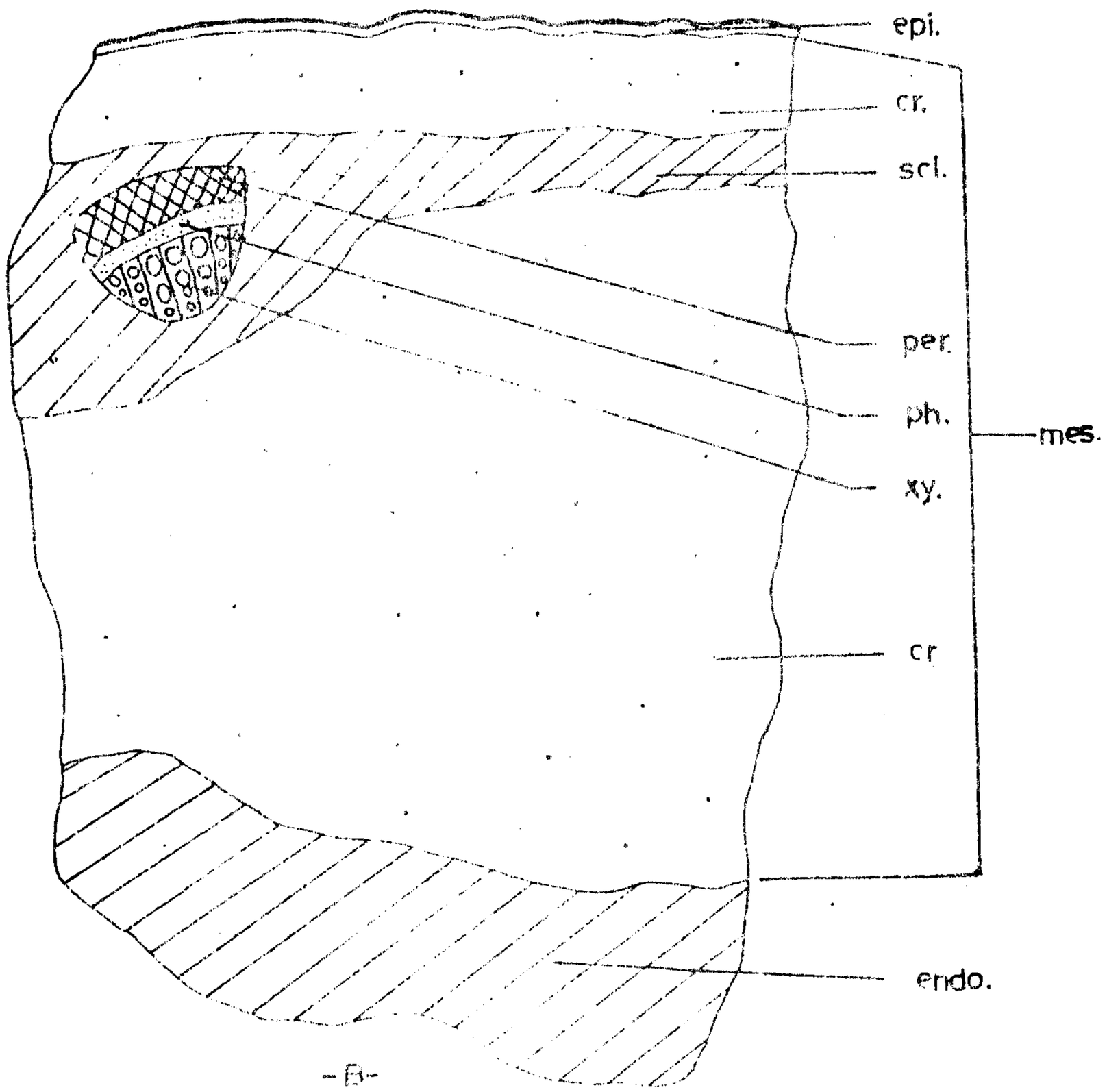
Part II: The-Flower, Fruit and Seed.



-A-



-B-

Fig.10 : The Fruit

A-Surface preparation in the pericarp X 299

B-Diagrammatic T.S.in the pericarp X 68

cr.,crystals of ca.ox.;endo.,endocarp;epi.,epicarp;mes.,mesocarp;
per.,pericycle;ph.,phloem;scl.,sclereids;xy.,xylem

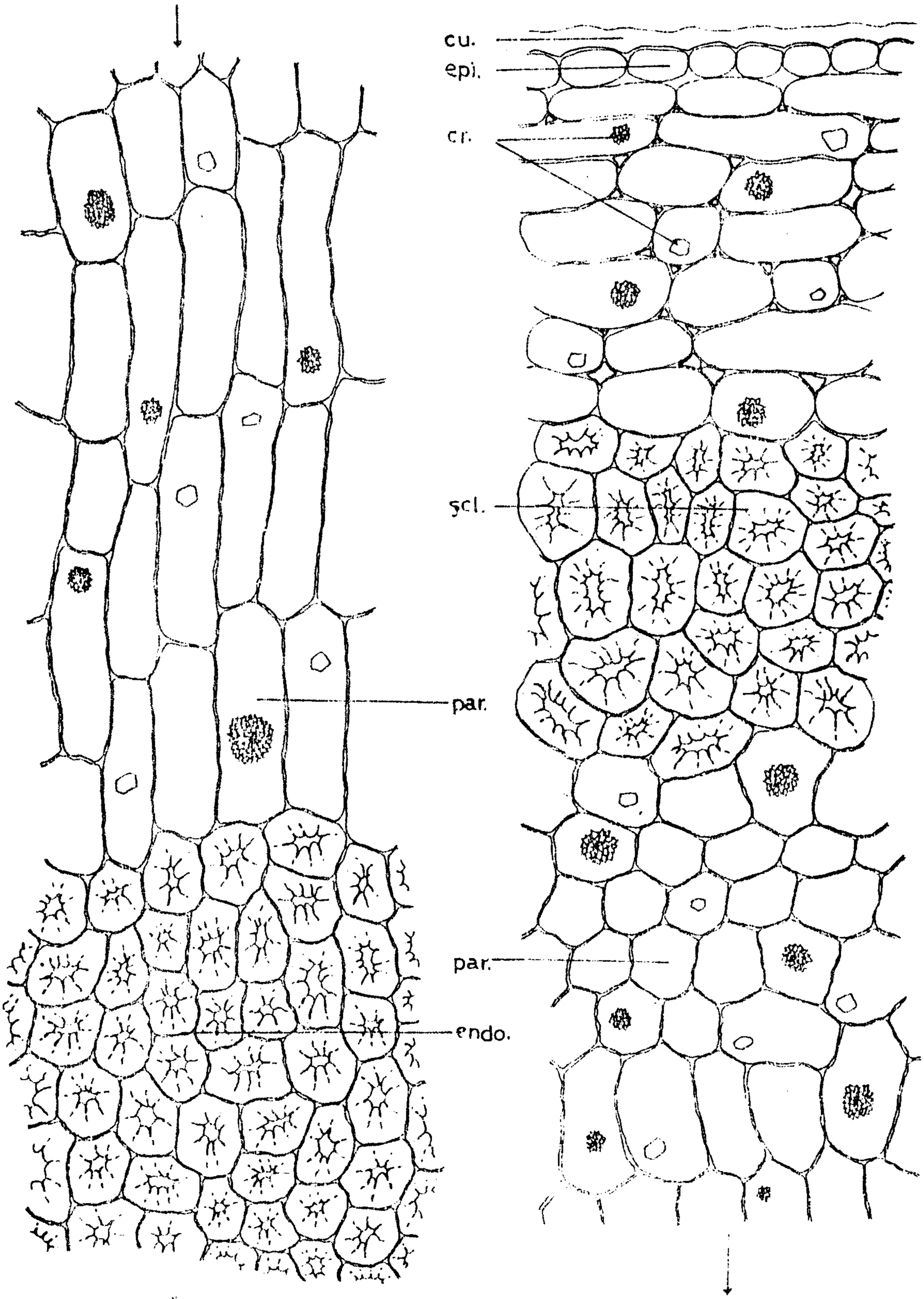


Fig.11: T.S.sector in the pericarp X 299

cr.,crystal of ca.ox.,cu.,cuticle;endo.,endodermis;epi.,epidermis par.,parenchyma;scl.,sclereids.

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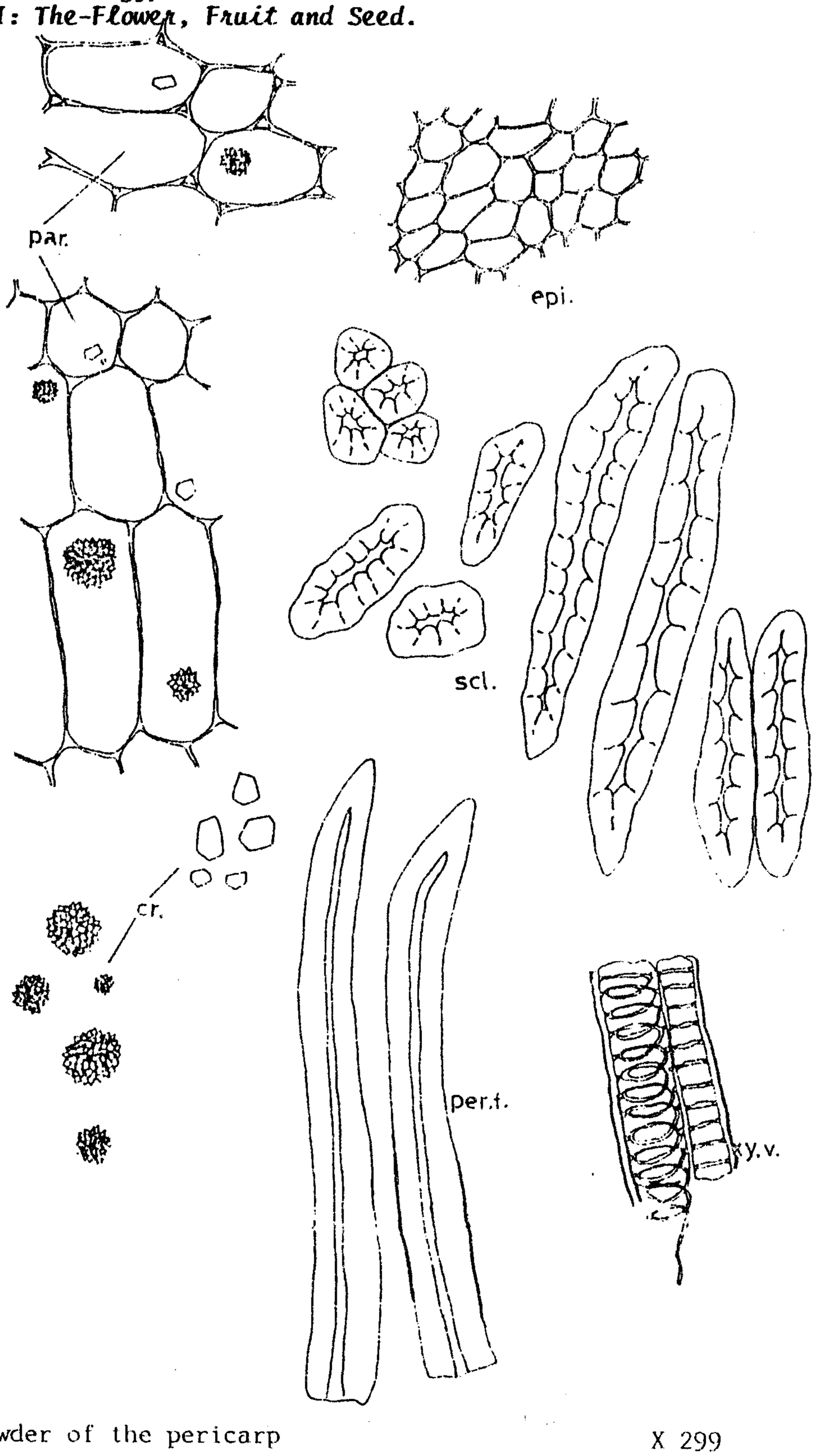

Fig.12 :Powder of the pericarp X 299
cr.,crystals of ca.ox.;epi.,epicarp; par.,parenchyma;per.f.,pericyclic fibres
scl.,sclereids;xy.,xylem vessels.

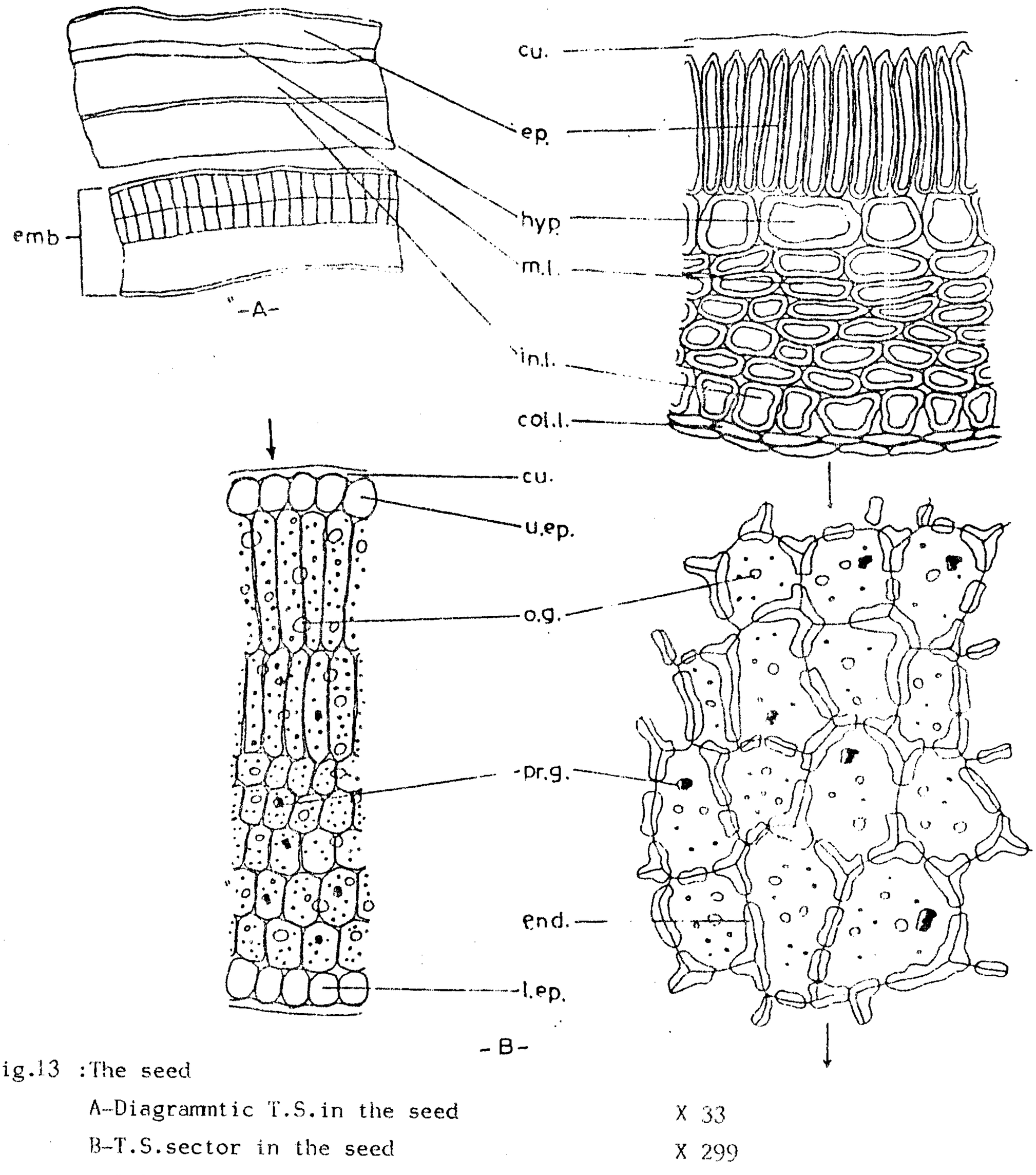

Fig.13 :The seed

A-Diagrammtic T.S.in the seed

B-T.S.sector in the seed

col.l.,collapsed layer;cu.,cuticle;emb.,embryo;end.,endosperm;ep.,epidermis; hyp.,hypodermis;in.l.,inner layer;l.ep.,lower epidermis of the embryo;m.l., middle layer;o.g.,oil globules;pr.g.,protein granules;u.ep.,upper epidermis of the embryo.

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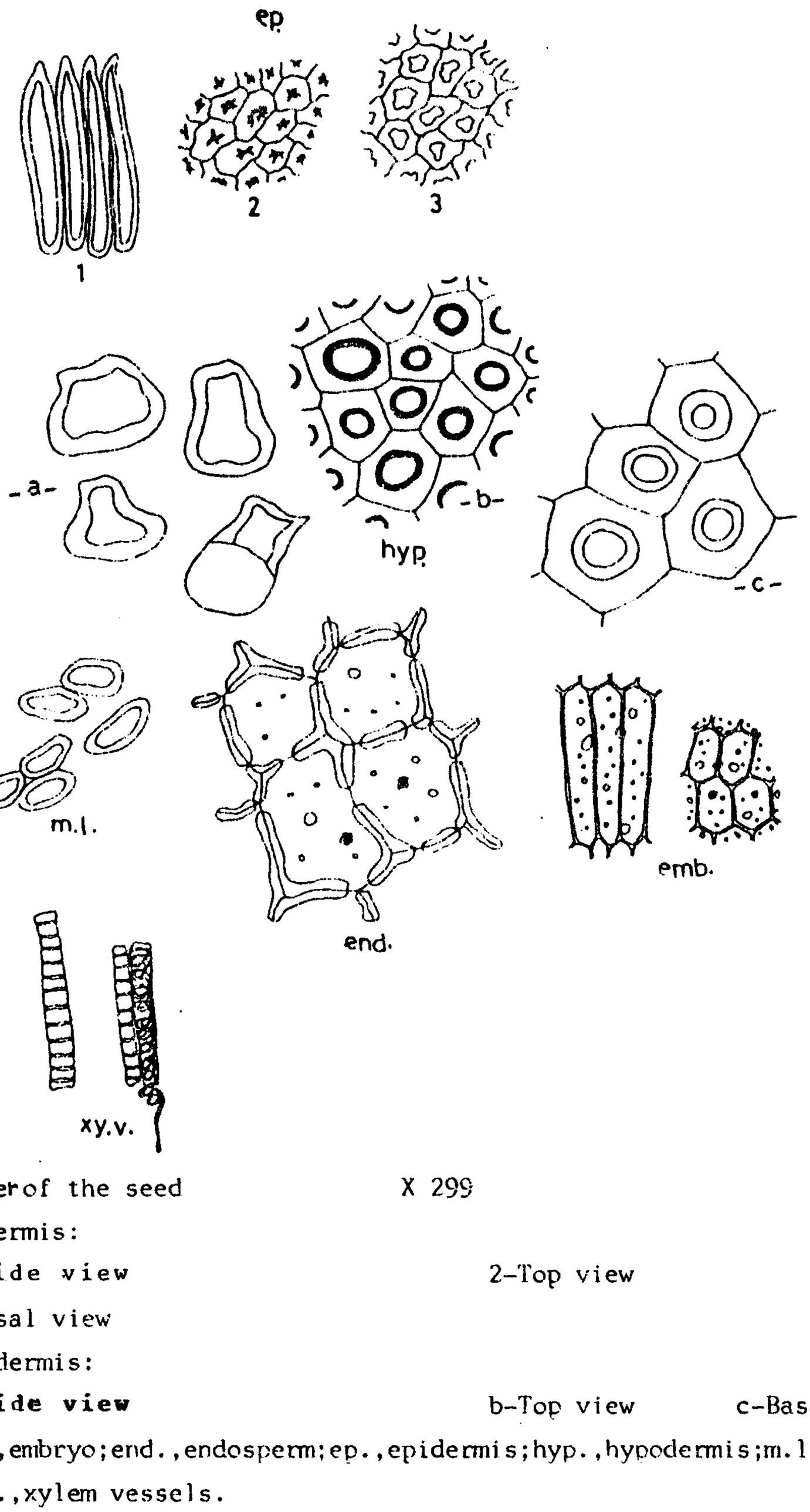

Fig. 14: Powder of the seed X 299

Epidermis:

1- Side view 2-Top view

3-Basal view

Hypodermis:

a- Side view b-Top view c-Basal view

emb., embryo; end., endosperm; ep., epidermis; hyp., hypodermis; m.l., middle layer

xy.v., xylem vessels.

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الصفات العيانية والمجهرية لنبات

كاسيا سبكتابيليس ـ دى كندول المنزرع فى مصـــر

الجزء الثانى ـ الزهرة ـ الثمرة والبذره

سامية محمد الصياد ـ عفاف محمد عبد الباقى ـ محمد أحمد الشنوانى ـ خالد مصطفى الغندقلى.

قسم العقاقير ـ كلية الصيدلة ـ جامعة أسيوط ـ أسيوط ـ مصر .

فـــى هـذا الجزء من الدراسة تـــم عمل دراسة عيانية ومجهرية لزهرة ـ ثمـــــره وبذرة نبات الكاسيا سبكتابيليس دى كندول لامكان التعرف عليها ســـواء كانت كامـــلة أو علـــــى هيئة مســـــــحوق .

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