

MACRO-AND MICROMORPHOLOGY OF *DALBERGIA SISSOO* ROXB. GROWING IN EGYPT. Part II: Inflorescence and Fruit

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ABSTRACT

The macro- and micromorphological characters of the inflorescence and the fruit of *Dalbergia sissoo* Roxb. growing in Egypt are reported in order to find out the features of these diagnostic organs by which the plant could be identified in both the entire and powdered forms.

INTRODUCTION

Dalbergia sissoo Roxb. is a plant indigenous to India and Afghanistan^(1,2) and has been cultivated in Egypt. In view of the important folkloric medicinal uses of *Dalbergia* plants⁽³⁻¹⁰⁾, a comprehensive pharmacognostical study was done by the authors. In previous publications^(11,12), we demonstrated the chemical constituents and pharmacological characters of the plant extracts, as well as the botanical investigation of the leaf and stem of the plant.

In the present report, the macro- and micromorphology of the inflorescence and fruit is presented in order to facilitate the identification of the plant and these organs in both the entire and powdered forms.

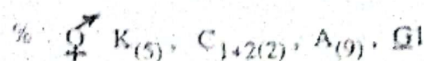
EXPERIMENTAL

Plant Material:

Fresh flowering and fruiting branches of *Dalbergia sissoo* Roxb. (family Leguminosae) were collected from the vicinity of Zagazig, Egypt in May and July 1994. The identification of the plant was kindly verified by Dr. Nabil El-Hadidi, Prof. of Plant Taxonomy, Faculty of Science, Cairo University Egypt. A voucher specimen is deposited in the Department of Pharmacognosy, Faculty of Pharmacy, Zagazig University, Egypt.

A- Macromorphology:

1- The inflorescence (Fig. 1) is racemose panicle with 40 to 60 yellowish-white papilionaceous flowers, they are arranged axillary on the stem. The florets (Fig. 1) are shortly pedicellate, yellowish-white in colour with aromatic odour, bitter taste and measure 5 to 15 mm in length and 2.5 to 6 mm in diameter. There are complete, hermaphrodite, zygomorphic, pentamerous, tetra-cyclic and have the following floral formula.



The rachis (Fig. 1) is cylindrical, solid with dark green pubescent surface. It is flexible when fresh but

when dry, it breaks with fibrous fracture, it measures 3.0 to 3.9 cm in length and 0.5 to 1.5 mm in diameter.

The pedicel (Fig. 1) is cylindrical, solid with dark green pubescent surface and measures 1 to 2 mm in length and 0.4 to 1 mm in diameter.

The Floret:

The calyx (Fig. 1) is persistent, campanulate, gamosepalous and formed of five united sepals with bell-shaped united part and 5 subequal apical teeth; the free part of the calyx forms nearly 1/3 of its length and measures 1.2 to 2 mm in length. The teeth are subequal with dark green hairy outer surface and smooth paler inner one, entire margin, obtuse apices and numerous covering trichomes concentrated at the obtuse apex of each tooth. The united part of the calyx forms 2/3 of its length with dark green pubescent outer surface. The calyx shows pinnately-reticulate venation with one main vein for each sepal and few small lateral veins at the lower part. The united part measures 2.8 to 4.5 mm in length and 1.5 to 2.5 mm in diameter.

The corolla (Fig. 2) is pentapetalous with one large petal forming the standard, two lateral ones forming the wings and two inner united ones forming the keel. The standard petal is obovate with entire margins, emarginate apex, symmetric base and measures 6 to 10 mm in length and 3.5 to 4 mm in width. The two wings are formed of spatulate petals with entire margins, obtuse or rounded apices and measure 5 to 8 mm in length and 1.4 to 2.5 mm in width. The keel is formed of two united lanceolate petals enclosing the androecium, it has entire margins, rounded apex and measures 5 to 7 mm in length and 1.2 to 2.5 mm in width. The corolla has smooth yellowish-white velvety surfaces and pinnately-reticulate venation.

The androecium (Fig. 1) consists of 2 monadelphous stamens in one whorl. The filaments are yellowish in colour and united with their lower 3/4 forming a tube-like structure, transversed by nine vascular strands and measure 5.5 to 8.5 mm in length and 0.5 to 1.7 mm in diameter. The free apical part of

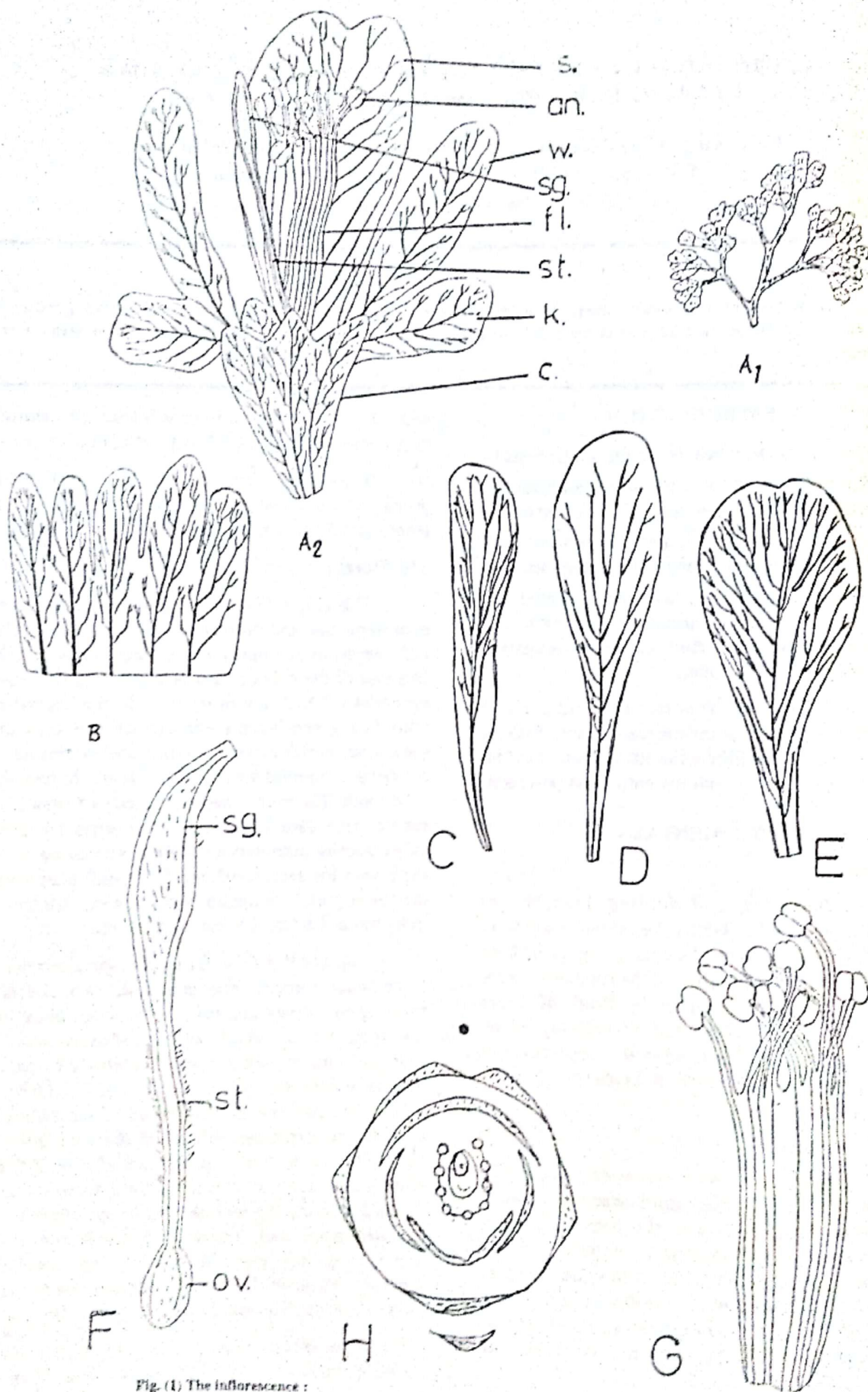


Fig. (1) The inflorescence :

- A₁ - The inflorescence (X 0.6) A₂ - The floret (X 7.7) B - The calyx (8.1) C - The keel petal (X 9.5)
 D - The wing petal (X 11) E - The standard petal (X 7)
 G - The stamens (X 11) H - The floral diagram
 F - The gynoecium (X 12.6)

an., anther; c., calyx; fl., filament; k., keel; ov., ovary; s., standard petal; sg., stigma; st., style; w., wing.

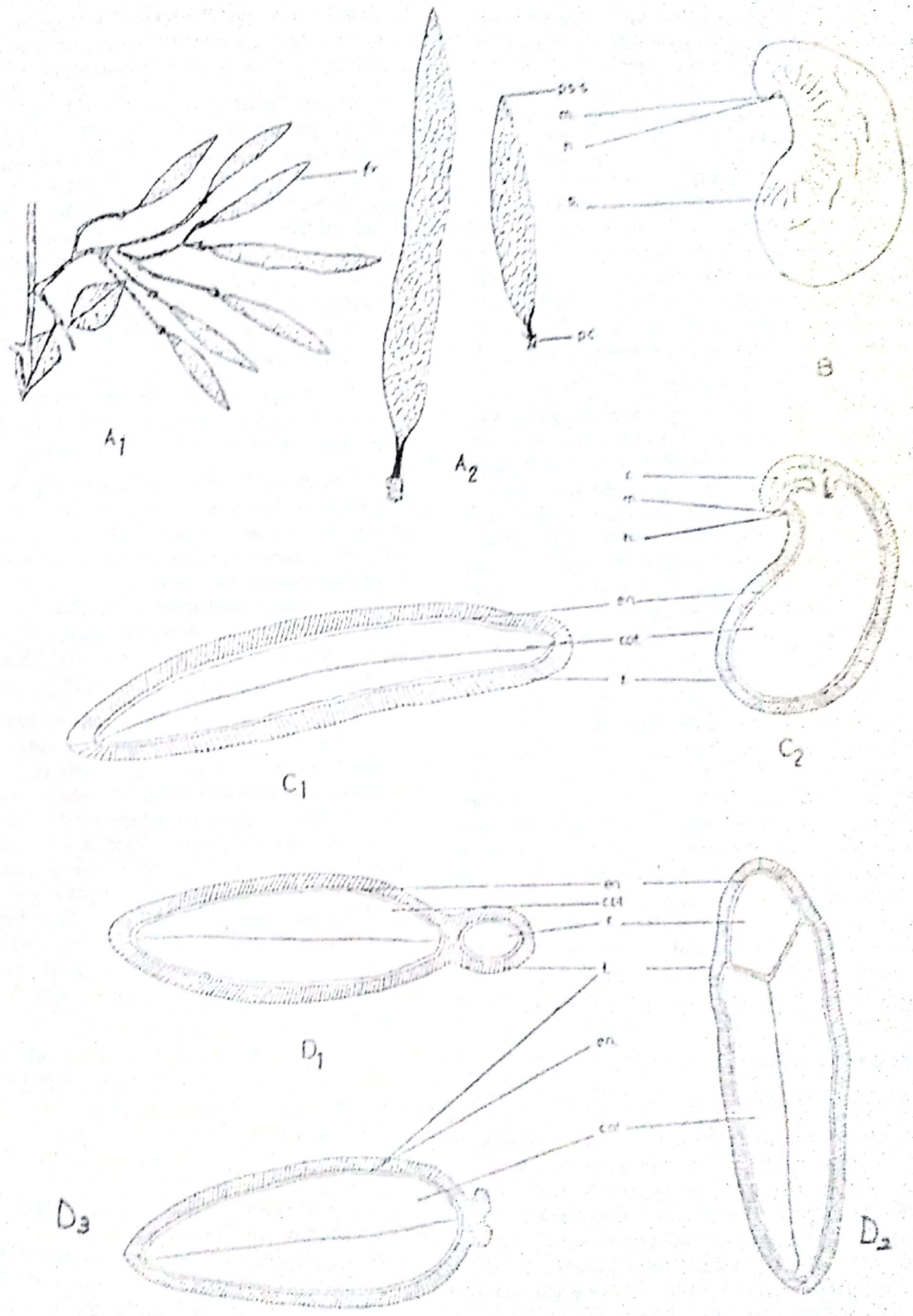


Fig. (2) The Fruit: (A₁ X 80, A₂ X 0.8, B, C₁ X 55, C₂ X 21).
 A₁ - The trifoliate branch. A₂ - Morphology of the fruit. B - Morphology of the seed.
 C₁ - Longitudinal section of the seed perpendicular to the tip surface. C₂ - Longitudinal section of the seed parallel to the tip surface.
 D₁, D₂ - Transverse section of the seed at the cotyledons and the embryo region.
 D₃ - Transverse section of the seed at the cotyledons region.
 cot - cotyledon, en, endosperm, h, hilum, m, micropyle, ps, persistent style, s, suture, i, hilum, f, surface.

the filament is slender with yellowish smooth surface and transversed by one vascular strand; it measures 1.3 to 2.0 mm in length and 0.1 to 0.3 mm in diameter. The anther is more or less rounded bilobed and basifixed with chocolate brown smooth surface and measures 0.3 to 0.5 mm in diameter.

The gynaecium (Fig. 1) is monocarpellary consists of superior ovary, terminal style and capitate stigma. It has chocolate brown hairy surface. The ovary is ovoid or oblong, unilocular with 1 to 4 ovules arranged on a marginal placenta. The style is filiform transversed longitudinally by two small vascular strands and measures 3.5 to 6.5 mm in length and 0.3 to 0.5 mm in diameter. The capitate stigma measures 1.8-3 mm in length.

2- The fruit (Fig. 2) is oblong, glabrous legume with stiff persistent remains of the style at its rounded or obtuse apex. It is unilocular with 1 to 4 seeds arranged on parietal placenta and measures 4 to 9.5 cm in length and 0.5 to 1 cm in breadth. It is pedicellate and measure 3 to 8 mm in length and 0.3-0.6 mm in diameter. The pericarp is leathery with pale green glabrous surface when fresh being faint brown on maturation, it shows reticulate venation and swollen paler parts over the seeds position.

The seed (Fig. 3) is reniform in shape with reddish-brown to dark brown glossy surface, showing few reticulations near the concave part. It shows a narrow groove dividing it into two unequal parts; the small upper part contains the radicle and the large lower one contains the two cotyledons. The hilum is present as a raised point at the concave part and the micropyle as a depressed point at the face of the radicle. The seed is albuminous with scanty endosperm surrounding a curved accumbent embryo formed of two thick plano-convex cotyledons and a terete radicle pointed towards the micropyle. It measures 8 to 11 mm in length, 4 to 6 mm in width and 1.0 to 3.0 mm in thickness.

B- Micromorphology :

1. The Inflorescence :

The transverse section of the rachis (Fig. 3) is almost rectangular in outline showing an outer epidermis surrounding a narrow parenchymatous cortex with subepidermal collenchyma and a complete ring of 15 to 17 collateral vascular bundles surrounding a wide parenchymatous pith; the pericycle is formed of batches of lignified pericyclic fibres abutting the vascular bundles and surrounded by crystal sheath.

A transverse section of the pedicel (Fig. 3) is almost circular in outline showing an outer epidermis surrounding a wide cortex. The cortex is formed of an outer collenchyma and inner parenchyma. The pericycle

is collenchymatous and the vascular tissue is formed of a complete ring of an outer phloem and inner xylem surrounding a narrow parenchymatous pith.

The epidermis (Fig. 3) is formed of polygonal, axially elongated cells with straight anticlinal walls and covered with thick striated cuticle. They measure 13 to 47 μ in length 3 to 15 μ in height and 5 to 12 μ in width. Stomata are almost absent. Trichomes (Fig. 3) are of covering type only; they are uniseriate multicellular formed of 1 to 3 short basal cells and a long terminal one. Trichomes are long conical with moderately thick walls, wide lumens, blunt apices, warty cuticle and measure 160 to 230 μ in length and 8-16 μ in diameter.

The cortex (Fig. 3) is formed of 3 to 4 rows of outer rounded collechyma and 3 to 5 rows of inner tangentially elongated parenchymatous cells.

The pericycle (Fig. 3) is formed of large groups of pericyclic fibres abutting the vascular bundles forming interrupted ring separated by parenchymatous cells. Each group consists of fibres surrounded by parenchymatous cells containing prisms of calcium oxalate forming crystal sheath. The fibres (Fig. 3) are spindle-shaped with smooth thin lignified walls, wide lumens, acute apices and measure 381, 529 μ in length and 5 to 14 μ in diameter.

The vascular tissue (Fig. 3) consists of a ring of 15 to 17 collateral vascular bundles separated by narrow medullary rays. The phloem consists of polygonal moderately thick-walled cellulosic elements and the xylem is composed of lignified spiral and pitted vessels, 5 to 20 μ in diameter, moderately thick walled cellulosic wood parenchyma, in addition to tracheids and tracheidal vessels measuring to 28 to 44 μ in length and 5 to 11 μ in diameter. The medullary rays (Fig. 3) are uniseriate to multiseriate, formed of radially elongated cells with thick cellulosic walls in the phloem region and moderately thick lignified walls in the xylem region.

The pith (Fig. 3) is narrow, composed of rounded parenchymatous cells with moderately thick pitted lignified walls, wide intercellular spaces and measure 10 to 32 μ in diameter.

The Floret :

The sepals : A transverse section (Fig. 4) shows an outer and inner epidermis enclosing in between a parenchymatous mesophyll transversed longitudinally by numerous vascular bundles and shows secretory cells. The outer and inner epidermis (Fig. 5) are formed of polygonal cells with straight anticlinal walls, contain mucilage and covered with finely striated cuticle. The outer epidermal cells at the apex, the margin and over veins are axially elongated, while at the upper and the middle parts the cells are isodiametric.

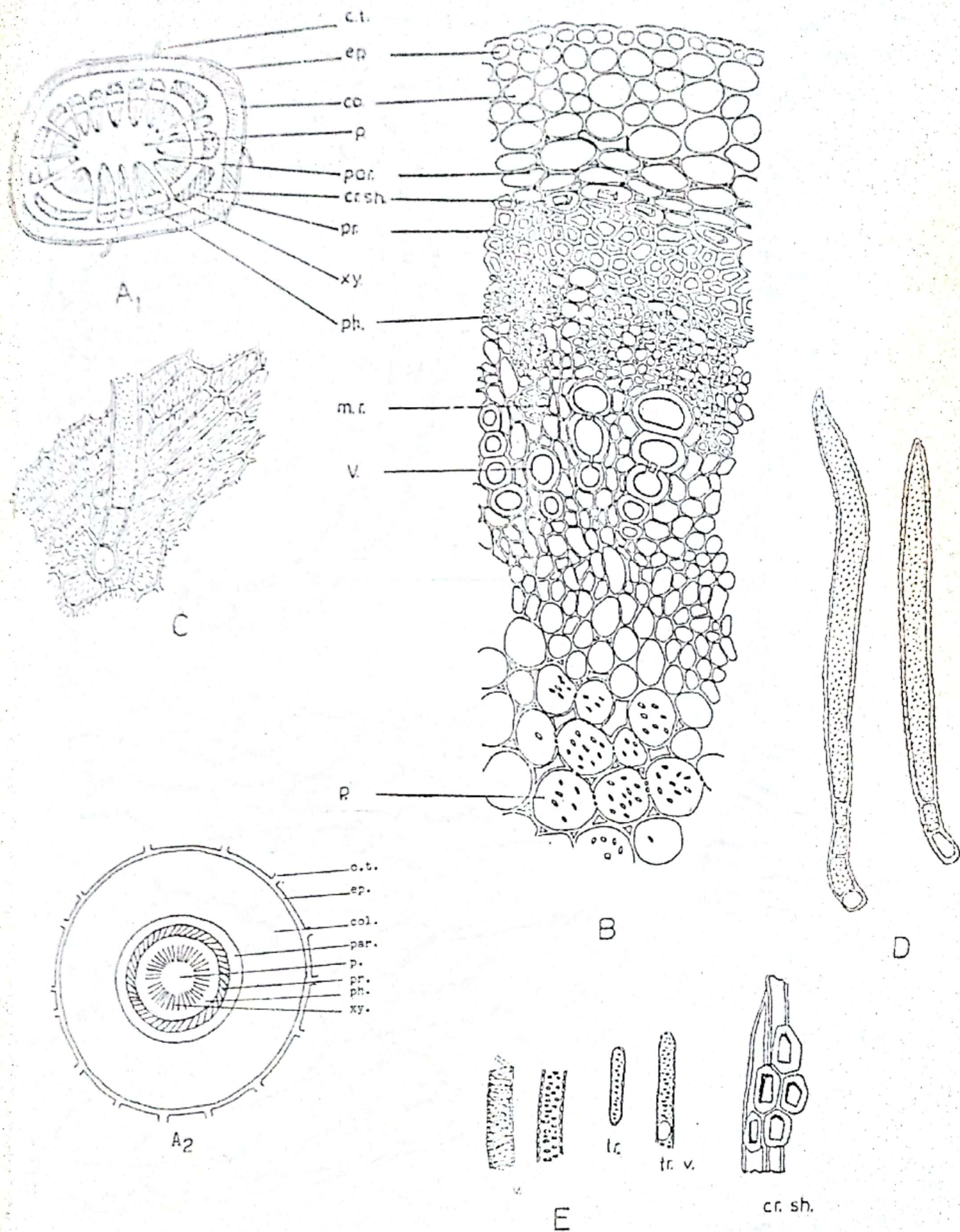


Fig. 13) The Rachis of the Inflorescence and the Pedicel of the Floret: (All X 370 except A₁ X 37, A₂ X 70).

A₁ - Diagrammatic transverse section of rachis. A₂ - Diagrammatic transverse section of pedicel of rachis.
 B - Detailed transverse section of rachis. C - Epidermal cells of rachis. D - Covering trichomes. E - The isolated elements
 col., collenchyma; c.t., covering trichomes; cr. sh., crystal sheath; ep., epidermis; m.r., medullary ray; p., pith; par., parenchyma; ph.,
 phloem; pr., pericycle; tr., tracheids; tr. v., tracheidal vessel; v., vessels; xy., xylem.

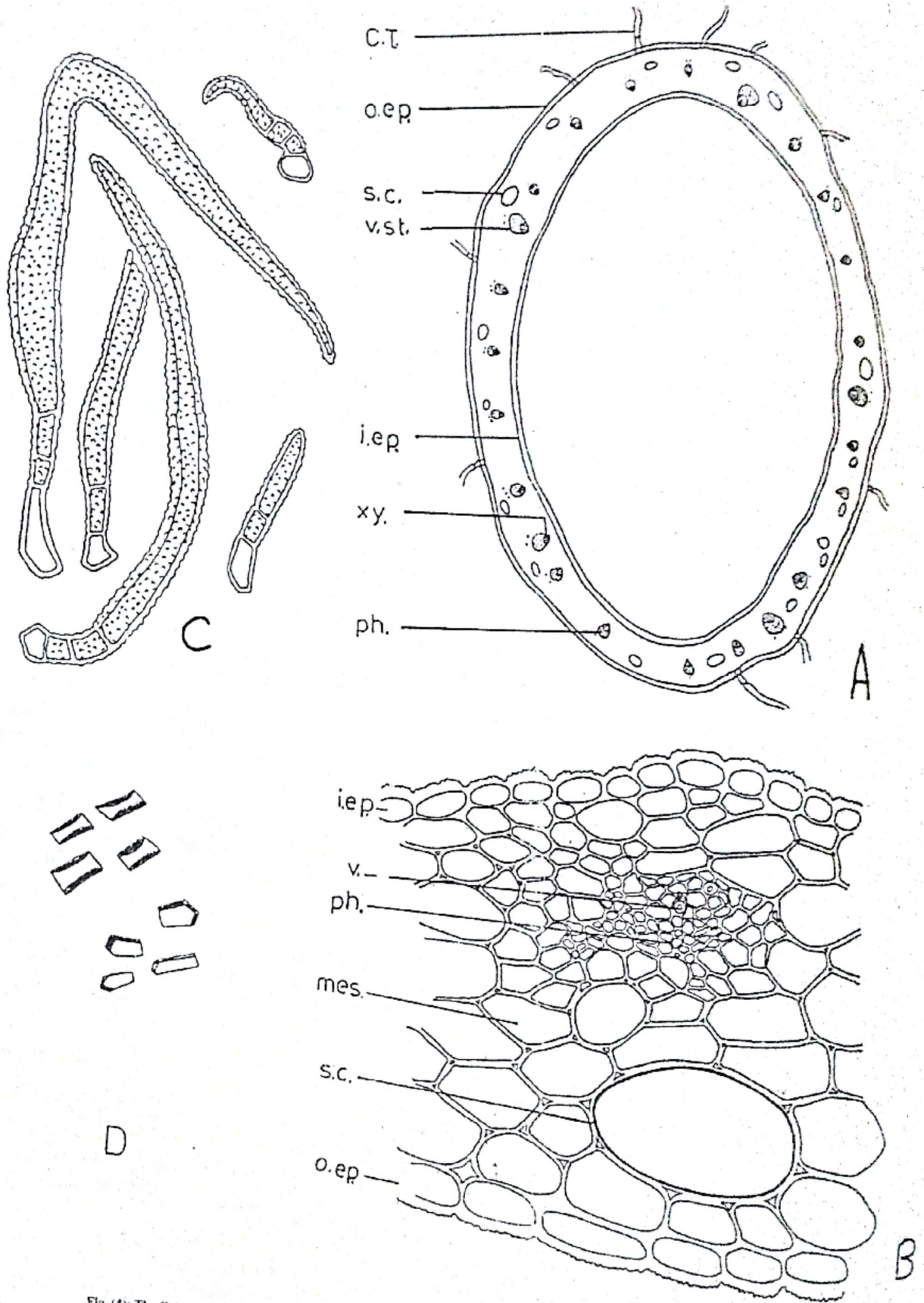


Fig. (4): The Calyx : (All X487, except B X 57).

A- Diagrammatic transverse section.

C- Covering trichomes.

cr., crystals; c.t., covering trichomes; i.ep., inner epidermis; mes., mesophyll; o.ep., outer epidermis; ph., phloem; s.c., secretory cells; v.

vessels; v.st., vascular strand; xy., xylem.

B- Detailed transverse section.

D- Prismatic crystals of calcium oxalate.

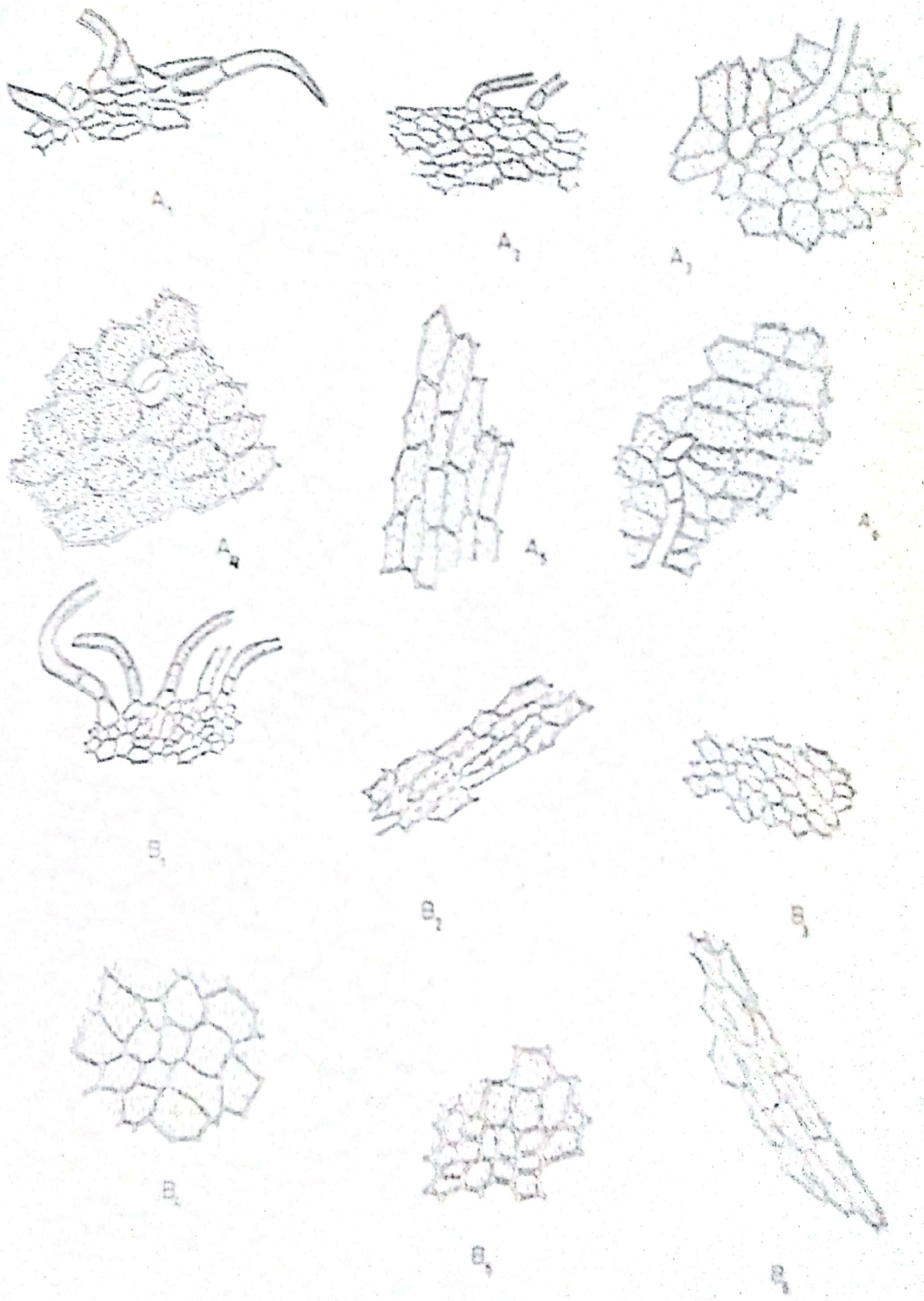


Fig. (5). Epidermal Cells of the Tongue. (140 X 250).
 A - Cover epidermal cells.
 A₁ - At the apex. A₂ - At the margin. A₃ - At the apical part. A₄ - At the middle part. A₅ - At the basal part. A₆ - Over the apex.
 B - Lower epidermal cells.
 B₁ - At the apex. B₂ - At the margin. B₃ - At the apical part. B₄ - At the middle part. B₅ - At the basal part. B₆ - Over the apex.

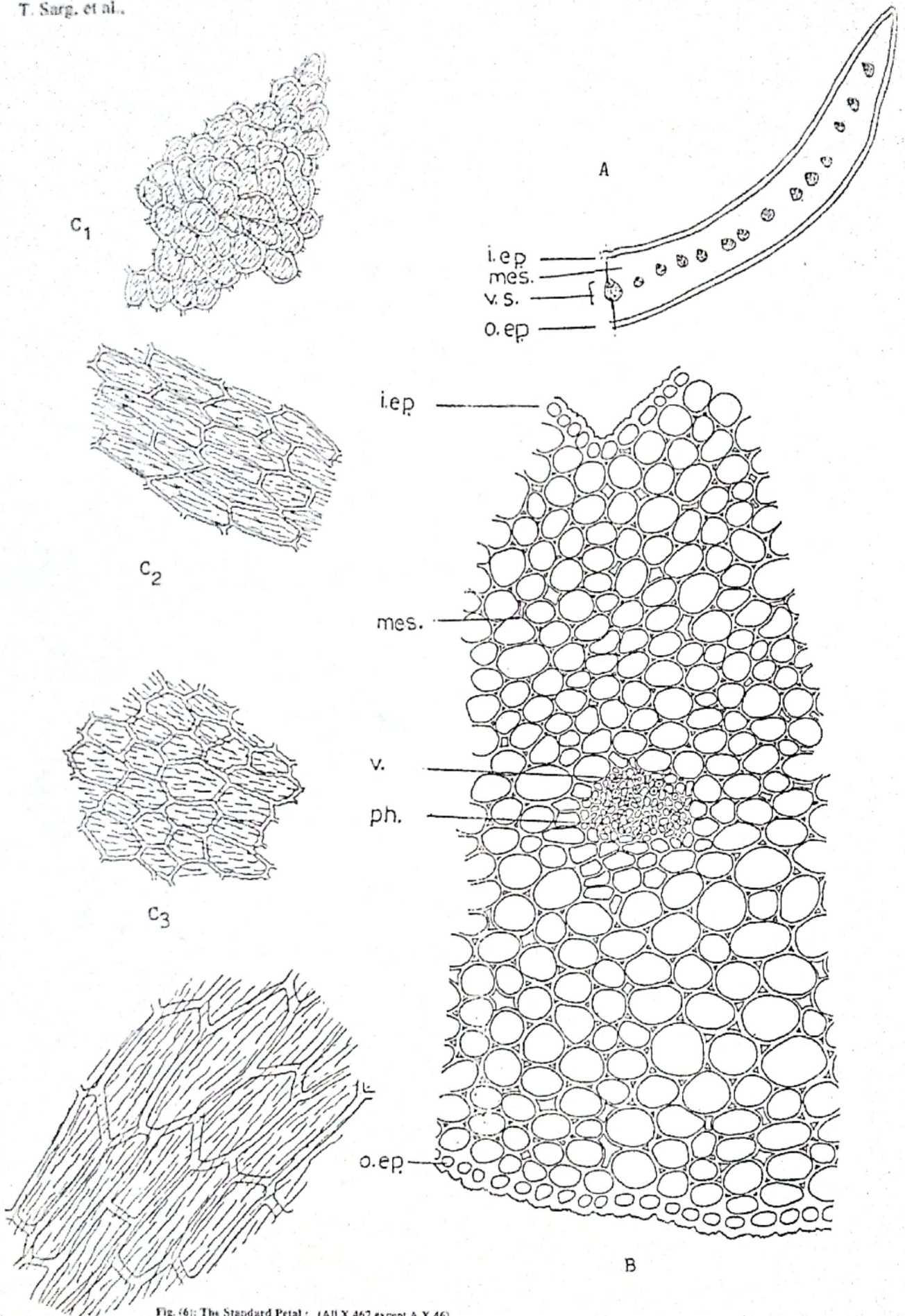


Fig. (6): The Standard Petal: (All X 462 except A X 46)
 A- Diagrammatic transverse section. B- Detailed transverse section.
 C- The outer epidermal cells
 C₁- At the apex C₂- At the margin C₃- At the upper part C₄- At the middle part.
 i.ep., inner epidermis; mes., mesophyll; ph., phloem; o.ep., outer epidermis; v., vessel; v.s., vascular strand.

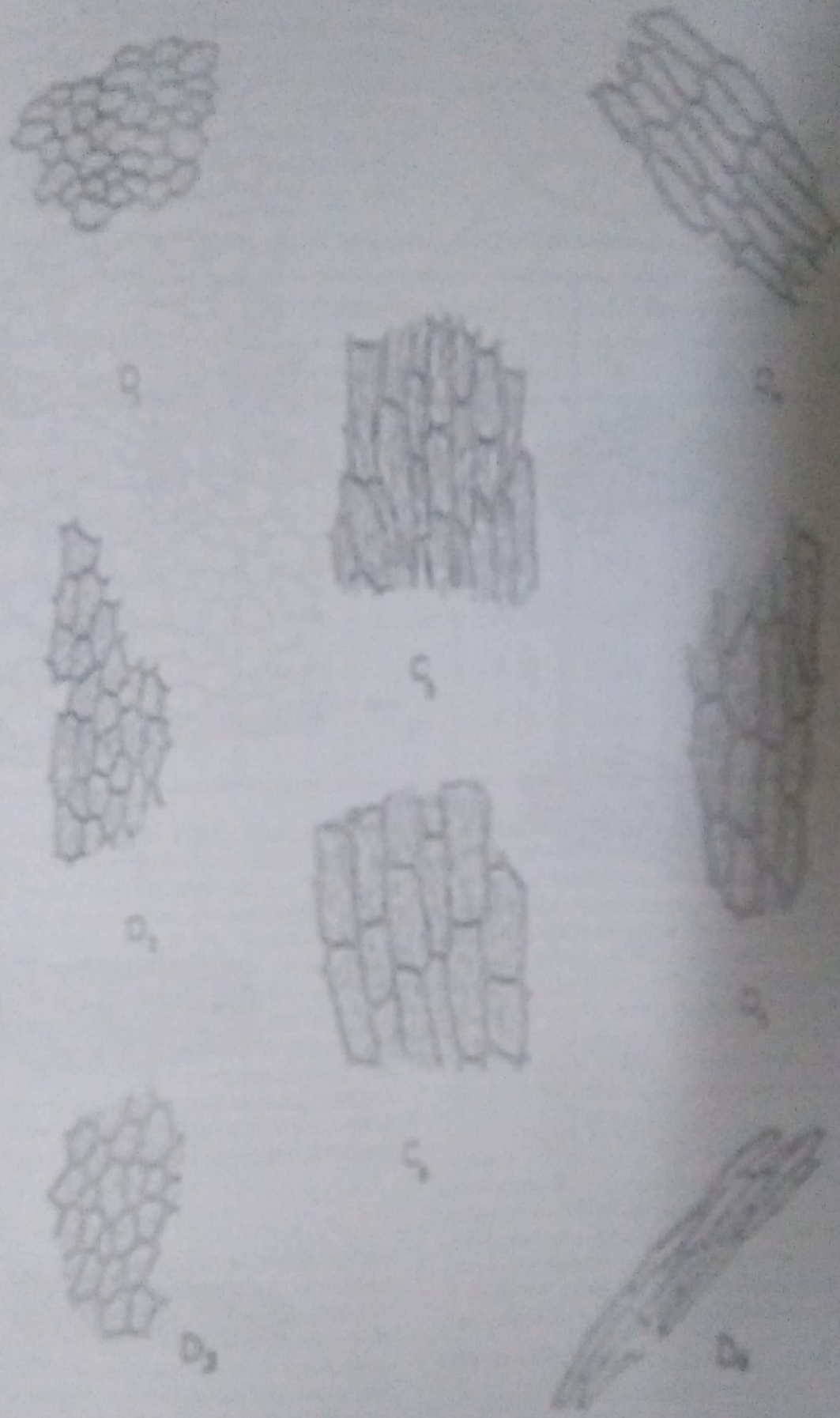


Fig. 1. The typical structure of the ...
 P, ... S, ... D₁, ... D₂, ...

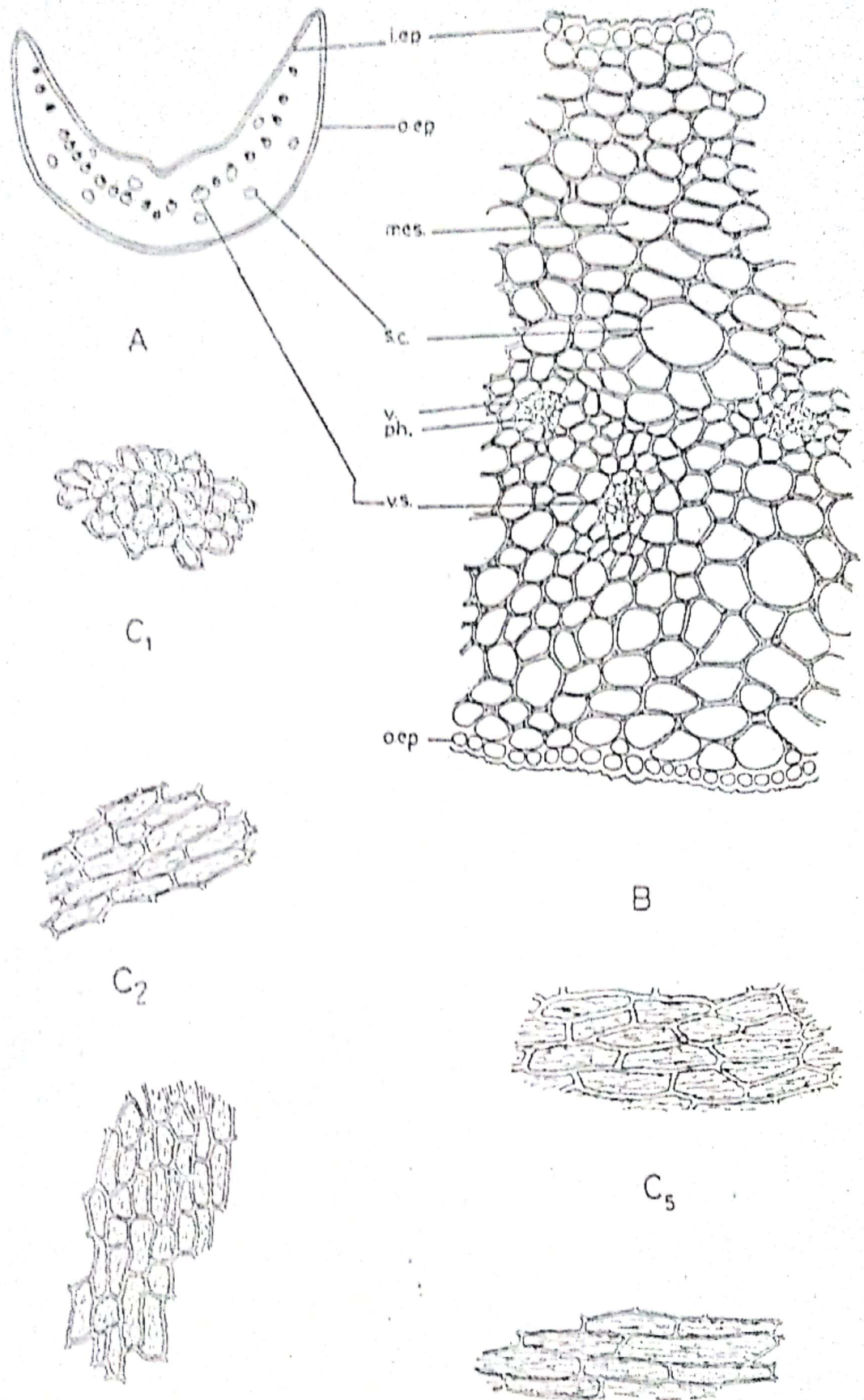


Fig. (8). The Wing or Keel Petal: (All X 370 except A X 38)

A. Diagrammatic transverse section

B. Detailed transverse section

C. Outer epidermal cells

C₁ - At the apex

C₂ - At the margin C₃ - At the upper part

C₄ - At the middle part

C₅ - At the lower part

C₆ - Over the vein

lep. - outer epidermis; mes. - mesophyll; oep. - outer epidermis; ph. - phloem; v. - vessel; v.s. - vascular strand

The epidermal cells at the base show beaded anticlinal walls. The inner epidermal cells at the apex, upper part and the base are isodiametric, while those at the margin and over veins are axially elongated. At the middle part, the cells are isodiametric with beaded straight anticlinal walls. The size of the epidermal cells of the sepals in

microns are given in Table (1). Stomata (Fig. 8) are present on the outer epidermis only, they are of anomicytic type and measure 17 to 21 μ in diameter.

Trichomes (Fig. 4.5) are numerous and present only on the outer surface of sepal. They are uniserial

Table (1): Dimensions of the epidermal cells of the sepal in (microns).

Epidermis	Outer epidermis			Inner epidermis		
	L.	B.	H.	L.	B.	H.
At the Apex	6-19	4-10	8-13	5-17	3-9	6-9
Of the marginal part	9-28	3-11	8-13	18-48	6-15	6-9
Of the upper part	16-38	13-31	8-13	9-15	5-10	6-9
Of the middle part	17-43	11-29	8-13	15-39	17-26	6-9
Of the basal part	17-36	9-22	8-13	13-25	6-22	6-9
Over veins	34-55	7-16	8-13	30-65	9-15	6-9

multicellular formed of 1 to 3 short basal cells and a long terminal one with moderately thick cellulose walls, wide lumens and rounded apices. They have waxy cuticle and measure 45 to 350 μ in length and 8 to 20 μ in diameter. The mesophyll (Fig. 4) is homogenous formed of rounded parenchymatous cells, shows numerous scattered oval oil cells with thin suberized walls and measuring 46 to 72 μ in length and 30 to 54 μ in width. The pericycle is parenchymatous and containing prismatic crystals of calcium oxalate. The vascular bundle consists of a xylem showing lignified spiral vessels measuring 2 to 4 μ in diameter and a phloem formed of moderately thick-walled cellulose elements.

The corolla :

Transverse sections of standard, wings or keel petals (Fig. 6.8) show outer and inner epidermis enclosing inbetween a wide mesophyll. The epidermal cells of standard petal (Fig. 6.7) are polygonal with straight anticlinal walls and covered with moderately thick striated cuticle. At the apex, the cells are isodiametric and prolonged into conical-shaped papillae with rounded apices. At the margin, the middle part, the base and over veins, they are axially elongated with straight anticlinal walls, while at the upper part the cells have beaded anticlinal walls. The epidermal cells of wings or keel petals (Fig. 8C₁, 9D₁) are polygonal with

straight anticlinal walls, contain mucilage, covered with thick striated cuticle and vary in shape and size in different parts of the petals. At the apex of outer and inner epidermis and upper part of outer epidermis (Fig. 8C, 9D), the cells show conical-shaped papillae with rounded apices. At the lower part and over veins, the cells are axially elongated, while the epidermal cells of the middle part show beaded anticlinal walls. The measurement of outer and inner epidermal cells of standard, wings and keel petals in microns are given in Table (2). Stomata and trichomes are absent.

The mesophyll of the petals (Fig. 6B, 8B) is formed of thin-walled more or less rounded parenchymatous cells occasionally containing prisms of calcium oxalate. The mesophyll of keel petal shows numerous secretory cells with thin suberized walls containing volatile oil. The vascular tissue (Fig. 6B, 8B) is formed of xylem showing few lignified spiral vessels and a phloem of thin-walled cellulose elements.

The Androecium :

The transverse section of the united filaments (Fig. 10H,G) shows an outer and inner epidermis enclosing in between a parenchymatous ground tissue transversed longitudinally by nine vascular strands. A transverse section of the free part of the filament (Fig. 10 I) is formed of an epidermis surrounding a

Table (2): Dimensions of the epidermal cells of the sepal in (microns).

Petal	Epidermis	Outer epidermis			Inner epidermis		
		L.	B.	H.	L.	B.	H.
Standard	At the Apex	7-16	4-9	4-6	10-18	6-15	5-6
	Of the marginal part	23-46	5-10	4-6	17-38	5-12	5-6
	Of the upper part	13-27	7-13	4-6	11-26	5-13	5-6
	Of the middle part	43-73	11-19	4-6	26-56	7-11	5-6
	Of the basal part	32-65	6-13	4-6	32-65	9-17	5-6
	Over veins	34-59	7-18	4-6	35-69	4-7	5-6
Wing	At the Apex	12-18	8-14	8-10	10-18	8-16	7-12
	Of the marginal part	13-32	7-13	8-10	25-50	8-15	7-12
	Of the upper part	12-19	9-12	8-10	12-20	10-19	7-12
	Of the middle part	10-29	5-14	8-10	19-49	11-20	7-12
	Of the basal part	26-30	9-13	8-10	28-55	9-17	7-12
	Over veins	36-65	8-15	8-10	29-59	7-19	7-12
Keel	At the Apex	11-16	9-11	5-8	9-16	7-13	6-10
	Of the marginal part	14-35	8-12	5-8	30-59	7-12	6-10
	Of the upper part	11-17	10-13	5-8	9-18	7-15	6-10
	Of the middle part	13-31	3-11	5-8	23-55	10-18	6-10
	Of the basal part	26-39	7-12	5-8	30-59	7-15	6-10
	Over veins	36-71	6-11	5-8	31-61	9-17	6-10

parenchymatous ground tissue and transversed longitudinally by small vascular strand. The epidermal cells of united part (Fig. 10 J) are axially elongated with straight anticlinal walls and covered with smooth cuticle. The epidermal cells of the free part (Fig. 10 K) are polygonal, isodiametric or slightly axially elongated with straight anticlinal walls, short papillae and covered with striated cuticle. The measurements of epidermal cells of the filament in microns are given in Table (3). The epidermal cells contain mucilage and show neither stomata nor trichomes.

A transverse section of the anther (Fig. 10 A,B) consists of two anther-lobes, each enclosing two pollen

sacs, separated by a connective. The anther-wall (Fig. 10B) is formed of an outer epidermis followed by a single row of fibrous layer and a collapsed tapetum. The epidermal cells (Fig. 10F) are polygonal with straight or wavy anticlinal walls and prolonged in the form of conical-shaped papillae with rounded apices. They are covered with thin striated cuticle and measure 9 to 25 μ in length 7 to 17 μ in width and 6 to 19 μ in height. Stomata are absent all over the anther wall.

The fibrous layer (Fig. 10B,C) is formed of one row of polygonal cells with straight anticlinal walls and lignified spiral bands of thickening which appear as bars in the anticlinal plane and as beads in surface view.

Table (3): Dimensions of the epidermal cells of the filament (in microns).

Epidermis of the filament	Free Part			United Part		
	L.	B.	H.	L.	B.	H.
At the upper part	9-27	5-11	4-9	34-69	6-8	4-9
At the lower part	27-52	7-19	4-9	26-52	5-11	4-9

They measure 9 to 20 μ in length, 6 to 13 μ in width and 10 to 18 μ in height. Pollen grains (Fig. 10E) are spherical, oval or triangular and yellow in colour, each with one germ pore, one germinal furrow and finely granular exine, they measure 18 to 33 μ in diameter.

The epidermal cells of connective (Fig. 10D) are polygonal with straight anticlinal walls and covered with thin striated cuticle. They are prolonged to form conical-shaped papillae with rounded apices and measure 8 to 15 μ in length and 7 to 12 width.

The Gynaecium :

The tissues of the stigma and the style (Fig. 11) are formed of an epidermis enclosing a parenchymatous ground tissue transversed by two vascular strands. The epidermis of stigma (Fig. 12F) is formed of polygonal axially elongated cells and covered with striated cuticle. At the apex, the cells are prolonged to form cylindrical or conical-shaped papillae with rounded apices, while at the middle and lower parts, the cells have slightly beaded anticlinal walls. They measure 7 to 28 μ in length and 4 to 12 μ in width. The epidermis of style (Fig. 12 G) is formed of polygonal axially elongated cells and covered with smooth cuticle. At the upper part and the base, the cells have straight anticlinal walls, while at the middle part, the cells show wavy anticlinal walls. They measure 7 to 39 μ in length, 4 to 9 μ in width and 4 to 10 μ in height.

A transverse section of the ovary-wall (Fig. 11 A,B) shows an outer and inner epidermis enclosing in between a parenchymatous mesophyll transversed by two vascular strands. Each vascular strand consists of an outer cellulosic phloem and inner xylem showing few lignified spiral vessels. The outer epidermis (Fig. 12H) is formed of polygonal isodiametric cells with straight anticlinal walls and striated cuticle. They measure 5 to 24 μ in length, 4 to 14 μ in breath and 4 to 7 μ in height. Prismatic crystals of calcium oxalate are occasionally present in the epidermal cells of the upper part of the ovary. The epidermal cells of the ovary and the style (Fig. 12H,G) show few stomata of anomocytic type.

The epidermal cells of the ovary and the upper part of the style (Fig. 12 H, G₁) show few covering trichomes; they are formed of 1 to 4 short basal cells and a long terminal one with moderately thick cellulosic walls, wide lumens and rounded apices. They have warty cuticle and measuring 88 to 230 μ in length and 8 to 14 μ in diameter.

Powdered Inflorescence :

The powdered inflorescence is yellowish-brown in colour with slight aromatic odour and slight bitter taste. It is characterised microscopically by :

- 1- Numerous spherical, oval or triangular pollen grains, they are yellow in colour with finely granular exine, one germ pore and one germinal furrow.
- 2- Fragments of fibrous layer of anther showing polygonal isodiametric cells with lignified beaded walls.
- 3- The epidermal cells of rachis, sepal and petals are polygonal axially elongated or isodiametric with straight or beaded anticlinal walls and striated cuticle.
- 4- Fragments of papillosed epidermal cells of the stigma showing beaded anticlinal walls covered with striated cuticle.
- 5- Fragments of papillosed epidermal cells of the connective and the anther with straight or wavy anticlinal walls and covered with striated cuticle.
- 6- Numerous covering trichomes: they are uniseriate multicellular with 1 to 4 short basal cells and a long terminal one with moderately thick cellulosic walls, wide lumens, rounded apices and warty cuticle.
- 7- Fragments of lignified thin-walled fibres with wide lumen, acute apices and surrounded by crystal sheath.
- 8- Numerous prismatic crystals of calcium oxalate are free or present in the parenchymatous cells of sepal, connective and ovary.

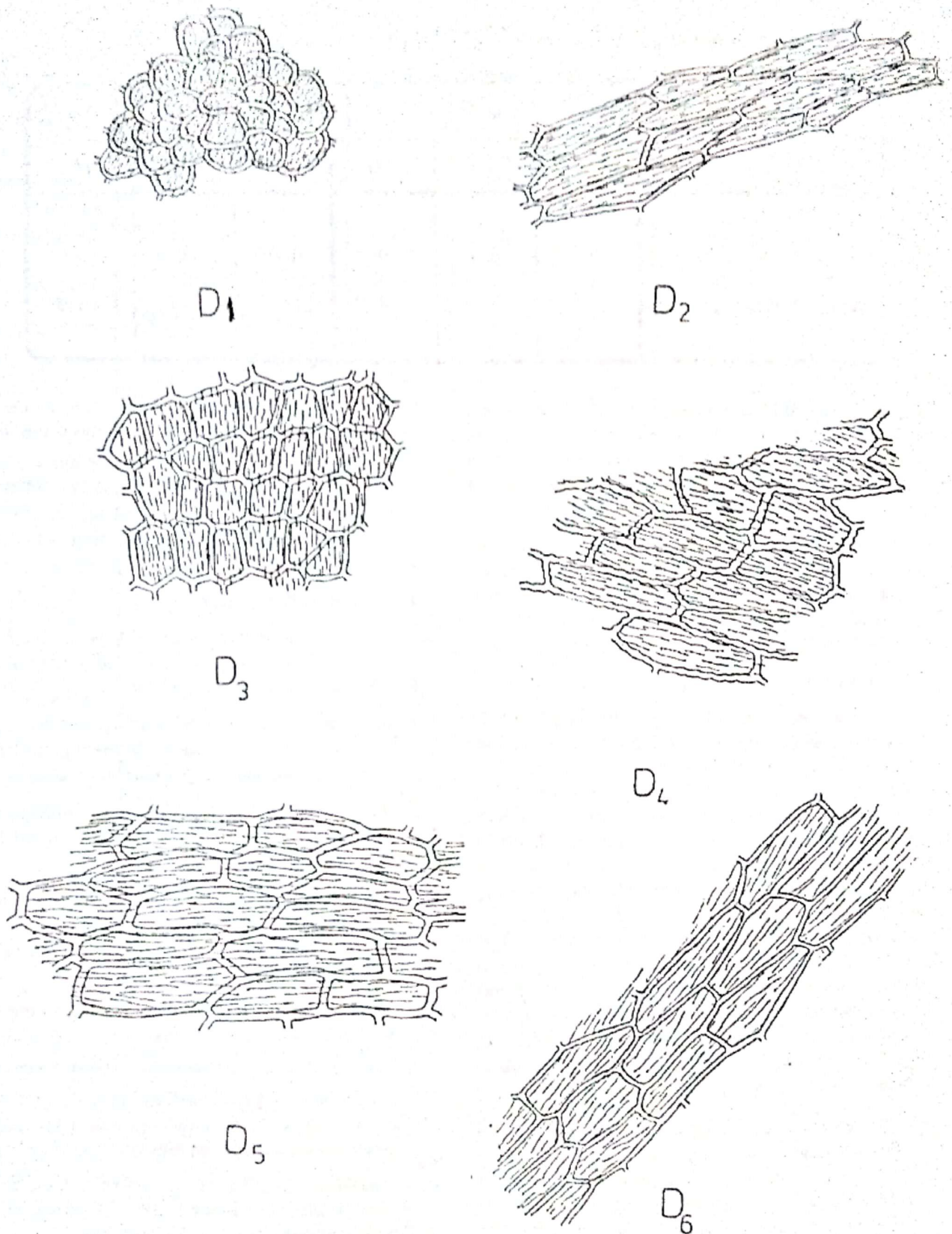


Fig. (9): Inner Epidermal Cells of the Wing or Keel Petal : (All X 468).
D₁- At the apex. D₂- At the margin. D₃- At the upper part. D₄- At the middle part.
D₅- At the lower part. D₆- Over the vein

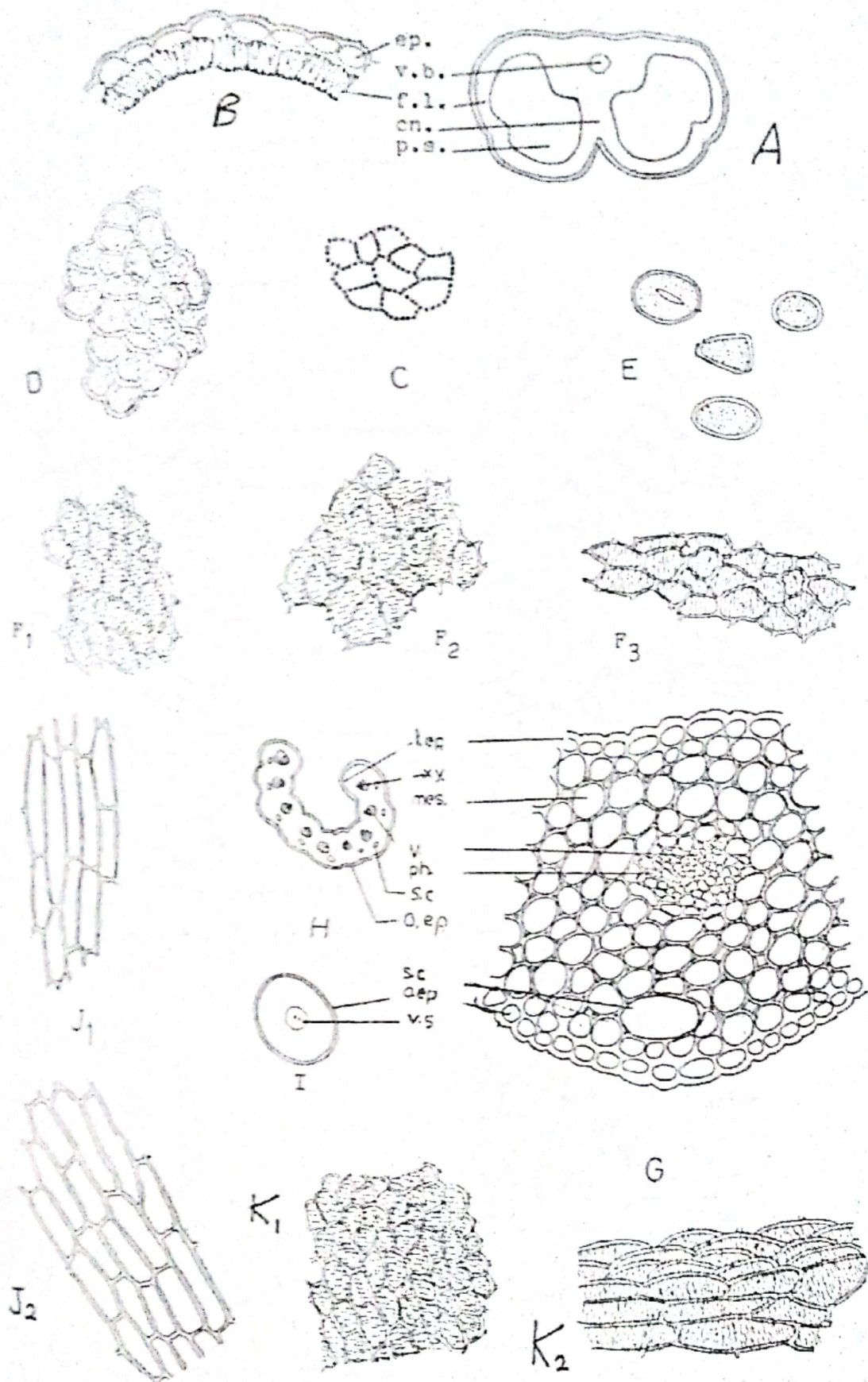


Fig. 1080. The *Androsaceum*: (All 135, except A X 80, H X 33, I X 33.5).

- A: Diagrammatic transverse section of the anther
- B: Detailed transverse section the anther
- C: Pinnous layer
- D: Epidermal cells of the connective
- E: Pollen grains
- F₁: Epidermal cells at the apex of the anther
- F₂: Epidermal cells at the middle of the anther
- F₃: Epidermal cells at the basal part of the anther
- G: Detailed transverse section of the filament
- H: Diagrammatic transverse section of the filament
- I: Epidermal cells of the filament at the part
- J₁: At the upper part
- J₂: At the lower part
- K₁: At the upper part
- K₂: At the lower part

ep., epidermal cell; fl., filament layer; lep., lower epidermis; mes., mesophyll; o.ep., outer epidermis; ph., phloem; sc., secretory cells; v., vascular bundle; v.b., vascular bundle; xy., xylem.

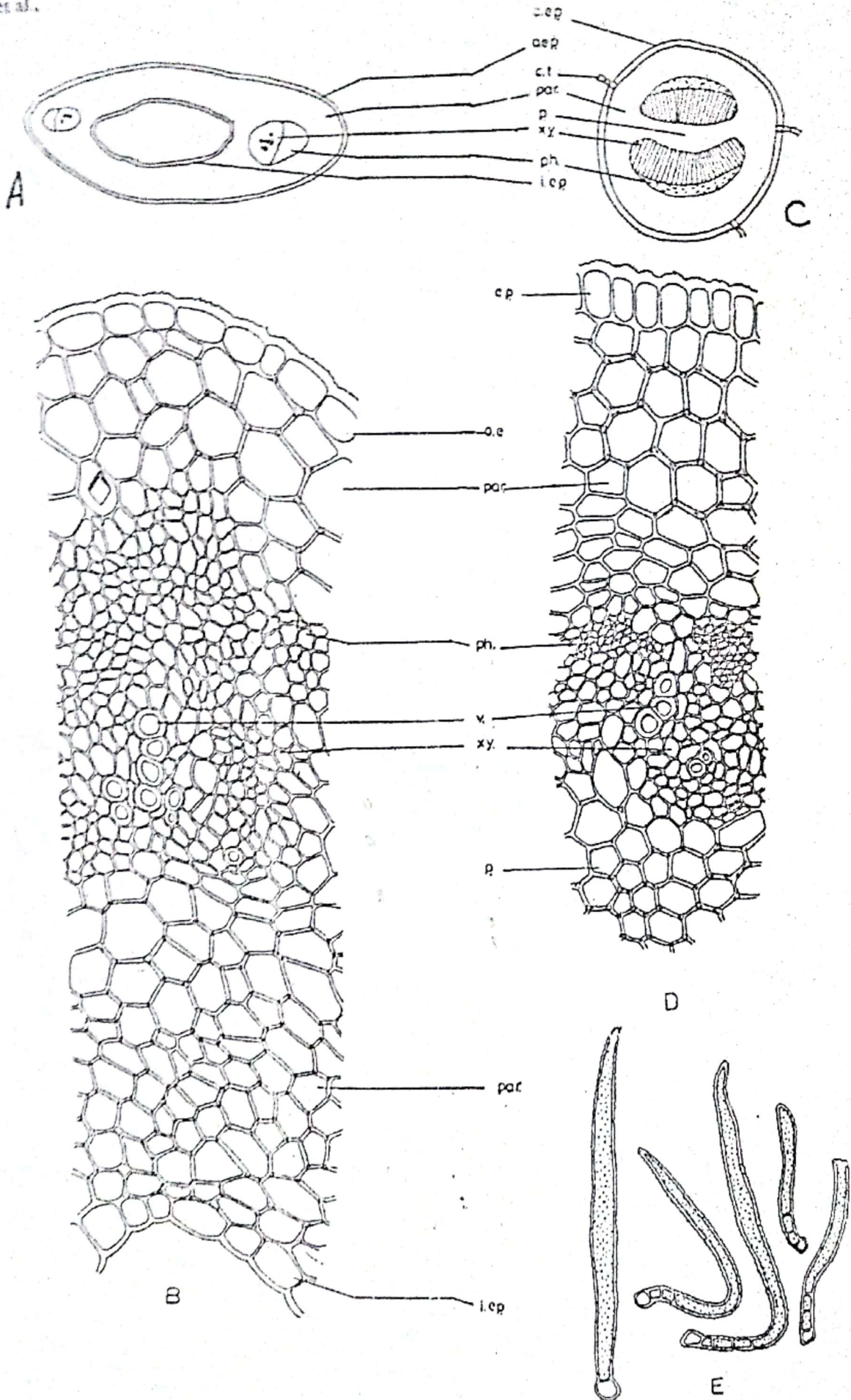


Fig. (11): The Gynoecium : (A, C X 70, B, D X 693, E X 282).

A- Diagrammatic transverse section of the ovary.

B- Detailed transverse section of the ovary.

C- Diagrammatic transverse section of the style.

D- Detailed transverse section of the style.

E- Covering trichomes.

ct., covering trichomes; ep., epidermis, i.ep., inner epidermis, o.ep., outer epidermis; p., pith., par., parenchyma; ph., phloem; v., vessel;

xy., xylem

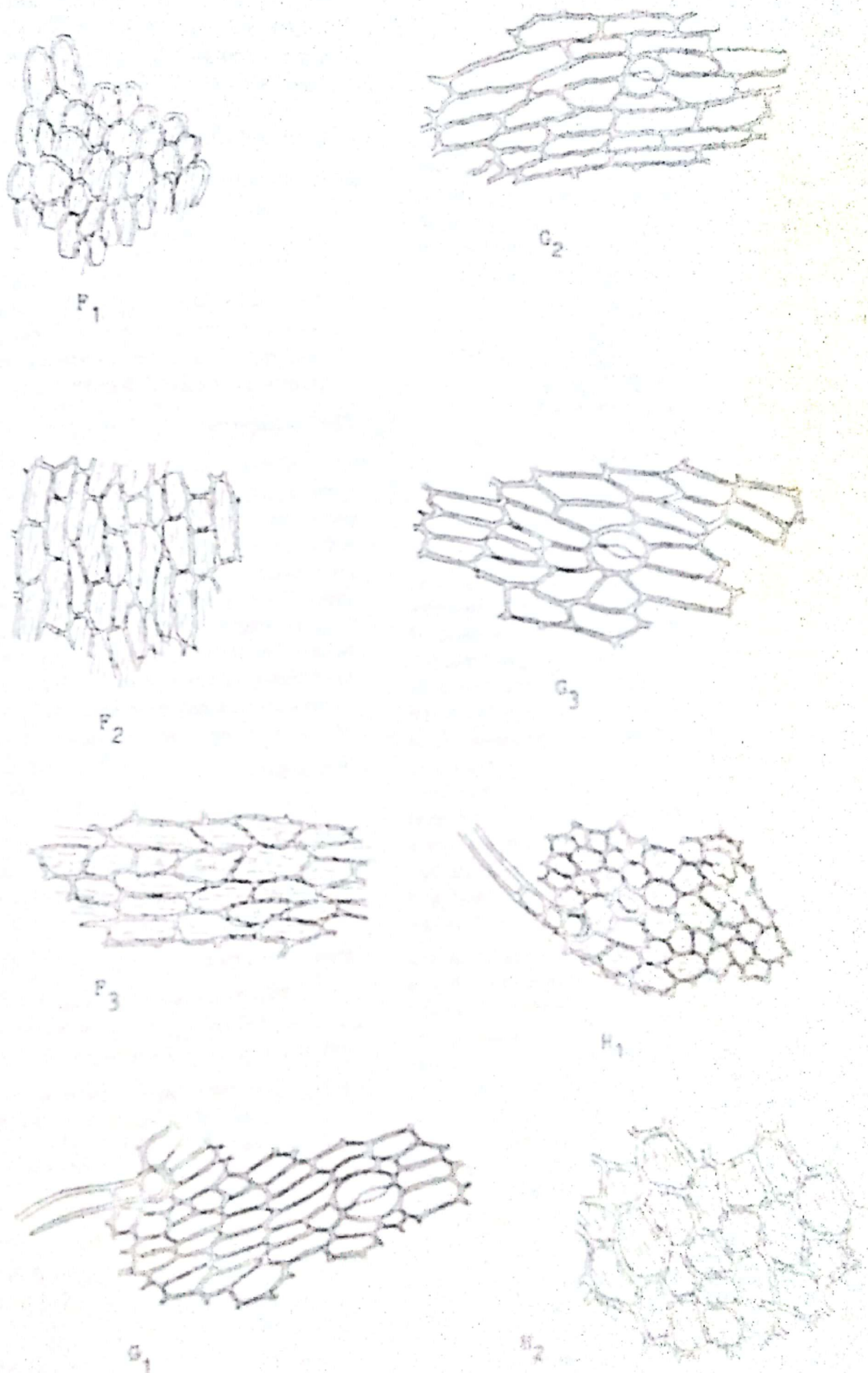


Fig. 12. Epidermal cells of the *Gymnosium* (100 X MPH).

P₁ - the middle part
 C₂ - the upper part
 F₂ - the lower part

F₃ - the middle part
 G₃ - the upper part
 H₁ - the lower part

G₁ - the middle part
 H₂ - the upper part
 H₁ - the lower part

P₁ - the middle part
 C₂ - the upper part

2- The Fruit :

A- The pedicel :

A transverse section of the pedicel (Fig. 13A) is almost circular in outline showing an outer epidermis surrounding a wide parenchymatous cortex with subepidermal collenchyma and a complete ring of three collateral vascular bundles surrounding a very narrow parenchymatous pith. The pericycle is formed of batches of lignified pericyclic fibres abutting the vascular bundles and surrounded by crystal sheath.

B- The pericarp :

The epicarp (Fig. 13, 14A) is formed of polygonal isodiametric or slightly elongated cells with straight anticlinal walls and thick striated cuticle and contain mucilage. They measure 13 to 47 μ in length, 6 to 16 μ in width and 3 to 7 μ in height. Neither stomata nor trichomes are present on the epicarp.

The hypodermis (Fig. 13B, 14B) is formed of polygonal isodiametric cells with straight anticlinal walls appearing more or less rounded in sectional view, they measure 21 to 59 μ in length, 17 to 30 μ in width and 6 to 18 μ in height. The rest of mesocarp consists of 8 to 16 rows of polygonal parenchymatous cellulose walls. Groups of pitted lignified parenchymatous cells are scattered among this layer; the cells show pitted walls, numerous oval or rounded pits and measure 25 to 62 μ in length, 19 to 40 μ in width and 11 to 24 μ in height. Also, it shows some cells containing mucilage. The mesocarp is transversely by 8 to 10 small collateral vascular bundles in addition to large one in the suture regions. The phloem consists of thin-walled cellulose elements and the xylem shows lignified spiral and annular vessels (Fig. 13B₂, C, 14F) measuring 6 to 12 μ in diameter and few lignified pitted tracheids and tracheidal vessels (Fig. 14F) measuring 45 to 120 μ in length and 9 to 17 μ in width. Each vascular bundle shows an arc of lignified pericyclic fibres surrounded by crystal sheath. The fibres (Fig. 14F) are spindle-shaped with moderately thick walls, wide lumen, blunt apices and measure 154 to 301 μ in length and 9 to 19 μ in diameter. The innermost layer of mesocarp (Fig. 13C, 14D,E) is differentiated and consists of polygonal cells with straight anticlinal walls, each cell containing prismatic crystal of calcium oxalate.

The endocarp (Fig. 13C, 14E) is formed of spindle-shaped prosenchymatous cells with wide lumens, rounded apices, thin lignified pitted walls and covered with thin smooth cuticle. They measure 129 to 201 μ in length and 6 to 15 in diameter.

C- The seed :

A transverse section of the testa (Fig. 15A) shows the following layers :

- 1- The epidermis (Fig. 15 A,B) consists of polygonal isodiametric cells with thin straight anticlinal walls and covered with thick smooth cuticle, the cells are filled with reddish-brown contents and mucilage. They measure 10 to 24 μ in length, 3 to 11 μ in width and 10 to 14 μ in height.
- 2- The hypodermis (Fig. 15 A,C) is formed of one row of basket-shaped more or less rounded parenchymatous cells measuring 3 to 12 μ in diameter.
- 3- The nutritive layer (Fig. 15 A,D) is formed of 5 to 6 rows of flattened tangentially elongated cells. The cells of the outer rows show idioblasts containing prismatic crystals of calcium oxalate.

The Endosperm :

The endosperm (Fig. 15 A,F) is scanty and formed of an outer aleurone layer and inner parenchymatous one. The aleurone layer (Fig. 15 A,E,I) is formed of one row of polygonal cells with moderately thick straight cellulose anticlinal walls and containing starch granules and aleurone grains. They measure 21 to 31 μ in length, 13 to 25 μ in width and 3 to 5 μ in height. The inner parenchyma (Fig. 15A) consists of 2 to 3 rows of polygonal flattened cells with thin cellulose walls and measure 21 to 31 μ in length, 11 to 24 μ in width and 6 to 8 μ height.

The Embryo :

The cotyledons (Fig. 15 A) are formed of an outer epidermis consists of polygonal cells with thin straight anticlinal walls and inner mesophyll formed of moderately thick-walled cells containing oil globules and aleurone grains.

Powdered Fruit :

The powdered fruit is reddish-brown in colour with characteristic odour and slightly bitter taste. It is characterised microscopically by :

- 1- Fragments of epicarp showing polygonal slightly elongated cells with straight anticlinal walls and thick striated cuticle.
- 2- Fragments of mesocarp showing polygonal parenchymatous cells with straight pitted anticlinal walls and oval or rounded pits.
- 3- Fragments of innermost layer of mesocarp formed of polygonal cells; each one containing prismatic crystal of calcium oxalate.
- 4- Fragments of endocarp showing elongated spindle-shaped prosenchymatous cells with wide lumens, thin lignified pitted walls and blunt apices.
- 5- Fragments of pericyclic fibres surrounded by crystal sheath.
- 6- Fragments of the epidermis of testa accompanied by hypodermis.

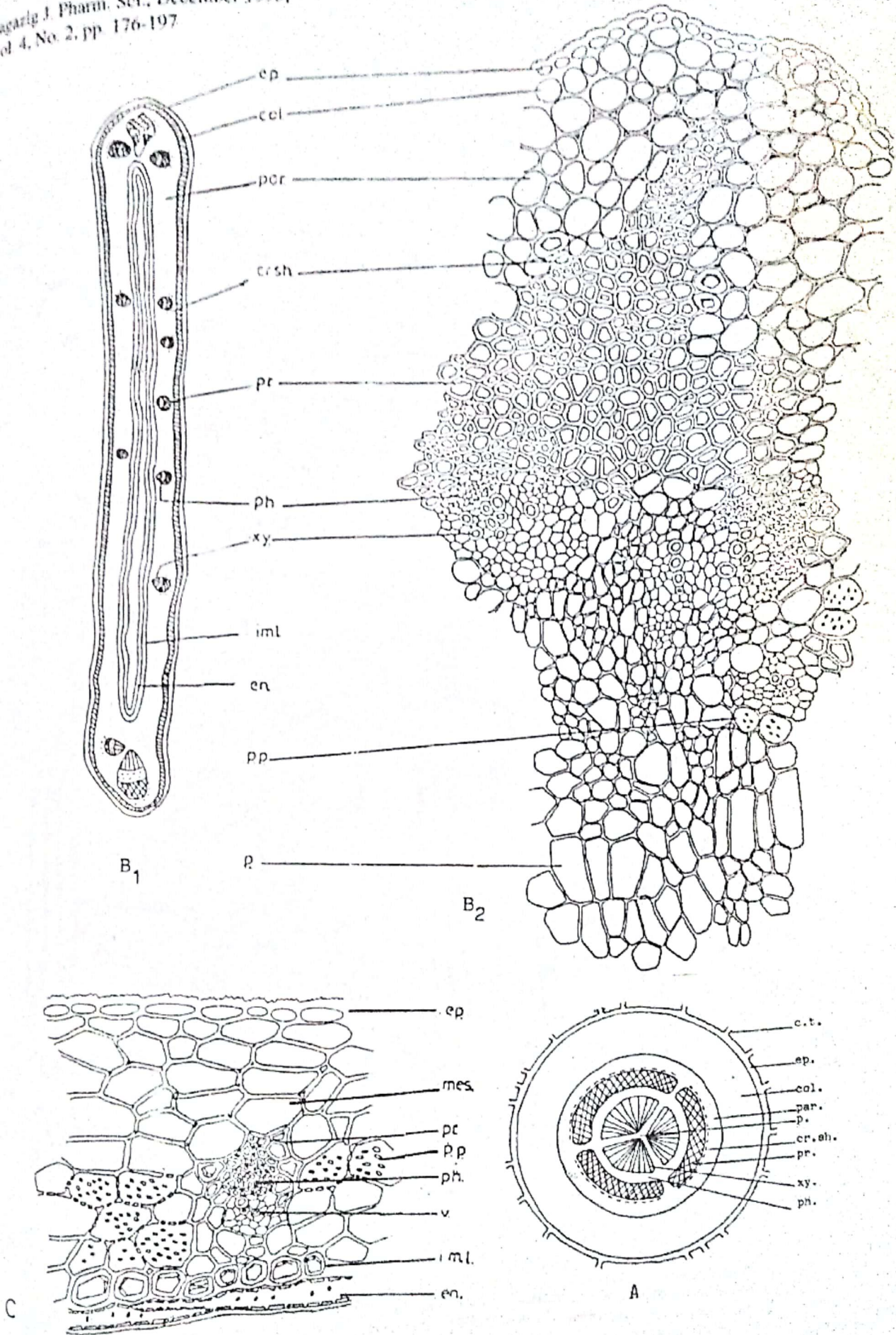


Fig (13): The Fruit : (All X 330 Exapt A X 85).

A- Diagrammatic transverse section of the pedicel of fruit.

B₁- Detailed transverse section at the suture region.

B₂- Diagrammatic transverse section of the pericarp.

C- Detailed transverse section at the flat part.

col., collenchyma; cr.sh., crystal sheath; en., endocarp; ep., epicarp; i.m.l., innermost layer of mesocarp; mes., mesocarp; par., parenchyma; ph., phloem; p., pith; p.p., pitted parenchyma; pr., pericycle; v., vessel; xy., xylem.

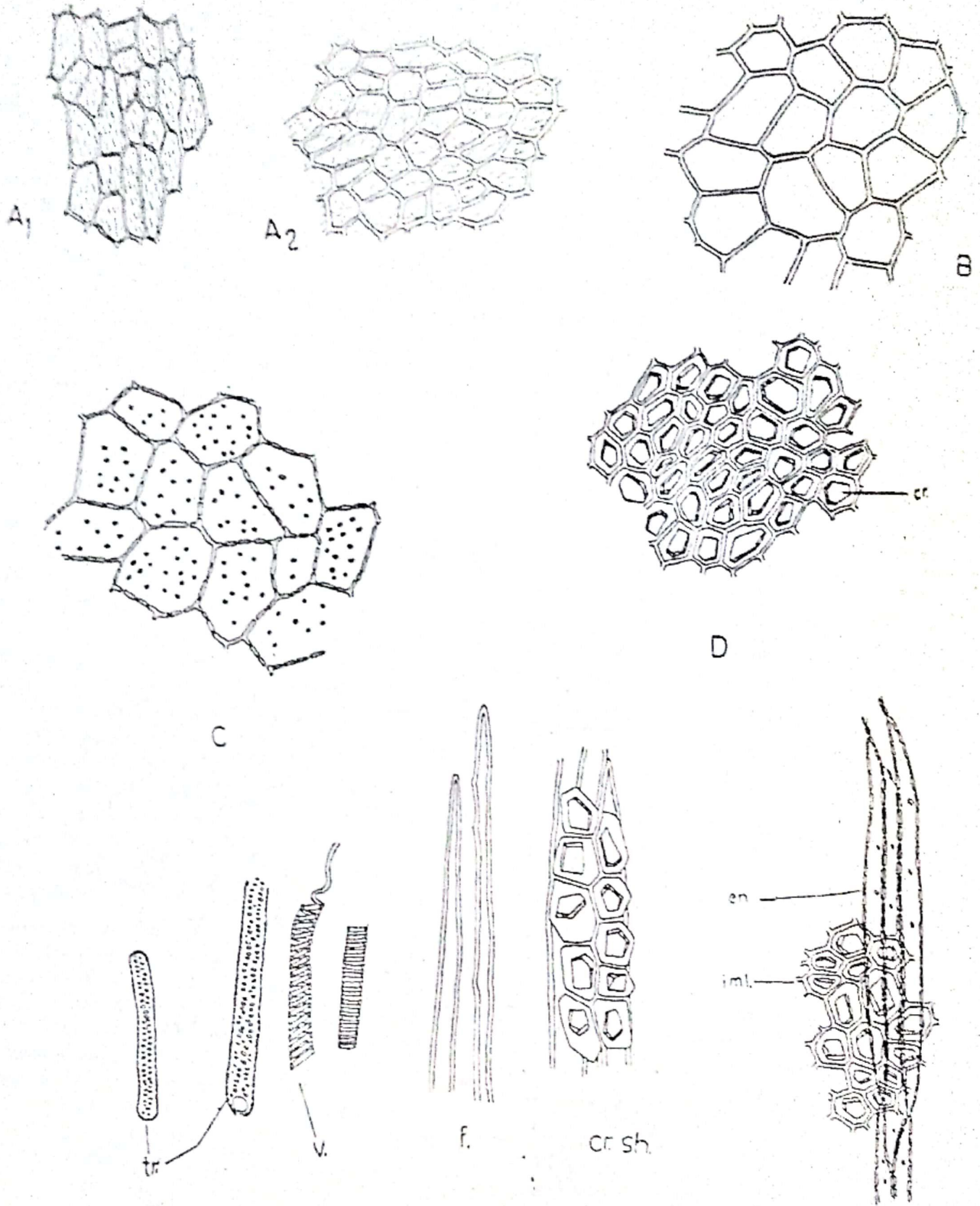


Fig. (14): The Pericarp : (All X 323).

A- The epidermal cells. A₁- At the suture region. A₂- At the flat part. B- The hypodermal cells. C- Pitted parenchyma. D- The innermost layer of mesocarp. E- The endocarp accompanied with the innermost layer of mesocarp. F- Isolated element. cr. sh., crystal sheath; cr., crystal; en., endocarp; f., fibre; i.m.l., innermost layer of mesocarp; tr., tracheids; v., vessels.

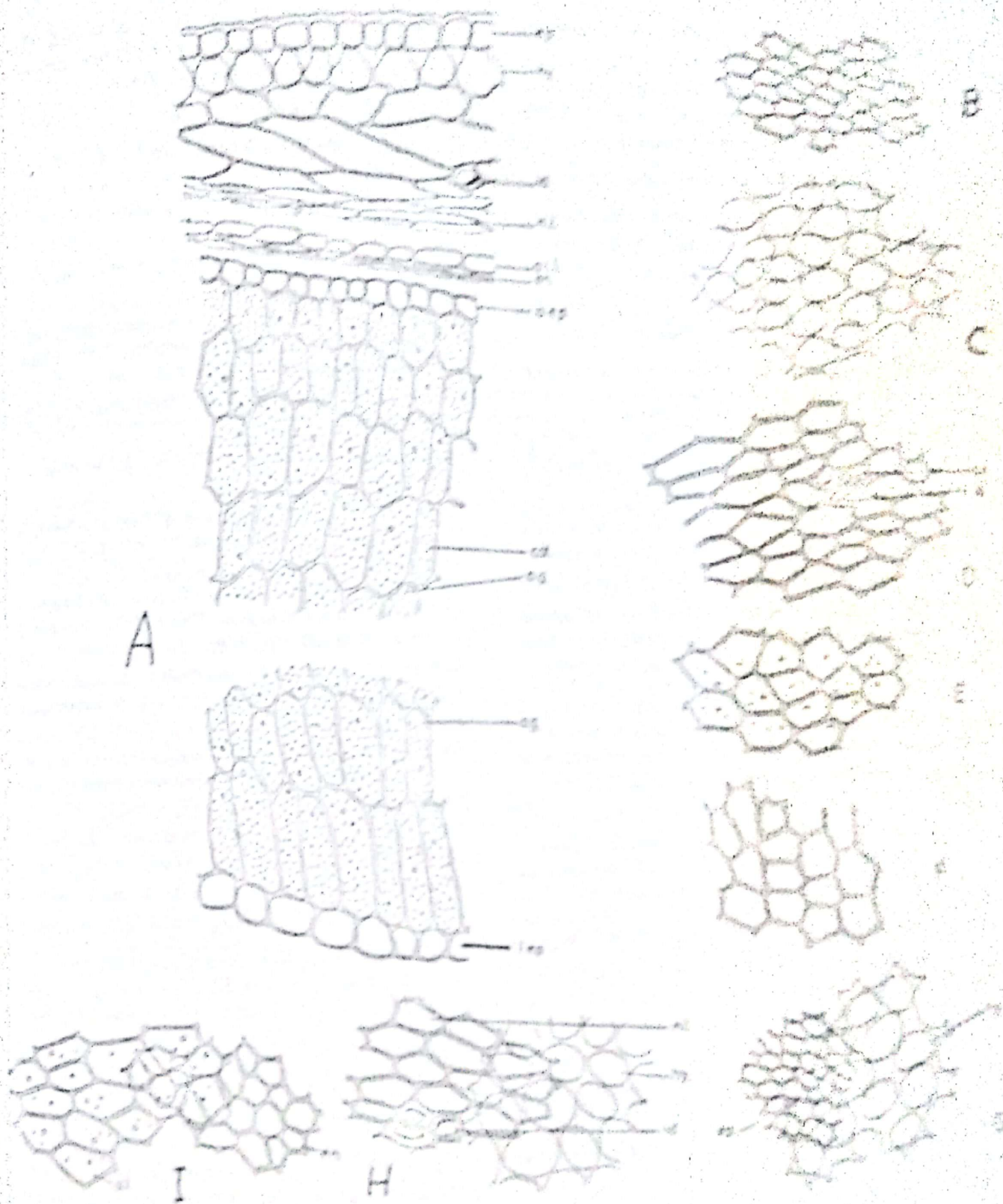


Fig. 15a. Seed (x40, 2, 207). **A** - Detailed longitudinal section of the stem. **B** - The epidermal cells of the stem. **C** - The collenchyma. **D** - Sclerenchyma. **E** - Alveolar tissue. **F** - Endodermis. **G** - The epidermis of the stem. **H** - The epidermis of the stem. **I** - The endodermis of the stem. **a** - Epidermis. **b** - Collenchyma. **c** - Sclerenchyma. **d** - Endodermis. **e** - Alveolar tissue. **f** - Endodermis. **g** - Epidermis. **h** - Epidermis. **i** - Epidermis.

- 7- Fragments of endosperm accompanied by aleurone layer.
- 8- Fragments of cotyledons showing polygonal cells with moderately thick cellulose walls and filled with fixed oil globules and aleurone grains.

CONCLUSION

From the previously mentioned study, one can conclude that, the characteristic features of the plant are the following:

- 1- The inflorescence is axillary racemose panicle with 40 to 60 yellowish-white papilionaceous flowers.
- 2- The fruit is oblong glabrous legume with faint brown colour, each contains 1 to 4 reddish-brown seeds.
- 3- The pericycle of the rachis and the pedicel of the fruit is formed of batches of lignified pericyclic fibres surrounded by crystal sheath.
- 4- The mesopyll of the calyx and keel petals show secretory cells with thin suberized walls containing volatile oil.
- 5- The innermost layer of mesocarp is differentiated and consists of polygonal parenchymatous cells, each cell containing prismatic crystal of calcium oxalate.
- 6- The endocarp is formed of spindle-shaped prosenchymatous cells with wide lumens, rounded apices, thin lignified pitted walls and covered with smooth cuticle.
- 7- Numerous covering trichomes occur on rachis, pedicel and sepals; they are uniseriate multicellular with 1 to 4 short basal cells and a long terminal one and covered with warty cuticle.
- 8- Numerous prismatic crystals of calcium oxalate.

- 9- The presence of mucilage in the epidermal cells, covering trichomes of rachis, pedicels and sepals and the parenchymatous cells of mesocarp.

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الدراسة العيانية والمجهريّة لنبات *دالبرجيا سيسو* روكسب (السوسوج) المنزوع في مصر الجزء الثاني : النورات والثمار

طه مصطفى سرح - عبد المنعم محمد عطية - عفاف السيد عبد الغنى - و فاء حسن بدر
قسم العقاقير - كلية الصيدلة - جامعة الزقازيق - مصر

سبق أن قام الباحثون بدراسة محتويات النبات الكيميائية وخواصه الحيوية وكذلك الصفات العيانية والمجهريّة لأوراق وساق النبات وفي هذا البحث يتم دراسة الصفات العيانية والمجهريّة لنورات وثمار النبات حتى يسهل التعرف عليه سواء في حالته الصحيحة أو على هيئة مسحوق.