

MACRO AND MICROMORPHOLOGICAL CHARACTERS OF *ABERIA CAFFRA* (HOOK.f. & HARV.) WARB. CULTIVATED IN EGYPT. PART I: STEMS AND LEAVES

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تنمو النباتات من جنس الابريا فى المناطق الأستوائية على شكل شجيرات ثنائية المسكن ولها أشواك وبعضها يزرع كنباتات سور لحماية الحدائق. والعديد من نباتات هذا الجنس تستخدم فى الطب الشعبى ، موضعيا فى علاج الروماتيزم والبرص والتهابات الجلد المختلفة وداخليا فى علاج مرضى السكر والكبد وبإجراء المسح الكيمايى الأولى للمواد الفعالة فى الخلاصات المختلفة لنبات الابريا كافرا (هوك.ف. وهارف) وارب تبين لنا وجود مواد فلافونية وقلوانيات وصابونينات بالإضافة إلى التربينات الثلاثية والاستيرولات والكربوهيدرات بينما أثبت المسح البيولوجى للخلاصات المختلفة أن الخلاصة الكحولية أظهرت تأثيرا واضحا ومشجعا ضد الخلايا السرطنة. مما شجع الباحثين على إجراء دراسة عقاقيرية متكاملة للأجزاء المختلفة لهذا النبات. وفى هذا البحث نعرض دراسة تفصيلية للصفات العينية والمجهرية لسيقان وأوراق هذا النبات بهدف التعرف على أجزائه المختلفة سواء كاملة أو على هيئة مسحوق.

The macro and micromorphological characters of the stems and leaves of Aberia caffra (Hook.f. & Harv.) Warb. were studied and found helpful in identifying them in both the entire and powdered forms.

INTRODUCTION

The genus *Aberia* (Family *Flacourtiaceae*) comprises about 22 species¹⁻³, distributed in tropical, subtropical and temperate regions.⁴⁻⁶ They are represented by small spiny trees or shrubs with dioecious flowers and sometimes edible fruits.^{2,7}

Certain *Aberia* species have been used medicinally as tonic, flavouring agent and as remedy against rheumatism,^{7,8} while other members of the family have been used in treatment of leprosy, lupus and pustular eruption of the skin,⁷⁻⁹ treatment of jaundice, diabetes and bladder disorders.^{10,11}

Flacourtiaceae has not yet been extensively studied. Preliminary phytochemical screening of the title plant revealed the presence of saponins, flavonoids and alkaloids.¹² Preliminary biological screening revealed that the ethanolic extract of the leaves has anti-cancer effect.¹²

To the best of our knowledge there is no

phytochemical data on this genus. This prompted us to undertake a pharmacognostical investigation of this plant. The macro- and micromorphological features of the stems and leaves of *Aberia caffra* (Hook.f. & Harv.) Warb. are the subject of this paper.

MATERIAL

Sampled were collected during summer (1994) from trees cultivated in the Experimental Station of Faculty of Agriculture, Assiut University. The plant was identified by Dr. M. Nabil El-Hadidi, Prof. of Plant Taxonomy, Faculty of Science, Cairo University, and a voucher specimen is kept in Pharmacognosy Department Herbarium, Faculty of Pharmacy, Assiut University.

Fresh stems and leaves as well as preserved samples in a mixture of alcohol-glycerin-water 1:1:1 were used. The powdered material was obtained from air-dried stems and leaves.

HABITAT

Aberia caffra (Hook.f. & Harv.) Warb. (Fig. 1) is an erect evergreen shrub or small dioecious tree up to 3-4 meters in height with numerous spiny branches. It is cultivated in gardens as hedges plant. It carries simple alternate, ovate to lanceolate leaves. Flower is yellowish-green in colour and arranged in axillary umbel-like cymes. Fruit is berry enclosing numerous seeds.

MACROMORPHOLOGY

1- The stem (Fig. 1)

The main trunk of the plant is erect, cylindrical, woody, monopodially branched, reaching about 2-3 meters in height and about 15-20 cm in diameter. It carries numerous cylindrical alternate or opposite decussate spiny branches with short internodes. The young parts of the stem are spiny, green in colour while the older parts are light brown, rough and covered with brown ridged cork, longitudinally wrinkled bearing transverse cracks and carry scars of fallen leaves. The stem is odourless with a slight bitter taste.

2- The leaf (Fig. 1)

The plant carries leaves which are variable in shape and size. The leaf is simple, petiolate, exstipulate, alternate or spirally arranged and arise from the bud either singly or in clusters of 4-7 leaves. In the terminal young branches, a spine arises from the axil of the leaf measuring 3-4 cm in length, while in older branches two clusters of leaves arises on both sides of the spine. The leaf is green in colour, vary in shape, being ovate, obovate and ovate-lanceolate, with entire margin obtuse to retuse apex and a symmetric base. The venation is pinnate-reticulate and texture is papery. The leaf measures about 3-5 cm in length and 2-3 cm in width. It is odourless with a slight bitter taste.

MICROMORPHOLOGY

1- The stem (Fig. 2)

A transverse section in the young stem is more or less circular in outline, it shows an

outer hairy epidermis, followed by collenchymatous, then a comparatively narrow parenchymatous cortex, followed by the pericycle which surrounds a central complete ring of vascular elements enclosing a comparatively wide parenchymatous pith. The endodermis is indistinct.

The old stem (Fig. 3) shows an outer brownish cork originating superficially in the subepidermal region. The pericycle consists of groups of fibers and sclerieds alternating with parenchyma cells. The xylem is more developed than that of the young stem and the pith is pitted and lignified.

The epidermis: The epidermis of young stem (Fig. 2,C) is formed of one row of square to sub-rectangular cells in transverse section, while being in surface view (Fig. 2,B), polygonal to subrectangular with straight anticlinal walls covered with smooth cuticle and measuring (30-50-80 μ) in length, (15-19-23 μ) in width and (19-23-26 μ) in height. Non-glandular, unicellular hairs, covered with thick, smooth cuticle, measuring (76-80-84 μ) in length and (8-11-15 μ) in width are present, while stomata are almost absent.

In old stem (Fig. 3,B&C), the cork consists of several rows of subrectangular slightly lignified cells appearing polygonal to isodiametric with straight slightly lignified walls. In surface view, they measure (57-69-84 μ) in length, (34-46-61 μ) in width and (19-26-46 μ) in height.

The cortex (Fig. 2,C): The outermost region of the cortex consists of 4-5 rows of collenchymatous cells, the remaining of the cortex consists of several rows of rounded parenchyma cells containing cluster and prismatic crystals of calcium oxalate measuring (26-30-34 μ) diameter, (20-26-32 μ) in length and (11-15-19 μ) in width, respectively. The endodermis is indistinct.

The pericycle (Fig. 2,C): It is formed of a more or less continuous ring of groups of lignified fibers, with moderately thick lignified irregular

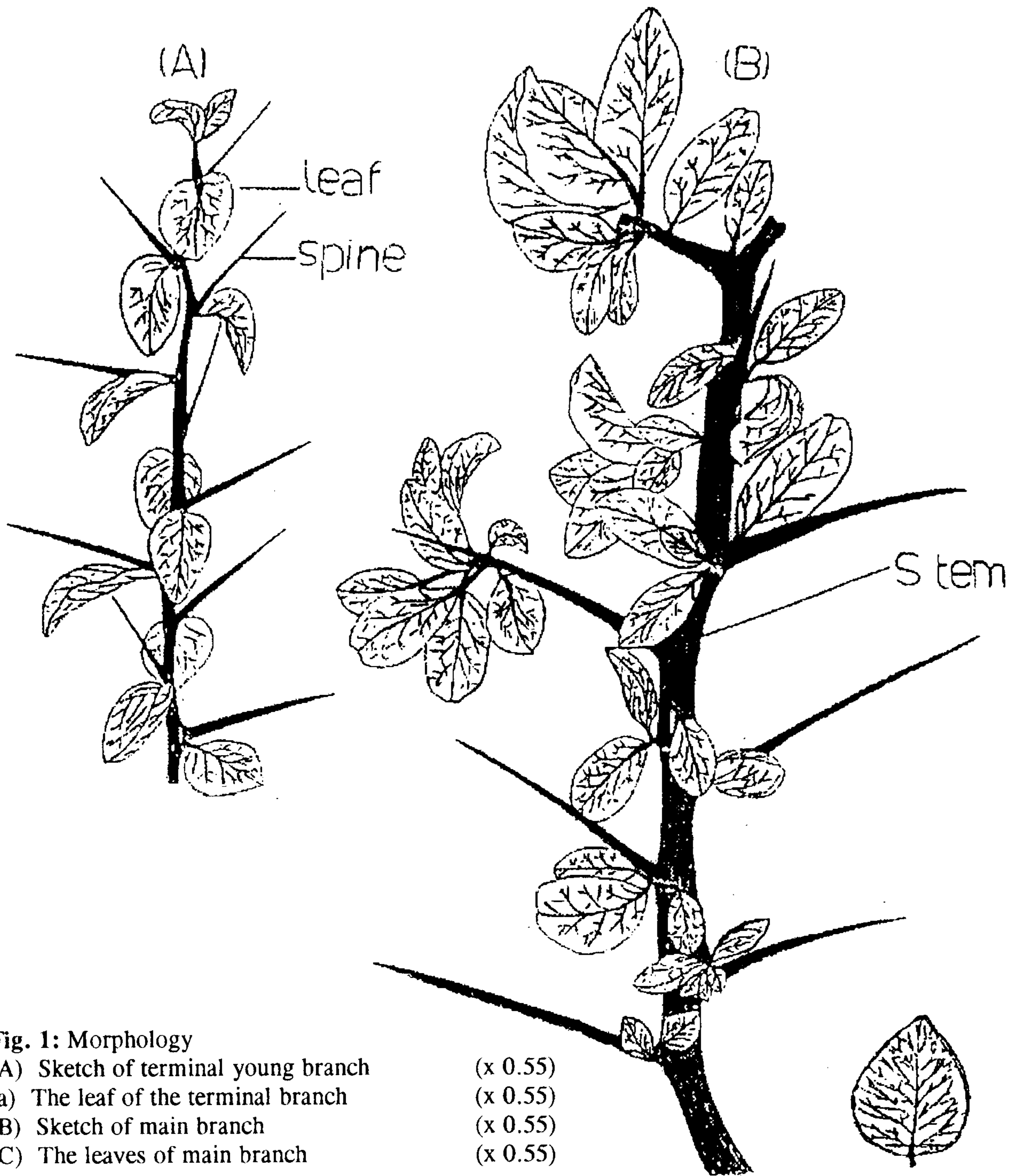


Fig. 1: Morphology

- (A) Sketch of terminal young branch
- (a) The leaf of the terminal branch
- (B) Sketch of main branch
- (C) The leaves of main branch

(x 0.55)
 (x 0.55)
 (x 0.55)
 (x 0.55)



(a)



(C)



blade
 petiole

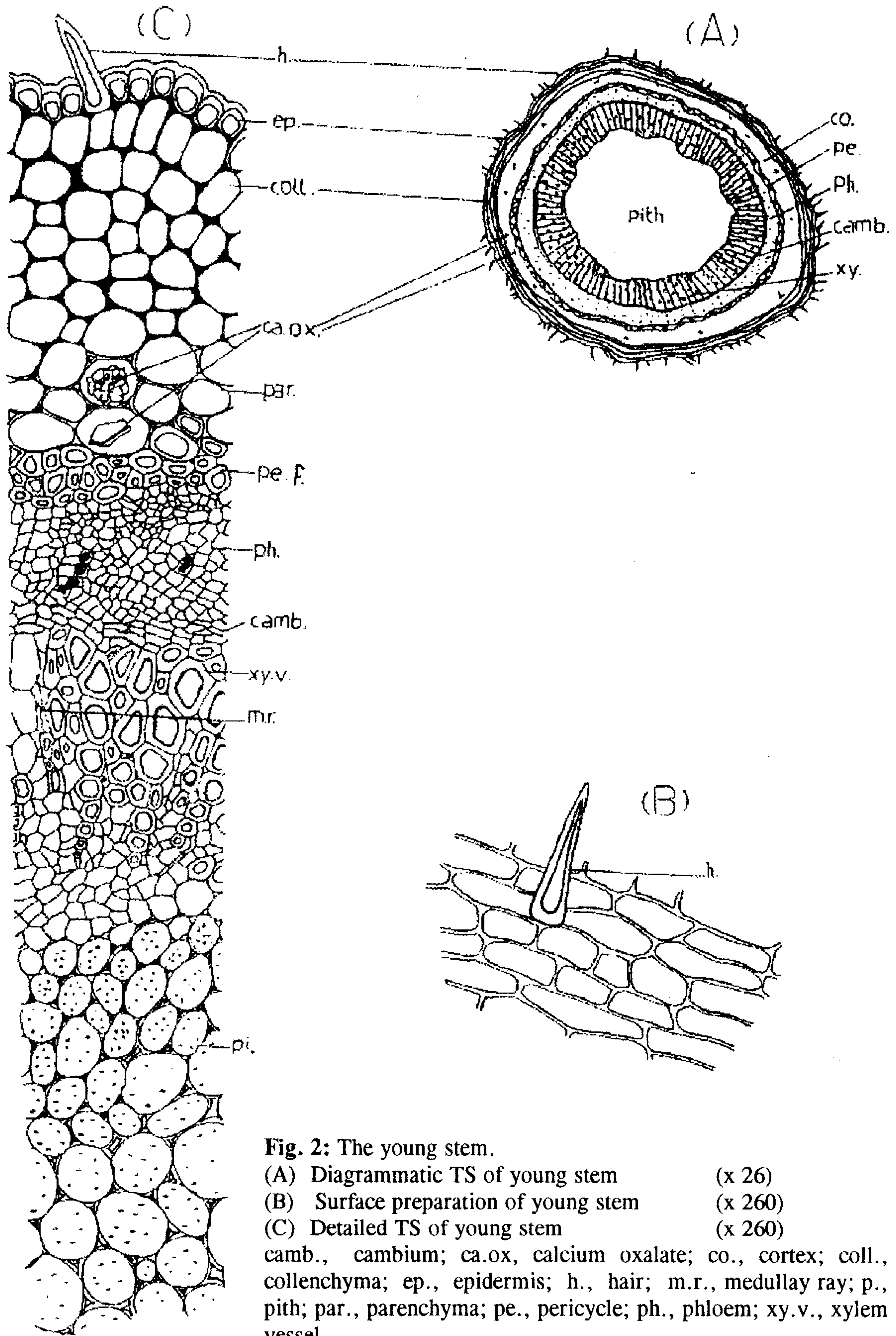


Fig. 2: The young stem.

(A) Diagrammatic TS of young stem (x 26)

(B) Surface preparation of young stem (x 260)

(C) Detailed TS of young stem (x 260)

camb., cambium; ca.ox, calcium oxalate; co., cortex; coll., collenchyma; ep., epidermis; h., hair; m.r., medullay ray; p., pith; par., parenchyma; pe., pericycle; ph., phloem; xy.v., xylem vessel.

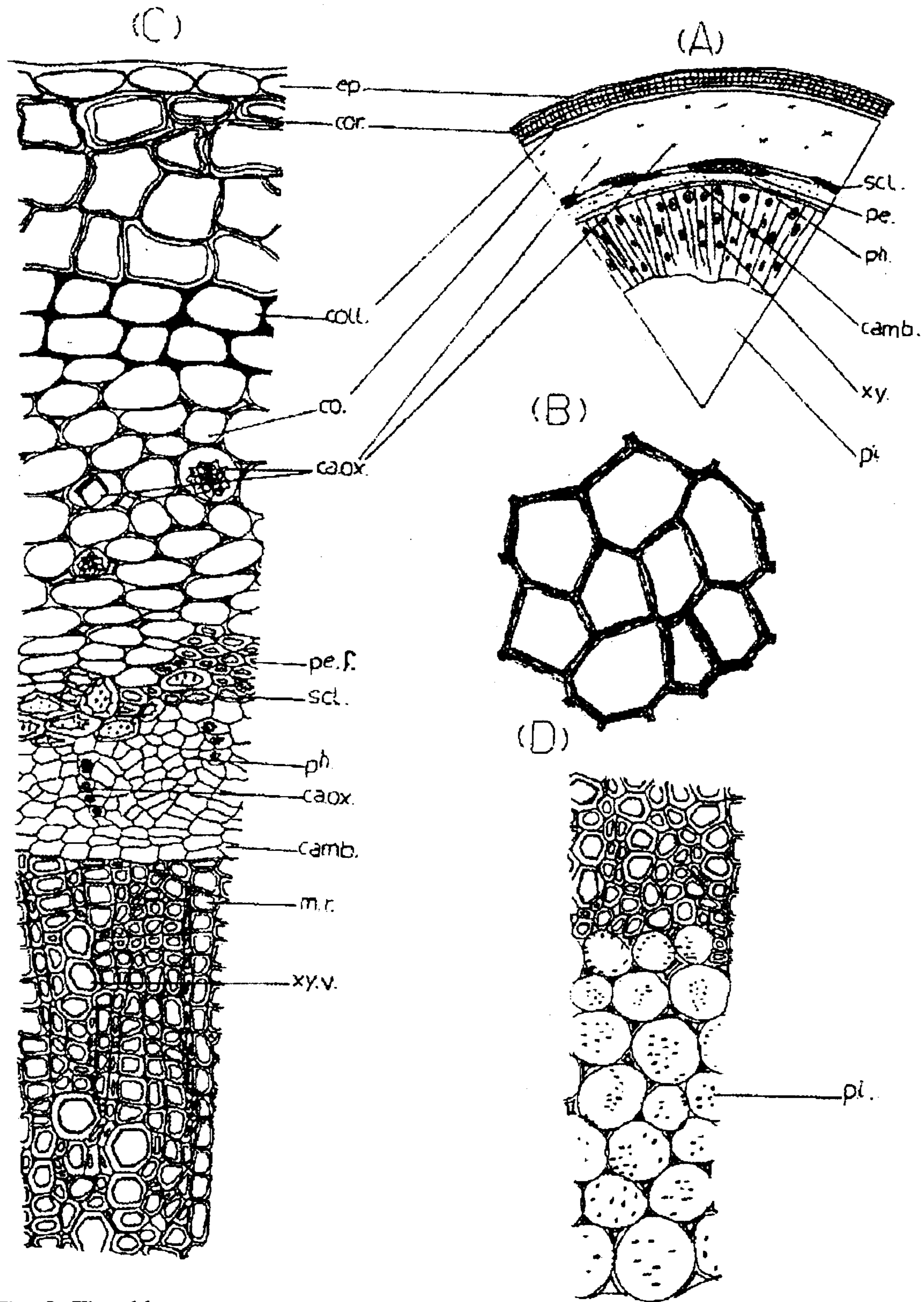


Fig. 3: The old stem.

- (A) Diagrammatic TS of old stem (x 26)
 (B) Cork cells (surface view) (x 230)
 (C,D) Detailed TS of old stem (x 230)

camb., cambium; ca.ox, calcium oxalate; co., cortex; coll., collenchyma; cor., cork; ep., epidermis; m.r., medullay ray; p., pith; pe., pericycle; ph., phloem; scl., sclerieds; xy.v., xylem vessels.

margin and comparatively wide lumina with blunt to rounded apices measuring (76-180-384 μ) in length and (23-30-42 μ) in diameter.

In old stem (Fig. 3,C), the pericyclic fibers are accompanied by groups of rectangular to square of lignified sclerieds with thick, pitted, branched lumina, measuring (38-54-100 μ) in length and (15-27-38 μ) in width.

The vascular system (Fig 2,C): Is represented by a continuous ring of phloem and xylem. The phloem is formed of sieve tubes, companion cells, and phloem parenchyma containing small cluster crystals of calcium oxalate measuring (4-8-12 μ) in diameter. Cambium is formed of few rows of thin-walled tangentially elongated and radially arranged cells. The xylem (Fig. 2,C) consists of lignified radially-arranged elements. The vessels are lignified with reticulate or simple-pitted thickening and measuring (30-38-46 μ) in diameter. The wood fibers are few elongated with thick lignified walls, narrow lumina and rounded apices, measuring (60-100-130 μ) in length and (11-15-19 μ) in diameter. The wood parenchyma are subrectangular cells with slightly pitted lignified walls. The medullary rays are uni- to biseriate, in the xylem region they are formed of radially elongated subrectangular cells, with thick, pitted and lignified walls.

The pith is formed of rounded to oval finely pitted lignified cells followed by large oval parenchymatous cells, no calcium oxalate are observed.

The powder (Fig. 4): Powdered stem is dark green to greenish-brown in colour, having faint odour and a slight bitter taste. It is characterized microscopically by the following:

- 1- Fragments of polygonal to subrectangular epidermal cells with straight anticlinal walls, covered with smooth cuticle and carrying nonglandular unicellular hairs.
- 2- Fragments of yellowish brown polygonal slightly lignified cork cells from old stem.
- 3- Fragments of cortical parenchyma with rounded, cellulose, thin-walled cells containing clusters and prismatic crystals of

calcium oxalate.

- 4- Groups of sclerieds of different shapes and sizes being subrectangular to polygonal with pitted lignified walls from the pericycle of the old stem.
- 5- Fragments of pericyclic fibers with thick-pitted, lignified walls, narrow lumina and irregular margin.
- 6- Fragments of lignified spiral, reticulate and simple, sometimes bordered pitted xylem vessels, tracheids with pitted lignified walls, also lignified pitted wood parenchyma and lignified medullary ray cells are observed.
- 7- Fragments of wood fibers with pitted lignified walls, rounded apices and moderately wide lumina.
- 8- Groups of lignified pitted cells of the pith.
- 9- Numerous scattered cluster and prismatic crystals of calcium oxalate.

2- The leaf

A transverse section in the lamina through the midrib (Fig. 5,A) appears planoconvex in outline. It shows an upper and a lower hairy epidermises enclosing in between isobilateral mesophyll, interrupted in the midrib region by collenchyma. The vascular system in the midrib region is represented by a large crescent-shaped main vascular bundle surrounded by an incomplete ring of pericyclic fibers.

The upper and lower epidermal cells (Fig. 5,B) consist of one row of square to subrectangular cells. The upper epidermal cells, in surface view are polygonal slightly elongated with straight anticlinal walls, covered with smooth cuticle, measuring (34-42-64 μ) in length, (26-30-34 μ) in width and (20-27-35 μ) in height. Non glandular, unicellular hairs are observed measuring (70-92-150 μ) in length and (8-11-15 μ) in width, stomata are almost absent. The lower epidermal cells in surface view are polygonal nearly isodiametric with straight anticlinal walls covered with smooth cuticle measuring (19-30-38 μ) in length, (15-19-23 μ) in width and (11-15-19 μ) in height. Stomata are rounded to oval of anomocytic type measuring (20-25-35 μ) in length and (22-27-32 μ) in

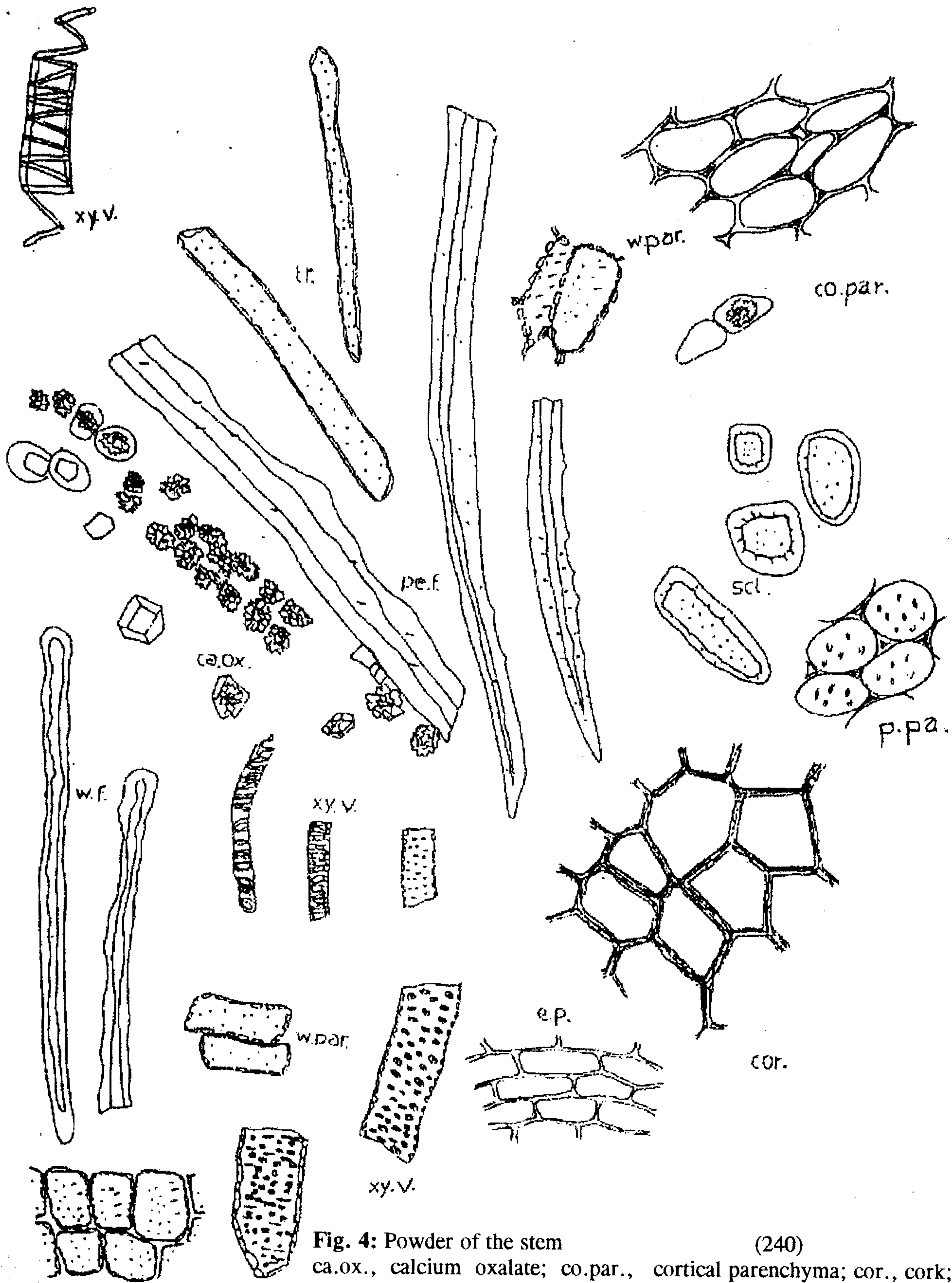


Fig. 4: Powder of the stem

(240)

ca.ox., calcium oxalate; co.par., cortical parenchyma; cor., cork; ep., epidermis; m.r., medullary ray cell; pe.f., pericyclic fibre; p.par., pith parenchyma; scl., sclerieds cells; tr., tracheids; w.f., wood fibre; w.par., wood parenchyma; xy.v., xylem vessels.

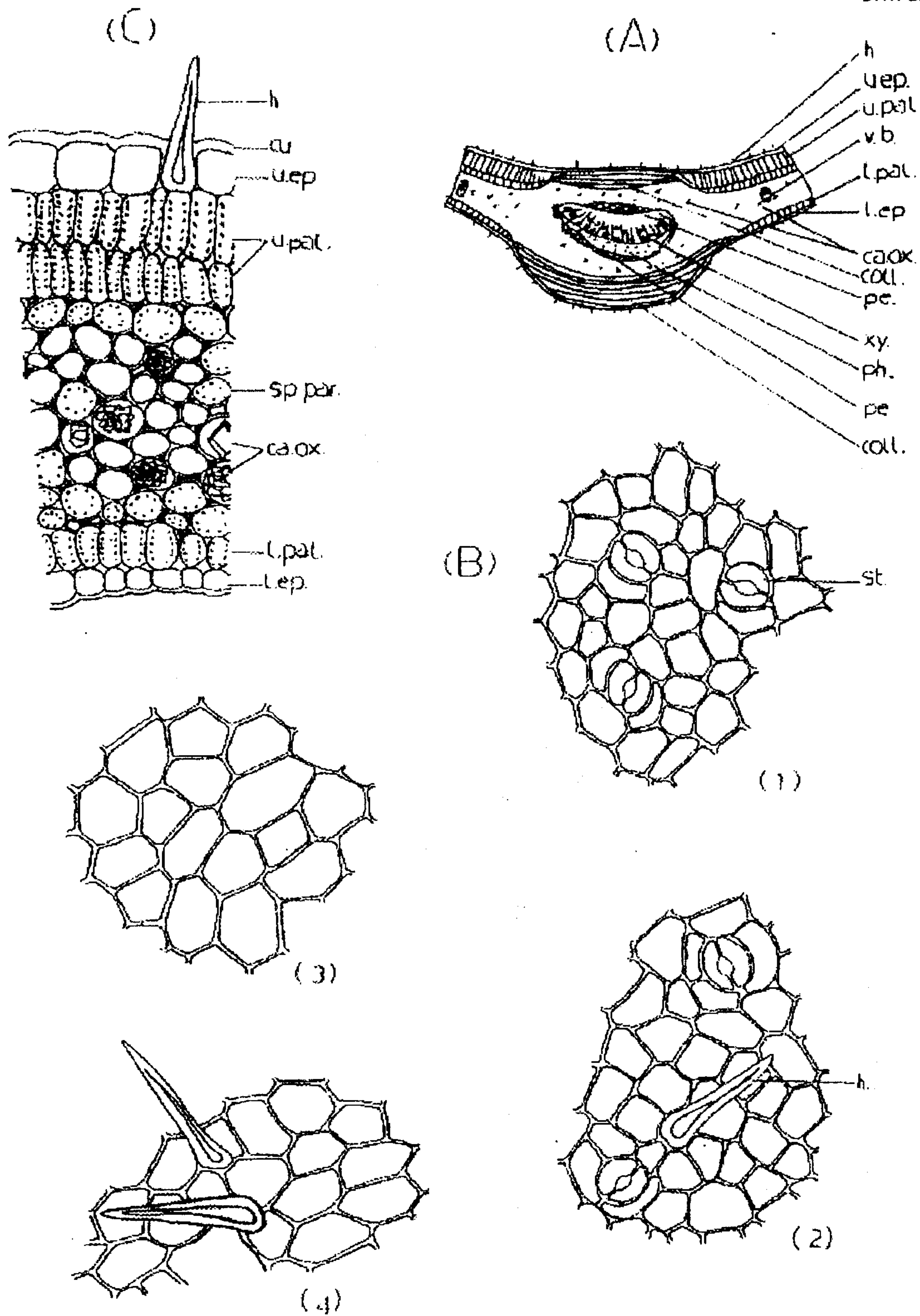


Fig. 5: The leaf.

(A) Diagrammatic TS of the leaf (x 26)

(B) Surface preparation of the leaf

1- Lower epidermis (x 220)

3- Upper epidermis (x 220)

2- Lower epidermis (neural) (x 220)

4- Upper epidermis (neural) (x 220)

(C) Detailed TS in the lamina (x 220)

ca.ox, calcium oxalate; coll., collenchyma; cu., cuticle; h., hair; l.ep., lower epidermis; l.pal., lower palisade; pe., pericycle; ph., phloem; sp.par., spongy parenchyma; st., stomata; u.ep., upper epidermis; u. pal., upper palisade; v.b., vascular bundle; xy., xylem.

width, hairs resemble those of the upper surface.

The mesophyll: The upper palisade is formed of two rows of columnar cells, those of the upper row are larger than those of the lower one. The lower palisade is formed of one layer of illdefined short cells. The spongy tissue consists of thin-walled, rounded or slightly irregular parenchymatous cells with intercellular spaces containing cluster and prismatic crystals of calcium oxalate measuring (26-38-46 μ) in diameter, (12-15-19 μ) in length and (15-17-22 μ) in width, respectively.

The cortical tissue (Fig 6,A&B): The main vascular bundle is surrounded by an upper and a lower layer of oval to rounded collenchyma cells. The remaining cortical tissue is parenchymatous, with wide intercellular spaces, some of them containing clusters and prismatic crystals of calcium oxalate.

The vascular system (Fig. 6): The vascular system consists of radiating xylem and phloem surrounded by pericyclic fibers. The pericyclic fibers are lignified with moderately wide pitted lumina, irregular margin and tapering to rounded apices measuring (450-610-660 μ) in length and (26-45-75 μ) in diameter. The phloem is formed of small thin walled cells of sieve tubes, companion cells and phloem parenchyma, most of them containing cluster crystals of calcium oxalate measuring (4-7-12 μ) in diameter. The xylem is formed of lignified, spiral, reticulate and pitted vessels measuring (15-23-30 μ) in diameter. Wood fibers are few with moderately wide lumina, rounded to tapering apices, slightly pitted, lignified walls measuring (230-260-284 μ) in length and (15-19-25 μ) in diameter. Medullary rays are uni- or biserriate, consisting of polygonal to subrectangular cellulosic cells.

The petiole: A transverse section through the petiole (Fig. 7) is crescent-shaped, with an inner concave surface and outer convex one. It has an outer hairy epidermis followed by comparatively narrow collenchymatous then wide parenchymatous cortex enclosing a wide main vascular bundle.

The epidermis (Fig. 7,B&D): The epidermis consists of a single row of square cells, appearing polygonal nearly isodiametric with thin straight anticlinal walls covered with smooth cuticle in surface view, measuring (15-19-26 μ) in length, (8-15-23 μ) in width and (19-26-30 μ) in height, carrying non-glandular, unicellular hairs covered with smooth cuticle, measuring (60-70-84 μ) in length and (11-15-19 μ) in width. Stomata are almost absent.

The cortex (Fig. 7): The cortical tissue consists of few rows of thick cellulosic rounded to oval collenchyma cells, followed by several rows of parenchymatous cells with wide intercellular spaces, containing cluster and prismatic crystals of calcium oxalate, measuring (23-30-34 μ) in diameter, (8-11-15 μ) in length and (7-10-12 μ) in width, respectively.

The vascular system: Consists of strands of xylem and phloem surrounded by pericyclic fibers which are lignified with wide, pitted lumina, irregular margin, acute to rounded apices, measuring (450-600-650 μ) in length and (23-26-45 μ) in diameter. The xylem is represented by reticulate, spiral and few pitted lignified vessels, measuring (11-19-23 μ) in diameter. Phloem consists of soft thin, cellulosic-walled sieve tissue, companion cells and phloem parenchyma containing small cluster crystals of calcium oxalate measuring (4-7-10 μ) in diameter. The medullary rays are uni- or biserriate, consisting of polygonal to subrectangular thin cellulosic parenchymatous cells.

The powder (Fig. 8): The powder of the leaves is green to yellowish-green in colour with faint odour and slight bitter taste. It is characterised microscopically by the following fragments:

- 1- Fragments of upper and lower epidermal cells of the lamina, consisting of polygonal subrectangular cells, with straight anticlinal walls, covered with smooth cuticle and carrying non-glandular, unicellular hairs, the lower epidermis showing rounded to oval anomocytic stomata.
- 2- Fragments of mesophyll, showing columnar palisade cells and parenchyma cells

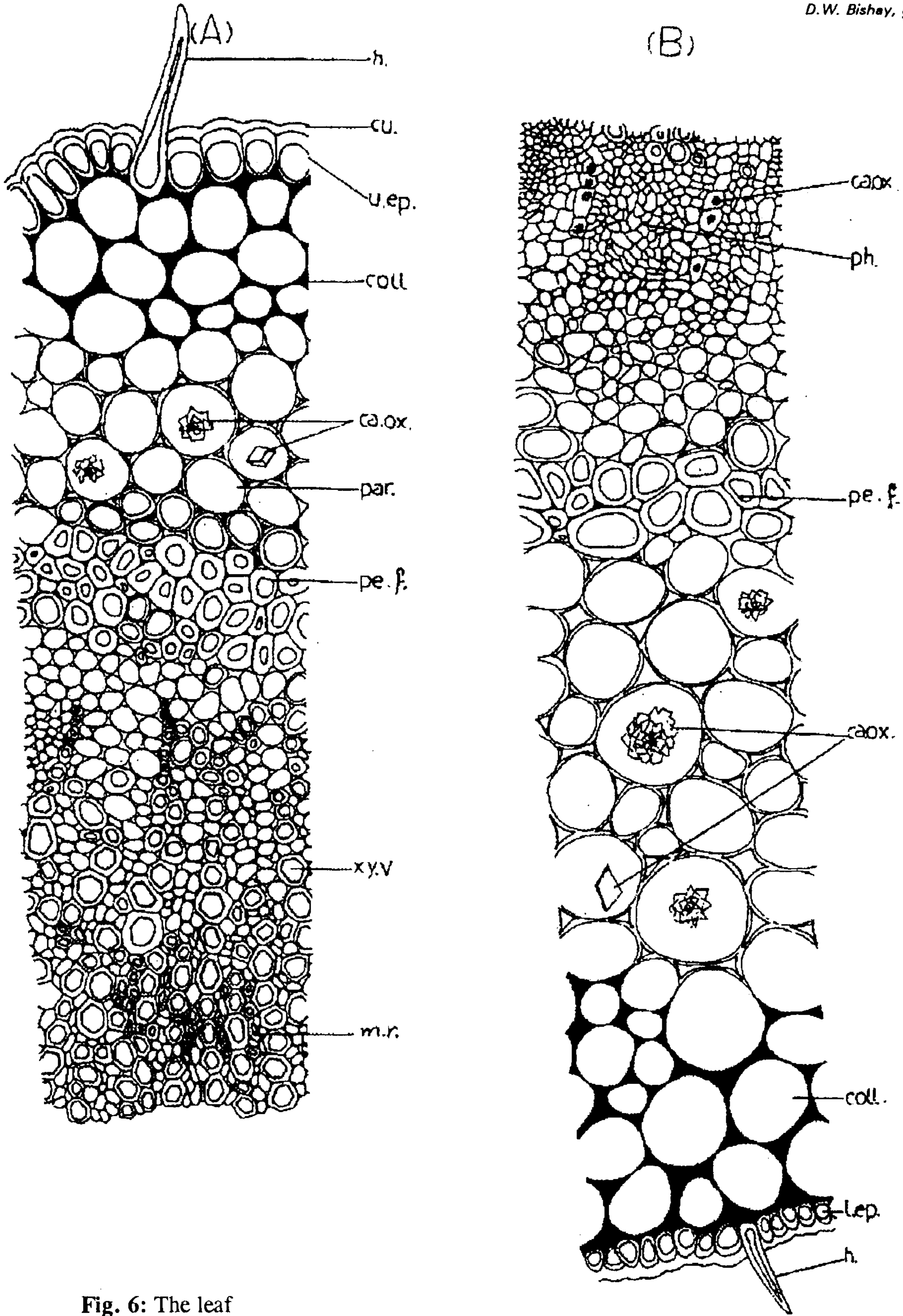


Fig. 6: The leaf

(A,B) Detailed TS in the leaf

(x 220)

ca.ox., calcium oxalate; coll., collenchyma; cut., cuticle; h., hair; l.ep., lower epidermis; m.r., medullary ray; par., parenchyma; pe.f., pericyclic fibre; ph., phloem; u.ep., upper epidermis; xy.v., xylem vessel.

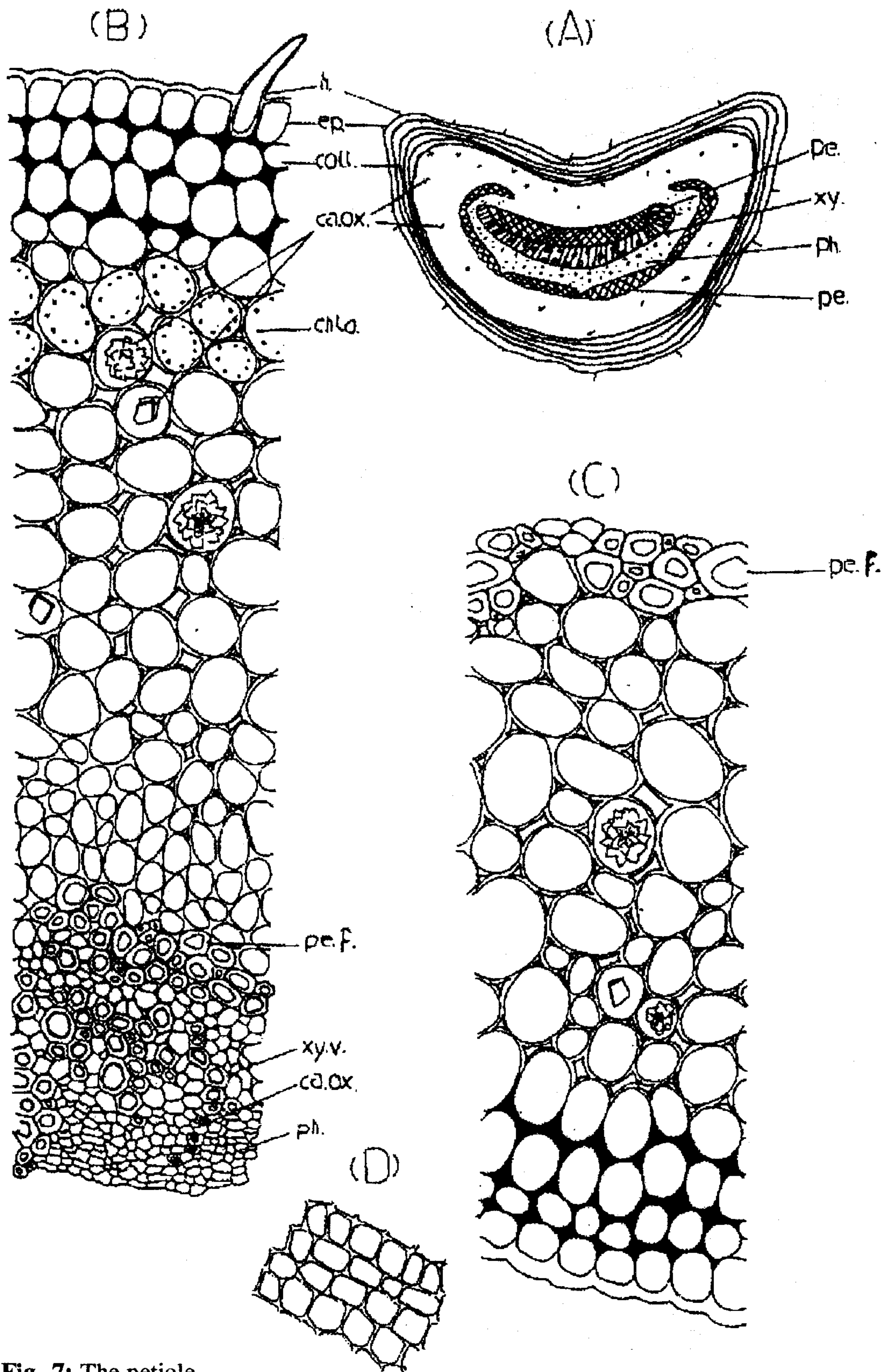


Fig. 7: The petiole

(A) Diagrammatic TS in the petiole

(x 26)

(B,C) Detailed TS in the petiole

(x 240)

(D) Surface preparation of the petiole

(x 240)

ca.ox., calcium oxalate; chlo., chloroplasts; coll., collenchyma; ep., epidermis; h., hairs; pe., pericycl; pe.f., pericyclic fibre; ph., phloem; xy.v., xylem vessel.

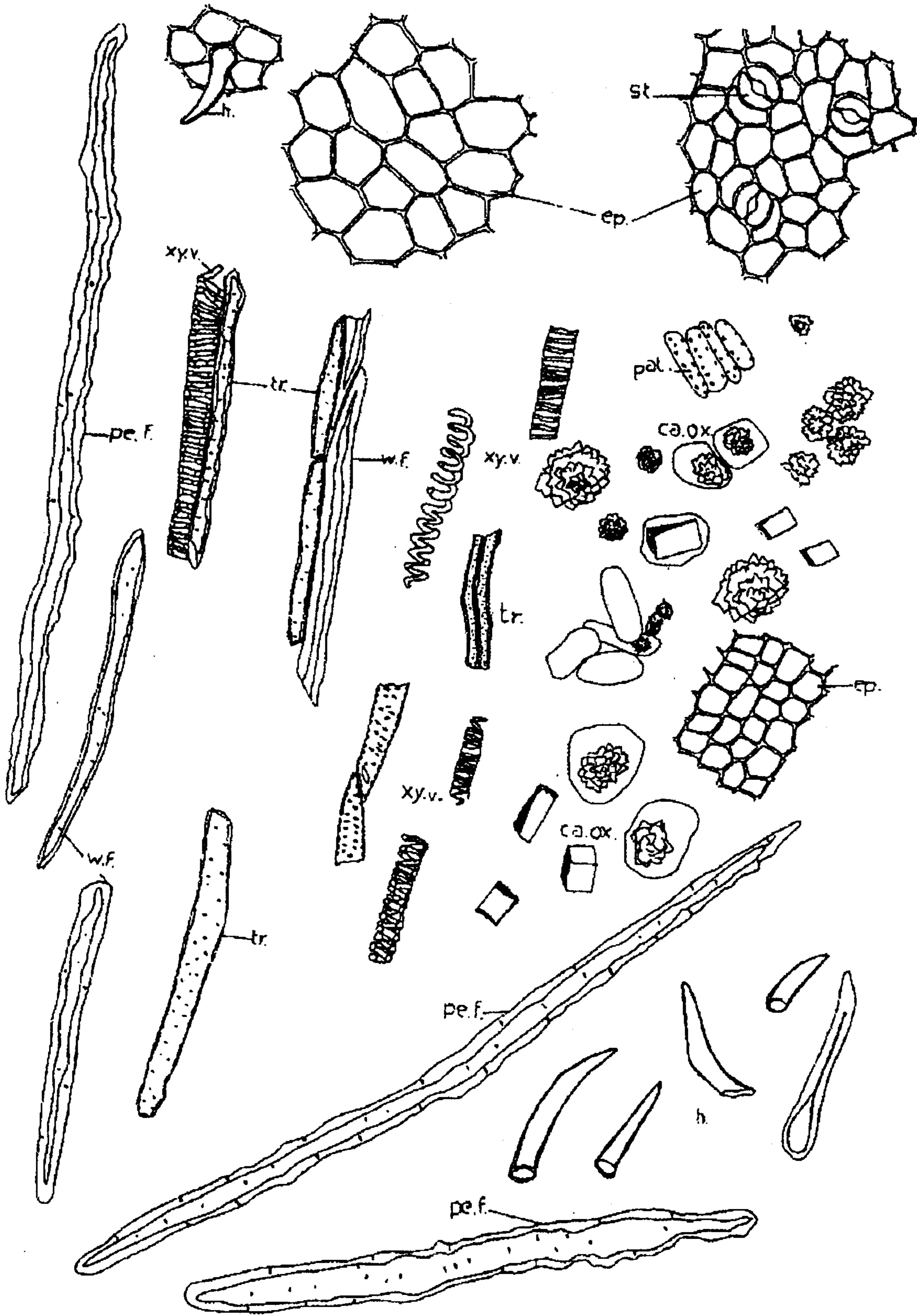


Fig. 8: Powder of the leaf

(x 260)

124 ca.ox., calcium oxalate; ep., epidermis; h., hair; pal., palisade; pe.f., pericyclic fibre; st., stomata; tr., trachied; w.f., wood fibre; xy.v., xylem vessel.

containing clusters and prismatic crystals of calcium oxalate.

- 3- Fragments of pericyclic fibers either entire or broken with moderately thickened finely pitted, lignified walls, wide lumina, irregular margin and acute to rounded apices.
- 4- Fragments of wood fibers with lignified pitted walls, wide lumina and rounded apices.
- 5- Fragments of epidermal cells of the petiole, polygonal with thin straight anticlinal walls covered with smooth cuticle and showing unicellular, non-glandular hairs.
- 6- Fragments of lignified spiral, reticulate and pitted xylem vessels.
- 7- Few tracheids with thickened lignified pitted walls.
- 8- Abundant scattered cluster and prismatic crystals of calcium oxalate.
- 9- Fragments of entire or broken, non-glandular unicellular trichomes.

REFERENCES

- 1- L. H. Bailey and E. Z. Bailey, "Hortus Third", MacMillan & MacMillan, London, 396 (1976).
- 2- L. H. Bailey, "The Standard Cyclopedia of Horticulture", New York, The MacMillan Company, Vol. II, 1250 (1963).
- 3- R. Hegnauer, "Chemotaxonomie der Pflanzen", Birkhauser Verlag Basel and Stuttgart, Band 4, 155-67 (1966).

- 4- J. C. Willis, "A Dictionary of the Flowering Plants and Ferns", Cambridge at the University Press, 8th Ed., 461 (1985).
- 5- G. H. Lawrence, "Taxonomy of Vascular Plants", The MacMillan Company, New York, 11th Printing, 613-14 (1966).
- 6- V. H. Heywood, D. M. Moore and W. T. Stearn Hon, "Flowering Plants of the World", Croom Helm, London, Sydney, 101-102 (1978).
- 7- J. M. Watt and M. G. Brayer-Brandwijk, "Medicinal and Poisonous Plants of Southern and Eastern Africa", Livingstone, L.T.D., London, 440 (1962).
- 8- B.O. Bever, "Medicinal Plants in Tropical West Africa", Cambridge University Press, London, New York, New Rochello, Melbourne, Sydney, 131 (1986).
- 9- M. M. Iwu, "Hand book of African Medicinal Plants", CRC Press, Boca Raton, Ann Arbor, London, Tokyo, 130 (1992).
- 10- M. G. Dijoux, C. Lavaud, G. Massiot, L. Oliver and D. M. Sheeley, *Phytochemistry*, 34 (2), 497-99 (1993).
- 11- N. Gopalsany, D. Vargas, T. Gueho, C. Ricaud and K. Hostettman, *Phytochemistry*, 27 (11), 3593-95 (1988).
- 12- D. W. Bishay, H. M. Sayed, S. A. Youssef, R. M. Abd Elsalam and M. S. Kamel, Novel nitrogenous compounds from *Aberia caffra*, Accepted in The 38th Annual Meeting of The American Society of Pharmacognosy, July (1997).