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MARCO AND MICROMORPHOLOGY OF CRINUM MOOREI VAR. SCHMIDTII, HOOK F. CULTIVATED IN EGYPT PART 1: ROOT, BULB (fleshy scale leaves) and foliage leaf

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نبات بصل الكرينم موارى هو أحد الأبصال الأنيقة المعمرة التابعة للفصيلة النرجسية والذى يزرع كنبات زينة فى الحدائق العامة والخاصة لجمال نوراته.

وأغلب أنواع الكرينم ذات استعمالات شعبية واسعة وخاصة فى الحمى الروماتيزمية وبعض الأمراض الجلدية. وقد تمكن الباحثان من فصل قلويدات وأحماض عضوية ومواد مخاطية من النبات المذكور. ولما كانت أنواع الكرينم شديدة التشابه من الناحية المرفولوجية والتشريحية مما يصعب تمييزها عن بعضها البعض، فلقد رأى الباحثان ضرورة اجراء دراسه الصفات العيانية والمجهرية لهذا النبات وهى البصلة نفسها (الأوراق الحرشفية الغضة) وجذورها وأوراقها الخضراء، وذلك لامكان التعرف عليها سواء كانت كاملة أو على شكل مسحوق.

The detailed macro- and micromorphological characters of the root, bulb and leaf of crinum moorei Schmidtii, Hook. F., are studied with the aim to facilitate their identification in both entire and powdered forms, and to find out the diagnostic elements which can help in differentiating this species from the other closely related species of crinum.

INTRODUCTION

Crinum moorei var. schmidtii Hook. F. is a perennial ornamental bulb belonging to Fam. Amaryllidaceae. It is usually cultivated in common and private gardens for its showy flowers.

The genus crinum (subfamily: Amaryllidoidea) includes over than 100 species found in Tropics and subtropics especially on Sea coasts[1-3].

Many crinum species are used in the treatment of scrofula, difficulty in micturition, rheumatic fever and treatment of malaria[4]. Externally the bulb with foliage leaves are prepared in the form of emollient ointment and used as a topical remedy to reduce inflammation[5].

A survey of literature revealed the absence of any previous botanical or chemical studies on the plant (cultivated in Egypt or in abroad). Our preliminary phytochemical screening of Crinum moorei var. schmidtii Hook. F. revealed the presence of alkaloids, mucilage and organic acids. This work describes the macro and micromorphological characters of the root, bulb and leaf of the plant under investigation.

EXPERIMENTAL

Materials Used:

Samples of flowering and fruiting plant of *Crinum moorei* var. schmidtii were collected in May 1992 and 1993 by the authors from plants cultivated in the Experimental Station of Faculty of Pharmacy, Assiut University, Assiut, and plants cultivated in the Garden of Montazah Palace at Alexandria.

The plant was identified by Dr. Mahmoud Omar, Head of Gardens Research Center, Montazah Palace, Alexandria and by Dr. Bothaina M. Labib, at the same Center. Fresh roots, bulb and leaves in the flowering and fruiting stages as well as samples preserved in a mixture of alcohol-glycerine-water (1:1:1) were used.

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Habitat:

Crinum moorei var. schmidtii Hook. F. is a handsome perennial, bulbous ornamental garden plant with showy flowers attaining a height of 50 to 94 cm. when flowering. The aerial portion is composed of the sessile; green, broad, wavy or undulated, and deeply channelled long foliage leaves and a scape carrying a large umbel-shaped inflorescence of 5 to 12 cm, white or white with rose tinged-flowers. The foliage leaves radiate from a basal long stem-like neck to form a spreading crown or circular area of 60 to 90 cm in diameter. The underground portion is composed of a large conical to ovoid tunicated bulb and a freshly adventitious fibrous root system attached to the solid disc of the bulb. They are propagated by bulblets and usually cultivated as ornamentals. The plant flowers in the period extending from March to June.

It grows well in moist heavy soil with some clay in it.

MACROMORPHOLOGY: (Fig. 1)

1-The Roots: are typically adventitious with fibrous roots completely enveloping the flattened discoid underground stem of large bulb. They are cylindrical, stout, fleshy and soft, penetrating the soil vertically, obliquely and horizontally; measuring from 20-30 up to 40 cm long and 0.3-0.8 cm thick and from these arise several lateral fibrous rootlets, which never exceed the main root in diameter or length. The surface of the fresh washed roots is smooth. mostly longitudinally, rarely transversely, wrinkled and the wrinkles become clear on drying. The dried root breaks with a short fracture exposing a white interior; it has a slight odor and mucilaginous, bitter taste.

2-The Bulb:is single, tunicated and conical to ovoid in shape. Its underground portion is embedded in the soil at a depth of about 10-15 cm It has a long columnar, stem-like aerial neck. The basal solid disc-like stem carries the fibrous root system. The outer tunics are membranous, scaly and brownish in color while the inner ones are white, fleshy, succulent, mucilaginous and having bitter taste.

The bulb may attain up to 17 cm long and 10 to 16 cm in diameter at its widest portion. The weight of the mature fresh bulb varies according to age and environmental condition being commonly from 500 to 1250 up to 1800 g in weight. The fleshy scales are broad ranging from 20 to 30 cm wide and 1.5 to 2 mm thick at the middle region. They are externally marked with fine longitudinal ribs or lines representing the vascular strands. The dried [illegible] are more or less irregular being crescent-shaped to concave-convex in outline, somewhat flattened. They are yellowish white some what translucent, brittle when freshly dried in oven. The transversely cut surface shows a number of yellowish dots arranged in a regular lines and representing the vascular bundles which are embedded in the ground tissue. The scales have a mucilaginous disagreable and bitter taste.

The Foliage Leaves: are simple, sessile and possessing an undivided strap-shaped lamina with an entire wavy or undulated margin and an acute apex. The leaf measures about 50-90 cm long and an acute apex. The leaf measures about 50-90 cm long and about 6 to 10 cm wide at the middle portion. The fresh leaves are persistent, smooth, pale green to dark green in color in both upper and lower surfaces and becoming paler in color on drying. The venation is parallel and the mesophyll is axially traversed by several anastomosing veins. The dry leaf is brittle, breaks with a short fracture, and possesses no odor but having a bitter mucilaginous taste.

MICROMORPHOLOGY

A- The Root

A transverse section in the root (Fig. 2) is nearly circular in outline. It shows an outer brownish zone consisting of the remains of the ruptured epidermal cells and several layers of brownish irregular exodermis, followed by a wide parenchymatous cortex, limited with a distinct brownish endodermis and surrounding a

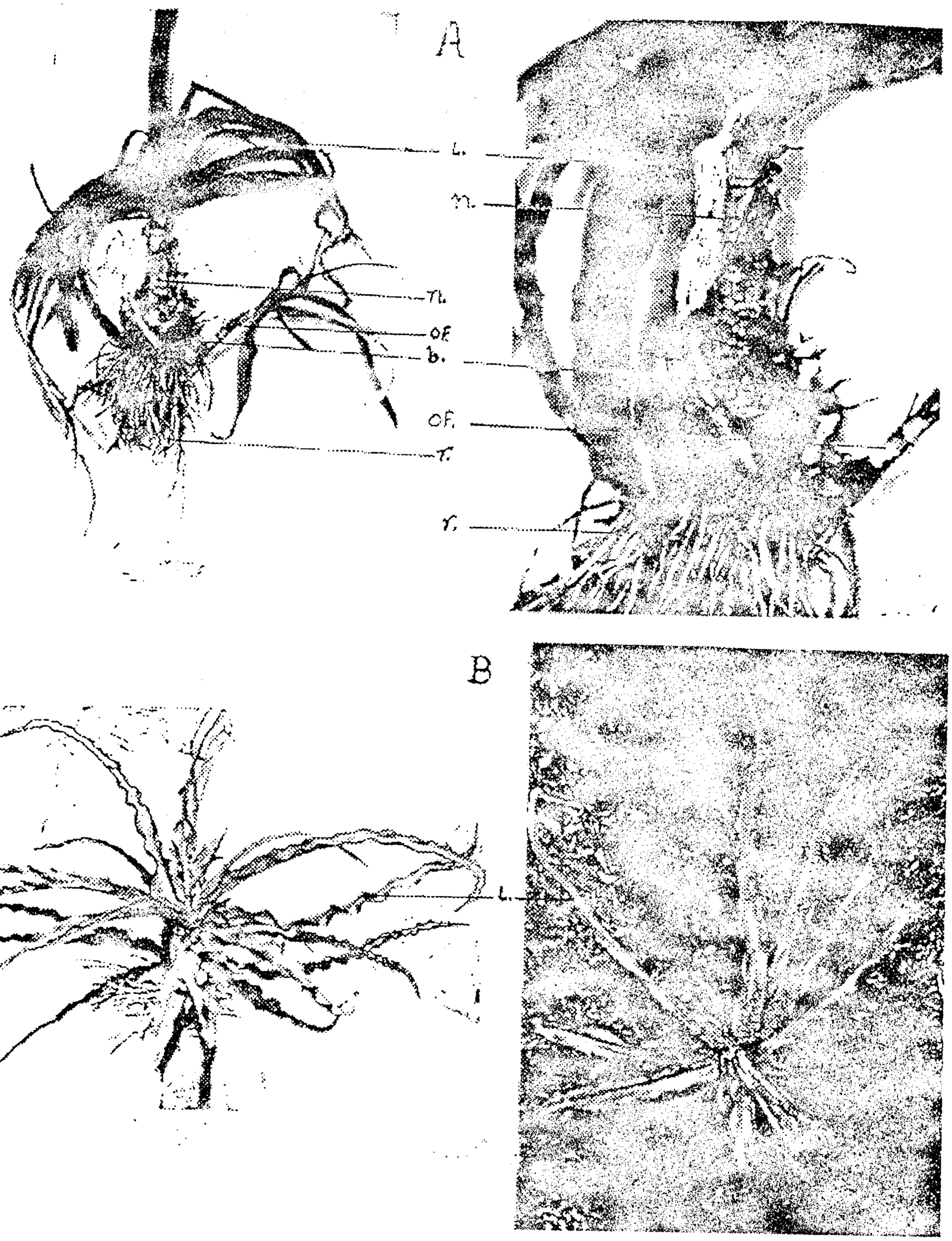


Fig. 1: A Photograph of *Crinum moorei* var. *schmidtii*, Hook. F.
A- Side view of the plant. lx 1/12, 1x 1/3
B-Top view of the plant. lx 1/12
b., bulb; l., leaf; n., neck; of., offset; r., root.

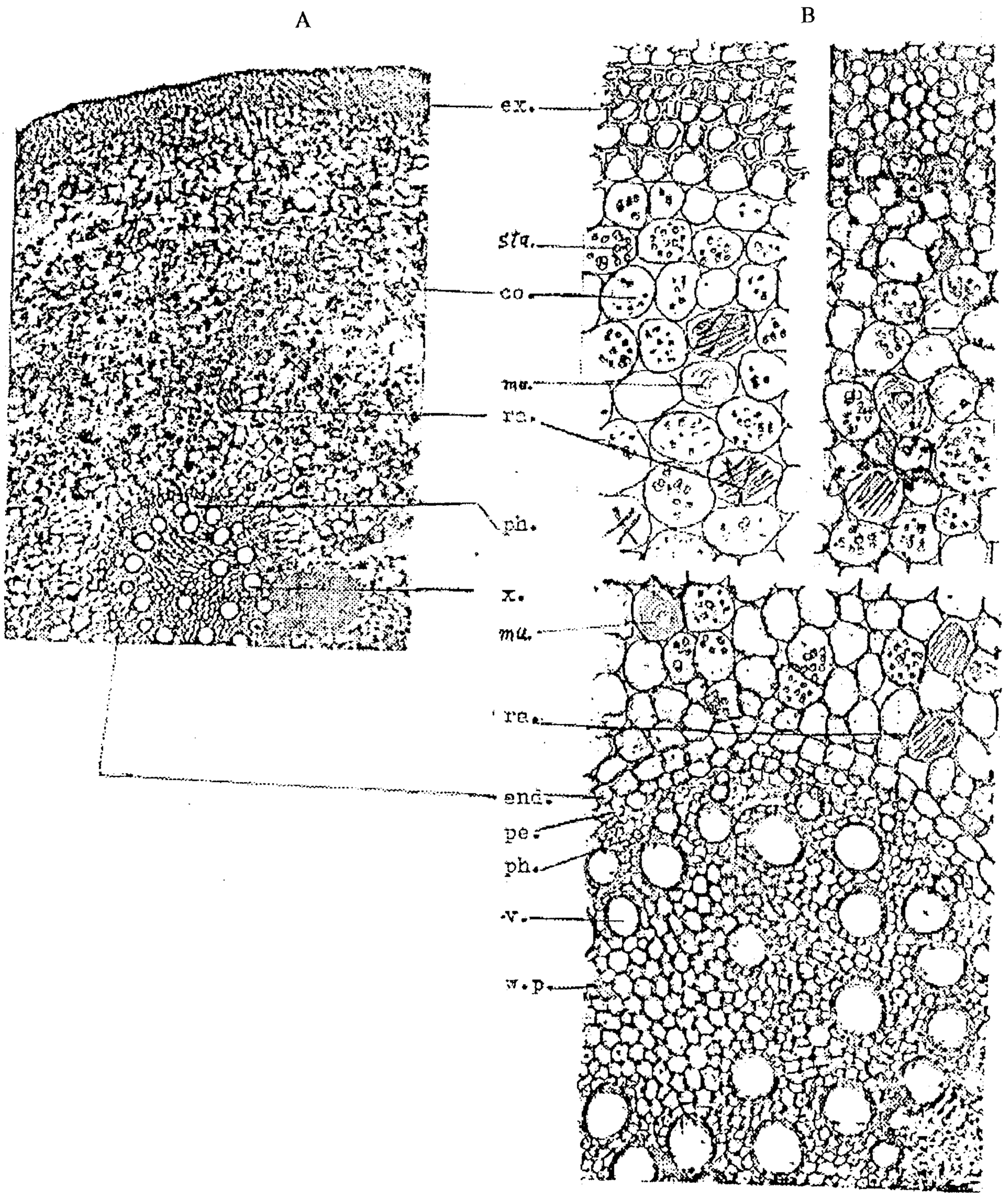


Fig. 2: The Root:

A- Diagrammatic T.S. X 40

B- Sector of T.S. X 100

co., cortex; end., endodermis; ex., exodermis; ph., phloem; ra., raphide of calcium oxalate; v., vessel; w.p., wood parenchyma; v., vessel; mu., mucilage; sta., starch.

narrow complete ring of central small stele. The stele is surrounded by a parenchymatous pericycle which encloses from 12-24 vascular bundles of alternated arcs of primary xylem and primary phloem on separate radii.

There is a very narrow parenchymatous exceptional pith in the center. The stele constitutes about 1/6 or 1/5 of the whole diameter of the root. Typical medullary rays are absent but conducting parenchyma of one or more layers separate the xylem and phloem groups.

The Epidermis: (Fig. 2) is usually ruptured.

The Exoderm: (Fig. 2) is formed of 3-7 rows of brownish, irregularly arranged suberized cells. The innermost layer of which consists of rounded to polygonal cells with the outer tangential and radial walls more thickened than the inner tangential one.

The cortex: (Fig. 2B) it is of primary origin, very wide and comprises a broad region of isodiametric, rounded to polygonal thin- walled parenchyma with wide intercellular spaces. The majority of cortical parenchyma are packed with starch granules and many cells contain mucilaginous masses which do not stain with corallin soda test solution but stain red with ruthenium red solution and blue with methylene blue. The starch granules are mainly simple and some are compound of 2-3 components having a mular-shape. The hilum is centric, distinct in some granules and appearing as a point, cleft or radiating. The individual granules are mostly rounded or oval and measuring 4-12 up to 18 microns in diameter.

Few bundles of raphides as well as isolated single acicular crystal of calcium oxalate are scattered in parenchyma of the cortex and measuring 25-30 up to 40 microns long.

The Endodermis: (Fig. 2B) is very distinct and consists of one layer of yellowish brown square to subrectangular cells, with thickened lignified lenticular bands on the radial and transverse walls (casparian strip). Few unlignified passage cells are usually observed opposite to the xylem arcs.

The Stele: (Fig. 2B) it includes about 12 to 16 arcs of primary xylem and phloem. The pericycle consists of 1 or 2 layers of thin walled cellulosic, collapsed parenchyma and usually compressed by xylem groups.

The Phloem: Is well marked, and is represented by shining small radial or oval areas consisting of sieve tubes and companion cells and free from contents.

The Xylem: Is polyarch, composed of radial groups with the protoxylem towards outside and metaxylem towards the center. It comprises non-lignified pitted wood parenchyma (Fig. 2B) as will as lignified vessels with reticulated scalariform, spiral and annular thickening, measuring from 10-40 up to 70 microns in diameter.

The Pith: It is a very small central zone, formed of thin cellulosic, parenchyma containing starch which is closely identical with that of the cortex in all aspects.

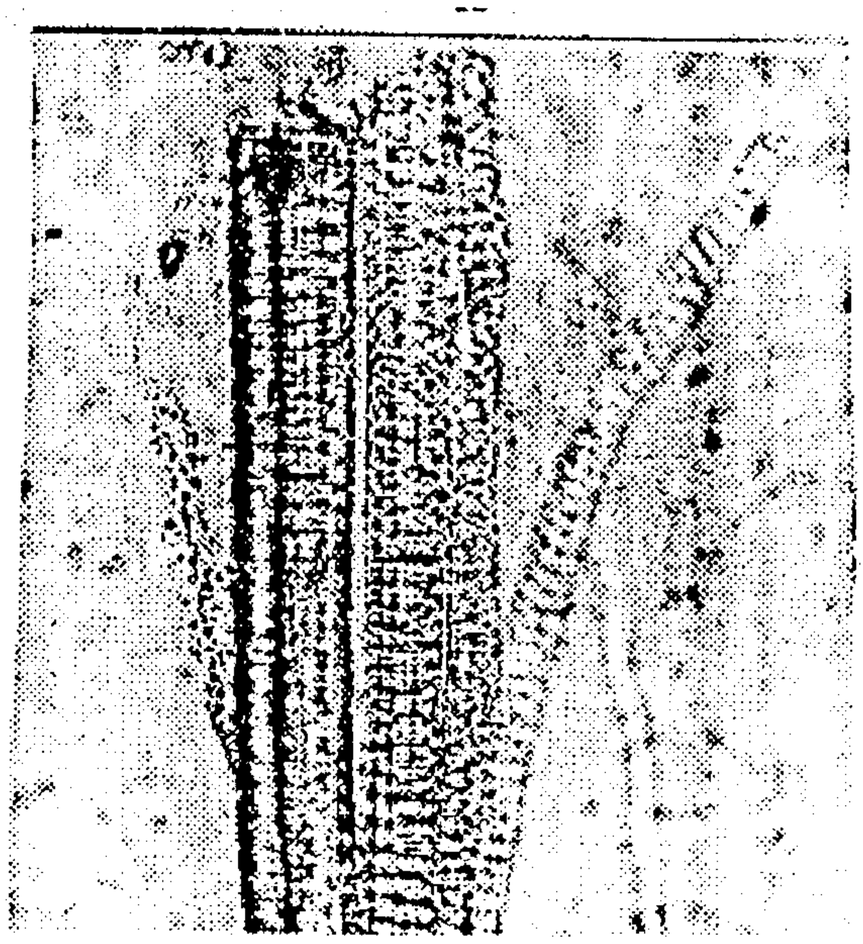
Powdered Root: (Fig. 3) is light to dark brown in color with slight odor and mucilaginous bitter taste. Under microscope it is characterized by the presence of the following diagnostic elements:

1- Fragments of exodermis with polygonal, usually irregular cells with brown suberized walls.
2- Fragments of thin-walled parenchymatous cells from the cortex containing starch granules and masses of mucilage as well as very few acicular crystals of calcium oxalate either isolated or grouped as raphides.
3- Fragments of lignified vessels with spiral scalariform and reticulate thickening, rarely annular thickening.
4- Few Free starch granules, mostly simple, sometimes compound of 2-3 components and showing centric hilum.
5- Absence of fibers and sclereids.

B- Fleshy Scales

A transverse section through the fleshy scales (Fig. 4&5), shows an outer and an inner epidermis enclosing in between a homogenous

A



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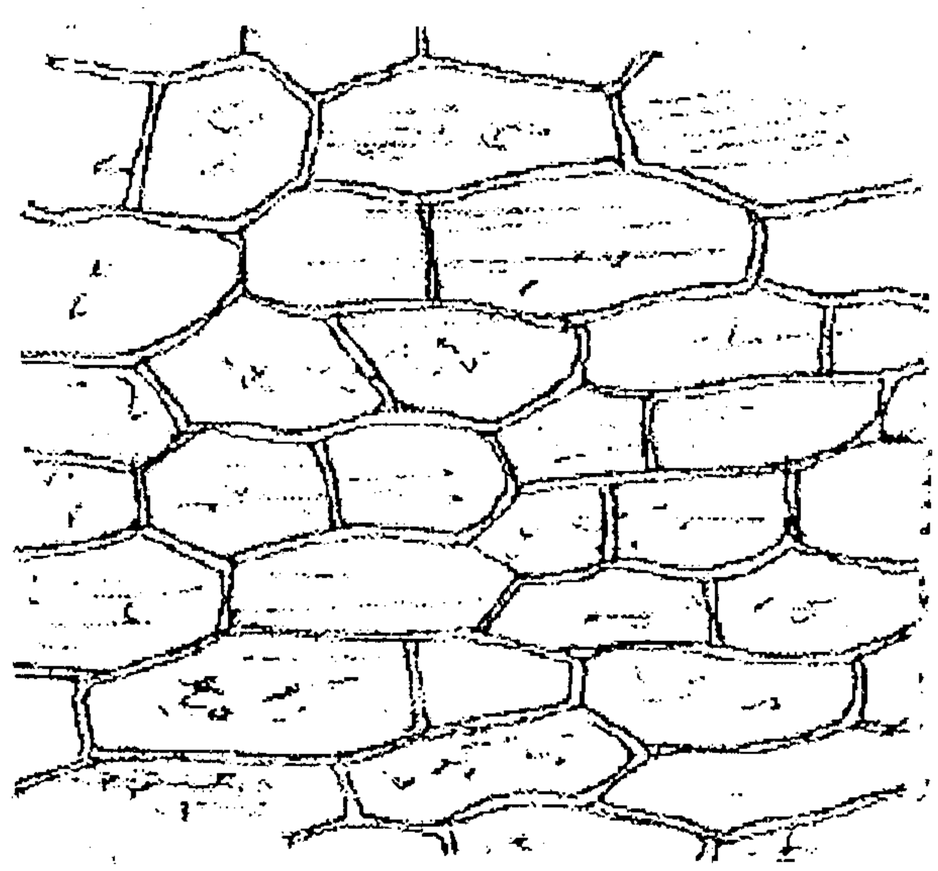

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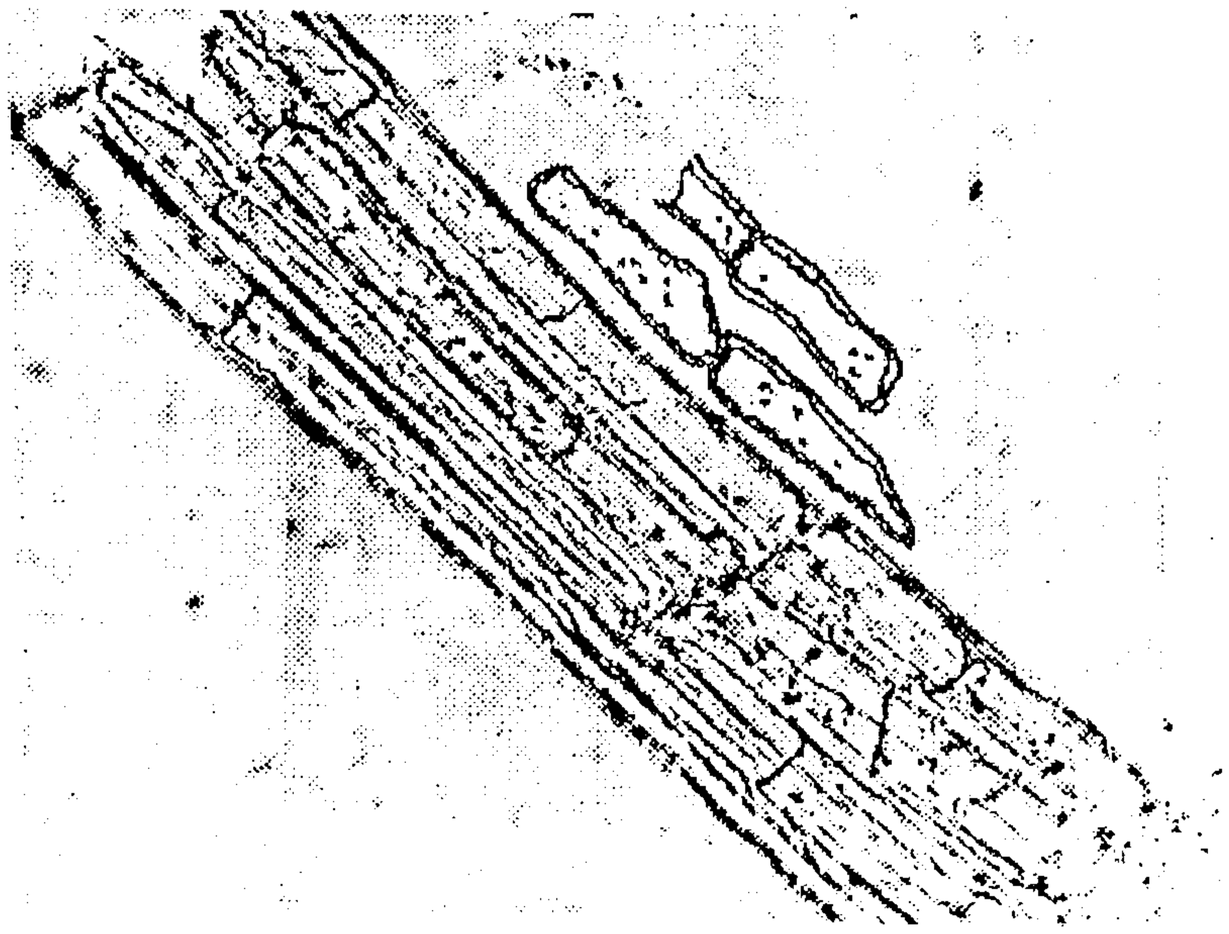


Fig.3: isolated Elements of Root.

A- Xylem Vessels	X 250
B- Exodermis	X 250
C- Wood parenchyma	X 250

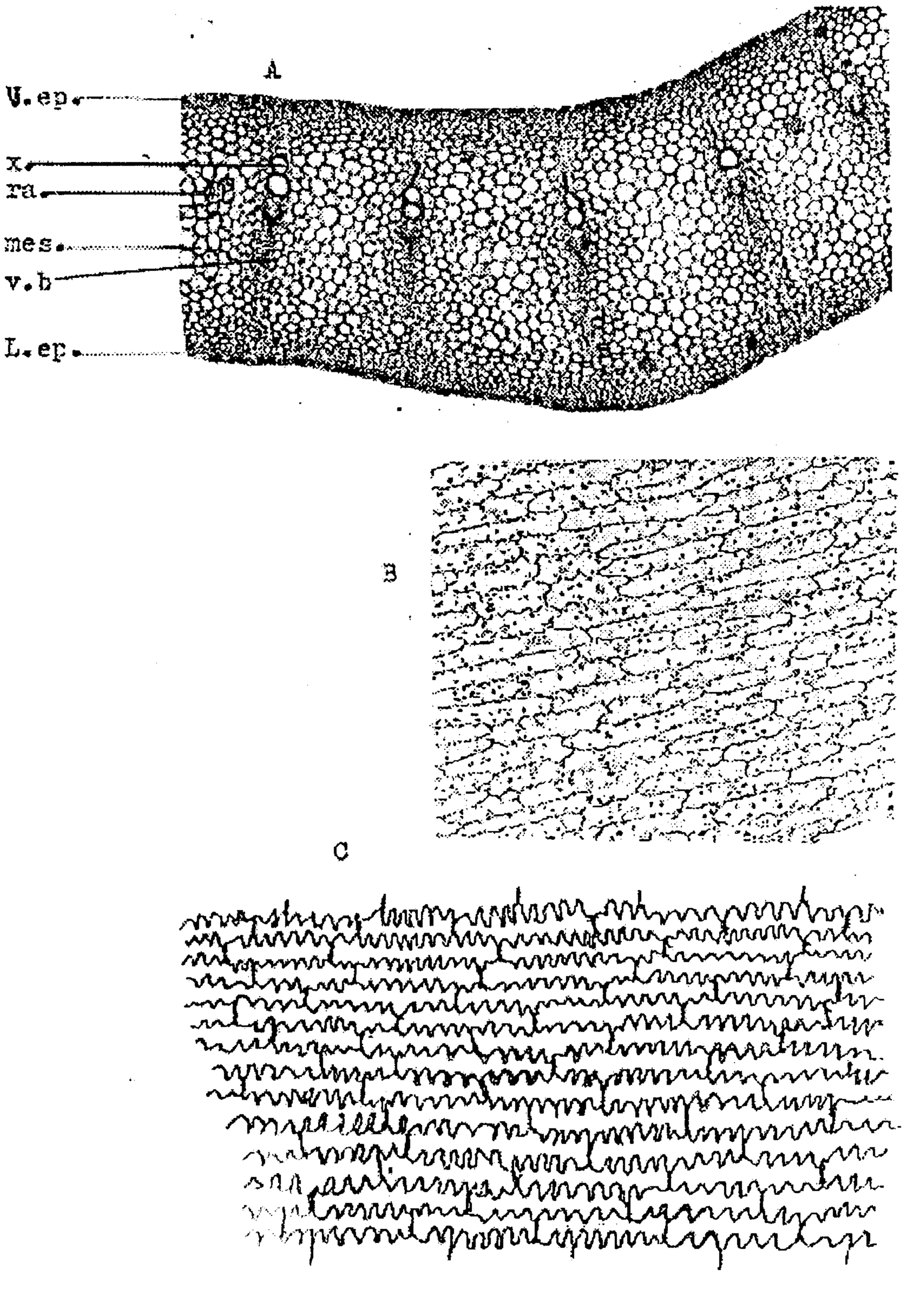


Fig. 4: The Fleshy Scale

A- Diagrammatic T.S. of the Fleshy scale. X 37

B- Surface preparation of the Upper epidermis. X 100

C- Surface preparation of the Lower epidermis. X 100

L.ep., lower epidermis; mes., mesophyll; ra., raphide of calcium oxalate; V.B., vascular bundle; X., Xylem.

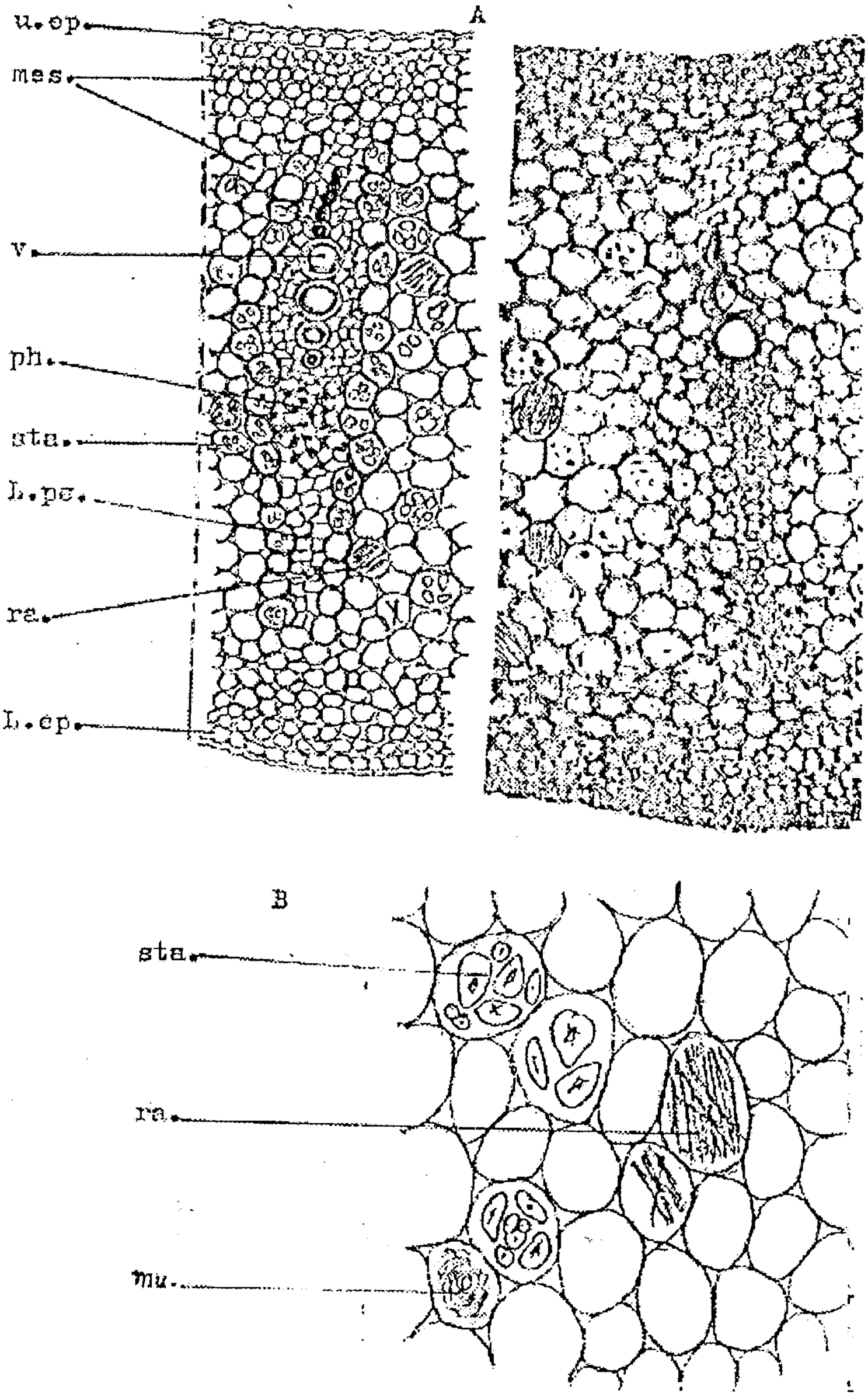


Fig. 5: The Fleshy Scale

A- Detailed T.S. of Fleshy scale X 100

B- Magnified mesophyll showing a raphide X 250

L.ep., Lower epidermis; l.pe., lower pericycle; mes., mesophyll; ph., phloem; ra., raphide; sta., starch; u.ep., upper epidermis; v., vessel; mu., mucilage.

mesophyll, through which numerous radially elongated vascular bundles are embedded forming a single row running nearer to the upper epidermis than the lower one and at a short distance from it.

Lower (Outer) Epidermis: (Fig. 4C) consists of square to subrectangular cells as seen in transverse section and appearing polygonal in surface view, axially elongated with very wavy or sinuated thin anticlinal walls and covered with thin smooth cuticle, measuring 80-130 up to 200 microns long, 20-28 up to 40 microns wide and 16-22 up to 30 microns high. Trichomes and stomata are not observed.

Upper (Inner) Epidermis: (Fig. 4B) consists of subrectangular cells in transverse section, but in surface view the cells are polygonal, axially elongated having slight wavy anticlinal walls and covered with thick smooth cuticle, they measure about 120-150 up to 225 microns long, 25-30 up to 40 microns high. Stomata and trichomes are not observed.

The Mesophyll: (Fig. 5B) is homogenous and consists of several rows of polyhedral or rounded parenchyma. The cells are colorless having thin walls and showing wide intercellular spaces. Nearly all of the mesophyll parenchyma are packed with starch granules and mucilage. The starch is large, mainly simple and few are compound of 2-3 components. The individual grains are oval, rounded or pyramidal, sometimes muller shaped, with usually centric, distinct hilum appearing as a point, cleft or radiating and measuring 6-30 up to 44 microns in diameter. The mucilage does not stain red with corallin soda test solution but stains red with ruthenium red test solution and blue with methylene blue solution.

Numerous bundles of raphides as well as isolated single acicular crystals of calcium oxalate are scattered in the mesophyll parenchyma and measuring about 40-60 up to 80 microns in length.

Vascular system: The mesophyll (Fig. 5A) is traversed by several closed, collateral radially elongated vascular bundles which are devoid of any fibers. The xylem is formed of vessels and wood parenchyma. The vessels are lignified and arranged in radial rows of 3-6 and showing mainly spiral, reticulate, scalariform and rarely annular thickening. These vessels measure 10-40 up to 70 microns in diameter. They are surrounded by small thin-walled non-lignified wood parenchyma. The phloem is well marked and formed of thin-walled shining sieve tubes and companion cells. The bundle is surrounded by a sheath of large parenchyma containing starch granules which are closely identical to those of the mesophyll.

The Powder: (Fig. 6) The dried fleshy scales when reduced to powder are yellowish-white in color with a faint odor and distinctly bitter, starchy and mucilaginous taste. The diagnostic microscopical features are the following:

1- Numerous fragments of translucent polyhedral rounded thin-walled parenchyma, many of them are packed with starch granules and mucilage as well as acicular crystals of calcium oxalate either single or grouped in raphides.
2- Few fragments of outer and inner epidermis showing polygonal, axially elongated, subrectangular cells with wavy, thin anticlinal walls and covered with smooth cuticle.
3- Numerous free starch granules and acicular crystals of calcium oxalate in raphides or single forms, in addition to mucilaginous masses.
4- Few fragments of vascular tissue consisting mainly of narrow lignified vessels.
5- Absence of stomata, trichomes, sclereids, and fibers.

C- The Foliage Leaf

A transverse section in the Lamina of the foliage leaf (Fig. 7A) appears crescent-shaped to concavo-convex in outline. It shows an upper and lower epidermis enclosing in between the mesophyll. The vascular system is a parallel one being formed of closed, collateral vascular bundles embedded in the mesophyll, large oval, radially elongated lacunae are situated between the bundles and alternated with them and running in the direction of the axis of the leaf.

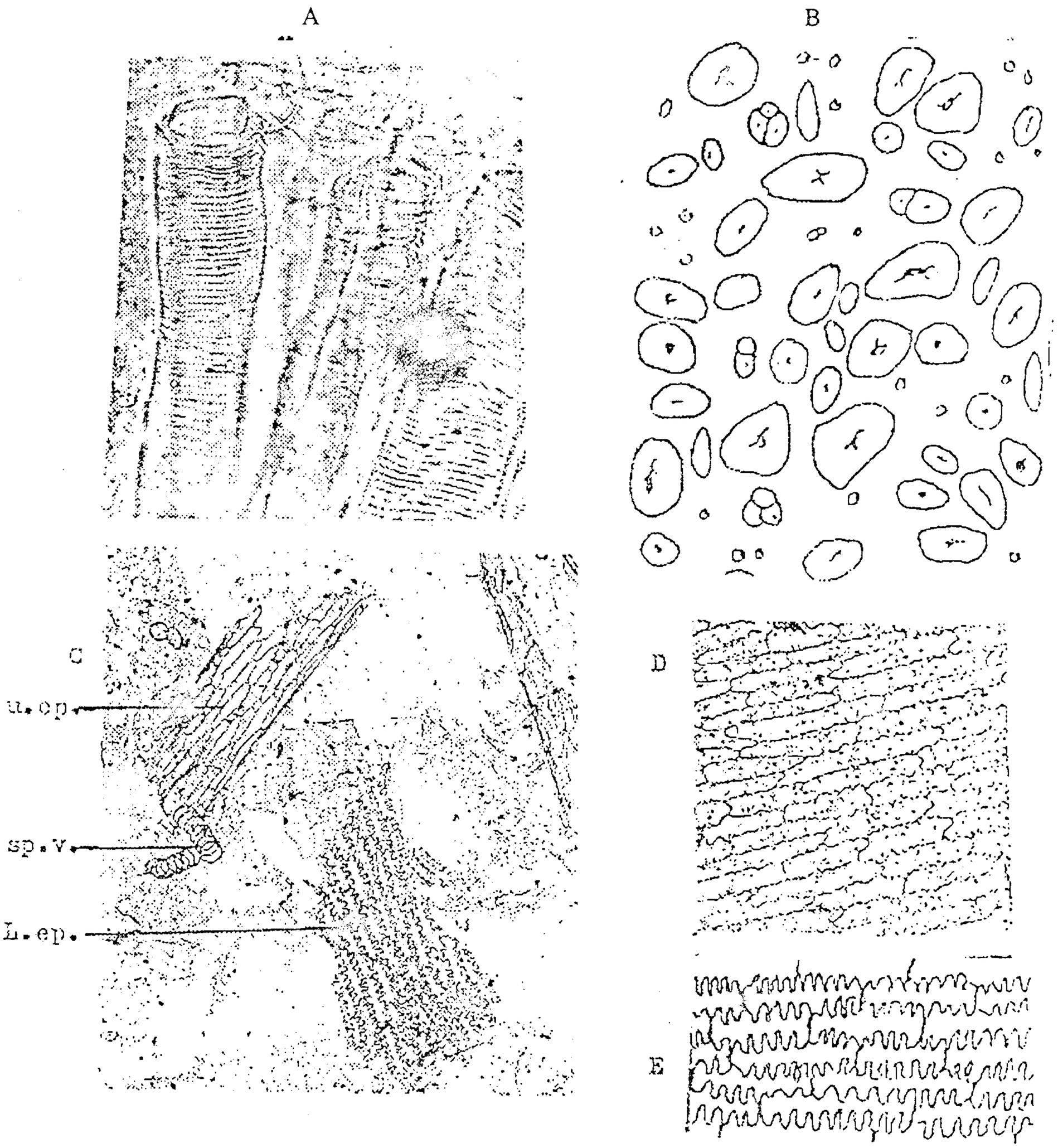
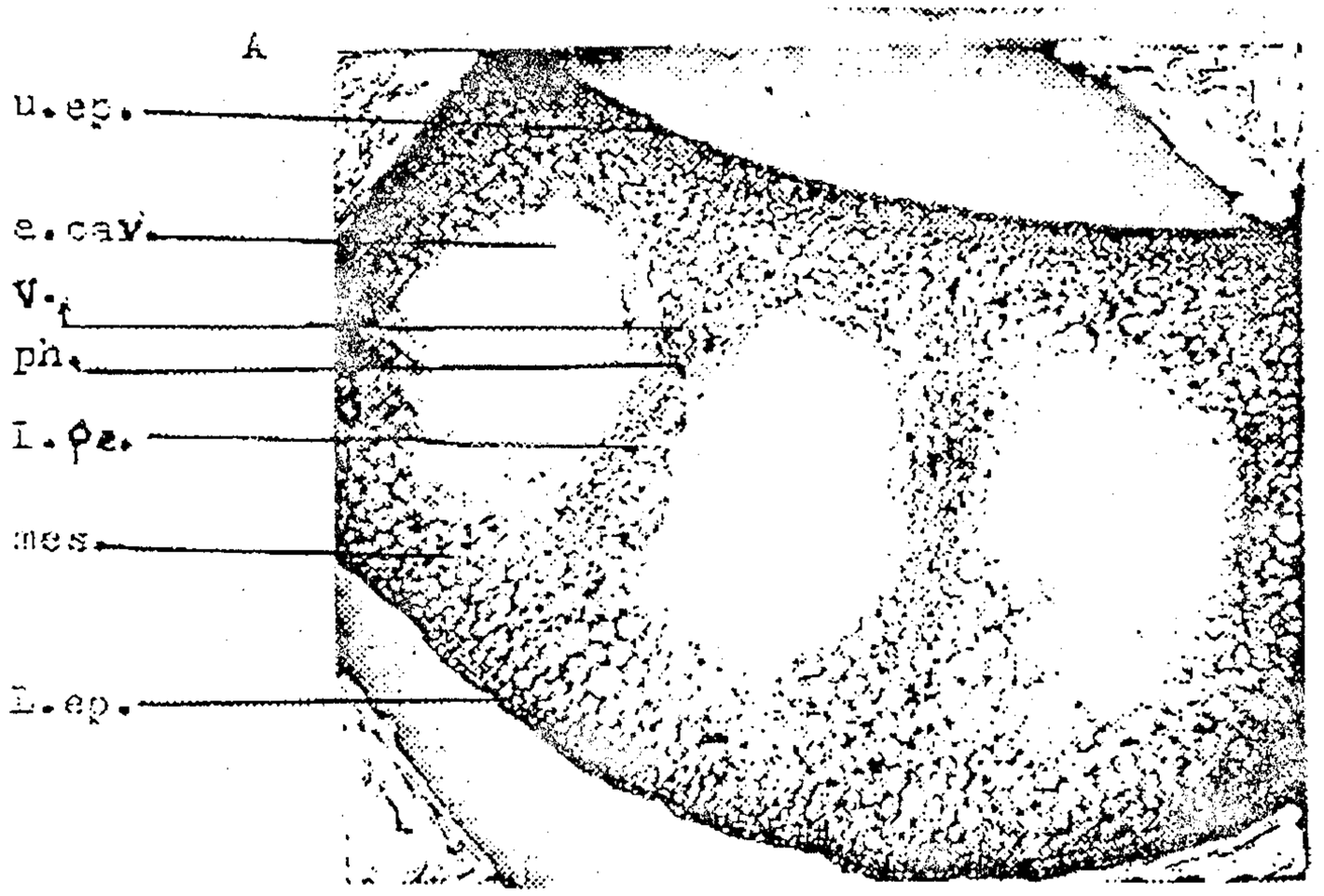
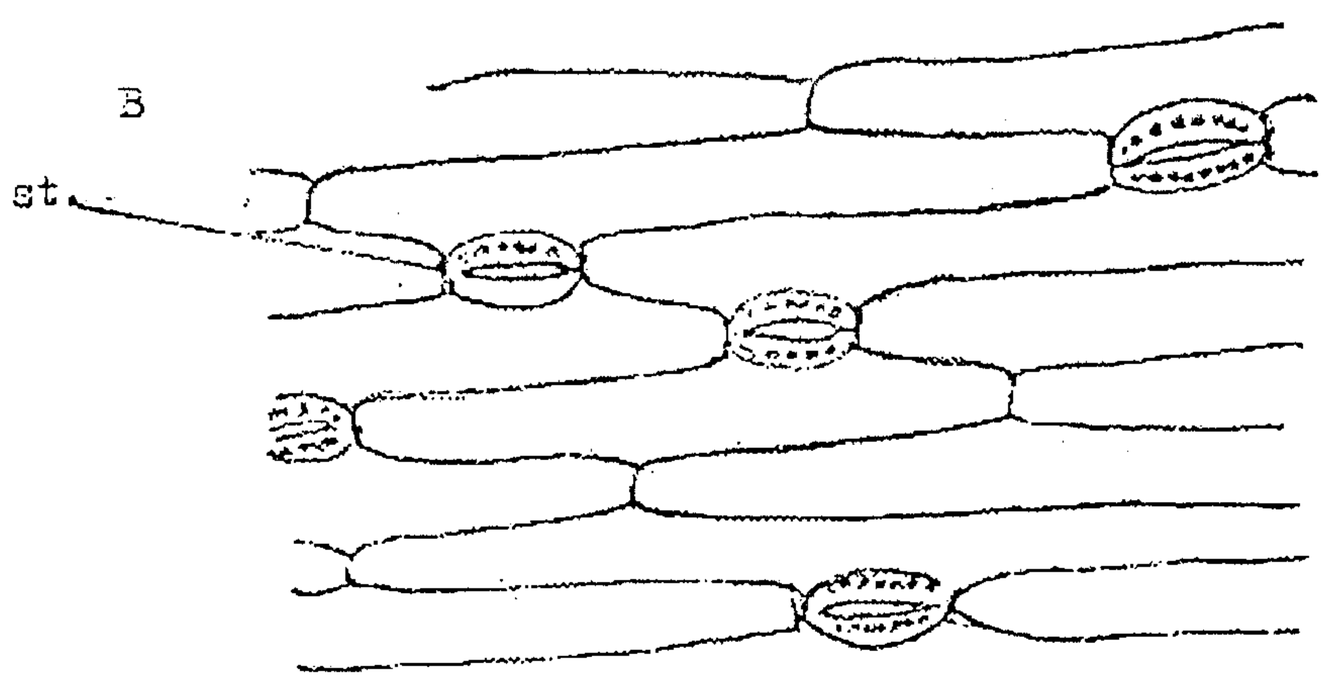


Fig. 6: Isolated Elements of Fleshy Scale:

A- Types of vessels	X 250
B- Starch granules	X 250
C- Upper and lower epidermises in surface view	X 39.5
D- Upper epidermis	X 100
E- Lower epidermis	X 100

L.ep., lower epidermis; u.ep., upper epidermis; sp.v., spiral vessel





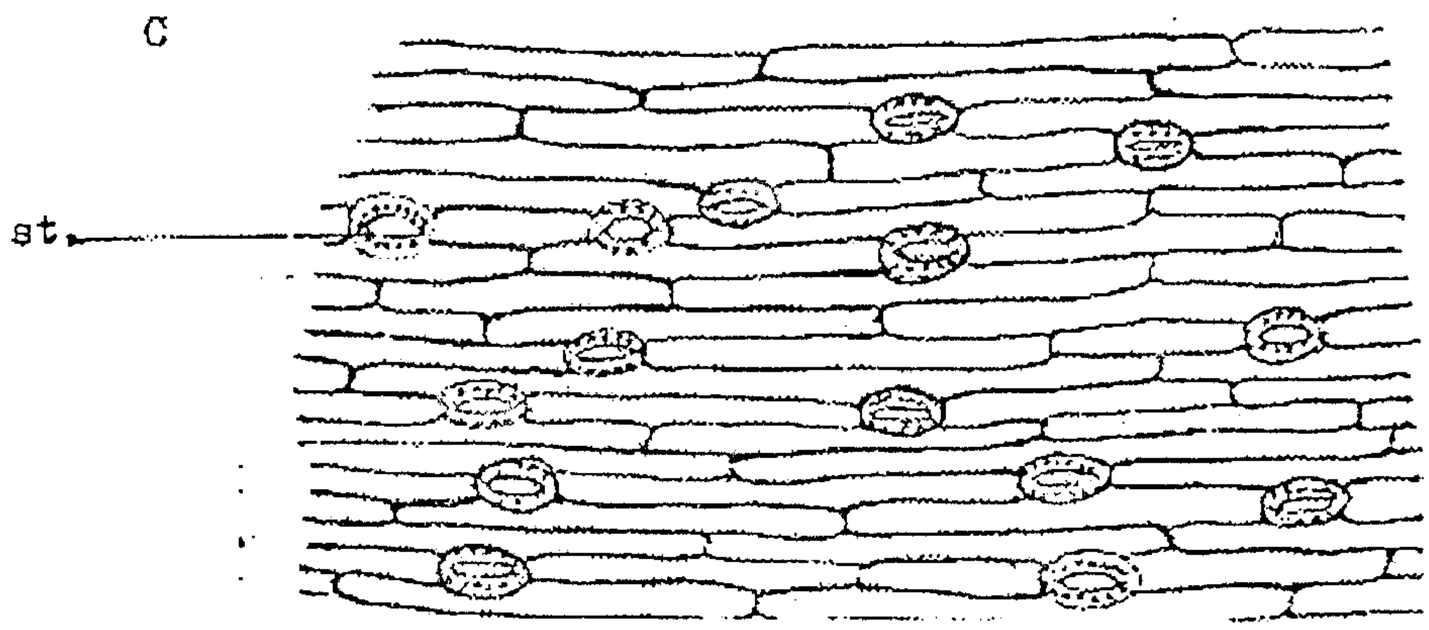


Fig. 7: The Folige Leaf:

A- A diagram of T.S. X 25

B- Surface preparation of upper epidermis X 250

C- Surface preparation of lower epidermis X 100

a.cav., air cavity; l.ep., lower epidermis; l.pe., lower pericycle; mes., mesophyll; ph., phloem; st., stomata; u.ep., upper epidermis; v., vessel.

The spongy parenchyma contains acicular crystals of calcium oxalate, small starch granules as well as mucilage.

Upper Epidermis: (Fig. 7B) is formed of one layer of square to subrectangular cells as seen in transverse section. In surface view the cells are polygonal mainly axially elongated, with straight anticlinal walls and measuring 110- 150 up to 350 microns longs, 25-30 up to 45 microns wide and 20-30 up to 35 microns high. The epidermis is covered with thick smooth cuticle. Numerous cells are filled with mucilage which stains red with ruthenium red test solution and blue with methylene blue. Stomata of anomocytic type are present, being oval to rounded in shape, usually surrounded by 4 epidermal cells and measuring about 45-50 up to 60 microns in length and 35-45 up to 55 microns in diameter. Trichomes are absent.

Lower Epidermis: (Fig. 7C) exactly identical with the upper one especially in the shape of cells which are polygonal, axially elongated, in surface view, but differs in that the cells are smaller in size than those of the upper epidermis and measuring 80-160 up to 200 microns long and 15-20 up to 30 microns high and 25-30 up to 40 microns wide. The epidermal cells are covered with thick smooth cuticle and many cells are filled with mucilage. Stomata are present in a larger number than those of the upper epidermis. They are oval to rounded in shape, being of anomocytic type usually surrounded by 4 epidermal cells and measuring about 40-45 up to 55 microns in length and 35-40 up to 50 microns in diameter. Epidermal trichomes are absent.

The Mesophyll: (Fig. 8) is homogenous and the palisade is not pronounced. There is a single band of subepidermal collenchyma abutting to the upper epidermis particularly in the vein region and formed of 1-3 raws of rounded or nearly rounded shining small cells. The spongy tissue is formed of several rows of large parenchyma with wide intercellular spaces. In the middle region these cells increase much in size. Those towards the upper and lower epidermis are smaller in size and containing chloroplast. The cells surrounding the endodermis are rounded to subrectangular parenchyma forming a starch sheath around the vascular bundle. Many of these cells contain starch granules specially the endodermal parenchyma. The starch granules are mainly simple and some are compound of 2-3 components which are oval in shape with distinct centric hilum and in some granules the hilum appears cleft or radiating. The individual granules are mostly oval in shape and measuring 6-15 up to 20 microns in diameter. Few acicular crystals of calcium oxalate are either grouped in raphides or scattered in the parenchyma of the mesophyll and cortical tissue and measuring 40-60 up to 80 microns long. Many cells of the mesophyll and cortex contain mucilaginous masses, which do not stain with corallin soda test solution, but stains blue with methylene blue test solution and stains red with ruthenium red test solution.

There is a single band of subepidermal collenchyma abutting to the lower epidermis and formed of one row, of rounded shining small cells. Several wide oval or rounded air spaces or lacunae are present in the mesophyll between the vascular bundles, being large in size in middle region and measuring 250-500-850 microns in diameter and becoming reduced gradually towards the margin of the leaf.

The Vascular System:(Fig. 8B) is represented by several radially elongated closed collateral vascular bundles appearing linear lanceolate in outline as seen in transverse section.

Each vascular bundle is devoid of any type of sclerenchyma and shows a parenchymatous pericycle surrounding the vascular bundles. The pericycle shows two well developed arcs, the upper arc is smaller and consists of larger parenchyma, but the lower arc is longer consisting of smaller parenchyma and extending to a distance near to the lower epidermis.

The xylem forms a radial row or group of about 4 to 6 lignified vessels, towards the upper surface. The vessels have usually spiral,

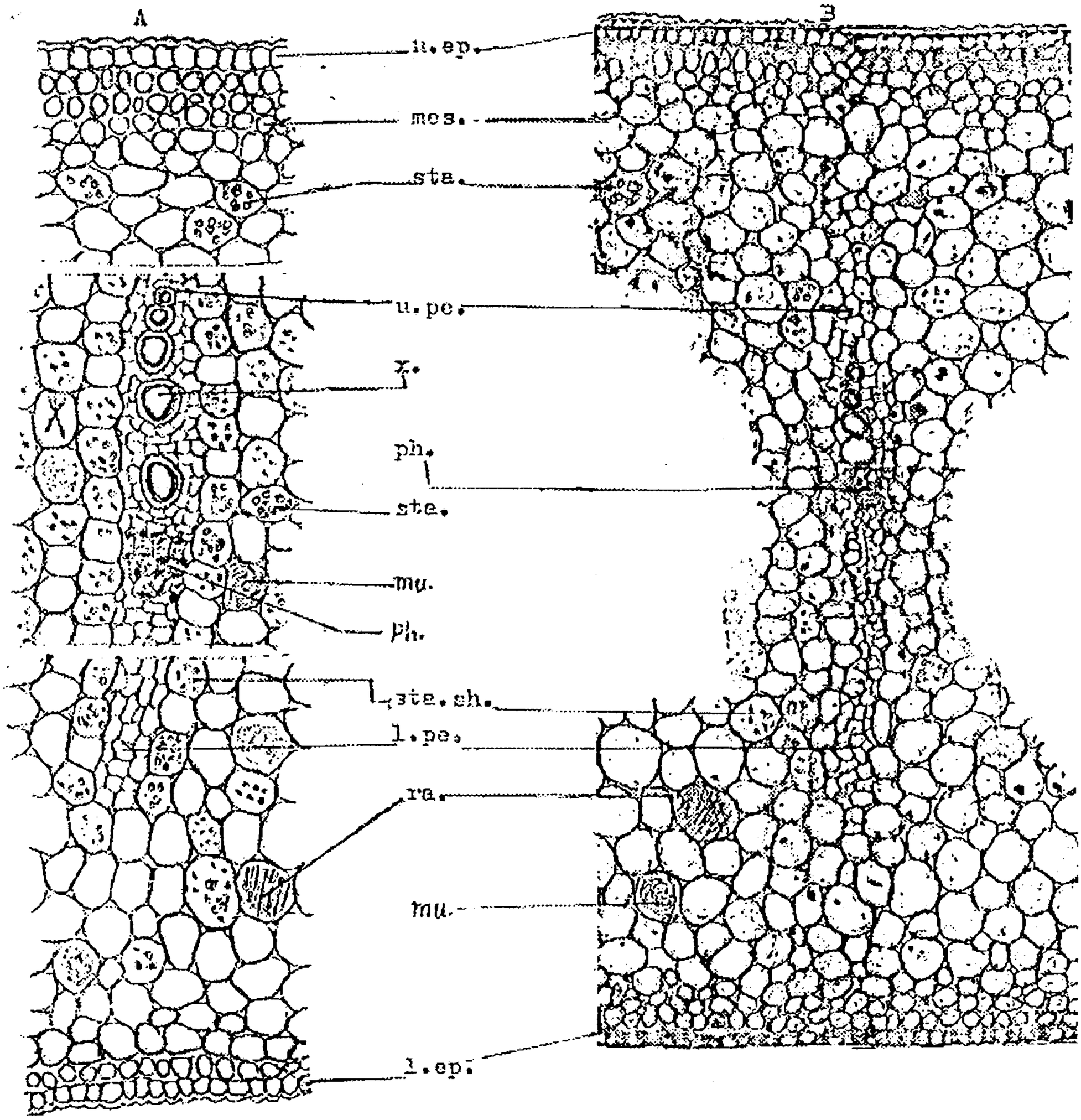


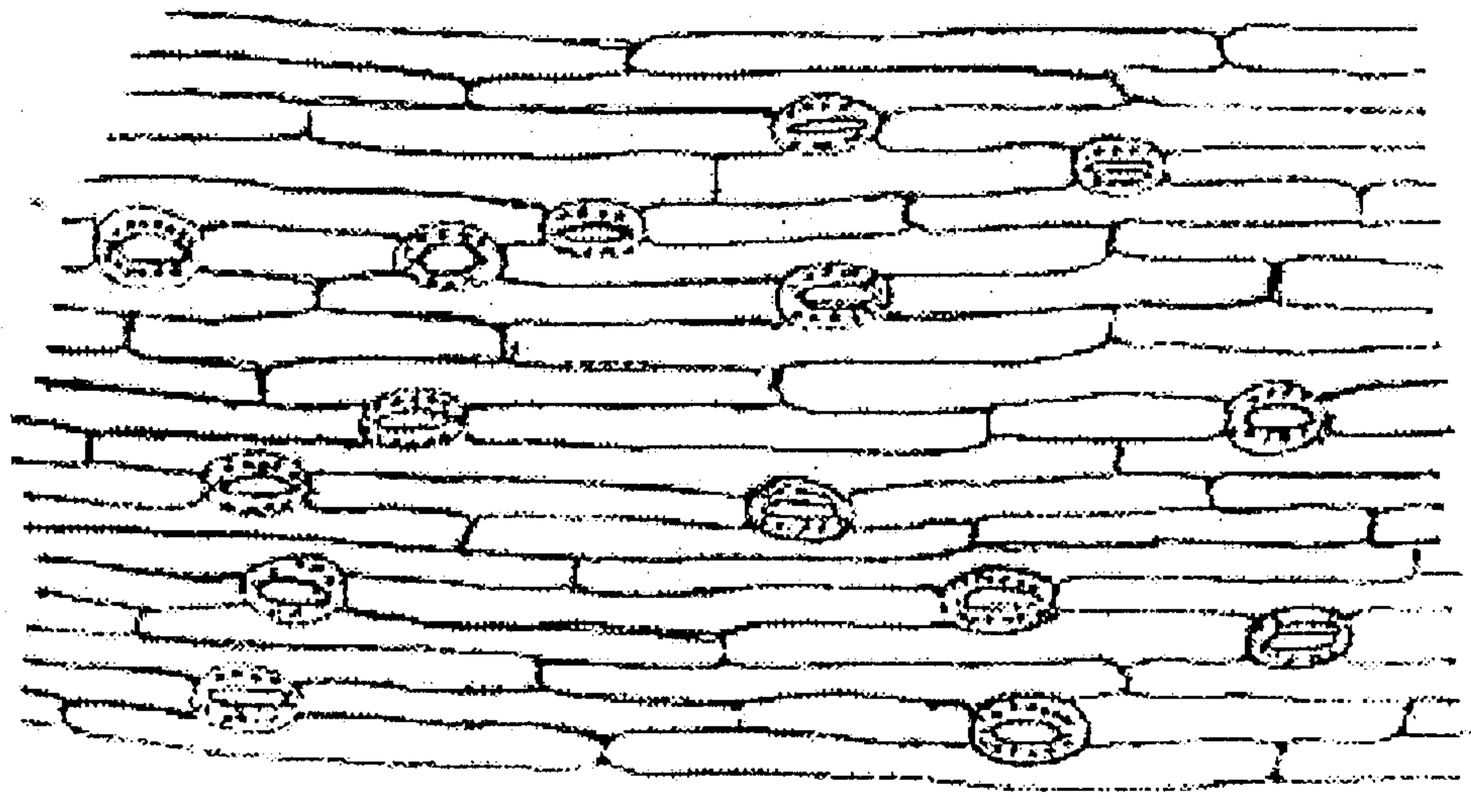
Fig. 8: Detailed T.S. of the Foliage Leaf

A- Detailed T.S. of the middle portion of the leaf. X 100

B- Detailed T.S. at one side of the leaf X 100

a.cav., air cavity; l.ep., lower epidermis; l.pe.,lower pericycle; mes., mesophyll; ra., raphide; ph., phloem; sta., starch granules; sta. sh., starch sheath; u.ep., upper epidermis; x., xylem; mu., mucilage; u.pe., upper pericyle.

A



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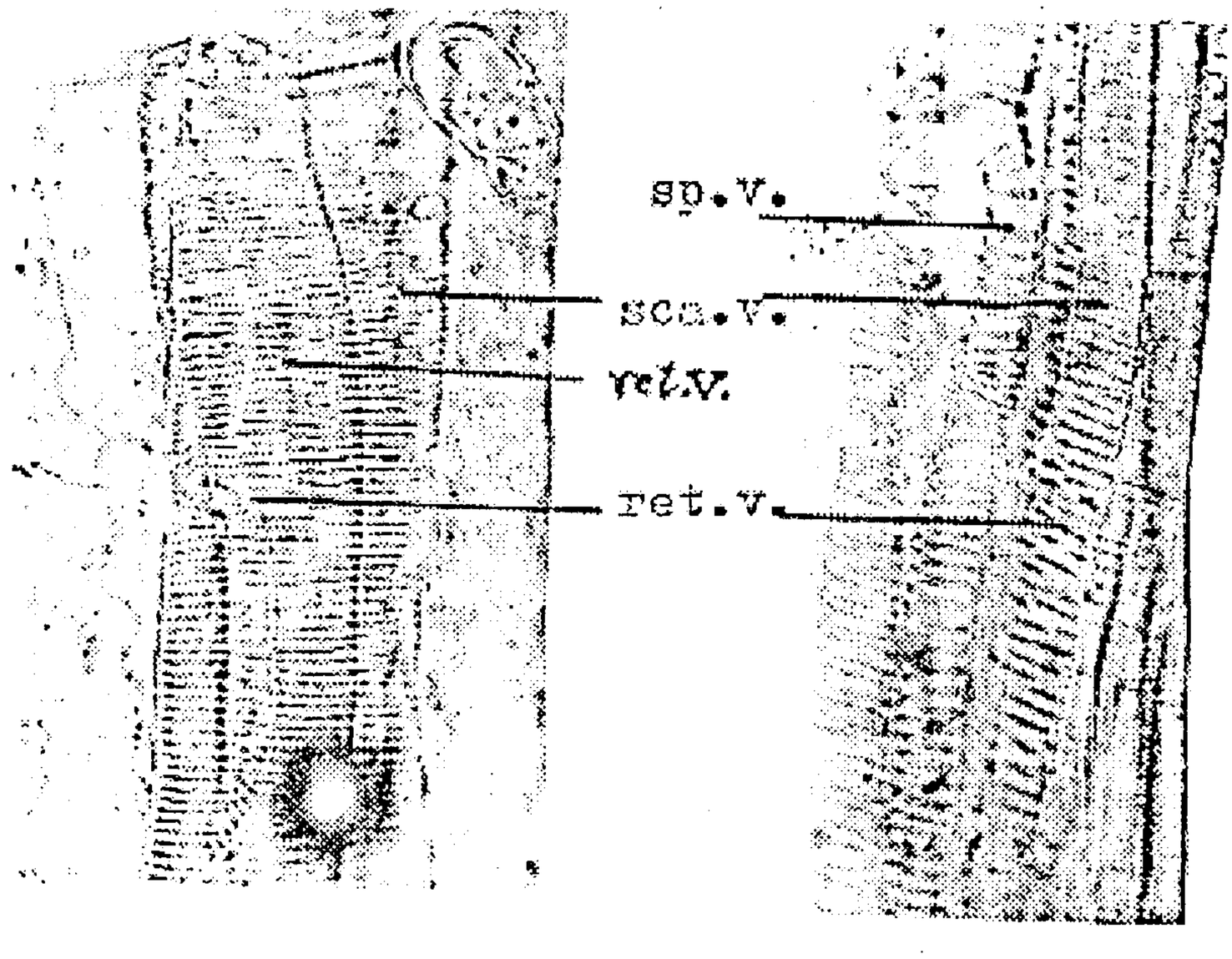

Fig. 9: Isolated Elements of Foliage leaf

A- Epidermis in surface view X 100

B- Xylem vessels X 250

ret.v., reticulated vessel; sca.v., scalariform vessel; sp.v., spiral vessel

scalariform, reticulated and rarely annular thickening and measuring 10-50 up to 75 microns in diameter. These vessels are surrounded by small thin-walled non-lignified wood parenchyma.

The Phloem: is represented by small soft area of thin walled shining soft cellulosic sieve tubes and companion cells. The bundle is surrounded by a starch sheath of wide parenchyma filled with small granules of starch exactly identical to those mentioned before.

The Powder: (Fig. 9) The dried powder is pale green in color with slight odor and bitter taste, the diagnostic microscopical features of powder are:

1- Numerous fragments of epidermis with smooth cuticle and consisting of polygonal subrectangular, axially elongated, thin-walled cells and having straight anticlinal walls. The epidermis shows anomocytic stomata and contains mucilaginous masses.
2- Greenish fragments of mesophyll consisting of thin-walled, rounded sometimes oval chlorenchymatous cells.
3- Fragments of cortical tissue consisting of cellulosic thin-walled parenchyma containing mucilage masses, starch granules and acicular crystals of calcium oxalate in raphides and single forms.
4- Fragments of vascular tissue consisting of lignified spiral, reticulated and scalariform vessels and soft cellulosic sieve tubes and companion cells.
5- Absence of trichomes, sclereids, fibers and pitted or annular vessels.

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