VI ANATOMY OF *PTERIS VITTATA*

Anatomy :

Epidermal appendages :

1. Root hairs : Root hairs are simple, multicellular, uniseriate and brown in colour (Text Fig. III - a,b, Plate No. VI - 1).

2. Scales : The scales are simple, flat, one cell thick, lanceolate, attached by the broad base and tapering to a terminal elongated single cell. The margin is smooth and devoid of marginal hairs. The basal cells of scales are much elongated. The walls are thickened. The scales found on rhizome and basal part of rachis are nearly 15 to 16 cells broad, while those on the upper part of rachis are thin narrow and 3 to 4 cells broad. (Text Fig.2- a-d, Plate No. V).

Root : (Text Fig. III - a,b; Plate No. VI - 1,2)

The T. S. of root shows the following structures :

1) It shows the outermost, continuous epidermal layer often referred as epiblema. It is composed of highly cutinized comparatively smaller cells bearing the root hairs.

2) Below epidermis is the cortex of 5 to 6 rows of polygonal cells. The cells of outer cortex are large in size, less thickened but those of inner cortex are small in size and highly thickned.

Text - Fig - II

Explanation to Plate V (1 - 2)

1) Epidermal scale

2) Magnified view of epidermal scale

Explanation to Text - Fig. III (a - b)

Text - Fig. III Anatomy of Root

a) Outline of T.S. of Root (x 28)

1) Root hair
2) Epideblema
3) Outer cortex
4) Inner cortex
5) Central vascular bundles

b) A portion of T.S. of Root (x 150)

1) Root hair
2) Epideblema
3) Outer cortex
4) Inner cortex
5) Endodermis
6) Pericycle
7) Phloem
8) Protoxylem
9) Metaxylem

Explanation to Plate VI (1 - 2)

1) T.S. of Root

2) T.S. of root showing cortex, endodermis and central stelar region.

Explanation to Text-Fig. IV (a - c)

Text-Fig. IV Anatomy of Rachis

a) Outline of T.S. of rachis (x 20)

1) Epidermis

2) Cortex

3) Vascular strand

b) Magnified view of vascular strand (x 70)

1) Endodermis

2) Xylem

3) Phloem

c) Part of T.S. of rachis (x 150)

1) Epidermis

2) Outer cortex

3) Inner cortex

4) Endodermis

5) Pericycle

6) Phloem

7) Protoxylary elements

8) Metaxylary elements

9) Tannin cell

Explanation to Plate VII (1 - 2)

1) T.S. of Rachis

2) Magnified part of T.S. of rachis showing epidermis, ground tissue and central stele.

Explanation to Text - Fig. V (a - j)

Text - Fig. V Anatomy of Rhizome

a - j Outline of T.S. of rhizome (x 20)
Showing the path of Leaf trace.

1) Leaf trace

2) Leaf gap

3) Root trace

Explanation to Plate VIII (1 - 5)

(1 - 5) Serial sections of rhizome showing the path of leaf trace.

Explanation to Text-Fig. VI

Text - Fig. VI A part of C. S. of rhizome (x 100)

1) Epidermis
2) Ground tissue
3) Outer endodermis
4) Outer pericycle
5) Outer phloem
6) Protoxylary elements
7) Metaxylary elements
8) Inner phloem
9) Inner pericycle
10) Inner endodermis
11) Starch grain
12) Tannin cells

Explanation to Plate IX

C.S. of rhizome showing ground tissue, root trace and a part of vascular strand.

Explanation to Text-Fig. VII (a - c)

Text - Fig. VII Anatomy of Pinnule and Structure of Sorus and Sporangium.

a) T.S. of sterile pinnule (x 150)

1) Upper epidermis
2) Palisade
3) Spongy parenchyma
4) Lower epidermis

b) Single Sporangium (x 150)

1) Stalk
2) Annulus
3) Stomium

c) T.S. of Fertile Pinnule (x 150)

1) Upper Epidermis
2) Palisade
3) Spongy Parenchyma
4) Lower epidermis
5) Receptacle
6) Sporangium
7) Indusium

Explanation to Plate X (1 - 2)

1) T.S. of pinna showing upper and lower epidermis palisade, spongy parenchyma.

2) T.S. of pinna passing through midrib region.

Explanation to Text-Fig. VIII (a - b)

Text - Fig. VIII Leaf epidermal details

a) Part of upper epidermis showing wavy epidermal cells - (x 400).

b) Part of Lower epidermis with Stomata - (x 40

1) Guard cells

2) Subsidiary cell

3) Stomata

Explanation to Plate XI (1 - 2)

1) Lower epidermis of Pinna showing distribution of stomata.

2) Stomata showing stoma, guard cells, and subsidiary cells.

3) In the centre there is a single stele which shows the following structures :

i) The outer layer of stele or the layer demarcating the cortex and the stele is the endodermis, made up of barrel shaped cells with thickened outer walls.

ii) Below endodermis is a single layer of thin-walled cells-the pericycle.

iii) In the centre, the diarch xylem with 4 - 5 metaxylem cells in the centre and periferal protoxylem consisting of 2 - 3 cells is present.

iv) Phloem made up of few cells alternating with the xylem.

Thus the root is protostelic, diarch with exarch xylem.

Rachis : (Text Fig. IV - a,b,c; Plate No. VII - 1,2),

In order to study the anatomical changes in the stelar structure of the rachis from the base to the apex, cross sections were taken at different levels of rachis.

The stelar anatomy at different levels was same and there was no significant change in stelar region but the difference is found in the cortical region. At the basal region, that is the older region of rachis, the cortex consists more of thickwalled sclerenchymatous tissue which are devoid of chloroplast. While at the apical region of rachis, that is the younger region, the cortex mainly consists of comparatively thin walled, chlorenchymatous tissue.

Thus at the basal region which is older and mature part of rachis, the cortex performs the function of mechanical strength while at the apical region, which is the young part of rachis, the cortex also performs the photosynthetic function.

The general anatomical structures seen in T. S. of rachis are as follows :

1) The outermost layer i.e. epidermis is single cell thick, made up of some-what rectangular cells with wavy, lignified outer wall.

At the basal region of rachis multicellular scales are present on epidermis while at the apical region of rachis hairs and narrow scales are present.

2) Cortex can be divided into two distinct zones -

i) Outer cortex - Consisting of thick walled sclerenchyma.

ii) Inner cortex - Consisting of thin walled large parenchymatous cells with intercellular spaces.

There are some cells filled with tannin contents.

Stele : A single large horse-shoe shaped stele is present at the centre showing the following features :

i) Outermost, single layer of barrel shaped cells i.e. the endodermis. The outer wall is highly thickened and having casparian bands.

ii) Below endodermis is the pericycle, made-up of thin-walled polygonal cells. Pericycle is one cell thick but 2 to 3 cells thick at some places.

iii) Below pericycle is the continuous mass of phloem, made-up of slightly tangentially elongated sieve-cells and phloem parenchyma.

iv) In the centre "C" shaped xylem core is present, made-up of proto & meta xylary elements. There are five protoxylary points and metaxylem present inbetween them.

Thus the stele is of primitive type- the protostelic one.

Rhizome : (Text Fig. V -a-j, Fig. No. VI, Plate No. VIII,IX).

The general anatomy as seen in the T. S. of rhizome is as follows :

The various tissues that can be seen from the centre to the periphery are the (i) pith (ii) inner endodermis (iii) inner pericycle (iv) inner phloem (v) xylem (vi) outer phloem (vii) outer pericycle (viii) Outer endodermis (ix) cortex and the (x) epidermis.

1) The epidermis is one cell thick layer with lignified outer walls. The scales covering the rhizome are seen at some places.

2) Cortex is made-up of compactly packed polygonal parenchymatous cells. They contain starch grains.

The inner cortex and the peripheral region of pith show presence of tannin cells.

3) Stele

In the smaller rhizome the stele is a complete ring of the vascular tissue. It consists of pith in the centre made-up of polygonal thin-walled parenchymatous cells with starch grains.

Pith is surrounded by continuous xylem ring made-up of tracheids and xylem parenchyma. It is surrounded by inner and outer phloem on both the sides which consists of phloem parenchyma and sieve cells.

Outside the inner and outer phloem, is thes single layered inner & outer pericycle which is made-up of large polygonal cells.

The inner and outer endodermis binds the vascular tissue and is made-up of elongated barrel shaped cells with thickened outer walls.

The young part of rhizome where leaves are closely placed the stelar ring is interrupted by several foliar gaps. This involves no other innovention than the shortening of the internodes and the consequent overlapping of the leaf-gaps. The vascular system is represented by a

ring of "meristeles" each delimited by unbroken endodermis. In the mature rhizome the leaves are distantly placed, as a result the leaf gaps get filled up and the stelar ring is again a continuous one. Thus basically the rhizome is solenostelic but only in the younger parts it is dictyostelic

Pinnule :

The leaf lamina is coriaceous in texture. The stomata are restricted to the lower epidermis only. The guard cells are kidney shaped and stoma is a narrow elongated slit. There is a single subsidiary cell covering most of the part of the guard cell. Thus it is the "Polocytic" type of stomata. The frequency of stomata is approximately 145/millimicrometer area. The average length of stomata is 40.96 U and average breadth is 23.04 U (Text Fig. VIII-b, Plate No.XI 1

The cross section of the pinule reveals the following structure : (Text Fig. VII -a, Plate No. X -1).

1) It shows the upper and lower epidermis. The epidermal cells have a highly sinous outline. The cells of upper epidermis are much larger, rectangular with thickened outer wall. Being the shade loving plants epidermis is chlorophyllous. The cells of the lower epidermis are smaller elongated and this epidermal layer is interrupted by stomata.

2) In between the upper and lower epidermis the mesophyll tissue is present which is differentiated into; i) Palisade and ii) Spongy Parenchyma.

i) Palisade is made-up of 2 rows of compactly arranged parenchymatous cells not with much elongation.

ii) Spongy parenchyma consists of 3 to 4 rows of cells which are laterally elongated, irregular in shape with intercellular space.

The midrib bundle : There is a single vascular bundle in the midrib region. It shows the same protostelic anatomical features as rachis except, the shape of the vascular bundle which is 'C' shaped but not with much concavity.

The cross-section through midrib region shows the following features : (Plate No. X -2)

1) The outermost epidermal layer, made-up of small, polygonal cells with thickened outer wall.

2) Below epidermis is the hypodermis made-up of 2-3 rows of thick walled sclerenchyma.

3) Below hypodermis is 4 to 5 rows of parenchymatous cells, without any intercellular spaces.

Stele :

The stele of midrib bundle shows the same anatomy as that of the rachis.

1) The central core of "V" shaped xylem tissue is made-up of proto and meta xylary elements. There are three

protoxylary points, one at the joining region and two on the tips of "V" shaped xylem. Protoxylem consists of 5 to 6 smalltracheids.

The metaxylem consists of 8 to 10 large tracheids present inbetween the three protoxylary points.

2) Xylem is surrounded by continuous phloem cells made-up of sieve cells and phloem parenchyma.

3) Outside the phloem is a single layer of polygonal cells-the pericycle.

4) The outermost boundary of stele is the endodermis or the bundle sheath made-up of narrow, elongated, barrel shaped cells with highly lignified outerwall.

The lateral bundels of pinnae have one or two protoxylary cells and 4-5 metaxylary cells surrounded by phloem, pericycle and endodermis.

Plate - V

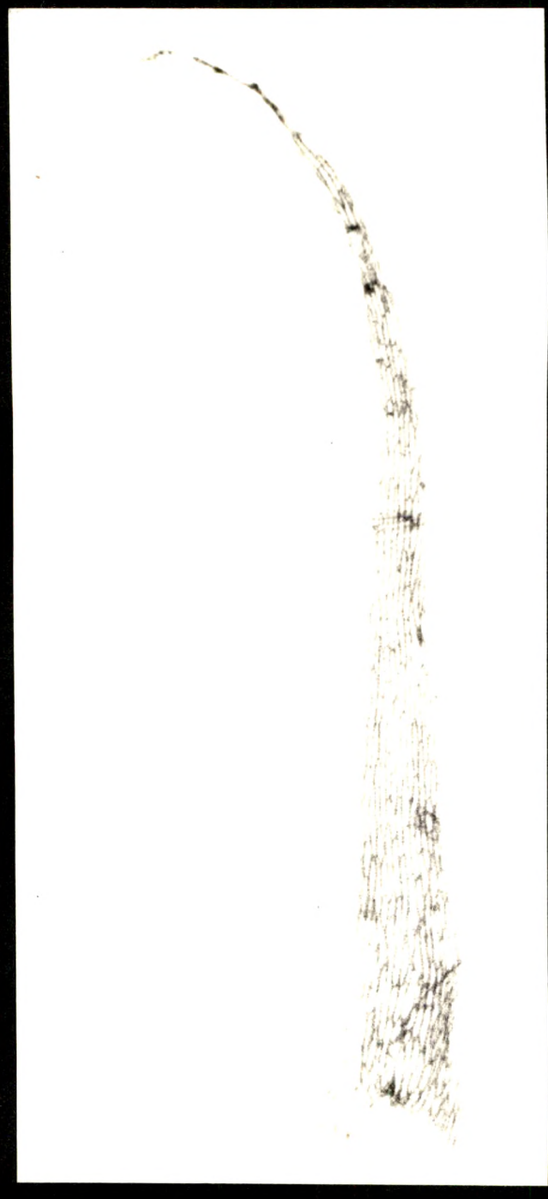


Fig - 1

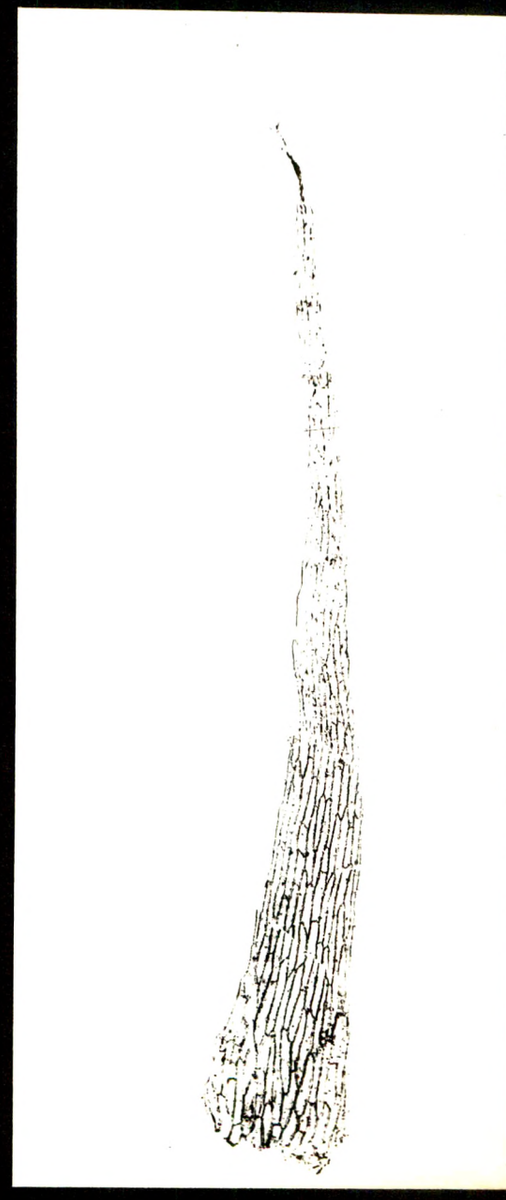


Fig - 2

Text – Fig – III

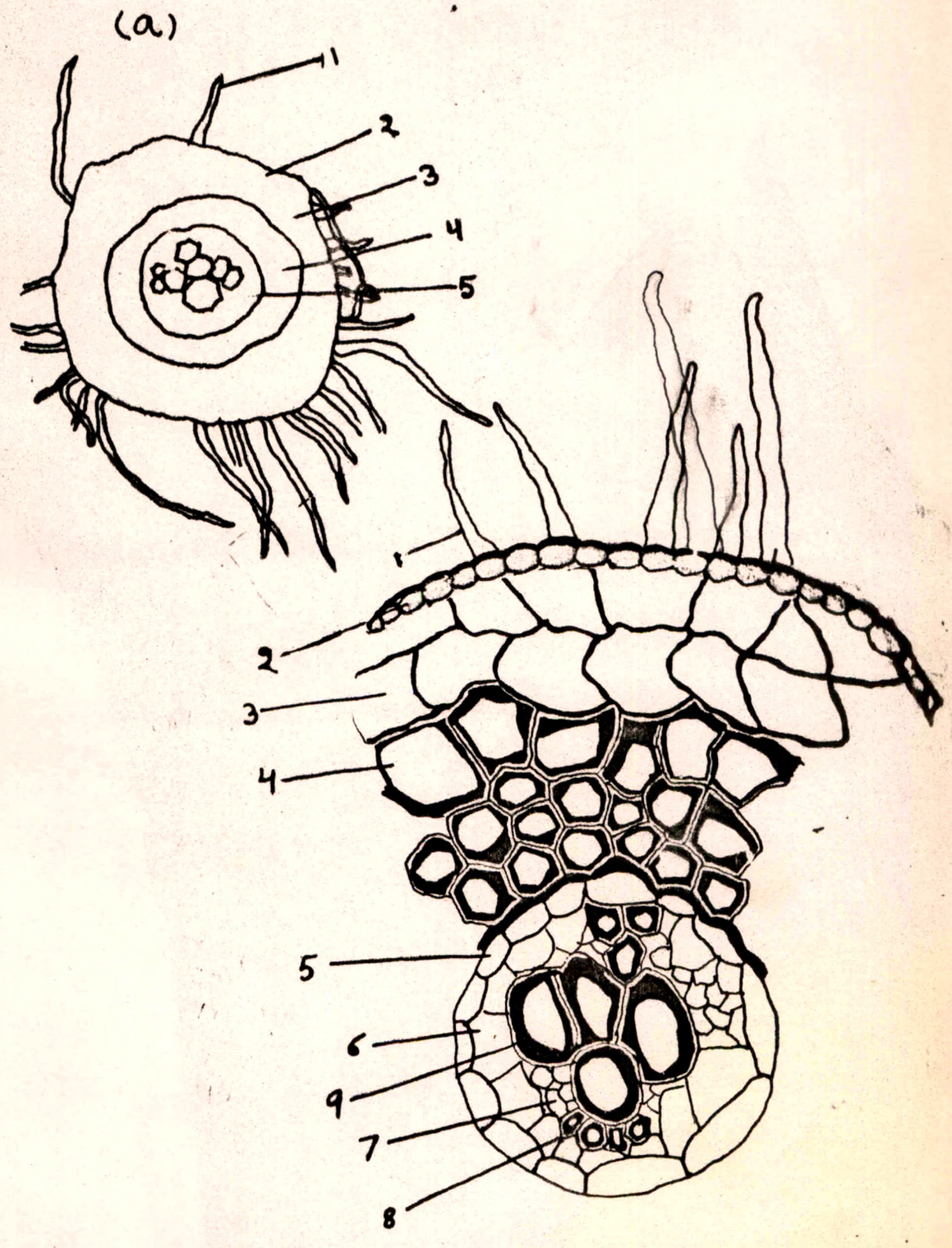


Plate – VI

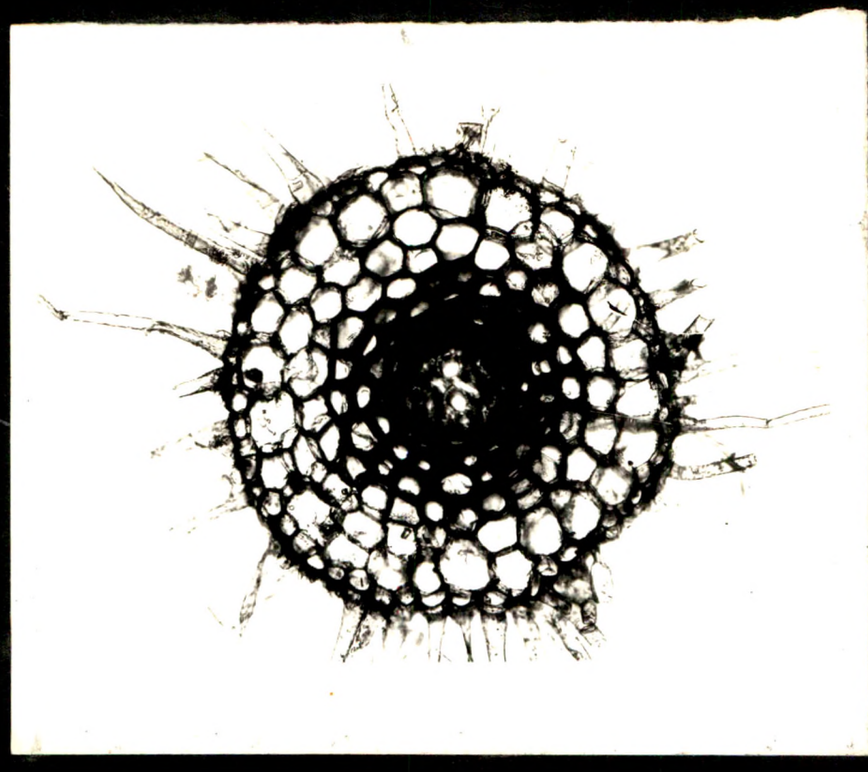


Fig-1

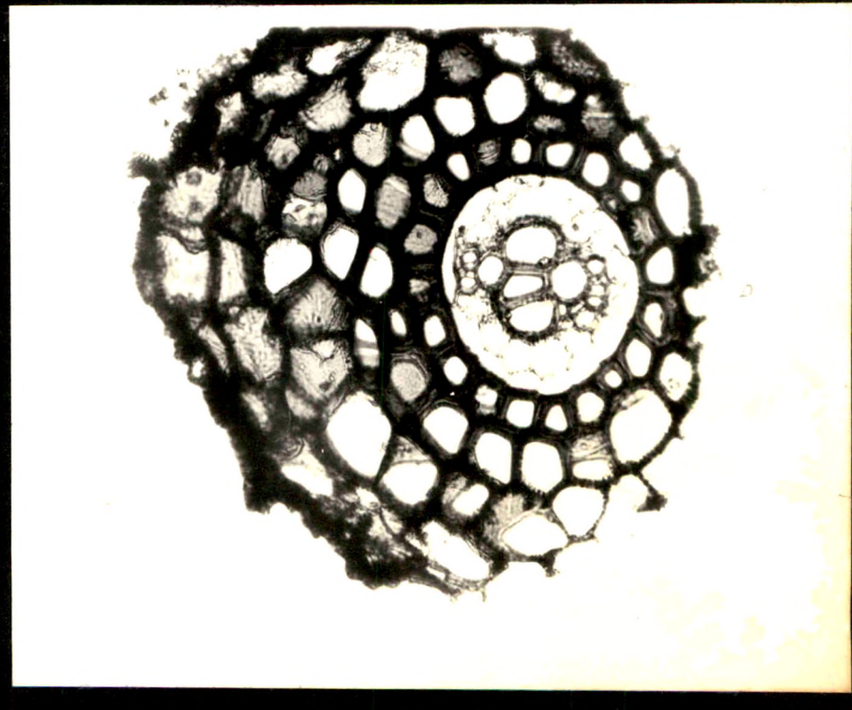


Fig-2

Text – Fig – IV

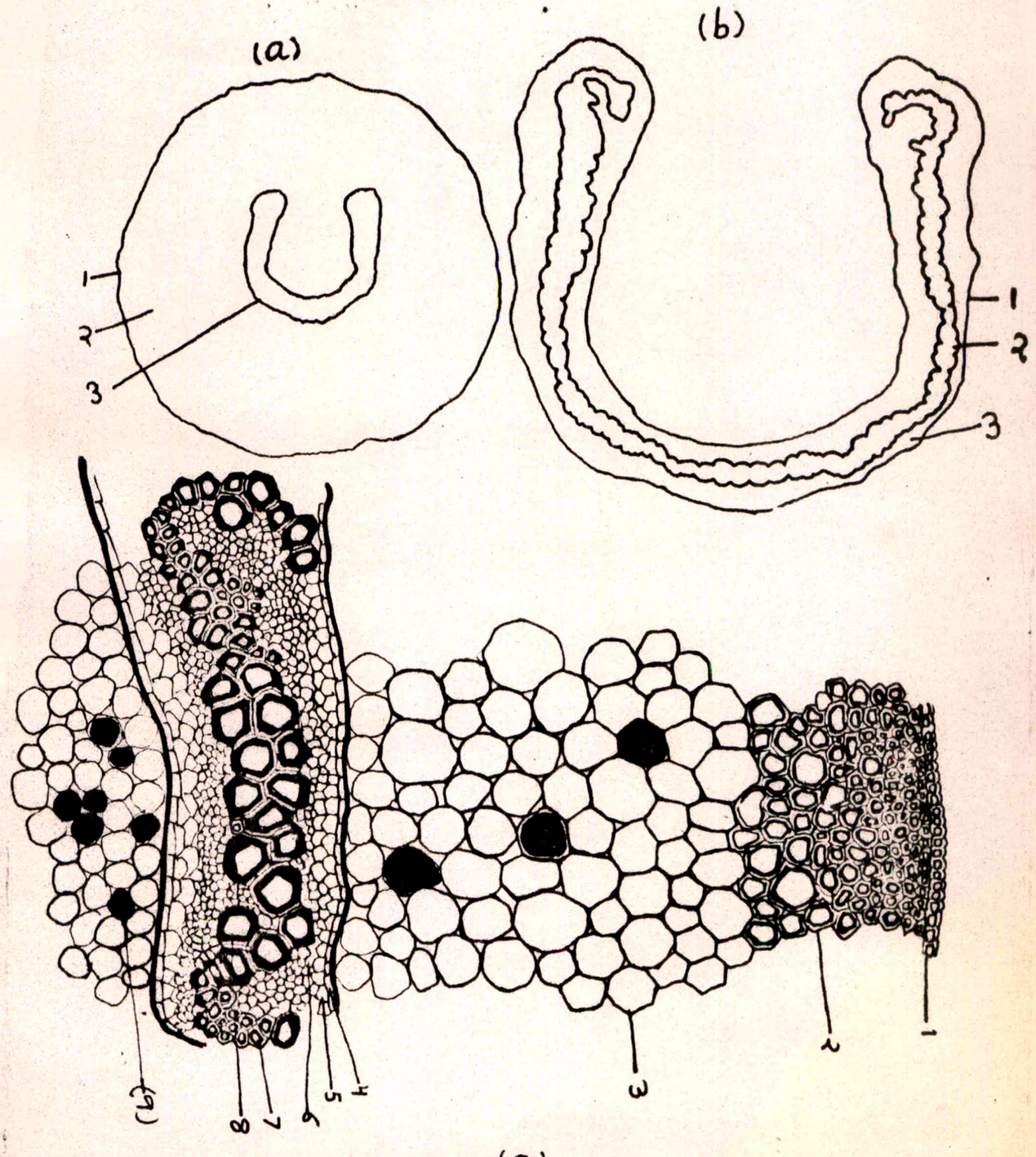


Plate - VII

Fig - 1

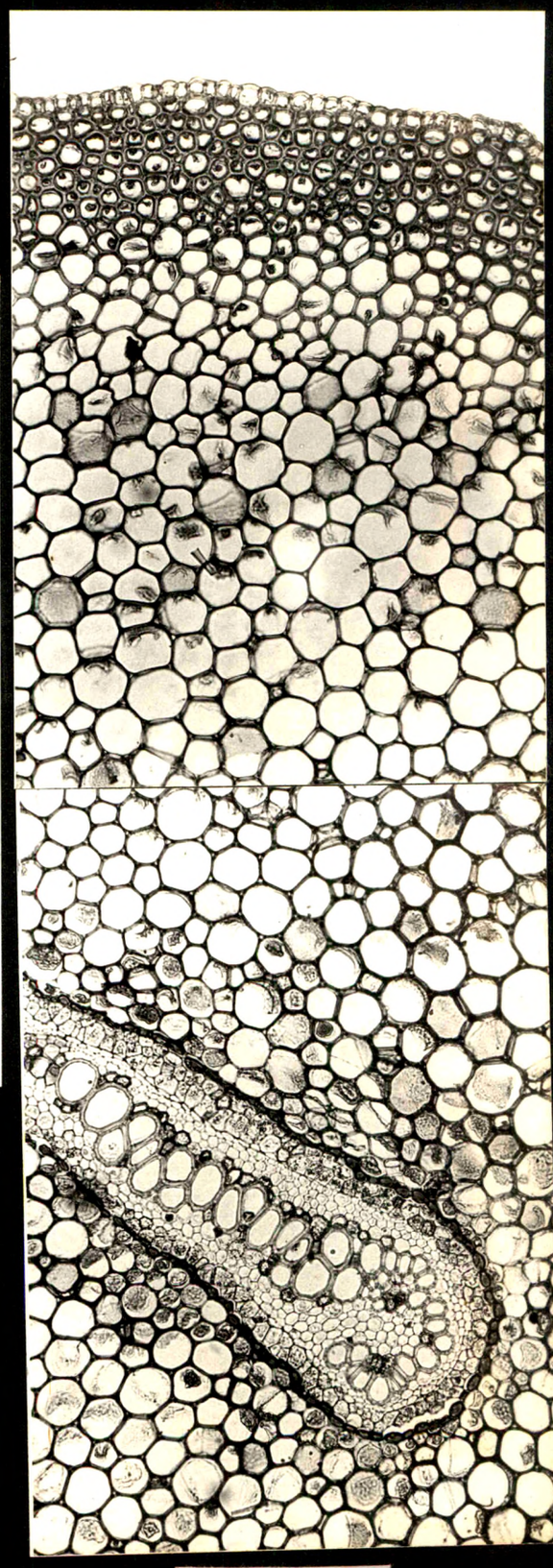


Fig - 2

Text – Fig – V

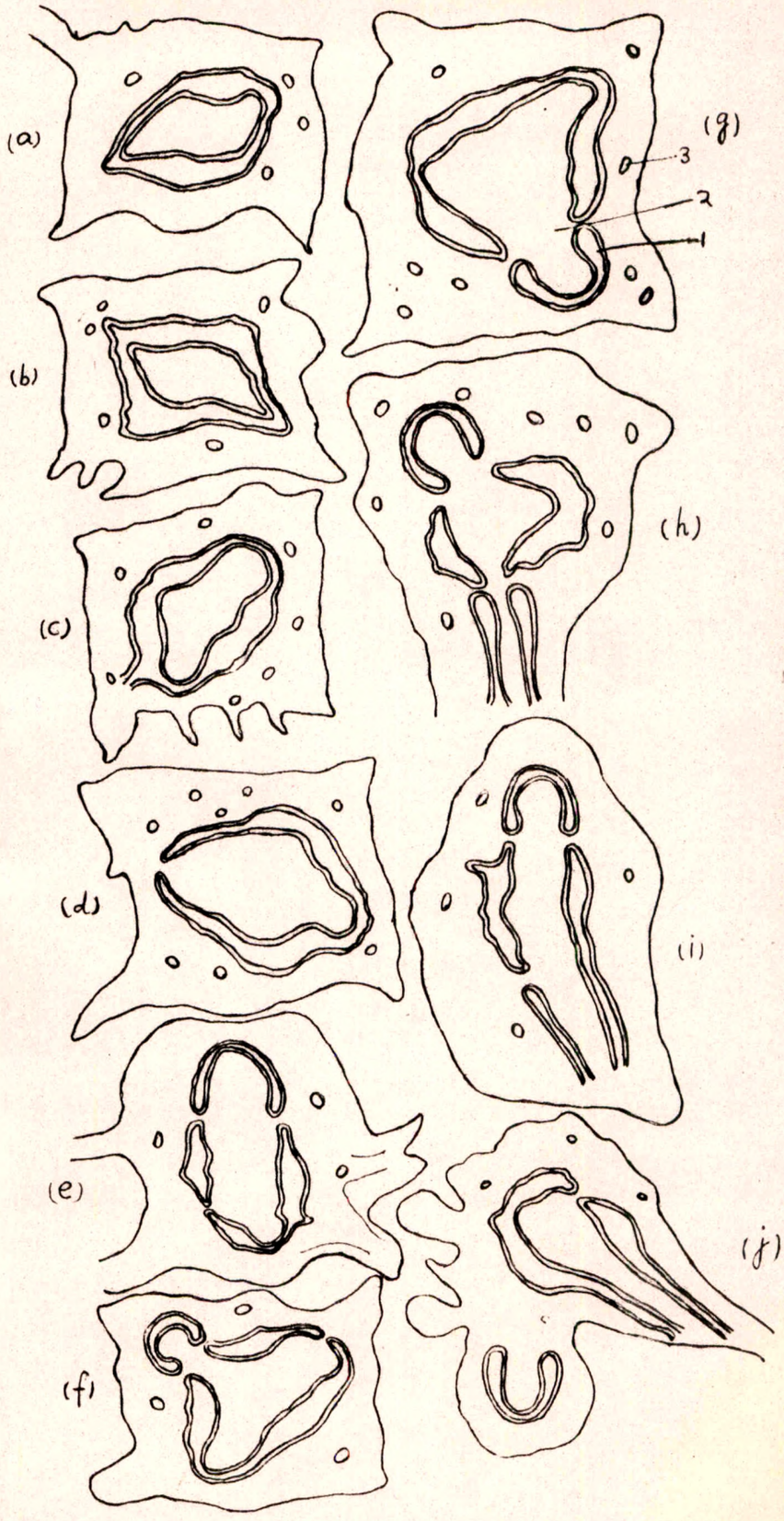


Plate - VIII

Fig-1

Fig-2

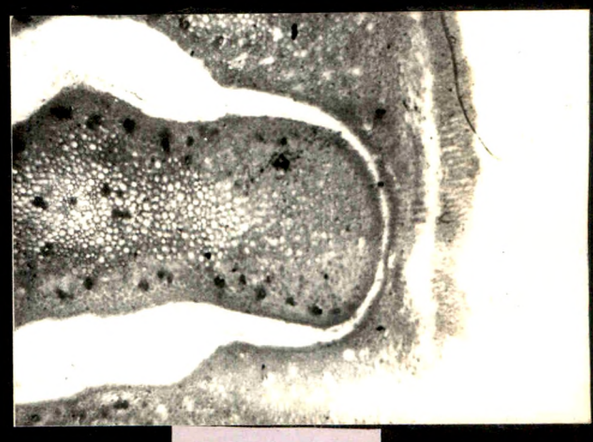


Fig-3

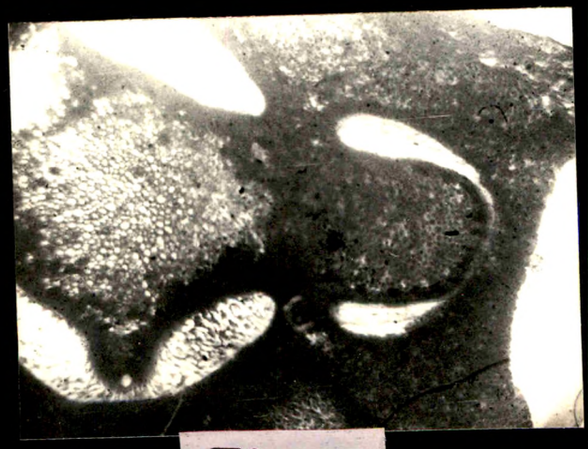


Fig-4

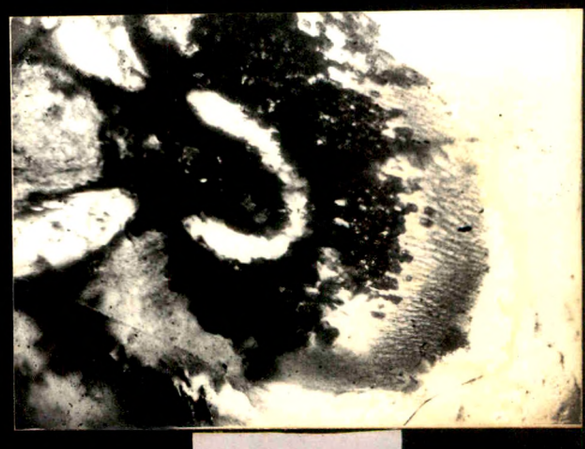


Fig-5

Text – Fig – VI

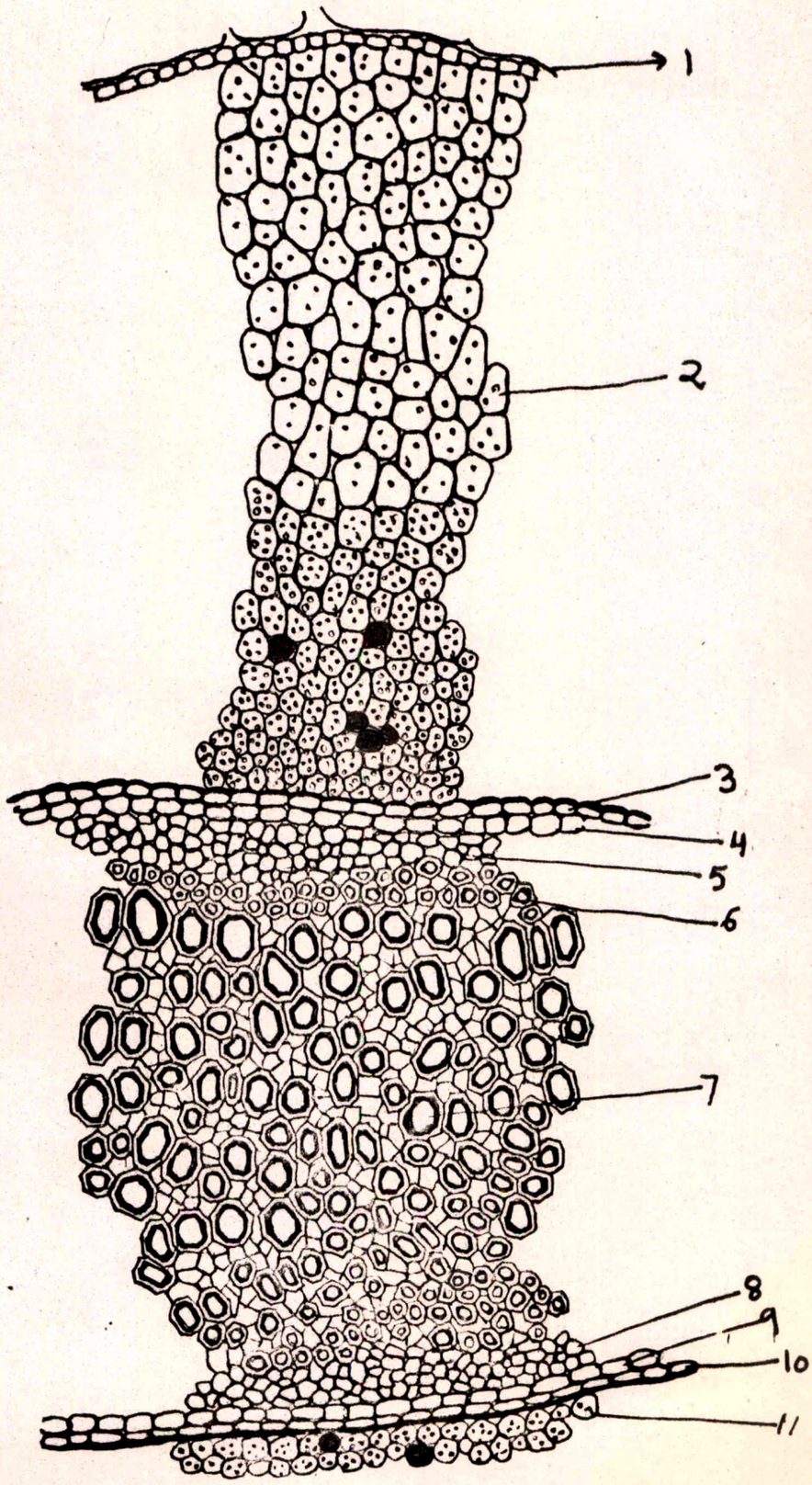
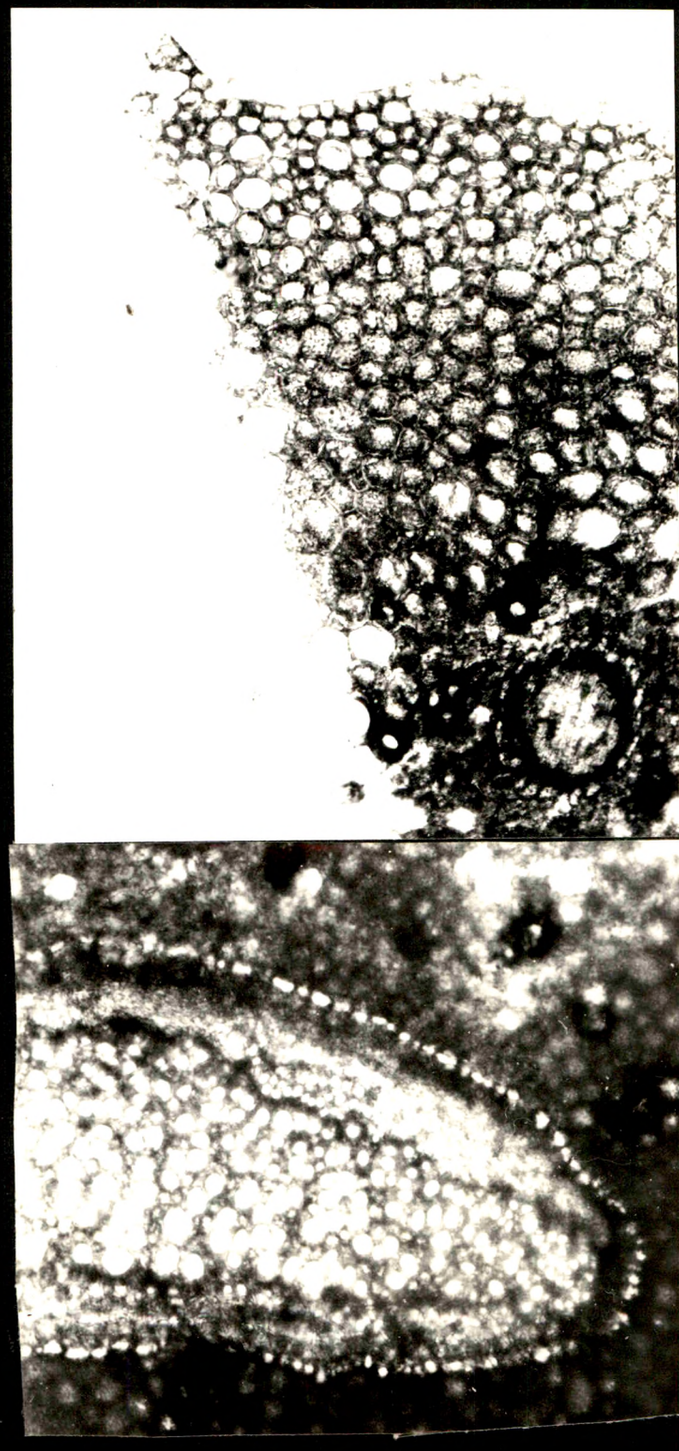


Plate – IX



Text - Fig - VII

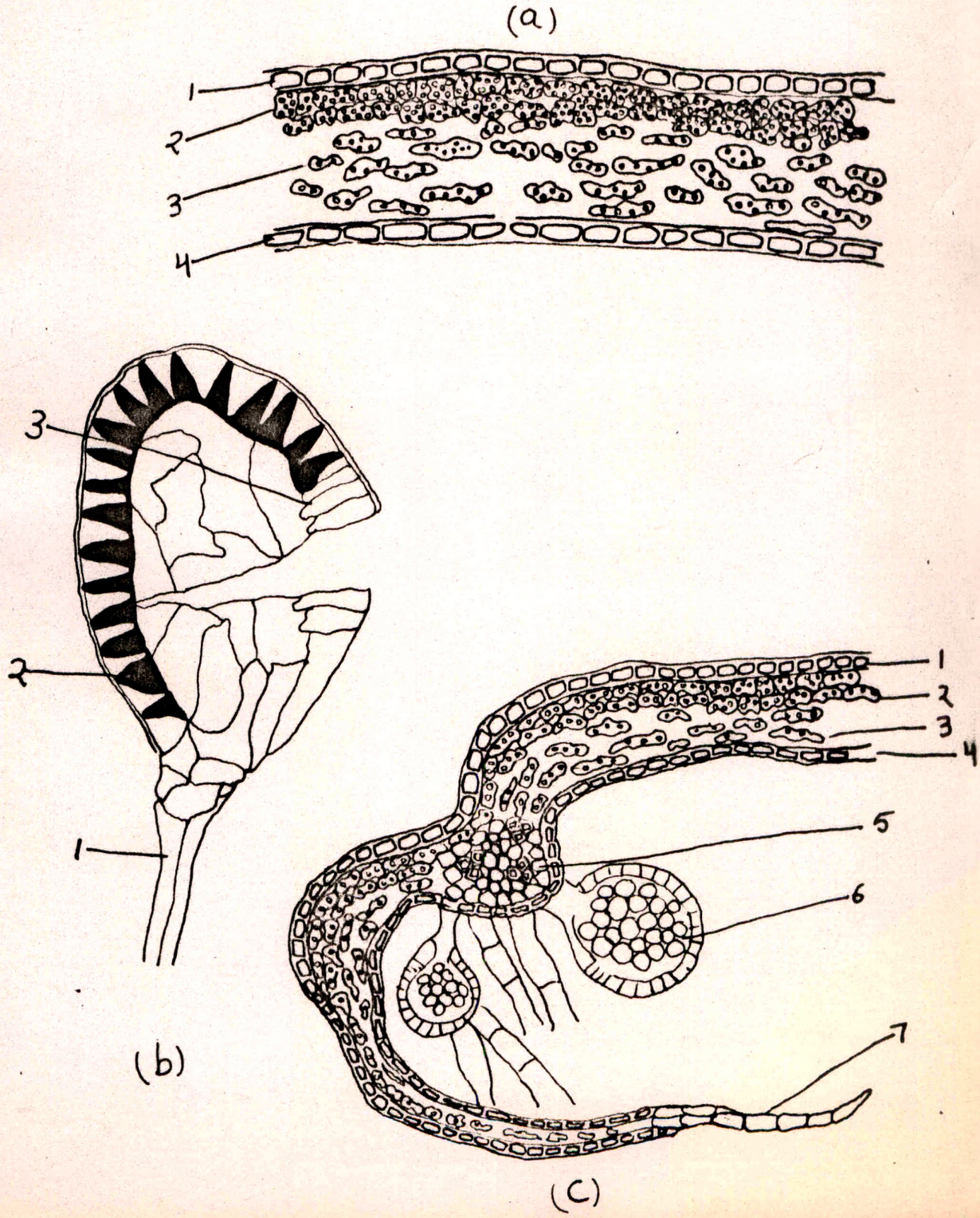


Plate – X

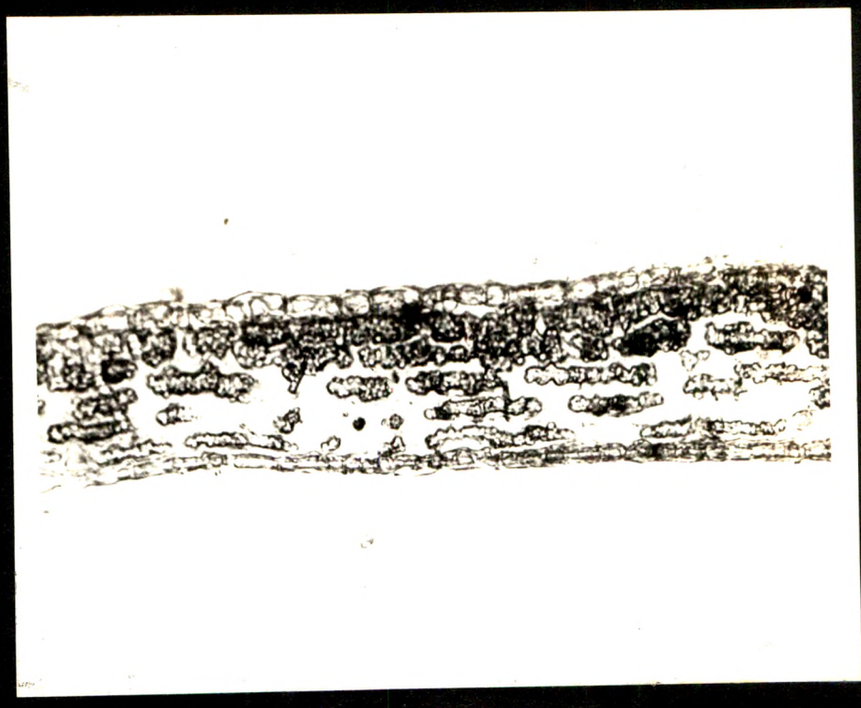


Fig -1

Fig -2

Text-Fig-VIII

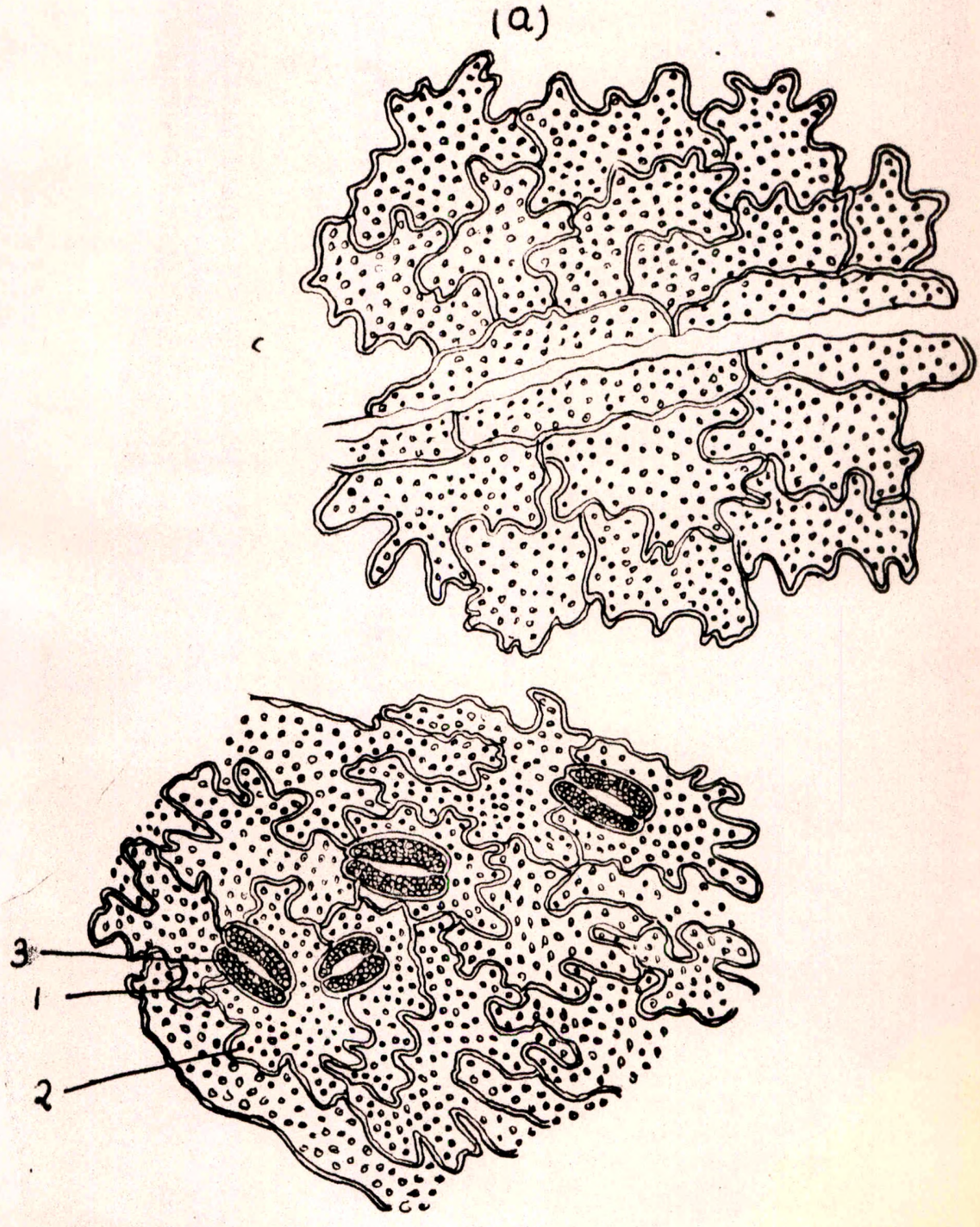


Plate - XI

Fig -1

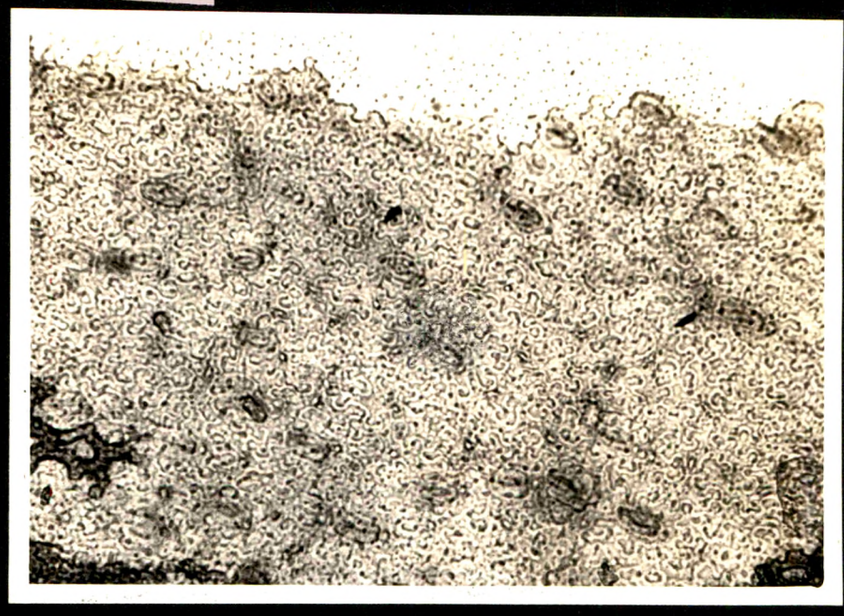


Fig -2