SAHNIOCARPON HARRISII GEN. ET. SP. NOV. FROM THE MOHGAONKALAN BEDS OF INDIA*

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ABSTRACT

The present paper deals with a description of a new petrified fruit from the famous Intertrappean beds of Mohgaonkalan, District Chhindwara, India. The fruit is dicotyledonous pentalocular, septicidal capsule with one elongated triangular seed in each loculus on axile placenta. The seed is anatropous, endospermic showing embryo with axis. The seed coat is characteristically differentiated into three regions. The fruit wall is smooth and parenchymatous with well developed vascular supply. Affinities are shown with Linaceae though not convincing. Hence this new fruit is named as, *Sahniocarpon harrisii* gen. et sp. nov.

INTRODUCTION

FROM the Deccan Intertrappean beds of Mohgaonkalan, India, four dicotyledonous fruits have so far been described. They are *Enigmocarpon parijai* Sahni (1943), *Indocarpa intertrappea* Jain (1964), *I. mahabalei* Nambudiri (1969) and *Harrisocarpon sahnii* Chitaley and Nambudiri (1968). One more dicotyledonous fossil fruit is now being described in this paper by us from the same beds.

MATERIAL AND METHODS

The fossiliferous cherts collected by the junior author from the Mohgaonkalan beds showed five specimens of pentalocular fruits exposed in different planes. After etching the rock with HF, peel sections were taken serially for investigation of these fruits.

DESCRIPTION

The five specimens of the fruit are tabled below for their size, plane of exposure and macroscopic details.

From the table it is clear that the five specimens are of one and the same fruit except for slight variation in their size. All these specimens are used for description.

The fruit is more or less spherical, slightly tapering at the apical and basal ends, and is broad in the middle portion (PL. 1, FIGS. 1 and 2; Text-Figs. 1 and 4). It is 6·5-7·5 mm. long and 4-6 mm. broad at the broadest part. It shows a stalk-like structure.

The fruit wall is smooth without any scales or hairs. Transection of the fruit shows five loculi, each with a single seed (PL. 1, FIG. 1; Text-fig. 1). The fruit wall shows five segments by splits or some demarcating lines against the five septae (PL. 1, FIG. 1; Text-fig. 1). The segments are curved on the inner side. The thickness of the fruit wall is 0·85-1·6 mm. against each chamber, narrowing towards the septae. Thus it shows five curves or convexities fitting against the concavities of the five seeds. It is differentiated into two zones, the outer and the inner (PL. 2, Fig. 9; Text-fig. 1). The 0·35-0·7 mm. thick outer zone is limited by an epidermis which is made up of a single layer of thin walled parenchymatous cells without any cuticle (Text-figs, 7, 10). This zone is of many layers of thick walled parenchymatous cells, each cell in surface view is penta-hexagonal measuring 27×32 μ size (Text-fig. 12). In this zone, below the epidermis, at some places are seen branched, septate fungal hyphae (Text-fig. 5).

SPECIMEN NUMBER	PLANE OF EXPOSURE	SIZE OF SPECIMEN	THICKNESS OF WALL	NUMBER OF SEPTAE AND LOCULI	NUMBER OF SEED IN EACH LOCULUS	SHAPE AND SIZE OF SEED
1.	T.S.	6·5×6 mm.	1·5 mm.	5	1	Triangular, 1·9 mm. wide
2.	T.S. oblique	...×6 mm	1·4 mm.	5	1	Triangular, 1·9 mm. wide
3.	L.S.	7·5×6 mm.	1·6 mm.	2	1	Oval, 3·9×1·9 mm.
4.	T.S.	...×6 mm.	1·6 mm.	5	1	Triangular, 1·9 mm. wide
5.	L.S.	4×4 mm.	0·85 mm.	3	1	Oval, 1·5×0·5 mm.

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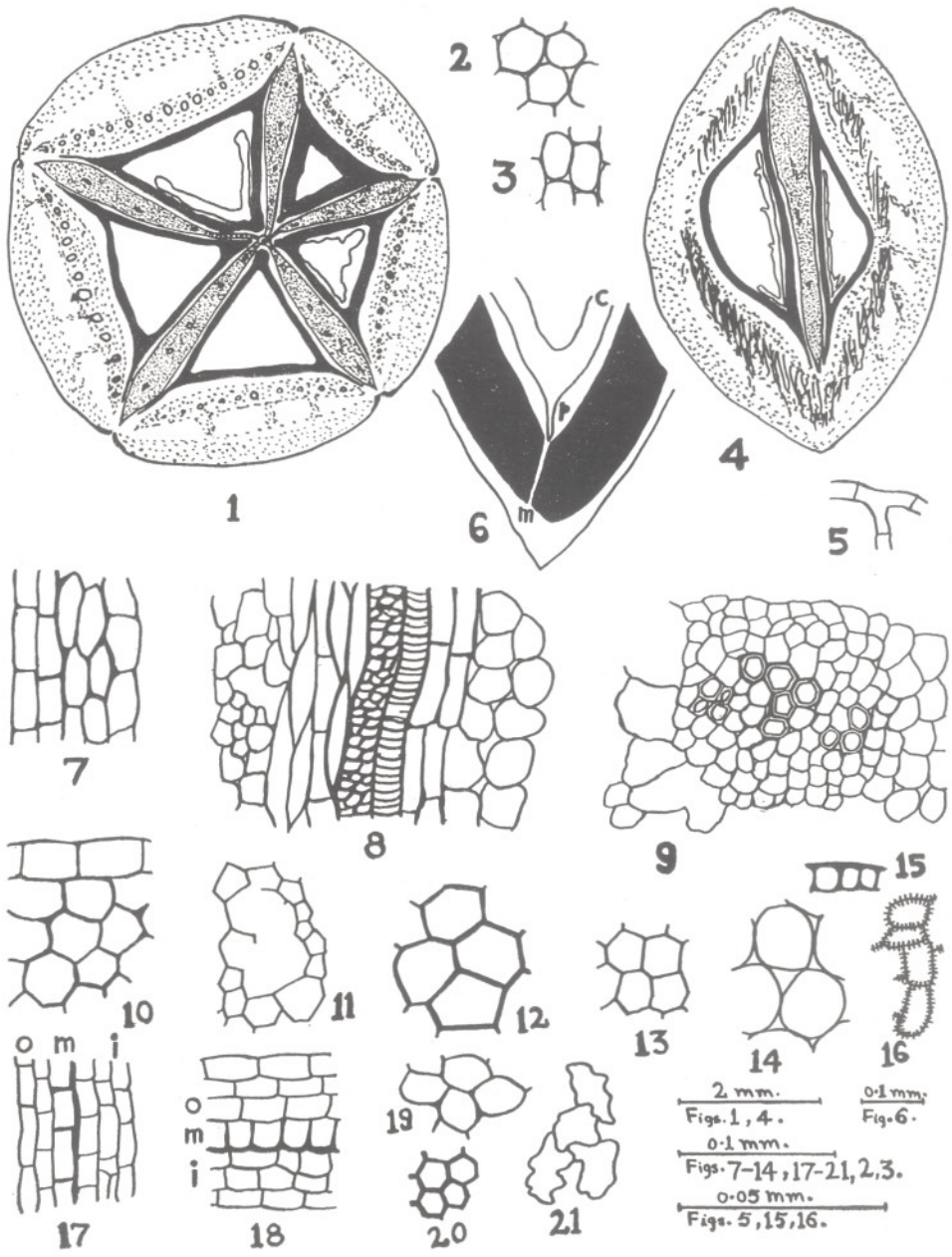

TEXT-FIGS. 1-21 — 1. T.S. fruit drawn to scale. 2. T. S. placenta cells. 3. L.S. placenta cells. 4. L.S. fruit drawn to scale. 5. Fungal hyphae. 6. L.S. part of seed showing cotyledon (c), radicle (r) and micropyle (m). 7. L.S. fruit wall showing epidermis and underlying cells. 8. Part of fruit wall in l.s. showing thickening of vessels, fibres and parenchyma. 9. Vascular bundles of fruit wall in T.S. 10. T.S. fruit wall showing epidermis and outer zone cells. 11. Cells around air cavity in T.S. of fruitwall 12. Cells of outer zone of fruit wall in surface view. 13. Cells of inner zone of fruit wall in surfaceview. 14. Mesophyll cells of cotyledon. 15. T.S. epidermal cells of cotyledon. 16. Surface view of epidermal cells of cotyledon. 17. L.S. seed coat — outer (o), middle (m) and inner (i). 18. T.S. seed coat. Outer, middle and inner. 19. Cells of seed coat epidermis in surface view. 20. Cells of middle layer of seed coat in surface view. 21. Surface view of inner epidermis of seed coat.

The outer zone is followed by an inner one which is 0·45-0·85 mm. thick. It consists of thin walled parenchymatous cells with intercellular spaces (PL. 2, Fig. 9; Text-figs. 8 and 13) though, moderately thick walled near the loculi and are hexagonal in surface view. Even at places, cavities are seen to be formed by the dissolution of the cell walls (PL. 2, Fig. 9; Text-fig. 9 and 11). In this inner zone are seen fibrovascular bundles in a ring (PL. 1, Fig. 1; Text-fig. 1). They are 50-55 in number, each measuring 250×200 μ in size. The outer zone does not have any vascular supply. Each fibrovascular bundle shows 2-3 metaxylem and 1-2 protoxylem elements radially placed (PL. 2, Fig. 10; Text-fig. 9). They are associated with thick walled aseptate fibres and moderately thick walled parenchymatous cells (Pl. 2, FIG. 12; Text-Fig. 8). These fibrovascular bundles are seen anastomosing in l.s. (PL. 2, Fig. 8). Protoxylem elements are 90-100 μ long and 12-15 μ broad having annular and spiral thickenings. Metaxylem elements are 80-90 μ long and 15-20 μ broad having scalariform and reticulate thickenings on the walls (Text-Fig. 8). Phloem is not preserved.

The five seeds in the fruit are separated by five septae (PL. 1, FIG. 1). The septae are made up of parenchymatous cells as seen in the inner zone of the fruit wall. In each septum there is a single row of fibrovascular bundles as seen in the T.S. of the fruit (Pl. 2, Fig. 9). These are about 3-4 per septum. The five septae meet in the centre and form a placenta on which seeds are borne by the inner angular ribs (PL. 1, FIG. 1; Text-Fig. 1). In the central placental axis are five fibrovascular bundles in a ring in the parenchymatous ground tissue (Text-Figs. 2 and 3). They are similar in structure to those of septae and fruit wall but are smaller than both of them.

Each seed is free from the wall of the fruit and the septae. There are also wider gaps present at places between the seed and the septum and the seed and the fruit wall. Each chamber has a single seed vertically placed (Pl. 1, Fig. 2; Text-Fig. 4). Each seed is considerably large in relation to the size of the fruit. It is elongated, measuring 1·5-3·9 mm. long and 0·5-1·9 mm broad with three ribs running longitudinally from base to apex. The ribs show pointed extensions. Out of these three ribs one is directed towards the centre and the outer two ribs are placed laterally (Pl. 2, Fig. 9). The concave wall between two ribs fit against the convex protrusion of the inner fruit wall. The seed coat (Pl. 2, Figs. 11 and 14; Text-Figs. 17,18 & 19) is thick with an epidermis of thin walled cells present in a single layer. It is followed by three zones of the seed coat. The outer being of 2-3 layers of thin walled polygonal parenchymatous cells (Text-Figs. 17 and 18). The inner zone consists of 2-3 layers of rectangular, smaller parenchymatous cells. Both these zones are connected with each other by a single layer of somewhat prominent cells. These cells are hexagonal in surface view and elliptical in sectional view (Pl. 1, Fig. 4; PL. 2, Figs. 11 and 14; Text-Figs. 20, 17 and 18). In T.S. inner and radial walls of these cells look thickened. The innermost epidermis of the seed coat is made up of thin walled parenchymatous cells which are seen with wavy or folded walls in surface view (Text-fig. 21).

Inside each seed is present a dicotyledonous embryo consisting of two large cotyledons with plumule and radicle. Cotyledons are seen folded and are with finger like projections (Pl. 2, Fig. 13; Pl. 1, Fig. 2). They show outer and inner unilayered epidermis (Text-Fig. 15) of polygonal cells. These cells in surface view show bar like structures placed at right angles to cell walls (Pl. 1, Fig. 3; Text-Fig. 16). Mesophyll cells are loosely arranged (Text-Fig. 14). Plumule is provided with two embryonic folded leaves. Radicle is long and directed towards the central axis (Pl. 2, Fig. 13). The embryo axis is placed towards the basal end of the seed. All the five seeds are seen in S.L. attached on the central axis by a raphe present on the inner rib towards the basal end of each seed, 0·5 mm. away from the base (Pl. 1, Fig. 5). It is 0·75 mm. long and 0·4 mm. broad. Hilum is also seen on the raphe, from where the vascular supply from the axis enters the seed for supplying the food nourishment to the developing embryo axis (Pl. 1, Fig. 7). Near hilum, micropyle is distinct in some seeds, indicating anatropous position of the seed (PL. 2, fig. 13; Text-Fig. 6). Embryo is embedded in an endosperm (Pl. 1, Fig. 7), the cells of which are thin walled parenchymatous.

A stalk like axis is observed at the base of the fruit in some sections (Pl. 1, Fig. 6). It is not in organic connection with the fruit wall but in close association, almost juxtaposed. The stalk shows 3-4 layers of thin walled, polygonal, parenchymatous cells with epidermis around.

DISCUSSION

From the description it is evident that the present fossil fruit is formed from a pentacarpellary, syncarpous, superior ovary with axile placentation, having a single dicotyledonous, endospermic seed in each loculus vertically placed. The large seeds completely fill the loculi so that they almost look embedded in the soft tissues of the fruit. Splits are seen in the fruit, separating the seeds from the fruit wall and from the septae. The fruit wall also shows slits or demarcation lines one against each septum. Such structure of the fruit suggests a pentalocular capsule with septicidal dehiscence having an erect anatropous seed in each loculus.

Following are the families in which the fruits are capsules:— Tiliaceae, Malvaceae, Sterculiaceae, Sapindaceae, Convolvulaceae, Guttiferae, Geraniaceae and Linaceae.

In Tiliaceae, Malvaceae, Sterculiaceae, Sapindaceae and Convolvulaceae capsules are loculicidal or schizocarpic dehiscing into one or many seeded cocci. This condition is different from the present fossil fruit.

The family Guttiferae has capsular fruits with septicidal or septifragal dehiscence. They are 3-6 locular with many seeds in each loculus. In the present fruit there is a single seed in each loculus.

Geraniaceae has 3-5 locular capsules with endospermic seeds in each loculus as seen in the present fossil fruit. The position of the seed is also similar being anatropous. However, the capsules here are loculicidal. When septicidal the condition is many seeded with false partitions.

Another family to which few resemblances are seen is Linaceae. Here fruits are 3-5 locular with septicidal dehiscence as in the fossil specimens. However, the loculi in the capsule divide by false septae and the number of seeds is 1-2 per loculus. The fruit dehisces by number of valves, which is not seen in the present specimen. As such no satisfactory comparisons can be drawn between the fossil specimen and the fruits of the modern families. Comparisons are also done as under with the known fossil fruits from India.

This fruit is not in the least comparable to the fruit *Enigmocarpon parijai* Sahni (1943), where the seeds and loculi are many and the dehiscence is loculicidal.

Indocarpa Jain (1964) is also different being tetralocular with many seeds in each loculus.

Harrisocarpon sahnii Chitaley and Nambudiri (1968) though pentalocular and of more or less the same size as the present fruit, is ribbed and has two seeds in each loculus, a condition not seen in the present specimen. The only comparable character in all the three fruits and the present fossil fruit is their capsular nature. Another pentalocular fruit, *Pondicherria ebenaceoidea* Sahni (1933) is described from Pondicherry beds of South India. Geological age according to Sahni was unknown, probably upper Cretaceous (vide supra). This fruit is very much bigger than the present one. Though five locular with a single seed vertically placed in each locule, it is different from the present specimen in having the micropyle outwardly directed. Also all the other structural details of this fruit are different from our fruit specimen.

Thus the present fruit, being different from all the known fossil fruits from India and not satisfactorily resembling the modern fruits, is named *Sahniocarpon harrisii* gen. et sp. nov. The generic name is after the renowned Indian Palaeobotanist, late Prof. B. Sahni and the specific name is after Prof. T. M. Harris, a Palaeobotanist of International fame.

DIAGNOSIS OF *SAHNIOCARPON* GEN. NOV. Chitaley & Patil

Fruit a dicotyledonous, pentalocular, septicidal capsule with a single endospermic, anatropus seed vertically placed in each loculus. Placentation axile.

DIAGNOSIS OF *SAHNIOCARPON HARRISII* SP. NOV. Chitaley & Patil.

Fruit a pentalocular capsule, more or less spherical, slightly narrow at both the ends, 6·5-7·5 mm. long and 4-6 mm. broad at the broadest part. Fruit wall 0·85-1·6 mm. thick, differentiated into outer and inner zones; outer zone 0·35-0·7 mm. thick, many layered of thick walled parenchymatous cells, each cell measuring 27×32 μ in surface view, limited on outer side by single layered, smooth walled epidermis

with five splits, one against each of the five septae; inner zone 0·45-0·85 mm. thick, many layered, aerenchymatous, cells thin walled, parenchymatous. Vascular bundles in a ring in inner cortex, 50-55 in number, each vascular bundle spherical in shape, measuring 250×200 μ in size, showing 2-3 metaxylem and 1-2 protoxylem elements associated with thick walled parenchyma; metaxylem vessels 80-90 μ long and 15-20 μ broad, with scalariform and reticulate thickenings; protoxylem with vessels 90-100 μ long and 12-15 μ broad, with annular and spiral thickenings. Five septae meeting in the centre, each septum with 3-4 vascular bundles in a radial row in parenchymatous tissue.

Seeds five, one in each loculus, vertically placed in anatropous position on the axile placenta with micropyle directed inwards; raphe 0·75 mm. long and 0·4 mm. broad present towards lower end of the seed on its inner rib; each seed oval in L.S. and triangular in T.S. measuring 1·5-3·5 mm. in length and 0·5-1·9 mm. in breadth, with three ribs or projections, two lateral, with a concavity in between them to fit in the convexity of the inner fruit wall lying against each seed; inner projection or rib directed towards the centre.

Seed coat differentiated into outer, middle and inner regions; outer of thin walled, parenchymatous cells with epidermis on outer side, inner one of rectangular parenchymatous cells, both connected with each other by a single layer of hexagonal cells in surface view, having inner and radial walls thickened as seen in sectional view. Innermost epidermis of the seed coat of thin walled parenchymatous cells with wavy or folded margins, in surface view.

Embryo dicotyledonous embedded in an endosperm of thin walled, parenchymatous cells. Radicle pointed towards the inner side and plumule towards the outside. Cotyledons large with finger-like projections, epidermis unilayered of thick walled cells and mesophyll of isodiametric cells.

Stalk 2·5 mm. long and 1·0 mm. broad.

Syntypes — Moh 1-5/P-8 Chitaley and Patil, at the Dept. of Botany, Institute of Science, Nagpur.

Locality — Mohgaonkalan.

Horizon — Deccan Intertrappean Series of India.

Age — ? Upper most Cretaceous.

ACKNOWLEDGEMENT

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EXPLANATION OF PLATES I & II

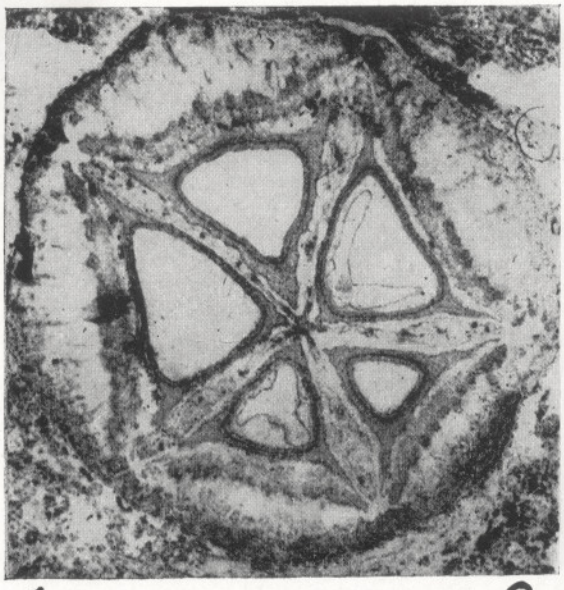
Sahniocarpon harrisii gen. et sp. nov.

PLATE I

1. Fruit No. 1 in T.S. × 10.
2. Specimen No. 3 in L.S. × 10.
3. Epidermal cells of cotyleden in surface view. × 650.
4. Middle layer of seed coat in surface view. × 180.
5. Part of L.S. of fruit showing raphe (r). × 25.
6. Part of fruit in L.S. showing fruit base and part of stalk. × 6.
7. Part of seed in T.S.— seed coat (s), hilum (h), vascular supply (v), and cotyledon (c). × 100.

PLATE II

8. L.S. fruit wall showing anastomosing fibrovascular bundles. × 25.
9. Part of fruit enlarged showing fruit wall and line of dehiscence (d), vascular bundle (v), seed (s), and septum (P). × 30.
10. T.S. fibrovascular bundle from fruit wall. × 180.
11. T.S. seed coat — Outer (o), middle (m), and inner (i). × 220.
12. L.S. fruit wall showing vessels. × 300.
13. Part of seed in T.S. showing micropyle (m), and hilum (h).
14. L.S. seed coat; outer (o), middle (m), and inner (i). × 220.



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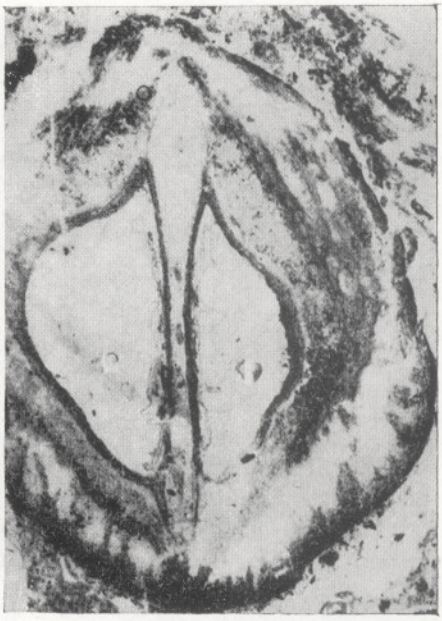

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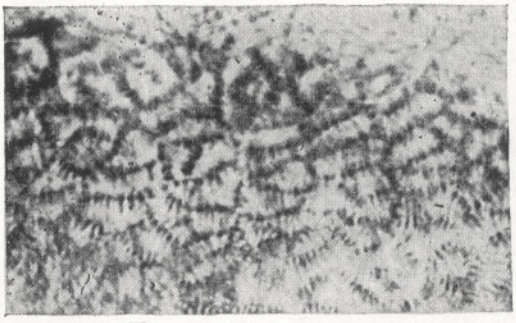

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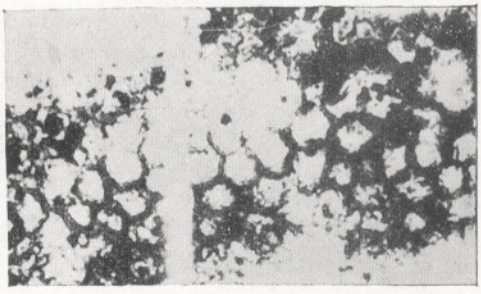

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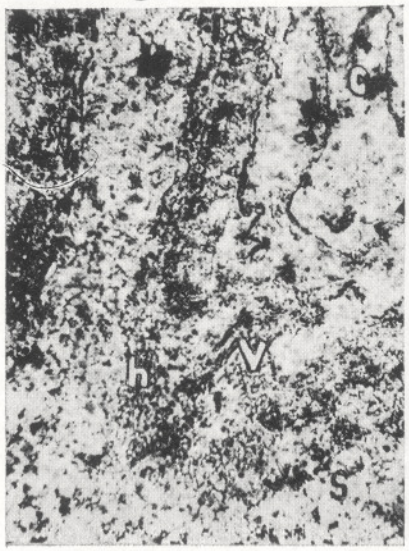

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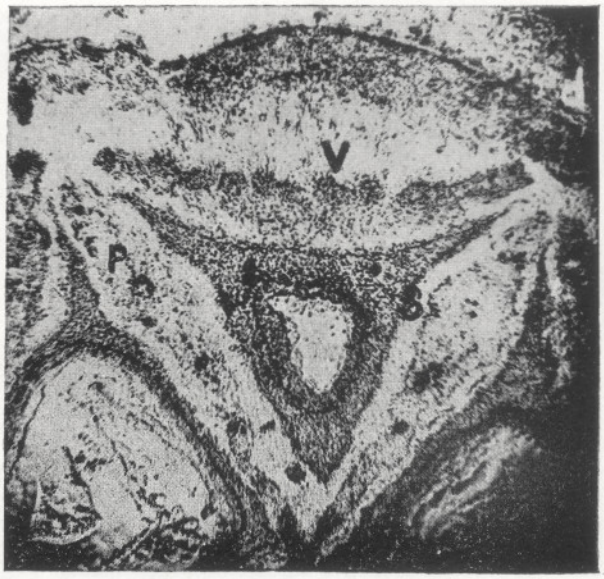

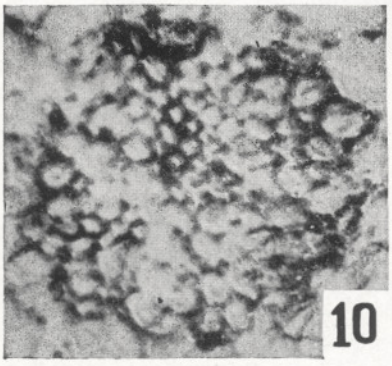
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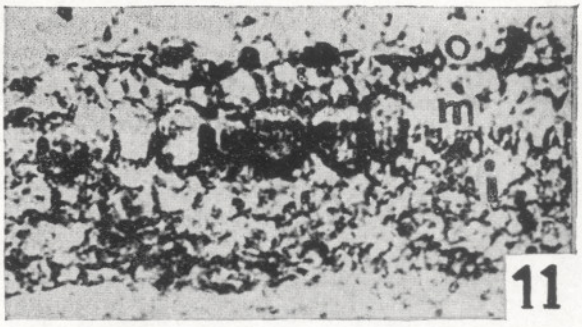

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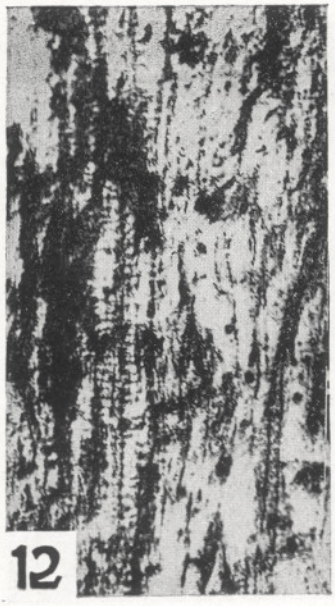
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