

# STUDIES IN THE GLOSSOPTERIS FLORA OF INDIA:

## 14. TWO NEW FOSSIL WOODS FROM THE LOWER GONDWANAS OF INDIA

K. R. SURANGE & P. K. MAITHY

Birbal Sahni Institute of Palaeobotany, Lucknow

### ABSTRACT

Two new fossil woods, viz. *Indoxylon canalosum* gen. et sp. nov. and *Dadoxylon parenchymosum* have been described from the Lower Gondwanas of India. The former wood is characterized by the presence of secretory canals in the pith, one in centre and rest on the margin and connected by horizontal running canals. The latter wood *Dadoxylon parenchymosum* is characterized by the presence of solid parenchymatous pith, araucaroid pitting on the radial and tangential walls of the tracheids.

### INTRODUCTION

RECENTLY a good number of petrified woods were collected by one of us (Maithy) from the 18th Coal seam of Kharkhari Colliery, Barakar stage, Lat. 23°46'24", Long. 86°14'36", Jharia coalfield. Out of this collection two specimens showed very distinct characters, which were hitherto unknown in any of the fossil woods from the Lower Gondwanas. They are, therefore, described here.

### DESCRIPTION

*Indoxylon* gen. nov.

#### 1. *Indoxylon canalosum* sp. nov.

Only one wood of this type has been collected so far.

*Pith* — The wood has a solid circular pith in the centre, fairly large, 2.2-5 cm. in diameter. In transverse section the pith is composed of circular, thick-walled parenchymatous cells, loosely packed with intercellular spaces and with bigger cells towards the centre. In longitudinal section the pith cells are square or rectangular and are arranged in tiers. Some of the pith cells are little longer and dark; these cells are pitted (PL. 1, FIG. 4). The pitting is simple, one or two seriate, sometimes more; alternate or subopposite and contiguous or separate.

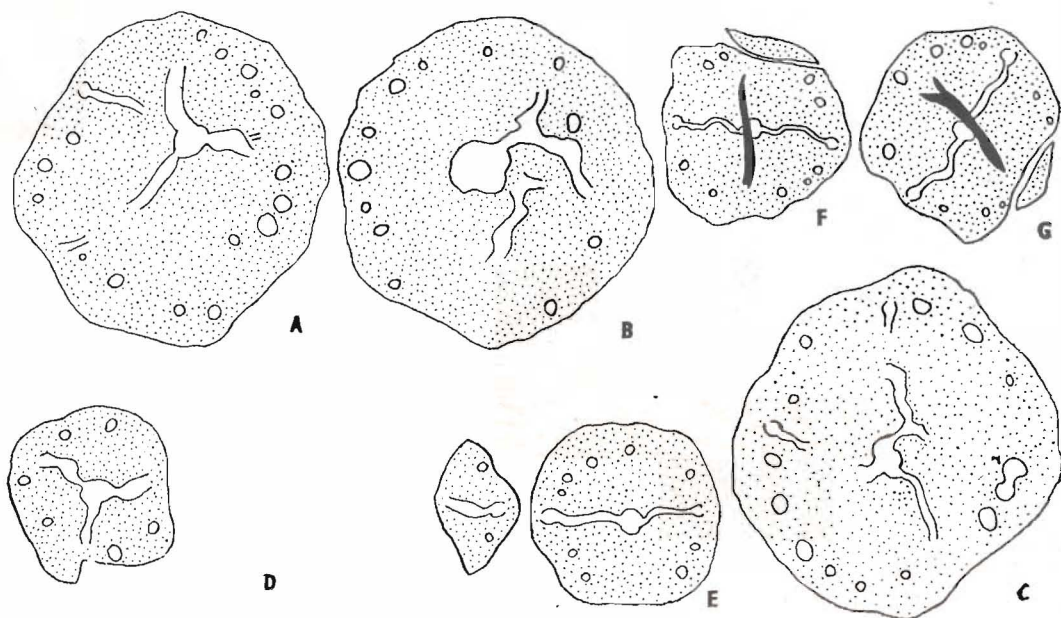
Secretory canals and secretory cells are present in the pith. The secretory cells are scattered all over the pith, isolated or in groups, and slightly thick-walled than the ordinary pith cells. These cells are elongated and filled with dark black substance. Usually they are septate (PL. 1, FIG. 2).

In the pith there are two types of secretory canals: (i) longitudinally running and (ii) transversely connecting canals. There is one longitudinally running canal placed in the centre of the pith and the rest are confined to the peripheral region. The peripheral canals are connected to the central canal by transverse canals (PL. 1, FIG. 1) and consequently the number and the arrangement of the transverse canals varies in different transverse sections (TEXT-FIG. 1). The longitudinally running canals are circular, or oval in transverse section (PL. 1, FIG. 1) lined by small rectangular cells, filled with silica. The transversely connecting canals are just like longitudinally running canals but their course is not straight and hence in longitudinal section they are cut oval, square, or rectangular (PL. 1, FIG. 3). The transverse canals also do not possess encircling cells; they are only encircled by parenchymatous cells of the pith.

In one section two piths are seen, one bigger and circular and the other smaller and triangular in shape. The smaller one probably belongs to a branch (TEXT-FIG. 1D).

*Primary Xylem* — There is no trace of centripetal xylem and the primary xylem encircles the pith, projecting deep at some places. The primary xylem is 5-12 cells deep, rectangular, polygonal and hexagonal in shape. Protoxylem is endarch, and has spiral thickenings. Metaxylem consists of scalariform and reticulate tracheids (PL. 1, FIG. 5). Reticulate elements are not much common.

*Secondary Xylem* — The secondary xylem abuts just over the primary xylem. Early wood 40-60 cells deep, thick-walled, square to



*Indoxylon canalosum.*

TEXT-FIG. 1 A-G. — Transverse section of the pith from different regions of the stem showing the arrangement of secretory canals.  $\times 2$ .

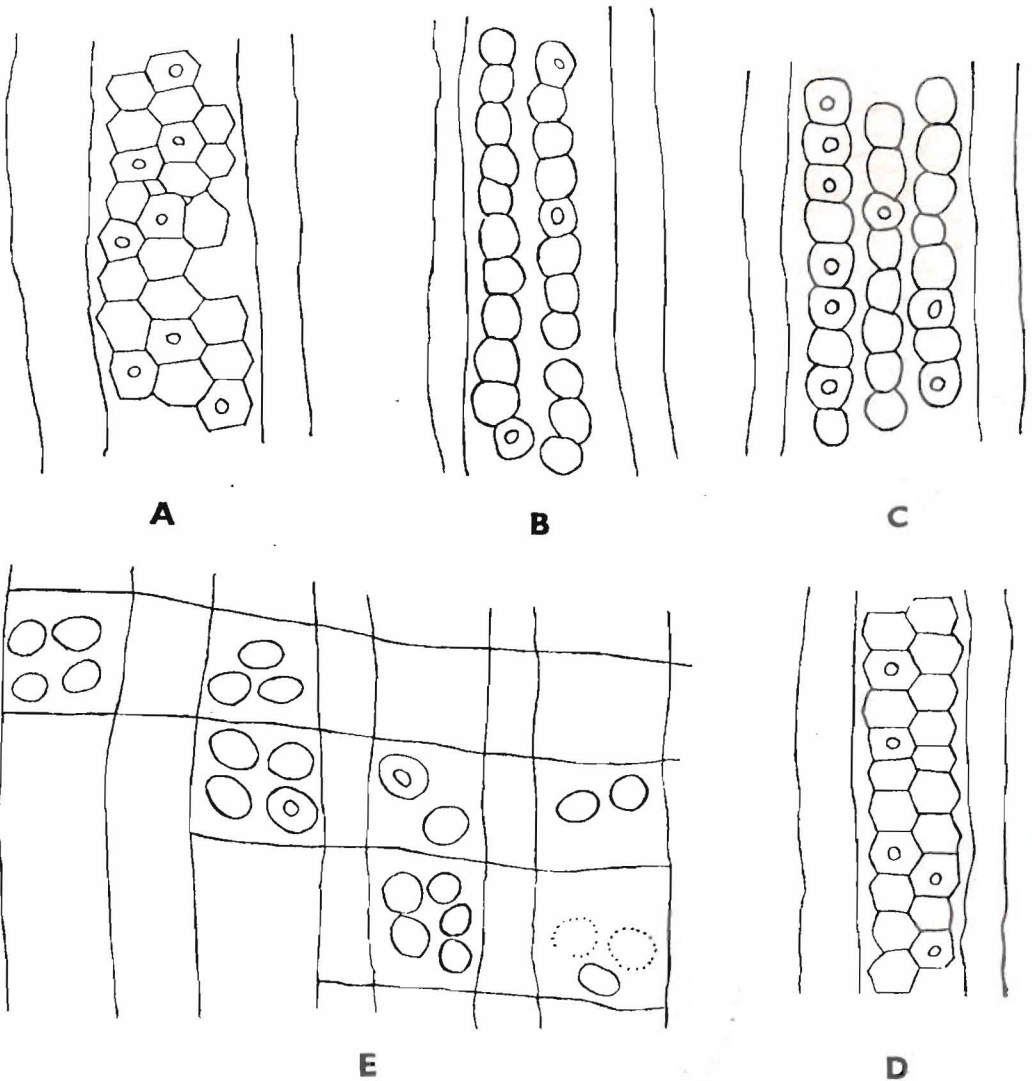
rectangular. The size of the early wood tracheids varies from  $21$  to  $42\mu$ , and in exceptional cases up to  $53\mu$ . Late wood 2-4 cells only, tracheids transversely elongated, and thick-walled. The size of the late wood elements varies from  $10$  to  $21\mu$ , the intervening wall between the two tracheids being quite thick, about  $10-21\mu$ .

Tracheids radially pitted, 1-4 seriate, but commonly biseriate and triseriate. When uniseriate the pits are placed in a row, contiguous or separate. Biseriate pits are alternate, subopposite or opposite, mostly contiguous, but sometimes the two rows of pits are placed apart (PL. 1, FIG. 7; TEXT-FIGS. 2B, D). In triseriate tracheids pits are alternate and contiguous and are rarely placed apart (PL. 1, FIG. 6; TEXT-FIGS. 2A, C). In Tetraseriate condition pits are always contiguous and alternate. The pits are bordered, circular-oval or flattened. In biseriate pitting the pits measure  $12.5 \times 12.5\mu$  to  $9 \times 9\mu$ . The coefficient ( $e = d/D$ ) varies from  $1.0$  to  $0.85$ . In uniseriate the pits measure  $10.5 \times 14\mu$  to  $14 \times 14\mu$ . The coefficient varies from  $1.04$  to  $0.75$ .

The number of cross-field pits is 1-7 (commonly 4-5). They are bordered and circular or oval (PL. 1, FIG. 8; TEXT-FIG. 2E). Pore probably circular to oval but not very distinct. The size of the field pits varies from  $10.5 \times 10.5\mu$  to  $9 \times 7\mu$ .

Tangential walls of the tracheids are unpitted. Medullary rays are commonly uniseriate and biseriate, sometimes partially triseriate. Medullary rays varies in height from 1 to 18 cells. The ray cells are oval in shape and they vary from  $21-42\mu \times 17.5-24.5\mu$ . The average frequency of biseriate to uniseriate rays are 11 and 89 per cent respectively and the density of rays is 11 rays per square millimetre. The density of ray cells per  $\text{mm.}^2$  is  $369/12 = 30$ -ray cells/ $\text{mm.}^2$  and neglecting the biseriate ray cells  $343/12 = 28$ -ray cells/ $\text{mm.}^2$ . The maximum frequency is of 3 ray cells (TEXT-FIG. 3). There is no xylem parenchyma or resin canals.

*Comparisons and Remarks* — Secretory canals in the pith are also present in the following genera: *Solenopitys* Kräusel & Dolinaiti, *Solenoxylon* Kräusel, *Polysolenoxylon*



*Indoxylon canalosum*.

TEXT-FIG. 2 A-D. — Part of the early wood tracheids in radial section showing the arrangements of pits.  $\times 500$ . E, pits in the cross-field.  $\times 500$ .

Kräusel & Dolianiti and *Barakaroxylon* Surange & Maithy. But *Indoxylon* differs from all the above woods in possessing transversely connecting canals. Also in *Indoxylon* the pith is solid as against discoid pith in *Solenopitys* and *Solenoxyton* and air gaps in *Polysolenoxylon*. Secretory cells which are present in *Indoxylon* are absent in the above three genera. It differs from *Barakaroxylon* in possessing transverse canals. Thus the present wood is different

from all the known genera from southern hemisphere and hence a new generic name is proposed.

#### DIAGNOSIS

*Indoxylon* gen. nov.

Pith solid with secretory canals and secretory cells. The secretory canals are arranged one in the centre and rest in the peripheral





and the uniseriate pits from  $10.5 \times 14 \mu \times 13.5-14 \mu$ . The number of cross-field pits is 1-7 (commonly 4-5), circular to oval; bordered, and the dimension varies from  $9-10.5 \mu \times 7-10.5 \mu$ .

Medullary rays uniseriate, biseriate and sometimes partially triseriate. The height of the medullary rays varies from 1 to 18 cells; maximum frequency is attained by 3-ray cells. The ray cells are oval in tangential section and  $21.42 \mu \times 17-24 \mu$  in size. The density of rays is 11 ray per square millimetre. The density of ray cells 30 cells/mm.<sup>2</sup>. The average frequency of biseriate to uniseriate ray is 11 per cent.

*Holotype* — 31722/430 preserved at the museum of the Birbal Sahni Institute of Palaeobotany, Lucknow.

*Locality* — Kharkhari Colliery, Jharia Coalfield, Bihar.

*Horizon* — Barakar.

### *Dadoxylon* Endlicher

#### 2. *Dadoxylon parenchymosum* sp. nov.

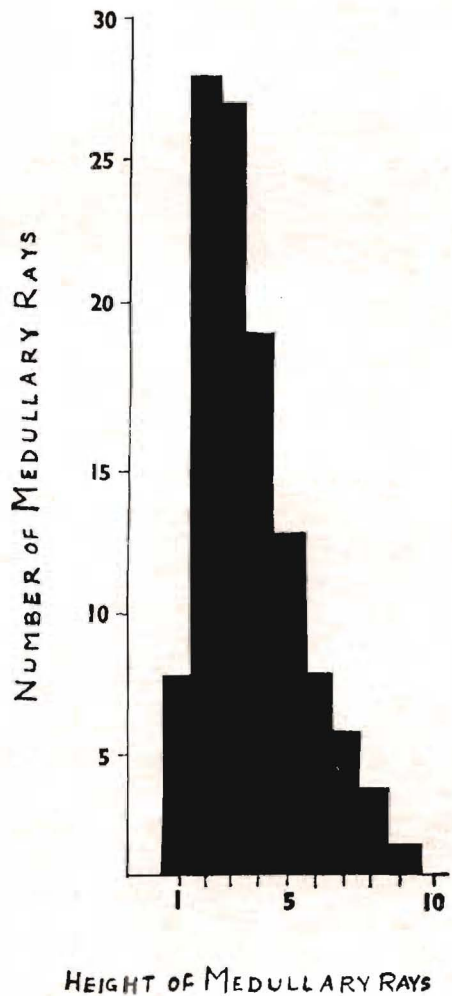
Only one specimen of wood has been collected so far.

*Pith* — The pith is solid  $\pm$  oval, 1 cm. in diameter (PL. 2, FIG. 9). It is composed of circular thick-walled parenchymatous cells with intercellular spaces (PL. 2, FIG. 10) and the cells become bigger towards the centre and smaller towards the periphery. In longitudinal section the pith cells are square or rectangular and are arranged in tiers. Secretory or sclerotic elements are absent.

*Primary Xylem* — Pith is encircled by the primary xylem and no transfusion tissue is present between the pith cells and the primary xylem. The primary xylem is endarch, squarish or pentagonal in transverse section and 5-8 cells deep. The protoxylem consists of anular elements and the metaxylem consists of scalariform and reticulate tracheids (PL. 2, FIG. 11).

*Secondary Xylem* — The secondary xylem abuts over the primary xylem. Early wood is 30-40 cells deep, rectangular or square in outline,  $35-67.5 \mu$ . Late wood 2-3 cells deep, transversely elongated, smaller in size,  $10.5 \times 17.5 \mu$ . The intervening wall is  $7-10 \mu$  thick. The medullary rays are placed at intervals of 3-10 tracheids (PL. 2, FIG. 12). There is no xylem parenchyma or resin canals.

Both the radial and the tangential wall of the tracheids are pitted. Radial wall pitting is 1-4 seriate, commonly biseriate and triseriate. Uniseriate pits are in one row and contiguous. Pits in biseriate and triseriate conditions are arranged alternately, contiguous, sometimes subopposite to opposite (PL. 2, FIGS. 13, 14; TEXT-FIG. 4A, B). They are hexagonal or flattened by mutual contact with small circular pore,  $3-4 \mu$ . In biseriate tracheids the pits measure  $10.5 \times 14 \mu$ ,  $10.5 \times 12 \mu$ ,  $7.5 \times 10.5 \mu$ ; and  $10.5 \times 10.5 \mu$ . The coefficient ( $e = d/D$ ) varies from 1.0 to 0.75. In uniseriate tracheids the pits



TEXT-FIG. 5—*Dadoxylon parenchymosum*. Graph showing the frequency of medullary ray cells (surface examined 12 mm.<sup>2</sup>).

measure  $10.5 \times 10.5 \mu$  and  $10.5 \times 14 \mu$ . The coefficient varies from 1.00 to 0.75.

The number of cross-field pits is 2-8 (commonly 4-5), bordered, circular to oval with transversely oval pore (PL. 2, FIG. 15; TEXT-FIG. 4C). The size of the field pits varies from  $10.5-12 \mu \times 10.5 \times 13 \mu$ .

Tangential wall of the tracheids pitted, 1-2 seriate, alternate and contiguous.

Medullary rays vary from 1 to 18 cells. The height varies from  $17.5$  to  $28 \mu$ , and tangential width from  $14.0$  to  $28 \mu$ . Medullary rays are commonly uniseriate and very rarely biseriate. The average frequency of biseriate to uniseriate rays are 2 and 98 per cent respectively. The density of ray per  $\text{mm}^2$  is 12-ray, and the density of ray cells is  $34/\text{mm}^2$ . The maximum frequency is of 3-ray cells (TEXT-FIG. 5).

*Comparisons and Remarks* — So far only three woods with parenchymatous piths are known from the Lower Gondwanas of southern hemisphere, i.e. *Dadoxylon rangei* Kräusel, *Dadoxylon porosum* Kräusel and *Dadoxylon kraeuseli* (Sahni & Singh) Sahni. *Dadoxylon rangei* and *Dadoxylon porosum* are distinguished from the present wood by the presence of pitting on the radial walls only, uniseriate medullary rays, and several pits in the field. *Dadoxylon kraeuseli* Sahni & Singh is comparable to the present wood in the possession of parenchymatous pith, but *D. kraeuseli* differs from the present wood by the presence of simple pits in the field, and air gaps in the pith, and pits on the radial wall of the tracheids only. Thus the present wood does not resemble with any of the

known species of *Dadoxylon*, and hence a new specific name is proposed here.

#### DIAGNOSIS

*Dadoxylon parenchymosum* sp. nov.

Solid pith of parenchymatous cells, primary xylem endarch, consisting of annular, scalariform and reticulate elements. Secondary xylem with distinct growth zones. Early wood 30-40 cells deep, rectangular or square in outline,  $35-67.5 \mu$ . Late wood 2-3 cells,  $10.5 \times 11.5 \mu$ . Radial and tangential wall of tracheids pitted, 1-4 seriate, commonly 2-3 seriate. Pits arranged alternately, rarely subopposite or opposite, contiguous. The size of biseriate pits varies from  $7.5-10.5 \mu \times 10.5-14 \mu$  and the uniseriate pits from  $10.5 \times 10.5-14 \mu$ . Pits bordered, hexagonal or flattened, with a circular pore. The number of cross-field pits 2-8, circular-oval; bordered, and their dimension varies from  $10.5 \times 10.5 \mu$  to  $10.5 \times 14 \mu$ .

Medullary rays uniseriate, rarely biseriate. The height of medullary rays varies from 1 to 18 cells; maximum frequency is attained by 3-ray cells. The ray cells are oval in tangential section;  $17.5-28 \mu \times 14.0-28 \mu$ . The density of ray cells  $12/\text{mm}^2$ . The average frequency of biseriate to uniseriate rays is 2 per cent.

*Holotype* — 31724/483 preserved at the museum of the Birbal Sahni Institute of Palaeobotany.

*Locality* — Kharkhari Colliery, Jharia Coal-field, Bihar.

*Horizon* — Barakar.

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## EXPLANATION OF PLATES

## PLATE 1

*Indoxylon canalosum* gen. et. sp. nov.

1. A transverse section of the pith to show the arrangements of the longitudinal and transversely running secretory canals.  $\times 5$ .
2. A part of the pith in longitudinal section to show the secretory cells and the parenchymatous cells of the pith.  $\times 80$ .
3. A part of the pith in longitudinal section to show the transverse secretory canals.  $\times 10$ .
4. A part of the pith in longitudinal section to show the pitted cells of the pith.  $\times 200$ .
5. Longitudinal radial section of the primary xylem.  $\times 100$ .
6. A radial longitudinal section of the tracheid to show the triseriate, alternate and contiguous pitting.  $\times 175$ .
7. Another tracheid in radial section showing biseriate, separate circular pits.  $\times 250$ .
8. Radial longitudinal section showing the field pits.  $\times 175$ .

## PLATE 2

*Dadoxylon parenchymosum* sp. nov.

9. A transverse section of the stem showing the pith in the centre surrounded by the primary and the secondary xylem.  $\times 7$ .
10. A part of the pith in transverse section enlarged to show the parenchymatous cells of the pith. The dark black areas show the portion filled with iron pyrites.  $\times 40$ .
11. Longitudinal radial section through the primary xylem.  $\times 100$ .
12. A part of the stem showing a well-marked growth ring with early wood comparatively much more developed than the late wood.  $\times 40$ .
13. Part of radial section enlarged, showing uniseriate and biseriate, contiguous, hexagonal pits in early wood tracheids.  $\times 400$ .
14. Other tracheids in radial section to show triseriate and tetraseriate, alternate and contiguous pitting.  $\times 400$ .
15. Radial longitudinal section showing the pits in the cross field.  $\times 400$ .

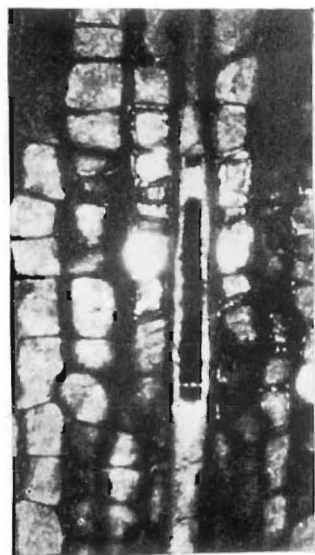




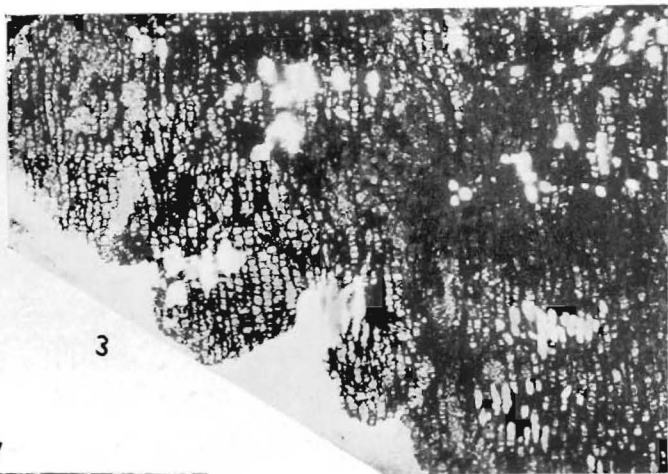
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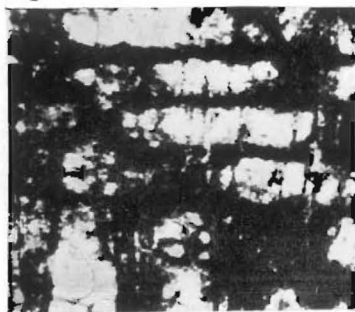
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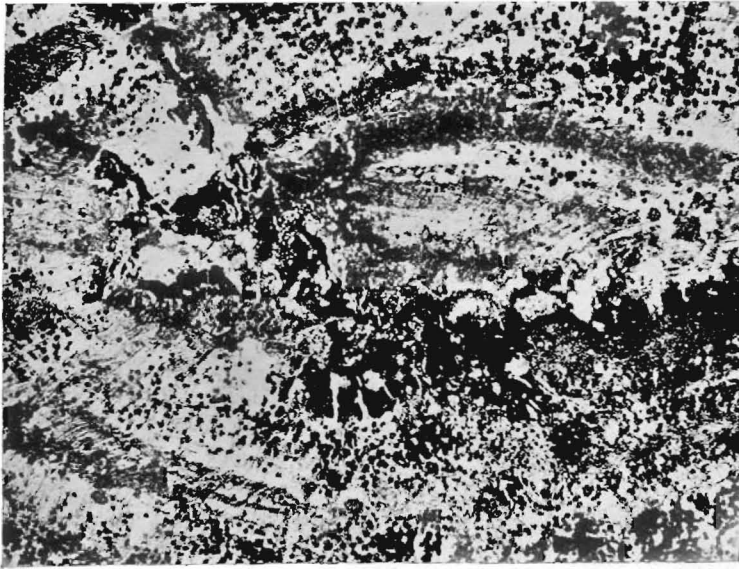


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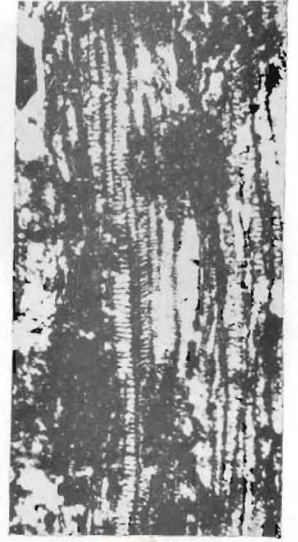


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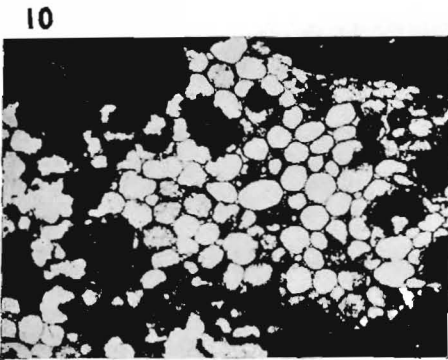




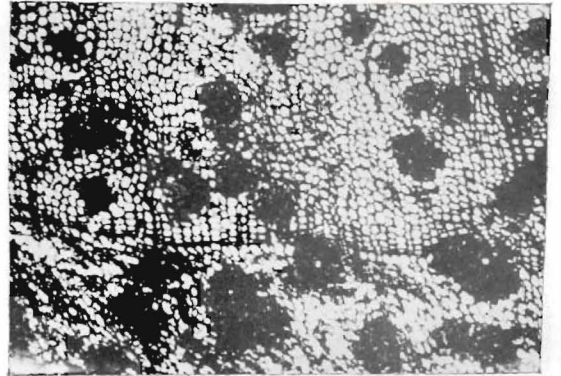
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