

V. DISCRIPTIVEPART I - IMPRESSIONS(1) Glossopteris verticellata Thomas

(Text Fig. 1 Pl. Fig. 1)

The specimen is a leaf measuring 12 cms in length and 2.8 cm in breadth. The leaf is lanceolate in shape and gradually contracts towards the base. The complete basal portion is not preserved. The midrib is distinct about 3 mm broad near the base and 2 mm near the upper part. It is distinct and showing longitudinal striations. Near the apical region midrib gives out final veins. The secondary veins arise from the midrib at an angle of  $49^\circ$  and follow a sinuous course. The veins are parallel to each other and show a distance of 1 mm between them. They divide dictomously but rarely anastomose very few meshes are formed.

Identification and comparison : The morphological characters of the present specimen resembles with Glossopteris verticellata in having whorled nature of leaves showing lanceolate shape and somewhat bluntly pointed apex. It also agrees with gradual contraction towards the base. Thomas (1952) described certain whorled leaves from South Africa. He named the leaves as G. verticellata earlier, it was named as G. longicaulis but this name was already used by Feistmantel (1876) for certain long petiolated leaves from the Karharbari beds of India. Hence he suggested the name as G. verticellata from Raniganj stage of Raniganj coal field in Bengal. Therefore,

the leaf is described as G.verticellata Thomas. Present specimen come from Satnori in Nagpur district of Maharashtra. The locality belongs to Kamthi Stage. This suggest a wider distribution of G.verticellata in India. It is first time reported from this place.

Type No. : Satn. 32/91  
 Locality : Satnori, Dist : Nagpur,  
 Maharashtra.  
 Horizon : Kamthi Stage (Upper Permian).

Glossopteris damudica Feistmantel

(Text Fig. 2 Plate Fig. 2)

The specimen is an impression of a large leaf showing pink and white surface with poorly carbonised crust at some places. Here the basal and apical parts are missing. The leaf measures 9.9 cm long and 5.2 cm broad in the widest part. The midrib is strong and distinct. It is 4 mm thick and striated longitudinally. The secondary veins arise at an angle of 79° but later on follow a course almost at right angles to midrib. The veins divide dicotomously and form broad and short meshes near the midrib and elongated narrow meshes near the margins.

The morphological characters of the present specimen resemble with Glossopteris damudica described by Feistmantel in (1881). It was described from Iron stone shale of Damuda Series. Arber (1905) suggested that venation of G.ampla is more

oblique than the G.damudica. He included G.damudica and G.musaefolia under G.ampla but Halle (1911) suggested that G.ampla is quite distinct from Indian leaves. Archangelsky (1958), recently again separated G.damudica from G.ampla and showed that G.ampla is orbicular in shape while G.damudica is taeniopteroide in shape. Recently Maheshwari and Prakash described G.damudica from Lower Gondwana exposures along Bansloi river in Rajmahal hills of Bihar. The characters given by Maheshwari also agree with present specimen. Hence it is described as such. Our specimen is collected from Satnori in Nagpur district of Maharashtra. This suggests that G.damudica is widely distributed in Lower Gondwana of India. Further it is reported from this place for the first time.

Type No. : Satn. 20/91  
 Locality : Satnori, District : Nagpur,  
 Maharashtra.  
 Horizon : Kamthi Stage (Upper Permian).

Glossopteris brownii Brongniart

(Text Fig.14 Plate Fig. 3)

The specimen is a leaf impression measuring 5.8 cm. in length and 2.8 cm. in breadth. It is broken in the lower and upper part. The overall shape of the leaf is oval-spathulate. It gradually becomes narrow towards the basal part. Midrib is prominent and broad about 2 mm. wide and present throughout the lamina of the leaf. It is longitudinally

striated showing several depressions on it. Lateral veins arise from the midrib at an angle of  $60^{\circ}$ . The veins curved near the midrib and later on they are more or less straight. They divide dicotomously and anastomose to form polygonal, open, elongated meshes. The meshes are broad and short near the midrib and narrow and elongated near the margin. The leaf shows poorly preserved carbonised crust at some places.

Identification and Comparison : The morphological characters of the present leaf closely resemble with the character of Glossopteris brownii described by Maheshwari and Prakash. Hence it is identified as such. Feistmantel (1880) proposed the name Glossopteris inntermedia for leaves collected from Raniganj. In (1881) he thought the name G.intermedia may produce some problems and hence merged these leaves in G.brownii. Recently Maheshwari (1965) described the leaf from Raniganj coal field as G.intermedia. He suggested that the leaves described by Feistmantel (1880) are definitely distinct from G.brownii. Therefore, placing them under G.brownii by Feistmantel in (1881) is not justified. Further, it is suggested that leaves of G.intermedia are linear, lanceolate in shape, while leaves of G.brownii are spatulate in shape. Therefore, the present leaf is identified as G.brownii on the basis of its shape and venation pattern. Earlier G.brownii is reported from Raniganj stage while the present leaf comes from Kamthi stage. It indicates a wider distribution of G.brownii in Lower Indian Gondwana. It is first time described from Bazargaon which is a new locality for this plant.

Type : BAZG-9/91  
 Locality : Bazargaon, Dist : Nagpur,  
 Maharashtra.  
 Horizon : Kamthi Stage (Upper Permian).

Glossopteris musaefolia Bunbury

(Text Fig.7 Plate Fig. 4)

The specimen is a big leaf measuring 11.5 cm in length and 6.2 cm in width. The basal portion is not preserved. The apical portion is nearly complete but at some places the preservation is not clear. The shape of leaf is oblong it gradually becomes narrow towards the basal portion. The midrib is stout, distinct and 3 mm thick reaching the apex. The lateral veins are given out from the midrib at an angle of 55°. After a gentle curve near the midrib they run perpendicular to the midrib and margin. The secondary veins dicotomise and form narrow linear meshes. The apex appears to be obtuse. The morphological characters of the specimen closely agree with those of Glossopteris musaefolia described by Chandra and Prasad (1981) from Bazargaon in Maharashtra. The authors have discussed the overall morphology and venation pattern of G.musaefolia and compared with G.mahudensis, Chandra and Surange (1979) and G.raniganjensis Chandra and Surange (1979). The basis for comparison is all these three leaves are big leaves. Further G.mahudensis was distinguished from G.musaefolia in having taeniopteroid venation while G.raniganjensis was distinguished from G.musaefolia in having

dense Communis type venation. G.musaefolia resembles with G.ampla but G.ampla is reported from Australia, while G.musaefolia is from India. Therefore, considering all these facts the present leaf is described as G.musaefolia. G.musaefolia is earlier reported by Bunbury from Kamthi stage of Maharashtra. Recently Chandra and Prasad described it from Bazargaon belonging to Kamthi Stage in Maharashtra. Present specimen is collected from Satnori in Nagpur district of Maharashtra. The locality is in the close vicinity of Bazargaon area. Hence its occurrence here supports the earlier findings of G.musaefolia. It is first time reported from Satnori.

Type : Satn. 34/90  
 Locality : Satnori, Dist : Nagpur,  
 Maharashtra  
 Horizon : Kamthi Stage (Upper Permian).

Glossopteris Cf. G.fibrosa Pant .

(Text Fig. 6 Plate Fig. 5)

The specimen is a simple, linear and lanceolate leaf measuring 7.2 cm in length and 2.7 cm in the width. The apex is obtuse. The leaf gradually tapers towards the basal part, Petiole is absent. The midrib is 2 mm thick, near the base and runs upto the apex, near the apex it resolves into finer veins. The midrib shows longitudinal striations. The lateral veins arise from the midrib at an angle of  $47^\circ$  and after a curve pass obliquely towards the margins. The veins branched

dicotomously and show anastomoses. They form narrow elongated meshes near the margins and broad meshes near the midrib. Inside the meshes slender fibres are present which are parallel to the main secondary veins.

Identification and comparison : The morphological characters of the present specimen closely agree with Glossopteris fibrosa described by Pant (1958) from Tanganyika. The important features of this species is the presence of interstitial fibres showing parallel course with main secondary veins. He also described cuticular features of G.formosa. However, in the present specimen the cuticle is absent hence it is described as Glossopteris Cf. G.fibrosa Pant.

Maheshwari (1965) described Glossopteris fibrosa from Raniganj stage of Bengal. In his specimen also cuticle is absent. Therefore, it is also described as Glossopteris Cf. G.fibrosa Pant. Present specimen comes from Bazargaon in Maharashtra belonging to Kamthi Stage. This indicates wider distribution of G.fibrosa ranging from Africa to India. In India it is distributed in Raniganj and Kamthi Stage. It is first time described from Bazargaon which is a new locality for this plant.

Type	:	BAZG-14/92
Locality	:	Bazargaon, Dist : Nagpur, Maharashtra.
Horizon	:	Kamthi Stage (Upper Permian).

Glossopteris intermedia Feistmantel

(Text Fig. 9 Plate Fig. 6)

The specimen is a broken leaf measuring 9.5 cm. in length and 3.6 cm. in width. It is lanceolate to spatulate in shape and slowly contracts towards the basal part. The midrib is distinct, longitudinally striated and 3 mm thick. The midrib is resolved into fine veins. The secondary veins emerge from the midrib at an angle of 50°. They curve near the midrib and then reach the margins. The veins divide dichotomously and form polygonal to oblong meshes.

Identification and comparison : The morphological characters of the present specimen closely resemble with the characters of Glossopteris intermedia described by Feistmantel (1980) and Maheshwari in (1965). The important characters are (1) Lanceolate, spatulate shape, (2) Midrib is resolved into fine veins in the apical part. (3) Gradual contraction towards the basal part (4) Secondary veins form oblong polygonal meshes. Hence it is described as such. It is compared with G.brownii in having lanceolate to spatulate shape. But in G.brownii the meshes are of intermediate in size and in G.intermedia more broader and more or less of equal size. Feistmantel (1880) and Maheshwari (1965) have described G.intermedia from Raniganj stage of Bengal while present specimen comes from Bazargaon in Nagpur district of Maharashtra. The locality belongs to Kamthi stage. This suggests wider distribution of G.intermedia in India.



Type : BAZG-12/91  
 Locality : Bazargaon, Dist : Nagpur,  
 Maharashtra.  
 Horizon : Kamthi Stage (Upper Permian).

Glossopteris communis Feistmantel (1881)

(Text Fig. 5 Plate Fig. 7)

The specimen is an impression of the leaf measuring 7 cm in length and 2.7 cm in breadth. The apex is broken. It becomes narrower towards the base. The midrib is distinct and stout. It is 3 mm. thick and persist throughout the preserved part of the lamina. Secondary veins are numerous and arise from the midrib at an angle of 45°. They take a broad curve and reach the margins. The veins branch dichotomously and form narrow elongate meshes of equal size all over the lamina.

Identification and comparison : The present specimen resembles with the morphological characters of Glossopteris communis described by Feismantel in (1881). It also agrees with the descriptions of G.communis described by Maheshwari the name G.communis for broad and long leaves, having narrower meshes. But Arbor (1905) and Zeiller (1896) did not agree with the description made by Feistmantel and merged these leaves with Glossopteris indica. Srivastava (1957) studied the cuticular characters of G. indica and G.communis and showed that they are distinct from each other. Maheshwari and Prakash (1965) noted that G.communis is found in Talchir, Barakar,

Raniganj in Maharashtra belonging to Kamthi Stage. Hence present report supports wider distribution of G.communis in India. It is first time reported from this place.

Type : BAZG-7/92  
 Locality : Bazargaon, Dist : Nagpur,  
 Maharashtra.  
 Horizon : Kamthi Stage (Upper Permian).

Glossopteris indica Schimper

(Text Fig. 3 Plate Fig. 8)

The specimen is an incomplete leaf measuring 11.5 cm in length and 3 cm in breadth. The basal portion of the leaf is broken and the apex is partly preserved. The leaf shows lanceolate shape and probably acute apex. The midrib is distinct and stout and present throughout the entire lamina. It is 3 mm thick, and longitudinally striated. The secondary veins arise from the midrib at an angle of 40°. They show arching near the midrib, divide dichotomously and form broad and short meshes near the midrib and elongated narrow meshes near the margin.

Identification comparison : The morphological characters of the present specimen closely agree to that of Glossopteris indica described by Feistmantel in (1881). It also resembles with the characters of G.indica described by Maheshwari and Prakash (1965). Zeiller (1896) merged G.indica in G.communis

due to similarity in the venation pattern. Recently Srivastava (1957) showed that the epidermal characters of G.communis and G.indica are distinct. Maheshwari and Prakash suggested that G.indica represents a complex species. Since the venation pattern found in G.arberi (Srivastava, 1957) and G.jamottei (Hoeg & Bose, 1960) is some what similar to G.indica. Further, they suggested that specimens described under G.indica without showing epidermal characters and preserved as impressions only. Hence, the present specimen is described as such. It comes for Bazargaon in Maharashtra belonging to Kamthi Stage, while Feistmantel (1881) and Maheshwari and Prakash (1965) described it from Raniganj Stage. This suggests wider distribution of G.indica in India.

Type : BAZG-6/91  
 Locality : Bazargaon, Dist : Nagpur,  
 Maharashtra.  
 Horizon : Kamthi Stage (Upper Permian).

Glossopteris euryneura Maheshwari

(Text Fig.4 Plate Fig. 9)

The specimen is an incomplete leaf measuring 4 cm. in length and 2.5 cm in width. The midrib is 2 mm. broad near the base and slowly becomes narrow in the upper part. The secondary veins arise from the midrib at broad angles and proceed straight to the margins, nearly at right angles to the midrib. This gives an impression of Taeniopteris leaf. The

veins are sinus and dichotomise only once or twice. They form only few elongate and wide meshes showing little anastomosing of the veins.

Identification comparison : Maheshwari (1965) created this new species for leaves found in the Raniganj coal field in Bengal. According to author the diagnostic characters of the species are as follows :

"Leaf simple shape and apex not known, Leaf gradually contracts towards the base; midrib broad and distinct; secondary veins arise at broad angles, run straight to the margins, fork once or twice; anastomoses rare near the midrib, more frequent at the margins, meshes broad and elongate". The present specimen closely agree with the above characters and therefore, described as Glossopteris euryneura Maheshwari. It is collected from Bazargaon in Nagpur district of Maharashtra belonging to Kamthi Stage. This indicates wider distribution of the plant in India. It is first time reported from this locality.

Type	:	BAZG-21/92.
Locality	:	Bazargaon, Dist : Nagpur, Maharashtra.
Horizon	:	Kamthi Stage (Upper Permian).

Neocalamites foxii Lele

(Text Fig.12 Plate Fig. 10)

The specimen is an Equisetaceous stem measuring 9.5cm

in length and 2 cm in width. The stem shows presence of one node. Probably internodes must have been quite long. They are show distinct ridges and ferrows. Which are not much crowded, and show a distance of 1 mm between them. The number of ridges and ferrows per cm is 11. The ridges and ferrows are contineous from one internode into other. The characters of the present specimen closely agrees with Neocalamites foxii described by Lele (1956) from South Rewa Gondwana basin. Hence it is identified and described as such. Lele (1956) described it from Triassic beds of Parsora while present specimen comes from Kamthi Stage of Maharashtra. Hence there are two probabilities (1) Neocalamites was widely distributed in Lower Gondwana ranging from Upper Permian to Lower Triassic or the element rather suggest that Kamthis are younger than Upper Permian and can be considered as Lower Triassic in age.

Type : ADR-51/68  
 Locality : Adhari, Dist : Chandrapur,  
 Maharashtra.  
 Horizon : Kamthi Stage (Upper Permian).

Dictyopteridium sporiferum Feismantel 1881.

(Text Fig. 13 Plate Fig. 11)

The specimen is a fragmentary leaf measuring 3.5 cm in length and 1.2 cm in width. The basal and upper part of the leaf is not preserved. Near the basal part a lanceolate

fertile structure is present it overlaps the major part of the midrib. The fertile structure is 1.8 cm. in length and 0.5 cm in breadth near the broadest area. The structure shows several oval to circular elevations of seed cushions on the surface. They are arranged in spiral manner. The specimen closely resembles with Dictyopteridium sporiferum described by Surange and Chandra (1973-a) from Hingrida Ghati in Orissa. It also resembles with Dictyopteridium sporiferum described by Chandra and Prasad (1981) from Bazargaon in Chandrapur District of Maharashtra. Their specimen is in detached condition. However, present specimen shows that the fructification is attached near the basal part of the leaf. The leaf is in fragmentary condition showing a midrib and venation pattern of Glossopteris. The venation pattern resembles with that of Glossopteris brownii. The specimen is collected from Satnori in Nagpur District of Maharashtra. It belongs to Kamthi formation. Hence it appears that D.sporiferum occurs at two places in the Kamthi formation.

Type : Satn. 10/91  
 Locality : Satnori, Dist : Nagpur,  
 Maharashtra.  
 Horizon : Kamthi Stage (Upper Permian).

Gangamopteris cyclopteroides Feistmantel

(Text Fig. 11 Plate Fig. 12)

The specimen is an incomplete leaf measuring 8 cm. in

in length and 2.8 cm in breadth. Apex and basal part are missing. The leaf is lanceolate in shape and gradually becomes narrow towards the base. The median part shows number of parallel veins. These veins are more prominent in the basal region. Secondary veins arise from the median veins at an angle of  $46^\circ$ . The veins are curved near the median region and then reach the margin. They divide and form broad and long meshes near the median region and narrow meshes near the margin.

Identification and comparison : The morphological characters of the present specimen closely resemble with that of G.cyclopteroides Feistmantel. In (1879) Feistmantel described G.cyclopteroides on the characters which show the broad base hence the species has number of variable characters. According to Feistmantel (1879) the important characters of G.cyclopteroides are lanceolate shape, tapering base, entire margin, midrib absent, number of parallel veins occupy the median region of the leaf and secondary veins form broad and long meshes near the centre and small and narrow meshes near the margin. Maithy (1965) described several species of Gangamopteris from the Karharbari beds in India. He described epidermal characters of several species. But in case of G.cyclopteroides only morphographic characters are given. Hence, our species due to resemblance with the description given by Maithy it is identified as such. Recently Chandra and Prasad (1981) described G.cyclopteroides from Bazargaon in Maharashtra belonging to Kamthi Stage. Present specimen

comes from Adhari in Chandrapur district of Maharashtra also belongs to Kamthi Stage. This suggests a wider range of distribution for this plant in India. It ranges from Karharbari Stage (lower permian) to Kamthi Stage (Upper Permian).

Type : ADR 20/91  
 Locality : Adhari, Dist : Chandrapur,  
 Maharashtra.  
 Horizon : Kamthi Stage (Upper Permian).

Schizoneura Schimper & Mougeot

Schizoneura gondwanensis Feistmantel 1876.

(Text Fig. 10 Plate Fig. 13)

The specimen shows leaf sheaths attached to the axis. It measures 8 cm. long and 5.5 cm. broad. There are 4 leaf sheaths attached at the nodes on the axis. Each leaf sheath is 5 cm long and 1.2 cm broad, showing 9 veins. The veins run almost parallel to each other and coverage near the apex. The stem is 2 mm broad showing 4 internodes. Each internode is 2.5 cm long.

Identification and comparison : The present specimen closely agrees with the characters of Schizoneura gondwanensis Feistmantel given by Surange (1964). It also agrees with the description of S.gondwanensis given by Chandra and Prasad (1981). Genus Schizoneura is found in Raniganj and Panchet stages of India. Feistmantel (1876) described S.gondwanensis



from Raniganj coal field. Present specimen comes from Satnori in Nagpur district of Maharashtra. Chandra and Prasad (1981) recently described it from Bazargaon in Nagpur district of Maharashtra. Bazargaon and Satnori are present on the same track belonging to Kamthi Stage. Therefore, present specimen supports the occurrence of S.gondwanensis in the Kamthi Stage. It also suggests wider distribution of this plant in India.

Type : Satn. 6/91  
 Locality : Satnori, Dist : Nagpur,  
 Maharashtra.  
 Horizon : Kamthi Stage (Upper Permian).

Psymphyllum flabellatum (Lindley & Hutton) Seward

(Text Fig. 8 Plate Fig. 14)

The specimen is an impression on the yellowish brown sandstone. It measures 4 cm. in length and 3.6 cm. in breadth. The lamina is divided into 4 segments which are regularly lobed. The larger segment is broad showing obtuse apex while the smaller segments show somewhat rounded apex. Veins arise from the base, they are parallel and near the apex they show forking. There are so many veins/cm. in each lobe.

Identification and comparison : The specimen closely resembles with the character of Psymphyllum flabellatum (Lindley and Hutton) Seward, in having lamina divided into broad segments showing obtuse or rounded apex. The lamina

is partially torn showing several parallel veins forking in the upper region. Hence it is identified as P.flabellatum. According to Surange (1974) genus Psygmyphyllum is represented by following three species in India. (1) P.hollandi Seward (1907) (2) P.haydeni Seward (1912) (3) P. sahnii Ganju, (1943). Present specimens in compared with P. haydeni due to flabellate leaves. However, in P.haydeni the segments are prolonged downwards into a narrow stalk. In the present specimen the segments are not deeply divided and stalk is absent. All the earlier reports of Psygmyphyllum in India come from Permian rocks of Kashmir. The present specimen is reported from Bazargaon belonging to Kamthi Stage of Maharashtra. This suggests wider distribution of Psygmyphyllum in India.

Type	:	BAZG-15/91
Locality	:	Bazargaon, Dist : Nagpur, Maharashtra.
Horizon	:	Kamthi Stage (Upper Permian).

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Text Figs. : 1-6 Impressions from Kamthi formation  
of Maharashtra State.

1. Glossopteris verticellata Thomas showing venation pattern & shape at the leaf x N.S.
2. Glossopteris damudica Feistmantel showing shape of the leaf and venation pattern x N.S.
3. Glossopteris indica Schimper showing venation pattern x N.S.
4. Glossopteris euryneura Maheshwari. showing venation pattern x 1.5
5. Glossopteris communis Feistmantel showing shape of the leaf and venation pattern x N.S.
6. Glossopteris fibrosa Pant. showing shape of the leaf and venation pattern x N.S.

Plate figs. : 1-8 Impressions from Kamthi formation of  
Maharashtra State.

1. Glossopteris verticellata Thomas showing venation pattern and shape of the leaf x 0.5.
2. Glossopteris damudica Feistmantel showing shape of the leaf and venation pattern x 0.75.
3. Glossopteris brownii Brongniartf showing venation pattern x 0.75.
4. Glossopteris musacfolia Bunbury, showing shape of the leaf and venation pattern x 0.75.
5. Glossopteris fibrosa Pant showing shape of the leaf and venation pattern x 0.75.
6. Glossopteris intermedia Feistmantel showing shape of the leaf and venation pattern x 0.5.
7. Glossopteris communis Feistmantel showing shape of the leaf and venation pattern x 0.75.
8. Glossopteris indica schimper showing venation pattern x 0.75.

Text figs. : 7-14 Impressions from Kamthi formation of  
Maharashtra State.

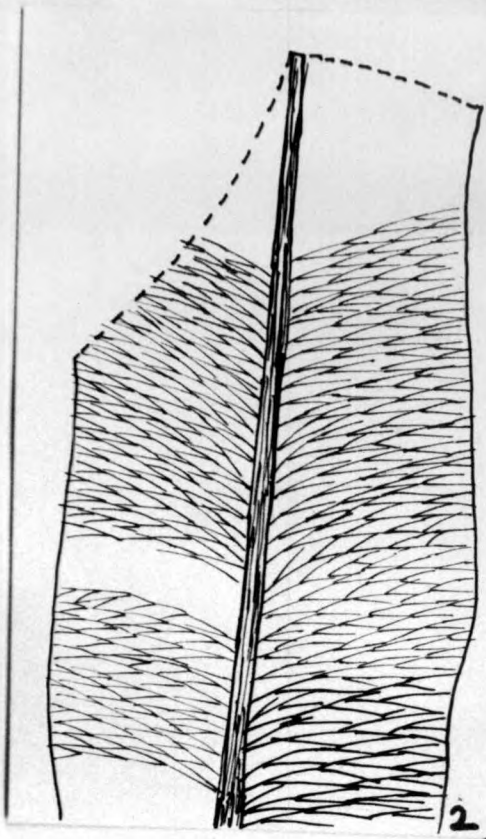
7. Glossopteris musaefolia Bunbury showing shape of the leaf and venation pattern x N.S.
8. Psygmyphyllum flabellatum Lindley and Hutton x 1.25.
9. Glossopteris intermedia Feistmantel showing shape of the leaf and venation pattern x N.S.
10. Schizoneura gondwanensis Feistmantel showing leaf sheaths and axis x 0.75.
11. Gangamopteris cyclopteroides Feistmantel showing venation pattern x N.S.
12. Neocalamites foxii Lele showing a node and parallel ridges and furrows x 0.75.
13. Dyctiopteridium sporiferum Feistmantel showing ovules x 2.
14. Glossopteris brownii Brongniart showing venation pattern x N.S.

Plate figs. : 9-14 Impressions from Kamthi formation  
of Maharashtra State.

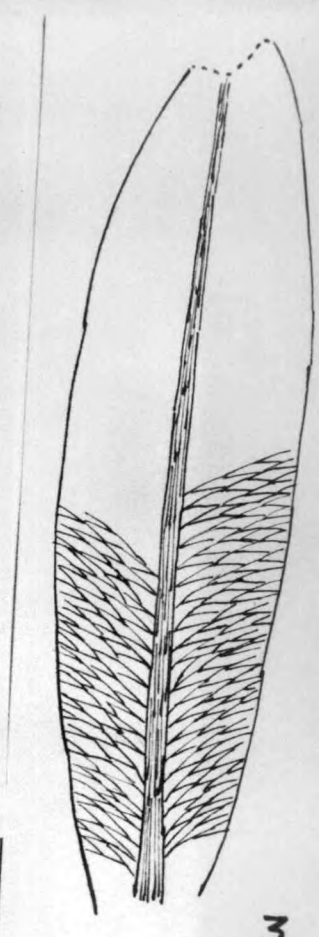
9. Glossopteris euryneura Maheshwari showing venation pattern x 1.25.
10. Neocalamites foxii Lele showing a node and parallel ridges and furrows x 0.75.
11. Dyctiopteridium sporiferum Feistmantel showing ovules x 2.
12. Gangamopteris cyclopteroides Feistmantel showing venation pattern x N.S.
13. Schizoneura gondwanensis Feistmantel showing leaf sheaths and axis x 0.75.
14. Psygmophyllum flabellatum Lindley and Hutton x 0.75.



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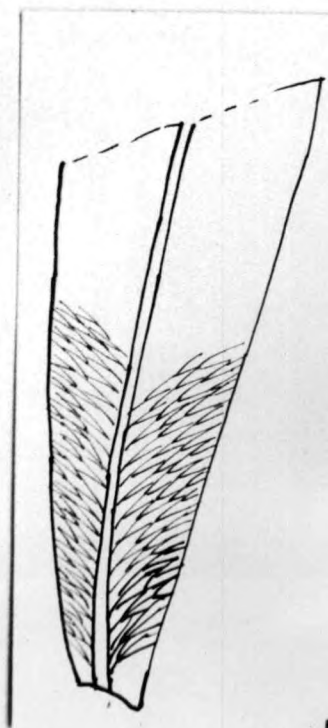
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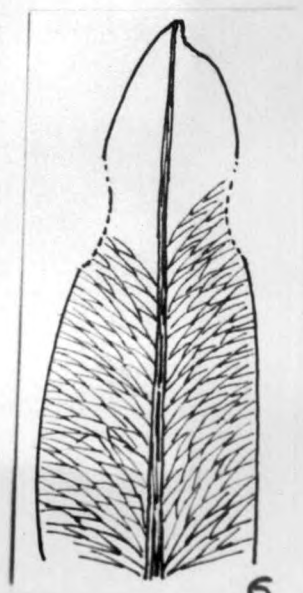
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PLATE - I



1



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4



8



6



5



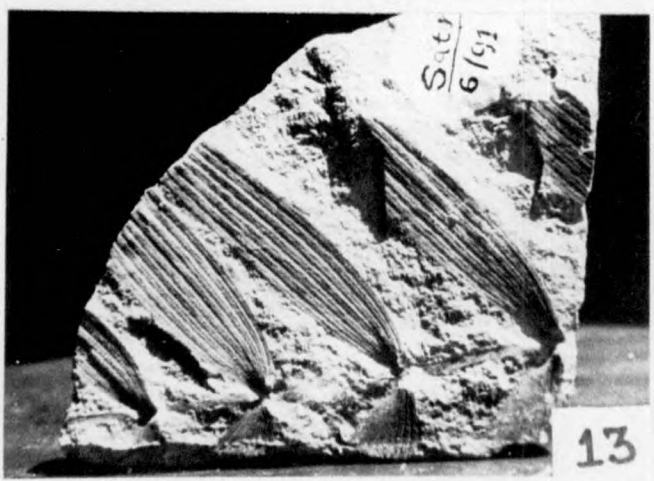
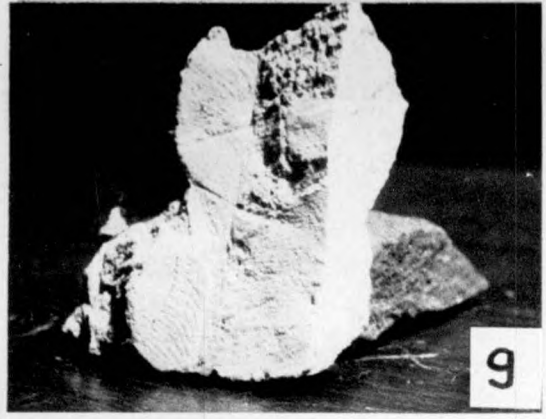
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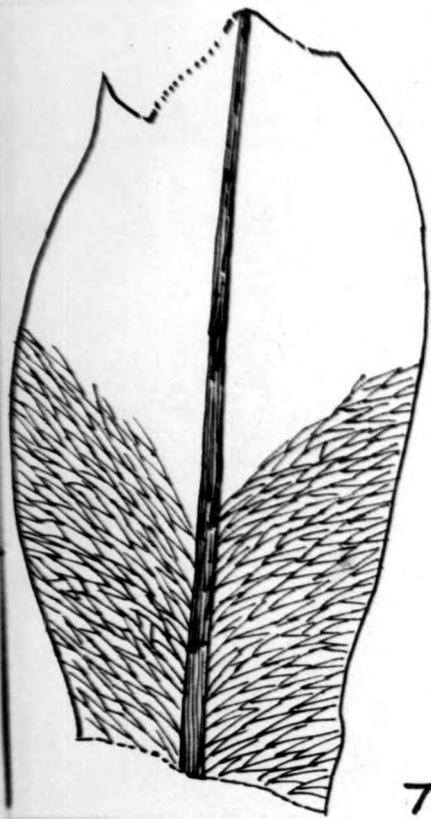


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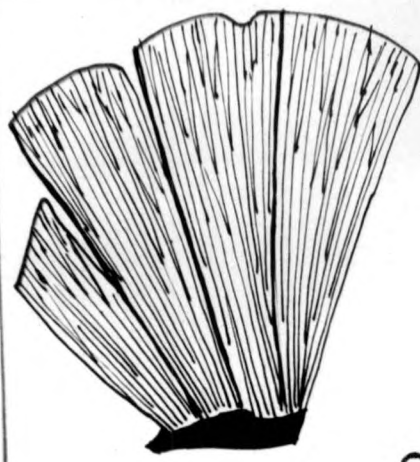


PLATE - II

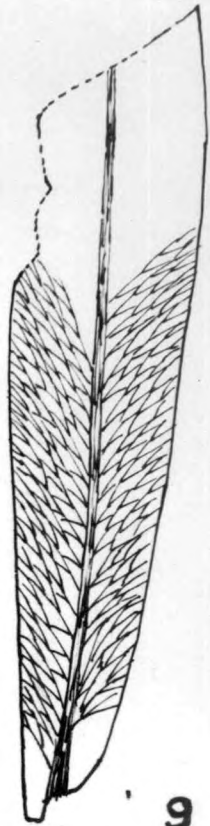




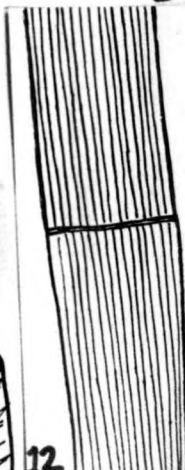
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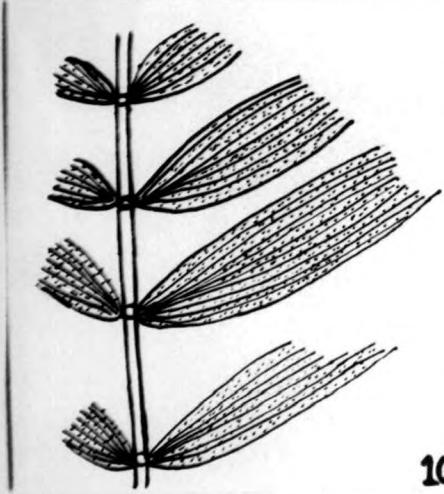
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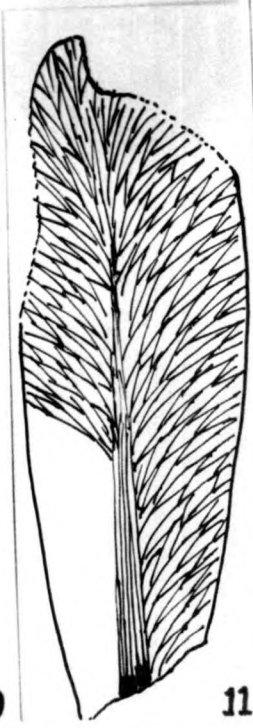
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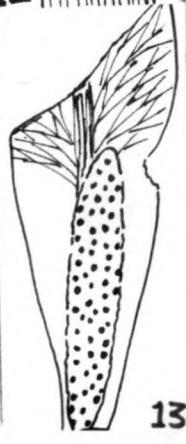
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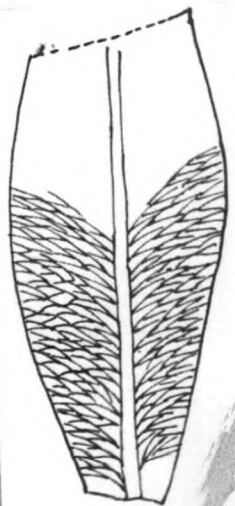
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11



13



14

PART II - WOODSAustraloxylon panwadalensis sp. nov.

A petrified wood numbering PNW-5/90 shows interesting characters and described here. It was collected from Panwadala in Chandrapur district of Maharashtra State. The locality belongs to Kamthi stage showing upper permian age. The wood is brownish red in colour and measures 7.2 x 4.8cms.

T.S. : It is a piece of decorticated secondary xylem devoid of pith and primary xylem. There are distinct growth rings in a width of 4 cms. The secondary xylem is distinguishable into spring wood and autumn wood. The height of spring wood is 52 cells. Its tracheids are squarish in outline with broad lumen. They measure 28 x 22  $\mu$ . The autumn wood is 3 celled thick. Its tracheids are transversely elongated. They are thick walled with narrow lumen. The tracheids measure 16 x 12  $\mu$ . (Text fig. 1, Plate Fig. 1).

T.L.S. : Xylem rays observed here are only uniseriate. Their height varies from 3 to 14 cells. Average height is 7 cells in 10 counts. The ray cells are barrel shaped and measure 21 x 19  $\mu$ . The important feature observed here is the presence of xylem parenchyma. It is marked by horizontal septa. Tangential pitting is absent. (Text Fig. 2 Plate Fig.3).

R.L.S. : The pits on the radial walls of the tracheids shows following patterns.

1. Uniseriate pits are circular and separate. They measure 5 x 4  $\mu$ . (Text Fig. 3 Plate Fig. 2).
2. Biseriate pits are circular, separate and arranged in opposite pairs. They measure 6 x 3  $\mu$ . (Text Fig. 5 Plate Fig. 4).
3. Multiseriate pits are circular and alternate. They show 3-4 seriate condition and measure 5 x 4  $\mu$ . Pit pore is circular and 3  $\mu$ . (Text Fig. 4 & 7 Plate Fig. 5 & 7).
4. Circular pits are present in groups of 2,3 & 5. They measure 5 x 4  $\mu$ . (Text Fig.6 Plate Fig.6).
5. Multiseriate pits are hexagonal alternate and compact. They measure 6 x 4  $\mu$ . (Text Fig. 8 Plate Fig. 8).

Cross field pits : The number of the cross field pits is 3-5. They are circular to oval in shape and measure 5 x 3 $\mu$ . (Text Fig. 9 Plate Fig. 9).

Identification and comparison : The present wood shows, 1-4 seriate circular pits, multiseriate, hexagonal alternate pits, pits in groups of 2-3 & 5 and opposite circular pits in pairs. These characters agree with the generic characters of Australoxylon Marguerier, Hence, it is identified with it. Marguerier (1971) instituted the genus. Australoxylon for pycnoxylic decorticated secondary woods showing Araucarian and Abietinean pitting. Recently Prasad and Chandra (1981) described two new species of the genus from Kamthi formation of Maharashtra. They have also merged six earlier described wood under this genus.

The present wood is compared with A.teixeirae Marguerier(1973)) in having 1-3 seriate mixed type of pitting and pits in groups of 3,4 & 5. But it differs from A.teixeirae in having only uniseriate xylem rays and 3-5 field pits; and absence of tangential pitting. In A.texeriae number of field pits is 1-10 (mostly 4-6) and xylem rays are 1-2 seriate. Besides it shows presence of tangential pitting.

It is comparable with A.kanhargaoense Prasad and Chandra (1981) in having 1-3 seriate mixed type of pitting and pits in clusters of 2,3 & 4. But present wood differs from A.kanhargaoense in having only uniseriate xylem rays, 3-5 field pits and absence of tangential pitting. In A.kanhargaoense number of field pits is 1-7 (mostly 3-4) xylem rays are 1-2 seriate and tangential pitting is present.

It is also compared with A.longicellularis Prasad and Chandra (1978) in having 1-3 seriate mixed type of pitting and pits in clusters of 2,3 & 4. But present wood differs from A.longicellularis in having 3-5 field pits, Uniseriate xylem rays and absence of tangential pitting. A.longicellularis number of field pits is 1-7 (mostly 4) xylem rays are 1-2 seriate and upto 64 cells in length. Besides, it shows the presence of tangential pitting.

The present wood differs from all other species of Australoxylon in one or other characters. Hence it is described as a new species namely Australoxylon panwadalensis. The specific name is after the locality Panwadala from which it was collected.

Diagnosis : Decorticated secondary wood, growth ring, spring wood 52 cells high, tracheids squarish with broad lumen 28 x 22  $\mu$ , autumn wood 3 cells high, tracheids transversely stretched and 16 x 12  $\mu$ , Xylem rays uniseriate 3-14 cells high, average height 7 cells, ray cells barrel shaped 21 x 19  $\mu$ , tangential pitting absent. Radial pitting 1-4 seriate circular, uniseriate pits circular separate and 5 x 4  $\mu$ . Biseriate pits in opposite pairs 6 x 3  $\mu$ . Multiseriate circular pits upto 4 seriate and 5 x 4  $\mu$ . Hexagonal alternate pits, 6 x 4  $\mu$ . Clustered pits in groups of 2,3 & 5. Crossfield pits 3-5, circular to oval and 4 x 3  $\mu$ .

Type No.	PNW - 5/90
Locality	Panwadala, Dist : Chandrapur, Maharashtra.
Horizon	Kamthi Stage (Upper Permian).

Explanation of Text Figures

Text Figs. 1-9 : Australoxylon panwadalensis sp. nov.

1. T.S. showing secondary xylem distinguished into spring wood - sp. and autumn wood - au x 187.
2. T.L.S. showing uniseriate xylem rays and xylem parenchyma - XP x 187 .
3. R.L.S. showing uniseriate, circular, contiguous or separate pits x 600.
4. R.L.S. showing multiseriate, circular, alternate pits x 600.
5. R.L.S. showing biseriate, circular, opposite pairs x 600.
6. R.L.S. showing circular pits in groups of 2,3 and 4 x 600.
7. R.L.S. showing multiseriate, circular pits x 600.
8. R.L.S. showing multiseriate hexagonal alternate pits x 600.
9. R.L.S. showing circular to oval, field pits cfp x 600.

Explanation of Plate Figures

Plate I, Figs. 1-9 : Australoxylon panwadalensis sp. nov.

1. T.S. showing secondary xylem distinguished into spring wood - sp. and autumn wood - au x 124.
2. R.L.S. showing uniseriate, circular, contiguous or separate pits x 300.
3. T.L.S. showing uniseriate xylem rays and xylem Parenchyma - XP x 180.
4. R.L.S. showing biseriate, circular pits in opposite pairs x 600.
5. R.L.S. showing multiseriate, circular, alternate pits x 600.
6. R.L.S. showing circular pits in groups of 2, 3 and 4 x 600.
7. R.L.S. showing multiseriate, circular pits x 450.
8. R.L.S. showing multiseriate, hexagonal alternate pit x 1200.
9. R.L.S. showing circular to oval field pits, cfp x 1200.



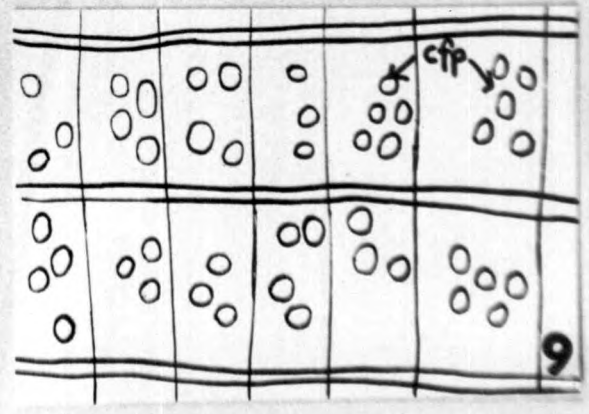
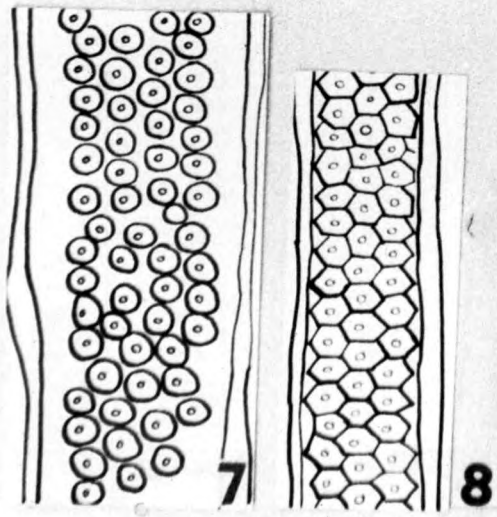
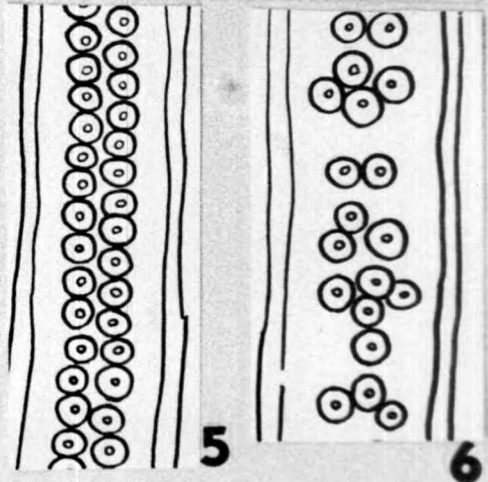
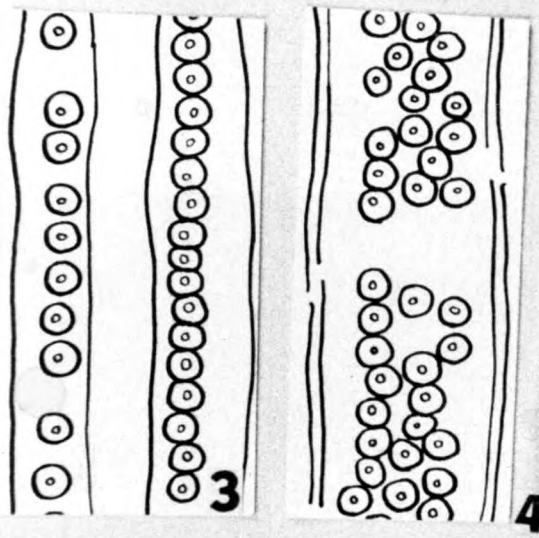
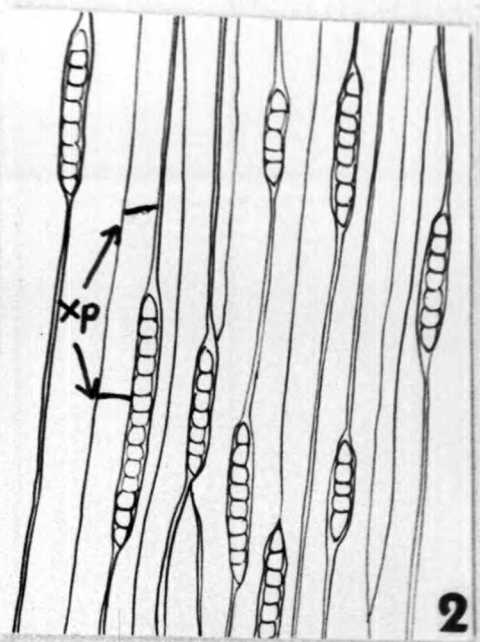
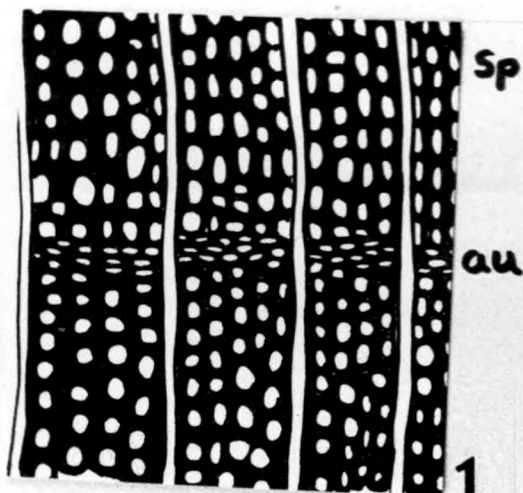
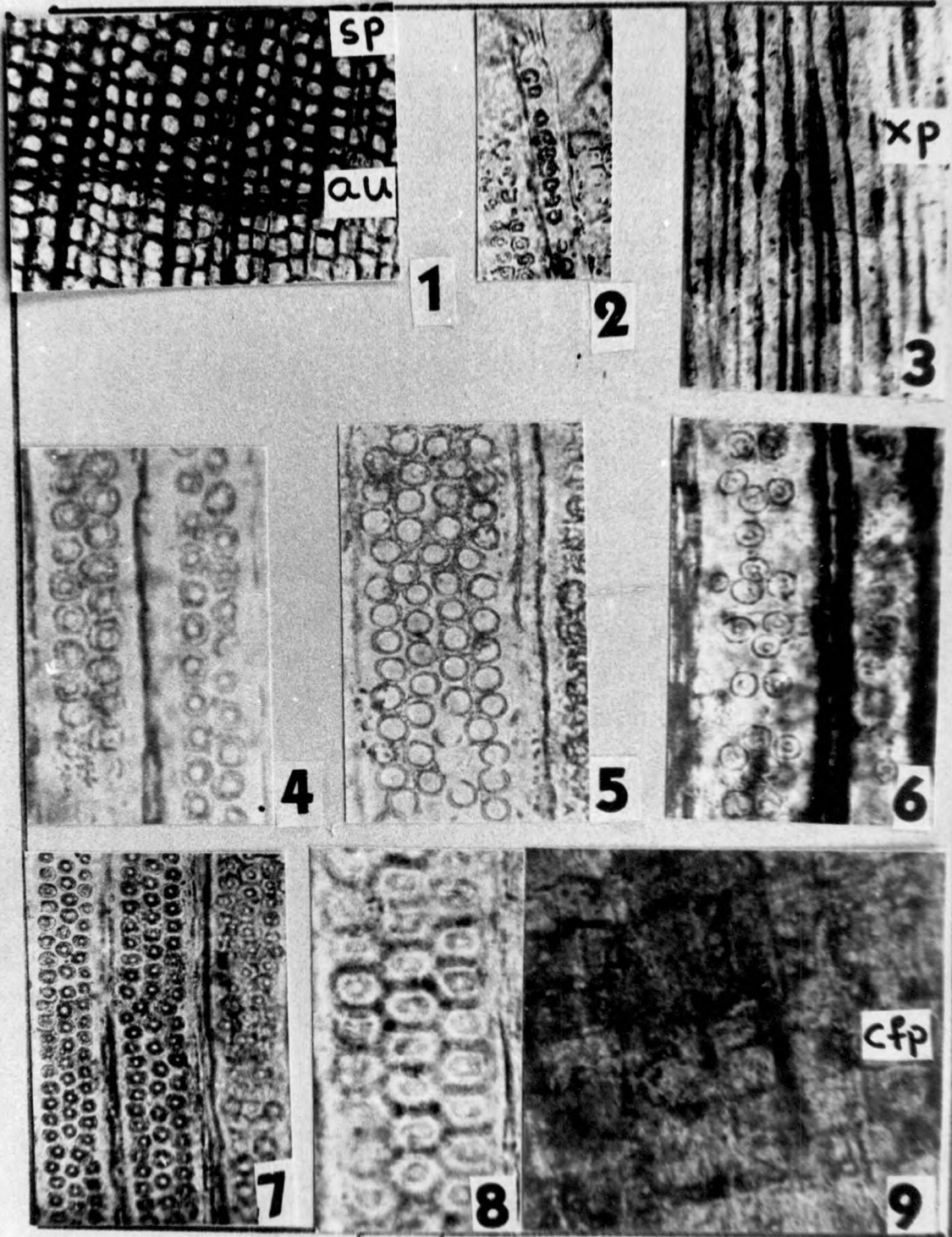


PLATE - I



Prototaxoxylon uniseriale Prasad 1986.

The specimen is yellowish brown silicified coniferous wood collected from Adhari in Chandrapur district of Maharashtra. It is a piece of decorticated secondary wood without pith and primary xylem. The wood measures 10.9 cms in length and 4.6 cms in width. Following characters are observed in it.

T.S. : It shows 8 growth rings in a width of 4 cm. The secondary xylem was differentiated into spring wood and autumn wood. The spring wood is 97 cells wide. The tracheids are rectangular in shape, thick walled and show broad lumen. They measure 24 x 20  $\mu$ . The autumn wood is 4 cells wide. Its tracheids are 12 x 8  $\mu$  horizontally stretched and show narrow lumen. (Text Fig. 10 Plate Fig. 10).

T.L.S. : The wood shows only uniseriate xylem rays. The height of rays varies from 1-11 cells, average height being 6 cells in 25 counts. The ray cells are barrel shaped and measure 24 x 16  $\mu$ . Pits on the tangential walls at the tracheids are present. They are uniseriate circular and contiguous measuring 9 x 6  $\mu$ . (Text Fig. 13 Plate Fig.15).

R.L.S. : The pits on the radial walls of the tracheids are uniseriate, circular and contiguous. They measure 8 x 6  $\mu$ . The pits pore is oblique. (Text Fig. 11 & 14 Plate Fig. 14). Biseriate pits are circular and contiguous. But this type is quite rare. The pits measure 8 x 6  $\mu$ . The cross field

pits large and circular to oval in shape. Their number is 1-2 per field. They measure 3 x 2  $\mu$ . (Text Fig. 16 Plate Fig.16).

The radial walls shows spiral thickening passing over the pit borders. The thickening is 0.9  $\mu$  broad. (Text Fig.12, 15 Plate Fig. 11,12, 13).

Identification and comparison : The present wood represents only secondary wood having uniseriate and biseriate circular pits, spiral thickening and uniseriate xylem rays. Hence it is identified with the genus Prototaxoxylon Krausel and Dolianti 1958. Recently Prasad (1986) has given a brief account of coniferous woods described from Kamthi formation. He has also given a comparative table of different species of Prototaxoxylon described by several workers. He further reported two species of Prototaxoxylon from Chandrapur district of Maharashtra viz. (1) Prototaxoxylon uniseriale, and (2) P.maithyi. Present wood agrees with P.uniseriale in most of the characters like uniseriate radial pits (rarely biseriate), tangential pitting, uniseriate xylem rays and 1-2 circular oval cross field pits. Hence, it is identified with it and described as P.uniseriale. Prasad described it from Kanhargaon in Chandrapur district while present wood comes from Adhari, also in the same area. This suggests that P.uniseriale has a range of distribution from Kanhargaon to Adhari. Both the woods belongs to Kamthi formation.

Type	ADR-14/91
Locality	Adhari, Dist : Chandrapur, Maharashtra.
Horizon	Kamthi Stage (Upper permian.)

Kamthioxylon nandorii sp. nov.

A piece of petrified wood numbered NDR-17/91 was collected from Nandorii in the Chandrapur district of Maharashtra State. It shows excellent preservation and unique combination of characters.

T.S. : It is a piece of decorticated secondary wood without pith and primary xylem. The wood measures 6.5cm in length and 4.5 cm in width. There are 14 distinct growth rings within a distance of 6 cm. The secondary xylem is distinguishable into spring wood and autumn wood. Height of spring wood is 86 cells. Its tracheids are rectangular with broad lumen and measure 25 x 22  $\mu$ . The autumn wood is 3 celled thick. Its tracheids are transversely stretched and shows narrow lumen and measures 18 x 9  $\mu$ . (Text Fig. 17 Plate Fig. 17).

T.L.S. : Xylem rays noticed are uniseriate to biseriate, but mostly uniseriate. Height of xylem rays varies from 1-21 cells. The average height found is 10 in 25 counts. The ray cells are barrel shaped and measure 18 x 15  $\mu$ . Tangential walls of the tracheids shows circular pits. They measure 4 x 3  $\mu$ . (Text Fig. 19, Plate Fig. 22). Xylem parenchyma is present. It is marked by horizontal septa. (Text Fig. 18 Plate Fig. 18). Resin plugs are seen. They are biconcave in shape (Text Fig. 18 Plate Fig. 19).

R.L.S. : Pits on the radial walls of the tracheids shows various types. They are :-

1. Uniseriate pits are circular, vestured and separate. They measure 6 x 6  $\mu$ . (Text Fig. 23 Plate Fig. 20).
2. Biseriate pits are circular separate, alternate or opposite. They show vestured nature. The pits measure 6 x 5  $\mu$ . (Text Fig. 22, Plate Fig. 21).
3. Hexagonal pits are 2-3 seriate, alternate and compact. They measure 6 x 5  $\mu$ . (Text Fig. 20 Plate Fig. 24).
4. Bars of sanio are present. They are found between successive uniseriate circular pits. (Text Fig. 21 Plate Fig. 23).
5. Cross field pits : They are simple or bordered and oval in shape. Their number varies from 2-6. They measure 4 x 2  $\mu$ . (Text Fig. 24 Plate Fig. 25). Resin plugs are present. They are dark coloured biconcave structures.

Identification and comparison : Present wood shows following characters. Uniseriate and biseriate circular vestured pits., multiseriate circular pits, hexagonal alternate pits and cupresoid type of field pits. Besides these it also shows presence of xylem parenchyma tangential pits, resin plugs and bars of sanio. These characters shows variety of pitting and some striking feature to accomodate such characters. Mahabale and Vagyani (1980) instituted the genus Kamthioxylon and described as K.adhariense from Adhari in Chandrapur district

of Maharashtra. Present specimen closely agree with the characters of Kamthioxylon and hence it is generically identified with it. It is compared with K.adhariense in most of the characters. But it differs from K.adhariense in having 2-6 field pits and the hexagonal alternate pits. In K.adhariense the number of field pits is 3-9 and hexagonal pits are absent in it. Therefore, it is described as a new species namely K.nandorii. The specific name is after the place Nandori from which it was collected.

Diagnosis : Secondary wood with primary structures, spring wood 86 cells high. Tracheids rectangular 25 x 22  $\mu$ . Autumn wood 3 cells wide. Tracheids transversely stretched, 18 x 9  $\mu$ . Xylem rays uniseriate to biseriate, 1-21 cells high, average heights 10 cells. Ray cells barrel shaped 18 x 15  $\mu$ . Tangential pits and xylem parenchyma present. Radial pits uniseriate to multiseriate. Uniseriate pits are vestured circular and separate 6 x 6  $\mu$ . Biseriate pits are vestured circular and separate. Multiseriate pits are circular, alternate and 6 x 5  $\mu$ . Hexagonal pits are biseriate, alternate and 6 x 5  $\mu$ . Bars of sanio present. Resin plugs are present. Cross field pits, cupressoid and 2-6 in number, measuring 4 x 2  $\mu$ .

Type : NDR-17/91  
 Locality : Nandori District : Chandrapur,  
 Maharashtra State.  
 Horizon : Kamthi Stage(Upper permian).



Agathioxylon sahnii sp. nov.

A piece of petrified wood was collected from Nandori in district Chandrapur of Maharashtra. It shows secondary xylem without pith and primary xylem. The wood is yellowish brown in colour, measuring 7 cm. long and 5 cm. broad. The preservation is excellent.

T.S. : It shows 11 distinct growth rings within a width of 5 cms. The secondary xylem is differentiated into spring wood and autumn wood. Height of spring wood 103 cells. Its tracheids are radially arranged squarish in outline and shows broad lumen. They measure  $28 \times 26 \mu$ . The autumn wood is 7 celled thick. Its tracheids are horizontally stretched and shows narrow lumen. They measure  $21 \times 10 \mu$ . (Text Fig. 25 Plate Fig. 26).

T.L.S. : Xylem rays observed here are uniseriate to biseriate. Uniseriate rays are predominant than the biseriate ones. The height of rays varies from 1-21 cells. Average height counted is 8 cell in 10 counts.

The ray cells are barrel shaped and measure  $21 \times 12 \mu$ . The striking feature of this wood is presence of xylem parenchyma. It is represented by a horizontal septa (Text Fig. 26 Plate Fig. 27 & 28).

R.L.S. : Pits on the radial wall of the tracheids are :-

1. Uniseriate pits are circular, contiguous, and vested. The ornamentation resembles with those of Agathis. (Gregus 1955). The pits measure 8 x 7  $\mu$ . (Text Fig. 27 Plate Fig. 30).
2. Biseriate pits are circular, contiguous and alternate. They measure 7 x 6  $\mu$ . (Text Fig. 29 Plate Fig. 29).
3. Multiseriate pits are hexagonal, compact and alternate. They measure 8 x 5  $\mu$ . (Text Fig. 28 Plate Fig. 31).
4. Cross field pits - They oval in shape and their number varies from 3-5. Pits measure 3 x 2  $\mu$ . (Text Fig. 30 Plate Fig. 32).

Identification and comparison : The important features of the present wood are -

1. Distinct growth rings.
2. Uniseriate to biseriate xylem rays.
3. Gradual transition of spring wood into autumn wood.
4. Uniseriate to multiseriate circular pits.
5. Vested pits of Agathis type.
6. Presence of xylem parenchyma.
7. 3-5 oval cupressoid type of field pits.

The above characters agree with those of the genus Agathioxylon Hartig. Hence it is generically identified with it.

Hartig (1848) instituted the genus Agathioxylon for a wood collected from German Veuper. He described A. cordainum.

He did not give the diagnosis of the wood. But his wood shows Araucarian pitting and presence of xylem parenchyma. Later on Evans (1934) described a wood from Newzealand and named it as Agathioxylon australe. The wood belongs to pliocene period.

Patton (1958) described Agathis resinifera from Australia. In his wood bark and resin tracheids are present. Recently Krausel and Jain (1964) described Dadoxylon agathioides from India. It shows pits in groups, having 8 cross shaped apertures. But xylem parenchyma is absent in this wood. Radial pits are uniseriate cross field pits are 2-8 in number. They are circular with elliptical pit pores.

The specimen is compared with A.cordainum Hartig in having xylem parenchyma and arrangement of radial pits. Since other characters are not known correct comparison is not possible.

It agrees with A.australe Evans (1937) in the arrangement of radial pits. But A.australe comes from pliocene of Australia and present wood comes from upper permian of Maharashtra (India).

It differs from A.resinifera described by Patton (1958) in having Xylem parenchyma and absence of resin tracheids. In A.resinifera resin tracheids are present and xylem parenchyma is absent.

It is compared with Dadoxylon agathioides Krausel and Jain (1964) in having 1-3 seriate radial pits. But it differs from D.agathioides in having 3-5 field pits, and presence of xylem parenchyma. In D. agathioides field pit number is 2-8 and parenchyma is absent.

Recently Vagyani & Jamane (1986) described A.maheshwarii from Kamthi beds of Maharashtra.

The present wood is closely compared with D.maheshwarii in having 1-3 seriate radial pits, vestured pits and presence of xylem parenchyma. But it differs from D.maheshwarii in having 3-5 field pits. In D.maheshwarii the number of field pits is 2-3.

Therefore, it is evident that the present wood differs from all known species of Agathioxylon and as such it is described as a new species viz. Agathioxylon sahnii. The specific name is after the eminent Palaeobotanist of India Dr.B.Sahni.

Diagnosis : Decorticated secondary wood with pith and primary xylem. Growth rings distinct, spring wood 103 cells high. Its tracheids squarish 28 x 26  $\mu$ . Autumn wood 7 celled thick, tracheids 21 x 10  $\mu$ . Xylem rays 1-2 seriate, height 1-21 cells. Ray cells barrel shaped 21 x 12  $\mu$ . Xylem parenchyma present, uniseriate pits vestured, circular and contiguous 8 x 7  $\mu$ , biseriate pits circular contiguous and

alternate, 7 x 6  $\mu$ . Multiseriate pits are hexagonal alternate  
8 x 5  $\mu$ , field pits oval, 3-5 and measure 3 x 2  $\mu$ .

Type : NDR-15/91  
Locality : Nandori, Dist : Chandrapur,  
Maharashtra.  
Horizon : Kamthi Stage (Upper Permian).

Explanation of Text Figures

Text Fig. 17 - 24 : Kamthioxylon nandori sp. nov.

17. T.S. showing secondary xylem distinguished into spring wood - sp. and autumn wood - au x 187.
18. T.L.S. showing uniseriate and biseriate xylem rays, xylem Parenchyma - xp and resin plugs - rp. x 187.
19. T.L.S. showing uniseriate circular, tangential pits - tp. x 600.
20. R.L.S. showing multiseriate, hexagonal, alternate pits x 600.
21. R.L.S. showing bars at sanio BS present between uniseriate circular pits x 600.
22. R.L.S. showing biseriate, circular, alternate or opposite, vestured pits - vp x 600.
23. R.L.S. showing circular, separate and vestured pits vp x 600.
24. R.L.S. showing circular to oval cross field pits cfp x 600.

### Explanation of Text Figures

Text Figs. 10-16 : Prototaxoxylon uniseriate Prasad.

10. T.S. showing secondary xylem differentiated into spring wood - sp. and autumn wood - au. x 187.
- 11.& 14.R.L.S. showing uniseriate, circular and contiguous pits with spiral thickning - spt x 600.
12. R.L.S. showing uniseriate, circular, separate pits with double spiral thickning x 600.
13. T.L.S. showing uniseriate xylem rays. x 187.
15. R.L.S. showing biseriate circular pits with spiral thickning - spt. x 600.
16. R.L.S. showing circular to oval, large field pits - cfp - 600.

Explanation of plate figures

Plate II Figs. 10-16 : Prototaxoxylon uniseriate Prasad

10. T.S. showing secondary xylem differentiated into spring wood - sp and autumn wood - au x 246.
11. & 12. R.L.S. showing uniseriate, circular and contiguous pits with spiral thickning - spt x 600.
13. R.L.S. showing uniseriate, circular, separate pits with double spiral thickning x 600.
14. R.L.S. showing uniseriate, circular and contiguous pits x 600.
15. T.L.S. showing uniseriate xylem rays x 138.
16. R.L.S. showing circular to oval, large field pits, cfp - 720.



Explanation of plate figures

Plate III figs. 17-25 : Kamthioxylon nandori sp. nov.

17. T.S. showing secondary xylem distinguished into spring wood - sp and autumn wood - au x 276.
18. T.L.S. showing uniseriate and biseriate xylem rays, xylem parenchyma - XP x 187.
19. T.L.S. showing uniseriate and biseriate xylem rays and resin plug - rp x 230.
20. R.L.S. showing circular, separate and vestured pits - vp x 500.
21. R.L.S. showing biseriate, circular, alternate or opposite vestured pits - vp x 500.
22. T.L.S. showing uniseriate circular, tangential pits - tp x 600.
23. R.L.S. showing bars of sanio - BS present between uniseriate circular pits x 600.
24. R.L.S. showing multiseriate, hexagonal, alternate pits x 300.
25. R.L.S. showing circular to oval cross field pits - cfp x 450.

Explanation of Text Figures

Text Fig.25 - 30 : Agathioxylon sahani sp. nov.

25. T.S. showing secondary xylem distinguished into spring wood - sp and autumn wood - au. x 187.
26. T.L.S. showing uniseriate and biseriate xylem rays with xylem parenchyma - xp x 187.
27. R.L.S. showing uniseriate, circular contiguous vested pits - vp x 600.
28. R.L.S. showing multiseriate hexagonal compact and alternate pits x 600.
29. R.L.S. showing biseriate, circular, contiguous, alternate pits x 600.
30. R.L.S. showing oval cross field pits cfp x 600.

Explanation of Plate figures

Plate IV figs. 26-32 Agathioxylon sahani sp. nov.

26. T.S. showing secondary xylem distinguished into spring wood - sp and autumn wood - au x 266.
27. T.L.S. showing uniseriate and biseriate xylem rays x 138.
28. T.L.S. showing uniseriate and biseriate xylem rays with xylem parenchyma - xp x 374.
29. R.L.S. showing biseriate, circular, contiguous, alternate pits x 480.
30. R.L.S. showing uniseriate, circular, contiguous, vestured pits - vp x 500.
31. R.L.S. showing multiseriate, hexagonal, compact and alternate pits x 450.
32. R.L.S. showing oval crossfield pits - cfp x 450.

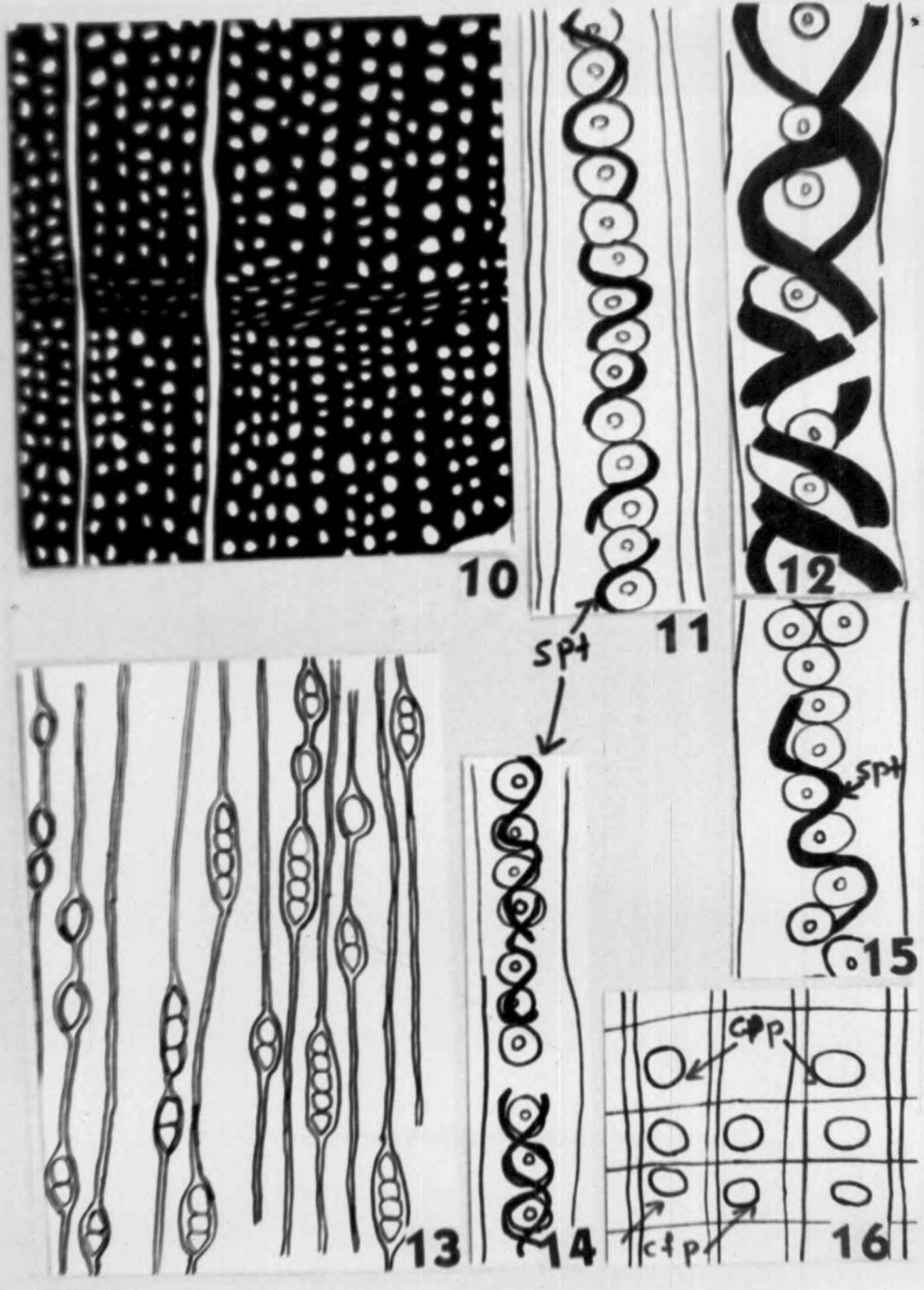
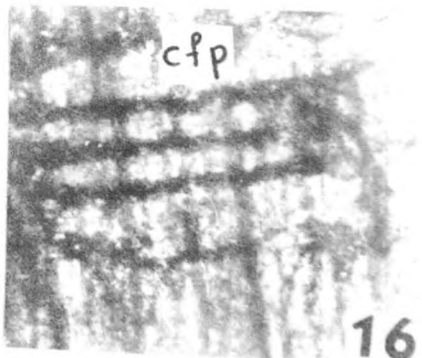
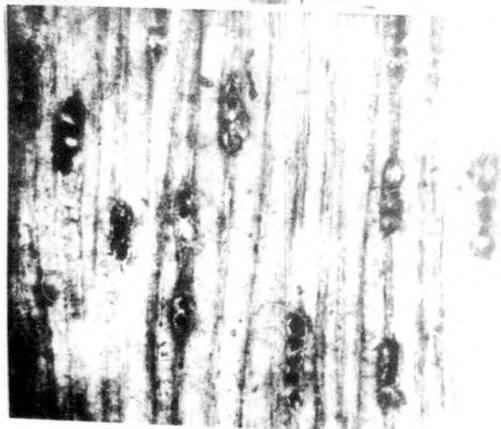
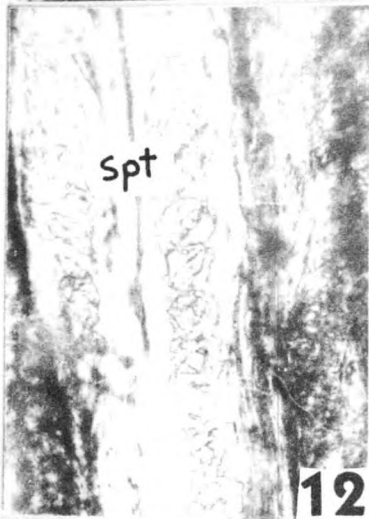
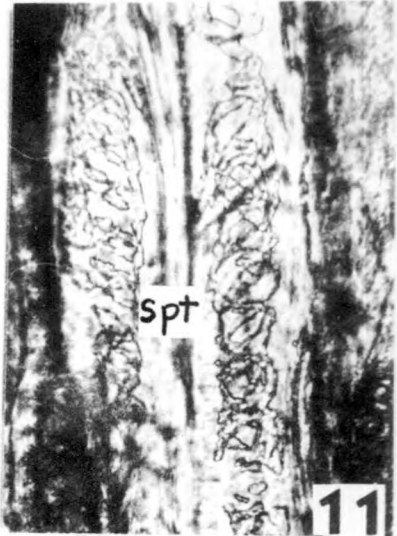
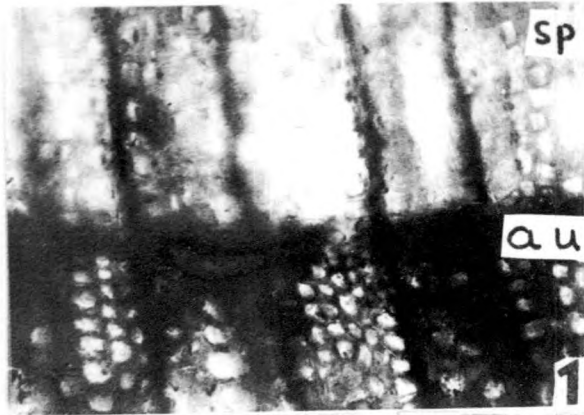


PLATE - II



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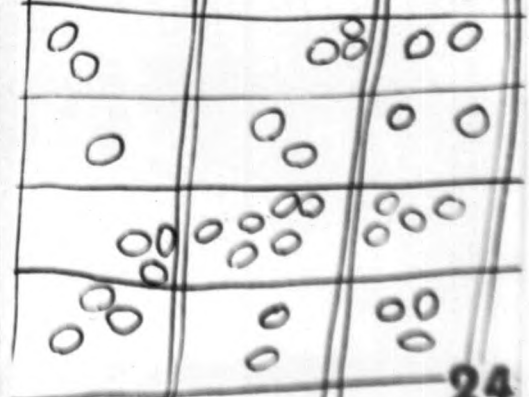
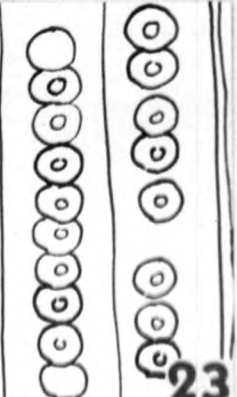
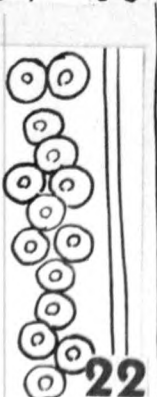
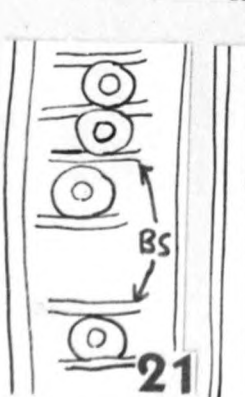
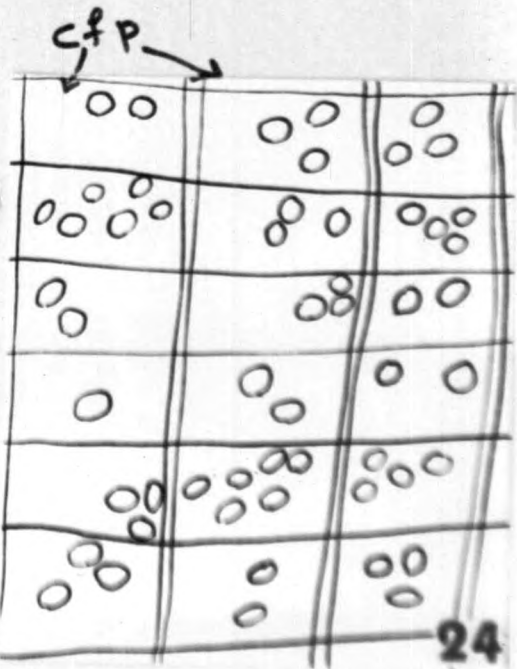
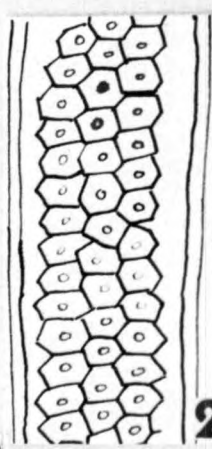
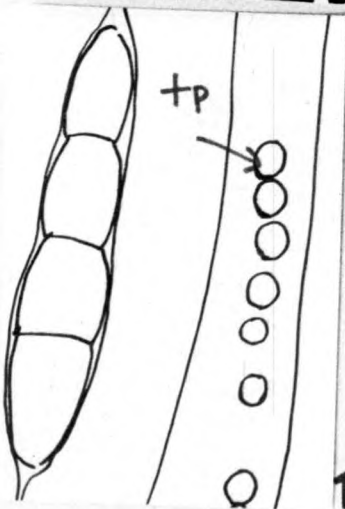
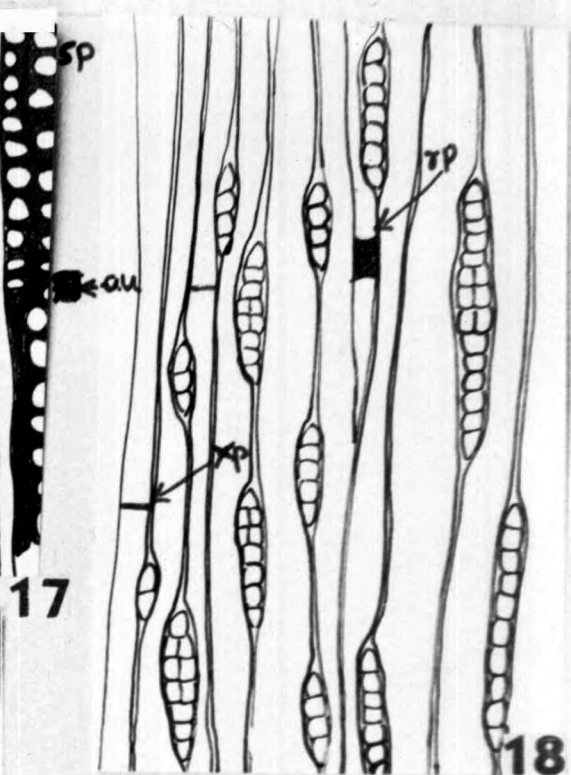
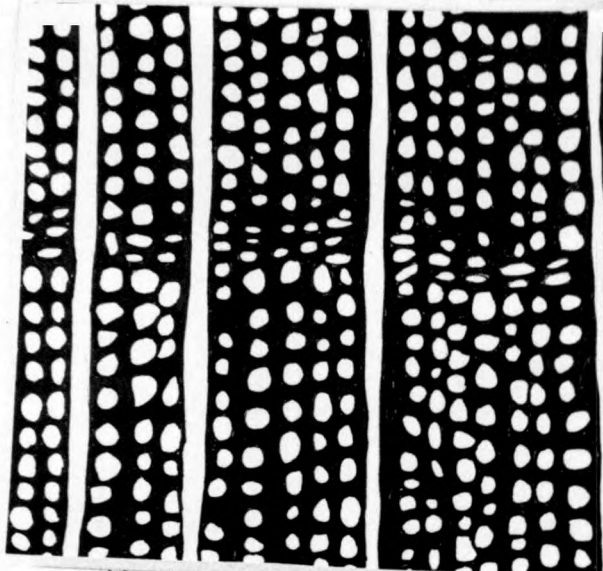
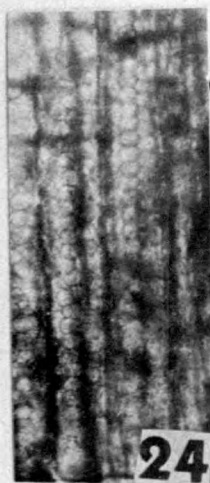
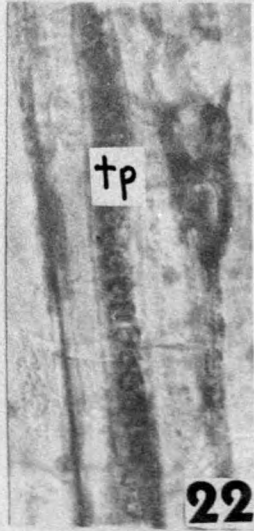
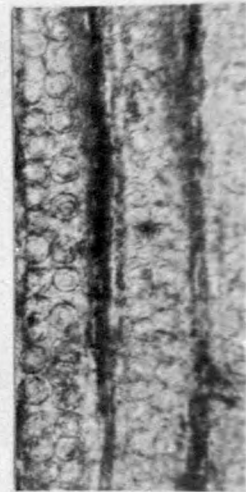
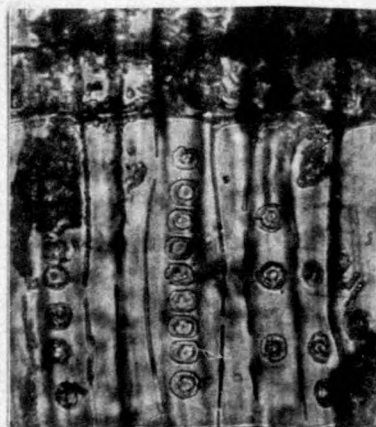
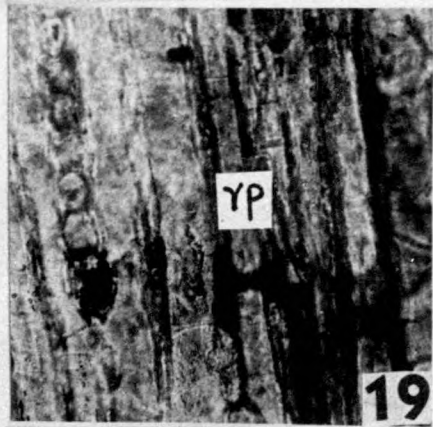
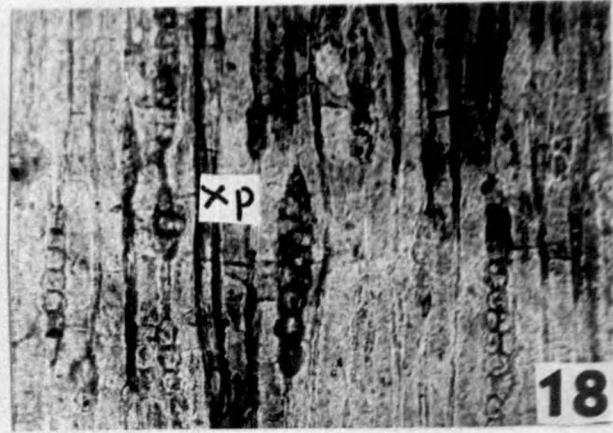
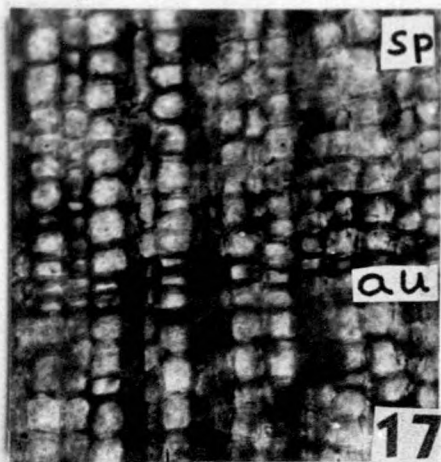




PLATE - III



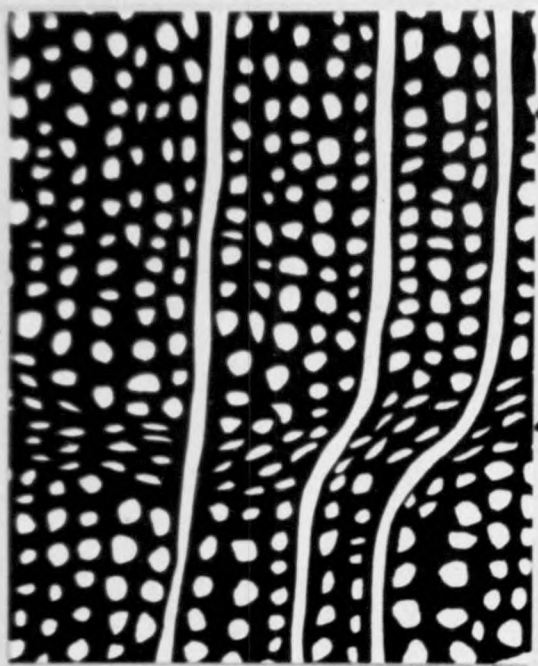
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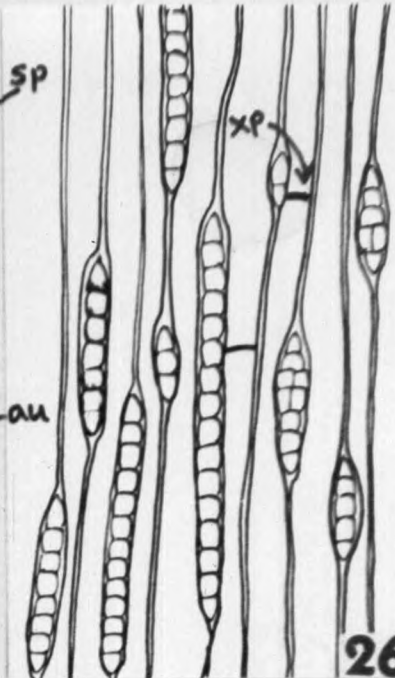
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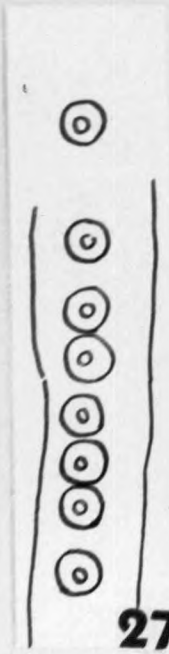
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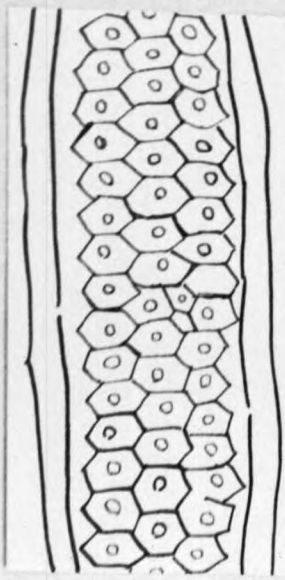
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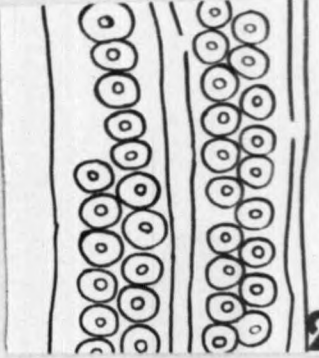
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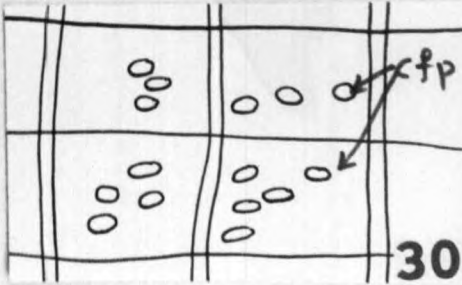
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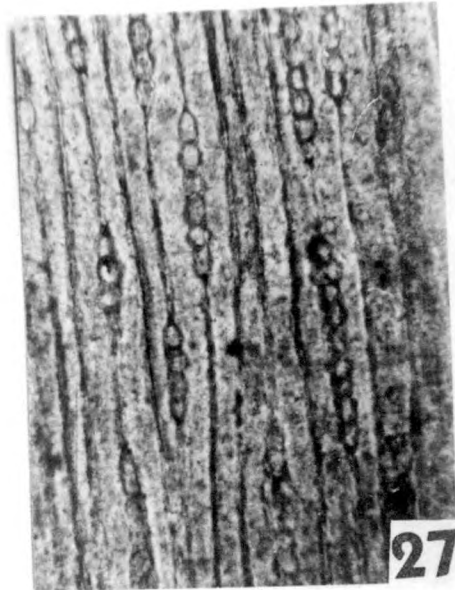
PLATE - IV



sp

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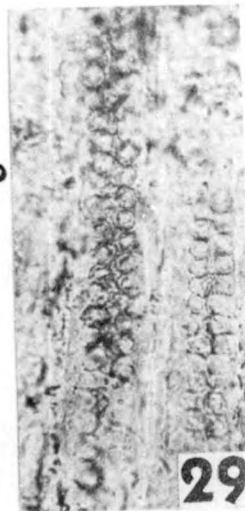
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27



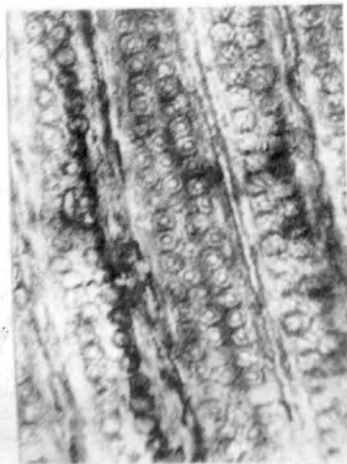
28



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ct+p

xp