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# CHAPTER – V

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## P A R T - I

### Petrified Woods

Genus - Araucarioxylon Kraus 1870

Araucarioxylon garudmangalensis sp. nov.

Several petrified coniferous woods were collected from Garudmangalam in Trichinopoly district of Tamil Nadu. One of the specimen found promising due to presence of interesting characters.

The specimen is a piece of decorticated secondary wood bearing number GARD 795 and measures 7 cm long and 5 cm broad. It is faint brownish in colour and shows excellent preservation. The sections were cut through the planes showing T.S., T.L.S. and R.L.S. following characters were noticed in it.

T.S. : It shows 5 growth rings within a distance of 5 cm. The secondary xylem is differentiated into spring wood and autumn wood. The height of spring wood is 68 cells. Its tracheids are radially arranged. They are squarish in outline and show broad lumen measuring 24 X 28  $\mu$ m. The autumn wood is 2 cells thick. Its tracheids are tangentially flattened and show narrow lumen. They measure 24 X 18  $\mu$ m. Resin canals are absent.

(Text Fig.1, Plate Fig.1)

T.L.S. : Xylem rays are uniseriate. The ray cells are barrel shaped and measure  $12 \times 9 \mu\text{m}$ . The height of rays varies from 1-16 cells. Average height being 5 cells in 25 counts. Ray-cells barrel-shaped and measure  $15 \times 20 \mu\text{m}$ . The interesting features of this wood is presence of xylem parenchyma. It is marked by horizontal septa. Tangential walls of the tracheids are pitted. The pits are uniseriate circular and contiguous or separate. The pits measure  $15 \times 22 \mu\text{m}$ . The pit pore is circular.

(Text Fig.2, Pl. Fig.2)

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

a) Uniseriate pits are circular and contiguous. They measure  $7 \times 6 \mu\text{m}$ . The pit pore is circular.

(Text Fig.4, Pl.Fig.4)

b) Biseriate pits are circular and alternate. The pits measure  $7 \times 7 \mu\text{m}$ . The pore is circular.

(Text Fig.5, Pl.Fig.5)

c) Biseriate pits are hexagonal, alternate and compact. They measure  $6 \times 9 \mu\text{m}$ .

(Text Fig.8, Pl.Fig.8)

d) Multiseriate pits are circular and alternate. They measure  $7 \times 7 \mu\text{m}$ .

(Text Fig.7, Pl.Fig.7)

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e) Bars of sainio are present. They are seen as horizontal bars between successive biseriate circular pits.

(Text Fig.6, Pl.Fig.6)

Cross Field Pits : They are circular to oval and cupressoid in nature. The number of pits is 3-7 cells. They measure 6 X 7  $\mu$ m.

(Text Fig.9, Pl.Fig.9)

Identification and Comparison :

The wood is characterised by 1-2 seriate, circular pits and biseriate hexagonal alternate pits, uniseriate xylem rays and cupressoid type of field pits. In over all features the wood shows affinities of the family Araucariaceae; and agrees with the generic characters of Araucarioxylon Kraus. Lepekhina (1972) suggested the following schemes.

Those woods with radial araucaroid pitting having only secondary xylem should be identified with the genus Araucarioxylon Krausel while the woods with radial Araucaroid pitting having primary feature like pith and primary xylem are identified with genus Dadoxylon Endlicher. Accordingly the present wood is placed under the genus Araucarioxylon but it shows several distinct features like xylem parenchyma, bars of sainio, tangential pits etc. Therefore, it is compared with the other known species of Araucarioxylon described from Indide.

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It is compared with A. santalense (Sah and Jain) Bose and Maheshwari 1974 in having uniseriate xylem rays, 2-6 field pits and 1-2 rows of circular flattened radial pits but the present wood differs from A. santalense in having presence of xylem Parenchyma, bars of Sanio and tangential pitting. Both the woods come from Jurassic beds of India.

It is comparable with A. giftii Jeyasingh and Kumarsamy, 1994 in having uniseriate xylem rays; 1-2 seriate, contiguous, alternate, circular radial pitting and 1-7 field pits. But it differs from A. giftii in having multiseriate circular pits; presence of xylem parenchyma, bars of sanio and tangential pitting. Both these woods come from Mesozoic beds of Tamil Nadu. A. giftii comes from Early Cretaceous of Sriperumbuder formation while present specimen belongs to Trichinoppoly formation in Tamil Nadu.

It is also compared with A. eocenum (Chitale 1949) Trivedi and Srivastav 1989 in having 1-2 seriate circular or hexagonal alternate pits, 1-7 field pits but differs from A. eocenum in having tangential pitting, xylem parenchyma and bars of sanio. Further A. eocenum comes from Eocene beds of India while the present wood belongs to Lower cretaceous of east-coast.

It is further compared with A. mosurensis Jeyasingh and Kumarsamy 1994 in having 1-3 seriate radial pitting; 2-6 field

pits but it differs from A. mosurensis in having uniseriate xylem rays; tangential pitting presence of xylem parenchyma and bars of Sanio. A. mosurensis comes from Cretaceous beds of Tamil Nadu and present wood also belongs to similar horizon from Tamil Nadu.

From the above comparison it appears that the present wood differs from all known species of Araucarioxylon reported from India in one or other characters. Therefore, it is identified and described as a new species namely Araucarioxylon garudmangalensis sp. nov. The specific name is after the locality Garudmangalam in Trichinopoly district of Tamil Nadu.

Diagnosis : Decorticated secondary wood with spring wood and autumn wood. spring wood 68 cells thick, tracheids squarish with broad lumen. Autumn wood 2 cells high. Tracheids tangentially flattened with narrow lumen. Xylem rays uniseriate, 1-16 cells high. Average height 5 cells. Ray-cells barrel shaped. Xylem-parenchyma present. Tangential pitting present. Pits uniseriate and circular. Radial pitting uniseriate circular and contiguous. Biseriate pits circular and alternate. Hexagonal pits are biseriate and alternate. Multiseriate pits are circular and alternate. Bars of sanio present. Cross-field pits cupressoid, 3-7.

Type	:	GARD ---- 7/95
Locality	:	Garudmangalam, District-Trichinopoly, (Tamil Nadu)
Horizon	:	Lower Cretaceous

Genus - Agathoxylon Hartig

Agathoxylon trichinopoliense sp. nov.

For the present studies a number of petrified coniferous woods were collected from Garudmangalam (11°5' : 78°55') in Trichinopoly district of Tamil Nadu. These beds belong to Cretaceous horizon and represent Upper Gondwana flora. A piece of silicified wood measuring 7.7 cm long and 5 cm broad was selected for this work.

It is reddish-brown in colour and shows promising characters. Its sections showing T.S., T.L.S. and R.L.S. were prepared by using thin ground section technique and following anatomical characters are observed in it.

T.S. : The secondary xylem shows 8 growth rings within a distance of 5 cms. It consists of spring wood and autumn wood. The width of spring wood is 20 cells. The tracheids are radially arranged and rectangular in shape. They are thin walled with broad lumen and measure 24 X 20  $\mu$ m. The autumn wood zone is narrow and 3 cells thick. The tracheids are horizontally stretched with narrow lumen. They measure 22 X 14  $\mu$ m.

(Text Fig.10, Pl.Fig.10)

T.L.S. : Xylem rays observed here are only of uniseriate type. Their height varies from 1-10 cells. Average height 4 cells in 25 counts. The ray cells are ovoid in shape

measuring 10 X 23  $\mu\text{m}$ . Tangential walls of the tracheids are unpitted. A remarkable feature observed here is presence of xylem parenchyma. It is marked by a transverse septa.

(Text Fig.11, Pl.Fig.11)

R.L.S. : Radial walls of the tracheids show :

a) Uniseriate circular flattened separate pits. They are bordered and measure 6 X 5  $\mu\text{m}$ .

(Text Fig.12, Pl.Fig.15)

b) Biseriate pits are circular and vestured. They show ornamentation on the wall resembling the vestured pits of Agathis australis Salisb.

(Text Fig.15, Pl.Fig.16)

c) Multiseriate pits are circular and alternate measuring 7 X 6  $\mu\text{m}$ .

(Text Fig.14, Pl.Fig.12)

d) Hexagonal pits of araucaroid type are biseriate to multiseriate alternate and compact. They measure 7 X 8  $\mu\text{m}$ .

(Text Fig.13, Pl.Fig.13)

Cross-field pits : They are circular to oval in shape bordered and measure 5 X 4  $\mu\text{m}$ . Their number varies from 3 to 9.

(Text Fig.16,17, Pl.Fig.14,17).



Identification and Comparison :

This wood shows outstanding features, (1) Distinct growth rings, (2) Presence of xylem parenchyma, (3) Uniseriate and multiseriate circular pits, (4) Hexagonal alternate pits of araucaroid type, (5) Biseriate vestured pits and (6) 3-9 circular to oval cross-field pits. These features belongs to the family Araucariaceae and the genus Agathis (Greguss, 1955).

The fossil woods of Agathis are described under the generic name Agathoxylon Hartig. Hence this wood is identified with it. Hartig (1848) instituted the genus Agathoxylon for the wood collected from Triassic of Germany. It shows presence of xylem parenchyma. Evans (1939) described A. australe from lignites of Australia belonging to Pliocene period. He compared it with living member A. australis. Patton (1958) described A. resinifera showing characters resembling A. australis. But this wood shows some additional features like bark and true resin tracheids. Gregus (1952) described A. hungaricum from Lower Cretaceous of Germany.

Recently Krausel and Jain (1964) have described Dadoxylon agathiodes from Jurassic of Rajmahal hills in Bihar. It shows 1-2 seriate radial pitting, 1-2 seriate xylem rays and 2-8 field pits. Vagyani and Jamane (1986) described Agathoxylon maheshwarii from Kamthi beds of Maharashtra which represent

the Upper Permian age. It shows 1-2 seriate xylem rays, presence of xylem parenchyma, 1-3 seriate radial pits, vestured pits and 2-3 field pits.

From the above comparison it is found that the present wood differs from the known species of Agathoxylon in one or other characters and hence it is described as a new species viz. Agathoxylon trichinopoliense sp. nov. The specific name is after the district Trichinopoly to which it belongs.

Diagnosis :

A petrified secondary wood with distinct growth rings. Spring wood 20 cells high. Tracheids rectangular 24 X 20  $\mu\text{m}$ . Autumn wood narrow 3 cells thick, tracheids 22 X 14  $\mu\text{m}$ . Xylem rays uniseriate 1-10 cells high average 4 cells. Ray cells ovoid 16 X 23  $\mu\text{m}$ . Radial pits, uniseriate pits circular separate 6 X 5  $\mu\text{m}$ . Biseriate pits circular, vestured. Hexagonal pits 2-3 seriate alternate 7 X 8  $\mu\text{m}$ . Cross-field pits 3-9 bordered, oval 5 X 4  $\mu\text{m}$ .

Type : GARD  
2/95

Locality : Garudmangalam, Dist.Trichinopoly,(Tamil Nadu).

Horizon : Lower Cretaceous

Genus - Podocarpoxylon Gothan 1905

Podocarpoxylon rajmahalense (Jain 1965) Bose & Maheshwari 1974

Several pieces of petrified coniferous woods were collected from Uttatur in Trichinopoly district of Tamil Nadu. The pieces are yellowish white in colour highly silicified showing weathered conditions resulting in the poor preservation of the characters.

One of the specimen is selected showing moderate preservation for the present investigation. It represents secondary xylem and devoid of primary features.

The specimen measures 7 cm long and 8 cm wide. The sections were prepared showing T.S., T.L.S. and R.L.S. Following characters are observed in it.

T.S. : It shows indistinct growth rings their number found is 15 within a distance of 8 cms. The secondary xylem is differentiated into spring wood and autumn wood. The spring wood consists of tracheids which are oblong in shape measuring 27 X 17  $\mu$ m, they are thick walled with broad lumen. The height of spring wood is 80 cells. Resin field tracheids are absent. The autumn wood is 2 cells in width and consist of horizontally stretched tracheid with narrow lumen. The tracheids measure 21 X 15  $\mu$ m.

(Text Fig.18, Pl.Fig.18)

T.L.S. : The xylem rays observed in T.L.S. are prominent they are only of uniseriate type. The ray cells are thin walled rounded or oval in shape. The height of rays varies from 1-9 cells. The average height being 4 cells in 25 counts. Xylem parenchyma is absent. Tangential walls of the tracheids are smooth. The ray cell measures 14 X 16  $\mu\text{m}$ .

(Text Fig.19, Pl.Fig.19)

R.L.S. : Pits on the radial walls of the tracheids show the following patterns.

- a) Uniseriate pits are circular and separate the pits measure 7 X 6  $\mu\text{m}$ . The pit-pore is circular and measures 6 X 6  $\mu\text{m}$ .

(Text Fig.21, 22, Pl.Fig.20,21)

- b) Biseriate pits are circular and more or less in opposite pairs. The pits measures 6 X 7  $\mu\text{m}$  and the pit pore is circular.

(Text Fig.20, Pl.Fig.22)

Cross field pits : The pits in the cross field area are circular showing round to oblique pit pore the number of field pit varies from 1 to 2. They measure 4 X 4.5  $\mu\text{m}$ .

(Text Fig.23,24, Pl.Fig. 23,24)

Identification and Comparison :

The wood shows important characters of family podocarpaceae. The fossil woods of Podocarpaceae are described under

different generic names. Genus Podocarpoxyton was institute by Gothan (1905). He also instituted genus Phyllocladoxyton for Podocarpaceae woods showing resemblance with the genus Phyllocladus. Stopes (1915) merged Phyllocladoxyton Gothan with Podocarpoxyton. Later on Seward (1919) created a new genus Mesembrioxylon for such woods and rejected the name Podocarpoxyton. The reason given was the fossil woods do not show clear affinities of a particular living genus like Podocarpus or Phyllocladus. The name Mesembrioxylon is an artificial name and adopted by several workers from Indian and outside. Recently Bose and Maheshwari (1974) suggested that the name Podocarpoxyton is a correct name due to its earlier use hence on the basis of principal of priority. The name Mesembrioxylon should be replaced by the name Podocarpoxyton.

It is compared with Podocarpoxyton fusiforme (Sahni) Bose and Maheshwari 1974 in having 1 to 2 simple fusiform pits and uniseriate xylem rays and absence of xylem parenchyma. However, in the present wood, radial pitting is unicellular circular as well as biseriate circular pits. Further in P. fusiforme field pit number is 3 to 5. In the present wood, it is a restricted to 1 to 2 only.

It is also compared with P. fluviale (Sahni) Bose and Maheshwari (1974 in having uniseriate circular separate radial pits; 1 to 2 field pits and uniseriate xylem rays. But the

present wood differs from it in having biseriate circular radial pits and absence of xylem parenchyma. P. fluviale belongs to Tertiary horizon while present wood comes from Cretaceous horizon of India.

It is comparable with P. trichinopoliense (Verma) Bose and Maheshwari 1974 in having uniseriate xylem rays; 1 to 2 field pits and uniseriate circular separate radial pits, however, the present wood differs from P. trichinopoliense in absence of Xylem parenchyma and biseriate circular radial pitting. The interesting fact about this wood is it belongs to Cretaceous beds of Tamil Nadu and the present wood also comes from the same horizon.

From the above comparison, it is closely compared with P. rajmahalense (Jain) Bose and Maheshwari 1974 in having 1 to 2 field pits; uniseriate and biseriate circular radial pitting. Uniseriate xylem rays and absence of xylem parenchyma. It is reported from Jurassic beds of Rajmahal hills of Bihar while present wood comes from Cretaceous beds of Trichinopoly in Tamil Nadu. Due to similarities with most of the characters found in these two woods the present wood is described and identified as P. rajmahalense from Trichinopoly.

Occurrence of P. rajmahalense in the Upper Gondwana beds of the east coast suggests that it has wider range of

distribution from Bihar to Tamil Nadu. It is well-known fact that Rajmahal flora is rich in conifers particularly the podocarpaceous genera like Elatocladus and Podocarpoxyton are already known from the area. Present observation suggests that the family Podocarpaceae was widely distributed in the past however now it is localised to the peninsular India only.

Type : UTR  
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5/95

Locality : Uttatur, District-Trichinopoly (Tamil-Nadu)

Horizon : Lower Cretaceous

Explanation of Text Figures

1. Ptilophyllum sp. cf. P. sahani X 2
2. Ptilophyllum acutifolium X 1.25
3. Ptilophyllum cf. P. distans. X 2
4. Pterophyllum rajmahalense X 1.25
5. Dictyozamites indicus X 2
6. Dictyozamites feistmantelii X 0.75
7. Otozamites X 1.25
8. Anomozamites amarjolense X 1.25
9. Elatocladus tennerrimus X 1.25
10. Elatocladus plana X 2
11. Brachyphyllum X 2
12. Desimophyllum indicum X 2

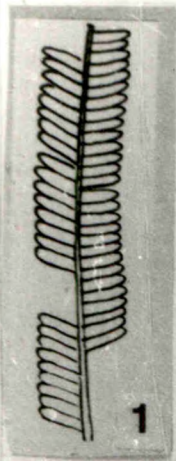


Explanation of Plate Figures

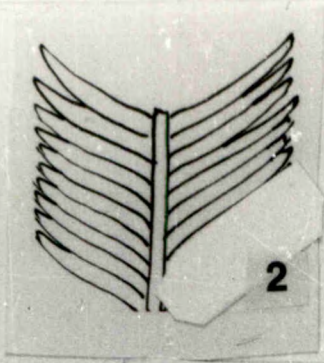
1. Ptilophyllum sp. cf. P.Sahni X 2.50
2. Ptilophyllum acutifolium X 2.25
3. Ptilophyllum cf. P. distans X 2.50
4. Pterophyllum rajmahalense X 2
5. Dictyozamites indicus X 2.50
6. Dictyozamites feistmantelii X 1.25

Explanation of Plate Figures

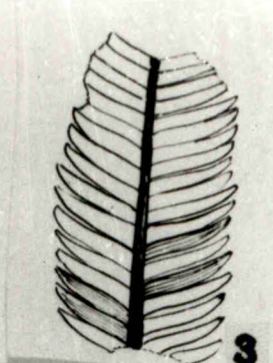
7. Otozamites X 2.25
8. Anomozamites amarjolense X 2.20
9. Elatocladus tenerrimus X 1.25
10. Elatocladus plana X 2.25
11. Brachyphyllum X 2
12. Desimophyllum indicum X 2.25



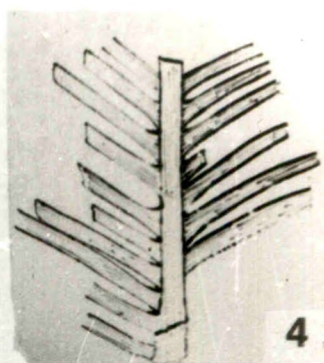
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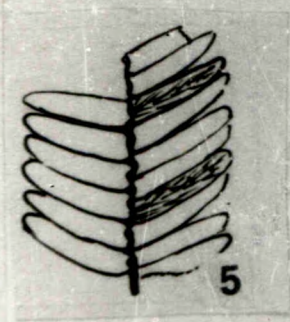
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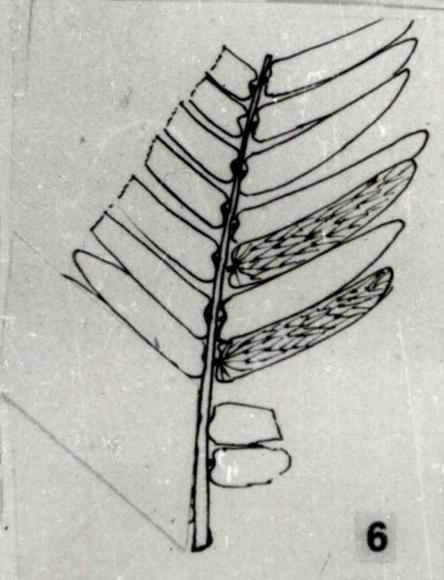
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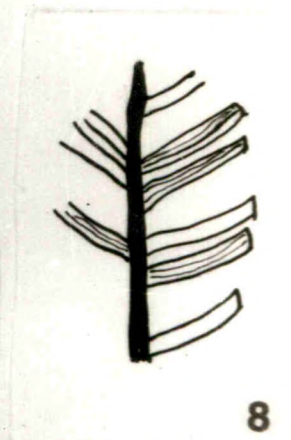
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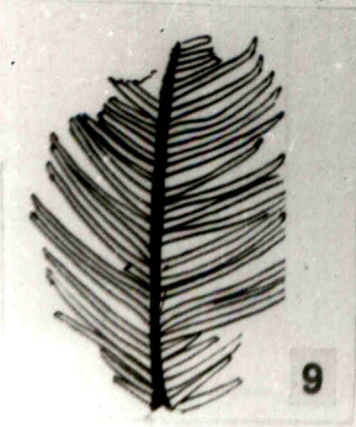
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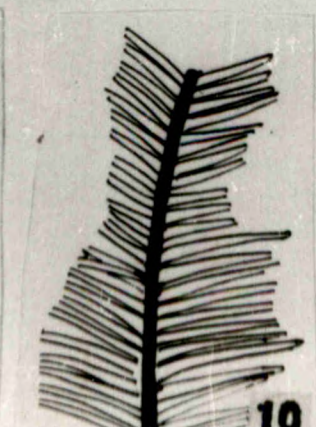
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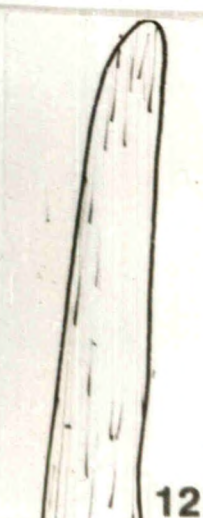
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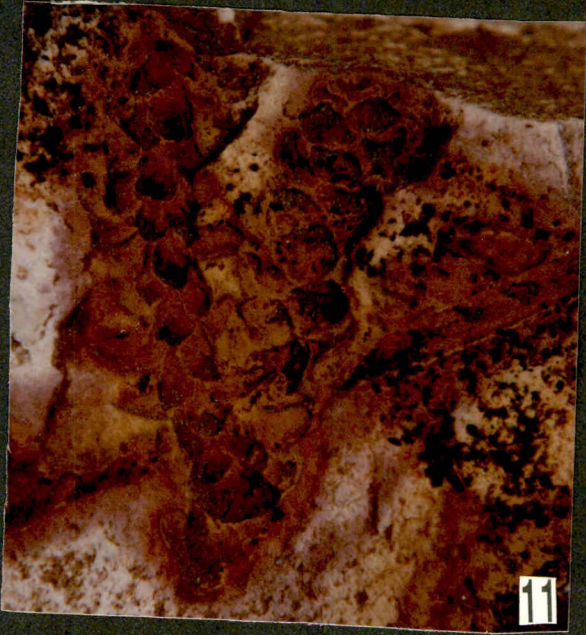
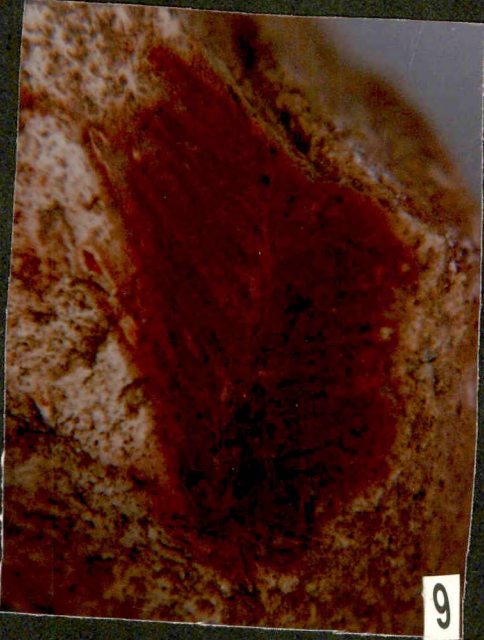
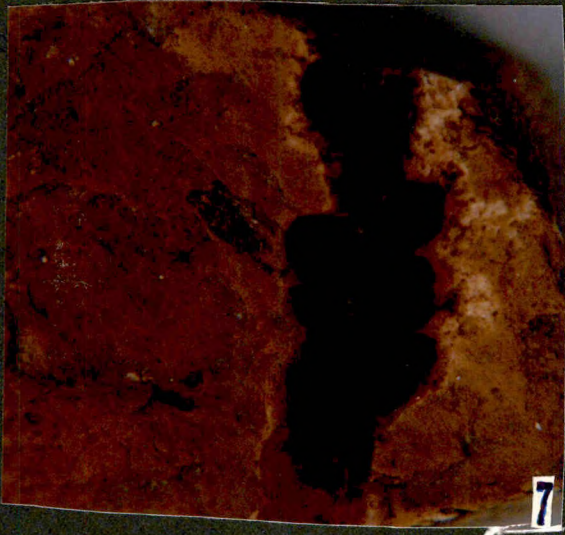


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PLATE-I



PLATE-II



- Podocarpoxyton uttaturensis sp. nov.

Several pieces of silicified coniferous woods were collected from Uttatur in Trichinopoly district of Tamil Nadu. Due to weathering the woods do not show well preserved characters. Hence only those pieces are selected having moderately preserved characters. For the present work a piece numbered UTR/18/95 was studied on account of its better preservation. The specimen is a decorticated piece of secondary wood measuring 10 cm long and 3.5 cm broad. It is devoid of pith and primary xylem. The sections passing through various planes such as T.S., T.L.S. and R.L.S. were prepared. Following characters are observed in it :

T.S. : It shows 4 distinct growth rings within a width of 3 cms. The secondary xylem is distinguishable into spring

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wood and autumn wood. The height of spring wood is 40 cells. Its tracheids are rectangular, thick-walled and show broad lumen measuring 25 X 27  $\mu\text{m}$ . The autumn wood is 2 celled thick. Its tracheids are horizontally stretched and show narrow lumen. They measure 22 X 18  $\mu\text{m}$ .

(Text Fig.25, Pl.Fig.25)

T.L.S. : The xylem rays are of uniseriate type only. Height of xylem rays ranges from 2-13 cells. Average height found is 5 cells in 25 counts. The ray-cells are barrel-shaped and measure 16 X 22  $\mu\text{m}$ . Xylem parenchyma is absent. Tangential walls of the tracheids are devoid of pitting.

(Text Fi.26, Pl.Fig.28)

R.L.S. : Pits on the radial walls of the tracheids show following types -

- a) Uniseriate pits are circular and separate. They measure 5 X 6  $\mu\text{m}$ . Pit pore is round and 3 X 4  $\mu\text{m}$ .

(Text Fig.27, Pl.Fig.27)

- b) Biseriate pits are circular and more or less arranged in opposite fashion. They measure 4 X 5  $\mu\text{m}$ . Pit pore is circular and 5 X 6  $\mu\text{m}$ .

(Text Fig.28, Pl.Fig.26)

- c) Bars of Sanio are present. They are found between successive pits.

(Text Fig.29, Pl.Fig.30)

Cross-field pits : Pits in the cross-field area are large and more or less obliquely arranged. In each field area, single pit is present. It measures 4 X 5  $\mu$ m.

(Text Fig.30, Pl.Fig.31)

Identification and comparison :

The characters of the present wood agrees with those of Podocarpoxyton Gothan 1905. Hence generically it is identified with it.

It is compared with Podocarpoxyton fusiformae (Sahni) Bose and Maheshwari 1974 in having uniseriate xylem rays. Uniseriate radial pitting and presence of bars of Sanio. But present wood differs from P. fusiformae in having single field pit; while in P. fusiformae 1-2 long fusiform and sometimes 3-5 small field pits are present.

It is comparable with P. parthsarthyi (Sahni) Bose and Maheshwari 1974 in having uniseriate xylem rays and uniseriate radial pitting. But present wood differs from P. parthsarthyi in having single pit in the cross-field area and presence of bars of sanio. In P. parthsarthyi number of field pits is 2-5 and bars of sanio are absent.

It is further compared with Podocarpoxyton sahnii (Ramanujam) Bose and Maheshwari 1974 in having uniseriate xylem rays, uniseriate radial pits and single pit in the field.



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However present wood is distinct from P. sahnii due to presence of bars of Sanio which is absent in Ramanujam's wood.

It is also compared with Podocarpoxydon trichinopoliense (Verma) Bose and Maheshwari 1974 in having uniseriate Xylem rays and uniseriate radial pits. But present wood differs from P. trichinopoliense in having bars of sanio and single field pit. In P. trichinopoliense number of field pits is 1-2 and it is devoid of bars of sanio.

From the above comparison it appears that the present wood differ from known species of Podocarpoxydon in one or other characters. Hence it is described as a new species viz. Podocarpoxydon uttaturensis sp.nov.

The specific name is after the locality Uttatur from which it was collected. From Uttatur Sahni (1931) described a coniferous wood as Dadoxylon sp. Later on there are no reports of fossil woods from this locality. Hence present report adds more information about the coniferous woods from this place.

Diagnosis :

A decorticated secondary wood with spring wood and autumn wood. Spring wood 40 cells high. Tracheids rectangular with broad lumen. Autumn wood 2 cells thick. Tracheids

horizontally stretched with narrow lumen. Xylem rays uniseriate, 2-3 cells high, average height 5 cells. Ray-cells barrel shaped. Radial pits uniseriate, circular and separate. Biseriate pits circular and opposite, bars of sanio present. Single large pit in the field area obliquely placed.

Type : UTR-8/95.

Licality : Uttatur, Dist.Trichinapoly, Tamil Nadu.

Horizon : Lower Cretaceous.

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PART-II

IMPRESSION

Genus - Ptilophyllum Morris 1840

Ptilophyllum sp. cf. P. sahnii Gupta & Sharma.

(Text Fig. 1 - Pl.I, Fig.1)

The specimen is a Pinnate leaf measuring 4.6 cm long and 1 cm wide. Rachis is nearly covered by the Pinnae on the upper surface and 1 mm thick. Pinnae are small oblong to ovate in shape and arranged in the sub-opposite fashion. They measure 0.6 cm in length and 0.2 cm in width. Pinnae are attached on the upper part of the rachis by whole base at an angle at 60°. Episcopic margin rounded and basiscopic margin decurrent. Margins are entire and apex is obtuse. Number of venins per pinna is 4-5. They arise from the basal part run parallel and show forking.

Identification : The specimen closely agrees with the morphological characters of P. Sahnij Gupta & Sharma given by Bose & Kasat (1972) in having small oblong to ovate pinna; obtuse apex. Episcopic rounded margin, number of vein and angle of attachment. However, Gupta & Sharma (1968B) and Bose & Kasat (1972) have described the cuticular features of the P. sahnii. In the present specimen cuticle is absent. Hence it is described as Ptilophyllum sp. cf. P. sahnii Gupta and Sharma.

Recently Mahabale & Satyanarayana (1979) described it from Raghudevapuram in East Godavari district of Andhra Pradesh. Present specimen comes from Uttatur in Tiruchirapalli district of Tamil Nadu and supports its occurrence on the east-coast.

Type -  $\frac{UTR}{16/95}$

Locality - Uttatur, District - Trichanapalli (T.N.)

Horizon - Lower Cretaceous.

Ptilophyllum acutifolium

(Text Fig.2, Pl. I - Fig.2)

The specimen is a biseriate pinnate frond measuring 3.2 cm long and 2.4 cm wide. The apical and basal region is missing. rachis is partly covered by pinnae bases and 1 mm broad. Pinnae are linear to lanceolate in shape and measure 1.2 X 0.3 cm. They are attached on the upper region of the rachis at an angle of 60°. They are closely set and alternately disposed. Pinnae margins are somewhat straight. Episcopic margin rounded while basispic margin is decurrent. Number of veins per pinnae is 3. They emerge from the whole base run parallel and show forking. Apex is acute.

Identification : The present specimen closely resembles with the characters of P. acutifolium Morris given by Bose and Kasat

(1972). The principal characters are linear to lanceolate pinnae, Acute apex, Episcopic margin rounded and basispic margin decurrent, therefore, it is identified and described as such.

According to Bose & Kasat (1972) P. acutifolium Morris is widely distributed in species in the Upper Gondwana flora of India. Recently several authors recorded it from East Coast Gondwana localities. Mahabale & Satyanarayana (1979) described it from Raghudevapuram in East-Godavari district of Andhra Pradesh. Jeyasingh & Sudhersan (1986) reported it from Sivaganga beds in Tamil Nadu. Sukh-Dev and Rajanikanth (1988) reported its occurrence from Tiruchirapalli district in Tamil Nadu. Present specimen comes from Uttatur in Tamil Nadu and supports its wider distribution along the East Coast.

Type - UTTR  
15/94

Locality - Uttatur, District - Trichanapolli (T.N.)

Horizon - Lower Cretaceous

Ptilophyllum cf. P. distans (Feistmantel) Jacob & Jacob

(Text Fig.3, Pl.I - Fig.3)

The specimen is a pinnate leaf measuring 2.9 cm long and 1.7 cm broad. Rachis is distinct and 2 mm thick. Pinnae are linear to oblong in shape and arranged in alternate fashion. They measure 9 mm long and 2 mm broad. Pinnae are attached on upper surface of the rachis at an angle of 70°. Margins are

entire and apex is obtuse. Episcopic margin rounded and basispic margin is decurrent. Number of veins per pinna is 7. They arise from the basal part of the pinna run parallel and show forking.

Identification : The specimen resembles with the morphological characters of P. distans given by Bose & Kasat (1972) in having linear to oblong pinnae, obtuse apex and angle of attachment of the pinnae to the rachis. Further pinnae are arranged in such a way that they show distance between successive pinnae. However, cuticular characters of P. distans is described by Bose and Kasat (1972) and Bose and Banerji (1934). Hence it is described as Ptilophyllum sp. cf. P. distans (Feistmantel) Jacob and Jacob. Recently it is described by Mahabale and Satyanarayana (1979) from East Godavari district of Andhra Pradesh. Present specimen is collected from Therani in Trichanapalli district of Tamil Nadu. This suggests wider distribution of P. distans on the East Coast.

Type - THR  
6/95

Locality - Therani, District - Trichanapalli (T.N.)

Horizon - Lower Cretaceous.

Genus - Pterophyllum Brongniart

Pterophyllum rajmahalense Morris

(Text Fig.4, Pl.I - Fig.4)

The specimen is a pinnate leaf measuring 6 cm in length and 2.8 cm in width. Rachis is broad striated longitudinally and 3 mm thick. Pinnae are attached to the rachis laterally at an angle of 80°. They are closely set and sub-opposite in arrangement. Pinnae are smaller in size, 2 cm long and 1 cm broad. Apex is obtuse and margins are entire. Number of veins per pinnae is 10-11 simple and running parallel.

Identification : The present leaf broadly resembles with the characters of P. rajmahalense Morris given by Bose and Banerji (1981) in having pinnae smaller in size, closed set and sub-opposite in arrangement, obtuse apex and number of veins 10-11. Hence it is identified as such. P. rajmahalense is so far reported from localities in Rajmahal hills of Bihar only. Present specimen is collected from Therani in Tamil Nadu. This suggests its wider distribution in India. Further it is reported for the first time from the East Coast.

Type - THR  
2/95

Locality - Therani, District -Trichanapalli (T.N.)

Horizon - Lower Cretaceous.

Genus - Dictyozamites Oldham

Dictyozamites indicus Feistmantel

(Text Fig.5, Pl.I - Fig.5)

The specimen is a pinnate frond measuring 8.5 cm in length and 3 cm in breadth. It is uniformly broad for major part of the length. Rachis is distinct, 3 mm wide and partially concealed by the pinnae bases. Pinnae are closely set and touch each other. Pinnae are linear to lanceolate falcate and slightly curved. They measure 1.5 cm long and 0.4 broad. Acroscopic and basiscopic margins auriculate. Margins are entire and apex is obtuse. Pinnae are attached to the rachis at an angle of 75°. Veins arise from the basal part divide and from the basal part divide and form reticulate venation. They show meshes of equal size.

Identification : The present specimen closely agrees with the morphological characters of D. indicus Feistmantel given by Bose and Zeba-Bano (1978) in having uniformly broad frond, leaves, falcate, auriculate margins, obtuse apex and venation showing meshes of equal size. Therefore, it is identified and described as such. According to Bose and Zeba-Bano (1978) it is earlier reported from Rajmahal hills in Bihar, Parsapani in Hoshangabad district in M.P. and Vemavaram in Andhra Pradesh. Present specimen is collected from Uttatur in Trichanapalli district of



Tamil Nadu. It supports the presence of D. indicus on the East Coast and shows wider distribution.

Type -  $\frac{UTTR}{8/84}$

Locality - Uttatur, District - Trichanapalli (T.N.)

Horizon - Lower Cretaceous.

Dictyozamites feistmantelii Bose & Zeba-Bano

(Text Fig. 6, Pl.I.-Fig.6)

The specimen is a pinnate leaf having available length is 8 cm and width is 4.5 cm. Rachis is partly covered by pinnae bases and 2 mm wide. Pinnae are alternately arranged closely set and almost straight. They are linear to lanceolate in shape and measure 4.2 cm long and 0.9 cm broad. Margins are entire and apex is obtuse. Episcopic and basispic margins auriculate. A stalk is formed from middle part of pinnae base and pinnae are attached by the stalks. From the basal part of pinnae 4-6 veins arise and divide to form reticulate venation. The meshes in the middle part are longer in size while those near the margins are short.

Identification : The present specimen resembles with the morphological characters of D. feistmantelii Bose and Zeba-Bano (1978) in having falcate pinnae, both margins auriculate, obtuse

apex, and formation of stalk by the pinnae bases. Hence it is identified as such. According to Bose and zeba-Bano (1978) D. feistmantelli is reported from Gollapalle, Raghavapuram, Sriperambudur and Vemavaram on the East Coast. It is also found in Hoshangabad district of Madhya Pradesh. Vagyani and Jamane (1987) described it from Uppugunduru in Andhra Pradesh. Sukh-Dev and Rajanikanth (1988) described it from Therani in Tamil Nadu. Present specimen is collected from Uttatur in Trichanapalli district of Tamil Nadu. It supports the wider distribution of D. feistmantelli on the East Coast.

Type -  $\frac{\text{UTTR}}{10/95}$

Locality - Uttatur, District - Trichanapalli (T.N.)

Horizon - Lower Cretaceous

Otozamites sp.

(Text Fig.7, Pl.II - Fig.7)

The specimen is a fragmentary pinnate frond having 1.8 cm length and 0.6 cm width. Rachis is slender and almost covered by the pinnae bases. Pinnae are orbicular in shape and attached to the rachis at an angle of 60°. They measure 3 mm long and 2 mm broad. Margins are entire and apex is obtuse. Number of veins per pinnae is 4-5. The veins are radiating from basal region of the pinnae and show forking once.

Identification : The specimen resembles with generic characters of Otozamites Braun in gross features. It is compared with Otozamites walkamotaensis Bose and zeba-Bano (1984) in having orbicular pinnae and obtuse apex. But number of veins per pinna in O. walkamotaensis is 8-14. Further cuticular features of the species are known. Present species is devoid of cuticle. It is also compared with O. vemavarmensis Bose and Jain (1967) described from Vemavaram in Andhra Pradesh in having lesser number of veins. But pinna of O. vemavarmensis are deltoid in shape while here they are orbicular in shape. On account of these differences the present specimen appears as a distinct species. However, due to its fragmentary nature it needs more characters to ascertain the species. Hence it is described as Otozamites sp. It is collected from Therani in Trichanapalli district in Tamil Nadu. Bose (1974) has given a brief report of Otozamites in India. He observed that Otozamites is rare genus in India. Recently Vagyani (1986) described O. vemavarmensis from Uppugunduru in new locality in Andhra Pradesh.

Type - THR  
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14/95

Locality - Therani, District - Trichanapalli (T.N.)

Horizon - Lower Cretaceous

Genus - Anomozamites Schimper 1870

Anomozamites amarjolense Sharma, Suranga, Singh 1971

(Text Fig.8, Pl.II - Fig.8)

The specimen is a pinnate frond measuring 3.5 cm long and 1.2 cm wide. Rachis is distinct and 1.5 mm thick. Lamina is segmented. Segments are closely set and contiguous. They are broad and measure 4 mm long and 2 mm wide. Margins are entire and apex is obtuse. Segments are attached to the entire base at an angle of 60°. Number of veins per segment is 4-5. They arise from the base run parallel and show forking.

Identification : The specimen resembles with generic characters of Anomozamites in having segmented lamina with parallel veins. It closely resembles with A. amarjolense described by Sharma, Suranga and Singh (1971) in having prominent rachis size and shape of segments and pattern of venation. Hence it is identified and described as A. amarjolense. Recently Jeysingh and Sudharsan (1986) described A. hamsapurensis Bose and Banerji (1981) from Sivaganga formation in Tamil Nadu. Sukh-Dev and Rajanikanth (1988) reported the occurrence of A. habarensis Bose and Banerji (1981) from Therani in Trichanapalli district of Tamil-Nadu. Present specimen is collected from Uttatur in Trichanapalli district of Tamil Nadu. It supports the occurrence of Anomozamites on the East coast. A. amarjolense is described by Sharma, Surana and Singh (1971) from Rajmahal hills in

Bihar. Present report suggests wider distribution of this species in India.

Type -  $\frac{\text{UTTR}}{22/94}$

Locality - Uttatur, Dist - Trichanapalli (T.N.)

Horizon - Lower Cretaceous.

Genus - Elatocladus Halle

Elatocladus tenerrimus (Feistmentel) Sahni.

(Text Fig.9, Pl.II - Fig.9)

The specimen is vegetative shoot, having 2.2 cm length and 1.5 cm width. Rachis is slender 1 mm thick and striated longitudinally. Leaves are spirally disposed. They are linear to lanceolate in shape and arise at an angle of 70°. Leaf base is constructed. Leaves measures 1.2 cm in length and 1 mm in width. Margins are entire. Apex is obtuse. Each leaf shows a single mid-vein traversing the entire length of the lamina.

Identification :The morphological characters of the present specimen closely agree with those of E. tenerrimus (Feistmantel) Sahni (1928) and hence it is identified as such. The important features are linear to lanceolate leaves, constructed base and obtuse apex. Earlier it is reported from Satpura basin, in Madhya Pradesh.

Recently it is reported from Gardeshwar by Bose et al (1984), Sukh-Dev and Rajanikanth (1988) described it from Therani in Tiruchirapalli district in Tamil Nadu. Present specimen is collected from Uttatur in the same area and supports its occurrence in the area.

Type -  $\frac{UTR}{7794}$

Locality - Uttatur, District - Trichanapalli (T.N.)

Horizon - Lower Cretaceous

Elatocladus plana (Feistmantel) Seward, 1919.

(Text Fig.10 : Pl.II - Fig.10)

The specimen is an unbranched sterile leafy twig having length of 3.2 cm and breadth of 3 cm. Rachis is distinct and 1.5 mm thick. Leaves are linear to lanceolate in shape showing spiral arrangement. They are spread in one plane. Each leaf measures 1.8 cm long and 0.1 cm broad. Margins are entire and apex is sub-acute. A persistent midrib is observed in each leaf traversing the entire length of the lamina. Leaves are attached to the rachis by entire base at an angle of 65°.

Identification : The specimen closely resembles with the characters of E. plana (Feistmentel) seward in having linear to lanceolate leaves spreading in one plane. Leaf base broad, persistent midrib and sub-acute apex. Hence it is identified

and described as such. It is described by Sahni (1928) from Sriperambudur in Tamil Nadu. Bakshi (1968) reported it from Raghavapuram in Andhra Pradesh. Sukh-Dev and Rajanikanth (1988) described it from Therani in Trichinapalli district of Tamil Nadu. Jeysingh and Sudharsan (1986) described it from Sivaganga in Ramnathpuram district of Tamil Nadu. Vagyan and Jamane (1987) described it from Uppugunduru in Andhra Pradesh. Mahabale and Satyanarayana (1979) described it from Andhra Pradesh. This shows wider occurrence of E. plana on the East Coast. Present specimen is collected from Uttatur in Trichinapalli district of Tamil Nadu and supports its entire occurrence on the East Coast.

Type -  $\frac{UTTR}{2/95}$

Locality - Uttatur, District - Trichanapalli (T.N.)

Horizon - Lower Cretaceous

Genus- Brachyphyllum Brongniart 1828  
Brachyphyllum rhombicum (Feistmantel) Sahni 1928  
 (Text Fig.II, Pl.II - Fig.II)

The specimen is a branched shoot measuring 3.5 cm long and 3 cm wide. Branches are sparsely given out at an angle of 55°. Leaves are spirally arranged and closely appressed. They are rhomboidal in shape and measure 4 X 3 mm keel is absent. Margins are entire and apex is acute.

Identification : It resembles with the characters of B. rhombicum in having sparsely branched habit, rhomboidal shaped leaves, absence of keel and acute apex. Hence it is identified as such. It is further compared with B. royii Bose and Banarji (1984) from Cutch in having rhomboidal leaves. But cuticle of B. royii is known while present specimen is devoid of it. Sahn (1928) mentioned that B. rhombicum is reported from Sriperambudur in Tamil Nadu and South Rewa in Madhya Pradesh. Present specimen is collected from Therani in Trichanapalli district of Tamil Nadu. Recently Sukh-Dev and Rajanikanth (1988) described B. theraniense from the above locality having dimorphic leaves. Present specimen is distinct from it. Hence it appears that B. rhombicum is widely distributed on the East Coast of Tamil Nadu.

Type - THR  
3795

Locality - Therani, District - Trichanapalli (T.N.)

Horizon - Lower Cretaceous

Genus - Desmiophyllum Lesquereux

Desmiophyllum indicum Sahn 1928.

(Text Fig.12, Pl.II - Fig.12)

The specimen is a sublinear strap shaped leaf measuring 3.5 cm in length and 0.9 cm in breadth. The margins are entire



and apex is obtuse. The veins are parallel and their number is 8. Longitudinal striations are present between the veins.

Identification : The specimen agrees with the characters of D. indicum described by Sahni (1928) in having shape of the leaf, obtuse apex and simple parallel veins. Hence it is described as such. According to Sahni (1928) it is reported from Bansa in South Rewa, Sher river and Shakkar valley in Madhya Pradesh. From East Coast it is reported from Raghavapuram in Godavari district of Andhra Pradesh. Recently Vagyan (1984) described it from Vemavaram in Prakasam district of Andhra Pradesh. Present specimen comes from Uttatur in Trichanapalli district in Tamil Nadu. It supports the wider occurrence of Desmiophyllum on the East Coast.

Type -  $\frac{UTTR}{8794}$

Locality - Uttatur, District - Trichanapalli (T.N.)

Horizon - Lower Cretaceous.