On some plant remains from Deccan Intertrappean localities of Seoni and Mandla districts of Madhya Pradesh, India

J.S. Guleria & R.C. Mehrotra

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The paper describes dicot and monocot leaves along with some wood remains from new Deccan Intertrappean fossiliferous localities situated in the Seoni and Mandla districts of Madhya Pradesh. The leaf remains belong to *Dicotylophyllum* Saporta, *Phoenicites* Brongniart, *Amesoneuron* Goeppert and the woods are represented by *Hydnocarpoxylon* Bande & Khatri, *Polyalthioxylon* Bande and *Palmoxylon* Schenk. Occurrence of mucilage canal in a fossil wood of palm has been reported for the first time.

Key-words—Fossil leaves, Woods, Deccan Intertrappean sediments (Maastrichtian to Palaeocene), Madhya Pradesh (India).

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सारॉंश

भारत के मध्य प्रदेश के सिवनी एवं माण्डला जिलों के अन्तर्गत दक्कन अन्तर्द्रेपीय स्थलों के कुछ पादप अवशेषों का विवेचन

जसवन्त सिंह गुलेरिया एवं राकेश चन्द्र मेहरोत्रा

इस शोध-पत्र में मध्य प्रदेश के सिवनी एवं माण्डला जिलों के नए दक्कन अन्तर्द्रेपीय जीवाश्ममय क्षेत्रों से प्राप्त द्विबीजपत्री एवं एकबीजपत्री पत्तियों तथा काष्ठ अवशेषों का वर्णन किया गया है। पत्र अवशेष *डाइकॉटिलोफिल्लम* सैपोर्टा, *फोइनीसाइटिस* ब्रोंग्नियार्ट, *अमीसोन्यूरॉन* गोइपर्ट से सम्बन्धित हैं तथा काष्ठ का प्रतिनिधित्व *हिडनोकार्पाक्सीलॉन* बाण्डे एवं खत्री, *पॉलीएल्थियॉक्सीलॉन* बाण्डे एवं *पामॉक्सीलॉन* शेंक द्वारा किया गया है। खजूर कुल के काष्ठ पादपाश्म में पहली बार श्लेष्मायुक्त नलिकाओं की उपस्थिति प्रदर्शित हुई है।

A LARGE number of plant fossils representing almost all groups of the Plant Kingdom have been reported from various Deccan Intertrappean localities of India. A list of the known fossils has been given by Bande *et al.* (1988). Thereafter, some more megafossils have also been reported from the known localities. In addition, fossils from new intertrappean localities have also been reported from Betul and Mandla districts of Madhya Pradesh (Gayakwad & Patil, 1989; Mehrotra, 1990) and Kutch District of Gujarat (Guleria, 1991).

A perusal of the large data reveals that the angiosperms are represented mostly by wood remains and rarely by leaves, flowers and fruits, etc. Most of the angiospermous leaf remains have been described from the Mohgaon Kalan in Chhindwara District of Madhya Pradesh (Achuthan, 1968; Bonde, 1986a; Chitaley & Patel, 1970; Dwivedi, 1961; Nambudiri, 1966, 1970; Patil, 1975; Prakash *et al.*, 1979; Sheikh, 1980; Sheikh & Kohle, 1980; Trivedi & Chandra, 1971). In addition, Trivedi (1956) and Bonde (1986b) described leaf remains from Nagpur and Wardha districts of Maharashtra. Amongst these the leaf remains reported by Bonde (1986a), Nambudiri (1966, 1970), Patil (1975), Prakash *et al.* (1979), Sheikh (1980), Trivedi (1956), Trivedi and Chandra (1971) are based on impressions and the leafy remains reported by rest of the workers are based on petrifactions.

The material described in the present paper comes from two adjoining districts of Madhya Pradesh, viz., Seoni and Mandla. The large monocot leaves and palm stems were collected from block number 661 and 662 of Binori Reserve Forest which falls in Seoni District. Binori (22° 40' 40": 80° 1' 30") can be approached both from Mandla and Lakhnadon in Seoni District. It is about 45 km from Lakhnadon and about 5 km

north-east of Ghansor (Map 1). All the woods are petrified, well preserved and mostly brownish in colour. The petrified palm stems (trunk pieces) were found scattered, some of them fully and some half buried in the lateritic "murram" along with palm leaves in the locality. Some of the woods were about 45 cm in diameter. In contrast to the petrified palm woods, two specimens of monocot leaves (impressions) were also collected. No dicotyledonous wood piece or leaf specimen was encountered in the field either as petrifaction or impression. So far no plant fossil has been described from this locality. The only known fossil from the Seoni District is a palm stem, namely *Palmoxylon sclerodermum* reported by Sahni (1943). However, the exact locality of the fossil is not known.

The other localities from where the fossils have been collected are Chati and Dewargarh in the Mandla District (Map 1). Chati (23° 5' : 80° 40') is situated at a distance of about 13 km from Shahpura on Shahpura-Mehdwani road. The exact locality is about 2.5 km on the western side of the road. The locality is rich in dicotyledonous and palm woods. Dewargarh (22° 57' : 80° 46') is also about 13 km from Mehdwani on Mehdwani-Kathotia road. This locality is rich in dicotyledonous woods. These localities are near to the other well known fossil localities of the Mandla District such as Ghughua and Parapani. Thus the fossils occurring in Chati and Dewargarh are the component of the same fossil forest which encounters in Ghughua, Parapani, etc. Since these two localities are not formally known earlier, they are being reported here and representative fossils from both the localities are briefly described in the present paper. Besides, dicotyledonous leaves collected from Ghughua (23° 7' : 80° 37') situated between Niwas and Shahpura in the Mandla District have also been described in the paper. Dicot leaves which are in the form of impressions have not been reported so far from the area. The exact age of Deccan Intertrappean has been a matter of controversy. According to the latest views the age may range from Maastrichtian to Palaeocene (Biswas, 1990; Joshi, 1995; Venkatesan *et al.*, 1993). All the specimens and slides have been deposited in the Museum of Birbal Sahni Institute of Palaeobotany, Lucknow.

GENERAL DESCRIPTION

Dicotyledons

Genus—*Dicotylophyllum* Saporta, 1894

Dicotylophyllum ghughuensis sp. nov.
Pl. 1, figs 1, 2

Material—This species is based on a well preserved, incomplete leaf-impression.

Description—Leaf appearing symmetrical, ovate, preserved lamina length about 5.5 cm, maximum width 2.5 cm; apex broken, appearing acute; base broken; margin unpreserved; texture thick chartaceous; venation pinnate, ? eucamptodromous; primary vein prominent, stout, more or less straight; secondary veins 5-6 pairs visible, 8-12 mm apart, alternate, narrow to moderately acute (40°- 50°), uniformly curved; intersecondary

PLATE 1 ⟶

1. *Dicotylophyllum ghughuensis* sp. nov., leaf showing natural shape, size and venation. x 1, Specimen no. BSIP 37727.
2. *D. ghughuensis* sp. nov., showing details of venation. x 3, Specimen no. BSIP 37727.
3. *Dicotylophyllum mandlaensis* sp. nov., leaf showing size and venation. x 1, Specimen no. BSIP 37728.
4. *Dicotylophyllum pulvinatum* sp. nov., leaf showing shape, size and venation. x 1, Specimen no. BSIP 37729.
5, 6, 7. *Amesoneuron deccanensis* sp. nov., fragments of lamina showing midrib and parallel venation. x 1, Specimen nos. 37730-31, 37734.
8. *Hydnocarpoxylon indicum* Bande & Khatri, cross section showing nature and distribution of vessels, fibres and lack of parenchyma. x 80, Slide no. BSIP 37735-I.
9. *H. indicum* Bande & Khatri, tangential longitudinal section showing nature and distribution of xylem rays. x 90, Slide no. BSIP 37735-II.
10. *H. indicum* Bande & Khatri, radial longitudinal section showing heterocellular rays and scalariform vessel perforation. x 165, Slide no. BSIP 37735-III.
11. *Polyalthioxylon parapaniense* (Bande) Mehrotra, cross section showing shape, size and distribution of parenchyma and vessels. x 40., Slide no. BSIP 37736-I.

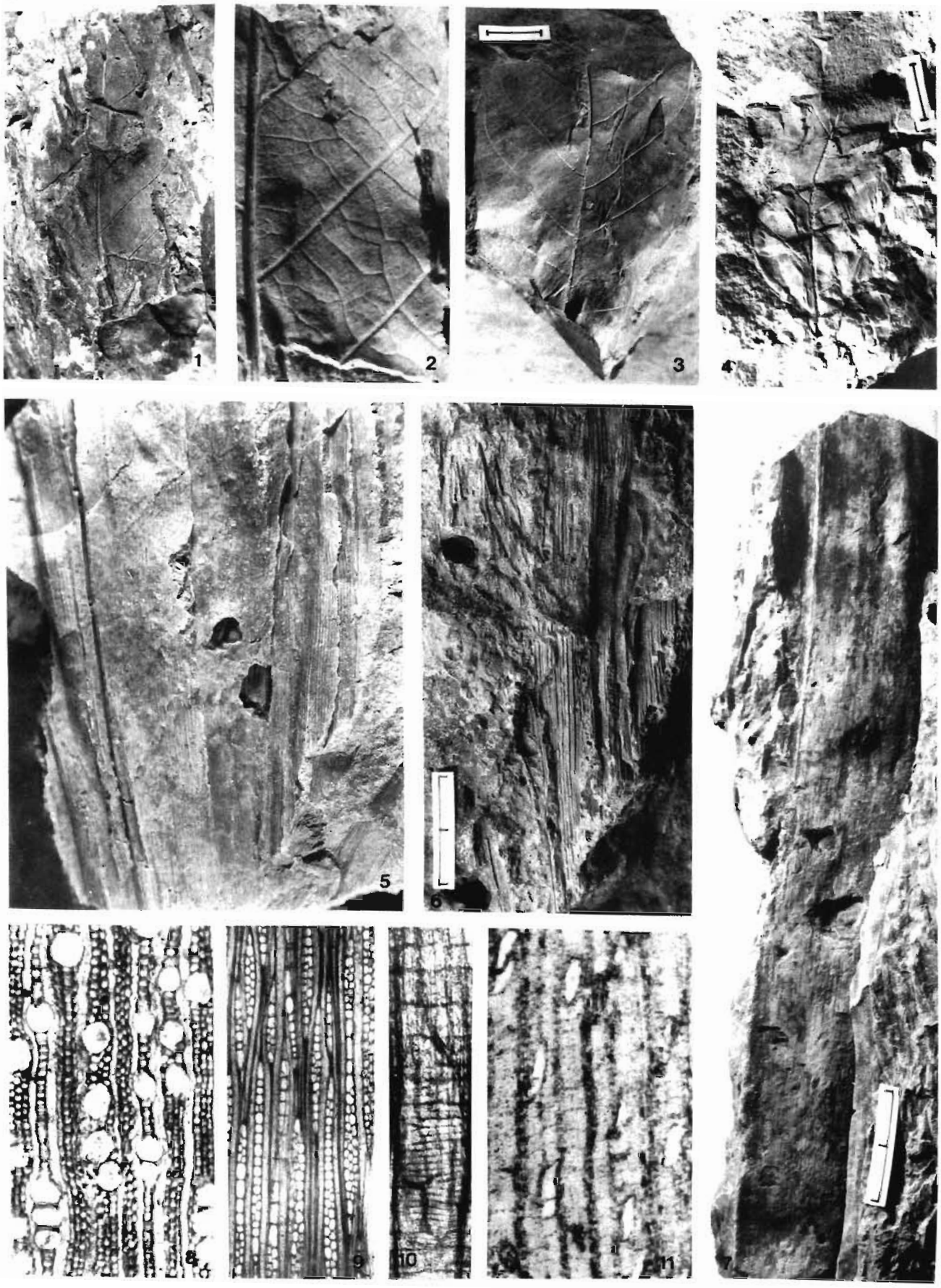
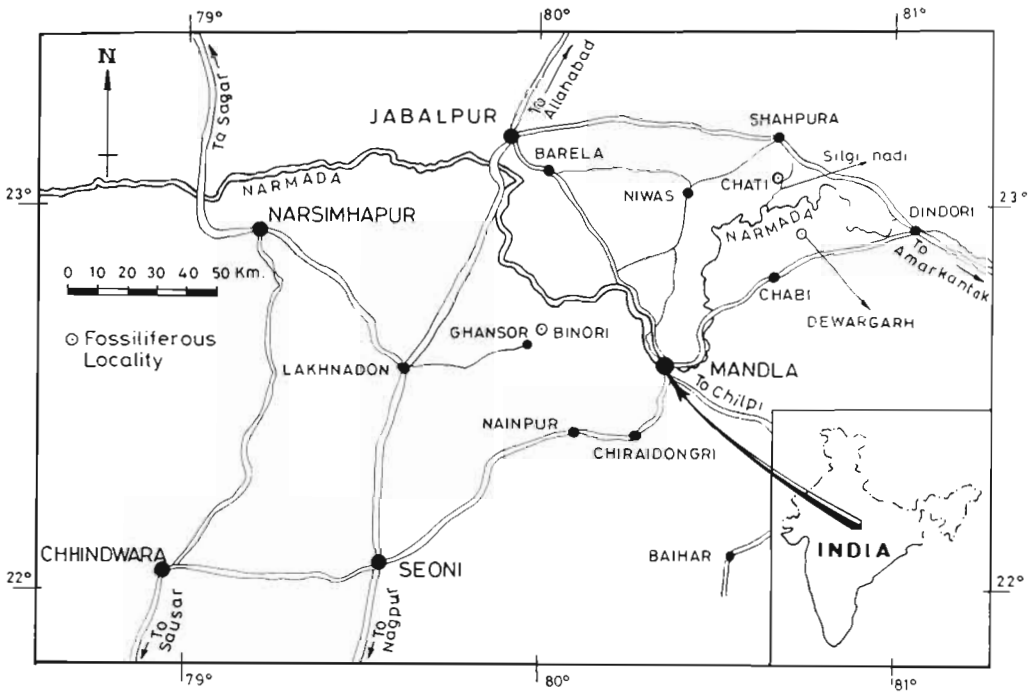


PLATE 1



Map 1—Showing new fossil localities in Seoni and Mandla districts, Madhya Pradesh.

veins absent; tertiary veins fine, angle of origin RR-RA, percurrent, frequently forked, sometimes recurved, straight to slightly wavy, oblique, predominantly alternate, close; quaternaries present, randomly oriented; higher order of venation not seen, areoles well developed, shape variable, usually quadrangular, occasionally polygonal, medium in size.

Holotype—Specimen no. BSIP 37727.

Locality—Ghughua near Shahpura, Mandla District, Madhya Pradesh.

Discussion—The above characters clearly show that the fossil is a dicot leaf. In the absence of base, margin and other details it is difficult to assign the fossil to its natural genus. The authors have, however, tried to compare it with the known fossil dicotyledonous leaves.

Fossil records & comparison—On comparing the present fossil with the known fossil leaves described simply as dicotyledonous leaves (Bose, 1952; Trivedi, 1956; Trivedi, 1959*; Lakhanpal, 1964; Chowdhury *et al.*, 1970; Mahabale & Rao, 1973; Patil, 1975; Sheikh, 1980; Puri & Mishra, 1982; *Dicotylophyllum* (Chaudhri, 1969; Dayal & Chaudhri, 1967; Nambudiri, 1966, 1970; Sahni, 1953; Verma & Mathur, 1968; Singh & Prakash, 1980; Lakhanpal & Guleria, 1981); *Deccanophyllum* (Sheikh & Kolhe, 1980); and *Phyllites* (Lakhanpal, 1952; Ramanujam & Rao, 1967; Rode, 1935; Seward, 1912) from various parts of India, it was found that the fossil does not resemble any of them. Amongst these, the only fossil which shows general resemblance with the present specimen is a dicotyledonous leaf specimen no. 2 described by Patil (1975) from the Deccan Intertrappean beds of Mohgaon Kalan in Chhindwara District. However, lack of features such as tertiaries and areoles in Patil's specimen made it difficult to compare that with the present fossil. Further, Patil's specimen no. 2 is about double the size of the present fossil.

Thus the present fossil leaf shows the characters of a dicotyledonous leaf but its natural affini-

* The specimens reported by Trivedi (1959) were subsequently identified by her in 1980 as *Ficus* spp. and *Psidium guava*. They are not true fossils and have been discarded (Guleria, 1992, p. 290) being the imprints of recent leaves on tufaceous sediments.

ties could not be ascertained. So it is being placed under the form genus *Dicotylophyllum* Saporta and described as *Dicotylophyllum ghughuensis* sp. nov. The specific epithet is after the locality Ghughua from where the leaf was collected.

Dicotylophyllum mandlaensis sp. nov.
Pl. 1, fig. 3

Material—This species is based on a single well preserved specimen represented by middle part of the leaf. Lower middle part of the leaf is curved.

Description—Leaf seemingly symmetrical, appearing oblong, preserved lamina length about 6.5 cm, maximum width about 4 cm; apex broken; base broken; margin entire; texture seemingly chartaceous; venation pinnate, eucamptodromous; parimary vein moderate, more or less straight; secondary veins 5 pairs visible, alternate, 8-13 mm apart, angle of divergence moderately acute (50°-60°), moderately thick, unbranched and uniformly curved upward, diminishing apically inside the margin; intersecondaries absent; tertiary veins fine, angle of origin RR-RA, percurrent, rarely recurved, straight to slightly wavy, occasionally forked, relationship to mid-vein oblique, alternate to opposite, close; higher order venation forming areoles, polygonal in shape, small in size.

Holotype—Specimen no. BSIP 37728.

Locality—Ghughua near Shahpura, Mandla District, Madhya Pradesh.

Discussion & comparison with the known fossil leaves—From the above description it is evident that the fossil is a dicot leaf. The specimen, being incomplete and lacking both apex and base, can not be compared with any living genus with certainty. However, the fossil was compared with all the earlier known fossil leaves including those described as *Phyllites*, *Dicotylophyllum* and simply as dicotyledonous leaves (see p. 71 section 'Fossil records & Comparision') from India. Amongst them, the present fossil shows somewhat resemblance in shape with a leaf specimen no. 3 of Patil (1975) and specimen no. A of Trivedi (1956) described from the Deccan Intertrappean beds of Mohgaon Kalan in Chhindwara District of Madhya Pradesh and Bharatwada in Nagpur District of Maharashtra, respectively. Patil's specimen, however, differs in the course of secondaries at the point of origin and in having prominent midrib. Moreover, it lacks tertiary venation.

Trivedi's specimen no. A, although shows apparent resemblance with the present fossil in shape and course of secondaries, differs in having distinct intersecondaries and intramarginal veins (pl. 29, figs 1, 2). As the fossil is a dicot leaf and differs from the known fossil leaves, it is being described as *Dicotylophyllum mandlaensis* sp. nov. The specific name is after Mandla District from where the specimen was collected.

Dicotylophyllum pulvinatum sp. nov.
Pl. 1, fig. 4

Material—This species is represented by a single specimen whose apical part is broken.

Description—Leaf symmetrical, appearing elliptic, preserved lamina length 4.5 cm, maximum width 2.5 cm; apex broken; base wide acute, normal, symmetrical; margin entire; texture chartaceous; petiole short, somewhat swollen; venation pinnate, eucamptodromous; primary vein stout, slightly curved; 4 pairs of secondary veins visible, alternate, 10-15 mm apart, angle of divergence narrow to moderately acute (40°-45°), unbranched, moderately thick, intersecondary veins not seen; tertiary veins fine, angle of origin RR, percurrent, sometimes recurved, straight to slightly wavy, oblique in relation to midvein, predominantly opposite, close; higher order venation forming reticulum, areoles small, variously shaped.

Holotype—Specimen no. BSIP 37729.

Locality—Ghughua near Shahpura, Mandla District, Madhya Pradesh.

Discussion & comparison—The above mentioned characters indicate that the fossil is a dicotyledonous leaf. Leaves with short somewhat swollen petiole are found in many living genera

but the lack of apical portion in the fossil makes it difficult to compare the present specimen with the leaf of any extant plant with certainty. As the fossil is a dicot leaf and its generic affinities uncertain so it is placed under the form genus *Dicotylophyllum* Saporta 1894. Since our fossil differs from all the known fossil leaves and species of *Dicotylophyllum*, a new name *Dicotylophyllum pulvinatum* sp. nov., is assigned to it. The specific name refers to the pulvinate petiole of the leaf.

Family—Anonaceae

Genus—*Polyalthioxylon* Bande 1973 syn.

Polyalthioxylon Kramer 1974

Polyalthioxylon parapaniense (Bande) Mehrotra 1990

Pl. 1, fig. 11; Pl. 2, fig. 8

Material—The study is based on a piece of secondary wood measuring 7 cm in length and 5 cm in width.

Brief description—The important diagnostic characters of the fossil are : wood diffuse-porous, vessels small to medium, solitary and in radial multiples, without tyloses; perforations simple; parenchyma usually apotracheal in the form of thin, broken tangential lines forming a net-work with the rays; xylem rays moderately thick (mostly 3-6 seriate), very long; ray tissue heterogeneous; ray cells filled with oil or mucilage cells; fibres moderately thick-walled and non-septate.

Specimen—Museum no. BSIP 37736.

Locality—Chati near Shahpura, Mandla District, Madhya Pradesh.

Discussion—The above characters collectively indicate that the fossil belongs to the genus *Polyalthioxylon* Bande 1973 syn. *Polyalthioxylon* Kramer 1974. Out of 4 species of *Polyalthioxylon* known so far (Prakash, 1978), our fossil shows best resemblance with *P. parapaniense* (Bande) Mehrotra 1990 and hence it has been placed under the same species. The fossil shows close resemblance with the woods of extant genus *Polyalthia* Bl., a widely distributed genus ranging from tropical Africa, Madagascar, through tropical Asia to Australia but most numerous in South east Asia. *Polyalthia simiarum* Benth. et Hook.f., the comparable living species is found in moist forests of Orissa, Assam, Chittagong Hill tracts, the Andamans and Myanmar (Pearson & Brown, 1932; Chowdhury & Ghosh, 1958).

Family—Flacourtiaceae

Genus—*Hydnocarpoxylon* Bande & Khatri 1980

Hydnocarpoxylon indicum Bande & Khatri 1980

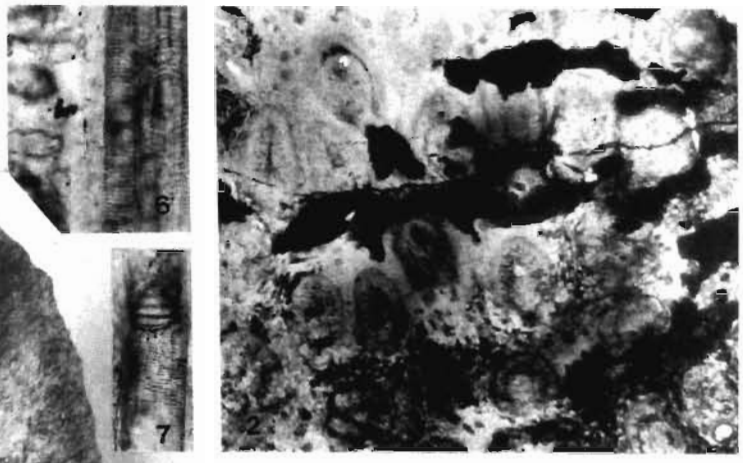
Pl. 1, figs 8-10

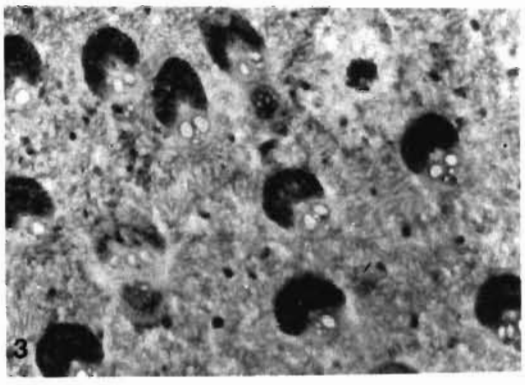
Material—The study is based on a piece of secondary wood measuring 6 cm in length and 4 cm in width.

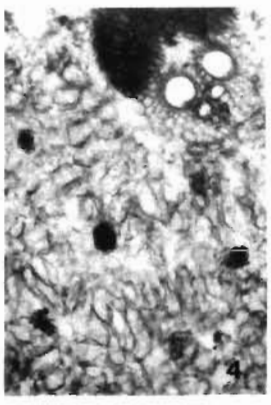
Brief description—The important characters of the fossil are: usually small sized vessels arranged in radial multiples of 2-8, 35-60 per sq mm; perforations sclariform; 1-3 seriate xylem rays, 8-76 cells or 255-1880 μm in height; heterogeneous ray tissue; septate fibres and absence of parenchyma.

PLATE 2 ⟶

1. *Phoenicites lakhanpalii* sp. nov., leaf showing midrib and successive veins of lamina. x 1, Specimen no. BSIP 37732.
2. *Palmoxylon binoriensis* sp. nov., cross section of outer part of dermal region showing shape and arrangement of fibrovascular bundles. x 16, Slide no. BSIP 37737-I.
3. *P. binoriensis* sp. nov., cross section of inner part of the dermal region showing shape and arrangement of fibrovascular bundles. x 16, Slide no. BSIP 37737-I.
4. *P. binoriensis* sp. nov., cross section of inner part of dermal region showing nature of parenchyma cells and fibre. x 40, Slide no. BSIP 37737-II.
5. *P. binoriensis* sp. nov., single fibrovascular bundle showing dorsal sclerenchyma cap, phloem, xylem vessels, and absence of ventral sclerenchyma cap. x 60, Slide no. BSIP 37737-II.
6. *P. binoriensis* sp. nov., longitudinal section showing spiral thickenings in the young vessels, stegmata and parenchyma cells. x 100, Slide no. BSIP 37737-III.
7. *P. binoriensis* sp. nov., single old vessel showing multiseriate scalariform pitting with perforation plate. x 100, Slide no. BSIP 37737-III.
8. *Polyalthioxylon parapaniense* (Bande) Mehrotra, longitudinal section showing nature of xylem rays. x 40, Slide no. BSIP 37736-II.
9. *Phoenicites lakhanpalii* sp. nov., another leaf specimen showing part of lamina and venation. x 1, Specimen no. 37733.







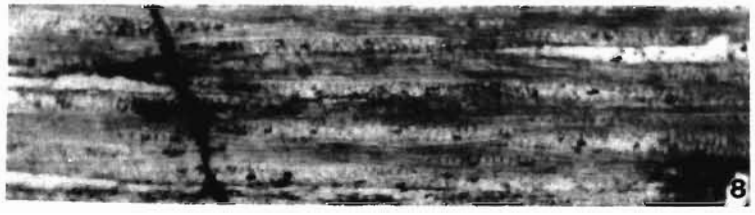


PLATE 2

Specimen—Museum no. BSIP 37735.

Locality—Dewargarh near Mehdwani, Mandla District, Madhya Pradesh.

Discussion—The above features of the fossil wood indicate that it belongs to the genus *Hydnocarpoxylon* Bande & Khatri 1980. Only two species of the genus are known so far (Awasthi & Srivastava, 1990). Out of the two, the present fossil shows all the characters of *H. indicum* Bande & Khatri 1980 and hence it is placed under the same species. The fossil is reported as a representative from Dewargarh, a new locality in Mandla District. Evidently the fossil shows close similarity with the woods of genus *Hydnocarpus* Gaertn., which is largely confined to the tropics and is native of tropical South east Asia. The comparable species *H. alpina* Wt. and *H. wightiana* Bl. occur in Western Ghats from south Kanara to Travancore (Pearson & Brown, 1932; Willis, 1973).

MONOCOTYLEDONS

Family—Arecaceae

Genus—*Phoenicites* Brongniart 1828

Phoenicites lakhanpalii sp. nov.

Pl. 2, figs 1, 9

Material—The present species is based on two specimens, one of which is 5 x 4 cm in size and the other is about 20 cm in length and 8.5 cm width. The bigger specimen is preserved with its counterpart. The specimens are in the form of impressions and their preservation is fairly good.

Description—Lamina large, unsplit, thick coriaceous, apex and base unpreserved, primary costa or rachis strong, up to 1.0 cm thick, narrowing towards apical region, preserved length 19 cm, leaflets or segments about 11, fused, attached to rachis by entire base, preserved segment width ranges from 1.5 to 2.0 cm, length up to 10 cm, venation pinnate, decurrent, midvein distinct, strong, uniform, arching away from rachis, angle of divergence narrow acute (25°-45°), about five secondaries running parallel on either side of midvein, veins equidistant from each other on surface layer, spines absent on the exposed surface and rachis.

Holotype—Specimen no. BSIP 37732.

Paratype—Specimen no. BSIP 37733.

Locality—Block number 661-662 of Binori Reserve Forest, Seoni District, Madhya Pradesh.

Discussion—The distinctive features of the fossil are : large unsplit, thick coriaceous leaf, leaflets or segments fused, joined to strong rachis by their entire bases, venation pinnate, decurrent, strong midvein, secondaries running parallel to midvein

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PLATE 3 ⟶

1. *Palmoxylon canalosum* sp. nov., cross section showing shape, size and distribution of fibrovascular bundles in the ground tissue. x 16, Slide no. BSIP 37738-I.
2. *P. canalosum* sp. nov., cross section showing parenchyma cells, black tanin cells and a fibrovascular bundle. x 40, Slide no. BSIP 37738-I.
3. *P. canalosum* sp. nov., cross section showing mucilage canal surrounded by thin walled parenchyma cells. x 60, Slide no. BSIP 37738-I.
4. *P. canalosum* sp. nov., longitudinal section showing spiral thickenings in the protoxylem, scalariform thickenings in the metaxylem and perforation plate with many bars. x 60, Slide no. BSIP 37738-II.
5. *Palmoxylon lunarianum* sp. nov., cross section showing general arrangement and distribution of fibrovascular bundles. x 16, Slide no. BSIP 37740-I.
6. *P. lunarianum* sp. nov., enlarged cross section showing general shape and size of fibrovascular bundles. x 40, Slide no. BSIP 37740-I.
7. *Palmoxylon vaginatum* sp. nov., cross section showing shape and general distribution of fibrovascular bundles and parenchyma. x 40, Slide no. BSIP 37739-I.
8. *P. vaginatum* sp. nov., cross section enlarged to show general parenchyma and distribution of fibre bundles in the ground tissue. x 60, Slide no. BSIP 37739-II.
9. *P. vaginatum* sp. nov., single fibrovascular bundle showing dorsal and ventral sclerenchyma cap with single vessel. x 60, Slide no. BSPI 37739-I.
10. *P. lunarianum* sp. nov., single fibrovascular bundle showing massive dorsal sclerenchyma, single vessel and absence of ventral sclerenchyma cap. x 60, Slide no. BSIP 37740-I.
11. *P. lunarianum* sp. nov., cross section showing fibre bundle, parenchyma and part of fibrovascular bundles. x 100, Slide no. BSIP 37740-I.
12. *P. canalosum* sp. nov., fibre bundles in cross section along with lower part of fibrovascular bundle. x 60, Slide no. BSIP 37738-I.
13. *P. canalosum* sp. nov., longitudinal section showing stegmata inthe fibre cells of a fibrovascular bundle. x 60, Slide no. BSIP 37738-III.

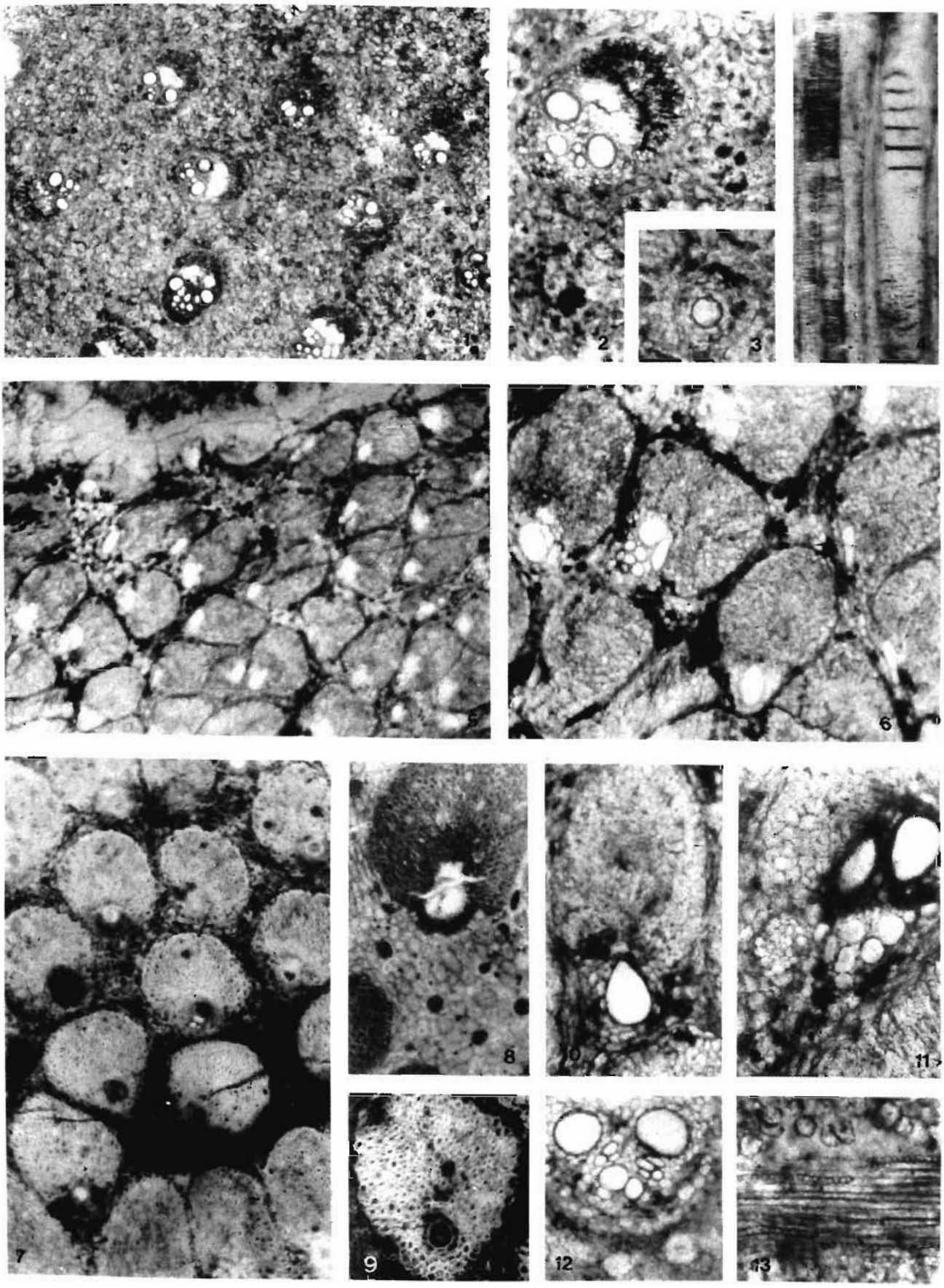

PLATE 3

on either side. The rigid nature of lamina along with the above characters indicates that the fossils represent a part of palm leaf. Read and Hickey (1972) in their revised classification of fossil palm and palm-like leaves have pointed out that "numerous similarities in the form and gross external features of palm leaves make it difficult or impossible to assign them to modern genera, based only on external morphology (except *Phoenix* Linn.) .....Since it is difficult to identify specimens of modern palms accurately from their leaves alone, no attempt should be made to place fossil palm fragments in genera of modern palms unless unquestionably identifiable with them". Keeping the above observation in view the present specimens can only be identified in a broad sense. Tomlinson (1990, p. 229) while discussing leaf blade of pinnate leaves states "leaves of a few palms remain unsegmented, but with an extended rachis, so it is clear that they are essentially pinnate-leaved. These leaves are not necessarily small" (see also Tomlinson, 1961, p. 26). Simple leaves of truly pinnate genera can be distinguished even if a portion of the leaf blade exhibiting a number of fused segments attached to mid-costa is available. In such leaves the midvein ridges of the fused segments are noticeably decurrent and arch basally away from costa (Read & Hickey, 1972, pp. 130, 134). As the available specimens particularly specimen no. 37732 (Pl. 2, fig. 1) exhibit the above mentioned features distinctly, they belong to pinnate-leaved palms or feather palms. Some of the extant genera which bear similar type of leaves such as *Neophloga* Baill (see Mahabale, 1982, fig. 19.2), *Sclerosperma* Mann et Wendl., *Stevensonia* Dun. ex Bal f.f., *Vershaffeltia* Wendl., are confined to nearby regions, viz., Seychelles Islands and tropical Africa. The fossils probably may represent anyone of such genera.

Indian fossil records & comparison—While surveying literature on the fossil palm leaves from India, a total of seventeen records could be gathered reported under various genera or simply as palm leaves. They are *Livistona wadiai* Lakhanpal & Guleria, 1983 (in Lakhanpal *et al.*, 1983); *Palmacites khariensis* Lakhanpal & Guleria 1982; *Palmophyllum* sp. (Chaudhri, 1969); *Sabalites microphylla* Sahni 1964; *Sabalites* sp. (Sahni, 1964); *Trachycarpus ladakhensis* Lakhanpal & Guleria 1984 (in Lakhanpal *et al.*, 1984); a fan palm (Sahni & Bhatnagar, 1962); a palmate leaf (Mahabale & Rao, 1968); a plicate palm leaf (Trivedi & Chandra, 1971); *Amesoneuron borassoides* Bonde 1986a; *Palmophyllum mohgaoense* Mahabale 1966; *P. dakshinense* Achuthan 1968; ? *Sabalites* sp. (Bose & Sah, 1964); *Sabalophyllum livistonoides* Bonde 1986b; *Zalaccites jaintiensis* Barman & Duara 1970; a *Phoenix* like palm leaf referred to *Phoenicites* (Lakhanpal, 1964); and a pinnate leaf (Mahabale & Rao, 1973). Amongst them, first nine belong to fan palms which are not comparable with the present fossil. *Palmophyllum dakshinense* Achuthan 1968 and *Sabalophyllum livistonoides* Bonde 1986b are based on anatomical features of petrified material and hence incomparable with the present specimens. In the absence of midrib in *Amesoneuron borassoides* Bonde 1986a, whose affinities have been traced to *Borassus*, a true palmate palm, also differs from the present fossils. Of the remaining leaves, a palm leaf referred to *Phoenicites* on account of its possible affinities with *Phoenix* (Lakhanpal, 1964) cannot be compared with the fossils for want of details of characters. Moreover, the present fossils show unsegmented nature of lamina which is not the case in *Phoenix*. Consequently the two are not comparable at all. The fossils show near resemblance with a pinnate leaf reported by Bose and Sah (1964, p. 220, pl. 1, fig. 1) as ? *Sabalites* sp. from the Lower Tertiary of Laitryngew in Assam (now in Meghalaya) and the one reported by Mahabale and Rao (1973, pl. 2, fig. 32) from the Rajahmundry Sandstones of Bommuru, in addition to *Zalaccites jaintiensis* described by Barman and Duara (1970) from the Cherra Sandstone of Jaintia Series (Palaeocene) Assam. In the first two cases leaves are seemingly unsegmented pinnate type. Moreover, total lack of descriptions about them has made it difficult to compare these fossils with the present ones. The last *Zalaccites jaintiensis* differs in the angles

of leaflets or segments which are said to be 30° in contrast to the present specimens wherein the angle ranges from 25°-45°. Moreover, the leaflets bear three parallel costae in *Z. jaintiensis* whereas in the present fossils about five secondaries run parallel to midvein. Hence, *Zalaccites jaintiensis* also differs from the present fossils. It is necessary to point out here that *Salacca* (*Zalacca*) is a palm with pinnate leaflets and normally bears spines on its rachis (Mc Currach, 1960; Tomlinson, 1961). In the absence of any spines on rachis as long as 25 to 55 cm and seemingly fused leaflets of *Zalaccites jaintiensis* (p. 64, fig. 1) its supposed affinities with the leaf of extant *Salacca* are doubtful.

Since the present fossils differ from all the known fossil palm leaves from India and the specimens adequately indicate affinities with the pinnate-leaved palms so they are assigned to the genus *Phoenicites* Brongniart 1828 which has been created to accommodate this type of fossil palm leaves (Read & Hickey, 1972). The fossils have been given a new specific name, *Phoenicites lakhanpalii* in honour of Dr R.N. Lakhanpal, a distinguished Tertiary Palaeobotanist.

The pinnate palm leaf reported by Mahabale and Rao (1973, pl. 2, fig. 32) and the so-called ? *Sabalites* sp. of Bose and Sah (1964, p. 220, pl. 1, fig. 1) which infact is a pinnate leaf (the name *Sabalites* is a misnomer) in all likelyhood, belong to *Phoenicites*. However, due to non-availability of their type specimens for detailed study they are not being merged under the present species, although they show strong affinities with our species having fused segments. Likewise *Zalaccites jaintiensis* Barman & Duara 1970 possibly represents a different species of *Phoenicites*.

Genus—*Amesoneuron* (Goeppert) Read & Hickey 1972

Amesoneuron deccanensis sp. nov.
Pl. 1, figs 5-7

Description—Leaf fragments vary in size, preserved length 10 to 19.5 cm, coriaceous, strap shaped, width 1.5 to 4.0 cm, midvein distinct, stout, running more or less straight, about 15-20 secondaries, closely placed, running parallel on either side of midvein, veins equidistant, no spines or teeth seen either on midvein or on margins. Further details obscure.

Holotype—Specimen no. BSIP 37734.

Paratypes—Specimen nos. BSIP 37730, 37731.

Locality—Block number 661-662 of Binori Reserve Forest, Seoni District and Ghughua near Shahpura, Mandla District, Madhya Pradesh.

Discussion—The sturdiness of the material due to fibrous nature, coriaceous texture and typical parallel venation (Pl. 1, figs 5-7) suggest the affinity of the specimens with palm leaves. Of the three main types of lamina encountered in palms—palmate, costapalmate and pinnate, the specimens in all likelihood belong to pinnate-leaved palm although it still cannot be said definitely. The prominent midvein as seen in one of the leaflets (Pl. 1, fig. 7) apparently indicates that the specimen possibly belongs to reduplicate type of pinnate palms. The midvein groove as seen in other specimen (Pl. 1, fig. 5) shows that the fragment was preserved from the abaxial side.

Hence, the specimens are placed under the form genus *Amesoneuron* (Goeppert) Read & Hickey 1972, which was created specially to accommodate such leaf or leaflets. A number of fossil palm leaves both pinnate and palmate types are known from India (p. 77). The oldest Indian record comes from the Deccan Intertrappean sediments. Amongst the known Indian records, fossils representing fan palm leaves based on anatomical characters and fused pinnate leaves are not comparable with the present fossils (p. 77). Of the remaining, an incomplete leaf impression of *Phoenix* - like palm (Lakhanpal, 1964, fig. 1), *Palmophyllum mohgaoense* Mahabale 1966 and *Amesoneuron borassoides* Bonde 1986a are the only records comparable with the present fossils. *Phoenix*-like palm leaf from the Garo Hills of Assam (Lakhanpal, 1964) lacks morphological details. Moreover, *Phoenix* leaflets are without distinct midrib, in contrast to the present specimens, hence the two are not comparable.

Palmophyllum mohgaoense Mahabale 1966 is unaccompanied by its description. A fragmentary leaf impression of *Amesoneuron borassoides* Bonde 1986a, compared with *Borassus*, a fan palm, differs from the present fossils in the absence of distinct midrib and distantly placed secondaries. On account of the above differences with the earlier known fossils, the present specimens have been described as *Amesoneuron deccanensis* sp. nov.

Palmoxylon Schenk 1882

Palmoxylon binoriensis sp. nov.
Pl. 2, figs 2-7

Material—The species is based on a small piece of petrified palm wood measuring about 12 x 10 cm in dimensions. The specimen seems to be a part of subdermal region of the palm wood. Preservation is fairly good.

Description—The specimen represents a part of subdermal region of stem as is evident by the arrangement and orientation of fibrovascular bundles (Sahni, 1964, text-fig. 1). In the outer part fibrovascular bundles are fairly closely placed, orientation of the bundles normal, i.e., xylem part of the bundles is pointed towards the central region (Pl. 2, figs 2, 3). Fibrovascular bundles 495-660 x 660-1045 μm, 88-100 per sq cm, dorsal sclerenchyma cap reniform, well developed as compared to dorsal sclerenchyma caps of fibrovascular bundles of the inner part of stem. Fibrovascular ratio about 12-16/1, median sinus round. Parenchyma part of the bundles is very little as compared to inner bundles. The vascular part consists mostly of a single xylem vessel, sometimes with 3-4 small vessels, phloem forming a very small patch, phloem cells usually preserved. In the inner part fibrovascular bundles are distantly placed, 50-56 per sq cm, mostly with two big vessels along with some small vessels (Pl. 2, fig. 3), large vessels with multiseriate scalariform pitting, spiral thickening in small or young vessels (Pl. 2, figs 6-7). Fibrovascular ratio about 2-5/1, dorsal sclerenchyma cap reniform, ventral sclerenchyma caps absent, median sinus round to angular, parenchymatous portion of the bundles well developed in this part as compared to outer part. Leaf-trace bundles present in which smaller vessels are mostly exserted. Stegmata present in the fibrovascular bundles (Pl. 2, fig. 6). *Ground parenchyma* compact in the outer part, cells more or less isodiametric in shape, spongy and lacunar in the inner part (Pl. 2, fig. 4), thin-walled, irregular and elongated, palisade-like tangentially elongated cells are seen between the fibrovascular bundles occasionally (Sahni, 1964, p. 46; pl. 15, fig. 100), tabular parenchyma associated with fibrovascular bundles in 1-2 layers, radiating parenchyma absent. *Fibre bundles* distinct, frequently seen in ground tissue of outer and inner part of the specimen (Pl. 2, figs 3, 4), 55-66 x 55-66 μm in size, stegmata not seen.

Holotype—Specimen no. BSIP 37737.

Locality—Block number 661-662 of Binori Reserve Forest, Seoni District, Madhya Pradesh.

Discussion—A large number of *Palmoxylon* species have been reported from India (Sahni, 1964). In a comprehensive review of fossil palm remains from India, Rao and Achuthan (1973) have listed 53 species of *Palmoxylon*. Later, six more species, viz., *P. cordatum, P. keriense, P. mohgaoensis, P. pantii, P. splendidum* and *P. superbum* were added to the list by Prakash (1974). In addition to these, 17 more species have since been reported (Table 1). Amongst the known species of *Palmoxylon*, the present fossil has been compared with those species which are based on corresponding (sub dermal) part of the palm wood belonging to Reniformia group and possessing fibre bundles and stegmata (Rao & Achuthan, 1973, table 1; Prakash, 1974, table 1; Table 1 of the present paper). A perusal of the records shows that the following species are comparable with the present fossil—*P. arviensis* Ambwani 1981, *P. burmense* Sahni 1964, *P. dilacunosum* Ambwani 1984b, *P. livistonoides* Prakash & Ambwani 1980, *P. mandlaensis* Lakhanpal *et al.* 1979, *P. parapaniensis* Lakhanpal *et al.* 1979, *P. taroides* Ambwani & Mehrotra 1989 and *P. trabeculosum* Sahni 1964. Among these *P. dilacunosum, P.*

parapaniensis and *P. trabeculosum* possess highly lacunar parenchyma. The first two species alongwith *P. arviensis, P. mandlaensis* and *P. taroides* possess diminutive fibrovascular bundles. Moreover, leaf trace bundles are frequent in *P. taroides*. Hence, they can be easily differentiated from the present fossil. Of the remaining two species, *P. livistonoides* differs in having radiating parenchyma, absence of fibrous bundles and frequent leaf trace bundles in its subdermal zone. *P. burmense* also differs from the present fossil in possessing radiating parenchyma and absence of tabular parenchyma. From the above comparison it is clear that the present fossil is different from the known species and hence a new name *Palmoxylon binoriensis* sp. nov., is assigned to it.

Palmoxylon canalosum sp. nov.
Pl. 3, figs 1-4, 12, 13

Material—The species is based on a small piece of petrified palm wood, 13 cm long and 6 cm wide representing the central portion of the stem.

Description—Fibrovascular bundles irregularly oriented and widely spaced. The arrangement of the fibrovascular bundles indicates that the specimen is a part of central portion of stem (Sahni, 1964, p. 14, text-fig. 1). The bundles are more or less of same size throughout the section, oval to somewhat round in shape (Pl. 3, fig. 12), mostly 660-825 x 710-1210 μm in size, 30-36 per sq cm, dorsal sclerenchyma cap reniform, sclerenchyma usually circular in outline, lobed, rounded to slightly pointed, median sinus shallow round to round, xylem consisting of two or more big vessels along with number of small vessels, ventral sclerenchyma cap consisting of a few cells, univasal bundles absent. The spiral or annular vessels of the protoxylem and the scalariform vessels of the metaxylem are well preserved (Pl. 3, fig. 4), phloem well developed and occasionally preserved, fibrovascular ratio about 1.5-2/1-3, stegmata present in irregular longitudinal files which are short to long and do not always remain continuous, adjacent to fibrovascular bundle cells (Pl. 3, fig. 13). Leaf trace bundles present in which smaller vessels exserted. *Mucilage canals* small, 55 μm in diameter, round, filled with yellowish substance or open, surrounded by thin layers of small transparent parenchyma cells forming sheath-like structure around the canals, scattered in the ground tissue (Pl. 3, fig. 3). *Ground Parenchyma* compact, cells round, oval to cribriform, intercellular spaces very small, usually angular, cells filled with yellowish and black material; tabular parenchyma forming 1-2 layers around the fibrovascular bundles, radiating parenchyma not seen. *Fibre bundles* present in ground tissue without stegmata, 60-110 μm in size (Pl. 3, fig. 12).

Holotype—Specimen no. BSIP 37738.

Locality—Block number 661-662 of Binori Reserve Forest, Seoni District, Madhya Pradesh.

Discussion—Palmoxylon species based on central portion of palm wood belonging to Reniform group have only been compared with the present fossil. About 22 species belong to this category (Rao & Achuthan, 1973, table 1; Prakash, 1974; Table 1 of the present paper). Among them only five species, viz., *Palmoxylon arviensis* Ambwani 1981, *P. keriense* Trivedi & Verma 1971, *P. mandlaensis* Lakhanpal *et al.* 1979, *P. parapaniensis* Lakhanpal *et al.* 1979 and *P. trabeculosum* Sahni 1964 having both fibrous bundles and stegmata come closer to the fossil. Out of these, the last two can easily be differentiated from the present fossil in having highly lacunar parenchyma. Likewise *P. keriense* also differs in having lacunar parenchyma. The first two which show near resemblance with the present fossil, however, differ in the absence of mucilage canals. Hence, the present fossil which differs from the known *Palmoxylon* species has been assigned a new name, *Palmoxylon canalosum* sp. nov.

Palmoxylon vaginatum sp. nov.
Pl. 3, figs 7-9

Material—This species is based on a well preserved petrified palm wood measuring 20 x 10 cm.

Description—Fibrovascular bundles closely placed, at time touching the adjoining bundles,

Table 1—List of palm stem (*Palmoxylon*) reported from the Deccan Intertrappean sediments since Prakash, 1974.

Species	Parts available for study	Broad Group	Fibrous bundles; stegmata	Ground-Tissue			Special features
				General	Tabular present(+) absent(–)	Radial present(+) absent(–)	
Palmoxylon arviensis Ambwani 1981	Cortical, dermal, sub-dermal and central	Cordata-Reniformia	Both present	Compact to lacunar in the central region	+	+ around leaf trace bundles	Diminutive fibrovascular bundles present
P. betulensis Gayakwad & Patil 1989	Cortical, dermal, sub dermal and central	Cordata-Reniformia	Fibrous bundles present; stegmata absent	Compact	+	+	Ventral sclerenchyma absent
**P. coromandelensis* Mahabale & Rao 1973	Central zone	Reniformia	Present, without stegmata	Compact	–	–	Ventral sheath present; Septate fibres present
P. dilacunosum Ambwani 1984b	Cortical, dermal and sub-dermal	Reniformia	Both present	Compact to lacunar in central region	+	–	Central part highly lacunar divisible into two zones. Diminutive fibrovascular bundles occasionally present. Leaf trace bundles frequently present
P. ghoshii Bera & Benerjee 1990	Dermal, sub-dermal and central	Reniformia – Lunaria	Both absent	Lacunar	+	–	Idioblasts present
P. ghuguensis Ambwani & Prakash 1983	Outer and inner zone	Reniformia	Fibrous bundles absent but stegmata present	Compact	+	–	
P. hyphaeneoides Rao & Shete 1989	Cortical, dermal and sub dermal	Lunaria	Fibrous bundles present in cortical region; stegmata absent	Lacunar	–	–	
P. kachchhensis Guleria 1983	Sub dermal zone	Reniformia Cordata	Fibrous bundle absent; stegmata present	Compact	+	+	
P. kondhaliensis Mahabale & Kulkarni 1981	Periderm, cortex, sub-dermal and central	Reniformia Cordata	Fibrous bundles present in cortical region; stegmata absent	Lacunar	–	–	
P. liculaense Gayakwad & Patil 1989	Cortical, dermal, sub-dermal and central	Reniformia Cordata	Fibrous bundles present but stegmata absent	Compact to less lacunar	+	–	Ventral sclerenchyma present with leaf trace bundles

* The species is listed here as it has not been referred by Rao & Achuthan, 1973 and Prakash, 1974.

P. livistonoides Prakash & Ambwani 1980	Cortical, dermal and sub dermal	Reniformia	Both present (Fibre bundles absent in subdermal zone)	Compact in dermal and slightly lacunar in subdermal region	+	+	
P. mandlaensis Lakhanpal *et al.* 1979	Dermal, sub dermal and central	Cordata, sagittata, sometimes Reniformia	Both present	Compact, loose in central region	+	–	Diminutive fibre vascular bundles rarely seen
P. parapaniensis Lakhanpal *et al.* 1979	Outer zone and inner zone	Reniformia Lunaria	Both present	Highly lacunar	–	–	Diminutive fibre vascular bundles present. Ventral sclerenchyma sheath absent
P. penchense Trivedi & Verma 1974	Cortical, dermal, sub dermal and central	Median sinus concave	Present without stegmata	Lacunar	–	–	No ventral sclerenchymatous sheath
P. shahpuraensis Ambwani 1983	Dermal, sub dermal and central	Cordata Reniformia	Fibrous bundles absent but stegmata present	Compact in central part loosely packed	Indistinct	–	
P. siltherensis Ambwani 1984a	Dermal, sub dermal and central	Reniformia	Both absent	Compact	+	–	A narrow ventral sclerenchymatous sheath present
P. taroides Ambwani & Mehrotra 1989	Cortical, outer and inner	Reniformia	Both present	Compact	+	–	Diminutive fibrovascular bundles present. Leaf trace bundles frequent

Amongst the known *Palmoxylon* species, eight species have been reported subsequently by several workers from other localities. They are *Palmoxylon coronatum* Sahni (Roy & Ghosh, 1980); *P. kamalam* Rode (Kulkarni & Mahabale, 1973); *P. mathurii* Sahni (Agarwal & Lalitha, 1977); *P. pantii* Trivedi & Surange (Bonde & Biradar, 1981; Biradar & Bonde, 1984); *P. sundaram* Sahni (Mahabale & Rao, 1973); *P. wadiai* Sahni (Prasad, 1987); *P. sagari* Sahni (Bonde & Biradar, 1981) and *P. sclerodermum* Sahni whose stem with leaf-sheaths has been reported by Shete and Kulkarni, 1983.

somewhat pyriform or ovate, wide obovate to orbicular in shape (Pl. 3, fig. 7), 400-800 x 528-1280 μm in size, 150-275 per sq cm, dorsal sclerenchyma lunate, ventral sclerenchyma arch present, the two forming normally complete sheath (Pl. 3, figs 7-9) (Sahni, 1964, p. 19, text-fig. F); median sinus small, round to angular; xylem most commonly univasal sometimes divided into two, rarely with 3-4 small vessels; phloem scanty (Pl. 3, figs 7-9). Fibrovascular ratio about 8-30/1. *Ground Parenchyma* in small patches seen among the fibrovascular bundles, cells compactly arranged in chain-like form (Pl. 3, fig. 8); tabular parenchyma consisting of narrow 1-2 cells, wide sheath around fibrovascular bundles. *Fibre bundles* present, frequent without stegmata (Pl. 3, fig. 8), 56-112 μm in size.

Holotype—Specimen no. BSIP 37739.

Locality—Block number 661-662 of Binori Reserve Forest, Seoni District, Madhya Pradesh.

Discussion—The arrangement and distribution of fibrovascular bundles indicate that the fossil represents the dermal region of a palm stem. The fossil palm wood belongs to *Vaginata* Group of Sahni (1964, p. 18) on the basis of its lunate dorsal sclerenchyma forming a complete sheath with ventral sclerenchyma cap. In this case ventral sclerenchyma and dorsal sclerenchyma of fibrovascular bundles form more or less complete

sheath (Sahni, 1964, p. 18). After going through the tables of Rao and Achuthan (1973), Prakash (1974) and Guleria and Mehrotra (present paper) it was found that only two fossil woods of palms, viz., *Palmoxylon raoi* Menon 1968 and *P. mahabalei* Rao & Menon 1965 belong to Vaginata Group. In *P. raoi* fibre bundles are absent, stegmata present, vessels many and arranged in concentric form as compared to the present fossil in which fibre bundles are present, stegmata absent and xylem most commonly univasal. *P. mahabalei*, although shows near resemblance, differs in the absence of fibre bundles in dermal part and in the presence of stegmata. The complete sclerenchyma sheath formation as seen in the present fossil makes the species different from all the known *Palmoxylon* species. Hence, the wood has been described as *Palmoxylon vaginatum* sp. nov.

Palmoxylon lunarianum sp. nov.
Pl. 3, figs 5, 6, 10, 11

Material—This species is based on a well preserved petrified palm wood measuring 15 x 5 cm, representing dermal region of the stem.

Description—Fibrovascular bundles highly crowded and contiguously arranged, compressed due to pressure of the adjoining bundles, variously shaped, elliptic to wide elliptic, oblate, ovate, obovate to pyriform (Pl. 3, figs 5-6, 10), 400-720 x 480-1280 μm in size, 200-220 per sq cm, dorsal sclerenchyma well developed, lunate, median sinus round to angular; xylem mostly univasal, sometimes vessel dividing into two to three, occasionally a number of small vessels present, vessels are surrounded by thin walled parenchyma cells; ventral sclerenchyma cap absent; phloem scanty. Fibrovascular ratio 4.5-14/1. *Ground parenchyma* in small patches among the fibrovascular bundles (Pl. 3, figs 5-6, 10), compact, cells round, oval to elongate forming chain like feature; tabular parenchyma forming 1-2 cell layers; radiating parenchyma absent. *Fibre bundles* present in ground tissue, 160-240 μm in size (Pl. 3, fig. 11).

Holotype—Specimen no. BSIP 37740.

Locality—Block number 661-662 of Binori Reserve Forest, Seoni District, Madhya Pradesh.

Discussion—The normal orientation, highly crowded and contiguous arrangement of fibrovascular bundles indicate that the fossil represents the dermal region of the stem. The palm can easily be placed under the *Lunaria* Group of Sahni (1964, p. 18) in view of its lunate dorsal sclerenchyma cap and the absence of ventral cap in the fibrovascular bundles. The fossil has been compared with only those species of *Palmoxylon* which are based on dermal part of the wood belonging to Lunaria Group (Rao & Achuthan, 1973, table 1; Prakash, 1974, table 1; Table 1 of the present paper). Eight species, viz., *P. caudatum* Sahni 1964, *P. coronatum* Sahni 1964, *P. ghoshii* Bera & Banerjee 1990, *P. hyphaenoides* Rao & Shete 1989, *P. krishna* Sahni 1964, *P. parapaniensis* Lakhanpal *et al.* 1979, *P. pondicherriense* Sahni 1964 and *P. sundaram* Sahni 1964 fall under this category. In the first three species and in the dermal part of the fourth species fibre bundles are absent and hence differ from the present fossil. *P. parapaniensis* differs in having highly lacunar parenchyma as compared to compact parenchyma in the present fossil. *P. pondicherriense* differs in having stegmata and a pair of large vessels. Diminutive fibrovascular bundles present in *P. sundaram* distinguishes it from the present fossil. *P. krishna* which apparently shows some resemblance with the present fossil, however, differs in having lesser F/V ratio ranging from 1/1- 2/1 as compared to 4.5-14/1 in the present fossil. Moreover, xylem is mostly univasal in the present fossil whereas it is normally bivasal in *P. krishna*. In addition to the above species *P. penchense* Trivedi & Verma 1974 has also been compared with the fossil on account of absence of ventral sclerenchyma cap. However, the presence of lacunar parenchyma and absence of tabular parenchyma in *P. penchense* differentiate it from the present fossil. Absence of ventral sclerenchyma cap in the present fossil further distinguishes it from the other comparable species. Obviously, the fossil has been given a new

name, *Palmoxylon lunarianum* sp. nov.

DISCUSSION

The aim of the present paper is to describe dicotyledonous and monocotyledonous leaves and wood remains from some new Deccan Intertrappean fossiliferous localities in the Seoni and Mandla districts of Madhya Pradesh. So far no fossil leaf has been described from these two districts as compared to a large number of woods known from the area, mainly Mandla District (Bande *et al.*, 1988). The leaves are preserved as impressions. Further possibility of occurrence of petrified leaf remains is quite strong in the area. The dominance of palms can be judged by their fossils which are found abundantly scattered in the fields as well as in *'nala'* cuttings. This is further confirmed by the investigated material wherein four types of structurally different palm woods have been found in one locality of Seoni District. The reported palms belong to the category of hard palms on account of the presence of fibrous bundles (Sahni, 1964, pp. 72-73). Occurrence of muscilage canals, an important anatomical character of the lepidocaryoid palms, has been reported for the first time in one of the palm woods, namely *Palmoxylon canalosum* sp. nov. Mucilage canals have been reported in the ground parenchyma of stems of lepidocaryoid palms (Tomlinson, 1961, 1990, p. 55). The dicotyledonous leaves and woods in the reported locations of Mandla District have been found in association with palm woods. The dicot woods show resemblance with the extant woods of *Polyalthia* and *Hydnocarpus*.

The palms indicate a characteristic feature of tropical vegetation where the temperature and humidity remain high throughout the year. Their occurrence together with the woods of *Polyalthia* and *Hydnocarpus* which also thrive mostly in moist tropical forests ranging from tropical Africa, Madagascar to South-east Asia indicate that the climate of the area when these plants were growing, must have been more humid than at present. *Phoenicites lakhanpalii* sp. nov., an unsplit palm lamina shows apparent resemblance with such palm genera like *Neophloga* Baill., *Sclerosperma* Mann *et* Wendl., *Stevensonia* Dun ex Balf.f., *Verschaffeltia* Wendl. which are presently confined to Seychelles Islands, Madagascar and tropical Africa. The above data indicate the possibility of some common ancestral elements in African and Indian flora such as *Ctenolophon, Hyphaene, Sclerosperma, Turraeanthus* since India was close to the African Plate at the time of deposition of the Deccan Intertrappean sediments. Some such elements may have perished like the unsplit palm (*Phoenicites lakhanpalii* sp. nov.) as the Indian Plate moved northwards whereas others like *Polyalthia* and *Hydnocarpus* managed to survive.

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