

# A REVIEW OF FOSSIL PALM REMAINS FROM INDIA

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## ABSTRACT

A number of palm remains in the Deccan Intertrappean beds (Eocene) in the form of impressions of petrifications have been described from time to time. Several others have also been described from various parts of India. All this data on fossils and their important diagnostic characters on which the various species are based have been included in this review in the form of four tables. An historical account of the work on Indian fossil palm and the various fossil palm features are discussed. An exhaustive bibliography of the relevant literature on the subject is also included. It is hoped that the review will be of great use to future students of extinct palms in Indian tertiary deposits.

## INTRODUCTION

A LARGE number of petrified palm stems have been described from the Deccan Intertrappean beds of the Mohgaon Kalan area in Madhya Pradesh. Other palm remains, such as impressions and petrifications of leaves, petioles and fruits have also been described from other parts of India. It was thought desirable that the salient features of all these and the scattered literature on the subject also could be collected in one place for the benefit of the future workers. Consequently the information available on the subject was tabulated below in four tables. For the detailed descriptions the reader is referred to the publications indicated in the table and to the bibliography.

A historical review of the work done on Indian palm remains is given below. Four exhaustive tables furnishing the important and distinctive anatomical features of all palm remains known from India, according to well known criteria employed in the description of petrified material are also

included. The tables also indicate the references to the literature cited and the section to which the given palm remains can roughly be assigned. It is hoped that this compilation will be useful to the student of Indian fossil palm remains.

## A HISTORICAL ACCOUNT OF THE INDIAN FOSSIL PALMS

A historical account of the study of palms in general has been given by Mahabale (1958) and fossil palms in particular by late Professor Sahni (1964). As quoted by Sahni, Colonel W. H. Sleeman (1830) was the first to discover some palm stems near Sagar in Central India. While dealing with the geology of the Deccan in one of his earliest papers, Malcolmson in 1837 reported the presence of palm woods as well as some "grass-like or reed-like fragments" in some Intertrappean cherts in the Sichel Hills in the southern part of Madhya Pradesh. In 1852 Carter also reported some palm woods, parallel-veined leaves and bamboo stems from the Deccan Intertrappean beds. In 1853 Stephen Hislop gave a short account of the fossils collected by him along with Dr. R. Hunter and others, from the Deccan Intertrappean beds of Nagpur. This collection includes "endogenous (monocotyledonous) leaves, palm stems, roots, species of *Nipadites*, as well as several interesting fruits which he provisionally referred to the Aroideae" (Sahni, 1964), but the descriptions are brief, vague and without illustrations.

Capt. Vicary in 1846 reported the existence of fossil palms along with some bones of Vertebrates from Bellochistan Hills. Wynne (1875) discovered some "palm like"

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TABLE 1

1 NAME OF SPECIES	2 PARTS AVAILABLE	3 BROAD GROUP AND SECTION OF STENZEL'S CLASSIFICATION	4 FIBROUS BUNDLES; STEGMATA	5 FREQUENCY OF THE FIBROVASCULAR BUNDLES PER CM. <sup>2</sup>	6 F/V RATIO OF THE FIBROVASCULAR BUNDLES	7 DIAMETER OF THE FIBROVASCULAR BUNDLES IN MM	8 MAIN SINUS	9 AURICULAR SINUS AND ATRICULAR LOBES	10 VASCULAR PART OF FIBROVASCULAR BUNDLES, NUMBER AND DISTRIBUTION OF MAIN VESSELS	11 GROUND TISSUE			12 ANY SPECIAL PECULIARITY	13 LOCALITIES	14 GEOLOGICAL HORIZON	15 TYPE SPECIMENS (REGISTERED NUMBERS ETC.) AND DUPLICATES
										General parenchyma	Tabular parenchyma	Radiating parenchyma				
<b>RENIFORMIA</b>																
<i>Palmoxylon wadaii</i> Sahni	Subdermal and central	Cocos-like; Reniformia	Absent	SD-30 C-20	SD-21/1-4/1	1 × 1-3 mm	Rounded, deeper in subdermal bundles than in central	Present; lobes rounded	Exserted; usually one large vessel	Cells isodiametric walls straight, inter-spaces angular	Several layers over sclerenchymatous part only	Absent	Scattered thick walled cells in ground tissue	Jammu	Upper Siwalik conglomerate (= Pliocene) but possibly derived from older strata	Type specimen in Sahni collection and duplicate in Geol. Surv. India
<i>P. sagari</i> Sahni	Subdermal	Reniformia	Absent	10-12	3-3-5/1	—	Rounded	Obtuse-angled; lobes rounded	Exserted; usually a pair of large vessels	Cells of simple shapes, air-spaces small	2-3 layers over sclerenchymatous part	Present over xylem not marked in development	—	Sagar	Probably Deccan Intertrappean series	Brit. Mus. V. 7953, V. 7957 also Roy. Coll. Surg. No. RK 72 Madras Museum; duplicate in Sahni collection
<i>P. indicum</i> Sahni	Dermal and subdermal almost to central region	Corypha-like; Reniformia with tendency to cordate	Absent	D-50-80 SD-15-20	D-7-8-9/1 SD-5-6/1	D-0-5-1 SD-2 or more	Rounded rarely angular	Obtuse-angled; lobes rounded	do	Not compact	1-2 layers over sclerenchyma, rarely all round	Present, markedly developed in the more central parts	—	Unknown	Unknown	Unknown
<i>P. mathuri</i> Sahni	Central	Reniformia	Present, no stegmata	24-25	2/3	0.3-0.4 × 0.5-0.6	Rounded	Absent; lobes rounded	Exserted; usually two large vessels	Markedly trabecular with very large inter-spaces	Absent	Absent	Ground tissue markedly trabecular low fibrovascular ratio	Lackpore = Lackhapur in Cutch	Bluj series of Dr. R. Nath	Banaras University Geol. Dept., duplicate in Sahni collection
<i>P. burmense</i> Sahni	Dermal and subdermal	Cocos-like; Reniformia	Present with stegmata	D-14-17 SD-14-17	D-6/1 SD-4/1-8/1	0-9-1	Rounded, shallow	Obsolete, lobes rounded	Exserted; badly preserved	Cells branched with large inter-spaces	Absent	Present over whole bundle specially developed over sclerenchyma	Specialized outer layers of sclerenchymatous part of fvb or say "stigmata even in sclerenchyma of fvb's"	Mt. Popa region, Myingyan District, upper Burma	Near Pegu-Irrawaddian boundary either Oligo-Miocene or Mio-Pliocene	Chhibber's P. 63, now in Sahni collection; duplicate in Geol. Surv. India
<i>P. cribriforme</i> Sahni	Deep subdermal zone	Reniformia	Absent	31-33	6-8/1	1.4 × 1-2	Rounded	Present; lobes rounded	Exserted; usually one large vessel	Cells stellate with very short arms, leaving rounded spaces between	2-3 layers over sclerenchymatous parts	Absent	Criferiform ground tissue	Unknown	Unknown	—
<i>P. sinuosum</i> Sahni	Subdermal	Reniformia	Absent	21-30	3-4/1	—	Rounded	Present; lobes rounded	Exserted as a tongue-like process; usually one large median vessel somewhat oval	Lacunar cells isodiametric with a stellate tendency; inter-spaces rounded	1-2 layers over sclerenchyma	Absent	Ground tissue cells with a tendency to become stellate	Tatchaung, Burma	Near Pegu-Irrawaddian boundary	G.S.I. K15/309
<i>P. trabeculosum</i> Sahni	Complete cross section; no roots	Reniformia	Present, large with stigmata	D-320 SD-138	D-20-40/1 SD-1-3-8-10/1 C-2-4/1	—	Rounded or angular	—	—	Scanty, compact in dermal, very lacunar in central, composed of trabeculae	1 layer of much elongated cells	Absent	Ground tissue of horizontally elongated trabecular cells	Saugor	Probably Deccan Intertrappean series	Roy. Coll. Surg. London. No. 146; duplicate in Sahni collection
<i>P. sahnii</i> Rode	Complete cross section of stem with leaf bases and roots	Reniformia	Present, no stigmata	—	—	—	—	—	—	—	—	—	Highly developed posterior sclerenchymatous arch, large fusiform bundles	Mohgaon Kalan	Deccan Intertrappean series	—
<i>P. blanfordi</i> Schenk	Central	Corypha-like, Reniformia but Stenzel puts it in Complanata	Absent	14	2-3/1	—	Shallow arch	Obtuse-angled; lobes rounded	Exserted; bisasal	Lacunar, cells cylindrical, with stellate tendency	A few layers over whole bundle	Present all round the fvb	—	Near Jhansi in the bed of the upper Nerbada	Unknown either Deccan Intertrappean series or Nerbada alluvium	Bot. Inst. Leipzig (Felix collection)
<i>P. khalsa</i> Sahni	Subdermal	Reniformia	Absent	—	—	—	Rounded	—	Exserted, usually 3-4 rarely 2	Lacunar, cells rod-like sometimes branched	—	Present rounded the vascular parts	Usually fibrovascular bundles have 3-4 large vessels and a number of small vessels in addition (? leaf-traces)	Unknown	Unknown	Bomb. Br. Roy. Asiatic Soc. No. 16 fragment in Sahni collection
<i>P. barbatum</i> Sahni	Dermal and subdermal	Reniformia	Present	D-46 SD-17	D-6/1 SD-4/1	D-0-7-1-16 SD-1 × 1-2	Rounded	—	Exserted; bisasal	Compact in dermal zone with isodiametric to elongate cells; lacunar in subdermal zone with elongated cells	Present	Present	Ground tissue cells often form a palisade like layer over sclerenchyma in dermal zone and a beard-like tuft over vascular part in subdermal zone	Unknown	Unknown	Brit. Mus. V. 4627; fragment in Sahni collection
<i>P. reuahense</i> Sahni	Subdermal near central region	Usually Reniformia and cordate	Absent	SD-50-72	2-5/1	1-065 × 0-84	Angular or rounded	Present; lobes angular to rounded	Included or partly excluded, bisasal	Compact, cells circular to oval	Usually 1-2 layers	Absent	—	Hirwar, near Tiki South Rewah	Unknown	G.S.I. K25/789; specimen and a section in Sahni collection
<i>P. deccanense</i> Sahni	Sub-dermal	Reniformia	Absent	SD-28-45	8/1-15/1	1-13-1-2	Rounded	Present; lobes rounded or slightly angular	Included or partly excluded, bisasal	Lacunar, cells variously shaped	Absent	Present	—	Maerjour, Wardha District	Probably Deccan Intertrappean series	G.S.I. B.3; Specimen and three sections in Sahni collection
<i>P. sp.</i> Sahni	Subdermal	Reniformia	Absent	SD-25-40	3/1-10/1	1-1-26	Usually rounded	Present; lobes rounded or slightly angular	Excluded; 1-2 basal	Slightly lacunar, cells rectangular to Y-shaped	1-2 layers	Absent	—	Unknown	Miocene or Pliocene	G.S.I. K12/24; pieces of type specimen in Sahni collection
<b>LUNARIA</b>																
<i>P. jammuense</i> Sahni	Subdermal	Lunaria	Absent	SD-13	12-16/1	1-50 × 1-45	Rounded to angular	Obtuse-angled; lobes narrowly rounded to angular	Exserted; usually one large vessel	Cells cylindrical, more or less stellate, spaces oval or circular	2-3 layers over sclerenchymatous part only	2-3 layers	Bundles very large	Jammu	Upper Siwalik Congluvereti (= Pliocene) but possibly derived from older strata	Sahni collection, duplicate in Geol. Surv. India
<i>P. sundaram</i> Sahni	Dermal subdermal and central	Corypha-like, Lunaria	Present no stegmata	D-200 SD-100 C-35	D-3/1-4/1 SD-3/2-1/1 C-1/1	D-1 × 0-5 SD-1-1 × 0-75 C-1-1 × 0-75	Rounded or angular in D, rounded in SD and C	Absent; lobes sharp	Exserted; usually a pair of large vessels, sometimes one large vessel	Cells ellipsoid; of uniform shape and size; tissue compact in dermal region, loose in interior	Several layers	Absent	Minute accessory fvb in central region	Saugor	Deccan Intertrappean series	Sahni collection, Nagpur Museum
<i>P. pondicherrise</i>	Dermal, subdermal and central	Mauritia-like; (form variable) Lunaria-Reniformia	Present with stegmata	D-108 SD-74-78 C-6-6-9	D-6-10/1 SD-2/1 C-1/2-3	—	Rounded	Absent	Exserted; usually a pair of large vessels	Compact in D, trabecular in C	Present	Absent	Contrast in f/v ratio between dermal and central bundles	Pondicherry (Harford coll. 1895)	? Miocene	Brit. Mus. Geol. Dept. V. 3339 duplicate section in Sahni collection
<i>P. krishna</i> Sahni	Dermal and subdermal	Corypha-like, Lunaria	Present, cells thin walled, without stigmata	D-250-300 SD-90-92	D-1/1 SD-2/1	D-0-5 SD-0-45-0-55 × 0-6-0-7	Deep in dermal and shallow in subdermal bundles	Lobes acute angled in dermal and obtuse angled or approaching a right angle in subdermal	A pair of vessels present	Compact, cells small usually circular or elliptic, occasionally with dense black contents	Usually 1-2 layers	Absent	Thin walled fibrous bundles	Near Sitabaldi (Nagpur)	Probably Deccan Intertrappean series	Brit. Mus. Geol. Dept. V. 7137; duplicate in Sahni collection
<i>P. coronatum</i> Sahni	Dermal and subdermal	Lunaria	Absent	D-70 SD-40-50	D-3-4/1	0-64 × 0-4	Rounded, deep	Absent; lobes angular	Inserted; usually 1-2 large vessels	—	—	Present over specialized fvb	Specialized fvb with corona, unusually numerous horizontal bundles; specialized outer layer of sclerenchyma	Mt. Popa region, Myingyan District upper Burma	Either top of Pegu series (Oligo-Miocene) or base of Irrawaddy series (Miocene)	Chhibber's P. 277, now in Sahni collection
<i>P. caudatum</i> Sahni	Dermal and subdermal	Usually Lunaria	Absent	D-32-41 SD-36-38	D-12/1-15/1 SD-12/1-15/1	—	Very narrow, rounded angular	Present; lobes usually angular	Very much exserted; usually one large vessel much compressed laterally	Very lacunar	2-3 layers over sclerenchymatous part	Absent	Form of fvb with narrow sinus and far protruding vascular part	Mt. Popa region, Myingyan District upper Burma	Near Pegu-Irrawaddian boundary; either Oligo-Miocene or Mio-Pliocene	Chhibber's P. 432 (Type specimen), P. 37 (Co-Type), now in Sahni collection
<i>P. megalosiphon</i> Sahni	Central	Lunaria	Absent	72-95	2/1	0-66 × 0-5	Rounded	; lobes angular	; a single very large median vessel	Lacunar, cells thin walled, isodiametric or rod-shaped, sometimes more or less stellate, inter-spaces round	1-2 layers all round the fvb, specially well developed over the sclerenchyma	Absent	—	Sindh	Tertiary	G.S.I. G226/3
<i>P. liebiganum</i> Schenk	Subdermal and central	Cocos-like; Lunaria	Present, but without stigmata	SD-200-250 C-150	2-3/1	1/5-1/3	Shallow, rounded	Absent; lobes angular	Exserted; metaxylem usually bisasal	Compact, cells circular to oblong, many with black content	Usually 1 layer or 2 over sclerenchyma	Absent	Ground tissue cells with black contents	Sitabaldi (Nagpur)	Probably Deccan Intertrappean series	Bot. Inst. Leipzig (Felix collection)
<i>P. ceylanicum</i> Ungar	Probably subdermal	Probably Cocos-like; Lunaria	Present, large	330	—	1/2	Slightly arched	; lobes sharp	; metaxylem usually of 2-4 vessels in tangential row	—	—	—	Fvb very thin	Ceylon	Unknown	Sections in Unger collection, Paris; block probably in London
<i>P. hislopi</i> Rode	Subdermal	Lunaria	Absent	65-104	5-8/1	—	Rounded	Lobes usually angular, some times rounded	Badly preserved; usually bisasal	Lacunar, cell rod-like or slightly branched, air-spaces about equal in to area the cell	One layer over sclerenchyma but not well defined and not always continuous	Absent	—	Mohgaon Kalan near Chhindwara, M.P.	Base of Deccan Intertrappean series	Banaras University Geol. Dept. M/s; fragment of type-specimen and duplicate in Sahni collection
<b>COMPLANATA</b>																
<i>P. edwardsi</i> Sahni	Dermal and subdermal	Corypha-like (Mauritia-like in the f/v ratio of central bundles which is <1); Complanaata	Present without stigmata	D-70-90 SD-60	D-3-1/1 SD-1/1	—	Absent or extremely shallow	Absent or very slightly developed; lobes always rounded in SD zone	Exserted; usually 2 large vessels	Compact cells rounded or slightly sinuous walled	Absent	Absent	Sclerotic nets with erratic distribution present in SD zone	"Near Jabulpore (Capt. Routh)"	Either Nerbada alluvium or Deccan Intertrappean series	Sahni collection; duplicates in Brit. Mus. Geol. Dept. V. 5380, V. 7136
<i>P. hamalam</i> Rode	Subdermal	Complanata	Absent	70	1-5-2/1	—	Absent	Absent; lobes rounded	Wholly exserted; usually bisasal	Markedly trabecular with very large inter-spaces	Absent	Present	Fvb lie in the centre of the radiating trabeculae and air-spaces	Mohgaon Kalan, near Chhindwara	Base of the Deccan Intertrappean series	Banaras University Geol. Dept. M/8; fragment and duplicate sections in Sahni collection
<b>CORDATA</b>																
<i>P. compactum</i> Sahni	Subdermal	Cordata	Absent	12-34	12/1	1-65-1-85	Right angled	Present; lobes rounded	Exserted; large vessels 1-3, usually one with long diameter, horizontal	Compact, cells variously shaped	2-3 layers not well marked	Absent	Compact ground tissue	Burma	Tertiary	Chhibber's P. 365 now in Sahni collection, G.S.I. K682
<i>P. prismaticum</i> Sahni	Dermal and subdermal and central; roots attached	Corypha-like; Cordata	Present, stigmata	D-71-85 SD-37-41 C-30-34	D-5-6/1 SD-C-4-5/1 or 5/1	1-08-0-75	Sinus small, angular or slightly rounded	Absent; lobes rounded	Exserted; usually two large vessels	Compact in D region, palisade like in SD, irregular in C	2-3 layers round the entire bundles in D region	Present round the zylem of SD bundles	Ground tissue variable, palisade like cells found in SD zone	Unknown	Unknown	Sahni collection
<i>P. intertrappean</i> Sahni	Complete basal part of trunk, with leaf scars but not roots	Corypha-like; Cordata	Present without stigmata	D-140 SD-19-21	D-32-16/1 SD-9-10/1	D-1-0-6 SD-1-2-1-55	Sinus small angular	; lobes rounded	; universal in the D, bisasal in SD	Compact in D region, lacunar in SD with cells rod-like to variously shaped	—	—	—	Sindh, Narbada Distt. M.P.	Deccan Intertrappean Series	G.S.I. K22/296
<i>P. sclerodermum</i> Sahni	Dermal and part of subdermal	Cordata	Present, no stigmata	D-108 SD-65 C-22	D-10-1-15/1 SD-15/1-25/1 8 or more/1	D-0-3-0-5 SD-1	Obtuse-angled	; lobes broadly rounded	Scarcely exserted; one large vessel	Very lacunar, cells of various geometric shapes	Absent	Absent	—	Seoni, M.P.	Deccan Intertrappean series	G.S.I. K18/400
<i>P. geometricum</i> Sahni	Central	Cordata	Absent	—	—	—	Rounded or angular	; lobes angular	; usually one large vessel	Very lacunar, cells of various geometric shapes	1-2 layers over sclerenchyma but interrupted by air-spaces	Absent	Ground tissue cells of regular geometric forms	Sind	Tertiary	G.S.I. G226/3
<b>SAGITTATA</b>																
<i>P. seriatum</i> Sahni	Dermal, subdermal and central; roots attached	Corypha-like; Sagittata	Present	D-110-140 SD-52-66 C-29-41	D-3-6/1 SD-2-4/1 C-2/1	D-0-7-0-5 C-0-9-0-65	Angular	Absent; lobes acute-angled but rounded at the ends	Exserted; generally two large cells	Relatively compact cells rounded, spaces small	1-2 layers over sclerenchymatous part	—	Radial arrangement of outer bundles; scattered thick walled cells in ground tissue; radial plates of tangentially elongated cells in D zone	Not definitely known probably Cutch	Probably Cretaceous	Palaeontology Department Univ. Liege No. 97 a fragment from same in Sahni collection
<i>P. pyriforme</i> Sahni	Subdermal and central	Cocos-like; Sagittata (leaf-traces of reniformia type)	Absent	SD & C-23	SD & C-8-10/1	—	Sinus small, acute angled sometimes rounded at the top	Absent; lobes sharp and angular	Exserted; generally one large vessel with its radial diameter much longer than tangential	Relatively compact cells, isodiametric, somewhat stellate, spaces small	A few layers, specially well developed over sclerenchymatous part	Absent	Scattered diminutive fvb's specially in C region mixed with large reniformia type of leaf-traces	Burma	Pegu-Irrawaddian boundary (= Pliocene)	G.S.I. K15/101, duplicate in Sahni collection

Footnote: C — Central region  
D — Dermal region  
fvb — Fibrovascular bundle  
SD — Sub-dermal zone

Table A based upon the table in Dr. Sahni's monograph (1964).

TABLE 2

NAME OF SPECIES	PARTS AVAILABLE	BROAD GROUP AND SECTION OF STENZEL'S CLASSIFICATION	FIBROUS BUNDLES AND STEGMATA	FREQUENCY OF THE FVB PER CM.	F/V RATIO OF THE FVB	DIAMETER OF THE FVB	MEDIAN SINUS	AURICULAR LOBES	VASCULAR PART OF THE FVB, NUMBER AND DISTRIBUTION OF MAIN VESSELS	GROUND TISSUE			ANY SPECIAL PECULIARITY	LOCALITIES	GEOLOGICAL HORIZON		
										General parenchyma	Tabular parenchyma	Radiating parenchyma					
<b>PALM WOODS</b>																	
<i>Palmoxylon parthasarathyi</i> sp. nov. Rao & Menon (1963a)	Dermal, subdermal and central	Cocos-like	Present, stigmata absent	D-350-380 SD-90-110 C-60-66	D-0.2/1.0-8/1 SD-0.2/1.0-6/1 C-0.3/1.0-4/1	D-0.16-0.41 SD-0.2-0.4 C-0.19-0.43	Concave	Mostly rounded	Excluded; generally two xylem vessels side by side	Thin walled, compact, uniform cells arranged loosely	Absent	Absent	Some of the ground parenchyma cells show reticulations giving the appearance of a cellular structure	Mohgaon Kalan	Deccan series	Intertrappean	
<i>P. sundaram</i> Sahni var. <i>Vidarbhai</i> Rao & Menon (1964d)	Subdermal	Cocos-like	Absent	80-100	0.5/1-1/1	0.25-0.6	Concave	Mostly rounded	Excluded; usually 2 main xylem vessels side by side	Smooth walled elliptical of uniform sizes loosely packed	Absent	Absent	—	Mohgaon Kalan	Deccan series	Intertrappean	
<i>P. krauseli</i> sp. nov. Rao & Menon (1965b)	Root region, dermal and subdermal	Cocos-like	Present, stigmata present?	D- SD-50-55	D-0.2/1-1/1 SD-0.4/1-1/1 C-	D-0.18-0.3 SD-0.27-0.4	Concave	Mostly rounded	Excluded; usually 2 main xylem vessels	Elongated thin walled loose cells	Absent	Present	—	Mohgaon Kalan	Deccan series	Intertrappean	
<i>P. raoi</i> sp. nov. Menon (1964c)	Cortical, dermal, subdermal roots attached	Cocos-like; Vaginata	Absent, stigmata present around the fibrovascular bundles	D-120-130 SD-44-55	D-0.37/1-1-1/1 SD-0.56/1-0.9/1	D-0.35-0.73 SD-0.26-0.67	Mostly rounded	Both dorsal and ventral sclerenchyma joined together	Vascular part is surrounded by sclerenchyma sheath, xylem vessels many, arranged in a crescentic manner	Compact thin walled angular cells	Absent	Absent	Crescentically arranged xylem vessels, ventral sclerenchyma bigger than dorsal sclerenchyma	Mohgaon Kalan	Deccan series	Intertrappean	
<i>P. mahabalei</i> sp. nov. Rao & Menon (1967)	Cortical, peripheral and central zones	Cocos-like Vaginata	Present in the cortex but absent in other zones. Stigmata around the fibrovascular bundles	CO-90-105 ppt-120-150 cpt-250-300	CO-0.7/1-1-8/1 (smaller bundles) 0.4/1-0.9/1 (bigger bundles) ppt-0.76/1-3-1/1 cpt-0.68/1-1-6/1 D-1/1-4/1 SD-1/1-3/1 C-1/1-2.5/1	CO-0.15-0.39 (smaller bundles) 0.47-0.93 (bigger bundles) ppt-0.23-0.72 cpt-0.23-0.69 D-0.25-0.5 SD-0.31-0.78 C-0.7-1	Concave	Rounded in the cortex otherwise united with the ventral sheath	Vascular part is surrounded by sclerenchyma. Main xylem vessel one	Thin walled, rounded to oval cells with slight inter-cellular spaces	Absent	Absent	Dorsal and ventral sclerenchyma separated at the cortex and peripheral part, united at the central. Ventral sclerenchyma more than dorsal	Mohgaon Kalan	Deccan series	Intertrappean	
<i>P. pyriforme</i> Sahni Rao & Menon (1960-1964)	Dermal, subdermal and central	Corypha-like	Absent	D-250-300 SD-150-185 C-90-130	D-1/1-4/1 SD-1/1-3/1 C-1/1-2.5/1	D-0.25-0.41 SD-0.17-0.37 C-0.19-0.31	Concave	Rounded to pointed	Excluded; usually 2 or more main xylem vessels	Compact, rounded to oval cells with small inter-cellular spaces	Two layered tabular parenchyma surrounding the whole bundle	Absent	Diminutive bundles present. Leaf-trace bundles very big in size	Mohgaon Kalan	Deccan series	Intertrappean	
<i>P. narayani</i> sp. nov. Rao & Menon (1962)	Dermal, subdermal and central	Mauritia-like	Absent	D-105-110 SD-60-66 C-40-45	D-1.3/1-4/1 SD-1/1-2.5/1 C-0.6/1-1-7/1	D-0.25-0.41 SD-0.17-0.37 C-0.19-0.31	Not clear, somewhat flat	Not clear	Excluded; usually 2 main xylem vessels	Thin walled, cells of various shapes closely packed	Absent	Present	Some dark stained bodies looking like cell contents are seen	Mohgaon Kalan	Deccan series	Intertrappean	
<i>P. maheshwarii</i> sp. nov. Rao & Menon (1963b)	Root, cortical, dermal, subdermal and central	Mauritia-like	Present in the cortex, but absent in other zones. Stigmata absent	CO-80-85 D-540-630 SD-86-100 C-35-45	CO-3/1-10/1 D-0.2/1-0.6/1 SD-0.12/1-0.3/1 C-0.1/1-0.2/1	CO-0.14-0.42 D-0.12-0.25 SD-0.23-0.42 C-0.17-0.56	Somewhat rounded	flat to Mostly pointed	Excluded; main xylem vessels 2 or more	Thin walled, compact uniform cells with inter-cellular spaces	Absent	Absent	The development of leaf-trace bundles are very clear	Mohgaon Kalan	Deccan series	Intertrappean	
<i>P. spittii</i> Dayal & Menon (1965)	Dermal, subdermal and central	Mauritia-like	Absent, except in the cortex. Stigmata absent	D-245-320 SD-150-170 C-80-125	D-0.5/1-1-4/1 SD-0.4/1-1/1 C-0.3/1-0.8/1	D-0.2-0.5 SD-0.3-0.6 C-0.5-0.8	Concave	Rounded to pointed	Excluded; Main xylem vessels usually two	Thin walled round to oval cells with inter-cellular spaces	Absent	Absent	—	Mohgaon Kalan	Deccan series	Intertrappean	
<i>P. sahnii</i> , Menon, 1964a)	Dermal, subdermal and central	Mauritia-like	Numerous. Stigmata absent	D-400-500 SD-250-350 C-170-225	D-0.5/1-0.8/1 SD-0.4/1-1/1 C-0.3/1-0.6/1	D-0.17-0.27 SD-0.23-0.49 C-0.35-0.57	Concave	Rounded to pointed	Excluded; 2 main vessels	Not preserved properly	Absent	Absent	Enormous number of fibrous bundles	Mohgaon Kalan	Deccan series	Intertrappean	
<i>P. freytmanteli</i> sp. nov. Menon (MS.)	Cortical, dermal, subdermal and central	Mauritia-like	Present, Stigmata absent	D-140-179 SD-54-105 C-25-78	D-0.8/1-3-8/1 SD-0.4/1-1-2/1 C-0.4/0.9/1	D-0.2-0.4 SD-0.2-0.4 C-0.4-0.6	Concave	Rounded to pointed	Excluded; two xylem vessels usually	Lacunar	Absent	Radiating parenchyma present	Radiating elongated cells are seen in between the fvb of the dermal zone	Mohgaon Kalan	Deccan series	Intertrappean	
<b>PALM PETIOLES</b>																	
<i>Palmocaulon raoi</i> sp. nov. Menon (1964b)	Peripheral and central zones	Cocos-like	Absent	pz-250-350 C-135-150	pz-1.5/1-4.7/1 C-0.6/1-2.9/1	pz-0.29-0.91 C-0.23-0.8	Concave, variously shaped	sclerenchyma surrounds completely the vascular elements. vsc many times bigger than dsc	Excluded; xylem vessels arranged in crescentic manner	Thin walled angular cells	Absent	Absent	Complete sheath of sclerenchyma, in which vsc is bigger than dsc	Mohgaon Kalan	Deccan series	Intertrappean	
<i>Palmocaulon mahabalei</i> sp. nov. Menon (1965)	Peripheral and central zones	Cocos-like	Absent	—	ppt-0.8/1-1-7/1 cpt. Could not be measured	ppt-0.19-0.31 cpt-0.13-0.3	Somewhat concave	Not very clear	Both dsc and vsc separated in the cortex. vsc is bigger than dsc. Both dsc and vsc united in the central region	Compact thin walled angular cells	Absent	Absent	—	Mohgaon Kalan	Deccan series	Intertrappean	
<b>PALM LAMINA</b>																	
<i>Palmophyllum dakshinense</i> sp. nov. Menon (MS.)	is a fragment of plicated, keeled lamina showing the fibrous bundles and stigmata bundles of different sizes. They are arranged in a parallel manner. Three types of bundles are seen the biggest midrib bundle, median sized and small sized side bundles. Fibrous bundles occur in between the fibrovascular bundles. In all the fibrovascular bundles, the dorsal and ventral sclerenchyma joined together surrounding the xylem and phloem elements which are separated by a bundle of sclerenchyma. Xylem elements vary in number from bundle to bundle. The midrib portion of an older part of the lamina consists of a number of fibrovascular bundles having their own sclerenchyma sheath and xylem elements, are surrounded by a general sclerenchyma sheath.														Mohgaon Kalan	Deccan series	Intertrappean
<i>Phoenixites</i> sp. (Lakhanpal 1964)	is an incomplete <i>Phoenix</i> like leaf impression reported from the Nangal border on the Garo hills of Assam														Mohgaon Kalan	Deccan series	Intertrappean
<b>ROOTS</b>																	
Roots of <i>P. krauseli</i>	consists of an epidermis, outer thin walled hypodermis, inner thick walled hypodermis, an outer and inner compact cortex middle lacunar cortex and a stele having 26 to 33 xylem bundles alternating with phloem. The pith is parenchymatous.														Mohgaon Kalan	Deccan series	Intertrappean
<i>P. raoi</i>	As in <i>P. krauseli</i> , here also the roots consist of an outer thin walled and inner thick walled hypodermis, outer and inner compact cortex and middle lacunar cortex with some black contents in some of the cells. The stele contains 8-12 xylem arcs alternating with phloem. The pith is parenchymatous, rarely sclerenchymatous.														Mohgaon Kalan	Deccan series	Intertrappean

Footnotes: C—Central zone; CO—Cortical zone; cpt—Central part; D—Dermal zone; dsc—Dorsal sclerenchyma; fvb—Fibrovascular bundle; ppt—Peripheral part; pz—Peripheral zone; SD—Sub-dermal zone; and vsc—Ventral sclerenchyma.

woods from the Tertiary beds of the Trans Indus Salt Range in the Kohat District. Feistmantel in 1882 gave a note on remains of Palm leaves from the Murree and Kasauli beds (Tertiary) in India. Lydekker (1883) found "in the red clays (of the Murree Series) near the village of Chakoti, on the Jhelam, a portion of a palm frond." The same specimen had been referred to as *Sabal Major* Heer by Feistmantel in 1882 (Sahni, 1964).

Schenk in 1882 gave an illustrated account of the anatomy of two silicified palm woods, *Palmoxylon blanfordi* and *P. liebighianum* collected by Schlagintweit brothers from the central provinces. Stenzel in 1904 described these specimens in great detail in his "monograph" containing all the species known from the world at that time. He included Schenk's *P. liebighianum* as a variety of *P. ceylanicum* (Ungar) a species originally named as *Fasciculites ceylanicum* by Ungar in 1845, and briefly described by him (without figures) in 1850 (Sahni, 1964).

In 1920 Sahni described *P. wadiai* collected from the bed of the river Tawi at Jammu. Later on in 1932 another species, *P. mathuri* Sahni was reported from Kackhipur in Cutch. Since then Sahni, Rode, Ramanujam, Lakhanpal, Mahabale, Uttam Prakash, Rao and Menon & Menon have described different species of petrified palms from India (see Tables 1-3). Kaul (1960) also has listed the fossil palm remains of India and other countries. Sahni's recent posthumous monograph (1964) on the petrified palms of India, Burma and Ceylon gives a wealth of information on the anatomy of petrified palms of India and elsewhere. The localities from which these palms have been obtained are indicated in the Tables 1-3 attached herewith. It will, however, be noticed that most of the petrified palms are from the Mohgaon Kalan area in M.P. and seem to have been found *in situ*. This suggests that these palm woods really belonged to palms that grew in that area.

A study of petrified palms suffers from certain limitations. Only a part of the stem is preserved and in that also the dermal zone is very often weathered off. The internal structure may or may not be well preserved. In fact in a living palm, sections can be taken at various levels of the stem and the changing pattern of the vascular bundles, their distribution, structure and

ground tissue can be studied and the range of variation noted. But in fragmentary petrified palms this method of study cannot be employed. At the same time it may not be perhaps advisable to discard the specimens as perfectly useless, particularly when they show between themselves striking differences in internal structures. It, therefore, becomes necessary to study these pieces of stems as carefully as possible noting down minute variations in the structure and distribution of internal tissues. For this purpose, Knowlton (1888), Stenzel (1904), Stevens (1912 & 1921), Kräusel (1939), Kräusel & Stromer (1924), Chiarugi (1931 & 1933), Stockmans and Williere (1938 & 1943), Sahni (1931, 1943 & 1964), Gothan (1942), Kaul (1935), Ogura (1952 & 1955), Greguss (1954 & 1959) and others have used different criteria like the zonation of stem into dermal (peripheral), sub-dermal and central zones, the size, frequency and form of both the fibrous and fibrovascular bundles in the respective zones, their fibrovascular ratio, the relative proportion of the dorsal and ventral sclerenchyma in each bundle, the presence or absence of fibrous bundles, the presence or absence of stegmata, tabular and radiating parenchyma around the fibrovascular bundles, the form of the dorsal sclerenchyma in transverse sections, the median sinus and auricular lobes, the form and disposition of xylem (whether included within the sinus or exserted), the number and position of the main xylem vessels, the form and structure of the ground tissue and lastly the occurrence of peculiar structures like the stone-cells, idioblasts and radiating plates of tangentially colongated cells between the bundles. The identification of the following palm remains are based upon as many of these criteria as are available in the specimens.

#### PETIOLES AND LAMINA

It is only in recent years that petrified petioles and lamina of palms have been discovered although leaf impressions have been known for some time. A few words about these may not be out of place here.

Two interesting petrified palm petioles discovered in Mohgaon Kalan have been referred to the petiole genus *Palmocaulon* and referred to as *Palmocaulon raoi* Menon (1964) and *Palmocaulon mahabalei* Menon

(1965). These two are very likely the petioles of the two petrified *Palmoxylon* woods with the same specific names respectively, because of the striking similarity in the structure of the vascular bundles and their arrangement also. The generic name has been borrowed from Deshpande from his unpublished paper on *Palmocaulon Mohgaonse*, also collected from Mohgaon Kalan area.

A few petrified leaves with characteristic plication and typical vascular bundles like those of Palms, from Mohgaon Kalan area have been referred to the leaf genus *Palmophyllum* under a new specific name *Palmophyllum dakshinense* Menon. Conventz instituted the genus for palm leaf impressions only. The generic diagnosis has now been slightly modified to include petrifications also.

#### PETRIFIED WOODS

A large number of petrified woods have been described from India from time to time (see Tables 1-3). The peculiar distinguishing features are also indicated in the table. So a description of these woods is not included here as it will be an unnecessary repetition. The occurrence of a similar species of fossil palm wood *Palmoxylon pyriforme* Sahni in the Pegu System of Irrawady in Burma and also in the Deccan Intertropical beds of India is rather interesting.

Table 4 shows impressions and petrifications of the leaves, inflorescence floral axis, fruits and roots of palms reported from India. As many characters as could possibly be collected from the preliminary incomplete descriptions of these specimens have been included in the table. The inflorescences are referred to *Palmostrobus* the fruits as *Palmocarpon* and detached roots as *Rhizopalmoxylon*.

#### CONCLUSIONS

The affinities of the various palm woods shown in the tables cannot be easily determined. The anatomical data available though not insufficient are perhaps unreliable. It might be pointed, however, that

Kaul (1935 & 1938) has compared the fossil *Palmoxylon sundaram* of Sahni with *Cocos* and *Palmoxylon mathuri* Sahni with *Bactris*, *Palmoxylon coronatum* Sahni with *Borassus*. Ramanujam (1953) has compared *Palmoxylon arcotense* with *Livistona* and Mahabale (1958) has compared *Palmoxylon* sp. with *Phoenix*. It is also worth noticing that these and all the other fossil palms have been referred to the three main groups of Palm types, the *Cocoid*, *Coryphoid* and *Mauritoid* type as put forth in an artificial classification of fossil palms by Von Mohl (1845 & 1849) and Stenzel (1904). According to Blatter (1926) the following genera of palms are natives of India and Ceylon: *Phoenix* L., *Trachycarpus* Wendl., *Corypha* L., *Nannorhops*. Wendl., *Licuala* Wurmbl., *Livistona* R., *Hyphaene* Gaertn., *Borassus* L., *Zalacca* Reinw., *Korthalsia* Bl., *Plectoconia* Mart. *Plectocomiopsis* Becc., *Calamus* L., *Demonorhops* Bl., *Caryota* L., *Arenga* Labill., *Didymosperma* W., *Wallichia* Roxb., *Bentinkia* Berr., *Oncosperma* Bl., *Loxococcus* Wendl., *Ptychoraphis* Becc., *Pinanga* Bl., *Areca* L., *Cocos* L., and *Nipa* Thunb. The living genera compared to the fossils above, certainly belong to this list of palms indigenous to India and listed by Blatter. This may or may not be of significance. But recent work has shown that comparisons quoted above are open to question. Mahabale has pointed out that the various structural features like the form and distribution of fibrovascular bundles, their f/v ratio, dorsal and ventral sclerenchyma, ground tissue and other characters are liable to change from level to level in the same palm or even according to age (Mahabale, 1958). This has also been noted even in a short organ like the leaf-axis of *Nipa fruticans* (Menon, 1968). These facts show that the above features are not very reliable criteria and any generic affinities based mainly upon them are not likely to be correct. Consequently, definite comparisons of the fossil woods with living genera should be scrupulously avoided, although structural similarities may be pointed out. Perhaps a detailed anatomical study of all the living genera of palms described as endemic to India by Blatter, would provide data for more accurate comparison and generic identification of the fossil palms of India.

In view of the difficulty of definitely assigning these fossils to the living genera of

TABLE 3

1 NAME OF SPECIES	2 PARTS AVAILABLE	3 BROAD GROUP AND STENZEL'S CLASSIFICATION	4 FIBROUS BUNDLES AND STEGMATA	5 FREQUENCY OF THE fvb PER CM. <sup>2</sup>	6 F/V RATIO OF THE fvb	7 DIAMETER OF THE fvb	8 MEDIAN SINUS	9 AURICULAR LOBES	10 VASCULAR PART OF THE fvb, NUMBER AND DISTRIBUTION OF MAIN VESSELS	11 GROUND TISSUE			12 ANY SPECIAL PECULIARITY	10 LOCALITIES	14 GEOLOGICAL HORIZON
										General parenchyma	Tabular parenchyma	Radiating parenchyma			
<i>Palmoxylon sclerodermum</i> Sahni (Shukla, 1946)	Dermal, subdermal and central	Corypha-like; Cordata	Present with stegmata	D-105 SD-85 C-65-70	D-9/1-18/1 SD-20/1 C-23/1	D-0.4 SD-1 C-1	Cordate base	Lobes, mostly rounded, at times merge insensibly into the sides of the xylem elements	Exserted; one main vessel in D region and two in other zones	Lacunar, composed of isodiametric thin walled cells	1-2 layers of tabular parenchyma	Absent	Palisade-like rows of thin walled cells occur at the periphery of some ground tissue patches. Idioblasts present	Nawargaon, Wardha	Base of the Deccan Intertrappean series
<i>P. arcotense</i> Ramanujam (1953)	Dermal, subdermal and central	—	Absent	D-110 SD-50-65 C-20-25	D-15/1 SD-15/1-8/1 C-2/1-3/1	D-0.5-1 SD-0.175 C-1.2	—	Lobes generally rounded	Exserted; two main xylem vessels placed side by side	Narrow, rectangular cells of various shapes forming loosely fitted meshes with conspicuous inter-cellular spaces	Absent	Absent	Extremely lacunar nature of ground tissue	Tiruchhitambalam, South Arcot District	Miocene
<i>P. Surangei</i> Lakhanpal (1955)	Dermal, subdermal and central	Cordata	Present	D-90-95 (140 in inner bundles) SD-45-50 C-25	CO-5/1-10.5/1 D-9/2 SD-5/1-6/1 C-4/1	D-0.5-1 SD-0.65-0.95 C-0.8-0.95	Rounded cordate	Lobes are rounded	Excluded generally 1-3 vessels	Thin walled, elongated, oval, oblong cells with corners arranged horizontally, more compact in dermal zone	Present	Absent	—	500 yards to the north of the village Keria in Chhindwara District, M.P.	Deccan series Intertrappean
<i>P. puratanam</i> Ramanujam (1958)	Dermal, subdermal and central	—	Present	D-80-100 SD-65-75 C-20-25	D-4/1 SD-3/2-1½/1 C-1½/1	D-0.5-0.8 SD-0.95-1.2 C-1.1-1.5	Rounded, cordate to reniform in SD zone	—	Exserted; one to two or three large main vessel	Compact, thick walled, parenchymatous angular cells without any lobes or processes	2 layered tabular parenchyma	Absent	—	Cuddalore sand stones South Arcot District	Miocene
<i>P. dakshinense</i> Prakash (1958)	Dermal and subdermal	—	Absent, stegmata present on fvb	D-200-270 SD-50-90	D-10/1-16/1 SD-12/1-17/1	D-0.16-0.56 SD-0.6-0.9	Concave	Lobes round to pointed	Exserted; as a tongu-like process in leaf-trace bundles, 1-2-3 main xylem vessels	Lacunar, net work of narrow cells generally V-shaped enclosing conspicuous polygonal inter-cellular spaces	Present	Present	—	Mohgaon Kalan	Deccan series Intertrappean
<i>P. chhindwarensis</i> Prakash (1958)	Dermal, subdermal and central	—	Absent	D-297-625 SD-156-250 C-60-130	D-4.5/1-8/1 SD-3/1-5/1 C-2.5/1-3/1	D-0.2-0.694 SD-0.692-0.72 C-0.58-0.8	Concave, deep in D zone	Lobes round to bluntly pointed	Exserted; usually two main xylem vessels	Compact, thin walled in D zone slightly lacunar in SD, thin walled cells of various shapes forming loose meshes with conspicuous polygonal inter-cellular spaces	Present	Absent	—	Mohgaon Kalan	Deccan series Intertrappean
<i>P. eocenum</i> Prakash (1961)	Dermal, subdermal and central	—	Absent	D-300-360 SD-66-132 C-30-60	D-6.5/1-10.5/1 SD-3/1-6/1 C-2.5/1-3.5/1	D-0.288-0.56 SD-0.528-0.944 (0.24-0.4 in smaller bundles) C-0.6-1.07 (0.27-0.4 in smaller bundles)	Concave	Lobes round to bluntly pointed	Exserted; one to two main xylem vessels	Narrow, more or less rectangular to Y-shaped cells forming loose meshes with conspicuous inter-cellular spaces. The cells are small, spherical, tangentially elongated with somewhat rounded cells	Present	Present	Peculiar bundles showing vessels on both the dorsal and ventral sides of the fibrous part seen in SD zone	Mahurzari	Deccan series Intertrappean
<i>P. sp.</i> Mahabale (1958)	Comparable to <i>Phoenix</i> — closely resembles <i>P. robusta</i> and <i>P. rupicola</i> .														

Note: C — Central zone; CO — Cortex; D — Dermal zone; fvb — Fibrovascular bundles; SD — Sub-dermal zone.

TABLE 4—PETRIFIED PALM FRUITS

NAME	SHAPE OF THE FRUIT	NUMBER OF FACETS	LENGTH OF THE FRUIT	BREADTH AT ITS DISTAL PART	EPICARP	SARCOCARP OR MESOCARP	ENDOCARP	SEED SHAPE	SEED SIZE	SULCUS	ENDOCARP RIDGE	GERMINAL APERTURE	ENDOSPERM	LOCALITY
**1. <i>Nipadites</i> Bower bank Carter (1934)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
*2. <i>Palmocarpus</i> (? <i>Iriartites</i> ) <i>tahliensis</i> Sahni (Sahni, Srivastava and Rao, 1934, Sahni, 1964)	Obovoid	—	—	—	Epicarp with numerous fine ribs radiating from an apical umbo	—	—	—	—	—	—	—	—	Takli (near Nagpur)
*3. <i>Palmocarpus bracteatum</i> Sahni (Sahni, Srivastava and Rao, 1934, Sahni, 1964)	Sub spherical	—	—	—	—	—	—	—	—	—	—	—	—	Unknown somewhere in Deccan In er-trappeans
*4. <i>Palmocarpus</i> spp. Sahni (Sahni, Srivastava and Rao, 1934)	—	—	—	—	—	—	—	—	—	—	—	—	—	Unknown
5. <i>Nipa hindi</i> Rode and Sahni, 1937	Quadrangular through out the length	? 4	4.75 cm	4 cm	Membraneous, smooth	2.13 mm thick	0.3 mm	Roughly spherical	2.2-5 cm in diameter	1 cm broad not reaching the apex	Not projecting into sulcus	9 × 13 mm	—	Mohgaon Kalan
*6. <i>Palmocarpus Compressum</i> (Rode) Sahni (Rode and Sahni 1937, Sahni, 1964)	—	—	—	—	—	—	—	—	—	—	—	—	—	Mohgaon Kalan
*7. <i>Palmocarpus insigne</i> Mahabale 1950	Round	—	—	1.4 cm in diameter	Thin	Fibrous	Hard	—	—	—	—	—	—	Mohgaon Kalan
*8. <i>Cocos Sahnii</i> Kaul, 1951	—	—	—	—	—	—	—	—	—	—	—	—	—	Kapurdi, Rajasthan
9. <i>Nipa sahnii</i> Lakhanpal, 1952	Obovoid compressed	4-5	6.75-11 cm	—	Thin smooth	Thick	—	Roughly spherical	5 cm in diameter	Narrow, extending from base to apex	Narrow, extending from base to apex	—	—	Assam
10. <i>Palmocarpus mohgaense</i> Praksh, 1954	Obovoid, compressed slightly trigonous	4	6.4 cm	1.8 cm and 2.3 cm thick	Thin	Semifibrous	Hard and fairly uniform in thickness	Ellipsoidal	3 × 1.9 cm in the median longitudinal plane	—	—	—	Tough	Mohgaon Kalan
11. <i>Nipa fruit</i> Chitaley, 1960	Obovoid compressed	6	6.5 cm	5 cm	Thin smooth	10 mm thick	0.8 mm	Roughly oblong compressed	Length 3 cm breadth 2.2 cm thickness 1 cm	0.8 cm wide extending from base to apex	Projecting into sulcus extending from base to top	Not clear	—	Mohgaon Kalan
12. <i>Palmocarpus indicum</i> Praksh, 1960	Ovate	4-6	7.2 cm	3.2 cm, 3.1 cm thick	Thin	Semifibrous	Hard, thick walled	Well developed	3.7 × 2.6 cm	—	—	—	Tough	Mohgaon Kalan
13. <i>Palmocarpus sulcatum</i> Praksh, 1960	Quadrangular	—	5.75 cm	4.2 cm	Membraneous	Semifibrous	—, —	Roughly spherical distinctly grooved	2.8-3 cm in diam.	1.3 cm broad but does not extend upto the apex of the seed	Dipping into the groove	—	—	Mohgaon Kalan
†14. <i>Tricocites trigonum</i> Rode (Sahni 1964 and Chitaley, 1959) Fructification 140 mm long with crowded fruits, spathe having two or more sheaths	Exterior of fruit smooth or obscurely ribbed longitudinally	—	30 mm	30 mm	Smooth or ribbed longitudinally	With 20 longitudinal chambers 5-6 mm tangentially wide and 2.5-3 mm radially wide septa between chambers 1 mm thick	Solid, fibrous continued to the centre by fibrous septa 1-2 mm thick	Elongated	16-20 mm × 6-12 mm	—	—	—	—	Mohgaon Kalan
15. <i>Nypa Fruits Specimen No. 1</i> (E. M. Vasudevan, Nambudiri (1966))	Almost complete ovoid in shape	3	4.1 cm	3.8 cm	—	—	Endocarpic ridge	—	—	—	—	—	—	Mohgaon Kalan
<i>Specimen No. 2</i> Vasudevan Nambudiri!	Incomplete	5	4.5 cm	4.1 cm	—	—	Endocarpic ridge	—	—	—	—	—	—	Mohgaon Kalan

## LEAF (IMPRESSIONS)

1. *Sabalites microphylla* sp. nov. (Dahni, 1964) "Diagnosis — Flabellate leaf with a lamina 3 cm long by 2.5 cm broad; petiole broad (length unknown) continued distally into a spear-shaped rachis about 2.3 cm long, bearing 5 rays on either side. Rays 1-3 mm, wide, fused for about 5 mm of their length. Epidermal characters unknown".
2. *Sabalites* sp. (Sahni, 1964)  
 1. Parallel viened plicate leaf, belonging to a fan palm.  
 2. Small parallel viened fragments of leaf looking like the 1st leaf, Epidermal cells preserved.

## INFLORESCENCE (IMPRESSION)

1. *Palmostrobis* Mahabale (1960) (A mould of Palm inflorescence) Looking like a compound female palm inflorescence after the fruits have fallen off. Compared to the inflorescence axis of the Modern Genera like *Bactris* and the female inflorescence of *Hyphaene*, but real affinities not known.

## FLORAL AXIS PETRIFICATION

2. *Floral axis of palm* Mahabale (1960) Two pieces of stem looking like a floral axis which is ensheathed by bracts, anatomical characters resemble *Cyclanthodendron sahnii*. Also compared to the floral axis of *carludovica palmata* "It is therefore probable that these two pieces represent the floral axis of a fossil palm perhaps *Cyclanthodendron* which was also discovered at Mohgaon Kalan".

## PALM ROOTS (PETRIFICATIONS)

1. *Rhizopalmoxyton penchiensis* Rode (1934) This is the first finding of Roots of palm in India. Descriptions are not given. A number of *Rhizopalmoxytons* have been reported by Prof Sahni, but the descriptions are not given.

palms, it is not advisable also to speculate about the ecology of this group of plants in India, during the Eocene period. All that seems to be very clear is that the Mohgaon Kalan area supported a number of palm genera during the Eocene period and as already pointed out by Sahni (1938), that the area was on the Southern border of the Tethys Sea.

ACKNOWLEDGEMENT

The authors are extremely indebted to the University Grants Commission for the financial aid with which this paper has completed. We are also very grateful to the authorities of the Birbal Sahni Institute of Palaeobotany, Lucknow, for permission to consult their library.

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\*Original not seen by the authors.