J. Indian Bot. Soc. **64** : 45—50. 1985.

PALMOCARPON CORYPHOIDIUM SP. NOV. A CORYPHOID PALM FRUIT FROM DECCAN INTERTRAPPEAN BEDS OF WARDHA DISTRICT, MAHARASHTRA.[1]

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ABSTRACT

Palmocarpon coryphoidium Shete and Kulkarni, a petrified palm fruit of Coryphoid affinity has been described from the Deccan Intertrappean beds of Nawargaon-Maragsur (21° 1′: 78° 35′) area of Wardha District, Maharashtra, India.

INTRODUCTION

So far, three palm woods, *viz. Palmoxylon sclerodermum* Sahni (Shukla, 1946), *P. deccanense* Sahni (1964), *P. nawargaoensis* Shukla (1941); two palm petioles, *Palmocaulon costapalmatum* Kulkarni and Patil (1977a), *P. hyphaeneoides* Shete and Kulkarni and a single dicotyledonous wood, *Aristolochioxylon prakashii* Kulkarni and Patil (1977) have been described from the Deccan Intertrappean Beds of Wardha district, Maharashtra. Present communication deals with petrified palm fruits referable to Coryphoid stock of palms.

MATERIAL AND METHODS

A piece of cylindrical silicious chert containing half a dozen silicified fruits collected from Deccan Intertrappean beds of Nawargaon-Maragsur (21°1′ : 78°35′) area of Wardha district forms a subject matter of this communication. The fruits exposed were variously segmented longitudinally, transversely or obliquely (Pl. Fig. 1) while those embedded deep in the matrix were entire. One could easily recognise the demarcations of epicarp, mesocarp, endocarp, seed-coat and endosperm in the exposed cut fruits (Pl. Figs. 2, 3).

The ground sections of different fruits were prepared. The microscopic examination revealed the same structural organisation in all of them and hence are described here under one species.

OBSERVATIONS

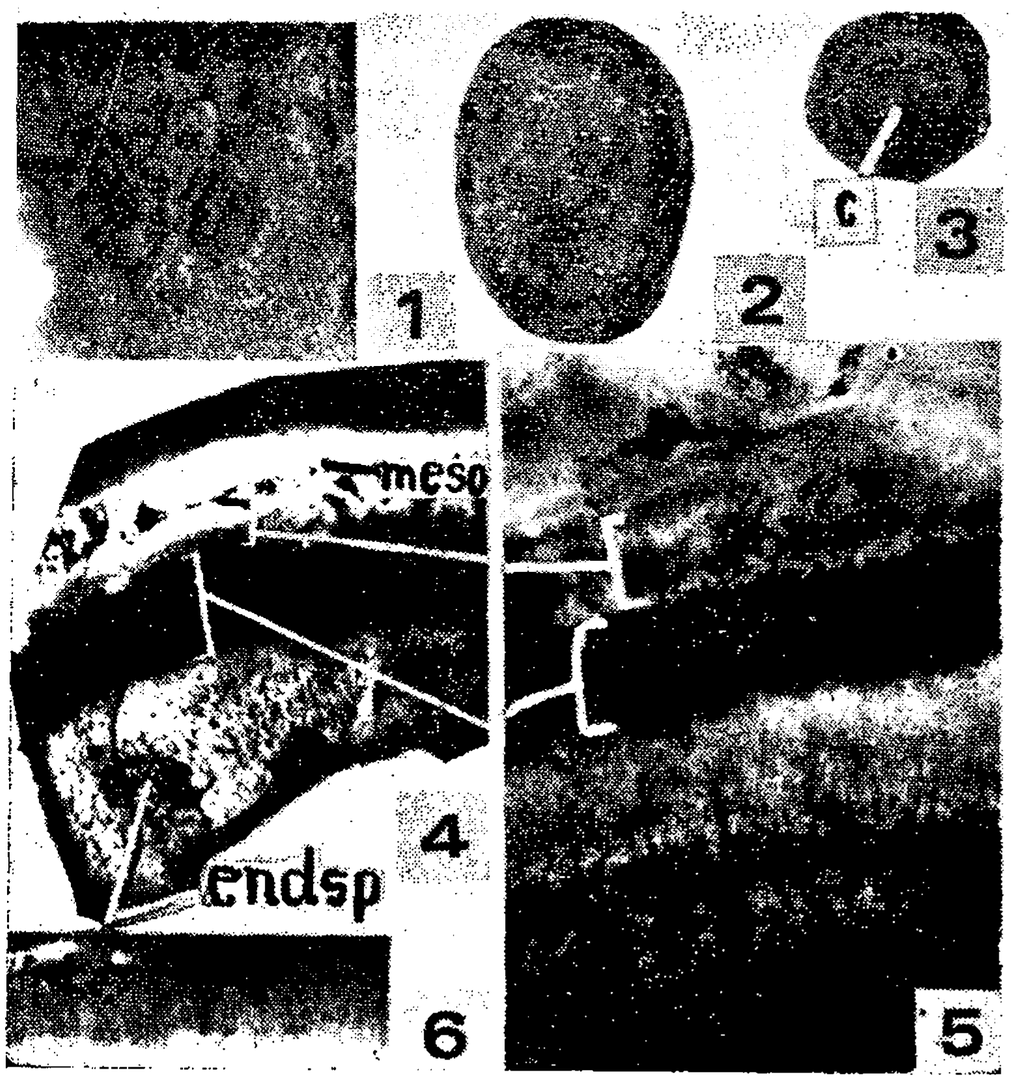
The fruits are ovoid, 1-1.2 cm in length and 0.8-1.2 cm in diameter in the middle part (Pl. Figs. 2, 3). The epicarp consisting of epidermis and hypodermis extends in radial width to 57 μm and is followed by a continuous cylinder of sclerotic cells. This sub-hypodermal sclerotic cylinder extends radially to 150 μm and consists of a single layer of columnar sclereids as seen in transverse section (Pl. Fig. 6).

The mesocarp ranges in radial thickness from 468 μm to 508 μm and is pulpy with poor preservation of cellular details. A few degenerating vascular bundles practically devoid of fibrous sheaths around them are seen at places (Pl, Fig. 4, Vb) Only a group of xylem elements is preserved in these bundles.

1. Accepted for publication on July 30, 1984.

The endocarp is multilayered extending to 288 μ in radial thickness (Fig. 5) and consists of polygonal to variously angled thick-walled sclerotic cells which vary in diameter from 6 μm to 7.2 μm. Many of these cells contain circular silica bodies in their lumina.

The fruits contain a single seed which tightly fits in the endocarp cavity. It is oval and 3-4 mm in diameter in the middle part. The seed coat is represented as a broad dark band recognizable even under hand lens in the cut fruits. It extends in radial thickness from 273 to 302 µm and has presumably tanniferous cells (Fig. 4,5). At obliquely basal ends of the seed, the chalazal tissue protrudes into the seed as a cylindrical cord penetrating half way in the endosperm. The chalazal intrusion is clearly seen. (Fig. 3*c*). The endosperm consists of radial files of cells converging in the centre of the seed (Figs. 4, 5). The cells are mostly radially elongated, 180 × 43 μm and thick-walled. Position of the embryo could not be revealed in any of the sections.



Figs. 1—6.

Palmocarpon coryphoidium sp. nov. Fig. 1. Chert showing exposed fossil fruits ×0.9. Figs. 2 and 3. Longitudinally and transversely cut halves of the fruits ×1.2. Fig. 4. T. S. of fruits in sector ×29. Fig. 5. the same, portion enlarged to show endocarp, seed coat and endosperm ×33.5. Fig. 6. Sector of sub-hypodermal sclerotic cylinder in T. S. ×72 (*C chalazal* ingrowth, *endo*-endocarp, *sec*-seed-coat, *endsp*-endosperm), *-vb* degenerating vascular tissues.

Magnifications : Fig. 1. ×0.9 Figs. 2,3. ×1.2 Fig. 4. ×28.8 Fig. 5. ×33.6 Fig. 6. ×72).

DISCUSSION

The diagnostic features of these fossil fruits are : (1) Presence of a continuous cylinder of sub-hypodermal sclerenchyma with a single layer of columnar sclereids ; (2) pulpy mesocarp with vascular bundles devoid of fibrous sheath ; 3 multilayered sclerotic endocarp with crystalliferous cells ; (4) single zoned tanniferous seed coat ; (5) presence of chalazal in growth into the endosperm tissue; and (6) the endosperm of radial files of thick walled cells completely filling the seed cavity.

Affinities with living : Of the diagnostic features mentioned above, the presence of chalazal ingrowth, the crystalliferous sclerotic endocarp and endosperm tissue with thick-walled cells are the important features found combination in fruits of certain palm groups only. So far as we are aware, these features toge ther are not reported to be occurring in fruits of any other angiospermous groups. As such we are strongly inclined to believe that the fossil fruits under consideration belong to palms Entire literature pertaining to fruit anatomy of palms has been exhaustively surveyed by Pande (1979) who has worked out the anatomy of 54 species of palm fruits distributed in nine palm groups. As per his observations, the coryphoid group of palms is characterised by single zoned seed-coat often with chalaza!

intrusion into the endosperm, pulpy mesocarp, weakly developed vascular bundles of the fruit wall with poorly differentiated fibrous sheath and the presence of sub-hypodermal sclerotic cylinder. All these features are found in the fossil fruits which, therefore, indicate their undoubted affinity with the Coryphoid stock of palms.

Three types of endocarp are found in the coryphoid palms : I. In genera like *Sabal* and *Raphis* endocarp is single layered representing the locular epidermis ; II. in genera like *Thrinax* and *Cocothrinax* the endocarp is multilayered and sclerotic but non-crystalliferous ; in addition, in these genera the vascular bundles of the fruit wall are situated between the endocarp and the seed coat, the mesocarp being devoid of vascular bundles ; type III endocarp represented in genera like *Livistona* and *Licuala* is also multilayered and sclerotic but many of the sclerotic cells here are crystalliferous. Further, this type can be distinguished from the second type by the presence of vascular bundles in the mesocarp.

In having crystalliferous endocarp and vascular bundles in the mesocarp the fossil fruits under consideration belong to type III endocarp of coryphoid palms mentioned above.

Sections of the fruits of following species of coryphoid palms showing endocarp type III were critically studied for comparison with the present fruits : *Chamaerops humilis* Linn., *Livistone chinensis* R. Br., *L. rotundifolia* Mart., *Licuala grandis* H. Wendl., *L. peltata* Roxb., *L. spinosa* Wurmb., *Pritchardia pacifica* seem. and H. wendl. and *Corypha elata* Roxb. The last species differs from the fossil in lacking chalazal in growth which is very prominent feature of the fossil fruits. In *Chamaerops humilis* the sub-hypodermal sclerotic cylinder is entirely lacking and in the species of *Livistona* examined here it does not form a conspicuous feature of the fruit wall. In fossil fruits on the other hand the sclerotic cylinder is very highly developed and continuous. *Pritechardia pacifica* and species of *Licuala* share most of the basic anatomical features of this fossil. In them the seed coat is single-zoned and the chalazal ingrowth is conspicuous, the endocarp is many layered, sclerotic and crystalliferous ; the vascular bundles are situated outside the endocarp in the fruit-wall and have poorly differentiated fibrous sheath around them and the sub-hypodermal sclerotic cylinder is present. In *Pritchardia pacifica* and *L. spinosa* however, the sub-hypodermal sclerotic cylinder is discontinuous consisting of isolated strips of sclercids while in the fossil fruits it is a continuous cylinder.

Species of *Licuala* like *L. grandis* and *L. peltata* examined here have a continuous sclerotic cylinder like that of fossil fruits. These species therefore share maximum features with the fossil fruits.

This comparison shows that the fossil fruits described here have undoubted affinity with the coryphoid stock of palms and come very close to some species of *Pritchardia* and *Licuala* specially the latter as shown in the Table I.

The coryphoid palms in general have tropical distribution mostly in tropical parts of America and Indomalayan region extending to the northern part of Australia. Genus *Licuala* with which the fossil fruits show closest affinity is represented by about 70 species (McCurrach, 1960) distributed from tropical Asia to Australia and Pacific islands. In India the genus is represented by two species. *L. peltata* Roxb. growing in Sikkim Himalayas, Khasia hills of Assam and Andamans and *L. spinosa* Wurmb. found in Andaman islands (Hooker, 1894).

TABLE I

COMPARATIVE ANATOMICAL FEATURES OF SPECIES OF *LICUALA* AND THAT OF *PALMOCARPON CORYPHOIDIUM* SP. NOV.

	Licuala grandis	*Licuala peltata*	*Palmocarpon coryphoidium* sp. nov.
Shape	globose	globose	ovoid
Size	1.3×1 cm	1.1×0.9 cm	1—1.2×0.8—1.2cm
Shape of seed	globose	globose	globose
Diameter of seed	0.5×0.4 cm	0.35×0.49 cm	0.3×0.4 cm
Chalazal seed coat ingrowth vertical extent	1.6 mm	1.7 mm	1.5 mm
Thickness of seed coat	single zoned	single zoned	Single zoned tanniferous
Thickness of endocarp	multilayered sclerotic crystalliferous	multilayered sclerotic crystalliferous	multilayered sclerotic crystalliferous
Thckness of mesocarp	560 μm	448 μm	504 μm
V. B. in mesocarp	poorly differentiated fibrous sheath		vascular bundle devoid of fibrous sheath
Inclusions of mesocarp	vascular bundles	vascular bundles, tannin sacs, raphid sac	degenerating vascular bundles
Subhypodermal sclerotic cylinder	continuous single layer	continuous single layer	continuous single layer
Thickness	320 μm	315 μm	130 μm
Thickness of epicarp	42 μm	40 μm	37 μm

Comparison with fossil fruits : So far 17 species of fruits referred to palms have been described from Tertiary deposits of India. Of these except two species, *Cocos sahnii* Kaul (1951) and *Nipa sahnii* Lakhanpal (1952) which come from Kapurdi beds of Rajasthan and Garo hills of *Assam* respectively rest of all the species are from Decan Intertrappean beds.

Of the 17 species described, six have been attributed to *Nypa*. In addition, *Palmocarpon compressum* (Rode) Sahni (Sahni and Rode, 1937) has now been referred to *Nipadites compressus* Rode by Sahni (1964) and *Palmocarpon sulcatum* Prakash (1960) also finds close comparison with *Nypa* in its quadrangular shape and sulcate seed with invagination of endocarp in it. Fruits attributed to *Nipadites* or *Nypa* are faceted. the number of facets varying from 3-6 in different species. Descriptions of *Palmocarpon takliensis*, *P. bracteatum*. *Palmocarpon* sp., *Nipadites hindi* nad *N. compressus* Sahni, 1964) are very meagre. *Cocos sahnii* Kaul (1951) is an impression fossil which does not reveal the internal features. *Palmocarpon insigne* Mahabale 1950) is also very briefly described but it differs from the fossil under consideration in

its semifibrous mesocarp. The mesocarp of the fossil fruit does not contain any fibrous tissue.

Palmocarpon mohgaoense Prakash (1954), *P. indicum* Prakash (1960) and *P. sulcatum* Prakash (1960) also differ very widely in their details from the present specimens. All these three species have a sub-hypodermal sclerotic cylinder consisting of fibrous strands whereas in the present fossil the sclerotic cylinder is of columnar sclereids. Further in the above mentioned species and in *P. splendidum* Trivedi and Chandra (1971) the mesocarp is rich in numerous fibre bundles and fibrovascular bundles with well-developed fibrous sheaths. Fibre bundles are wanting in our specimen and fibrovascular bundles have not got well-developed fibrous sheaths. Further, *P. mohgaoense* is trigonous and *P. indicum* and *P. sulcatum* are 4-6 angled. The fossil fruits described here does not show angular nature anywhere. Fossil fruits also differ in significant way from *Tricoccites trigonum* Rode (Sahni and Rode, 1937 ; Chitaley, 1956 ; Trivedi and Verma, 1976). A ring of sub-hypodermal fibrous strands, large regularly arranged air spaces of mesocarp, the composite endocarp containing sclerotic parenchyma and fibre and fibrovascular bundles are distinctive features of *Tricoccites* which are not found in the present fossil.

This comparison therefore shows that the fossil palm fruits described here are quite distinct from those already described from the Tertiary deposits of India.

The only fossil palm fruit which has so far been assigned to coryphoid stock is *Palmocarpon splendidum* Trivedi Chandra (1971) though well developed fibre bundles and fibrous sheaths for vascular bundles seen in this species are not known to occur in any living coryphoid genera.

To the best of our knowledge coryphoid fruits have not been described from abroad although seeds of coryphoid affinity are known to occur in Ecocene London clay flora (Reid and Chandler, 1933 ; Chandler, 1961-64) and in Upper Cretaceous-Paleocene boundary of West Green Land (Koch, 1972).

Considering the undoubted affinity of the fruits described here with the coryphoid stock of palms they have been kept here under *Palmocarpon coryphoidium* sp. nov.

Specific diagnosis :

P. coryphoidium sp. nov.

Fruit ovoid, 1-1.2 $\times$0.8-1.2 cms, one seeded, seed 0.3 to 0.4 cm in diameter, tightly fitting the endocarp cavity.

Epicarp 57 μm thick ; subhypodermal sclerotic cylinder 150 μm thick, of single layered macrosclereids ; mesocarp 504 μm thick, pulpy ; vascular bundles devoid of fibrous sheath ; endocarp many layered, of angular or variously lobed, crystalliferous sclerotic cells ; seed coat 344 μm thick, single zoned, tanniferous, chalazal intrusion into the endosperm prominent ; endosperm completely filling the seed, consisting of radial files of thick-walled cells.

Holotype : Department of Biological Sciences, Ramarain Ruia College, Matunga, Bombay 400 019. Museum No. N. 600.

Locality : Nawargaon-Maragsur, Wardha District, Maharashtra.

Horizon : Deccan Intertrappean Series.

Age : Early Tertiary (Probably Eocene).

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