PALMOCARPON MOHGAOENSE SP. NOV., A PALM FRUIT FROM THE DECCAN INTERTRAPPEAN SERIES, INDIA

U. PRAKASH
Birbal Sahni Institute of Palaeobotany, Lucknow

ABSTRACT

In this paper is described a petrified palm fruit from Mohgaon Kalan (22°1'N.; 79°11'E.), the well-known locality of the Deccan Intertrappean Series, in Chhindwara district of Madhya Pradesh. The palm fruit is sufficiently well preserved to reveal all its anatomical details and has been referred to the form genus *Palmocarpon* Lesquereux. The flora of this locality is regarded as early Tertiary, and most probably Eocene.

INTRODUCTION

THE palm fruit was collected by me from Mohgaon Kalan (22°1'N.; 79°11'E.), the well-known locality of the Deccan Intertrappean Series, in Chhindwara district of Madhya Pradesh. So far only a few palm fruits have been reported from the Deccan Intertrappean series. Rode (1933) briefly described two new species of *Nipadites*, *N. compressus* and *N. hindi*, from Mohgaon Kalan. In the same paper he described a trilocular fruit, *Tricoccites trigonum*, from the same locality, which, according to Sahni (SAHNI & RODE, 1937), belonged to a palm. In 1937 Sahni, in a joint paper with Rode, re-examined Rode's collection of 1933. He referred *Nipadites hindi* to *Nipa hindi*, but he found it difficult to decide whether *Nipadites compressus* was a Nipa fruit or some other type of palm fruit. He, therefore, provisionally placed the species under *Palmocarpon compressum*. In 1950, Mahabale briefly described a palm fruit from Mohgaon Kalan as *Palmocarpon insigne* resembling the fruits of modern palms like *Bactris*, *Howea*, *Pritchardia*, etc.

From Takli area near Nagpur only *Palmocarpon* (*Iriartites*) *takliensis* Sahni is known (SAHNI, 1934). In the same paper Sahni has also recorded a palm fruit, *Palmocarpon bracteatum* and some distorted fruits, probably of palms, under *Palmocarpon* spp., from the Hislop and Hunter collection. The locality of these fruits is unknown; but they might have come from Takli area in the Deccan Intertrappean series.

Apart from the Deccan Intertrappean series, a few palm fruits have also been reported from other Tertiary formations in this country. Kaul (1951) described *Cocos Sahnii* from Kapurdi (Jodhpur, Rajasthan Desert). Lakhanpal described *Nipa Sahnii* (LAKHANPAL, 1952, pp. 289-94) from the western extremity of Garo Hills, Assam.

DESCRIPTION

Monocotyledoneae

Palmae

Palmocarpon mohgaoense sp. nov.

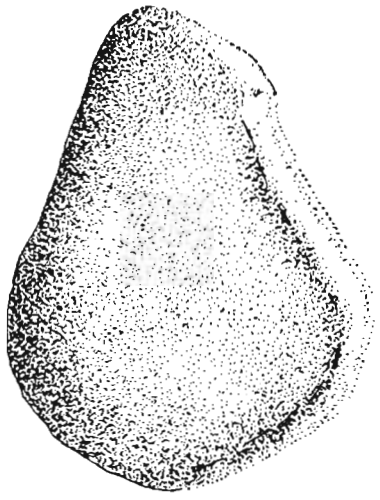
The palm fruit was embedded in a big block of chert. When the block was broken into smaller pieces, one of the pieces showed a palm fruit split up longitudinally. The fruit was further cut longitudinally into fourteen thin slices, each slice measuring about 2-4 mm. in thickness. Out of these, seven slices were ground to thin sections for microscopic study. A part of the fruit was also cut in a transverse plane, and a section prepared for study.

EXTERNAL FEATURES

Since the fruit was completely embedded in a block of chert, it was not possible to study its external morphology. A reconstruction is attempted by superimposing the sections and joining the outline (TEXT-FIG.1).

The fruit is a drupe of medium size, compressed and slightly elongated antero-posteriorly. It is somewhat obovoid in shape, slightly trigonous, about 6·4 cm. long, 4·8 cm. broad and 2·3 cm. thick. It is difficult to ascertain the presence of ridges on the surface of the petrified fruit which was completely embedded in the chert, but from one transverse section cut at the apex, it seems that there may have been four longitudinal ridges.

The pericarp of the fruit is similar to that of a palm fruit. It is made up of a thin epicarp, a semi-fibrous mesocarp and



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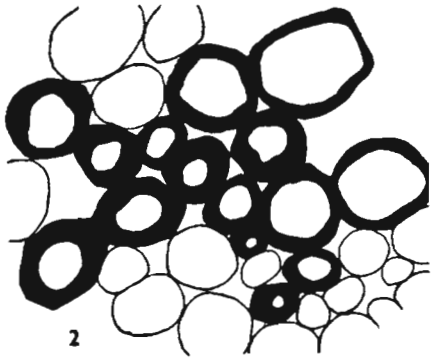
TEXT-FIG. 1 — Reconstructed fruit of *Palmocarpon mohgaoense*. Natural size.

a hard endocarp. The pericarp is well developed at the posterior end, but thins out along the sides and towards the anterior end of the fruit (PL. 1, FIG. 3). Cells of the epicarp are not preserved.

MESOCARP

Ground Tissue — The ground tissue (PL. 2, FIG. 8) is composed mostly of two types of loose, thin-walled parenchymatous cells of various dimensions. Some of these cells are oblong, longer than broad, while the rest are round to oval in shape. The oblong cells are generally found in association with the bundles (PL. 2, FIGS. 6, 8) and show radiating arrangement. Near the base of the fruit, among the parenchyma cells (TEXT-FIG. 2), are found groups of thick-walled, oval to angular cells which strengthen this end of the fruit. Throughout the parenchymatous ground tissue (PL. 2, FIG. 8) a large number of big empty cells are scattered,



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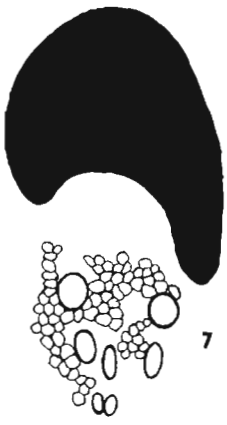

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TEXT-FIGS. 2-7 — 2, groups of thick-walled cells among the ground parenchyma of the mesocarp. × 275. 3, highly magnified cells of the fibrous girdle. × 275. 4, a fibro-vascular bundle from the basal end of the fruit showing radiating parenchyma round it. × 62·5. 5, a magnified fibro-vascular bundle with ventral sclerenchyma. × 137·5. 6, a fibro-vascular bundle near the endocarp at the basal end of the seed. × 110. 7, a fibro-vascular bundle with seven vessels. × 120.

which may have served as crystal sacs. Some of the ground tissue cells also contain yellowish crystalline deposits.

Bundles — Immediately beneath the outermost thin layer of the epicarp is a fibrous band running all round the fruit. It is about 112 μ thick and made up of thick-walled cells (TEXT-FIG. 3). Just below this fibrous zone are arranged numerous small fibrous bundles which have been cut in almost all the planes. At the apical end of the fruit, following the fibrous bundles, some oval to oblong fibro-vascular bundles are arranged in three alternate tiers (PL. 2, FIG. 7), of which the middle tier is composed of bigger bundles and the other two are made up of smaller bundles. Near the basal end of the seed both the fibrous and fibro-vascular bundles are somewhat closely arranged (PL. 2, FIG. 9). In the rest of the ground tissue (PL. 1, FIG. 5) both the fibrous and fibro-vascular bundles are seen running in all directions and are distantly placed. Some of these bundles branch to give out smaller bundles. Usually, the bundles of this region run lengthwise in the fruit.

The fibro-vascular bundles of the mesocarp show different shapes, sizes and forms. Usually, there are three kinds of bundles as seen in the longitudinal sections of the fruit. Some bundles situated at the basal end of the fruit near the periphery are large, circular to elliptic-ovate in outline. In cross-section some of these bundles (TEXT-FIG. 4) have a marked concavity or the median sinus of the dorsal sclerenchyma (*see* SAHNI, 1943, p. 211), embracing completely the vascular tissue, which is very small in comparison to the sclerenchymatous tissue. The arms of the dorsal sclerenchyma are big and roundly pointed. The vascular part shows either a single large median vessel or a pair of round vessels lying side by side. The ventral sclerenchyma is usually absent. However, in one of the bundles ventral sclerenchyma is clearly seen (TEXT-FIG. 5), joining the dorsal sclerenchyma, forming a ring round the vessels.

The bundles which are situated between the periphery and the seed towards the basal end of the fruit look somewhat different in cross-section (TEXT-FIGS. 6, 7). They are oval to elliptical in shape with curved median sinus of the massive dorsal sclerenchyma. The arms are usually small and somewhat roundly pointed and in some (TEXT-FIG. 7) one arm is bigger than the other. The vascular part is excluded and constituted of seven to eight vessels arranged in a V-shape, but each vessel is separated from the other by a few parenchymatous cells. The protoxylem is towards the bottom of the V. The ventral sclerenchyma is absent, and the phloem does not seem to be preserved. These bundles are similar to the leaf trace bundles of a palm stem.

A third type of fibro-vascular bundles is found, at the apical end of the fruit (PL. 2, FIG. 7) as well as towards the basal part of the stone (PL. 2, FIG. 9). It is oval or oblong in shape and usually possesses both the dorsal and ventral sclerenchyma enclosing the vascular part. The vessels as well as the phloem tissue is not preserved in any of the bundles.

As regards the fibrous bundles, they are small and circular in transverse section and are made up of thick-walled cells.

The thickening of the big metaxylem vessels is of scalariform type (PL. 1, FIG. 2).

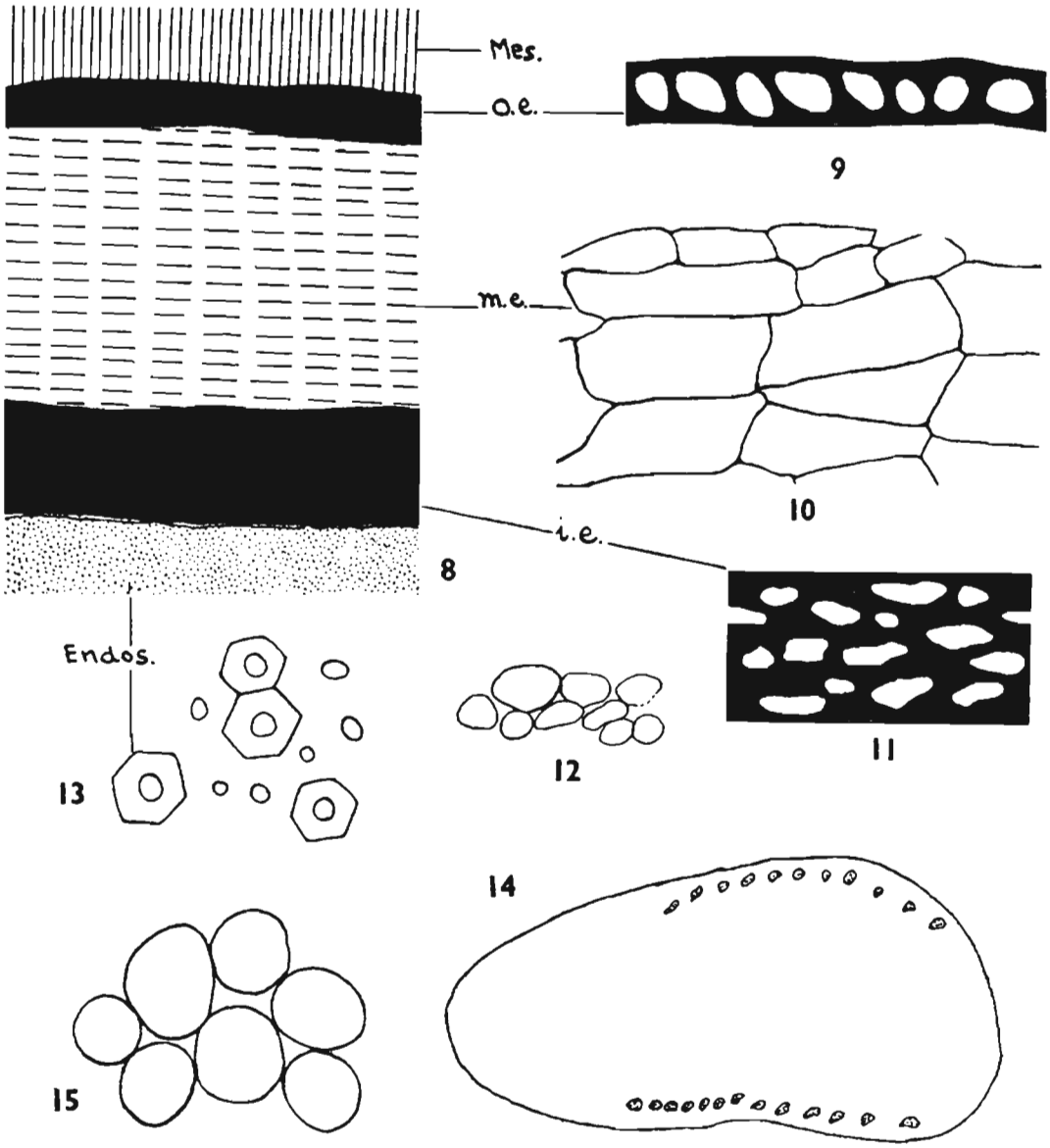
Stegmata are present round the sclerenchyma of the fibro-vascular as well as the fibrous bundles. They are to be seen clearly in the bundles which are cut longitudinally. The stegmata are generally arranged in longitudinal rows (PL. 2, FIG. 11).

ENDOCARP

The endocarp is fairly uniform in thickness. It is formed of three coats (TEXT-FIG. 8). The outer coat is thin and usually composed of 1-4 layers of cells, except at few places where it is many layered. Both the outer and inner coats are made up of thick-walled cells (TEXT-FIGS. 9, 11), whereas the middle coat is composed of thin-walled cells (TEXT-FIG. 10). This middle coat of the endocarp is traversed by a number of widely spaced fibro-vascular bundles which have been cut longitudinally (PL. 1, FIG. 5).

SEEDS

The seeds lie inside the pericarp. The longitudinal serial sections reveal that the fruit (PL. 1, FIG. 4) contains one well-developed seed occupying about three-fourths of the space. In addition two aborted seeds are also present (PL. 1, FIGS. 1, 3). The carpel which lies towards the basal end of the fruit is very small and completely aborted. It has been seen in only one slice (PL. 1, FIG. 3). The mid-



TEXT-FIGS. 8-15 — 8, a line drawing of endocarp and its neighbouring regions. Mes., mesocarp. × 120. 9, a layer of outer endocarp (o.e.) magnified. × 550. 10, a part of middle endocarp (m.e.) magnified. × 550. 11, a part of inner endocarp (i.e.) magnified. × 550. 12, thin-walled cells of the seed-coat. × 550. 13, a part of endosperm (Endos.) magnified. × 550. 14, obliquely cut embryo with a ring of procambial strands. × 20. 15, cellular tissue of the embryo. × 550.

dle carpel, which has formed a well-developed, ellipsoidal seed, measures 3×1·9 cm. in the median longitudinal plane (PL. 1, FIG. 4). The third seed, which lies towards the apical end, just beyond the median line on one side of the fruit (PL. 1, FIG. 1), is somewhat big, 1·1×0·9 cm. in size, but aborted, and the cavity

is filled mostly with siliceous matter. It appears, therefore, that in the earlier stages of development, there were three carpels, but as the fruit developed, only one of them became mature while others aborted.

The seed-coat is not well preserved and can be recognized at some places where only a part of the coat is seen. It is composed of thin-walled cells (TEXT-FIG. 12).

Embryo — Inside the seed (PL. 1, FIG. 1) is present an apical embryo and patches of rather badly preserved albuminous matter, the rest being replaced by chalcedony. The endosperm (PL. 2, FIG. 12; TEXT-FIG. 13) is tough and composed of thick-walled polygonal cells. The embryo is small, conical, 7 mm. in length and attached to the apex of the seed (PL. 2, FIG. 10) with its massive base, which is 3 mm. thick. The apex, on the other hand, is only 1 mm. thick. The embryo is obliquely placed to the breadth of the fruit and shows a small knob-like structure near its base. There is a ring of small yellowish patches (TEXT-FIG. 14) near the periphery of the embryo, which appear to be the procambial strands of the vascular tissue. The embryo is composed of thin-walled cells (TEXT-FIG. 15), with small intercellular spaces.

Diagnosis — Fruit a drupe, obovoid, compressed and slightly trigonous; about 6·4 cm. long, 4·8 cm. broad and 2·3 cm. thick. Possibly, four longitudinal ridges on the surface of the fruit. Epicarp thin, cells not preserved. Mesocarp semi-fibrous, composed of loose thin-walled cells of ground tissue with fibrous and fibro-vascular bundles; oblong ground parenchyma cells usually radiating from the bundles; groups of thick-walled cells present near the base of the fruit; numerous big cells also scattered in the mesocarp. Endocarp hard and formed of three coats. Carpels three, two aborted and one developed into an ellipsoidal seed measuring $3 \times 1{\cdot}9$ cm. Endosperm tough and formed of thick-walled cells. Embryo conical, attached to the apex of the seed.

Locality — Mohgaon Kalan, Deccan Intertrappean series, Madhya Pradesh.

Age — Early Tertiary (probably Eocene).

Type Specimen — B.S.I.P. No. 5525.

DISCUSSION

The identification of a fossil palm fruit is a difficult proposition since the fruits of recent species are not easily available for comparison and practically very little work has been done on them. Fossil palm fruits, where the affinities are not very certain, are included under the form genus *Palmocarpon*, proposed by Lesquereux in 1878. Several species of *Palmocarpon* have been described from various parts of the world. So far only a few species have been reported from the Deccan Intertrappean series.

Indian fossil palm fruits are imperfectly known. The comparison of *Palmocarpon mohgaoense*, therefore, cannot be made in detail.

Palmocarpon compressum (Rode) Sahni, also from Mohgaon Kalan, differs from *Palmocarpon mohgaoense* in the size of the fruit, in the absence of two aborted carpels, and in the oblong shape of the seed.

The other palm fruit from Mohgaon Kalan, *Palmocarpon insigne* Mahabale, also differs greatly from *P. mohgaoense*. The chief differences are in the size and shape of two fruits and in the presence of stellete fibres in *P. insigne* which run obliquely and lie on the endocarp.

Palmocarpon (*Iriartites*) *takliensis* Sahni is known from Takli, another Deccan Intertrappean locality, but it differs from *P. mohgaoense* in the ovoid shape of the fruit and in the presence of numerous very fine ribs on the surface radiating from the apical umbo.

Palmocarpon bracteatum Sahni known from the Deccan Intertrappean series differs from *P. mohgaoense* in the form of the fruit which is sub-spherical in *P. bracteatum*. The fruit of *P. bracteatum* is also attached on an axis, bearing short, thick, broadly rounded, longitudinally ribbed bracts.

The species of fossil *Nipa* described from Madhya Pradesh and Garo Hills, Assam, show marked differences from *P. mohgaoense*. Also, in order to compare the anatomy of *Nipa* with that of *P. mohgaoense*, I have prepared sections of the living fruit in the same plane in which the fossil fruit has been cut. The anatomy is also different in both the fruits.

P. mohgaoense, therefore, is distinct from all species known from India and is, therefore, described under a new specific name.

ACKNOWLEDGEMENTS

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EXPLANATION OF PLATES

PLATE 1

1. L.S. of the fruit towards one side of the median line with two seed cavities. Embryo (E) is seen at the apical end of the well-developed seed. × 2.

2. Pitting of the vessels. × 580.

3. L.S. of the fruit showing one well-developed and the other aborted seed. × 2.

4. Median L.S. of the fruit with one well-developed seed. × 2.

5. Basal half of the longitudinally cut fruit magnified to show the mesocarp (MES), the endocarp (END) and the endosperm (ENDOS). The distribution of the bundles in the mesocarp is clearly seen. × 3·5.

PLATE 2

6. The fibro-vascular bundles at the basal end of the fruit with radiating parenchyma all round. × 40.

7. L.S. of the fruit at the apical end showing three tiers of the fibro-vascular bundles. × 90.

8. L.S. of the mesocarp showing a longitudinally cut bundle, big cells, and loose ground tissue. × 120.

9. Aggregation of the fibrous and fibro-vascular bundles at the basal end of the seed near the endocarp. × 30.

10. Obliquely cut embryo attached to the apex of the seed with peripheral ring of procambial strands. × 14.

11. Stegmata highly magnified. × 350.

12. Endosperm of the seed. × 120.

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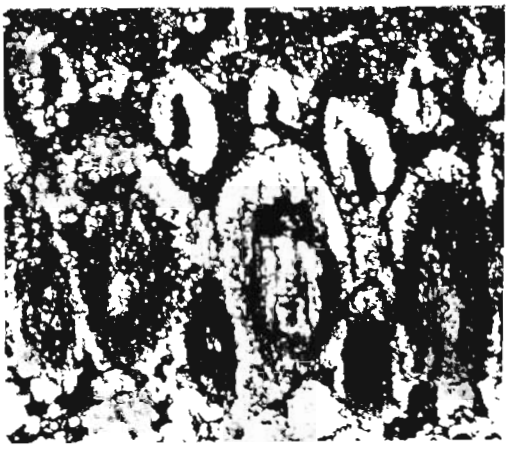

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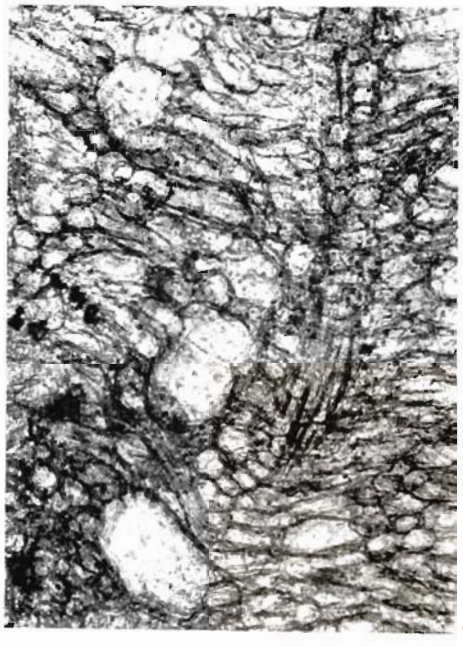

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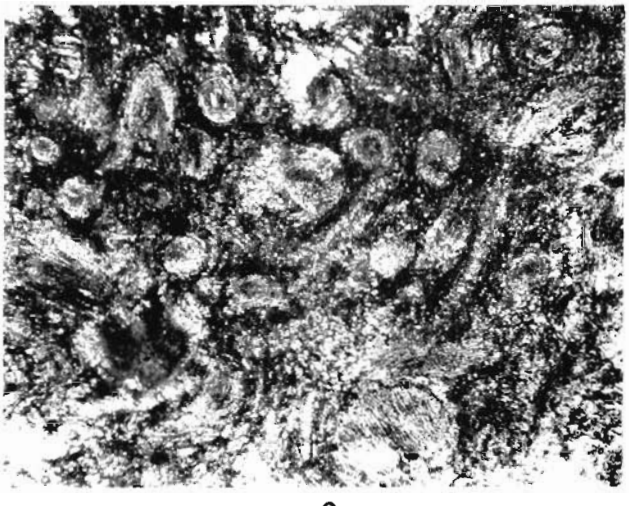

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