PALMOXYLON ARCOTENSE SP. NOV., A FOSSIL PALM RESEMBLING THE LIVING GENUS *LIVISTONA*, FROM SOUTH INDIA

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INTRODUCTION

THE species described here is represented by two blocks of silicified woods. It was collected from near a village Tiruchhitambalam (PL. 1, FIG. 1) in South Arcot district about 8 miles WNW of Pondicherry. But for Sahni's (1931) short description of a new species of palm, *Palmoxylon Pondicherriense*, there is no other published record of fossil palms from South India and up till now only the famous Deccan Intertraps have yielded the rich collection of palms from Indian horizons (two species of palms have also been described from the Cretaceous of Cutch and Tertiary of Jammu, Kashmir, by Sahni, 1931).

MATERIAL AND METHODS

Both the pieces collected are light greyish-brown and are 30 cm. in diameter. Preservation is excellent in both the specimens. Various sections, both longitudinal and transverse, have been cut although, as is customary with most of the palms, much importance is given to the transverse sections. No stain has been used since the structures are very clear.

DESCRIPTION

Peripheral Zone — There are three distinct zones present as usual with all the palms. The extreme which is not present completely is believed to be only a part of the actual dermal zone, followed by the well-represented subdermal and central regions. Cortex, unfortunately, is not represented.

Dermal Zone — In this region the fibro-vascular bundles are regularly orientated and are rather closely placed (PL. 3, FIGS. 9, 10). They are mostly elliptical, very small in size, 50 to 100 μ, and are exclusively provided with a single median elliptical vessel; phloem is not preserved. F/V ratio is about 15 : 1. No stegmata or tabular parenchyma are to be seen. Purely fibrous bundles are completely lacking. The auricular lobes are generally round. The fibro-vascular bundles on an average number 110 per cm.^{2}. The ground parenchyma consists of rather compactly placed thin-walled oval to rectangular cells. Leaf traces are not seen.

Subdermal Zone — The fibro-vascular bundles again regularly orientated are comparatively sparser being 50 to 65 per cm.^{2}, and are generally obovate to orbicular, although oval shape is not uncommon (PL. 3, FIGS. 9, 12). The bundles are about 175 μ and the F/V ratio varies from 5 : 1 to 8 : 1. There is no distinct layer of parenchyma round the fibrous part of the vascular bundles which may be called tabular parenchyma, nor is there any radiating parenchyma. The vascular part of the bundles consists of mostly two narrow vessels (this condition may probably be due to the heavy crushing during fossilization) placed side by side. The general ground tissue is quite distinct from that of the dermal zone in that it shows a highly lacunate condition due to the formation of small reticulations (meshes) by the individual parenchymatous cells (PL. 3, FIG. 12). This condition which is very predominant in the central region thus has its initiative in the subdermal region itself. Again, there are no purely fibrous bundles and the leaf traces are very rare.

Central Zone — The transverse section shows a large number of rather widely scattered fibro-vascular bundles with typically irregular orientation in well-preserved lacunate network of the fundamental parenchyma (PL. 1, FIG. 2). The fibro-vascular bundles are orbicular to reniform and generally 100 to 200 μ only (PL. 2, FIGS. 4, 5 ; PL. 3, FIG. 12). They number 20 to 25 per cm.^{2}, and the neighbouring bundles are 3 to 4 mm. apart. Most of them are provided with two big elliptical or circular vessels which lie side by side and in general partially excluded. No stegmata are found round the bundles. The arms of the scleren-

chyma are round and the median sinus concave. F/V ratio is 2 : 1 to 3 : 1. Xylem parenchyma is generally preserved but the phloem is not always preserved. No pure fibrous bundles whatsoever are to be seen.

The most interesting feature is the nature of the ground tissue, consisting of narrow rectangular cells often of various shapes forming loosely fitted meshes with conspicuous intercellular spaces (lacunae) which are unusually big enough to be visible to the naked eye (0·2 to 0·3 mm.). Rarely the cells between the neighbouring bundles are regularly rectangular and densely arranged leaving very narrow or no lacunae.

In longitudinal sections (PL. 2, FIGS. 6, 7) the cells of the ground tissue are small, square to rectangular and are arranged in chains. As regards the lignifications of the vessels, they show the usual scalariform plates.

Leaf traces are sporadic with both dorsal and ventral patches of xylem.

DIAGNOSIS

Dermal region with rather closely placed elliptical fibro-vascular bundles, F/V ratio 15 : 1, no stegmata or fibrous bundles; ground parenchyma rather compact, leaf traces not seen. Subdermal region with ovate to orbicular fibro-vascular bundles, F/V ratio 5 : 1 to 8 : 1, no stegmata or fibrous bundles, ground parenchyma highly lacunate due to the formation of small reticulations of the individual cells, leaf traces seen rarely.

Fibro-vascular bundles in the central region scattered rather widely and irregularly, 20 to 25 per cm.^{2}, orbicular to reniform, F/V ratio 2 : 1 to 3 : 1, ground tissue clearly visible to the naked eye, lacunate, lacunae formed by the network of narrow rectangular cells often of varied shapes, rarely ground tissue between neighbouring bundles densely packed leaving little or no lacunae, purely fibrous bundles lakcing, leaf traces sporadic.

Locality—Near Tiruchhitambalam, about 8 miles WNW of Pondicherry.

Age—Tertiary(?).

Type Specimen—No. 1590.

COMPARISONS AND DISCUSSION

The present species differs widely from the hitherto recorded Indian species of palm wood (SAHNI, 1943; SHUKLA, 1946 & RODE, 1933), and there is hardly any doubt of its distinctive nature from them. The first and foremost diagnostic feature which distinguishes it from the other Indian species is the characteristic nature of its aerenchymatous ground tissue. Of the Indian species Rode's *Palmoxylon kamalam*, in which only the central part has been described, invites special attention as it shows some similarities with the present species. *Palmoxylon kamalam*, while showing the lacunate ground tissue, differs greatly from *Palmoxylon arcotense* in having radial parenchyma, in the densely packed nature of the fibro-vascular bundles in the ground tissue (90 to 100 per cm.^{2}) which are oblong ovate with a flat complanta type of base where the vascular part joins the fibrous zone in the F/V ratio in which the fibrous portion is almost equal to the vascular portion and lastly, to quote Rode's words, " just midway between the neighbouring bundles, the parenchyma cells get compressed into linear, dark regions which serve to divide the whole ground-mass into distinct compartments ", a feature which is wanting in the present species.

The only other palm from South India *Palmoxylon Pondicherriense* described by Professor Sahni (1931) differs from the present palm in more than one respect. *Palmoxylon Pondicherriense* is peculiar in that the fibro-vascular bundles decrease in size from without inwards and along with this condition the sclerenchyma too exhibits a change of form. Moreover, there are purely fibrous bundles with distinct stegmata.

Among the foreign species *Palmoxylon ligerinum* Crié (1892) re-described in detail by Stockmans and Williere (1943) shows to a certain extent some similarity with the South Indian species. The nature of the ground tissue is quites imilar (STOCKMANS & WILLIERE, 1943; PL. 1, FIG. 4) although the cells in the longitudinal section of Crié's species are exclusively spherical rather than square or rectangular as in *P. arcotense*.

The similarity ends only there, and the differences are: (1) the presence of purely fibrous bundles in *P. ligerinum*; (2) the tendency of the formation of a cap of 3 to 4 layers of densely packed parenchyma round the fibrous part of the bundles (mixed bundles of Stockmans and Williere); and (3) the shape of the bundles in *P. ligerinum*, the fibrous part being hemispherical with a typically flat median sinus.

It is very interesting to note that the central part of the stem of *Livistona*, a living palm genus, also shows almost all the

same features. Pl. 2, Fig. 8 shows part of a thin section of the central zone of *L. chinensis*. The similarity of structure is obvious. Ground tissue is typically lacunate like that of the present species without any purely fibrous bundles and the nature of the fibro-vascular bundles also is very similar in the fossil as well in the living specimens. The fossil agrees with *Livistona* almost in all the characters (Pl. 2, Fig. 3). There is surprisingly, so to say, a layer by layer similarity in both the fossil and *Livistona*. Professor Kaul has kindly examined the sections of the fossil stem and in his opinion it is indeed very nearer to the living genus *Livistona*. The similarities between the fossil and the living palm are so strong as to lead us to name the fossil after the living genus. However, I believe that unless and until the complete stem with the cortical portion is available in the fossil condition it may not be advisable to take that step.

ACKNOWLEDGEMENTS

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EXPLANATION OF PLATES

Plate 1

1. A view of the fossiliferous locality.
2. *Palmoxylon arcotense* sp. nov. Cross-section of the central part showing the irregular distribution of the bundles in the lacunate ground tissue. × 2.

Plate 2

3. An enlarged fibro-vascular bundle from the central part of *Livistona*. × 400.
4. *P. arcotense*. Fibro-vascular bundle with elliptical vessels. × 200.
5. *P. arcotense*. The ground tissue between the two neighbouring bundles. × 200.
6. *P. arcotense*. Longitudinal section of a part of the stem. × 200.
7. Part of section in Fig. 6 enlarged. × 400.
8. *Livistona chinensis*. A part of the central region of the stem. × 200.

Plate 3

Figs. 9-12 — *Palmoxylon arcotense* sp. nov.

9. A part of the outer region showing the dermal (not complete) and subdermal zones. × 2.
10. Dermal zone enlarged. × 10.
11. Subdermal zone enlarged. Note the typically lacunate ground tissue. × 10.
12. A fibro-vascular bundle from the central zone. × 200.

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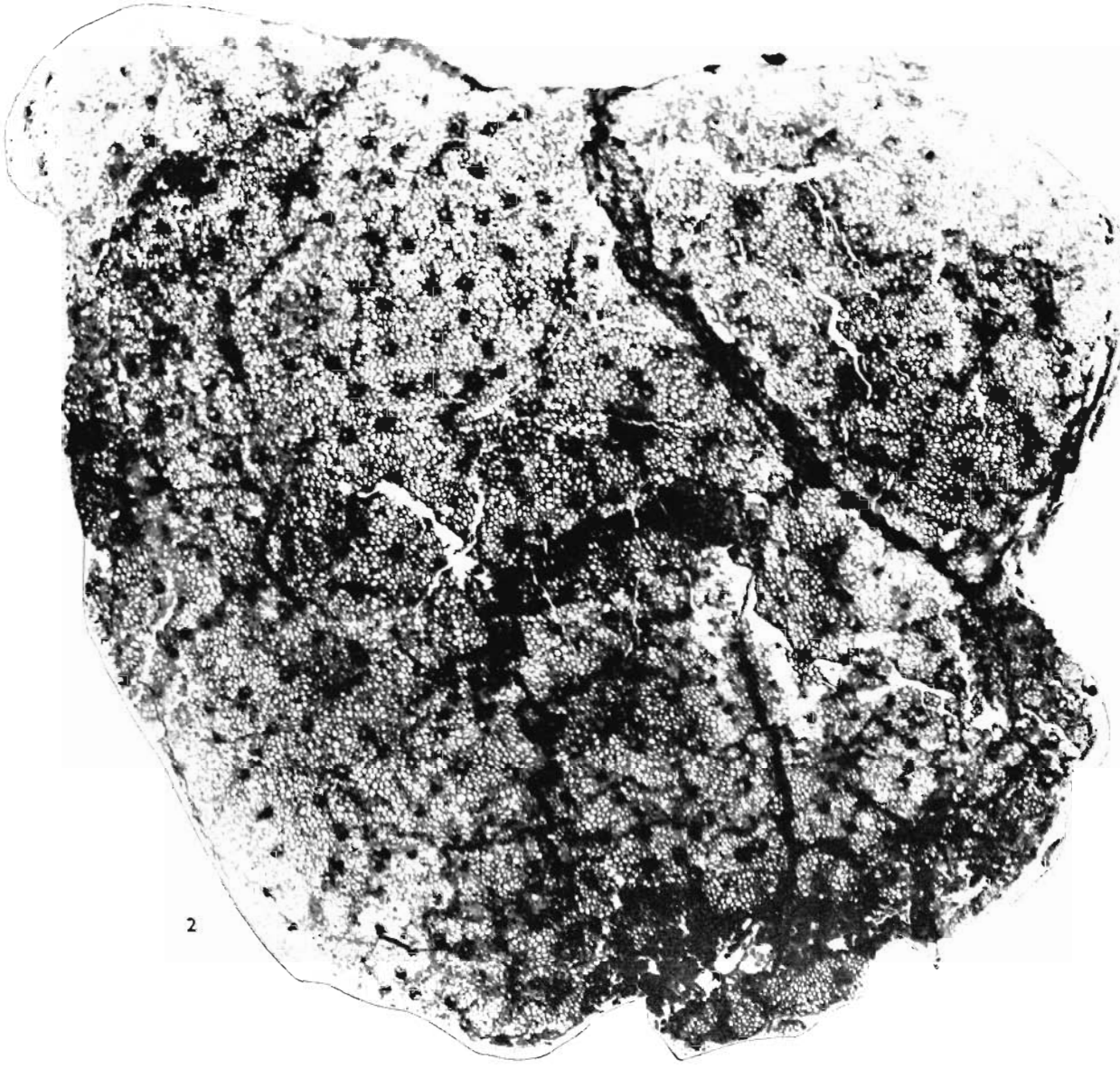

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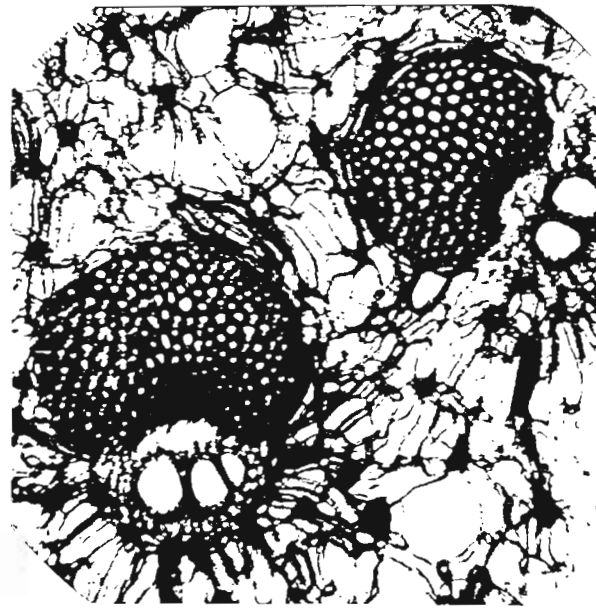

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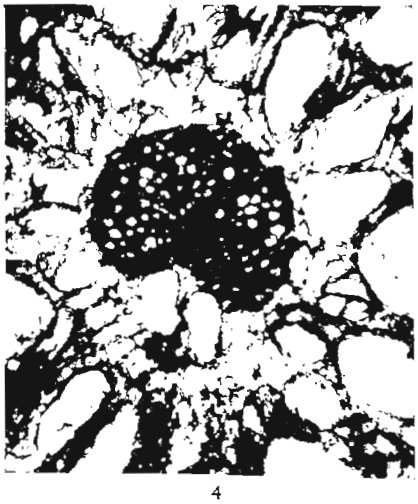

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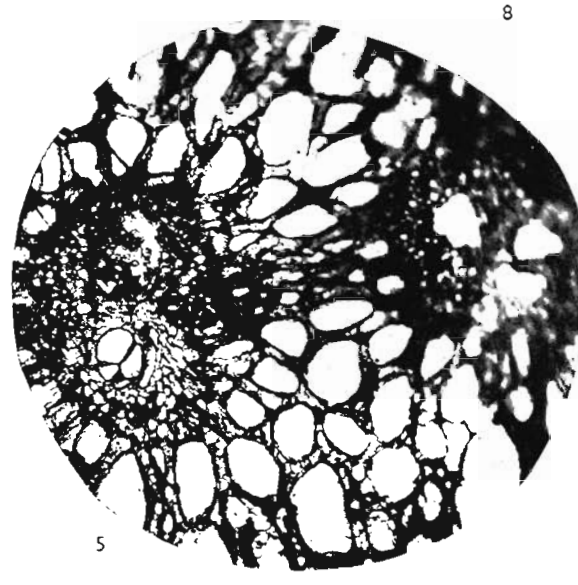

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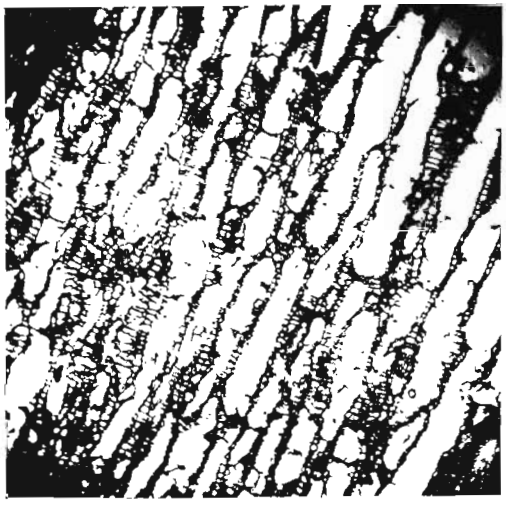

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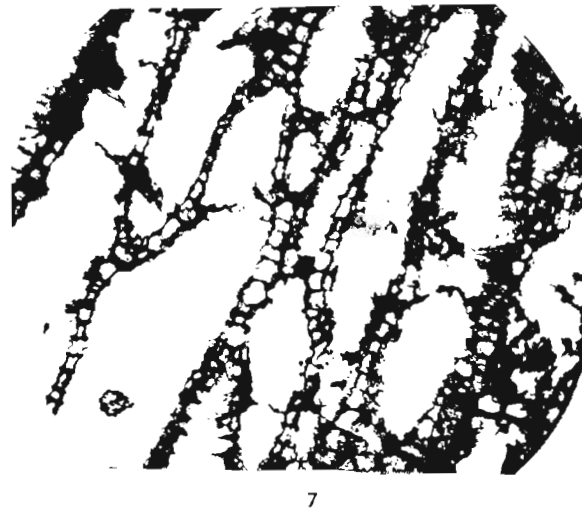

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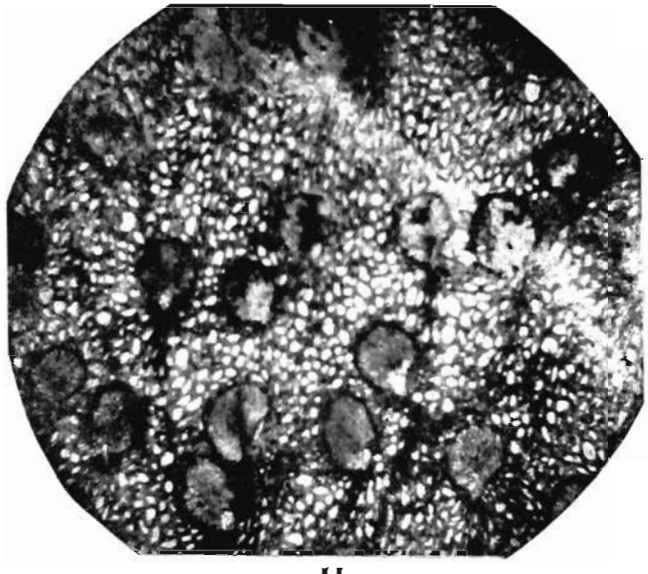

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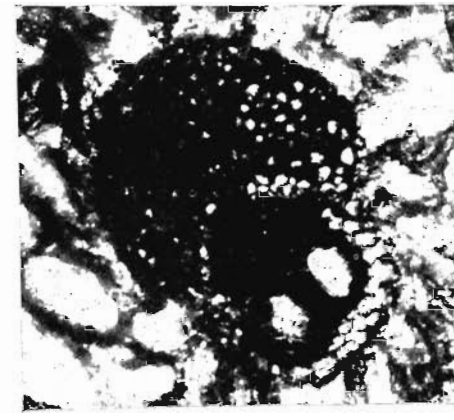

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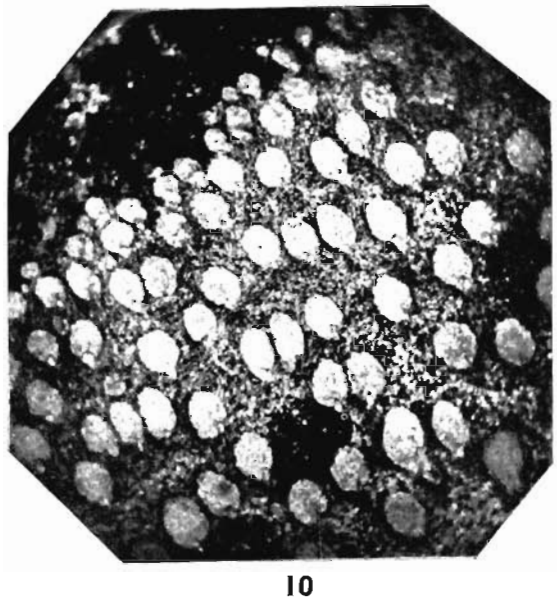

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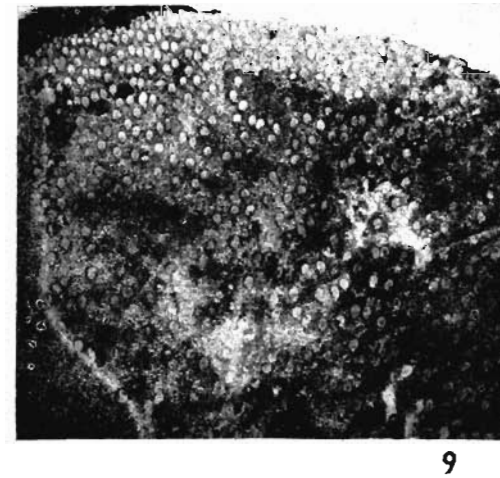

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