

ANATOMY OF PALM STEMS — II

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ABSTRACT

Stem anatomy of two palm taxa, *Phytelephas macrocarpa* R. & P. and *Nypa fruticans* van Wurmb is described. *Phytelephas macrocarpa* is characterized by spongy ground tissue in all the three zones and unique fibrovascular bundles with vascular part outside the dorsal sclerenchyma consisting of a large number of vessels. *Nypa fruticans* also possesses lacunar ground tissue throughout the stem and the mechanical tissue shows a very poor development. Further, the vascular part of the bundles lies far apart from the fibrous part, a peculiar feature not recorded in any species of palms.

Key-words — Palm, Stem anatomy, *Nypa*, *Phytelephas*.

सारांश

ताड़ीय तनों की शारीर—कैलाश नाथ कौल

दो ताड़ीय वर्गकों, फ्राइटेलिफ़ास मैक्रोकार्पा आर० एवं पी० तथा नाइपा फ्रूटिकेन्स वान वुम्ब, के तनों की शारीर का वर्णन किया गया है। फ्राइटेलिफ़ास मैक्रोकार्पा तीनों मंडलों में स्पंजी भरण ऊतक एवं विशेष प्रकार के ऐसे वाहिनो बंडलों से अभिलक्षणित है जिनमें कि पृष्ठ दृढ़ोतक के बाहर वाले संवहनी भाग में अनेक वाहिकायें विद्यमान हैं। नाइपा फ्रूटिकेन्स में भी सम्पूर्ण तने में रिक्तिका भरण ऊतक होता है तथा यांत्रिक ऊतक बहुत क्षीण विकास प्रदर्शित करता है। इसके अतिरिक्त बंडलों का संवहनी भाग तंतुवत भाग से काफी अलग होता है जो कि ताड़ की किसी भी अन्य जाति में न पाया गया एक विशिष्ट लक्षण है।

INTRODUCTION

A VERY large number of fossil palm stems are known from all over the world, but for want of sufficient diagnostic data they are not assigned to their corresponding living palm genera and placed under the fossil genus *Palmoxylon*. Realizing the importance of the study of stem anatomy of the modern palms in the identification of this huge collection of *Palmoxyla*, the author, in 1960, gave a comprehensive account of the occurrence of fossil palms and especially dealt with the general anatomy of the palm-stem. In the present paper, which is a continuation of the earlier publication, the author has described the stem anatomy of two palm genera which would be of special interest to palaeobotanists.

DESCRIPTION

SUB-FAMILY: PHYTELEPHASIEAE

Genus — *Phytelephas* R. & P.

Fifteen species of the genus are reported from tropical America. They are very different in habit from all the other palms not only in flower and fruit characters but also in their stems. The vertical stem-growth is very slow. As a rule the stems are always pulled down partly by their own weight and partly by the aerial roots to form a creeping caudex.

In this study a boring was obtained from a very old creeping thick stem of *Phytelephas macrocarpa* R. & P. growing in the Botanic Gardens, Peradeniya, Ceylon.

Salient Features — Ground tissue is spongy in all the three zones (dermal, sub-dermal

and central). The individual cells remain mostly circular or slightly stretched in spite of the horizontal expansion of the girth of the stem. Dermal zone is well-developed. It contains a large number of loosely arranged fibrovascular bundles, big fibrous bundles and leaf-traces.

Typical fibrovascular bundles, as found in other palm stems, are missing. The vascular part of the bundle lies outside the arms of sclerenchyma and consists of a large number of vessels in all the three zones. Big pure fibrous bundles are very conspicuous in all the three zones in the transverse section. Lignification of the fibrovascular bundles is very poor. Mechanical texture of the stem is very weak.

Description — The transverse section of the stem shows an outer cortical zone with small fibrous bundles loosely distributed in the parenchyma. It gradually passes into the dermal zone.

The dermal zone is represented by a large number of loosely distributed fibrovascular bundles and pure fibrous bundles which are very conspicuous in size. In this zone the leaf-trace bundles run very obliquely. This zone also passes inconspicuously into the subdermal zone.

In the subdermal zone, the fibrovascular bundles are bigger in size than those of the dermal zone and comparatively closely placed. The vascular tissue also shows enlargement in size and increase in the number of vessels.

The central zone is represented by a large number of scattered pure fibrous bundles with very few fibrovascular bundles.

The fibrovascular bundles increase in size from the periphery to the centre of the stem. The vascular parts lie outside the arms of the sclerenchyma which is always multicellular in all the zones. The sclerenchyma does not show much lignification. The lignified area appears as a crescent in the sclerenchyma. The sinus of the sclerenchyma is very shallow and contains the phloem cells.

The ground tissue is represented by very small, thin-walled, isodiametrical cells with very small air-spaces between them. The whole tissue is very spongy in nature and remains unaffected during the horizontal expansion of the stem.

Fossil History — While working on the *Palmoxydon* collection in the Geology De-

partment of the British Museum of Natural History (South Kensington) the author found a very well preserved specimen which in its anatomy matches completely, cell for cell, with the anatomy of the modern form above described. It was, therefore, named as *Phytelephas seawardii* Kaul (1943), the specific epithet being after the late Professor A. C. Seward of Cambridge. The type material was deposited in the Geology Department of the British Museum and a slide was presented to the Birbal Sahni Institute of Palaeobotany, Lucknow.

SUB-FAMILY — NYPACEAE

Genus — *Nypa* Steck

The preservation of the fossil stem is remarkably good considering the spongy parenchymatous cells of ground tissue and the unusual loose spreading type of fibrovascular bundle.

Only one modern species, *Nypa fruticans* van Wurmb, is found in estuarine or swampy mud in brackish or salt water of Sri Lanka, Ganga Delta, Burma, Malaysia, Marianne and Solomon Islands, Philippines, and tropical Australia (Queensland).

Salient features — The mechanical tissue of the stem shows very poor development and the fibrovascular bundles are loosely distributed in the ground tissue. The vascular part of the bundle lies far apart from the fibrous one. This is a peculiarity not recorded in any species of palms so far studied. The number of vessels in the typical bundles is 2 or 3. A large number of leaf-traces are found in the central parts of the stem. The ground tissue is lacunar. The lacunae are found in all the zones. They are circular or irregular and are situated between the loops of the interlocking chains of cells. Individual cells are very thin-walled. The whole ground tissue and the fibrovascular bundles are very unique and do not occur in any other species so far investigated.

Description — A prostrate aestival gregarious palm with very small thick stem it is often considered as a stemless form. When the stem is present as in very old specimens, it is very thick. The internal parts of the stem are very soft and spongy. There is no hard rind in the outermost part of the stem.

The fibrous zone is well-developed but the fibres are missing. It is represented by a spongy parenchymatous tissue.

The dermal zone is represented by a few loosely arranged fibrovascular bundles. The fibrovascular bundles in the sub-dermal zone are further loosely placed. The central zone shows a large number of leaf-trace bundles.

The form of fibrovascular bundles varies greatly. In the extreme peripheral parts the bundles are small and elliptical in form. Towards the subdermal the vascular parts of the bundles enlarge in size and the fibrovascular bundles take an electric bulb-like appearance. In the central part typical bundles are few. The lignification of the sclerenchyma is very poor, specially in the central zone. The sclerenchyma appears lunate in the dermal zone when the sinus is concave and complanate when it is flat. The flat sinus is more commonly found in the subdermal and the central parts. Number of the vessels in the typical bundles is variable 1-2-3 in the dermal and subdermal zones. In the central part mostly leaf-traces are found. The leaf-traces show a large number of vessels. The sinus is flat or slightly concave. Fibrous bundles are found distributed uniformly in all the three zones except in the outermost cortical area. A very important character of the bundles in this genus is that the vascular parts lie apart completely from the fibrous parts. This is not noticed in any other palm stem so far studied.

Ground tissue is lacunar. The lacunae are small and circular. They are surrounded by small thin-walled cells. The cells are circular or slightly stellate. The whole tissue appears like a sponge.

Fossil History — Hundreds of the pyritized nuts of *Nipadites* are found in the London Clay of Sheppey Island (which represents part of an Eocene estuary), Belgium, North France, North Italy, South Russia (Crimea), East of Cairo in Egypt, Central India (Mohgaon Kalan, Nagpur-Chhindwara), Assam (Miocene), Grenada, Grenada County, North Central Mississippi. These forms are all fruit fossils. However, from nowhere has fossilised stem been reported. In 1942, the author, while working on the fossil palm material in the Geological Department of the British Museum of Natural History, discovered a slide prepared by someone but without a name except a number, which on examination was found to show anatomical features exactly resembling, cell for cell, the modern form *Nypa fruticans*. This slide was photographed by the author and then left on the working table. Unfortunately, on the next day a flying bomb dropped next to the window of the author's room in the Geological Department, in the compound of the British Museum. The blast created by the explosion blew away every article on the table and in spite of the Museum authorities' best efforts the slide and the original black pebble could not be traced. The author possesses the negative of the enlarged microphotograph of the slide. The preservation of the fossil material is remarkably good, considering the spongy parenchymatous cells of the ground tissue and the unusual loose spreading type of the fibrovascular bundle. The material of the fossil was from S.E. England. The negative is deposited in the collection of the Birbal Sahni Institute of Palaeobotany, Lucknow.

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EXPLANATION OF PLATES

PLATE 1

Phytelephas macrocarpa R. & P.

1. Transverse section of the stem showing dermal and subdermal zone. $\times 4$.
2. Dermal central zone of stem. $\times 4$.
3. Dermal zone of the stem. $\times 12$.

4. Showing the central zone of stem. $\times 18$.

PLATE 2

5. Central zone with pure fibrous bundle. $\times 48$.
6. A typical fibrovascular bundle. $\times 48$.
7. Parenchymatous ground tissue cells. $\times 172$.

PLATE 3

Nypa fruticans van Wurmb

8. T.S. of stem showing dermal and sub-dermal zone. $\times 4$.
9. T.S. of stem showing central zone. $\times 4$.
10. Dermal zone. $\times 44$.

11. Subdermal zone. $\times 44$.
12. Ground tissue. $\times 88$.

PLATE 4

13. T.S. of fossil stem wood showing highly spongy ground tissue and fibrovascular bundles. $\times 26$.

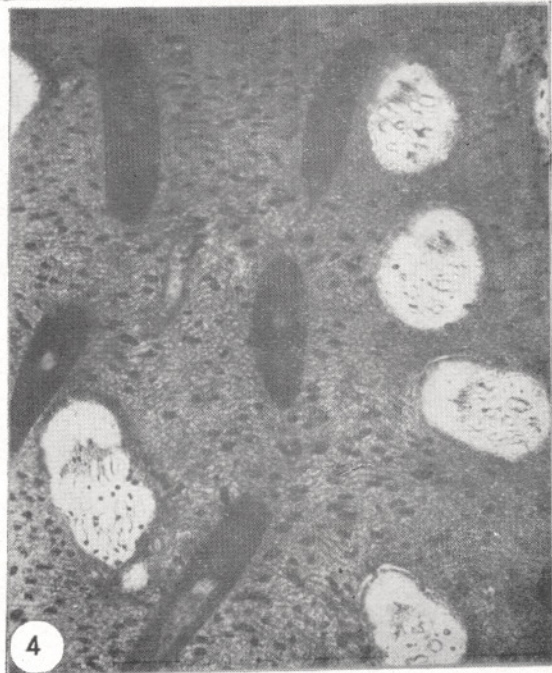
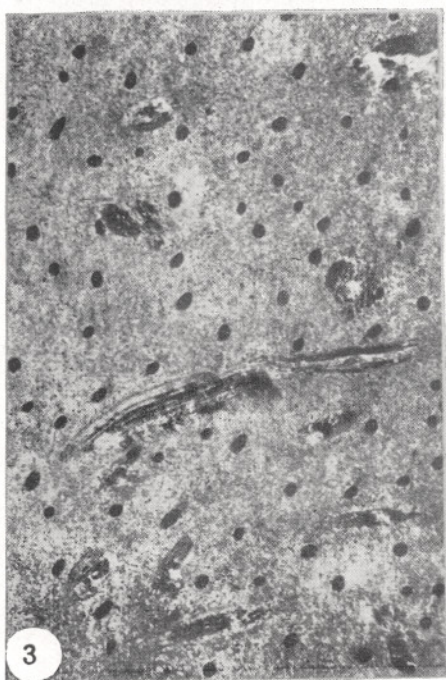
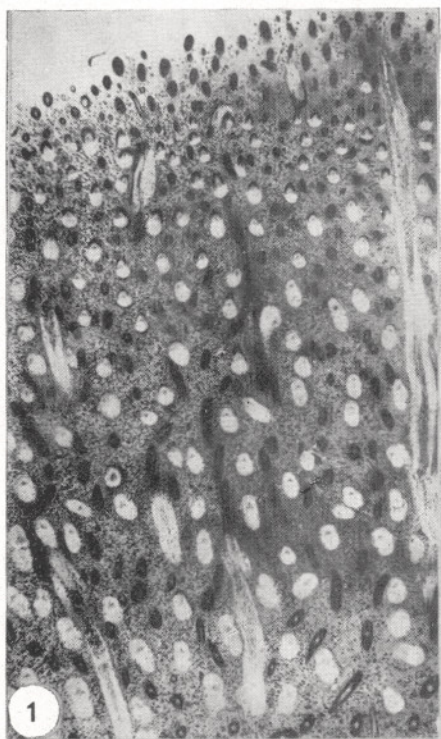


PLATE 1

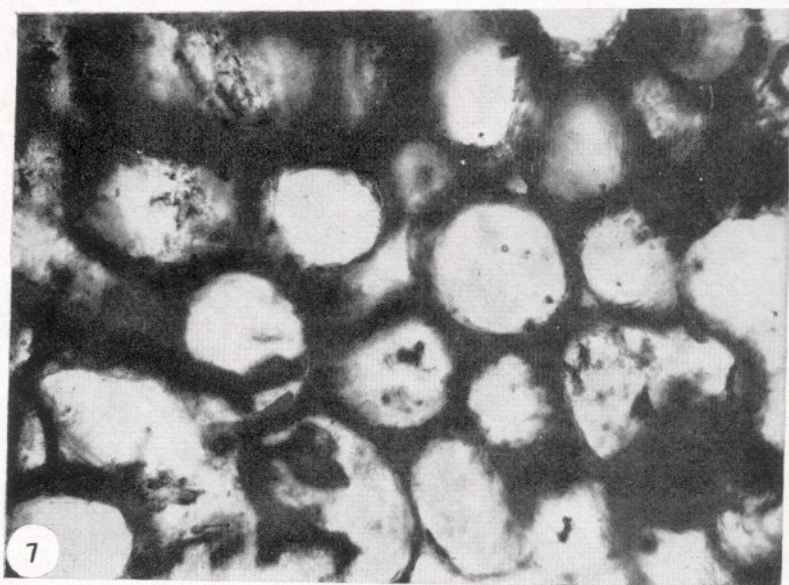
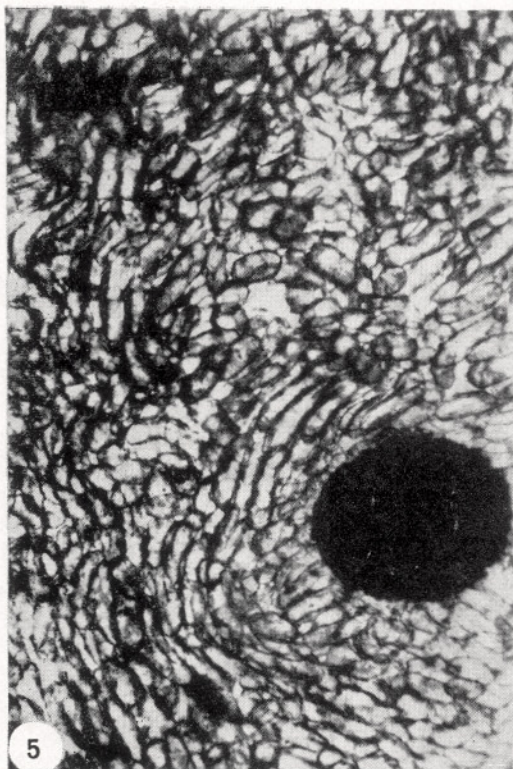


PLATE 2

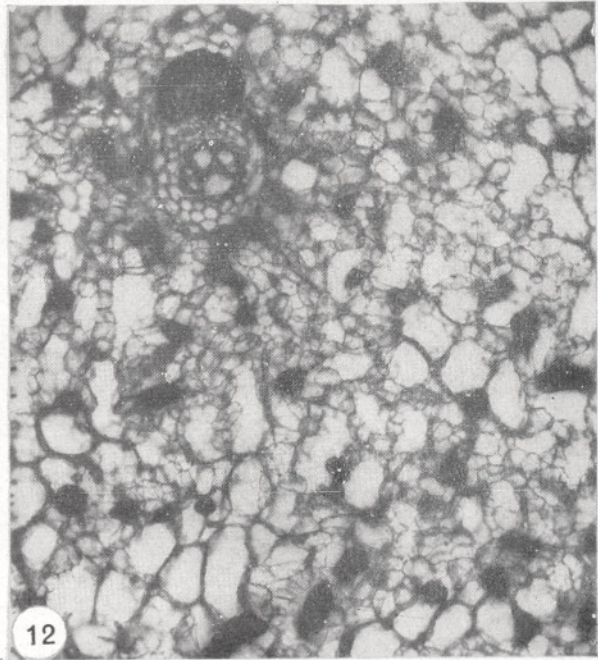
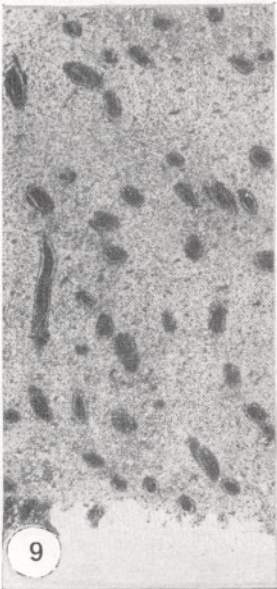
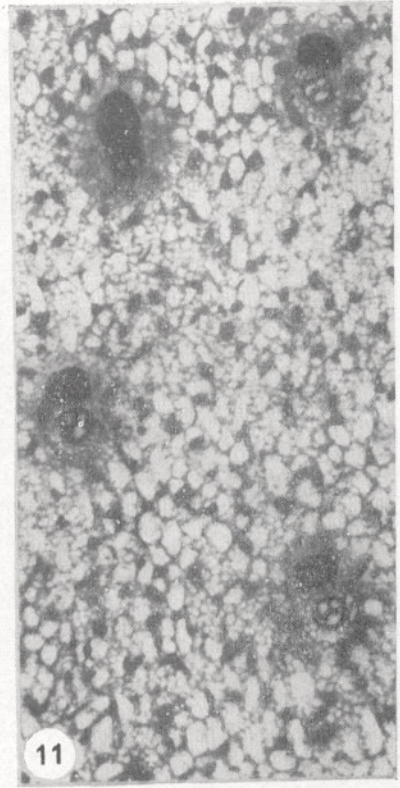
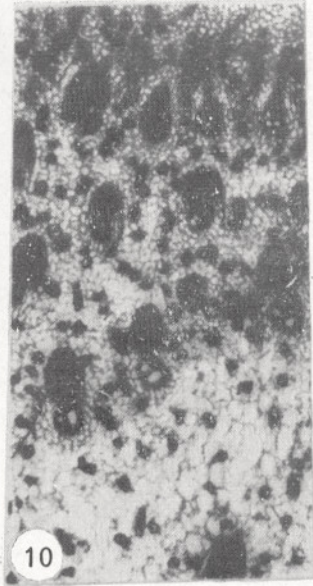
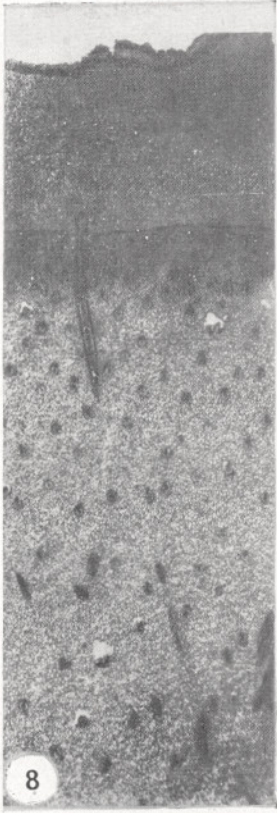


PLATE 3

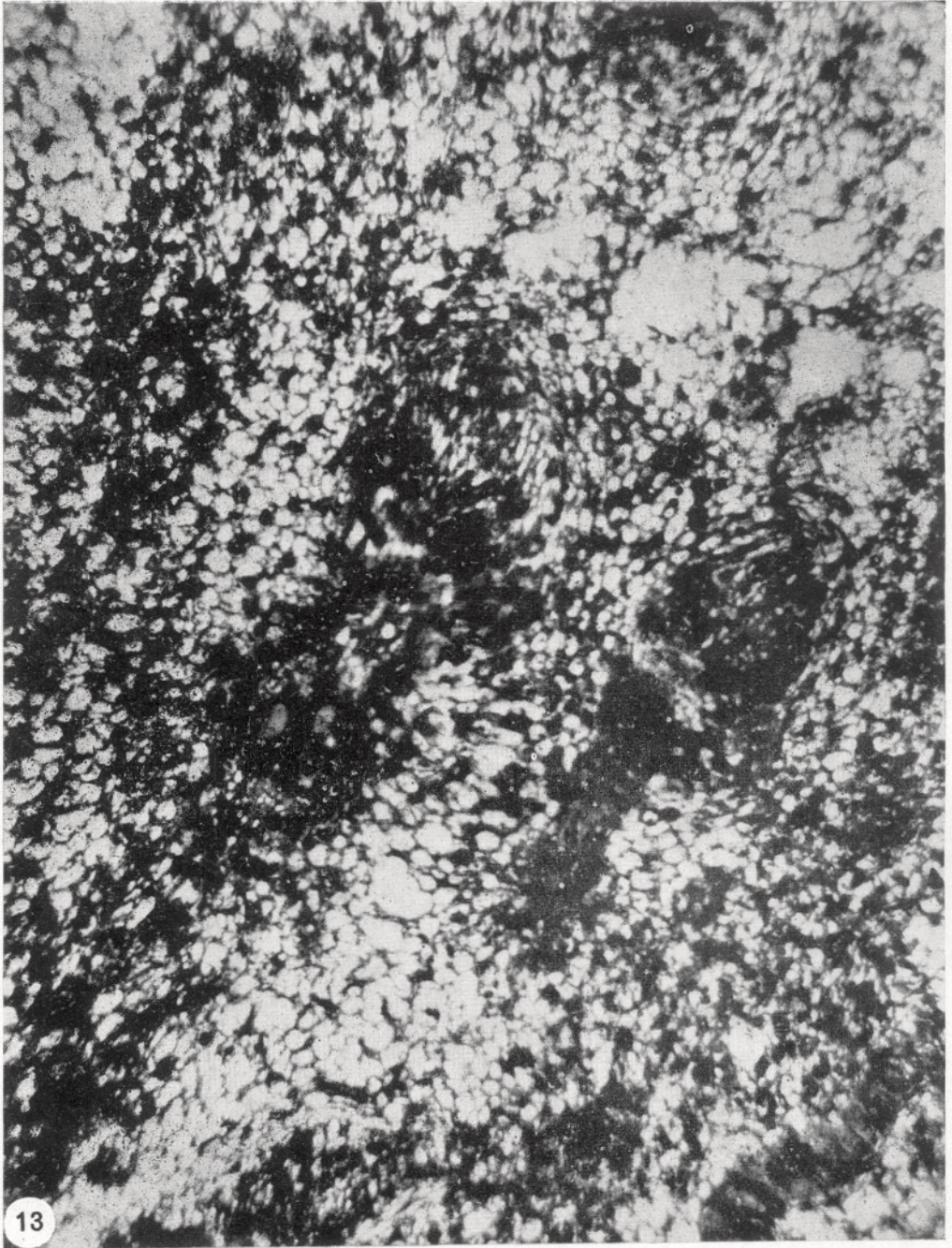


PLATE 4