

THE ROLE OF VEIN TERMINI IDIOBLASTS AS AN AID IN THE SYSTEMATICS OF *PTERNANDRA* JACK. (MELASTOMATACEAE)

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ABSTRACT

The recent revision of the genus *Pternandra* Jack. of the Melastomataceae is justified on the basis of veinlet elements morphology. The naturalness of the key characters is lucid and supports the taxonomical utility of the idioblastic features observed within this genus.

INTRODUCTION

The occurrence of varied idioblasts, chiefly sclereids, brachytracheoids and sclerotracheoids in a few species of *Pternandra* prompted us to examine all the authenticated as well as a few non-authenticated specimens available from Rijksherbarium, Leiden and Central National Herbarium, Howrah, with a view to elaborate their morphological aspects and systematic applicability.

The name *Pternandra* was established by Jack in 1882 and reviewed by Nayar (1978) and Maxwell (1981). As a starting point for a historical survey of this genus including *Kibessia*, the summarised account given by Nayar (1978) and Maxwell (1981) be conveniently used.

This genus is represented mostly by tall trees of about 25 metres. Some species are shrubs. Species which are constantly or noticeably arboreal are: *P. coriacea*, *P. galeata*, *P. hirtella* and *P. tuberculata*. All taxa are terrestrial but one species, *P. cogniauxii* has (apparently) the capacity to grow as an epiphyte and *P. echinata*, though usually recorded as a tree, has twice been recorded as a climber.

This genus is distinguished from other genera of Melastomataceae by its woody habit, tessellate to echinate calyx tube, calyptra or calyx cap in most species small, minutely appendaged anthers, 4-locular ovary, and many seeded fruit. It has palmately reticulate venation pattern (3-5 basal nerves) which is usually characteristic of most of the members of the family.

DISTRIBUTION OF THE SPECIES

P. coerulescens and *P. echinata* var. *pubescens* occur in Thailand, the former known from Chang island in Trat Province, the latter (which is indistinguishable from *P. echinata* var. *echinata*) from the southern peninsular part of Thailand. In the Malay peninsula and Singapore, four taxa occur: *P. coerulescens*, *P. galeata*, *P. tuberculata* and *P. echinata*—the latter is apparently restricted to the Malay Peninsula and the Riouw Archipelago. The three taxa endemic to Borneo are *P. cogniauxii*, *P. gracilis* and *P. galeata* var. *elmeri*. *P. teysmanniana* is uncommon in Borneo but occurs in Sumatra and Java. *P. coerulescens*, *P. galeata* s.s. and *P. tuberculata* range from W. Malaysia to New Guinea.

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Specimens examined: *P. acuminata* (Decne.) Nayar, Malaya, *Maingay* 804 (CAL); *P. angustifolia* Maxw., Sarawak, *Haron* 21444 (Holotype, L); *P. azurea* (Bl.) Burk. var. *azurea* Maxw., Sumatra, *Beccari* 622 (L); Sumatra, *Forbes* 1993 (CAL), Java, *Blume* 14 (L); *P. azurea* (Bl.) Burk. var. *cordata* (Korth.) Maxw., Sumatra, *de Wilde & de Wilde, Duyfjes* 12829 (L); *P. azurea* (DC.) Burk. var. *subulata* (Bl.) Nayar, Sumatra, *Beccari* 688 (CAL); *P. capitellata* Jack, Penang, *Wallich* 4079 (CAL); Malaya, *Maingay* 1568 (CAL); *P. coerulescens* Jack, Penang, *Wallich* 1831 (CAL), Perak, *Wray* 3254 (CAL), Malacca, *Holmberg* 863 (CAL), Singapore, *s.l., s.n.* (CAL), Thailand, *Smithinand* 5659 (L); *P. coerulescens* Jack var. *jackiana* (Walp.) Cl. Perak, *Wray* 1818 (CAL); *P. cogniauxii* Nayar, Borneo, *s.l., s.n.* (CAL), Borneo, *Sanvour* KS (L); *P. coriacea* (Cogn.) Nayar, Borneo, *Van Nier* 4623 (L); *P. crassicalyx* Maxw., Borneo, Lajangah SAN 32197 (L), *Wright* 23713 (CAL); *P. echinata* Jack, Malaya, *Garrick* 1482 (L), Perak, *King's Collector* 3518 (CAL); *P. echinata* Jack, var. *pubescens* King, Perak, *King's Collector* 3518 (CAL); *P. galeata* (Korth.) Ridl. var. *galeata* Maxw., Borneo, *Kostermans* 6868 (L); *P. galeata* (Korth.) Ridl. var. *elmeri* (Merr.) Maxw., Borneo, *Singh* 30042 (L); *P. gracilis* (Cogn.) Nayar, Borneo, *Luang* S. 23263 (L); *P. griffithii* King, Singapore, *S. Kurz* s.n. (CAL); *P. hirtella* (Cogn.) Nayar, Borneo, *Paie* 8452 (L); *P. multiflora* Cogn.; Borneo, *Hose* 598 (L), Borneo, *Haviland* 496 (CAL), *P. paniculata* Benth. Penang, *Wallich* 4080 (CAL), Perak, *Wray* 1952 (CAL); *P. rostrata* (Cogn.) Maxw., Borneo, *Haron* S. 21395 (L), Borneo, *Meijer* SAN 37999 (L), *P. tessellata* (Stapf) Nayar, Borneo, *Anderson & Paie* S. 28628 (CAL), Borneo, *Haviland* 1383 (CAL) (Holotype K, CAL specimen Isotype); *P. teysmanniana* (Cogn.) Nayar, Borneo, *Hallier* 2223 (L); *P. tuberculata* (Korth.) Nayar, Sumatra, *Korthals* s.n. (Holotype, L); *P. verrucosa*

(Merr.) Nayar, Borneo, *Merril* 20203 (CAL).

Leaves of herbarium specimens were cleared by potassium hydroxide and stained by basuc Fuchsin as suggested by Page and Tan (1986) to produce a deeply stained three dimensional vascular skeletons of the leaf *in situ* within a transparent whole leaf body.

OBSERVATION

The varied morphology of the idioblasts in the different species of the genus can be classified into two major categories.

Taxa with brachytracheoids

The idioblasts are sub-spheroidal to slightly lobed cell forms, mostly sub-terminal or terminal to the vein endings. They are thin walled, helical or pitted tracheoids, solitary or in pairs or in groups at the vein endings. These features can be observed in : *Pternandra azurea* var. *azurea* (Fig. 1), *P. azurea* var. *cordata* (Figs. 2,3), *P. echinata*, *P. galeata* var. *galeata*, *P. gracilis*, *P. hirtella* (Figs. 4,5) and *P. tessellata* (Fig. 6).

Taxa with sclerotracheoids (pitted or helical) along with or without brachytracheoids/ sclereids.

These idioblasts are helical or pitted elements of varied forms with thick secondary walls. They are markedly larger than the other elements of the vein endings. They occur singly or in groups. Helical sclerotracheoids can be seen rarely in *P. coerulescens* and *P. teysmanniana*.

In taxa with pitted sclerotracheoids, the sclereid idioblasts are thick walled cell forms showing a distinct terminal or subterminal relationship with the vein ends. Their shape varies from spheroidal, sub-spheroidal or rectangular to osteoform or vermiform. They often show the presence of orderly to regular pits. These are recorded in the

following : *P. angustifolia* Maxw. (Fig. 14), *P. cogniauxii* Nayar (Figs. 17, 18), *P. coriacea* (Cogn.) Nayar (Figs. 9, 20), *P. crassicalyx* Maxw. (Figs. 7, 8, 15, 16), *P. galeata* var. *elmeri*, *P. multiflora*, *P. rostrata*, *P. teysmanniana*, *P. tuberculata* (Korth.) Nayar (Figs. 9, 13).

DISCUSSION

1) *Systematic applicability*

In the earliest monographic treatment of Melastomataceae, Cogniaux (1891) recognised three sections : *Eukibessia* Cogn., *Rectomitra* (Bl.) Cogn. and *Macrop-lacis* (Bl.) Cogn. Nayar (1978) proposed that the genus *Kibessia* as a synonym of the genus *Pternandra*. Maxwell (1981) revised the genus *Pternandra* and included *Kibessia* as a synonym. There is but one structural difference which can be used to separate *Kibessia* from *Pternandra*, that is, the presence of a calyptra or calyx cap in the former and its absence in the latter. However, this distinction has not been considered to warrant recognising two separate genera by Nayar (1978) and Maxwell (1981) and thus, they merge

Kibessia with the earliest correct name *Pternandra* for this genus.

The endomorphological features observed are placed along-side Maxwell's key characters of the species of *Pternandra* with a view to assess the value of endomorphological observations (Table).

Maxwell's key characters are justified on the basis of veinlet elements morphology. The naturalness of the key is lucid and the table also reveals the taxonomic utility of the endomorphological features reported within the genus.

The homogeneity of idioblasts under the category 1, strongly supports the naturalness of the placement of a few taxa under the key characters. The same view cannot be held with respect to the category 2, wherein the taxa possess sclerotracheoids with or without brachytracheoids or sclereids in the same lamina. This heterogeneity cannot be considered a challenge to Maxwell's key based on exomorphological characters. It could however explain that varied idioblasts are the result of specialisation in different ways.

TABLE

Comparison of Maxwell's key characters of species and the idioblasts of the taxon

Main exomorphic key characters (according to Maxwell, 1981)	Names of taxa	Type of elements in the veinlets
1. Calyx tube with setose to echinate scales which are distinctly longer than wide	<i>P. azurea</i> var. <i>azurea</i> <i>P. azurea</i> var. <i>cordata</i> <i>P. echinata</i> <i>P. galeata</i> var. <i>galeata</i> <i>P. gracilis</i> <i>P. hirtella</i> <i>P. tessellata</i>	Brachytracheoids
2. Calyx tube with tessellate, umbonate, verrucose, tuberculate scales usually wider than long	<i>P. angustifolia</i> <i>P. coerulescens</i> <i>P. cogniauxii</i> <i>P. coriacea</i> <i>P. crassicalyx</i> <i>P. galeata</i> var. <i>elmeri</i> <i>P. multiflora</i> <i>P. rostrata</i> <i>P. teysmanniana</i> <i>P. tuberculata</i>	Helical or pitted sclerotracheoids with or without brachytracheoids or terminal sclereids

2) *Taxonomic implications*

Taxonomic implications alluded to by Maxwell (1981) are considered in relation to idioblast typology.

a) Anatomically, the two varieties of *Pternandra azurea*, namely *P. azurea* (Bl.) Burk. var. *azurea* and *P. azurea* (Bl.) Burk. var. *cordata* (Korth.) Maxw. are easily distinguished by their distinct vein endings. The terminal pitted and helical brachytracheoids of the former are in direct contrast to the prominent brachytracheoids of varied shape in the latter variety.

b) *P. cogniauxii* Nayar is distinguished from all other taxa by its relatively large, 5-nerved cordate leaf blades; solitary or fascicled flowers and the urceolate fruit with a nearly smooth or slightly umbonate pattern and persistent tuberculate calyx lobes. The fruit resembles that of *P. galeata* var. *galeata* in basic shape however, the scales in *P. galeata* var. *galeata* are tessellate throughout while in *P. cogniauxii*, the pattern is more raised; also the calyx lobes in *P. galeata* var. *galeata* are smooth on both sides. Anatomically, *P. cogniauxii* has vein endings with thick walled, pitted sclerotracheoids and pitted sclereids, singly or in pairs, whereas in *P. galeata* var. *galeata* veins and vein endings are encased in sclerenchymatous cells.

c) *P. gracilis* (Cogn.) Nayar is easily distinguished from all other taxa of *Pternandra* by its solitary flower on each primary axis, axes which are never more than 5 mm long, tuberculate-echinate calyx tube, cap which also has appendages and splits into 4 persistent lobes and the chartaceous, glabrous blades which are narrowed at both ends. Anatomically, the vein endings are not distinctive.

d) *P. rostrata* (Cogn.) Nayar is very variable in the size and texture of the leaves; pattern on the calyx tube and fruits; and shape of the calyx cap. *P. tuberculata* differs from the above species in having a more slender and much branched inflores-

cence and a short calyx cap which splits into 4 lobes. The leaves of the two species are indistinguishable. Leaf clearings have shown, however that in *P. rostrata*, pitted sclerotracheoids are present at the vein-endings whereas in *P. tuberculata*, the vein endings have sclerotracheoids and also sclereids of varied shapes and sizes.

e) Maxwell (1981) has reduced *P. echinata* Jack var. *pubescens* (Decne.) King to a synonym of *P. echinata* Jack since the pubescence of the branchlets, leaves and inflorescence axes vary considerably. According to him, no distinction can be made between those specimens which are glabrous or slightly pilose and those specimens which have "much minute rusty pubescence." King (Maxwell, 1981) also had his doubts about this variety and commented that Wallich (Maxwell, 1981) did not accept this variety and considered it as being true *P. echinata* Jack. Anatomical observations on the vein endings of *P. echinata* var. *pubescens* and *P. echinata* Jack are not helpful for taxonomic judgements since the similarity of vein endings in both taxa far outweigh their differences.

f) *P. angustifolia* Maxw. is readily distinguished from all other species of *Pternandra* by its small, narrow leaf blades which have a prominent midrib and two faint intramarginal nerves. The echinate calyx tube and smooth cap strongly resemble *P. echinata* Jack. Anatomically, *P. angustifolia* is very distinct and shows no resemblance to *P. echinata*. In *P. angustifolia*, the veins and veinlets are encased by sclerenchymatous cells having a spicular outline and the veinlets and in regularly pitted sclerotracheoids in pairs or groups of sclereids. *P. echinata* has vein endings with helical brachytracheoids in groups of one to three.

g) *P. multiflora* Cogn. is easily distinguished from other species by its long complex, many flowered inflorescence; tessellate to umbonate calyx pattern and absence of a

cap. The yellow petals and fruits also appear to be distinct. The closest species is *P. coerulescens* which has smaller inflorescences, thick white, blue or purple petals and fruits which dry black. Anatomically, however *P. multiflora* and *P. coerulescens* are similar in possessing the same type of vein endings.

h) *P. coerulescens* Jack is often confused with *P. galeata* but the latter species has a calyx cap which splits into 4 persistent calyx lobes and urceolate fruit. Anatomically, however they resemble each other to a great extent especially the vein reticula and the vein endings.

i) *P. galeata* (Korth.) Ridl. var. *elmeri* Maxw. has generally larger inflorescences which are identical in structure to some specimens of *P. rostrata* with larger leaves. However, the latter differs in having thinner blades, umbonate to tuberculate calyx tube pattern; calyx cap which falls off in one piece and campanulate-truncate fruits. However, leaf clearings reveal that in *P. galeata* var. *elmeri*, vein endings have prominent helical sclerotracheoids in groups, sometimes they are present attached in an end to end fashion whereas in *P. rostrata*, the veins have sheaves of sclerenchymatous cells, and the vein endings have prominent, pitted terminal sclerotracheoids. It may be pointed out here *P. galeata* var. *elmeri* is distinct from *P. galeata* var. *galeata* with reference to vein endings, and the situation warrants further study of the other anatomical features of the two taxa.

j) *P. hirtella* (Cogn.) Nayar is morphologically distinguished from other species by its dense, red brown pubescence which persists on the branches, blade abaxial surfaces, flowers and fruits. The fruit differs from that of *P. azurea* in being sub globose and truncate rather than campanulate. The leaf blades in *P. hirtella* are thicker and larger than those of *P. azurea*. Anatomically, the two taxa are characterised by the

presence of vein endings with pitted, terminal brachytracheoids in abundance.

k) *P. tessellata* (Stapf) Nayar vegetatively resembles *P. azurea* var. *cordata* with its sinuate, winged branchlets and cordate leaf-blades; however there are difference which include the setose and often branched calyx scales of the latter. Leaf clearings of *P. tessellata*, however reveal biseriate blunt vein endings whereas *P. azurea* var. *cordata* reveals uniseriate vein endings with brachytracheoids. Immature buds of *P. tessellata* frequently resemble those of *P. rostrata* when the tubercles on the cap are not apparent. The rostrate tip and calyx scales are also similar. However, leaf anatomy is distinctly different by which the two species can be separated.

3. Sclereidal types on taxonomy of a few taxa of the Melastomataceae

In *Mouriri* sclereid morphology has been found valuable in distinguishing the section and even the species of a specimen. However, due to the occurrence of similar sclereid types in a majority of species, sclereid morphology cannot be relied upon alone (Morley, 1953a, b; 1985).

In *Memecylon* it has been shown that sclereids are useful at sectional level (Rao and Jacques-Felix, 1978) or in the provisional identifications of vegetative specimens (Rao et al. 1980, 1983; Rao, 1957) and also in solving the problems of synonymy (Rao and Dakshini 1963; Rao and Bhupal, 1974). The sclereidal types are used in distinguishing *Lijndenia* from *Memecylon* (Rao et al. 1983) as well as from *Warneckea* and *Spathandra* (Jacques-Felix, 1978).

In *Blethiandra* the sclereid patterns are so distinctive that a satisfactory key for the identification of species has been constructed (Rao and Bhattacharya, 1977).

4) Phylogeny

Diversity of opinion regarding the placement of *Pternandra* is reflected in the phylogenetic systems of

of the Melastomataceae. The recent grouping of *Pternandra* along with *Memecylon* and *Mouriri* (Vliet *et al.* 1981) in the sub-family Memecylonideae is examined in the context of the recorded presence of varied terminal idioblasts mostly in the form of sclereids or tracheoids. In the two genera, *Mouriri* and *Memecylon*, it is well illustrated that terminal sclereids in the majority of species form a striking topographical feature of diagnostic value. As a contrast, in *Pternandra*, the vein endings in all the species possess tracheoidal idioblasts and infrequently in a few species, terminal spheroidal to lobed or astro or vermiform sclereids. Thus, it is clear that a dominant sclereidal character is common to *Mouriri* and *Memecylon* whereas tracheoidal character is common in *Pternandra*. The occurrence of sclereids and tracheoids in all the genera supports the view point of Vliet *et al.* (1981), that *Pternandra* might

have separated from the other two genera at an early date which has helped them to retain certain amount of homogeneity in possessing dominant types of idioblasts. The present work suggests that veinlets in all the three genera have a syndrome of endomorphological features that warrant assigning them to a single sub-family. While the differences among the different genera with respect to morphology of idioblasts are useful at generic and to a certain extent at specific level, it is suggestive of their close link as well as their separation into different genera.

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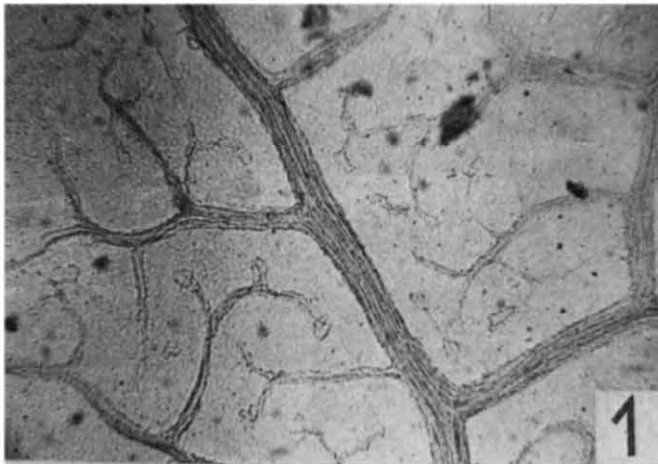


Fig. 1:

Pternandra azurea (Bl.) Burk. var. *azurea*.
vein ends free or with brachytracheoids,
× 100.

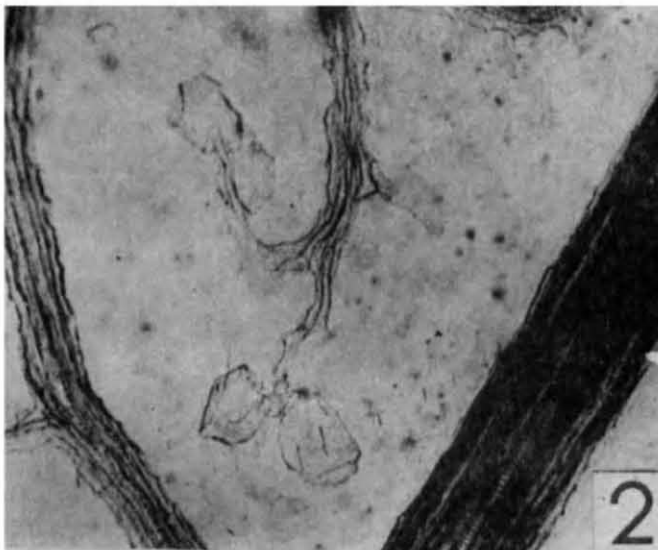
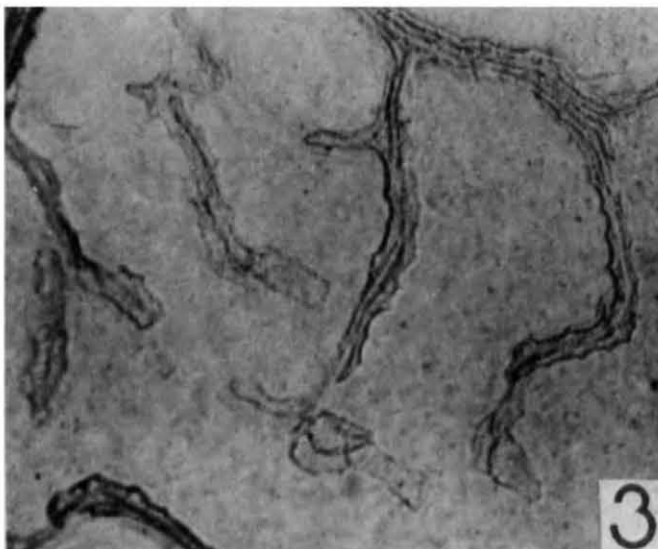
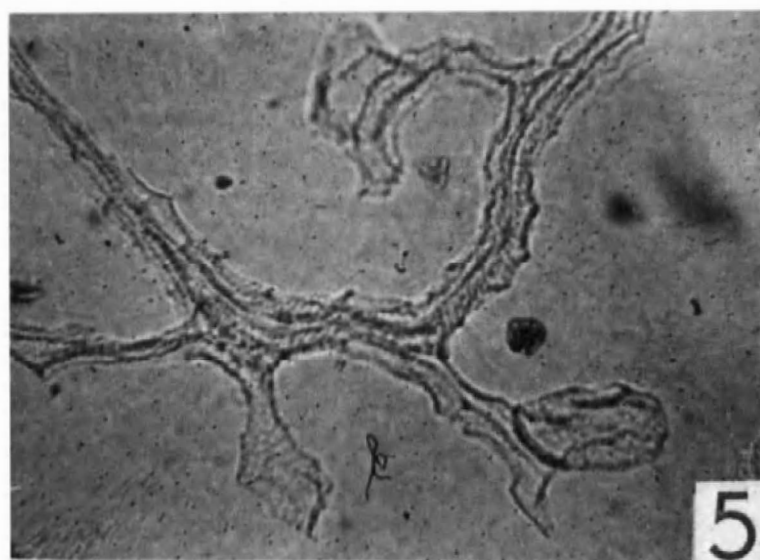


Fig. 2. 3:

Pternandra azurea (Bl.) Burk. var. *cordata*
(Korth.) Maxw.-vein ends with lobed bra-
chytracheoids, × 100.





Figs 4, 5:

Pternandra hirtella (Cogn.) Nayar-vein ends with terminal pitted brachytracheoids $\times 100 \times 200$.

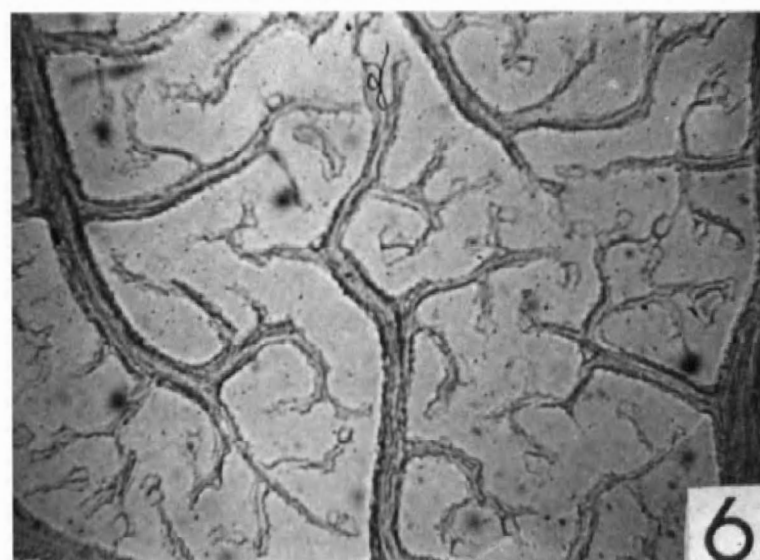
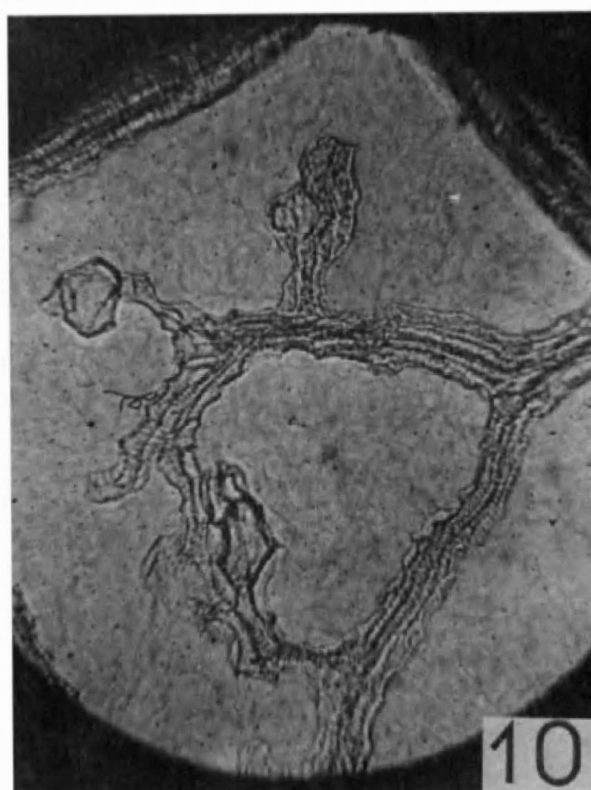
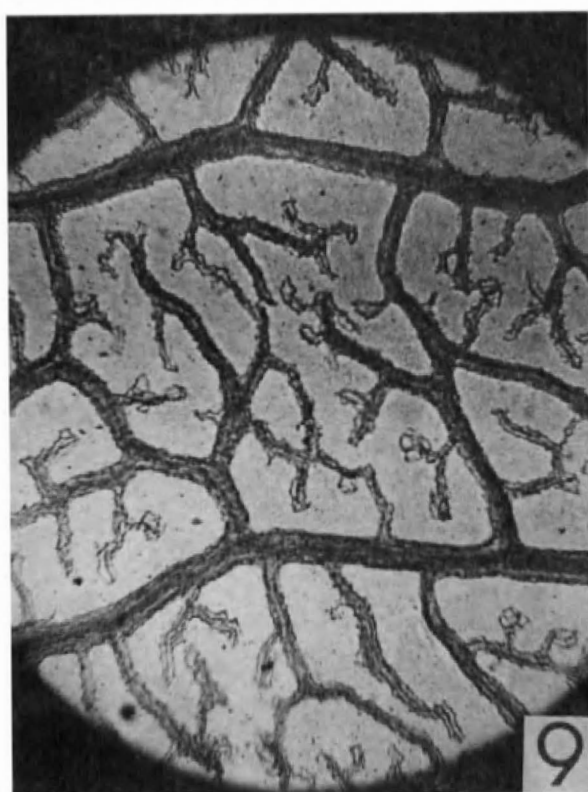
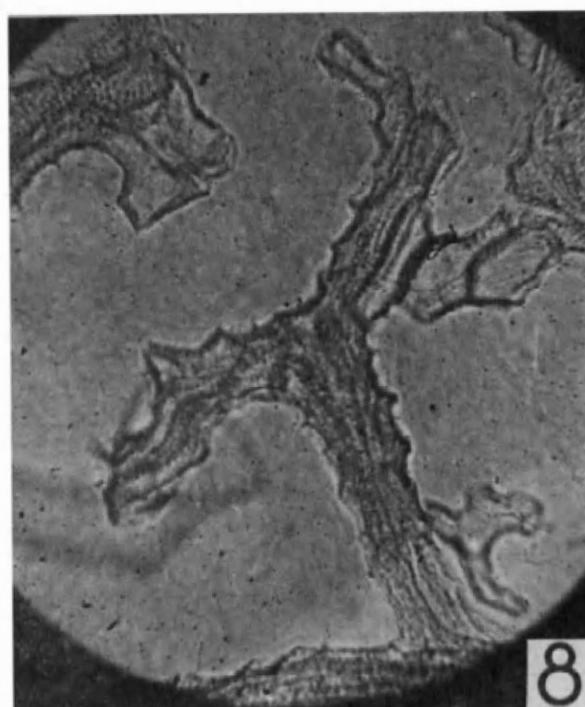
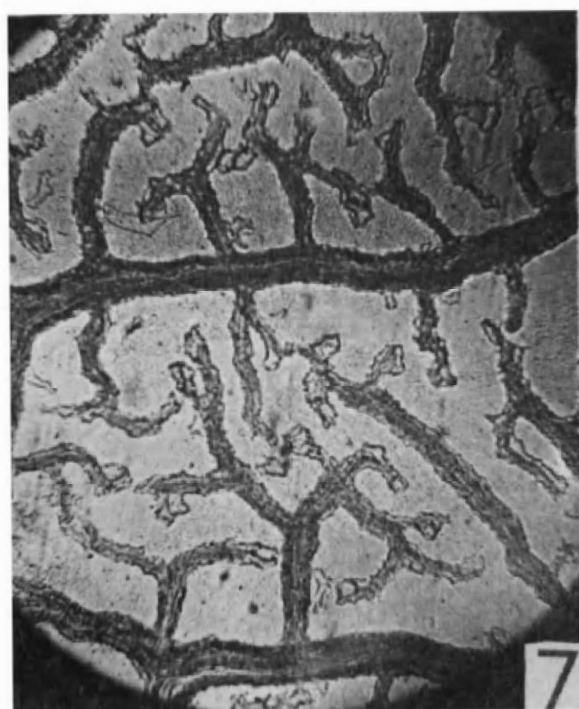


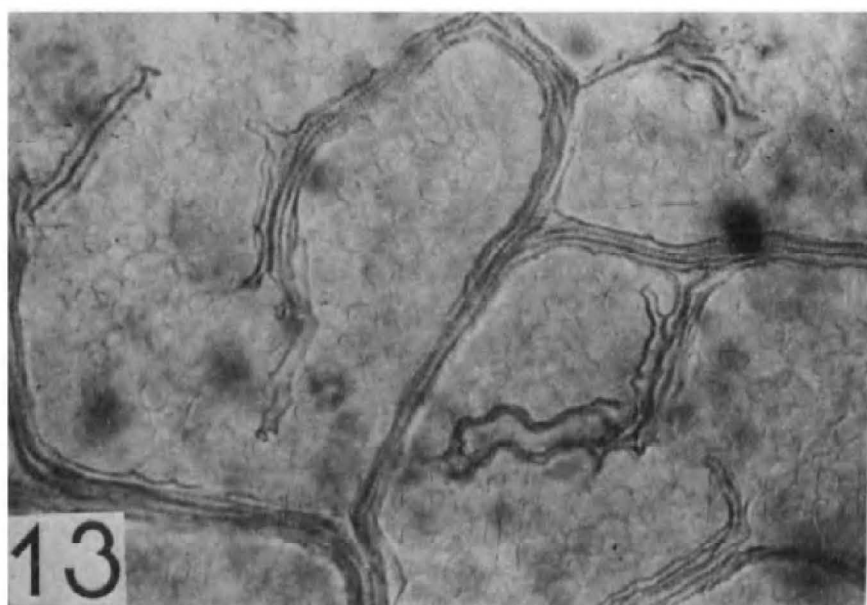
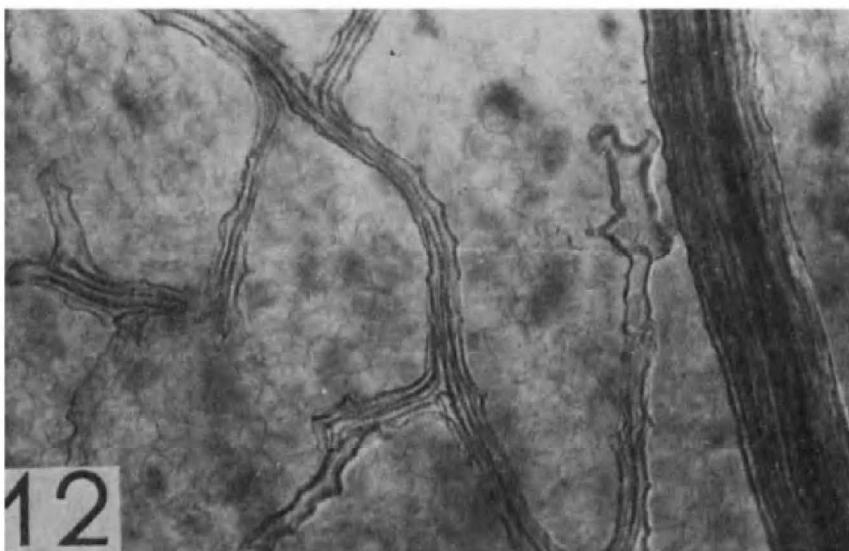
Fig. 6:

Pternandra tessellata (Stapf) Nayar-vein ends with globular brachytracheoids $\times 100$.



Figs. 7, 8: *Pternandra crassicalyx* Maxw.-vein ends with sclerotracheoids and sclereid like cells, $\times 100$; $\times 200$.

Figs. 9, 10: *Pternandra tuberculata* (Korth.) Nayar-vein ends, with sclerotracheoids, $\times 100$, $\times 200$.



Figs. 11, 12, 13:
Pternandra tuberculata (Korth) Nayar-
vein ends with terminal osteo or
vermiform sclereids, $\times 200$ each.

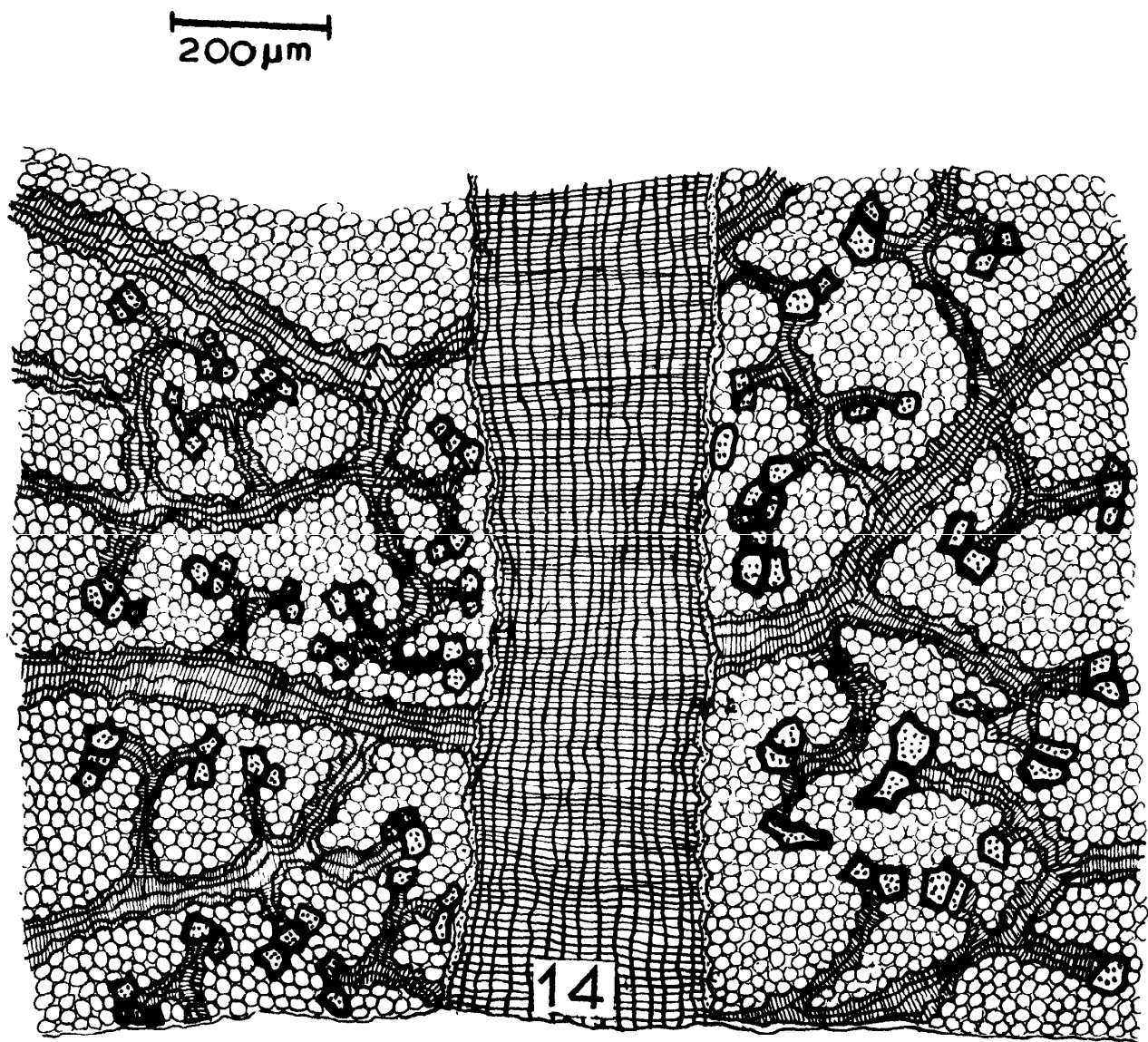
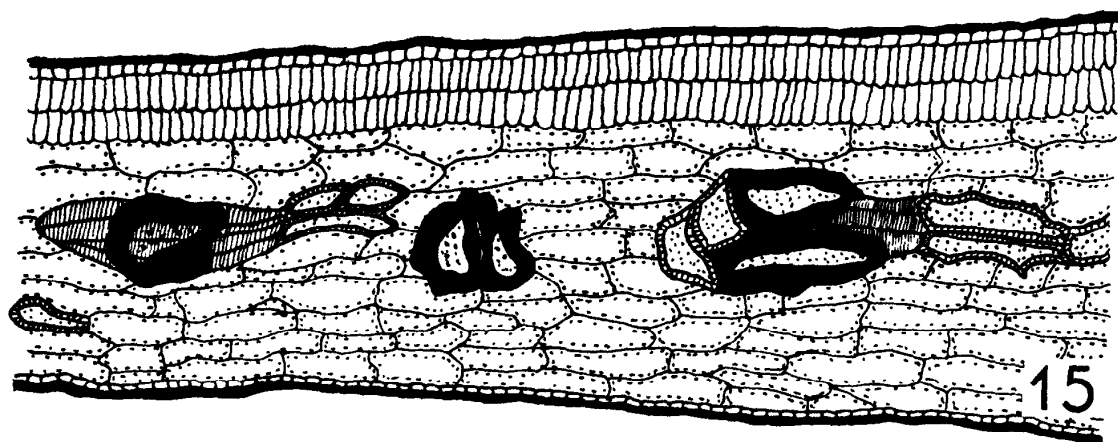
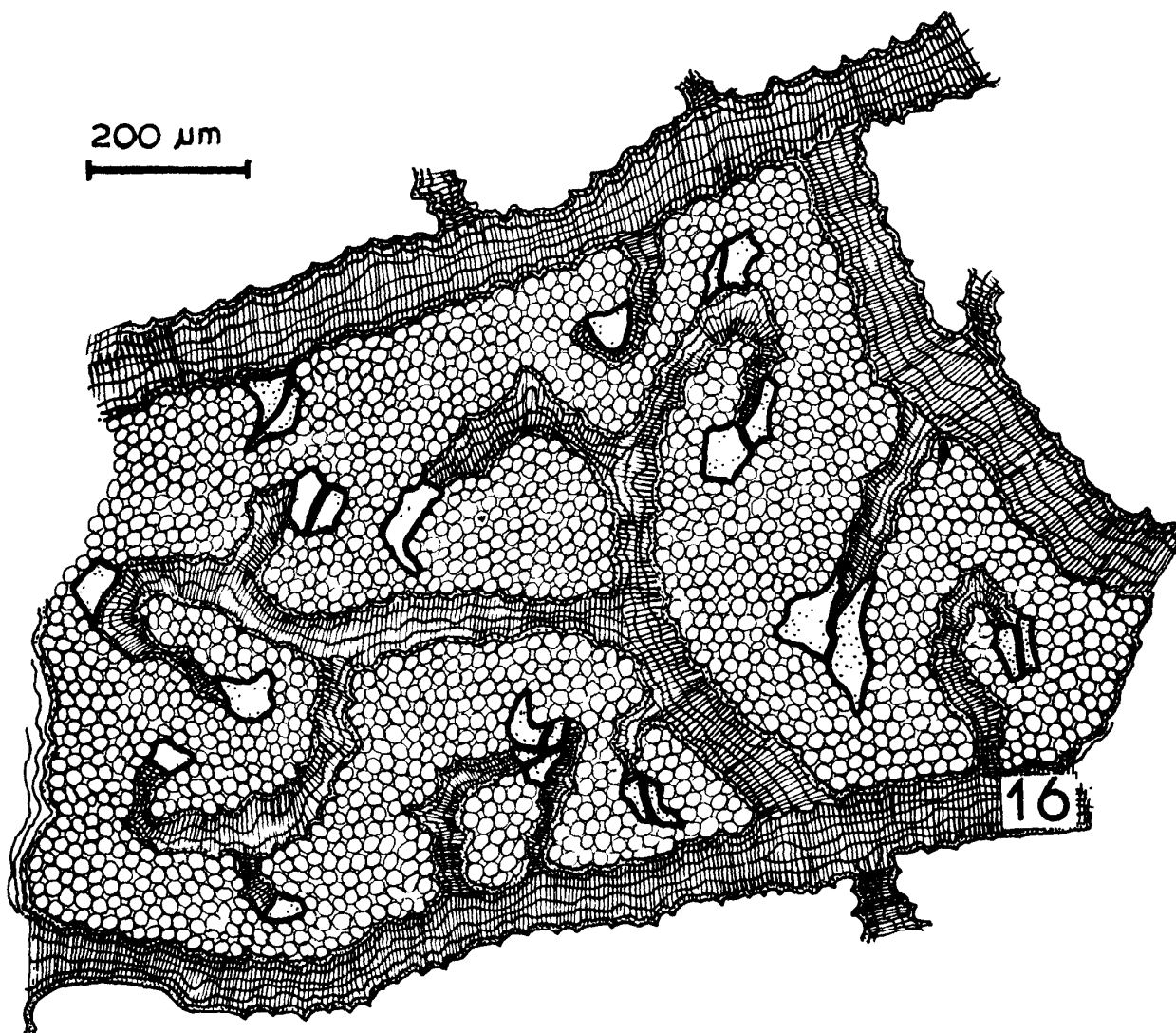


Fig. 14: *Pternandra angustifolia* Maxw.-vein ends with sub-spheroidal sclerotracheoids



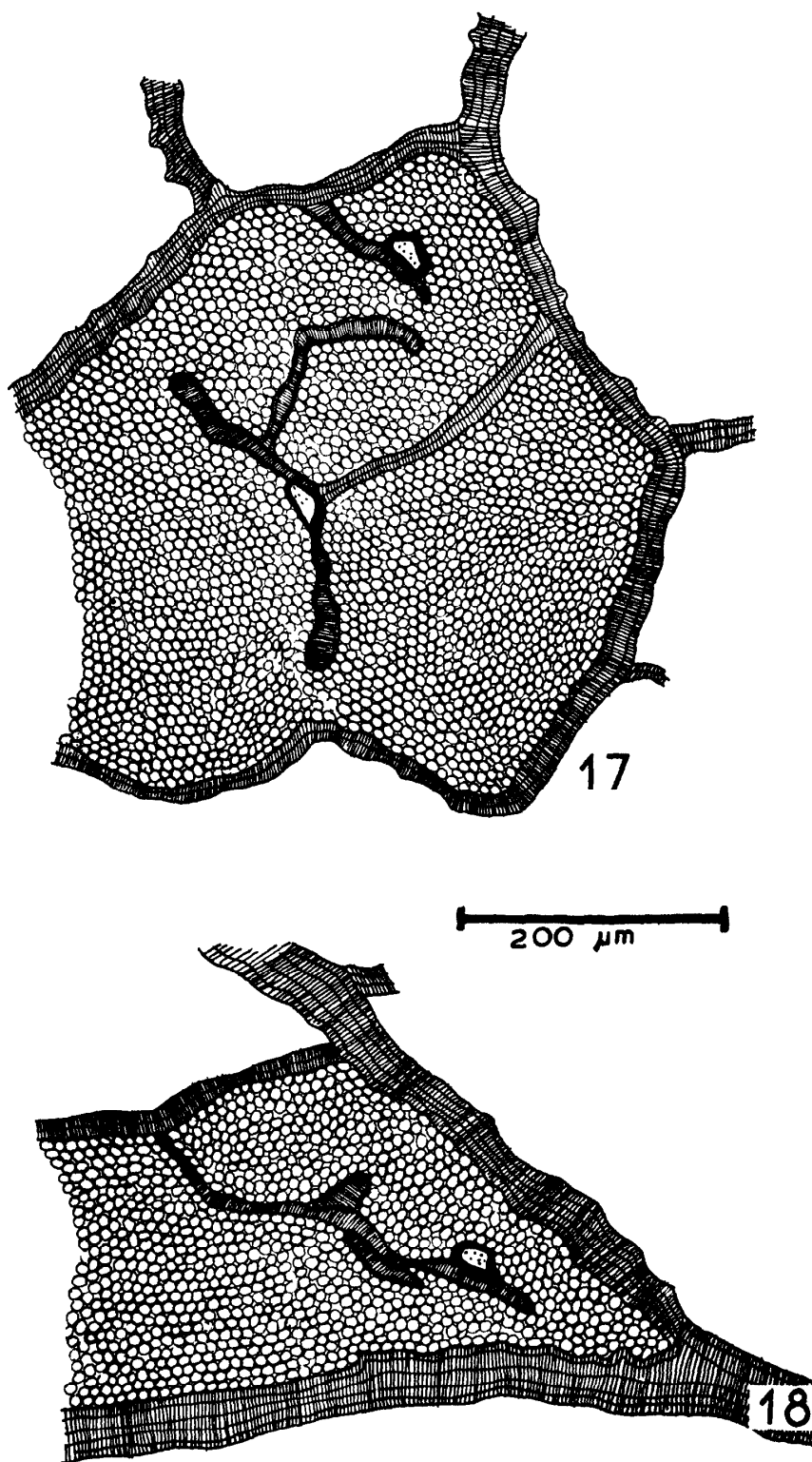
200 μ m



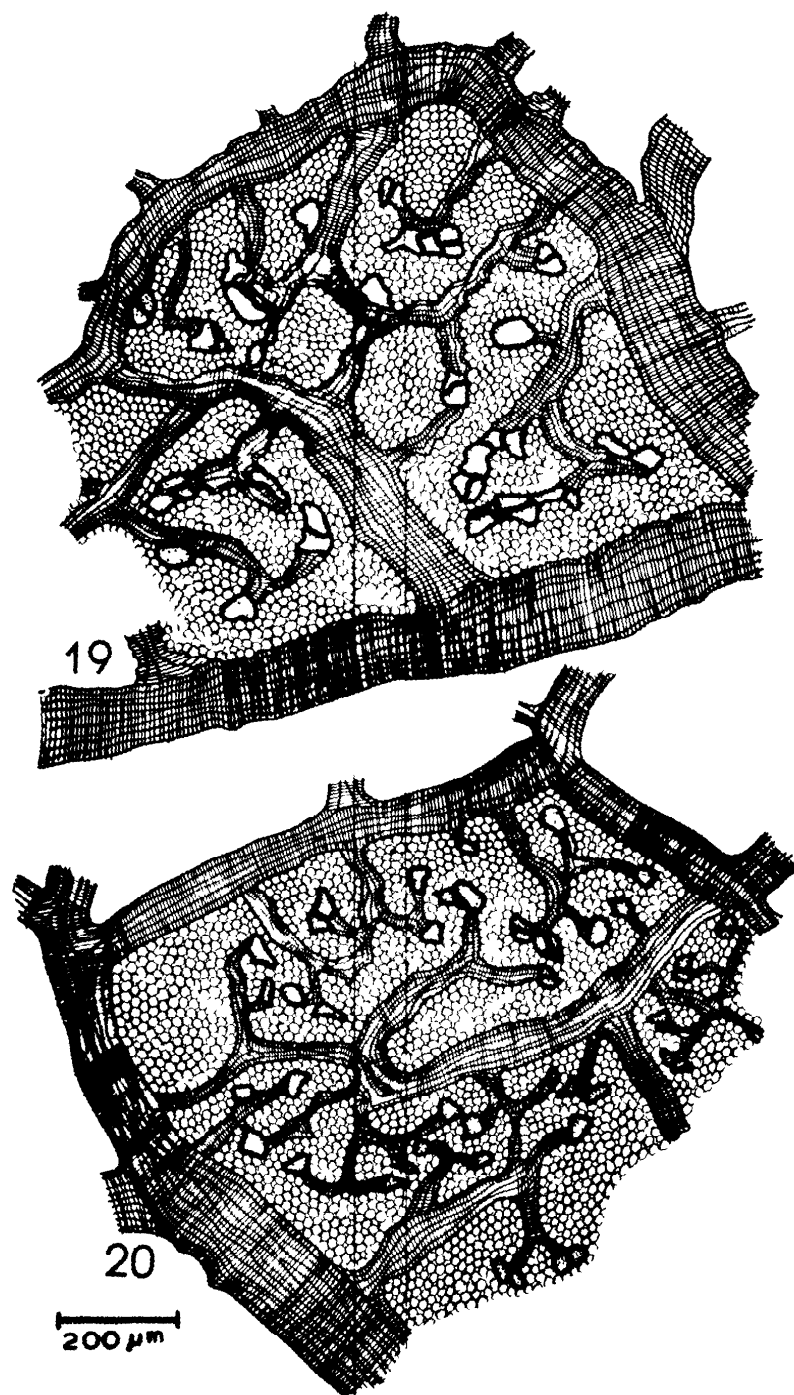
200 μ m

Pternandra crassicalyx Maxw.

Figs. 15,-16 15 Transection showing pitted sclerotracheoids and sclereids.
16 Vein ends with terminal sclerotracheoids.



Figs. 17,-18: *Pternandra cogniauxii* Nayar-vein ends with brachy and sclerotracheoids.



Figs. 19.-20: *Pternandra coriacea* (Cogn.) Nayar-vein ends with sclerotracheoids and sclereid like cells