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STRUCTURE AND TAXONOMIC SIGNIFICANCE OF LEAF VEINLETS OF THE RUTACEAE. II. *MEDICOSMA* HOOK. F. AND *FLINDERSIA* R. BR.

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ABSTRACT

The veinlet termini in several species of *Medicosma* Hook.f. and *Flindersia* R. Br. possess varied types of idioblasts : Brachytracheoids, Sclerotracheoids and terminal sclereids. In the light of details on the veinlet syndrome the group relationship among them have been examined. It is considered that varied types of idioblasts are due to different levels of specialisation. Taxonomic implications of veinlet elements are discussed.

INTRODUCTION

Medicosma consists of 22 species. Six of these are endemic to Eastern Australia, one to Southern New Guinea and 15 to New Caledonia (Hartley, 1985). They are found growing mainly in a wide range of habitats including maquis, rain forests and littoral forests. *Flindersia* is a genius of doubtful affinity represented by *ca* 24 species occurring in the New Guinea, New Caledonia and Eastern Australia (Hartley, 1969). They are medium to large sized trees confined to rain forests at lower elevations.

MATERIALS AND METHODS

Medicosma : The following herbarium specimens have been examined. *M. articulata* Hartley, *Mackee* 29259 (p), New Caledonia. *M. cunninghamii* (Hook.) Hook. f., *Beuzeville s. n.* (CANB), Australia, *M. diversifolia* Hartley, *Mackee* 36815 (CANB), New Caledonia. *M. elliptica* Hartley, *Mc Donald & Stanton* 2394 (CANB), Australia. *M. emarginata* Hartley. *Mackee* 30817 (CANB), New Caledonia. *M. exigua* Hartley, *Mackee* 16669 (P), New Caledonia. *M. fareana* (F. Mueller) Hartley, *Jones* 1497, *Schodde* 4403 (CANB). Australia. *M. glandulosa* Hartley, *Hyland* 2900 (CANB) Australia. *M. leratii* (Guillaumin) Hartley, *Mackee* 41281 (CANB), New Caledonia. *M. oblique* Hartley, *Mackee* 15008 (P), New Caledonia. *M. obovata* Hartley, *Jones* 3218 (CANB), Australia. *M. parvifolia* Hartley, *Mackee* 40232 (CANB), New Caledonia. *M. petiolaris* Hartley, *Mackee* 19550 (P), New Caledonia. *M. sessiliflora* (C.T. White) Hartley, *Brass* 20017 (CANB), Australia. *M. suberosa* Hartley, *McMillan* 5182.

Flindersia : *F. acuminata* C.T. White, *Hartley & Hyland* 14109 (CANB), Australia. *F. amboinensis* Poir., *Hartley* 20516 (CANB), Australia. *F. australis* R. Br., *Speck* 1861 (CANB), Australia. *F. bennettiana* F. Mueller ex Bentham, *Schodde & Hayes* 3561 (CANB), Australia. *F. brassii* Hartley Hyland, *Hyland* RFK 3074 (CANB), Australia. *F. brayleyana* F. Mueller, *Hartley & Hyland* 14108 (CANB), Australia. *F. bourjotiana* F. Mueller, *Risley*, 64 (CANB), Australia. *Schodde* 3326 (CANB), Australia. *F. collina* F. M. Bailey, *Jones* 2371 (CANB), Australia, *F. dissosperma* (F. Mueller) Domin, *Adams* 1317 (CANB), Australia. *F. fournieri* Pancher & Severt, *McPherson* 4552 (CANB), New Caledonia. *F. ifflaiana* F. Mueller, *Henry & Foreman* NGF 49439 (CANB), New Guinea; *Hyland* 7423 (CANB), Australia. *F. laevicarpa* White *et* Francis *var. laevicarpa, Risley* 46 (CANB), Australia. *F. laevicarpa* White *et* Francis var. *heterophylla* (Merr. *et* Perry) Hartley, *Hartley* 10705 (CANB), New Guinea. *F. maculosa* (Lindl.) Bentham, *Jones* 3771 (CANB), Australia, *F. pimenteliana* F. Mueller, *Hartley* 11513 (CANB) and *Hartley* 12018 (A), New Guinea; *Hyland* 5253 (CANB), Australia. *F. schottiana* F. Mueller, *Fisher* 184 (CANB), Australia; *Pullen* 7130 (CANB), New Guinea. *F. xanthoxyla* (A.

Cunn. ex Hook.) Domin, *Webb & Tracey* 3392 (CANB), Australia.

Medicosma : Leaves were cleared by the modified technique of trichloroacetic acid-phenol method. Idioblasts were isolated after maceration and categorised to their morphological features (Rao, 1991).

RESULTS

In *Medicosma* the vein reticulum is moderately broad with sclerenchymatous fibres around and elaborate with well developed areolation of pyramidal to hexagonal or polygonal, and also pyramidal to pentagonal or irregular outline. Veinlets are simple or branching with or without sheathing cells. The sheathing cells when present are parenchymatous or sclerenchymatous to a certain extent. The veinlet endings have varied types of cells : Conventional tracheids or infrequently brachytracheoids as in *M. articulata* (Figs. 2, 3) and *M. exiqua* (Fig. 1) in addition to sparesely distributed sheath cells around.

The veinlets termini are apparently broad of barrel-shaped with a net-like irregular shaped cells. Sometimes ensheathed cells around the veinlet termini are sclereified and few among them look like sclereid cells. Such cells exhibit irregular pits, thick sclereified cells wall and irregular shape. They are observed in *M. diversifolia, M. emarginata, M. fareana, M. glandulosa, M. leratii. M. obliqua, M. parvifolia, M. petiolaris, M. suberosa* and *M. subsessilis* (Fig. 4).

In *Flindersia* the veinlet reticulum ranges from thin to moderately thick strand with sparsely distributed sclerenchyma. The areolation shape varies from pyramidal or pentagonal to polygonal or sometimes entirely irregular in size. The veinlets are simple, branching dichotomously and having uniseriate or biseriate or triseriate to multiseriate condition with a few sclerenchymatous fibres around. The veinlets termini possess different types of idioblasts : —

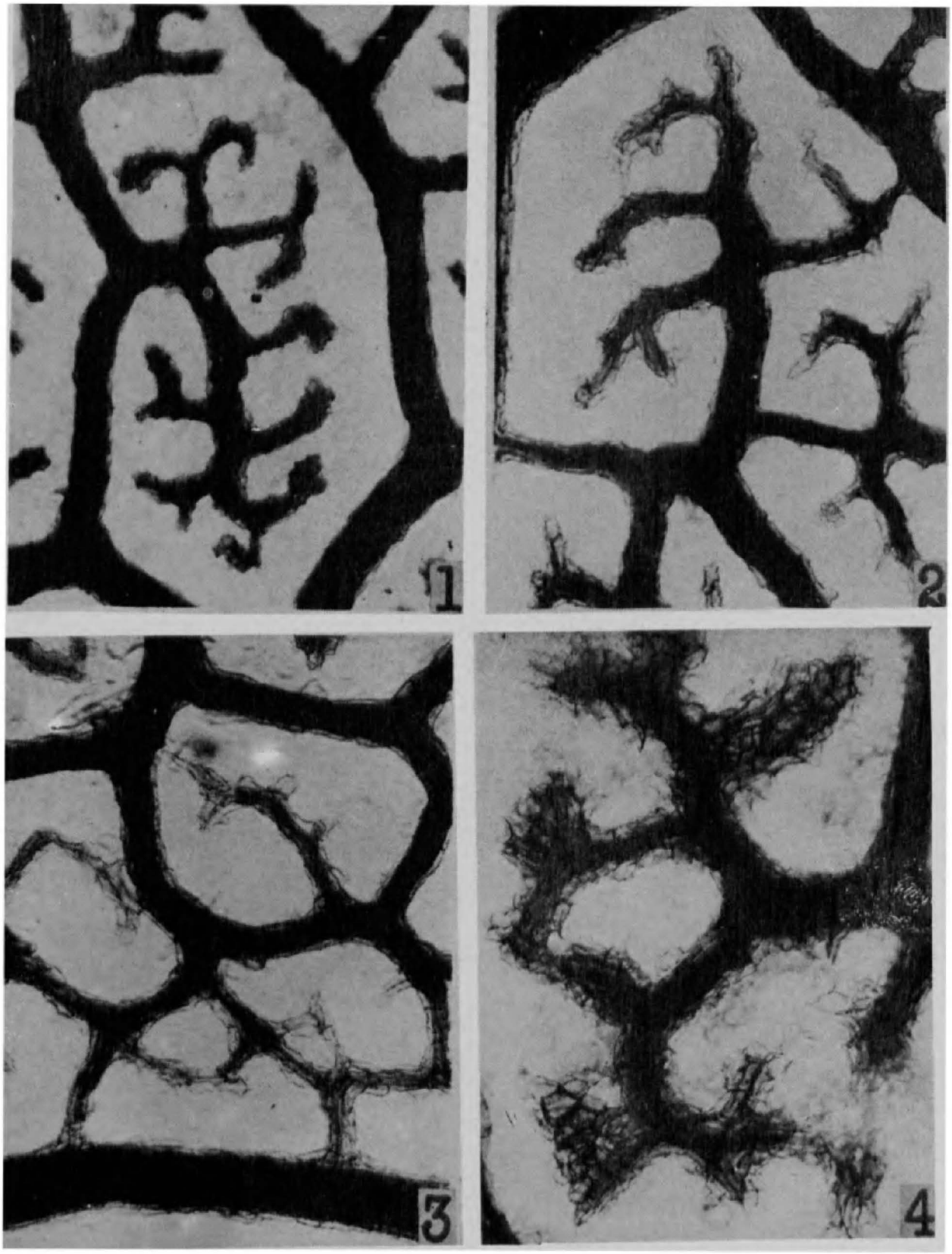
Conventional tracheoids or infrequently terminal brachytracheoids as in *F. bennettiana, F. brassii, F. collina, F. dissosperma, F. amboinensis, F. australis, F. maculosa, F. pimenteliana.*

Sclerotracheoids at the vein endings in *F. ifflaiana, F. laevicarpa* var. *laevicarpa, F. laevicarpa* var. *heterophylla, F. oppositifolia, F. schottiana* and *F. xanthoxyla.* The third category of idioblasts are the sclereids. Ramiform terminal or sub-terminal sclereids in *F. acuminata, F. bourjotian* (Figs. 9, 10), *F. brayleyana* (Figs. 11, 12) and *F. fournieri.* In *F. acuminata* and *F. fournieria* one can observe prominent sclerotracheoids in juxtaposition with sclerieds. In *F. bourjotiana* net-like irregularly lobed cells are distributed from the base to the apex of the veinlets. Among them, at the apices, sclereid like cells are present.

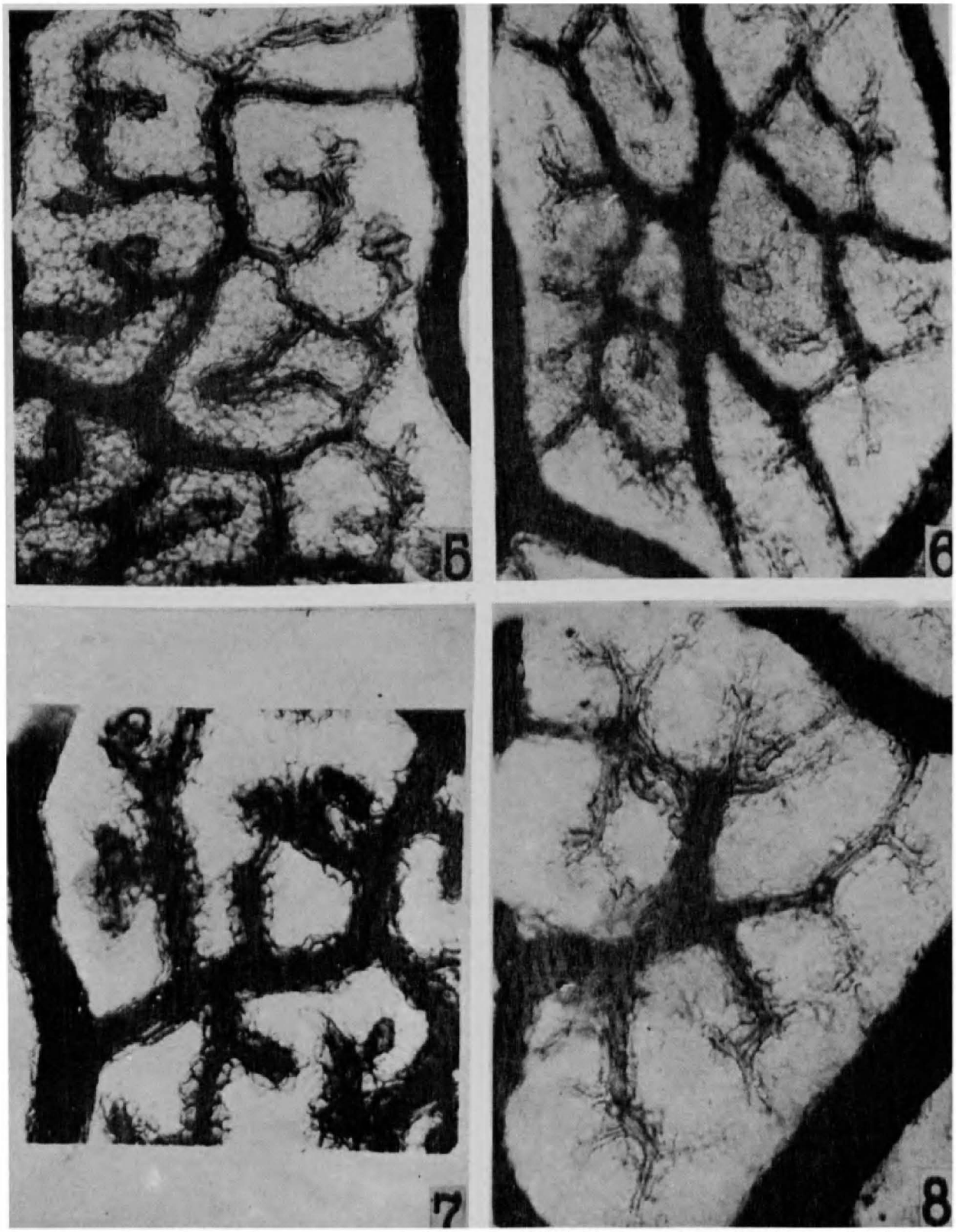
DISCUSSIONS

Recently Hartley (1985) has revised the genus *Medicosma.* He has covered the earlier literature comprehensively. The endomorphological features of vein reticula, veinlets and vein endings of the 17 species of *Medicosma* are placed along-side Hartley's key characters of the species of *Medicosma* with a view to assess the possible evolutionary relationships of the species as outlined by him (Table 1). It is evident that Hartley's key characters are justified on the basis of veinlet element morphology. Further it also reveals the naturalness of the placement of a few taxa under the key characters.

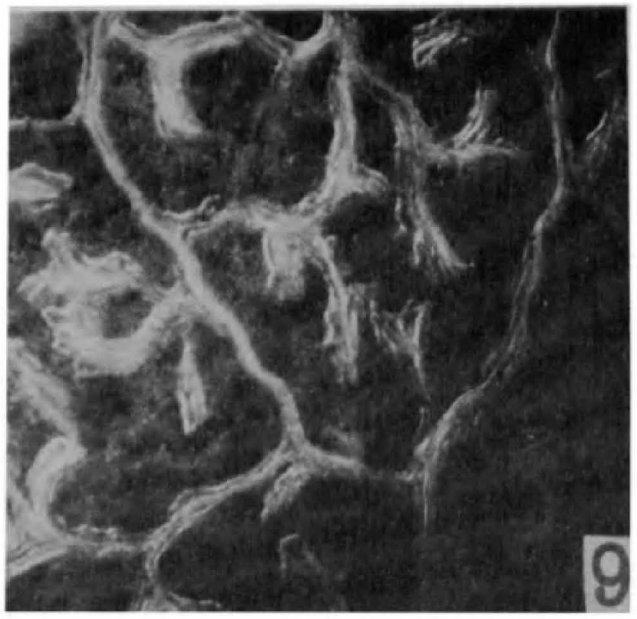
On exomorphological features, *M. elliptica* and *M. obovata* are said to be closely interrelated. Anatomically, they show similarity in their morphological features. *M. glandulosa* is said to have strongest affinities with the eight-staminate New Caledonian plants placed under the key. Anatomically, also this species shows sheathing under 'Leaves unifoliate key character.

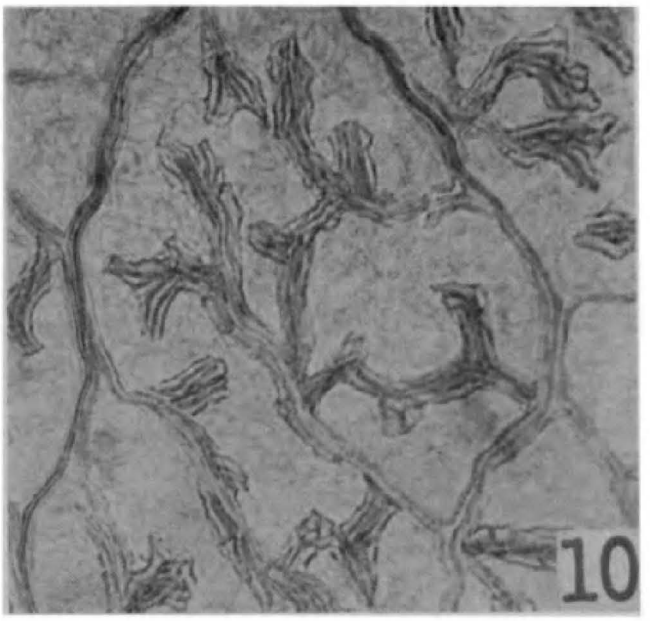


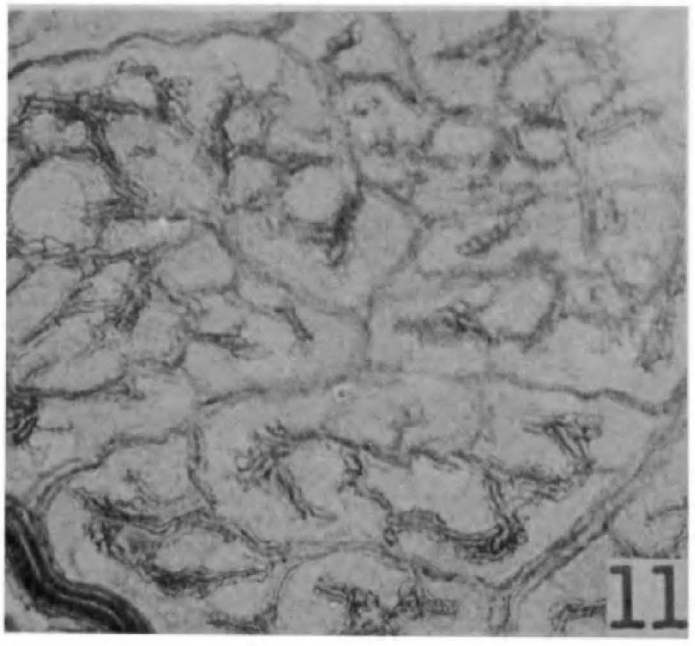
Figs. 1-4 each x 400. cleared leaf segments of *Medicosma* Hook. f. 1. *M. exigua* Hartley (Mackee 16669, P), veinlets and vein endings with sclerosed cells. 2, 3. *M. articulata* Hartley (Mackee 29159, P), veinlets and vein endings with sclerosed cells. 4. *M. subsessilis* Hartley (Cabalion 426, CANB), veinlets and vein endings with net-like irregularly shaped cells either thin or thick walled.

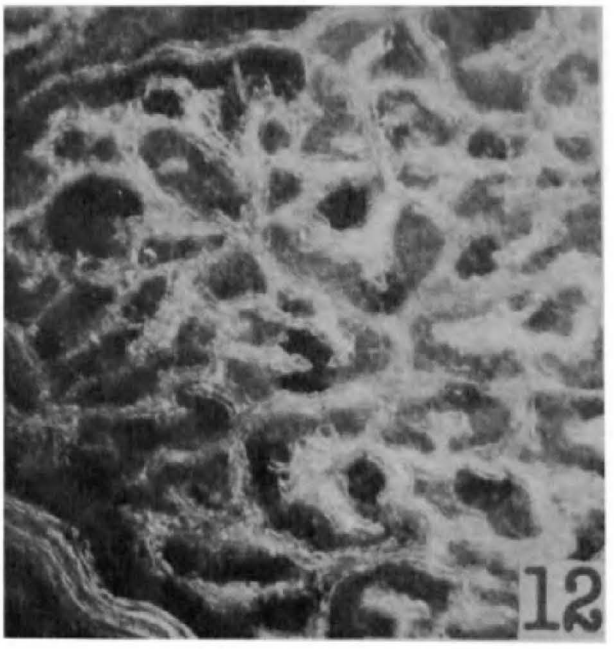


Figs. 5-8 : each x 400. cleared leaf segments of *Medicosma* Hook. f. 5. *M. diversifolia* Hartley (Mackee 36185, CANB), veinlets and vein endings with partially sclerosed cells, sheath around and also sclerosed terminal sclereids. 6. *M. parvifolia* Hartley (Mackee 40232, CANB), vein reticulum with sheath cells and vein termini with lobed sclereid like cells. 7. *M. petiolaris* Hartley (Mackee 19550, P), vein reticulum with sheath cells and vein termini with lobed sclereids.8. *M. suberosa* Hartley (McMillan 5182, L), vein reticulum with sheath cells and vein termini with drawn out partially thick walled sclereid like cells.









Figs. 9-12 each x 400. Cleared leaf segments of *Flindersia* R. Br. 9 & 10 : *F. bourjotiana* F. Muell. (Ridley 64, CANB), Terminal or sub-terminal sclereids-9. Under polarised light-10. Under ordinary light 11 & 12 : *F. brayleyana* F. Muell. Terminal or sub-terminal sclereids. 11. Under ordinary light. 12. Under polarised light-Birefringent.

Table - 1 : Comparison of possible evolutionary relationships of the species of *Medicosma* Hook. f.

*]	Exomorphic key characters according to Hartley 1985	Taxa	Endomorphic key features of the veinlet termini
1.	Petals enlarging in fruit	*M. cunninghamii*	Conventional tracheids with or without brachytracheoids.
2.	Petals and sepals enlarging in fruit	*M. fareana*	Vein termini ensheathed with irregularly shaped cells; a few are sclereified and pitted.
3.	Flowers 5-8 mm long; neither sepal nor petals enlarging in fruit :		
	a. Petals and stamens distinct	*M. elliptica* *M. obovata*	Conventional tracheids with or without brachytracheoids.
	Flowers 40mm long, coherent into tube 1/4 of their length	*M. riparia*	Not available for study.
	b. Petals distinct or coherent into a tube	*M. sessiliflora*	Conventional tracheids with or without brachytracheoids.
4.	Flowers 40mm long; petals coherent to tube.	*M. riparia*	Not available for study.
5.	Flowers bisexual; leaves oil dotted; stamens villous at	*M. glandulosa*	Vein termini ensheathed with irregularly shaped cells.
6.	Leaves trifoliata :	*M. diversifolia* (a few leaves)	Vein termini sheathed with irregularly chaped cells; a few are sclerefied and pitted.
6a.	8-staminate	*M. articulata* *M. leratii* *M. onligua* *M. parvifolia* *M. emarginata* *M. subsessilis* *M. suberosa* *M. petiolaris*	Vein termini with sclerotracheoids. Vein termini ensheathed with irregularly shaped cells; a few are sclereified and pitted.
		M. verticillata	Not available for study
		M. congesta	,,
		M. latifolia	,,
		M. gracilis	,,
6b.	4-staminate	*M. exigua*	Veinlets sparsely sheathed with terminal sclerotracheoids.
		M. gracilis	Not available for study.

Table - 2 : Comparison of possible evolutionary relationships of the species of *Flindersia R. Br.*

Exomorphic key characters according to Hartley, (1969, 1975, 1982)	Taxa	Endomorphic features of the veinlet termini
Trichomes simple; hypocotyl terminal or lateral-ascending :		
Group I :		
Leaves paripinnate; hypocotyl terminal	*F. fournieri*	Terminal or subterminal ramiform sclereids.
	F. laevicarpa	Terminal sclerotracheoids and also in its 2 varieties.
	F. brayleyana	Veinlets sheathed with irregularly lobed cells from the base to the apex. A few of them are sclereified and resemble sclereid-like cells.
Group II :		
Leaves basically imparipinnate; hypocotyl or lateral ascending	*F. pimenteliana*	Conventional tracheids or infrequently brachytracheoids.
	F. unifoliolata	Not available for study.
Trichomes stellate or lepidote, hypocotyl lateral or lateral-ascending :		
Croup III :		
Leaves alternate	*F. amboinensis*	Conventional tracheids or infrequently brachytracheoids.
	F. acuminata	Terminal or sub-terminal ramiform sclerieds.
Group IV :		
Leaves opposite or sub-opposite	*F. schottiana*	Terminal or sub-terminal scleretracheoids.
Group V :		
Ovules 4 in each loculus	*F. bennettiana* *F. collina* *F. dissosperma* *F. maculosa* *F. brassii*	Conventional tracheids or infrequently brachytracheoids.
Group VI :		
Valves of fruit not separating at maturity	*F. ifflaiana*	Sclerotracheoids at the vein endings.
	F. australis	Conventional tracheids or brachytracheoids at the vein ends, infrequently.

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In the light of the present study especially of the range of the veinlet synodrome of *Flindersia*, the group relationships of the 17 species as postulated by Hartley (1969, 1975, 1982) are examined, anatomically (Table 2).

In group-1 represented by *F. fournieri* and *F. brayleyana* there are distinct trends in the vein endings to possess sclerotracheoids or ramiform sclerieds. Similar trends are observed in group IV represented by *F. schottiana, F. bourjotiana* and *F. xanthoxyla.*

The conventional tracheids with or without brachytracheoids are characteristic of the vein endings in *F. pimenteliana* and the anatomical situation in the other species of this group, namely *F. unifoliolatais* not known, so far. The conventional tracheids are charcteristic of *F. amboinensis* whereas in other members of this group, namely *F. acuminata* the vein endings have ramiform sclercids. The group V represented by *F. bennettiana, F. collina, F. dissosperma* and *F. maculosa* appears to be a natural grouping in view of the fact that their vein endings are of conventional type with or without brachytracheiods. In group VI represented by *F. ifflaiana* and *F. australis* there is a distinct trend towards the formation of brachytracheoids or sclerotracheoids. The veinlet morphology has indicated heterogeneity to a certain extent in all the groups except the fourth group wherein all the taxa have more or less conventional tracheids with or without brachytracheoids. This heterogeneity cannot be considered as a challenge to Hartley's outline of species relationship based on exomorphological characters. It could however explain that varied vein endings or their idioblasts are the results specialisation in different ways.

Taxonomic implications :

Medicosma : The taxonomic implications alluded to by Hartley (1985) are considered in relation to veinlet and vein endings typology. *M. elliptica, M. obovata* and *M. sessiliflora* are closely interrelated as their similarities in respect of veinlet endings are more striking than their differences in leaf shape. In addition the angle of divergence of lateral veins of *M. sessiliflora* leaves are diagnostic to a certain extent. *M. diversifolia*, the only species with some trifoliata leaves is said to be closely related to unifoliate, eight-staminate new Caledonian plants (Hartley, 1985). Anatomically, the similarities of veinlets are very striking and thereby support their interrelationship as a closely knit group. *M. exigua* belongs to 4-staminate unifoliate group wherein the veinlets are sparsely sheathed and the vein endings have sclerotracheoids. The situation in the other member of this group, namely *M. gracilis* is not known, so far. *M. articulata* is distinguished from the other eight-staminate unifoliate New Caledonian species by its characteristic leaf and petiole. However, its affinities among the other taxa are said to be not clear. Anatomically, the veinlet morphology supports its key position and warrants taxonomic recognition.

The taxonomic judgement *M. parvifolia* is the closest relative of *M. leratii* can be confirmed anatomically. Its relationships with *M. oblique* does not warrant anatomic recognition since the differences in veinlet morphology are striking than the similarities, however.

Flindersia : Taxonomic implications alluded to by Hartley (1969) are considered in relation to vein termini idioblasts. *F. fournieri* is considered to be closely related to *F. laevicarpa* but differing rather strongly in having mostly alternate leaves. They are recognised by their distinct vein termni. The Sclerotracheoids of latter are in direct contrast to the raniform sclereids in the former species.

The two varieties of *F. laevicarpa*, namely *F. laevicarpa* var. *laevicarpa* and *F. laevicarpa* var. *heterophylla* can be seperated on the basis of glabrous filaments of the former, in contrast to the pubescent filaments of the latter. However, the vein endings with similar sclerotracheoids in both the taxa far outweigh their differences. *F.*

laevicarpa is apparently more closely related to *F. brayleyana* than to *F. fournieri.* However, their termini idioblasts are different.

F. amboinensis is said to be closely related to *F. acuminata* which differs mainly in having smaller leaves, narrow, more acuminate leaflets and shorter stamens. They have sharply defined differences in their vein endings. *F. schottiana* and *F. bourjotiana* and *F. xanthoxyla* appear to be more closely related to one another than to any of the other species of the genus. However, the vein endings are similar in *F. schottiana* and *F. xanthoxyla,* whereas in *F. bourjotiana,* the vein endings are quite distinct.

It is stated that *F. benoettiana, F. collina, F. dissossperma* and *F. maculosa* comprise a group of related species. The vein endings in all the three species are similar in possessing the conventional tracheids with or without brachytracheoids. This feature warrants further study on other anatomical features of the three taxa for taxonomical judgement.

F. ifflaina is apparently more closely related to *F. australis* to any other species of this genus. The two species do not appear to be particularly closely related, however. The vain endings and their differenciations tend to substantiate this.

F. brassii is related to all the four taxa grouped under V characterised by a terminal hypocotyl in the embryo. Anatomically, however, the vein endings is distinctly similar when compared to the other species under this group.

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