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# STRUCTURE AND TAXONOMIC SIGNIFICANCE OF LEAF VEINLETS OF THE RUTACEAE

## 1. *ACRONYCHIA* J. R. & G. FORST.

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ABSTRACT

The vein reticulum is more or less broad with strands of fibres. The areoles differ in shapes and sizes. The sheathed veinlets are of two types. Taxonomic implications of veinlet structures are discussed.

## INTRODUCTION

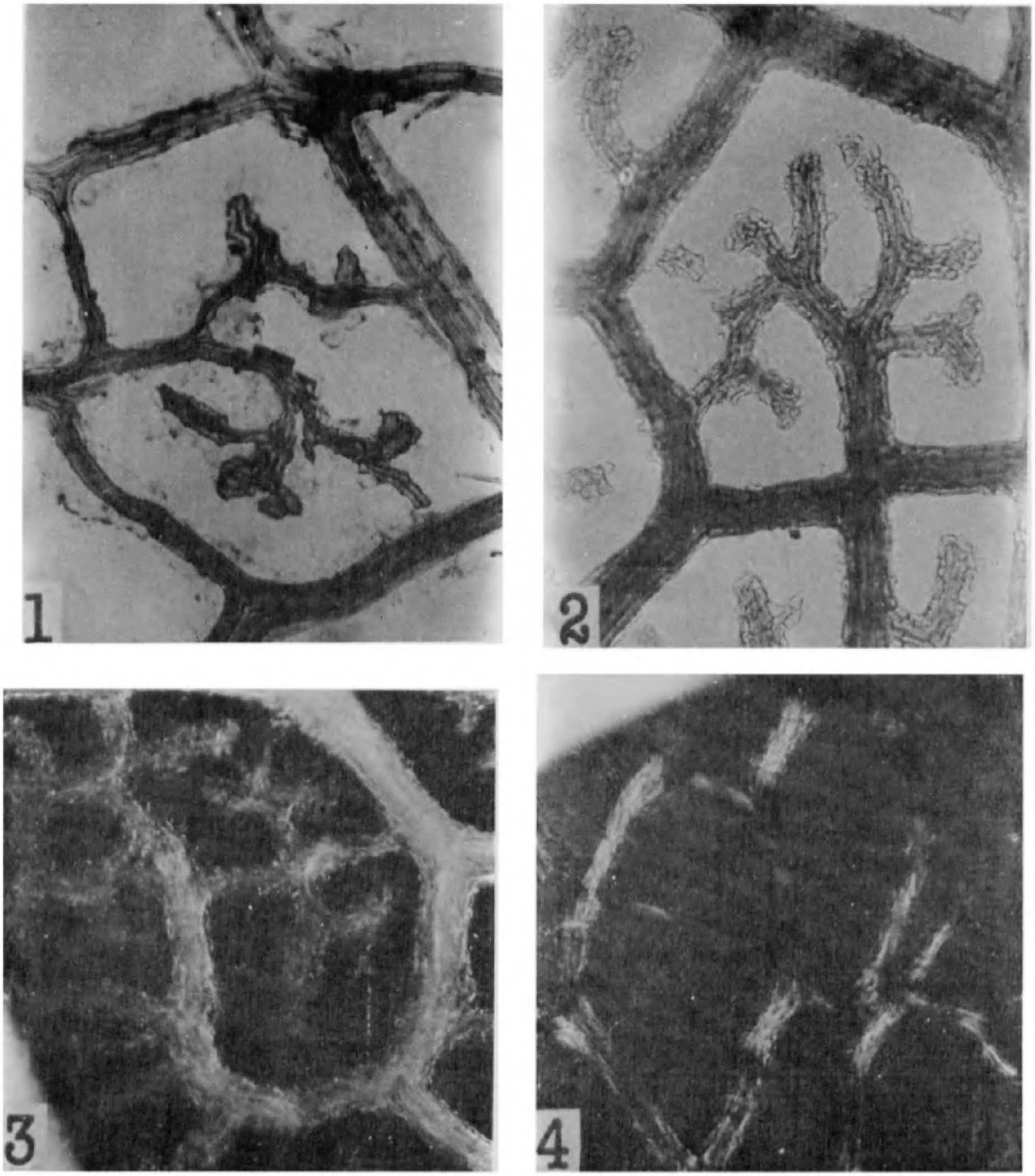
Systematic anatomy in plant classification dates back to Bureau (1864) who for the first time used anatomy for determination of the Bignoniaceae. The importance of this approach was also recognised by earlier workers, like Caspary (1865), Van Tiegham (1891) and Solereder (1908). In the middle of this century, Bailey (1951), Metcalfe (1954, 1961) and Metcalfe and Chalk (1950) had undertaken anatomical studies on a broader and comparable basis, and the data obtained find application in classifications. During the last three decades much progress has taken place in this respect (Hickey 1973; Dickison 1975; Metcalfe and Chalk 1979; Rao 1991). Finally, during the last two dacades attention is focussed on the morpho-taxonomic research to explore the structural features which have been neglected in the past.

There has been a resurgence of interest on the foliar anatomy in relation to systematics from very early years (Duval Jouve 1875). Several groups of taxa of different taxonomic hierarchy have been worked out, and the results proved to be encouraging (Cowan 1950; Hayes *et al.* 1951; Govindarajalu 1962, 1972; Koyama 1967; Ayensu 1974; Baas 1975; Tomlinson 1956, 1959a; Keating 1984; Cheluvaiah 1985; Rao & Bhattacharya 1978, 1981; Rao & Das 1978).

*Acronychia* was placed in the Toddalioideae (Engler 1896, 1931) but shifted to the Rutoideae because of its closer relationship with *Melicope*, *Euodia*, *Evodiella* and *Medicosma* (Hartley, 1974, 1985). This genus consisting of 46 species occurring from India east to south-west China and Taiwan to south-east through Malesia to the Solomon Islands, New Caledonia and Lord Howe Island and south in eastern Australia from Cape York peninsula to eastern Victoria (Hertley, 1974). They are shrubs or medium and tall trees and occurring mainly in rain forests.

## MATERIALS AND METHODS

*A. acidula* F. Mueller, *Moriarty* 1670 (CANB), Australia. *A. acronychioides* (F. Mueller) Hartley, Moriarty, 7/9/1972 (CANB), Australia; *Irvine* 543 (CANB), Australia. *A. acuminata* Hartley, *Webb and Tracey* 11671 (CANB), Australia. *A. arfakensis* Gibbs, *Sleumer & Vink* 14123 (CANB), New Guinea. *A. brassii* Hartley, *Hartley* 13143 (CANB), New Guinea. *A. carrii* Hartley, New Guinea, *Croft et al.* 65072 (CANB). *A. chooreechillum* (F. M. Bailey) C. T. White, *Hartley* 14040 (CANB), Australia. *A. crassipetala* Hartley, *Hartley & Hyland* 14084 (CANB), Australia. *A. dimorphocalyx* Hartley, *Van Royen* 3229 (CANB), New Guinea. *A. emarginata* Lauterb., *Vink & Schram* 8991 (CANB), New Guinea. *A. eungellensis* Hartley & Hyland, *Hyland* RFK 4197 (CANB), Australia. *A. foveata* Hartley, *Sayers* NGF 21202 (CANB), New Guinea. *A. imperforata* F. Mueller, *Haegi* 2040 (CANB), Australia. *Hyland* 5575 (CANB), Australia. *A. kaindiensis* Hartley, *Hartley* 11682 (CANB), New Guinea. *A. laevis* J. R. & G. Forster, *Everist* 2969 (CANB), Australia. *Hyland* 8724 (CANB), Australia; *Mackee* 41838 (CANB),




Figs. 1-4 : each · 250. Cleared leaf sectors of *Acronychia* 1. *A. schistacea* Hartley (*Brass* 23204)-terminal sclereids at the vein endings. 2. *A. arfakensis* Gibbs (*Sleumer & Vink* BW 14123) broad or club shaped vein endings encased by globular cells. 3. *A. ledermannii* Lauterb. (*Brass* 31608)-under polarised light, Birefringent splayed vein system. 4. *A. schistacea* Hartley, (*Brass* 23204)- under polarised light; interrupted birefringent vein system.

New Caledonia; *McPherson* 6164 (CANB), New Caledonia. *A. ledermanii* Lauterb., *Brass* 31608 (CANB), New Guinea. *A. montana* Hartley, *Brass* 29584 (CANB), New Guinea. *A. murina* Ridley, *Brass* 29584 (CANB), New Guinea. *A. oblongifolia* (A. Cunn. ex Hook.) Endl. ex Heynh., *Moriarty* 1241 (CANB), Australia. *Schodde* 5155 (CANB), Australia. *A. papuana* Gibb, *Sleumer & Vink* 14319 (CANB), New Guinea. *A. parviflora* C. T. White, *Webb & Tracey* 19748 (CANB), Australia. *A. pauciflora* C. T. White, *Jones* 3181 (CANB), Australia. *A. pedunculata* (L.) Miq., *Mendoza P.N.H.* 87756 (CANB). *A. pubescens* (F. M. Bailey) C. T. White, *Moriarty* 687 (CANB), Australia. *A. pullei* Lauterb, *Saunders* 630 (CANB), New Guinea. *A. reticulata* Lauterb., *Pullen* 1436 (CANB), New Guinea. *A. rugosa* Hartley, *Foreman & Galore* 45786 (CANB), New Guinea. *A. schistacea* Hartley, *Brass* 23204 (CANB), New Guinea. *A. similaris* Hartley, *Versteegh* BW 10398 (CANB), New Guinea. *A. smithii* Hartley, *Womersley* 11720, New Guinea. *A. suberosa* C. T. White, *Jones* 3429 (CANB), Australia. *A. trifoliata* Zoll. & Mor. var. *trifoliata, Elbert* 4676 (CANB). *A. trifoliolata* Zoll. & Mor. var. *ampla* Hartley, *Sijde* 4085 (CANB), New Guinea. *A. trifoliolata* Zoll. & Mor. var. *microcarpa* Hartley, *Craven & Schoddee* 1138 (CANB), New Guinea. *A. vestita* F. Mueller, *Moriarty* 1456 (CANB), Australia. *A. wilcoxiana* (F. Mueller) Hartley, *McDonald* 448 (CANB), Australia.

Leaf *in-situ* within a transparent whole leaf body was prepared for study following the technique suggested by Page and Tan (1986).

## OBSERVATIONS

The vein reticulum is more of less broad with strands of sclerenchymatous fibres. The shape of areoles are hexagonal or pentagonal and sometimes irregular. The border of the areoles have sheating cells which are either narrow, rectangular, parenchymatous or sclerenchymatous cells; sometimes they extend to the veinlets, also. The veinlets are slender, biseriate or triseriate with a few sclerenchymatous fibres. There are two types of sheathed veinlets. In the first type the sheath cells are lobed, papileate or semilunate, distributed around the veinlets. The vein endings are free from tracheoids or have a few brachytracheoids. In the second type, the veinlets are thick and possess sheath cells around, and the vein endings are surrounded by net like sheath cells of varied shape and size.

The distribution of sheath cells around the veinlets can be utilised to distinguish two groups of species. The group distinction is based primarily on the orientation of sheath cells along the veinlet.

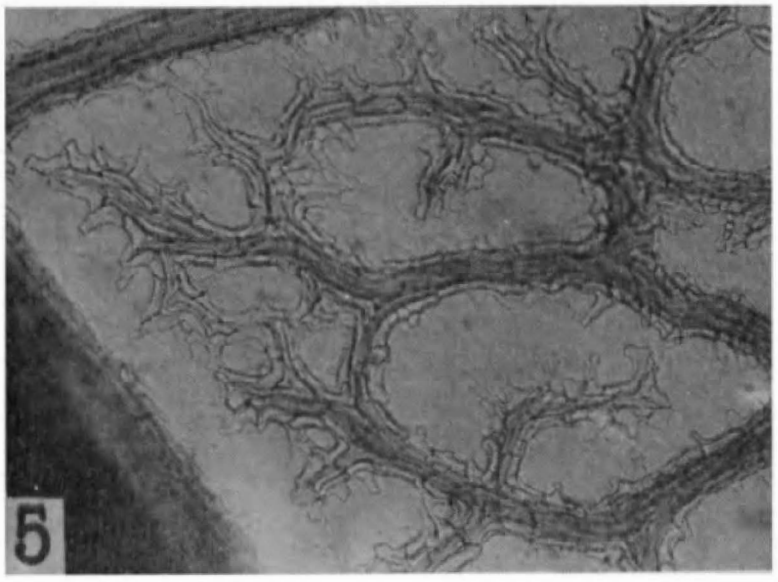
*Group I* : Veinlets sparsely oriented with a few sheath cells .and the vein endings possess brachytracheoids as in : *A. acidulla, A. acronychioides, A. acuminata, A. brassii, A. diomorphocalyx, A. imperforata, A. laevis, A. littoralis, A. oblongifolia, A. pauciflora, A. pedunculata, A. rugosa, A. trifoliolata,* var. *trifoliolata, A. trifoliolata* var. *ampla, A. vestita* and *A. wilcoxiana.*

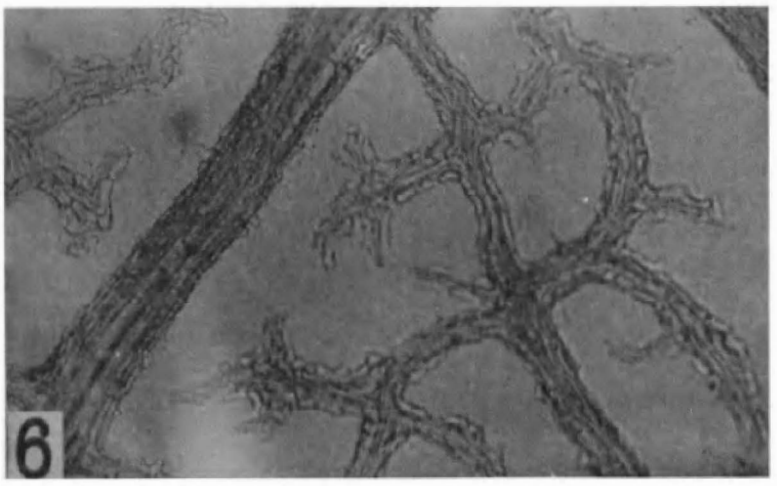
*Group II* : Veinlets ensheathed with irregularly shaped cells increasing in number from their base to the apex of veinlets giving a nest or club-like appearance. They are encountered in : — *A. arfankensis, A. carii, A. chooreachilum* (figure 6), *A. crassipetala, A. emarginata, A. eungellensis, A. foveata, A. gurakorensis, A. kaindiensis, A. laevis, A. lederamanni* (figure 3), *A. montana, A. murina, A. oblongifolia, A. papuana, A. pullei, A. reticulata, A. similaris, A. parviflora, A. pubescens, A. schistacea, A. smithii, A. suberosa, A. trifoliolata* var. *mircocarpa.*

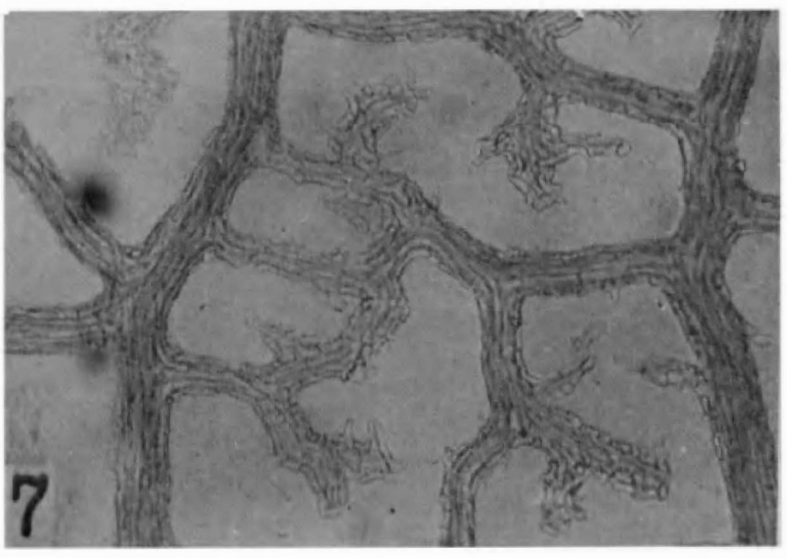
## SYSTEMATIC APPLICABILITY

The veinlet structure is enumerated along side Hartley's species group's based on exomorphological features (1974) with a view to evaluate the systematic value of one of the endomorphological features (Table 1).

Hartley's key characters for the species groups of III (a) and III (c) are justified on the bais of veinlet elements morphology. The naturalness of the species grouping is lucid and




**Figs. 5-7. Cleared leaf sectors of** *Acronychia* each 250 5 *A oblongifolia* ( A Cunn ex Hook ) Endl. ex Heynh. **(Moriarty 1241) - Veinlets ensheathed with irregularly shaped cells 6** *A chooreachillum* (F M Bailey) C. T White, (*Hartley* **14804). Veinlets encased by rectangular cells. 7.** ***A. imperforata*** F. Muellar. ( *Hartley* 11682) - Veinlets encased by globular to rectangular cells.

also reveals the closeness of the species in respect of their morphological features of the veinlet in the laminae. Further their grouping under distinct categories strongly support the naturalness of the placement of a few species in view of their veinlet similarity. However, the same view cannot be said in respect of the species grouped under I, Ia, Ib, IIa, IIb and IIIb wherein the taxa possess conventional tracheids with or without brachytracheoids and they are sparsely sheathed or completely ensheathed veinlets with irregularly lobed netlike cells at the vein endings. This heterogeneity within the above species groups cannot be considered a challenge to Hartley's species grouping based on exomorphological characters. It could, however, explain that the two types of veinlet morphology are the results of specialisation in different ways. Further, we have found in some of the homogenous groups as mentioned above a mixed feature of both the categories of veinlet morphology. This mixed feature in a few leaves of the investigated species does not warrant formal anatomical recognition. At best they can be considered as a striking link between the two recognised trends.

*Table* 1

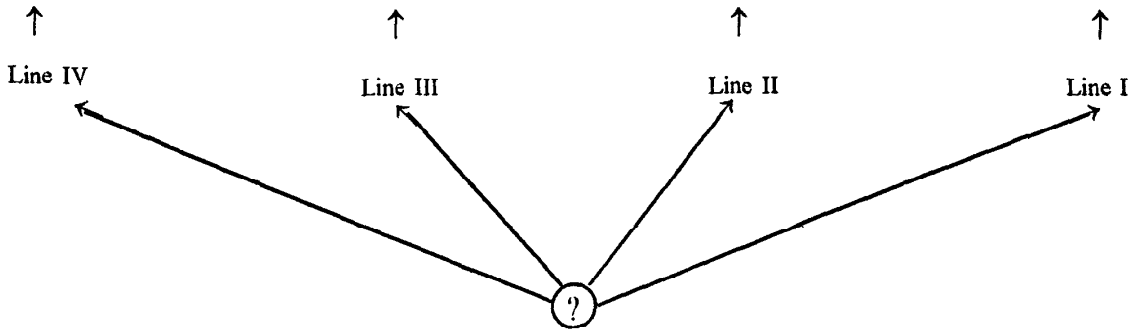
| Exomorphology | | Taxa | Veinlet syndrome |
|---|---|---|---|
| 1 | | 2 | 3 |
| Group I : | Septicidal fissures extending to at least one half of the length of ovary and fruit. | | |
| Group Ia: | Sporocarp drying semifleshy or soft spongy (without evident mesocarp). | *A. suberosa*<br>*A. chooreechillum* | Veinlets ensheathed; frequency increasing from base to apex resulting in net like irregularly shaped. |
| | | *A. baeuerlenii* | Not available for study. |
| | | *A. pauciflora* | Veinlets sparsely sheathed. |
| | | *A. wilcoxiana* | Vein endings with brachytracheoids. |
| | | *A. pubescens* | |
| Group Ib : | Epicarp drying with spongy crustanceous mesocarp. | *A. crassipetala* | Veinlets sheathed; irregularly lobed cells cluster at the vein endings. |
| | | *A. wabagensis* | Not available for study. |
| Group II: | Septicidal fissures 1/4 to 1/2 of the length of ovary and fruit. | | |
| Gruop IIa : | Entire epicarp drying semi fleshy without evident mesocarp. | *A. oblongifolia* | Veinlet ensheathed with parenchymatous irregularly lobed cells their frequency increases from base to apex resulting in net like cells around broad vein endings (figure 5). |
| | | *A. acuminata* | Veinlet sparsely sheathed; vain endings free or with brachytracheiods. |
| Group IIb : | Epicarp drying with a spongy crustaceous mesocarp. | *A. gonicarpa* | Not available for study. |
| | | *A. rugosa* | Veinlet sparsely ensheathed; vein endings with or without brachytracheoid. |
| | | *A. intermedia* | Not available for study. |
| | | *A. montana* | Veinlet ensheathed with irregularly lobed |

| 1 | 2 | 3 |
|---|---|---|
| | | cells; their frequency increasing from base to apex resulting in net-like cells are around vein endings. |
| Group III : Septicidial fissures apical or lacking. | | |
| Group IIIa : Entire epicarp drying semi fleshy; without evident mesocarp. | *A. brassii*<br>*A. acidula*<br>*A. dimorphocalyx*<br>*A. parviflora*<br>*A. laevis* | Veinlet sparsely sheathed with cells; vein endings free with brachytracheoids. |
| | *A. murina*<br>*A. emarginata*<br>*A. schistacea*<br>*A. arfakensis*<br>*A. similaris*<br>*A. kaindiensis*<br>*A. smithii*<br>*A. carrii*<br>*A. pullei*<br>*A. gurakorensis*<br>*A. trifoliate* var. *macrocarpa*<br>*A. papuana*<br>*A. aberrans* | Veinlets partially ensheathed with lobed sclered like cells, whose frequency increase from the base to the apex resulting in netlike cells at the broad vein endings (figures 1,2 & 4). |
| | *A. macrocalyx*<br>*A. normanbiensis* | Not available for study. |
| Group IIIb : Epicarp drying with spongy crustaceous mesocarp. | *A. foveata*<br>*A. ledermannii*<br>*A. reticulata* | Veinlets ensheathed with lobed cells whose frequency increases from the base to apex resulting in net-like cells around the broad vein endings. |
| | *A. trifoliata* var. *ampla* | Veinlet sparsely sheathed; vein endings with brachytracheoids. |
| | *A. cartilaginea* | Not available for study. |
| Group IIIc : Epicarp drying with woody or sub-woody. | *A. vestita*<br>*A. trifoliolata*<br>*A. acronychioides*<br>*A. imperforata* (figure 7)<br>*A. pedunculata* | Veinlet sparsely sheathed with cells; vein endings free or with brachytracheoids. |

*Table 2*

Four independent evolutionary lines postulated by Hartley (1975) Corresponding veinlet Morphology

| From *A. suberosa* through *A. crassipetala* | From *A. baedderlenii* through *A. leavis* | From *A. wilcoxiana* through *A. cartilaginea* | From *A. pubescens* through *A. pedunculata* |
|---|---|---|---|
| Veinlet ensheathed with lobed parenchyatous cells; vein endings with net-like cells around | Veinlet sparsely sheathed to dense sheathing; vein endings with net-like cells | Veinlets sparsely sheathed to dense sheating; vein endings with net-like cells around | Veinlets sparsely sheathed to dense sheathing; vein endings with net-like cells around |




Hartley (1974) has recognised 4 independent lines of evolution in *Acronychia* on the assumption that there is no evidence of ancestral species recorded so far.

From the table 2, it is evident that the presumed primitive species of Australian stock have veinlets sparsely sheathed with lobed cells. Adaptive radiations is towards the formation of densely sheathed veinlets and vein endings in most of the extra Australian species especially in the groups IIIa and IIIb.

## TAXONOMIC IMPLICATIONS

Taxonomic implications alluded to by Hartley (1974) are considered in relation to vain termini idioblasts. *A. suberosa* is considered to be closely related to *A. chooreechillum*. The vein endings are similar. *A crassipetala* is considered as very close to *A. chooreechillium*. The similarity in veinlet structure indicates their relationships. *A. oblongifolia* is often confused with *A. laevis* due to external similarity, however the vein endings are similar in both the species and not helpful for identification.

*A. acuminata* is said to be closely related to *A. parviflora* but differs in having longer acuminate leaflets, larger flowers and larger fruits. The vein endings are different and do not warrant close relationship.

*A. emarginata* is said to be a close relative of *A. murina*. However the veinlets and their endings are not different in both the species. *A. schistacea* is considered on morphological grounds to be allied to *A. papuana*. These vein endings are not helpful for taxonomic judgement as the vein endings are similar in both taxa. *A. papuana* is apparently most closely related to *A. arfakensis*. However, they are similar in possessing the same type of vein endings. *A. arfakensis* is said to be closely related to *A. similaris*. The vein ends have similar features and not helpful for identification. *A. kaindiensis* is apparently closely related to *A. similaris*. The vein endings are similar. *A. wilcoxiana* seems to be very close to *A. acidula*. The vein endings are similar in details. The same reasoning holds good in respect of *A. vestita* and *A. acidula* and also *A. smithii* and *A. foveata*. *A. carrii* is apparently most closely related to *A.*

*pullei*. There may also be fairly close relationship to *A. trifoliolata* var. *microcarpa*. Their closeness can be recognised because of their general similarity in the veinlet morphology. *A. gurakorensis* is apparently closely related to *A. macrocalyx* and *A. dimorphocalyx*. The veinlet elements, however are dissimilar in them. This feature may help to distinguish them from one other. The three varities of *Acronychia trifoliata* namely, *trifoliolata, ampla* and *microcarpa* can be distinguished on the basis of endomorphology which is similar in the varieties *trifoliolata* and *ampla* whereas in *microcarpa* they are different and distinct. Further, *A. acronychioides* is said to be closely related to variety *ampla*. The veinlet morphology supports their similarity. The variety *microcarpa* is said to have a close relationship with *A. carrii*. This relationship apparently holds good in respect of the similarity of the veinlet. *A. reticulata* is said to be closely related to *A. trifoliolata* var. *ampla*. From the anatomical point of view, this does not hold good because the former has ensheathed veinlet with net like irregularly lobed cells at the vein endings whereas the latter possess conventional tracheids sparsely saeathed with parenchymatous cells and the vein ends with brachytracheoids. The nearest relative of *A. ledermannii* is probably *A. trifoliolata* var. *ampla*. This view point is supported because in them the veinlet morphology is similar. *A. imperforata* is said to be the closest relative of *A. pedunculata*. Their closeness can be recognised because of their general similarity in the veinlet. The close relative of *A. pedunculata* appears to be *A. trifoliolata* var. *trifoliolata*. Their closeness can be recognised because of their general similarity in the veinlet.

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