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Artikel: Some new distinctive features between Freycinetia banksii Cunn. (Pandanaceae) of New Zealand and F. baueriana Endl. of Norfolk Island

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Some new distinctive features between Freycinetia banksii Cunn. (Pandanaceae) of New Zealand and F. baueriana Endl. of Norfolk Island

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RÉSUMÉ

HUYNH, K.-L. (1993). Quelques caractères distinctifs nouveaux entre Freycinetia banksii Cunn. (Pandanaceae) de la Nouvelle-Zélande et F. baueriana Endl. de l'île de Norfolk. *Candollea* 48: 501-510. En anglais, résumés français et anglais.

Freycinetia banksii est considéré à l'heure actuelle comme conspécifique de *F. baueriana*. Toutefois, la morphologie macroscopique de la feuille et de la bractée, comme leur anatomie, de même que l'anatomie d'autres organes (staminode, pistillode, pistil), indiquent conjointement avec la répartition géographique et la couleur de la bractée qu'ils sont deux espèces distinctes. La valeur taxonomique de ces caractères anatomiques et d'autres au niveau de l'espèce, en particulier leur utilisation pour distinguer entre espèces "voisines" à aires différentes, sont soulignées.

ABSTRACT

HUYNH, K.-L. (1993). Some new distinctive features between Freycinetia banksii Cunn. (Pandanaceae) of New Zealand and F. baueriana Endl. of Norfolk Island. *Candollea* 48: 501-510. In English, French and English abstracts.

Freycinetia banksii is at present considered conspecific with *F. baueriana*. However, both gross morphology and anatomy of leaves and bracts as well as the anatomy of other organs (staminodes, pistillodes, pistils), indicate that they are distinct species, which is corroborated by both geographic distributions and bract colours. The taxonomic significance of these anatomic characters and others at the species level, in particular their utilization in distinguishing between "close" species with different areas, is emphasized.

KEY-WORDS: Anatomo-taxonomy — *Freycinetia banksii* — *F. baueriana* — New Zealand — Norfolk Island — Pandanaceae — Species concept — Species endemism — Taxonomy.

Introduction

Freycinetia banksii is the only species of the genus in New Zealand, and likewise *F. baueriana* in Norfolk Island. Both belong in Sect. *Freycinetia* and appear to have the same and highest number of stigmas per pistil in *Freycinetia.* This similarity and the nearness of their areas suggest a very close relationship between them. WARBURG (1900: 29) tentatively distinguished between them by using the staminate spikes, which he assumed to be solitary in *F. banksii* but ternate in *F. baueriana*. However, the staminate inflorescences comprise (4-)5-6 spikes in the former species (HUYNH & SAMPSON, 1992: 177), and most probably also have variable numbers of spikes in the latter species. STONE (1973: 242) examined several features (leaf shape and sizes, morphology of auricles, robustness of plants, colour of bracts, size and structure of inflorescences, pistillate spikes, berries, stamens, number of stigmas per berry), but found that "the New Zealand and Norfolk Island plants

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hardly differ in any respect". The only difference that could actually distinguish between them consisted in some characters of leaves and floral bracts. The leaves are broader on average and slightly shorter in the Norfolk Island plants, whose floral bracts are a deep salmon-pink while those of the New Zealand plants are white or white tinged with purple. As a result, *F. banksii* was given subspecific rank as being *F. baueriana* subsp. *banksii* (Cunn.) Stone, "although even this may be open to question" (STONE, 1973: 244). The new status was adopted in MOORE & IRWIN (1978) and repeated in STONE (1981: 52), but in LORD (1991) *F. banksii* was simply called "*Freycinetia baueriana*". Similar cases of conspecificity with different geographic distributions can be found in STONE (1981).

Disregarding their biogeographic implications, Stone's conclusions raised the important problem of the identity of the species involved in such a case. That is: are these species distinct or conspecific? The present paper examines the case of *F. banksii* and *F. baueriana*.

Material and methods

The following collections were investigated for the case of *F. banksii* and *F. baueriana*.

F. banksii:

1. Cunningham 320 (K! type) (♀).
2. Melville 5086 (K!) (♂, ♀), North Island, Waitakere Ranges, 12 mls W of Auckland, 3.11.1961.
3. Melville 6947 (K!) (♀), Westland, Mitchell Hill above Shearers Swamp, 10.4.1962.
4. Sampson s.n. (NEU!) (♂, ♀) (spirit collect.), North Island, Lower Hutt, eastern Hutt Hills, Belmont Reserve, 1991. Part of this material has been used for studying the flower structure in Huynh & Sampson (1992).
5. Sinclair s.n., Herbarium Hookerianum 1867 (K!) (♂, ♀).
6. Wright 7059 (K!) (♀), North Island, Puketi State forest, 26.1.1985.

F. baueriana:

7. Evans & Ralston 7486 (K!) (♀), Jan. 1969.
8. Evans & Ralston s.n. (K!) (♂), 29.12.1968.
9. Ralston s.n. (K!) (♀), July 1965.
10. Sykes 803/87 (CHR 458968) (CHR!) (♀), 26.11.1987.
11. Sine collect. (K!) (♂), Oct. 1805.

Note:

Leaf anatomy was investigated with collections No. 3, 7, 8, 10, 11; bract anatomy with No. 2, 4, 5, 8; pistil anatomy with No. 3, 4, 5, 7, 9, 10; pistillode anatomy with No. 4, 8; staminode anatomy with No. 2, 3, 4, 5, 6, 7, 9, 10; stamen anatomy with No. 2, 4, 8, 11.

Stamens and staminodes were bleached in eau de Javelle after being rehydrated in hot water. Some were stained in aqueous safranin and astra blue, after which they were dehydrated with the remainder in ethanol and mounted in Euparal. The same method was applied to those pistils used to study the distribution and density of crystal cells in outer epidermises. These were isolated by previously partitioning the rehydrated pistils into halves, followed by removing the sub-epidermal tissues with scalpel and fine forceps. For pistillodes, those of *F. banksii* were investigated in a previous paper (HUYNH & SAMPSON, 1992) with microtome-made sections of fresh material fixed either in FAA or in 70% ethanol. The material of *F. baueriana* used to study pistillodes was rehydrated overnight in 65°C water, embedded in paraffin, microtome-sectioned, stained in safranin and astra blue, dehydrated, passed through toluol, and mounted in synthetic resin.

Results

F. banksii can be distinguished from *F. baueriana* by some characters of gross morphology and anatomy.

1. Data from leaves

The leaves of *F. baueriana* were about 3.8-4 cm broad and abundantly tessellately nerved, in particular on the abaxial face. Those of *F. banksii* did not exceed about 1.8-2 cm and were seldom tessellately nerved (if so, much less abundantly). In any case, the tessellate condition seems to be usual in the former species while occasional in the latter.

The most noticeable leaf feature of *F. banksii* was the pleats. When observed by the adaxial face, these were up to 2 mm broad and a little lighter than the lateral parts (Fig. 1), and were prominent over these along about one half of the leaf blade. Each pleat corresponded to 4 or 5 fibrovascular bundles (Fig. 2) but when examined under a stereo-microscope with e.g. × 6-50 magnification, no secondary veins were observed. In contrast, these were visible on the lateral parts. Both pleats and secondary veins showed longitudinal striations, but these were thinner on the former than on the latter. The leaves being viewed by the abaxial face, each pleat resembled a shallow and narrow gutter. Such pleats seem to be unusual in *Freycineti*a since they were not observed in several other species.

The leaf pleats of *F. baueriana* were quite different. On the adaxial face they normally showed secondary veins, and at no level were they lighter than the lateral parts nor prominent over these. Consequently, at no level on the abaxial face were they similar to two gutters. On the basal part of the adaxial face they were slightly visible by the fact that the blade makes a low and broad M (in transverse section) at this level; however, they were invisible in the upper part, where they were more or less on the same plane as the lateral parts.

Furthermore, the leaves of *F. banksii* were less flexible than those of *F. baueriana*. This can be explained. In the leaves of the latter species, the fibrovascular bundles were about 1.5 times further apart. In addition, the leaves of the former species were exceptionally rich in extra-vascular fibres (= fibres outside of fibrovascular bundles) at the adaxial side of the pleat sites, where these fibres formed 4 or 5 rows of strands (Fig. 2). Several of these fibre strands were very large, each having up to some 45 fibres or more, and were not observed in the lateral parts. This exceptionally high density of adaxial extra-vascular fibres at the pleat sites in contrast to that in the lateral parts seems to be unusual in *Freycinetia*, and renders possible the recognition of the pleat extents in transverse sections. It may explain why the pleats in dry state are prominent over the lateral parts on the adaxial face. At the abaxial side, the density of the extra-vascular fibres at the pleat sites was also higher than that in the lateral parts, and several of the strands they formed were also larger than those in the lateral parts.

In *F. baueriana*, the thickness of the mesophyll increased progressively from the margins of the leaves to the pleat sites, then decreased to the midnerve, as in other species of *Freycinetia* (see Fig. 2). The density of the extra-vascular fibres increased then decreased more or less in the same way. However, in contrast to *F. banksii*, it was not possible to recognize the pleat extents in transverse sections because there were no extra-vascular fibre strands at the pleat sites much larger than those in the lateral parts. Another difference in *F. baueriana* was that the adaxial extra-vascular fibres were generally not arranged into separate strands but into ribbon-shaped groups (Fig. 3), each generally formed of one or two cell layers. In particular, the big difference in the abundance of adaxial extra-vascular fibres at the pleat sites between *F. banksii* and *F. baueriana* (compare Fig. 2 with Fig. 3) indicates that the leaves of the former species can in no case be confused with those of the latter species.

Another leaf anatomical difference was the position of the tracheary elements opposite the abaxial side in the fibrovascular bundles at the pleat middles. These tracheary elements were readily recognizable by the fact that they had the largest diameter in the fibrovascular bundles. Each fibrovascular bundle generally had one such tracheary element. In *F. banksii*, the tracheary elements of these bundles extended over about one third, sometimes less, along their axes; as a result, the

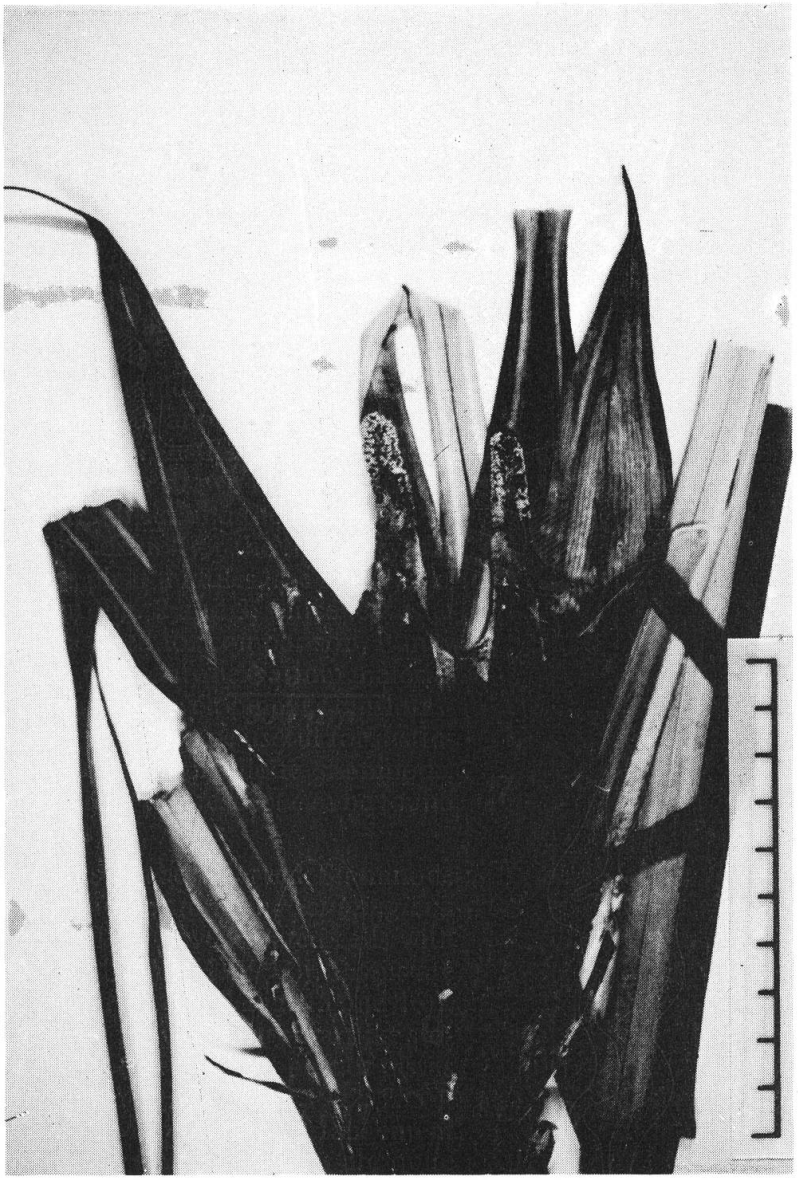

Fig. 1. — *Freycinetia banksii* (Melville 5086) (photo): staminate inflorescence, showing bracts and leaves both with pleats lighter than lateral parts (each scale-unit = 1 cm).

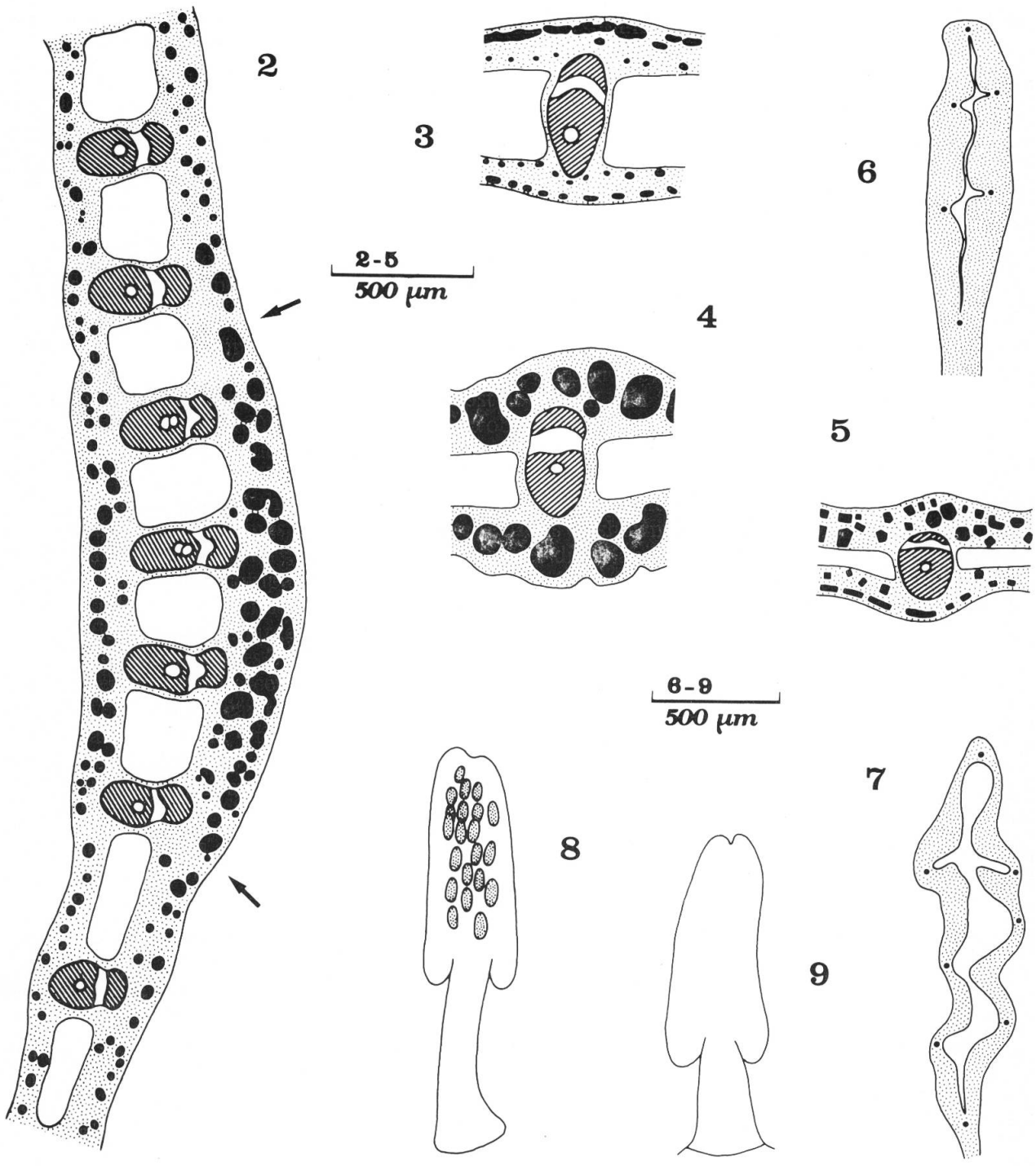

Fig. 2-9. — *Freycinetia banksii* [**2** (Melville 5086), **4, 8** (Sinclair s.n.), **6** (Sampson s.n.)] and *F. baueriana* [**3, 9** (Evans & Ralston 7486), **5, 7** (Evans & Ralston s.n.)]. — **2:** Midlevel transverse section of leaf, showing pleat extent between arrows (midnerve above, margin below). **3:** Midlevel transverse section of leaf at pleat middle. **4, 5:** Midlevel transverse sections of foliaceous parts of staminate upper leaf-like bracts at pleat sites. **6, 7:** Midlevel transverse sections of pistillodes, showing 6 and 8 locules respectively, apical locules up and down, lateral locules left and right (black: midpoints of locules). **8, 9:** Staminodes in general cases (dotted: raphide cells). — *Note.* In **2-5:** adaxial faces above or on right; black: extra-vascular fibre strands; hatched: fibrous parts in fibrovascular bundles; circles in these: tracheary elements with largest diameters.

tracheary element(s) opposite the abaxial side was generally located at about the middle in these axes (Fig. 2). In *F. baueriana*, the former tracheary elements were more numerous and extended over one half, sometimes more, along the axes of the fibrovascular bundles; as a consequence, the latter tracheary element(s) was generally at about the lower third in these axes (Fig. 3).

2. Data from bracts

Both the floral and leaf-like bracts of *F. banksii* were unusual by their pleats, which when dried became lighter than the lateral parts (Fig. 1) and prominent over these, as did those of the leaves as mentioned above. Both features were absent from the bracts of *F. baueriana.*

In order to test the grounds of these features, the bracts of a staminate inflorescence of *F. banksii* fixed in ethanol (Sampson s.n.) were separated and dried for observation. Actually, their pleats became lighter than the lateral parts and prominent over these to various extents, and consequently, resembled two gutters when viewed by the abaxial face. That in dry state they became prominent over the lateral parts may be explained as seen below, but why they became lighter than these remains to be elucidated.

Furthermore, the leaf-like bracts of *F. baueriana* were more flexible than those of *F. banksii.* This can be explained. Indeed, as seen in transverse sections of foliaceous parts (Fig. 4 and 5), the extra-vascular fibres were much less abundant in the bracts of the former species than in those of the latter species, where they formed very large fibre strands at both sides, each strand with up to some 75 fibres or more. In these transverse sections, as in those of leaves (see above), the pleat extents could be recognized in *F. banksii*, but not in *F. baueriana.* In *F. banksii*, each pleat corresponded to about 3 fibrovascular bundles at each of which the adaxial extra-vascular fibres were much more abundant than at any fibrovascular bundle in the lateral parts and formed much larger fibre strands. This big difference in the density of adaxial extra-vascular fibres may explain why in dry state the pleats of the bracts of this species were prominent over the lateral parts on the adaxial face (see above). In particular, the big difference in the size of extra-vascular fibre strands between *F. banksii* and *F. baueriana* (compare Fig. 4 with Fig. 5) indicates that the leaf-like bracts of the former species can in no case be confused with those of the latter species. Furthermore, in *F. baueriana* crystal cells (each with one prismatic sometimes rhombohedral crystal) were very abundant in both epidermises, in particular in the abaxial epidermis. In *F. banksii* they were of much lower density in the abaxial epidermis and rather rare in the adaxial epidermis. This difference also contributed to indicate that these species are distinct.

3. Data from pistillodes

In *F. banksii*, crystal cells were absent from the outer epidermis of the pistillode (they were probably present but very rare). Cavity hairs were sometimes observed. In pistillode transverse sections, which were elongated, the (two) apical locules were narrowly linear (Fig. 6), and despite the very large number of pistillodes studied no apical locule was found to be semicircular (see HUYNH & SAMPSON, 1992: 186 and 187).

In *F. baueriana*, in contrast, the outer epidermis of the pistillode was literally crowded with crystal cells. Such an abundance of crystal cells is probably rare in *Freycinetia*. Some were also observed in the inner epidermis. Cavity hairs were abundant in the pistillode. This feature, too, is not frequent in the genus. In pistillode transverse sections, which were also elongated, it was frequent that an apical locule was semicircular (Fig. 7). In addition, both apical and lateral locules were generally larger than in *F. banksii.* These distinctive characters of pistillodes also contributed to indicate that these species are distinct.

Another pistillode feature may further prove distinctive. In *F. banksii*, the pistillode wall has some lateral vascular bundles corresponding to those in the pistil wall (HUYNH & SAMPSON, 1992: 187), in contrast to other species (e.g. *F. cumingiana, F. funicularis, F. javanica* var. *expansa, F. reineckei, F. scandens*) where the pistillode walls have no lateral vascular bundles but only median vascular bundles (also see HUYNH, 1991: 301). It would be of interest to study the pistillode of

F. baueriana further with fresh material to ascertain if lateral vascular bundles are present or absent. It was not possible to elucidate this question with the small quantity of herbarium material used in the present paper.

4. Data from staminodes and pistils

Some data from these organs also contributed to indicate that *F. banksii* and *F. baueriana* are not conspecific. In the former species, the staminode anthers were always rich in raphide cells, up to some twenty or more (Fig. 8). In the latter species, some staminode anthers had 1-3 raphide cells, but most were devoid of these cells (Fig. 9). Several hundreds of staminodes were studied in either species, and all the pistillate specimens available were used. When staminodes were observed under the stereo-microscope, these cells were "shining" and therefore readily visible. Consequently, this anatomical difference may be considered reliable and also a gross-morphological character for distinction between these species. Furthermore, the staminode filaments were generally longer in *F. banksii* than in *F. baueriana.*

In *F. banksii*, crystal cells were of low density in the upper part of the outer epidermis of the pistil and lacking in the lower part. In *F. baueriana*, these cells were also lacking in the lower part, but abundant in the upper part. Furthermore, lignified cells above the ovule chambers were more abundant in the former species, disregarding the fibres in the partition walls of the pistils, these fibres being found in similar quantities in both species.

Discussion and conclusion

An important problem to be solved in the present paper is: should *F. banksii* be considered as a subspecies in *F. baueriana*, or as a distinct species? At the time when STONE (1973) assigned subspecific rank to *F. banksii*, the characters actually used to distinguish species in *Freycinetia* were the numbers and sizes of infructescence spikes, the sizes and shapes of berries, the number of stigmas per pistil, the sizes and shapes of bracts and leaves, etc. In some cases of "close" species the distinction did not work or not satisfactorily. In particular, numbers of stigmas can be an uncertain character for identification of species where these are in large, hence very variable numbers (e.g. some species in Sect. *Freycinetia*). In *F. banksii*, for example, MOORE & EDGAR (1970: 98) reported that the number of stigmas per pistil was about 6-12. STONE (1973: 242) also found that it varied roughly between 6 and 12. However, a recent statistical study of the numerical structure of the pistillate flower revealed that the number of stigmas varied from 2 to 18, but was most frequently 6-9 (HUYNH & SAMPSON, 1992: 189). Given this wide variation, it cannot be excluded that the most frequent numbers of stigmas in this species have other ranges of variation with other statistical studies.

If the distinctive characters described above between *F. banksii* and *F. baueriana* had been available when he wrote his paper, STONE (1973) would certainly not have considered them as being conspecific. Indeed, some specimens studied in the present paper have apparently not been investigated by Stone. Recently, Stone (pers. comm. 9 March 1992) suggested "... to seek some additional evidence and to evaluate bract color in terms of its significance" to tentatively separate them. Actually, besides the difference in bract colour, these characters indicate that both species are distinct, especially as some of them are unusual. In *F. banksii* these include: the fact that in dry state the pleats of both the leaves and bracts become lighter than the lateral parts (Fig. 1) and prominent over these; the easy recognition of the pleat extents in transverse sections of these organs, in particular in those of the leaves (Fig. 2). In *F. baueriana:* the exceptional abundance and density of crystal cells in the outer epidermis of the pistillode; the abundance of hairs in the pistillode cavity. Other reliable distinctive characters are: the big difference in richness in extra-vascular fibres in both leaves and leaf-like bracts (Fig. 2-5); the general absence of raphide cells from the staminode anthers of *F. baueriana* in contrast to the abundance of these cells in the staminode anthers of *F. banksii* (Fig. 8 and 9).

Some of these characters should be emphasized. As shown in the case of *F. banksii* and *F. baueriana*, bracts may prove useful in distinguishing between "close" species in this genus, for example by using their variable texture and anatomy, in particular their richness/paucity in extra-vascular fibres and the arrangement of these into strands. Such anatomical studies should be made in particular in cases where bracts show variable flexibility/rigidity from one species to another. Indeed, they can make it possible to both understand the variations and use these for distinction between the species (for example, by supplying drawings of bract transverse sections as shown in Fig. 4 and 5). The more the flexibility/rigidity differs, the more the anatomies differ and the more reliable is the distinction. The problem here is to determine which bracts, and what parts in these, should be studied anatomically. Such a comparison requires studying the organ involved at about the same levels and the same stages of development. In the present study, the upper (foliaceous) parts of upper leaf-like bracts of inflorescences from anthesis were used, i.e. at stages when they were assumed to be more or less fully developed. However, it would be of interest to further establish the stage(s) from which bracts are or may be considered fully developed in this genus by studying several species.

Leaf anatomy also in terms of richness/paucity in extra-vascular fibres and their arrangement into strands, may prove useful in distinguishing between "close" species in *Freycinetia* as well. It requires transverse sections at levels where these fibres are most abundant and form largest fibre strands (for example, middle or basal level) in order to be able to observe the biggest possible difference between the species in comparison. Such anatomical studies, also, should be made in particular in cases where leaves show variable flexibility/rigidity from one species to another. Actually, they can make it possible to both understand the variations and use these for distinction between the species (for example, by supplying drawings of leaf transverse sections as shown in Fig. 2 and 3). Also, the more the flexibility/rigidity differs, the more the anatomies differ and the more reliable is the distinction. Another feature to compare at these levels is the position of the tracheary element(s) opposite the abaxial side in the fibrovascular bundles at the pleat middles (see above), i.e. at the sites where the sections have the largest thickness, as seen in Fig. 2 and 3. Since leaves at about the same levels and the same stages of development should be used for comparison, it may be better to use leaves subtending inflorescences, especially in cases where only herbarium material is available, because the levels of leaves can be ascertained and the stages of development of inflorescences (hence of leaves) can be known. Other anatomical characters may also be useful for distinguishing between "close" species in *Freycinetia:* for example, those of pistil, pistillode, staminode, and stamen. Examples of the utility of staminode, pistil, and pistillode in this respect can be found above.

In addition, according to species, the following distinctive features can be observed. Staminode anthers in pistillate flowers are devoid of any endothecial thickenings [for example in *F. cumingiana* (HUYNH, 1991: 308) and *F. reineckei* (HUYNH & COX, 1992: 253)], or have isolated cells with these thickenings in the pollen-sac walls [for example in *F. scandens* (HUYNH, 1993)]. Pistils are either papillate in the upper part [for example in *F. funicularis* (HUYNH, 1992: Fig. 15 and 16)], or smooth [for example in *F. cumingiana* (HUYNH, 1991: Fig. 48)], or provided with wartlike stomates [for example in *F. reineckei* (HUYNH & COX, 1992: Fig. 8 and 46)]. The upper part of pistils has several longitudinal fibre-strands [for example in *F. reineckei* (HUYNH & COX, 1992: 255)], or does not have [for example in *F. cumingiana* (HUYNH, 1991: 323)]. Moreover, the arrangement of these fibres can vary markedly: for example, the pistil fibre-strands in *F. samoensis* are quite different from those in *F. reineckei*. Furthermore, the upper part of pistils has a central sclerenchyma [for example in *F. cumingiana* (HUYNH, 1991: Fig. 8)], or, instead, a central parenchyma bordered at either side by a sclerenchyma [for example in *F. banksii* (HUYNH & SAMPSON, 1992: Fig. 5)] or by another parenchyma formed of larger cells [for example in *F. scandens* (HUYNH, 1993: Fig. 2)]. Staminate flowers are normally indistinct on staminate spikes [for example in *F. reineckei* (HUYNH & COX, 1992: Fig. 22)], or distinct [for example in *F. cumingiana* (HUYNH, 1991: Fig. 26)]. Pistillodes are either readily visible when observed on staminate spikes with stamens removed because situated on the spike surface [for example in *F. cumingiana* (HUYNH, 1991: Fig. 26), *F. reineckei* (HUYNH & COX, 1992: Fig. 22), *F. banksii* (HUYNH & SAMPSON, 1992: Fig. 19)], or completely invisible since differentiated in the lower part of floral enclosures, these being located

beneath the spike surface and closed in the upper part (for example in *F. samoensis*). In addition, they have a regular arrangement on staminate spikes [for example in *F. cumingiana* (HUYNH, 1991: Fig. 26)], or an irregular arrangement [for example in *F. scandens* (HUYNH, 1993: Fig. 12)]; and their tracheary elements have annular/helical wall-thickenings as seen in *F. banksii*, or have not as observed in *F. scandens* (HUYNH, 1993). In particular, pistillode anatomy may prove very useful for distinguishing between "close" species: for example *F. banksii* from *F. baueriana* (see above) and *F. wilderi* from *F. arborea* (see below). For stamens, to mention some of their features that can be used as specific characters: the filaments are provided with one-celled papillas, or with one-rowed several-celled hairs (for example in *F. javanica* var. *expansa*); the pollen is smooth, or spinulose [for example in *F. williamsii* (STONE, 1972: 39)]; the anthers normally have endothecial thickenings, or have not (for example in *F. samoensis*), and have or not an apical notch (HUYNH, 1992: 432 & 433); the pollen sacs all coalesce at the anther apex, or converge to this point without coalescing (HUYNH, 1992: 432 & 433). Other characters may further be found with investigation of these organs in other species or of other organs (for example, seed surface and structure, anatomy of inflorescence stalks). Some of these characters can further prove diagnostic of groups of species as well (sections, subsections, etc.). However, in distinction between species, micromorphological characters in general and anatomical characters in particular can be useful only if they are clearly different from one species to another (for example, the exceptional abundance of crystal cells in the pistillode outer epidermis of *F. baueriana*, in contrast to the absence/rarity of these cells in that of *F. banksii*). In addition, given the fact that intraspecific variations frequently occur in micromorphological characters, these can be considered reliable only after having been tested with several collections. This may restrict their application. In any case, if such a character is observed in the majority of the collections studied for a species, it may be considered as a general tendency in this species, hence as a specific character.

Finally, the now evident distinct identities of *F. banksii* and *F. baueriana* confirm the species endemism in *Freycinetia*. This involves some important considerations in further taxonomic studies in this genus. Indeed, this endemism is a common feature in the family *Pandanaceae;* therefore cases where one and the same species at first sight appears to have wide geographic distribution, including other species in other areas as synonymous or conspecific, should be critically examined, while applying as many characters as possible in conjunction, from both gross and micromorphology, to tentatively separate them. In particular, anatomical features of pistillodes, bracts and leaves should be used since they appeared to be efficacious for this purpose, especially those of the first two organs, and also because their investigation requires neither fresh material nor "difficult" or time-consuming techniques, although some pistillode features cannot be observed suitably with herbarium material. One of these cases is *F. baueriana* (Norfolk Island), which was assumed to include *F. banksii* (New Zealand) (STONE, 1973 and 1981), both examined in the present paper.

Another case is *F. arborea* (Hawaii Islands), in which other species along the middle part of the Pacific down to the Southern Islands (e.g. *F. wilderi* in Cook Islands, *F. longispica* in New Caledonia) were included as being synonyms (STONE, 1979, 1981). Stone's decision can be justified by the present chaotic state of the taxonomy in this group and also by the fact that even now herbarium specimens cannot enable fully satisfactory distinction by gross morphology between these species. Nevertheless, *F. wilderi* for example, now can be distinguished from *F. arborea* by the anatomy of its pistil, pistillode, leaf and bract — to mention some available distinctive characters —, thus in accordance with their distinction in geographic distribution. Both distinctions in conjunction indicate that it is a distinct species from *F. arborea*, and induce to seek for other distinctive characters, in particular of gross morphology, and for the other species as well. Meanwhile subspecific or varietal status may be assigned to them to make it clear that they are not simple synonyms of *F. arborea*, especially for local floras. STONE (1981: 49) also, although using only gross morphology from herbarium specimens available at that time, did not exclude subspecific rank for *F. longispica*.

Certainly, the species concept is a matter of opinion. For example, despite all the distinctive characters described above between *F. banksii* and *F. baueriana*, the former may be considered as a subspecies in the latter. Nevertheless, true *F. baueriana* cannot be found anywhere except in Norfolk Island. In addition, in genera rich in specific differentiation, the species concept evolves along the process of their morphological knowledge, becoming more and more restrictive as the

knowledge widens and increases. Furthermore, taxa at specific level in the same genus that have both different geographic distributions and "significant" different characters between them may be considered distinct species: the more "significant" the difference and numerous the characters, the better founded the distinction. This is quite true with the genus *Freycinetia*, where it now becomes evident that both gross and micromorphology vary widely (for gross morphology, see various papers by STONE, e.g. STONE, 1968 and 1970; for micromorphology, see above and HUYNH, 1991, 1992, 1993, HUYNH & COX, 1992; HUYNH & SAMPSON, 1992), but neither morphology has been extensively investigated. Therefore, several other characters can further be found and prove actually useful in interspecific distinction.

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