

A revision of the fern family Cyatheaceae in the Mascarene Islands

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ABSTRACT

Based on the examination of herbarium specimens including numerous recent collections and on observations of the species *in situ*, we herein present a revision of the tree fern family Cyatheaceae for the Mascarene Islands. Three taxa are accepted for Réunion, two of which are endemic to the island. Four taxa, including one endemic species and two endemic varieties, are recognized for Mauritius. One introduced species is present on both islands. We describe one new species, *Cyathea grangaudiana* Th.Janssen & Rakotondr. and one new variety, *Cyathea borbonica* Desv. var. *sevathiana* Th.Janssen & Rakotondr. from Mauritius. *Cyathea grangaudiana* has a pinnate-pinnatisect lamina, scattered acicular hairs on the abaxial face of the costules and sporangiasters on the receptacle. *Cyathea borbonica* var. *sevathiana* has erect leaves, a bipinnate lamina with conduplicate pinnae and pinnules as well as smaller and more coriaceous pinnules than the type variety. We comment on the usage of ancient names having led to taxonomic confusion in the past, and discuss the status of doubtful taxa. Sporangiasters, sterile sporangiform structures on the receptacle, are documented for two species from Mauritius. In order to facilitate field identifications, we include in our treatment a complete illustration of each taxon as well as two different identification keys one of which is largely based on characters readily observable in the field.

KEY WORDS

Cyatheaceae,
Alsophila,
Cyathea,
Madagascar,
Mauritius,
Réunion,
sporangiaster,
new species,
new variety.

RÉSUMÉ

Révision de la famille des Cyatheaceae (fougères) des Îles Mascareignes.

Nous présentons ici une révision des fougères arborescentes (Cyatheaceae) des Mascareignes basée sur l'étude de spécimens d'herbier provenant en grande partie de récoltes récentes et sur l'observation des espèces *in situ*. Nous avons recensé trois taxons pour La Réunion, dont deux endémiques de l'île. Quatre taxons, dont une espèce et deux variétés endémiques, sont reconnus à Maurice. Une espèce introduite est présente dans ces deux îles. Nous décrivons, pour Maurice, une espèce nouvelle, *Cyathea grangaudiana* Th.Janssen & Rakotondr., et une variété nouvelle, *Cyathea borbonica* Desv. var. *sevathiana* Th.Janssen & Rakotondr. *Cyathea grangaudiana* présente un limbe penné-pinnatiséqué, des poils aciculaires dispersés sur la face inférieure des costulae et des sporangiastrés sur le réceptacle. *Cyathea borbonica* var. *sevathiana* possède des frondes dressées, un limbe bipenné avec pennes et pinnules conduplicuées et les pinnules plus petites et plus coriaces que celles de la variété type. L'emploi de certains noms anciens ayant conduit dans le passé à des confusions est commenté et nous discutons de quelques espèces douteuses. Sur le réceptacle de deux espèces de l'Île Maurice, nous signalons la présence de sporangiastrés, structures stériles ressemblant aux sporanges. Afin de faciliter l'identification des espèces sur le terrain, nous avons inclus dans notre traitement une illustration complète de chacun des taxons et deux clés de détermination dont l'une est en grande partie basée sur des caractères directement observables *in situ*.

MOTS CLÉS

Cyatheaceae,
Alsophila,
Cyathea,
 Madagascar,
 Maurice,
 La Réunion,
 sporangiastré,
 espèce nouvelle,
 variété nouvelle.

INTRODUCTION

Herein, we present a taxonomic revision of the scaly tree ferns, Cyatheaceae, constituting a conspicuous floristic element of the Mascarene pteridophyte flora. Members of this family are characterized by an erect aerial shoot ("trunk"), a scaly petiole base and sori in a dorsal position on the veins with a usually raised receptacle (Kramer 1990). Scaly tree ferns show a high degree of endemism (Tryon & Gastony 1975). In the Madagascar region, three species (one endemic) are known to occur on the Comoro islands (Tardieu-Blot 1951), the Seychelles harbor one endemic species (Christensen 1912; Tardieu-Blot 1960), whereas 48 taxa with 45 (94%) endemic to the island are currently recognized for Madagascar (Janssen & Rakotondrainibe unpubl.).

The three islands Mauritius, Réunion and Rodrigues form the Mascarene Archipelago. Cyatheaceae are absent from Rodrigues, the smallest of these islands (Lorence 1976). In the present treatment of

the family for Mauritius and Réunion we recognize four taxa (three endemic) for Mauritius and three taxa (two endemic) for Réunion. None of these taxa is known to occur outside the Mascarenes and their phylogenetic relationships are currently unexplored. Two (one species and one variety) of the six accepted Mascarene taxa are newly described in the present treatment. The introduced *Cyathea cooperi* (Baker) Domin is widely naturalized on both islands.

As was already noted before (Badré & Cadet 1978; Lorence 1978), scarcity of locality information and highly fragmentary material in ancient specimens hampered the understanding of the Mascarene tree fern flora in previous treatments (Bory 1804; Bojer 1837; Baker 1877; Cordemoy 1895; Tardieu-Blot 1960). Accordingly, most authors only put forward hypotheses on species distributions and affinities to Madagascar with hesitation (Christensen 1932; Tardieu-Blot 1951; Holttum 1981). The rapid deterioration of natural forests after the onset of human activity on Mauritius (Lorence 1978), Réunion likely

facing a similar situation, might be a reason for the relative paucity of tree fern material available from these islands in major herbaria. Recent fieldwork conducted on both Mascarene Islands had a major impact on our understanding of the Mauritian taxa as well as on the delimitation of Mascarene tree ferns from Madagascan members of that family.

SPORANGIASTERS IN MAURITIAN CYATHEACEAE

In the following paragraph, we shall briefly discuss sporangiasters as particular receptacular structures used as a discriminative character included in identification keys. Sporangiform sterile structures are present in the sori of *Cyathea excelsa* Sw. and *Cyathea grangaudiana* Th. Janssen & Rakotondr. Generally, these structures are borne on the receptacle and mixed with normally developed sporangia. They consist of a stalk composed of one to four bristle-like rows of cells and a bulbous to conspicuously sporangiform head usually bearing an apical hair of variable length. Mature structures are composed of sclerified cells and have a dark brown to black colour. They are, especially in *Cyathea excelsa*, persistent on the receptacle after the sporangia have fallen off. In *Cyathea excelsa* their head is small and club shaped bearing a short apical hair (Fig. 4D). The stalk of the structure is composed of one to three bristle-like rows of cells. In *Cyathea grangaudiana* the head is roughly twice as large as in *Cyathea excelsa* and somewhat flat-topped with a much longer apical hair (Figs 6E; 8F). In this species, the whole structure even more resembles a modified sporangium and usually has a bristle-like stalk composed of more than one row of cells. Such sterile receptacular structures have first been observed in Cyatheaceae by Gluck (1895) and reexamined by Pirard (1947). Pirard (1947) adopted a very narrow concept of the term “sporangia” only applying it to structures for which their origin from and hence homology to sporangia can be proven, which is the case in several species of *Polypodium* L. (Martens & Pirard 1943; Haufler *et al.* 1995). Accordingly, Pirard argues that the structures observed in *Cyathea excelsa* are originally hair-like because of their stalk being

often composed of a single line of cells in juvenile forms. However, we maintain that the structures observed in *Cyathea excelsa* are more likely to represent modified sporangia. In ferns, bristle-like arrangement of cell lines, i.e. with a terete rather than flat cross section, is usually a character of the sporangial stalk and only rarely observed in hairs. Furthermore, sporangia originate from a single epidermal cell in leptosporangiate ferns, which might explain the existence of stalks that are at least partly unicellular in cross-section. Contrary to Pirard’s observation we find the structures in question, especially in *Cyathea grangaudiana*, to be three dimensional and morphologically very similar to partly aborted sporangia.

We here adopt a pragmatic morphological concept and prefer to designate the structures in question as sporangiasters in order to underline their resemblance to aborted or modified sporangia rather than to scaly or hair-like structures (paraphyses *sensu lato*) in a concern not to further inflate the already vague concept of “paraphysis” (Wagner 1964). Baayen & Hennipman (1987) define paraphyses as “trichomes inserted within the sorus and showing (inferred) congruence with the indument on the frond”. This is clearly not the case for the structures encountered here. The authors adopt the term “abnormal sporangia”, an essentially superfluous term for “sporangia”, to designate sporangia-like sterile structures probably in order to avoid conflict with Pirard’s narrow conception of the term. In the lack of sufficient data on development and underlying genetics of the observed structures, we do not put forward a hypothesis about their actual homology with sporangia. However, users of keys and descriptions are likely to identify the term “paraphysis” with hairy or scaly receptacular appendages occurring for example in several species of Cyatheaceae from Madagascar, and might better grasp the morphological particularity of the structures in the two Mascarene taxa by applying the term sporangia to them.

Sporangiasters have been observed in all examined collections of *Cyathea excelsa* from Mauritius, but only in a fraction of specimens of that species from Réunion. They are present in all but a single specimen (Janssen *et al.* 2741) of *Cyathea grangaudiana*.

Similar receptacular structures are absent from all other taxa of Cyatheaceae in the Madagascar region (Janssen & Rakotondrainibe unpubl.). We are currently not in a position to explain the quasi-endemicity of sporangiasters on Mauritius.

MATERIAL AND METHODS

In our revision, following Holttum & Edwards (1983) and Kramer (1990), we recognize a single genus within Cyatheaceae, *Cyathea* Sm., in order to be consistent with previous treatments of the family in the palaeotropics. According to Holttum & Edwards (1983) all Mascarene species of *Cyathea* would be classified in *Cyathea* subgen. *Cyathea* sect. *Alsophila*, because they all share petiole scales with marginate (flabelloid) scales and an indurated terminal cell (spine).

For the present treatment we consulted the collections at B, BM, FI, G, K, M, MAU, MEL, P, REU, S, UPS and W. In the material examined sections, the quantity of unnumbered and hence potentially unrelated sheets of a same collector is given in brackets following the herbarium code. Fieldwork in Mauritius and Réunion permitted us to collect complete specimens showing all taxonomically relevant characters. In addition, a great number of plants could be observed *in situ*. As has been stated above, ancient collections from the region generally lack ecological or morphological annotation. Hence, all information pertaining to ecology, trunk-, habit-, and whole-leaf-characters, described here often for the first time, are based on information collected during fieldwork and mainly taken from annotations accompanying the cited specimens by Janssen *et al.* and Rakotondrainibe *et al.*

A more or less dense indument of trichomidia (i.e. reduced, paucicellular, often appressed and sometimes glandular hairs) and small, usually acaroid squamules (i.e. small, irregular scales with prominent setae projecting from a reduced body), which we do not consider taxonomically significant, is present on various leaf parts in all species. When talking about petiole scales, we refer to the scales on the lateral and abaxial faces at the very base of the petiole unless otherwise stated. Sometimes, these

scales agglutinate, i.e. they stick together in groups, sometimes only with their bases. Measurements and characters of pinnae and pinnules always refer to the largest pinnae in the leaf and the largest pinnules in the largest pinnae unless stated otherwise. Lamina cutting in Mascarene Cyatheaceae varies from pinnate-pinnatisect, i.e. pinnate with pinnae divided down to the costa into broadly adnate segments, *via* bipinnate to bipinnate-pinnatisect, i.e. bipinnate with pinnules divided down to the costula into broadly adnate segments. The tripinnate condition is only found at the very base of pinnules in the bipinnate-pinnatisect taxa. All pinnate or pinnatisect pinnae and pinnules become pinnatifid towards their apices. Basal pinnae are often retroflexed, i.e. sharply bent from their base with their apices directed towards the petiole base, and usually somewhat conduplicate, i.e. not patent, but folded together on the adaxial side of the lamina, forming a “V”. Sigmoid petiole bases are S-shaped, i.e. the petiole is curved upwards after leaving the trunk and then bent backwards after having paralleled the trunk for a short distance (Fig. 7D¹). Leaves are spirally inserted along the trunks of tree ferns, but leaves of a single growth period often appear at about the same height on the trunk (pseudoverticillate phyllotaxis).

Gastony (1974) reports 16 as the number of spores produced per sporangium in the majority of taxa belonging to *Cyathea* sect. *Alsophila*. The native Mascarene species most likely produce 16 spores per sporangium, considering the few available collections including suitable material for verification (Janssen *et al.* 2730, 2749: *Cyathea excelsa*; Janssen *et al.* 2711, 2727: *C. glauca*; Janssen *et al.* 2740: *C. grangaudiana*). Spore diameters are given as a mean value measured over polar and equatorial spore axes in dehydrated spores, i.e. taken directly from herbarium specimens without further treatment. This is sufficiently discriminative and will facilitate the utilization of this character in light-microscopic studies. A discussion of perine structures observed here for the Mascarene taxa can be found in Gastony & Tryon (1976). According to these authors, hair-like rodlets constitute a less frequent perine type in paleotropical Cyatheaceae and a verrucose surface corresponds to an inner layer of the perine, i.e. an earlier stage of spore development (Fig. 8).

SIMPLIFIED KEY FOR FIELD DETERMINATIONS OF *CYATHEA* SM. FROM THE MASCARENE ISLANDS

Macromorphological features usually not observable in herbarium specimens such as plant habit, stem surface, and apex structure are often helpful in determining tree ferns even from some distance. For the first time, we provide a simple key for field determination based mainly on these characters. Determinations obtained with this key should be verified with the detailed key (see below).

1. Trunk apex covered by whitish scales; leaves yellowish-green 4. *C. cooperi*
— Trunk apex different; leaves green..... 2
2. Réunion 3
— Mauritius 5
3. Trunk slender, diameter up to 9 cm, usually naked, i.e. leaf scars visible, sometimes covered by mosses; petioles and rachises spreading more or less horizontally (crown flat), crown relatively small, trunk apex obscured by close standing sigmoid petiole bases 1. *C. borbonica* var. *borbonica*
— Trunk thick, diameter at least 10 cm (not including the frequently persistent petiole bases); petioles and rachises arching (crown umbrella-shaped), crown relatively large, petiole bases usually not obscuring the densely scaly trunk apex 4
4. Petioles and rachises with thick orange-brown tomentum; trunk frequently branched below apex 6. *C. glauca*
— Petioles and rachises naked; trunk only rarely branching 5. *C. excelsa*
5. Trunk thick, diameter at least 10 cm (not including the usually persistent petiole bases); petioles and rachises arching (crown umbrella-shaped); leaves bipinnate-pinnatisect (i.e. bipinnate with pinnules divided down to the costula into broadly adnate segments) to tripinnate 5. *C. excelsa*
— Trunk slender, diameter up to 9 cm, usually naked; petioles and rachises arching to erect (crown umbrella- to funnel-shaped); leaves pinnate-pinnatisect (i.e. pinnate with pinnae divided down to the costa into broadly adnate segments) to bipinnate 6
6. Petioles and rachises arching (crown umbrella-shaped); pinnae and pinnules patent, plant up to 5 m, leaves bipinnate 2. *C. borbonica* var. *latifolia*
— Petioles and rachises stiffly erect or spreading more or less horizontally, pinnae and pinnules strongly conduplicate or patent, plant up to 4 m, leaves pinnate-pinnatisect or bipinnate 7
7. Petioles and rachises stiffly erect (crown funnel-shaped); pinnae and pinnules strongly conduplicate (i.e. folded together adaxially, forming a “V”), plant up to 1 m, leaves bipinnate 3. *C. borbonica* var. *sevathiana*
— Petioles and rachises spreading more or less horizontally (crown flat); pinnae patent, plant up to 4 m, leaves pinnate-pinnatisect 7. *C. grangaudiana*

DETAILED KEY TO THE SPECIES AND VARIETIES OF *CYATHEA* SM. FROM THE MASCARENE ISLANDS

1. Leaves pinnate-pinnatisect (i.e. pinnate with pinnae divided down to the costa into broadly adnate segments) to bipinnate 2
— Leaves bipinnate-pinnatisect (i.e. bipinnate with pinnules divided down to the costula into broadly adnate segments) to tripinnate 5

2. Ultimate segments adnate (leaves pinnate-pinnatisect); abaxial face of costulae with scattered, strong, patent to antrorse acicular hairs; sporangia mixed with light brown to blackish club-shaped sporangiasters; rachis always atropurpureous 7. *C. grangaudiana*
 — Ultimate segments free, sessile (leaves bipinnate); no conspicuous patent to antrorse hairs on abaxial face of costulae; receptacle always without sporangiasters; rachis stramineous to atropurpureous (*C. borbonica*) 3
3. Scales at petiole base dull brown, appressed, often agglutinating, but usually with free apices; pinnules 2-3 × 0.5-0.6 cm, patent with their margin usually flat and their apex acute (rarely rounded); crown flat 1. *C. borbonica* var. *borbonica* (Réunion)
 — Scales at petiole base shiny dark brown, spreading (if agglutinating, then only with their very base); pinnule size usually outside the range (bigger or smaller) given for the precedent variety; pinnules patent or conduplicate with their margin flat or more or less revolute and their apex acute to rounded; crown umbrella- or funnel-shaped 4
4. Pinnules 3.5-4 × 0.6-0.8 cm, herbaceous to subcoriaceous, apex acute to obtuse, margin usually flat; pinnae and pinnules patent; crown umbrella-shaped 2. *C. borbonica* var. *latifolia* (Mauritius)
 — Pinnules 1.5-2 × 0.4-0.5 cm, coriaceous, apex rounded (rarely obtuse), margin more or less revolute; pinnae and pinnules conduplicate; crown funnel-shaped 3. *C. borbonica* var. *sevathiana* (Mauritius)
5. Sori exindusiate; scales at petiole base of two types: stramineous, lanceolate scales with conform, setiferous margin and dark brown, short filiform scales 4. *C. cooperi*
 — Sori indusiate; scales at petiole base of one type, dark to blackish brown, with conspicuous margin of irregularly shaped cells distinct from the elongate cells of the scale center ... 6
6. Pinnule segments not widened at their base, clearly spaced from one another (sinuses rectangular), segment apex rounded to obtuse with subentire to sinuate margin; pinnules acute to shortly caudate; petiole, rachis and costae densely tomentose with intricate branched hairs; lamina subcoriaceous to coriaceous, abaxial surface glaucous 6. *C. glauca*
 — Pinnule segments widened and slightly confluent at their base (sinuses V-shaped), segment apex acute to obtuse with serrulate margin; pinnules long and conspicuously caudate; petiole, rachis and costae subglabrous; lamina herbaceous to subcoriaceous, green on both faces 5. *C. excelsa*

SYSTEMATICS

1. *Cyathea borbonica* Desv. var. *borbonica* (Figs 1; 7C; 8A)

Der Gesellschaft naturforschender Freunde zu Berlin Magazin für die neuesten Entdeckungen in der gesammten Naturkunde 5: 328 (1811); Christensen, *Dansk botanisk arkiv* 7: 21 (1932), *excl. specim. madag.*; Tardieu in Humbert, *Flore de Madagascar et des Comores*, fam. 4: 13, f. 1, 4-5 (1951), *excl. specim. madag.*; Tardieu, *Notulae Systematicae* (Paris) 16: 156 (1960). — *Cyathea mascarena* “Sw.” Desv., *Prodrome de la famille des fougères*: 322 (1827), *nom. superfl.* — *Alsophila borbonica* (Desv.) R.M. Tryon, *Contributions from the Gray herbarium* 200: 30 (1970). — Type: habitat in insula borboniae,

Anon. s.n. in hb. Desvaux p.p. (lecto-, sterile fragment, P!, here designated); Grand Étang, sentier menant du parking vers le point de vue, 21°05'44”S, 55°38'39”E, 557 m, 30.III.2005, *Janssen et al.* 2670 (epi-, P!, here designated; isoepi-, P!).

Cyathea borbonica Poir. in Lam., *Encyclopédie méthodique (Botanique)* suppl. 2: 425 (1812), *nom. illeg., non Desv.* (1811). — Type: Bourbon, *Bory de St-Vincent s.n.* in hb. Desfontaines (holo-, FI!).

Cyathea canaliculata auct. non Willd.: Cordem., *Flore de l'île de la Réunion* 39 (1895).

ADDITIONAL MATERIAL EXAMINED. — Réunion. Bonnet Carré, Cilaos, 15.XI.1973, *Badré 915* (P). — Brûlé de Ste-Rose, 21.XI.1973, *Badré 986* (P). — Sentier de la

Roche Écrite, 25.XI.1970, *Barclay 2053* (MAU). — *Barthe 56* (BM). — *Bédier s.n.* (P). — Brûlé, 1891, *Bédier 46* (P). — *Bélanger s.n.* (P). — *Boivin s.n.* (B [2], G, P). — *Boivin 898* (B, G, P). — *Bory de St-Vincent 330* (P). — St-Philippe, V.1957, *Bosser 11759* (P). — *Bréon s.n.* (P [4]). — Tévelave, 24.I.1962, *Cadet 93* (REU). — Plaine des Chicots, 25.XI.1970, *Cadet 2899* (REU). — Plaine des Palmistes, 14.VIII.1973, *Cadet 4344* (REU). — *Commerson s.n.* (P-JU, putative isolectotype). — *Delavaux s.n.* (P). — *Delessert s.n.* (G). — *Garnier 12* (BM). — VII.1837, *Gaudichaud s.n.* (G, P). — *Gaudichaud s.n.* (B, P [3]). — *Houillet s.n.* (P). — *Héribaud s.n.* (P). — *De l'Isle 580* (P). — Grand Étang, sentier menant du parking vers le point de vue, 21°05'44"S, 55°38'39"E, 557 m, 30.III.2005, *Janssen et al. 2675* (MO, P); *2676* (MO, P); *2678* (MO, P). — St-Philippe, forêt de Mare Longue, sentier botanique, puis sentier GR R.2, 21°21'18"S, 55°44'22"E, 190-300 m, 31.III.2005, *Janssen et al. 2697* (MO, P). — Forêt de Bébour, sentier pédagogique de Bras Cabot, 21°07'27"S, 55°34'25"E, 1345 m, 2.IV.2005, *Janssen et al. 2726* (MO, P). — *Lépervanche-Mézières 2* (P). — *Lépervanche-Mézières 3* (P). — *Limminghe s.n.* (P). — Petite Plaine, 6.XI.2004, *Rakotondrainibe et al. 6919* (P). — *Richard s.n.* (P). — *Richard 32* (P). — *Richard 83* (K). — *Richard 236* (P). — *Vieillard s.n.* (B, P). — *Vieillard et Deplanche s.n.* (W). — *Anon. s.n.* (P [6]). — *Anon. s.n.* in hb. Kuhn (B). — *Anon. s.n.* in hb. Roem (BM).

Without or with doubtful locality. [Mauritius?], *Boivin s.n.* (B, P [4]). — [Mauritius?], *Hooker s.n.* (P). — Cult. Hort. Parisi, II.1857, *Houillet s.n.* (P). — *McGregor s.n.* (BM). — *Richard s.n.* (P). — *Sieber s.n.* (P). — *Anon. s.n.* (BM [3], P [2]).

DESCRIPTION

Trunk: 1-6(-8) m tall, diameter 4-7(-9) cm, rarely branched, its surface smooth to muricate, dark brown, petiole bases persistent in upper 30 cm, but soon caducous and leaf scars exposed.

Leaf scars: (1-)-4-5 × 1-2 cm, rounded to elliptical, displaying 3-5 shallow very small to rather large cavities on their lower rim.

Crown: flat, petioles and rachises rather straight and spreading horizontally, sometimes deflexed, young leaves erect, arranged in approximately eight orthostichies forming distinct pseudoverticils.

Trunk apex: hidden by close standing sigmoid petiole bases, some dead rachises persistent and hanging from the apex, their pinnae having fallen off.

Petiole: 2-5(-7) cm long, diameter 1.7-2.5 cm, slightly muricate at its base, green to stramineous,

abaxial face brown to castaneous, rarely reddish to atropurpureous on both faces, one to several line(s) of very distant white to light brown small aerophores on either side.

Lamina: bipinnate, narrowly elliptical to oblanceolate, (110-)150-210 cm long, 50-75 cm wide at its widest point ([60-]85-100 cm from base of lamina), bearing 35-50 pinna pairs, basal pinnae gradually reduced in size, almost attaining the petiole base, retroflexed and more or less conduplicate, lamina herbaceous to subcoriaceous, pale green on abaxial face, shiny green on adaxial face, rachis coloured like petiole.

Largest pinnae: (20-)25-36 cm long, spaced by 3.5-4.5 cm, separate to overlapping, costae and costules stramineous, often tinged with red on abaxial face.

Largest pinnules: (1.8-)-2-3 × (0.4-)-0.5-0.6 cm, sessile to petiolulate with obtuse to truncate base, in lower 1/3 of pinnae somewhat biauriculate, becoming progressively adnate in upper 1/2 of pinnae and then often proximally decurrent, oblong, slightly falciform, margin subentire, apex obtuse to acute, rarely rounded, with crenulate to serrulate margin, veins once furcate.

Scales and hairs: scales of the petiole base ascending up to 15 cm, caducous, narrowly triangular, 2.5-3 × 0.15-0.2 cm, apex crispate, dull brown with a rather broad light brown (usually eroded) margin, appressed and with a tendency to agglutinate among themselves (their apices usually free), adaxial surface of costae with light brown, tortuous multicellular hairs, otherwise all axes glabrous except for scattered (often acaroid) squamules, adaxial face of rachis without hairs, adaxial face of costulae and veins in the pinnule apices with appressed straight stiff hyaline acicular hairs (often caducous in older leaves).

Sori: subcostular, separate, covering the pinnules from 3/4 to entirely, indusia globular, membranous, dehiscing in 2 or 3 lobes, receptacle capitate to short columnar, with short inconspicuous paraphyses.

Spores: trilete, diameter (dehydrated) 50-60 μm, surface covered by slender rodlets.

DISTRIBUTION

Réunion, endemic.

ECOLOGY

From 200 to 1400 m, i.e. lower to higher elevation evergreen forests, frequently on forest margins and in somewhat open habitats.

REMARKS

The type variety of *Cyathea borbonica* is endemic to Réunion and can be easily distinguished from the two closely related varieties on Mauritius, var. *latifolia* and var. *sevathiana*, by its habit and, in herbarium specimens, with the help of pinnule dimensions and scale morphology. The specimens *Bosser 11759* and *Boivin 898* are attributed to the type variety despite having small, but fertile leaves with pinnae only 15–18 cm long and pinnules up to 1.5 cm long.

VERNACULAR NAMES

Fanjan mâle (making reference to the base of the trunk not being broadened by adventitious roots), fanjan.

TYPIFICATION AND SYNONYMY

Desvaux (1811: 328) did not indicate any original collections and provided a rather vague description of the species as bipinnate with sessile, but not adnate pinnules. Fertile structures are not mentioned. A specimen from Desvaux' herbarium, bearing a label in Desvaux' writing including the description exactly as published has been traced at P. The place of publication has, probably later, been added in different ink and Desvaux' writing on this label. The sheet contains two different plants: in the first place there is a leaf fragment with nine pairs of fertile pinnules, a black rachis and brown acicular hairs on the abaxial face of the costules. This is *Cyathea grangaudiana* from Mauritius and most likely does not correspond to the original material in Desvaux' hands when describing *Cyathea borbonica*, because none of its particular features appear in his description. Secondly, there is a small sterile and glabrous fragment comprising four pinnae connected by a thin brown rachis probably from the apical part of a leaf. This fragment corresponds best to Desvaux' description and is chosen here as the lectotype of *Cyathea borbonica*.

A photograph by Morton of a specimen consisting of four sterile pinnae, *Commerson s.n.* in P-JU!

(Hb. Jussieu no. 1468) is filed as holotype of *Cyathea borbonica* in several herbaria (e.g., B!, BM!). Desvaux (1811) mentions that he consulted the collections of Jussieu and Lamarck. It is hence not improbable, that the fragment in his herbarium is originally from Jussieu's herbarium. This not being explicitly mentioned in the protologue, a specimen from Desvaux' own herbarium bearing the description in Desvaux' writing should clearly be preferred in lectotypifying the name. Even though the specimen in Jussieu's herbarium is morphologically completely identical to the lectotype here designated, it can only be called a putative isolectotype, because unnumbered sheets cannot be attributed with certainty to the same collection.

The leaf base with petiole scales and a description of the plant habit provide essential means of differentiating *Cyathea borbonica* var. *borbonica* from the Mauritius endemic *Cyathea borbonica* var. *latifolia* (Hook.) Bonap. and *Cyathea borbonica* var. *sevathiana* Th. Janssen & Rakotondr. Since the original material examined by Desvaux does not provide this information, we consider it necessary to designate an epitype to clarify the identity of Desvaux' species. Taking into account the numerous misapplications of names in designating bipinnate taxa from the Mascarene islands (see below), this measure is likely to contribute towards stability in name usage.

Independently from Desvaux, the name *Cyathea borbonica* has been published by Poirét (1812: 425), clearly indicating a type, *Bory s.n.* in hb. Desfontaines (FI!). This name is a later homonym of Desvaux' name. As it agrees morphologically with the type of Desvaux' species, no replacement name is being proposed here for Poirét's name. Later, Desvaux (1827: 322) writes: "2. *Cyathea mascarena* Sw., Mag. nat. ber., 1811, p. 328. *Cyathea borbonica* Poir., enc. suppl., 2, p. 423". The citation indicated for *Cyathea mascarena* refers to the protologue of *Cyathea borbonica*. Given that the name *Cyathea borbonica* does not appear in Desvaux (1827), and that the epithet *mascarena* does not appear in Desvaux' article (1811: 328) nor in any of Swartz' major works (Swartz 1788, 1801, 1806) we interpret *Cyathea mascarena* "Sw." Desv. as a name intended by Desvaux to replace *Cyathea*

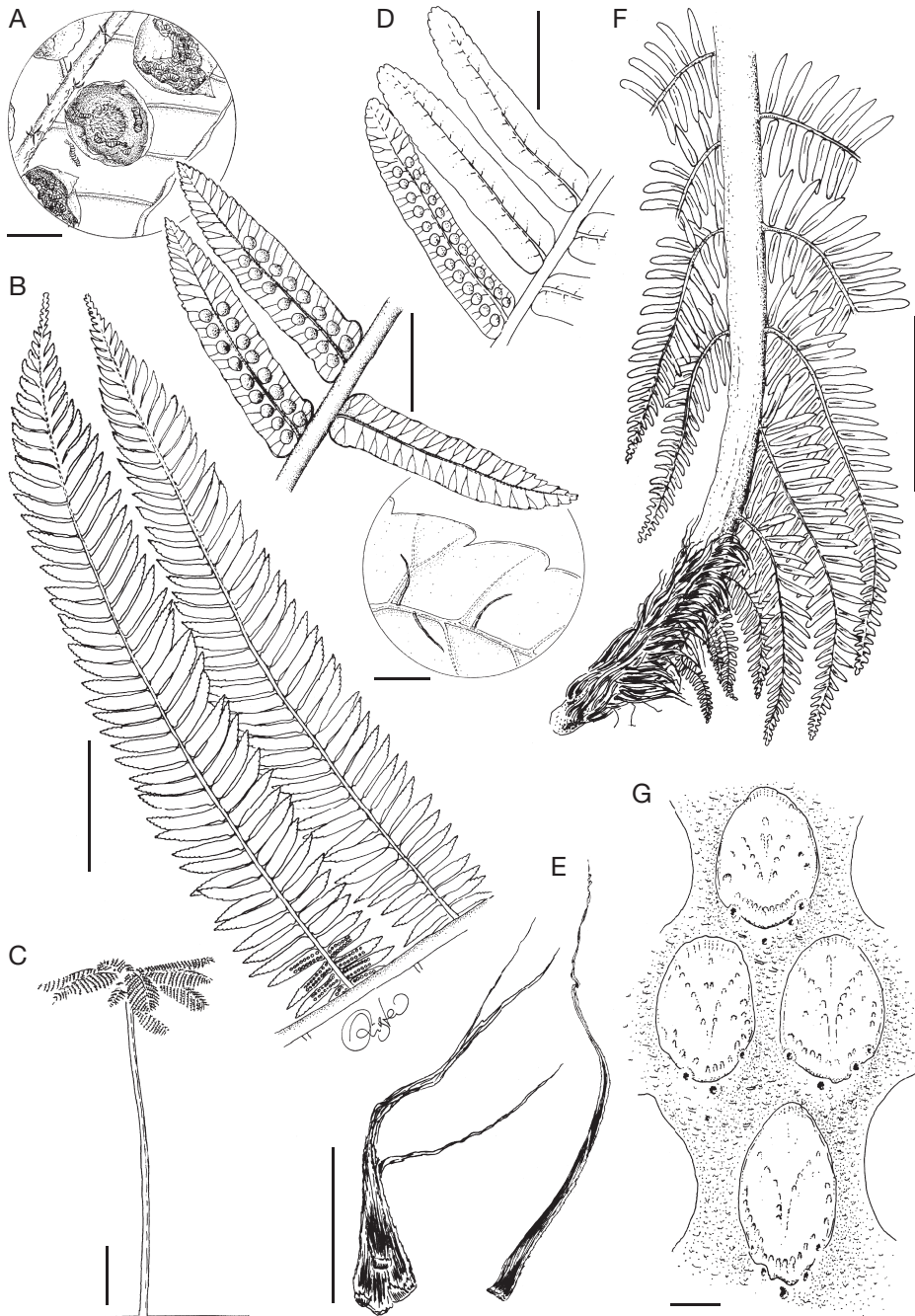


FIG. 1. — *Cyathea borbonica* Desv. var. *borbonica*: **A**, pinnules abaxially (sori partly omitted), detail of sori with acaroid squamules on costulae and appressed multicellular hairs on the veins of adaxial face of pinnule apices; **B**, two pinnules abaxially with part of rachis (sori partly omitted); **C**, habit; **D**, pinnules abaxially (sori partly omitted), form with rounded apices; **E**, scales from petiole base (left: three scales agglutinated with their bases; right: single scale); **F**, basal part of the leaf (petiole base up to first pinna pairs), lateral view; **G**, leaf scars. A, B, G, Janssen *et al.* 2697, P; C, uncollected, photograph at P; D-F, Janssen *et al.* 2670, P. Scale bars: A, D, E, G, 1 cm; A insets, 1 mm; B, F, 5 cm; C, 1 m.

borbonica Desv. in order to avoid homonymy with Poiret's name. Although this replacement name was probably intended to preserve Poiret's name, *Cyathea mascarena* "Sw." Desv. has to be regarded as a superfluous name and is thus illegitimate. It is unclear, for what reason Desvaux attributed this name to Swartz.

A multitude of varieties have been ascribed to this species. One, *Cyathea borbonica* Desv. var. *latifolia* (Hook.) Bonap., is accepted in this treatment. *Cyathea borbonica* Desv. var. *laevigata* (Willd. ex Kaulf.) Bonap., *Cyathea borbonica* Desv. var. *madagascariensis* (Kaulf.) Bonap., and *Cyathea borbonica* Desv. var. *pervilleana* (Fée) C.Chr. are discussed below as doubtful species. *Cyathea borbonica* var. *simulans* (Baker) C.Chr. with adnate pinnules and densely paraphysate receptacles is a taxon from Madagascar, probably without affinity to the Mascarene species and will be dealt with in an upcoming treatment. The name *Cyathea borbonica* has been misapplied to a Madagascan tree fern (Christensen 1932; Tardieu-Blot 1951) that is morphologically distinct from the Mascarene species (Janssen & Rakotondrainibe unpubl.).

2. *Cyathea borbonica* Desv. var. *latifolia*

(Hook.) Bonap.

(Figs 2; 7E; 8C)

Notes ptéridologiques 9: 48 (1920); Bonaparte, *Notes ptéridologiques* 16: 20 (1925), *excl. specim. madag.* — *Cyathea canaliculata* Willd. ex Spreng. var. *latifolia* Hook., *Species Filicum* 1: 24, t. 13, f. A (1846). — *Cyathea borbonica* Desv. f. *latifolia* (Hook.) C.Chr., *Dansk botanisk arkiv* 7: 21 (1932); Tardieu in Humbert, *Flore de Madagascar et des Comores*, fam. 4: 13, f. 1, 8-9 (1951), *excl. specim. madag.* — Type: Mauritius, *Sieber fl. mixt. exs. 304* (lecto-, K!, here designated; isolecto-, B!, BM!, G!, P!); Black River gorges NP, Brise Fer Conservation Management Area, 5.IV.2005, *Janssen et al. 2746* (epi-, P!, here designated; isoeppi-, MAU!).

?*Cyathea borbonica* auct.: Bojer, *Hortus Mauritianus*: 388 (1837).

?*Cyathea canaliculata* auct.: Baker, *Flora of Mauritius and the Seychelles*: 467 (1877).

ADDITIONAL MATERIAL EXAMINED. — **Mauritius**. Mare Longue, 13.II.1980, *Benl et al. MR124* (M). — *Boivin*

s.n. (W). — *Duncan s.n.* (BM). — Mare Longue, 9.XII.1999, *Florens & Sevathian 5* (MAU). — Kanaka Crater, 1982, *Guého & Bosser s.n.* (MAU). — Black River gorges NP, sur chemin 100 m avant Pigeon Wood Field Station, 20°26'22"S, 57°28'54"E, 707 m, 5.IV.2005, *Janssen et al. 2743* (MAU, P). — *Idem*, Brise Fer Conservation Management Area, 5.IV.2005, *Janssen et al. 2744* (MAU, P); 2747 (MAU, P). — Bassin Blanc, 6.VII.1979, *Lorence et al. 2704* (K). — Curepipe, *Rawson 21* (BM). — *Sieber syn. fil. exs. 59* [?, specimen differs morphologically from all other *Sieber syn. fil. exs. 59*] (G). — Pouce Mt., 6.VIII.1983, *Strahm s.n.* (MAU). — *Anon. s.n.* (B, K). — La Pouce, *Anon. s.n.* (K).

Without or with doubtful locality. *Sieber 336* (P). — *Anon. 6124 p.p.* (P).

DESCRIPTION

Trunk: 2-5 m tall, diameter 6.5-9 cm, its surface dark brown, relatively sharply and densely muricate, a rudiment of the petiole bases persists in upper part of trunk, but is soon caducous exposing the leaf scars.

Leaf scars: 3.5-6 × 1.5-2.5 cm, elliptical, displaying 3(-5) cavities on or below their lower rim.

Crown: usually umbrella-shaped, petioles and rachises arcuate, rarely petioles somewhat erect at their base, leaves spirally arranged in approximately five orthostichies forming more or less obvious pseudoverticils.

Trunk apex: hidden by close standing sigmoid petiole bases.

Petiole: 10-25 cm long, diameter 2.5-3 cm, its base rather strongly muricate, green to stramineous, abaxial face brown, rarely dark reddish brown on both faces, in young leaves with a tomentum of rapidly caducous brown squamules, at its base with distantly arranged brown aepophores on the entire abaxial face.

Lamina: bipinnate, widely elliptical, 150-220 cm long, 70-90 cm wide at its widest point (80-140 cm from base of lamina), bearing 27-35 pairs of alternate pinnae, basal pinnae gradually reduced in size, but rather widely spaced, slightly retroflexed and conduplicate, lamina subcoriaceous to coriaceous, pale green on abaxial face, shiny green on adaxial face, rachis coloured like petiole.

Largest pinnae: 30-42 cm long, spaced by 5-6.5 cm, separate to slightly overlapping, costae

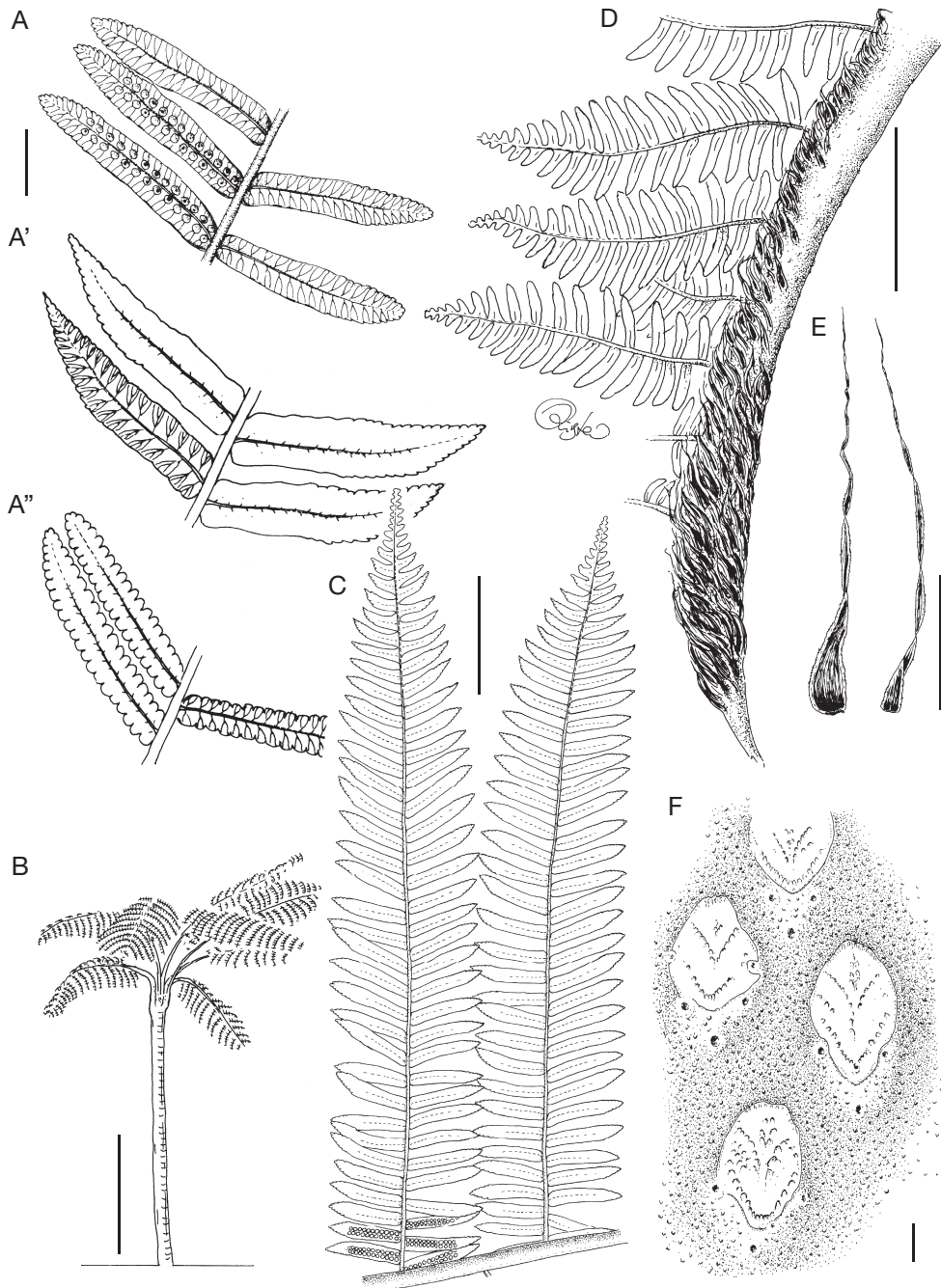


FIG. 2. — *Cyathea borbonica* Desv. var. *latifolia* (Hook.) Bonap.: **A-A''**, pinnules abaxially with part of costa (sori partly omitted), all drawings to same scale; **A**, common form with subcrenate margin and obtuse apices; **A'**, form with wide pinnules and acute apices; **A''**, form with strongly crenate margins; **B**, habit; **C**, two pinnae abaxially with part of rachis (sori partly omitted); **D**, basal part of the leaf (petiole base up to seventh pinna pair), lateral view, one half of the petiole pruned away by longitudinal section; **E**, scales from petiole base (left: broad scale from lateral face; right: narrow scale from adaxial face); **F**, leaf scars. **A, B, C**, Janssen et al. 2746, P; **A', F**, Janssen et al. 2743, P; **A'', D, E**, Janssen et al. 2747, P. Scale bars: **A-A''**, **E, F**, 1 cm; **B**, 1 m; **C, D**, 5 cm.

and costules stramineous, often tinged with red on abaxial face.

Largest pinnules: (3-)3.5-4 × 0.6-0.8 cm, sessile with an obtuse to truncate base, rarely auriculate, lanceolate to oblong, slightly falciform in their apical half, margin subentire, slightly revolute, rarely strongly and regularly crenate throughout, apex acute to obtuse, usually getting sharper from proximal to distal pinnules, with serrulate to crenulate margin, veins 1-2 furcate.

Scales and hairs: scales of the petiole base ascending up to 30 cm, more or less persistent, narrowly triangular, 3-4 × 0.2-0.3 cm, with long caudate twisted apex, shiny dark brown with a light brown (usually eroded) margin, spreading and with a tendency to agglutinate among themselves, but with their basal parts only, lateral scales usually shorter and with a broader base (usually about 0.3 cm), adaxial surface of costae and base of costulae with comparatively sparse, light brown, tortuous multicellular hairs, otherwise all axes glabrous except for scattered (often acaroid) squamules, adaxial face of rachis without hairs.

Sori: subcostular, separate to contiguous, covering entire pinnules (except their apex), but sometimes ascending only to 1/2, indusia globular, very thin and often inconspicuous, only a small collar-like rudiment around the base of the receptacle persists at maturity, receptacle capitate, with short inconspicuous paraphyses.

Spores: trilete, diameter (dehydrated) 50-60 µm, surface covered by slender rodlets.

DISTRIBUTION

Mauritius, endemic.

ECOLOGY

600-700 m. Middle elevation evergreen forest ("upland forest"). Inside the forest and on forest margins.

REMARKS

The plants are easily distinguishable in the field from *Cyathea borbonica* var. *sevathiana* and *Cyathea borbonica* var. *borbonica* by their stout habit with a usually umbrella-shaped crown and the strongly muricate trunk surface. In herbarium specimens,

larger sized and more distant, more or less herbaceous pinnae and pinnules as well as larger, shiny brown scales are discriminative characters.

Pinna shape in this taxon is variable. It ranges from rather broad pinnules with acute apices (Fig. 2A') to narrower pinnules with obtuse apices (Fig. 2A), which may in rare cases be regularly crenate throughout (Fig. 2A"). The first condition appears to be usually associated with sterile material (cf. the isoelectotype, *Sieber fl. mixt. exs. 304*, at P!) whereas the second condition is usually associated with fertile material (cf. the lectotype, *Sieber fl. mixt. exs. 304*, at K!, or the epitype *Janssen et al. 2746*, P!), although more material is needed to confirm this observation.

The specimen *Janssen et al. 2744* (P, MAU) is morphologically distinct in having smaller pinnules, 2-2.3 × 0.6-0.7 cm, with a rounded apex. The specimen was taken from a young fertile plant found near a population of *Cyathea borbonica* var. *latifolia* in a shady forest habitat. The specimen is distinct from *Cyathea borbonica* var. *sevathiana* by its arching crown and the patent, herbaceous pinnules. Crown shape and the atropurpureous rachis differentiate the specimen from *Cyathea borbonica* var. *borbonica* from Réunion.

VERNACULAR NAME

Fandia.

TYPIFICATION AND SYNONYMY

The varietal type (K!) is a sheet containing a specimen (one detached pinna), *Sieber fl. mixt. exs. 304*, Mauritius, together with a specimen (two detached pinnae), *Bojer s.n.*, "hab. in sylvis vastis insula Mauriti", both collections being cited in the protologue. There is a second sheet, *Bojer s.n.* (K!), carrying a specimen identical to the Bojer collection on the first sheet. The first sheet, containing Bojer's together with Sieber's specimen, carries the following annotation by Holttum making reference to the two above-mentioned sheets and the illustration accompanying the protologue of *Cyathea canaliculata* var. *latifolia* Hook.: "The two Bojer specimens differ from the Sieber specimen in venation and indusia: t. XIII A is mainly from Sieber, but shows some details from Bojer, 22.4.1980". We agree with this statement adding that *Cyathea*

borbonica var. *latifolia* exhibits considerable variability in pinnule shape (Fig. 2A-A") and that both collections, *Sieber fl. mixt. exs. 304* and *Bojer s.n.*, can undoubtedly be regarded as being conspecific. We designate *Sieber fl. mixt. exs. 304* the lectotype of the species following Holttum, who did not lectotypify but attached a holotype label to the Sieber specimen preferring it, as is also clear from his annotation, over the Bojer specimen.

Although the variety is rather well characterized by pinnule size, we chose to support the fragmentary type collection by designating an epitype providing scale characters and annotations concerning the plant habit in order to facilitate its separation from the other varieties of *Cyathea borbonica*.

The epithet *latifolia*, based on Hooker's type, has been combined under *Cyathea borbonica* Desv. by Bonaparte (1920: 48; *pro varietate*), and Christensen (1932; *pro forma*). It has been applied by these authors and Tardieu-Blot (1951) to broad-leaved forms of a Madagascan tree fern with adnate pinnules that is most likely only distantly related to the Mascarene taxa (Janssen & Rakotondrainibe unpubl.).

3. *Cyathea borbonica* Desv. var. *sevathiana*

Th. Janssen & Rakotondr., var. nov.

(Fig. 3)

A C. borbonicae Desv. var. *borbonicae et a C. borbonicae* var. *latifoliae* (Hook.) Bonap. *differt pinnulis minoribus, 1.5-2(-2.8) cm longis, 0.4-0.5 cm latis, coriaceis, conduplicatis, apice rotundo, margine plus minusve revolutis; rhachi fere atropurpurea; trunco usque ad 1 m alto; corona infundibuliformi rhachibus rectis erectis pinnis pinnulisque conduplicatis; paleis basis petioli lucidis atro-castaneis, distortis, angustissimis.*

TYPUS. — **Mauritius.** Black River gorges NP, Pétrin Field Station, 700 m, 5.IV.2005, *Janssen et al. 2748* (holo-, P!; iso-, MAU!).

ADDITIONAL MATERIAL EXAMINED. — **Mauritius.** NW of Mt. Cocotte, near waterfall, XI.1967, *Barclay 437* (K). — *Boivin s.n.* (P). — *Boivin s.n.* (W [2]). — In sylvis, *Bojer s.n.* (BM, K, M). — *Bojer s.n.* (K, W). — Pétrin (Réserve), 15.IV.1974, *Bosser 21867* (P). — Plaine Champagne, 4.VI.1976, *Cadet 5496* (REU). — *Lemann s.n.* (BM). — Pétrin Nature Reserve, 14.XI.1975, *Lorence 1492* (MAU). — Curepipe, 14.VII.1963, *Raub 10101* (BM). — Rivière Chevrettes, 17.X.1968, *Vaughan s.n.*

(MAU). — *Anon. s.n.* (MAU, W).

Without or with doubtful locality. *Boivin s.n.* (P). — *Hooker s.n.* (P). — Ins. Bourbonia [?], *Lenorman s.n.* (B). — *Anon. s.n.* (P).

DESCRIPTION

Trunk: up to 1 m tall, diameter 6-9 cm, its surface blackish, muricate, petiole bases persistent almost to the base, with their long sigmoid base appressed to the trunk and their apices spreading, but only persisting in rudiments at the base of the trunk.

Leaf scars: displaying three cavities on their lower rim.

Crown: funnel-shaped, with the petioles and rachises stiffly erect.

Trunk apex: hidden by close standing sigmoid petiole bases.

Petiole: 2-10 cm long, diameter 1.5-2 cm, usually atropurpureous, rarely light brown when dry.

Lamina: bipinnate, elliptic to oblanceolate, 125-140 cm long, 45-70 cm wide at its widest point (75-80 cm from base of lamina), bearing 28-33 pinna pairs, basal pinnae gradually reduced in size, retroflexed and conduplicate, lamina coriaceous, pale green on abaxial face, shiny dark green on adaxial face, rachis coloured like petiole.

Largest pinnae: 17-25(-30) cm long, spaced by (2.5-)3-4.5 cm, separate to slightly overlapping, all conduplicate, costae and costules stramineous, often tinged with red on abaxial face or completely atropurpureous, rarely light brown when dry.

Largest pinnules: 1.5-2 × 0.4-0.5 cm, gap between adjacent pinnules equalling 1/2 to 1/1 their width, sessile with obtuse to truncate base, never auriculate, oblong, not markedly falciform (apex somewhat asymmetric), more or less strongly conduplicate, margin subentire, more or less strongly revolute, apex rounded to obtuse, with finely crenulate margin, veins 1-2-furcate.

Scales and hairs: scales of the petiole base ascending up to 20(-25) cm, persistent, very narrowly triangular, 2.5-3 × 0.1-0.2 cm, dull to shiny brown with a narrow light brown (usually eroded) margin, more or less appressed, but their slightly twisted apex usually spreading, adaxial surface of rachis and costae with comparatively sparse light brown, tortuous multicellular hairs, otherwise all axes glabrous except for scattered (often acaroid) squamules.

Sori: subcostular, appearing median in narrow pinnules with strongly revolute margin, separate to contiguous, covering entire pinnules (except their apex), but sometimes ascending only to 1/2, indusia globular, membranous, dehiscing in 2 or 3 lobes, receptacle capitate, with short inconspicuous paraphyses.

Spores: trilete, diameter (dehydrated) 50-60 µm, surface covered by slender rodlets.

DISTRIBUTION

Mauritius, endemic.

ECOLOGY

Around 700 m. Forest margins and open, marshy habitats. Data were available for two specimens only.

REMARKS

This taxon can be distinguished from *Cyathea borbonica* var. *borbonica* and *Cyathea borbonica* var. *latifolia* by its smaller and coriaceous pinnules with usually rounded apices, and by its stiffly erect leaves with conduplicate pinnae and pinnules. Apart from characters observable in herbarium specimens, that are however mainly of quantitative nature, its particular habit in the field, which does not seem to be linked to specific ecological conditions makes this a distinctive taxon. Specimens of this variety have frequently been determined as *Cyathea canaliculata* or *C. borbonica*.

VERNACULAR NAME

Fandia.

ETYMOLOGY

The name of this variety has been chosen in honour of Jean-Claude Sevathian, field botanist in the service of Mauritian Wildlife Foundation who efficiently guided our fieldwork on Mauritius.

4. *Cyathea cooperi* (F.Muell.) Domin

Pteridophyta 262 (1929); Bostock, *Flora of Australia* 48: 202 (1998). — *Alsophila cooperi* F.Muell., *Fragmenta Phytographiae Australis* 5: 117 (1865-1866). — *Alsophila cooperi* Hook. & Baker, *Synopsis Filicum*, ed. 2, 459 (1874), *nom. illeg.* — *Alsophila excelsa* var. *cooperi*

(F.Muell.) Domin, *Bibliotheca Botanica* 20 (85): 31 (1914). — *Cyathea brownii* var. *cooperi* (F.Muell.) Domin, *Acta Botanica Bohemica* 9: 101 (1930). — *Sphaeropteris cooperi* (F.Muell.) R.M.Tryon, *Contributions from the Gray Herbarium* 200: 24 (1970). — Type: Australia, Wollongong, *Woolfs s.n.* (lecto-, MELI, designated by Tindale 1956: 358).

ADDITIONAL MATERIAL EXAMINED. — **Mauritius.** Macabé, 3.XII.1973, *Badré 1065* (P). — Mare Longue, 8.XII.1999, *Florens & Sevathian 3* (MAU); 1 p.p. (MAU). — Mont Lagrave, 17.IX.1974, *Lorence 976* (P). — Réduit, 18.IX.1974, *Lorence 983* (P). — Valley of cascade, 500 pieds, 13.III.1975, *Lorence 1168* (K, P). — Same locality, 11.V.1975, *Lorence 1233* (K, P). — Macabé, Black River gorge, Plaine Champagne, Cocotte Mts, *Ratcliffe s.n.* (BM). — Crown Land Gouly Père, near Grand Bassin, 13.XI.1968, *Vaughan 13917* (K).

Réunion. Route de La Plaine des Palmistes entre St-Benoît et La Plaine des Palmistes, 28.XI.1974, *Badré 1034* (K). — Route nationale 3 entre Le Tampon et Le Dix-Neuvième, 2.IV.2005, *Janssen et al. 2731* (MO, P). — Petite Plaine, 6.XI.2004, *Rakotondrainibe et al. 6921* (P). — Same locality, 6.XI.2004, *Rakotondrainibe et al. 6921 bis* (P).

DESCRIPTION

Cyathea cooperi can be easily distinguished from all native species by its yellowish-green foliage, the absent indusium being mimicked by ciliate scales inserted at the base of the receptacle, and its conspicuous whitish scales at the petiole base that are mixed with short, brown, filiform scales. The scales have a regularly setate margin composed of cells being conform to the elongate cells in the scale center.

DISTRIBUTION

Australia, widely cultivated, occasionally naturalized and invasive elsewhere. Introduced in the Mascarenes.

ECOLOGY

In the Mascarenes in roadside and open habitats and especially on Réunion frequently planted on private property. Becoming established also inside natural forests.

REMARKS

No data were available on the date of arrival of the species on the Mascarenes where it is, especially on

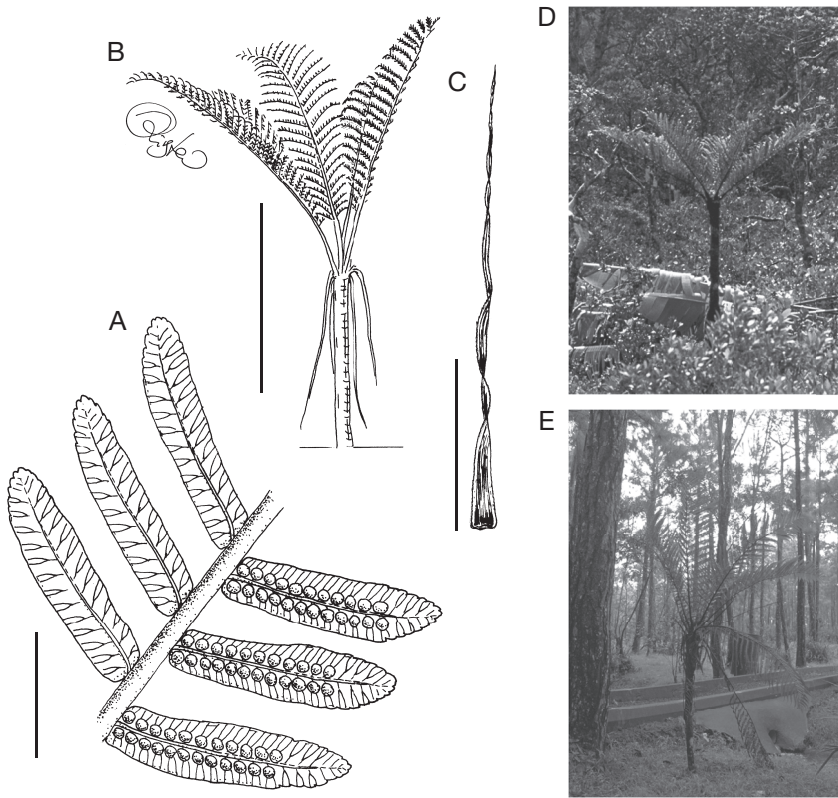


FIG. 3. — *Cyathea borbonica* Desv. var. *sevathiana* Th.Janssen & Rakotondr., var. nov.: **A**, pinnules abaxially with part of costa (sori partly omitted); **B**, habit; **C**, scale from petiole base; **D**, **E**, plants near the Pétrin Field Station, Black River gorges National Park, Mauritius. A-C, E, Janssen *et al.* 2748; **D**, uncollected. Scale bars: A, C, 1 cm; B, 1 m.

Réunion, becoming a serious weed. A few decades ago, and certainly before 1980, *Cyathea cooperi* was already in cultivation and established in a few natural forests, when this tree fern has been mistakenly multiplied and planted as a native by private growers and public authorities. Presently, *Cyathea cooperi* seems to spread from artificial roadside habitats to natural forests where young plants have been observed with increased frequency during recent years (Tho 2005; E. Grangaud pers. comm.; L. Tron pers. comm.). The species' wide ecological amplitude and high growth rate support its propagation. Currently, the National Forest Agency and environmental organizations are aware of the invasion threat and deploy important educational and practical measures to protect natural forests. On Mauritius, *Cyathea cooperi* seems to be

somewhat less invasive, but conservation measures are locally applied (Tho 2005).

5. *Cyathea excelsa* Sw. (Figs 4; 7B; 8D)

Journal für die Botanik (Schrader) 2: 93 (1800); Bojer, *Hortus Mauritianus* 388 (1837); Baker, *Flora of Mauritius and the Seychelles* 467 (1877); Cordemoy, *Flore de l'île de La Réunion* 39 (1895); Tardieu, *Notulae Systematicae* (Paris) 16: 156 (1960). — *Alsophila celsa* R.M.Tryon, *Contributions from the Gray Herbarium* 200: 30 (1970). — Type: ex insula Mauritii, Gröndal s.n. (lecto-, S! in hb. Swartz no. 3245, here designated; isolecto-, S!, UPS).

Cyathea canaliculata Willd. ex Spreng., *Systema Vegetabilium* 4: 126 (1827); Kaulfuss, *Enumeratio Filicum*

260 (1824), *nom. nud.*; Bojer, *Hortus Mauritianus* 388 (1837); Baker, *Flora of Mauritius and the Seychelles* 466 (1877); Baker in Hooker & Baker, *Synopsis Filicum*, ed. 2, 23 (1883); Cordemoy, *Flore de l'île de La Réunion* 39 (1895). — Type: Habitat in insula Mauritii, *A. du Petit-Thouars s.n.* (holo-, B-W! no. 20184; iso-, P! in hb. Luerssen no. 11216, fragment).

ADDITIONAL MATERIAL EXAMINED. — **Mauritius.** *Ayres s.n.* p.p. (B). — Sentier Nord vers le bassin Blanc, 6.XII.1973, *Badré 1089* (P). — Bois des parties élevées du Pouce, VIII.1849, *Boivin s.n.* (P). — *Boivin s.n.* (P). — In sylvis, *Bojer s.n.* (G). — In altis montibus, *Bojer s.n.* (K). — In sylvis in monte Pouce, *Bojer s.n.* (K). — *Bojer s.n.* (K, MAU). — *Bordas s.n.* (K, P). — Camp de Masque, *Bory de St-Vincent s.n.* (P). — *Bory de St-Vincent 24* (B-W). — *Bouron s.n.* (B, P). — *Duncan s.n.* (BM). — *Düring s.n.* (B). — *Gaudichaud s.n.* (B). — Black River gorges NP, chemin vers mt Cocotte, 20°26'19"S, 57°28'27"E, 728 m, 4.IV.2005, *Janssen et al. 2739* (MO, P). — *Idem*, Brise Fer Conservation Management Area, 5.IV.2005, *Janssen et al. 2745* (MO, P). — *Idem*, Pigeon Wood Field Station, 20°26'22"S, 57°28'54"E, 707 m, 5.IV.2005, *Janssen et al. 2749* (MO, P). — Montagne du Pouce, 7.VII.1887, *Johnston s.n.* (K). — Bassin Blanc crater, 25.X.1975, *Lorence 1464* (MAU, P). — Shoulder of Pouce, 2.I.1865, *Meller s.n.* (MAU). — *Néraud s.n.* (G). — La Pouce, 13.VII.1963, *Rauh 10086* (BM). — Curepipe, *Rawson 24* (BM). — *Richard s.n.* (P [2]). — *Sieber s.n.* (BM). — La Hance Garden[?], *Sieber syn. fil. exs. 58* (B, BM, G, K, P). — *Sieber fl. mixt. exs. 303* (B, BM, G, P). — *Telfaire s.n.* (K). — *Waglit s.n.* (K). — *Wallich 357* (BM). — Summit of the Pouce, VII.1858, *Anon. s.n.* (P). — *Anon. s.n.* (B [6], G, P). — *Anon. 35* (P).

Réunion. Sentier vers la Roche Écrite, forêt avant la plaine des Chicots, 25.XI.1973, *Badré 1031* (P). — Same locality, 25.XI.1970, *Barclay 2054* (K). — *Baudouin 259* (P). — *Bernier 22* (P). — *Boivin s.n.* (G, P). — *Boivin 899* (B, G). — Forêt du quartier Moka, *Bory de St-Vincent s.n.* (P). — *Bréon s.n.* (P). — *Carmichael s.n.* (BM, K). — *De Cordemoy s.n.* (P [2]). — V.1875, *de Cordemoy 14* (K). — *De Cordemoy 157* (P). — *Gaudichaud s.n.* (G). — *De l'Isle G 579* (P). — St-Philippe, forêt de Mare Longue, sentier botanique, puis sentier GR R.2, 21°21'18"S, 55°44'22"E, 190-300 m, 31.III.2005, *Janssen et al. 2700* (MO, P). — Le Maïdo, forêt de Maïdo, route forestière des Tamarins, au croisement avec le ravin Bras la Pompe, 21°04'27"S, 55°21'42"E, 1745 m, 1.IV.2005, *Janssen et al. 2713* (MO, P). — Forêt de Bébour, sentier pédagogique de Bras Cabot, 21°07'30"S, 55°34'20"E, 1348 m, 2.IV.2005, *Janssen et al. 2723* (P); 2737 (MO, P). — Forêt de Bébour, sentier de la rivière, 21°06'53"S, 55°33'54"E, 1360 m, 2.IV.2005, *Janssen et al. 2729* (P); 2730 (P). — *Leprieur 83* (P). — *Rawson 25* (BM). — *Richard s.n.* (P [2]). — *Richard 239* (P). — *Vieillard s.n.* (B, P). — Bois des hauts de St-Paul, 2.VI.1882, *Anon.*

67 (P). — VI.1848, *Anon. s.n.* (P). — *Anon. s.n.* in hb. Maire (P). — *Anon. s.n.* (B, G, K).

Without or with doubtful locality. Bourbon ou Maurice, *Boivin 899* (P). — *Forster s.n.* (UPS). — *Anon. s.n.* (K [2]). — *Anon. 30* (BM [3]).

DESCRIPTION

Trunk: 2-5(-10) m tall, diameter 15-20 cm including the always persistent, strongly muricate, blackish to greyish brown dead petiole bases, that completely cover the trunk in apparently vertical rows, but are more or less eroded in the lower half of the trunk.

Crown: large, umbrella-shaped, with arcuate rachises.

Trunk apex: visible through the distant, straight to arcuate petiole bases, blunt, densely scaly.

Petiole: 10-40(-90) cm long, diameter 4-4.5 cm, coarsely and distantly muricate, green, abaxial face (reddish) brown, 1-2 subcontinuous line(s) of white aerophores on either side, occasionally a pair of pinnae of reduced size is found between the base and middle of the petiole.

Lamina: bipinnate-pinnatisect, elliptical, 200-260 cm long, 110-160 cm wide at its widest point (110-120 cm from base of lamina), bearing 13-17 alternate pinna pairs, its base acute to obtuse, with pinnae rather abruptly reduced in size and usually increasingly spaced towards the base, basal pinnae more or less conduplicate, lamina herbaceous to subcoriaceous, more or less shiny green on both faces, rachis and costae smooth to finely muricate, glabrous, green to yellowish green, (reddish) brown on abaxial face.

Largest pinnae: 55-65 cm long, spaced by 10-15 cm, separate to contiguous, widest in or below their middle.

Largest pinnules: 12-14 × 1.5-2.5 cm, contiguous to distant, sessile, basal pair of segments overlapping the costae, oblong, apex long caudate, pinnatisect with 3-4 mm wide adnate segments (the basalmost sessile), base of segments more or less broadened, proximally slightly decurrent, usually narrowly confluent at their bases, sinuses between adjacent segments more or less V-shaped, segments falciform, apex acute to obtuse, margin revolute and distantly serrulate to subentire in lower 2/3 of segment, flat and conspicuously serrulate in upper

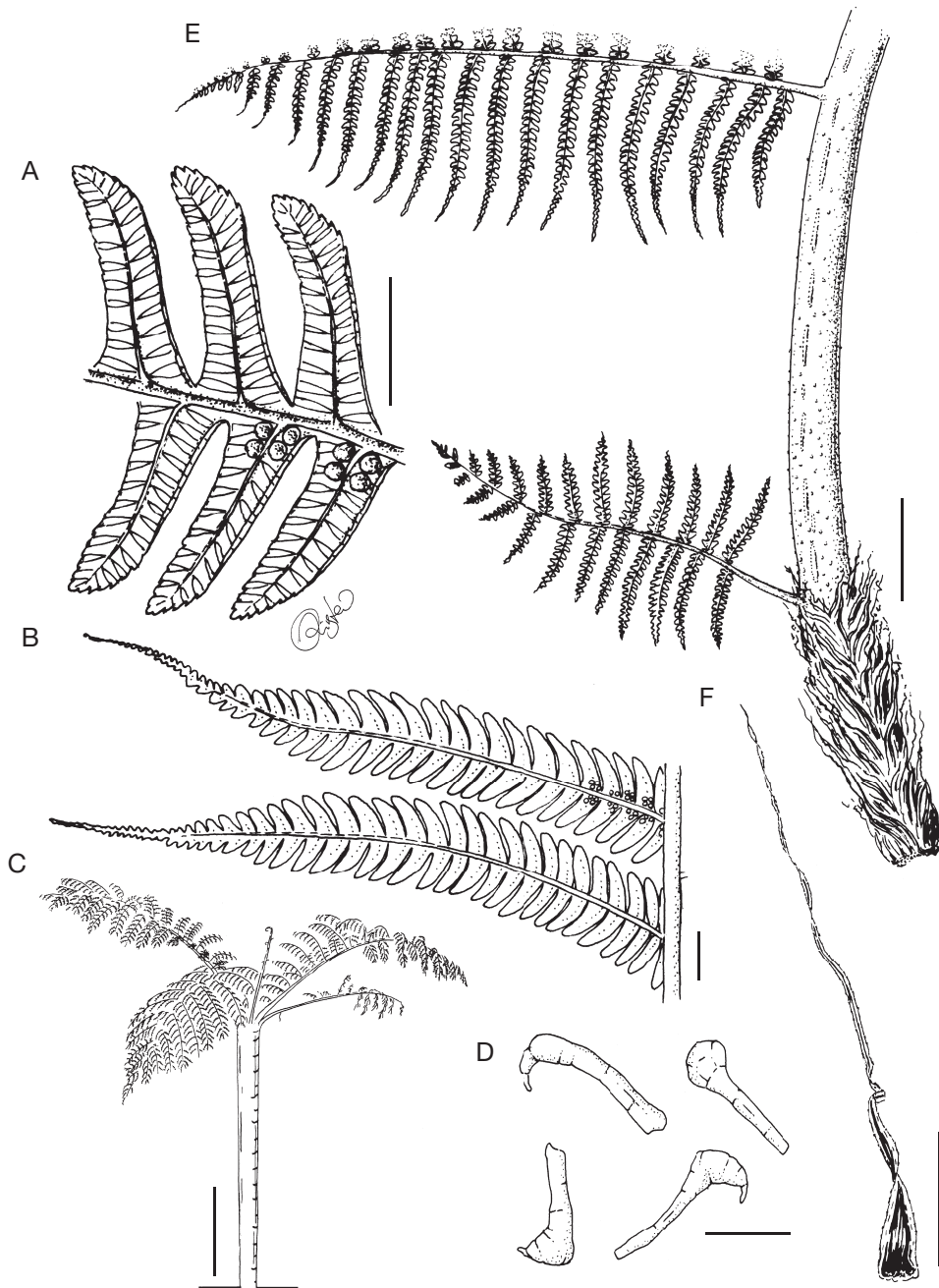


FIG. 4. — *Cyathea excelsa* Sw.: **A**, pinnule segments abaxially with part of costula (sori partly omitted); **B**, two pinnules abaxially with part of costa (sori partly omitted); **C**, habit; **D**, four sporangiasters from the receptacle; **E**, basal part of the leaf (petiole base up to first pinna), lateral view, one half of the petiole pruned away by longitudinal section, a pair of reduced pinnae is present at 14 cm from the petiole base; **F**, scale from petiole base. A-C, E, F, Janssen *et al.* 2749, P; D, Boivin *s.n.*, P. Scale bars: A, 0.5 cm; B, F, 1 cm; C, 1 m; D, 200 μm; E, 5 cm.

1/3 of segment, veins 1-2-furcate, rarely more often in forms with strongly serrate margins.

Scales and hairs: scales of the petiole base ascending up to 15 cm, caducous, narrowly triangular, 3-4.5 × 0.2-0.4 cm, twisted, dark brown, shiny, with narrow light brown toothed margin, spreading, petiole with brown caducous tomentum of short hairs and squamules, usually not dense, adaxial face of rachis and costae with dense, light brown, crispate antrorse multicellular hairs.

Sori: up to 5 pairs at the base of each segment, rarely covering entire segments and often confined to or even solitary at the base of the segments, contiguous, indusia globose, membranous, light brown, dehiscing irregularly in 2 or 3 lobes, receptacle capitate to short columnar, generally shorter than remnants of opened indusium, sporangia mixed with light brown to black sporangiasters consisting of a stalk composed by 3 or 4 rows of cells and a club-shaped head bearing a very short (1 or 2 cells) apical hair, sporangiasters are usually absent from specimens from Réunion which, in turn, exhibit short paraphyses among sporangia.

Spores: trilete, diameter (dehydrated) 30-40 µm, surface verrucose.

DISTRIBUTION

Mauritius, Réunion, endemic.

ECOLOGY

200-1700 m. Evergreen forest of various elevation although the species seems to prefer shaded habitats and is consequently rare in open vegetation of high altitudes.

REMARKS

The taxon is clearly distinct from all tripinnate taxa encountered in Madagascar and the Comoros by the cutting of its lamina in combination with globose indusia. On Réunion, *Cyathea excelsa* can be most easily distinguished from *C. glauca* by the slightly confluent pinnule segments with a serrulate apex in cases where the examination of the axial indument leaves any doubt. The receptacles of all specimens from Mauritius bear sporangiasters similar to those of *Cyathea grangaudiana*, although their head tends to be smaller and club-shaped bearing a shorter

apical hair. Sporangiasters are present in about 16% of the collections from Réunion, provided the locality information on the labels can be trusted. These are all ancient and fragmentary collections and sporangiasters have not been observed during recent fieldwork in *Cyathea excelsa* from Réunion. The lectotype of *C. excelsa* and the holotype of *C. canaliculata* display black sporangiasters. As we can currently only hypothesize about the nature and origin of this structure, which appears to be largely endemic to Mauritius, we prefer not to recognize the specimens from Réunion lacking sporangiasters as a variety. A single fragmentary specimen with strongly crenate segments in their lower soriferous half and subentire acute apex as well as with cup-shaped somewhat emarginate indusia from Réunion exists at P!, *Anon. s.n.* in hb. Maire. If the collection locality is correct, it is at present best to assign it to *Cyathea excelsa*, although with hesitation.

VERNACULAR NAMES

Fanjan femelle (apparently less frequently used than for *Cyathea glauca*), fanjan, fandia.

TYPIFICATION AND SYNONYMY

In the Swartz herbarium at S three equivalent sheets of a collection by *Gröndal s.n.* from Mauritius are present, all corresponding to the protologue and carrying Swartz' autograph. A holotype specimen is not obvious from Swartz' annotations. We here designate the specimen with the registration number 3245 as the lectotype and consider the two other sheets (no. 3248 and no. 3307) as well as one sheet marked *Gröndal* at UPS as isolectotypes. Although the type is fragmentary, it is well distinguished from the other tripinnate species by the cutting of its lamina and its axial indument making the designation of an epitype unnecessary.

Kuhn (1868: 163) is the first to publish a reference to *du Petit-Thouars s.n.* in hb. Willdenow (B-W) no. 20184 as the type of *Cyathea canaliculata* Willd. ex Spreng. which is the only specimen we could trace bearing a description of the taxon in Willdenow's hand. It consists of a single pinna without its adjacent rachis fragment. The name *Cyathea canaliculata* has been widely misapplied to designate virtually all, pinnate-pinnatisect to

tripinnate, taxa of Cyatheaaceae from the Mascarene islands (usually to the exception of *Cyathea glauca* Bory). Willdenow's original description of *Cyathea canaliculata* is glued on the cover of the type specimen in B-W! and has never been published: "*Cyathea canaliculata* frondis triplicato-pinnatis, pinnulis ovato acuminatis, stipite canaliculato glabro canali villosa, caudice arboreo". In contradiction to this, Sprengel (1827: 126) characterizes the species in his validating description by "fronde 2 pinnata". Baker in Hooker & Baker (1883: 23) also describes the species as being "bipinnate" and confirms the confusion having arisen from the fragmentary type by remarking: "It is possible that this may have tripinnate fronds, but my numerous specimens are not large enough to indicate if it be so".

Several authors (Bojer 1837; Baker 1877; Cordemoy 1895; Tardieu-Blot 1960) cite *Cyathea arborea* (L.) Sm., *Mémoires de l'Académie royale des Sciences* (Turin) 5: 416 (1793), as a synonym of *Cyathea excelsa* following Bory (1804: 179), although it is not obvious from Bory's text to which Mascarene tree fern species he refers. The neotropical *Cyathea arborea* is certainly distinct from all Mascarene species.

6. *Cyathea glauca* Bory (Figs 5; 7A; 8E)

Voyage dans les quatre principales îles des mers d'Afrique 2: 206 (1804); Cordemoy, *Flore de l'île de La Réunion* 39 (1895); Tardieu, *Norulae Systematicae* (Paris) 16: 156 (1960). — *Alsophila glaucifolia* R.M. Tryon, *Contributions from the Gray herbarium* 200: 30 (1970). — Type: "Le plus bel arbre de la plaine des Osmondes, dans l'enclos du volcan", Île des Mascareignes, Bory s.n. (holo-, P!; iso-, B-W! no. 20171; putative iso-, BM!).

ADDITIONAL MATERIAL EXAMINED. — Réunion. Sentier vers la Roche Écrite, forêt avant la plaine des Chicots, 25.XI.1973, Badré 1030 (P). — Balfour s.n. (B, K [2]). — Sentier de la Roche Écrite, 25.XI.1970, Barclay 2055 (K, MAU). — Baudouin 724 (P). — Plaine des Chicots, environs du gîte de la Roche Écrite, 25.IV.1980, Billet et al. 836 (K). — Plaine des Palmistes, montée de la Plaine des Cafres, Le Boucan, VI.1851, Boivin s.n. (P). — Boivin s.n. (B, G, K, P [2]). — Bory de St-Vincent 23 (B-W). — Bory de St-Vincent 332 (P). — Brenner s.n. (P). — V.1875, de Cordemoy 19 (K). — De Cordemoy 136 (P). — Frappier s.n. (P). — Gaudichaud s.n. (G). — Geay s.n. (P). — Bélouve, 24.IX.1875, de l'Isle 578 (K,

P). — Col de Bellevue, chemin vers Gros Piton Rond, 21°09'20"S, 55°35'54"E, 1425 m, 30.III.2005, Janssen et al. 2683 (MO, P). — *Idem*, colline à côté du parking au point culminant de la route nationale 3, 21°09'20"S, 55°35'54"E, 1433 m, 30.III.2005, Janssen et al. 2686 (MO, P). — Le Maïdo, route du Maïdo, à 2 km du sommet, 21°03'42"S, 55°22'46"E, 1965 m, 1.IV.2005, Janssen et al. 2709 (P); 2710 (MO, P). — Same locality, 1976 m, Janssen et al. 2711 (MO, P). — Forêt de Bébou, sentier pédagogique de Bras Cabot, 21°07'30"S, 55°34'20"E, 1348 m, 2.IV.2005, Janssen et al. 2715 (P); 2721 (MO, P); 2722 (P). — Forêt de Bébou, sentier de la rivière, 21°06'53"S, 55°33'54"E, 1360 m, 2.IV.2005, Janssen et al. 2727 (MO, P; REU); 2728 (P). — St-Denis, RN Roche Écrite, sentier menant du parking à la fin de la route forestière de la Roche Écrite vers la plaine des Chicots, 20°57'30"S, 55°26'21"E, 1335-1918 m, 7.IV.2005, Janssen et al. 2751 (MO, P); 2752 (MO, P). — *Idem*, juste en dessous du gîte d'étape de l'ONF, 20°59'06"S, 55°26'44"E, 1810 m, 7.IV.2005, Janssen et al. 2753 (MO, P). — Plaine des Cafres, au Piton Desforges, 9.XII.1969, Onraedt R116 (K). — Piton de la Mare à Boue, Plaine des Cafres, à 2 km à l'ouest du col de Bellevue, 6.XI.2004, Rakotondrainibe et al. 6918 (P). — Forêt de Bébou, col de Bébou, 5.XI.2004, Rakotondrainibe et al. 6913 (P). — Bélouve, 19.IX.1882, Anon. s.n. (P). — Anon. s.n. in hb. Vilmorin (P). — Anon. s.n. (P).

DESCRIPTION

Trunk: 1-5 m tall, diameter (9-)10-14 cm (up to 17 cm including the occasionally persistent petiole bases), its surface brown to greyish, muricate, more or less rudimentary scaly, petiole bases usually only persistent in upper part of the trunk, more or less rapidly caducous and exposing the leaf scars, trunk frequently with short ramifications near its apex.

Leaf scars: 3.5-7.5 × 3.5-4.5 cm, elliptic to distinctly rhombiform, rather close standing, with several shallow cavities on lower rim and below.

Crown: rather variable in size, more or less umbrella-shaped with long arching to rather straight and short petioles and rachises, leaves spirally arranged in approximately six orthostichies.

Trunk apex: visible through the distant arcuate to sigmoid petiole bases, blunt, densely scaly, occasionally obscured by pinnae of reduced size crowded at the petiole bases.

Petiole: (25-)50-100(-120) cm long, diameter 3.5-4 cm, sparsely muricate, stramineous to green, abaxial face castaneous to dark brown, one row of white to dark brown 0.5-1.5 cm long aerophores on

either side, a pair of pinnae of reduced size (about 15-30 cm long) occasionally inserted at about 10-20 cm from the base of the petiole.

Lamina: bipinnate-pinnatisect, ovate to elliptical, 140-220(-270) cm long, (85-)110-140 cm wide at its widest point (70-80[-120] cm from base of lamina), bearing 12-17 alternate pinna pairs, its base more or less truncate, basal pinnae frequently conduplicate and more or less retroflexed, lamina coriaceous, abaxial face glaucous to pale green, adaxial face shiny bright to dark green, rachis and costae smooth, coloured like the petiole.

Largest pinnae: 48-65 cm long, spaced by 8-12(-15) cm, oblong.

Largest pinnules: 8-10 × 1.5-2 cm, sessile, separate to overlapping, frequently slightly conduplicate, apex acute to shortly caudate, pinnatisect with 2-3 mm wide adnate segments, not widened (occasionally even tapered) towards their base, always clearly separated by a short stretch of the costula, basally confluent towards the pinnule apex, segment apices obtuse to rounded, falciform, with subentire to sinuate, revolute margins, veins once furcate, segments occasionally conduplicate, the basalmost segments of each pinnule sessile to petiolulate, overlapping the costa, and frequently with crenate margins.

Scales and hairs: scales of the petiole base caducous, narrowly triangular, 3-4.5 × 0.2-0.3 cm, with twisted and crispate, long caudate apex, brown, shiny, with narrow light brown ciliate (but often eroded) margin, petiole, rachis, and costae tomentose, bearing orange to light brown intricate, highly branched and crispate multicellular hairs, costulae less densely hairy, adaxial face of rachis and costae (less frequently also costulae) with ciliate-dentate triangular to lanceolate light brown membranous scales, these scales sparse on the abaxial face of the respective axes.

Sori: 1-5 pairs per segment, covering up to 2/3 of the segment, indusia globose, dehiscing in 2 or 3 lobes, receptacle capitate, shorter than rim of opened indusia.

Spores: trilete, diameter (dehydrated) 35-45 µm, surface finely verrucose.

DISTRIBUTION

Réunion, endemic.

ECOLOGY

1300-2000 m. Inside evergreen forest and (more frequently) on crests and slopes amidst low shrubby vegetation.

REMARKS

The taxon is clearly distinct from all Madagascan tripinnate taxa by its tomentum. Because of an occasionally sparse tomentum, the subconfluent segment bases, and a weakly developed colouring of the abaxial lamina surface, it is often impossible to unambiguously distinguish juvenile plants of *Cyathea glauca* from *C. excelsa*. The habit of *C. glauca* is rather variable. Plants in altitudinal, rather exposed habitats have smaller leaves and crowns, frequently subapically branched trunks, quickly decaying dead petiole bases that soon leave the leaf scars exposed, short petioles, stiff rachises, and a very dense axial tomentum as opposed to forms of lower altitude forest habitats with larger leaves and crowns, simple trunks that usually remain covered with dead petiole bases throughout, long and arched petioles, and a less dense tomentum. However, intermediate forms occur and the variation observed being most probably due to ecological conditions does not merit formal taxonomic recognition. *Bory 332*, *Janssen et al. 2752*, and *Anon. s.n.* in hb. Vilmorin (all at P) are distinct by their bigger pinnules (up to 12 × 2.5 cm) with strongly crenate segments. However, intermediate forms occur and this character is in our opinion too variable to justify formal description. According to Badré & Cadet (1978), the leaves of *Cyathea glauca* dry up and are regenerated with annual periodicity during the hot and humid season.

VERNACULAR NAMES

Fanjan femelle (with reference to the trunk base being occasionally widened by adventitious roots), fanjan bleu (*vide* Cordemoy 1895), fanjan.

TYPIFICATION

A specimen consisting of one detached pinna, morphologically completely identical to the holotype (P!), exists in B-W! (no. 20171) bearing the number "23" and being linked to the original material by the remark "envoi à Willdenow sous le no. 23" in

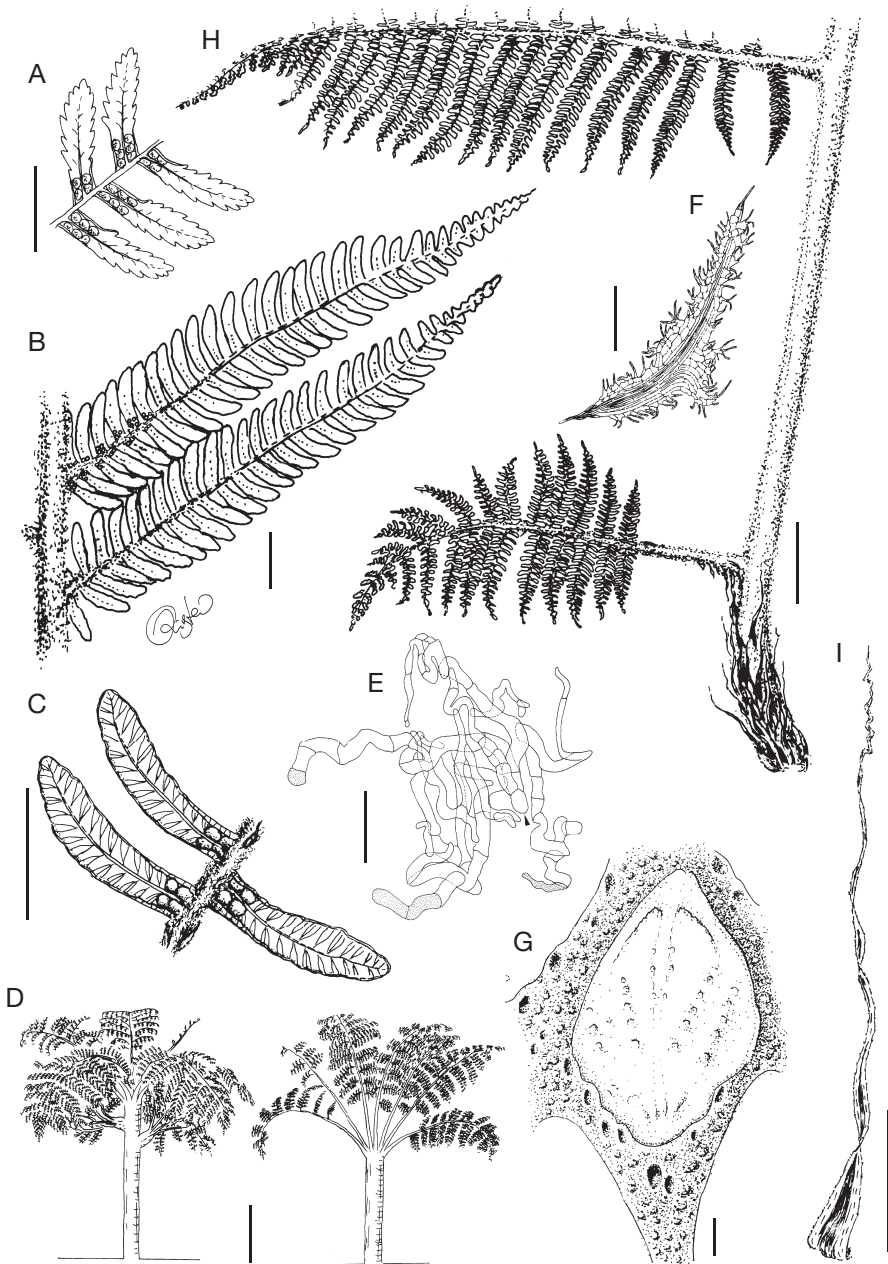


FIG. 5. — *Cyathea glauca* Bory: **A**, strongly crenate form, pinnule segments abaxially with part of costula; **B**, two pinnules abaxially with part of costa (sori partly omitted); **C**, pinnule segments abaxially with part of costula; **D**, habit (left: plant from open habitat on a mountain ridge; right: plant from understorey rainforest habitat); **E**, a single highly branched tortuous hair from the tomentum covering all major axes (arrow: point of attachment); **F**, scale from abaxial face of costula; **G**, leaf scar; **H**, basal part of the leaf (petiole base up to first pinna), lateral view, one half of the petiole pruned away by longitudinal section, a pair of reduced pinnae is present at 13 cm from the petiole base; **I**, scale from petiole base. **A**, *Anon. s.n.* in hb. Vilmorin, P; **B**, **C**, **G**-**I**, *Janssen et al. 2686*, P; **D**, left, *uncollected*, photograph at P; **D**, right, *Janssen et al. 2727*, P; **E**, **F**, *Janssen et al. 2683*, P. Scale bars: **A**, **B**, **G**, **I**, 1 cm; **C**, 0.5 cm; **D**, 1 m; **E**, 100 μ m; **F**, 500 μ m; **H**, 5 cm.

Bory's hand on the holotype specimen. It is hence an isotype. A morphologically identical fragment collected by Bory in 1803, but without number is present at BM! and considered to be a putative isotype. Although fragmentary, Bory's type collection cannot be confounded with any of the species from the region making epitypification unnecessary.

7. *Cyathea grangaudiana*

Th. Janssen & Rakotondr., sp. nov.

(Figs 6; 7D; 8B, F)

Truncus 1-3(-4) m altus, 4-5.5(-8) cm crassus, superficies atro-castanea, muricata, in parte superiore basibus petiolorum emortuorum mox caducis vestitus; cicatrices foliorum 1-1.5(-3) cm longae, 1-1.5 cm latae, ovato-rhombiformes, confertae, paulum eminentes, cavis tribus in margine inferiore; corona horizontaliter expansa vel leviter deflexa, sed folia iuvena plus minusve erecta, orthostichis 6 disposita, pseudo-verticillata; apex trunci basibus sigmoidibus petiolorum obiectus, nonnullae rachides emortuae persistentes, pendentes; petiolus 2-10(-15) cm longus, 2 cm crassus, laevis, atropurpureus, aerophorae subcastaneae remotae ad unam lineam utroque latere dispositae; lamina pinnato-pinnatisecta, anguste lanceolata, 90-100 cm longa, 30-40 cm lata in parte latissima (40-50 cm a basi laminae), coriacea, subtus pallide viridis, 30-40-iugata, pinnae alternae, longitudo pinnarum inferiorum gradatim diminuenda prope usque ad basem petioli, pinnae inferiores reflexae et plus minusve conduplicatae, rhachis atropurpurea; pinnae maximae 20-25 cm longae, 2.5-3.5 cm inter se remotae, distinctae vel margine parum superpositae, costae stramineae vel atrocastaneae; pinnulae maximae 1.5-2 cm longae, 0.4-0.6 cm. latae, ad costam adnatae (duo iuga infima sessiles), margine parum superpositae vel 1/2 ad 2/3 latitudine earum remotae, rectae vel paulum falciformes, apice rotundo vel obtuso, margine crenulato praecipue apicem versus, venis 1(-2)-furcatis, costulis viridibus vel stramineis; paleae et pila: paleae petioli adscendentes usque ad 20 cm, persistentes, angustissime triangulatae, 2-3 cm longae, 1-1.5(-2) mm latae, apice distorto, atro-castaneae, lucidae, adpressae vel porrectae; rhachis, costae et costulae subtus paleis acaroidis minutis conspersis; rhachis costaeque supra pilis acicularibus castaneis paucicellularibus antrorsis dense vestitae; costulae subtus pilis acicularibus paucicellularibus patentis vel antrorsis hyalinis vel subcastaneis sparse conspersae; sori subcostulares, distincti vel contigui, pinnula tota obtegentes, indusia globulosa, irregulariter fissa, sporangia sporangiastris permixta, haec subcastaneae vel ebeneae, pediculo 3-4 ordinibus cellularum constituto, capitulo clavi- vel Γ -formis, ferens in apice pilum paucicellularem hyalinum; spores triletae, diametro (siccae) 50-60 μ m, superficies pilis brevibus angustissimis obiecta.

A Cyathea borbonica Desv. *agg. differt pinnulis costae adnatis, costulis subtus pilis pluricellularibus antrorsis sparse vestitis, sporangiastris atro-castaneis.*

TYPUS. — Black River gorges NP, chemin vers Mt. Cocotte, 20°26'19"S, 57°28'27"E, 728 m, 4.IV.2005, Janssen et al. 2740 (holo-, P!; iso-, MAU!).

ADDITIONAL MATERIAL EXAMINED. — **Mauritius.** *Ayres s.n.* p.p. (B). — Chemin de Brise Fer à environ 500 m de la forêt Macabé, *Badré 1074* (P). — Rivière Noire, Unterlauf, 8.II.1980, *Benl et al. MR44* (M). — Cascade Alexandra, II.1980, *Benl et al. MR81* (M). — *Bijoux s.n.* (MAU) — *Boivin s.n.* (W). — In sylvis vastis locis depressis, *Bojer s.n.* (G). — In montibus campis, *Bojer s.n.* (K). — *Bordas s.n.* (P). — 5.XI.1909, *Bordas s.n.* (K). — *Bouton s.n.* (P). — *Duncan s.n.* (BM). — *Düring s.n.* (B). — Black River gorges, Le Bouton, 6.IV.1977, *Guého s.n.* (MAU). — Black River gorges NP, chemin vers Mt. Cocotte, 20°26'19"S, 57°28'27"E, 728 m, 4.IV.2005, Janssen et al. 2738 (MAU, P); 2741 (MAU, P). — Black River gorges NP, Pigeon Wood Field Station, 20°26'22"S, 57°28'54"E, 707 m, 5.IV.2005, Janssen et al. 2742 (MAU, P). — Mt. Cocotte, 11.XI.1975, *Lorence 1109* (MAU). — Curepipe, *Rawson 22* (BM). — Les Mares, 19.III.1946, *Rochecouste s.n.* (MAU). — *Sieber s.n.* (B, P [3]). — *Sieber syn. fil. exs. 59* (B, BM, G, K, P, W). — *Sieber fl. mixt. exs. 305* (B, BM). — Pétrin, Grand Bassin Range, rivière du Pate, 11.VII.1961, *St. John 26494* (G, K). — In sylvis, *Wallich 182* (BM). — *Anon. s.n.* in hb. Bélanger (P). — *Anon. s.n.* (B [4], K, MAU [4], P).

Without or with doubtful locality. *Boivin s.n.* (P). — *Bouton s.n.* (P). — *Friedman 3102* (P). — *Anon. s.n.* in hb. Desvieux p.p. (P, mounted together with the lectotype of *C. borbonica* Desv.). — *Hooker s.n.* (P). — *McGregor s.n.* (BM). — *Newton s.n.* (K). — *Du Petit-Thouars s.n.* (P). — *Anon. 29* (BM). — *Anon. s.n.* 33 in hb. Doerfler (P). — *Anon. 6124* p.p. (P). — *Anon. s.n.* (K, P [3], W [2]).

DESCRIPTION

Trunk: 1-3(-4) m tall, diameter 4-5.5(-8) cm, its surface blackish brown, muricate, covered by dead petiole bases in its upper part, but these soon caducous and exposing the leaf scars.

Leaf scars: 1-1.5(-3) × 1-1.5 cm, ovate to rhombiform, close standing and slightly raised, displaying three shallow cavities on their lower rim.

Crown: flat, the petioles and relatively stiff rachises more or less straight and spreading horizontally, sometimes deflexed, but young leaves more or less erect, arranged in approximately six orthostichies forming more or less well-developed pseudoverticils.

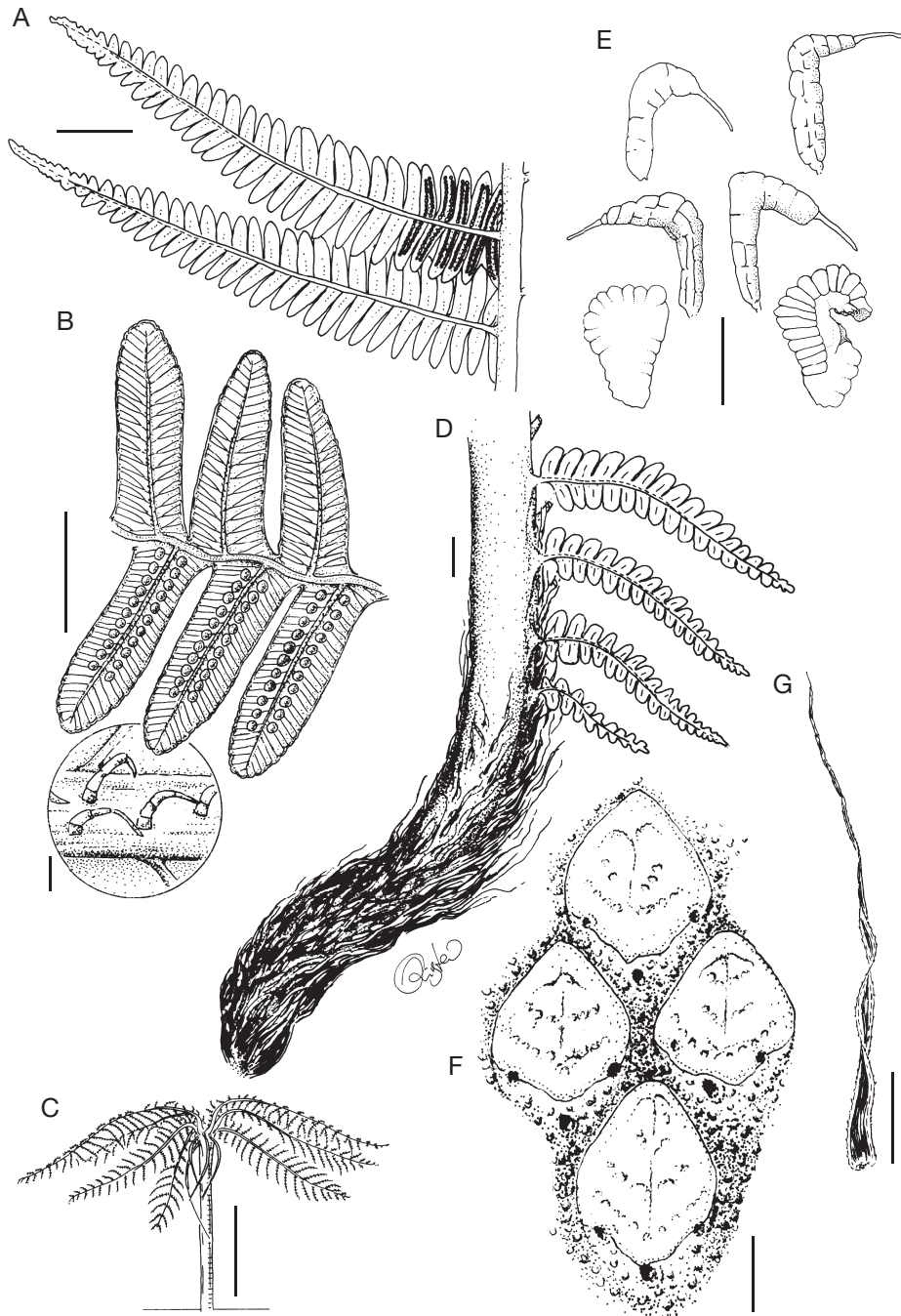


FIG. 6. — *Cyathea grangaudiana* Th.Janssen & Rakotondr., sp. nov.: **A**, pinnae abaxially (sori partly omitted) with part of rachis; **B**, pinnules abaxially with part of costa (sori partly omitted), antrorse acicular hairs on abaxial face of costula; **C**, habit; **D**, basal part of the leaf (petiole base up to first four pinna pairs), lateral view, pinnae pruned away on one side; **E**, two normally developed sporangia (below) and four sporangiasters from the receptacle; **F**, leaf scars; **G**, scale from petiole base. A-D, F, G, Janssen *et al.* 2738, P; E, Friedman 3102, P. Scale bars: A, 2 cm; B, D, F, 1 cm; B inset, E, 200 μ m; C, 1 m; G, 0.5 cm.

Trunk apex: hidden by close standing sigmoid petiole bases; some dead rachises persistent and hanging from the apex.

Petiole: 2-10(-15) cm long, diameter about 2 cm, its surface smooth, atropurpureous, displaying one line of distant, light brown aerophores on either side.

Lamina: pinnate-pinnatisect, narrowly elliptic, 90-100 cm long, 30-40 cm wide at its widest point (40-50 cm from base of lamina), bearing 30-40 pairs of alternate pinnae; basal pinnae gradually reduced in size, almost attaining the petiole base, retroflexed and more or less conduplicate; lamina coriaceous, abaxial face pale green; rachis atropurpureous.

Largest pinnae: 20-25 cm long, spaced by 2.5-3.5 cm, separate to slightly overlapping; costae stramineous to dark brown.

Largest pinnules: 1.5-2 × 0.4-0.6 cm, broadly adnate to the costa (the basalmost 1 or 2 pairs sessile), slightly overlapping to distant by 1/2 to 2/3 of their width, straight to slightly falciform, apex rounded to obtuse, margin crenulate especially near the pinnule apex, veins 1-(2)-furcate; costules green or stramineous.

Scales and hairs: scales of the petiole base ascending up to 20 cm on rachis, persistent, very narrowly triangular, 2-3 × 0.1-0.15(0.2) cm, with twisted apex, dark brown, shiny, appressed to spreading; abaxial face of younger rachises, costae and costules with scattered acaroid squamules, adaxial face of rachis and costae with dense stiff acicular antrorse brown multicellular hairs; abaxial face of costulae with scattered paucicellular acicular patent to antrorse hairs, hyaline to light brown.

Sori: subcostular, separate to contiguous, covering entire pinnules, indusia globular, irregularly dehiscent in several lobes; sporangia mixed with light brown to black sporangiasters, stalk of 3 or 4 rows of cells, head club- to Γ-shaped, bearing a relatively long paucicellular hyaline apical hair (often abraded in older specimens).

Spores: trilete, diameter (dehydrated) 50-60 μm, surface covered by slender rodlets.

DISTRIBUTION

Mauritius, endemic.

ECOLOGY

300-700 m. In the upland forest zone in rather open marshy vegetation on volcanic soils and inside forests.

REMARKS

This species can be easily distinguished from *C. borbonica* s.l. by its broadly adnate pinnules, its atropurpureous rachis, the paucicellular patent to antrorse hairs on the abaxial face of the costulae and its sporangiasters. Specimens of this species have frequently been determined as *Cyathea canaliculata* or *C. borbonica*. One collection, *Janssen 2741* (P, MAU), lacks sporangiasters, but otherwise conforms to all characters of this species. A specimen without collector and number in hb. Bélanger (P) has comparatively acute pinnule apices.

VERNACULAR NAME

Fandia.

ETYMOLOGY

This species is dedicated to Edmond Grangaud, an enthusiastic pteridologist from Réunion whose vast knowledge of the local flora greatly helped to improve the present revision.

DOUBTFUL SPECIES

Cyathea commersoniana Fée

Mémoires sur les familles des fougères, cinquième Mémoire, Genera Filicum 352 (1850-1852). — Type: "Habitat in insula Mauritiï", *Commerson 1773*.

REMARKS

We were unable to trace the type material. According to Fée's description, the species is likely to be close to or identical with *Cyathea borbonica* Desv. s.l. Kuhn (1868: 163) places *Cyathea commersoniana* in synonymy to *Cyathea canaliculata* var. *latifolia* Hook. citing *Goudot s.n.* (Madagascar) and *Commerson 1773* (Mauritius) as only specimens. Without access to the original material we are not in a position to confirm this judgement.

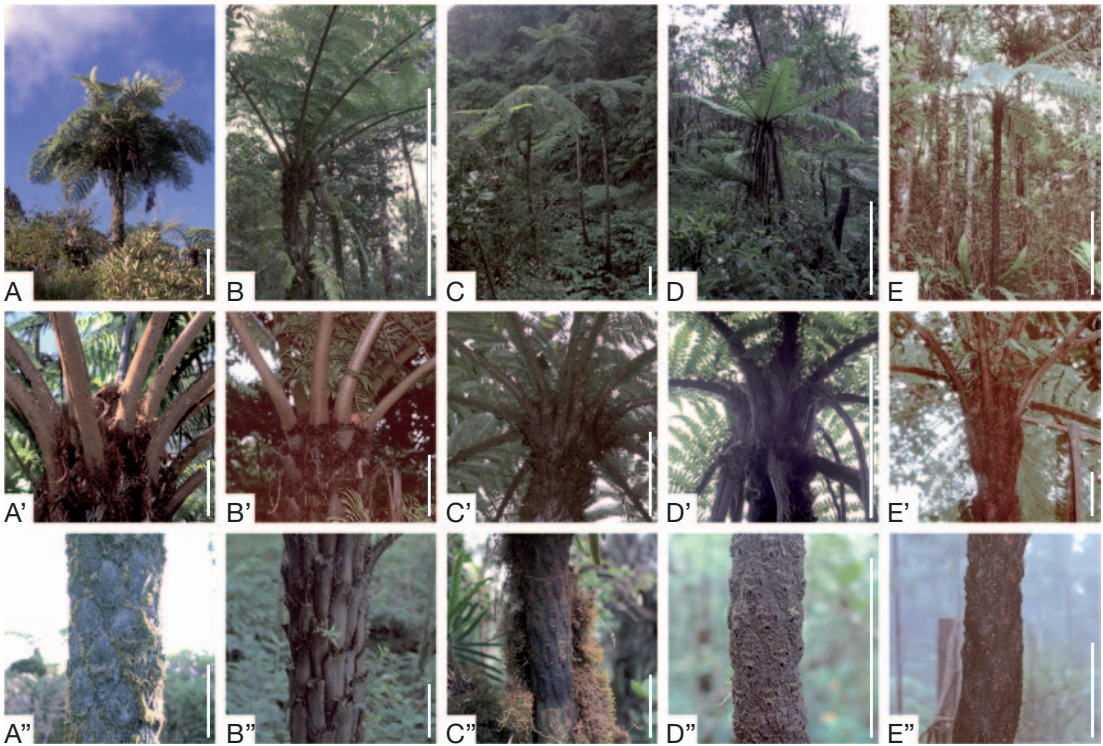


FIG. 7. — Photographic documentation of field characters: habit (A-E), shoot apex (A'-E'), and trunk surface at breast height (A''-E'') are shown for each species; A-A'', *Cyathea glauca* Bory; B-B'', *C. excelsa* Sw.; C-C'', *C. borbonica* Desv. var. *borbonica*; D-D'', *C. grangaudiana* Th.Janssen & Rakotondr.; E-E'', *C. borbonica* var. *latifolia* (Hook.) Bonap. A, uncollected; A', Janssen et al. 2728; A'', Janssen et al. 2686; B, B', Janssen et al. 2700; B'', uncollected; C, uncollected; C', Janssen et al. 2670; C'', Janssen et al. 2726; D, uncollected; D', Janssen et al. 2738; D'', Janssen et al. 2740; E, E', Janssen et al. 2746; E'', Janssen et al. 2743. Vouchers at P. Scale bars: A-E, 1 m; A'-E', A''-E'', 10 cm.

Cyathea discolor Fée

Mémoires sur les familles des fougères, cinquième Mémoire, Genera Filicum 353 (1850-1852), *nom. illeg.*, non Bory, *Voyage autour du monde* 1: 218 (1828). — Type: in 1802, Île de France [Mauritius], Bory *s.n.*

REMARKS

We were unable to trace the type material. According to the protologue, this species is close to *Cyathea commersoniana*, but the description is not sufficient to hypothesize about an affinity to the currently recognized Mascarene taxa. Kuhn (1868: 163) places this species in synonymy to his *Cyathea canaliculata* var. *rufescens* Mett. ex Kuhn, a synonym of *C. madagascariensis* Kaulf. We are unable to confirm his decision without having access to the

original material. Furthermore, we do not consider it useful to propose a replacement name for this later homonym before its status is clarified.

Cyathea laevigata Willd. ex Kaulf.

Enumeratio Filicum 256 (1824). — *Schizocaena laevigata* (Willd. ex Kaulf.) J.Sm., *Journal of Botany (Hooker)* 1: 661 (1842). — *Cyathea canaliculata* Willd. ex Spreng. var. *laevigata* Mett. ex Kuhn, *Filices Africanae* 163 (1868). — *Cyathea borbonica* Desv. var. *laevigata* (Willd. ex Kaulf.) Bonap., *Notes ptéridologiques* 9: 49 (1920); Christensen, *Dansk botanisk arkiv* 7: 21, pl. 4, f. 18-19 (1932), *excl. specim. madag.*; Tardieu in Humbert, *Flore de Madagascar et des Comores*, fam. 4: 14, f. 1, 6-7 (1951), *excl. specim. madag.* — Type: "Habitat in Madagascaria", *A. du Petit-Thouars s.n.* (holo-, B-W! no. 20181; putative iso-, P!).

REMARKS

The holotype in B-W! consists of a single pinna with a rachis fragment and oblong, sessile pinnules, 3×0.6 cm, subcordate at their base and with crenate apices. Except for scattered acaroid squamules on the abaxial face and rare narrowly lanceolate crispate scales on the adaxial face, rachis and costa do not carry any conspicuous indument. The sori are very young, distant from each other and subcostular on the first bifurcation of the 1-2-furcate veins. The lamina is glabrous on both surfaces. *Du Petit-Thouars s.n.* (P!) from Madagascar consists of a leaf apex and a rachis fragment with four pinnae. It is morphologically identical to the holotype and considered to represent a putative isotype.

Both specimens are morphologically very close to *Cyathea canaliculata* var. *latifolia* Hook. from Mauritius and to some forms of *Cyathea borbonica* var. *borbonica* from Réunion, but do not correspond to any known material from Madagascar. The leaf base with scales being unavailable in the original material, it is impossible to unambiguously assign the plant to either of these species or to a currently unrecognized Madagascan taxon. Du Petit-Thouars has been collecting in Madagascar (Dorr 1997) as well as on both of the Mascarene Islands and we can therefore not exclude that the type of the name is indeed from Madagascar. If it can be proven that the specimen has been collected on Mauritius or if more isotypes can be found to complement the current description of *Cyathea laevigata*, ascertaining its identity with a Mauritian taxon, an epitype should be chosen and necessary rearrangements in synonymy made. As both conditions are currently not fulfilled, we are unable to clarify the status of *Cyathea laevigata* Willd. ex Kaulf. in the present treatment.

The epithet *laevigata*, based on the type in Willdenow's herbarium, has been combined under *Cyathea borbonica* Desv. by Bonaparte (1920: 49; *pro varietate*). It has been applied by this author, Christensen (1932) and Tardieu-Blot (1951) to a Madagascan tree fern with adnate pinnules that is most likely only distantly related to the Mascarene taxa (Janssen & Rakotondrainibe unpubl.).

Cyathea madagascariensis Kaulf.

Enumeratio Filicum 257 (1824) as "*madagascariensis*"; Sprengel, *Systema Vegetabilium* 4: 127 (1827). — *Cyathea canaliculata* Willd. ex Spreng. var. *rufescens* Mett. ex Kuhn, *Filices Africanae*: 163 (1868). — *Alsophila madagascariensis* Willd. ex Kuhn, *nom. inval. pro syn.*, *Filices Africanae*: 163 (1868). — *Cyathea borbonica* Desv. var. *madagascariensis* (Kaulf.) Bonap., *Notes ptéridologiques* 9: 49 (1920); Tardieu in Humbert, *Flore de Madagascar et des Comores*, fam. 4: 13 (1951). — *Cyathea borbonica* Desv. f. *madagascariensis* (Kaulf.) C. Chr., *Dansk botanisk arkiv* 7: 21 (1932). — Type: "Habitat in Madagascaria", *A. du Petit-Thouars s.n.* (holo-, B-W! no. 20166; putative iso-, P!).

REMARKS

Kaulfuss (1824: 257) does not cite any type material, but it is obvious from his account that he consulted Willdenow's herbarium. The wording of his description of *Cyathea madagascariensis* is clearly based on the description in Willdenow's hand glued on the cover of *du Petit-Thouars s.n.* in B-W! no. 20166. The specimen consists of two detached pinnae with rachis fragments bearing subpetiolulate, oblong, coriaceous pinnules, $1.8-2 \times 0.3-0.4$ cm, with rounded to subobtusate, subcrenate apices and revolute margins. The sori are contiguous and subcostular. The pinnae form a rather acute angle with the rachis and, as can be deduced from their position in the dried specimen, the pinnules were most likely conduplicate in the life plant. The same description applies to a specimen by *du Petit-Thouars s.n.* at P!, which consists of a rachis fragment carrying five pinna pairs and which we consider to represent a putative isotype.

Both specimens are morphologically very close to *Cyathea borbonica* var. *sevathiana* from Mauritius, and might agree with some forms of *Cyathea borbonica* var. *borbonica* from Réunion, but they do not correspond to any known material from Madagascar. Like in the previous case, the type material is too incomplete to be unambiguously determined and of doubtful geographic provenance. We hence prefer to refrain from epitypifying *C. madagascariensis* and leave its status unclarified in the present treatment.

Kuhn (1868: 163) publishes the name *Cyathea canaliculata* var. *rufescens* Mett. ex Kuhn without a description citing as only specimen "Thouars in

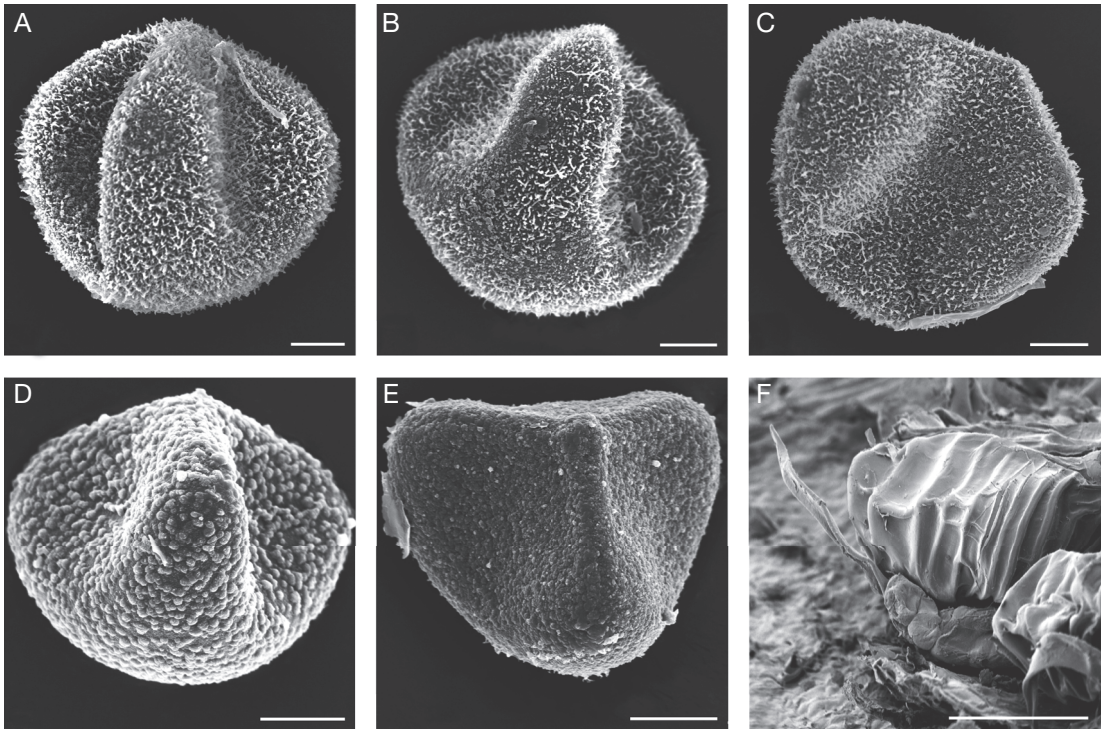


FIG. 8. — SEM images of spores: **A**, *Cyathea borbonica* Desv.; **B**, *C. grangaudiana* Th.Janssen & Rakotondr.; **C**, *C. borbonica* var. *latifolia* (Hook.) Bonap.; **D**, *C. excelsa* Sw.; **E**, *C. glauca*; **F**, *C. grangaudiana*, sporangium (above) and sporangiaster with long apical hair (below), natural position in the sorus. A, Gaudichaud s.n., P; B, Bouton s.n., P; C, Janssen et al. 2747, P; D, Boivin s.n., P; E, Rakotondrainibe et al. 6913, P; F, Anon. 33 in hb. Doerfler, P. Scale bars: A-E, 10 μ m; F, 100 μ m.

hb. W. 20166" and in synonymy *Alsophila madagascariensis* Willd., an unpublished name in Willdenow's hand on the said specimen.

The epithet *madagascariensis*, based on the type in Willdenow's herbarium, has been combined under *Cyathea borbonica* Desv. by Bonaparte (1920: 49; *pro varietate*), and Christensen (1932; *pro forma*). These authors and Tardieu-Blot (1951) do not cite additional material besides the type.

Cyathea pervilleana Fée

Mémoires sur les familles des fougères, cinquième Mémoire, Genera Filicum 352 (1850-1852), as "*pervilleana*". — *Cyathea borbonica* Desv. var. *pervilleana* (Fée) C. Chr., *Catalogue des plantes de Madagascar, Pteridophyta* 20 (1931); Tardieu in Humbert, *Flore de Madagascar et des Comores*, fam. 4: 14 (1951). — Type: Madagascar, Perville s.n. (putative type, Kl, "ex herb. Fée").

REMARKS

Fée indicates the original material in his protologue by "Habitat in Nos Beh [Nosy Bé] Madagascariensium (*Perville*), et in insula Borbonia". Perville collected in Madagascar (Dorr 1997), the Mascarenes and the Seychelles. We traced a specimen, *Perville* s.n. (Kl, "ex herb. Fée"), consisting of a single pinna with a short attached rachis fragment. The pinnules are sessile, 3 \times 0.4 cm, with acute apices, completely crenate margins, and 1(-2) furcate veins. The pinna is 34 cm long and bears approximately 40 pairs of pinnules. This characterization and especially the measurements taken on the specimen perfectly agree with the description given in the protologue leading us to assume that it is part of the original material. However, the locality information on the label is deviating from that accompanying the original description and although no further corresponding specimens from Fée's herbarium have been found

at P or STR, we suppose that the Kew specimen only represents a fraction of the original material and might be chosen as a lectotype as soon as the status of *Cyathea pervilleana* has been clarified.

Bory 330 (P!) from Réunion, determined here as *Cyathea borbonica* var. *borbonica*, has relatively long and narrow (3×0.4 cm) acute pinnules with completely crenate margins. This specimen is morphologically extremely close to the putative type of *Cyathea pervilleana* (K!). As we are not aware of any material from Madagascar conforming to the description of *Cyathea pervilleana*, this leads us to assume that the species is most likely not from Madagascar, but from Réunion and the name to be cited in synonymy to *Cyathea borbonica* var. *borbonica*. However, this cannot be proven with the available material.

Kuhn (1868: 163) places the species in synonymy to *Cyathea canaliculata* var. *laevigata*, but we argue that it is morphologically clearly different.

Cyathea robusta Bojer

In Wallich, *A Numerical List of Dried Specimens of Plants in the East India Company's Museum*, no. 182 (1828), *nom. nud.* — Type: Mauritius, Bojer s.n. [?].

REMARKS

Wallich likely cites an unpublished name written on a herbarium label without giving a validating description. The name is not validly published and cited here because of its occasional occurrence in determinations on specimens from the Mascarenes. A validating description of the name and the relevant herbarium specimen(s) could not be located.

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