

A revision of the indusiate scaly tree ferns (Cyatheaceae, *Cyathea* subgen. *Alsophila* sect. *Alsophila*) in Madagascar, the Comoros and the Seychelles

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ABSTRACT

Based on the examination of herbarium specimens including numerous recent collections and on observations of most species *in situ*, we herein present a revision of the indusiate scaly tree ferns (*Cyathea* sect. *Alsophila*) for Madagascar, the Comoros and the Seychelles. One endemic species occurs on the Seychelles and three taxa (one endemic) are found on the Comoros. For Madagascar, we describe 55 taxa (40 species and 15 varieties), 51 of which are endemic. Among these, 11 species and 12 varieties are new. The species newly described for Madagascar comprise *C. basirotundata* Rakotondr. & Janssen, *C. conferta* Janssen & Rakotondr., *C. dilatata* Rakotondr. & Janssen, *C. emilei* Janssen & Rakotondr., *C. hebes* Janssen & Rakotondr., *C. lisiae* Janssen & Rakotondr., *C. longispina* Janssen & Rakotondr., *C. meridionalis* Janssen & Rakotondr., *C. obtecta* Rakotondr. & Janssen, *C. pseudo-bellisquamata* Janssen & Rakotondr., and *C. valdesquamata* Janssen & Rakotondr. The newly described varieties are *C. acutula* (R.M. Tryon) Janssen & Rakotondr. var. *deltoides* Janssen & Rakotondr., *C. a.* var. *rufescens* Janssen & Rakotondr., *C. bellisquamata* Bonap. var. *ambrensis* Janssen & Rakotondr., *C. b.* var. *australis*

KEY WORDS

Cyatheaceae,
Alsophila,
Cyathea,
 Comoros,
 Madagascar,
 Seychelles,
 diversity centre,
 new species,
 new variety,
 typification.

Janssen & Rakotondr., *C. boivinii* Mett. ex Kuhn var. *andringitrensis* Janssen & Rakotondr., *C. b.* var. *bevolo* Janssen & Rakotondr., *C. b.* var. *parahildebrandtii* Janssen & Rakotondr., *C. decrescens* Mett. ex Kuhn var. *cristata* Janssen & Rakotondr., *C. d.* var. *manongarivensis* Janssen & Rakotondr., *C. emilei* var. *dauphinensis* Janssen & Rakotondr., *C. similis* C.Chr. var. *leptoderma* Rakotondr. & Janssen, and *C. s.* var. *montana* Janssen & Rakotondr. The descriptions of previously recognized taxa have been completed and where necessary corrected. Especially such characters have been added, that can be observed only *in situ*, e.g. trunk morphology and measurements of the entire leaf. Descriptions are accompanied by plates with detailed illustrations and by distribution maps. We thoroughly reviewed the nomenclatural status and typification of all names. We provide determination keys down to the varietal level including all taxa of Cyatheaceae of the Madagascan region. Photographic documentation of the trunk and habit of most species will facilitate determination in the field. Finally, we briefly comment on the distribution of the tree fern diversity in the Madagascan rainforests.

RÉSUMÉ

Révision des fougères arborescentes indusiées à écailles (Cyatheaceae, Cyathea subgen. Alsophila sect. Alsophila) à Madagascar, aux Comores et aux Seychelles.

Nous présentons ici une révision des fougères arborescentes indusiées à écailles (*Cyathea* sect. *Alsophila*) pour Madagascar, les Comores et les Seychelles basée sur l'étude de spécimens d'herbier provenant en grande partie de récoltes récentes et sur l'observation de la majorité des espèces *in situ*. Une espèce endémique croît aux Seychelles ; trois taxons, dont un endémique, ont été recensés aux Comores ; pour Madagascar, nous décrivons 55 taxons (40 espèces et 15 variétés) dont 51 sont endémiques. Parmi eux, 11 espèces et 12 variétés sont nouvelles. Les espèces nouvellement décrites à Madagascar sont *Cyathea basirotundata* Rakotondr. & Janssen, *C. conferta* Janssen & Rakotondr., *C. dilatata* Rakotondr. & Janssen, *C. emilei* Janssen & Rakotondr., *C. hebes* Janssen & Rakotondr., *C. lisiae* Janssen & Rakotondr., *C. longispina* Janssen & Rakotondr., *C. meridionalis* Janssen & Rakotondr., *C. obtecta* Rakotondr. & Janssen, *C. pseudobellisquamata* Janssen & Rakotondr. et *C. valdesquamata* Janssen & Rakotondr. Les variétés nouvelles sont *C. acutula* (R.M. Tryon) Janssen & Rakotondr. var. *deltoidea* Janssen & Rakotondr., *C. a.* var. *rufescens* Janssen & Rakotondr., *C. bellisquamata* Bonap. var. *ambrensis* Janssen & Rakotondr., *C. b.* var. *australis* Janssen & Rakotondr., *C. boivinii* Mett. ex Kuhn var. *andringitrensis* Janssen & Rakotondr., *C. b.* var. *bevolo* Janssen & Rakotondr., *C. b.* var. *parahildebrandtii* Janssen & Rakotondr., *C. decrescens* Mett. ex Kuhn var. *cristata* Janssen & Rakotondr., *C. d.* var. *manongarivensis* Janssen & Rakotondr., *C. emilei* var. *dauphinensis* Janssen & Rakotondr., *C. similis* C.Chr. var. *leptoderma* Rakotondr. & Janssen et *C. s.* var. *montana* Janssen & Rakotondr. Les descriptions des taxons déjà connus ont été élargies et corrigées si nécessaire. Elles ont été notamment complétées avec les caractères observables uniquement *in situ* tels l'aspect du tronc et les dimensions de la feuille entière. Les descriptions sont accompagnées de planches de dessins détaillées et de cartes de répartition. Le statut nomenclatural et la typification de tous les noms ont été rigoureusement revus. Nous mettons à disposition des clés de détermination incluant tous les taxons des Cyatheaceae de la région malgache jusqu'au niveau variétal. La documentation photographique du tronc et du port de la majorité des espèces facilitera la détermination sur le terrain. Enfin, nous commentons brièvement la distribution de la diversité des fougères arborescentes dans les forêts denses humides de Madagascar.

MOTS CLÉS

Cyatheaceae,
Alsophila,
Cyathea,
 Comores,
 Madagascar,
 Seychelles,
 centre de diversité,
 espèce nouvelle,
 variété nouvelle,
 typification.

INTRODUCTION

Classification within the scaly tree ferns (Cyatheaceae) has been and currently still is an object of controversy (Tryon 1977; Holttum 1977, 1981; Holttum & Edwards 1983). In agreement with the most recent accounts for Africa and Madagascar (Christensen 1932; Tardieu-Blot 1951; Schelpe & Anthony 1986; Burrows 1990; Edwards 2005), we recognize a single genus, *Cyathea* Sm., for the purpose of this study. If future authors decide to assign the rank of genus to the evolutionary lineages within the scaly tree ferns reported by Korall *et al.* (2007), several new combinations may need to be proposed. We paid attention on choosing epithets for newly described taxa currently unique in the entire Cyatheaceae to minimize the necessity for the creation of new names in such cases.

The Cyatheaceae are a characteristic component of the dense evergreen rainforests in the Madagascar region (Takhtajan 1986), i.e. Madagascar, the Mascarenes, the Comoros and the Seychelles. We herein present a taxonomic revision of *Cyathea* Sm. sect. *Alsophila* for Madagascar, the Comoros and the Seychelles. *Cyathea* sect. *Alsophila* (Holttum 1981; Holttum & Edwards 1983) has indusiate sori and pinnate-pinnatifid to tripinnate leaves. Aplebia are only occasionally developed and then comparatively small. In the Madagascar region the section is most diverse on Madagascar where 40 species and 15 varieties are accepted. The Comoros are young volcanic islands and harbour two species of this section, one, *Cyathea kirkii* Hook., being endemic. Of the granitic Seychelles only the islands Mahé and Silhouette harbour one endemic tree fern species, *Cyathea sechellarum* Mett. In the Madagascar region *Cyathea* sect. *Gymnosphaera* (Holttum 1981; Holttum & Edwards 1983) only occurs on the Comoros and Madagascar, i.e. not on the Seychelles and not on the Mascarenes. The section is characterized by exindusiate sori, bipinnate-pinnatifid to tripinnate leaves and the frequent presence of conspicuous aplebia near the base of the petiole. It has been treated by Rakotonrainibe & Lobreau-Callen (1999) and Janssen & Rakotonrainibe (2007). The Cyatheaceae of the Mascarenes have been revised by Janssen & Rako-

tondrainibe (2006). Cyatheaceae are not known to occur on other islands in the Western Indian Ocean except those mentioned above.

The tree ferns of the Comoros are treated together with the Madagascar flora because three out of four taxa found on the Comoros also occur on Madagascar. The Seychelles are included in this account because of close morphological affinities of the single endemic species to Madagascar taxa. The tree ferns of the Seychelles have been treated by Baker (1877), Christensen (1912) and Tardieu-Blot (1960). Detailed accounts on the Madagascar tree ferns have been published by Christensen (1932) and Tardieu-Blot (1951), the latter also including the Comoran species. As has been previously discussed (Janssen 2006; Janssen & Rakotonrainibe 2006), a great majority of the available tree fern herbarium specimens lack characters necessary for a complete description of the species. With many new specimens having become available during recent years and taking into account extensive observations made on most species *in situ* during recent fieldwork, many of the published descriptions could be complemented and were corrected where necessary. In addition to the description of 11 new species and 12 new varieties, we therefore include complete descriptions of all previously published and currently accepted taxa in the present treatment. For the first time, we provide full keys including the varietal level and covering the entire tree fern diversity in the Madagascar region. A detailed review of the typification of previously published names resulted in several nomenclatural changes (Table 1).

MORPHOLOGY OF MADAGASCAN TREE FERNS

Korall *et al.* (2006) conducted a phylogenetic analysis of the tree fern clade and revised the circumscription of some tree fern families. The scaly tree ferns (Cyatheaceae) are distinguished from all other members of the tree fern clade by an indument composed of scales and hairs, by their sori being in a dorsal position with a capitate receptacle, exindusiate or with small scale-like to globular indusia completely covering the sorus. They usually develop an erect trunk of large size.

The tree ferns of Madagascar show a high degree of morphological variation and groups without taxonomic

TABLE 1. — Nomenclatural changes. Changes affecting Madagascan taxa of *Cyathea* accepted in the most recent taxonomic treatments, i.e. Rakotondrainibe & Lobreau-Callen (1999, sect. *Gymnosphaera*) and Tardieu-Blot (1951, sect. *Alsophila*) are detailed below. Arrows indicate new synonyms (\Rightarrow) and new combinations or *nomina nova* (\rightarrow) published in this paper and in Janssen & Rakotondrainibe (2007).

 sect. *Alsophila*

- C. albida* Tardieu \Rightarrow *C. similis* C.Chr.
C. approximata var. *sorisquamata* (Bonap.) Tardieu \Rightarrow *C. approximata* Bonap.
C. ballardii Tardieu \Rightarrow *C. concava* Bonap.
C. boivinii var. *convava* (Bonap.) Tardieu \rightarrow *C. concava* Bonap.
C. boivinii var. *humblotii* (Baker) C.Chr. \Rightarrow *C. boivinii* Mett. ex Kuhn
C. borbonica var. *borbonica* Desv. sensu Tardieu \rightarrow *C. emilei* Janssen & Rakotondr.
C. borbonica var. *laevigata* (Willd. ex Kaulf.) Bonap. sensu Tardieu \rightarrow *C. remotifolia* Bonap.
C. borbonica f. *latifolia* (Hook.) C.Chr. sensu Tardieu \rightarrow ?, see Janssen & Rakotondrainibe (2006)
C. borbonica var. *madagascariensis* (Kaulf.) Bonap. sensu Tardieu \rightarrow ?, see Janssen & Rakotondrainibe (2006)
C. borbonica var. *pervilleana* (Fée) C.Chr. sensu Tardieu \rightarrow ?, see Janssen & Rakotondrainibe (2006)
C. borbonica var. *simulans* (Baker) C.Chr. sensu Tardieu \rightarrow *C. simulans* (Baker) Janssen & Rakotondr.
C. decrescens var. *hirsutifolia* (Bonap.) C.Chr. \Rightarrow *C. decrescens* var. *decrescens* Mett. ex Kuhn
C. dregei var. *polyphlebia* (Baker) C.Chr. \Rightarrow *C. dregei* Kunze
C. dregei var. *segregata* (Baker) C.Chr. \Rightarrow *C. dregei* Kunze
C. hildebrandtii Kuhn \rightarrow *C. boivinii* var. *hildebrandtii* (Kuhn) Janssen & Rakotondr.
C. humbertiana C.Chr. \Rightarrow *C. capensis* (L.f.) Sm.
C. isaloensis C.Chr. \Rightarrow *C. boivinii* Mett. ex Kuhn
C. melleri var. *virescens* (C.Chr.) Tardieu \Rightarrow *C. melleri* (Baker) Domin
C. pilosula Tardieu \Rightarrow *C. decrescens* var. *quadrata* (Baker) Janssen & Rakotondr.
C. quadrata Baker \rightarrow *C. decrescens* var. *quadrata* (Baker) Janssen & Rakotondr.
C. quadrata var. *ivohibensis* C.Chr. \rightarrow *C. ivohibensis* (C.Chr.) Janssen & Rakotondr.
C. subincisa C.Chr. \rightarrow *C. tsaratananensis* C.Chr.
C. tsaratananensis Tardieu \rightarrow *C. acutula* (R.M.Tryon) Janssen & Rakotondr.
C. zakamenensis Tardieu \Rightarrow *C. decrescens* var. *quadrata* (Baker) Janssen & Rakotondr.

 sect. *Gymnosphaera*

- C. bullata* (Baker) Domin \rightarrow *C. boiviniiformis* Rakotondr. & Janssen
C. bullata var. *lobata* Rakotondr. \rightarrow *C. boiviniiformis* var. *lobata* (Rakotondr.) Rakotondr. & Janssen
C. bullata var. *madagascariensis* (Bonap.) Rakotondr. \rightarrow *C. boiviniiformis* var. *madagascariensis* (Bonap.) Rakotondr. & Janssen
C. coursii (Tardieu) Tindale \Rightarrow *C. poolii* (C.Chr.) Domin
-

status have already been recognized by previous authors. Christensen (1932) treated the species of sect. *Gymnosphaera* in a separate genus, *Alsophila* R.Br., and recognized three morphological groups in the other Madagascan species, which he treated in the genus *Cyathea*. Tardieu-Blot (1951) published new combinations of the taxa of sect. *Gymnosphaera* in the genus *Gymnosphaera* Blume and treated the remaining taxa, i.e. *Cyathea* sect. *Alsophila*, in the genus *Cyathea* and did not point out morphological groups. Holttum (1981) recognized four morphological groups in African Cyatheaceae, which he all placed in *Cyathea*, and briefly discussed their relationships to species of Madagascar and the Mascarenes.

Currently, and in agreement with recent results from phylogenetic analysis (Janssen *et al.* 2008),

we recognize three major morphological groups, two of which are treated in this paper. "Group I" corresponds to *Cyathea* sect. *Gymnosphaera* and has been treated elsewhere (Rakotondrainibe & Lobreau-Callen 1999; Janssen & Rakotondrainibe 2007). "Group II" comprises all taxa with a pinnate-pinnatifid to bipinnate lamina, and "Group III" includes those with a bipinnate-pinnatisect to tripinnate lamina of sect. *Alsophila*. "Group II" is the most diverse and can be subdivided into four subgroups with respect to lamina dissection and indument (see key below).

The most important characters to distinguish tree ferns of the Madagascan region are the degree of lamina dissection, the morphology and density of the scales of the petiole base, the shape of the

indusium and the abaxial leaf indument. The adaxial leaf indument usually does not yield characters useful for species delimitation. Specimens lacking the scales of the petiole base often cannot be unambiguously identified.

In Madagascan Cyatheaceae, petiole scales always have a more or less prominent apical spine and a flabellate margin (Holtum 1957) composed of thin-walled, irregular cells diverging from the scale centre and being more or less erose in aged scales. Leaf arrangement is always spiral, although leaves may form characteristic pseudo-whorls in some species (e.g., Fig. 25H). Appressed one- to two-celled hairs, so-called trichomidia, are present on the abaxial face of the lamina of many species. These may be more or less dense and must not be confounded with the patent, multicellular, hyaline to light brown hairs characteristic for “Group IIb” (see below). Pinnae are always alternate to subopposite. Many taxa may develop forms with strongly crenate pinnules (Fig. 12E), which appears to be more frequently the case in young, sterile plants. Morphology may strongly depend on age and habitat of the plant. Young plants usually have much longer leaves with very long petioles and broader pinnae and pinnules. The petiole scales of very young plants are conspicuously different from those of adult plants, i.e. they are usually softer and lighter in colour. Plants growing in a (secondarily) open habitat frequently have more coriaceous and strongly reduplicate pinnules with a revolute margin. Sporangia, sterile sporangiform structures on the receptacle (Janssen & Rakotondrainibe 2006), do not occur in any of the species included in this account.

SPORES OF THE MADAGASCAN TREE FERNS

Due to the uniformity of spore characteristics these are not included in the description of individual species. All spores are trilete and two distinct perine morphologies can be distinguished in the Madagascan Cyatheaceae of sect. *Alsophila* (Tryon & Lugardon 1991). The spores of the taxa with a pinnate-pinnatifid to bipinnate lamina (“Group II”) have a perine densely covered with slender rodlets (Fig. 1A-C), whereas those of the taxa with a bipinnate-pinnatifid to tripinnate lamina (“Group III”) have a perine sculpted with crests (Fig. 1D, E).

Such crests are also typical for the spores of *Cyathea sechellarum* and the spores of sect. *Gymnosphaera* (Rakotondrainibe & Lobreau-Callen 1999). Spores of the crested type are distantly verrucose when young (Gastony & Tryon 1976; Fig. 1F). The tripinnate *Cyathea kirkii* from the Comoros has spores like those found in “Group II” (Fig. 1B). The spores of “Group II” are generally larger than those of “Group III”, although the size ranges overlap. Spore size is not discriminative within the groups. In “Group II” most spores have an equatorial diameter of 50-60 μm (size range 42-65 μm) and a polar diameter of 40-47 μm (size range 30-48 μm). In “Group III” most spores have an equatorial diameter of 35-45 μm (size range 32-50 μm) and a polar diameter of 25-30 μm (size range 20-35 μm). We noticed that all, even fully matured, spores are strongly concave when dehydrated and hypothesize that low desiccation tolerance due to a thin spore wall might be a reason for the remarkable degree of local endemism in Cyatheaceae (Tryon & Gastony 1975). This contrasts with many other fern groups, which show large areas of distribution and low levels of endemism (Smith 1972; Tryon 1985).

VERNACULAR NAMES AND ECONOMIC VALUE OF THE MADAGASCAN TREE FERNS

In Madagascar, most people interviewed were aware of a vernacular name for the tree ferns. These names are not or only rarely discriminative on the specific level. Tree ferns are usually designated by the vernacular name “ampanga bé”, meaning “large fern”, or simply by “ampanga”, meaning “fern”. The name “tsipahao” has been reported from the Itremo region in Central Madagascar (Birkinshaw *in sched.*). “Faho” is sometimes used in the Ranomafana region (Ranarijaona pers. comm.). In the Betsileo region around Ambositra, “ampanga vy”, meaning “iron hard fern”, is used and most likely refers to the strongly sclerified trunks. In the same region, all big ferns (including Osmundaceae, Pteridaceae, etc.) are called “tsipahofaho”. In the Tsaratanana massif and in the central high plateaux, the name “fanjana” is employed for tree ferns.

A finer differentiation of vernacular names on a specific level occurs in regions where the plants are of economic importance for manufacturing flower

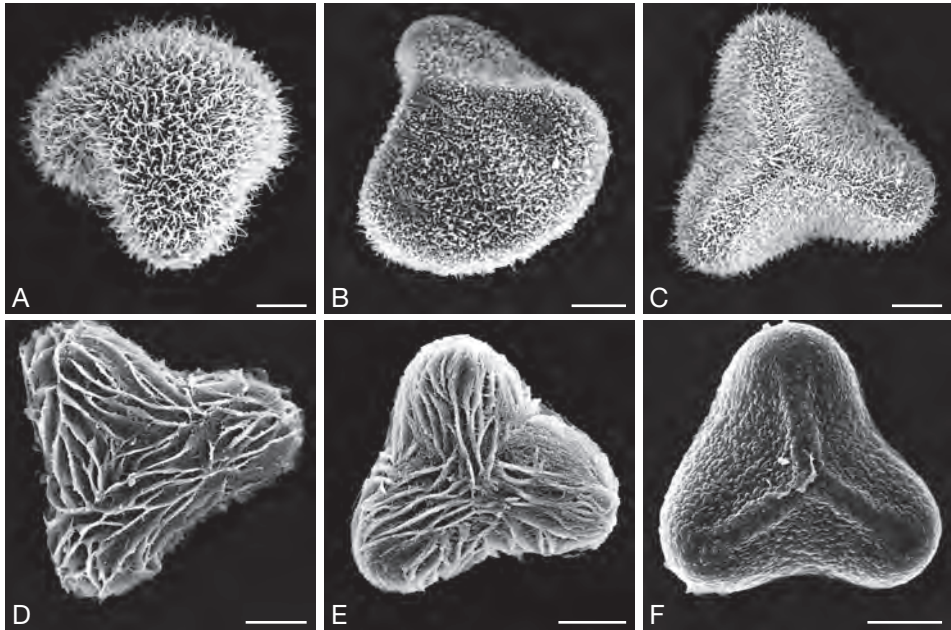


FIG. 1. — Spores of *Cyathea* sect. *Alsophila* in Madagascar and on the Comoros: **A-C**, spores of taxa belonging to the bipinnate clade (Janssen *et al.* 2008) have a perispore formed by dense slender rodlets; **D-F**, spores of taxa belonging to the tripinnate clade (Janssen *et al.* 2008) have a perispore with prominent crests; **A**, *C. approximata* Bonap.; **B**, *C. kirkii* Hook.; **C**, *C. serratifolia* Baker; **D**, *C. boivinii* Mett. ex Kuhn var. *boivinii*; **E**, *C. melleri* (Baker) Domin; **F**, *C. similis* C.Chr., a young spore with a distantly verrucose perispore (Janssen & Rakotondrainibe 2006; Gastony & Tryon 1976). **A**, Janssen *et al.* 2449 (P); **B**, Rakotondrainibe *et al.* 6751 (P); **C**, Rakotondrainibe *et al.* 6230 (P); **D**, Janssen *et al.* 2481 (P); **E**, Janssen *et al.* 2536 (P); **F**, Janssen *et al.* 2576 (P). Scale bars: 10 μ m.

pots from the thick mantle of adventitious roots at the base of the trunks of some species (“vazy”, “pots en fangeon”, Ranarijaona 1993; pers. comm.). “Vazimadinika” designates a group of species with thin trunks that yield small pots, e.g., *C. remotifolia* Bonap. “Vazimakikitra” is used for a group of species with thick trunks and very dense and hard adventitious roots that yield pots of better quality, e.g., *C. acutula* (R.M.Tryon) Janssen & Rakotondr. “Tsiholohana” designates species with densely interwoven adventitious roots, e.g., *C. similis* C.Chr. and “foranelina” is a term applied to the showy whitish colour of the pith of the trunk of most species when cut. For one village, the production of such pots has been estimated at 500 per week, which is an unsustainable use of the resources (Ranarijaona 1993). The thinner trunks of tree fern species that do not develop abundant adventitious roots are sometimes used for craftwork or construction, e.g., *C. ivohibensis* (C.Chr.) Janssen & Rakotondr. that is

locally appreciated in the Ivohibe region. In Central Madagascar, the leaves of *Cyathea dregei* Kunze are used to cover freshly excavated tombs during a resting period before the first entombment.

ECOLOGY OF THE MADAGASCAN TREE FERNS

Cyatheaceae occur from southern temperate to tropical vegetation zones and from coastal to high mountain habitats. In the Madagascar region, tree ferns are found in dense evergreen rainforests over the entire altitudinal range, they are quite frequent in cloud and crest forests, and two species also occur on forest margins or in open habitats. Despite their high species diversity, differentiation of their respective ecological niches is relatively weak in Madagascar tree ferns. However, most species occupy a well-defined altitudinal belt. Cyatheaceae are not homogeneously distributed in the Madagascar forests, but frequently occur in patches, i.e. individuals of one or different species appear

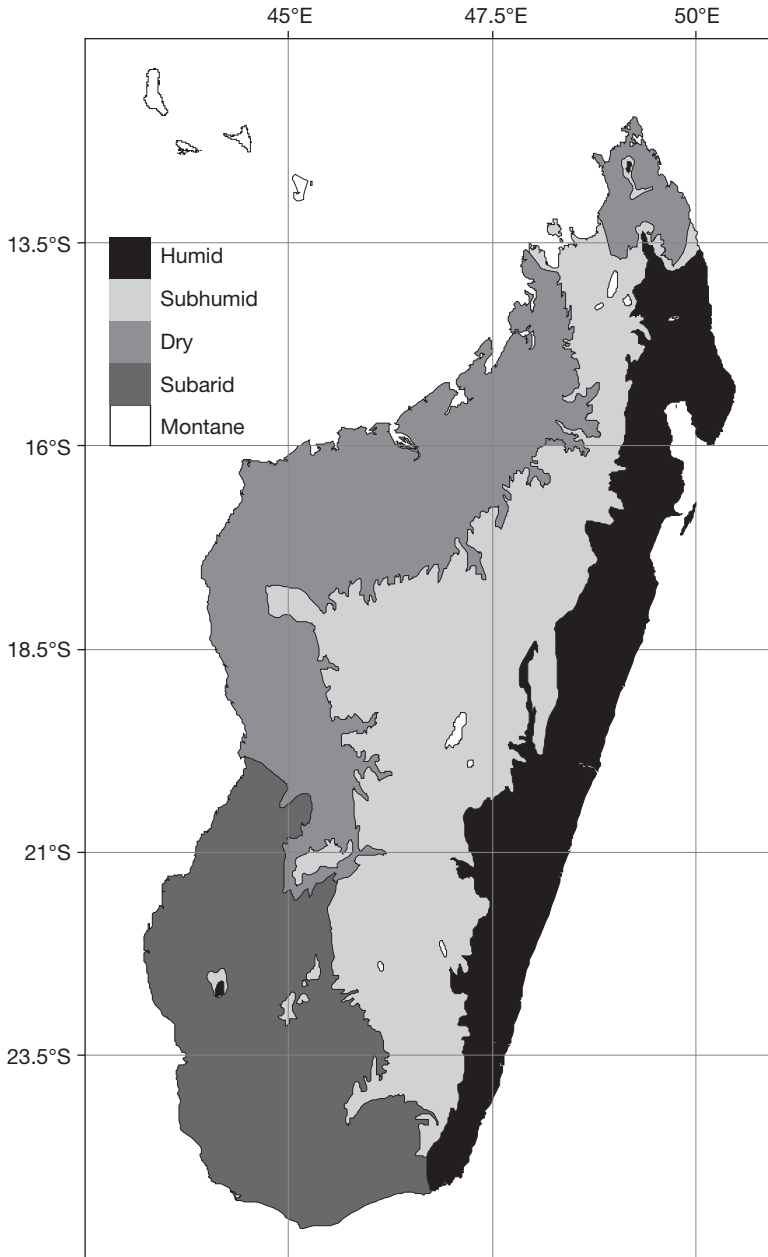


FIG. 2. — The bioclimatic regions of Madagascar. This map is a simplified version of the bioclimatic map of Madagascar by Cornet (1974) and redrawn from Schatz (2000). Suitable ecological conditions for the growth of tree ferns are found in the humid, subhumid and montane zones. This map has also been used as a base map for the distribution maps presented in Figures 44 to 46.

in clusters separated by forest regions without tree ferns or with only few individuals. Studies on the ecology of Cyatheaceae, especially with reference

to altitudinal gradients, are available for South America (e.g., Arens 2001; Jones *et al.* 2007), Costa Rica (Bittner & Breckle 1995), East Africa (Hemp

2001, 2002) and Madagascar (e.g., Rakotondrainibe 2000, 2003).

HYBRIDIZATION AND SPECIATION IN MADAGASCAN TREE FERNS

Natural hybridization events have been suggested or proven in numerous instances for Cyatheaceae and most likely contributed significantly to their morphological variation (e.g., Conant 1975, 1990; Conant & Cooper-Driver 1980). Chromosome counts are available for several species of *Cyathea* s.l. indicating $n = 69$ as constant for all diploid taxa and providing no evidence for polyploidy or apogamy on the species level (e.g., Kramer 1990; Tindale & Roy 2002). The reproductive biology of tree ferns has been examined in a few studies in the neotropics (e.g., Conant 1990; Soltis *et al.* 1991).

However, chromosome counts, information on the breeding system and population level studies being unavailable for the tree ferns of the Madagascar region, we cannot put forward a hypothesis on the mechanisms and magnitude of hybridization events and on their influence on the observed morphological variation in Madagascan Cyatheaceae. Janssen & Rakotondrainibe (2007) used morphological evidence to indicate the presence of putative hybrids in Madagascan *Cyathea* sect. *Gymnosphaera*. Leaf architectures with irregularly and deeply crenate pinule margins in some species described in the present treatment (e.g., *C. appendiculata* Baker, *C. dilatata* Rakotondr. & Janssen) are reminiscent of that of hybrids between species with pinnate-pinnatifid and bipinnate-pinnatifid leaves (Conant 1975; Conant & Cooper-Driver 1980; Conant pers. comm.). We failed, however, to identify putative parents of these plants by morphological comparison. Furthermore, sporangia quickly fall off in alcohol preserved material upon drying and are only rarely available to study their development in putative hybrid specimens. We hence cannot confirm hybrid origin of those plants and assume, that the observed variability of the leaf margins is inherent to some taxa of the Western Indian Ocean (cf. also *C. acutula* (R.M. Tryon) Janssen & Rakotondr. from Madagascar and *C. borbonica* var. *latifolia* (Hook.) Bonap. from Mauritius).

Janssen *et al.* (2008) showed that the Madagascan tree ferns belong to three distinct clades (*Gymno-*

sphaera, bipinnate and tripinnate clades) and propose a spatio-temporal scenario for the evolution of their regional diversity. The authors show that each clade corresponds to a cluster of very closely related taxa. The causes of this pattern and its implications for speciation processes in the scaly tree ferns remain to be studied.

DISTRIBUTION OF THE TREE FERN DIVERSITY IN MADAGASCAR

We were interested in the distribution of tree fern diversity in the Madagascan rainforests and mapped taxon richness in a 0.25° by 0.25° grid on a base map showing the principal bioclimatic regions of Madagascar (Fig. 2) as well as the remaining primary vegetation cover (DuPuy & Moat 1999; Fig. 3). The map takes into account georeferenced records of all species and varieties accepted in Janssen & Rakotondrainibe (2007) and in the present treatment. From bioclimatic niche analysis (Janssen *et al.* 2008) and observations made in the field, we conclude that the rainforest formations, i.e. most of the remaining primary vegetation cover in the eastern humid and central subhumid zones, provide habitats where Cyatheaceae might potentially occur. In agreement with this hypothesis, virtually all available tree fern specimens have been collected in the eastern rainforests and tree fern diversity is centred in the following regions: Andasibe region, Andohahela massif, Andringitra massif, Anjanaharibe massif, Manongarivo massif, Marojejy massif, Masoala peninsula, Ivohibe massif, Lac Alaotra region, Ranomafana region and Tsaratanana massif (Fig. 3).

However, all of these regions include protected areas and have been in the focus of plant collectors in recent years. We also mapped the number of collections made per grid cell (not shown) and found a high correlation ($R^2 \approx 0.9$) with taxon richness. The grid cells with high taxon richness do hence not necessarily constitute diversity centres for Madagascan tree ferns. Sampling density is not sufficiently evenly distributed over the Madagascan rainforests in order to extrapolate diversity data for the currently undercollected rainforest areas.

Contrasting the diversity grid with suitable habitats, i.e. remaining primary vegetation in the humid

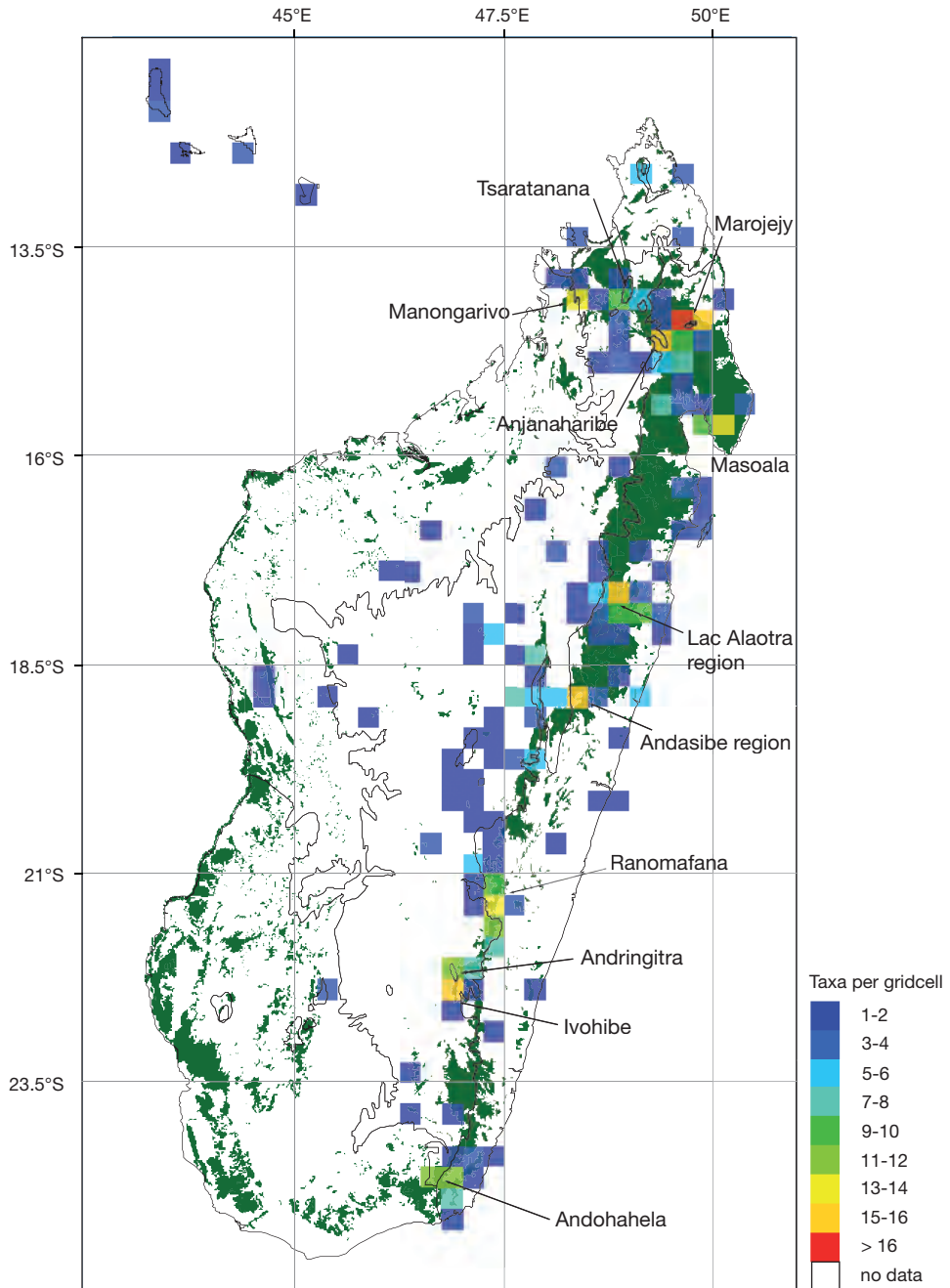


FIG. 3. — Distribution of tree fern diversity in Madagascar. The number of collected taxa per grid cell of $0.25^\circ \times 0.25^\circ$ is indicated on the varietal level and takes into account all currently recognized taxa of *Cyathea* sect. *Alsophila* (this treatment) and *Cyathea* sect. *Gymnosphaera* (Janssen & Rakotondrainibe 2007). This grid is superposed on a map indicating the remaining primary vegetation of Madagascar in dark green (DuPuy & Moat 1999) and outlining the bioclimatic regions of Madagascar according to Figure 2. All dark green areas in the humid and subhumid zones present high probabilities for the occurrence of *Cyathea*. Most specimens and hence most taxa have, however, been collected from the major mountain massifs and other well-known forests in the humid and subhumid zones (names indicated).

and subhumid zones, reveals potentially under-collected regions. The map also shows that especially the forests to the north of the Zahamena National Park (Lac Alaotra region), the Beampingaratra massif (north-northeast of the Andohahela) and the northern forests including the Tsaratanana massif are under-collected with respect to tree ferns. It is likely that high tree fern diversity and potentially new taxa may be encountered there.

Even though biased with respect to collecting intensity, we may draw the following conclusions from the data. The highest diversity has been documented for the Marojejy region and it is likely that this holds true for the neighbouring massifs, which are much less explored, especially the Tsaratanana. The forest corridors linking the Ranomafana region to the Andringitra and the latter to the Ivohibe massif harbour a high diversity and are of conservation concern, though currently not under protection. The southern mountains including the Andohahela harbour a diverse and distinctive tree fern flora, which is most likely strongly under-explored.

MATERIAL AND METHODS

SPECIMENS

For the present treatment we consulted the collections at B, BM, DSM, G, K, L, M, MO, P, SEY, TAN, TEF and W. Extensive fieldwork in Madagascar, on the Comoros and the Seychelles, especially in 2003–2005, permitted us to collect complete specimens showing all taxonomically relevant characters of 88% of the currently accepted species diversity, i.e. all species to the exception of five local endemics. In addition, a great number of plants could be observed *in situ*. Many of the recently collected specimens include trunk surface moulds taken according to the procedure described by Janssen (2006) permitting to illustrate the frequently characteristic trunk surfaces of most species.

INFRASPECIFIC TAXA

In the present treatment, we make extensive use of varieties in order to draw attention to distinct, but morphologically closely related taxa and in order to point out that taxon complexes putatively un-

dergoing rapid evolution exist in Madagascan scaly tree ferns. We leave it to future monographers to reconsider, preferably in the light of data on the reproductive biology of Madagascan tree ferns, the evidence provided in the current treatment to raise these taxa to specific rank, if they consider that the described entities represent reproductively isolated species. For some species, all recognized varieties are allopatric, e.g., *C. bellisquamata* Bonap. (Fig. 44F); for others they are at least partly sympatric, e.g., *C. decrescens* Mett. ex Kuhn (Fig. 44K). For the reason of simplicity and because tree ferns are still undercollected in many regions of Madagascar, we do not employ the rank of subspecies to distinguish allopatric and sympatric infraspecific variation.

TYPIFICATION

Tree fern specimens are generally large and accordingly a single collection is usually mounted on several herbarium sheets. In most ancient collections, the sheets corresponding to a single gathering are not cross-labelled. This holds true for many type specimens. Strictly applying the *Code* (McNeill *et al.* 2006), only one of such sheets should then be considered the holotype. Often, this choice is not obvious, especially if essential diagnostic features, e.g., characters pertaining to the middle pinnae or the petiole base of a given species, are distributed on different sheets. Provided that the type material can be considered as coming from a single gathering, we herein adopt a pragmatic approach: if several sheets of the collection have been annotated by the author as “original”, “type” or likewise, we consider the totality of these sheets the holotype or lectotype taking the author’s annotation as an equivalence of cross-labelling. In cases, where only one sheet has been distinguished in such a way, we follow that choice, even though the specimen is often not representative for the species. It is then important to consult the complete type material (i.e. including the isotypes) and not only the holotype when studying the species and we add a plea for keeping a representative sample of the original material in the same herbarium together with the designated holotype specimen instead of distributing incomplete isotypes. If multiple sheets are available of a collection and all of these are equivalent, i.e. they

are not cross-labelled and no subset has been designated as a holotype by the author, we either choose the most representative specimen as a lectotype or deliberately designate a 2- or 3-sheet lectotype to provide for a complete characterisation of the taxon. In many cases, however, the original material lacks essential characters such as petiole scales. We then designate an epitype to allow for an unambiguous application of the name.

DESCRIPTIONS

As has been stated above, ancient collections from the region generally lack ecological or morphological annotations. Hence, most of the information pertaining to ecology, trunk-, habit-, and whole-leaf-characters, described here often for the first time, is based on data collected during fieldwork and mainly taken from annotations accompanying the cited specimens by *Janssen et al.* and *Rakoton-drainibe et al.* Morphological features usually not preserved in herbarium specimens are described in a separate “field observations” section in order to keep descriptions as concise as possible.

The following abbreviations are used to save space (Janssen 2006):

DT	diameter of trunk at breast height;
FW	distance along the rachis from the first, i.e. basalmost, pinna pair to the widest part of the lamina;
HT	trunk height;
LL	length of the lamina;
NP	number of pinna pairs excluding the pinnatifid apex of the lamina;
WL	maximal width of the lamina.

All colours indicated in the descriptions have been observed in the fresh leaf unless otherwise stated. Petiole diameters are indicated for fresh material and are usually considerably smaller in dry specimens. Size measurements are given as ranges with extreme values indicated in parentheses occurring only in a single specimen or in a small fraction of specimens.

DISTRIBUTION MAPS AND SPECIMEN LISTS

In the additional material examined sections, coordinates for the majority of collections anterior to 1992 have been assigned *a posteriori* from a gazetteer (<http://middleware.alexandria.ucsb.edu/client/gaz/adl/index.jsp>; <http://www.mobot.org/>

MOBOT/research/madagascar/gazetteer/). All georeferenced records have been used to compile distribution maps (Figs 44–46) using a simplified version of Madagascar’s bioclimatic zones as a base map (Cornet 1974; Schatz 2000; Fig. 1).

Trunk surface moulds for most specimens by *Janssen et al.* are deposited at P, where they are kept in an envelope that is attached to a standard herbarium sheet.

In order to save space in the specimen lists, we use the following abbreviations:

PN	Parc national;
RN	Réserve naturelle;
RNI	Réserve naturelle intégrale;
RS	Réserve spéciale.

KEYS

In the keys and descriptions, the mention of characters of petiole scales refers to the scales on the lateral and abaxial faces at the very base of the petiole unless otherwise stated. Falciform petiole scales are more or less sickle-shaped and appressed to the petiole. Arched petiole scales are usually straight, but indurated and convexly curved so that the middle part of the scale is lifted off the surface to which the scale is attached, but its apex is (almost) touching it (Fig. 5E). Leaves are composed of the petiole and the lamina. The lamina is divided into pinnae, which are divided into pinnules, which may be, in turn, divided into pinnule segments. The central axis of the lamina is the rachis, of a pinna it is the costa and of a pinnule it is the costula. We designate the rachis, costae and costulae together as “lamina axes”. 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. For the reason of simplicity, the divisions of the pinnae are called pinnules even when not completely separated from each other. Pinnules can be free or broadly adnate to the costa with their bases. Free pinnules can be sessile or petiolulate. In a pinnate-pinnatifid lamina, the pinnae are more or less deeply lobed, but not down to the costa (Fig. 25A). A pinnate-pinnatisect lamina has pinnae dissected down to the costae and the pinnules are broadly adnate to the costa (Fig. 21A). A bipinnate lamina is pinnate with pinnate pinnae, i.e. the pinnules are free (Figs 4A;

12B). In a bipinnate-pinnatifid lamina, the pinnules are deeply lobed into pinnule segments, but not down to the costula. A bipinnate-pinnatisect lamina has the pinnules dissected down to the costula into broadly adnate segments (Fig. 38G). A tripinnate lamina is bipinnate with the pinnules divided into sessile to petiolulate segments (Fig. 35A shows the tripinnate condition in the proximal halves of the pinnules). When stating that structures are “spaced” from each other, this refers to the distance between adjacent margins of the respective structures. When stating that structures are “distant” from each other, this refers to the distance between adjacent points of insertion. Given the pinnules of a species are 1 cm wide and “distant” by 1.5 cm, they are then “spaced” by less than their width, i.e. 0.5 cm in this example.

No tree fern taxa are shared between Madagascar and the Mascarenes. In order to facilitate discrimination between the two tree fern floras, the keys presented here also include indigenous Mascarene taxa, treated

by Janssen & Rakotondrainibe (2006) and here cited in square brackets. *Cyathea cooperi* (F.Muell.) Domin is introduced in the Mascarenes and can be easily differentiated from all taxa occurring in the Western Indian Ocean by its whitish petiole scales in combination with exindusiate sori and yellowish green bipinnate-pinnatisect to tripinnate leaves. We provide full illustrations for most taxa supporting the keys.

A simplified key based on characters that can be easily observed in the field (cf. Janssen & Rakotondrainibe 2006) is not proposed for Madagascar, because such a key could only have been partial as many taxa are closely related and necessitate the examination of indument characters for determination. A “field key” would hence have been largely redundant with the standard determination key. We believe that the user is better assisted by the photographic plates including the plant habit, trunk apex and trunk surface in narrowing down possible determinations. Given data on distribution and altitudinal range may provide further guidance.

KEY TO THE MORPHOLOGICAL GROUPS OF SPECIES OF *CYATHEA* SUBGEN. *ALSOPHILA*
IN MADAGASCAR, THE MASCARENES AND THE COMOROS

1. Sori exindusiate and leaves bipinnate-pinnatifid to tripinnate; aplebia (skeletonized pinnae) frequently present near the base of the petiole group I
 — Sori indusiate (indusia sometimes small, hemitelioid: *C. melleri* and some specimens of *C. dregei*), if exindusiate then with a pinnate-pinnatisect lamina (*C. simulans*); few species with aplebioid pinnae (skeletonized, but with a distinct lamina remnant) near the base of the petiole 2
2. Lamina bipinnate-pinnatifid, bipinnate-pinnatisect or tripinnate group III
 — Lamina pinnate-pinnatifid, pinnate-pinnatisect or bipinnate (group II) 3
3. Patent to antrorse, multicellular hyaline hairs present on the abaxial face of the costae and costulae (in *C. ligulata* these hairs only in the upper half of the costae, in *C. auriculata* together with abundant scales and scale-topped hairs) group IIb
 — Patent to antrorse, multicellular hyaline hairs absent from the abaxial face of the costae and costulae (abundant appressed 1-2-celled hairs, so-called trichomidia, may be present; cf. in *C. appendiculata*) 4
4. Apex of each pinna not pinnatifid, but a pinnule resembling the lateral pinnules (i.e. apex conform) group IIa
 — Apex of each pinna pinnatifid with a gradual transition to the petiolulate to adnate pinnules (the apex of *C. serratifolia* is pinnatifid with only a few segments and an abrupt transition to the petiolulate pinnules) 5
5. Lamina bipinnate; pinnules sessile to petiolulate at least in the lower half of the pinna group IIc

- Lamina pinnate-pinnatifid to pinnate-pinnatisect; pinnules broadly adnate to the costa over its entire length (sessile in lower third to lower half of the costa in *C. emilei* var. *dauphinensis* from Southern Madagascar) group II d

KEY TO THE SPECIES OF GROUP I

A key is published in Janssen & Rakotondrainibe (2007).

KEY TO THE SPECIES OF GROUP IIA

1. Petiole scales stramineous, concolourous, rarely with a poorly contrasted darker centre 1. *C. marattioides*
 — Petiole scales with a well-contrasted brown centre and a stramineous margin or completely dark brown 2
2. Petiole scales dark brown without a stramineous margin; petiole and rachis dark brown to dark violaceous brown 2. *C. perrieriana*
 — Petiole scales with a dark brown centre and a distinct stramineous margin; petiole and rachis stramineous to light brown 3. *C. tsilotsilensis*

KEY TO THE SPECIES OF GROUP IIB

1. Pinnules $4 \times 0.8(-1)$ cm long, in their lower half with a deeply crenate margin, upwards crenulate; sori subtended by multicellular hairs inserted at the base of the receptacle 8. *C. leptochlamys*
 — Pinnules smaller, if margin crenate, then not only in the lower half of the pinnule; sori not subtended by multicellular hairs 2
2. Petiole scales strongly indurated, polygonal to circular in cross section, resembling patent conical spines 3
 — Petiole scales indurated or not, but always flat in cross section, appressed to the petiole or arched, deltoid to triangular in shape, never patent 4
3. Pinnules $1.1-2.2 \times 0.3-0.5$ cm; petiole scales $0.2-0.4$ cm long, slender; abaxial face of costae densely covered with scales, multicellular hairs and scale-topped hairs 4. *C. auriculata*
 — Pinnules $2.5-4 \times 0.5-0.7$ cm; petiole scales $0.5-0.8$ cm long, thick; abaxial face of costae densely scaly in lower half and hairy in upper half, scale-topped hairs absent 9. *C. ligulata*
4. Petiole scales 2-3 cm long, with strongly twisted apex; receptacle bearing dark brown sporangiasters [*C. grangaudiana*; Mauritius, endemic]
 — Petiole scales shorter, never conspicuously twisted; receptacle without sporangiasters ... 5
5. Petiole scales narrowly triangular, light to dark brown, not indurated, densely imbricate, more or less appressed to the petiole 7. *C. ivohibensis*
 — Petiole scales triangular to deltoid, at least their central part shiny black, very coriaceous to strongly indurated, spaced from each other to overlapping, but never densely imbricate, appressed to strongly arched 6
6. Petiole scales up to 0.4 cm, spaced, ascending on the petiole and gradually transforming into bicolourous scales with a whitish base and a black apex; scale-topped hairs present on the abaxial face of the costulae 10. *C. lisiae*

- Petiole scales usually longer, contiguous to overlapping, black, not conspicuously changing in colour when ascending on the petiole or rachis; scale-topped hairs absent 7
- 7. Petiole scales slightly to strongly arched; trunk surface densely covered with long antrorse squaminate spines 5. *C. decrescens*
- Petiole scales not arched; trunk without antrorse squaminate spines 8
- 8. Pinnules 1.8-2 cm long, widest above their middle, deeply crenate; trunk about 4-6 cm in diameter, its surface smooth 6. *C. dilatata*
- Pinnules 1-1.7 cm long, of equal width, entire to crenulate; trunk 7-10(-15) cm in diameter, its surface covered with short conical squaminate spines 11. *C. meridionalis*

KEY TO THE SPECIES OF GROUP IIC

1. Pinna apex triangular to hastate, pinnatifid, but only with few segments, with a rather abrupt transition to the regular, petiolulate lateral pinnules; pinnules very large, (7-)-8-12(-14) × (1.1-)-1.5-2.2 cm; petiole scales very caducous; trunk smooth 18. *C. serratifolia*
- Pinna apex pinnatifid, with a gradual transition to the lateral pinnae; pinnules smaller; petiole scales usually persistent; trunk muricate 2
2. Petiole scales strongly indurated, in adult plants resembling more or less patent pyramidal spines, spaced, persistent 3
- Petiole scales not strongly indurated nor spiny, contiguous to imbricate, persistent or caducous (very caducous and consequently often absent in *C. appendiculata* and *C. basirotundata*) 4
3. Petiole scales 1-1.5 cm long, strongly indurated at their base, the antrorse scale apex not indurated and caducous on the plant or breaking off in herbarium specimens; pinnules sessile 16. *C. costularis*
- Petiole scales 0.3-0.5 cm long, completely indurated and pyramidal; pinnules petiolulate 19. *C. tsaratananensis*
4. Pinnae gradually reduced in size and base of the lamina long attenuate, the petiole very short (at most 25 cm) [*C. borbonica*; Mascarenes, endemic]
- Pinnae near the petiole base rather abruptly reduced in size and base of the lamina shortly attenuate to truncate, the petiole usually considerably longer than 25 cm 5
5. Petiole scales up to 1.7 cm long, coriaceous, straight and appressed at the petiole base (scales caducous in *C. basirotundata*) 6
- Petiole scales 2.5-5 cm long, membranous to subcoriaceous, not appressed and more or less twisted at the petiole base (scales caducous in *C. appendiculata*) 7
6. Petiole scales persistent; pinnule base truncate, often auriculate; no fertile-sterile dimorphism; sori 0.1 cm in diameter, indusia membranous 12. *C. acutula*
- Petiole scales caducous; pinnule base rounded, not auriculate; fertile pinnules distinctly narrower than sterile pinnules; sori 0.2 cm in diameter, indusia coriaceous 14. *C. basirotundata*
7. Petiole scales caducous, restricted to the petiole base, at least 0.2 cm wide; pinnules up to 4 × 0.6 cm 13. *C. appendiculata*
- Petiole scales persistent, ascending on the petiole, if restricted to the petiole base then less than 0.1 cm wide; pinnules at least 4 × 0.7 cm 8

8. Margins of adjacent pinnules overlap; petiole scales filiform (less than 0.1 cm wide), restricted to the base of the petiole 15. *C. conferta*
 — Adjacent pinnules spaced to contiguous; petiole scales narrowly triangular, ascending at least halfway on the petiole 9
9. Petiole scales shiny brown to ferruginous, ascending up to the first pinna pair; pinnules 4-5.5(-7.5) × 0.7-1 cm; pinnule base truncate to cordate and generally auriculate; indusia dark brown, coriaceous 20. *C. viguieri*
 — Petiole scales dull brown, reaching at least halfway on the petiole, but never to the first pinna pair; pinnules 7-8(-9) × 1-1.3 cm; pinnule base rounded, truncate or cuneate, but never auriculate; indusia brown, subcoriaceous 17. *C. hebes*

KEY TO THE SPECIES OF GROUP IID

1. Receptacle with conspicuous long filiform or scaly paraphyses much longer than the sporangia 2
 — Receptacle without paraphyses or with inconspicuous filiform paraphyses shorter than the sporangia (to slightly longer than the sporangia in *C. emilei*) 3
2. Receptacle covered with dense, hyaline filiform paraphyses; pinnules 3-3.5 × 0.5-0.8 cm; petiole scales triangular, 1-1.5 × 0.2-0.3 cm 32. *C. simulans*
 — Receptacle bearing an apical tuft of scaly paraphyses; pinnules up to 2 × 0.4 cm; petiole scales minute (petiole apparently naked) 21. *C. approximata*
3. Petiole and rachis black; pinnae with not more than 15 (rarely 20) segments; petiole scales persistent; segment apex rounded 27. *C. melanocaula*
 — Petiole and rachis light brown to dark violaceous brown (but not black); pinnae with more than 25 segments (if rarely 15-25 segments then petiole scales caducous); segment apex acute to rounded 4
4. Petiole scales black, deltoid, spaced to contiguous; pinnae pinnatifid 5
 — Petiole scales brown, narrowly triangular, dense and overlapping (rarely spaced) or caducous; pinnae pinnatisect at least in their lower half (very rarely pinnatifid) 6
5. Petiole scales 0.3-0.6 × 0.1-0.2 cm; distance sinus-costa 0.3-0.7 cm; rachis brown 24. *C. longipinnata*
 — Petiole scales 1-1.3 × 0.3-0.4 cm; distance sinus-costa 0.1-0.3 cm; rachis dark reddish to violaceous brown 26. *C. madagascarica*
6. Petiole scales decaying quickly or caducous and leaving the petiole apparently naked in most herbarium specimens, restricted to the base of the petiole (ascending up to 10 cm) 7
 — Petiole scales persistent and not decaying quickly, not restricted to the base of the petiole (ascending at least halfway on the petiole) 8
7. Indusia subcoriaceous, persistent in mature sori; trunk surface muricate, no spines on the scar rim 23. *C. emilei*
 — Indusia membranous, quickly withering, only a rudiment persistent as a collar around the base of the receptacle in mature sori; trunk surface smooth, 5-7 strong acroscopic spines on the lower rim of the scars 31. *C. remotifolia*
8. Abaxial face of the costae and costulae densely covered with scales; aplebia present 28. *C. obtecta*

- Abaxial face of the costae and costulae subglabrous or with scattered scales; aplebia absent 9
- 9. Basalmost pinnae distinctly petiolulate; sori very small (less than 0.1 cm in diameter); trunk surface smooth and leaf scars not spiny 29. *C. orthogonalis*
- Basalmost pinnae sessile; sori bigger (at least 0.1 cm in diameter); trunk surface muricate or smooth and then with spines on the lower rim of the leaf scar 10
- 10. Pinnules 0.3-0.4 cm wide (rarely 0.5 cm) and spaced by about their width to more than their width, herbaceous to subcoriaceous (not coriaceous); abaxial face of the costae and costulae bearing scattered, shiny brown scales, up to 0.3 cm long, with prominent apical spines up to 0.1 cm long 25. *C. longispina*
- Pinnules at least 0.5 cm wide and spaced by less than to rarely about their width (if rarely only 0.4 cm wide, then spaced by much less than their width), coriaceous; abaxial face of the costae and costulae without scales (very rarely with sparse scales, that are dull brown and lack a prominent apical spine) 11
- 11. Trunk surface smooth, leaf scars with spines on their lower rim; pinnules 1.8(-2.4) × 0.4(-0.5) cm; pinnae pinnatisect; South Madagascar (Andohahela) 30. *C. pseudobellisquamata*
- Trunk surface coarsely muricate, leaf scars without spines on their lower rim; pinnules 1.8-4.5 × 0.4-0.9 cm; pinnae pinnatisect to rarely pinnatifid; North to Central Madagascar 22. *C. bellisquamata*

KEY TO THE SPECIES OF GROUP III

- 1. Basal pinnae of the lamina gradually decrescent in size, petiole up to 10 cm long; scattered to dense dark brown scales with prominent apical and lateral spines on the abaxial face of all lamina axes 42. *C. valdesquamata*
- Basal pinnae of the lamina not gradually decrescent in size, petiole at least 15 cm long, usually much longer; abaxial face of the lamina axes without scales, if with scales then these not dark brown or without prominent apical and lateral spines 2
- 2. Indusia hemitelioid, inserted on the costular side of the receptacle 3
- Indusia globular to variously cup-shaped, encircling the receptacle at least at its base 5
- 3. All lateral veins in the segments simple; one to two sori per pinnule segment; S Africa, Madagascar? 34. *C. capensis*
- Most lateral veins in the segments once furcate; more than two sori per pinnule segment 4
- 4. Petiole scales distant to contiguous, shiny dark brown to black, up to 1.5 cm long, their base strongly indurated, their apex not twisted; Madagascar 39. *C. melleri*
- Petiole scales dense and overlapping, shiny brown to dark brown, at least 2 cm long, their base not indurated, their apex twisted; Africa, Madagascar 36. *C. dregei*
- 5. The majority of the indusia globular, at maturity breaking up in 2-4 usually persistent lobes 6
- The majority of the indusia cup-shaped (i.e. not enclosing the entire sorus, but always with a conspicuous circular mouth), their rim at maturity shorter or longer than the receptacle, entire or more or less deeply incised 10

6. Petiole and rachis densely tomentose with persistent, intricate, branched, light brown hairs and scattered, membranous, crispate scales of the same colour [*C. glauca*; la Réunion, endemic]
- Petiole and rachis without a dense tomentum of intricate light brown hairs, although sometimes with a thin and caducous tomentum of minute squamules 7
7. Petiole scales more or less appressed, up to 2 cm long; shiny brown to black, triangular to linear scales, up to 0.5 cm long, scattered on the abaxial face of the costae and costulae; Comoros 37. *C. kirkii*
- Petiole scales not appressed, antrorse, at least 2.5 cm long, if rarely shorter than lamina very coriaceous; small, brown to black, triangular scales absent from the abaxial face of the costae and costulae; Madagascar, Mascarenes 8
8. Abaxial surface of the lamina glaucous; petiole scales persistent and ascending on the petiole, usually reaching the first pinna pair (if rarely restricted to the petiole base, then lamina very coriaceous and pinnule segments 0.1-0.2(-0.3) cm wide) 41. *C. similis* s.l.
- Abaxial surface of the lamina light green; petiole scales restricted to the petiole base, never reaching the first pinna pair 9
9. Bases of adjacent pinnule segments confluent only in the upper third of the pinnules; pinnule segments with rounded to obtuse apices, strongly concave, 0.4-0.6 cm wide 35. *C. concava*
- Bases of adjacent pinnule segments confluent almost from the base of the pinnules; pinnule segments with acute to obtuse apices, flat, 0.3-0.4 cm wide [*C. excelsa*; Mascarenes, endemic]
10. Petiole without scales in most specimens (scales rapidly caducous), petiole and rachis covered with an abundant and persistent tomentum of intricate squamules; Andringitra massif 33b. *C. boivinii* var. *andringitrensis*
- Petiole always with scales (scales persistent), petiole and rachis glabrous or with a conspicuous tomentum of intricate squamules, but then usually caducous and less abundant; not restricted to the Andringitra massif 11
11. The majority of the indusia shallowly cup-shaped, at most hemispherical, with an entire margin; fertile and sterile pinnules monomorphic 12
- The majority of the indusia forming a profound cup and/or having a deeply incised or irregular rim; fertile and sterile pinnules mono- or dimorphic 14
12. Sori spaced and in a median position, i.e. slightly distant from the midvein of the segment; fresh petioles pale green on both sides, covered with a bluish waxy layer 38. *C. lastii*
- Sori contiguous or slightly spaced, directly at the midvein of the segment; fresh petioles never green on both faces and without a waxy layer 13
13. Petiole scales (2-)2.5-3 × 0.2-0.3 cm; pinnule segments with an acute apex; Seychelles 40. *C. sechellarum*
- Petiole scales 3-4 × (0.2-)0.3-0.5 cm; pinnule segments with a rounded to obtuse apex; Madagascar, Comoros 33d. *C. boivinii* var. *hildebrandtii*
14. Scales ascending to the first pinna pair 15
- Scales not reaching the first pinna pair, usually restricted to the petiole base 16

15. Indusia light brown, never globular, but cup-shaped (more or less hemispherical) and persistent in mature sori with an entire, rarely dehiscing rim 33c. *C. boivinii* var. *bevolo*
 — Indusia light brown to whitish, globular, but withering quickly and only degraded lacera-
 ate lobes or a more or less collar-like rudiment present in mature sori
 41b. *C. similis* var. *leptoderma*
16. Largest pinnae up to 50 cm long with pinnules (5-)6-8 cm long; a dense indument of
 branched, crispate, light brown hairs loosely attached to the abaxial face of the costulae
 and segment midveins; fertile and sterile pinnules monomorphic..... 36. *C. dregei*
 — Largest pinnae at least 55 cm long with pinnules (7.5-)8-14 cm long; indument of branched,
 crispate, light brown hairs on the abaxial face of the costulae and segment midveins absent
 or sparse; fertile and sterile pinnules mono- or dimorphic 33. *C. boivinii* s.l.

SYSTEMATICS

Group I: *Cyathea* sect. *Gymnosphaera*

Alsophila sensu Christensen 1932; “group 1” sensu Holt-
 tum 1981; sect. *Gymnosphaera* sensu Rakotondrainibe &
 Lobreau-Callen 1999; *Gymnosphaera* – clade p.p. sensu
 Korall *et al.* 2007, Janssen *et al.* 2008.

DIAGNOSTIC CHARACTERS. — Leaves bipinnate-pinnatifid
 to tripinnate, sori exindusiate, conspicuous aplebia
 frequently present near the base of the petiole.

REMARKS

A recent revision of this group, based on Rako-
 tondrainibe and Lobreau-Callen (1999), has been
 published by Janssen & Rakotondrainibe (2007)
 and includes six species and three varieties for
 Madagascar and the Comoros.

Group II: *Cyathea* sect. *Alsophila*, species with
 bipinnate or less strongly dissected leaves

Alsophila – clade p.p. sensu Korall *et al.* 2007; bipinnate
 clade sensu Janssen *et al.* 2008.

DIAGNOSTIC CHARACTERS. — Leaves pinnate-pinnatifid
 to bipinnate, sori indusiate, aplebia rare. A highly
 diverse group including some taxa with very restricted
 distribution areas. All Madagascan species are endemic
 to the island.

Group IIa: group of *Cyathea marattioides*

Cyathea marattioides group p.p. sensu Christensen 1932;
 “group 4” p.p. sensu Holttum 1981.

DIAGNOSTIC CHARACTERS. — Leaves bipinnate, pinnules
 petiolulate, terminal pinnules conform to the lateral ones,
 i.e. the pinna apex is not pinnatifid.

1. *Cyathea marattioides* Willd. ex Kaulf.
 (Figs 4A-E; 45J; 47A)

Enumeratio Filicum: 256 (1824); Christensen, *Dansk
 Botanisk Arkiv* 7: 19, pl. 3 figs 7, 8 (1932); Tardieu in
 Humbert, *Flore de Madagascar et des Comores, IV^e famille,
 Cyathéacées*: 5 (1951). — *Alsophila marattioides* (Willd. ex
 Kaulf.) R.M. Tryon, *Contributions from the Gray Herbarium*
 200: 30 (1970). — Type: habitat in Madagascar, *du
 Petit-Thouars s.n.* (holo-, B-Willd.! [B-W 20180]; putative
 iso-, P! [2 sheets]). — Madagascar, Toamasina, Maroant-
 setra, Ambanizana, Ambon’Andraoka, piste menant
 d’Ambanizana à la crête E d’Ambanizana, 15°37’53”S,
 49°58’33”E, 2-471 m, 20.X.2004, Janssen *et al.* 2484
 (epi-, P! [4 sheets: P00589612-15], here designated;
 isoepi-, TAN!; one trunk surface mould at P!).

Cyathea phaneroplebia Baker, *Annals of Botany* 8: 122
 (1894). — Type: I.1892, *Baron 6109* (holo-, K!
 [K000009934]; photo, P).

Hemitelia cordata Desv., *Prodrome de la famille des fougères*:
 321 (1827). — Type: habitat in Madagascar, *hb.
 Desvaux s.n.* (holo-, P! [P00389539]).

ADDITIONAL MATERIAL EXAMINED. — **Madagascar.** Ant-
 siranana, Nosy-Bé, RNI de Lokobe, 13°24’S, 48°19’E,
 0-50 m, 17.III.1994, *Antilabimena 60* (P). — Nossi-Be,
 13°17’30”S, 48°15’30”E, *Boivin s.n.* (B, BM, P). —
Boivin s.n. (B, P). — Toamasina, Ste Marie, 16°53’S,
 49°53’E, *Boivin 1601* (G). — Entre Volotaraina et
 Ambodirofia, 9.XI.1942, *Cours 1723* (P). — Tamat-
 ave, de Sahalampy à Ampitanonoka, 17°46’S, 48°54’E,
 1200 m, 18.I.1945, *Cours 2417* (P). — Toamasina,
 forêt de Bekopila, près d’Antsirabe, 16°24’S, 49°47’E,
 350 m, 15.XI.1959, *Cours 5343* (P). — Toamasina, SW

de Vatomandry, Ifasina, 19°27'S, 48°41'E, 16.X.1920, *Decary s.n.* (P). — Fénérive, 17°22'S, 49°24'30"E, 30.IV.1926, *Decary 3942* (P). — Farafangana, Vondrozo, 26.VIII.1926, *Decary 4917* (P). — *hb. Desvieux s.n.* (P). — Antsiranana, Sambava, massif d'Ambatobiribiry, 14°11'S, 50°05'30"E, 50-345 m, XI.1950, *Humbert et al. 24436* (P). — Toamasina, Maroantsetra, Ambanizana, Ambon'Andraoka, 15°37'53"S, 49°58'33"E, 2-471 m, 20.X.2004, *Janssen et al. 2483* (MO, P, TAN). — *Idem*, piste menant d'Ambanizana à la crête E d'Ambanizana, 15°37'51"S, 49°58'35"E, 2-503m, 21.X.2004, *Janssen et al. 2488* (P, TAN). — *Idem*, entre Andranobe et Bedinta, 15°40'34"S, 49°58'03"E, 0-628 m, 26.X.2004, *Janssen et al. 2520* (P, TAN). — Toamasina, RNI Betampona, Rendriendry, 17°55'54"S, 49°12'12"E, 300-500 m, 8.XI.2004, *Janssen et al. 2558* (MO, P, TAN). — Antsiranana, Be Kilus Mts., 14°02'S, 48°19'E, 1890, *Last s.n.* (BM). — Maroantsetra-Mananara Road, 15°27'S, 49°42'E, 19.IV.1988, *Leeuwenberg 13948* (P). — Toamasina, RNI de Zahamena, forest of Amboditamena, 17°44'S, 49°00'E, 500-750 m, IX.1993, *Malcomber et al. 2535* (BR, G, MO, P). — Antsiranana, Daraina, forêt de Binara, 13°15'S, 49°37'E, 940 m, 15.XI.2005, *Nusbaumer et al. 1603* (P). — Sambirano, massif du Manongarivo, IX.1909, *Perrier de la Bâthie 7499* (P). — Fénérive, 17°22'S, 49°24'30"E, IX.1912, *Perrier de la Bâthie 7994* (BM, P). — Mahajanga, Ankaizina, 14°30'S, 48°55'E, 1500 m, VIII.1908, *Perrier de la Bâthie 15840* (P). — Antsiranana, Nossi-Be, 13°17'30"S, 48°15'30"E, 1853, *Pervillé s.n.* (P). — Nossi-Be, RNI de Lokobe, 13°24'S, 48°19'E, 340 m, 26.VII.1992, *Rakotondrainibe 1787* (MO, P). — Toamasina, Maroantsetra, S d'Ambanizana, 15°41'S, 49°58'E, 650 m, 19.XII.1993, *Rakotondrainibe et al. 2051* (P, TAN). — Toamasina, Sainte Marie, forêt de Kalalao, 16°53'S, 49°53'30"E, 100-200 m, 13.XI.2000, *Rakotondrainibe 6189* (K, P). — Ambodivato, SW of Maroantsetra, 15°27'25"S, 49°41'41"E, 0-30 m, 29.I.1999, *Schatz et al. 3865* (P). — Nossibé, forêt de Loucoubé, 13°24'S, 48°19'E, 27.III.1882, *Thiebaut 58* (P). — Antsiranana, Manongarivo massif, Ambodisa-koana, 14°05'S, 48°20'E, 500-1000 m, 20.X.1994, *van der Werff et al. 13537* (MO, P).

FIELD OBSERVATIONS. — Trunk: HT up to 6(-8) m, DT 4-6(-15) cm, dead petioles caducous and leaf scars exposed; trunk surface brown to black, densely and finely muricate, near its base covered with adventitious roots; stramineous scales sometimes persistent in the upper 50-100 cm of the trunk.

Petiole: with 1 or 2 rows of light brown to brown aerophores on either side, often inconspicuous; petiole base long sigmoid, usually parallel to the trunk surface for a considerable distance, then recurved and arching.

Leaf scars: 1.7-2.5 × 4-7 cm, elliptic to rhombic, somewhat raised, sometimes with 4-6 conical spines, up to 1 cm long, on their lower rim; usually arranged

in 4 orthostichies, often decussate.

Crown: horizontal to umbrella-shaped, the petioles and rachises more or less arching.

Trunk apex: densely covered with stramineous scales, concealed by or visible through the more or less close standing petiole bases.

Lamina: (broadly) elliptic to ovate; LL 135-160 (-250) cm, WL 70-100 cm, FW 40-90 cm, NP 11-16.

DESCRIPTION

Petiole: 15-60 cm long, 2-2.5 cm in diameter; completely blackish to violaceous brown, sometimes castaneous, with a thin and caducous tomentum of light brown squamules; rarely with a pinna of reduced size near the base of the petiole.

Lamina: bipinnate, subcoriaceous to coriaceous, light to pale green below, shiny green to dark green above, lamina base shortly attenuate to truncate, basal pinnae more or less reflexed and conduplicate; rachis of the same colour as the petiole.

Largest pinnae: 45-60 cm long, distant by 7.5-10 cm, adjacent pinnae contiguous to overlapping, their apex more or less truncate and the apical pinnule conform, i.e. resembling the lateral pinnules; costae and costulae of the same colour as the petiole.

Largest pinnules: 7-8.5 × 1-1.4 cm, spaced by less than to about their width, shortly petiolulate, the petiolule 0.1-0.2 cm long, articulated and the pinnules easily shed upon drying, lanceolate-oblong, straight, but sometimes with an asymmetric apex, their margin subentire, serrate in the acute to shortly caudate apex, their base cordate, truncate in distal pinnules, without auricles to conspicuously biauriculate; veins once to twice furcate.

Scales and hairs: scales present from the petiole base upwards to 20-60 cm on the petiole, rarely reaching the first pinna pair, dense and overlapping, persistent, narrowly triangular, 2-4 × 0.1-0.2 cm, straight, their apex more or less crispate, stramineous, concolourous, shiny or dull, their apical spine dark, occasionally with a pale brown centre when young, more or less appressed to the petiole, not indurated; scattered dark brown acaroid squamules on the abaxial face of the costulae and veins; adaxial face of the rachis and costae densely tomentose with more or less contorted and antrorse, brown multicellular hairs and bearing sparse filiform, brown scales; leaf otherwise glabrous.

Sori: subcontiguous to spaced by more than their width, spaced from the costula by at least their width, about 0.1 cm in diameter, covering the entire pinnule except the apex and sometimes the base; indusia globular, light brown, very thin and membranous, at maturity dehiscing in 2 or 3 lobes or irregularly, often only a rudiment persistent as a collar around the base of the receptacle; receptacle capitate to disciform, about as long as to longer than the rim of mature indusia, with inconspicuous filiform paraphyses much shorter than the sporangia.

DISTRIBUTION

Northern to Central Madagascar, one collection from southern Central Madagascar (Ifasina); endemic.

ECOLOGY

0-1000(-1800) m. Dense evergreen rainforests.

REMARKS

Cyathea marattioides is characterized by its bipinnate pinnae with a conform apex and stramineous petiole scales. It cannot be confounded with any other species in the Western Indian Ocean.

TYPIIFICATION AND SYNONYMY

Two sheets collected by *du Petit-Thouars s.n.* have been traced at P that are perfectly identical to the holotype specimen B-W 20180. They are considered here to represent putative isotypes.

Although pinnule size and shape may be used to distinguish the species of group IIa, this is not always reliable and we consider it necessary to provide an epitype including petiole scales to complement the fragmentary original material of *C. marattioides*.

2. *Cyathea perrieriana* C.Chr. (Figs 4H-K; 46C; 47B)

Dansk Botanisk Arkiv 7: 19, pl. 3 figs 1-6 (1932); Tardieu in Humbert, *Flore de Madagascar et des Comores, IV^e famille, Cyathacées*: 6 (1951). — *Alsophila perrieriana* (C.Chr.) R.M. Tryon, *Contributions from the Gray Herbarium* 200: 31 (1970). — Type: Madagascar, forêt orientale, bassin inférieur du Mangoro, 300 m, X.1927, *Perrier de la Bâthie 18086* (holo-, BM! [BM000800688]; iso-, P! [3 sheets]).

ADDITIONAL MATERIAL EXAMINED. — **Madagascar.** Toamasina, Maroantsetra, piste menant au sommet d'Ambohitsitondroinan'Amбанизана, 15°32'S, 50°00'30"E, 620-1109 m, 23.X.2004, *Janssen et al. 2503* (MO, P, TAN), *2504* (P, TAN), *2505* (P, TAN), *2511* (P, TAN). — Antsiranana, Andapa, RNI du Marojejy, 14°26'12"S, 49°44'30"E, 1200 m, 25.X.1996, *Rakotondrainibe 3502* (MO, P, TAN). — Mahajanga, Sofia, Bealanana, Mt. Ampomotra, 14°12'58"S, 49°04'12"E, 1820 m, 24.X.2005, *Rakotovao et al. 2337* (MO, TAN). — Ambohimirahavavy, 14°13'41"S, 49°08'10"E, 1992 m, XI.2005, *Rakotovao et al. 2529* (MO, P, TAN). — Toamasina, PN de Zahamena, Ankosy, 17°41'08"S, 48°59'43"E, 650 m, 11.VI.2001, *Rasolohery 467* (MO, P, TAN). — Toamasina, Masaola peninsula, Amбанизана, 15°38'S, 49°59'E, 300-700 m, 1.XI.1992, *van der Werff et al. 12822* (MO, P).

FIELD OBSERVATIONS. — Trunk: HT up to 8 m, DT (5-)6-9(-12) cm, dead petiole bases caducous and the leaf scars exposed, sometimes a rudiment persistent in the upper part of the trunk; trunk surface dark brown, usually with persistent, dense scales like those of the petiole base.

Petiole: with 1 row of light brown to orange aerophores on either side; long to short sigmoid, often parallel to the trunk surface and more or less fasciculate above the trunk apex before being gradually recurved and arching.

Leaf scars: 2.5 × 3-4.5 cm, elliptic, 4 or 5 conical spines, up to 0.7 cm long, on their somewhat raised lower rim; light brown to white in the upper part of the trunk, spirally arranged.

Crown: umbrella-shaped with arching rachises, petioles more or less erect and the crown center infundibuliform especially in young plants.

Trunk apex: densely covered with brown scales, concealed by or visible through the more or less spaced petiole bases.

Lamina: elliptic to ovate; LL 155-200(-350) cm, WL 110-125 cm, FW 65-75 cm, NP 12-15.

DESCRIPTION

Petiole: 20-85 cm long, 2.5-3 cm in diameter; completely violaceous to blackish brown, with a thin and caducous tomentum of brown squamules.

Lamina: bipinnate, coriaceous, pale green below, shiny green to dark green above, lamina base shortly attenuate to truncate, basal pinnae patent and often strongly conduplicate; rachis of the same colour as the petiole.

Largest pinnae: 45-60 cm long, distant by 10-15 cm, adjacent pinnae contiguous to overlapping, their apex more or less truncate and the apical

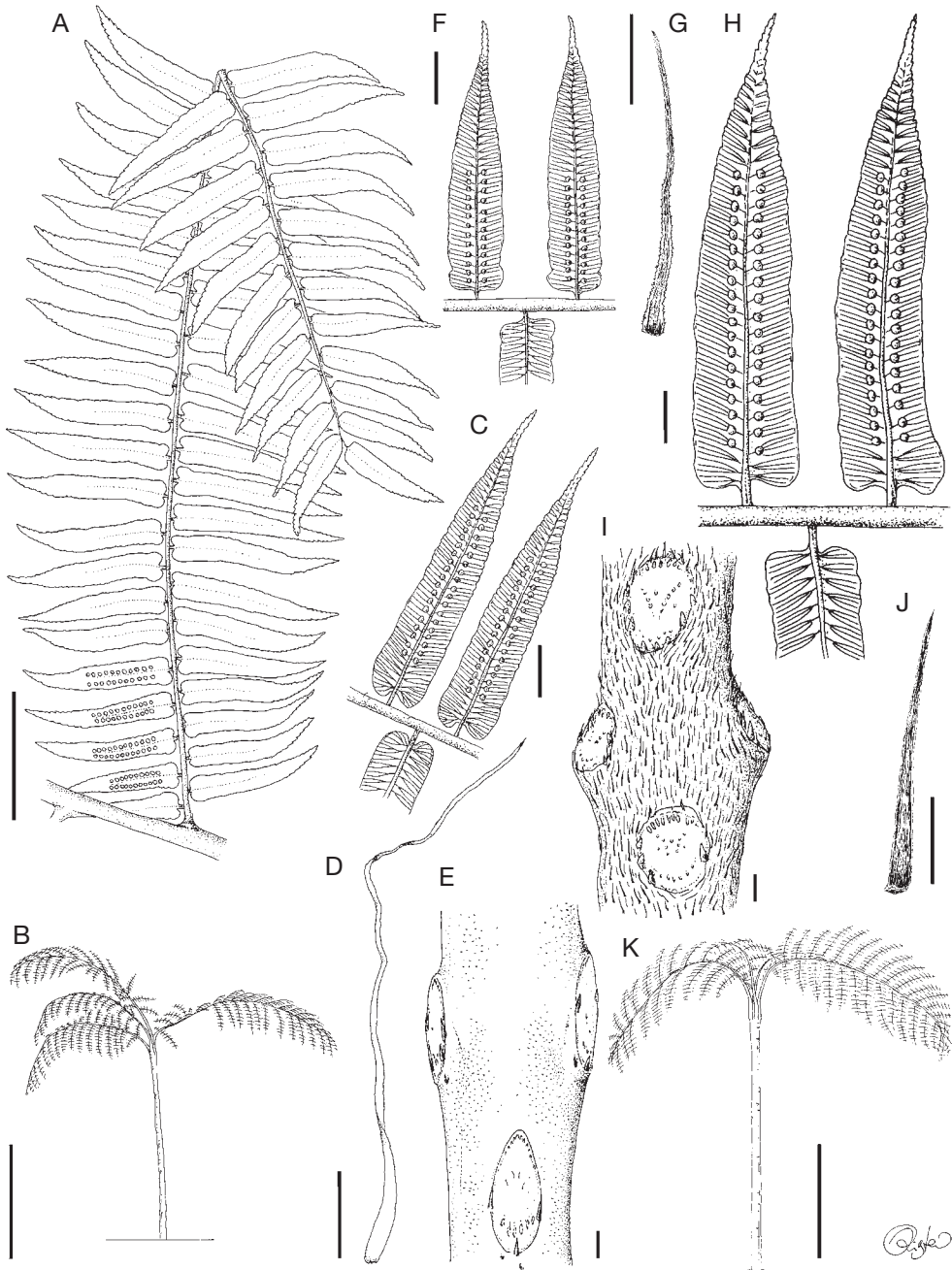


FIG. 4. — **A-E**, *Cyathea marattioides* Willd. ex Kaulf.; **A**, pinna abaxially with a fragment of the rachis, sori only partly indicated; **B**, habit; **C**, pinnules abaxially with a fragment of the costa; **D**, scale from the base of the petiole; **E**, trunk segment with leaf scars; **F, G**, *C. tsilosilensis* Tardieu; **F**, pinnules abaxially with a fragment of the costa; **G**, scale from the base of the petiole; **H-K**, *C. perrieriana* C.Chr.; **H**, pinnules abaxially with a fragment of the costa; **I**, trunk segment with leaf scars; **J**, scale from the base of the petiole; **K**, habit. **A-E**, Janssen *et al.* 2488 (P); **F, G**, van der Werff 12905 (P); **H-J**, Janssen *et al.* 2503 (P); **K**, uncollected, photograph at P. Scale bars: **A**, 5 cm; **B, K**, 1 m; **C, E, F, H, I**, 1 cm; **D, G, J**, 0.5 cm.

pinnule conform, i.e. resembling the lateral pinnules; costae and costulae of the same colour as the petiole.

Largest pinnules: 6-10 × 1.2-2.2 cm, spaced by less than their width, petiolulate, the petiolule 0.2-0.5 cm long, articulated and the pinnules easily shed upon drying, lanceolate-oblong, straight, their margin subentire, serrate in the acute to distinctly caudate apex, their base cordate in proximal, truncate in distal pinnules, occasionally slightly mono- or biauriculate; veins once to twice furcate.

Scales and hairs: scales present from the petiole base upwards to 30-60 cm on the petiole, often reaching the first pinna pair, moderately dense, sometimes only slightly overlapping, persistent, narrowly triangular, 1.5-2(-3) × 0.1-0.2 cm, straight to slightly falciform (adaxial scales more or less contorted), shiny to dull, brown to dark brown, with a light brown erose margin, appressed, adaxial scales not appressed, antrorse, coriaceous, not indurated; scattered, dark brown acaroid squamules on the abaxial face of the costulae and veins; adaxial face of the costae densely tomentose with more or less contorted and antrorse, dark brown multicellular hairs and bearing sparse, filiform, brown scales; these scales also on the adaxial face of the rachis; leaf otherwise glabrous.

Sori: spaced by less than to more than their width, spaced from the costula by at least their width, about 0.1 cm in diameter, covering the entire pinnule except its apex; indusia globular, brown, membranous, at maturity dehiscing in (2-)3-4 lobes, often only a rudiment persistent as a collar around the base of the receptacle; receptacle capitate to disciform, usually longer than the rim of mature indusia, with inconspicuous filiform paraphyses much shorter than the sporangia.

DISTRIBUTION

Northern to Central Madagascar, most frequent on the Masoala peninsula; endemic.

ECOLOGY

(300-)600-1200(-2000) m. Dense evergreen rainforests.

REMARKS

Even from fragmentary specimens this taxon is usually easily recognized by its large and long petiolulate coriaceous pinnules with a cordate base, although the short dark brown petiole scales may be necessary to unambiguously differentiate it from its close relatives of group IIa. *Cyathea perrieriana* cannot be confounded with any other taxon of the Western Indian Ocean.

Juvenile plants (cf. *Janssen et al.* 2511) have light brown crispate scales and pinnate to bipinnate leaves, the pinnae or pinnules being ovate-oblong with rounded to obtuse apices.

3. *Cyathea tsilotsilensis* Tardieu

(Figs 4F, G; 46J)

Bulletin de la Société botanique de France 88: 682 (1941); Tardieu in Humbert, *Flore de Madagascar et des Comores, IV^e famille, Cyathéacées*: 6, fig. 2 (1-3) (1951). — *Alsophila tsilotsilensis* (Tardieu) R.M. Tryon, *Contributions from the Gray Herbarium* 200: 31 (1970). — Type: montagnes entre l'Andohahela et l'Elakelaka, 24°50'S, 46°45'30"E, 1300 m, II.1934, *Humbert 14115* (holo-, P! [P00389552]; iso-, P! [2 sheets]).

ADDITIONAL MATERIAL EXAMINED. — **Madagascar.** Toliara, Tolanaro, RNI d'Andohahela, NW d'Eminiminy, 24°37'55"S, 46°45'29"E, 520 m, 22.X.1995, *Rakotondrainibe 2890* (P). — *Idem*, 24°38'S, 46°40'E, 500-1000 m, II.1993, *van der Werff et al.* 12902 (BR, G, MO, P), 12905 (G, MO, P).

FIELD OBSERVATIONS. — Trunk: HT up to 6 m.

Lamina: LL 200 cm.

DESCRIPTION

Petiole: about 30-83 cm long, 1-1.8 cm in diameter when dry; completely stramineous to light brown when dry, sometimes tinged with red, with a thin and caducous tomentum of light brown squamules.

Lamina: bipinnate, subcoriaceous, light green below, shiny green to dark green above when dry; rachis of the same colour as the petiole.

Largest pinnae: 40-63 cm long, distant by 9-11 cm, adjacent pinnae contiguous to overlapping, their apex more or less truncate and the apical pinnule conform, i.e. resembling the lateral

pinnules; costae and costulae of the same colour as the petiole.

Largest pinnules: 4-6(-8) × 1-1.5 cm, spaced by less than their width, petiolulate, the petiolule 0.1-0.2 cm long, articulated and the pinnules easily shed upon drying, pinnules lanceolate-oblong, straight, their margin subentire, serrate in the acute to caudate apex, their base truncate, rounded or cordate; veins once, rarely twice furcate.

Scales and hairs: scales present from the petiole base upwards to 15-50 cm on the petiole, usually not reaching the first pinna pair, dense and overlapping, persistent, narrowly triangular, (1.5-)2-2.5 × 0.1(-0.2) cm, straight to slightly falciform, with a shiny light to dark brown centre and a distinct stramineous border of elongate cells, with a light brown erose margin of irregularly shaped cells, appressed, adaxial scales not appressed, antrorse, not indurated; scattered dark brown acaroid squamules on the abaxial face of the costulae and veins; adaxial face of the costae moderately densely tomentose with more or less contorted and antrorse, dark brown multicellular hairs; leaf otherwise glabrous.

Sori: contiguous to spaced by about their width, spaced from the costula by at least their width, about 0.1 cm in diameter, covering the entire pinna or its lower half, but usually not the apex and the base; indusia most likely globular, light brown, very thin and membranous, at maturity dehiscing irregularly, only a rudiment persistent as a collar around the base of the receptacle; receptacle capitate to disciform, usually longer than the rim of mature indusia, with inconspicuous filiform paraphyses much shorter than the sporangia.

DISTRIBUTION

Southern Madagascar: Andohahela massif; endemic.

ECOLOGY

500-1300 m. Dense evergreen rainforests.

REMARKS

Cyathea tsilotsilensis has more delicate leaves than its close relatives of group IIa, with smaller pinnules that have a truncate to rounded, rarely cordate base. The petiole scales are much denser than in *C. perrieriana*

and differ from those of *C. marattioides* in having a distinct brown centre and stramineous border even in old leaves. *Cyathea tsilotsilensis* furthermore distinct by its petiole and leaf axes being of much lighter colour in the dry and consequently most likely also in the fresh state.

Group IIb: group of *Cyathea decrescens*

Cyathea borbonica group p.p. *sensu* Christensen 1932; "group 4" p.p. *sensu* Holttum 1981.

DIAGNOSTIC CHARACTERS. — Leaves pinnate-pinnatifid to bipinnate, pinnules broadly adnate to the costa to petiolulate; pinna apex pinnatifid; multicellular hyaline hairs present at least on the abaxial face of the costae and costulae; some taxa with aphyllous pinnae near the base of the petiole.

4. *Cyathea auriculata* Tardieu (Figs 44D; 47C)

Naturaliste malgache 3: 75, pl. 1 fig. 1 (1951); Tardieu in Humbert, *Flore de Madagascar et des Comores, IV^e famille, Cyathacées*: 25, fig. 3 (1-5) (1951). — *Alsophila auriculata* (Tardieu) R.M. Tryon, *Contributions from the Gray Herbarium* 200: 29 (1970). — Type: Madagascar, contreforts occidentaux du massif de Marojeje (nord-est), près du col de Doanyanala (limite des bassins de la Lokoho et de l'Andraronga), 14°28'S, 49°32'E, 900-1000 m, II.1949, *Humbert 23163* (holo-, P! [P00404420]; iso-, MO!, P! [3 sheets and 1 trunk fragment (P00404421)], TAN!).

ADDITIONAL MATERIAL EXAMINED. — **Madagascar.** Prov. de Toamasina, Maroantsetra, Ambanizana, piste menant au sommet d'Ambohitsitondroinan' Ambanizana, 15°34'31"S, 50°00'37"E, 620-1109 m, 23.X.2004, *Janssen et al. 2506* (P, TAN), *2508* (P, TAN). — Prov. de Fianarantsoa, RS Pic d'Ivohibe, haute vallée de l'Andranomainty, 22°29'49"S, 46°57'22"E, 1450-1520 m, 23.IV.2005, *Janssen et al. 2804* (MO, P, TAN), *2805* (MO, P, TAN). — Prov. de Toamasina, Maroantsetra, Ambanizana, piste menant au sommet d'Ambohitsitondroinan' Ambanizana, sur le versant ouest, 15°34'S, 50°00'E, 820 m, 6.XII.1993, *Rakotondrainibe et al. 2048* (MO, P), *2055* (MO, P, TAN). — Mananara-Avaratra, Sandrakatzy, forêt de Verezanantsoro, 16°26'S, 49°38'E, 460 m, 6.I.1994, *Rakotondrainibe et al. 2056* (P). — Prov. de Fianarantsoa, RS Pic d'Ivohibe, près de la source de la rivière Andranomainty, 22°29'48"S, 46°57'18"E, 1500-1650 m, 24.X.1997, *Rakotondrainibe et al. 4187* (P, TAN).

FIELD OBSERVATIONS. — Trunk: HT up to 4 m, DT 5–8 cm, dead petioles caducous and leaf scars exposed; trunk surface blackish brown, tuberculate with distant, conical squaminate spines up to 0.5 cm long; more or less annulated between the pseudo-whorls.

Petiole: with 1 row of very distant, small, brown aepophores on either side; petiole base straight or arched, but not sigmoid.

Leaf scars: 1.3–2 × 1.3–3.5 cm, rounded to ovate, slightly concave, 1–5 conspicuous orifices on or below their lower rim, arranged in distinct pseudo-whorls that are 3–5 cm distant.

Crown: more or less umbrella-shaped, 6–8 leaves per pseudo-whorl.

Trunk apex: densely covered with small conical brown scales, elevated beyond the last whorl of developed leaves and visible through the distant petiole bases.

Lamina: (narrowly) elliptic; LL 115–160 cm, WL 40–70 cm, FW 50–55 cm, NP 42–48.

DESCRIPTION

Petiole: 10–22 cm long, 1–2 cm in diameter; green to stramineous or light brown, abaxial face reddish brown; aplebia absent.

Lamina: bipinnate, subcoriaceous, light green below, dark green above, lamina base attenuate, but basalmost pinna pair usually more than 5 cm long, basal pinnae conduplicate and reflexed; rachis of the same colour as the petiole.

Largest pinnae: 21–33 cm long, distant by 2.5–3 cm, adjacent pinnae contiguous to overlapping, their apex acute, pinnatifid, pinnae twisted to about 45° with respect to the leaf surface; costae and costulae of the same colour as the petiole.

Largest pinnules: 1.1–2.2 × 0.3–0.5 cm, spaced by less than their width to slightly overlapping, distinctly petiolulate (*c.* 0.1 cm), ovate-oblong, margin distantly and shallowly crenate to entire; apex rounded, base truncate-cordate and conspicuously biauriculate, rarely only the distal auricle developed, adjacent auricles overlapping; pinnule surface twisted to about 45° with respect to the pinna surface; veins once to twice furcate, pinnate in the auricles.

Scales and hairs: scales present from the petiole base upwards to 20 cm on the petiole and rachis, spaced from each other, persistent, 0.2–0.4 × 0.1–0.2 cm, indurated and transformed into slender, patent, black conical spines, sometimes with an antrorse apex, distally transforming into shiny

brown to black appressed scales with a light brown margin, up to 0.4 cm long, spaced and persistent on the rachis; abaxial face of the costae with a dense indument consisting mostly of appressed, filiform, shiny dark brown scales, up to 0.3 cm long, in the lower third of the costae and consisting mostly of multicellular, patent, hyaline hairs and scale-topped hairs further up on the costae; adaxial face of petiole and rachis with filiform, patent, dark shiny brown scales with narrow, light brown margins, 0.7–1 cm long; adaxial face of rachis and costae with dense crispate, soft, multicellular, light brown, more or less appressed hairs.

Sori: subcostular, spaced to contiguous, covering the lower half of the pinnules; mature indusia a shallow cup or collar with a lacerate rim or irregularly lobed, membranous, stramineous to light brown; receptacle capitate, usually longer than the mature indusium, paraphyses inconspicuous.

DISTRIBUTION

Disjunct in Northern Madagascar (Masoala peninsula) and southern Central Madagascar (Ivohibe and Mananara region); endemic.

ECOLOGY

(500–)600–1500 m. Dense evergreen rainforests of higher altitudes, usually in wet valleys and gorges.

REMARKS

A complete illustration of this species can be found in Tardieu-Blot (1951: 27).

5. *Cyathea decrescens* Mett. ex Kuhn

REMARKS

Varieties of this taxonomically difficult species are defined here primarily based on the degree of lamina dissection. Characters proposed in previous treatments (Tardieu-Blot 1951), such as pinnule shape and axial indument, are not sufficiently discriminative within this taxonomic complex. Indurated, shiny black and arched petiole scales are common to all varieties of this species.

KEY TO THE VARIETIES OF *CYATHEA DECRESCENS*

1. At least the first five proximal pinnule pairs free, sessile to petiolulate, the following pinnules progressively adnate to the costa, adnate for their entire width only from above the middle of the pinna 5d. var. *quadrata*
 — At most the first two proximal pinnule pairs free, sessile, all other pinnules broadly adnate to the costa for their entire width 2
2. Pinnules 2.5-3.5 × 0.3-0.4 cm, spaced by at least their width; trunk 8-10 cm in diameter 5a. var. *cristata*
 — Pinnules (1-)1.5-2 × 0.4-0.6(-0.8) cm, spaced by less than their width; trunk up to 6 cm in diameter 3
3. Aphlebia present; petiole scales strongly indurated and arched, not bullate 5b. var. *decrescens*
 — Aphlebia absent; petiole scales less strongly indurated and only slightly arched, with a slightly bullate base 5c. var. *manongarivensis*

5a. *Cyathea decrescens* Mett. ex Kuhn
 var. *decrescens*
 (Figs 5; 44K; 47D)

Filices Africanæ: 164 (1868); Christensen, *Dansk Botanisk Arkiv* 7: 28, pl. 5 figs 1-7 (1932); Tardieu in Humbert, *Flore de Madagascar et des Comores, IV^e famille, Cyathéacées*: 20 (1951). — *Alsophila decrescens* (Mett. ex Kuhn) R.M. Tryon, *Contributions from the Gray Herbarium* 200: 30 (1970). — Type: Madagascar, Ste Marie, *Boivin 1600* (lecto-, W!), designated by Christensen [1932: 28]; isolecto-, B!, G!, MO!, P! [5 sheets], TAN!, W!). — Prov. de Toamasina, Betampona, Rendriendry, piste sur versant est entre piste Sahabefaza et piste Varikandana, 17°55'54"S, 49°12'12"E, 300-500 m, 7.XI.2004, *Janssen et al.* 2541 (epi-, P! [3 sheets: P00589556-58], here designated; isoepti-, P! [3 sheets], TAN!).

Cyathea hirsuta Baker, *Journal of Botany* 22: 140 (1884), *nom. illeg.* non C. Presl *Deliciae Pragenses*: 190 (1822). — *Cyathea hirsutifrons* C. Chr., *Index Filicum*: 192 (1906). — Type: Madagascar, *Humboldt 262* (holo-, K!; iso-, P!).

Cyathea hirsutifolia Bonap., *Notes ptéridologiques* 5: 46 (1917), 9: 55 (1920). — *Cyathea decrescens* var. *hirsutifolia* (Bonap.) C. Chr., in Perrier, *Catalogue des plantes de Madagascar, Ptéridophytes*: 20 (1931); *Dansk Botanisk Arkiv* 7: 29 (1932); Tardieu in Humbert, *Flore de Madagascar et des Comores, IV^e famille, Cyathéacées*: 21 (1951). — Type: Madagascar, Centre, Analamazaotra, 800 m, II.1912, *Perrier de la Bâthie 11535* (lecto-, P!, here designated; isolecto-, P!).

ADDITIONAL MATERIAL EXAMINED. — **Madagascar**. Andovoranto, Fanovana, 18°55'30"S, 48°32'E, 24.X.1912,

Afzelius s.n. (K). — Prov. de Toamasina, Makira, 15°26'S, 49°23'E, 2004, *Antilahimena et al.* 2616 (MO, TAN). — Antsiranana, Andapa, Doany, Ankarongameloka forest, 14°14'56"S, 49°26'19"E, 1546 m, *Antilahimena et al.* 4740 (MO, P). — *Boivin s.n.* (P[3], W). — Ambodiriana, 14.XII.1944, *Cours 1909* (P). — Prov. d'Antsiranana, Anjanaharibe-Sud, 14°42'30"S, 49°27'30"E, 19.XII.1950, *Cours 3765* (P). — *Idem*, 1600-1700 m, 19.XII.1950, *Cours 3769* (P). — Brickaville, Ambalarondra, 18°50'S, 49°04'E, 300 m, 21.IV.1951, *Cours 4505* (P). — *Cowan s.n.* (BM). — Prov. d'Antsiranana, Daraina, 13°15'S, 49°37'E, 1140 m, 25.III.2004, *Gautier et al.* 4691 (P). — 1933, *Goudot s.n.* (G, P[2]). — Ambanivoul, II.1834, *Goudot s.n.* (P). — N Chaînes Anosyennes, 700 m, 27.XI.1971, *Guillaumet 3981* (P). — Massif du Beampingaratra, col de Vohipaha, 24°32'S, 46°53'E, 1100-1400 m, 16.XI.1928, *Humbert 6632* (BM, P). — Prov. d'Antsiranana, Marojejy, E d'Ambalamanasy II, 14°31'30"S, 49°35'30"E, 1000-1500 m, XII.1948, *Humbert 22257* (P). — Marojejy (NE), W de la riv. Manantenina, 14°27'30"S, 49°42'30"E, 500-700 m, XII.1948, *Humbert 22421* (G). — Marojejy, col de Doanyanala, 14°28'S, 49°32'E, 900-1000 m, 1949, *Humbert 23095* (P). — Vallée inférieure de l'Androranga, 14°27'30"S, 49°42'30"E, 100-250 m, XI.1950, *Humbert & Capuron 23938* (G, K, P). — Prov. de Toamasina, Anjanaharibe, W d'Andapa, 15°11'S, 49°38'E, 1200-1600 m, XII.1950, *Humbert 24682* (P). — Prov. d'Antsiranana, Marojejy, de la vallée de l'Ambatorahana au bassin supérieur de l'Antsahaberoka, 14°27'30"S, 49°42'30"E, 1200 m, XI.1959, *Humbert & Saboureaux 31565* (P), *31675* (P). — Prov. de Toamasina, Maroantsetra, Ambanizana, 15°37'53"S, 49°58'33"E, 2-471 m, 20.X.2004, *Janssen et al.* 2485 (MO, P, TAN). — *Idem*, piste menant au sommet de l'Ambohitsitondroinan' Ambanizana, 15°31'08"S, 50°00'16"E, 620 m, 22.X.2004, *Janssen et al.* 2495 (MO,

P, TAN). — *Idem*, 620-1109 m, 23.X.2004, *Janssen et al. 2500* (MO, P, TAN). — Andranobe, piste menant au sommet de Bedinta, 15°40'34"S, 49°58'03"E, 0-628 m, 26.X.2004, *Janssen et al. 2521* (MO, P, TAN), 2524 (MO, P, TAN). — Analamazaotra, 18°56'S, 48°26'E, 15.VIII.1935, *Jardin Botanique de Tananarive 3413* (P). — Prov. de Fianarantsoa, Ambondrombe, 21°52'S, 47°16'E, 1700 m, 12.IV.1941, *Jardin Botanique de Tananarive 4276* (P). — *Idem*, 10.IV.1941, *Jardin Botanique de Tananarive 4676* (P). — Soanierana, Ambohoabé, 16°46'S, 49°30'E, 50 m, 5.XII.1938, *Lam & Meeuse 5767* (BR, G, K). — Maroantsetra, Nosy Mangabe, 15°29'30"S, 49°46'E, 332 m, 14.IV.1988, *Leeuwenberg 13903* (P). — Andranobe, 15°41'S, 49°58'E, 10-110m, 25.II.1999, *McPherson 17685* (P). — Prov. d'Antsiranana, Marojejy, north slopes of Ambatosoratra, 14°32'S, 49°42'E, 600-660 m, 6.X.1988, *Miller 3388* (P). — *Idem*, 700-850 m, 10.II.1989, *Miller & Lowry 3925* (P). — *Idem*, 600-700 m, 12.II.1989, *Miller & Lowry 3994* (P). — *Idem*, 700-900 m, 24.II.1989, *Miller 4244* (P). — Trail to summit of Marojejy Est, 14°26'S, 49°46'E, 700-900 m, 24.XI.1989, *Miller & Randrianasolo 4564* (P). — Daraina, forêt d'Antsahabe, 20.I.2004, *Nusbaumer 1124* (P). — Est, rivière Anove, 200 m, VII.1912, *Perrier de la Bâthie 7984* (P). — Andasibe, Analamazaotra, 18°56'S, 48°26'E, 800 m, 1912, *Perrier de la Bâthie 11595* (P). — Forêt orientale, près de Beforona, 18°58'S, 48°34'E, *Perrier de la Bâthie 14051* (P). — Entre Andilamena et Mandritsara, 17°01'S, 48°35'E, 900 m, XI.1922, *Perrier de la Bâthie 15009* (P). — Analamahitso, Ht Bemarivo, 16°11'30"S, 48°08'30"E, VIII.1907, *Perrier de la Bâthie 15845* (P). — Betampona, près d'Ambodiriana, 17°56'S, 49°17'E, XII.1925, *Perrier de la Bâthie 17472* (BM). — Fianarantsoa, Mandriandry, 21°35'S, 47°29'E, 800 m, 26.X.2000, *Rabarimanarivo & Rakotoarimanana 72* (P). — Corridor reliant les PN de Ranomafana et d'Andringitra, ONO d'Ikongo, 21°49'17"S, 47°24'05"E, 600-700 m, 19.XI.2000, *Rabarimanarivo & Rakotoarimanana 152* (P). — Maroantsetra, Nosy Mangabe, 15°30'S, 49°46'E, 330 m, 1.XII.1993, *Rakotondrainibe et al. 2058* (P, TAN). — *Idem*, 250 m, 1.XII.1993, *Rakotondrainibe et al. 2059* (P). — Maroantsetra, Ambanizana, piste menant au sommet d'Ambohitsitondroinan' Ambanizana, 15°38'S, 49°58'E, 5.XII.1993, *Rakotondrainibe 2060* (P). — Prov. d'Antsiranana, RS d'Anjanaharibe-Sud, 14°45'18"S, 49°30'18"E, 850 m, 19.X.1994, *Rakotondrainibe et al. 2083* (MO, P, TAN). — Prov. de Toliara, Tolanaro, RNI d'Andohahela, Eminiminy, 24°35'07"S, 46°44'30"E, 800 m, 30.X.1995, *Rakotondrainibe 3009* (P). — *Idem*, 840 m, 2.XI.1995, *Rakotondrainibe 3034* (MO, P, TAN). — Prov. d'Antsiranana, Marojejy, au bord de la rivière Manantenina, 14°29'S, 49°49'E, 5.X.1996, *Rakotondrainibe 3275* (P). — *Idem*, 530 m, 11.X.1996, *Rakotondrainibe 3358* (P, TAN). — Forêt de Betaolana, Ambodiangezoka, 14°32'18"S, 49°26'18"E, 800-950 m, 8.X.1999, *Rakotondrainibe et*

al. 4835 (P, TAN). — *Idem*, 14.X.1999, *Rakotondrainibe et al. 4922* (P). — *Idem*, 14°32'36" S, 49°25'30" E, 1200 m, 16.X.1999, *Rakotondrainibe et al. 4926* (P, TAN). — Anajanaharibe-Sud, forêt d'Analabe, 14°46'S, 49°26'30"E, 1120 m, 1.XI.1999, *Rakotondrainibe et al. 5112 bis* (P). — Prov. d'Antsiranana, PN de Marojejy, Doany, 14°26'12"S, 49°37'12"E, 1230 m, 25.X.2001, *Rakotondrainibe et al. 6394* (P, TAN). — Vohemar, Daraina, forêt de Binara, 13°15'12"S, 49°37'12"E, 1050 m, 9.XI.2001, *Rakotondrainibe et al. 6562* (K, P, TAN). — Prov. d'Antsiranana, Masoala, Ambohitralanana, Sahafari, 15°16'18"S, 50°20'35"E, 430 m, 25.II.2001, *Rasolohery 324* (MO, P, TAN). — Prov. de Toamasina, Zahamena, 17°41'08"S, 48°59'43"E, 650 m, 11.VI.2001, *Rasolohery 469* (P). — *Idem*, 17°38'30"S, 48°50'E, 900-1000 m, 1.II.2002, *Rasolohery 601* (P). — Maroantsetra, Nosy Mangabe, 15°29'30"S, 49°46'E, 0-330 m, 8.X.1987, *Schatz 1613* (P). — Maroantsetra, Ambodivato, 15°27'25"S, 49°41'41"E, 0-30 m, 29.I.1999, *Schatz et al. 3866* (P). — Maroantsetra, Ankirindro massif, 15°18'27"S, 49°33'08"E, 320 m, 1.II.1999, *Schatz et al. 3907* (P). — Prov. de Fianarantsoa, Ranomafana, 21°13'30"S, 47°27'30"E, 900 m, 10.X.1992, *van der Werff et al. 12660* (P). — Prov. d'Antsiranana, Masoala, Ambanizana, 15°38'S, 49°58'E, 350-550 m, 29.X.1992, *van der Werff et al. 12782* (P), 12784 (BR, G, MO). — *Idem*, 10 m, 30.X.1992, *van der Werff et al. 12799* (P).

FIELD OBSERVATIONS. — Trunk: HT up to 5(-7) m, DT 4-6 cm, dead petioles caducous and leaf scars exposed; trunk surface dark brown to black, with dense squaminate spines, antrorse and often longer than the scales of the petiole base; trunk sometimes with adventitious buds and very rarely bifurcate.

Petiole: with 1 or 2 rows of light brown, distant, small aepiphores on either side; petiole bases distinctly sigmoid.

Leaf scars: 1-1.5 × 1-2.5(-3.5) cm, rounded to narrowly elliptic, not raised, whitish or light brown, adjacent scars 1-2 cm distant, spirally arranged.

Crown: umbrella-shaped to horizontal (i.e. leaves with rather straight rachises), usually with 1 or 2 whorls of 4-6 leaves.

Trunk apex: densely covered with appressed, shiny black scales, concealed by close standing petiole bases.

Lamina: (narrowly) elliptic; LL 80-180(-220) cm, WL 30-45 cm, FW 30-70 cm, NP (13-)/30-40(-70).

DESCRIPTION

Petiole: (0-)5-15 cm long, up to 35 cm in juvenile plants, 1-1.3 cm in diameter; green to stramineous, abaxial face reddish; aphlebia present, light to yellowish green, up to 4 cm long, in juvenile plants 3 or 4 pairs near the base of the petiole, in adult

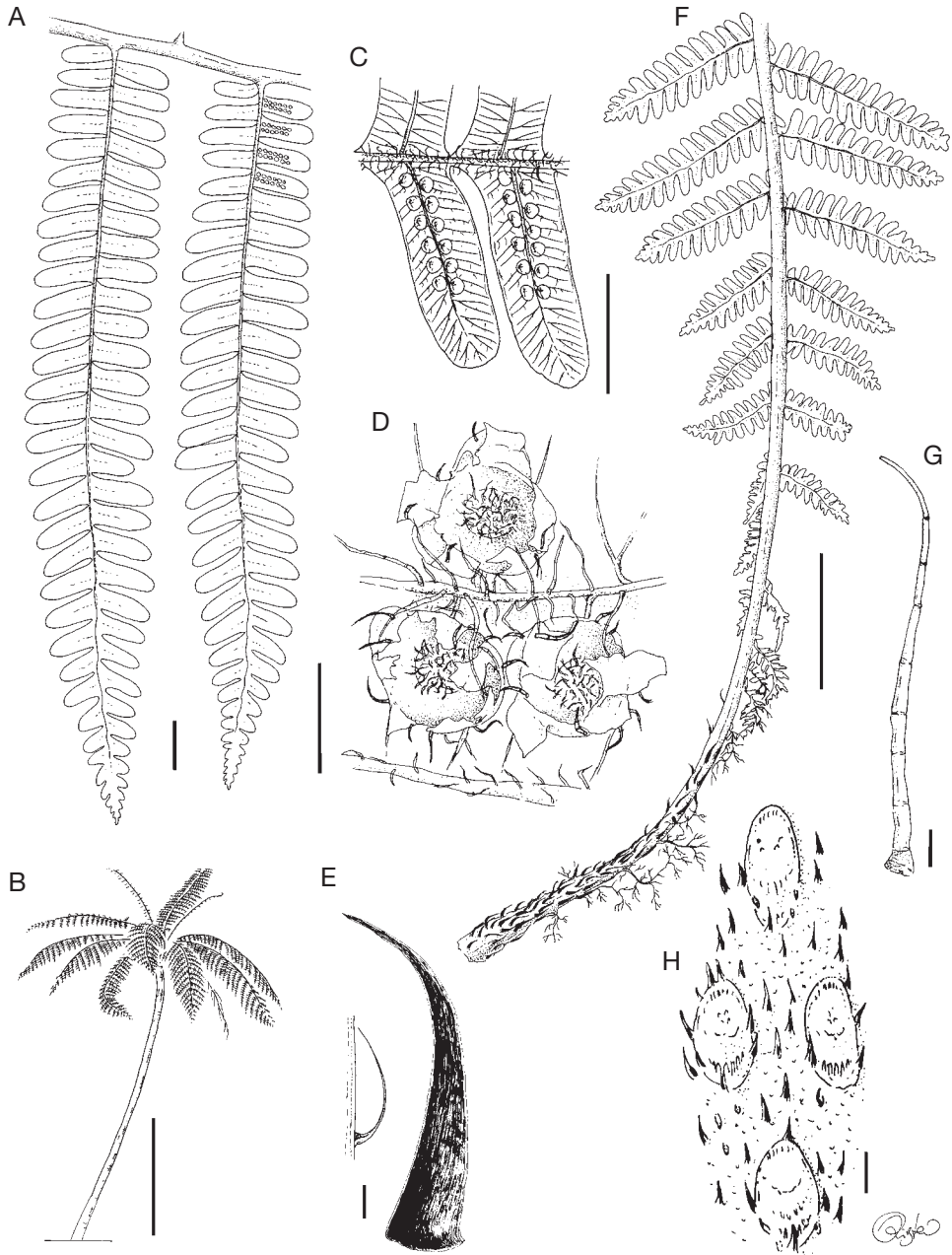


FIG. 5. — *Cyathea decrescens* Mett. ex Kuhn var. *decrescens*: **A**, pinnae abaxially with a fragment of the rachis, sori only partly indicated; **B**, habit; **C**, pinnules abaxially with a fragment of the costa; **D**, pinnule fragment abaxially with sori, note the dense indument of patent, hyaline, multicellular hairs on the costula, veins and indusia; **E**, scale from the base of the petiole (left: lateral view, not to scale; right: dorsal view); **F**, basal part of the leaf (from the petiole base up to the first several pinna pairs), lateral view, note gradual transition of the decrescent pinnae into aphaebia; **G**, a multicellular, hyaline hair, part of this taxon's typical indument; **H**, leaf scars and trunk surface. A, C, F, Janssen et al. 2541 (P); B, uncollected, photograph at P; D, E, G, Cours 4505 (P); H, Janssen et al. 2578 (P). Scale bars: A, C, H, 1 cm; B, 1 m; D, E, G, 0.1 cm; F, 5 cm; G, 0.1 mm.

plants the basal pinnae gradually transforming into aplebia, leaves with up to 10 pairs of well-developed aplebia near the base of the petiole.

Lamina: pinnate-pinnatisect to bipinnate, herbaceous to subcoriaceous (never coriaceous), light to pale green below, green above, lamina base cuneate with pinnae gradually decreasing in size, truncate in juvenile plants, basal pinnae reflexed; rachis of the same colour as the petiole.

Largest pinnae: 15-25 cm long, distant by 3-5(-8) cm, adjacent pinnae not overlapping, their apex acute to shortly caudate, pinnatifid; costae and costulae of the same colour as the petiole.

Largest pinnules: (1-)1.5-2 × 0.4-0.6(-0.8) cm, spaced by less than their width, at most the first 2 proximal pinnule pairs sessile to petiolulate, all others broadly adnate to the costa, bases of adjacent pinnules confluent only in the upper half of the pinna, pinnules oblong, margin entire, crenulate near the obtuse to rounded apex, base never auriculate; veins once furcate.

Scales and hairs: scales present from the petiole base upwards to 10(-15) cm on the petiole and rachis, contiguous to slightly overlapping, persistent, deltoid to triangular, 0.7-1.5 × 0.1-0.3 cm, arched (i.e. their base more or less patent, the middle part curved and their apex touching the surface of the petiole), shiny black, with an early vanishing, narrow, brown margin and strongly indurated; more or less dense patent, multicellular, hyaline, 0.1-0.15(-0.3) cm long hairs on the abaxial face of the costae, costulae, veins and on indusia, but sparse and short on or absent from the adaxial face of the veins; dense crispate to straight, patent to antrorse multicellular hairs on the adaxial face of the rachis and costae.

Sori: subcostular, contiguous to distant, about 0.1 cm in diameter, covering entire pinnules or only their lower half; indusia globular, light brown, membranous, at maturity dehiscing in 2-4 irregular lobes; receptacle capitate, as long as or shorter than the rim of mature indusia, with inconspicuous filiform paraphyses shorter than the sporangia.

DISTRIBUTION

Northern and Central Madagascar, few specimens from Southern Madagascar; endemic.

ECOLOGY

(0-)300-1200(-1700) m. Dense evergreen rainforests, often near streams, but also on drier slopes and in high-altitude forests.

REMARKS

In juvenile plants, the indument on the abaxial surface of the lamina is sparse, their pinnules are comparatively broad (up to 0.8 cm), have a rounded apex and may be confluent with their bases from the first pinnule pair. The petiole scales are smaller and rather appressed. The base of the lamina is truncate and the petiole is comparatively long bearing several pairs of well-developed aplebia near its base (cf. *Janssen et al.* 2485, 2521; *Rakotondrainibe et al.* 2058, 2059; all at P).

Guillaumet 3981, *Humbert* 6632 and *Rakotondrainibe* 3009 from Southern Madagascar have reddish petioles and rachises, a very sparse indument and a petiole up to 25 cm long, but agree with var. *decrescens* with respect to lamina dissection and petiole scales. As petiole colour is often not a constant character and as basal pinnae often fall off upon drying without leaving a distinct scar we do not assign varietal status to these specimens.

McPherson et al. 17685 has strongly crenate, adnate pinnules with two to three times furcate veins and distant sori. Scales are ascending comparatively far on the petiole and the lamina base appears to be truncate, but basal pinnae have most likely fallen off.

Cyathea decrescens may develop adventitious buds and furcate trunks, most likely as consequences of a former trunk injury.

TYPIFICATION AND SYNONYMY

Christensen (1932) chose one sheet of *Boivin* 1600 (W!) as lectotype among the material cited by Kuhn (1868). Although Christensen's label is attached to a sheet not bearing a determination in Mettenius' hand, his lectotypification must be followed. The lectotype specimen consists of five pinnae with a short rachis fragment. Two fragmentary islectotype specimens determined by Mettenius are at W. Although complete islectotype specimens are present at P, we consider it necessary to designate an epitype, because the characteristic petiole scales are strongly damaged in the available original material.

5b. *Cyathea decrescens* Mett. ex Kuhn
var. *cristata* Rakotondr. & Janssen, var. nov.
(Figs 6A, B; 44K)

A typo differt pinnulis maximis 2.5-3.5 cm longis et 0.3-0.4 cm latis, spatium inter eas latitudinem earum aequans vel superans, apice acuto et margine serrulato. Pinnulae adjacentes basibus confluentibus solum prope apicem pinnae. Pinnae basales laminae non gradatim decrescentes itaque petiolus conspicuus.

TYPUS. — Madagascar, province de Toliara, Tolanaro, Eminiminy, Parcelle 1, RNI n° 11 d'Andohahela, versant Est et sommet du Trafon'omby: 12,5 km au NW du village d'Eminiminy, Camp 2, 24°35'07"S, 46°44'30"E, 840 m, 2.XI.1995, *Rakotondrainibe 3030* (holo-, P! [2 sheets: P00067126, -27]; iso-, MO, TAN).

ADDITIONAL MATERIAL EXAMINED. — Madagascar. N d'Ampasimena, Mt. Vohimavo, 24°20'S, 47°08'E, 100 m, III.1947, *Humbert 20648* (K, P).

DIFFERENTIAL FIELD OBSERVATIONS. — Trunk: HT up to 6 m, DT 8-10 cm; surface covered with antrorse squaminate spines, the lower half of the scars somewhat raised.

Petiole: with up to 8 pairs of aphanidia near its base.
Lamina: leaf up to 230 cm long.

DIFFERENTIAL DESCRIPTION

The petiole, rachis and costae are light to copper brown. The largest pinnae are oblong and widest above their middle. Basalmost pinnules are not gradually reduced and do not reach the petiole base; the petiole is conspicuous. At most the 2 proximal pinnule pairs are sessile. The following pinnule pairs are adnate and proximally decurrent, but distant (i.e. always separated by a short stretch of the costa). Adjacent pinnules are confluent only near the pinna apex. The largest pinnules are 2.5-3.5 × 0.3-0.4 cm, distant by at least their width, have an acute apex, a serrate to serrulate margin and their base is never auriculate. The indument is sparse.

DISTRIBUTION

Southern Madagascar: Tolanaro region; endemic.

ECOLOGY

100-900 m. Rainforest.

REMARKS

Humbert 20648 lacks aphanidia (*in sched.*), whereas *Rakotondrainibe et al. 3030* has a pair of aphanidia at the petiole base.

The taxon is morphologically close to *Cyathea dilatata* Rakotondr. & Janssen, but it differs by its pinnules not strongly proximally and distally dilated at their base, not conspicuously widened above their middle, and with much less strongly crenate-lobate to subentire margins. Furthermore, the trunk is strongly spiny and not smooth.

ETYMOLOGY

The epithet refers to the long, narrow and distant pinnules lending a comb-like appearance to the pinnae.

5c. *Cyathea decrescens* Mett. ex Kuhn var.
manongarivensis Janssen & Rakotondr., var. nov.
(Figs 6C-E; 44K)

A typo differt absentia aphanidiorum, paleis petioli minus induratis leviter arcuatis, aliquantum bullatis. Pili superficiae abaxialis rhachidis et costarum relative longi.

TYPUS. — Madagascar, province d'Amboanja, Mt. d'Antsatrotro, sur les berges de la rivière Ankaramihely, 14°04'60"S, 48°24'E, 1340 m, 15.V.1992, *Rakotondrainibe 1711* (holo-, P! [P00100225]; iso-, P!).

ADDITIONAL MATERIAL EXAMINED. — Madagascar. Prov. d'Antsiranana, Manongarivo, source de l'Andranomalaza, 14°00'S, 48°23'30"E, 1600 m, 22.III.1999, *Gautier et al. 3645* (G, P). — *Idem*, partie centrale, 14°01'33"S, 48°24'47"E, 1566 m, 27.IX.2004, *Janssen et al. 2404* (MO, P, TAN). — *Idem*, cuvette de la Haute Antsahakolana, 14°03'04"S, 48°24'16"E, 1657 m, 29.IX.2004, *Janssen et al. 2406* (P, TAN), *2414* (MO, P, TAN).

DIFFERENTIAL DESCRIPTION

Aphanidia are always absent. The shiny black petiole scales are 0.6-0.8(-1.2) × 0.2-0.3 cm, always overlapping, less strongly indurated, less pronouncedly arched and have a slightly bullate base. Multicellular hairs on the abaxial face of the rachis and costae are patent and comparatively long, with generally more than 10 cells per hair.

DISTRIBUTION

Northern Madagascar: Manongarivo massif; endemic.

ECOLOGY

1300-1700 m. Dense evergreen rainforests.

REMARKS

Janssen et al. 2406 has distinctly tubercle-based hairs on the abaxial face of its rachis and costae, i.e. the hairs have dark and thickened basal cells leaving a distinct scar when falling. *Aphlebia* are truly absent in the cited specimens, i.e. no scars or remnants of fallen, broken or decomposed *aphlebia* could be found.

ETYMOLOGY

Currently, the taxon is known only from the Manongarivo massif.

5d. *Cyathea decrescens* Mett. ex Kuhn
var. *quadrata* (Baker) Janssen & Rakotondr.,
comb. et stat. nov.
(Figs 6F-J; 44K)

Cyathea quadrata Baker, *Journal of the Linnean Society* 15: 411 (1876); Christensen, *Dansk Botanisk Arkiv* 7: 28, pl. 5 figs 8-10 (1932); Tardieu in Humbert, *Flore de Madagascar et des Comores, IV^e famille, Cyathéacées*: 21 (1951). — *Alsophila quadrata* (Baker) R.M. Tryon, *Contributions from the Gray Herbarium* 200: 31 (1970). — Type: Madagascar, Tananarive, *Pool s.n.* (holo-, K! [K000009929]). — Prov. de Toamasina, Ambatondrazaka, Antanandava, PN de Zahamena, à 2 km d'Ankoso, 17°30'14"S, 48°43'52"E, 1100-1330 m, 28.I.2001, *Rasolohery* 232 (epi-, P! [P00246415]), here designated; isoeipi-, MO, TAN).

Cyathea pilosula Tardieu, *Bulletin de la Société botanique de France* 88: 681 (1941); Tardieu in Humbert, *Flore de Madagascar et des Comores, IV^e famille, Cyathéacées*: 22, fig. 2 (6-8) (1951). — *Alsophila pilosula* (Tardieu) R.M. Tryon, *Contributions from the Gray Herbarium* 200: 31 (1970). — Type: Madagascar, massif de l'Andrangovallo, SE du Lac Alaotra (RN de Zahamena), 1200 m, X.1937, *Humbert & Cours* 17763 (lecto-, P! [P00389454], excluding the leftmost rachis fragment with rudimentary pinnae], here designated; isolecto-, P! [3 sheets]).

Cyathea zakamenensis Tardieu, *Bulletin de la Société botanique de France* 88: 683, pl. 1 fig. VI, 3 (1941); Tardieu in Humbert, *Flore de Madagascar et des Comores, IV^e famille, Cyathéacées*: 19 fig. 2 (4-5), fig. 3 (1951). — *Alsophila zakamenensis* (Tardieu) R.M. Tryon, *Contributions from the Gray Herbarium* 200: 31 (1970). — Type: Madagascar, massif de l'Andrangovallo, Réserve n° 3 de Zahamena ("Zakamena"), vers 1200 m, X.1937, *Humbert & Cours* 17880 (holo-, P! [P00389470]; iso-, P!).

ADDITIONAL MATERIAL EXAMINED. — **Madagascar.** Prov. de Toamasina, Ambatovy, 18°49'S, 48°18'E, *Antilabimena et al.* 3490 (MO, TAN). — Central Madagascar, *Baron* 3921 (K). — Région de Tsinjoarivo, forêt d'Ankilahila, 19°42'24"S, 47°51'E, 1400-1560 m, I.1999, *Borie* 503 (K, MO, P). — *Idem*, 19°37'30"S, 47°41'30"E, I.1999, *Borie* 504 (P). — Prov. de Toamasina, Périmet-Analamazaotra, 18°56'S, 48°26'E, VI.1959, *Bosser* 13022 (P, TAN). — Prov. d'Antananarivo, Angavokely, 18°55'S, 47°46'E, VI.1953, *Capuron* 20 (K, P), 24 (K, P). — Forêt de l'Ankaroha, 17°48'S, 48°32'E, 1400 m, 24.V.1942, *Cours* 1667 (P). — Prov. de Toamasina, Rahobevava, 17°58'S, 48°44'E, 1000 m, 12.III.1951, *Cours* 4350 (P). — Moramanga, 18°56'20"S, 48°13'40"E, *Decary* 15312 (P). — Antananarivo, 18°55'S, 47°31'E, III.1877, *Gilpin s.n.* (K). — Périmet, 18°56'S, 48°26'E, 2.X.1971, *Guillaumet* 3870 (K, MO, P). — Imerina, Andrangoloaka, 19°02'S, 47°55'E, XI.1880, *Hildebrandt* 3764 (B, BM, K, P, W). — Massif de l'Ankaratra, Tsiarafajavona, 19°22'S, 47°18'E, 1700-2000 m, X.1933, *Humbert* 11168 (K, P). — Massif du Kalambatitra, 23°22'S, 46°20'E, 1650-1800 m, XI.1933, *Humbert* 11936 (BR, K, P), 11937 (K). — Marojejy, col de Doanyanala, 14°28'S, 49°32'E, 900-1000 m, 1949, *Humbert* 23110 (B, P). — RN Zahamena, massif de l'Andrangovallo, 17°40'S, 48°45'E, 1200-1400 m, X.1937, *Humbert & Cours* 17763 (P), 17880 (P). — Prov. de Toamasina, Andasibe, Station forestière Mitsinjo, 18°56'S, 48°26'E, 930-950 m, 11.XI.2004, *Janssen et al.* 2562 (MO, P, TAN). — RS d'Analamazaotra, autour du Lac Vert, 18°56'S, 48°26'E, 930-950 m, 11.XI.2004, *Janssen et al.* 2568 (MO, P, TAN), 2570 (MO, P, TAN). — *Idem*, 900-950 m, 13.XI.2004, *Janssen et al.* 2578 (MO, P, TAN). — Prov. d'Antananarivo, Mandraka, 18°55'30"S, 47°55'10"E, 1200-1250 m, 13.XI.2004, *Janssen et al.* 2583 (MO, P, TAN), 2584 (MO, P, TAN). — Prov. de Fianarantsoa, PN Ranomafana, forêt de Talatakely, 21°15'43"S, 47°25'23"E, 1020 m, 26.IV.2005, *Janssen et al.* 2822 (MO, P, TAN), 2825 (MO, P, TAN). — *Idem*, forêt de Vohiparara, 21°14'03"S, 47°23'52"E, 1100-1150 m, 27.IV.2005, *Janssen et al.* 2847 (MO, P, TAN), 2848 (MO, P). — Mandraka, 18°55'30"S, 47°55'10"E, 1200 m, XII.1927, *Perrier de la Bâthie* 18347 (P). — Antananarivo, 18°55'S, 47°31'E, IV.1876, *Pool s.n.* (K). — Prov. de Fianarantsoa, PN Ranomafana, Ranomena, 21°17'S, 47°27'E, 1100 m, 27.X.1992, *Rakoto* 286 (P). — Prov. de Toamasina, Ambatovy, 18°49'S, 48°18'E, *Rakotomalaza s.n.* (P). — Prov. d'Antananarivo, Ankazobe, RS d'Ambohitantly, 18°10'S, 47°17'E, 1200-1650 m, 5.X.1983, *Rakotondrainibe* 455 (P). — *Idem*, 16.XI.1985, *Rakotondrainibe* 545 (P, TAN). — Prov. d'Antananarivo, région de Tsinjoarivo, forêt d'Ankilahila, 19°42'24"S, 47°51'E, 1400-1560 m, 15.I.1999, *Rakotondrainibe* 4742 (P, TAN). — Prov. de Fianarantsoa, PN de Ranomafana, forêt de Vatoharanana, 21°17'24"S, 47°26'E, 960-980 m, 3.X.2000, *Rakotondrainibe et al.*

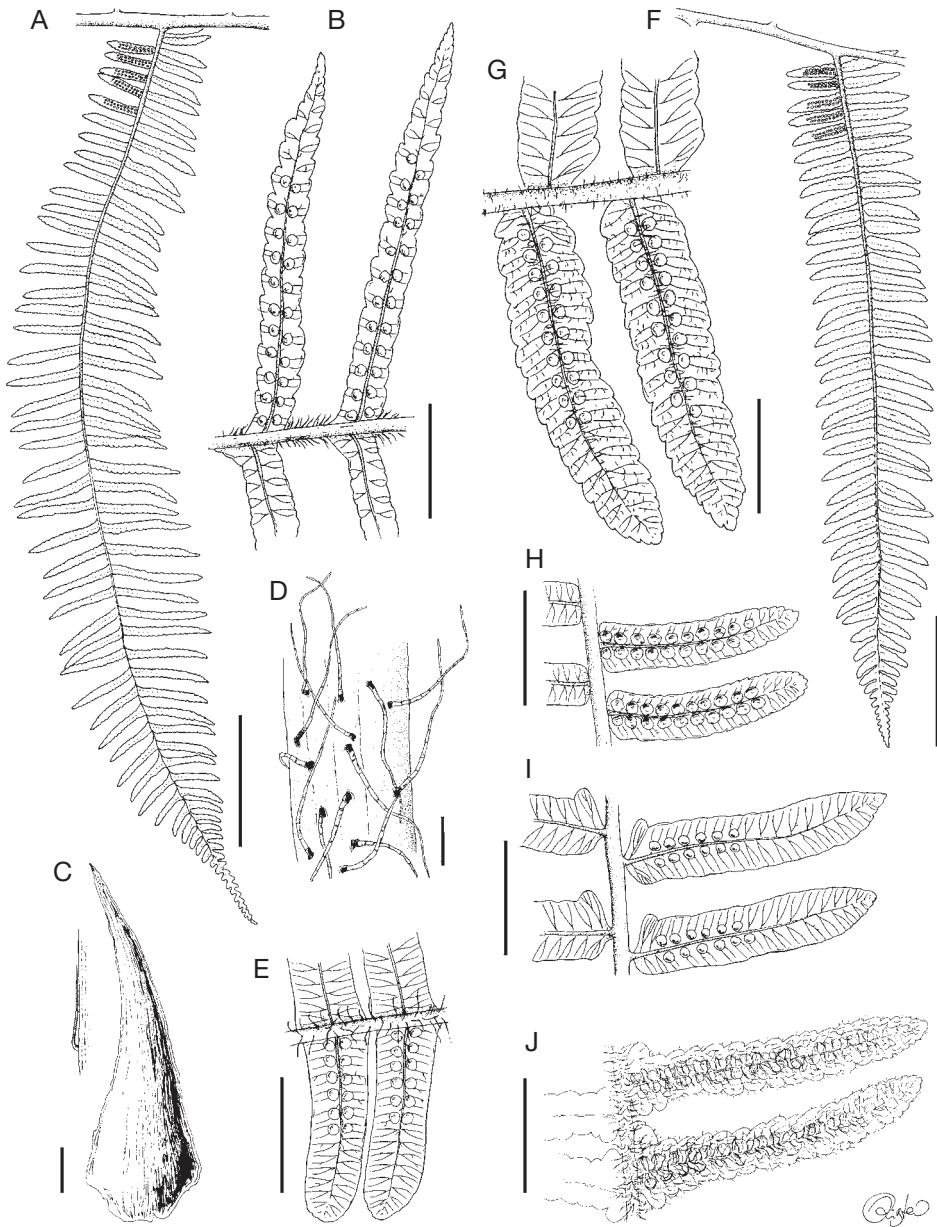


FIG. 6. — **A, B**, *Cyathea decrescens* Mett. ex Kuhn var. *cristata* Janssen & Rakotondr.; **A**, pinna abaxially with a fragment of the rachis, sori only partly indicated; **B**, pinnules abaxially with a fragment of the costula; **C-E**, *C. decrescens* var. *manongarivensis* Janssen & Rakotondr.; **C**, scale from the base of the petiole (left: lateral view, not to scale; right: dorsal view); **D**, fragment of the rachis abaxially, note the hyaline hairs being generally more than 10 cells long and having an indurated basal cell; **E**, pinnules abaxially with a fragment of the costula; **F-J**, *C. decrescens* var. *quadrata* (Baker) Janssen & Rakotondr.; **F**, pinna abaxially with a fragment of the rachis, sori only partly indicated; **G**, pinnules abaxially with a fragment of the costula, form of the Andasibe region, cf. "zakamenensis"-morphotype; **H**, pinnules abaxially with a fragment of the costula, "quadrata"-morphotype; **I**, pinnules abaxially with a fragment of the costula, "zakamenensis"-morphotype; **J**, pinnules abaxially with a fragment of the costula, "pilosula"-morphotype. **A, B**, *Rakotondrainibe* 3030 (P); **C-E**, *Rakotondrainibe* 1711 (P); **F, G**, *Janssen et al.* 2578 (P); **H**, *Rasolohery* 232 (P); **I**, *van der Werff* 12854 (P); **J**, *Capuron* 24 (P). Scale bars: **A, F**, 5 cm; **B, E, G-J**, 1 cm; **C, D**, 0.1 cm.

5821 (K, MO, P, TAN). — Prov. de Fianarantsoa, PN Ranomafana, Vatorahana, 21°16'S, 47°26'E, 980 m, 16.XI.1994, *Randriambololona et al.* 273 (P). — PN Ranomafana, Vohiparara, 21°14'S, 47°24'E, 1270 m, 24.XI.1994, *Randriambololona et al.* 312 (P). — Prov. de Toamasina, PN Zahamena, Ankosy, 17°30'14"S, 48°43'52"E, 1100-1330 m, 30.I.2001, *Rasolobery* 289 (MO, P, TAN). — Ambatovy, entre Tapimbato et Berano, 18°50'14"S, 48°18'55"E, 1215 m, 17.I.2005, *Razanatsoa et al.* 109 (P). — Prov. de Fianarantsoa, Ranomafana, 21°13'30"S, 47°27'30"E, 9.IX.1992, *van der Werff* 12594 (P). — Prov. d'Antananarivo, Anjozorobe, 18°23'30"S, 47°53'E, 1250 m, 6.XI.1992, *van der Werff et al.* 12854 (BR, G, MO). — Prov. de Toamasina, forest of Mantadia, 18°55'S, 48°25'E, 900 m, 2.XI.1994, *van der Werff et al.* 13605 (MO, P).

DIFFERENTIAL FIELD OBSERVATIONS. — Trunk: DT 4-6(-10) cm, often thicker than in var. *decrescens*.

Petiole: diameter up to 1.5 cm, in some specimens green to stramineous and speckled with red.

Lamina: WL up to 60 cm.

DIFFERENTIAL DESCRIPTION

The largest pinnae are up to 30 cm long and at least the 5 proximal pairs of pinnules are sessile to petiolulate. Pinnules are broadly adnate only from above the middle of the pinna. Adjacent pinnules are confluent only near the pinna apex. Largest pinnules are 1.5-1.7(-3.5) × 0.4-0.5 cm, spaced by less than to about their width, have an obtuse to acute apex and an entire to strongly crenate margin. The base of petiolulate pinnules is truncate without auricles to strongly biauriculate. Petiole scales are scarcely different from var. *decrescens* but tend to be longer (up to 1.5 cm) and less strongly arched.

DISTRIBUTION

Central Madagascar (most specimens within the triangle Antananarivo, Fianarantsoa, Zahamena); endemic.

ECOLOGY

900-1000(-1700) m. Dense evergreen rainforests.

REMARKS

This taxon includes several morphotypes that have been previously described as species, but cannot be maintained because a clear morphological distinction is no longer possible taking into account numer-

ous recent collections. The "quadrata"-morphotype s.str. corresponds to sparsely hairy forms with comparatively small pinnules having a rounded apex, truncate to rounded base and regularly and conspicuously crenate margins. The "pilosula"-morphotype is strongly hairy on all leaf parts and has comparatively narrow pinnules, auriculate or not and usually strongly crenate. The "zakamenensis"-morphotype corresponds to plants with strongly biauriculate pinnules, margins may be crenate down to one third of the pinnule's width, the leaves are moderately hairy to subglabrous and the rachis and costae are often tinged with red.

Aphlebioid pinnae were absent in some species from Ranomafana, but field observations indicate, that these are frequently being decomposed with the leaf litter accumulating in the centre of the crowns.

TYPIFICATION AND SYNONYMY

This taxon is variable with respect to pinnule shape and density of the indument. The holotype specimen of *C. quadrata* Baker consists of two detached pinnae. An epitype has been chosen among the "quadrata"-morphotype specimens included here.

The original material of *C. pilosula* Tardieu most likely includes fragments from the original material of *C. zakamenensis* Tardieu on the holotype sheet and on one of the isotype sheets. We hence designate as lectotype of the species the big leaf fragment including the petiole base on *Humbert & Cours* 17763 (P00389454), excluding the rachis fragment with rudimentary pinnae.

6. *Cyathea dilatata* Rakotondr. & Janssen, sp. nov. (Figs 7; 44L)

Filix arborescens Cyatheae *decrescens* affinis, sed differt pinnulis profunde crenatis, latitudine maxima super medianum, apice obtuso et basi proximali longe decurrentia et distincte dilatata. Paleae basi petioli adpressae vel leviter arcuatae, coriaceae, induratae sed non spinosae. Truncus conspicue laevis.

TYPUS. — Madagascar, Province de Toliara, District de Tolanaro, Eminiminy, RNI n° 11 d'Andohahela, versant Est et sommet du Trafon'omby, 24°34'S, 46°43'E, 1500 m, 20.XI.1995, *Rakotondrainibe* 3165 (holo-, P! [P00067286]; iso-, P!).

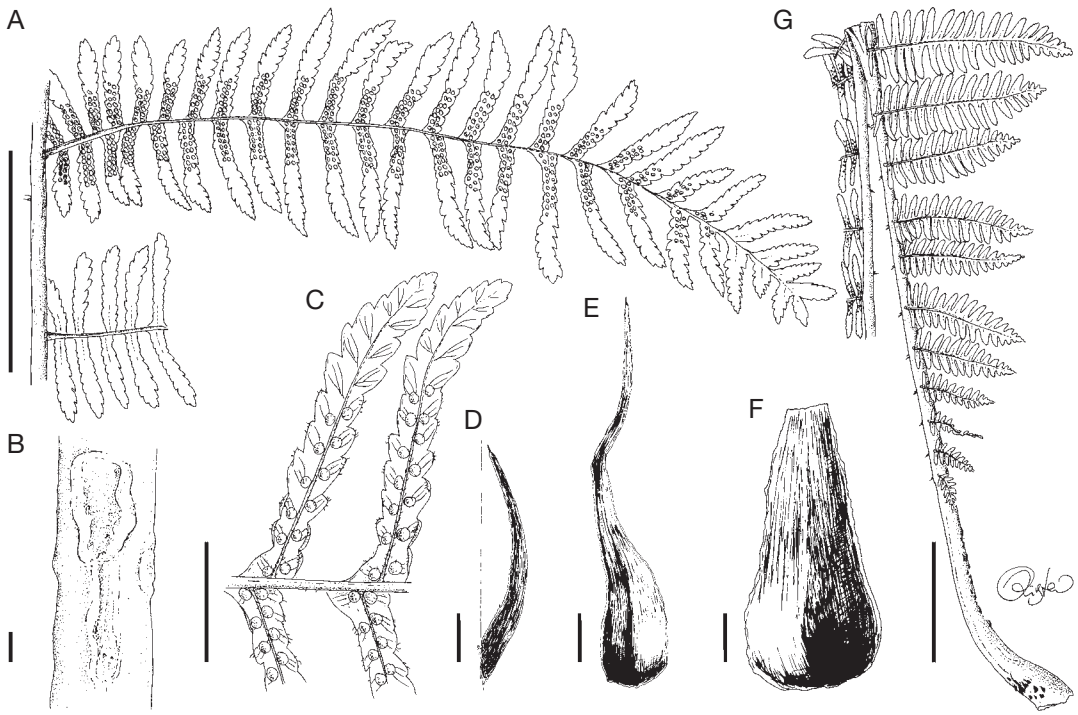


FIG. 7. — *Cyathea dilatata* Rakotondr. & Janssen: **A**, pinna abaxially with a fragment of the rachis; **B**, leaf scar and trunk surface; **C**, pinnules abaxially with a fragment of the costa; **D**, scale from the dorso-lateral face of the petiole, about 5 cm above its base, lateral view; **E**, scale from the dorso-lateral face of the petiole, about 3 cm above its base, dorsal view; **F**, deltoid scale fragment from the dorsal face of the base of the petiole, dorsal view; **G**, basal part of the leaf (from the petiole base up to the first several pinna pairs), lateral view, folded upper part in dorsal view, note the damaged (fragmentary) and potentially caducous scales. A-G, *Rakotondrainibe 3165* (P). Scale bars A, G, 5 cm; B, C, 1 cm; D-F, 0.1 cm.

FIELD OBSERVATIONS. — Trunk: adult plant, most likely 1-3 m tall according to the size of the leaf scars; surface smooth.

Leaf scars: 3 × 1 cm, elliptic.

Lamina: elliptic; LL 90-93 cm, WL 30 cm, NP 24-26.

DESCRIPTION

Petiole: 8-9 cm long, 0.8 cm in diameter and dull dark brown when dry; aphlebia absent.

Lamina: pinnate-pinnatisect, subcoriaceous, pale green below, dark green above (when dry), lamina base cuneate with pinnules gradually reduced in size, the basalmost 0.5-1 cm long; rachis of the same colour as the petiole.

Largest pinnae: 17 cm long, widest in or above their middle, distant by 3.5-4 cm, adjacent pinnae contiguous to overlapping, their apex pinnatifid,

damaged in the available material; costae and costulae of the same colour as the petiole.

Largest pinnules: 2-2.8 × 0.3-0.4 cm, spaced by about 0.5 cm, broadly adnate to the costa, obovate-oblong, widest above their middle, slightly falciform, margin irregularly and deeply crenate and dentate, base distally widened and proximally long decurrent, apex obtuse; veins once or twice furcate.

Scales and hairs: scales of the petiole base distant, persistent, deltoid to narrowly triangular, caudate, 1.5-2 × 0.3 cm (but mostly damaged in the specimen and only their basal part conserved), straight, shiny black, with a vanishing, narrow, light brown margin, more or less appressed to slightly arched, indurated, but not spiny; hyaline to brown, patent or appressed, straight or curved hairs on the abaxial face of the main axes and veins, some hairs fixed

on indusia, never mixed with scales; dense, brown, stiff, multicellular hairs present on the adaxial face of the costae and rachis.

Sori: all young in the available material, costular, distant, covering the lower half of each pinnule; indusia globular, completely covering the sorus, brown, membranous; receptacle capitate, shorter than indusia, paraphyses inconspicuous.

DISTRIBUTION

Southern Madagascar: Andohahela massif; endemic.

ECOLOGY

1500 m. Evergreen rainforest.

REMARKS

The species is distinguished from *C. decrescens* by its appressed to weakly arched, coriaceous, but not strongly indurated or spiny petiole scales. With respect to lamina dissection, it is similar to *C. decrescens* var. *cristata* from which it differs by its deeply crenate pinnules widest above their middle, with obtuse apices and widened bases. Furthermore, its smooth trunk surface and pinnule shape separate the species from *C. meridionalis* Janssen & Rakotondr.

ETYMOLOGY

The epithet refers to the characteristically dilated base of the pinnules.

7. *Cyathea ivohibensis* (C.Chr.)

Janssen & Rakotondr., comb. et stat. nov.

(Figs 8; 45D; 47E)

Cyathea quadrata Baker var. *ivohibensis* C.Chr. in Perrier, *Catalogue des Plantes de Madagascar, Prêridophytes*: 22 (1931), *nom. nud.*; *Dansk Botanisk Arkiv* 7: 28 (1932); Tardieu in Humbert, *Flore de Madagascar et des Comores, IV^e famille, Cyathéacées*: 21 (1951). — Type: Pic d'Ivohibe (Bara), 1500-2000 m, XI.1924, *Humbert 3200* (holo-, BM, not found; iso-, P! [3 sheets], G!). — Fianarantsoa, village d'Ivohibe, corridor forestier reliant la RS d'Ivohibe au PN d'Andringitra, forêt d'Angodongodona, lieu-dit Amparambatopitsinjova, 22°25'07"S, 46°55'31"E, 1100-1150 m, 21.IV.2005, *Janssen et al. 2795* (epi-, P! [4 sheets: P00589591-94], here designated; isoepi-, P! [3 sheets], TAN!; one trunk surface mould at P!).

ADDITIONAL MATERIAL EXAMINED. — **Madagascar**. Prov. de Fianarantsoa, Ivohibe, corridor forestier reliant la RS d'Ivohibe au PN Andringitra, forêt d'Angodongodona, lieu-dit Amparambatopitsinjova, 22°25'07"S 46°55'31"E, 1100 m, 20.IV.2005, *Janssen et al. 2790* (MO, P, TAN). — *Idem*, 1100-1150 m, 21.IV.2005, *Janssen et al. 2791* (MO, P, TAN). — *Idem*, *Janssen et al. 2792* (P), *2794* (MO, P, TAN). — RS d'Ivohibe, à 8 km à l'est du village d'Ivohibe, 22°29'S 46°59'E, 1100-1250 m, 14.X.1997, *Rakotondrainibe et al. 4131* (MO, P, TAN). — Corridor reliant les réserves d'Andringitra et d'Ivohibe, à 8 km au NE du village d'Ivohibe et 5,5 km à l'ESE du village d'Angodongodona, 22°25'18"S, 46°53'54"E, 1150-1300 m, 3.XI.1997, *Rakotondrainibe et al. 4277* (P, TAN). — *Idem*, 9.XI.1997, *Rakotondrainibe et al. 4342* (P).

FIELD OBSERVATIONS. — Trunk: HT up to 4 m, DT 4-5 cm, dead petioles caducous and leaf scars exposed; sometimes with adventitious buds; trunk surface brown, densely muricate, bearing persistent brown scales.

Petiole: with 1 or 2 rows of brown, distant aerophores on either side; petiole bases distinctly sigmoid.

Leaf scars: 1 × 2.5 cm, rounded to ovate, slightly raised, with about 5 thin rather caducous spines, up to 0.7 cm long, on their lower rim, spirally arranged.

Crown: spreading more or less horizontally.

Trunk apex: densely scaly, concealed by the close standing petiole bases.

Lamina: elliptical to oblanceolate; LL 90-130 cm, WL 30-40 cm, FW 50-70 cm, NP 40-55.

DESCRIPTION

Petiole: 8-15 cm long, 0.8-1.3 cm in diameter; green to stramineous, abaxial face sometimes reddish to dark brown; aphlebia absent.

Lamina: pinnate-pinnatisect, herbaceous (not coriaceous), dull green below, shiny dark green above, lamina base cuneate with pinnae gradually reduced in size, basal pinnae reflexed; rachis of the same colour as the petiole.

Largest pinnae: 14-(-22) cm long, distant by 2.5-3 cm, adjacent pinnae not overlapping, their apex caudate, pinnatifid; costae and costulae of the same colour as the petiole.

Largest pinnules: (0.8-)1-1.5(-2.5) × (0.2-)0.3-0.4 cm, spaced by less than their width, broadly adnate to the costa to subsessile with a narrowed base in the lower half of the pinna, oblong, slightly falciform, margin entire to crenate, apex rounded to obtuse; veins once furcate.

Scales and hairs: scales present from the petiole base upwards to 10 cm on the petiole, densely imbricate,

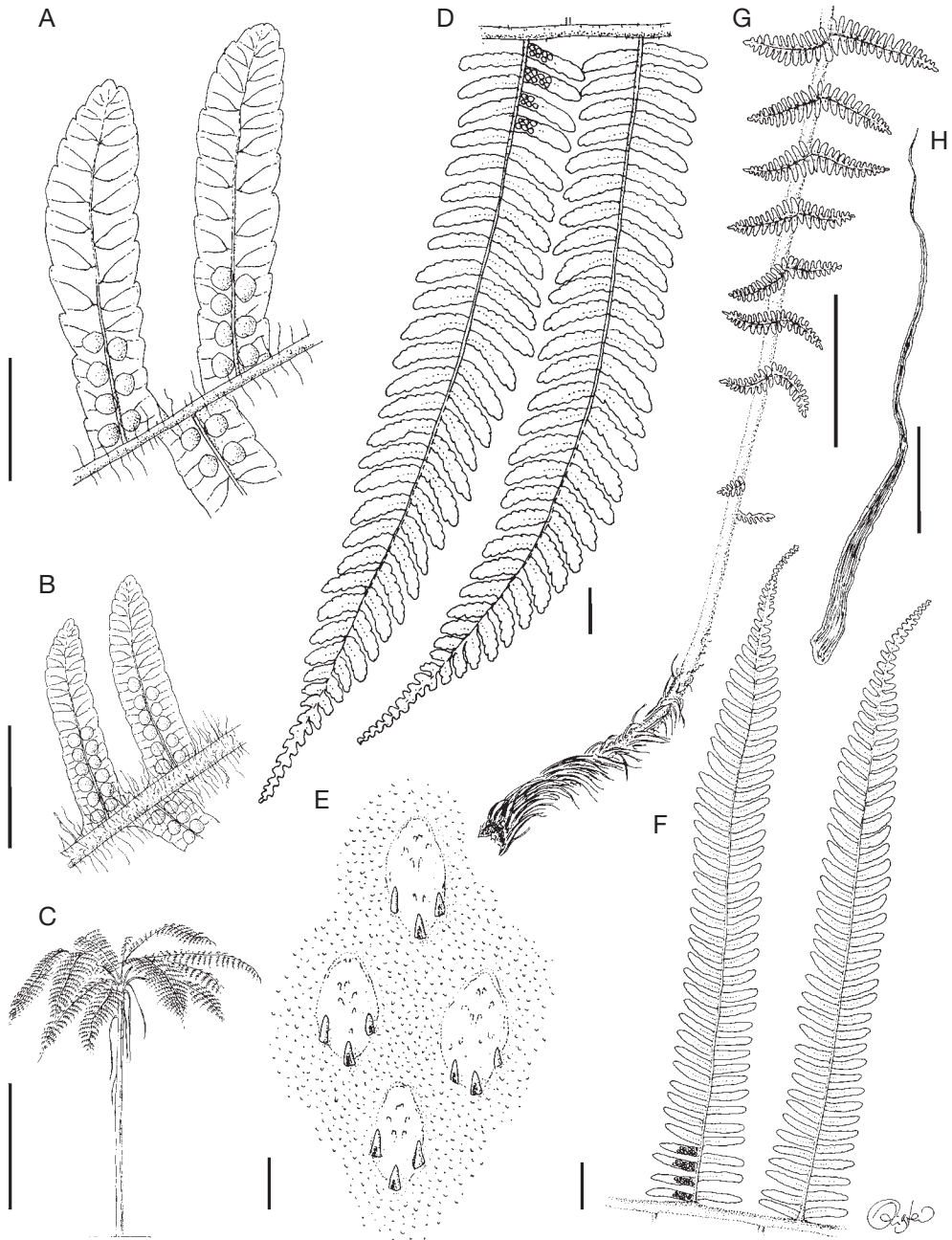


FIG. 8. — *Cyathea ivohibensis* (C.Chr.) Janssen & Rakotondr.: **A**, pinnules abaxially with a fragment of the costa, large form with crenate margins; **B**, pinnules abaxially with a fragment of the costa, small form with subentire margins; **C**, habit; **D**, pinnae abaxially with a fragment of the rachis, sori only partly indicated, large form with crenate margins; **E**, leaf scars and trunk surface; **F**, pinnae abaxially with a fragment of the rachis, sori only partly indicated, small form with subentire margins; **G**, basal part of the leaf (from the petiole base up to the first eight pinna pairs), lateral view; **H**, scale from the base of the petiole. A, D, Janssen *et al.* 2795 (P); B, C, E-H, Janssen *et al.* 2790 (P). Scale bars: A, B, H, 0.5 cm; C, 1 m; D-F, 1 cm; G, 5 cm.

persistent, narrowly triangular, 0.8-2(-2.5) × 0.1-0.15 cm, straight, their apex rarely somewhat twisted or crispate, shiny brown with a dark brown to black centre, appressed to the petiole or not and then antrorse, not indurated; dense, patent, multicellular, hyaline, hairs present on the abaxial face of all axes and veins as well as on indusia and, less dense and mixed with many smaller antrorse, brown, more or less straight and appressed hairs, on the adaxial face of the rachis and costae.

Sori: subcostular, contiguous to distant, about 0.1 cm in diameter, covering the pinnules in their lower one to three quarters; indusia globular, light brown, membranous, at maturity dehiscent in 2 or 3 lobes or irregularly; receptacle capitate, shorter than the rim of mature indusia, with inconspicuous filiform paraphyses shorter than the sporangia.

DISTRIBUTION

Southern Central Madagascar: Ivohibe-Andringitra region; endemic.

ECOLOGY

(800-)1100-1500(-2000) m. Dense evergreen rain-forests.

REMARKS

This species is easily distinguished from *Cyathea decrescens* and its varieties, including *C. decrescens* var. *quadrata*, by its brownish, narrowly lanceolate scales that are not indurated, nor arched, nor spiny. Furthermore, the trunk surface is muricate and not covered with squaminate spines. Considerable variation with respect to segment shape (Fig. 8A, B) and density of the hairy indument occurs. The type specimen has large, strongly serrate and subsessile pinnules in the basal half of the pinnae (Fig. 8D). Juvenile plants exhibit wider segments with rounded apices and subtentire margins. *Rakotondrainibe 4131* has abundant multicellular hairs with a dark thick-walled basal cell, leaving a black scar when fallen.

TYPIFICATION AND SYNONYMY

The holotype of this species has not been found at BM, but should be in Christensen's herbarium. As the specimen is referenced in the catalogue of BM we

currently refrain from choosing a lectotype among the duplicates of the original collection.

The petiole scales are of prime importance in distinguishing this species from *C. decrescens*, but only a few rudimentary scales are left in the currently available original material. We therefore consider it useful to designate an epitype.

8. *Cyathea leptochlamys* Baker

Journal of the Linnean Society 22: 535 (1887); Christensen, *Dansk Botanisk Arkiv* 7: 27, pl. 5 figs 17-19; Tardieu in Humbert, *Flore de Madagascar et des Comores, IV^e famille, Cyathéacées*: 18 (1951). — *Alsophila leptochlamys* (Baker) R.M. Tryon, *Contributions from the Gray Herbarium* 200: 30 (1970). — Type: Madagascar, *Baron 3665* (holo-, K! [K000009939]).

DESCRIPTION

Lamina: bipinnate, herbaceous (not coriaceous).

Largest pinnae: 36 cm long, apex shortly caudate, pinnatifid.

Largest pinnules: 4 × 0.8-1 cm, spaced by less than to about their width, shortly petiolulate, but sessile in the upper third of the pinnae, oblong-triangular, their margin deeply crenate up to halfway to the costula in the lower two thirds of each pinnule, crenulate to subtentire in the upper third, the apex acute in distal, obtuse in proximal pinnules; veins twice furcate to pinnate.

Scales and hairs: scattered multicellular hyaline hairs present on the abaxial face of the costae, costulae and veins; sori subtended by hyaline multicellular hairs, inserted on the veins near the base of the receptacle and more or less overtopping the rim of the indusia.

Sori: median, distant by more than their width, restricted to lower half of pinnules; mature indusia dehiscent irregularly, brown; receptacle capitate, paraphyses inconspicuous.

DISTRIBUTION

Madagascar; endemic?

TYPIFICATION AND SYNONYMY

Christensen (1932) suggested, that *C. leptochlamys* might be near *C. mossambicensis* Baker from con-

tinental Africa, but the latter species has pinnate-pinnatisect leaves with broadly adnate pinnules. The African *C. thomsonii* Baker has bipinnate-pinnatifid leaves with sessile, profoundly lobed pinnules, but these are larger than in *C. leptochlamys*, up to 6 × 1 cm. Furthermore, only the basal 1-4 pinnule pairs are distinctly petiolulate and the distinct hairs inserted at the base of the receptacle are absent. The Madagascan *C. decrescens* var. *quadrata* has less distinctly petiolulate, smaller and less deeply crenate pinnules.

The holotype specimen consists of three detached pinnae, but cutting and indument make this a distinctive taxon. Currently, we are not aware of a Madagascan or African specimen, which sufficiently agrees with Baron's fragmentary collection to be designated as an epitype.

9. *Cyathea ligulata* Baker (Figs 9; 45F; 48B)

Journal of Botany 22: 140 (1884); Christensen, *Dansk Botanisk Arkiv* 7: 26, pl. 5 figs 11-13; Tardieu in Humbert, *Flore de Madagascar et des Comores, IV^e famille, Cyathéacées*: 14. — *Alsophila ligulata* (Baker) R.M. Tryon, *Contributions from the Gray Herbarium* 200: 30 (1970). — Type: Madagascar, *Humboldt* 299 (holo-, K! [K000009938]; iso-, MO!, P! [3 sheets], TAN!, W!). — Madagascar, Prov. d'Anstiranana, Andapa, RNI 12 du Marojejy, au bord d'un affluent de la rivière Manantenina, à 10 km au NW du village de Manantenina, 14°26'S, 49°45'42"E, 750-800 m, 22.X.1996, *Rakotondrainibe 3443* (epi-, P! [3 sheets: P00084923-25], here designated).

ADDITIONAL MATERIAL EXAMINED. — **Madagascar.** Toamasina, Makira, 15°26'S, 49°23'E, 2004, *Antilahimena et al. 2543* (MO, TAN). — Anjanaharibe, 15°11'S, 49°38'E, 800 m, 27.XII.1950, *Cours 3892* (P). — Massif de l'Anjanaharibe, pentes et sommet Nord, 14°36'S, 49°27'E, 900 m, 1951, *Humbert et al. 24583* (G, P). — Toamasina, Maroantsetra, piste menant au sommet de l'Ambohitsitondroinan' Ambanizana, 15°31'08"S, 50°00'16"E, 620 m, 22.X.2004, *Janssen et al. 2494* (MO, P, TAN). — *Idem*, 15°34'S, 50°00'E, 680 m, 9.XII.1993, *Rakotondrainibe et al. 2057* (P). — Antsiranana, Anjanaharibe-Sud, Befingotra, 14°42'30"S, 49°27'30"E, 24.X.1994, *Rakotondrainibe 2196* (P). — *Idem*, 14°45'18"S, 49°30'18"E, 810 m, 27.X.1994, *Rakotondrainibe et al. 2213* (K, MO, P, TAN). — RNI du Marojejy, Manantenina, 14°26'12"S,

49°46'30"E, 450m, 5.X.1996, *Rakotondrainibe 3272* (MO, P, TAN). — *Idem*, 14°26'S, 49°45'42"E, 780 m, 15.X.1996, *Rakotondrainibe 3377* (K, P, TAN). — Forêt de Betaolana, Ambodiangezoka, 14°32'18"S, 49°26'18"E, 870-880 m, 8.X.1999, *Rakotondrainibe et al. 4811* (P, TAN), *4813* (P). — *Idem*, 800 m, 12.X.1999, *Rakotondrainibe et al. 4910* (P). — Antsiranana, massif d'Anjanaharibe-Sud, forêt d'Analabe, SW de Befingotra, 14°46'S, 49°26'30"E, 1120 m, 29.X.1999, *Rakotondrainibe et al. 5110* (P). — PN de Marojejy, Doany, 14°25'36"S, 49°36'30"E, 800 m, 19.X.2001, *Rakotondrainibe et al. 6301* (K, MO, P, TAN).

FIELD OBSERVATIONS. — Trunk: HT up to 4 m, DT 5-8 cm, dead petioles caducous and leaf scars exposed, sometimes a rudiment persistent on the scars; trunk surface tuberculate with patent, black, pyramidal, spiny scales, up to 0.5 cm wide at their base, mixed with many smaller squaminate spines, trunk surface brown to black and rather smooth between the spines.

Petiole: with 1 row of brown, much spaced aerophores on either side; petiole bases more or less straight.

Leaf scars: about 2 × 3 cm, elliptical, spirally arranged.

Crown: more or less funnel-shaped, petiole and base of rachis straight, upper half of rachis arched.

Trunk apex: densely spiny-scaly, scales patent, black, apex raised and well visible through the distant petiole bases.

Lamina: elliptical to ovate; LL 120-200 cm, WL 70 cm, FW 79 cm, NP 18-30.

DESCRIPTION

Petiole: 15-80 cm long, about 2 cm in diameter; castaneous, rarely greenish, covered with a caducous indument of minute brown squamules.

Lamina: bipinnate, herbaceous to subcoriaceous (never coriaceous), pale green below, dull dark green above, basal pinnae usually strongly reflexed; rachis of the same colour as the petiole.

Largest pinnae: 30-35 cm long, distant by about 6 cm; broadest in or above their middle; adjacent pinnae slightly spaced to contiguous, their apex shortly caudate, pinnatifid; costae and costulae of the same colour as the petiole.

Largest pinnules: 2.3-4(-4.5) × 0.5-0.7(-0.8) cm, spaced by less than to almost their width, sessile, linear-oblong, conspicuously biauriculate, adjacent auricles overlapping, margin crenate to subentire, apex rounded to obtuse, rarely acute, distal pinnules usually with a sharper apex than proximal pinnules; veins once to thrice furcate.

Scales and hairs: scales present from the petiole base upwards to 30(-50) cm on the petiole, spaced, i.e. not overlapping, persistent, conical to pyramidal, 0.5-0.8 × 0.2-0.4 cm, straight, patent to very slightly antrorse, shiny dark brown to black, strongly indurated and spiny; dense triangular to deltoid, brown scales, up to 0.2 cm long, on the abaxial face of the costae and costulae, mixed with whitish acaroid to amorphous squamules; brown, antrorse, contorted multicellular hairs on the adaxial face of the costae and in the apical part of the costae also on the abaxial face; scattered patent, hyaline hairs present on the abaxial face of the costulae; sparse and short contorted hairs and scattered filiform brown scales on the adaxial face of the rachis.

Sori: median to subcostular, contiguous to slightly distant, about 0.1 cm in diameter, covering the lower three quarters of the pinnules or entire pinnules; indusia globular, light brown, membranous, at maturity dehiscing in irregular lobes or persistent as a cup with a lacerate rim; receptacle capitate, about as long as the rim of mature indusia, with inconspicuous filiform paraphyses shorter than the sporangia.

DISTRIBUTION

Northern Madagascar: Marojejy and baie d'Antongil; endemic.

ECOLOGY

(450-)700-1100 m. Dense evergreen rainforests, frequently in wet places next to small streams.

REMARKS

We here publish the first complete description of this taxon including characters of the petiole base. *Cyathea isaratanensis* C.Chr. has similar, but usually smaller, petiole scales and is easily distinguished from the present taxon by its larger pinnules and glabrous adaxial face of costae and costulae.

TYPIFICATION AND SYNONYMY

The original material consists of single pinnae and pairs of pinnae with rachis fragments and lacks petiole scales. We hence designate an epitype to unambiguously define this taxon.

10. *Cyathea lisiae* Janssen & Rakotondr., sp. nov. (Figs 10; 45H)

Filix arborescens Cyatheae decrescenti affinis sed differt paleis petioli distantibus, breviter deltoideis, 0.2-0.3 cm longis et 0.1-0.15 cm latis, nitide atris, adpressis vel parum arcuatis, ascendentibus ad primum par pinnarum, transientibus in paleis bicoloribus in parte superiore petiolo (palei bicolores basi straminei membranacei, apice brunnei vel atri et coriacei). Pagina abaxialis rhachidis, costarum et costularum dense obtecta pilis multicellularibus hyalinis interdum apice in palea anguste lanceolata transientibus. Pinnulae 1.5-1.7 cm longae et 0.3 cm latae, costae adnatae, margine integra, apice acuta vel obtusa et crenulata.

TYPUS. — Madagascar, Province de Fianarantsoa, PN Ranomafana, Marotrehô à 6 km au S du village de Ranomafana, 21°18'14"S, 47°27'42"E, 900 m, 10.XII.2000, *Rabarimanarivo 204* (holo-, P! [P00477696]).

FIELD OBSERVATIONS. — Trunk: HT 4 m, DT 5 cm, dead petioles caducous and leaf scars exposed; surface dark brown, smooth to finely muricate, covered with distant, deltoid, appressed, black scales.

Leaf scars: with 4 or 5 distinct orifices on their lower rim.

Lamina: LL 100 cm, NP 30.

DESCRIPTION

Petiole: 45 cm long, about 1 cm in diameter; light reddish brown to stramineous; aphlebia absent.

Lamina: pinnate-pinnatisect, subcoriaceous, dull pale green below, dark green above (when dry), lamina base acute to truncate, i.e. basal pinnae slowly and gradually reduced in size and not attaining the petiole base; rachis of the same colour as the petiole.

Largest pinnae: 23 cm long, distant by 3-3.5 cm, adjacent pinnae contiguous, their apex caudate, pinnatifid; costae and costulae of the same colour as the petiole.

Largest pinnules: 1.5-1.7 × 0.3 cm, spaced by much less than their width, broadly adnate to the costa, oblong, slightly falciform, margin entire, the acute to obtuse apex crenulate; veins once furcate.

Scales and hairs: scales present from the petiole base upwards to about 45 cm on the petiole, reaching the first pinna pair, distant, persistent, deltoid, 0.2-0.3 × 0.1-0.15 cm, shiny black with a narrow brown margin, appressed to slightly arching, very coriaceous, becoming gradually reduced

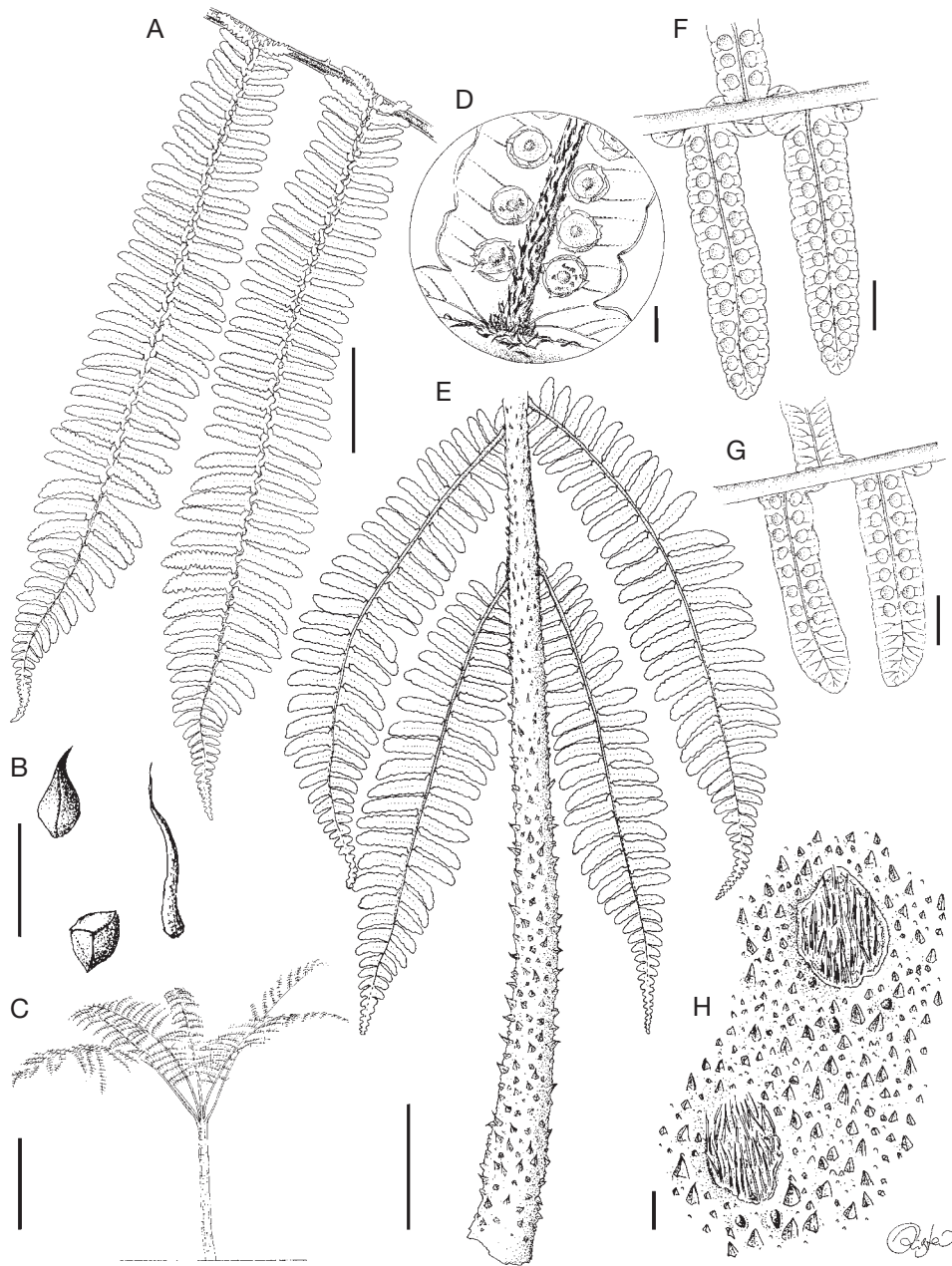


FIG. 9. — *Cyathea ligulata* Baker: **A**, pinnae adaxially with a fragment of the rachis, note that the auricles of the pinnules overlap the rachis; **B**, two strongly indurated pyramidal scales from the base of the petiole (left) and one narrowly triangular scale from the abaxial face of the costa (right); **C**, habit; **D**, basal part of a pinnule abaxially (at the junction of the costula with the costa) showing indusia as well as the densely scaly costa and costula; **E**, basal part of the leaf (from the petiole base up to the second pinna pair), dorsal view, basalmost pinnae are strongly reflexed; **F**, pinnules abaxially with a fragment of the costa, form with long pinnules with a crenate margin and an obtuse apex; **G**, pinnules abaxially with a fragment of the costa, form with short pinnules with a subentire margin and a rounded apex; **H**, leaf scars and spiny trunk surface. A, D, G, *Rakotondrainibe et al.* 5110 (P); B, E, *Rakotondrainibe et al.* 2057 (P); C, H, *Janssen et al.* 2494 (P); F, *Rakotondrainibe et al.* 2057 (P). Scale bars: A, E, 5 cm; B, F, G, 0.5 cm; C, 1 m; D, 0.1 cm; H, 1 cm.

in size upwards on the petiole, where they become bicolourous with a patent to antrorse, stramineous, membranous base and a blackish brown, coriaceous tip; dense, patent, multicellular, hyaline hairs and scale-topped hairs, up to 3 mm long, present on the abaxial face of the lamina axes and veins, these hairs on the rachis and, to a lesser extent, on the costae with an indurated, dark basal cell; dense, more or less straight, patent to antrorse, sometimes appressed, multicellular, brown hairs cover the adaxial face of the rachis and costae.

Sori: subcostular, distant, about 0.1 cm in diameter, covering the pinnules for three quarters of their length; mature indusia membranous, light brown, a relatively shallow cup or appressed collar around the base of the receptacle; receptacle capitate, longer than the rim of mature indusia, paraphyses inconspicuous.

DISTRIBUTION

Southern Central Madagascar: Ranomafana region; endemic.

ECOLOGY

900 m. Evergreen rainforest, next to a small stream.

REMARK

The species is clearly distinct from all taxa of group IIb by its distant short deltoid petiole scales grading into bicolourous scales further up on the petiole. It is, with *C. auriculata*, the only Madagascan taxon with scale-topped hairs on the lamina axes.

ETYMOLOGY

This species is dedicated to Ms Hery Lisy Ranarijaona, botanist at the University of Mahajanga having extensively worked in the Ranomafana area, in acknowledgement of her substantial contributions to fieldwork associated with the present revision.

11. *Cyathea meridionalis*

Janssen & Rakotondr., sp. nov.

(Figs 11; 46A; 48A)

Filix arborescens Cyatheae decrescenti affinis sed differt paleis petioli adpressis non arcuatis, anguste triangularibus,

1-1.3 cm longis et 0.1-0.2 cm latis, nitide atris, coriaceis non valde induratis. Pinnulae 1.3-2.2 cm longae et 0.3-0.4 cm latae, apice acuta vel obtusa, spatium inter eas latitudine earum minus, proxime decurrentia et confluentia in parte superiore pinnae. Truncus 7-12 cm diametro, grosse muricatus protuberationibus conicis, usque ad 0.5 cm longis, distantibus provisus.

TYPUS. — Madagascar, province de Fianarantsoa, PN d'Andringitra, camp d'Imaitso, vallée d'Ambaravandanitra, 22°08'52"S, 46°56'45"E, 1800-1900 m, 20.XI.2004, Janssen et al. 2603 (holo-, P! [4 sheets: P00589636-39]; iso-, TAN!; one trunk surface mould at P!).

ADDITIONAL MATERIAL EXAMINED. — Madagascar.

Prov. de Toliara, massif du Beampingaratra, vallée de la Maloto, 24°31'S, 46°58'E, 800-1500 m, *Humbert 6320* (BM, P). — Prov. de Fianarantsoa, PN Andringitra, forêt d'Anjavidilava et descente vers camp Imaitso, 22°09'36"S, 46°57'39"E, 1800-2000 m, 19.XI.2004, Janssen et al. 2593 (MO, P, TAN), 2599 (MO, P, TAN), 2601 (P, TAN). — RS Pic d'Ivohibe, haute vallée de l'Andranomainty, 22°29'49"S, 46°57'22"E, 1520-1580 m, 24.IV.2005, Janssen et al. 2815 (MO, P, TAN), 2816 (MO, P, TAN). — Amalavao, RNI d'Andringitra, source de la Sahavatoy, 22°11'39"S, 46°58'16"E, 1650 m, 31.V.1995, *Rakotondrainibe 2744* (P, TAN). — Prov. de Toliara, Tolanaro, RNI d'Andohahela, Eminiminy versant E du Trafon'omy, 24°33'30"S, 46°43'E, 17.XI.1995, *Rakotondrainibe 3110* (P). — RS Pic d'Ivohibe, source de l'Andranomainty, 22°29'48"S, 46°57'18"E, 1500-1650 m, 24.X.1997, *Rakotondrainibe et al. 4184* (P, TAN). — *Idem*, 25.X.1997, *Rakotondrainibe et al. 4233* (MO, P, TAN).

FIELD OBSERVATIONS. — Trunk: HT up to 8 m, DT (5-7-12(-15) cm, dead petioles caducous and leaf scars exposed; trunk surface grey to brown, tuberculate, covered with short, conical, distant, obtuse, blackish, up to 0.5 cm long squaminate spines.

Petiole: with brown, slightly raised, short aerophores on the whole abaxial face near the petiole base, then 1 or 2 rows on either side; petiole bases distinctly sigmoid.

Leaf scars: (1.7-)3-4 × (1.7-)2-2.5 cm, rounded to elliptic, more or less concave, usually very close, with 1-5 more or less conspicuous orifices on their lower rim; arranged in very regular pseudo-whorls.

Crown: many-leaved, usually at least 2 or 3 whorls present, each bearing 8-12 leaves; young leaves more or less erect, older leaves arching, crown centre funnel-shaped, collecting leaf litter.

Trunk apex: densely scaly, concealed by close standing petiole bases.

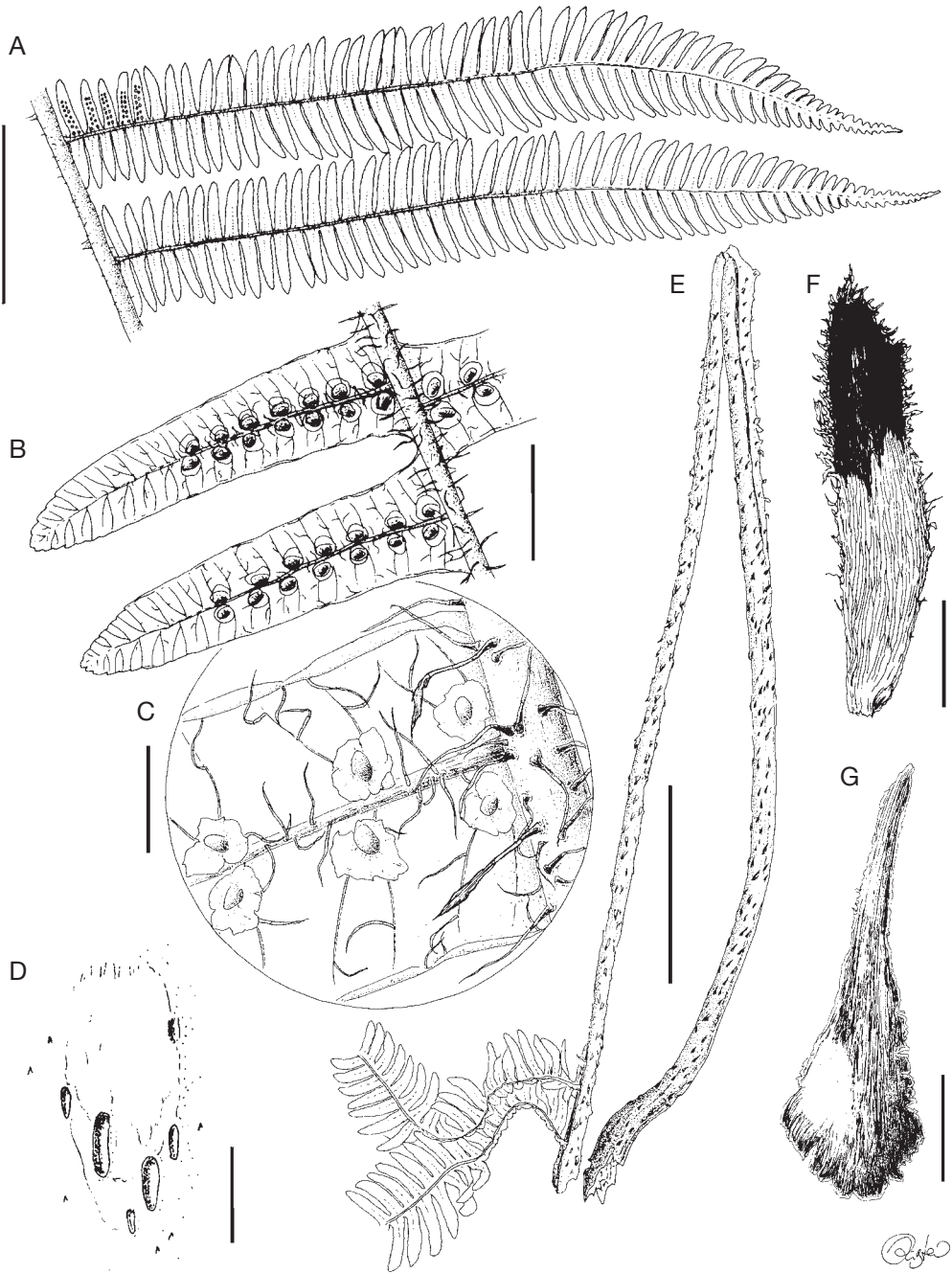


FIG. 10. — *Cyathea lissiae* Janssen & Rakotondr.: **A**, pinnae abaxially with a fragment of the rachis, sori only partly indicated; **B**, pinnules abaxially with a fragment of the costa; **C**, proximal part of a pinnule abaxially with a dense indument of multicellular hairs and scale-topped hairs, note the rudimentary collar-like indusium; **D**, leaf scar; **E**, basal part of the leaf (from the petiole base up to the first pinna pair), lateral view; **F**, bicolorous scale from the upper third of the petiole; **G**, concolorous scale from the base of the petiole. A-G, *Rabarimanarivo* 204 (P). Scale bars: A, E, 5 cm; B, 0.5 cm; C, F, G, 0.1 cm; D, 1 cm.

Lamina: narrowly elliptic; LL (90-)110-150(-200) cm, WL 35-50 cm, FW 50-70 cm, NP 39-47.

DESCRIPTION

Petiole: 4-10 cm long, 1.0-2.2 cm in diameter; green to light brown, abaxial face sometimes reddish, brown at its base; basal pinna gradually transforming into aphlebioid pinnae and aphlebia, several pairs of such aphlebia near the base of the petiole, up to 5 cm long.

Lamina: pinnate-pinnatisect, subcoriaceous, light green below, dark green above, lamina base cuneate with pinnae gradually reduced in size, basal pinnae reflexed and somewhat falciform; rachis of the same colour as the petiole.

Largest pinnae: 15-29 cm long, distant by 2.5-4 cm, adjacent pinnae not overlapping to contiguous, their apex acute to caudate, pinnatifid; costae and costulae of the same colour as the petiole.

Largest pinnules: (0.9-)1.3-2.2 × 0.3-0.4 cm long, spaced by less than their width, broadly adnate to the costa, proximally decurrent and confluent from the middle of the pinnae or below, sometimes from the base of the pinna (in young or small leaves), oblong, slightly falciform, margin crenulate to conspicuously crenate, apex acute to obtuse; veins once furcate.

Scales and hairs: scales present from the petiole base upwards to 25(-40) cm on the petiole and rachis, distant to slightly overlapping, very narrowly triangular-caudate, 1-1.3 × 0.1-0.2 cm, straight, shiny black with a narrow brown margin, not arched, appressed to the petiole, scale apex often free, not strongly indurated, but at least very coriaceous; usually dense (rarely scattered), multicellular, hyaline hairs, up to 0.1(-0.15) cm long, present on the abaxial face of the costae and costulae and on indusia, also on both faces of veins; more or less crispate, patent to appressed, antrorse stramineous to brown hairs on the adaxial face of the rachis and costae.

Sori: subcostular, contiguous, about 0.1 cm in diameter, covering up to three quarters of the pinnules; indusia globular, brown, membranous to subcoriaceous, at maturity dehiscing in several irregular lobes; receptacle capitate, shorter than the rim of mature indusia, with filiform paraphyses shorter than the sporangia.

DISTRIBUTION

Southern Madagascar: Andringitra, Ivohibe and Andohahela massifs; endemic.

ECOLOGY

(800-)1500-2000 m. Dense evergreen rainforests of higher altitudes and cloud forests.

REMARKS

The species is closely related to *C. decrescens* from which it can be easily distinguished in the field by its stout habit with a thicker trunk and the many-leaved crown. The greyish brown trunk surface is covered with patent conical spines and not by blackish brown antrorse spines. In herbarium specimens the taxon is easily recognized by its petiole scales being appressed, not arched, and less strongly indurated as well as by its acute to obtuse pinnule apices. *Cyathea dilatata* differs from this taxon by its smooth trunk surface and larger pinnules that are widest above their middle. *Rakotondrainibe 3110* does not have aphlebia and rather small pinnules, 0.9-1.1 × 0.2-0.3 cm, and a very sparse indument.

ETYMOLOGY

The epithet reflects the distribution of the taxon, which is restricted to the mountains of Southern Madagascar.

Group IIc: group of *Cyathea acutula*

Cyathea borbonica group p.p. *sensu* Christensen 1932; "group 4" p.p. *sensu* Holttum 1981.

DIAGNOSTIC CHARACTERS. — Leaves bipinnate, lateral pinnules sessile to petiolulate; pinna apex pinnatifid; multicellular hyaline hairs absent from the abaxial face of the lamina axes; never with aphlebioid pinnae.

12. *Cyathea acutula* (R.M.Tryon) Janssen & Rakotondr., comb. nov.

REMARKS

Large bipinnate leaves and short, black to brown scales are common to all varieties of this species.

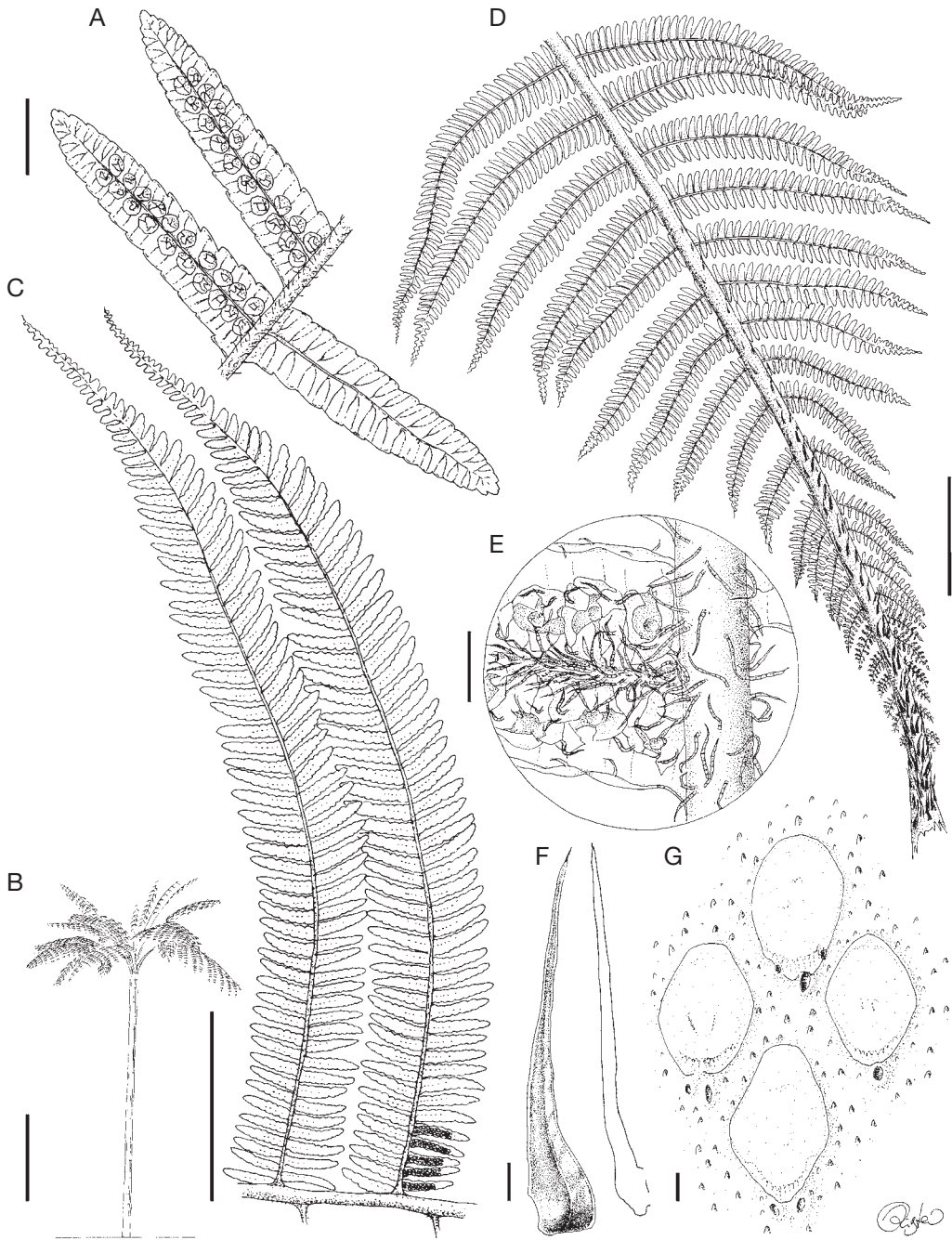


FIG. 11. — *Cyathea meridionalis* Janssen & Rakotondr.: **A**, pinnules abaxially with a fragment of the costa, sori omitted from one pinna; **B**, habit; **C**, pinnae abaxially with a fragment of the rachis, sori only partly indicated; **D**, basal part of the leaf (from the petiole base up to the first several pinna pairs), dorsal view; **E**, proximal part of a pinnule abaxially, with a dense indument of multicellular hairs; **F**, scale from the base of the petiole (left: dorsal view; right: lateral view, schematic); **G**, leaf scars and trunk surface. A-G, *Janssen et al.* 2603 (P). Scale bars: A, 0.5 cm; B, 1 m; C, D, 5 cm; E, F, 0.1 cm; G, 1 cm.

KEY TO THE VARIETIES OF *CYATHEA ACUTULA*

1. Rachis and costae dark reddish brown when fresh or dry; scales dull to shiny brown to dark brown 12c. var. *rufescens*
 — Rachis and costae light to medium brown when dry, never reddish; scales shiny black ... 2
2. Scales at the very base of the petiole 0.3-0.8 × 0.2-0.3 cm, deltoid, contiguous 12b. var. *deltoidea*
 — Scales at the very base of the petiole (0.8-)1-1.7 × 0.1-0.2 cm, narrowly triangular-caudate, overlapping 12a. var. *acutula*

12a. *Cyathea acutula* (R.M. Tryon)
 Janssen & Rakotondr. var. *acutula*
 (Figs 12A-H; 44A; 48C, D)

Alsophila acutula R.M. Tryon, *Contributions from the Gray Herbarium* 200: 29 (1970), nom. nov. — *Cyathea tsaratananensis* Tardieu, *Bulletin de la Société botanique de France* 88: 681 (1941); Tardieu in Humbert, *Flore de Madagascar et des Comores, IV^e famille, Cyathéacées*: 16, fig. 2 (1-3) (1951), nom. illeg. non *C. tsaratananensis* C. Chr., *Index Filicum Supplementum Tertium*: 64 (1934). — Type: Madagascar, Mt. Tsaratanana, 1600 m, XII.1922, *Perrier de la Bâthie 15257* (lecto-, P! [P00389591], here designated; isolecto-, P! [4 sheets]).

ADDITIONAL MATERIAL EXAMINED. — **Madagascar.** Fianarantsoa, Ireimo massif, 20°36'S, 46°33'48"E, 1600 m, 24.XI.2004, *Birkinshaw 1392* (MO, P). — Montagnes entre le haut Sambirano et le haut Maevarano, 14°08'S, 48°52'E, 1400-1800 m, XI.1937, *Humbert 18120* (P). — Antsiranana, massif du Manongarivo, 14°01'33"S, 48°24'47"E, 1566 m, 27.IX.2004, *Janssen et al. 2401* (P, TAN). — *Idem*, cuvette de la Haute Antsahakolana, 14°03'04"S, 48°24'16"E, 1657 m, 29.IX.2004, *Janssen et al. 2410* (MO, P, TAN). — Mahajanga, massif du Tsaratanana, Antetikalambazaha, 14°10'27"S, 48°56'43"E, 1700 m, 7.V.2005, *Janssen et al. 2849* (MO, P, TAN), *2850* (MO, P, TAN). — Massif de Tsaratanana, Beangona, Ambevy, 14°02'51"S, 48°47'34"E, 1100 m, 28.XI.2000, *Rasolohery 108bis* (P, TAN). — *Idem*, Matsabory maika, 14°55'08"S, 48°34'22"E, 1600-2063 m, 27.IV.2001, *Rasolohery 437* (MO, P, TAN).

FIELD OBSERVATIONS. — Trunk: HT up to 7 m, DT 10-12 cm, dead petiole bases caducous and leaf scars exposed, petiole rudiments sometimes persistent in the upper half of the trunk; trunk surface blackish brown, densely muricate, with rudimentary scales identical to those of the petiole base.

Petiole: with 1 to 3 rows of white to brown, spaced, slightly raised aerophores on either side; petiole bases straight to more or less sigmoid.

Leaf scars: 2-3 × 3.5-5 cm, ovate to elliptical, their lower rim sometimes raised, shallow orifices on or below the lower rim, marginal spines not documented; scars spirally arranged.

Crown: petioles and rachises arching and crown umbrella-shaped to more or less horizontal, plants from the Manongarivo massif have crowded basal pinnae just above the trunk apex (Fig. 12C right).

Trunk apex: densely scaly, brown to black, visible through the spaced petiole bases, often somewhat raised and young croziers well visible.

Lamina: elliptical to ovate; LL (100-)180-270 cm, WL (80-)120-140 cm, FW (60-)110-120 cm, NP 15-25.

DESCRIPTION

Petiole: 25-55 cm long, (1-)2.5-4 cm in diameter; green above, dark green to brownish below, light brown when dry.

Lamina: bipinnate, subcoriaceous, dull light green below, shiny dark green above, lamina base shortly attenuate, acute; basal pinnae patent or reflexed, more or less strongly conduplicate; rachis of the same colour as the petiole.

Largest pinnae: (30-)60 cm long, distant by 7-11.5 cm, usually widest above their middle, adjacent pinnae contiguous to slightly overlapping, their apex acute to shortly caudate, pinatifid; costae and costulae of the same colour as the petiole.

Largest pinnules: (3-)5-7.5(-9) × (0.6-)1-1.2 cm, spaced by less than their width, distinctly petiolulate, petiolule up to 0.3 cm in proximal pinnules, triangular-oblong, margin serrate in the upper half of the pinnules or only near the apex, sometimes crenate near the pinnule base or rarely margin completely crenate, base truncate to cordate, biariculate, but sometimes only slightly, apex acute to shortly caudate, rarely obtuse, serrate; veins once to twice furcate.

Scales and hairs: scales present from the petiole base upwards to 50 cm on the petiole, overlapping, dense at the base, thinning further up, persistent, narrowly triangular, caudate, (0.8-)1-1.7 × 0.1-0.2 cm, more or less falciform, appressed, shiny dark brown to black, with a narrow light brown margin, coriaceous, their base rarely slightly indurated; sparse to dense, short, stiff, contorted, light brown hairs on the adaxial face of the rachis and costae; scattered black, acaroid squamules on the abaxial face of the costulae; leaf otherwise glabrous.

Sori: subcostular, spaced by about their width, 0.1-0.15 cm in diameter, covering entire pinnules except their apical region; indusia globular, membranous to subcoriaceous, light brown, at maturity dehiscent in 2-4 lobes or irregularly; receptacle capitate or disciform, shorter than the rim of mature indusia, with inconspicuous, short filiform paraphyses.

DISTRIBUTION

Northern and Central Madagascar: Manongarivo, Tsaratanana, Itremo; endemic.

ECOLOGY

(1100-)1500-2000 m. Dense evergreen rainforests.

REMARKS

Plants from the Manongarivo massif have a stout habit and strongly conduplicate pinnae near the petiole base imparting a crowded appearance to the crown directly above the stem apex. This habit has not been observed elsewhere.

TYPIFICATION AND SYNONYMY

When describing the taxon, Tardieu-Blot (1941) cited three syntypes. Among these, *Perrier de la Bâthie 15257* with a stramineous rachis corresponds best to the protolog. One sheet of this collection, distinguished as "type" in Tardieu's writing, carries two middle pinnae and is chosen here as the lectotype. A petiole base is available in the isolectotype material and should not be dissociated from the lectotype. *Humbert 18120* is *C. acutula* var. *acutula* with a copper-brown petiole and rachis, but shiny black scales. *Humbert 5747*, in the protolog

erroneously cited as "*Perrier 5747*", is *C. emilei* var. *dauphinensis* Janssen & Rakotondr. and does not correspond to the description given in the protolog. The ensemble of the lectotype and isolectotypes is representative for the taxon making epitypification unnecessary.

12b. *Cyathea acutula* (R.M. Tryon)

Janssen & Rakotondr.

var. *deltoidea* Janssen & Rakotondr., var. nov.

(Figs 12I-K; 44A; 48D)

A typo differt paleis basi petioli parvis deltoideis, 0.3-0.8 cm longis et 0.2-0.3 cm latis, contiguis vel leviter superpositis, non falciformibus, induratis et exigue bullatis.

TYPUS. — Madagascar, Fianarantsoa, Ivohibe, corridor forestier reliant la RS d'Ivohibe au PN d'Andringitra, forêt d'Angodongodona, lieu-dit Amparambatopitsinjova, 22°25'07"S, 46°55'31"E, 1100 m, 20.IV.2005, Janssen et al. 2788 (holo-, P! [4 sheets: P00589521-24]; iso-, P! [3 sheets], TAN!; one trunk surface mould at P!).

ADDITIONAL MATERIAL EXAMINED. — Madagascar. Région de Tsinjoarivo, forêt d'Ankilahila, 19°42'24"S, 47°51'E, 1400-1560 m, I.1999, Borie 555 (MO, P). — Toamasina, Maroantsetra, piste menant au sommet de l'Ambohitsitondroinan' Ambanizana, 15°31'08"S, 50°00'16"E, 620 m, 22.X.2004, Janssen et al. 2496 (MO, P, TAN). — Fianarantsoa, Ivohibe, forêt d'Angodongodona, 22°25'07"S, 46°55'31"E, 1100-1150 m, 21.IV.2005, Janssen et al. 2793 (MO, P, TAN). — Corridor reliant les PN de Ranomafana et d'Andringitra, Tolongoina, 21°35'S, 47°29'E, 750 m, 26.X.2000, Rabarimanarivo et al. 74 (P). — *Idem*, Ikongo, 21°49'17"S, 47°24'50"E, 640 m, 19.XI.2000, Rabarimanarivo et al. 155 (P). — Toamasina, piste menant au sommet d'Ambohitsitondroinan' Ambanizana, 15°34'S, 50°00'E, 680 m, 6.XII.1993, Rakotondrainibe et al. 2065 (P, TAN). — Fianarantsoa, Ambalavao, Ambatomboay, RNI d'Andringitra, 22°13'40"S, 47°01'30"E, 800 m, 17.V.1995, Rakotondrainibe 2623 (P, TAN). — *Idem*, 18.V.1995, Rakotondrainibe 2634 (P, TAN). — Toliara, Eminiminy, RNI d'Andohahela, Trafon'omby, 24°37'55"S, 46°45'29"E, 420 m, 23.X.1995, Rakotondrainibe 2898 (MO, P, TAN). — Fianarantsoa, Ambalavao, RS d'Ivohibe, 22°28'12"S, 46°57'36"E, 850-950 m, 8.X.1997, Rakotondrainibe et al. 4067 bis (P). — *Idem*, 13.X.1997, Rakotondrainibe et al. 4124 (P, TAN). — RS d'Ivohibe, source de l'Andranomainty, 22°29'48"S, 46°57'18"E, 1500-1650 m, 25.X.1997, Rakotondrainibe et al. 4228 (MO, P). — Corridor reliant

les réserves d'Andringitra et d'Ivohibe, Angodongodona, 22°25'36"S, 46°56'18"E, 880-950 m, 16.XI.1997, *Rakotondrainibe et al.* 4389 (P). — Antsiranana, forêt de Betaolana, Ambodiangezoka, 14°32'18"S, 49°26'18"E, 820 m, 8.X.1999, *Rakotondrainibe et al.* 4870 (P, TAN). — Fianarantsoa, PN de Ranomafana, forêt de Vatoharanana, 21°17'24"S, 47°26'E, 1000-1100 m, 3.X.2000, *Rakotondrainibe et al.* 5859 (K, P, TAN), 5867 (P). — *Idem*, 980 m, 5.X.2000, *Rakotondrainibe et al.* 5913 (P). — Antsiranana, PN de Marojejy, Doany, 14°25'36"S, 49°36'30"E, 800 m, 17.X.2001, *Rakotondrainibe et al.* 6281 (K, P, TAN). — Forêt de Ranomafana, 21°14'S, 47°24'E, 18.II.1992, *Rana-rijaona 87a* (P). — Fianarantsoa, PN Ranomafana, Vatoharanana, 21°16'S, 47°27'E, 980 m, 15.IX.1994, *Randriambololona et al.* 155 (G, P). — Fianarantsoa, Ranomafana, 21°14'S, 47°24'E, 900 m, 9.IX.1992, *van der Werff et al.* 12593 (MO, P).

DIFFERENTIAL FIELD OBSERVATIONS. — Trunk: HT up to 8 m, DT 6-10(-12) cm, trunk surface apparently less densely muricate than in var. *acutula*; rarely with adventitious buds; base more or less thickened by adventitious roots.

Leaf scars: up to 3 × 8 cm, whitish when young, 3-6 spines on the lower rim of the scars, but caducous on older scars.

Lamina: WL 95-100 cm, FW 60-90 cm.

DIFFERENTIAL DESCRIPTION

Scales of the petiole base small, deltoid, 0.3-0.8 × 0.2-0.3 cm, contiguous to slightly overlapping, not falciform, indurated and more or less bul-late, grading into scales similar to those of var. *acutula* further up on the petiole, i.e. becoming narrower and longer, but always remaining shorter than the basal scales of var. *acutula*. Petiole up to 90 cm long.

DISTRIBUTION

Southern Central Madagascar (Ivohibe, Ranomafana) and few specimens from Northern Madagascar; endemic.

ECOLOGY

400-1500 m. Dense evergreen rainforests.

ETYMOLOGY

The epithet *deltoides* refers to the short deltoid scales of this variety as opposed to the much longer, narrowly triangular scales of var. *acutula*.

12c. *Cyathea acutula* (R.M.Tryon)

Janssen & Rakotondr.

var. *rufescens* Janssen & Rakotondr., var. nov.

(Figs 12L; 44A)

A typo differt colore petioli, rachidis et costarum rufobrunneo in vivo et sicco et paleis petioli atrobrunneis vel rufobrunneis.

TYPUS. — Madagascar, Mahajanga, massif du Tsarananana, montagnes au nord de Mangindrano, environs de Matsaborimaiky, 14°09'11"S, 48°57'27"E, 2050 m, 8.V.2005, *Janssen et al.* 2877 (holo-, P! [4 sheets: P00589528-31]; iso-, P! [3 sheets], TAN!; one trunk surface mould at P!).

ADDITIONAL MATERIAL EXAMINED. — Madagascar. Antsiranana, massif d'Anjanaharibe-Sud, Befingotra, 14°46'12"S, 49°15'47"E, 1150 m, 26.X.1999, *Rakotondrainibe et al.* 5039 bis (P). — *Idem*, 14°45'54"S, 49°25'55"E, 1600 m, 4.XI.1999, *Rakotondrainibe et al.* 5141 (P, TAN). — *Idem*, 1525 m, 10.XI.1999, *Rakotondrainibe et al.* 5199 (P, TAN). — RNI Tsarananana, Beangona Ambevy, 14°25'10"S, 48°47'34"E, 1100 m, 28.XI.2000, *Rasolohery 108* (P, TAN).

DIFFERENTIAL FIELD OBSERVATIONS. — Trunk: HT up to 3 m, DT 7-10 cm.

Trunk apex: densely scaly, brown.

DIFFERENTIAL DESCRIPTION

Petiole, rachis and costae reddish brown in fresh and dry specimens. Scales of the petiole base 0.6-1.2 × 0.1-0.2 cm, deltoid to narrowly triangular, contiguous to slightly overlapping, dark brown to reddish brown with a light brown margin.

DISTRIBUTION

Northern Madagascar: Tsarananana, Anjanaharibe; endemic.

ECOLOGY

1100-2050 m. Dense evergreen rainforests.

REMARKS

Rasolohery 108 is sterile and has pinnules up to 9 × 1.6 cm. *Rakotondrainibe 5141* has coriaceous indusia.

ETYMOLOGY

Although more vividly red when in life, the epithet *rufescens* refers to the distinctly reddish to violaceous

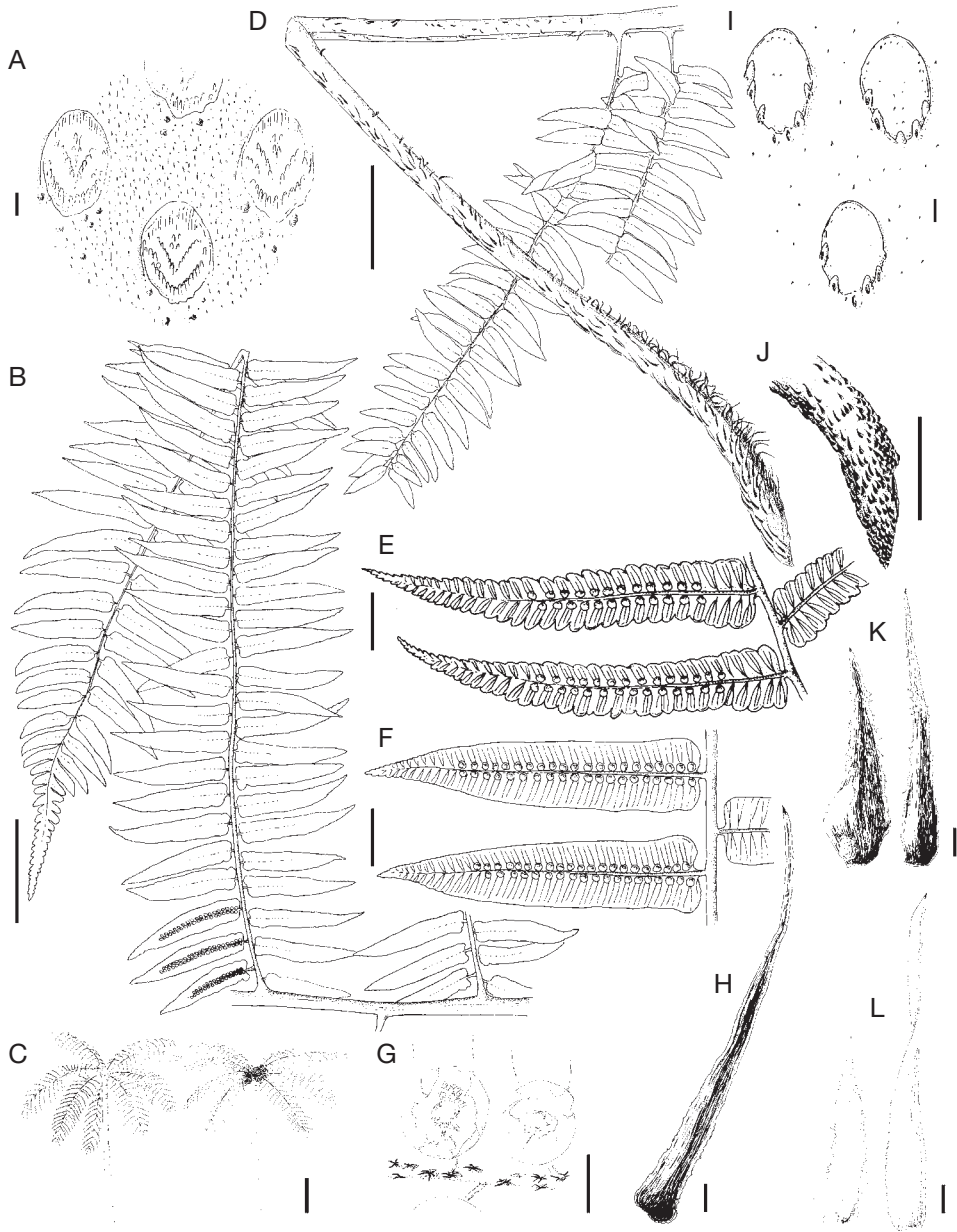


FIG. 12. — **A-H**, *Cyathea acutula* (R.M.Tryon) Janssen & Rakotondr. var. *acutula*; **A**, leaf scars and trunk surface; **B**, pinna abaxially with a fragment of the rachis, sori only partly indicated; **C**, habit (left: common form; right: form of the Manongarivo massif with dense pinnules near the petiole bases clustered above the trunk apex); **D**, basal part of the leaf (from the petiole base up to the first pinna pair), lateral view; **E**, pinnules abaxially with a fragment of the costa, crenate form; **F**, pinnules abaxially with a fragment of the costa, common form; **G**, sori with a fragment of the costula carrying acaroid scales; **H**, scale from the petiole base; **I-K**, *C. acutula* var. *deltoidea* Janssen & Rakotondr.; **I**, leaf scars and trunk surface; **J**, basal part of the petiole with contiguous deltoid scales; **K**, scales from the petiole (left: from the base of the petiole; right: from about 20 cm above the base of the petiole); **L**, *C. acutula* var. *rufescens* Janssen & Rakotondr., scales from the base of the petiole of two different specimens. **A**, **B**, **D**, **F-H**, Janssen *et al.* 2849 (P); **C**, uncollected, photographs at P; **E**, Rakotondrainibe 4124 (P); **I**, Janssen *et al.* 2496 (P); **J**, **K**, Rabarimanarivo 74 (P); **L** (left), Rakotondrainibe *et al.* 5039bis (P); **L** (right), Rasolohery 108 (P). Scale bars: **A**, **E**, **F**, **I**, 1 cm; **B**, **D**, **J**, 5 cm; **C**, 1 m; **G**, **H**, **K**, **L**, 0.1 cm.

brown axes of this variety in the dry state as opposed to the light brown to stramineous dry axes of var. *acutula*, that are green when fresh.

13. *Cyathea appendiculata* Baker, *mut. char.*
(*emend.* Janssen & Rakotondr.)
(Figs 13; 44B; 48E)

Journal of the Linnean Society 15: 411 (1876); Christensen, *Dansk Botanisk Arkiv* 7: 26, pl. 5 figs 14-16 (1932); Tardieu in Humbert, *Flore de Madagascar et des Comores, IV^e famille, Cyathéacées*: 18 (1951). — *Al-sophila appendiculata* (Baker) R.M. Tryon, *Contributions from the Gray Herbarium* 200: 29 (1970). — Type: Madagascar, Antananarivo, VI.1876, *Pool s.n.* (lecto-, K! [K000009957], here designated; isolecto-, B!). — Madagascar, Fianarantsoa, 35 km S Ambositra, Ambatofitorahana, forêt d'Ankazomivady, 20°49'07"S, 47°11'54"E, 1719 m, 15.IV.2005, *Janssen et al.* 2766 (epi-, P! [3 sheets: P00589535-37], here designated; isoepi- P! [3 sheets], TAN!).

ADDITIONAL MATERIAL EXAMINED. — **Madagascar.** Antananarivo, Ost-Imerina, Andrangoloaka, 19°02'S, 47°55'E, XI.1880, *Hildebrandt 3763* (B, BM, G, K, P, W). — Environs d'Ambositra, forêt d'Ambatofitorahana, 20°49'S, 47°11'E, 1600-1700 m, 26.VII.1928, *Humbert & Swingle 4881* (BM, K, P). — Fianarantsoa, Ambositra, Ambatofitorahana, forêt d'Ankazomivady, 20°46'19"S, 47°10'57"E, 1708 m, 14.IV.2005, *Janssen et al.* 2755 (MO, P, TAN). — *Idem*, 20°49'07"S, 47°11'54"E, 1719 m, 15.IV.2005, *Janssen et al.* 2763 (MO, P, TAN), 2764 (MO, P, TAN), 2765 (MO, P, TAN). — Ambatofitorahana, à 35 km au sud d'Ambositra, 20°49'S, 47°11'E, 1700 m, 21.I.1970, *Onraedt 70M59* (BR). — Antananarivo, 18°55'S, 47°31'E, IV.1876, *Pool s.n.* (B, K). — Région de Tsinjoarivo, forêt de Mahatsinjo, 19°40'51"S, 47°46'12"E, 1450-1500 m, 7.I.1999, *Rakotondrainibe 4544 bis* (P). — *Idem*, 1550 m, 7.I.1999, *Rakotondrainibe 4577* (P). — *Idem*, 8.I.1999, *Rakotondrainibe 4578 bis* (P).

FIELD OBSERVATIONS. — Trunk: HT up to 3.5 m, DT 12-14 cm including a sheath of persistent dead petiole bases, each 15-20 cm long and appressed, forming distinct vertical rows, rarely only a petiole rudiment present on the scar rim; some dead rachises persistent and hanging from the apex.

Petiole: with 1 or 2 rows of small, light brown, slightly raised, very distant aerophores on either side; petiole bases arched to sigmoid.

Leaf scars: about 2 × 2 cm, rounded, contiguous, somewhat raised, with a rudiment of the petiole on their rim, spirally arranged.

Crown: funnel-shaped to horizontal, several whorls of green leaves present.

Trunk apex: truncate appearance, densely scaly, visible through the spaced petioles.

Lamina: elliptic to ovate; LL (70-)140-160 cm, WL (35-)60-70 cm, FW (30-)65-70 cm, NP 16-25.

DESCRIPTION

Petiole: 25-45 cm long, 1.7-2 cm in diameter, green to stramineous, abaxial face dark reddish brown, black at its base, with a dense, but very caducous indument of light brown squamules; aplebia and aplebioid pinnae absent.

Lamina: bipinnate, subcoriaceous, dull light green below, shiny dark green above, lamina base abruptly attenuate to truncate, basal pinnae patent or reflexed, slightly conduplicate; rachis brown below, green above.

Largest pinnae: up to 35 cm long, distant by 4-6 cm, adjacent pinnae overlapping or spaced, their apex acute or shortly caudate, pinnatifid; costae and costulae stramineous to green (sometimes reddish?).

Largest pinnules: (2.5-)3.5-4(-5) × 0.5-0.6(-0.8) cm, spaced by about their width, shortly petiolulate with the petiolule up to 0.1 cm, oblong to lanceolate, margin deeply crenate to subentire, apex acute to obtuse and crenulate or serrulate, pinnule base mono- or biauriculate, the acroscopic auricle usually much more prominent; basalmost pinnule pair deeply lobed and overlapping the rachis; veins once to three times furcate, pinnate in deeply crenate forms.

Scales and hairs: scales present from the petiole base upwards to about 10 cm on the petiole, dense, very caducous, narrowly triangular, 3-4 × 0.2-0.3 cm, straight, their apex crispate, but rarely preserved, dull to shiny brown, scarious, margin erose; abundant appressed trichomidia and scattered, stramineous to hyaline, soft, contorted hairs and acaroid squamules on the abaxial face of the costae and costulae in young leaves; more or less dense, brown, crispate, patent to antrorse, multicellular hairs on the adaxial face of the rachis and costa; leaf otherwise glabrous.

Sori: subcostular, contiguous to distant by about their width, about 0.1 cm in diameter, covering entire pinnules or restricted to their lower half;

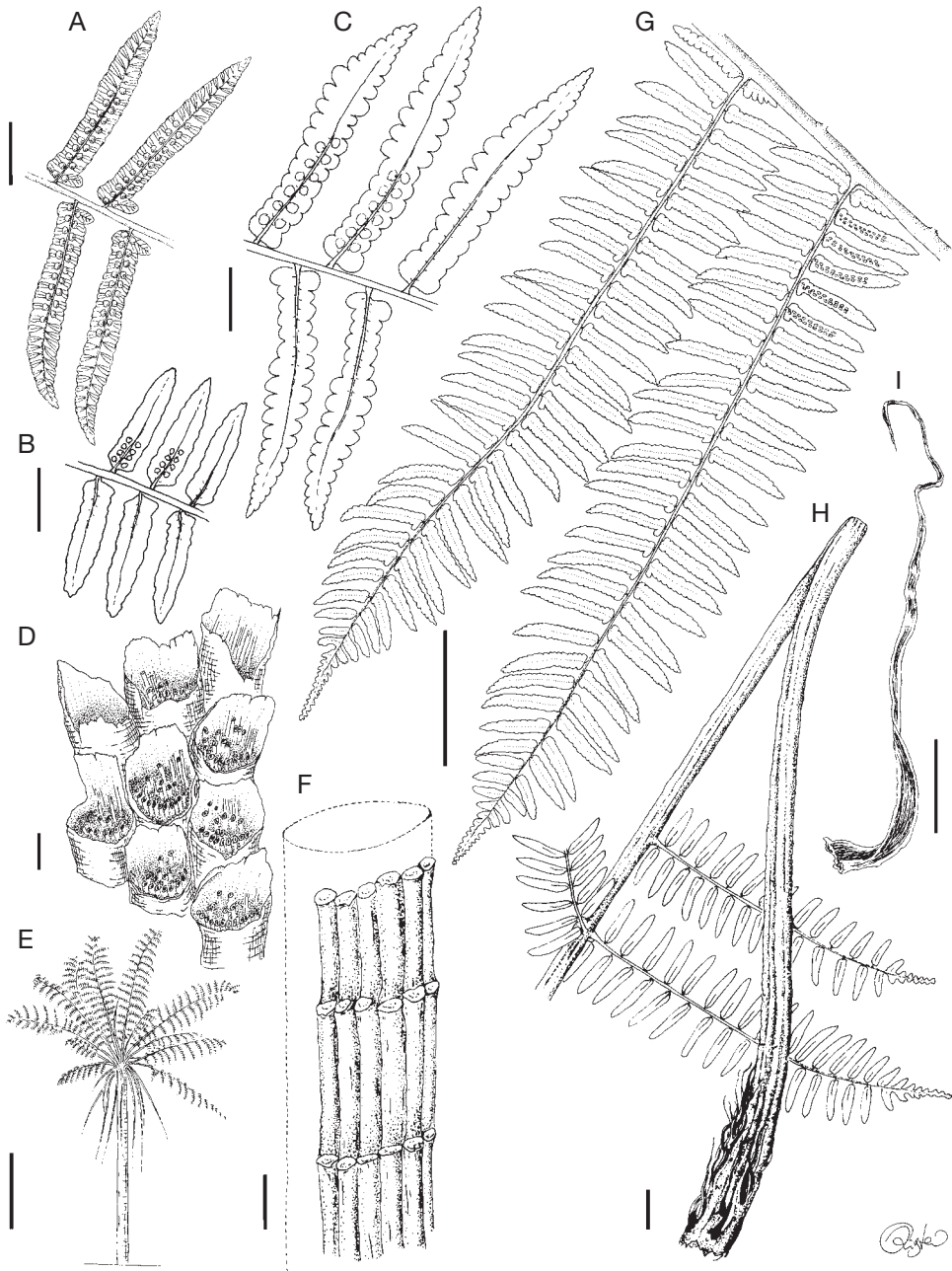


FIG. 13. — *Cyathea appendiculata* Baker: **A**, pinnules abaxially with a fragment of the costa, small and weakly auriculate form, veins not indicated, sori only partly indicated; **B**, pinnules abaxially with a fragment of the costa, crenate form, veins not indicated, sori only partly indicated; **C**, pinnules abaxially with a fragment of the costa, crenate form, veins not indicated, sori only partly indicated; **D**, trunk surface with close standing leaf scars and rudiments of dead petioles; **E**, habit; **F**, trunk surface, common aspect with close standing appressed petiole bases in pseudo-whorls; **G**, pinnae abaxially with a fragment of the rachis, sori only partly indicated; **H**, basal part of the leaf (from the petiole base up to the second pinna pair), lateral view, scales caducous; **I**, scale from the base of the petiole. A, G-I, Janssen *et al.* 2766 (P); B, Janssen *et al.* 2765 (P); C, F, Janssen *et al.* 2764 (P); D, Janssen *et al.* 2755 (P); E, uncollected, photograph at P. Scale bars: A-D, F, H, 1 cm; E, 1 m; G, 5 cm; I, 0.5 cm.

indusia globular, brown, subcoriaceous, at maturity dehiscent in 2-4 lobes; receptacle capitate, shorter than the rim of mature indusia; filiform paraphyses short and inconspicuous.

DISTRIBUTION

Central Madagascar: Ambositra region; endemic.

ECOLOGY

About 1700 m. Dense evergreen rainforests and on forest margins, many specimens collected next to small streams or on marshy ground.

REMARKS

This taxon has been described from heterogeneous original material. We here lectotypify on the specimen corresponding best with the protolog and amend the original description. *Cyathea appendiculata* has never been observed with aphanophyllous or aphanophyllous pinnae near the base of the petiole; neither on specimens, nor in the field. We cannot confirm Christensen's (1932: 26) observation of such structures in *Hildebrandt 3763*.

Hildebrandt 3763 is a widely distributed collection with narrow pinnules up to 2.5×0.4 cm with a revolute margin. Considering variation in pinnule size in the available material it is not recognized here as a distinct taxon. *Humbert & Swingle 4881* and *Janssen et al. 2765* with distinctly spaced pinnae up to 13-17 cm long and the largest pinnules $1.4-2 \times 0.3-0.5$ cm are from young, fertile plants, but otherwise agree with all characters described above.

All known collections stem from Central Madagascar and most are from the same relictual forest region near Ambositra. Only a few specimens come from the Mahatsinjo forest near Tsinjoarivo. Its very restricted habitat being under anthropogenic pressure, the species is likely to be highly threatened.

TYPIFICATION AND SYNONYMY

The type material at K comprises four sheets all carrying identical labels in Baker's hand. K000009960 comprises two detached aphanophyllous, most likely of *Cyathea boiviniiformis* Rakotondr. & Janssen, and two detached aphanophyllous pinnae, most likely of *C. melleri* (Baker) Domin. K000009958 carries a

juvenile leaf, which cannot be unambiguously determined. K000009959 carries a stramineous rachis fragment with seven sterile and glabrous pinnae with reddish costae and is most likely conspecific with K000009957, although not from the same plant. K000009957 comprises a stramineous rachis fragment with six fertile pinna pairs with stramineous costae and is chosen here as the lectotype of the species. In the light of our observations, it is best to treat the original material as a mixture of different gatherings and the four sheets as being unrelated, unnumbered collections. Hence, no isolectotype specimens exist at K. An analogous set of specimens – three aphanophyllous, a juvenile fragment with a red rachis and a fertile fragment with a stramineous rachis – is glued on a single sheet at B. The fragment in the lower left corner of that sheet, morphologically perfectly corresponding with K000009957, should be considered an isolectotype.

Although the species can be characterized by its auriculate glabrous pinnules, petiole scales are necessary for an unambiguous differentiation from certain forms of *C. decrescens* and we here designate a complete specimen as epitype.

14. *Cyathea basirotundata*

Rakotondr. & Janssen, sp. nov.

(Figs 14; 44E)

Filix arborescens Cyathea acutulae et Cyathea viguieri affinis, sed differt paleis petioli valde caducis, anguste triangularibus (ad 1.5 cm longis et 0.2 cm latis), strictis, nitide sordide brunneis centro atro et pinnulis sessilibus basi rotundatis nunquam auriculatis apice longe caudato et distincte serrato. Pinnulae fertiles pinnulis sterilibus conspicue angustiores, sori 0.2 cm in diametro, indusia coriacea sordide brunnea.

TYPUS. — Madagascar, Antsiranana, Doany, PN de Marojeje, à 13 km au sud-est de Doany, $14^{\circ}26'12''S$, $49^{\circ}37'12''E$, 1130 m, 24.X.2001, *Rakotondrainibe et al. 6377* (holo-, P! [4 sheets: P00244939-42]; iso-, P! [3 sheets], TAN!).

FIELD OBSERVATIONS. — Trunk: HT up to 2.5 m, DT 6-7 cm, dead petioles caducous and leaf scars exposed; trunk surface blackish brown, finely muricate, covered with rudimentary scales identical to those at the base of the petiole.

Leaf scars: about 2×4 cm, elliptic.

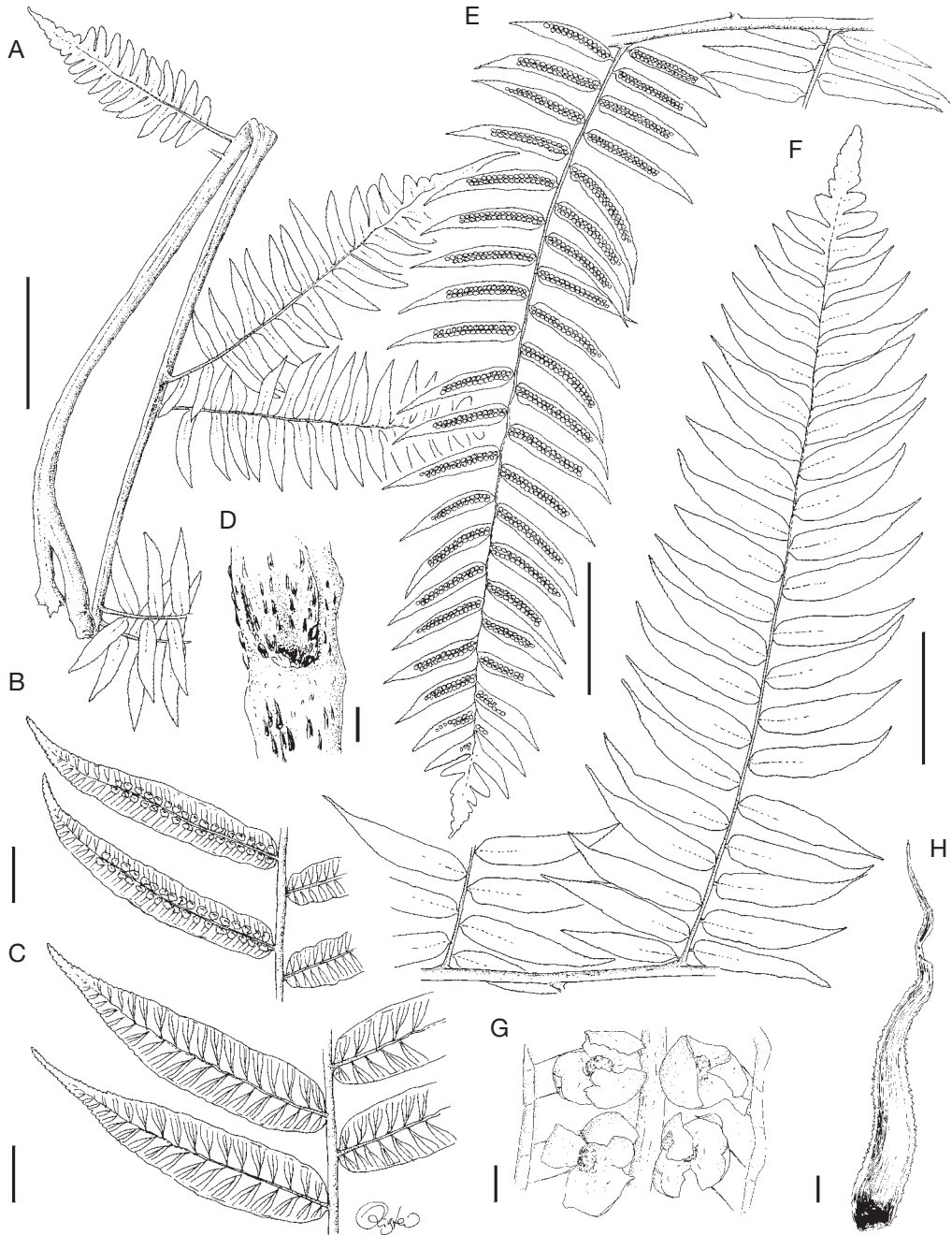


FIG. 14. — *Cyathea basiotundata* Rakotondr. & Janssen: **A**, basal part of the leaf (from the petiole base up to the third pinna pair), lateral view, scales caducous; **B**, fertile pinnules abaxially with a fragment of the costa; **C**, sterile pinnules abaxially with a fragment of the costa; **D**, leaf scar and scaly trunk surface; **E**, fertile pinna with a fragment of the rachis; **F**, sterile pinna with a fragment of the rachis; **G**, sori in the upper half of a pinnule; **H**, scale from the base of the petiole. A-H, *Rakotondrainibe* 6377 (P). Scale bars: A, E, F, 5 cm; B-D, 1 cm; G, H, 0.1 cm.

Trunk apex: densely covered with erect, ferruginous scales.

Lamina: LL 160 cm, NP 17.

DESCRIPTION

Petiole: 20 cm long, 1 cm in diameter and light brown when dry.

Lamina: bipinnate, subcoriaceous, dark green when dry, lighter below, lamina base gradually attenuate, basal pinnae patent; exhibiting a fertile-sterile dimorphism; rachis of the same colour as the petiole.

Largest pinnae: 33 cm long, distant by 9 cm, adjacent pinnae only slightly overlapping, lanceolate-oblong, their apex acute, pinnatifid; costae and costulae of the same colour as the petiole.

Largest pinnules: 6 × 0.8 cm (fertile), 6.5 × 1.4 cm (sterile); fertile pinnules spaced by about their width, sterile by less than their width, sessile, the first 2 proximal pairs shortly petiolulate, oblong-lanceolate, margin entire, sharply serrate in the distinctly caudate pinnule apex, base rounded, not auriculate; veins twice (fertile) or thrice furcate (sterile).

Scales and hairs: scales of the petiole base caducous, narrowly triangular, 1.5 × 0.2 cm, straight, shiny dark brown with a blackish centre and a distinct, ciliate, light brown margin; very sparse, short, stiff, contorted hairs on the adaxial face of the rachis and costae; leaf otherwise glabrous.

Sori: subcostular, contiguous to slightly spaced, 0.2 cm in diameter, covering entire pinnules except their apical region; indusia globular, dark brown, coriaceous, at maturity dehiscing in about 3 lobes; receptacle capitate, shorter than the rim of mature indusia, with very short inconspicuous paraphyses.

DISTRIBUTION

Northern Madagascar: Marojejy; endemic.

ECOLOGY

1100 m. Evergreen rainforest, on crest.

ETYMOLOGY

The epithet *basirotundata* has been chosen in allusion to the characteristically rounded bases of the pinnules of this species.

15. *Cyathea conferta*

Janssen & Rakotondr., sp. nov.

(Figs 15A-E; 44J)

Filix arborescens affinis Cyatheae viguieri, *sed differt paleis petioli filiformibus, 4.5-5 cm longis et minus quam 0.1 cm latis, strictis, nitide brunneis, ad basim petioli restrictis, in parte superiore valde caducis. Pinnulae maximae 4.5 × 1.2 cm, coriacei, basi cordatae et distincte biauriculatae, margine subintegrae, sed apice rotundato vel obtuse serrulatae, arcte dispositae marginibus pinnulis adjacentibus leviter superpositis.*

TYPUS. — Madagascar, Antananarivo, forest remnants 5 km E of Anjozorobe, 18°22'S, 47°47'E, 1250 m, 6.XI.1992, van der Werff *et al.* 12850 (holo-, P! [2 sheets: P00477698, -99]; iso-, MO).

FIELD OBSERVATIONS. — Trunk: HT up to 4 m.

DESCRIPTION

Petiole: at least 28 cm long, 1.5 cm in diameter and light brown to stramineous when dry.

Lamina: bipinnate, coriaceous, light green below, dark green above when dry; rachis of the same colour as the petiole.

Largest pinnae: 52 cm long, distant by 8.5 cm, adjacent pinnae slightly overlapping, their apex acute to shortly caudate, pinnatifid; costae and costulae of the same colour as the petiole.

Largest pinnules: 4.5 × 1.2 cm, close to each other, the margins of adjacent pinnules slightly overlapping, sessile, triangular-oblong, the base cordate in proximal and truncate in distal pinnules, distinctly biauriculate in the lower half of the pinna, the acroscopic auricle overlapping the adaxial face of the costa indicating an oblique insertion of the pinnules with respect to the rachis, the margin sub-entire, serrulate near the rounded to obtuse apex, the 1 or 2 proximal pinnule pairs with a lobate base; veins once to very rarely twice furcate.

Scales and hairs: scales present from the petiole base upwards to 8 cm on the petiole, dense and overlapping, caducous, filiform, 4.5-5 × < 0.1 cm, straight, twisted, with a slightly crispate apex, not appressed to the petiole, antrorse, shiny brown to ferruginous, not indurated; adaxial face of the costae densely tomentose with dark brown, antrorse, contorted multicellular hairs, shorter and very sparse on the adaxial face of the rachis; very sparse,

brown, short filiform scales on the adaxial face of the costae; scattered light to dark brown acaroid scales on the abaxial face of the costulae and veins; leaf otherwise glabrous.

Sori: subcostular, contiguous, 0.1-0.15 cm in diameter, covering the lower three quarters of each pinnule; indusia globular, light brown, membranous, at maturity dehiscing in 2 or 3 lobes or irregularly; receptacle capitate, shorter than to about as long as the rim of mature indusia, with inconspicuous filiform paraphyses shorter than the sporangia.

DISTRIBUTION

Central Madagascar: Anjozorobe; endemic.

ECOLOGY

1250 m. Forest remnants.

REMARKS

Cyathea conferta is well characterized by its filiform scales restricted to the petiole base and its dense, overlapping pinnules. It cannot be confounded with any other taxon in the Western Indian Ocean.

ETYMOLOGY

The epithet *conferta* refers to the close standing, crowded pinnules.

16. *Cyathea costularis* Bonap. (Figs 16; 44J; 48F)

Notes ptéridologiques 5: 44 (1917); l.c. 9: 51 (1920); Christensen, *Dansk Botanisk Arkiv* 7: 25 pl. 3 figs 13-15 (1932); Tardieu in Humbert, *Flore de Madagascar et des Comores, IV^e famille, Cyathéacées*: 16 (1951). — *Alsophila rolandii* R.M. Tryon, *Contributions from the Gray Herbarium* 200: 31 (1970). — Type: Maroantsetra, 15°26'S, 49°45'E, 300 m, VIII.1912, *Perrier de la Bâthie* 7980 (lecto-, P! [3 sheets: P00389606-08], here designated; isolecto-, P! [3 sheets]).

ADDITIONAL MATERIAL EXAMINED. — **Madagascar.** Antsiranana, Nossi-Be, forêt de Loucoubé, 13°17'30"S, 48°15'30"E, I.1850, *Boivin s.n.* (P). — Forêt d'Ambatosoratra, 14°46'S, 48°52'E, 1000 m, 8.I.1949, *Cours* 3413 (P). — Route d'Ambodihasina à Mandaleha, 30.XII.1950, *Cours* 3936 (P). — Toamasina, Sandrakatsy, forêt de Bekopila, 16°20'S, 49°37'E, 350 m, 15.XI.1959, *Cours* 5345 (P). — Forêt de Lokobe,

13°24'30"S, 48°18'30"E, 260 m, 4.XII.1989, *Deroin et al.* 180 (P). — Vallée de la Lokoho, Ambalavonihy, 14°34'S, 49°44'E, 75-300 m, I.1949, *Humbert et al.* 22967 (K). — Antsiranana, Nossi-Be, 13°17'30"S, 48°15'30"E, *Humboldt s.n.* (P). — Toamasina, Maroantsetra, Ambanizana, Ambon'Andraoka, 15°37'53"S, 49°58'33"E, 2-471 m, 20.X.2004, *Janssen et al.* 2478 (MO, P, TAN), 2486 (MO, P, TAN). — *Idem*, 15°37'51"S, 49°58'35"E, 2-503 m, 21.X.2004, *Janssen et al.* 2489 (MO, P, TAN). — *Idem*, entre Ambanizana et Andranobe, 14°40'53"S, 49°57'26"E, 0-30 m, 25.X.2004, *Janssen et al.* 2518 (MO, P, TAN). — *Idem*, Andranobe, entre Andranobe et Bedinta, 15°40'34"S, 49°58'03"E, 0-628 m, 26.X.2004, *Janssen et al.* 2523 (MO, P, TAN). — Baie d'Antongil, 1897, *Mocquerys* 329 (G). — Toamasina, Nosy Mangabé, 15°29'30"S, 49°46'E, 1897, *Mocquerys* 423 (G). — Antsiranana, Nossi-Be, bois Lokobe, 13°17'30"S, 48°15'30"E, VIII.1913, *Perrier de la Bâthie* 7616 (P, paratype). — Toamasina, Maroantsetra, Ambanizana, Andranobe, 15°41'S, 49°58'E, 100 m, 18.XII.1993, *Rakotondrainibe et al.* 2052 (P, TAN). — Nosy Mangabe, 15°30'S, 49°46'E, 230 m, 1.XII.1993, *Rakotondrainibe et al.* 2054 (P, TAN), 2054 bis (P). — Toamasina, Maroantsetra, Ambanizana, Andranobe, 15°40'54"S, 49°57'26"E, 18.XII.1993, *Rakotondrainibe* 2068 (P). — Antsiranana, Andapa, RNI du Marojejy, Manantenina, 14°26'12"S, 49°46'30"E, 450 m, 5.X.1996, *Rakotondrainibe* 3294 (P, TAN). — *Idem*, 500 m, 6.X.1996, *Rakotondrainibe* 3301 (K, P, TAN). — Antalaha, Ambohitralana, Sahafari, 15°16'18"S, 50°20'35"E, 430 m, 18.II.2001, *Rasolohery* 313 (MO, P, TAN). — Maroambihy, Sambava, 14°27'30"S, 49°42'30"E, 11.XII.1961, *Réerves naturelles* 11737RN (P). — Maroantsetra, Nosy Mangabe, 15°29'30"S, 49°46'E, 0-330 m, 11.X.1987, *Schatz* 1625 (P). — Antsiranana, Nossi Bé, Loucoubé, 13°24'S, 48°19'E, I.1883, *Thiebaut s.n.* (K, P). — Nossibé, forêt de Loucoubé, 13°24'S, 48°19'E, 27.III.1882, *Thiebaut* 60 (P). — Toamasina, Maroantsetra, Ambanizana, 15°38'S, 49°58'E, 25-200 m, 25.X.1992, *van der Werff et al.* 12759 (P).

FIELD OBSERVATIONS. — Trunk: HT up to 6 m, DT 7-9(-12) cm, dead petioles caducous and leaf scars exposed, but sometimes a few spiny petiole bases persistent; trunk surface dark brown to black, densely spiny-tuberculate with sclerified, pyramidal, more or less antrorse scales up to 1.5 cm long, trunk surface finely muricate among these spines.

Petiole: with 1 or 2 rows of distant, light brown aerophores on either side, distributed over the entire abaxial face near the petiole base; petiole bases sometimes rather long sigmoid and appressed to the trunk.

Leaf scars: 2-2.5 × (2.5-)4-7 cm, rounded to narrowly elliptical, with some orifices on their lower rim, sometimes with a rudiment of the petiole, spirally arranged.

Crown: erect-arched, often with a distinct

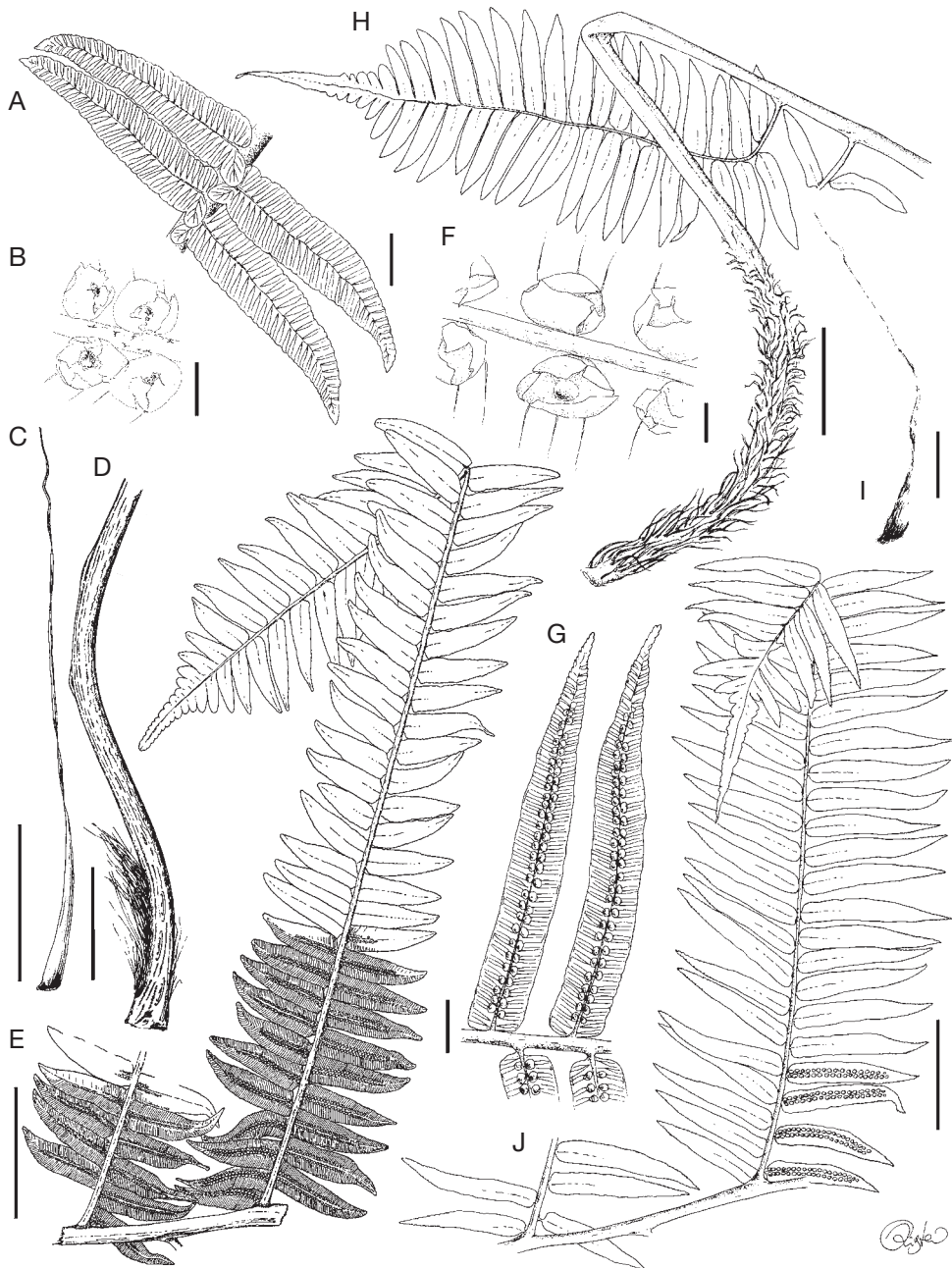


FIG. 15. — **A-E**, *Cyathea conferta* Janssen & Rakotondr.; **A**, pinnules adaxially with a fragment of the costa, note that the auricles overlap the costa; **B**, sori, note that these are small and very close standing; **C**, scale from the base of the petiole; **D**, petiole, note that the filiform scales are restricted to its base; **E**, pinna abaxially with a fragment of the rachis, sori and veins only partly indicated, note the close standing pinnules; **F-J**, *C. hebes* Janssen & Rakotondr.; **F**, sori, note that these are big and spaced from each other; **G**, pinnules abaxially with a fragment of the costa; **H**, basal part of the leaf (from the petiole base up to the first pinna pair), lateral view; **I**, scale from the base of the petiole; **J**, pinna abaxially with a fragment of the rachis, sori only partly indicated. **A-E**, *van der Werff et al.* 12850 (P); **F-J**, *Janssen et al.* 2480 (P). Scale bars: **A**, **C**, **G**, 1 cm; **B**, **F**, 0.1 cm; **D**, **E**, **H**, **J**, 5 cm; **I**, 0.5 cm. **D**, **E**, Drawings by B. Raufeisen.

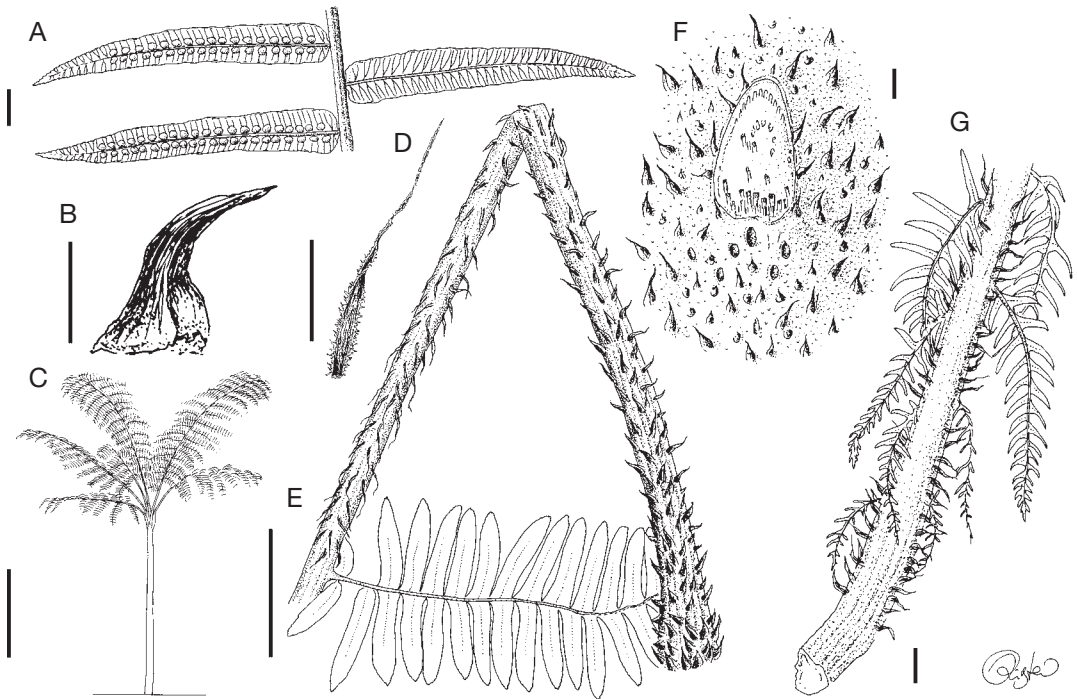


FIG. 16. — *Cyathea costularis* Bonap.: **A**, pinnules abaxially with a fragment of the costa, sori omitted from one pinnule; **B**, strongly indurated scale from the abaxial face of the base of the petiole; **C**, habit; **D**, scale from the lateral face of the upper half of the petiole; **E**, basal part of the leaf (from the petiole base up to the first pinna pair), dorsal view, lateral view in upper half, one pinna pruned; **F**, leaf scar and trunk surface; **G**, basal part of the leaf of a juvenile plant, ventral view, note the strongly reflexed decrescent pinnules and soft scales. A, B, D, E, *Rakotondrainibe* 3301 (P); C, uncollected, photograph at P; F, *Janssen et al.* 2489 (P); G, *Janssen et al.* 2486 (P). Scale bars: A, F, G, 1 cm; B, D, 0.5 cm; C, 1 m; E, 5 cm.

infundibuliform centre.

Trunk apex: densely scaly, black, somewhat raised and well visible through the distant petioles.

Lamina: elliptical; LL 150-200 cm, WL 60-80 cm, FW 70-85(-100) cm, NP 15-20.

DESCRIPTION

Petiole: 13-28(-45) cm long, 1.8-2.2(-3) cm in diameter; stramineous to green, abaxial face violaceous brown.

Lamina: bipinnate to pinnate-pinnatisect, very coriaceous, pale green below, shiny yellowish to dark green above; lamina base shortly attenuate, basal pinnae more or less strongly reflexed and conduplicate; rachis stramineous to green.

Largest pinnae: 40-60 cm long, distant by 9-10(-14) cm, adjacent pinnae spaced to distinctly overlapping, their apex acute to shortly caudate,

pinnatifid; costae and costulae of the same colour as the rachis.

Largest pinnules: 5.5-8.5 × 0.7-1(-1.2) cm, spaced by less than to about their width, sessile, at most the 1 or 2 proximal pairs petiolulate, frequently broadly adnate to the costa in the upper half of the pinna; narrowly oblong, margin subentire to shallowly crenate, slightly revolute, apex acute and serrulate, base truncate to subcordate, rarely slightly auriculate; veins twice furcate.

Scales and hairs: scales present from the petiole base upwards to 40 cm on the petiole and rachis, distant to contiguous, but never very dense, persistent, narrowly triangular to deltoid, 1-1.5(-2) × 0.2-0.5 cm, abaxial scales patent, strongly indurated and transformed into more or less pyramidal spines, shiny black to dull brown, their apex antrorse and

often breaking away in herbarium specimens, adaxial scales coriaceous, not appressed to the petiole, crispate, usually dull brown, scales further up on the petiole less indurated and more or less deltoid and appressed; sparse short, stiff, contorted, brown hairs mixed with caducous, dull brown, filiform scales on the adaxial face of the rachis; dense multicellular, dark brown, antrorse hairs on the adaxial face of the costae; leaf otherwise glabrous.

Sori: subcostular, contiguous to slightly spaced, 0.15–0.2 cm in diameter, covering entire pinnules; indusia globular, brown, subcoriaceous to coriaceous, at maturity dehiscing in 3 or 4 lobes, but usually not down to their base; receptacle capitate, shorter than to as long as the rim of mature indusia, paraphyses inconspicuous.

DISTRIBUTION

Northern Madagascar: Nosy Be, Marojejy, Masoala; endemic.

ECOLOGY

0–600(–1000) m. Low altitude dense evergreen rainforests and littoral forests. Also on forest margins.

REMARKS

The species is well characterised by its strongly indurated, patent to antrorse petiole scales. It is also distinct from other members of group IIc by its pinnules being frequently adnate in the upper half of the pinnae and never conspicuously petiolulate.

Juvenile plants have an obovate lamina with a cuneate base composed of gradually reduced, strongly reflexed, light green, herbaceous (not coriaceous) pinnae. Their pinnae are pinnatifid with narrow more or less sharply serrate segments (Fig. 16G). The petiole is very short and scales are not or only slightly indurated.

TYPIFICATION AND SYNONYMY

The protolog cites two syntypes. Of these, *Perrier de la Bathie* 7980 comprises six sheets at P. Three sheets, carrying a leaf apex, middle pinna and petiole base respectively, have been marked “Original” by Bonaparte and are here chosen as the lectotype of the species.

17. *Cyathea hebes* Janssen & Rakotondr., sp. nov. (Figs 15F–J; 45C; 49A)

Felix arborescens affinis *Cyathea* viguieri, *sed differt paleis petioli sordide brunneae, anguste triangularibus, 2.5–3 cm longis et usque ad 0.15 cm latis, non nisi in parte inferiori petioli, saepe leviter induratis et contortis expansisque. Pinnulae parum longiores, 7–8(9) cm longae sine basi auriculata. Indusia brunnea, membranacea vel subcoriacea.*

TYPE. — Madagascar, Toamasina, Maroantsetra, presqu’île de Masoala, Ambanizana, Ambon’Andraoka, piste menant du village d’Ambanizana à la crête E d’Ambanizana 15°37’53”S, 49°58’33”E, 2–471 m, 20.X.2004, *Janssen et al.* 2480 (holo-, P! [4 sheets: P00589575–78]; iso-, P! [3 sheets], TAN!; one trunk surface mould at P!).

ADDITIONAL MATERIAL EXAMINED. — Madagascar. Toamasina, Maroantsetra, Ambanizana, 15°37’49”S, 49°58’37”E, 220 m, 16.IV.2002, *Antilahimena et al.* 1008 (P). — Toamasina, Maroantsetra, Ambanizana, Ambon’Andraoka, 15°37’53”S, 49°58’33”E, 2–471 m, 20.X.2004, *Janssen et al.* 2479 (MO, P, TAN). — *Idem*, 15°37’51”S, 49°58’35”E, 2–503 m, 21.X.2004, *Janssen et al.* 2487 (MO, P, TAN). — *Idem*, entre Ambanizana et Andranobe, 15°40’53”S, 49°57’26”E, 0–30 m, 25.X.2004, *Janssen et al.* 2519 (MO, P, TAN). — Masoala Peninsula, Andranobe, 15°41’S, 49°58’E, 10–110 m, 25.II.1999, *McPherson et al.* 17689 (P). — *Idem*, 15°41’S, 49°58’E, 70 m, 19.XII.1993, *Rakotondrainibe et al.* 2053 (MO, P). — Antsiranana, Andapa, RS d’Anjanaharibe-Sud, 14°45’18”S, 49°30’18”E, 800 m, 20.X.1994, *Rakotondrainibe et al.* 2117 (P). — Toamasina, Masoala Peninsula, near Ambizana, 15°39’S, 49°58’E, 10 m, 30.X.1992, *van der Werff et al.* 12798 (MO, P).

FIELD OBSERVATIONS. — Trunk: HT up to 6 m, DT 5.5–7 cm, dead petioles caducous and the leaf scars exposed, rudiments of the base may persist in its apical part; trunk surface brown to black, muricate.

Petiole: with 1 or 2 rows of brown aerophores on either side; petiole bases sigmoid, sometimes forming a fascicle above the trunk apex before being gradually recurved.

Leaf scars: 2.5–3 × 5.5–7 cm, elliptic, slightly raised, several orifices below the scars; spirally arranged.

Trunk apex: densely scaly, dull brown; concealed among the more or less close standing petioles.

Crown: horizontal to umbrella-shaped, in young plants more or less funnel-shaped with straight petioles.

Lamina: elliptic; LL 100–175 cm, WL 80–110 cm, FW 50–100 cm, NP 8–14.

DESCRIPTION

Petiole: (20–)40–55 cm long, 1.5–2 cm in diameter; stramineous green, abaxial face more or less violaceous brown, light brown when dry.

Lamina: bipinnate, very coriaceous, pale green below, shiny green to dark green above; lamina base shortly attenuate to truncate, basal pinnae conduplicate, patent to reflexed; rachis of the same colour as the petiole.

Largest pinnae: 40-50 cm long, distant by (9-)10-12 cm, adjacent pinnae overlapping, their apex acute, pinnatifid; costae and costulae of the same colour as the petiole.

Largest pinnules: 7-8(-9) × 1-1.3 cm, spaced by less than to about their width, petiolulate, triangular-oblong, their base rounded, truncate or cuneate, but never auriculate, their margin subentire and slightly revolute, sharply serrate in the shortly caudate apex of the pinnules; veins 2 to 3 times furcate, 12-16 veins per cm.

Scales and hairs: scales present from the petiole base upwards to 30 cm on the petiole, never reaching the first pinna pair, dense and overlapping, persistent, narrowly triangular to filiform, 2.5-3 × 0.05-0.15 cm, straight and twisted to very much contorted, not appressed to the petiole, dull brown to dull dark brown, shiny in young specimens only, not or slightly indurated at their point of insertion; sparse, contorted, dark brown, antrorse multicellular hairs on the adaxial face of the rachis and costae; leaf otherwise glabrous.

Sori: subcostular, spaced by less than their width, sometimes by more than their width in young specimens, 0.15-0.2 cm in diameter, covering the entire pinnule; indusia globular, light brown, membranous to subcoriaceous, at maturity dehiscing in 2-4 lobes; receptacle capitate to disciform, as long as to shorter than the rim of mature indusia, paraphyses inconspicuous.

DISTRIBUTION

Northern Madagascar: Masoala peninsula and baie d'Antongil; endemic.

ECOLOGY

0-400 m. Dense evergreen rainforests.

REMARKS

Cyathea hebes is easily distinguished from *C. costularis* by its muricate, not spiny, trunk surface and its much denser and much less indurated petiole scales.

It differs from *C. viguieri* Tardieu by its narrow and dull brown petiole scales ascending only to about halfway on the petiole as well as by its light brown, membranous to subcoriaceous indusia.

Rakotondrainibe 2117 and *Janssen et al.* 2479 have shiny petiole scales, but the specimens are taken from young plants.

ETYMOLOGY

The epithet *hebes* refers to the dull petiole scales in adult plants of this species as opposed to shiny scales in the closely related *C. viguieri*.

18. *Cyathea serratifolia* Baker (Figs 1C; 17; 46F; 49B)

Journal of Botany 22: 139 (1884); Christensen, *Dansk Botanisk Arkiv* 7: 18, pl. 3 figs 9-12 (1932); Tardieu in Humbert, *Flore de Madagascar et des Comores, IV^e famille, Cyathéacées*: 4 (1951). — *Alsophila serratifolia* (Baker) R.M. Tryon, *Contributions from the Gray Herbarium* 200: 31 (1970). — Type: Madagascar, North-East, *Humboldt* 278 (holo-, K! [K000009922]; iso-, B!, BM!, G!, K!, MO!, NY!, P! [4 sheets], TAN!).

Cyathea regularis Baker, *Journal of the Linnean Society* 25: 349 (1890). — Type: Madagascar, East Androna, *Baron* 5604 (holo-, K! [2 sheets: K000009924, -25]; iso-, P! [fragment]).

ADDITIONAL MATERIAL EXAMINED. — **Madagascar.** Toamasina, Ambatovy forest, 18°49'S, 48°18'E, 1088 m, 14.I.2005, *Antilahimena et al.* 3137 (MO, P, TAN). — *Idem*, 1102 m, 11.II.2005, *Antilahimena et al.* 3374 (P). — Forêt entre Volotaraina et Ambodirofia, 9.XI.1942, *Cours* 1724 (P). — De Manakabahiny à Nonokambo, 17°46'S, 48°39'E, 1200 m, 16.I.1945, *Cours* 2353 (P). — Antsiranana, Ambatosoratra, 14°32'S, 49°42'E, 6.I.1949, *Cours* 3305 (P). — Au pied de l'Anjanaharibe, 14°42'30"S, 49°27'30"E, 850 m, 15.XII.1950, *Cours* 3628 (P), 3629 (K). — Antananarivo, Anjozorobe, 18°23'S, 47°53'E, 20.IX.1971, *Cremers* 1853 (BR). — Toamasina, Andasibe, Analamazaotra, 18°56'S, 48°26'E, XII.1905, *D'Alleizette* 12 (P). — *Idem*, X.1906, *D'Alleizette* 218 (P). — *Idem*, X.1905, *D'Alleizette* 227 (P). — Moramanga, Anosibe, 18°55'S, 48°03'E, 6.IX.1942, *Decary* 18275 (BR, K, MO, P). — Manantenina, Beondroka, 14°25'S, 49°50'E, 850 m, 12.XI.1989, *Deroin et al.* 15 (P). — Toamasina, massif de l'Andrangovallo, SE Lac Alaotra, 17°40'S, 48°45'E, 1000 m, X.1937, *Humbert et al.* 17614 (P). — Andapa, massif de Marojejy (Nord-Est), 14°31'30"S, 49°35'30"E, 450-800 m, 1948, *Humbert et al.* 22058 (MO, P). — Mont Ambatosoratra, N d'Ambalavonihio

et de Belaoka, 14°32'S, 49°42'E, 1100-1300 m, I.1949, *Humbert et al.* 22877 (K). — Massif du Marojejy, col de Doanyanala, 14°28'S, 49°32'E, 800-900 m, 1949, *Humbert* 23089 (K, P). — Toamasina, RNI Betampona, Rendriendry, 17°55'48"S, 49°12'E, 310-580 m, 6.XI.2004, *Janssen et al.* 2537 (MO, P, TAN). — *Idem*, piste entre les sommets Mahasolatra et Betampona, 17°54'36"S, 49°13'12"E, 580-550 m, 6.XI.2004, *Janssen et al.* 2538 (MO, TAN). — *Idem*, Main Crest Trail, 17°55'54"S, 49°12'12"E, 300-500 m, 7.XI.2004, *Janssen et al.* 2539 (MO, P, TAN), 2552 (P). — Nonokambo, 17°45'S, 48°45'E, 18.VIII.1937, *Jardin Botanique* 2690 (P). — Varahina, 17°46'S, 48°48'E, 19.VIII.1937, *Jardin Botanique* 3002 (P). — RN Betampona, 17°55'S, 49°13'E, 450 m, 16.XII.1938, *Lam & Meeuse* 5987 (K, P). — Toamasina, W of Vavatenina, RNI Zahamena, 17°44'S, 49°00'E, 500-750 m, IX.1993, *Malcomber et al.* 2520 (P). — Antsiranana, trail to the summit of Marojejy Est, NW of Mandena, 14°26'S, 49°46'E, 600-660 m, 6.X.1988, *Miller et al.* 3395 (P). — *Idem*, 14°26'S, 49°46'E, 600-700 m, 12.II.1989, *Miller et al.* 4029 (P). — Environs de la baie d'Antongil, X.1912, *Perrier de la Bâthie* 7987 (BM, P). — Betampona, près d'Ambodiriana, 17°55'S, 49°13'E, XII.1925, *Perrier de la Bâthie* 17475 (BM, P). — Moramanga, forêt d'Ambatovy, 18°49'S, 48°18'E, *Rakotomalaza* 1600 (P), 1628 (P). — Antananarivo, forêt d'Anjozorobe, 18°24'S, 47°53'E, 23.IV.1988, *Rakotondrainibe* 717 (P). — Antsiranana, RS d'Anjanaharibe-Sud, Befingotra, 14°45'18"S, 49°30'18"E, 870 m, 19.X.1994, *Rakotondrainibe et al.* 2079 (K, MO, P, TAN). — RNI du Marojejy, Manantenina, 14°26'S, 49°45'42"E, 760 m, 15.X.1996, *Rakotondrainibe* 3373 (P, TAN). — *Idem*, 800 m, 15.X.1996, *Rakotondrainibe* 3379 (P). — Forêt de Betaolana, Ambodiangezoka, 14°32'18"S, 49°26'18"E, 800-950 m, 8.X.1999, *Rakotondrainibe et al.* 4852 (P, TAN). — *Idem*, 950 m, 14.X.1999, *Rakotondrainibe et al.* 4923 (P). — Anjanaharibe-Sud, forêt d'Analabe, Befingotra, 14°46'S, 49°26'30"E, 1200-1220 m, 26.X.1999, *Rakotondrainibe et al.* 5053 (P, TAN). — PN de Marojejy, Doany, 14°25'36"S, 49°36'30"E, 800-820 m, 14.X.2001, *Rakotondrainibe et al.* 6230 (K, P, TAN). — *Idem*, 500-600 m, 20.X.2001, *Rakotondrainibe et al.* 6317 (P). — Andapa, Anjialavabe, forêt de Tsaralanto, 14°14'10"S, 49°23'02"E, 1138 m, 27.II.2006, *Rakotovoao et al.* 2756 (MO, P, TAN). — Toamasina, Ambatondrazaka, Androrangabe, 17°45'S, 48°43'E, 900 m, 22.IX.2002, *Rasolohery* 748 (MO, P). — Maroantsetra, massif of Ankirindro, 15°18'27"S, 49°33'08"E, 320 m, 1.II.1999, *Schatz et al.* 3910 (P).

FIELD OBSERVATIONS. — Trunk: HT up to 7 m, DT 5-7 cm, dead petioles persistent as a rudiment, but soon caducous and the leaf scars exposed; surface of young trunks smooth, orange to brown, with very distant leaf scars; surface of older trunks greyish brown, with less

distant leaf scars, older trunks usually thinner (*sic*) than young trunks.

Petiole: with several irregular rows of brown aerophores on either side; petiole bases straight, not arched or sigmoid.

Leaf scars: 2-2.5 × 3.5(-6) cm, obovate to rounded, slightly raised, with up to 5 short, conical, caducous spines on their lower rim, several shallow orifices on the trunk surface below each scar, spirally arranged.

Crown: leaves of young plants with very long, arching petioles and rachises, spreading and supported by the surrounding vegetation; crown of adult plants smaller, more or less umbrella-shaped.

Trunk apex: green, smooth; shiny black scales usually confined to the young croziers; apex often much raised above the point of insertion of the uppermost petiole and well visible through the much spaced petioles.

Lamina: elliptic to ovate, lamina apex often caudate; LL (120-)200-280 cm, WL 100-150 cm, FW 70-130 cm, NP 11-15.

DESCRIPTION

Petiole: (20-)50-70 cm long, 1.5-2 cm in diameter; green, violaceous brown below; in some specimens 1-5 much reduced and less deeply dissected pinnae inserted in the lower two thirds of the petiole.

Lamina: bipinnate, very coriaceous, dull light green below, shiny dark green above, lamina base shortly attenuate to truncate, basal pinnae patent and more or less conduplicate; rachis green.

Largest pinnae: 50-80 cm long, distant by 15-28 cm, adjacent pinnae contiguous to overlapping; their apex triangular to hastate, more or less strongly pinnatifid, frequently with only 2 or 3 segments; abrupt transition from the pinna apex to the petiolulate lateral pinnules; costae and costulae green; a very conspicuous aerophore at the base of each costa.

Largest pinnules: (7-)8-12(-14) × (1.1-)1.5-2.2 cm, spaced by less than to more than their width, petiolulate with a distinct petiolule 0.3-0.6 cm, narrowly ovate-oblong, margin subentire to erose, more or less undulate, serrulate near the pinnule apex, base rounded, slightly asymmetric, apex acute to very shortly caudate; veins twice furcate.

Scales and hairs: scales of the petiole base very caducous, densely imbricate in young leaves, shortly triangular, 1-1.7 × 0.2-0.4 cm, straight, shiny dark brown to black, with a relatively broad, lighter

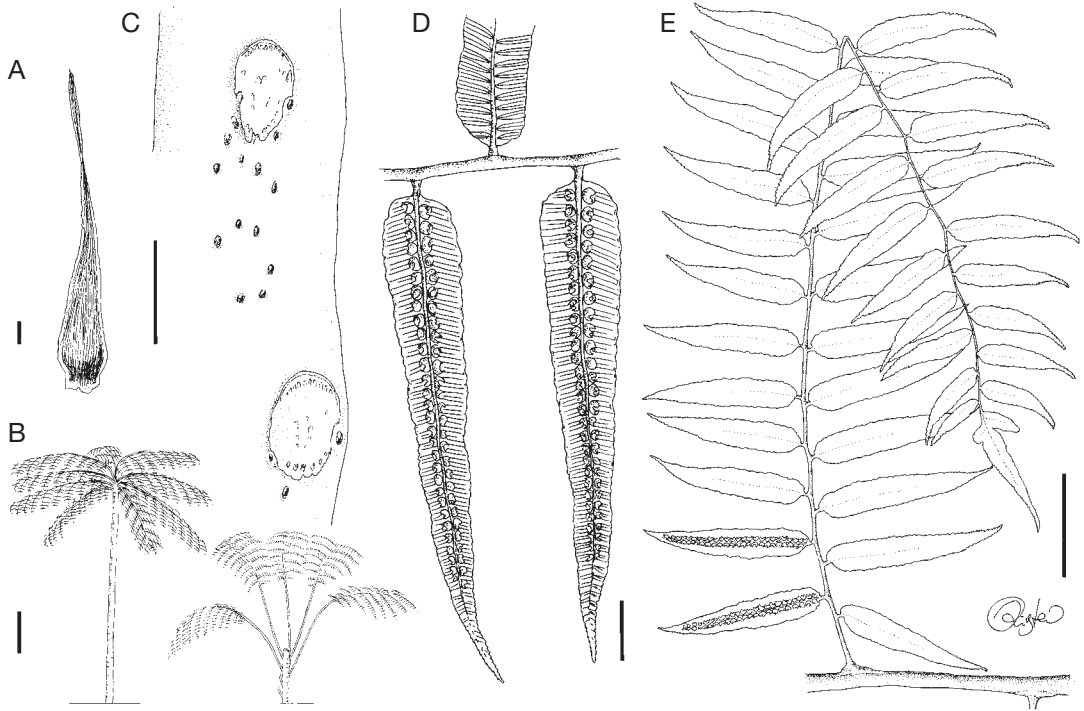


FIG. 17. — *Cyathea serratifolia* Baker: **A**, scale from the base of the petiole; **B**, habit (left: old plant, short and close standing petioles; right: young plant, long and distant petioles); **C**, leaf scars and trunk surface; **D**, pinnules abaxially with a fragment of the costa; **E**, pinna abaxially with a fragment of the rachis, sori only partly indicated. A, D, E, *Janssen et al.* 2537 (P); B, uncollected, photographs at P; C, *Janssen et al.* 2538 (P). Scale bars: A, 0.1 cm; B, 1 m; C, E, 5 cm; D, 1 cm.

and erose margin, appressed, coriaceous; scattered brown, contorted, antrorse, multicellular hairs on the adaxial face of the costae, sometimes very sparse and short; leaf otherwise glabrous.

Sori: subcostular, contiguous, about 0.2–0.3 cm in diameter, covering entire pinnules or restricted to their lower half; indusia globular, dull brown, coriaceous at least in their lower half, at maturity dehiscing in 3 or 4 lobes or irregularly, but usually not down to their base; receptacle capitate to disciform, much shorter than the rim of mature indusia, paraphyses inconspicuous.

DISTRIBUTION

Northern and Central Madagascar; endemic.

ECOLOGY

(300–)500–1200 m. Dense evergreen rainforests.

REMARKS

A very characteristic species even in fragmentary herbarium collections due to the size and shape of its pinnae and pinnules and easily identified in the field by its peculiar habit.

Young plants have very large leaves with comparatively soft petioles and rachises supported by the surrounding vegetation. Their leaves are up to 5.2 m long, the petiole up to 2.5 m and their pinnules are bigger than those of adult plants. Also, young plants have more vividly orange-brown coloured trunks.

TYPIFICATION AND SYNONYMY

Two sheets of *Humblot 278* exist at K. Only one of them carries the species name in Baker's hand and is here considered to represent the holotype. The fragmentary holotype cannot be confounded with

any other taxon from the Western Indian Ocean making epitypification superfluous.

19. *Cyathea tsaratananensis* C.Chr.
(Figs 18; 46I; 49C)

Index Filicum Supplementum Tertium 64 (1934), nom. nov. — *Cyathea subincisa* C.Chr., in Perrier, *Catalogue des plantes de Madagascar, Ptéridophytes*: 22 (1931), nom. nud.; Christensen, *Dansk Botanisk Arkiv* 7: 27, pl. 5 figs 20-22 (1932), nom. illeg. non *Cyathea subincisa* (Kunze) Domin, *Pteridophyta*: 264 (1929); Tardieu in Humbert, *Flore de Madagascar et des Comores, IV^e famille, Cyathéacées*: 19 (1951). — *Alsophila tsaratananensis* (C.Chr.) R.M.Tryon, *Contributions from the Gray Herbarium* 200: 31 (1970). — Type: Madagascar, massif du Tsaratanana, 1700 m, I.1923, Perrier de la *Bâthie* 15286 (holo-, P! [P00389621]; iso-, P! [3 sheets], TAN! [2 sheets]).

ADDITIONAL MATERIAL EXAMINED. — **Madagascar**. Forêt d'Ambatosoratra, 14°46'S, 48°52'E, 8.I.1949, *Cours* 3363 (P). — Anjanaharibe, 14°42'30"S, 49°27'30"E, 1600-1700 m, 19.XII.1950, *Cours* 3768 (P). — *Idem*, 1700 m, 24.XII.1950, *Cours* 3850 (P). — Vallée de la Lokoho, près d'Ambalavoniho, 14°34'S, 49°44'E, 75-300 m, I.1949, Humbert *et al.* 22819 (P). — Antsiranana, Montagne d'Ambre, Grand Lac, 12°35'48"S, 49°09'34"E, 1300-1450 m, 8.X.2004, Janssen *et al.* 2446 (MO, P, TAN), 2456 (P, TAN). — *Idem*, entre Grand Lac et Lac Maudit, 12°35'48"S, 49°09'34"E, 1300 m, 9.X.2004, Janssen *et al.* 2463 (MO, P, TAN). — Antsiranana, Montagne d'Ambre, entre Lac Maudit et Grand Lac, 12°31'S, 49°09'E, 1350 m, 29.III.1992, Rakotondrainibe 1662 (P). — Andapa, RS d'Anjanaharibe-Sud, Befingotra, 14°44'30"S, 49°26'30"E, 1550 m, 15.XI.1994, Rakotondrainibe *et al.* 2414 (K, MO, P, TAN). — Anjanaharibe-Sud, forêt d'Analabe, Befingotra, 14°45'54"S, 49°25'55"E, 1600 m, 4.XI.1999, Rakotondrainibe *et al.* 5159 (P, TAN). — *Idem*, 1660-1680 m, 6.XI.1999, Rakotondrainibe *et al.* 5181 (MO, P, TAN). — *Idem*, 1600 m, 8.XI.1999, Rakotondrainibe *et al.* 5194 (P, TAN).

FIELD OBSERVATIONS. — Trunk: HT up to 4(-7) m, DT (9-)10-15 cm, dead petioles caducous or only a rudiment persistent and leaf scars usually exposed; trunk surface brown to black, tuberculate with dense squaminate spines.

Petiole: with white, distant aerophores on either side; petiole bases shortly sigmoid.

Leaf scars: 2.5-4 × 2.5-5 cm, rounded and distally emarginate to elliptic, concave, lower margin somewhat raised, contiguous to spaced, with up to 5 big and deep orifices on their lower rim; spirally arranged.

Crown: more or less umbrella-shaped, petioles straight.

Trunk apex: densely scaly, brown to black, usually concealed by the petiole bases.

Lamina: elliptic to ovate; LL 145-200 cm, WL 70-90 cm, FW 60-90 cm, NP 18-26.

DESCRIPTION

Petiole: 20-50 cm long, 2.5-3.5 cm in diameter; brown to castaneous, sometimes violaceous brown.

Lamina: bipinnate, herbaceous (not coriaceous), pale green to slightly glaucous below, dull to shiny green above, lamina base shortly attenuate, basal pinnae patent to reflexed and conduplicate; rachis of the same colour as the petiole, but often more pronouncedly reddish, sometimes green.

Largest pinnae: 45-60 cm long, distant by 6-7 cm, adjacent pinnae contiguous to overlapping, their apex acute to shortly caudate, pinnatifid; costae and costulae of the same colour as the rachis.

Largest pinnules: 5-7 × 0.9-1.2 cm, spaced by less than their width, shortly petiolulate, triangular-oblong, their apical half slightly falciform, margin deeply crenate up to halfway down to the costula, more shallowly crenate in fertile parts of the pinnule, undulate, apex acute to caudate, more or less sharply serrate, base truncate to subcordate, more or less pronouncedly biauriculate; veins 2 to 4 times furcate, pinnate in larger lobes.

Scales and hairs: scales present from the petiole base upwards to 40 cm on the petiole, spaced, i.e. not overlapping, persistent, dull dark brown to shiny black, abaxial scales conical to pyramidal, 0.3-0.5 × 0.2-0.3 cm, straight, patent, not antrorse, strongly indurated, transforming into blunt warts further up on the petiole, adaxial scales narrowly triangular to deltoid, up to 0.7 cm long, slightly crispate, patent or appressed, coriaceous; dense multicellular, more or less antrorse, brown to stramineous, more or less crispate hairs on the adaxial face of the costae; scattered, caducous, dull brown filiform scales and sparse hairs on the adaxial face of the rachis; leaf otherwise glabrous.

Sori: subcostular, spaced by less than to more than their width, 0.1-0.2 cm in diameter, covering the pinnules in their lower half, rarely covering the entire pinnule; indusia globular, brown, subcoria-

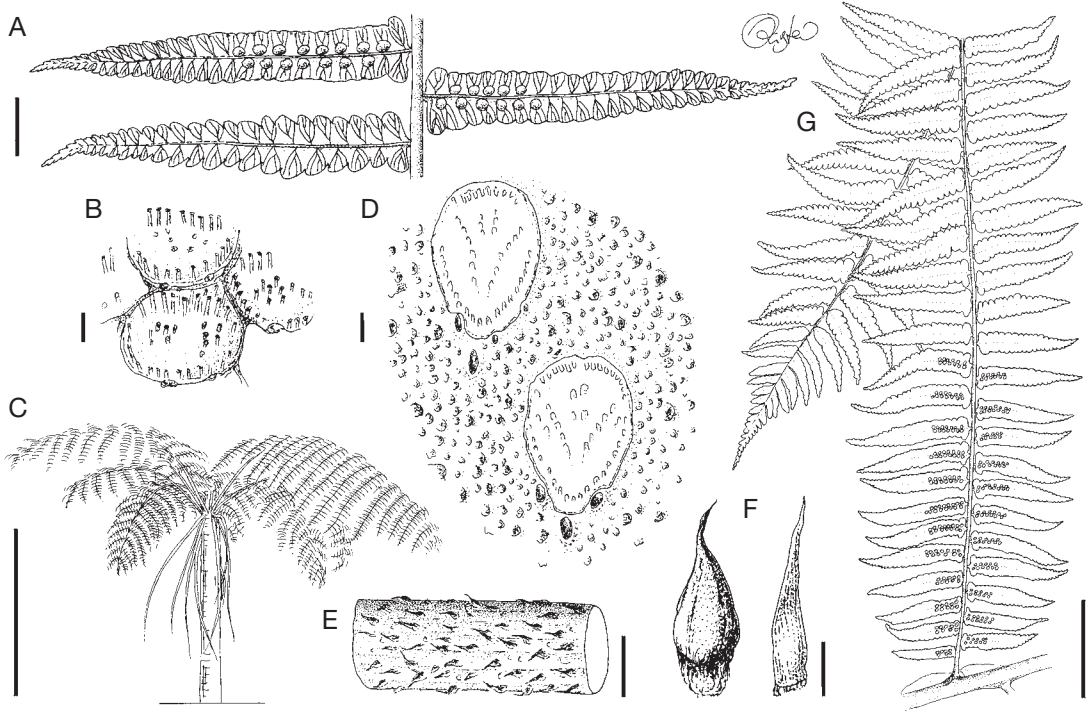


FIG. 18. — *Cyathea tsaratananensis* C.Chr.: **A**, pinnules abaxially with a fragment of the costa, note that the sterile pinnule is more strongly crenate; **B**, leaf scars and trunk surface, form with close standing petioles; **C**, habit; **D**, leaf scars and trunk surface, common form; **E**, segment from the basal part of the petiole with scales; **F**, scales from the base of the petiole (left: strongly indurated, pyramidal scale; right: less strongly indurated scale); **G**, pinna abaxially with a fragment of the rachis, fertile in its lower half only. A, G, *Rakotondrainibe et al.* 5181 (P); B, *Janssen et al.* 2456 (P); C-F, *Janssen et al.* 2446 (P). Scale bars: A, B, D, E, 1 cm; C, 1 m; F, 0.1 cm; G, 5 cm.

ceous, at maturity dehiscing in 2-4 lobes; receptacle capitate, shorter than the rim of mature indusia, paraphyses inconspicuous.

DISTRIBUTION

Northern Madagascar: Montagne d'Ambre, Anjanaharibe, Marojejy; endemic.

ECOLOGY

(100-)1300-1700 m. Dense evergreen rainforest, on slopes and crests.

REMARKS

Cyathea ligulata has similar, but usually bigger, petiole scales. It can be easily distinguished from the present taxon by its prominent indument of

scales and hairs on the abaxial face of the costae and costulae as well as by its smaller pinnules.

Rakotondrainibe 5159 has particularly small, subentire pinnules up to 3×0.6 cm with an obtuse apex and close standing sori, but perfectly agrees with *C. tsaratananensis* in all other characters.

TYPIFICATION AND SYNONYMY

Four sheets of *Perrier de la Bâthie 15286* are present at P. A label "*Cyathea subincisa* n. sp. C.Chr. Original" in Christensen's hand is glued to one sheet and although the most fragmentary, this sheet must be considered the holotype of the species. Together with the isotypes, which should not be dissociated from the holotype specimen, the original material can be unambiguously distinguished from all

other Madagascan species making epitypification superfluous.

20. *Cyathea viguieri* Tardieu
(Figs 19; 46L; 49D)

Bulletin de la Société botanique de France 88: 682 (1941); Tardieu in Humbert, *Flore de Madagascar et des Comores, IV^e famille, Cyathéacées*: 15, fig. 1 (12-15) (1951). — *Alsophila viguieri* (Tardieu) R.M. Tryon, *Contributions from the Gray Herbarium* 200: 31 (1970). — Type: Madagascar, district de Moramanga, forêt d'Analamazaotra, vers 950 m, 21.X.1912, *Viguière & Humbert* 825 (holo-, P! [P00404447]; iso-, B!, P! [3 sheets]). — Madagascar, Fianarantsoa, Ambalavao, RS d'Ivohibe, 22°28'12"S, 46°57'36"E, 850-950 m, 7.X.1997, *Rakotondrainibe et al.* 4020 (epi-, P! [2 sheets: P00134023, -24], here designated; isoepi-, TAN!).

ADDITIONAL MATERIAL EXAMINED. — **Madagascar.** Toamasina, Sahalampy à Ampitanonoka, 17°46'S, 48°54'E, 1200 m, 18.I.1945, *Cours* 2413 (P). — Brickaville, Ambalarondra, 18°50'S, 49°04'E, 300 m, 21.IV.1951, *Cours* 4498 (P). — Farafangana, Vondrozo, 22°49'S, 47°19'30"E, 26.VIII.1926, *Decary* 5077 (P). — Antsiranana, massif du Manongarivo, Bekolosy, *Gautier* 2926 (G). — *Idem*, Haute Ambahatra, 13°59'51"S, 48°25'43"E, 1150 m, 24.IX.2004, *Janssen et al.* 2380 (P, TAN). — *Idem*, 14°01'33"S, 48°24'47"E, 1566 m, 27.IX.2004, *Janssen et al.* 2403 (MO, P, TAN). — Toamasina, Maroantsetra, Ambanizana, 15°32'S, 50°00'30"E, 620-1109 m, 23.X.2004, *Janssen et al.* 2510 (P, TAN). — Andasibe, Station forestière Mitsinjo, 18°56'S, 48°26'E, 930-950 m, 11.XI.2004, *Janssen et al.* 2563 (P, TAN). — *Idem*, PN de Mantadia, 18°49'30"S, 48°28'E, 930-1000 m, 12.XI.2004, *Janssen et al.* 2575 (MO, P, TAN). — Antsiranana, R.N. Marojejy, trail to summit of Marojejy Est, north of Mandena, 14°26'S, 49°46'E, 700-1150 m, X.1988, *Miller et al.* 3455 (P). — *Idem*, 700-900 m, 24.XI.1989, *Miller et al.* 4560 (MO, P). — Fianarantsoa, Maroangira, 21°44'S, 47°24'E, 720 m, 4.XI.2000, *Rabarimanarivo et al.* 118 (P). — Antsiranana, Manongarivo, Bekolosy, 14°02'S, 48°19'E, 1000 m, 5.II.1992, *Rakotondrainibe* 1412 (P). — *Idem*, Mt. d'Antsatroto, 14°05'S, 48°23'E, 1540 m, 18.V.1992, *Rakotondrainibe* 1710 (K, MO, P). — Toamasina, Maroantsetra, Ambanizana, 15°34'S, 50°00'E, 670 m, 5.XII.1993, *Rakotondrainibe* 2069 (P). — Fianarantsoa, Ambalavao, RS d'Ivohibe, 22°28'12"S, 46°57'36"E, 850-950 m, 7.X.1997, *Rakotondrainibe et al.* 4020 bis (P). — Toamasina, Ambatondrazaka, PN de Zahamena, 17°41'08"S, 48°59'43"E, 650 m, 12.VI.2001, *Rasolohery* 498 (MO, P, TAN). — RNI Zahamena, Androrangabe,

vers le sommet Andrangovalo, 17°40'34"S, 48°45'32"E, 1100-1351 m, 14.IX.2002, *Rasolohery et al.* 662 (MO, P, TAN). — Andasibe, forest of Mantadia, 18°55'S, 48°25'E, 900 m, 3.XI.1994, *van der Werff et al.* 13616 (MO, P). — *Idem*, 1000-1200 m, 7.XI.1994, *van der Werff et al.* 13726 (MO, P).

FIELD OBSERVATIONS. — Trunk: HT up to 6 m, DT (5-)7-9(-12) cm, dead petioles caducous and the leaf scars exposed, rudiments persistent only in the upper quarter of the trunk or on scar rims; trunk surface brown to black, muricate to rather smooth.

Petiole: with 1 or 2, rarely more, irregular rows of light brown aerophores on either side; petiole bases short to long sigmoid.

Leaf scars: 2.5 × 4.5-5 cm, ovate, not or only slightly raised, 3-6 orifices near and below their lower rim, no pronounced spines on the scar rim; spirally arranged.

Crown: umbrella-shaped, juvenile plants with more or less erect rachises and a funnel-shaped crown.

Trunk apex: densely scaly, light brown to ferruginous; petioles distant or forming a short fascicle hiding the apex.

Lamina: elliptic to obovate; LL (100-)150-250 cm, WL (50-)80-110 cm, FW (30-)50-80 cm, NP (10-)17-26.

DESCRIPTION

Petiole: 30-60(-100) cm long, 1.5-2.5 cm in diameter; usually dark reddish or violaceous to blackish brown on both faces, rarely light brown.

Lamina: bipinnate, coriaceous, light green below, shiny green to dark green above; lamina base shortly attenuate to truncate, basal pinnae more or less reflexed and conduplicate; rachis of the same colour as the petiole.

Largest pinnae: 40-50 cm long, distant by 7-9 cm, adjacent pinnae contiguous to overlapping, their apex acute, pinnatifid; costae and costulae light brown when dry.

Largest pinnules: 4-5.5(-7.5) × 0.7-1 cm, spaced by less than their width to contiguous, petiolulate, triangular-oblong, apex acute to obtuse, base truncate to cordate, more or less biauriculate, the acroscopic auricle more strongly developed, margin subentire to deeply crenate, in the first 2 proximal pinnule pairs often deeply crenate-lobate; veins twice furcate, more often divided in sterile pinnules, 15-17(-20) veins per cm.

Scales and hairs: scales ascending on the petiole and reaching the first pinna pair, dense and overlapping, persistent, narrowly triangular, 2.5-5 ×

0.1-0.3 cm, straight, twisted, not appressed to the petiole, further up more or less sinusoid and appressed, shiny copper to dark brown, not indurated; dense multicellular, brown, antrorse hairs mixed with light brown, filiform scales on the adaxial face of the costae; sparse hairs and more abundant filiform scales on the adaxial face of the rachis; leaf otherwise glabrous.

Sori: subcostular, contiguous to spaced by less than their width, 0.15-0.2 cm in diameter, covering the entire pinnule; indusia globular, brown to blackish brown, coriaceous, at maturity dehiscing in 2-4 stiff and persistent lobes; receptacle capitate, shorter than the rim of mature indusia, paraphyses inconspicuous.

DISTRIBUTION

Northern Madagascar to southern Central Madagascar: Manongarivo to Ivohibe massifs; endemic.

ECOLOGY

(300-)700-1600 m. Dense evergreen rainforests.

REMARKS

Forms of *C. viguieri* with small pinnules are close to rare forms of *C. appendiculata* with large pinnules, but can be differentiated by their dark coriaceous indusia and persistent, ascending petiole scales. Judging from its petiole scales and the colour range observed in petioles and rachises, *C. bellisquamata* may be considered near *C. viguieri* but it is easily distinguished by its pinnules being broadly adnate to the costa. Note, that juvenile plants of *C. viguieri* may have reduced pinnae near the petiole base, but then normally lack a gradual transition to the fully developed pinnae of the lamina.

Gautier 2926 (G) is placed here with hesitation, but its long, shiny dark brown, ascending petiole scales in combination with large, sessile coriaceous pinnules currently do not justify another determination. In *Janssen et al. 2380, Rakoton-drainibe et al. 1412* and *1710* the petiole scales are restricted to the lower 15 cm of the reddish to light brown petiole. *Janssen et al. 2403* has light brown indusia and scales ascending only halfway on the petiole. *Cours 4498* exhibits a

slight fertile-sterile dimorphism. With respect to their other characters and considering the closely related taxa, these specimens are currently best assigned to *C. viguieri* although recognition of further taxa might prove necessary with more material at hand.

TYPIFICATION AND SYNONYMY

The original material lacks the petiole base and scales are only available on a rachis fragment. We hence consider it useful to designate an epitype more precisely establishing the identity of this taxon with respect to arrangement and morphology of the petiole scales.

Group IId: group of *Cyathea remotifolia*

Cyathea borbonica group p.p. *sensu* Christensen 1932; "group 4" p.p. *sensu* Holttum 1981.

DIAGNOSTIC CHARACTERS. — Leaves pinnate-pinnatifid to pinnate-pinnatisect; pinna apex pinnatifid; multicellular hyaline hairs absent from the abaxial face of the lamina.

21. *Cyathea approximata* Bonap. (Figs 1A; 20; 44C; 49E)

Notes ptéridologiques 5: 41 (1917), l. c. 9: 47 (1920); Christensen, *Dansk Botanisk Arkiv* 80: 23, pl. 4 figs 1-5 (1932); Tardieu in Humbert, *Flore de Madagascar et des Comores, IV^e famille, Cyathéacées*: 9 (1951). — *Alsophila approximata* (Bonap.) R.M. Tryon, *Contributions from the Gray Herbarium* 200: 29 (1970). — Type: Madagascar, environs de la baie d'Antongil, Côte Est, 500 m, VIII.1912, *Perrier de la Bâthie 7985* (holo-, P! [P00418668]; iso-, P! [2 sheets]).

Cyathea sorisquamata Bonap., *Notes ptéridologiques* 16: 21 (1925). — *Cyathea approximata* Bonap. var. *sorisquamata* (Bonap.) Tardieu in Humbert, *Flore de Madagascar et des Comores, IV^e famille, Cyathéacées*: 10 (1951). — Type: Madagascar, forêt orientale, environs de Beforona, 700 m, XI.1921, *Perrier de la Bâthie 14047* (holo-, P! [3 sheets: P00418663-65]; iso-, BM! [fragment], P! [2 sheets]).

ADDITIONAL MATERIAL EXAMINED. — **Madagascar.** Antsiranana, Montagne d'Ambre, 12°36'S, 49°09'E, 1400-1475 m, IV.1993, *Andrianantoanina 37* (P). —

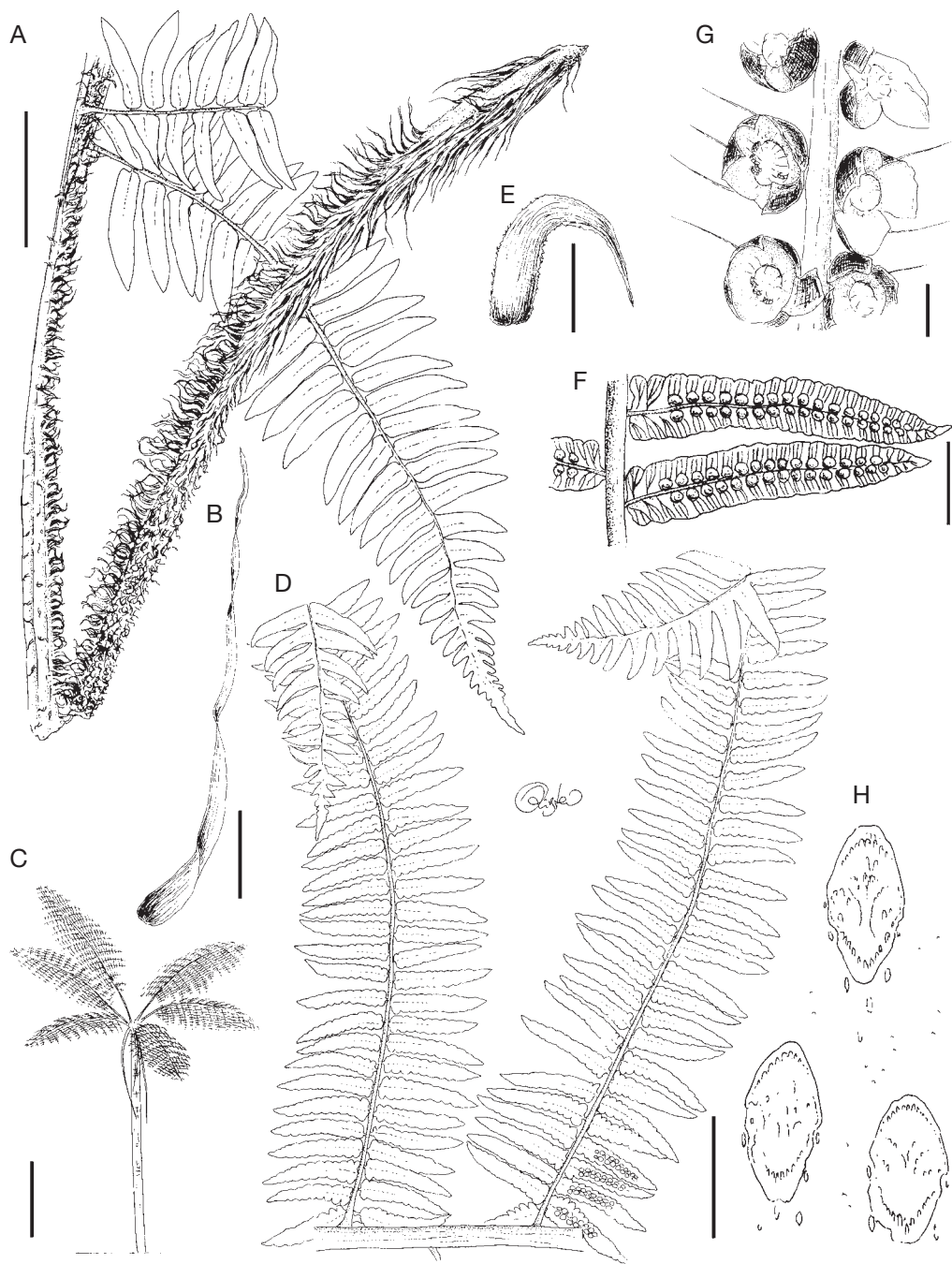


FIG. 19. — *Cyathea viguieri* Tardieu: **A**, basal part of the leaf (from the petiole base up to the first pinna pair), lateral view; **B**, scale from the abaxial face of the base of the petiole; **C**, habit; **D**, pinnae abaxially with a fragment of the rachis, sori only partly indicated; **E**, scale from the lateral face of the middle part of the petiole; **F**, pinnules abaxially with a fragment of the costa; **G**, sori with dark brown, coriaceous indusia; **H**, leaf scars and trunk surface. A, B, D-G, Janssen et al. 2575 (P); C, H, Janssen et al. 2380 (P). Scale bars: A, D, 5 cm; B, E, 0.5 cm; C, 1 m; F, H, 1 cm; G, 0.1 cm.

Toamasina, de Sahalampy à Ampitanonoka, 17°46'S, 48°54'E, 18.I.1945, *Cours 2415* (P). — *Idem*, 1200 m, 18.I.1945, *Cours 2416* (P). — Toamasina, de Bemaity à Androndramanitra, 18°00'S, 48°47'E, 800-850 m, 9.III.1951, *Cours 4228* (P). — RNI de Zahamena, massif de l'Andrangovaly, 17°40'S, 48°45'E, 1200 m, X.1937, *Humbert et al. 17862* (P). — Marojejy (Nord-Est), col de Doanyana, 14°28'S, 49°32'E, 800-1200 m, 1949, *Humbert 23059* (BR, K, MO, P). — Antsiranana, Montagne d'Ambre, Grand Lac, 12°35'48"S, 49°09'34"E, 1300-1450 m, 8.X.2004, *Janssen et al. 2449* (MO, P, TAN), 2460 (P, TAN). — *Idem*, entre Grand Lac et Lac Maudit, 12°35'48"S, 49°09'34"E, 1300 m, 9.X.2004, *Janssen et al. 2466* (P, TAN). — Fianarantsoa, PN Ranomafana, Ranomena, 21°12'S, 47°27'E, 980 m, 1.XII.2000, *Rabarimanarivo et al. 178* (P). — Antsiranana, Montagne d'Ambre, col des Fougères, 12°31'S, 49°09'E, 1200 m, 23.III.1992, *Rakotondrainibe 1663* (P). — *Idem*, entre Lac Maudit et Grand Lac, 12°31'S, 49°09'E, 1380 m, 29.III.1992, *Rakotondrainibe 1664* (MO, P). — *Idem*, Lac Maudit, 12°35'S, 49°09'E, 1300 m, 31.III.1992, *Rakotondrainibe 1665* (K, P). — Toamasina, Maroantsetra, Ambanizana, piste menant au sommet d'Ambohitsitondroinan' Ambanizana, 15°34'S, 50°00'E, 820 m, 6.XII.1993, *Rakotondrainibe et al. 2066* (MO, P). — Fianarantsoa, Ambalavao, RNI d'Andringitra, berges de la rivière Sahanivoraky, 22°13'40"S, 47°01'30"E, 800 m, 17.V.1995, *Rakotondrainibe 2630* (P, TAN). — *Idem*, 20.V.1995, *Rakotondrainibe 2673* (P, TAN). — Antsiranana, RNI du Marojejy, NW de Manantenina, 14°26'12"S, 49°44'30"E, 1200 m, 26.X.1996, *Rakotondrainibe 3530* (MO, P, TAN). — Fianarantsoa, Ambalavao, RS d'Ivohibe, 22°29'S, 46°58'E, 1100-1250 m, 14.X.1997, *Rakotondrainibe et al. 4143* (MO, P, TAN). — *Idem*, 19.X.1997, *Rakotondrainibe et al. 4174* (P). — Fianarantsoa, corridor reliant les réserves d'Andringitra et d'Ivohibe, ESE d'Angodongodona, 22°25'18"S, 46°53'54"E, 1150-1300 m, 3.XI.1997, *Rakotondrainibe et al. 4281* (P). — *Idem*, 9.XI.1997, *Rakotondrainibe et al. 4345* (P). — Antsiranana, Andapa, forêt de Betaolana, 14°32'36"S, 49°25'30"E, 1200 m, 16.X.1999, *Rakotondrainibe et al. 4946* (P, TAN). — Massif d'Anjanaharibe-Sud, forêt de Betaolana, SW de Befingotra, 14°46'12"S, 49°15'47"E, 1150 m, 26.X.1999, *Rakotondrainibe et al. 5039* (P, TAN). — Fianarantsoa, PN de Ranomafana, forêt de Vatoharanana, 21°17'24"S, 47°26'E, 1100 m, 8.X.2000, *Rakotondrainibe et al. 5936* (K, P, TAN). — Toamasina, PN de Zahamena, Antanandava, entre Antenina et Ankosy, 17°30'53"S, 48°46'14"E, 917-1080 m, 4.II.2002, *Rasolohery 660* (MO, P, TAN).

FIELD OBSERVATIONS. — Trunk: HT up to 5(-8) m, DT (5-)6-8(-12) cm, dead petioles caducous and the leaf scars exposed; trunk surface smooth, greyish brown; ramifications may develop after injury.

Petiole: with irregular rows of light brown, inconspicuous, much spaced aerenchyma on either side; petiole more or less triangular in cross section; petiole bases straight, not sigmoid.

Leaf scars: (1-)-2-4 × (1-)-2-2.5 cm, rounded to elliptic, with 3-5 strong, conical spines on their lower rim, these up to 0.7 cm long; leaf scars spaced, rarely contiguous; either spirally arranged or in distinct pseudo-whorls of 6 or 8, in the latter case plants with thicker trunks.

Crown: more or less horizontal to arched, young leaves erect, crown centre more or less infundibuliform and collecting leaf litter; many-leaved, with up to 2 pseudo-whorls of up to 8 leaves.

Trunk apex: more or less naked, green, the unfolding croziers covered with minute light brown scales, concealed among the close standing petiole bases and leaf litter or conspicuously raised and visible through the petioles.

Lamina: narrowly elliptic; LL 100-170(-220) cm, WL 27-35(-60) cm, FW 50-80 cm, NP 40-55.

DESCRIPTION

Petiole: 5-30(-50) cm long, about 1.5 cm in diameter; green, abaxial face more or less brown.

Lamina: pinnate-pinnatisect, coriaceous, pale green below, shiny green above, lamina base cuneate to shortly attenuate, pinnae gradually reduced in size, the petiole more or less conspicuous, basal pinnae patent or reflexed and conduplicate; rachis of the same colour as the petiole.

Largest pinnae: 17-30 cm long, distant by 2-3 cm, adjacent pinnae slightly spaced to overlapping, their apex caudate, pinnatifid; costae and costulae green to stramineous.

Largest pinnules: 1.2-2 × 0.2-0.4 cm, spaced by less than to about their width, broadly adnate to the costa, oblong, straight to slightly falciform, margin entire to crenate, apex rounded to obtuse, the first proximal pinnule pair sometimes sessile and more or less profoundly lobed, overlapping the rachis adaxially; veins once furcate.

Scales and hairs: scales usually present from the petiole base upwards to 30 cm on the petiole and rachis, distant to contiguous, rapidly caducous and the petiole apparently naked in older leaves, minute, 0.3-0.6(-0.8) × up to 0.1 cm, subulate to filiform, more or less contorted, shiny to dull brown, ferruginous in young leaves, with a light brown erose margin, the adaxial scales thinner and longer (up to 0.8 cm), the abaxial scales with a more or less indurated base and slightly arched; scattered

appressed, narrowly lanceolate, shiny brown scales, up to 0.3 cm long, on the abaxial face of the costae and costulae; scattered dull brown, caducous, filiform scales on the adaxial face of the rachis and costae, the latter also covered with dense antrorse, multicellular hairs.

Sori: subcostular, contiguous, about 0.1 cm in diameter, covering the lower half to three quarters of the pinnule; indusia globular, brown, subcoriaceous to membranous, at maturity dehiscing in 2-4 lobes or irregularly, sometimes only a cup-like structure with a lacinate rim persistent, indusia more or less oblique with their opening directed outwards; receptacle capitate, shorter than the rim of mature indusia, bearing a conspicuous apical tuft of small scales that have sometimes a long apical catenate hair, but always arise from a multiseriate base, protruding from the mouth of the indusium.

DISTRIBUTION

Northern to southern Central Madagascar: Montagne d'Ambre and eastern forests from Marojejy to Andringitra; endemic.

ECOLOGY

(500-)800-1400 m. Dense evergreen rainforests.

TYPIIFICATION AND SYNONYMY

Five sheets of *Perrier de la Bâthie 14047* are available at P. Of these, three have been marked as "Original" by Bonaparte and are considered together to represent the holotype of *Cyathea sorisquamata*. One of the three sheets of *Perrier 7985* at P is marked "Original" by Bonaparte and is hence the holotype of *Cyathea approximata*.

22. *Cyathea bellisquamata* Bonap.

REMARKS

Cyathea bellisquamata has comparatively large, elliptic to oblanceolate, pinnate-pinnatisect or rarely deeply pinnate-pinnatifid leaves as well as usually dense and long, light to dark brown, persistent petiole scales. A rather stout trunk with a muricate surface and rounded leaf scars is characteristic for all varieties of this species. Morphological variability within *Cyathea bellisquamata* is particularly high. Lamina dissection, petiole length and colour together with scale colour and density are the principal characters for the separation of varieties. Complete specimens are required for unambiguous identification.

KEY TO THE VARIETIES OF *CYATHEA BELLISQUAMATA*

1. Petiole scales up to 1.5 cm long, straight, sparse and distant to contiguous; lamina pinnate-pinnatifid, i.e. adjacent pinnules always confluent with their bases in the lower third of the pinnae; pinnule apex distinctly acute 22c. var. *australis*
- Petiole scales at least 2 cm long, straight to crispate, dense and overlapping; lamina pinnate-pinnatisect, i.e. adjacent pinnules separated by a short stretch of the costa or with contiguous bases in the lower third of the pinnae; pinnule apex rounded to obtuse, rarely acute 2
2. Petiole (18-)25-60 cm long, basal pinnae not densely and regularly decrescent, distinctly spaced; petiole stramineous to brown 22d. var. *basilobata*
- Petiole up to 18 cm long, basal pinnae densely and regularly decrescent, slightly spaced to overlapping; petiole light brown to dark violaceous brown 3
3. Petiole and rachis with a reddish to violaceous tinge; petiole scales shiny, light brown to brown 22a. var. *bellisquamata*
- Petiole and rachis never with a reddish to violaceous tinge; petiole scales dull, brown to dark brown 22b. var. *ambrensis*

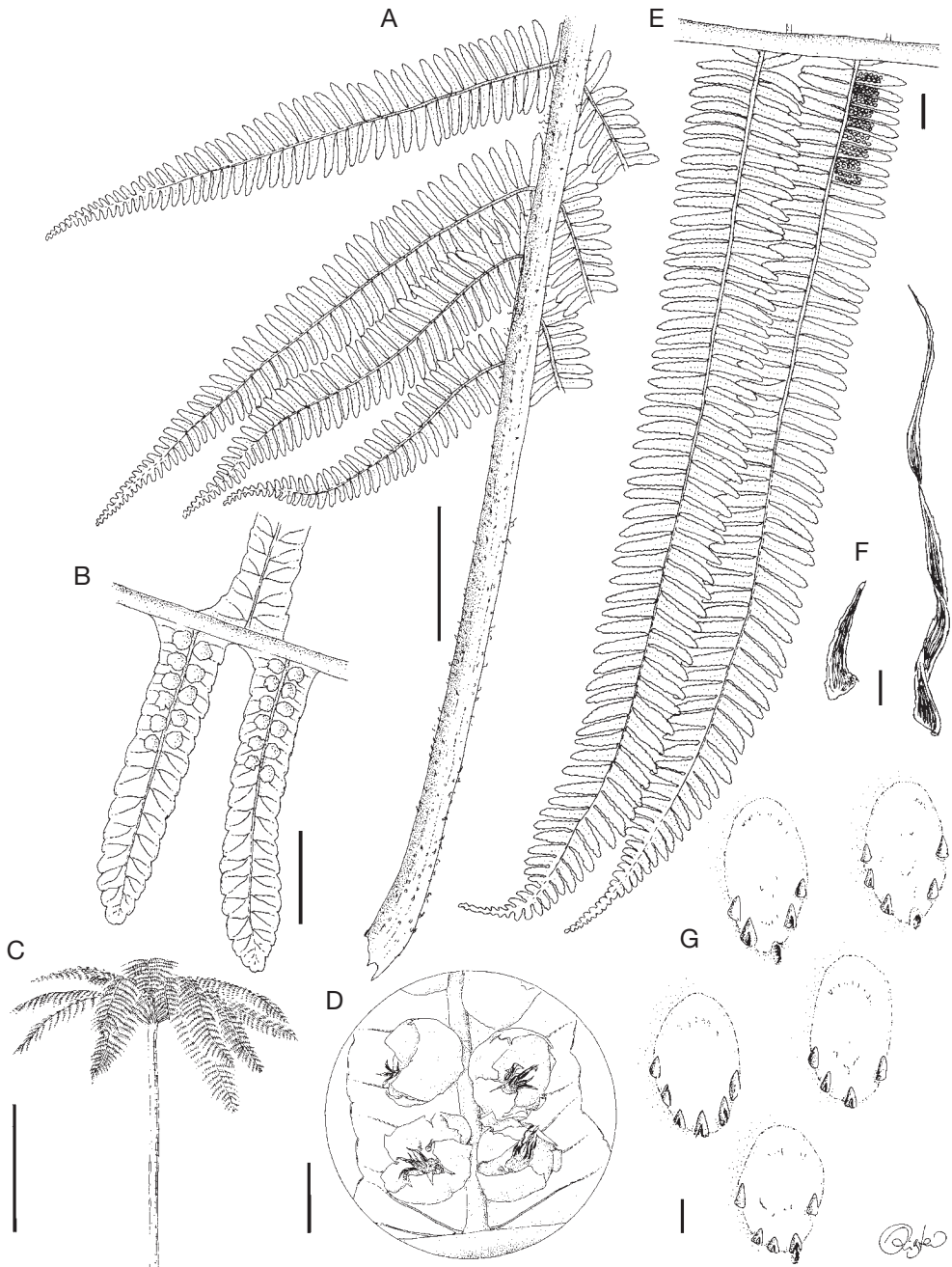


FIG. 20. — *Cyathea approximata* Bonap.: **A**, basal part of the leaf (from the petiole base up to the first four pinna pairs), dorso-lateral view, note the minute scales on the petiole, the pinnae are pruned away on one side; **B**, pinnules abaxially with a fragment of the costa; **C**, habit; **D**, sori, note the dense scaly paraphyses inserted on the apex of the receptacle; **E**, pinnae abaxially with a fragment of the rachis, sori only partly indicated; **F**, scales from the base of the petiole (left: minute scale from the adult petiole; right: filiform scale from a crozier); **G**, leaf scars, note that the trunk surface is smooth. A, B, D-G, *Janssen et al.* 2449 (P); C, uncollected, photograph at P. Scale bars: A, 5 cm; B, E, G, 1 cm; C, 1 m; D, F, 0.1 cm.

22a. *Cyathea bellisquamata* Bonap.
var. *bellisquamata*
(Figs 21; 44F; 50A)

Notes ptéridologiques 16: 18 (1925); Christensen, *Dansk Botanisk Arkiv* 7: 25, pl. 4 figs 6-11 (1932); Tardieu in Humbert, *Flore de Madagascar et des Comores, IV^e famille, Cythéacées*: 12 (1951). — *Alsophila bellisquamata* (Bonap.) R.M. Tryon, *Contributions from the Gray Herbarium* 200: 29 (1970). — Type: Madagascar, forêt orientale, environs de Beforona, 700 m, IX.1912, *Perrier de la Bâthie 14024* (holo-, P! [5 sheets: P00404255-59]; iso-, P! [3 sheets]).

ADDITIONAL MATERIAL EXAMINED. — **Madagascar**. Toamasina, Maroantsetra, Ambanizana, 15°38'S, 49°58'E, 140 m, 17.IV.2002, *Antilahimena et al. 1010* (P). — Toamasina, Sainte Marie, 16°50'S, 49°55'E, X.1849, *Boivin 1600/2* (P). — District de Brickaville, canton d'Ambalarondra, 18°50'S, 49°04'E, 300 m, 21.IV.1951, *Cours 4503* (P). — Toamasina, Didy, 18°07'S, 48°32'40"E, IV.1954, *Cours 4881* (P). — *Goudot s.n.* (B, G, P). — Fito, I.1833, *Goudot s.n.* (G). — Vallée de la Lokoho, E d'Andapa, 14°31'45"S, 49°49'30"E, 250-550 m, 11.I.1949, *Humbert 22996* (K, P). — *Humblot s.n.* (P). — *Humblot 295* (K, P, W). — Toamasina, Maroantsetra, Ambanizana, 15°37'53"S, 49°58'33"E, 2-471 m, 20.X.2004, *Janssen et al. 2482* (MO, P, TAN). — *Idem*, entre Andranobe et Bedinta, 15°40'34"S, 49°58'03"E, 0-628 m, 26.X.2004, *Janssen et al. 2522* (G, MO, P, TAN), 2525 (P, TAN). — Toamasina, Betampona, 17°56'S, 49°17'E, XII.1925, *Perrier de la Bâthie 17476* (P). — Toamasina, Masoala Peninsula, near Ambanizana, 15°38'S, 49°59'E, 25-200 m, 27.X.1992, *van der Werff et al. 12773* (MO, P). — *S. coll. s.n.* (P).

FIELD OBSERVATIONS. — Trunk: up to 6 m, DT 7-10 cm, dead petioles caducous and the leaf scars exposed, rudimentary petiole bases persistent in the upper part of the trunk; trunk surface dark brown to black, densely and rather coarsely muricate with excrescences not more than 0.3 cm long; trunk sometimes annulated, i.e. with constrictions between the pseudo-whorls formed by the leaf scars.

Petiole: with 2 to several rows of white to light brown, small aerophores on either side; petiole bases sigmoid.

Leaf scars: 2-3 × 2-4(-6) cm, rounded, their apex more or less emarginate, elliptical towards the base of the trunk, flat or concave, their lower half more or less raised, their centre fibrous, spirally arranged.

Crown: petioles and lower part of the rachis more or less straight and erect, then arched; the leaves with their cuneate bases frequently forming a dense infundibuliform basket, collecting leaf litter in which the basalmost pinnae may decompose.

Trunk apex: densely scaly like the petioles, concealed

among the close standing petiole bases.

Lamina: elliptic to oblanceolate; LL 170-270 cm, WL 60-75 cm, FW 80-140 cm, NP 40-60.

DESCRIPTION

Petiole: up to 5-18 cm long, 2.5-4 cm in diameter; reddish to violaceous brown, sometimes greenish above.

Lamina: pinnate-pinnatisect, coriaceous, pale light green below, shiny light to dark green above, lamina base cuneate with the pinnae gradually reduced in size and almost attaining the petiole base, basal pinnae sessile, patent and progressively conduplicate towards the petiole base; basal pinnae contiguous to distinctly overlapping; rachis of the same colour as the petiole or lighter.

Largest pinnae: 30-47 cm long, distant by 6-7 cm, adjacent pinnae spaced by less than their width or contiguous, rarely slightly overlapping, their apex acute to shortly caudate, pinnatifid; costae and costulae of the same colour as the rachis or lighter.

Largest pinnules: (2-)3-4.5 × 0.6-0.9 cm, spaced by less than to about their width, broadly adnate to the costa, their bases at least in the lower third of the pinnae separated by a short stretch of the costa or somewhat widened and contiguous, up to 3 proximal pinna pairs sessile, oblong, straight to slightly falciform, the costulae forming an acute acroscopic angle with the costa, margin entire or crenate, crenulate near the rounded to obtuse apex, more or less revolute in dried specimens, the basalmost pinnules sometimes distinctly crenate and auriculate; veins once to twice furcate.

Scales and hairs: scales present from the petiole base upwards to at least 50 cm on the petiole and rachis, persistent, dense and overlapping, narrowly triangular, 2-3 × 0.2-0.3 cm, gradually thinning and becoming smaller upwards, twisted and their apex crispate, more strongly contorted further up on the petiole, shiny light brown to brown with a lighter, ciliate-erose margin, appressed to the petiole or not and then antrorse, not indurated; dense, brown, stiff, more or less contorted, antrorse, multicellular hairs on the abaxial face of the rachis and costae, on the rachis mixed with more or less crispate, filiform, brown scales; in few specimens scattered,

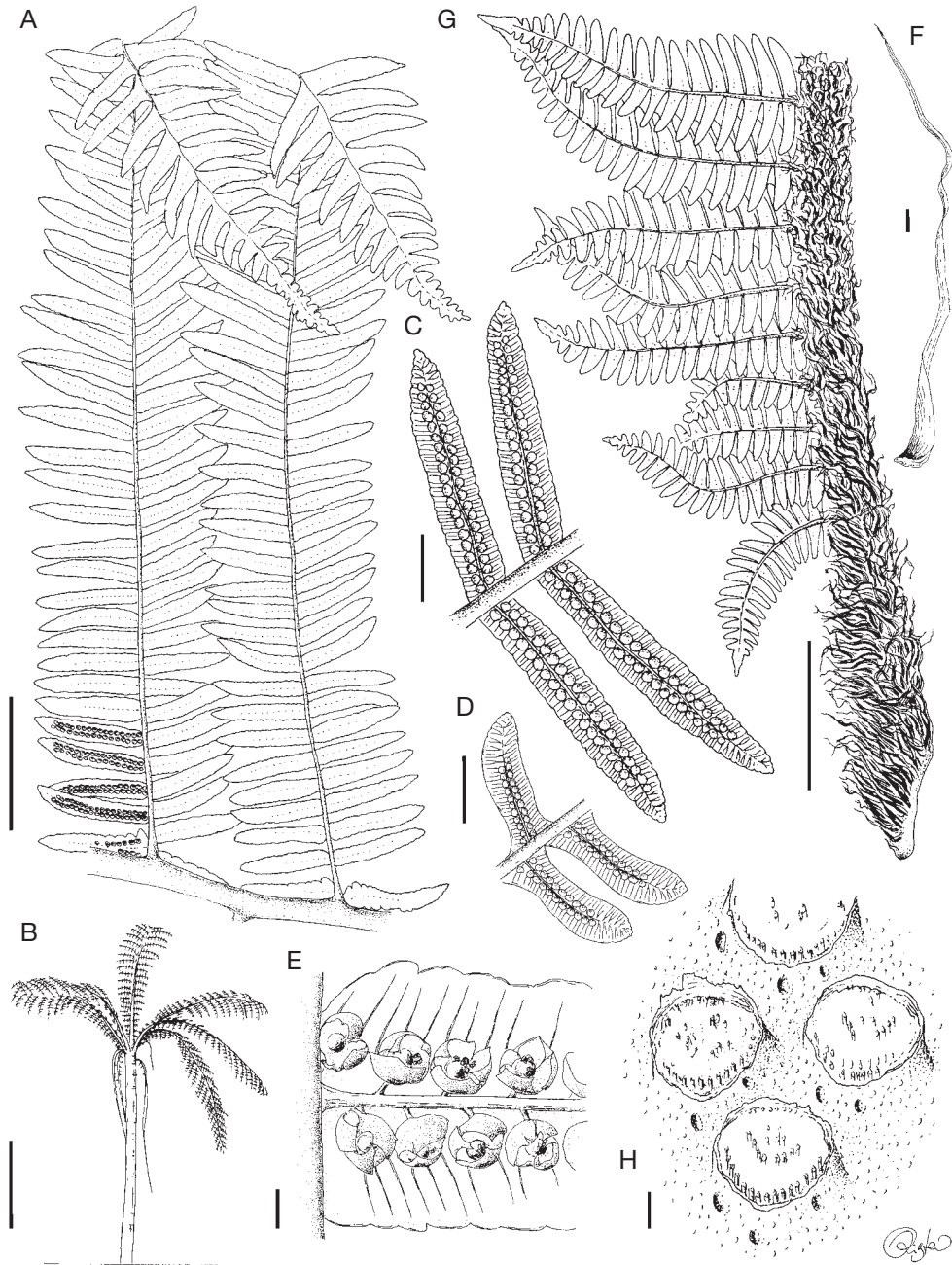


FIG. 21. — *Cyathea bellisquamata* Bonap. var. *bellisquamata*: **A**, pinnae abaxially with a fragment of the rachis, sori only partly indicated; **B**, habit; **C**, pinnules abaxially with a fragment of the costa, common form; **D**, pinnules abaxially with a fragment of the costa, small form; **E**, proximal part of a pinnule abaxially (at the junction with the costa), note the dark, coriaceous indusia; **F**, scale from the base of the petiole; **G**, basal part of the leaf (from the petiole base up to the first nine pinna pairs), lateral view, one half of the petiole pruned away by longitudinal section; **H**, leaf scars and trunk surface. A, C, E-G, *Janssen et al.* 2482 (P); B, H, *Janssen et al.* 2522 (P); D, *Humbert 22996* (P). Scale bars: A, G, 5 cm; B, 1 m; C, D, H, 1 cm; E, F, 0.1 cm.

caducous, filiform, brown scales on the abaxial face of the costae; leaf otherwise glabrous.

Sori: subcostular, contiguous to slightly spaced, about 0.15 cm in diameter, covering the entire pin-nule or its lower half; indusia globular, brown to black, coriaceous, at maturity dehiscent in 2 or 3 lobes or irregularly; receptacle capitate, much shorter than the rim of mature indusia, with inconspicuous filiform paraphyses shorter than the sporangia.

DISTRIBUTION

Northern to Central Madagascar: Masoala and along the east coast south to Toamasina; endemic.

ECOLOGY

100-700 m. Dense evergreen rainforests.

REMARKS

The taxon is well characterized by its cuneate leaf base with the gradually reduced pinnae almost attaining the petiole base, the dark reddish to violaceous brown axes, dark coriaceous sori and the shiny light brown petiole scales. Juvenile plants lack the regularly decrescent lamina base and develop a conspicuous petiole.

TYPIFICATION AND SYNONYMY

Seven sheets of *Perrier de la Bâthie 14024* are available at P. Five of these sheets (P00404255-59), carrying a leaf base and apex as well as rachis fragments with pinnae taken near the base, middle and apex of a leaf, have been designated "Original" by Bonaparte. Although it cannot be proven that this material comes from a single leaf, we follow Bonaparte in considering this material as a multiple sheet holotype.

22b. *Cyathea bellisquamata* Bonap.

var. *ambrensis* Janssen & Rakotondr., var. nov.
(Fig. 44F)

A typo differt paleis petiolorum sordide brunneis, petiolis et rhachidibus non rubello vel violaceo suffusis.

TYPUS. — Madagascar, Antsiranana, Montagne d'Ambre, sur piste joignant la Station des Roussettes au Grand Lac, entre Grand Lac et sentier menant au Lac Maudit, 12°35'48"S, 49°09'34"E, 1300 m, 9.X.2004, *Janssen et*

al. 2462 (holo-, P! [4 sheets: P00589541-44]; iso-, P! [4 sheets], TAN!; one trunk surface mould at P!).

ADDITIONAL MATERIAL EXAMINED. — Madagascar. Antsiranana, Montagne d'Ambre, 12°31'30"S, 49°10'20"E, 1200-1250 m, 24.XII.1967, *Bernardi 12036* (G, K, P). — Montagne d'Ambre, Grand Lac, 12°35'48"S, 49°09'34"E, 1300-1450 m, 8.X.2004, *Janssen et al. 2461* (MO, P, TAN). — *Idem*, entre Grand Lac et Lac Maudit, 12°35'48"S, 49°09'34"E, 1300 m, 9.X.2004, *Janssen et al. 2465* (MO, P, TAN). — Antsiranana, Montagne d'Ambre, 12°30'S, 49°10'E, 1200 m, 23.III.1992, *Rakotondrainibe 1659* (P).

DIFFERENTIAL FIELD OBSERVATIONS. — Trunk: DT up to 12 cm.

Leaf scars: sometimes with up to 5 orifices on their lower rim.

DIFFERENTIAL DESCRIPTION

The taxon is morphologically close to var. *bellisquamata*, but differs by its dark brown petiole scales being dull, not shiny, due to their minutely wrinkled surface. The petiole and rachis are green, sometimes with a brownish abaxial face when fresh and brown when dry, but never have a reddish or dark violaceous tinge. Indusia are light brown, membranous to subcoriaceous. The apex of the largest pinnules is rounded to acute. Pinnae appear to be less densely inserted and less overlapping in the decrescent lamina base.

DISTRIBUTION

Northern Madagascar: Montagne d'Ambre; endemic.

ECOLOGY

1200-1300 m. Dense evergreen rainforests.

REMARKS

Janssen et al. 2465 was collected on a forest clearing and has reduplicate, crenate pinnules with a strongly revolute margin as well as some persistent, filiform, dull brown scales on the abaxial face of the costae.

ETYMOLOGY

So far, this variety is known only from the Montagne d'Ambre, the northern limit of the distribution range of *C. bellisquamata*.

22c. *Cyathea bellisquamata* Bonap.

var. *australis* Janssen & Rakotondr., var. nov.
(Figs 22A-D; 44F)

A typo differt lamina pinnato-pinnatifida pinnulis in parte basali pinnarum basibus confluentibus. Petiolus 16-30 cm, non colore rubello vel violaceo suffusus, paleis sordide brunneis usque ad 1.5 cm longis contiguis vel distantibus obtectus.

TYPUS. — Fianarantsoa, Ambalavao, RNI d'Andringitra, 22°11'39"S, 46°58'16"E, 900-1000 m, 4.VI.1995, *Rakotondrainibe* 2789 (holo-, P! [2 sheets: P00075164-65]).

ADDITIONAL MATERIAL EXAMINED. — **Madagascar.** Fianarantsoa, Ambalavao, RNI d'Andringitra, 22°13'22"S, 46°58'18"E, 1200 m, 24.V.1995, *Rakotondrainibe* 2696 (P, TAN). — *Idem*, corridor reliant les réserves d'Andringitra et d'Ivohibe, ESE d'Angodongodona, 22°24'30"S, 46°53'E, 9.XI.1997, *Rakotondrainibe* 4330 (P). — *Idem*, 22°25'18"S, 46°53'54"E, 1150-1300 m, 9.XI.1997, *Rakotondrainibe et al.* 4331 (P, TAN).

DIFFERENTIAL FIELD OBSERVATIONS. — Trunk: HT up to 10 m.

DIFFERENTIAL DESCRIPTION

The lamina base is attenuate with the basal pinnæ reduced in size, but not densely and regularly decrescent down to the petiole base. Adjacent pinnæ are never overlapping, but always distinctly spaced. The petiole is 16-30 cm long and dull brown, not distinctly reddish or violaceous. The largest pinnules are 2.5-3 × 0.6-0.7 cm and have an acute apex. Adjacent pinnules are distinctly confluent with their widened bases throughout the entire length of the pinna. The scales of the petiole base are subulate, straight, appressed, contiguous to distant, dull dark brown, up to 1.5 × 0.1 cm. The proximal sori are slightly distant from the costulae, whereas the distal sori are close to the costulae. Indusia are subcoriaceous, brown and dehisce in 2 or 3 lobes at maturity.

DISTRIBUTION

Southern Central Madagascar: Ivohibe and Andringitra massifs; endemic.

ECOLOGY

900-1300 m. Dense evergreen rainforests.

REMARKS

Although the petiole scales of this taxon are peculiar, it is treated as a variety of *C. bellisquamata* because the type specimen includes a leaf scar with a part of the trunk surface showing the typical morphology for *C. bellisquamata*. Furthermore, forms with narrow, dull brown scales exist in the other varieties.

ETYMOLOGY

The taxon has been named *australis* with respect to its occurrence in the Andringitra massif, marking the southern border of the distribution range of *C. bellisquamata*.

22d. *Cyathea bellisquamata* Bonap. var.
basilobata C.Chr.
(Figs 22E-H; 44F)

Dansk Botanisk Arkiv 7: 25 (1932); Christensen in Perrier, *Catalogue des plantes de Madagascar, Ptéridophyta*: 19 (1931), nom. nud.; Tardieu in Humbert, *Flore de Madagascar et des Comores, IV^e famille, Cyathéacées*: 12 (1951). — Type: Madagascar, massif de Tsaratanana, 1700 m, I.1923, *Perrier de la Bâthie* 15292 (holo-, P! [P00404241]; iso-, BM!, P! [4 sheets]).

ADDITIONAL MATERIAL EXAMINED. — **Madagascar.** Antsiranana, Andapa, Ankarongameloka forest, 14°14'56"S, 49°26'19"E, 1546 m, 11.III.2006, *Antilahimena et al.* 4754 (P, MO). — Montagne d'Ambatosoratra, 14°32'S, 49°42'E, 400 m, 7.I.1949, *Cours* 3335 (P). — Antsiranana, Andapa, Anjanaharibe-Sud, 14°42'30"S, 49°27'30"E, 1200 m, 17.XII.1950, *Cours* 3689 (P), *Cours* 3769 (P). — *Idem*, 1600-1700 m, 19.XII.1950, *Cours* 3767 (P). — Massif du Tsaratanana, gorges de l'Andavaka, 14°02'30"S, 48°57'30"E, 1600 m, 1937, *Humbert* 18289 (P). — Massif de l'Anjanaharibe, 14°42'30"S, 49°27'30"E, 1600-1800 m, 1951, *Humbert et al.* 24684 (G, K, P). — Montagnes au N de Mangindrano, sommets d'Ambohimirahavavy, 14°12'S, 49°06'30"E, 2200 m, 1951, *Humbert et al.* 25259 bis (P). — Antsiranana, Anjanaharibe-Sud, W d'Andapa, 14°42'30"S, 49°27'30"E, 1600-1800 m, XII.1950, *Humbert* 25684 (P). — Mahajanga, massif du Tsaratanana, entre Antetikalambazaha et Matsaborimaiky, 14°09'49"S, 48°57'05"E, 1700-2050 m, 8.V.2005, *Janssen et al.* 2866 (MO, P, TAN). — *Idem*, 14°10'27"S, 48°56'43"E, 1700-2050 m, 14.V.2005, *Janssen et al.* 2937 (MO, P, TAN), 2938 (MO, P, TAN). — Andapa, RS d'Anjanaharibe-Sud, WSW de Befingotra, 14°44'30"S, 49°26'30"E, 1560 m, 16.XI.1994, *Rakotondrainibe et al.* 2440 (P, TAN). — Antsiranana, Marojejy,

NW de Manantenina, 14°26'12"S, 49°44'30"E, 1200 m, 26.X.1996, *Rakotondrainibe 3531* (P), 3532 (MO, P, TAN). — *Idem*, 14°26'24"S, 49°44'30"E, 1520 m, 4.XI.1996, *Rakotondrainibe 3603* (P, TAN). — *Idem*, 5.XI.1996, *Rakotondrainibe 3606* (P, TAN). — Forêt de Betaolana, NW d'Ambodiangezoka, 14°32'36"S, 49°25'30"E, 1200 m, 16.X.1999, *Rakotondrainibe et al. 4960* (P, TAN). — Anjanaharibe-Sud, forêt d'Analabe, SW de Befingotra, 14°45'54"S, 49°25'55"E, 1600 m, 4.XI.1999, *Rakotondrainibe et al. 5158* (P, TAN). — PN de Marojejy, SE de Doany, 14°26'12"S, 49°37'12"E, 1050 m, 25.X.2001, *Rakotondrainibe et al. 6388* (K, MO, P, TAN). — Mahajanga, Mangindrano, 14°13'05"S, 49°07'52"E, 2129 m, XI.2005, *Rakotovao et al. 2466* (MO, P, TAN).

DIFFERENTIAL FIELD OBSERVATIONS. — Trunk: DT 5-10 cm, 12-14 cm including occasionally persistent rudiments of the petiole base.

Leaf scars: sometimes with up to 5 orifices on their lower rim.

Crown: forming a less dense infundibuliform basket.

Lamina: NP (24-)30-73.

DIFFERENTIAL DESCRIPTION

The lamina base is attenuate with the basal pinnules reduced in size, but not densely and regularly decrescent down to the petiole base. Adjacent basal pinnae are not overlapping, but distinctly spaced. The petiole is longer than 25 cm and green when fresh, brown to stramineous when dry, never distinctly reddish or violaceous. The dense and overlapping scales of the petiole base are shiny to dull, light to dark brown, 0.1-0.2 cm broad, at the petiole base more or less straight with a crispate apex, contorted and more or less appressed further up on the petiole. Occasionally, the base of the petiole scales is slightly indurated. They are patent to antrorse, rarely retrorse. The largest pinnae are pinnatisect, distant by 3.5-7 cm; adjacent pinnules are, with rare exceptions, not confluent with their bases in the lower two thirds of the pinnae. Pinnules are 1.8-4 × 0.4-0.6 cm, spaced by less than their width. Their costulae form a right angle with the costa, at least in the lower half of the pinnae, their apex is rounded to acute, and they are often distinctly falciform in the upper half of the pinna. Sori are smaller, about 0.1 cm in diameter, very close to each other and to the costula, including the proximal sori. Indusia are membranous to subcoriaceous,

light brown, rarely darker, and dehisce in several lobes at maturity.

DISTRIBUTION

Northern Madagascar: Anjanaharibe, Marojejy and Tsaratanana massifs; endemic.

ECOLOGY

(1000-)1500-2200 m. Dense evergreen rainforests.

REMARKS

Although the taxon has originally been named with respect to its crenate-lobate proximal pinnules, this character also occurs at least in var. *bellisquamata* and var. *ambrensis*, although less frequently, and in many other species of *Cyathea* in Madagascar.

A closely related species, *C. longispina* Janssen & Rakotondr., occurs in the Tsaratanana massif. It is distinct by its pinnules being slightly narrower, spaced by about their width, less coriaceous, and by the presence of scattered, shiny brown scales with a very prominent apical spine on the abaxial face of its costae and costulae. The trunk of *C. longispina* is, at least in the upper half, covered with dead petiole bases.

Pinnules of *Rakotondrainibe et al. 6388* are up to 5 × 0.9 cm and the sori are slightly distant from each other, but a long petiole with somewhat degraded dull brown scales, including scale rudiments that are at least 2 cm long, make us believe that the specimen is best to be associated with this variety. *Rakotondrainibe et al. 3531* is close to var. *australis* because of its subconfluent pinnules. Its scales and pinnule size let us, however, rather assign the specimen to var. *basilobata*.

TYPIFICATION AND SYNONYMY

Five sheets of *Perrier de la Bâthie 15292* are available at P. Only one sheet (P00404241) carries the name of the taxon followed by "n. var." and is considered to represent the holotype of *C. bellisquamata* var. *basilobata*. As the sheet does not include the petiole with scales, it should not be dissociated from the isotypes currently at P.

23. *Cyathea emilei* Janssen & Rakotondr., sp. nov.

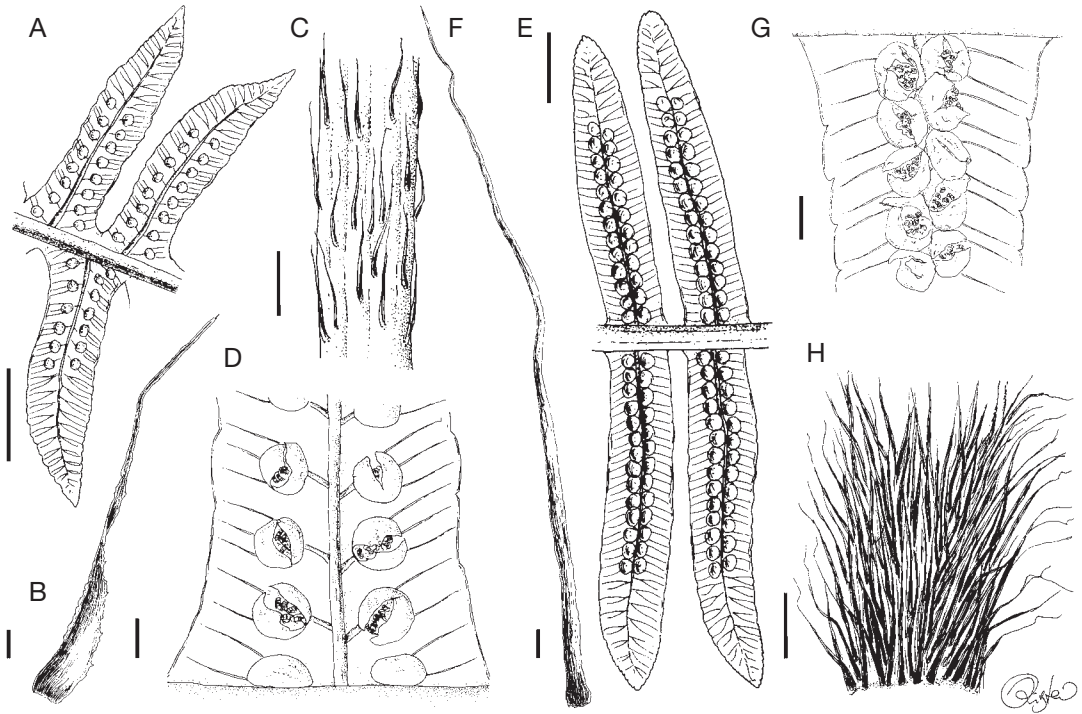


FIG. 22. — **A-D**, *Cyathea bellisquamata* var. *australis* Janssen & Rakotondr.; **A**, pinnules abaxially with a fragment of the costa; **B**, scale from the base of the petiole; **C**, segment from the basal part of the petiole with scales; **D**, proximal part of a pinnule abaxially (at the junction with the costa); **E-H**, *C. bellisquamata* var. *basilobata* C. Chr.; **E**, pinnules abaxially with a fragment of the costa; **F**, scale from the base of the petiole; **G**, proximal part of a pinnule abaxially (at the junction with the costa); **H**, segment from the basal part of the petiole with scales. A-D, *Rakotondrainibe et al.* 4331 (P); E-H, *Janssen et al.* 2937 (P). Scale bars: A, C, E, H, 1 cm; B, D, F, G, 0.1 cm.

KEY TO THE VARIETIES OF *CYATHEA EMILEI*

1. Pinnules up to 3 cm long, rarely 4 cm, broadly adnate to the costa from the base of the pinnae, their apex rounded to acute; sori usually contiguous to spaced by less than their width 23a. var. *emilei*
- Pinnules at least 4 cm long, sessile with a rounded base at least in the lower quarter of the pinnae, their apex acute to caudate; sori usually spaced by at least their width 23b. var. *dauphinensis*

23a. *Cyathea emilei* Janssen & Rakotondr. var. *emilei* (Figs 23; 45B; 50B)

Cyathea borbonica Desv. var. *borbonica* auct.: Christensen, *Dansk Botanisk Arkiv* 7: 20 (1932); Tardieu in Humbert, *Flore de Madagascar et des Comores, IV^e famille, Cyathacées*: 12 fig. 1 (4-5) (1951).

Filix arborescens lamina pinnato-pinnatifida vel pinnato-pinnatisecta, subcoriacea vel coriacea. Pinnulae maximae

1.5-3(4) cm longae et 0.5-0.8(0.9) cm latae, spatium inter eas latitudine pinnularum minus, ad costam late adnatae, integrae, sed crenulatae prope apicem rotundatum ad acutum. Paleae petioli valde caducae, dense imbricatae, in petiolis foliorum juvenilium ascendentes ad 10 cm, sed petioli foliorum adultorum saepe omnino nudi. Paleae petioli anguste triangulares vel filiformes, 2-3 cm longae et 0.05-0.2 cm latae, strictae, sordide vel dilute brunneae. Indusia globularia, brunnea vel sordide brunnea, subcoriacea vel coriacea, in maturitate in 2-3 lobis persistentibus debiscentia. Receptaculum capitatum lobis indusii maturi brevius

paraphysibus trichiformibus sporangiis aequilongis vel leviter longioribus provisum.

TYPUS. — Madagascar, Toamasina, Andasibe, RS d'Analamazaotra, 18°56'S, 48°26'E, 900-950 m, 13.XI.2004, *Janssen et al.* 2580 (holo-, P! [4 sheets: P00589562-65]; iso-, P! [6 sheets], TAN!; one trunk surface mould at P!).

ADDITIONAL MATERIAL EXAMINED. — **Madagascar.** Toamasina, PN de Masoala, d'Ambanizana à Analambolo, 15°34'S, 50°01'E, 600-700 m, 24.I.1996, *Aridy et al.* 60 (P). — Périnet, 18°56'S, 48°26'E, 12.IX.1966, *Boiteau* 133 (K, MO, P). — *Idem.* 18°56'S, 48°26'E, 17.IV.1961, *Buchloh s.n.* (K). — Toamasina, Moramanga, 18°56'20"S, 48°13'40"E, 1000 m, 22.XI.1942, *Cours* 1741 (P). — D'Ambodihiasina à Manandaleha, 17°11'S, 49°02'E, 800 m, 30.XII.1950, *Cours* 3937 (P). — Toamasina, Périnet, 18°56'S, 48°26'E, 15.II.1971, *Cremers* 1423 (BR). — Antsiranana, Manongarivo, Bekolosy, 14°02'S, 48°19'E, 750 m, 5.IV.1996, *Gautier* 2987 (G). — Prov. des Ambanivoul, 1834, *Goudot s.n.* (P). — 1833, *Goudot s.n.* (P). — 1834, *Goudot s.n.* (P). — *Goudot s.n.* (P). — Massif de Marojejy (Nord-Est), W de la rivière Manantenina, 14°29'S, 49°49'E, 100-300 m, III.1949, *Humbert* 23399 (P). — Toamasina, Andasibe, RS d'Analamazaotra, 18°56'S, 48°26'E, 930-950 m, 11.XI.2004, *Janssen et al.* 2567 (MO, P, TAN), 2572 (MO, P, TAN). — *Idem.* 900-950 m, 13.XI.2004, *Janssen et al.* 2581 (MO, P, TAN). — Mahajanga, massif du Tsaratanana, entre Antetikalambazaha et Mangindrano, 14°11'24"S, 48°56'44"E, 1670-1700 m, 15.V.2005, *Janssen et al.* 2959 (MO, P, TAN). — Soanirana, Antasibé, 16°46'S, 49°30'E, 10.XII.1938, *Lam & Meuse* 5064 (BR, K). — *de Limminghe s.n.* (P). — Antsiranana, Manongarivo, Bekolosy, 14°02'S, 48°19'E, 830 m, 25.III.1993, *Malcomber et al.* 2244 (G). — *Idem.* 1000-1480 m, IV.1993, *Rakotomalaza* 69 (BR, G, MO). — Toamasina, Maroantsetra, Ambanizana, piste menant au sommet d'Ambohitsitondroinan' Ambanizana, 15°34'S, 50°00'E, 670 m, 5.XII.1993, *Rakotondrainibe et al.* 2067 (MO, P, TAN). — Antsiranana, RNI du Marojejy, NW de Manantenina, 14°26'12"S, 49°46'30"E, 500 m, 5.X.1996, *Rakotondrainibe* 3282 (P). — Antsiranana, Andapa, massif d'Anjanaharibe-Sud, forêt d'Analabe, SW de Befingotra, 12°30'20"S, 49°31'20"E, 27.X.1999, *Rakotondrainibe* 5066 (P). — *Idem.* 1120 m, 27.X.1999, *Rakotondrainibe et al.* 5068 (P). — *Idem.* 28.X.1999, *Rakotondrainibe et al.* 5074 (P, TAN). — *Idem.* 1.XI.1999, *Rakotondrainibe et al.* 5113 (P). — PN de Marojejy, SE de Doany, 14°26'12"S, 49°37'12"E, 1150 m, 23.X.2001, *Rakotondrainibe et al.* 6351 (MO, P, TAN), 6361 (K, P, TAN). — Toamasina, Ambatondrazaka, PN de Zahamena, Ankosy, 17°41'08"S, 48°59'43"E, 650 m, 13.VI.2001, *Rasolohery* 529 (MO, P, TAN). — *Idem.* Antenina, 17°30'S 48°46'E, 917-1020 m, *Rasolohery* 634 (P). — Moango Valley, Zahamena Reserve, 17°38'30"S, 48°50'E, 800 m, 1994, *Tedd* 2 (K). — 1846, *s. coll. s.n.* (K).

FIELD OBSERVATIONS. — Trunk: HT up to 5(-10) m, DT 3.5-7(-9) cm, dead petioles generally caducous and the leaf scars exposed, but rudiments may persist in the upper half of the trunk; trunk surface brown to black, finely muricate, with numerous short squaminate spinules.

Petiole: with 1-3 irregular rows of light brown to brown aepophores on either side; petiole bases distinctly sigmoid.

Leaf scars: 1-1.5 × 2.5-3.5(-5) cm, elliptic to ovate, very close standing to much spaced, often with 3-5 orifices on their lower rim and below the scar; the surface of the leaf scars more or less fibrous with rudiments of the petiole and of the vascular bundles, but without spines on the scar rim; spirally arranged.

Crown: more or less horizontal.

Trunk apex: densely covered with dark brown, caducous scales; concealed among the very close standing petiole bases.

Lamina: elliptic; LL (80-)125-170 cm, WL (30-)40-55 cm, FW (35-)45-60 cm, NP 12-27.

DESCRIPTION

Petiole: 15-70(-100) cm long, 1-2 cm in diameter; green to stramineous, reddish to dark brown on its abaxial face.

Lamina: pinnate-pinnatifid to pinnate-pinnatisect, subcoriaceous to coriaceous, dull to shiny light green below, shiny green to dark green above, lamina base shortly attenuate, basal pinnae more or less strongly reflexed, sometimes conduplicate; rachis of the same colour as the petiole.

Largest pinnae: 25-33 cm long, distant by (3.5-)4.5-7 cm, adjacent pinnae spaced by less than their width, not overlapping, widest in or below their middle, their apex acute to shortly caudate, pinnatifid; costae and costulae green.

Largest pinnules: 1.5-3(-4) × 0.5-0.8(-0.9) cm, spaced by less than their width, broadly adnate to the costa, more or less strongly decurrent, usually straight, their margin entire, crenulate near the rounded to acute apex, adjacent pinnules sometimes confluent from the base of the pinna, at most the first proximal pinnule pair sessile; veins once to twice furcate.

Scales and hairs: scales of the petiole base very caducous, densely imbricate near the petiole base in young leaves, present upwards to 10 cm on the petiole, petioles of adult leaves frequently completely naked, scales narrowly triangular to filiform, 2-3 × 0.05-0.2 cm, straight, dark to light dull brown,

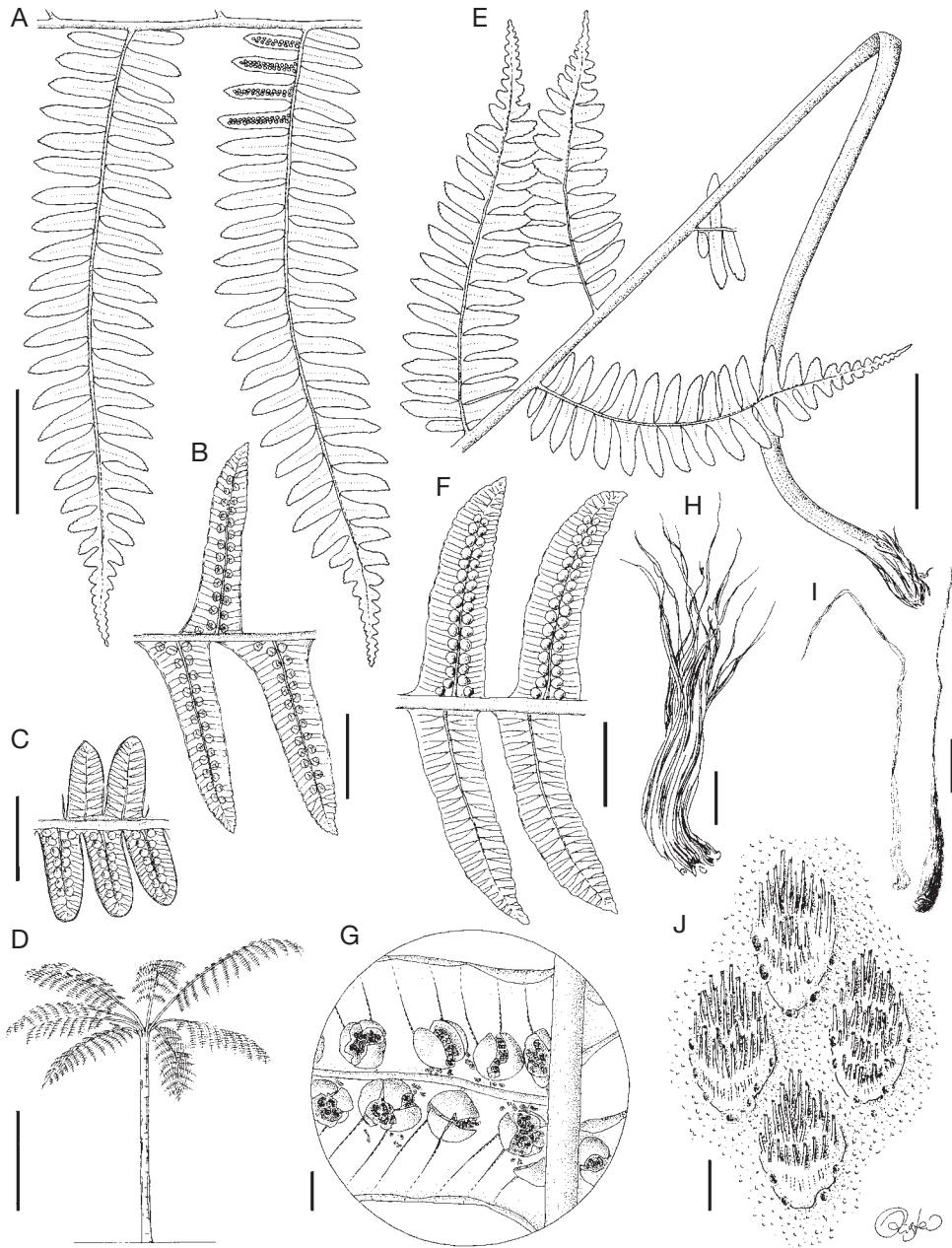


FIG. 23. — *Cyathea emilei* Janssen & Rakotondr.: **A**, pinnae abaxially with a fragment of the rachis, sori only partly indicated; **B**, pinnules abaxially with a fragment of the costa, common form; **C**, pinnules abaxially with a fragment of the costa, form with small pinnules with rounded apices; **D**, habit; **E**, basal part of the leaf (from the petiole base up to the second pinna pair), lateral view in lower, dorsal view in upper half; **F**, pinnules abaxially with a fragment of the costa, form with big pinnules with acute apices, sori omitted from two pinnules; **G**, proximal part of a pinnule abaxially (at the junction with the costa), note the persistent, coriaceous indusia; **H**, group of agglutinated scales from the base of the petiole; **I**, scale from the base of the petiole (left: common form, light brown and caducous; right: dark brown and persistent form); **J**, leaf scars and trunk surface. A, B, D, E, G-I (left), Janssen *et al.* 2580 (P); C, J, Janssen *et al.* 2567 (P); F, I (right), Janssen *et al.* 2959 (P). Scale bars: A, E, 5 cm; B, C, F, J, 1 cm; D, 1 m; G, 0.1 cm; H, I, 0.5 cm.

concolourous, never stramineous, usually quickly withering and more or less agglutinating and sometimes splitting into longitudinal fibres before they fall, not indurated; sparse to moderately dense, contorted, patent to antrorse, brown, multicellular hairs on the adaxial face of rachis and costae; leaf otherwise glabrous.

Sori: subcostular, proximal sori sometimes more distant from the costula than the distal sori, contiguous to spaced by less than their width, about 0.1–0.15 cm in diameter, covering entire pinnules; indusia globular, brown to dark brown, subcoriaceous to coriaceous, at maturity dehiscent in 2 or 3 persistent lobes; receptacle capitate, shorter than the rim of mature indusia, with conspicuous filiform paraphyses as long as or slightly longer than the sporangia.

DISTRIBUTION

Northern (Marojejy, Tsaratanana) to Central (Andasibe) Madagascar; endemic.

ECOLOGY

(100–)500–1200(–1700) m. Dense evergreen rainforests.

REMARKS

Specimens of this taxon have been determined as *C. borbonica* Desv. var. *borbonica* by former authors. However, it is easily distinguishable from the Mascarene endemic *C. borbonica* Desv. (see Janssen & Rakotondrainibe, 2006). Although frequently collected previously, this Madagascan species is described here for the first time.

The closely related Madagascan species *C. remotifolia* Bonap. and *C. emilei* differ, among other characters, from the Mascarene *C. borbonica* by their pinnules being broadly adnate to the costa. *Cyathea emilei* can be distinguished from *C. remotifolia* by its muricate trunk with fibrous, but not spiny leaf scars, a more coriaceous lamina with adjacent pinnules not overlapping, longer and less rapidly caducous petiole scales, and by its subcoriaceous to coriaceous indusia being persistent in mature leaves. Its usually well-developed paraphyses place *C. emilei* near *C. simulans* (Baker) Janssen & Rakotondr., but the receptacular paraphyses in the

latter species are much denser and longer and its petiole scales are shiny brown and much shorter than in *C. emilei*.

Without the petioles, i.e. lacking information on the persistence and morphology of the petiole scales, it is difficult to distinguish between *C. bellisquamata* and *C. emilei* which both have coriaceous, persistent indusia and overlapping pinnule size ranges.

Pinnule size and shape in this species varies from narrow to wide with rounded to acute apices, adjacent pinnules being subconfluent or distinctly spaced. Gradual transitions occur and the type specimen has been chosen to represent an intermediate condition. It includes scales of the petiole base and a trunk surface mould, which helps in unambiguously distinguishing the species from *C. remotifolia*.

Gautier 2987 and *van der Werff 13536* from the Manongarivo are forms with very wide, obtuse to acute pinnules and shiny dark brown petiole scales. *Janssen et al. 2567* has fertile leaves, that are much smaller than the sterile leaves. The fertile pinnae are pinnatifid from their base, the pinnules up to 1 × 0.4 cm and the proximal sori are clearly distant from the costula. Plants with shiny dark brown petiole scales that are more or less persistent occasionally occur, but the transition to plants with light brown, caducous scales is gradual (Fig. 23I).

Young plants usually have decrescent, patent and more or less entire basal pinnae (as opposed to *C. remotifolia*), that are of the same shade of green as the rest of the lamina.

ETYMOLOGY

This species is dedicated to Mr Émile Randrianjohany, scientist at the Centre national de Recherches sur l'Environnement in Antananarivo, in acknowledgement of his invaluable logistic and scientific contributions to fieldwork conducted for the present revision.

23b. *Cyathea emilei* Janssen & Rakotondr.
var. *dauphinensis* Janssen & Rakotondr., var. nov.
(Figs 24; 45B; 50C)

A typo differt pinnulis subsessilibus basi rotundata plusminusus asymmetrica saltem in quarta parte inferiori pinnarum,

4-7.5 cm longis, 0.7-0.8 cm latis, apice acuto. Paleae petioli typo similes caducae, sed dilute brunneae vel stramineae.

TYPUS. — Madagascar, Toliara, Tolanaro, forêt de Manantantely, piste menant de la Station de la Cascade sur la colline Bevitanaona, 24°59'19"S, 46°55'25"E, 50-600 m, 26.XI.2004, *Janssen et al.* 2617 (holo-, P! [3 sheets: P00589569-71]; iso-, P! [3 sheets], TAN!).

ADDITIONAL MATERIAL EXAMINED. — **Madagascar.** Toliara, Fort Dauphin, N des Chaînes Anosyennes, 24°45'S, 46°51'E, 23.VI.1932, *Decary* 9905 (P). — District de Fort-Dauphin, col d'Ivolo, 5.IX.1932, *Decary* 10542 (P). — N des Chaînes Anosyennes, 24°45'S, 46°51'E, 350 m, *Guillaumet* 3991 (P). — Toliara, Fort Dauphin, forêt de Manantantely, 24°59'S, 46°55'E, 60-300 m, 15.IX.1928, *Humbert et al.* 5747 (BM, P; paralectotype of *C. acutula*). — *Idem*, 24°59'15"S, 46°56'08"E, 330 m, 25.XI.2004, *Janssen et al.* 2611 (MO, P, TAN), 2612 (MO, P, TAN), 2613 (P, TAN). — *Idem*, 24°59'19"S, 46°55'25"E, 150 m, 25.XI.2004, *Janssen et al.* 2615 (MO, P, TAN), 2616 (MO, P, TAN). — *Idem*, Rakotondrainibe et al. 6966 (P, TAN). — Prov. de Toliara, Tolanaro, forêt d'Ankarambilo, 27.XI.2004, *Rakotondrainibe* 6980 (P). — Toliara, Tolanaro, forêt de Manantantely, 24°59'S, 46°55'E, 60-300 m, 15.IX.1928, *Viguier et al.* 5747 (P). — Fort Dauphin, Andohahela, 24°45'S, 46°51'E, 250-500 m, X.1992, *van der Werff et al.* 12740 (P).

DIFFERENTIAL FIELD OBSERVATIONS. — Trunk: surface more coarsely muricate and frequently more or less densely covered with short scales.

Leaf scars: often whitish and their lower rim somewhat raised, without orifices on their lower rim.

Crown: more or less umbrella-shaped.

Trunk apex: densely covered with light brown to stramineous scales.

Lamina: LL 100-180 cm, WL (50-)60-85 cm, FW (45-)80-85 cm, NP 13-21.

DIFFERENTIAL DESCRIPTION

The petiole and rachis are dark violaceous brown, sometimes greenish on the adaxial face. The largest pinnae are 30-35 cm long, distant by 6-9.5 cm and adjacent pinnae do overlap. The pinnules are lanceolate, subsessile with a rounded, more or less asymmetric base at least in the lower quarter to lower third of the pinnae, progressively adnate and proximally decurrent further up, confluent only near the pinna apex. Pinnules are big, 4-7.5 × 0.7-0.8 cm, and have an acute apex. Morphology and persistence of the petiole scales are comparable to the typical variety, but they are light brown to stramineous. Sori are distant by about their width or more.

DISTRIBUTION

Southern Madagascar: Tolanaro; endemic.

ECOLOGY

50-500 m. Dense evergreen rainforests.

REMARKS

This taxon may be confounded with some forms of *C. borbonica* var. *latifolia* (Hook.) Bonap. from Mauritius, but is well distinguished by its light brown, filiform to narrowly lanceolate, rapidly caducous petiole scales, its pinnules being sessile only in the lower third of the pinnae and the base of the lamina being only shortly attenuate (*Janssen & Rakotondrainibe* 2006).

Forms with strongly crenate-lobate pinnules have been observed (cf. *Janssen et al.* 2612). Very young plants have up to 1.2 cm wide, broadly lanceolate pinnules with a rounded base and somewhat ascending, stramineous scales (cf. *Janssen et al.* 2615, 2616).

ETYMOLOGY

The epithet *dauphinensis* refers to the collection locality of the type specimen near Tolanaro (Fort Dauphin).

24. *Cyathea longipinnata* Bonap. (Figs 25; 45H; 50D)

Notes ptéridologiques 5: 48 (1917), l.c. 9: 57 (1920); Christensen, *Dansk Botanisk Arkiv* 7: 24, pl. 5 figs 23, 24 (1932); Tardieu in *Humbert, Flore de Madagascar et des Comores, IV^e famille, Cyathéacées*: 10 (1951). — *Alsophila longipinnata* (Bonap.) R.M. Tryon, *Contributions from the Gray Herbarium* 200: 30 (1970). — Type: Madagascar, côte Est, Masoala, 500 m, X.1912, *Perrier de la Bâthie* 7941 (holo-, P! [P00418687]; iso-, P! [4 sheets]). — Madagascar, Toamasina, Maroantsetra, Ambanizana, piste menant du camp intermédiaire (15°31'08"S, 50°00'16"E) au sommet du Ambohitsitondroinan' Ambanizana (15°34'31"S, 50°00'38"E), versant W, 620-1109 m, 23.X.2004, *Janssen et al.* 2507 (epi-, P! [4 sheets: P00589598-601], here designated; isoeppi-, P! [3 sheets], TAN; one trunk surface mould at P!).

ADDITIONAL MATERIAL EXAMINED. — **Madagascar.** Toamasina, Makira, 15°26'S, 49°23'E, *Antilahimena et al.* 2614 (MO, TAN). — Central Madagascar, *Baron* 1586 (K). — Route d'Ambodihasina à Manandaleha,

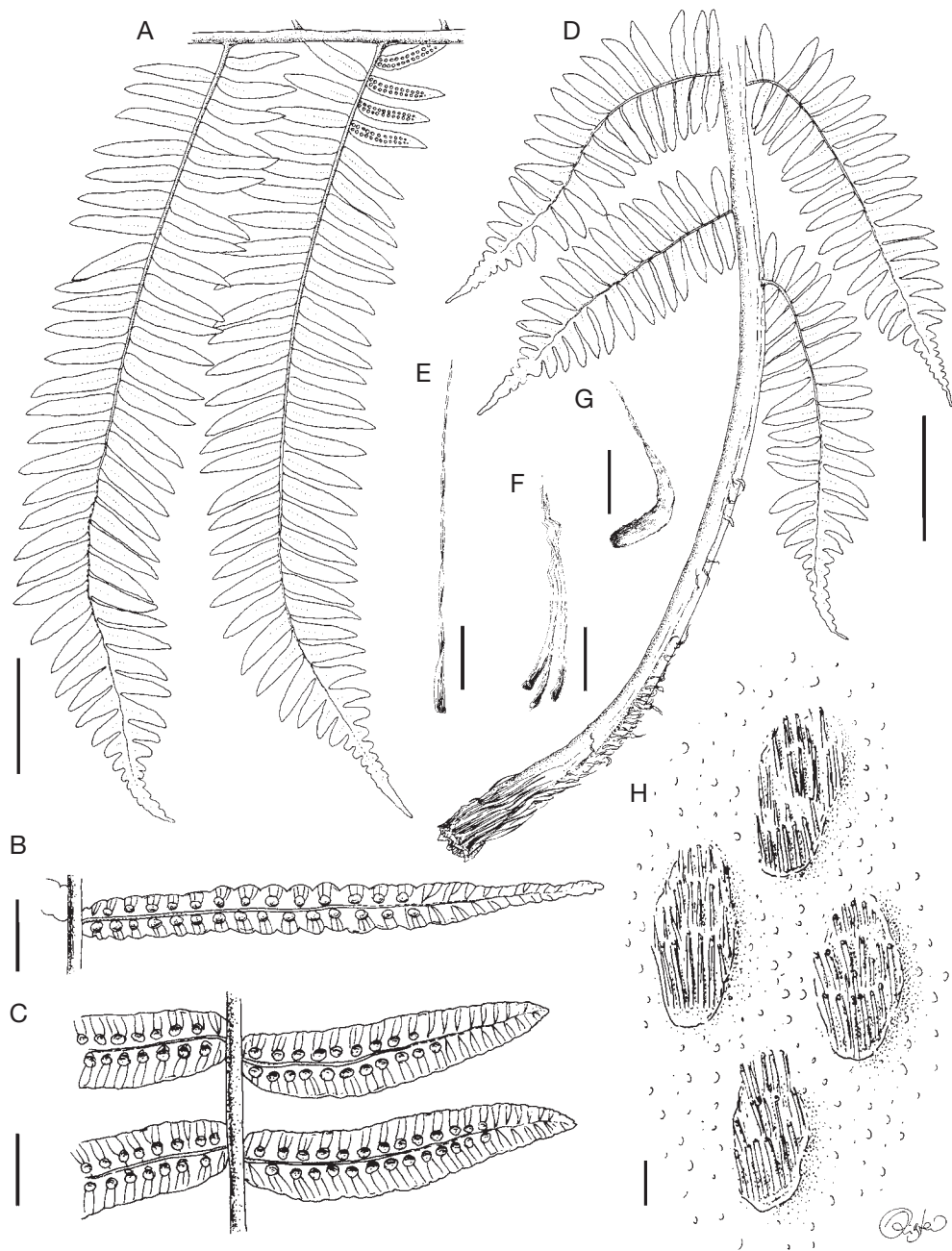


FIG. 24. — *Cyathea emlei* var. *dauphinensis* Janssen & Rakotondr.: **A**, pinnae abaxially with a fragment of the rachis, sori only partly indicated; **B**, pinnule abaxially with a fragment of the costa, crenate form; **C**, pinnules abaxially with a fragment of the rachis, common form; **D**, basal part of the leaf (from the petiole base up to the second pinna pair), lateral view; **E**, scale from the base of the petiole; **F**, group of scales from the base of the petiole, their upper half stramineous and membranous; **G**, scale from the lateral-adaxial face of the middle part of the petiole; **H**, leaf scars and trunk surface. A, C-E, G, Janssen *et al.* 2617 (P); B, F, H, Janssen *et al.* 2612 (P). Scale bars: A, D, 5 cm; B, C, H, 1 cm; E-G, 0.5 cm.

30.XII.1950, *Cours 3935* (P). — Brickaville, Am-balarondra-Andranampony, 18°50'S, 49°04'E, 350 m, 22.IV.1951, *Cours 4525* (P). — Antsiranana, massif du Manongarivo, 14°01'33"S, 48°24'47"E, 1566 m, 27.IX.2004, *Janssen et al. 2399* (MO, P, TAN), 2400 (P, TAN). — Toamasina, Maroantsetra, Ambanizana, piste au sommet d'Ambohitsitondroinan' Ambanizana, 15°32'S, 50°00'30"E, 620-1109 m, 23.X.2004, *Janssen et al. 2509* (MO, P, TAN). — RNI Betampona, Rendriendry, 17°55'54"S, 49°12'12"E, 250 m, 8.XI.2004, *Janssen et al. 2557* (MO, P, TAN), 2560 (MO, P, TAN). — Zahamena, W of Vavatenina, 17°44'S, 49°00'E, 500-750 m, IX.1993, *Malcomber et al. 2548* (P). — Toamasina, Maroantsetra, Ambanizana, piste au sommet d'Ambohitsitondroinan' Ambanizana, 15°34'S, 50°00'E, 940 m, 8.XII.1993, *Rakotondrainibe et al. 2064* (MO, P, TAN). — Antsiranana, RS d'Anjanaharibe-Sud, SSW de Befingotra, 14°45'18"S, 49°30'18"E, 840 m, 22.X.1994, *Rakotondrainibe et al. 2160* (MO, P, TAN). — RNI du Marojejy, NW de Man-antenina, 14°26'12"S, 49°46'30"E, 480 m, 5.X.1996, *Rakotondrainibe 3270* (MO, P, TAN). — Toamasina, PN de Zahamena, Ankosy, 17°41'08"S, 48°59'43"E, 650 m, 12.VI.2001, *Rasolohery 500* (MO, P, TAN). — Andasibe, forest of Mantadia, 18°55' S, 48°25'E, 900 m, 3.XI.1994, *van der Werff et al. 13617* (P).

FIELD OBSERVATIONS. — Trunk: HT up to 5 m, DT 8-10(-15) cm, dead petioles caducous and the leaf scars exposed; trunk surface muricate, brown to black; trunk frequently annulated between the pseudo-whorls formed by the leaf scars.

Petiole: with 1 or 2 rows of widely spaced, light brown arophanes on either side.

Leaf scars: 2-2.5 × 2.5-4 cm, rounded to obovate or elliptic, slightly concave, with 3-5 orifices on their lower rim and some orifices below the scars, spirally arranged or forming distinct pseudo-whorls.

Crown: more or less umbrella-shaped with a distinct infundibuliform centre forming a dense basket collect-ing leaf litter.

Trunk apex: densely scaly, concealed by the close standing petiole bases.

Lamina: oblanceolate; LL 155-205(-250) cm, WL 37-83 cm, FW 85-120 cm, NP (45-)52-63.

DESCRIPTION

Petiole: 0-10 cm long, 1.7-2.5 cm in diameter; green to stramineous, its abaxial face sometimes reddish to violaceous brown.

Lamina: pinnate-pinnatifid, pale green below, shiny green to dark green above, lamina base long and narrowly cuneate, adjacent basal pinnae overlapping, reflexed and conduplicate; rachis of the same colour as the petiole, completely green further up.

Largest pinnae: (19-)28-33 cm long, distant by 3-5 cm, adjacent pinnae spaced by less than their width, not overlapping, their apex acute to caudate, pinnatifid; costae and costulae stramineous to green.

Largest pinnules: (1.3-)1.6-2.4 × (0.4-)0.6-0.7 cm, spaced by less than their width, broadly adnate to the costa, adjacent pinnae confluent from the pinna base, thus forming a narrow and obtuse to rounded sinus, distance sinus-costa 0.3-0.7 cm, pinnule apex obtuse to rounded, margin entire, sometimes crenulate near the apex, the proximal pinnules often overlap the rachis adaxially; veins once furcate.

Scales and hairs: scales ascending from the petiole base to at least 30 cm on the petiole and rachis, gradually smaller and thinning upwards, contiguous to distant, not or hardly overlapping, persistent, deltoid to short and narrowly triangular, 0.3-0.6 × 0.1-0.2 cm, straight, shiny blackish brown to dull brown, with a narrow, light brown, erose margin, appressed to very slightly arched, very coriaceous; adaxial face of the rachis and costae densely tomentose with brown, contorted, antrorse, multicellular hairs; scattered filiform, dull brown scales on the adaxial face of the rachis; leaf otherwise glabrous.

Sori: subcostular to median, proximal sori gradually retreating from the costula, contiguous to spaced by about their width, covering the pinnules in the lower quarter to three quarters; indusia brown, subcoriaceous, at maturity dehiscing in 2-4 lobes or irregularly; receptacle capitate to disciform, shorter or longer than the rim of mature indusia, paraphyses inconspicuous.

DISTRIBUTION

Northern Madagascar: Manongarivo and east coast from Marojejy to Betampona; endemic.

ECOLOGY

500-950(-1500) m. Dense evergreen rainforests.

REMARKS

Cyathea longipinnata resembles *C. madagascariensis* Bonap. from which it can be distinguished by its smaller scales and less deeply divided pinnae. Juvenile plants of *C. longipinnata* have pinnatifid to simply pinnate leaves.

Specimens from the Manongarivo, *Janssen et al.* 2399 and 2400, representing two neighbouring plants growing at much higher altitudes (1500 m) than the rest of the specimens, have comparatively small pinnae and pinnules and sparse dull brown scales that are sometimes sharply reflexed. All other characters agree perfectly with *C. longipinnata* and dull brown scales occur in some rare instances in the other specimens.

TYPIFICATION AND SYNONYMY

Three sheets of *Perrier de la Bâthie* 7941 could be traced. One of these is marked "Original" by Bonaparte and is the holotype of the species. It contains two middle pinnae and a leaf apex. However, Bonaparte gives a description of petiole scales in the protolog. Hence, there must exist at least one further sheet of the original collection, which is currently lost. We designate an epitype to compensate for the associated lack of information.

25. *Cyathea longispina*

Janssen & Rakotondr., sp. nov.

(Figs 26; 45G; 50E)

Filix arborescens. Lamina herbacea (non coriacea) pinnato-pinnatisecta pinnulis angustis, 0.3-0.5 cm latis, spatium inter eas latitudine pinnularum vel majus, apice acuta an obtusa, margine subintegro vel crenato. Paleae petioli 2-3.5 cm longae et 0.1-0.2(-0.3) cm latae, strictae, nitentes, sordide brunneae, basi petioli densissime instructae. In pagina abaxiali costarum et costularum paleae nitentes brunneae filiformes (1 cm longae) et anguste triangulares (c. 0.3 cm longae) apice spina prominente sordide brunnea nitente c. 0.1 cm longa provisae.

TYPUS. — Madagascar, Prov. de Mahajanga, massif du Tsaratanana, montagnes au N de Mangindrano, crête menant de Matsaborimaiky vers Bepia, entre la source de la rivière Maevarano (14°08'49"S, 48°58'11"E) et le point culminant de la crête (14°08'45"S, 48°58'18"E), 2360 m, 12.V.2005, *Janssen et al.* 2916 (holo-, P! [4 sheets: P00589605-08]; iso-, P! [3 sheets], TAN!; one trunk surface mould at P!).

ADDITIONAL MATERIAL EXAMINED. — **Madagascar.** Antsiranana, massif du Tsaratanana, Andohanisambirano, 14°08'30"S, 48°58'30"E, 25.IV.2001, *Birkinshaw* 873 (P). — Mahajanga, massif du Tsaratanana, N de Mangindrano, entre Matsaborimaiky et la source du Maevarano, 14°08'54"S, 48°57'56"E, 2250-2300 m,

11.V.2005, *Janssen et al.* 2901 (MO, P, TAN). — *Idem*, 14°08'49"S, 48°58'11"E, 2330 m, 11.V.2005, *Janssen et al.* 2906 (MO, P, TAN), 2908 (MO, P, TAN). — *Idem*, entre Matsaborimaiky et Bepia, point culminant de la crête, 14°08'45"S, 48°58'18"E, 2360 m, 12.V.2005, *Janssen et al.* 2915 (MO, P, TAN). — Mangindrano, 14°12'43"S, 49°07'34"E, 2191 m, XI.2005, *Rakotovoao et al.* 2453 (MO, P, TAN). — Antsiranana, massif de Tsaratanana, Ampanopia, Ampitsinjovana, 14°08'S, 48°52'E, 25.IV.2001, *Rasolohery* 405 (P).

FIELD OBSERVATIONS. — Trunk: HT up to 4 m, DT 8-9.5 cm excluding and 10-14 cm including the persistent petiole bases; some dead rachises persistent and hanging from the apex, dead petiole bases persistent, relatively long and appressed to the trunk, arranged in distinct vertical rows and covering the trunk in its upper part, decomposed below and trunk more or less naked with the leaf scars exposed; trunk surface muricate, dark brown.

Petiole: with 1, 2 or several rows of small, much spaced, whitish to dark brown aerophores on either side; petiole bases short to long sigmoid.

Leaf scars: 1.5-2 × 1.5-2.5 cm, rounded to elliptic, spaced to contiguous, with 5-7 orifices on their lower rim or below, the lower rim more or less raised; spirally arranged.

Crown: many-leaved, usually about 16 leaves in two pseudo-whorls present; crown more or less erect to arching, its centre infundibuliform creating a more or less dense basket collecting leaf litter.

Trunk apex: densely scaly, hidden among the close standing petiole bases.

Lamina: elliptic to oblanceolate; LL 120-155 cm, WL 55-70 cm, FW 50-75 cm, NP 24-34.

DESCRIPTION

Petiole: 23-42 cm long, 1.5-2.7 cm in diameter; stramineous to green, more or less reddish to castaneous on its abaxial face; aplebia absent.

Lamina: pinnate-pinnatisect, herbaceous to subcoriaceous (not coriaceous), dull pale green below, shiny green to dark green above, lamina base attenuate, basal pinnae more or less strongly conduplicate and reflexed; rachis of the same colour as the petiole, completely stramineous green further up.

Largest pinnae: 27-35 cm long, distant by 4-5 cm, adjacent pinnae overlapping, their apex shortly caudate, pinnatifid; costae and costulae of the same colour as the rachis.

Largest pinnules: 1.5-3.5 × 0.3-0.5 cm, spaced by about to slightly more than their width, linear-oblong, straight to slightly falciform in the upper

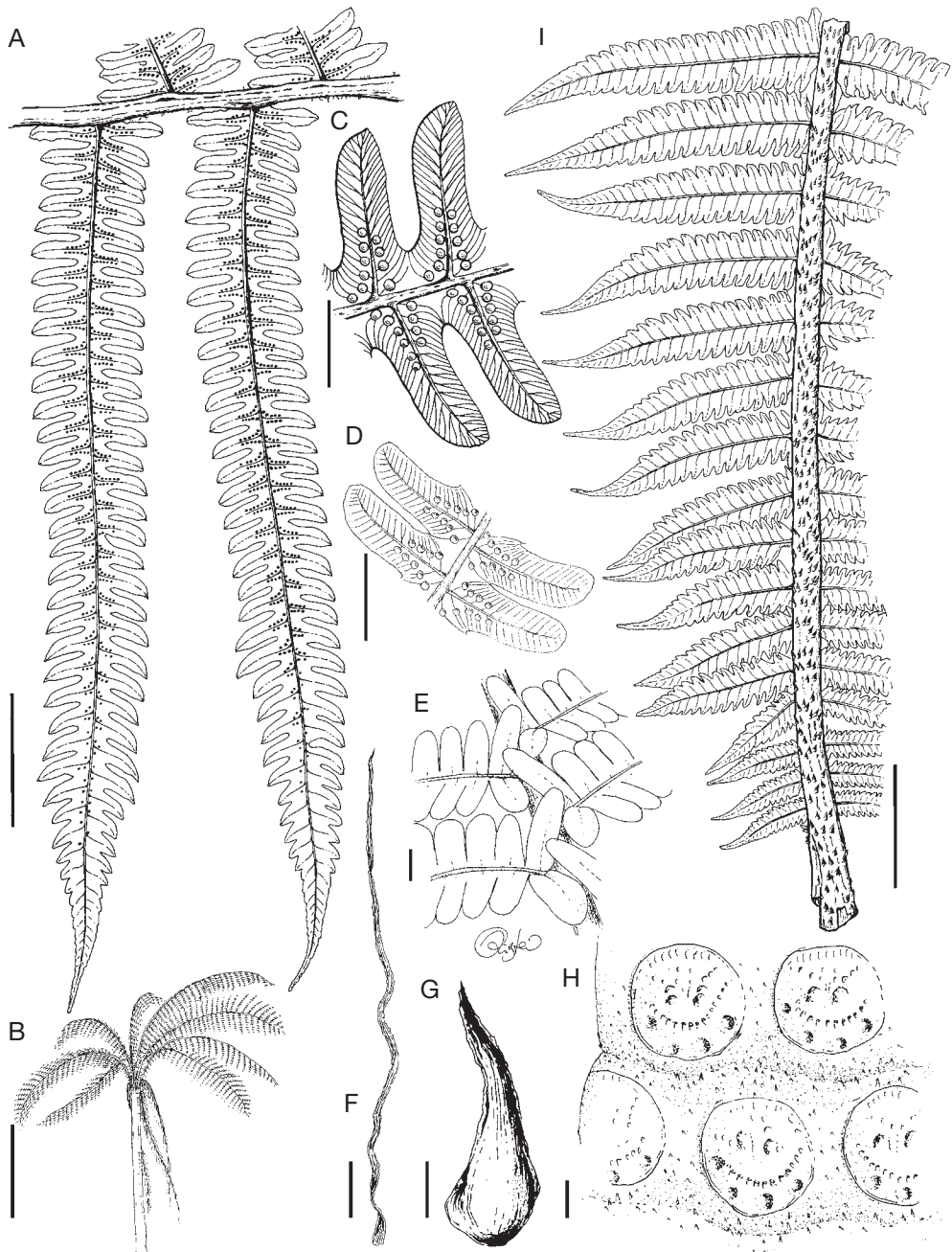


FIG. 25. — *Cyathea longipinnata* Bonap.: **A**, pinnae abaxially with a fragment of the rachis; **B**, habit; **C**, pinnules abaxially with a fragment of the costa, common form; **D**, pinnules abaxially with a fragment of the rachis, small form with rounded apex; **E**, adaxial view of the rachis from the lower half of the leaf, note that the proximal pinnules overlap the rachis; **F**, scale from the lateral-adaxial face of the lower half of the rachis; **G**, scale from the abaxial face of the base of the rachis; **H**, leaf scars and trunk surface; **I**, basal part of the leaf (from the base of the petiole up to the first several pinna pairs), dorsal view. A-C, E, I, Janssen *et al.* 2557 (P); D, F-H, Janssen *et al.* 2507 (P). Scale bars: A, I, 5 cm; B, 1 m; C-E, H, 1 cm; F, G, 0.1 cm. A, C, I, drawings by B. Raufeisen.

half of the pinnae, margin subentire or crenate, apex acute to obtuse, the first proximal pinnule pair sessile and more or less deeply lobed, overlapping the rachis adaxially; veins once to twice furcate.

Scales and hairs: scales present from the petiole base upwards to 15-30 cm on the petiole, at the petiole base very dense and overlapping, rather abruptly thinning and the upper part of the petiole without conspicuous scales, narrowly triangular, 2-3.5 × 0.1-0.2(-0.3) cm, persistent, straight near the petiole base, more or less contorted further up on the petiole, apex not crispate, scales shiny dark brown with a narrow, light brown, erose margin, appressed to the petiole or not and then antrorse, not indurated; shiny brown scales with a lighter, erose margin and a very prominent, shiny dark brown apical spine, up to 0.1 cm long, present on the abaxial face of the costae and costulae, narrowly triangular and mostly up to 0.3 cm long, or filiform and up to more than 1 cm long; whitish, amorphous or acaroid squamules with strong, dark brown, long spines on the abaxial face of the rachis and costae; adaxial face of the rachis and costae densely tomentose with stramineous, contorted, patent hairs.

Sori: subcostular, contiguous to spaced by about their width, about 0.1 cm in diameter, covering the lower half to three quarters of the pinnules; indusia globular, brown, subcoriaceous, at maturity dehiscing in irregular lobes, but not to the base of the receptacle, usually a cup-like structure with a lacinate-lobate rim persistent, oblique with its opening directed outwards; receptacle capitate to disciform, much shorter than the rim of mature indusia, paraphyses inconspicuous.

DISTRIBUTION

Northern Madagascar: Tsaratanana massif; endemic.

ECOLOGY

2200-2400 m. Dense evergreen rain and cloud forests, on crests.

REMARKS

This species is well characterized by its narrow, herbaceous (not coriaceous) pinnules with an acute

to obtuse apex, spaced by about their width and by the presence of scattered, shiny brown scales with a very prominent apical spine on the abaxial face of the rachis and costae. In the Tsaratanana, it might be confounded with *C. bellisquamata* var. *basilobata*, which however has coriaceous pinnules with a rounded to obtuse apex, spaced by less than their width and lacks the characteristic costa scales of *C. longispina*. Rarely however, *C. bellisquamata* may exhibit dull brown, filiform scales without a prominent apical spine on the abaxial face of its rachis and costae.

ETYMOLOGY

The epithet makes reference to the prominent apical spines of the characteristic shiny brown scales that are scattered on the rachis and costae of this species.

26. *Cyathea madagascariensis* Bonap.

(Figs 27; 45I; 51A)

Notes ptéridologiques 5: 49 (1917); Christensen, *Dansk Botanisk Arkiv* 7: 23, pl. 4 figs 16, 17 (1932); Tardieu in Humbert, *Flore de Madagascar et des Comores, IV^e famille, Cyathéacées*: 9 (1951). — *Alsophila matitanensis* R.M. Tryon, *Contributions from the Gray Herbarium* 200: 30 (1970). — Type: Madagascar, bassin du Matitana, bord d'un petit affluent du Rainany, 700 m, *Perrier de la Bâthie* 7559 (holo-, P! [2 sheets: 00418693, -94]; iso-, P! [3 sheets]).

ADDITIONAL MATERIAL EXAMINED. — **Madagascar.** *Baron R 6112* (K), *6113* (K). — Fianarantsoa, PN Ranomafana, forêt de Talatakely, 21°15'54"S, 47°25'36"E, 1010 m, 26.IV.2005, *Janssen et al.* 2829 (MO, P, TAN), 2830 (MO, P, TAN), 2834 (P). — Fianarantsoa, PN de Ranomafana, Ranomena, 21°17'S, 47°27'E, 1100 m, 27.X.1992, *Rakoto* 287 (G, MO, P). — Toamasina, PN de Zahamena, Ankosy, 17°41'08"S, 48°59'43"E, 650 m, 12.VI.2001, *Rasolobery* 499 (MO, P, TAN).

FIELD OBSERVATIONS. — Trunk: HT up to 8 m, DT 5-9 cm; in smaller plants dead leaves persistent and hanging from the apex, the trunk covered with a mantle of dead petiole bases, adventitious roots and leaf litter; in taller plants dead leaves caducous and the leaf scars exposed, a rudiment of the petiole persists in the uppermost part of the trunk; trunk surface dark brown, sometimes with persistent dark brown scales, coarsely muricate.

Petiole: with 1-3 rows of orange-brown, much spaced,

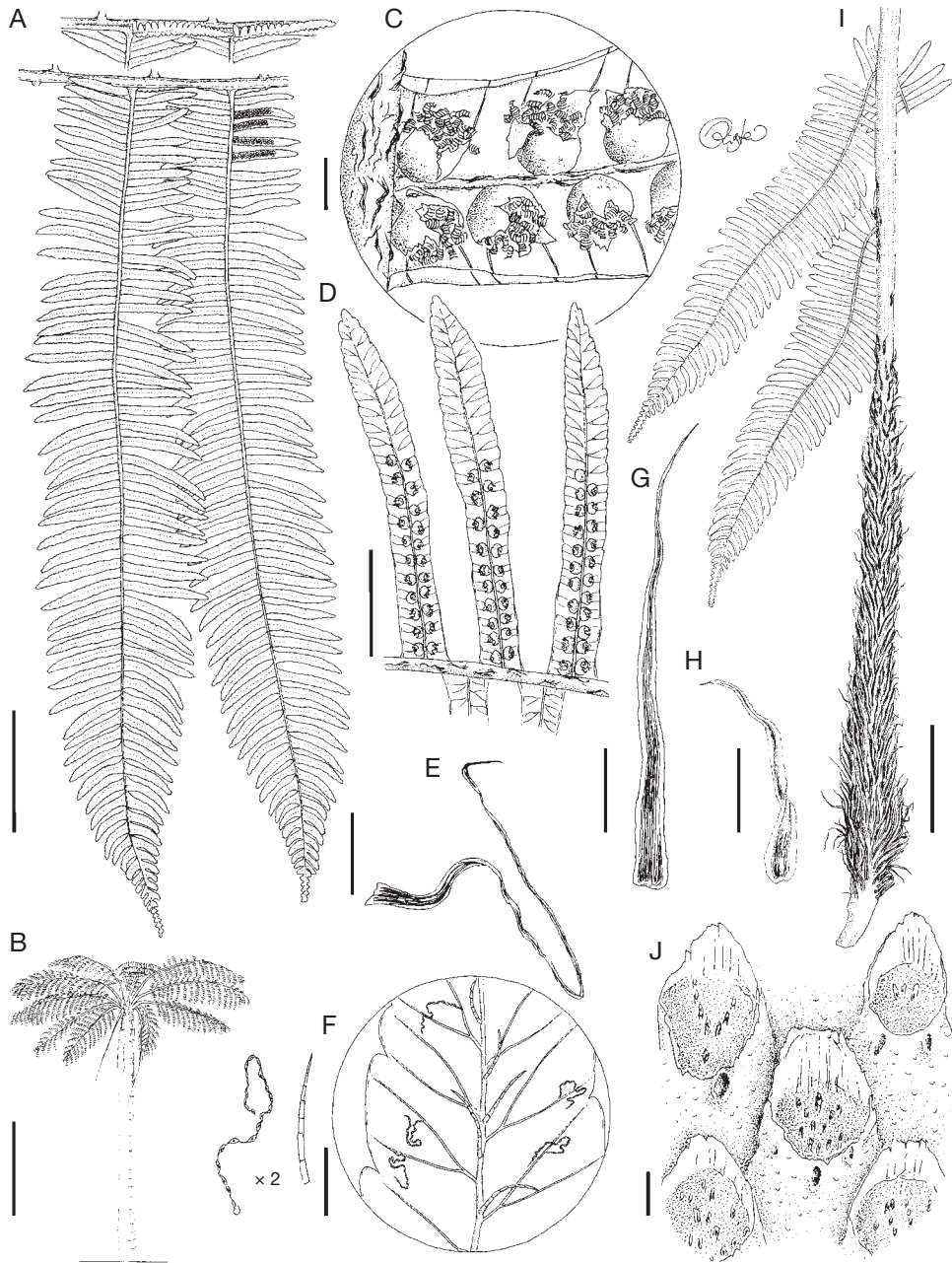


FIG. 26. — *Cyathea longispina* Janssen & Rakotondr.: **A**, pinnae with a fragment of the rachis (above: adaxially; below: abaxially, sori only partly indicated); **B**, habit; **C**, proximal part of a pinnule abaxially (at the junction with the costa), note the scaly indument on the costa and costula; **D**, pinnules abaxially with a fragment of the costa; **E**, scale from the abaxial face of the costa, note the long apical spine; **F**, pinnule apex adaxially with straight multicellular hairs on the costa and crisped catenate hairs on the veins, both types of hairs two-fold magnified on the left; **G**, scale from the base of the petiole; **H**, scale from the upper half of the petiole; **I**, basal part of the leaf (from the petiole base up to the second pinna pair), dorsal view, pinnae pruned away on one side; **J**, leaf scars and trunk surface. A, C–J, Janssen *et al.* 2916 (P); B, Janssen *et al.* 2908 (P). Scale bars: A, I, 5 cm; B, 1 m; C, E, F, 0.1 cm; D, J, 1 cm; G, H, 0.5 cm.

aerophores on either side, distributed over the entire abaxial surface near the base of the rachis; petiole bases straight.

Leaf scars: 2-2.5 × 3-3.5 cm, elliptic to rounded, obovate or cordate, with 3-5 orifices on their lower rim, slightly concave, arranged in distinct pseudo-whorls.

Crown: many-leaved, about 40 green leaves present, about 8 leaves per pseudo-whorl, petiole bases straight, rachises arched further up, crown with a dense infundibuliform centre forming a basket collecting leaf litter.

Trunk apex: concealed among the close standing petiole bases.

Lamina: oblanceolate; LL (110-)190-250 cm, WL 45-53 cm, FW 95-150 cm, NP 78-95.

DESCRIPTION

Petiole: 0-10 cm long, 2.5-3 cm in diameter; abaxial face dark brown to blackish, adaxial face dark reddish brown.

Lamina: pinnate-pinnatifid to pinnate-pinnatisect, very coriaceous, shiny light green below, shiny green above, lamina base long and narrowly cuneate with the pinnae gradually reduced in size, basal pinnae triangular, patent and slightly falciform, strongly conduplicate, adjacent basal pinnae overlapping; rachis of the same colour as the petiole, somewhat lighter.

Largest pinnae: 20-26 cm long, distant by 3-3.5 cm, adjacent pinnae not overlapping, spaced by less than their width to contiguous, their apex caudate, pinnatifid; costae and costulae stramineous.

Largest pinnules: 1.5-2 × 0.4-0.5 cm, spaced by less than their width, broadly adnate to the costa, adjacent pinnae usually slightly confluent from the pinna base, thus forming an obtuse to rounded sinus, distance sinus – costa 0.1-0.3 cm, pinnules oblong, falciform, margin entire to serrulate, apex rounded, rarely obtuse, the proximal pinnules distinctly overlap the rachis adaxially; veins once furcate.

Scales and hairs: scales present from the petiole base upwards to at least 40 cm on the petiole and rachis, usually further up, gradually smaller and thinning, distant, rarely slightly overlapping, persistent, deltoid to narrowly triangular, 1-1.3 × 0.3-0.4 cm, straight, shiny blackish brown, with a very narrow, light brown, erose margin, appressed or very slightly arched, very coriaceous; adaxial face of the rachis and costae tomentose with brown contorted, patent to antrorse, multicellular hairs; scattered brown,

crispate, filiform scales on the adaxial face of the rachis; leaf otherwise glabrous.

Sori: subcostular, contiguous to spaced by about their width, about 0.1 cm in diameter, covering entire pinnules or only their lower half; indusia globular, light brown, membranous to subcoriaceous, at maturity dehiscent in irregular lobes, but usually not down to their base; receptacle capitate to disciform, shorter than the rim of mature indusia, paraphyses inconspicuous.

DISTRIBUTION

Central Madagascar: Zahamena region to Matitana river; endemic.

ECOLOGY

650-1100 m. Dense evergreen rainforests.

REMARKS

This taxon must not be confounded with *Alsophila madagascariensis* Bonap. (= *Cyathea boiviniiformis* Rakotondr. & Janssen), a widespread tripinnate, exindusiate species of the *Gymnosphaera*-clade (Janssen *et al.* 2008). *Cyathea madagascariensis* is easily recognized by its appressed, coriaceous, much spaced, shiny black scales at the petiole base that are bigger than those of *C. longipinnata*. Furthermore, the latter taxon has less deeply divided pinnae. *Cyathea melanocaula* Desv. is distinct by its petiole scales and much wider pinnae divided into fewer segments.

Rasolohery 499 has a petiole length of 20 cm and small, shiny black, deltoid to spiniform scales. In cutting, the pinnae of the petiole base and the middle pinnae perfectly resemble what has been found in juvenile plants of *C. madagascariensis* (cf. Janssen *et al.* 2008). Despite its morphological particularities, we presume that the said specimen is currently best included in *C. madagascariensis*.

TYPIFICATION AND SYNONYMY

Five sheets of *Perrier de la Bathie 7559* are available at P. Two are marked as "Original" by Bonaparte and include a petiole base, a part of the cuneate lamina base, middle pinnae and pinnae near the apex of the leaf. Together, they represent the holotype, which is characteristic for the species rendering

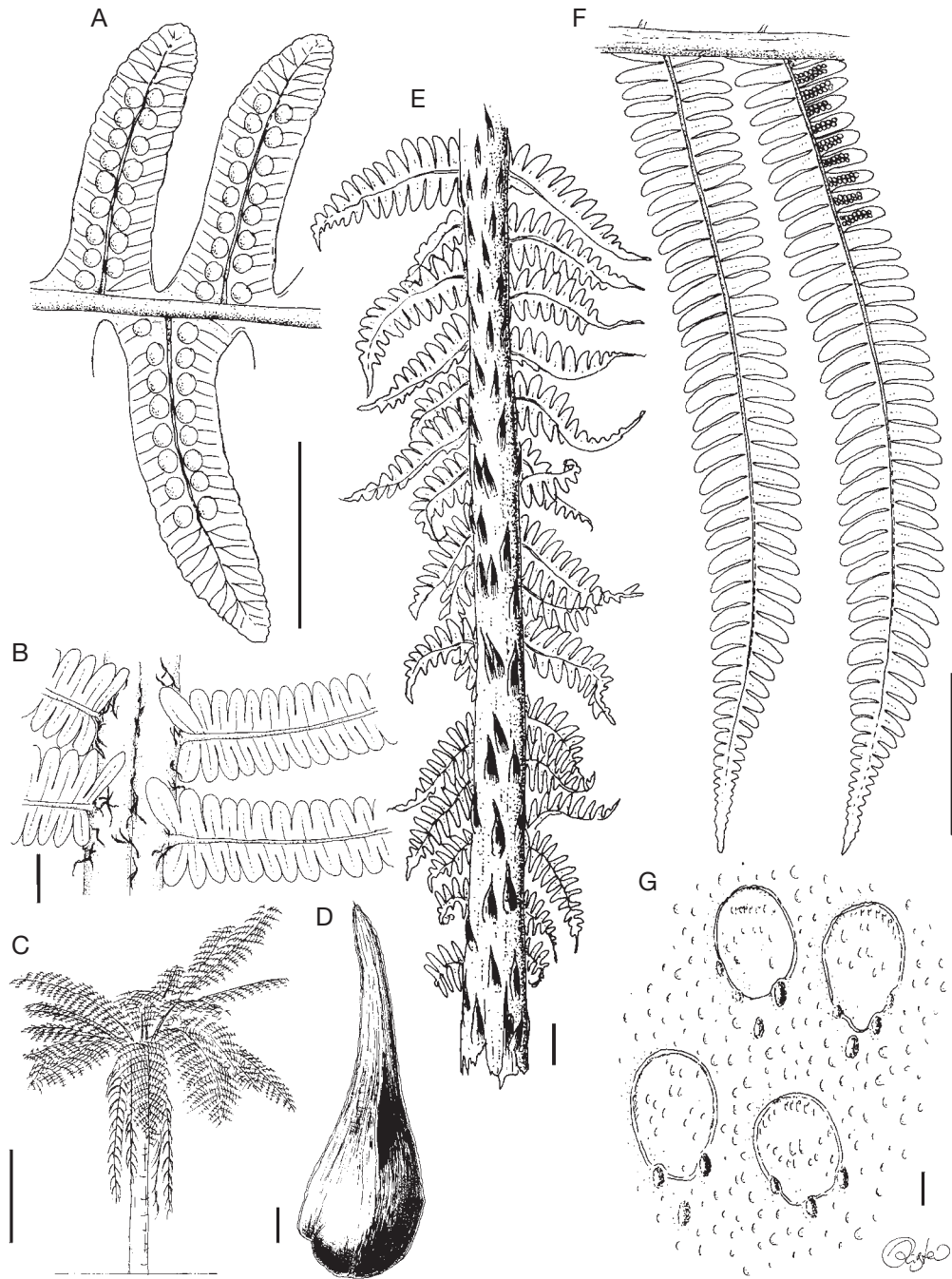


FIG. 27. — *Cyathea madagascariensis* Bonap.: **A**, pinnules abaxially with a fragment of the costa; **B**, adaxial view of the rachis from the lower half of the leaf, note that the proximal pinnules overlap the sparsely scaly rachis; **C**, habit; **D**, scale from the abaxial face of the base of the rachis; **E**, basal part of the leaf (from the base of the petiole up to the first several pinna pairs), dorsal view; **F**, pinnule abaxially with a fragment of the rachis, sori only partly indicated; **G**, leaf scars and trunk surface. *Janssen et al. 2829 (P)*. Scale bars: A, B, E, G, 1 cm; C, 1 m; D, 0.1 cm; F, 5 cm.

epitypification superfluous. However, the holotype should not be dissociated from the three available isotype sheets, which most likely carry parts from the same leaf as deduced from the size and colouring of the pinnae they contain.

27. *Cyathea melanocaula* Desv.
(Figs 28A-F; 45K; 51B)

Prodrome de la famille des fougères: 322 (1827); Christensen, *Dansk Botanisk Arkiv* 7: 23, pl. 4 figs 12-15 (1932); Tardieu in Humbert, *Flore de Madagascar et des Comores, IV^e famille, Cyathéacées*: 8 (1951). — *Alsophila melanocaula* (Desv.) R.M. Tryon, *Contributions from the Gray Herbarium* 200: 30 (1970). — Type: habitat in Madagascar, *Desvieux s.n.* (holo-, P! [P00418680]). — Madagascar, Toliara, Tolanaro, forêt de Manantantely, Domaine de la Cascade, aux bords de la rivière au-dessus de la cascade, 24°59'19"S, 46°55'25"E, 150 m, 25.XI.2004, Janssen et al. 2608 (epi-, P! [4 sheets: P00589616-19], here designated; isoepi-, P! [3 sheets], TAN!; one trunk surface mould at P!).

ADDITIONAL MATERIAL EXAMINED. — **Madagascar.** Bernard s.n. (P). — Toliara, Ebakika, 24°44'S, 47°09'E, 17.XI.1932, Decary 11055 (P). — Toamasina, Andovoranto, 18°08'30"S, 49°23'E, Higginson s.n. (K). — Fort Dauphin, forêt de Manantantely, 24°59'S, 46°55'E, 60-300 m, 22.IX.1928, Humbert 5837 (BM, P). — Bassin de la Manampanihy, mont Vohimavo N d'Ampasimena, 24°20'S, 47°08'E, 100 m, III.1947, Humbert 20642 (P). — Toliara, Tolanaro, forêt de Manantantely, 24°59'19"S, 46°55'25"E, 150 m, 25.XI.2004, Janssen et al. 2609 (MO, P), 2610 (MO, P, TAN), 2614 (P). — Bas Matitana, 22°26'S, 47°55'E, X.1911, Perrier de la Bâthie 11554 (P). — Fianarantsoa, corridor reliant les PN de Ranomafana et d'Andringitra, Ambatofotsy, 21°44'S, 47°24'E, 680-700 m, 4.XI.2000, Rabarimanarivo et al. 114 (P). — Fianarantsoa, Farafangana, 2 km S d'Analamena, 24°10'41"S, 47°44'11"E, 27 m, 15.VIII.2006, Razafitsalma et al. 977 (P). — Prov. d'Andovoranto, rive gauche de la Vohitra, près de Brickaville, 18°50'S, 49°04'E, 4.X.1912, Viguier et al. 474 (B, P). — Without locality, s. coll. s.n. (K).

FIELD OBSERVATIONS. — Trunk: HT up to 2(-5) m, DT (4-)5-7(-10) cm, the appressed bases of dead petioles persist in the upper part of the trunk, caducous below and leaf scars exposed; trunk surface black, muricate with short and distant excrescences carrying a caducous scale on their tip; trunk more or less thickened at its base.

Petiole: with 1 or 2 rows of light brown to blackish, much spaced aepophores on either side and on its entire

abaxial surface near the petiole base; petiole bases long, appressed to the trunk and gradually recurved.

Leaf scars: 1.5-2.7 × 3.5-4 cm, elliptic, with relatively short and blunt spines on their lower rim, big and shallow, brown orifices below the scar; spirally arranged.

Crown: many-leaved, more or less infundibuliform, petioles and rachis erect.

Trunk apex: densely scaly, dark brown, concealed by the petiole bases.

Lamina: narrowly elliptic to oblanceolate; LL (60-)100-180 cm, WL 38-60 cm, FW 57-100 cm, NP 19-25(-40).

DESCRIPTION

Petiole: 10-25 cm long, 1-1.7 cm in diameter; completely black to dark violaceous brown.

Lamina: pinnate-pinnatifid to pinnate-pinnatisect, subcoriaceous, shiny light green below, shiny green above, lamina base attenuate to acute, the basal pinnae patent and not conduplicate; basal pinnae less deeply dissected than the middle pinnae, spaced by several times their width, the basalmost much reduced and oblong with an entire to sinuate margin and more or less caducous; rachis of the same colour as the petiole.

Largest pinnae: 24-32 cm long, distant by 5-8 cm, adjacent pinnae slightly spaced to slightly overlapping, their apex pinnatifid and long attenuate-caudate and only shallowly lobed; costa black at least in its lower half, its upper part and the costulae light brown to stramineous (dry).

Largest pinnules: 2.7-4 × 0.7-1.0 cm, spaced by less than their width, broadly adnate to the costa, slightly decurrent, adjacent pinnules confluent from the base of the pinna or only in its upper half, sinus rounded, pinnules oblong, straight, their margin entire, crenulate near the rounded apex; veins once to three times furcate.

Scales and hairs: scales present from the petiole base upwards to about 30-40 cm on the petiole and rachis, moderately dense and overlapping, persistent, narrowly triangular, 1.5-2 × 0.2 cm, straight, at most their apex slightly twisted, shiny light to dark brown, with a narrow light brown erose margin, coriaceous, slightly to conspicuously indurated at their base and more or less arching, adaxial scales not appressed to the petiole; very sparse antrorse hairs on the adaxial face of the costae; leaf otherwise completely glabrous.

Sori: subcostular, spaced by less than to about their width, 0.1-0.2 cm in diameter, covering up to three quarters of the pinnule; indusia globular, dark brown, coriaceous, at maturity dehiscing in 2-4 lobes; receptacle capitate, shorter than the rim of mature indusia, paraphyses inconspicuous.

DISTRIBUTION

Central and Southern Madagascar: south of 18°S; endemic.

ECOLOGY

50-300(-700) m. Dense evergreen rainforests, usually in very wet places, i.e. near or in small streams.

REMARKS

Young plants have less strongly dissected, i.e. pinatifid to lobate, narrowly lanceolate pinnae, spaced by about their width. Very young plants have simply pinnate leaves and the pinnules have a sinuate margin (cf. *Janssen et al. 2609, 2614*).

Only few specimens of this taxon exist and most have been collected, in lowland forests. As a rare species depending on a rare habitat it is probably highly threatened.

TYPIFICATION AND SYNONYMY

Even though the fragmentary holotype is characteristic of the species with respect to lamina dissection and its black axes, the specimen has been confounded with *C. borbonica* Desv. (Christensen, 1906: 193) and epitypification with specimens including the petiole base with scales seems to be useful.

28. *Cyathea oblecta* Rakotondr. & Janssen, sp. nov. (Figs 28G-K; 46B)

Filix arborescens valde characteristic, foliis ornatis duobus paribus aphlebiis, 3-4 cm longis prope basim petioli. Lamina pinnato-pinnatisecta, basi attenuata, petiolus 35-40 cm longus, dense oblecta paleis anguste triangularibus, 0.7-1 cm longis et 0.1-0.15 cm latis, strictis vel plusminusve contortis, nitide cupreo-brunneis. Paleae similes densae ad 0.7 cm longae in pagina abaxiali rhachidis, costarum et costularum. Pinnulae maximae 1.5-2 cm longae et 0.3 cm latae, costae late adnatae, spatium inter eas latitudinem aequans, margine crenulata et revoluta, apice obtusa.

TYPUS. — Madagascar, Province d'Antsiranana, district d'Andapa, Befingotra, RS d'Anjanaharibe-Sud, sur le versant Sud-Est, à 12 km à l'WSW de Befingra, 14°44'48"S, 49°26'0"E, 1920 m, 25.XI.1994, *Rakotondrainibe & Rabarimalala 2524* (holo-, P! [P00046991]).

FIELD OBSERVATIONS. — Trunk: HT 0.2-0.3 m.
Lamina: elliptic; LL 90 cm, NP 20-25.

DESCRIPTION

Petiole: 35-40 cm long, 1 cm in diameter and dark brown when dry; with 2 pairs of aphlebia near its base, these 3-4 cm long.

Lamina: pinnate-pinnatisect, subcoriaceous, lamina base shortly attenuate, basal pinnae reflexed; rachis brown, abaxial face copper brown.

Largest pinnae: 20-22 cm long, distant by 2.5-3 cm; adjacent pinnae overlapping, their apex shortly caudate, pinatifid; costae and costulae of the same colour as the rachis.

Largest pinnules: 1.5-2 × 0.3 cm, spaced by about their width, the 2 or 3 proximal pinnule pairs sessile, other pinnules broadly adnate to the costa, linear-oblong, straight, margin crenulate and revolute, apex obtuse; veins once furcate.

Scales and hairs: scales present from the petiole base upwards to at least 40 cm on the petiole and rachis, persistent, at the petiole base dense and overlapping, contiguous to scattered and smaller in the upper half of the petiole, narrowly triangular with a long caudate apex, 0.7-1 × 0.1-0.15 cm, straight to contorted, shiny copper brown with a light brown erose margin, appressed to the petiole or not and then antrorse, somewhat indurated at their base; the same type of scales, narrower and up to 0.7 cm long, with a conspicuous but not very prominent apical spine, densely covering the abaxial face of the costae and costulae as well as scattered on both faces of the rachis; adaxial face of the costae, costulae and, to a lesser extent, of the veins densely tomentose with whitish multicellular hairs.

Sori: subcostular, contiguous to slightly spaced, about 0.1 cm in diameter, covering the lower three quarters of the pinnules; indusia globular, hyaline, membranous, dehiscing irregularly at maturity; receptacle capitate, shorter than the rim of mature indusia, paraphyses inconspicuous.

DISTRIBUTION

Northern Madagascar: Anjanaharibe-Sud; endemic.

ECOLOGY

About 1900 m. On siliceous rock in low ericoid vegetation.

ETYMOLOGY

The epithet *obtecta* refers to the petiole and the abaxial surface of the rachis and costae that are densely covered with scales.

29. *Cyathea orthogonalis* Bonap.

(Figs 29; 46B)

Notes ptéridologiques 5: 32 (1917); Bonaparte, *Notes ptéridologiques* 5: 29 (1917), nom. nud.; Christensen, *Dansk Botanisk Arkiv* 7: 24, pl. 5 figs 26, 27 (1932); Tardieu in Humbert, *Flore de Madagascar et des Comores, IV^e famille, Cyathéacées*: 11 (1951). — *Alsophila orthogonalis* (Bonap.) R.M. Tryon, *Contributions from the Gray Herbarium* 200: 31 (1970). — Type: Madagascar, *Baron* 6126 (holo-, P! [P00338265]; iso-, P!, K!). — Madagascar, Antananarivo, Anjozorobe, forêt d'Andranomay, 2 km au NE d'Andranomay, 13 km au SE d'Anjozorobe, 18°28'48"S, 47°57'18"E, 1300-1450 m, 16.XII.1996, *Rakotondrainibe* 3754 (epi-, P! [3 sheets: P00084603-05], here designated).

ADDITIONAL MATERIAL EXAMINED. — **Madagascar.** Toamasina, Zahamena National Park, Andranomalaza Atsimo, 17°39'40"S, 48°39'30"E, 1182 m, 24.X.2000, *Birkinshaw et al.* 752 (P). — District d'Ambatondrazaka, Onibe, 17°50'S, 48°25'E, 850 m, XI.1938, *Cours* 1198 (P). — Forêt de Didy, 18°07'S, 48°32'40"E, 1000 m, 8.XI.1941, *Cours* 1631 (P). — Est de Moramanga, 18°56'S, 48°13'E, 1000 m, 22.XI.1942, *Cours* 1739 (P). — Antananarivo, Anjozorobe, 18°23'30"S, 47°53'E, 1200 m, 21.I.1944, *Cours* 1769 (P). — Massif de l'Andringitra, forêt Ambodipaiso, 21°17'S, 47°34'E, 1100 m, 12.I.1945, *Cours* 2281 (P). — Fianarantsoa, Antsiranana, Ambatofitorahana, 20°49'S, 47°11'E, 1000 m, 6.III.1951, *Cours* 4124 (P). — Didy, SE of Lac Alaotra, 17°56'37"S, 48°27'20"E, 1130 m, 28.I.1995, *du Puy et al.* 805 (K, MO, P, WAG). — Lac Alaotra, 17°33'S, 48°25'E, *Jardin Botanique Tananarive* 4341T (P). — Toamasina, RN de Zahamena, massif de l'Andrangoval, 17°40'S, 48°45'E, 1000 m, X.1937, *Humbert et al.* 17607 (P), 17610 (P). — Toamasina, PN de Zahamena, Antanandava, 17°29'S, 48°44'E, 1107 m, 26.I.2001, *Rasolohery* 203 (MO, P, TAN). — *Idem*, 917-1020 m,

2.II.2002, *Rasolohery* 628 (MO, P, TAN). — Zahamena, Manakambahiny Est, NW Androrangabe, 17°40'34"S, 48°45'32"E, 1100 m, 17.IX.2002, *Rasolohery* 720 (MO, P, TAN). — Ambatondrazaka, Sahamalaza, Onibe, 17°44'07"S, 48°43'01"E, 1010 m, 2.III.2001, *Ratovoson et al.* 451 (MO, P).

FIELD OBSERVATIONS. — Trunk: HT up to 6(-10) m, DT 6-12 cm, dead petioles caducous and the leaf scars exposed, rudiments of the petiole base persistent in the upper part of the trunk; trunk surface smooth, blackish brown, rarely with persistent scales.

Petiole: base sigmoid.

Leaf scars: 2 × 3 cm, obovate to elliptic, sometimes rounded, somewhat raised, their rim not spiny.

Crown: a flat umbrella.

Lamina: LL 150-300 cm, NP 46-58.

DESCRIPTION

Petiole: about 10-20 cm long, 1-1.5 cm in diameter and dark brown when dry.

Lamina: pinnate-pinnatisect, very coriaceous, shiny dark green above, dull pale green below, lamina base attenuate, but pinnae not decrescent down to the petiole base; basal pinnae spaced by about to more than their width, distinctly petiolate and with an acute base, patent, i.e. their costae are perpendicular to the rachis; rachis green to brown when fresh, light brown when dry.

Largest pinnae: 33-38 cm long, spaced by 5-5.5 cm, adjacent pinnae not overlapping, spaced by less than their width to contiguous, their apex acute, pinnatifid; costae and costulae of the same colour as the rachis.

Largest pinnules: 2-2.5 × 0.5-0.6 cm, spaced by less than their width to almost contiguous, up to 3 proximal pinnule pairs sessile, others broadly adnate to the costa, oblong, straight and costulae perpendicular to the costa or slightly falciform, margin entire, crenulate near the acute to obtuse apex; veins once furcate.

Scales and hairs: scales present from the petiole base upwards to at least 40 cm on the petiole and rachis, persistent, narrowly triangular, 1.5-2 × 0.2-0.3 cm, never straight, not appressed to the petiole and variously contorted, dull to shiny dark brown, with a narrow, light brown, erose margin, slightly indurated at their base, the adaxial lateral scales narrower, i.e. about 0.1 cm wide; dense dark brown, patent to antrorse,

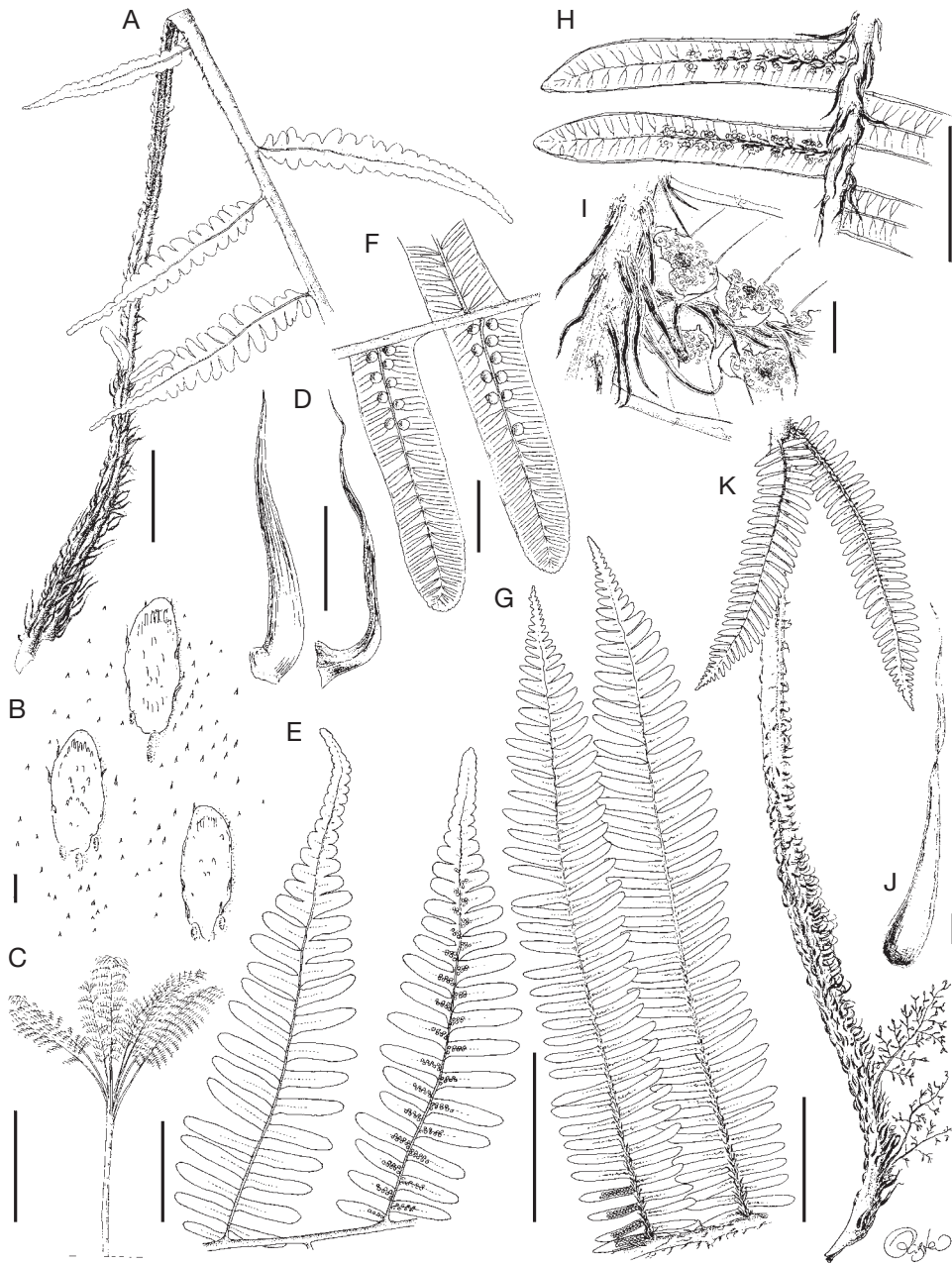


FIG. 28. — **A-F**, *Cyathea melanocaula* Desv.; **A**, basal part of the leaf (from the petiole base up to the first several pinna pairs), basal part in lateral view, upper part in adaxial view, folded part in abaxial view; **B**, leaf scars and trunk surface; **C**, habit; **D**, scales from the base of the petiole (left: dorsal view; right: lateral view); **E**, pinnae abaxially with a fragment of the rachis, sori omitted from one pinna; **F**, pinnules abaxially with a fragment of the costa; **G-K**, *C. obtecta* Rakotondr. & Janssen; **G**, pinnae abaxially with a fragment of the rachis, sori only partly indicated; **H**, pinnules abaxially with a fragment of the costa; **I**, detail from the base of a pinnule, note the obliquely cup-shaped indusia and dense scaly indument on the costa and costula; **J**, scale from the base of the petiole; **K**, basal part of the leaf (from the petiole base up to the first pinna pair), lateral view, note the two pairs of aplebioid pinnae near the base of the petiole. **A-F**, Janssen *et al.* 2608 (P); **G-K**, Rakotondrainibe 2524 (P). Scale bars: A, E, G, K, 5 cm; B, F, H, 1 cm; C, 1 m; D, 0.5 cm; I, J, 0.1 cm.

stiff, multicellular hairs on the adaxial face of the rachis and costae; some dark brown acaroid squamules on the abaxial face of the costulae, but leaf otherwise glabrous.

Sori: subcostular, contiguous to spaced by less than their width, less than 0.1 cm in diameter, covering entire pinnules or the lower three quarters; indusia globular, light brown, membranous, at maturity dehiscent in 2-4 lobes or irregularly; receptacle capitate, shorter than the rim of mature indusia, with conspicuous filiform paraphyses shorter than the sporangia.

DISTRIBUTION

Central Madagascar: Anjozorobe to Zahamena; one specimen collected near Antsirabe; endemic.

ECOLOGY

850-1300 m. Dense evergreen rainforests.

REMARKS

We here provide the first complete description of this taxon including characters of the petiole scales and trunk. Although many more or less complete collections exist, these have been frequently misidentified as *C. bellisquamata* and related species. Although distinct by its coriaceous, acute pinnules carrying comparably small sori, *C. orthogonalis* is most easily identified by its patent, petiolate basal pinnae, the appressed and contorted dark brown scales and a smooth trunk surface. *Cyathea pseudobellisquamata* is very near *C. orthogonalis* but differs by its spiny leaf scars, its shiny brown, straight petiole scales and by its sessile basalmost pinnae.

TYPIFICATION AND SYNONYMY

The holotype at P! has been clearly indicated by Bonaparte ("Original"), but all available original material consists of middle pinnae with rachis fragments necessitating epitypification with a specimen including discriminative characters of the petiole base and trunk. Bonaparte (1917: 29, 30) introduces *C. orthogonalis* as a nomen nudum and cites "*Baron 2126*" as the only specimen. Said specimen could not be traced and the citation is most likely erroneous and should be corrected to *Baron 6126*.

30. *Cyathea pseudobellisquamata*

Janssen & Rakotondr., sp. nov.

(Figs 30A-F; 46D)

Filix arborescens Cyatheaae bellisquamatae affinis sed differt paleis petioli sparsis vel caducis, (0.8-)2-2.5 cm longis et 0.1-0.2 cm latis, strictis et nitide brunneis. Pinnulae pro ratione parvae, 1.8(-2.4) cm longae et 0.4(-0.5) cm latae. Praecipue insignis superficie laevi trunci cicatricibus ellipsoideis margine inferiore c. 5 spinis brevibus conicis praeditis.

TYPUS. — Madagascar, Toliara, Tolanaro (Fort Dauphin), Eminiminy, Parcelle 1, RNI n° 11 d'Andohahela, versant est et sommet du Trafon'omby, 13.5 km au NW d'Eminiminy, Camp 3, 24°35'40"S, 46°44'80"E, 1300 m, 8.XI.1995, *Rakotondrainibe 3059* (holo-, P! [2 sheets: P00067163, -64]; iso-, MO!, TAN!).

ADDITIONAL MATERIAL EXAMINED. — Madagascar. Massif du Beampingaratra, col de Vohipaha, 24°32'S, 46°53'E, 1100-1400 m, 16.XI.1928, *Humbert 6642* (K, P).

FIELD OBSERVATIONS. — Trunk: HT 5-6 m, DT 6 cm; trunk surface smooth, distantly papillate, dark brown.

Leaf scars: 2 × 4.5 cm, elliptic to obovate; with about five short conical spines on their lower rim and 1-3 shallow orifices below the scar.

Lamina: LL 130 cm, NP 35-40.

DESCRIPTION

Petiole: (20-)40 cm long, 1.2 cm in diameter when dry; dark reddish brown when fresh, light to dark brown when dry.

Lamina: pinnate-pinnatisect, coriaceous, dark green above, light green below, lamina base shortly attenuate; rachis of the same colour as the petiole, somewhat lighter.

Largest pinnae: 28 cm long, distant by 4-5 cm, adjacent pinnae spaced by less than their width to contiguous, their apex acute, pinnatifid; costae and costulae of the same colour as the rachis.

Largest pinnules: 1.8(-2.4) × 0.4(-0.5) cm, spaced by much less than their width to contiguous, up to 4 proximal pinnule pairs sessile, others broadly adnate to the costa, oblong, slightly falciform, margin entire, but up to 2 proximal pinnule pairs crenate and auriculate, apex rounded to obtuse; veins once, rarely twice furcate.

Scales and hairs: scales present from the petiole base upwards to 15 cm on the petiole, probably further in fresh specimens, moderately dense, overlapping,

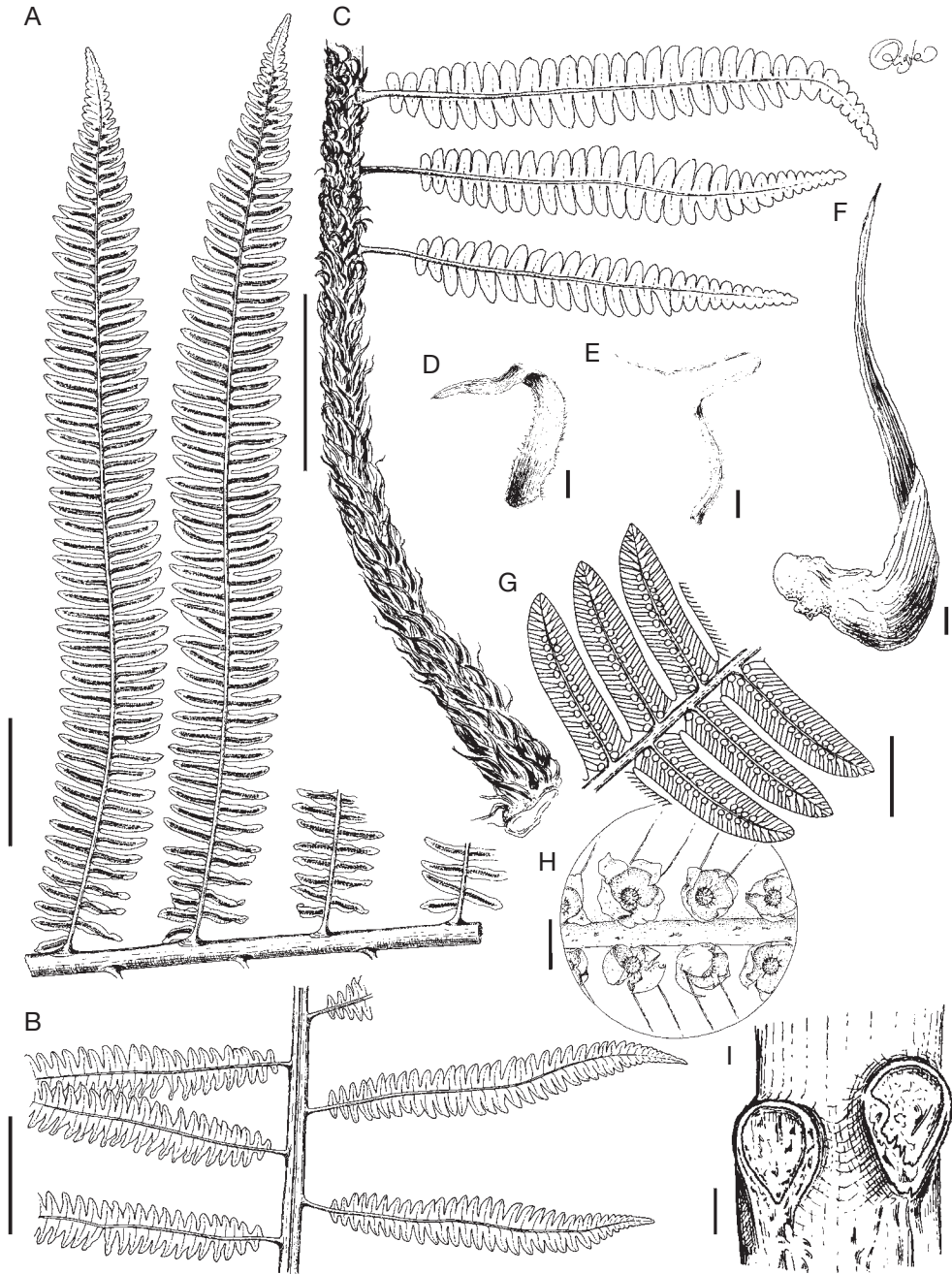


FIG. 29. — *Cyathea orthogonalis* Bonap.: **A**, pinnae abaxially with a fragment of the rachis; **B**, patent, petiolulate pinnae near the base of the lamina (arrangement reconstructed from the herbarium specimen); **C**, basal part of the leaf (from the petiole base up to the first two pinna pairs), lateral view, all pinnae folded to one side of the rachis; **D**, scale from the abaxial face of the lower part of the rachis, about 30 cm above the base of the petiole; **E**, scale from the lateral face of the lower part of the rachis, about 30 cm above the base of the petiole; **F**, scale from the abaxial face of the base of the petiole; **G**, pinnules abaxially with a fragment of the costa; **H**, sori; **I**, trunk with leaf scars. A-C, G-I, *Rakotondrainibe et al.* 3754 (P); D-F, *DuPuy et al.* M805 (P). Scale bars: A-C, 5 cm; D-F, H, 0.1 cm; G, I, 1 cm. A, B, G, I, drawings by B. Raufeisen.

persistent near the base of the petiole, caducous further up, narrowly triangular, (0.8-)2-2.5 × 0.1-0.2 cm, straight, concolourous, shiny brown, more or less appressed to the petiole, further up smaller and more or less contorted or with a reflexed apex, not indurated; moderately dense, dark brown, appressed, antrorse multicellular hairs on the adaxial face of the rachis and costae; scattered caducous, appressed, shiny dark brown, narrowly triangular, scales on the abaxial face of the costae; leaf otherwise glabrous.

Sori: sori subcostular, contiguous, less than 0.1 cm in diameter, covering one third to three quarters of the pinnule; indusia globular, brown, membranous, dehiscing irregularly at maturity, but not down to the base of the receptacle; receptacle capitate, shorter or longer than the rim of mature indusia, with inconspicuous short, filiform paraphyses, rudimentary brown sporangia on their apex.

DISTRIBUTION

Southern Madagascar: Andohahela and Beampingaratra; endemic.

ECOLOGY

About 1300 m. Dense evergreen rainforests.

REMARKS

The species differs from *C. bellisquamata* by its smooth trunk surface with elliptical and spiny leaf scars, and sparse or caducous petiole scales. Its pinnules are smaller than in most specimens of *C. bellisquamata*. It differs from *C. approximata* by its bigger petiole scales and the absence of scales on the receptacle. *Cyathea orthogonalis* has conspicuously petiolulate pinnae near the lamina base, dense dull dark brown, contorted scales and usually acute to obtuse pinnules, its leaf scars are not spiny.

Cyathea pseudobellisquamata is furthermore distinguished from *C. remotifolia* and *C. emilei* by its coriaceous, subcontiguous pinnules and persistent, shiny brown petiole scales. Petiole scales may rarely persist in *C. emilei* and *C. remotifolia*, but are then shorter than in *C. pseudobellisquamata*. In addition, *C. pseudobellisquamata* differs from *C. emilei* by its smooth and spiny trunk surface and from *C. remotifolia* by its persistent indusia.

Humbert 6642 agrees perfectly with the type specimen with respect to lamina dissection, but its pinnules are bigger, its scales smaller and the trunk is unknown. The specimen has been collected in the far Southeast and is morphologically more similar to *C. pseudobellisquamata* than to all other taxa discussed in this section. The identification of *Humbert 6642* as *C. pseudobellisquamata* must remain ambiguous in the absence of trunk characters and considering the variability of *C. bellisquamata*.

ETYMOLOGY

The taxon has been named *pseudobellisquamata* because it is morphologically similar to *C. bellisquamata*, the trunk surface being the most important difference.

31. *Cyathea remotifolia* Bonap. (Figs 31; 46E; 51C)

Notes ptéridologiques 5: 51 (1917); l. c. 9: 62 (1920). — Type: Madagascar, Toamasina, Andasibe, forêt d'Analamazaotra, 800 m, XII.1912, *Perrier de la Bâthie 6121* (holo-, P! [P00404227]; iso-, P!). — Madagascar, Antsiranana, Montagne d'Ambre, piste menant de la station forestière des Roussettes à la Route des Mille Arbres, 12°31'38"S, 49°10'20"E, 1130 m, 5.X.2004, *Janssen et al. 2432* (epi-, P! [4 sheets: P00589640-43], here designated; isoeppi-, P! [3 sheets], TAN!; one trunk surface mould at P!).

Cyathea borbonica Desv. var. *laevigata* auct.: Bonaparte, *Notes ptéridologiques* 9: 49 (1920); Christensen, *Dansk Botanisk Arkiv* 7: 21, pl. 4 figs 18, 19 (1932); Tardieu in Humbert, *Flore de Madagascar et des Comores, IV^e famille, Cyathéacées*: 14 fig. 1 (6-7).

ADDITIONAL MATERIAL EXAMINED. — Madagascar. Antsiranana, Mt. d'Ambre, 12°31'S, 49°08'E, 800-1000 m, VII.1993, *Andrianantoanina et al. 212* (P). — *Idem*, 12°30'S, 49°10'E, 800-1000 m, VII.1993, *Andrianantoanina et al. 215* (P). — Toamasina, Andasibe, Ambatovy forest, 18°50'36"S, 48°19'55"E, 979 m, 16.I.2005, *Antilahimena et al. 3178* (MO, P). — Antsiranana, Mt. d'Ambre, 12°31'30"S, 49°10'20"E, 1050 m, 20.X.1988, *Badré et al. 2100* (P). — *Baron 3187* (BM, K), 3784 (B, K), 6304 (BM). — Antsiranana, 13°47'52"S, 48°48'22"E, 1100-1300 m, 17.IV.2000, *Birkinshaw et al. 715* (P). — Antananarivo, Mandraka, 18°55'30"S, 47°55'10"E, X.1948, *Corrèard s.n.* (P). — Tampoketsa de Tsaratanana, forêt d'Ananimahandaniavatsy, 16°35'30"S,

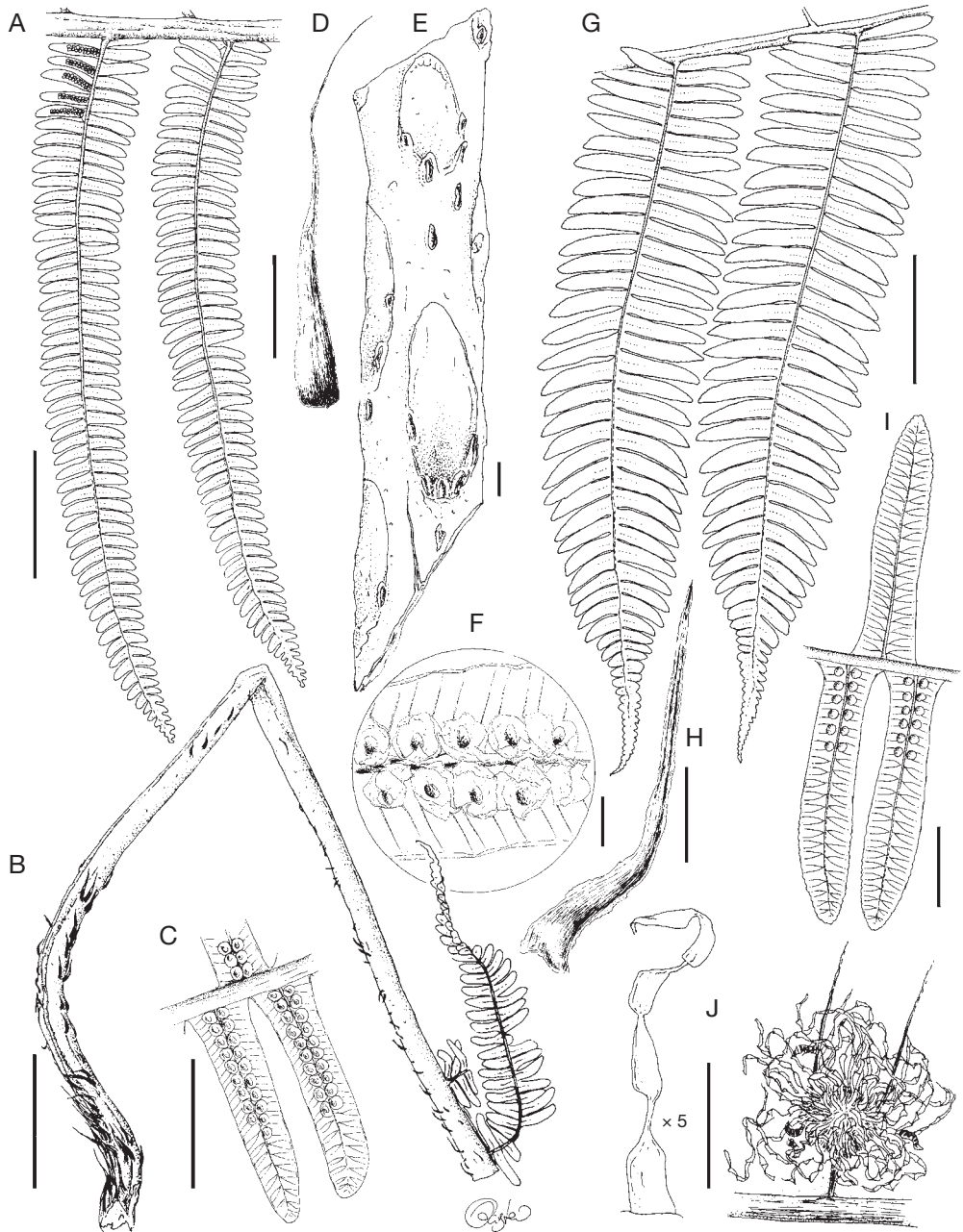


FIG. 30. — **A-F**, *Cyathea pseudobellisquamata* Janssen & Rakotondr.; **A**, pinnae abaxially with a fragment of the rachis, sori only partly indicated; **B**, basal part of the leaf (from the petiole base up to the first pinna pair), lateral view; **C**, pinnules abaxially with a fragment of the costa; **D**, scale from the base of the petiole; **E**, trunk segment with leaf scars; **F**, part of a pinnule abaxially, note the close standing sori and small scales on the costula; **G-J**, *C. simulans* (Baker) Janssen & Rakotondr.; **G**, pinnae adaxially with a fragment of the rachis; **H**, scale from the petiole; **I**, pinnules abaxially with a fragment of the costa, sori omitted from one pinnule; **J**, one sorus with dense paraphyses much longer than the sporangia, indusium absent, one catenate paraphysis on the left. **A-F**, *Rakotondrainibe* 3059 (P); **G-J**, *Perrier de la Bâthie* 7444 (P). Scale bars: **A**, **B**, **G**, 5 cm; **C**, **E**, **I**, 1 cm; **D**, **H**, 0.5 cm; **F**, **J**, 0.1 cm.

- 47°53'E, 1200 m, 28.VIII.1941, *Cours 1621* (BR, K, MO, P). — Antananarivo, Anjozorobe, 18°23'30"S, 47°53'E, 1200 m, 21.I.1944, *Cours 1768* (P); 2117 (P). — Montagne d'Ambatosoratra, 14°46'S, 48°52'E, *Cours 3255* (P). — Fianarantsoa, Ambatofitorahana, 20°49'S, 47°11'E, 1000 m, 5.III.1951, *Cours 4033* (P). — Dpt de Brickaville, d'Andrambolahy kely à Andranampony, 18°50'S, 49°04'E, 300 m, 21.IV.1951, *Cours 4499* (P); 4502 (P). — 100 km W Tsiromandidy, vers Maofenobe, 22.VII.1974, *Cremers 3289* (P). — Antananarivo, Mandraka, 18°55'30"S, 47°55'10"E, 13.VIII.1906, *D'Alleizette 70* (P). — *Idem*, 15.VIII.1906, *D'Alleizette 87* (P). — Prov. Mahajanga, NW of Ambohitsaratelo-Bebao, 18°22'S, 45°35'E, 1200 m, 13.I.1985, *Dorr et al. 3521* (P). — Fianarantsoa, Mansarivolo-Andrianony, 22°17'S, 46°52'E, 1300 m, 4.XI.1970, *Guillaumet 3508* (P). — N des Chaînes Anosyennes, 24°25'S, 46°58'30"E, 700 m, 27.XI.1971, *Guillaumet 3981* (P). — Massif de l'Andohahela, vallée de Ranohela, X.1928, *Humbert 6109* (BM, P). — Toliara, Andohahela, col de Tsilotsilo, 24°50'S, 46°45'30"E, 1300 m, II.1934, *Humbert 14129* (P). — Antsiranana, Tsaratanana, haute vallée du Sambirano, 13°57'S, 48°52'E, 1600 m, XII.1937, *Humbert 18292* (P). — Massif du Marojejy, E d'Ambalamanasy, 14°31'30"S, 49°35'30"E, 450-800 m, 1948, *Humbert et al. 22104* (K, P). — Fianarantsoa, Andrambovato, 21°31'S, 47°25'E, 800-1000 m, I.1955, *Humbert 28454* (P). — Antsiranana, Montagne d'Ambre, 12°31'53"S, 49°10'16"E, 1132 m, 6.X.2004, *Janssen et al. 2443* (MO, P, TAN). — Toamasina, RNI Betampona, Rendriendry, 17°55'48"S, 49°12'E, 310-580 m, 6.XI.2004, *Janssen et al. 2535* (MO, P, TAN). — *Idem*, Rendriendry, piste Betakonana, 17°55'54"S, 49°12'12"E, 300-500 m, 8.XI.2004, *Janssen et al. 2561* (MO, P, TAN). — Antananarivo, Mandraka, 18°55'30"S, 47°55'10"E, 1200-1250 m, 13.XI.2004, *Janssen et al. 2582* (MO, P, TAN). — Fianarantsoa, Ivohibe, corridor forestier entre RS d'Ivohibe et PN d'Andringitra, 22°25'14"S, 46°55'38"E, 1180 m, 21.IV.2005, *Janssen et al. 2802* (MO, P, TAN). — Mahajanga, massif du Tsaratanana, entre Antetikalambazaha et Mangindrano, 14°11'24"S, 48°56'44"E, 1670-1700 m, 15.V.2005, *Janssen et al. 2960* (MO, P, TAN). — *Jardin Botanique de Tananarive 2091* (P). — Antananarivo, Sarobaratra, 19°40'S, 47°33'E, 27.VIII.1937, *Jardin Botanique de Tananarive 2884* (P). — Toamasina, Andasibe, Analamazaotra, 18°56'S, 48°26'E, 4.XI.1970, *Keraudren-Aymonin et al. 25349* (P), 25350 (P). — Toamasina, Didy, forêt de Tsiazomborona, 18°07'S, 48°32'40"E, 20.XI.2005, *Labat et al. 3575* (P). — Tsiroanomandidy, 11.II.1966, *Peltier 5671* (P). — Toamasina, forêt d'Analamazaotra, 18°56'S, 48°26'E, 800 m, XII.1912, *Perrier de la Bâthie 6122 p.p.* (P). — Antsiranana, Montagne d'Ambre, 12°37'S, 49°09'30"E, 800 m, IX.1909, *Perrier de la Bâthie 7500* (P). — Tampoketsa de Tsaratanana, entre Mahazamba et Bemarivo, 16°35'30"S, 47°53'E, 1400 m, VII.1920, *Perrier de la Bâthie 13209* (P). — Mt. Takarandoha, W de Vatomanandy, 19°20'S, 48°59'E, 400 m, XII.1921, *Perrier de la Bâthie 14125* (BM, P). — Massif de Tsaratanana, Centre, 14°02'30"S, 48°57'30"E, XII.1992, *Perrier de la Bâthie 15256* (P). — Mahajanga, Analamaitso, 16°11'30"S, 48°08'30"E, 800 m, VIII.1907, *Perrier de la Bâthie 15841* (P). — Forêt d'Ambre, 12°37'S, 49°09'30"E, IX.1926, *Perrier de la Bâthie 17757* (BM, P). — Fianarantsoa, corridor entre les PN de Ranomafana et d'Andringitra, WNW d'Ambatofotsy, 21°44'S, 47°24'E, 760 m, 3.XI.2000, *Rabarimanarivo et al. 111* (P). — *Idem*, WNW d'Ikongo, 21°49'17"S, 47°24'50"E, 700 m, 19.XI.2000, *Rabarimanarivo et al. 153* (P). — Antananarivo, RS d'Ambohitantely, NW d'Ankazobe, 18°10'S, 47°17'E, 1200-1650 m, 18.IV.1985, *Rakotondrainibe 409* (P). — *Idem*, 24.VI.1983, *Rakotondrainibe 457* (P, TAN). — Antsiranana, Montagne d'Ambre, Lac Texier, 12°32'S, 49°10'E, 1050 m, 24.VI.1992, *Rakotondrainibe 1745* (MO, P). — Forêt d'Ambre, versant ouest, 12°32'S, 49°10'E, 1160 m, 19.VII.1992, *Rakotondrainibe 1786* (MO, P). — Antsiranana, RS d'Anjanaharibe-Sud, SSW de Befingotra, 14°45'18"S, 49°30'18"E, 800 m, 19.X.1994, *Rakotondrainibe et al. 2105* (K, MO, P, TAN). — *Idem*, 850 m, 24.X.1994, *Rakotondrainibe et al. 2187* (P). — Fianarantsoa, RNI d'Andringitra, berges de la rivière Sahainivoraky, 22°13'40"S, 47°01'30"E, 800 m, 16.V.1995, *Rakotondrainibe 2590* (P, TAN). — *Idem*, 22°15'S, 47°01'E, 20.V.1995, *Rakotondrainibe 2676* (P). — Toliara, Tolanaro RNI d'Andohahela, NW du village d'Eminiminy, 24°35'S, 46°44'30"E, 840 m, 29.X.1995, *Rakotondrainibe 2968* (P, TAN). — *Idem*, 800 m, 29.X.1995, *Rakotondrainibe 2989* (MO, P, TAN). — *Idem*, 30.X.1995, *Rakotondrainibe 3006* (P, TAN). — *Idem*, 820 m, 1995, *Rakotondrainibe 3017* (P, TAN). — *Idem*, 24°33'30"S, 46°43'E, 8.XI.1995, *Rakotondrainibe 3051* (P). — *Idem*, 24°34'S, 46°43'E, 1500 m, 20.XI.1995, *Rakotondrainibe 3150* (P). — Fianarantsoa, RS d'Ivohibe, 22°28'12"S, 46°57'36"E, 850-950 m, 6.X.1997, *Rakotondrainibe et al. 4003* (P), 4004 (MO, P, TAN). — *Idem*, 7.X.1997, *Rakotondrainibe et al. 4050* (P, TAN). — *Idem*, 8.X.1997, *Rakotondrainibe et al. 4067* (P). — Fianarantsoa, corridor entre les réserves d'Andringitra et d'Ivohibe, ESE d'Angodongodona, 22°25'36"S, 46°56'18"E, 880-950 m, 16.XI.1997, *Rakotondrainibe et al. 4388* (P). — Antananarivo, RS d'Ambohitantely, 18°12'S, 47°17'E, 1400-1450 m, 6.XII.1997, *Rakotondrainibe 4422* (P). — Antsiranana, forêt de Betaolana, NW d'Ambodiangezoka, 14°32'18"S, 49°26'18"E, 800-820 m, 10.X.1999, *Rakotondrainibe et al. 4891* (P, TAN). — Antsiranana, massif d'Anjanaharibe-Sud, forêt d'Analabe, SW de Befingotra, 12°30'20"S, 49°31'20"E, 26.X.1999, *Rakotondrainibe 5038* (P). — *Idem*, 27.X.1999, *Rakotondrainibe 5067* (P). — Fianarantsoa, PN de Ranomafana, forêt de Vatoharanana, 21°16'S, 47°26'E, 3.X.2000, *Rakotondrainibe et al. 5841* (P), 5847 (K, P). — Antsiranana, PN de

Marojejy, SE de Doany, 14°25'36"S, 49°36'30"E, 800-850 m, 14.X.2001, *Rakotondrainibe et al.* 6230 bis (K, P, TAN). — Vohepar, forêt de Binara, SW de Daraina, 6.XI.2001, *Rakotondrainibe et al.* 6524 (K, P). — Andapa, Doany, forêt d'Ankarongameloka, 14°15'29"S, 49°26'20"E, 1235 m, 10.III.2006, *Rakotovo et al.* 2945 (MO, P, TAN). — Fianarantsoa, Ranomafana, 21°18'S, 47°38'30"E, 17.XI.1994, *Randriambololona* 278 (P). — Antsiranana, RNI de Tsaratanana, E de Beangona, 14°14'40"S, 48°39'50"E, 1550 m, 29.XI.2000, *Rasolohery* 143 (MO, P, TAN). — Toamasina, Zahamena, Ankosy, 26.I.2001, *Rasolohery* 184 (P). — Antenina, 17°53'S, 49°25'E, 3.II.2002, *Rasolohery* 650 (P). — Fianarantsoa, Ranomafana, 21°16'S, 47°25'E, 1000 m, II.1989, *Schatz* 2580 (P). — *Idem*, 21°13'30"S, 47°27'30"E, 900 m, 10.X.1992, *van der Werff et al.* 12661 (P). — Antananarivo, Anjozorobe, 18°23'30"S, 47°53'E, 1250 m, 6.XI.1992, *van der Werff et al.* 12846 (P). — *Idem*, 18°23'30"S, 47°53'E, 1250 m, 6.XI.1992, *van der Werff et al.* 12848 (P). — Toliara, RNI d'Andohahela, NW Eminiminy, 24°38'S, 40°46'E, 500-1000 m, 6-12.II.1993, *van der Werff et al.* 12881 (G, MO). — Mahajanga, Andribe, 16°11'S, 48°56'E, 1500 m, 21.X.1994, *van der Werff et al.* 13547 (MO, P).

FIELD OBSERVATIONS. — Trunk: HT up to 8 m, usually 2-4 m, DT 3.5-6(-8) cm, dead petioles caducous and the leaf scars exposed; trunk surface ferruginous or light to greyish brown, smooth; the trunk may rarely develop ramifications, most likely as a result of a previous injury.

Petiole: with 1 or 2 irregular rows of whitish to light brown aerophores, distributed over the entire abaxial surface near the petiole base; petiole base short to long, but always distinctly sigmoid.

Leaf scars: 1.5-2 × 2-5 cm, obovate to narrowly elliptic, flat or slightly raised, much spaced to rarely contiguous; with 3-7 strong, acroscopic, conical spines, that are up to 1.5 cm long, caducous in older trunks; sometimes several orifices below the scar; spirally arranged.

Crown: not dense, more or less umbrella-shaped.

Trunk apex: young croziers densely covered with soft, caducous, brownish scales, completely concealed among the very close standing petiole bases.

Lamina: widely elliptic; LL (90-)105-160(-200) cm, WL 50-75 cm, FW 55-70 cm, NP 13-30.

DESCRIPTION

Petiole: (8-)20-40(-70) cm long, 1-2 cm in diameter; green to stramineous, reddish to violaceous brown on abaxial face.

Lamina: pinnate-pinnatisect, herbaceous (not coriaceous), pale green below, shiny light to dark green above, lamina base attenuate, basal pinnae gradually reduced in size, but not reaching the

petiole base, reflexed, more or less conduplicate, usually very distinctly caudate; rachis of the same colour as the petiole.

Largest pinnae: 25-40 cm long, distant by 5-9 cm, adjacent pinnae spaced by less than their width to overlapping, usually widest above the middle, their apex shortly caudate, pinnatifid; costae and costulae green.

Largest pinnules: (2.5-)3-5.5 × (0.4-)0.5-0.8(-1) cm, spaced by less than to about their width, never contiguous, broadly adnate to the costa, more or less strongly decurrent, straight, but in their apical half sometimes falciform, their margin entire, crenulate near the apex, rarely deeply crenate-lobate, their apex acute to rounded, usually gradually more sharply pointed from proximal to distal pinnules, the first proximal pinnule pair sometimes sessile; veins once to twice furcate.

Scales and hairs: scales of the petiole base very caducous, densely imbricate and appressed to the croziers, but petioles of adult leaves more or less naked, rarely with some persistent scales near the petiole base, scales narrowly triangular, soft, 1-2 × 0.2-0.3 cm, straight, dark to light dull brown with a darker centre, but young scales with a shiny centre, margin lacinate-erose, scales quickly withering and often agglutinating before they fall, not indurated, but somewhat thickened at their base, leaving a hardly visible wart-like trace when shed; sparse to moderately dense, appressed, antrorse, brown multicellular hairs on the adaxial face of the rachis and costae; leaf otherwise glabrous.

Sori: subcostular, spaced by about to more than their width, about 0.1 cm in diameter, covering the entire pinnule or its lower half only; indusia globular when young, light brown to stramineous, membranous, caducous, i.e. at maturity only an appressed collar-like rudiment persists around the base of the receptacle; receptacle disciform to capitate, usually longer than the rim of mature indusia, with inconspicuous hyaline to reddish filiform paraphyses, sometimes with very short scaly paraphyses on its apex.

DISTRIBUTION

Madagascar, eastern rainforests from North (Montagne d'Ambre) to South (Andohahela); endemic.

ECOLOGY

(300-)800-1600 m. Dense evergreen rainforests.

REMARKS

The closely related Madagascan species *C. remotifolia* and *C. emilei* differ, among other characters, from the Mascarene *C. borbonica* Desv. by their pinnules being broadly adnate to the costa. *Cyathea remotifolia* has a smooth trunk surface with conspicuous conical spines on the lower rim of the leaf scars and membranous, light brown to hyaline indusia that are persistent as a collar-like rudiment at the base of the receptacle, and a herbaceous (not coriaceous) lamina. These characters distinguish it from *C. emilei*. In their natural habitat, both species can be quickly and easily distinguished when observing the trunk surface. However, determination of herbarium specimens not annotated with trunk characters may be difficult in rare cases, because pinnule shape is variable in both species and valvately opening globular indusia exist in a minority of specimens of *C. remotifolia*, although these are then lighter coloured and thinner than in *C. emilei*.

Some specimens have deeply crenate pinnule margins (cf. *Rakotondrainibe* 2968, 3051, 4388). Few specimens have a light brown to hyaline, membranous indusium, which is irregularly lobed and persistent in mature leaves, not reduced to a collar at the base of the receptacle (cf. *Andrianantoanina* 212, 215, *Guillaumet* 3981, *Humbert* 6109, *Rabarimanarivo* 153, *Rakotondrainibe* 3150). Such plants are occasionally collected over the entire range of the species and we believe that sorus age and drying conditions are responsible for the observed variation. Very thin trunks with contiguous leaf scars are preserved in a few specimens (cf. *Rakotondrainibe* 1786, 6230bis). The petiole scales of *Rakotondrainibe* 3150 are up to 1.5 cm long, brown and persist on the petiole and the lower part of the rachis.

Young plants usually have leaves with decrescent basal pinnae, which are light green, reflexed and divided into acute, serrulate segments (as opposed to *C. emilei*). Very young trunkless plants, e.g., *Janssen et al.* 2561, have stramineous scales ascending up to 20 cm on the petiole and rachis.

TYPIFICATION AND SYNONYMY

This taxon has previously been determined as *C. laevigata* Willd. ex Kaulf. (Christensen 1932; Tardieu-Blot 1951; pro forma *C. borbonicae*). It differs, however, from *C. laevigata* by its pinnules being broadly adnate to the costa, not sessile, and it is most likely not closely related to the Mascarene endemic *C. borbonica* (Janssen & Rakotondrainibe 2006).

Two sheets of *Perrier de la Bâthie* 6121 are available at P. The holotype, identified as "Original" by Bonaparte, is composed of a leaf base, a young and a mature leaf apex. The middle part of a leaf constitutes the isotype sheet. Young sori and the lamina are covered with pluricellular hairs frequently found in young leaves, but are of no taxonomic value. The type specimen has the characteristic collar-like rudimentary membranous indusium characteristic for the taxon, but it does not preserve nor mention the distinctive features of the species' trunk surface. To unambiguously associate these with the present taxon we designate an epitype including a trunk surface mould. The epitype specimen designated here also includes a very young leaf with adherent scales. Further samples of very young scaly croziers are included in some recent collections.

Pinnule shape in *C. remotifolia* is variable ranging from linear, oblong pinnules with rounded apices and rather large sinuses (including the type of the species) to forms with acute pinnule apices and narrow sinuses between the decurrent pinnules (more frequently observed and including the epitype designated here). Transitions between these forms are gradual and no formal recognition of the observed variation is possible. None of these forms possess long receptacular paraphyses or short shiny brown petiole scales and we believe that the assignment of the type of *C. remotifolia* to *C. simulans* by former authors (Christensen 1932; Tardieu-Blot 1951; pro forma *C. borbonicae*) resulted from a lack of sufficient material for comparison.

32. *Cyathea simulans* (Baker)

Janssen & Rakotondr., comb. nov.
(Figs 30G-J; 46H)

Alsophila simulans Baker, *Journal of Botany* 29: 3 (1891). — *Cyathea borbonica* Desv. var. *simulans* (Baker)

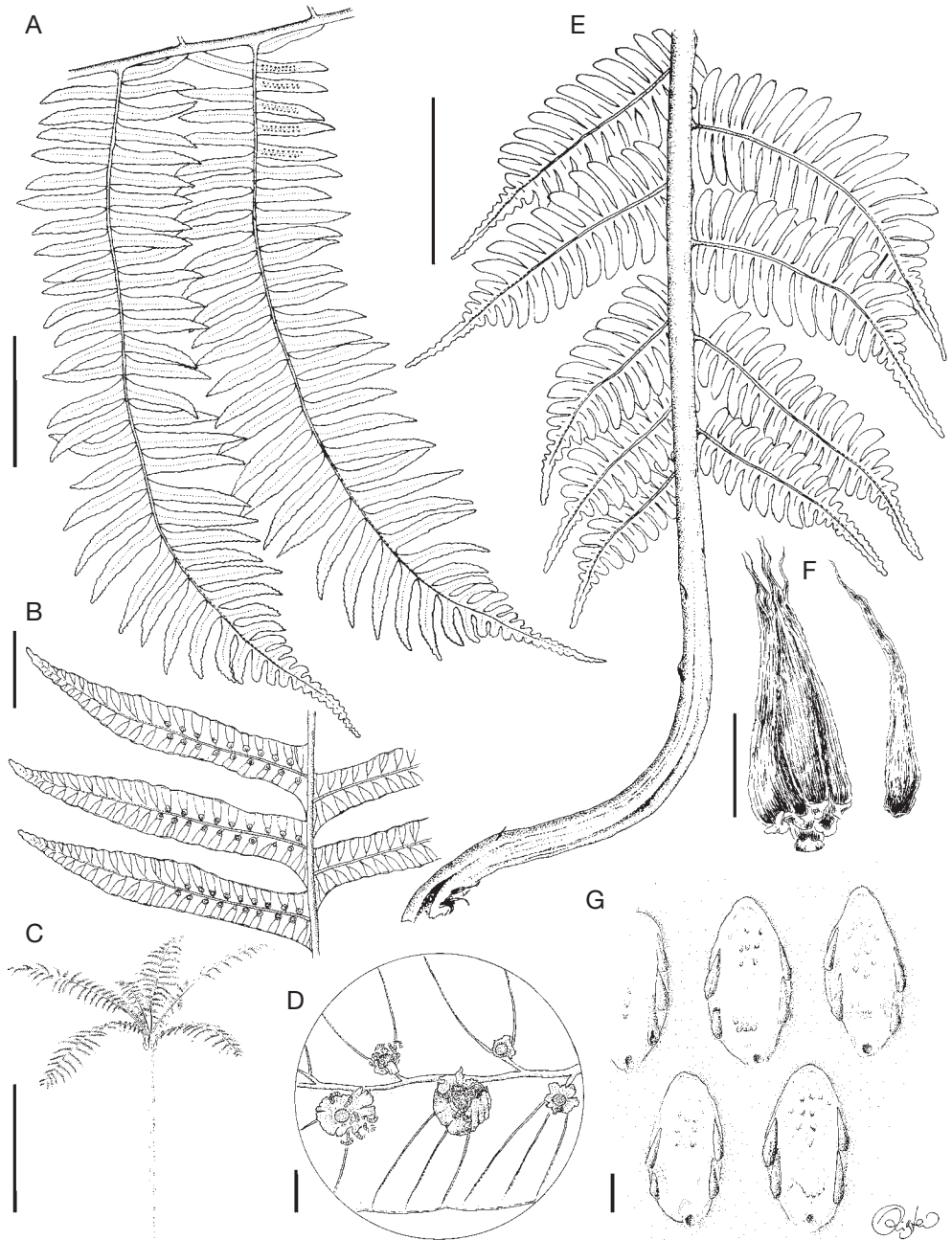


FIG. 31. — *Cyathea remotifolia* Bonap.: **A**, pinnae abaxially with a fragment of the rachis, sori only partly indicated; **B**, pinnules abaxially with a fragment of the costa, sori only partly indicated; **C**, habit; **D**, sori on the abaxial face of a pinnule, the sorus in the centre with an irregularly dehiscent indusium, all other sori with showing rudimentary indusia usually reduced to a collar-like structure at the base of the receptacle; **E**, basal part of the leaf (from the petiole base up to the fifth pinna pair); **F**, scales from the base of the petiole (left: a group of agglutinated scales; right: a single scale); **G**, leaf scars with prominent spines and smooth trunk surface. A, B, D, E, *Janssen et al.* 2432 (P); C, F, *Janssen et al.* 2582 (P); G, *Janssen et al.* 2443 (P). Scale bars: A, E, 5 cm; B, G, 1 cm; C, 1 m; D, 0.1 cm; F, 0.5 cm.

C. Chr. in Perrier, Catalogue des plantes de Madagascar, Prérédiphytes: 20 (1931); Christensen, *Dansk Botanisk Arkiv* 7: 22, pl. 4 figs 20-22; Tardieu in Humbert, *Flore de Madagascar et des Comores, IV^e famille, Cyathéacées*: 13, fig. 1 (10-11). — Type: North West Madagascar, Be Kilus Mountains, 14°02'S, 48°19'E, XII.1890, *Last s.n.* (holo-, K! [2 sheets: K000009955, -56]).

ADDITIONAL MATERIAL EXAMINED. — **Madagascar**. Environs du Mt. Bekolong, Massif de Manongarivo, Sambirano, 14°02'S, 48°19'E, 500 m, III.1909, *Perrier de la Bâthie 7444* (P).

FIELD OBSERVATIONS (*Perrier 7444*). — Trunk: HT up to 0.3 m, DT 12 cm, creeping.

Lamina: LL 120-140 cm, WL 35-45 cm, NP 16-20.

DESCRIPTION

Lamina: pinnate-pinnatifid to pinnate-pinnatisect, herbaceous (not coriaceous); rachis light brown (dry).

Largest pinnae: 29-33 cm long, distant by 6-7 cm, adjacent pinnae not overlapping, spaced by less than their width, their apex conspicuously caudate, pinnatifid; costae and costulae of the same colour as the rachis.

Largest pinnules: 3-3.5 × 0.5-0.7 cm, spaced by much less than their width, almost contiguous, broadly adnate to the costa, their bases slightly widened and adjacent pinnules confluent, distance sinus-costa about 0.1 cm, oblong, margin subentire, crenulate near the rounded to obtuse apex; veins once furcate.

Scales and hairs: scales of the petiole base narrowly triangular, somewhat falciform, 1-1.5 × 0.2-0.3 cm, with a shiny dark brown centre and a broad, dull light brown, erose margin, coriaceous; moderately dense, brown, more or less contorted, antrorse multicellular hairs on the adaxial face of the rachis and costae; leaf otherwise glabrous.

Sori: subcostular, contiguous to slightly spaced, about 0.1 cm in diameter, covering the entire pinna or its lower half; indusium absent; receptacle capitate, bearing conspicuous, multicellular, catenate, hyaline paraphyses, much longer than the sporangia, sori hence whitish to the unarmed eye.

DISTRIBUTION

Northern Madagascar: Manongarivo, Mont Bekolosy; endemic.

ECOLOGY

About 500 m. Wet and shady rocks, on syenite (*Perrier 7444*).

REMARKS

This species is distinct from all other Madagascan taxa by its pinnate-pinnatisect leaves in combination with exindusiate sori and receptacles bearing dense, white, filiform paraphyses, that are longer than the sporangia. It has been collected only twice from Mont Bekolosy in the Manongarivo massif. Petiole scales are preserved separately in *Perrier 7444*. The arrangement of scales on the petiole and the trunk of this taxon are unknown. Christensen (1932: 22) states that a rudimentary, collar-like indusium may be present, but this statement most likely had its foundation in the inclusion of the type of *C. remotifolia* Bonap., which we consider to represent a distinct species lacking the long receptacular paraphyses and possessing dull brown, caducous petiole scales.

Cyathea simulans has been treated as a variety of *C. borbonica* Desv. by some authors, but that species and its varieties all have sessile to petiolulate pinnules and are endemic to the Mascarene Islands (Janssen & Rakotondrainibe 2006).

Group III: *Cyathea* sect. *Alsophila*, species with bipinnate-pinnatisect to tripinnate species

Cyathea excelsa group *sensu* Christensen 1932; "group 2" p.p. and "group 3" *sensu* Holttum 1981; *Alsophila* – clade p.p. *sensu* Korall *et al.* 2007; tripinnate clade *sensu* Janssen *et al.* 2008.

DIAGNOSTIC CHARACTERS. — Leaves bipinnate-pinnatifid to tripinnate, sori indusiate, aphyloidioid pinnae rare, indument variable.

A difficult group including some widespread, variable and closely related taxa. Specimens should be determined with the additional help of a reference collection.

33. *Cyathea boivinii* Mett. ex Kuhn

REMARKS

Cyathea boivinii is a difficult species widespread in Madagascar and on the Comoros and exhibits a

high intraspecific variability of indusium and indument characters as well as of the degree of lamina dimorphism and pinnule dissection. Several formerly described species and varieties have been reduced to synonyms because of continuous character variation. The varietal key provided below is an attempt

to formally recognize discrete character variation within this taxon, although the determinations of a minority of specimens may remain ambiguous. All varieties of *C. boivinii* have cup-shaped, never globular, indusia and large pinnæ with a usually sparse to absent abaxial lamina indument.

KEY TO THE VARIETIES OF *CYATHEA BOIVINII*

1. Petiole in most specimens without scales (i.e. the scales are rapidly caducous); petiole and rachis covered with an abundant and persistent tomentum of intricate hairs and squamules; all leaves are apparently periodically and simultaneously shed; Andringitra massif 33b. var. *andringitrensis*
- Petiole in most specimens with scales (i.e. the scales are persistent); petiole and rachis glabrous or with a conspicuous and caducous squamulate tomentum; leaves not simultaneously shed; not restricted to the Andringitra massif 2
2. Petiole scales reaching the first pinna pair, a noticeable sparse tomentum of crispate hairs on the abaxial face of the costulae is always present 33c. var. *bevolo*
- Petiole scales restricted to the lower half of the petiole, abaxial face of the costulae glabrous or with a caducous tomentum of crispate hairs 3
3. Fertile and sterile pinnules slightly to strongly dimorphic, surface of the petiole base usually finely muricate (Fig. 32N) 33a. var. *boivinii*
- Fertile and sterile pinnules monomorphic, surface of the petiole base coarsely muricate (Fig. 34K) 4
4. Mature indusia shallowly cup-shaped, at most hemispherical, with an entire rim 33d. var. *hildebrandtii*
- Mature indusia hemispherical to profoundly cup-shaped, dehiscing in lobes or with irregular slits, their rim not entire 33e. var. *parahildebrandtii*

33a. *Cyathea boivinii* Mett. ex Kuhn
var. *boivinii*
(Figs 1D; 32; 44G; 52A)

Filices Africanae. 162 (1868); Ettingshausen, *Farnkräuter der Jetztwelt*. 224, pl. 159 fig. 4, pl. 160 fig. 4 (1865), nom. nud.; Christensen, *Dansk Botanisk Arkiv* 7: 33, pl. 6 figs 4-6, pl. 7 figs 8-10 (1932); Tardieu in Humbert, *Flore de Madagascar et des Comores, IV^e famille, Cyathéacées*: 31 (1951). — *Alsophila hyacinthi* R.M. Tryon, *Contributions from the Gray Herbarium* 200: 30 (1970). — Type: Ste Marie de Madagascar, forêt de Lafondrou, III.1849, *Boivin 1602* (lecto-, P! [2 sheets: P00411672, -73], here designated; isolecto-, B! [fragment], G!, P! [2 sheets], W!; putative isolecto-, W! [2 sheets]).

Cyathea humblotii Baker, *Journal of Botany* 22: 140 (1884). — *Cyathea boivinii* Mett. ex Kuhn var. *humblotii* (Baker) C. Chr., *Dansk Botanisk Arkiv* 7: 34, pl. 7 figs 1-7 (1932); Tardieu in Humbert, *Flore de*

Madagascar et des Comores, IV^e famille, Cyathéacées: 31 (1970). — Type: Madagascar, *Humblot 264* (holo-, K! [3 sheets: K000009947-49]; iso-, P! [4 sheets], W!).

Cyathea isaloensis C. Chr., *Dansk Botanisk Arkiv* 7: 35, pl. 6 figs 7-15 (1932); Christensen in Perrier, *Catalogue des plantes de Madagascar, Ptéridophytes*: 21 (1931), nom. nud.; Tardieu in Humbert, *Flore de Madagascar et des Comores, IV^e famille, Cyathéacées*: 32 (1951). — *Alsophila isaloensis* (C. Chr.) R.M. Tryon, *Contributions from the Gray Herbarium* 200: 30 (1970). — Type: Madagascar, Fianarantsoa, Isalo, 1000 m, X.1924, *Perrier de la Bâthie 16573* (lecto-, P! [4 sheets: P00418732, -33, P00483270 and P00411674], here designated; isolecto-, BM!, P! [3 sheets]).

ADDITIONAL MATERIAL EXAMINED. — **Madagascar**. Antananarivo, NW of Ambohitsaratelo-Bebao, 1100-1200 m, 21.I.1985, *Barnett et al.* 373 (MO, P). — Toamasina, Andasibe, Analamazaotra, 18°56'S, 48°26'E, 1925, *Académie Malgache s.n.* (P). — *Bernier 30?* (P). — *Boivin*

- s.n. (B, P[2], W). — Toamasina, Ste Marie, 16°50'S, 49°55'E, 1848, *Boivin 1608* (K). — Antananarivo, Mandraka, 18°55'30"S, 47°55'10"E, X.1948, *Corréard s.n.* (P). — Anjozorobe, de Mahandanivatsy à Antanifotsy, 18°23'30"S, 47°53'E, 1200 m, 21.I.1944, *Cours 1770* (P). — Fianarantsoa, Andringitra, forêt d'Ambodipaiso, 12.I.1945, *Cours 2313* (P), 2315 (P). — Antsirabe, Ambatoharanana, 17°58'S, 48°32'E, 1000 m, 5.III.1951, *Cours 4032* (P). — Brickaville, Ambalarandra, 300 m, 20.IV.1951, *Cours 4501* (P). — Forêt du Bongolava, 120 km W de Tsiroanomandidy, 18°49'S, 45°28'E, 1000 m, 18.VII.1974, *Cremers 3270* (P), 3271 (P). — Antananarivo, Mandraka, 18°55'30"S, 47°55'10"E, 17.IV.1905, *D'Alleizette 54* (P). — *Idem*, VIII.1906, *D'Alleizette 224* (P), 226 (P). — Imerimandroso, 17°26'S, 48°35'E, 800 m, 1.V.1926, *Decary 3956* (P). — Prov. de Farafangana, Befotaka, 12.VIII.1926, *Decary 4786* (P). — Environs de Tananarive, Anosivato, 22.IV.1928, *Decary 6273* (P). — Fort Dauphin, 400 m, 11.VII.1932, *Decary 10086* (P). — Fort Dauphin, massif de Bezavona, 25°00'S, 46°58'E, 28.VIII.1932, *Decary 10419* (P). — Fianarantsoa, vallée du Sakaleona, 20°34'30"S, 48°04'30"E, 1939, *Decary 14357* (P). — Tampoketsa d'Ankazobe, 17°58'30"S, 47°12'E, 17.VII.1939, *Decary 14360* (P). — Zahamena, 17°38'30"S, 48°50'E, 1941, *Decary 16743* (P). — Environs de Fito, 1833, *Goudot s.n.* (G). — 1832, *Goudot s.n.* (G). — 1830, *Goudot s.n.* (G, P). — Ambanivoul, 1834, *Goudot s.n.* (P). — 1830, *Goudot "27"* (K). — Nord des Chaines Anosyennes, W de Soavala, 24°25'S, 46°58'30"E, 300 m, 27.XI.1971, *Guillaumet 3992* (P). — District de Vatomandry, 19°20'S, 48°59'E, 21.II.1904, *Guillot s.n.* (G), 108 (B, P). — Tampoketsa au N d'Ankazobe, forêt d'Ambohitantly, 17°58'30"S, 47°12'E, 1600 m, X.1933, *Humbert 11129* (BR, K, MO, P). — Toamasina, Zahamena, massif de l'Andrangovallo, 17°40'S, 48°45'E, 1200 m, X.1937, *Humbert 12934* (P). — Montagne au Sud de Tanadava, vallée du Mandrere, 24°26'S, 47°00'E, 300 m, III.1947, *Humbert 20472* (K, P). — Antsiranana, Marojejy, W de la rivière Manantenina, 14°27'30"S, 49°42'30"E, 400-700 m, XII.1948, *Humbert 22422* (P). — E d'Andapa, vallée de la Lokoho, 14°31'45"S, 49°49'30"E, 250-550 m, 11.I.1949, *Humbert 22998* (K, MO, P, TAN). — Massif de Marivorahona, SW de Manambato, 13°46'40"S, 48°59'30"E, 1100 m, III.1951, *Humbert et al. 25631* (P). — Toamasina, Maroantsetra, Ambanizana, Ambon'Andraoka, 15°37'53"S, 49°58'33"E, 2-471 m, 20.X.2004, *Janssen et al. 2481* (MO, P, TAN). — *Idem*, piste entre Ambanizana et Andranobe, 14°40'53"S, 49°57'26"E, 0-30 m, 25.X.2004, *Janssen et al. 2517* (P, TAN). — Antsiranana, Masoala, Tampolo, 15°43'44"S, 49°58'03"E, 15 m, 27.X.2004, *Janssen et al. 2534* (MO, P, TAN). — Toamasina, RNI Betampona, Rendriendry, 17°55'54"S, 49°12'12"E, 300 m, 8.XI.2004, *Janssen et al. 2559* (MO, P, TAN). — Fianarantsoa, PN Isalo, canyon des Rats, 22°29'06"S, 45°23'E, 930 m, 22.XI.2004, *Janssen et al. 2604* (MO, P, TAN). — Toliara, Tolanaro, forêt de Manantantely, 24°59'19"S, 46°55'25"E, 50-600 m, 26.XI.2004, *Janssen et al. 2619* (P, TAN), 2620 (P, TAN). — Fianarantsoa, PN de Ranomafana, forêt de Talatakely, 21°15'43"S, 47°25'23"E, 1020 m, 26.IV.2005, *Janssen et al. 2823* (MO, P, TAN). — *Idem*, 21°15'44"S, 47°25'31"E, 1020 m, 26.IV.2005, *Janssen et al. 2826* (MO, P, TAN). — Toamasina, Varahina, 17°46'S, 48°48'E, 19.VIII.1937, *Jardin Botanique de Tananarive 3001* (P). — Antsiranana, Montagne d'Ambre, 12°37'S, 49°09'30"E, 25.XI.1970, *Keraudren-Aymonin et al. 25588* (P). — Toliara, Soanierana, 25°00'S, 46°53'E, 5 m, 30.XI.1938, *Lam & Meeuse 5555* (P). — Antsiranana, Manongarivo, Antsatrotro, 14°00'S, 48°00'E, 600-900 m, 30.III.1993, *Malcomber et al. 2290* (MO, P). — NW of Fort Dauphin, 24°46'S, 46°53'E, 200-360 m, 13.XI.1989, *McPherson 14458* (K, P, TAN). — Toamasina, Masoala Peninsula, Andranobe, 15°41'S, 49°58'E, 10-110 m, 25.II.1999, *McPherson et al. 17687* (P). — Baie d'Antongil, Maroa, *Mocquerys 328* (G). — Toamasina, Ambohimahasoa, 21°06'30"S, 47°13'30"E, 1700 m, 16.I.1970, *Onraedt 70M94* (BR). — Andasibe, Analamazaotra, 18°56'S, 48°26'E, 800 m, *Perrier de la Bâthie 6122 p.p.* (P). — Forêt d'Analamaitso, 16°11'30"S, 48°08'30"E, 900 m, VIII.1907, *Perrier de la Bâthie 15843* (P). — Antsiranana, Zangoa, VI.1909, *Perrier de la Bâthie 15844* (P). — Antananarivo, Manerinerina, Tampoketsa entre l'lkopa et la Betsiboka, 17°58'S, 47°12'E, 1500 m, XII.1924, *Perrier de la Bâthie 16838* (BM, P). — Fianarantsoa, corridor entre les PN de Ranomafana et d'Andringitra, ONO d'Ikongo, 21°49'17"S, 47°24'50"E, 660 m, 19.XI.2000, *Rabarimanarivo et al. 154* (P). — Fianarantsoa, PN de Ranomafana, Ranomena, 21°12'S, 47°27'E, 990 m, 3.XII.2000, *Rabarimanarivo et al. 184* (P), 185 (P). — Moramanga, forêt d'Ambatovy, 18°49'S, 48°18'E, 1997, *Rakotomalaza s.n.* (P). — Antananarivo, RS d'Ambohitantly, NW d'Ankazobe, 18°10'S, 47°17'E, 1200-1650 m, 5.X.1983, *Rakotondrainibe 453* (P, TAN). — *Idem*, 30.VI.1985, *Rakotondrainibe 468* (P, TAN). — *Idem*, 19.XI.1983, *Rakotondrainibe 471* (P). — *Idem*, 18.IV.1985, *Rakotondrainibe 529* (P), 530 (P), 531 (P). — *Idem*, 30.VI.1985, *Rakotondrainibe 541* (P, TAN). — Toamasina, Mananara-Avaratra, forêt de Verezanantsoro, 16°26'S, 49°38'E, 460 m, 6.I.1994, *Rakotondrainibe et al. 2045* (P). — Toamasina, Maroantsetra, Nosy Mangabe, 15°30'S, 49°46'E, 330 m, 1.XII.1993, *Rakotondrainibe et al. 2047* (P, TAN). — *Idem*, Ambanizana, 15°34'S, 50°00'E, 820 m, *Rakotondrainibe et al. 2048* (P). — *Idem*, Andranobe, 15°41'S, 49°58'E, 10-20 m, 19.XII.1993, *Rakotondrainibe et al. 2049* (P). — Antsiranana, RS d'Anjanaharibe-Sud, SSW de Befingotra, 14°42'30"S, 49°27'30"E, 19.X.1994, *Rakotondrainibe et al. 2096* (K, P). — *Idem*, 15.XI.1994, *Rakotondrainibe 2419* (P). — Fianarantsoa, RNI d'Andringitra, berges de la rivière Sahanivoraky, 22°13'40"S, 47°01'30"E,

800 m, 17.V.1995, *Rakotondrainibe* 2622 (P). — Toliara, RNI d'Andohahela, NW d'Eminiminy, 24°37'55"S, 46°45'29"E, 500 m, X.1995, *Rakotondrainibe* 2880 (MO, P, TAN). — *Idem*, 24°33'30"S, 46°43'E, 21.X.1995, *Rakotondrainibe* 2881 (P). — *Idem*, 24°41'S, 46°49'E, XI.1995, *Rakotondrainibe* 3016 (P). — *Idem*, 24°33'07"S, 46°43'03"E, 1600 m, 2.XII.1995, *Rakotondrainibe* 3234 (P). — Antsiranana, RNI du Marojejy, NW de Manantenina, 14°29'S, 49°49'E, 6.X.1996, *Rakotondrainibe* 3303 (P). — *Idem*, 14°26'S, 49°45'42"E, 800 m, 15.X.1996, *Rakotondrainibe* 3380 (P, TAN). — Fianarantsoa, Ambalavao, RS d'Ivohibe, 22°28'12"S, 46°57'36"E, 850-950 m, 7.X.1997, *Rakotondrainibe* et al. 4030 (P). — *Idem*, 22°31'30"S, 46°59'E, 25.X.1997, *Rakotondrainibe* 4232 (MO, P, TAN). — *Idem*, corridor reliant les réserves d'Andringitra et d'Ivohibe, ESE d'Angodongodona, 22°25'18"S, 46°53'54"E, 1150-1300 m, 3.XI.1997, *Rakotondrainibe* et al. 4280 (P, TAN). — *Idem*, 22°25'36"S, 46°56'18"E, 880-950 m, 11.I.1997, *Rakotondrainibe* et al. 4351 (P, MO, TAN). — *Idem*, 12.I.1997, *Rakotondrainibe* et al. 4373 (P). — Antananarivo, RS d'Ambositantely, 18°12'S, 47°17'E, 1400-1450 m, 6.XII.1997, *Rakotondrainibe* 4407 (P, TAN). — *Idem*, 18°13'S, 47°17'E, 1300-1400 m, 11.XII.1997, *Rakotondrainibe* 4488 (P, MO, TAN). — Antsiranana, Andapa, forêt de Betaolana, NW d'Ambodiangezoka, 8.X.1999, *Rakotondrainibe* 4841 (P). — Antsiranana, massif d'Anjanaharibe-Sud, SW de Befingotra, 14°30'S, 49°26'30"E, 1120 m, 26.X.1999, *Rakotondrainibe* et al. 5036 (P, TAN). — *Idem*, 14°30'20"S, 49°31'20"E, 29.X.1999, *Rakotondrainibe* 5098bis (P). — *Idem*, 1.XI.1999, *Rakotondrainibe* 5120 (P). — Fianarantsoa, PN de Ranomafana, forêt de Vatoharanana, 21°17'24"S, 47°26'E, 1000-1100 m, 9.X.2000, *Rakotondrainibe* et al. 5958 (P). — Fianarantsoa, forêt d'Andrambovato, 21°30'42"S, 47°24'36"E, 1000-1100 m, 13.X.2000, *Rakotondrainibe* et al. 5979 (P, TAN). — Antsiranana, PN de Marojejy, SE de Doany, 14°22'25"S, 49°31'05"E, 14.X.2001, *Rakotondrainibe* et al. 6231 (K, P). — *Idem*, 14°25'37"S, 49°36'30"E, 750-800 m, 20.X.2001, *Rakotondrainibe* et al. 6309 (P, TAN). — Antsiranana, forêt de Binara, SW de Daraina, 13°15'12"S, 49°37'12"E, 980 m, 7.XI.2001, *Rakotondrainibe* et al. 6542 (K, P, TAN). — *Idem*, 9.XI.2001, *Rakotondrainibe* et al. 6549 (P, TAN). — Toamasina, PN de Zahamena, Miarinarivo, Savaharina, 17°41'S, 48°59'E, 650 m, 13.VI.2001, *Rasolohery* 526 (MO, P, TAN). — *Idem*, Antanandava, Antenna, 17°00'S, 48°00'E, 900-1100 m, 1.II.2002, *Rasolohery* 602 (MO, P, TAN). — Toamasina, NW of Maroantsetra, massif of Ankirindro, 15°19'20"S, 49°33'26"E, 100 m, 2.II.1999, *Schatz et al.* 3927 (P). — Nossi Comba, 13°27'30"S, 48°20'30"E, 3.IV.1882, *Thiebaut* 62 (P). — *Thompson s.n.* (BM). — Antananarivo, E of Anjozorobe, 18°22'S, 47°47'E, 1250 m, 6.XI.1992, *van der Werff et al.* 12852 (MO, P). — Toliara, PN d'Andohahela, NW of Eminiminy, 24°41'S,

46°48'E, 500-1000 m, II.1993, *van der Werff et al.* 12868 (BR, G, MO, P), 12904A (BR, G, MO), 12907 (BR, G, MO), 12917 (BR, MO). — Toamasina, Mantadia, 18°49'30"S, 48°28'E, 900 m, 2.XI.1994, *van der Werff et al.* 13604 (P). — *S. coll. s.n.* (B, P).

FIELD OBSERVATIONS. — Trunk: HT up to 8 m, DT (8-)9-12 cm excluding and 9-20 cm including the persistent petiole bases, these sigmoid and appressed for 20-30 cm, usually forming distinct vertical rows, persistent usually at least in the upper quarter, but degraded and the leaf scars exposed in the lower part of the trunk in older plants, which soon develop a dense mantle of adventitious roots, hence the trunk base often being considerably thickened; trunk surface blackish brown, muricate.

Petiole: with 1 or 2 regular rows of white to light brown aerophores on either side; petiole base long sigmoid, appressed to the trunk.

Leaf scars: 3-4 × 3.5-9 cm, ovate in upper, elliptic or rhombic to obovate in lower part of the trunk, more or less fibrous with remnants of the petiole, with up to 10 big orifices on their lower rim or these obscured by rudiments of the petiole, lower rim sometimes raised; spirally arranged.

Crown: more or less umbrella-shaped, petioles relatively short, the crown centre often distinctly infundibuliform with rather dense pinnae; some dead leaves persistent and hanging from the apex; the crown appears denser than in *C. boivinii* var. *hildebrandtii*.

Trunk apex: densely scaly like the petiole bases, visible through or concealed by the petiole bases.

Lamina: elliptic; LL (90-)150-320(-400) cm, WL (65-)80-180 cm, FW (45-)65-110(-180) cm, NP (9-)12-17(-19).

DESCRIPTION

Petiole: (15-)25-55 cm long, 2-4 cm in diameter; stramineous to green, its abaxial face dark violaceous brown, more or less sharply, but always densely and finely muricate, bearing a more or less dense, caducous tomentum of intricate brownish squamules; occasionally a reduced pinna about halfway on the petiole and then usually not found on all leaves of a single plant.

Lamina: bipinnate-pinnatisect to tripinnate, subcoriaceous to coriaceous, displaying a more or less pronounced fertile-sterile dimorphism; shiny green to dark green, rarely yellowish green above, pale green to more or less strongly glaucous below, lamina base shortly attenuate, the basal pinnae patent and conduplicate; rachis of the same colour as the petiole, its distal part completely green and smooth.

Largest pinnae: (35-)55-80 cm long, distant by 10-18 cm, adjacent pinnae overlapping to contiguous; costae and costulae of the same colour as the rachis, smooth.

Largest pinnules: (7.5-)8-14 × (1.2-)1.4-2.2(-3) cm, adjacent pinnules spaced by less than their width to contiguous, rarely overlapping, linear-oblong to triangular, their apex acute to shortly caudate, divided to the costula into broadly adnate segments, the 0-2 proximal segment pairs sessile, the bases of adjacent sterile segments confluent from the lower third of the pinnule or below, adjacent fertile segments confluent at most in the upper quarter, rarely in the upper half of the pinnule; fertile pinnule segments 0.1-0.3 cm wide, spaced by less than to rarely several times their width, straight to falciform, with a shallowly to strongly crenate and slightly to strongly revolute margin, their apex serrulate, acute to obtuse, rounded in forms with narrow segments; sterile pinnule segments (0.2-)0.3-0.4 cm wide, their margin at most slightly revolute; lateral veins in the segments once, rarely twice furcate.

Scales and hairs: scales present from the petiole base upwards to 10-30(-60) cm on the petiole, very dense and overlapping, persistent at the petiole base, but caducous further up on the petiole, long and narrowly triangular to subulate, (2-)3-5 × 0.1-0.3 cm, straight, more or less twisted and with a crispate apex, shiny brown to dark brown, concolourous or with a darker centre and base, antrorse, not appressed to the petiole, not indurated; sparse, ramified, crispate, soft, light brown hairs (as in *C. dregei*) and soft, lanceolate, dull light brown appressed scales (as in *C. sechellarum*) loosely attached to the abaxial face of the lamina axes and veins, but this indument is caducous; adaxial face of the rachis and costae densely tomentose with light to dark brown, soft, contorted, multicellular hairs and carrying scattered, light brown, filiform, caducous scales.

Sori: very close to the midvein, contiguous, up to 0.1 cm in diameter, covering the entire segment or its lower three quarters, one sorus per lobe in forms with strongly crenate, narrow pinnule segments; indusia hemispherical to more or less profoundly cup-shaped, brown to dark brown, subcoriaceous, at maturity with an oblique rim, that is often higher near the midvein, indusia then usually opening with

a slit towards the margin of the segment or rarely in 2 lobes, rarely with an entire rim; receptacle capitate to columnar, shorter to longer than the rim of mature indusia, with inconspicuous filiform paraphyses shorter than the sporangia.

DISTRIBUTION

Madagascar, widespread except in the West; endemic.

ECOLOGY

0-1200(-1500) m. Dense evergreen rainforests and forest margins, also frequently in forest clearings and open habitats.

REMARKS

Cyathea boivinii var. *boivinii* is a variable taxon characterized by a more or less strongly pronounced fertile-sterile leaf dimorphism, variously cup-shaped, but never globular, indusia and dense, long scales on a finely muricate petiole. Mature indusia in this variety form a more or less profound cup with an oblique rim opening with a slit towards the margin of the segment. In young sori, the upper part of the high, cup-shaped to, rarely, urceolate indusium, is composed of elongated cells with thin walls and differentiated with a sharp transition from the lower part, which is composed of smaller, thick-walled cells (Fig. 32L). The upper part of the indusium is caducous, leaving a persistent, more or less profound cup-shaped structure with an entire rim, which subsequently dehisces towards the margin of the pinnule segment. This sequence of events may explain the variety of indusium shapes observed in the examined specimens.

Some taxa of the Western Indian Ocean are morphologically closely related to *C. boivinii* s.l. These species and their differential characters are: *C. excelsa* Sw. from the Mascarenes, which has globular indusia and lacks any form of dimorphism. *Cyathea sechellarum* Mett. has shorter, appressed petiole scales, comparably abundant, appressed soft scales on the abaxial face of the costulae and midveins and lacks any fertile-sterile lamina dimorphism. *Cyathea dregei* Kunze is most easily distinguished by its smaller pinnae and pinnules, the costae usually forming acute acroscopic angles with the rachis and by a comparably abundant indument of crispate, branched hairs loosely

attached to the abaxial face of the lamina axes and veins. The globular indusia, at maturity dehiscing and opening in lobes, as well as a strongly glaucous abaxial leaf surface together with usually dense scales ascending to the first pinna pair and beyond are the most reliable characters in differentiating *C. similis* C.Chr. from *C. boivinii* s.l.

Cyathea concava Bonap., previously ascribed to *C. boivinii* as a variety, is easily distinguished by its globular indusia, very caducous, filiform petiole scales, strongly concave and coriaceous pinnule segments and a rather triangular than oblong pinnule shape. Furthermore, its habit is completely different with small, more or less horizontal crowns and much thinner, usually naked trunks, that are not covered with persistent petiole bases except in their apical region.

TYPIFICATION AND SYNONYMY

Typification of C. boivinii Mett. ex Kuhn

The original collection of *C. boivinii*, *Boivin 1602* is widely distributed. Three sheets have been traced at W, one with a partly fertile middle pinna from “St. Marie” not carrying Mettenius’ writing and two others, one carrying a partly fertile middle pinna and the other a sterile pinna taken from near the leaf apex. Both include labels with the name of the species in Mettenius’ hand, but “Mayotte 1846-1848” as collection locality. Mettenius’ manuscript name first appeared in print in Ettingshausen (1865: 224), who undoubtedly depicted a sterile pinnule from one of the latter two sheets at W that was annotated by Mettenius. Accordingly, Ettingshausen cites Mayotte as collection locality. However, Kuhn (1868) in his validating description cites “St. Mariae ad Madagascarium” as collection locality for *Boivin 1602*, which is consistent with numerous further sheets of *Boivin 1602* including the sheet bearing the original label in Boivin’s hand (P!, P00411672). The original label carries more precise locality information, “Ste. Marie, forêt de Lafondrou”. All cited specimens are morphologically identical and most likely belong to the same collection, including both sheets *Boivin s.n.* from “Mayotte” at W. As no other collection of *C. boivinii* from Mayotte is known, an error in labelling the sheets seems likely. This not being proven, we can choose none of these two specimens as lectotype in agreement with Kuhn’s protolog. From the original

material composed of many equivalent sheets in various herbaria, we here designate a representative lectotype comprising a petiole base with scales, sterile pinnae from the apical part of the leaf identical to those depicted by Ettingshausen (P!, P00411672) and partly fertile middle pinna (P!, P00411673).

Typification of C. isaloensis C.Chr.

We traced one sheet of *Perrier de la Bâthie 16573* with two young, fertile middle pinnae at BM! as well as seven sheets at P! carrying several mature, fertile middle pinnae, a young, fertile middle pinna, one petiole with scales (halved lengthwise), a young, fertile leaf apex and a mature, sterile middle pinna. Christensen (1932: 35) notes that he received a single mature sterile pinna, which he clearly designates as the holotype specimen, two petioles and three middle pinnae as well as one apex of young, fertile leaves from Perrier and that he described *C. isaloensis* C.Chr. from that material. The said specimens have not been traced in Christensen’s herbarium at BM, but the Paris material corresponds well to this enumeration. However, the sterile middle pinna at P! lacks an annotation in Christensen’s hand and we hence consider the holotype specimen cited by Christensen as being currently lost and designate a lectotype. In the light of a more ample material, we regard it as established that the fertile and sterile material belongs to the same plant and gathering and refrain from restricting lectotypification to the only currently known specimen of a sterile middle pinna. We choose a four sheet lectotype from the Paris material in which we include the only sheets carrying the name of the species and “type” in Christensen’s hand (namely a young leaf apex and a mature fertile pinna), the only currently available sheet carrying a mature sterile middle pinna as well as the sheet carrying the petiole base with scales.

The status of Cyathaea humbloti Baker and *C. isaloensis* C.Chr.

Two species, *C. isaloensis* and *C. humbloti* Baker, have been distinguished from *C. boivinii* primarily based on pinnule shape and colouring. After examination of the ample material currently available it is obvious, that the types of both species correspond to extreme morphotypes in a continuous spectrum

of variation and that they cannot be maintained as independent taxonomic entities. The “isaloensis”-morphotype (Fig. 32H, I; e.g., *Guillot 108, McPherson 14458, van der Werff 12904A*) is characterized by a pronounced dimorphism with long and narrow fertile segments, spaced by several times their width and having a strongly revolute and crenate margin. Sterile pinnule segments are much wider and their serrate margin is only slightly revolute. The lamina is usually strongly glaucous below and shiny yellowish green above when dry. The “humblotii”-morphotype (Fig. 32F, G; e.g., *Rakotondrainibe et al. 2096, 5063, 6231*) corresponds to specimens with comparatively short and broad fertile pinnule segments with a flat, not revolute, margin and often much longer and wider sterile pinnule segments with a flat, subentire margin. Specimens collected in the Ranomafana National Park form a homogeneous population intermediate between the “humblotii”-morphotype and the type specimen of *C. boivinii* var. *boivinii* in having longer and narrower segments with an only slightly revolute and distinctly serrate margin (Fig. 32E; e.g., *Janssen et al. 2823, 2826*). A correlation of the development of these morphotypes with climatic and geographic parameters is not supported by the available data.

33b. *Cyathea boivinii* Mett. ex Kuhn

var. *andringitrensis* Janssen & Rakotondr., var. nov.
(Figs 33A-G; 44H; 52C, E)

A typo differt petiolo et rhachide tomento densissimo paleolis brunneis intricatis oblecto. Paleae petioli valde caducae, longe subulatae, basi 0.2-0.3 cm latae, apicibus valde crispatis.

Petiolus brevis, pinna reducta ad basim destituta. Ut videtur folia omnia certo tempore recurrente exuta.

TYPUS. — Madagascar, Fianarantsoa, PN Andringitra, forêt d'Anjavidilava et descente vers le camp Imaitso, 22°09'36"S, 46°57'39"E, 1950 m, 19.XI.2004, *Janssen et al. 2595* (holo-, P! [4 sheets: P00589549-52]; iso-, P! [3 sheets], TAN!; one trunk surface mould at P!).

ADDITIONAL MATERIAL EXAMINED. — Madagascar, Fianarantsoa, PN Andringitra, forêt d'Imaitso, 22°08'52"S, 46°56'45"E, 1580-1650 m, 18.XI.2004, *Janssen et al. 2591* (MO, P, TAN). — *Idem*, forêt d'Anjavidilava, 22°09'36"S, 46°57'39"E, 1800-2000 m, 19.XI.2004, *Janssen et al. 2594* (MO, P, TAN), 2597 (P, TAN), 2598 (P, TAN), 2600 (P, TAN). — *Idem*, Ambohitsipanefy, 22°10'34"S, 46°56'15"E, 2050 m, 17.IV.2005, *Janssen et al. 2770* (MO, P, TAN). — *Idem*, source de la rivière Sahavatoy, 22°11'39"S, 46°58'16"E, 1650 m, 31.V.1995, *Rakotondrainibe 2745* (MO, P, TAN).

DIFFERENTIAL FIELD OBSERVATIONS. — Trunk: DT 12-13 cm, dead petiole bases short and persistent only for a short distance below the crown, more or less fibrous and mixed with dense tufts of scales imparting a distinctly thickened appearance to the upper part of the trunk; the trunk is more or less naked below with the leaf scars exposed, its surface coarsely muricate.

Petiole: base straight (or very shortly curved to sigmoid), never distinctly sigmoid.

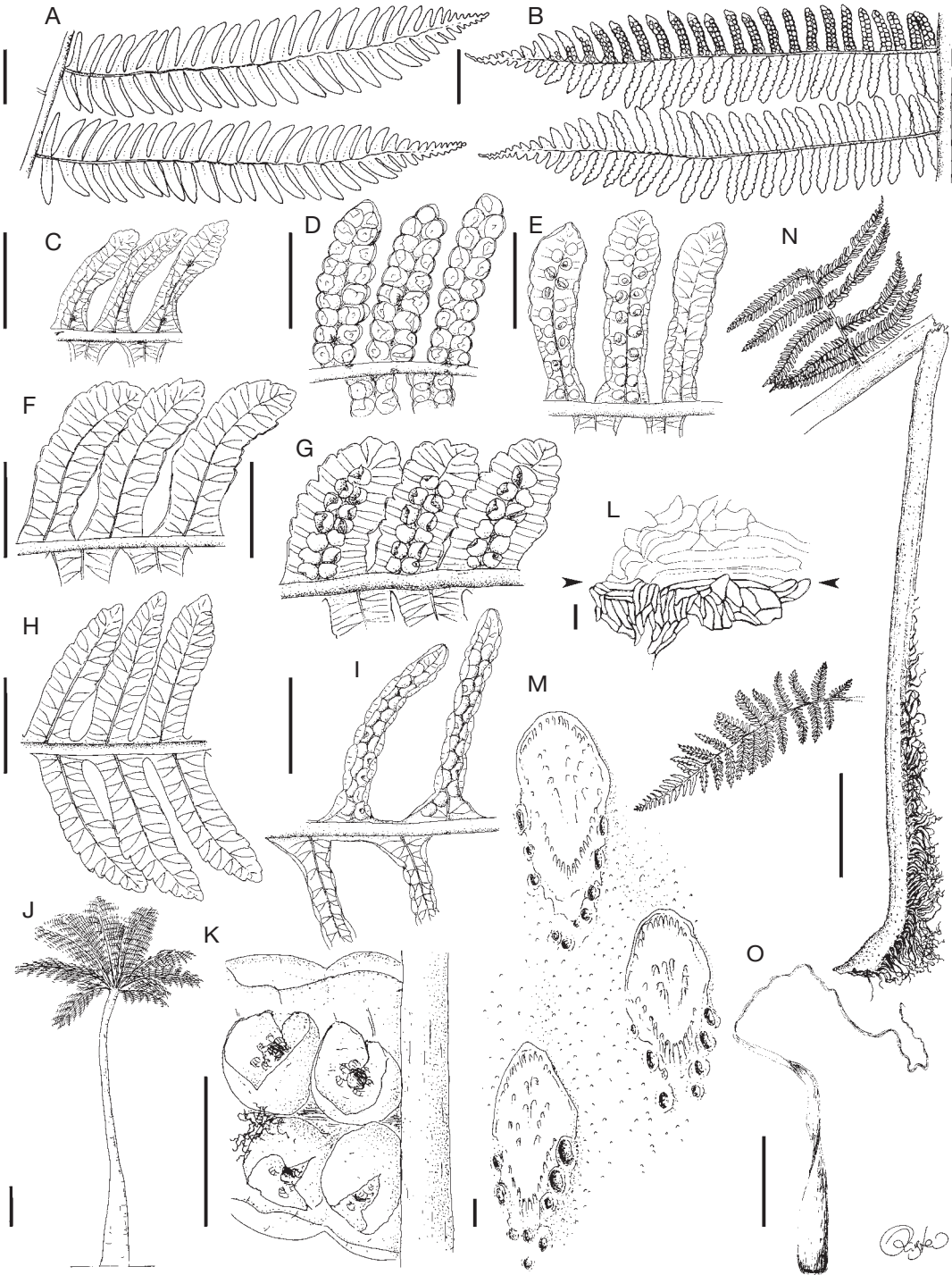
Leaf scars: with 7 or 8 big orifices on their lower rim.

Crown: smaller; leaves apparently periodically shed, distinct heaps of leaves present at the base of the trunks, which were defoliated in November 2004; shedding of leaves is not fully simultaneous in the populations observed.

DIFFERENTIAL DESCRIPTION

Fertile and sterile pinnules are not dimorphic. Even in old leaves, a very dense tomentum of intricate,

FIG. 32. — *Cyathea boivinii* Mett. ex Kuhn var. *boivinii*: **A**, sterile pinnules abaxially with a fragment of the costa; **B**, fertile pinnules abaxially with a fragment of the costa, sori only partly indicated; **C**, **D**, pinnule segments abaxially with a fragment of the costula, common form; **C**, sterile, **D**, fertile; **E**, fertile pinnule segments abaxially with a fragment of the costula, transitional form between common form and “humblotii”-morphotype; **F**, **G**, pinnule segments abaxially with a fragment of the costula, “humblotii”-morphotype; **F**, sterile, **G**, fertile; **H**, **I**, pinnule segments abaxially with a fragment of the costula, “isaloensis”-morphotype; **H**, sterile; **I**, fertile; **J**, habit, note that the trunk base is often conspicuously thickened by a mantle of adventitious roots; **K**, proximal part of a pinnule segment abaxially with a fragment of the costula, note the oblique, emarginate rim of the sori and the sparse indument of crispate, branched hairs; **L**, fragment of the indusium showing the transition (arrows) from cells with thickened walls of its persistent cup-shaped basal part to thin-walled, rapidly decaying cells of its upper part; **M**, leaf scars and trunk surface from an old trunk, the dead petiole bases having decayed completely; **N**, basal part of the leaf (from the petiole base up to the first pinna pair), lateral view, one half of the petiole pruned away by longitudinal section, note that a pair of reduced pinnules is sometimes present in the lower half of the petiole (its approximate position and morphology here indicated from *Janssen et al. 2517* [P]); **O**, scale from the base of the petiole. A-D, K, L, N, O, *Janssen et al. 2559* (P); E, *Janssen et al. 2826* (P); F, G, *Rakotondrainibe et al. 5036* (P); H, *van der Werff 12917* (P); I, *van der Werff 12904a* (P); J, M, uncollected, photograph at P. Scale bars: A, B, M, 1 cm; C-I, O, 0.5 cm; J, 1 m; K, 0.1 cm; L, 50 µm; N, 5 cm.



brown squamules persists on the petiole and rachis, but can be wiped off easily. The scales of the petiole base are very rapidly caducous and often not preserved in herbarium specimens. They are narrow, 0.2-0.3 cm wide, and have strongly crispate and often intricate apices. Dense clusters of fallen scales are found in the leaf axils near the trunk apex. Reduced pinnae are absent from the base of the petiole, which is often very short (10-22 cm long, occasionally up to 40 cm and rarely 80 cm) due to the lamina being attenuate by increasingly spaced pinnae. The petiole surface is coarsely and distantly muricate. Indusia are high, cup-shaped, rarely urceolate when young. At maturity, they are cup-shaped with an entire rim or lobed down to the base of the receptacle, which is shorter than the rim of the mature indusium.

DISTRIBUTION

Southern Madagascar: Andringitra massif; endemic.

ECOLOGY

1500-2000 m. Dense evergreen rainforests of higher altitudes.

ETYMOLOGY

The variety is currently only known from the Andringitra massif in South-Central Madagascar.

33c. *Cyathea boivinii* Mett. ex Kuhn
var. *bevolo* Janssen & Rakotondr., var. nov.
(Figs 33H-J; 44H)

A typo differt paleis petioli ascendentes ad pinnam primam et saepe transientes in paleis filiformes crispatas.

TYPUS. — Madagascar, Antananarivo, Mt. Tsiafajavona, [19°21'S, 47°14'30"E], 2000 m, *Perrier de la Bâthie 13508* (holo-, P! [3 sheets: P00411706, -07, P00573831]; iso-, P! [2 sheets]).

ADDITIONAL MATERIAL EXAMINED. — **Madagascar.** Anjanaharibe, 1600-1700 m, 12.XII.1950, *Cours 3764* (P). — Massif de l'Andohahela, vallée de la Sakamalio, 24°32'S, 46°41'E, 1600-1900 m, I.1934, *Humbert 13576* (P). — Andapa, massif de l'Anjanaharibe, 14°36'S, 49°27'E, 1800 m, *Humbert et al. 24646* (P), *24676* (G, MO, P, TAN), *24760* (G, K, P), *24761* (G, K, MO,

P). — Mahajanga, massif du Tsaratanana, montagnes au N de Mangindrano, Antetikalambazaha, 14°10'27"S, 48°56'43"E, 1700 m, 7.V.2005, *Janssen et al. 2852* (MO, P, TAN). — Mahajanga, massif du Tsaratanana, montagnes au N de Mangindrano, entre la source du Maevarano et Bepia, 14°08'39"S, 48°58'24"E, 2480-2490 m, 12.V.2005, *Janssen et al. 2929* (MO, P). — *Idem*, entre Antetikalambazaha et Mangindrano, 14°10'27"S, 48°56'43"E, 1670-1700 m, 15.V.2005, *Janssen et al. 2955* (MO, P, TAN). — Antsiranana, RS d'Anjanaharibe-Sud, WSW de Befingra, 14°44'30"S, 49°26'30"E, 1600 m, 22.XI.1994, *Rakotondrainibe et al. 2491* (P). — Toliara, RNI d'Andohahela, NW d'Eminiminy, 24°34'15"S, 46°43'58"E, 1480 m, 19.XI.1995, *Rakotondrainibe 3136* (MO, P, TAN).

DIFFERENTIAL DESCRIPTION

The petiole scales are up to 5 cm long and 0.25-0.4 cm wide, shiny blackish brown, moderately densely inserted, persistent and ascend on the petiole usually up to the first pinna pair, but at least more than halfway on the petiole. Further up on the petiole and rachis the scales grade into lighter, crispate, filiform scales. Specimens attributed to this variety have a more abundant indument of loose, crispate hairs on the abaxial face of the lamina than the other varieties of *C. boivinii* except var. *andringitrensis*.

DISTRIBUTION

Madagascar: mountains of Northern Madagascar (Anjanaharibe, Tsaratanana), one collection from the South (Andohahela); endemic.

ECOLOGY

1500-2500 m. Dense evergreen rainforests of higher altitudes.

REMARKS

Some specimens included here have been previously determined as *C. polyphlebia*, but especially with respect to their sparse indument of crispate hairs and the size of their pinnae and pinnules they are rather different from *C. dregei*, where *C. polyphlebia* has been included in the current treatment.

Humbert 24676, 24760, 24761 (Madagascar: Anjanaharibe) have coriaceous, concave segments, strongly glaucous below, and shiny blackish brown, comparatively narrow scales. The pinnule segments of *Humbert 24646* are deeply crenate.

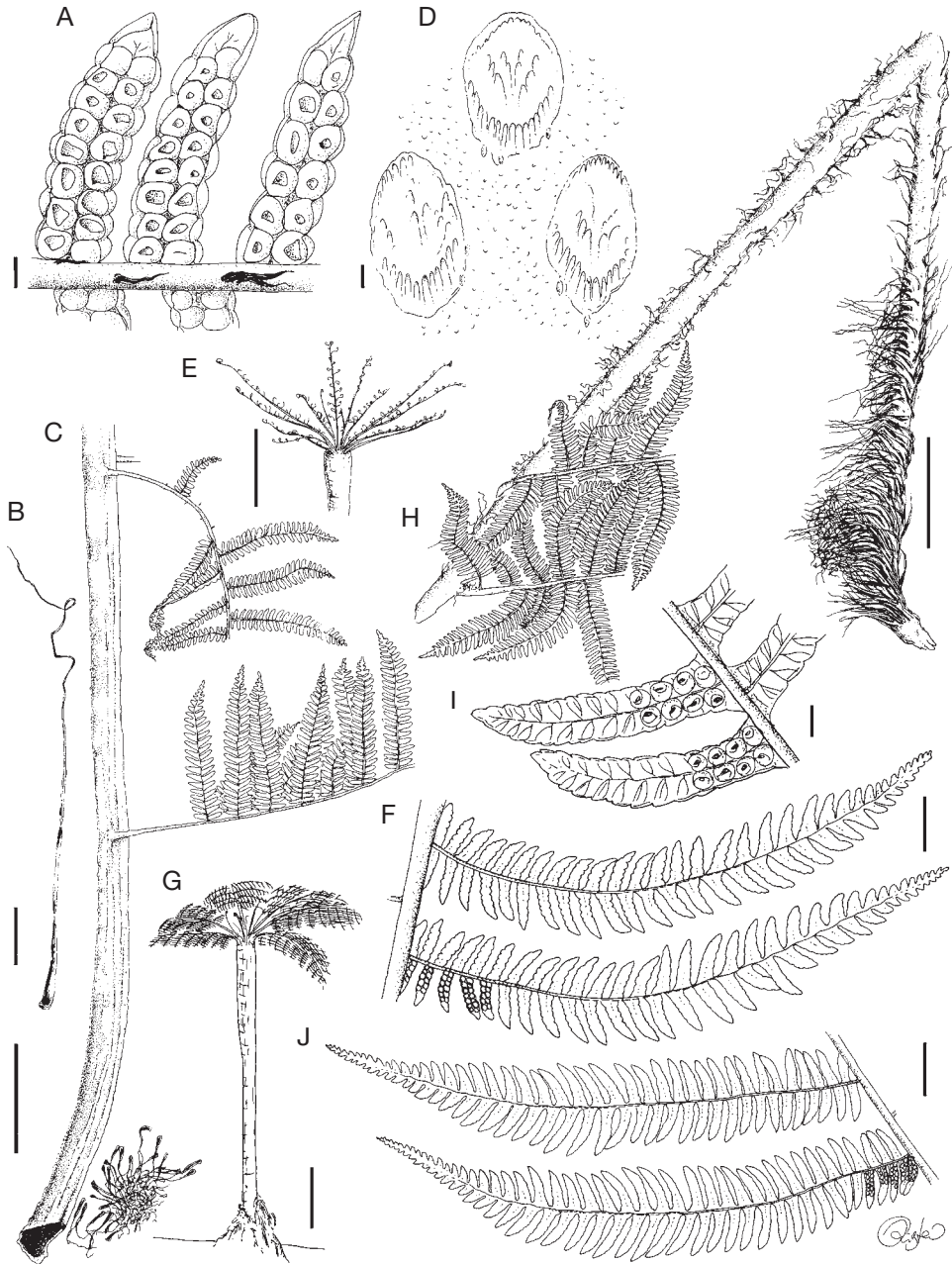


FIG. 33. — **A-G**, *Cyathea boivinii* Mett. ex Kuhn var. *andringitrensis* Janssen & Rakotondr.; **A**, pinnule segments abaxially with a fragment of the costula; **B**, scale from the base of the petiole; **C**, basal part of the leaf (from the petiole base up to the second pinna pair), lateral view, the scales are caducous; **D**, leaf scars and trunk surface; **E**, habit of a crown with simultaneously unrolling young leaves; **F**, pinnules abaxially with a fragment of the costa, sori only partly indicated; **G**, habit, note the heap of dead leaves at the base of the trunk from the last simultaneous shedding; **H-J**, *Cyathea boivinii* var. *bevolo* Janssen & Rakotondr.; **H**, basal part of the leaf (petiole base up to the first pinna pair), lateral view; **I**, pinnule segments abaxially with a fragment of the costula; **J**, pinnules abaxially with a fragment of the costa, sori only partly indicated. A-C, F, Janssen *et al.* 2600 (P); D, Janssen *et al.* 2594 (P); E, G, uncollected, photographs at P; H-J, Perrier de la Bâthie 13508 (P). Scale bars: A, I, 0.1 cm; B, 0.5 cm; C, H, 5 cm; D, F, J, 1 cm; E, G, 1 m.

ETYMOLOGY

The epithet is derived from the Madagascan *be* (many) and *volo* (hair) alluding to the scaly petioles of this variety.

- 33d. *Cyathea boivini* Mett. ex Kuhn
var. *hildebrandtii* (Kuhn)
Janssen & Rakotondr., comb. nov.
(Figs 34; 44H; 52B)

Cyathea hildebrandtii Kuhn, *Index seminum horto botanico Berolinensi*: 20 (1875); Baker & Moore, *Journal of Botany* 6: 71 (1877); Christensen, *Dansk Botanisk Arkiv* 7: 33, pl. 6 figs 19, 20 (1932); Tardieu in Humbert, *Flore de Madagascar et des Comores, IV^e famille, Cyathacées*: 28 (1951). — *Alsophila hildebrandtii* (Kuhn) R.M. Tryon, *Contributions from the Gray Herbarium* 200: 30 (1970). — Type: Comoro-Insel Johanna, von 800-1500 m, VIII.1875, *Hildebrandt 1747* (lecto-, B! [2 sheets: B200129540 and B200129542], here designated; isolecto-, B! [3 sheets], BM!, K!, P!).

ADDITIONAL MATERIAL EXAMINED. — **Comoros.** Grande Comore, environs de Nioumbadjou, 11°46'S, 43°18'E, 400-500 m, IV.1911, *Humblot s.n.* (P). — *Idem*, 11°49'S, 43°18'E, 420 m, 15.XI.1999, *Labat et al. 3132* (G, K, P). — Massif du Karthala, Singani, 11°51'S, 43°19'E, 400 m, 21.XI.2002, *Rakotondrainibe et al. 6755* (P).

Madagascar. Antsiranana, Montagne d'Ambre, 12°36'S, 49°09'E, 1400-1475 m, IV.1993, *Andrianantoanina et al. 30* (P). — *Idem*, 12°31'S, 49°09'E, 700-900 m, V.1993, *Andrianantoanina et al. 128* (P). — *Idem*, 12°31'30"S, 49°10'20"E, 1200-1250 m, 24.XII.1967, *Bernardi 12039* (G, K, P). — Massif du Marojejy, col de Doanyanala, 14°28'S, 49°32'E, 600-700 m, 1949, *Humbert 23014* (G). — Montagnes au nord de Mangindrano, sommets d'Ambohimirahavavy, 14°12'S, 49°06'30"E, 1800-2000 m, 1951, *Humbert et al. 25056* (P). — Antsiranana, Montagne d'Ambre, 12°31'38"S, 49°10'20"E, 1130 m, 5.X.2004, *Janssen et al. 2433* (MO, P, TAN). — *Idem*, entre Station des Roussettes et Grand Lac, 12°31'53"S, 49°10'16"E, 1132 m, 6.X.2004, *Janssen et al. 2442* (MO, P, TAN). — *Idem*, entre Grand Lac et Lac Maudit, 12°35'48"S, 49°09'34"E, 1300 m, 9.X.2004, *Janssen et al. 2464* (MO, P, TAN). — Mahajanga, massif du Tsaratanana, montagnes au N de Mangindrano, Antetikalambazaha, 14°10'27"S, 48°56'43"E, 1700 m, 7.V.2005, *Janssen et al. 2851* (MO, P, TAN). — *Idem*, source du Maevarano, 14°08'49"S, 48°58'11"E, 2330 m, 11.V.2005, *Janssen et al. 2910* (MO, P, TAN). — *Idem*, entre la source du Maevarano et Bepia, 14°08'45"S, 48°58'18"E, 2330-2480 m, 12.V.2005, *Janssen et al. 2914* (MO, P, TAN). — *Idem*, entre Antetikalambazaha

et Mangindrano, 14°10'27"S, 48°56'43"E, 1670-1700 m, 15.V.2005, *2956* (MO, P, TAN). — Antananarivo, Tampoketsa d'Ankazobe, 17°52'S, 47°33'E, 1410 m, 18.III.1999, *Labat et al. 2945* (MO, P, TAN). — Antsiranana, Montagne d'Ambre, Petit Lac, 12°36'S, 49°09'E, 700 m, 21.X.1991, *Malcomber et al. 984* (G, MO, P). — Forêt d'Ambre, 12°37'S, 49°09'30"E, 1000 m, IX.1926, *Perrier de la Bâthie 17756* (P). — Antsiranana, Montagne d'Ambre, forêt d'Ampamelonabe, 12°30'S, 49°10'E, 1300 m, 19.III.1992, *Rakotondrainibe 1666* (P). — *Idem*, Lac Texier, 12°32'S, 49°10'E, 1020 m, 25.VI.1992, *Rakotondrainibe 1744* (MO, P). — Forêt de Mahatsinjio, 10 km SE de Tsinjoarivo, 19°40'51"S, 47°46'12"E, 1550 m, 11.I.1999, *Rakotondrainibe 4709* (P). — Mahajanga, NE de Mangindrano, 14°12'18"S, 49°05'31"E, 2182 m, 29.X.2005, *Rakotovoao et al. 2360* (MO, P, TAN). — Antsiranana, Ambohimirahavavy, 14°13'41"S, 49°08'10"E, 1992 m, XI.2005, *Rakotovoao et al. 2528* (MO, P, TAN). — Andapa, Ambodivohitra, SW d'Anjialavabe, 14°13'59"S, 49°26'10"E, 1120 m, 25.II.2006, *Rakotovoao et al. 2703* (MO, P, TAN). — Massif de Tsaratanana, montagne au nord de Mangindrano, Ampitsinjovana, 14°08'S, 48°52'E, 2300-2500 m, 26.IV.2001, *Rasolohery 421* (MO, P, TAN). — Mahajanga, near Andribe, 16°11'S, 48°56'E, 21.X.1994, *van der Werff 13543* (P).

Mayotte. Grande Terre, Combani, 12°48'S, 45°10'E, 100 m, 11.IV.1997, *Pascal 910* (P). — Rivière de Coumbani, ENE de Combani, 12°48'S, 45°09'E, 260 m, 5.XI.2002, *Rakotondrainibe et al. 6612* (P). — *Idem*, 12.XI.2002, *Rakotondrainibe 6676* (P).

DIFFERENTIAL FIELD OBSERVATIONS. — Trunk: HT up to 8(-10) m, DT 9.5-15(-22) cm excluding, and up to 30 cm including the persistent dead petiole bases, which usually cover the entire trunk, rarely only its upper part; trunks occasionally in groups arising from a common mantle of adventitious roots, producing young plants from amidst this ensemble.

DIFFERENTIAL DESCRIPTION

Cyathea boivini var. *hildebrandtii* has a large crown. Its fertile and sterile pinnules are not dimorphic, its scales are less dense and its petioles are more coarsely and distantly muricate than in var. *boivini*. It bears a sparse and caducous tomentum of brownish intricate squamules or it is glabrous. The petiole scales are narrowly triangular with a comparatively broad base, 3-4 × (0.2-)0.3-0.5 cm, caudate, straight, with a twisted and crispate apex, shiny brown to black. The majority of indusia are shallowly cup-shaped to hemispherical, even when young. The rim of mature indusia is always entire and usually not

oblique. The receptacle is short to long columnar, slightly shorter to usually much longer than the rim of mature indusia. One or 2 pairs of reduced pinnae are frequently present at 5-20 cm from the petiole base, 14-28 cm long, but are occasionally absent or often not collected and sometimes degraded in the leaf litter accumulating in the crown centre.

DISTRIBUTION

Comoros: Anjouan, Grande Comore. Northern Madagascar: Montagne d'Ambre, Marojejy, Tsaratanana; one specimen from Central Madagascar (Tsinjoarivo). Mayotte.

ECOLOGY

(700-)1000-2500 m on Madagascar, most collections from above 1500 m. In lower altitudes on the islands, 200-1800 m on Grande Comore and up to 300 m on Mayotte. Dense evergreen rainforests.

REMARKS

Plants from the Madagascar Tsaratanana massif (1700-2300 m) and Tsinjoarivo massif (1500 m) have darker and narrower scales (Fig. 34I) than plants from the Montagne d'Ambre (700-1400 m) and the Comoros. However, the transition between both forms is gradual.

Bernardi 11807 exhibits a slight lamina dimorphism with fertile pinnule segments having a revolute margin and being slightly narrower than the sterile segments. It is, however, clearly distinguished from *C. boivini* var. *boivini* by its broad scales and the coarsely muricate petiole. The pinnule segments of *Rakotondrainibe 4709* (Madagascar, Tsinjoarivo) are 0.25-0.3 cm wide and adjacent segments are confluent from the third to fourth segment pair (Fig. 34B, C).

TYPIFICATION AND SYNONYMY

Hildebrandt 1747 is widely distributed. A sheet containing a fertile pinna exists at BM, K, and P. Further four such sheets have been traced at B together with a sheet containing petiole fragments with scales and cross sections of the trunk. A holotype sheet is not distinguishable from the annotations. Consequently, we here designate the sheet containing the petiole bases (B200129542) together with one fertile pinnae (B200129540),

both from Kuhn's herbarium, as the lectotype of this taxon. The lectotype is sufficiently informative making epitypification superfluous.

33e. *Cyathea boivini* Mett. ex Kuhn
var. *parahildebrandtii* Janssen & Rakotondr.,
var. nov.
(Figs 34G; 44H)

A typo differt indusiis hemisphaericis vel urceolatis, ore irregulariter fisso (non truncato integro) vel in 2-3 lobis dehiscentia. Receptaculum elongatum vel capitatum indusiis brevius rarior longius.

TYPUS. — Comoros, Grande Comore, massif du Karthala (versant ouest), piste menant de Boboni à Convalescence, 11°45'S, 43°17'E, 800-1000 m, 19.XI.2002, *Rakotondrainibe et al. 6730* (holo-, P! [3 sheets: P00311458-60]; iso-, K!).

ADDITIONAL MATERIAL EXAMINED. — **Comoros.** Grande Comore, Ntsorale Dimani, 11°41'24"S, 43°24'56"E, 250-950 m, 9.XII.1967, *Bernardi 11807* (K, P). — Massif du Karthala, descente vers Boboni, 11°45'20"S, 43°19'E, 1540 m, 20.XI.1999, *Labat et al. 3182* (K, P). — *Idem*, de Boboni à Convalescence, 11°45'S, 43°17'E, 800-1000 m, 19.XI.2002, *Rakotondrainibe et al. 6733* (P). — *Idem*, La Convalescence, 11°45'S, 43°19'E, 1600-1700 m, 24.XI.2002, *Rakotondrainibe et al. 6783* (P). — *Idem*, 1750-1800 m, 24.XI.2002, *Rakotondrainibe et al. 6786* (P), *6790* (P). — Massif de la Grille, 11°28'20"S, 43°20'37"E, 1000 m, 30.XI.2002, *Rakotondrainibe et al. 6849* (K, P).

Madagascar. Antsiranana, massif de Tsaratanana, path from Tsaratanana to Matsabory, 14°46'S, 49°00'E, 2500 m, 29.IV.2001, *Birkinshaw 903* (P). — Tampoketsa de Tsaratanana, forêt d'Anahandandivatsy, 16°35'30"S, 47°53'E, 1200 m, 28.VIII.1941, *Cours 1622* (P). — Massif de l'Andringitra, vallées de la Rimbava et de l'Antsifotra, 22°13'30"S, 46°55'30"E, 2000 m, 1924, *Humbert 3731* (P). — Mahajanga, massif du Tsaratanana, montagnes au N de Mangindrano, entre Antetikalambazaha et Matsaborimaiky, 14°10'27"S, 48°56'43"E, 1700-2050 m, 14.V.2005, *Janssen et al. 2939* (MO, P, TAN).

Mayotte. Grande Terre, Combani, 12°48'S, 45°10'E, 20.X.2001, *Barthelat et al. 561* (P). — *Idem*, Mroni Mouala, 12°46'21"S, 45°09'05"E, 120-200 m, 17.IV.1999, *Pignal et al. 1204* (P).

DIFFERENTIAL DESCRIPTION

Fertile and sterile pinnules are not dimorphic. Indusia are more or less hemispherical, sometimes urceolate.

The rim of juvenile indusia is entire, but dehisces in 2 or 3 lobes or irregularly in mature indusia. The receptacle is capitate to elongate and shorter than to, rarely, longer than the rim of mature indusia. Otherwise, this variety is morphologically close to var. *hildebrandtii*.

DISTRIBUTION

Comoros: Grande Comore. Madagascar: Northern Madagascar (Tsaratanana massif), one collection from the Andringitra massif. Mayotte.

ECOLOGY

800-1800 m on Grande Comore, 1200-2500 m in Madagascar, 200 m on Mayotte. Dense evergreen rainforests, usually in higher altitudes.

ETYMOLOGY

The epithet *parahildebrandtii* underlines the morphological affinity of this taxon to var. *hildebrandtii*.

34. *Cyathea capensis* (L.f.) Sm. (Fig 44I)

Mémoires de l'Académie des Sciences (Turin) 5: 417 (1793); Sim, *Ferns of South Africa* (ed. 2): 85, pl. 7 (1915); Schelpe, *Flora Zambesiaca, Pteridophyta*: 74, pl. 21d (1970); Holttum, *Kew Bulletin* 36: 470 (1981); Schelpe & Anthony, *Flora of Southern Africa, Pteridophyta*: 69, pl. 19 fig. 1 (1986); Burrows, *Southern African Ferns and Fern Allies*: 88 (1990); Roux, *Conspectus of Southern African Pteridophyta*: 86 (2001). — *Polypodium capense* L.f., *Supplementum Plantarum*: 445 (1781). — *Aspidium capense* (L.f.) Sw., *Journal für die Botanik (Schrader)* 1800 (2): 42 (1801). — *Hemitelia capensis* (L.f.) Kaulf., *Enumeratio Filicum*: 253 (1824); Sim, *Ferns of South Africa* (ed. 2): 85 (1915). — *Alsophila capensis* (L.f.) J.Sm., *London Journal of Botany* 1: 666 (1842); Tryon, *Contributions from the Gray Herbarium* 200: 30 (1970); Schelpe & Diniz, *Flora de Moçambique, Pteridophyta*: 74 (1979); Jacobsen, *Ferns and Fern Allies of Southern Africa*: 202 (1983). — *Polystichum capense* (L.f.) J.Sm., *Curtis Botanical Magazine* 72: 35 (1846). — *Cormophyllum capense* (L.f.) Newman, *Phytologist* 5: 238 (1854). — *Amphicosmia capensis* (L.f.) Klotzsch, *Allgemeine Gartenzeitung* 1856: 107 (1856). — Type: Cape of Good Hope, *Sparrmann s.n.* (holo-, LINN 1251/61).

Trichomanes incisum Thunb., *Prodromus Plantarum Capensium*: 173 (1800). — Type: Cape Province, Grootvadersbosch, *Thunberg s.n.* (holo-, UPS).

Cyathea riparia Willd., *Species Plantarum* (ed. 4) 5: 493 (1810). — *Hemitelia riparia* (Willd.) Desv., *Prodrome de la famille des Fougères*: 322 (1827). — *Amphicosmia riparia* (Willd.) Gardn., *Journal of Botany (Hooker)* 1: 441, pl. 12 (1842). — Type: Cape Province, *Meuron s.n.* (holo-, B-W 20172).

Trichomanes cormophyllum Kaulf., *Enumeratio Filicum*: 266 (1824). — Type: hab. in promontorio bonae spei (not traced).

Cyathea humbertiana (C.Chr.) Domin, *Acta Botanica Bohemica* 9: 123 (1930); Christensen in Perrier, *Catalogue des plantes de Madagascar, Préridophytes*: 21 (1931), nom. nud.; Christensen, *Dansk Botanisk Arkiv* 7: 30, pl. 6 figs 1-3 (1932); Tardieu in Humbert, *Flore de Madagascar et des Comores, IV^e famille, Cyathéacées*: 22 (1951). — *Hemitelia humbertiana* C.Chr., *Archives de Botanique (Caen), Bulletin mensuel* 2 (12): 210 (1928). — *Alsophila humbertiana* (C.Chr.) R.M.Tryon, *Contributions from the Gray Herbarium* 200: 30 (1970). — Type: Madagascar, massif de l'Andringitra (Iratsy), vallées de la Riambava et de l'Antsifotra et montagnes environnantes, 2000 m, XII.1924, *Humbert 3749* (holo-, P! [P00404160]; iso-, P!).

ADDITIONAL MATERIAL EXAMINED. — **South Africa.** Houteniqua, *Breutel s.n.* (P). — Cat. Geogr. Plant. Afr. Aust. Extratrop. 5862, *Burcell s.n.* (P). — Cap Bon Spei, *Chamisso s.n.* (P). — 1838-1839, *Hennecart s.n.* (P). — Cape Province, XI.1913, *Peter 5314* (P). — Jonkers Hoek near Stellenbosch, 10.I.1948, *Rodin 3253* (P).

Zimbabwe. Inyenga dist., 1500 m, 25.VII.1957, *Chase 6644A* (P).

DIFFERENTIAL DESCRIPTION

Cyathea capensis is well characterized and distinct from all African and Western Indian Ocean taxa by the petiole base bearing one to several pairs of up to 15(-30) cm long aplebia, the lamina being bipinnate-pinnatifid with the margin of the pinnule segments distinctly serrate. The lateral veins in the segments are simple and one to two sori, covered with a big, hemitelioid indusium attached at the proximal side of the receptacle, are inserted near the costula on the midvein of each segment. Scattered bullate scales are present on the abaxial face of the costulae.

This short description is sufficient to recognize this characteristic species whose presence in Madagascar and the surrounding islands is doubtful. Full descriptions can be found in Holttum (1981), Schelpe & Anthony (1986), Burrows (1990) and other African floras.

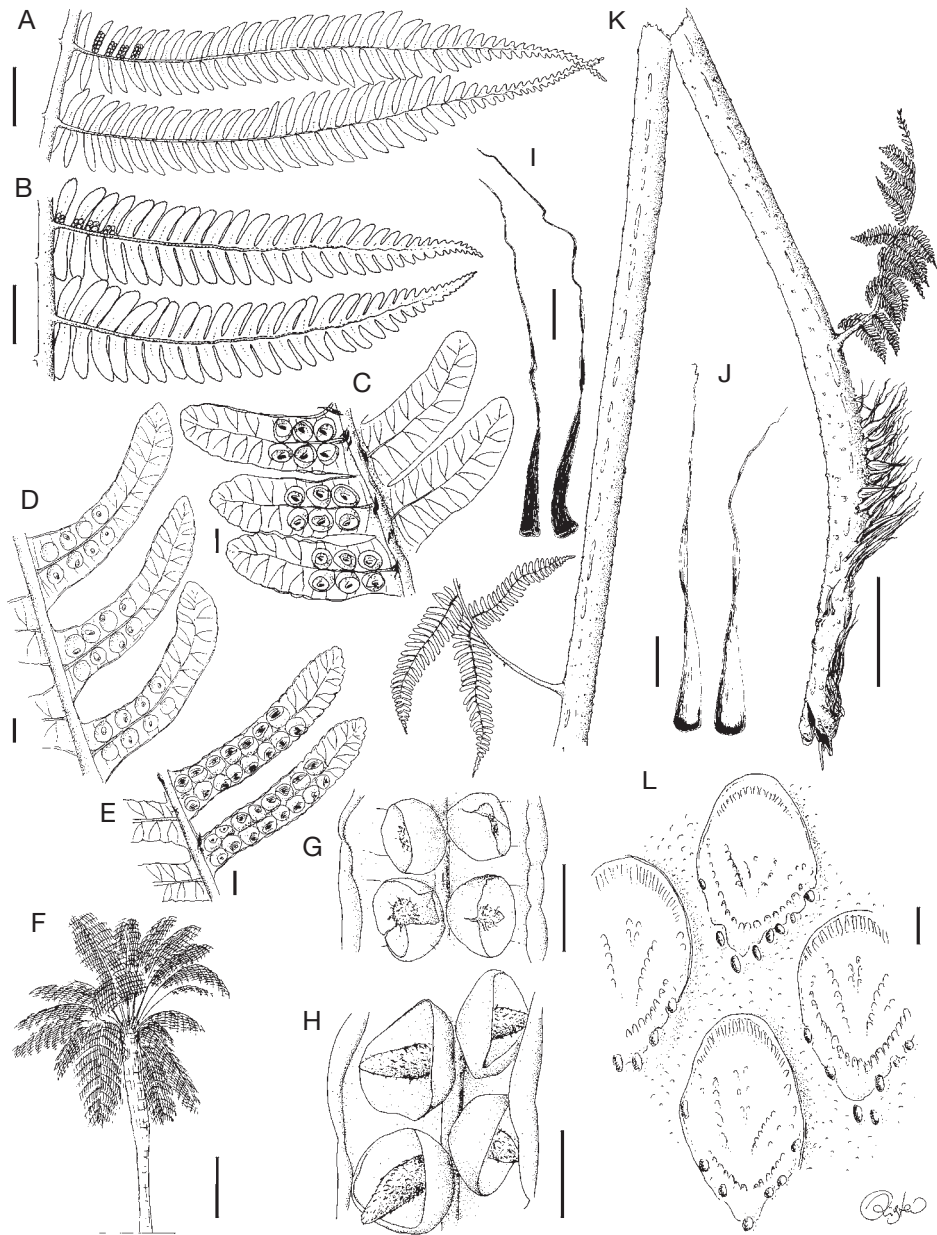


FIG. 34. — **A-F, H-L**, *Cyathea boivinii* Mett. ex Kuhn var. *hildebrandtii*; **A**, pinnules abaxially with a fragment of the costa, common form, sori only partly indicated; **B**, pinnules abaxially with a fragment of the costa, form with broader pinnule segments, sori only partly indicated; **C**, pinnule segments abaxially with a fragment of the costula, form with broader pinnule segments; **D, E**, pinnule segments abaxially with a fragment of the costula, common forms; **F**, habit; **H**, sori, common form with long receptacles and cup-shaped indusia with entire rims; **I**, scales from the base of the petiole, form with narrow, blackish scales; **J**, scales from the base of the petiole, common form; **K**, basal part of the leaf (from the petiole base up to the first pinna pair), lateral view, one half of the petiole pruned away by longitudinal section, note the presence of a pair of reduced pinnae at about 20 cm above the base of the petiole; **L**, leaf scars and trunk surface; **G**, *C. boivinii* var. *parahildebrandtii* Janssen & Rakotondr., mature sori with dehiscing indusia. **A, D, H, J, K**, Rakotondrainibe 1666 (P); **B, C**, Rakotondrainibe 4709 (P); **E, I**, Janssen et al. 2956 (P); **F**, Janssen et al. 2442 (P); **G**, Rakotondrainibe et al. 6730 (P); **L**, Janssen et al. 2464 (P). Scale bars: **A, B, L**, 1 cm; **C-E, G, H**, 0.1 cm; **F**, 1 m; **I, J**, 0.5 cm; **K**, 5 cm.

DISTRIBUTION

Cyathea capensis occurs in the Southwestern Cape Province along the coastal region of Southern Africa up to Southern Tanzania (*vide* Schelpe & Anthony 1986). A small population might have existed in Madagascar (see below). *Cyathea capensis* var. *poly-podioides* (Sw.) Conant occurs in SE Brazil.

ECOLOGY

Moist and forested ravines, shady mountain slopes, temperate forests, 1370-1800 m (*vide* Schelpe & Anthony 1986; Burrows 1990). In Madagascar putatively in forest remnants at 2000 m (Humbert *in sched.*).

TYPIFICATION AND SYNONYMY

Christensen (1928) describes the type of *C. humbertiana* from Madagascar. The material is fragmentary, consisting of a single detached pinna, 30 × 12 cm in size. The description given is in perfect agreement with those of *C. capensis* published in Holtum (1981), Schelpe & Anthony (1986) and Burrows (1990). The pinnae of several specimens of *C. capensis* examined for comparison had bigger indusia, more distinctly serrate pinnule segments with adjacent segments more widely spaced and proximally decurrent as compared to *Humbert 3749*. This is most likely due to the fact that the pinnae of *Humbert 3749* have been taken from the apical part of a leaf, and we here establish synonymy of *C. humbertiana* with *C. capensis*.

REMARKS

Humbert has collected in Kenya in 1924 and about 10 years later in Southern Africa. Although *Humbert 3749* is within a number range from the Andringitra massif of Madagascar, we cannot exclude that the label became inadvertently associated with an erratic fragment originally from Africa. This is the more likely, as all other available specimens of Cyatheaceae collected by Humbert are complete and annotated and *Humbert 3749* would hence be an unusual specimen with respect to Humbert's collecting standards.

Alternatively, a population of *C. capensis* may indeed have been present in the Andringitra massif whose altitudinal climate is compatible with

the ecological preferences of the species. A recent and thorough search for the plants at the locus classicus was, however, not successful as all forest remnants in the region were damaged by fire several years ago and are currently very much degraded. Thus, if *C. capensis* existed in Madagascar and if the locus classicus of *C. humbertiana* C.Chr. was its only locality, it is currently undoubtedly extinct on the island.

Phylogenetically, this taxon is sister to the *Gymnosphaera*-clade (Korall *et al.* 2007), corresponding to "Group I" of the present account, and not closely related to the other tripinnate Madagascan species (Janssen *et al.* 2008). For the purpose of the present treatment it has nevertheless been included in the group of tripinnate taxa, i.e. "Group III".

35. *Cyathea concava* Bonap. (Figs 35; 44I; 51D)

Notes ptéridologiques 5: 43 (1917); l. c. 9: 49 (1920). — *Cyathea boivinii* Mett. ex Kuhn var. *concava* (Bonap.) Tardieu in Humbert, *Flore de Madagascar et des Comores, IV^e famille, Cyathéacées*: 32 (1951). — Type: Madagascar, forêt d'Analamazaotra, 800 m, *Perrier de la Bâthie 6120* (holo-, P! [2 sheets: P00422553, -54]; iso-, P! [2 sheets]).

Cyathea ballardii Tardieu, *Naturaliste malgache* 3: 75 (1951); Tardieu in Humbert, *Flore de Madagascar et des Comores, IV^e famille, Cyathéacées*: 25 (1951). — *Alsophila ballardii* (Tardieu) R.M. Tryon, *Contributions from the Gray Herbarium* 200: 29 (1970). — Type: Madagascar, Analamazaotra, *Jardin Botanique de Tananarive 3768* (lecto-, P! [P00422556], here designated; isolecto-, P!).

ADDITIONAL MATERIAL EXAMINED. — **Madagascar.** Forêt d'Analamazaotra, 18°56'S, 48°26'E, *Académie Malgache s.n.* (P). — Toamasina, Ambatovy, Berano village, 18°50'11"S, 48°19'17"E, 1125 m, 17.I.2005, *Antilabimena et al.* 3192 (P). — Andasibe, station forestière Mitsinjo, 18°56'S, 48°26'E, 930-950 m, 11.XI.2004, *Janssen et al.* 2564 (MO, P, TAN), 2565 (MO, P, TAN), 2566 (MO, P, TAN), 2573 (MO, P). — RS d'Analamazaotra, 18°56'S, 48°26'E, 900-950 m, 13.XI.2004, *Janssen et al.* 2579 (MO, P, TAN). — Andasibe, Analamazaotra, 18°56'S, 48°26'E, 9.VI.1938, *Jardin Botanique de Tananarive 3768* (P). — *Idem*, 1000 m, *Lam & Meeuse 5311* (K). — Perinet, 18°56'S, 48°26'E, 1930, *Olsouffieff s.n.* (B). — Toamasina, Ambatovy, 18°49'13"S, 48°20'06"E, 2.II.2005, *Razafindraibe et al.* 30 (P). — Forêt d'Analamazaotra,

18°56'S, 48°26'E, 900 m, 19.X.1912, *Viguiet et al.* 800 (B, P). — Toamasina, Andasibe, forest of Mantadia, 18°55'S, 48°25'E, 1000-1200 m, 10.XI.1994, *van der Werff et al.* 13788 (MO, P). — Perinet, 18°56'S, 48°26'E, s. coll. M525 (K).

FIELD OBSERVATIONS. — Trunk: HT up to 5(-10) m, DT 5.5-7 cm, dead petiole bases persistent in the upper part of the trunk, i.e. about 1 m below the apex, caducous below and the leaf scars exposed, at most a rudiment remaining on the scar rim; trunk surface blackish brown, finely muricate; formation of adventitious buds after damage to the trunk is most likely possible; occasionally 2 or 3 trunks seem to arise from the same stock in young plants.

Petiole: with 1 row of light brown aerophores on either side, usually with a dark margin, 0.2-0.5 cm long; petiole bases recurved to sigmoid, in young plants long sigmoid forming a short fascicle above the trunk apex.

Leaf scars: 1.5 × 1.5-4 cm, rounded or elliptic to rhombic, flat or their lower half somewhat raised, some orifices below the scar; spirally arranged.

Crown: comparatively small, more or less horizontal, rarely umbrella-shaped.

Trunk apex: covered with very dense, brown scales, usually concealed by the more or less spaced petioles.

Lamina: elliptic to rounded; LL 95-150 cm, WL 85-110 cm, FW 35-60 cm, NP 8-10.

DESCRIPTION

Petiole: 25-40(-55) cm long, 1-1.7 cm in diameter; green to stramineous, reddish brown abaxially and adaxially, finely and distantly muricate, the tubercles rather blunt and never stinging; without or with a very thin and caducous tomentum of brown, intricate squamules; never with reduced pinnae in the lower half of the petiole.

Lamina: bipinnate-pinnatisect to tripinnate, coriaceous, exhibiting a slight fertile-sterile dimorphism; shiny green to shiny dark green above, below pale green to shiny light green, but never glaucous; lamina base truncate, lamina apex abruptly attenuate, basal pinnae patent to slightly reflexed and slightly conduplicate, leaves usually completely fertile including lamina and pinnule apices; rachis of the same colour as the petiole.

Largest pinnae: 45-60 cm long, distant by 10-14 cm, adjacent pinnae contiguous to overlapping; costae and costulae green to stramineous.

Largest pinnules: 7-12 × 1.4-2.5(-3) cm, adjacent pinnules spaced by less than their width, triangular,

acute to shortly caudate, divided to the costula into segments, the 1-3 proximal segment pairs distinctly petiolulate, segments sessile in the lower third of the pinnule and progressively adnate further up, adjacent segments confluent only in the upper third of the pinnule; fertile pinnule segments distinctly concave, 0.4-0.5 cm wide, spaced by less than to about their width, rarely contiguous, straight, their margin crenate-serrate to biserrate and not revolute, their apex rounded to obtuse, somewhat asymmetric; sterile pinnule segments slightly wider, 0.5-0.6 cm, with subentire to crenulate margins, less strongly concave and adjacent segments more or less contiguous, confluent already from the middle of the pinnule; lateral veins in the segments once furcate.

Scales and hairs: scales present from the petiole base upwards to 15 cm on the petiole, very dense and overlapping, persistent at the petiole base, rapidly caducous further up on the petiole with a sudden transition from densely covered to naked, very narrowly triangular to filiform, 2.5-3.5 × < 0.1-0.1(-0.2) cm, straight, their apices twisted, crispate and somewhat intricate, shiny brown, concolourous, sometimes with a dark centre, with a narrow and finely dentate margin, appressed to the petiole or not and then antrorse, not indurated; adaxial face of the rachis, costae and costulae moderately densely tomentose with short, patent, contorted, dark brown, stiff, multicellular hairs; leaf otherwise glabrous.

Sori: very close to the midvein, contiguous to spaced by less than their width, about 0.1 cm in diameter, covering the entire segment or its lower three quarters; indusia globular, light to dark brown, coriaceous to membranous, at maturity dehiscing in 2-3(-4) persistent lobes, occasionally not dehiscing down to the base of the receptacle; receptacle capitate to rarely disciform, shorter than the rim of mature indusia, with inconspicuous filiform paraphyses shorter than the sporangia.

DISTRIBUTION

Central Madagascar: Analamazaotra and Mantadia forests; endemic.

ECOLOGY

800-1100 m. Dense evergreen rainforests and forest margins.

REMARKS

Cyathea concava is well characterized by its habit with slender and usually naked trunks in combination with a more or less horizontal crown composed of comparatively short leaves and therefore much smaller than the large umbrella-shaped crowns of *C. boivinii*, *C. hildebrandtii*, and *C. similis*. It has been cited as a synonym of *C. humblotii* (= *C. boivinii*, Christensen 1932: 34) from which it is easily distinguished by its thin petioles, very narrow scales restricted to the base of the petiole, concave, serrate pinnule segments, which are petiolulate or sessile in the lower third of the pinnule, globular indusia and a complete lack of a lamina indument of loose, crispate hairs.

Young leaves may have a caducous indument of loosely attached, light brown, crispate, branched hairs and scales (cf. *van der Werff et al. 13712*, *Janssen et al. 2573*) that completely disappears in mature leaves.

TYPIFICATION AND SYNONYMY

Two sheets of *Perrier de la Bâthie 6120*, containing a leaf apex and a longitudinally halved petiole base respectively, are marked "Original" by Bonaparte and are considered together to represent the holotype. Two further sheets, comprising the other half of the petiole base and a middle pinna, constitute independent isotypes, but should be kept associated as they provide complementary morphological information.

Both sheets of *Jardin Botanique de Tananarive 3768* carry the name *C. ballardii* in Tardieu's writing, but none is distinguished as the holotype of the species. We choose P00422556 as the lectotype.

36. *Cyathea dregei* Kunze
(Figs 36; 45A; 51E)

Linnaea 10: 551 (1836); Hooker, *Species Filicum* 1: 23, pl. 17a (1844); Sim, *The Ferns of South Africa* (ed. 2): 82, pl. 6 (1915); Peter, *Flora von Deutsch-Ostafrika*: 17 (1929); Christensen, *Dansk Botanisk Arkiv* 7: 30, pl. 7 figs 18-21 (1932); Brenan, *Checklist of Trees and Shrubs of the British Empire* 5 (2): 180 (1949); Tardieu in Humbert, *Flore de Madagascar et des Comores, IV^e famille, Cyathéacées*: 23, fig. 6(1) (1951); Egging, *Indigenous Trees of the Uganda*

Protectorate: 103 (1952); Tardieu, *Mémoires de l'Institut français d'Afrique Noire* 28: 52 (1953); Alston, *Ferns of West Tropical Africa*: 27 (1959); Schelpe, *Flora Zambesiaca, Pteridophytes*: 74, pl. 21e (1970); Holttum, *Kew Bulletin* 36 (3): 473 (1981); Schelpe & Anthony, *Flora of Southern Africa, Pteridophyta*: 69 (1986); Burrows, *Southern African Ferns and Fern Allies*: 84 (1990); Johns, *Pteridophytes of Tropical East Africa*: 51 (1991); Roux, *Conspectus of Southern African Pteridophyta*: 86 (2001); Edwards, *Flora of Tropical East Africa, Cyatheaceae*: 8 (2005). — *Alsophila dregei* (Kunze) R.M. Tryon, *Contributions from the Gray Herbarium* 200: 30 (1970); Schelpe in Fernandes *et al.*, *Conspectus florae angolensis*: 60 (1977); Schelpe & Diniz, *Flora de Moçambique, Pteridophyta*: 73 (1979); Jacobsen, *Ferns and Fern Allies of Southern Africa*: 201 (1983). — Type: Inter cataractam magnam et Omsamcaba, in valle rupestri umbrosa ad rivulum, 500 p., 1838, *Drège s.n.* (LZ⁺; lecto-, BM! [BM000600677], designated by Roux (1986), *Botanical Journal of the Linnean Society* 92: 378; isolecto-, K!, P! [fragment in hb. Luerssen no. 6147: P00404133]).

Cyathea burkei Hook., *Species Filicum* 1: 23, pl. 17b (1844). — Type: Transvaal, Macalisberg, *Burke "150"* (holo-, K!; iso-, BM).

Cyathea angolensis Welw. ex Hook., *Synopsis Filicum* 1: 22 (1865). — Type: Angola, Benguella, Huilla, *Welwitsch 83, 83bis?, 186* (syn-, K!, BM, *vide* Edwards [2005], *Flora of Tropical East Africa*: 9).

Cyathea segregata Baker, *Journal of the Linnean Society* 20: 303 (1883). — *Cyathea dregei* Kunze var. *segregata* (Baker) C. Chr. in Perrier, *Catalogue des plantes de Madagascar, Ptéridophytes*: 21 (1931); Christensen, *Dansk Botanisk Arkiv* 7: 31, pl. 7 figs 26-31 (1932); Tardieu in Humbert, *Flore de Madagascar et des Comores, IV^e famille, Cyathéacées*: 24 (1951). — Type: Central Madagascar, *Baron 997* (holo- K! [K000227906]; iso-, B!).

Cyathea polyphlebia Baker, *Journal of the Linnean Society* 20: 303 (1883). — *Cyathea dregei* Kunze var. *polyphlebia* (Baker) C. Chr. in Perrier, *Catalogue des plantes de Madagascar, Ptéridophytes*: 21 (1931); Christensen, *Dansk Botanisk Arkiv* 7: 31, pl. 7 figs 22-25 (1932); Tardieu in Humbert, *Flore de Madagascar et des Comores, IV^e famille, Cyathéacées*: 24 (1951). — Type: Central Madagascar, *Baron 840* ("440"; holo-, K! [K000009953]; iso-, K!, B!).

Alsophila baronii Baker, *Journal of the Linnean Society* 21: 455 (1885). — Type: Madagascar, *Baron 3143* (holo-, K! [K000009926]; iso-, P! [fragment, P00316084]).

Cyathea rigidula Baker, *Journal of the Linnean Society* 22: 534 (1887). — Type: Madagascar, *Baron 3845* (holo-, K! [K000009927]).

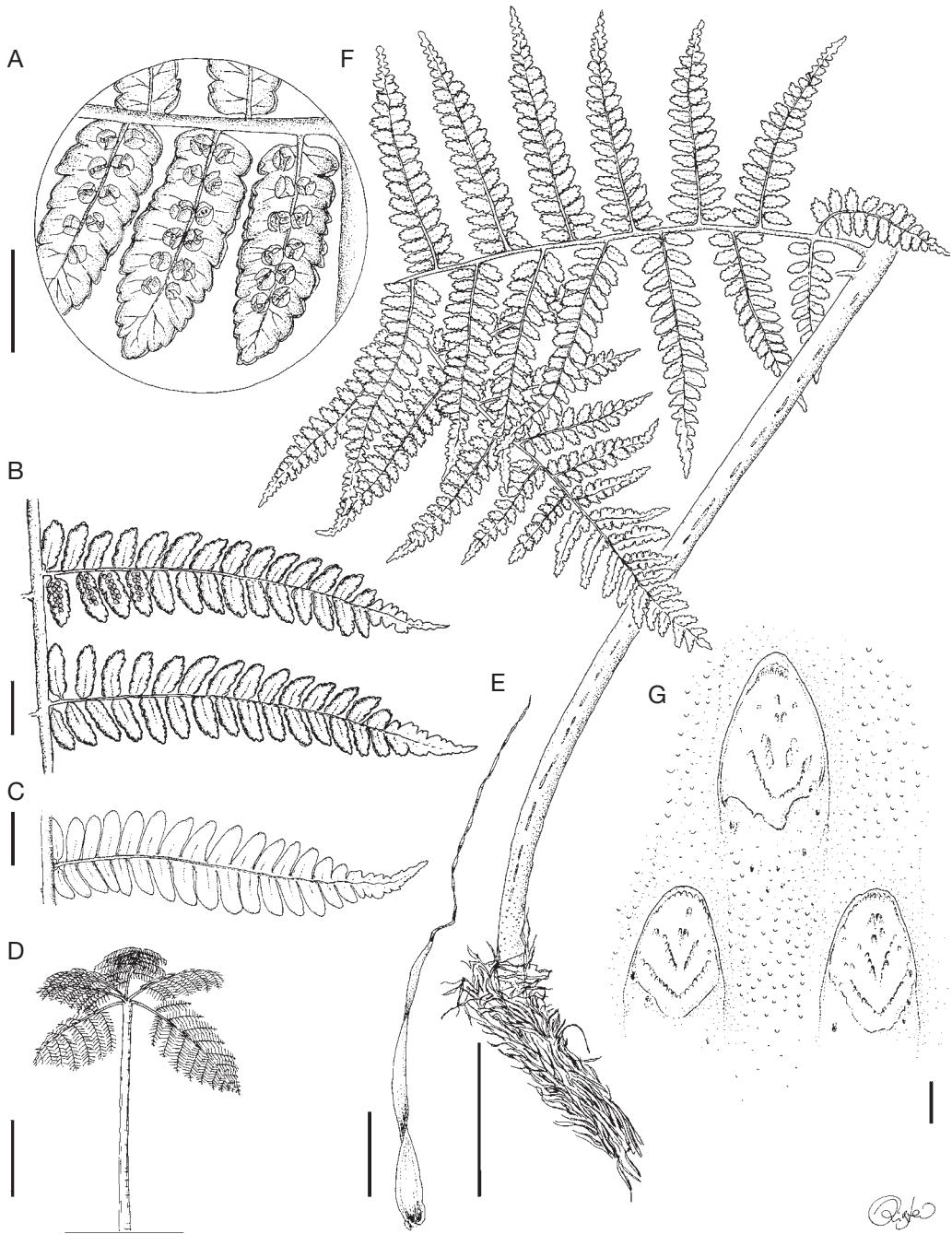


FIG. 35. — *Cyathea concava* Bonap.: **A**, pinnule segments abaxially with a fragment of the costula (at the junction with the costa); **B**, fertile pinnules abaxially with a fragment of the costa, sori only partly indicated; **C**, sterile pinnule abaxially with a fragment of the costa; **D**, habit; **E**, scale from the base of the petiole; **F**, basal part of the leaf (from the petiole base up to the first pinna pair, one pinna pruned), lateral view; **G**, leaf scars and trunk surface. A, B, D, F, G, Janssen *et al.* 2565 (P); C, Janssen *et al.* 2564 (P); E, Janssen *et al.* 2579 (P). Scale bars: A, E, 0.5 cm; B, C, G, 1 cm; D, 1 m; F, 5 cm.

Cyathea flavovirens Kuhn ex Diels, *Natürliche Pflanzenfamilien* 1 (4): 127 (1902). — Type: Maroharona pr. Tananarivo, 14.VI.1880, *Hildebrandt 3473* (putative holotype, B! [B200129562]; putative iso-, B!, BM!).

ADDITIONAL MATERIAL EXAMINED. — **Cameroon.** Ngaoundéré à Meiganga, VI.1939, *Jacques-Félix 4145* (P). — Montagne de Tabenken, 10 km SE Nkambe, 14.XI.1974, *Letouzey 13251bis* (P). — Entre Bayangam et Bafousam, 29.V.1947, s. coll. 23 (P).

Congo. Bogozo, 8.VII.1914, *Bequaert 4938* (P). — Kisanu, à Kiyala, 26.X.1948, *Callens 1908* (P). — Rives du Lac Tanganika, 8.V.1910, *Lechaptos s.n.* (P). — Regione del lago Kivu, lungo la costa della penisola di Cofonya nella baia di Nguba, 22.X.1953, *Pichi-Sermolli 4421* (P).

Guinea. Fouta Djallon, Mt. Laura, 23.II.1945, *Portières s.n.* (P).

Madagascar. Tananarive à Antsirabe, 1300 m, 26.VII.1956, *Abbayes 2306* (P). — *Baron 3829* (K, P). — North West, *Baron 5302* (K). — *Baron 6956* (K). — *Baron 9829* (P). — Ankazondandy, 18°42'S, 47°47'E, 22.IX.1966, *Boiteau 258* (P). — Station forestière de l'Angavokely près Carion, 18°55'S, 47°46'E, 23.IV.1970, *Boiteau 2090* (P). — P.K. 39 route du Sud, VIII.1953, *Bosser 6205* (P). — Environs de Tananarive, X.1956, *Bosser 10087* (P). — *Campenon s.n.* (P). — Antananarivo, Ankadivavala, 19°13'S, 47°19'E, 30.IV.1889, *Catat 209* (P). — Sarobaratra, 7.V.1889, *Catat 455* (P). — *Colin s.n.* (P). — Ankafana, 21°12'S, 47°12'E, 1880, *Cowan s.n.* (BM). — Antananarivo, Imerina, 1881, *Cowan s.n.* (BM). — *Cowan s.n.* (BM). — Ankazobe, 18°19'S, 47°06'30"E, IX.1921, *Decary s.n.* (P). — Tananarive (Observatoire), 18°55'S, 47°31'E, 3.IV.1921, *Decary s.n.* (P). — *Decary s.n.* (P). — Antananarivo, 18°55'S, 47°31'E, 3.IV.1921, *Decary s.n.* (P). — Mahajanga, Ankaizinana, 14°30'S, 48°55'E, 1100 m, 17.IV.1923, *Decary 1719* (P). — Antananarivo, 18°55'S, 47°31'E, 6.XI.1927, *Decary 6045* (P). — Environs de Tananarive, Soamanandrarinny, 19°39'S, 47°17'E, 28.VII.1928, *Decary 6606* (P). — Antananarivo, Ankazobe, 18°19'S, 47°06'30"E, 11.III.1930, *Decary 7417* (P). — Tampoketsa au nord-est de Fenoarivo, 16.III.1930, *Decary 7586* (P). — Vavavato (Betafo), 19°34'S, 46°52'E, 25.XI.1938, *Decary 13829* (P). — Ankazomanga (Vakinankaratra), 19°54'S, 46°55'E, 6.XII.1939, *Decary 15270* (P). — District d'Ambohimalasoa, Ialatsara, 21°04'30"S, 47°12'E, 7.II.1942, *Decary 17499* (P). — 1869, *Garnier 93* (B). — 1839, *Goudot s.n.* (G, G-DEL). — Central Plateau, 1914, *Hodgkin et al. s.n.* (K). — Fianarantsoa, Ambositra, Mont Vatovavy, 20°27'S, 47°07'E, 1500-1870 m, 23.VII.1928, *Humbert 4709* (BM). — Massif du Kalambatitra, 23°22'S, 46°29'30"E, 1600 m, XI.1933, *Humbert 11890* (P). — Massif de l'Ivakoany, 23°50'30"S, 46°26'E, 1933, *Humbert 12172* (P). — Environs de Fianarantsoa, 21°27'S, 47°04'E, 15.XI.1946, *Humbert 19297* (P). — Montagnes à l'ouest d'Itremo,

20°34'30"S, 46°37'30"E, 1500-1700 m, 1955, *Humbert 28282* (P, TAN). — Isalo, W de Ranohira, 22°24'S, 45°17'E, 800-1250 m, 1955, *Humbert 28724* (P). — Montagnes à l'ouest d'Itremo, 20°34'30"S, 46°37'30"E, 1500-1700 m, 1955, *Humbert 30087* (P). — Fianarantsoa, PN d'Andringitra, forêt de Riambavy, 22°07'38"S, 46°53'40"E, 1550-1650 m, 17.XI.2004, *Janssen et al. 2586* (MO, P, TAN). — *Idem*, forêt de Ramihova, 22°07'38"S, 46°53'40"E, 1550-1650 m, 17.XI.2004, *Janssen et al. 2587* (P, TAN). — Ambatofitorahana, environs de Tanandava, 20°49'07"S, 47°11'54"E, 1705 m, 15.IV.2005, *Janssen et al. 2762* (MO, P, TAN). — PN d'Andringitra, haute vallée de l'Antsifotra, 22°11'18"S, 46°55'49"E, 2043 m, 18.IV.2005, *Janssen et al. 2779* (MO, P, TAN). — Mahajanga, Plateau de Tampoketsa, Antokonana, 76 km N Ankazobe, 17°52'55"S, 47°04'43"E, 1500 m, 19.V.2005, *Janssen et al. 2966* (MO, P, TAN), 2967 (MO, P, TAN). — Fianarantsoa, Ambatofitorahana, 20°49'S, 47°11'E, III.1960, *Keraudren 270* (P). — Fianarantsoa, massif de l'Itremo, 20°34'30"S, 46°37'30"E, 1.XII.1970, *Keraudren-Aymonin et al. 25752* (P). — *Idem*, 24.XI.1993, *Labat et al. 2419* (K, P). — Forêt d'Analandraisoa (Ambohitajovo), SW de Tsiroanomandidy, 19°09'S, 45°49'E, 1200-1300 m, XI.1952, *Leandri et al. 1892* (K, MO, P, TAN). — Antananarivo, 25 km N of Ankazobe, 17°58'30"S, 47°12'E, 1600 m, 22.XI.1985, *Leeuwenberg 13724* (BR, WAG). — Près de la Betsiboka, à Bemakampy, 17°24'S, 46°01'E, 400-500 m, VI.1911, *Mazières s.n.* (P). — Fianarantsoa, PN Andringitra, forêt de Ravaro, SW Antanitotsy, 22°13'30"S, 46°55'30"E, 1500 m, 15.I.2000, *Messmer et al. 876* (G, P). — Entre Ambohitilomahitsy et Savabe, 10.XI.1963, *Peltier 4292* (P). — Pont de la Manankazo, 18°09'S, 47°14'E, 17.XI.1963, *Peltier 4375* (P). — Mahitsy, 11.I.1964, *Peltier 4594* (P). — Fianarantsoa, Isalo, 22°24'S, 45°17'E, 16.IV.1965, *Peltier 5521* (P). — Entre Sandrandahy et Fiadanana, 20°21'S, 47°18'E, I.1966, *Peltier 5638* (P). — Bords de l'Isandrano, affluent de l'Ikopa, 16°58'S, 46°43'E, XI.1902, *Perrier de la Bâthie 349bis* (P). — Le Berizoka, X.1897, *Perrier de la Bâthie 349* (P). — Antananarivo, Manankazo, 18°09'S, 47°14'E, *Perrier de la Bâthie 7072* (P). — Environs d'Anstirabe, 19°51'S, 47°02'E, 1600 m, VI.1913, *Perrier de la Bâthie 7595* (P). — Mahiatra, VI.1912, *Perrier de la Bâthie 7890* (P). — Ampasimena, bassin du Demoka, Menabe, 24°22'S, 47°10'E, 200 m, VII.1911, *Perrier de la Bâthie 7898* (P). — Environs d'Antsirabe, 19°51'S, 47°02'E, 1500 m, *Perrier de la Bâthie 11527* (P). — Environs de Midongy ouest, III.1919, *Perrier de la Bâthie 12535* (P, TAN). — Analamahitso, Ht Bemarivo, VIII.1907, *Perrier de la Bâthie 15842* (P, TAN). — Bongoloka près de Malaimbondy (Tiribihina), VIII.1910, *Perrier de la Bâthie 15856* (P, TAN). — Fianarantsoa, Isalo, 22°24'S, 45°17'E, 1000 m, X.1924, *Perrier de la Bâthie 16561* (BM, G, P). — Tananarive, 18°55'S, 47°31'E, 15.IV.1897, *Prudhomme 63* (P), 65 (P), 68 (P). — Antananarivo, RS d'Ambohitantely, 18°13'S,

47°17'E, 1300-1400 m, 11.XII.1997, *Rakotondrainibe 4517* (P). — *Idem*, 12.XII.1997, *Rakotondrainibe 4532* (P, TAN). — Forêt de Mahatsinjo, 10 km SE de Tsinojoarivo, 19°37'30"S, 47°41'30"E, 7.I.1999, *Rakotondrainibe 4561* (P). — Fianarantsoa, RNI Andringitra, Anjavidilava, 22°09'S, 46°57'E, 1990 m, 5.III.1997, *Randriambololona et al. 14* (P). — Ibyty, Antelisarotra, 7 km SW cimetièrè Holcim, 20°06'52"S, 46°59'23"E, 1541 m, 9.II.2003, *Rasolohery et al. 895* (P), *919* (P), *920* (P). — Prov. Toliara, Ivahona, Kalambatritra, 23°27'30"S, 46°24'40"E, 1540 m, 7.XI.2004, *Razafitsalama et al. 661* (MO, P). — Fianarantsoa, Ambositra, 20°31'30"S, 47°15'E, 1300 m, 16.XII.1959, *Schlieben 8168* (B, BM, BR, G, K, M). — Antananarivo, Antsirabe, NW Ambohiponana, 20°04'S, 47°03'E, 1600 m, 20.XI.1912, *Viguier et al. 1486* (B, P). — Betafo, pentes des Vavavato vers Antanifotsy, 19°34'S, 46°52'E, 2000-2100 m, 29.XI.1912, *Viguier et al. 1605* (P). — Tananarive, 18°55'S, 47°31'E, VII.1914, *Waterlot s.n.* (P). — *S. coll. s.n.* (P). — Rive de la Betsioka, Nadinilatsaka près de Tsaratanana, 2.VIII.1911, *s. coll. s.n.* (P). **Mali.** XII.1944, *Schnell 2369* (P). **South Africa.** Natal, *Buchanan s.n.* (P). — Cap, *Drège s.n.* (B). — "P. b. sp." (promontorio bonae spei), *Drège s.n.* (B). — Portus Walaleas, *Gucingius s.n.* (B). **Tanzania.** Iringa District, 1962, *Polhill et al. 1715* (P). — Kilimandjaro, Mkuu, 3°12'S, 37°36'E, 1510 m, 29.VI.2004, *Hemp 4178* (DSM). **Zimbabwe.** Elephant Forest Vumba, Umtali Distr., 19.I.1949, *Chase 5018* (BM).

FIELD OBSERVATIONS IN MADAGASCAR. — Trunk: HT up to 2.5 m, erect, reclining, or creeping, often several times bifurcate, rarely simple, DT 13-22(-30) cm, always covered with a dense mantle of adventitious roots or with persistent dead petiole bases, occasionally with adventitious buds; creeping trunks may be many times bifurcate forming a more or less circular population of up to 10 crowns.

Petiole: with 1 or 2 irregular to subcontinuous rows of white to brown aerophores, 0.2-1 cm long, on either side; petiole base straight to shortly sigmoid.

Leaf scars: visible in dead trunks where the adventitious roots are decayed, contiguous, their lower half distinctly raised, with conspicuous orifices on their lower rim; spirally arranged.

Crown: infundibuliform with erect (c. 15-45°) and straight rachises in creeping forms, more or less horizontal in plants with an erect trunk.

Trunk apex: densely scaly with dark brown scales, usually visible through the more or less spaced petioles; some dead leaves persistent and hanging from the apex, only rarely forming a dense skirt.

Lamina: more or less narrowly elliptic to oblong; LL (80-)115-170(-250) cm, WL 55-85(-110) cm, FW 45-70 cm, NP 11-16(-20).

DESCRIPTION

Petiole: 35-50(-90) cm long, 2.5-3 cm in diameter; green to stramineous, abaxially reddish brown, blackish at its base, rarely completely reddish brown, distantly muricate, the tubercles rather blunt and not stinging, with a moderately dense, brown, caducous, squamulate tomentum; 1 or 2 pairs of reduced pinnae, 10-30 cm long, usually present at 2-20 cm from the petiole base, acroscopic.

Lamina: bipinnate-pinnatisect to tripinnate, subcoriaceous to coriaceous; shiny green to shiny dark green above, below light to pale green, but not glaucous, lamina base attenuate to truncate, basal pinnae patent and more or less conduplicate; rachis of the same colour as the petiole, becoming completely green to stramineous and smooth distally.

Largest pinnae: 30-50 cm long, i.e. smaller than in *C. boivinii* s.l., distant by 6.5-10.5 cm, forming an acute acroscopic angle (c. 30-45°) with the rachis, adjacent pinnae overlapping; costae and costulae of the same colour as the rachis.

Largest pinnules: (5-)-6-8 × (1-)-1.4-2 cm, adjacent pinnules contiguous to spaced by less than their width, triangular to rarely oblong, their apex acute to shortly caudate; divided to the costula into broadly adnate segments, 1 or 2 proximal segment pairs sessile, the bases of adjacent segments confluent only near the pinnule apex; pinnule segments 0.1-0.2 cm wide, spaced by less than to about their width, straight to slightly falciform, with a crenate to subentire, slightly to conspicuously revolute margin, their apex rounded to acute; lateral veins in the segments once to twice furcate.

Scales and hairs: scales present from the petiole base upwards to 5-15(-25) cm on the petiole, dense and overlapping, persistent at the petiole base, caducous further up on the petiole, narrowly triangular, (2-)-3-5.5 × 0.1-0.2 cm, straight to rarely crispate, more or less twisted and with a crispate apex, shiny brown to dark brown, concolourous, their margin more or less erose, antrorse, not appressed to the petiole, not indurated; a usually dense indument of ramified, crispate, soft, light brown hairs and scattered soft, lanceolate to filiform, light brown, shiny to dull, long ciliate scales loosely attached to the abaxial face of the lamina axes and veins, sometimes sparse in older leaves; adaxial face of the costae

and costulae densely tomentose with long, crispate, soft, brown, multicellular hairs that decay rapidly, becoming short, whitish and scattered in older leaves; caducous, shiny brown, filiform scales on the adaxial face of the costae and costulae in young leaves; rachis subglabrous; appressed trichomidia sometimes abundant on the abaxial face of the lamina.

Sori: very close to the midvein, contiguous, about 0.1 cm in diameter, covering the entire segment or restricted to its lower quarter; indusia cup-shaped to hemitelioid, i.e. a scale-like rudiment inserted at the costular side of the receptacle, light brown to brown, membranous to subcoriaceous, cup-shaped indusia at maturity with an entire rim or opening with a slit towards the margin of the segment and consequently with a more or less oblique rim; receptacle capitate to elongate, as long as or longer than the rim of mature indusia, with inconspicuous filiform paraphyses shorter than the sporangia.

DISTRIBUTION

Widespread in tropical Africa and in Madagascar, where the species is most frequently encountered on the central high plateau.

ECOLOGY

1050-2200(-2600) m (Edwards 2005: 8). In Madagascar 1500-2000 m, along streams in open grassland, sometimes in rock crevices, on wet meadows, forest remnants and on forest margins, rarely in dense evergreen rainforests.

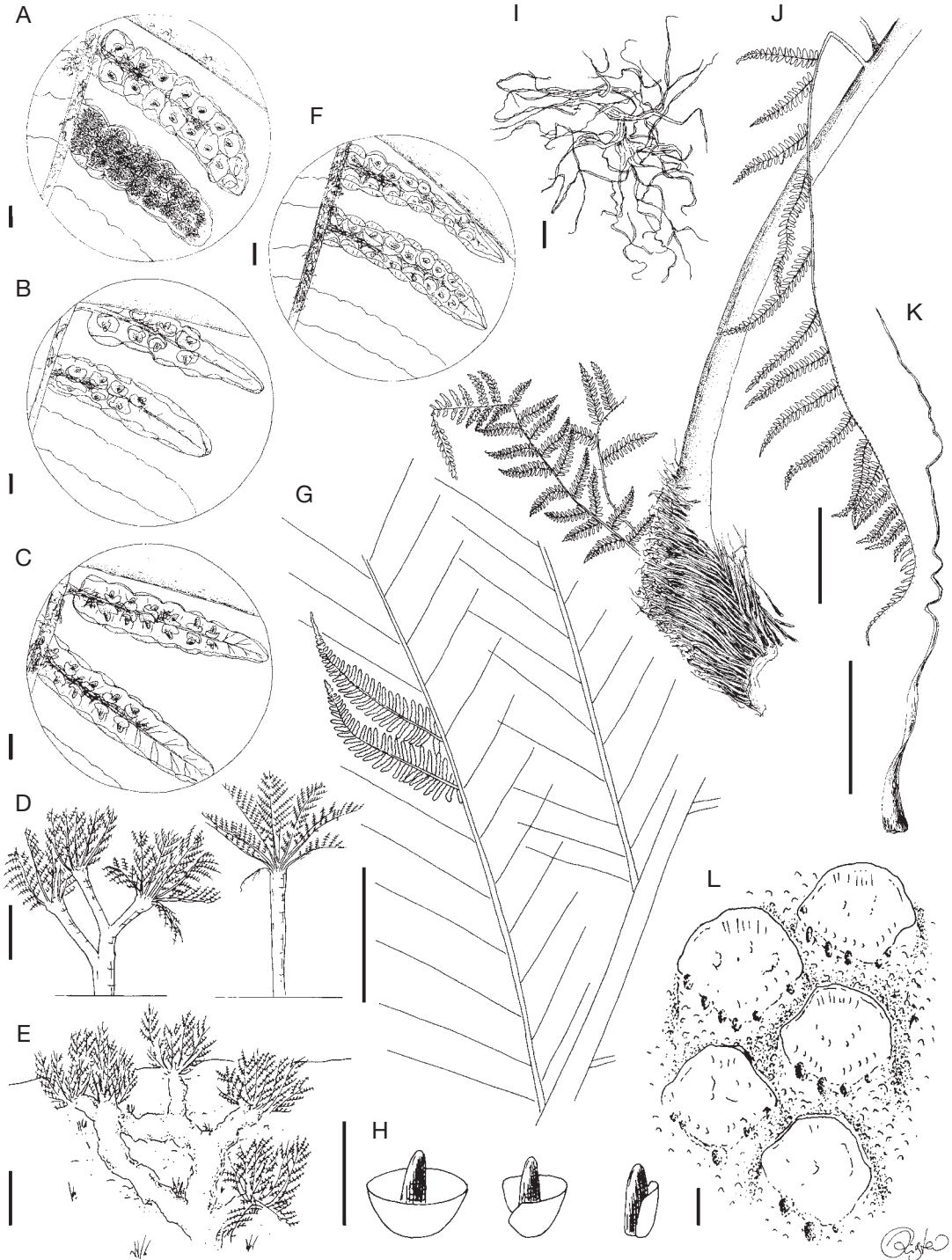
REMARKS

Edwards (2005: 8) describes the trunk of African *C. dregei* as "0.4-5 m tall [...] rarely with one or

more small branches, many old leaves persistent as a pendulous skirt" in agreement with illustrations in Sim (1915: pl. 6) and Roux (2001: cover photo). In Madagascar, *C. dregei* is frequently observed having creeping and several times bifurcated trunks forming more or less circular colonies of apparently trunkless, erect crowns (Figs 36E; 51E bottom). This peculiar habit has been previously described by Koechlin *et al.* (1974: 120, fig. 6) and Christensen (1932: 31). Hallé (1966) showed that trunk ramifications frequently occur in certain species of West African tree ferns, but, to our knowledge, a creeping habit of *C. dregei* has never been reported for Africa. In Madagascar, the mantle of adventitious roots covering the trunk has often been observed to be blackened by fire and may have a protective function. We hence suggest that the creeping habit is either a result of fires frequently occurring in the Madagascan grasslands and weakening the supporting structures of young trunks, which subsequently recline, or that it is an adaptation improving resistance to fire as the creeping trunks are usually covered with a thin layer of soil. Christensen (1932) discusses a putative correlation of erect trunks with a denser abaxial indument of branched, crispate hairs in the African specimens. However, all specimens that we have seen from Africa and Madagascar perfectly agree in all leaf characters. The density of the lamina indument is variable and not correlated with the habit of the plant and we hence do not propose distinct varieties. We suggest that the different trunk habits most likely represent ecological modifications.

Indusium shape and density of the hairy indument in *C. dregei* and closely related Madagascan

FIG. 36. — *Cyathea dregei* Kunze: **A**, pinnule segments abaxially with a fragment of the costula (at the junction with the costa), common form with cup-shaped indusia; **B**, pinnule segments abaxially with a fragment of the costula (at the junction with the costa), transitional form with deeply emarginate sori with oblique rim; **C**, pinnule segments abaxially with a fragment of the costula (at the junction with the costa), "segregata"-morphotype with hemitelioid indusia and narrow, acute segments; **D**, habit, erect form (left: branched trunk; right: simple trunk); **E**, habit, creeping form; **F**, pinnule segments abaxially with a fragment of the costula (at the junction with the costa), form with narrow, acute segments (cf. "segregata"-morphotype) and cup-shaped indusia; **G**, schematic representation of two pinnae with a fragment of the rachis, two pinnules are shown in detail, note the acute angles formed by the lamina axes; **H**, schematic representation of indusia encountered in *C. dregei* (left: cup-shaped, common form; middle: transitional form; right: hemitelioid form of the "segregata"-morphotype); **I**, ramified, crispate hair from the abaxial face of a segment midvein; **J**, basal part of the leaf (from the petiole base up to the first pinna pair), lateral view, note presence of a pair of erect, reduced pinnae at about 10 cm above the base of the petiole; **K**, scale from the base of the petiole; **L**, leaf scars and trunk surface, taken from a dead trunk (same population as Janssen *et al.* 2966) with the mantle of adventitious roots having completely decayed. A, I-K, Janssen *et al.* 2966 (P); B, Janssen *et al.* 2762 (P); C, Decary 17499 (P); D, E, uncollected, photographs at P; F, G, Janssen *et al.* 2967 (P); H, drawn after Janssen *et al.* 2966 (P), Janssen *et al.* 2762 (P), Decary 17499 (P); L, uncollected, surface mould at P. Scale bars: A-C, F, H, 0.1 cm; D, E, 1 m; G, J, 5 cm; I, 0.1 mm; K, L, 1 cm.



Q. J. G.

species is variable. In the field, *C. dregei* is most easily recognized by its habit, i.e. with creeping or short erect trunks densely covered with adventitious roots and relatively small crowns, and its habitat in open grasslands. In herbarium specimens, *C. dregei* may be most easily distinguished from the closely related *C. boivinii* by its smaller pinnae (two or three usually fit on one sheet at P, but only one pinna of *C. boivinii*) and pinnules, the rather constant presence of reduced basal pinnae and a denser abaxial indument of crispate hairs. See under *C. boivinii* for a more detailed discussion of the closely related tripinnate Madagascan species.

Humbert 12172 has pinnae up to 48 cm long and pinnules up to 9.5 × 2.2 cm. The presence of a distinctly erect acroscopic reduced basal pinna (*Humbert in sched.*) and a very dense tomentum, which is never found in leaves of *C. boivinii* of similar age distinguish this specimen as *C. dregei*. Furthermore, pinnae and pinnules are usually distinctly bigger in *C. boivinii*, although smaller forms occur. Some specimens, e.g., *Baron 5302*, have strongly revolute margins and consequently acute segment apices. Diels (1902: 127) notes that in Southern Africa *C. dregei* grows on mountain slopes among bushes or fully exposed to the sunlight. In the latter case, the crown is said to be smaller and the lamina margins to be strongly revolute with the most strongly revolute margin and accordingly narrowest segments found in the southernmost specimens.

TYPIFICATION AND SYNONYMY

Three sheets of *Drège s.n.* are marked as types at B, but only B200129536 carries a label with the original collection locality. The other specimens are from the Cape ("*P. b. sp.*", i.e. *promontorio bonae spei*) and should not be regarded as being part of the original material. A fragmentary isotype at P does not carry any locality information, but undoubtedly is part of the original material as it has been sent from Kunze to Luerssen about one year before the publication of the name as is obvious from the annotations and as it is morphologically identical to the lectotype at BM.

Epitypification might be less crucial for differentiating *C. dregei* from African taxa, but it will be

useful in unambiguously distinguishing the taxon from *C. boivinii* and *C. hildebrandtii* in Madagascar. We suggest that an epitype be chosen including the basal pinnae and scales and entire middle pinnae from which their size may be assessed. We prefer that such an epitype be chosen from material coming from near the type locality, i.e. Southern Africa, and not Madagascar. As we did not scrutinize the African material sufficiently for this account to choose an epitype, we here refrain from designating an epitype.

Baron 840 is the type of *C. polyphlebia* Baker. The number 440 on Baker's original label has been corrected to 840 in Baker's writing. This emendation is lacking on a second sheet at K!, which should nevertheless be regarded as an isotype. It is morphologically identical. The specimen distributed to B! only carries the number 840 indicating this to represent the correct designation of Baker's specimens.

Diels (1902: 127) cites the name of *C. flavovirens* Kuhn only stating that the pinnule segments have entire and revolute margins as opposed to *C. kirkii*. "Inner Madagascar" is given as the collection locality, but no type is cited. *Hildebrandt 3473*, carries the name "*C. flavovirens* n. sp." in Kuhn's writing and is consequently cited as the putative type of the name.

The shape of the pinnule segments of *C. rigidula* Baker is close to that of the "humblotii-morphotype" of *C. boivinii* to which it was assigned as a synonym by previous authors (Christensen 1932: 33). However, judging from the comparatively small size of pinnae and pinnules and the acute acroscopic angle the costae form with the rachis, we now rather include this taxon as a synonym in *C. dregei*.

Cyathea segregata Baker has been described from a fragmentary specimen carrying detached pinnae, agreeing in size with *C. dregei*, and sori with a hemitelioid indusium, i.e. a big costular "scale". Appressed trichomidia are rather abundant and the margin of the pinnule segments is fertile in its lower half to lower third, where it has a crenate and slightly revolute margin. *Cyathea polyphlebia* Baker has been described from a fragmentary specimen carrying detached pinnae agreeing in size with *C. dregei*, being subglabrous and displaying cup-

shaped indusia. The pinnule segments are fertile and crenate in their lower quarter. Trichomidia are abundant on the lower face of the lamina. None of the characters of *C. polyphlebia* and *C. segregata* is differential considering that indusium shape continuously varies from cup-shaped to hemitelioid (Fig. 36H) and that pinnule shape and indument are subject to continuous intraspecific variability in *C. dregei*. Supposing that the fragmentary type material comprises middle pinnae, we include both taxa as synonyms in *C. dregei* on the basis of pinna and pinnule sizes.

All specimens cited by Christensen (1932) under the name *C. dregei* var. *polyphlebia* are currently determined as *C. dregei* except for *Humbert 3731* (*C. boivinii* var. *parahildebrandtii*). All specimens cited by Tardieu-Blot (1951) under the name *C. dregei* var. *polyphlebia* are currently determined as *C. dregei* except for *Alleizette 226* (*C. boivinii*), *Humbert 11167* (*C. similis* var. *similis*), *Humbert 13576*, *Perrier 13508* (*C. boivinii* var. *bevolo*), *Humbert 22671*, *23768* (*C. similis* var. *montana*). All specimens cited by Christensen (1932) under the name *C. dregei* var. *segregata* are here included in *C. dregei*. The same is true for all specimens under that name in Tardieu-Blot (1951) except for *Alleizette 54* (*C. boivinii* var. *boivinii*).

37. *Cyathea kirkii* Hook.
(Figs 1B; 37; 45D; 52D)

Synopsis Filicum: 22 (1865); Tardieu in Humbert, *Flore de Madagascar et des Comores, IV^e famille, Cyathées*: 26, fig. 2 (9-10) (1951). — *Alsophila kirkii* (Hook.) R.M. Tryon, *Contributions from the Gray Herbarium* 200: 30 (1970). — Type: Comoros, Johanna, 2000 ft. [Anjouan, 600 m], VIII.1862, *Kirk s.n.* (holo-, K! [K000009946]; iso-, K!).

ADDITIONAL MATERIAL EXAMINED. — **Comoros.** *Lim-minghe 60* (P).

Anjouan, 12°15'S, 44°25'E, III.1877, *Bewsher s.n.* (K). — *Idem*, V.1850, *Boivin s.n.* (P[2]). — *Idem*, 1859, *Grey 1845* (BM). — *Idem*, 800-1200 m, *Hildebrandt 1748* (B, BM, K, P, W). — *Sunley s.n.* (K). — *S. coll. s.n.* (P). Grande Comore, Nioumbadjou, Karthala Volcano, 11°47'57"S, 43°17'50"E, 450 m, 9.VIII.1958, *Benson 28* (BM). — *Idem*, de Boboni à Convalescence, 11°45'S, 43°17'E, 600-700 m, 19.XI.2002, *Rakotondrainibe et al.*

6729 (P). — *Idem*, 800-1000 m, 19.XI.2002, *Rakotondrainibe et al. 6734* (P). — *Idem*, E de Singani, 11°51'S, 43°19'E, 400-450 m, 21.XI.2002, *Rakotondrainibe et al. 6751* (P).

Moheli, Miringoni, Voundrouvou, 12°17'17"S, 43°39'50"E, 660 m, 24.XI.1999, *Labat et al. 3208* (K, MO, P). — Miringoni, Mdawnyombe, chalet St. Antoine, 12°17'18"S, 43°39'51"E, 688 m, *Labat 3738* (P). — St. Antoine, 12°17'48"S, 43°38'07"E, 700 m, *Schlieben 11198* (B, K).

FIELD OBSERVATIONS. — Trunk: HT up to 3(-7) m, DT 7-10 cm, dead petiole bases caducous and the leaf scars exposed.

Leaf scars: 2.5 × 6 cm, elliptic.

Lamina: LL 160-180 cm, NP 13-26.

DESCRIPTION

Petiole: 15-75 cm long, about 2 cm in diameter and light brown to stramineous when dry, finely muricate to smooth; without reduced pinnae in the lower half of the petiole.

Lamina: pinnate-pinnatisect to tripinnate, herbaceous to subcoriaceous (not coriaceous), fertile-sterile dimorphism absent; dark green above, light green below; rachis of the same colour as the petiole, smooth.

Largest pinnae: 50-65 cm long, adjacent pinnae overlapping; costae and costulae of the same colour as the rachis.

Largest pinnules: 8-12 × 1.5-2.5 cm, adjacent pinnules spaced by less than their width, linear-oblong, their apex caudate, divided to the costula into broadly adnate segments, the 0-2 proximal segment pairs sessile to shortly petiolulate, segments proximally more or less decurrent, the bases of adjacent segments confluent from about the middle of the pinna or only in its upper third; pinnule segments 0.3-0.4 cm wide, spaced by less than to about their width, straight and with an asymmetric apex to slightly falciform, their margin crenulate, flat, their apex rounded to obtuse; lateral veins in the segments once furcate.

Scales and hairs: scales present from the petiole base upwards to 30 cm on the petiole and rachis, at its base densely imbricate to contiguous, sometimes only slightly overlapping, gradually thinner and smaller further up on the petiole, persistent, narrowly triangular, 1.2-2 × 0.1-0.2 cm, straight to falciform, not twisted, at most their apex slightly crispate, more

or less contorted further up on the petiole, shiny brown to dark brown, with a narrow, light brown, erose margin, more or less appressed, coriaceous, not indurated; scattered dull to shiny dark brown to black, narrowly triangular, appressed scales on the abaxial face of the costae, where they are up to 0.5 cm long and sparse, and of the costulae where they are up to 0.2 cm long and more abundant; scattered shiny brown, acaroid squamules on the abaxial face of the segment midveins and in the upper part of the costulae; adaxial face of the costae and costulae densely tomentose with antrorse, brown, more or less contorted, multicellular hairs, these hairs less dense on the rachis; scattered brown, filiform scales on the adaxial face of the rachis and costae.

Sori: very close to the midvein, contiguous to spaced by less than their width, about 0.1 cm in diameter, covering up to three quarters of the segment; indusia globular, subcoriaceous, brown, at maturity dehiscing into irregular lobes, but usually not down to the base of the receptacle; receptacle capitate, shorter than the rim of mature indusia, with inconspicuous filiform paraphyses shorter than the sporangia.

DISTRIBUTION

Comoros: Anjouan, Grande Comore and Moheli; endemic.

ECOLOGY

450-1000 m. Dense evergreen rainforests.

REMARKS

Cyathea kirkii might be confounded with *C. boivini* var. *hildebrandtii* in the Comoros, from which it is most easily distinguished by its smooth petiole, shorter and narrower petiole scales, globular indusia and dark brown, lanceolate scales on the abaxial face of the rachis and costae. Its short, appressed petiole scales distinguish the species from all Madagascar tripinnate taxa. *Labat et al.* 3208 has a reduced pinna, 11 cm long, about halfway on the petiole.

The species is phylogenetically closely related to the bipinnate Madagascar taxa (Janssen *et al.* 2008). It is included together with the tripinnate species in group III in the present treatment in order to facilitate usage of the keys.

TYPIIFICATION AND SYNONYMY

The specimens on the two sheets of *Kirk s.n.* (K!) are fertile, but only one of them, carrying a fertile pinna with a rachis fragment, includes the name "*Cyathea kirkii* Hk." in Hooker's handwriting and is considered to represent the holotype specimen.

38. *Cyathea lastii* Baker (Figs 38; 45E; 52F)

Journal of Botany 29: 3 (1891); Christensen, *Dansk Botanisk Arkiv* 7: 32, pl. 6 figs 16-18 (1932); Tardieu in Humbert, *Flore de Madagascar et des Comores, IV^e famille, Cyathacées*: 26 (1951). — *Alsophila lastii* (Baker) R.M. Tryon, *Contributions from the Gray Herbarium* 200: 30 (1970). — Type: North West Madagascar, Bé Kilus Mountains, XII.1890, *Last s.n.* (lecto-, K! [2 sheets: K000009940, -41], here designated; isolecto-, K! [4 sheets]).

ADDITIONAL MATERIAL EXAMINED. — **Madagascar.** Maro-mandia, Ankaramy, 13°59'S, 48°10'30"E, 11.VI.1923, *Decary* 2167 (P). — Antsiranana, Manongarivo, Bekolosy, 14°02'S, 48°19'E, 1280 m, 30.III.1996, *Gautier et al.* 2929 (G). — *Idem*, 800 m, 10.IX.1997, *Gautier et al.* 3261 (G, P). — *Idem*, crête entre les deux bras de l'Ambahatra, 14°00'S, 48°23'30"E, 850 m, 5.III.1999, *Gautier et al.* 3474 (G, P). — *Idem*, 13°59'51"S, 48°25'43"E, 1150 m, 24.IX.2004, *Janssen et al.* 2381 (P, TAN). — *Idem*, 14°01'22"S, 48°25'03"E, 1614 m, 26.IX.2004, *Janssen et al.* 2390 (MO, P, TAN). — *Idem*, 13°59'51"S, 48°25'43"E, 1200 m, 1.X.2004, *Janssen et al.* 2430 (P, TAN). — *Idem*, 1147 m, 1.X.2004, *Janssen et al.* 2431 (MO, P, TAN). — Antsiranana, Manongarivo, E of Ankaramy, Antsatrotro, 14°05'S, 48°23'E, 600-900 m, III.1993, *Malcomber et al.* 2290 (G, MO). — *Idem*, 14°05'S, 48°24'E, 1000-1400 m, 11.X.1991, *Rakotondrainibe* 1385 (P). — Manongarivo, Bekolosy, 14°02'S, 48°19'E, 550 m, 24.I.1992, *Rakotondrainibe* 1415 (P). — *Idem*, Mt. d'Antsatrotro, 14°05'S, 48°24'E, 1200 m, 20.V.1992, *Rakotondrainibe* 1712 (K, MO, P). — Antsiranana, Manongarivo massif, above village of Ambo-disakoana, 14°05'S, 48°20'E, 500-1000 m, 20.X.1994, *van der Werff et al.* 13538 (MO, P). — Without locality, 1860, *Barbey s.n.* (G).

FIELD OBSERVATIONS. — Trunk: HT up to 4.5(-8) m, DT 11-13 cm excluding, 15-20 cm including the persistent petiole bases that cover the entire trunk or its upper part only, the leaf scars usually visible below; trunk thickened at its base by a mantle of adventitious roots; trunk surface dark brown, muricate.

Petiole: with a row of white to brown aerophores on either side; petiole base more or less sigmoid.

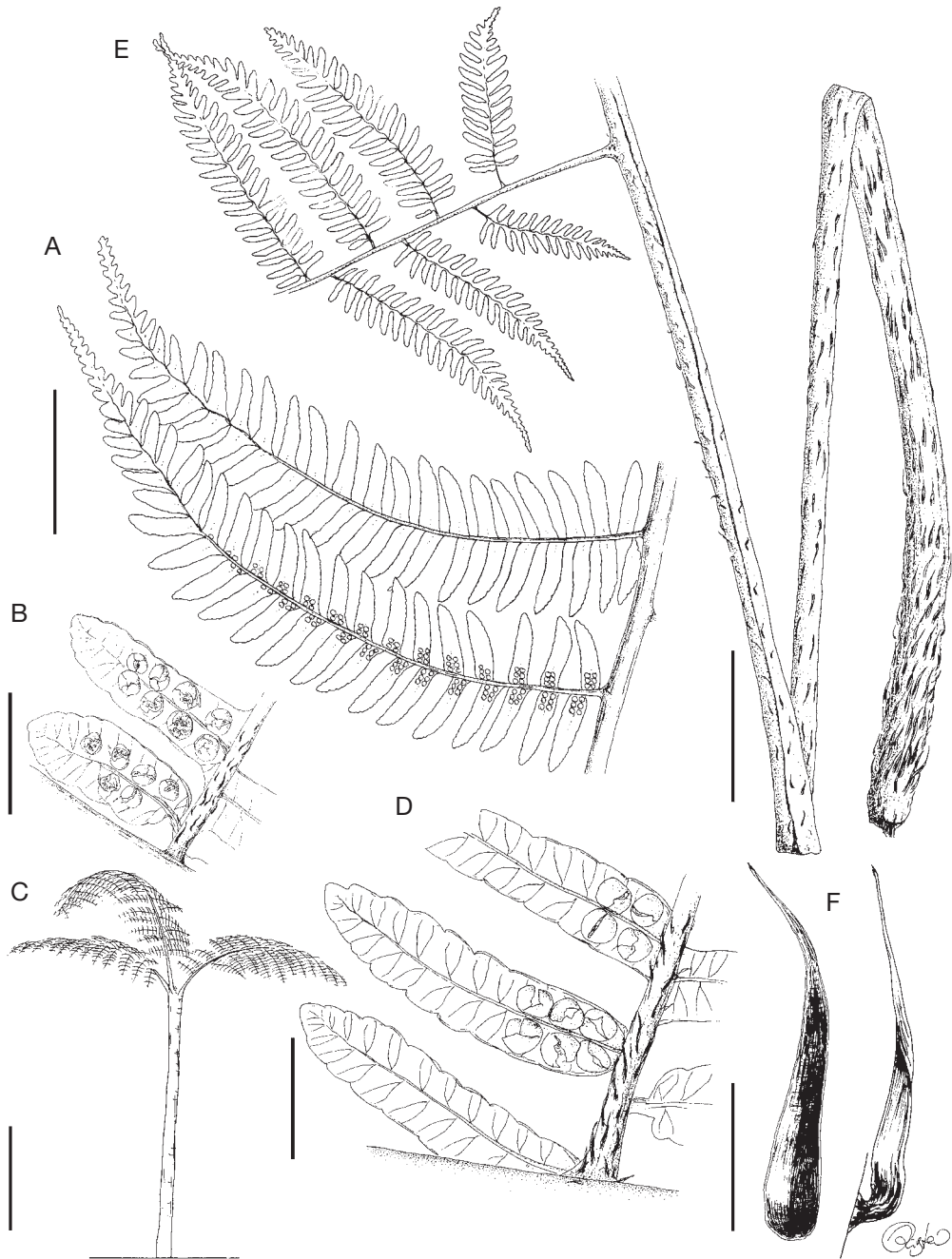


FIG. 37. — *Cyathea kirkii* Hook.: **A**, pinnules abaxially with a fragment of the costa, sori omitted from one pinnule; **B**, pinnule segments abaxially from the basal part of a pinnule (at the junction of the costula with the costa), form with smaller segments; **C**, habit; **D**, pinnule segments abaxially from the basal part of a pinnule (at the junction of the costula with the costa), common form; **E**, basal part of the leaf (from the petiole base up to the first pinna pair), dorso-lateral view, ventral view in upper third, one half of the petiole pruned away by longitudinal section; **F**, scale from the base of the petiole (left: dorsal view; right: lateral view). A, D-F, *Rakotondrainibe et al.* 6729 (P); B, C, *Labat et al.* 3208 (P). Scale bars: A, E, 5 cm; B, D, F, 0.5 cm; C, 1 m.

Leaf scars: 2-4 × 3-9 cm, elliptic to ovate, with orifices below the scars; spirally arranged.

Crown: large and umbrella-shaped with arching petioles and rachises.

Trunk apex: densely covered with brown scales, concealed among the more or less spaced petioles; some dead leaves persistent and hanging from the apex.

Lamina: elliptic to ovate; LL 250-300 cm, WL 120-180 cm, FW (75-)120-145(-195) cm, NP 11-20.

DESCRIPTION

Petiole: 50-80(-130) cm long, 2.5-3 cm in diameter; green, abaxial face violaceous, distantly and sharply muricate; glabrous, covered with a bluish to glaucous waxy layer, that can be easily wiped off, invisible in herbarium specimens; reduced pinnae absent from the lower half of the petiole.

Lamina: bipinnate-pinnatisect to tripinnate, herbaceous to subcoriaceous (not coriaceous), fertile-sterile dimorphism absent; shiny light to dark green above, pale light green below, lamina base shortly attenuate to truncate, basal pinnae patent to slightly reflexed, more or less conduplicate; rachis of the same colour as the petiole, completely green distally.

Largest pinnae: 60-75 cm long, distant by 16-20 cm, often distinctly petiolulate with the petiolule 1-4 cm long, adjacent pinnae overlapping; costae and costulae of the same colour as the rachis, the costulae usually darker than the costae when dry.

Largest pinnules: (10.5-)12-14 × (1.5-)2.5-3 cm, the 2 or 3 proximal pinnule pairs distinctly petiolulate, petiolule up to 1 cm long, adjacent pinnules spaced by less than their width, linear-oblong, their apex conspicuously caudate, divided to the costula into broadly adnate segments, the 1-3 proximal segment pairs distinctly petiolulate to sessile and deeply crenate, segments proximally decurrent, the bases of adjacent segments confluent from about the middle of the pinnule; pinnule segments 0.3-0.5 cm wide, spaced by less than to about their width, more or less falciform, the margin of proximal segments crenate, becoming serrate in distal segments, flat, the apex of proximal segments obtuse, becoming acute in distal segments, rarely rounded; lateral veins in the segments once to rarely twice furcate.

Scales and hairs: scales present from the petiole base upwards to about 10 cm on the petiole, at its base moderately dense and overlapping, rapidly

caducous further up, narrowly triangular, 3-4.5 × 0.2-0.4 cm, straight, with a twisted and slightly crispate apex, shiny brown, concolourous or with a very narrow, light brown, erose margin, not appressed to the petiole, not indurated; costulae and upper part of the rachis adaxially with sparse contorted, light brown, multicellular hairs, the lower part of the costa and the rachis glabrous adaxially; leaf otherwise glabrous.

Sori: in a median position between the midvein and the segment margin, distinctly spaced from each other by less than to about their width, about 0.1 cm in diameter, covering the entire segment except its apex; indusia cup-shaped, even when young, subcoriaceous to coriaceous, light brown to stramineous, at maturity persistent as a cup with an entire rim, very rarely with 1 or 2 slits; receptacle elongate, somewhat flattened, slightly to conspicuously longer than the rim of mature indusia, its apex with inconspicuous short, filiform paraphyses.

DISTRIBUTION

Northern Madagascar: Manongarivo massif; endemic.

ECOLOGY

550-1600 m. Dense evergreen rainforests and crest forests.

REMARKS

A very characteristic taxon, which can easily be distinguished from other species of the Western Indian Ocean region by its big, petiolulate pinnae and big, acute pinnule segments as well as by its always cup-shaped indusia and its sori being spaced from each other and from the midvein of the segment. In the forest, it is easily recognized by its big leaves and naked green petioles covered with a bluish waxy layer (Fig. 52F). *Rakotondrainibe 1415* has 0-3 pairs of reduced pinnae inserted in the lower half and especially near the base of the petiole.

TYPEIFICATION AND SYNONYMY

Five sheets of *Last s.n.* (K!) have been traced comprising two detached fertile middle pinnae, each halved and glued on two separate sheets as well as a smaller fertile pinna with a rachis fragment probably taken

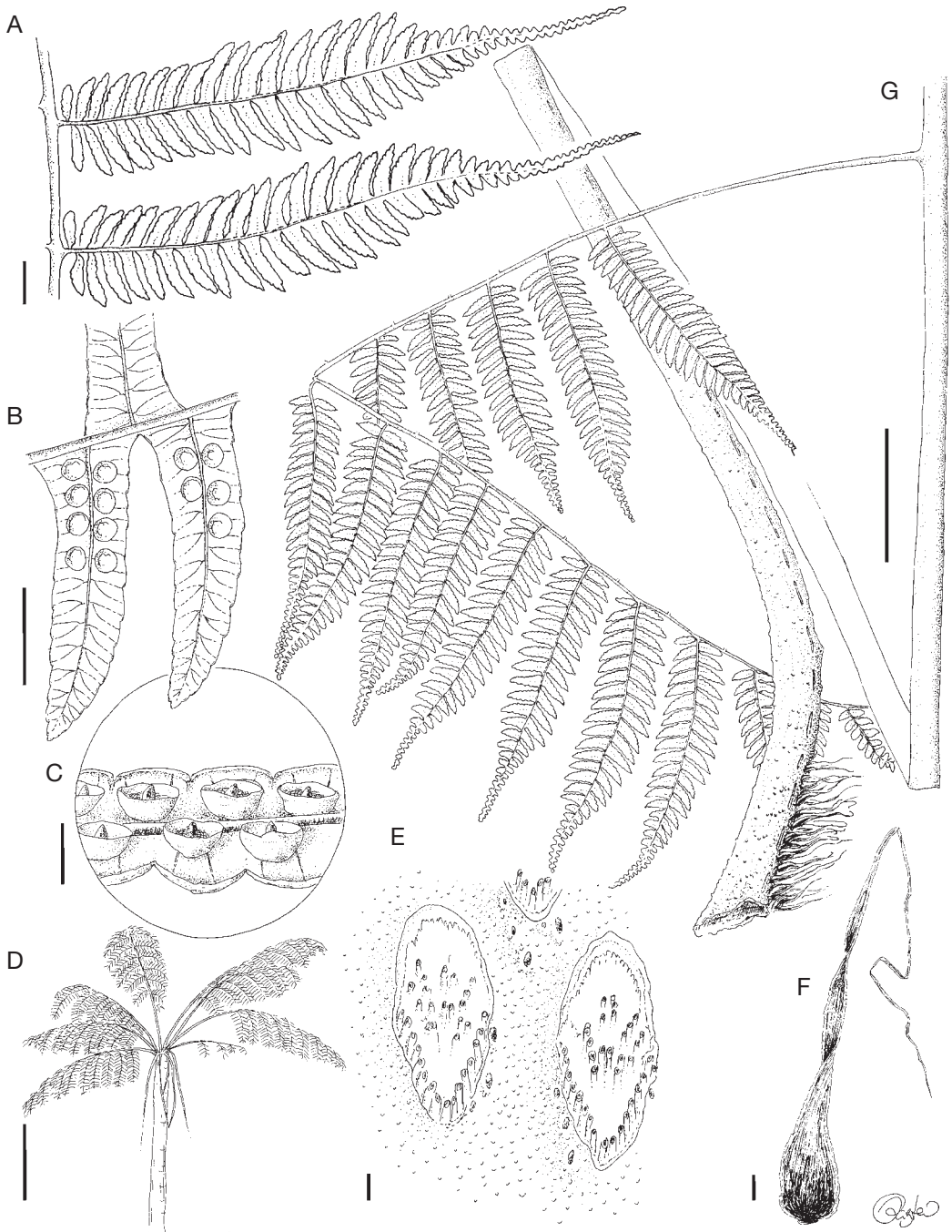


FIG. 38. — *Cyathea lastii* Baker: **A**, pinnules adaxially with a fragment of the costa; **B**, pinnule segments abaxially with a fragment of the costa; **C**, part of a pinnule segment abaxially with sori, dorso-lateral view, note the cup-shaped indusium and the distance between adjacent sori; **D**, habit; **E**, leaf scars and trunk surface; **F**, scale from the base of the petiole; **G**, basal part of the leaf (from the petiole base up to the first pinna pair), lateral view, one half of the petiole pruned away by longitudinal section. A-C, F, G, *Janssen et al.* 2430 (P); D, *Janssen et al.* 2431 (P); E, *Janssen et al.* 2381 (P). Scale bars: A, E, 1 cm; B, 0.5 cm; C, F, 0.1 cm; D, 1 m; G, 5 cm.

near the apex of the leaf. All sheets are equivalent in carrying the name and collection locality in Baker's handwriting. The sheets that need to be associated to constitute an entire pinna are obvious from the arrangement of the pinnules and we here designate an entire fertile pinna as a two-sheet lectotype of *C. lastii* Baker (K000009940, -41). Epitypification is superfluous as all important differential characters are available in the fragmentary original material.

39. *Cyathea melleri* (Baker) Domin
(Figs 1E; 39; 45L; 53A)

Pteridophyta: 264 (1929); Domin, *Acta Botanica Bohemica* 9: 135 (1930); Christensen in Perrier, *Catalogue des Plantes de Madagascar, Ptéridophytes*: 21 (1931); Christensen, *Dansk Botanisk Arkiv* 7: 36, pl. 7 figs 11-17 (1932). — *Hemitelia melleri* Baker, *Synopsis Filicum*: 456 (1874). — *Gymnosphaera melleri* (Baker) Tardieu in Humbert, *Flore de Madagascar et des Comores, IV^e famille, Cyathéacées*: 38 (1951). — *Alsophila melleri* (Baker) R.M. Tryon, *Contributions from the Gray Herbarium* 200: 31 (1970). — Type: Madagascar, from the sea to Antananarivo (*sic*), VIII-IX.1862, *Meller s.n.* (lecto-, K! [K000009937], here designated; isolecto-, K!). — Madagascar, Toamasina, Andasibe, RS d'Analamazaotra, autour du Lac Vert, 18°56'S, 48°26'E, 930-950 m, 11.XI.2004, *Janssen et al.* 2569 (epi-, P! [7 sheets: P00589623-29], here designated; isoepi-, P! [6 sheets], MO!, TAN!; one trunk surface mould at P!).

Hemitelia glandulosa Kuhn ex Baker, *Annals of Botany* 5: 188 (1891). — *Cyathea glandulosa* (Kuhn ex Baker) Domin, *Pteridophyta*: 264 (1929); Domin, *Acta Botanica Bohemica* 9: 119 (1930). — Type: Madagascar, Imerina, Andrangoloaka, XI.1880, *Hildebrandt* 4176 (lecto-, B! [B200129546], here designated; isolecto-, B! [4 sheets], BM!, G!, K!, P! [4 sheets]).

Cyathea melleri (Baker) Domin var. *virescens* C.Chr., *Dansk Botanisk Arkiv* 7: 36, pl. 6 figs 24-27 (1932). — *Cyathea virescens* C.Chr. in Perrier, *Catalogue des plantes de Madagascar, Ptéridophytes*: 22 (1931), nom. nud. — *Gymnosphaera melleri* var. *virescens* (C.Chr.) Tardieu in Humbert, *Flore de Madagascar et des Comores, IV^e famille, Cyathéacées*: 38 (1951). — Type: Madagascar, forêt orientale, Mt. Andriantantely au nord d'Anivorano, VI.1922, *Perrier de la Bâthie* 14746 (lecto-, P! [3 sheets: P00418729-31], here designated; isolecto-, P! [4 sheets]).

ADDITIONAL MATERIAL EXAMINED. — Madagascar. Ambodiriana, 14.XII.1944, *Cours* 1916 (P). — Fianarantsoa,

Andringitra, forêt d'Ambodipaiso, 12.I.1945, *Cours* 2261 (P). — De Nonokambo à Varaina, 17°45'S, 48°45'E, 1200 m, 17.I.1945, *Cours* G 2382 (P). — Bemainty à Andranomanitra, 800-850 m, 9.III.1951, *Cours* 4227 (P). — Brickaville, Ambalarondra, 300 m, 21.IV.1951, *Cours* 4506 (P). — Analamazaotra, 18°57'20"S, 48°24'30"E, XII.1905, *D'Alleizette* 8 (P). — Antananarivo, 18°55'S, 44°31'E, *Gilpin s.n.* (K). — Manjarivolo, Andrianomy, 22°17'S, 46°52'E, 1300 m, 4.XI.1970, *Guillaumet* 3509 (P). — Périnet, Analamazaotra, 18°56'S, 48°26'E, 1.X.1971, *Guillaumet* 3868 (P). — *Helsenberg & Bojer s.n.* (BM). — Toamasina, Zahamena, massif de l'Andrangoval, 17°40'S, 48°45'E, 1200 m, X.1937, *Humbert et al. s.n.* (P). — Bassin de l'Itomampy, Mt. Papanga près de Befotaka, 23°51'S, 46°57'E, 1000-1600 m, XII.1928, *Humbert* 6894 (P). — Vallée de la Lokoho, près d'Ambalavonihy, 14°34'S, 49°44'E, 75-300 m, I.1949, *Humbert et al.* 22822 (P). — *Idem*, mont Ambatosoratra, 14°32'S, 49°42'E, 1000 m, I.1949, *Humbert et al.* 22845 (BR, K, P). — Toamasina, RNI Betampona, Rendriendry, 17°55'48"S, 49°12'E, 310-580 m, 6.XI.2004, *Janssen et al.* 2536 (MO, P, TAN). — Fianarantsoa, corridor forestier reliant la RS d'Ivohibe au PN Andringitra, forêt d'Angodongodona, 22°25'07"S, 46°55'31"E, 1100 m, 20.IV.2005, *Janssen et al.* 2789 (MO, P, TAN). — Toamasina, Analamazaotra, 18°56'S, 48°26'E, *Jardin Botanique de Tananarive* 3231 (P). — *Idem*, Didy, forêt de Tsiazomborona, 20.XI.2005, *Labat et al.* 3574 (P). — *Idem*, RN de Betampona, 17°55'S, 49°13'E, 450 m, 19.XII.1938, *Lam & Meeuse* 5989 (K, P). — Antsiranana, RN de Marojejy, trail to the summit of Marojejy Est, 14°26'S, 49°46'E, 850-1000 m, 11.II.1989, *Miller et al.* 3981 (P). — Toamasina, Andasibe, Analamazaotra, 18°56'S, 48°26'E, 800 m, VII.1914, *Perrier de la Bâthie* 7579 (P). — *Idem*, II.1912, *Perrier de la Bâthie* 11539 (P). — Forêt d'Ambatovy, 11 km NE Moramanga, 18°49'S, 48°18'E, 1997, *Rakotomalaza* 1599 (P). — Toamasina, Sandrakatzy, forêt de Verezanantsoro, SE de Varary, 16°26'S, 49°38'E, 500 m, 6.I.1994, *Rakotondrainibe et al.* 2050 (MO, P, TAN). — Antsiranana, RS d'Anjanaharibe-Sud, SSW de Befingotra, 14°45'18"S, 49°30'18"E, 790 m, 20.X.1994, *Rakotondrainibe et al.* 2115 (P). — *Idem*, 14°44'42"S, 49°27'42"E, 1280 m, 4.XI.1994, *Rakotondrainibe et al.* 2340 (MO, P, TAN). — Fianarantsoa, RNI d'Andringitra, piste menant d'Ambalamenjana à Ambatomboay, 22°13'S, 47°12'E, 720 m, 14.V.1995, *Rakotondrainibe* 2556 (P, TAN). — *Idem*, berges d'un affluent de la rivière Sahavatoy, 22°13'22"S, 46°58'18"E, 1280 m, V.1995, *Rakotondrainibe* 2714 (P, TAN). — Toliara, Tolanaro, RNI d'Andohahela, NW d'Eminiminy, 24°35'40"S, 46°44'30"E, 800 m, 30.X.1995, *Rakotondrainibe* 3003 (MO, P, TAN). — *Idem*, 1100 m, 8.XI.1995, *Rakotondrainibe* 3050 (MO, P, TAN). — Antsiranana, RNI du Marojejy, NW de Manantenina, 14°26'12"S, 49°46'30"E, 480 m, 5.X.1996, *Rakotondrainibe* 3271 (MO, P). — *Idem*, 450 m, 5.X.1996, *Rakotondrainibe* 3293 (P,

TAN). — *Idem*, 490 m, 9.X.1996, *Rakotondrainibe* 3335 (P). — Antananarivo, forêt d'Andranomay, SE d'Anjozorobe, 18°28'48"S, 47°57'18"E, 1300-1450 m, 15.XII.1996, *Rakotondrainibe* 3718 (P). — Fianarantsoa, RS d'Ivohibe, ENE d'Ivohibe, 22°28'12"S, 46°57'36"E, 850-950 m, 7.X.1997, *Rakotondrainibe et al.* 4055 (P, TAN). — Antananarivo, forêt d'Ankilahila, SE de Tsinojoarivo, 19°42'24"S, 47°51'E, 1400-1560 m, 15.I.1999, *Rakotondrainibe* 4743 (P, TAN). — Antsiranana, forêt de Betaolana, NW d'Ambodiangezoka, 14°32'18"S, 49°26'18"E, 900 m, 14.X.1999, *Rakotondrainibe et al.* 4911 (P, TAN). — Fianarantsoa, PN de Ranomafana, forêt de Vatoharanana, 21°17'24"S, 47°26'E, 1000-1100 m, 3.X.2000, *Rakotondrainibe et al.* 5866 (K, P, TAN). — Antsiranana, PN de Marojejy, SE de Doany, 14°25'36"S, 49°36'30"E, 820 m, 14.X.2001, *Rakotondrainibe et al.* 6219 (P, TAN). — Forêt de Ranomafana, forêt de Talatakely, 21°18'S, 47°38'30"E, 950 m, 25.VIII.1991, *Ranarijaona et al.* 91 (P). — Toamasina, PN de Zahamena, Ankosy, 17°29'S, 48°44'E, 1107m, 27.I.2001, *Rasolohery* 204 (MO, P, TAN). — *Idem*, 17°30'14"S, 48°43'52"E, 1100-1330 m, 30.I.2001, *Rasolohery* 290 (MO, P, TAN). — *Idem*, 17°41'S, 48°59'E, 650 m, 15.VI.2001, *Rasolohery* 546bis (MO, P, TAN). — Moramanga, 18°56'20"S, 48°13'40"E, 900 m, 1.II.1959, *Schlieben* 8114 (B, BM, BR, G, K).

FIELD OBSERVATIONS. — Trunk: HT up to 8 m, DT 9.5-15(-20) cm, dead petiole bases persistent in the upper quarter only, caducous below and the leaf scars exposed; trunk surface coarsely and bluntly muricate, dark brown to black, some scales persist occasionally; base of the trunk usually considerably thickened by a mantle of adventitious roots.

Petiole: with a subcontinuous row of white to light brown aereophores, up to 2 cm long, on either side; petiole base long sigmoid.

Leaf scars: 3-4 × 5-9 cm, elliptic, about 5-7 very big and shallow orifices on their lower rim; spirally arranged.

Crown: more or less horizontal with stiff petioles and rachises to umbrella-shaped with arching petioles and rachises.

Trunk apex: densely covered with black scales, usually concealed by the more or less spaced petioles; some dead leaves persistent and hanging from the apex.

Lamina: elliptic; LL (130-)185-250(-300) cm, WL 110-160 cm, FW 70-95 cm, NP 10-20.

DESCRIPTION

Petiole: (20-)40-80(-120) cm long, 3.5-4 cm in diameter; completely blackish to violaceous brown, adaxially sometimes green, distantly and bluntly muricate; covered with a thin caducous tomentum of light brown squamules; always 1 or 2 pairs of aplebioid pinnae with a much reduced lamina, 15-

25 cm long, inserted at 5-30 cm from the petiole base, distinctly petiolate, usually positioned just above the trunk apex.

Lamina: bipinnate-pinnatifid to tripinnate, herbaceous to subcoriaceous (not coriaceous), fertile-sterile dimorphism present; shiny green to dark green above, pale green below, lamina base shortly attenuate to truncate, basal pinnae patent to slightly reflexed, conduplicate; rachis of the same colour as the petiole, gradually becoming green distally.

Largest pinnae: 50-80 cm long, distant by 10-20 cm, adjacent pinnae contiguous to overlapping; costae and costulae of the same colour as the rachis.

Largest pinnules: 7.5-11 × 1.2-2.2 cm (fertile), 10.5-13.5 × 2-3 cm (sterile), adjacent pinnules contiguous to spaced by less than their width, linear-oblong to rarely triangular, their apex caudate, divided to the costula into broadly adnate segments, the 0-2 proximal segment pairs sessile and often deeply crenate; fertile pinnule segments 0.2-0.3 cm wide, spaced by less than to more than their width, slightly falciform to straight, their margin crenate to serrate to rarely subentire, flat or slightly revolute, their apex rounded, the bases of adjacent segments widened and confluent from the lower third of the pinnule; sterile pinnule segments 0.3-0.4 cm wide, spaced by less than their width, with a subentire to serrulate margin and a rounded to obtuse apex, the bases of adjacent segments usually confluent from the lower half of the pinnule or from its base; lateral veins in the segments once furcate, rarely simple.

Scales and hairs: scales present from the petiole base upwards to 15-30 cm on the petiole, at its base distant to contiguous, at most slightly overlapping, persistent, narrowly triangular, 1-1.5 × 0.1-0.2 cm, straight, slightly contorted further up on the petiole, their apex at most slightly crispate, not twisted, shiny dark brown to black, with a very narrow, light brown, erose margin, at the petiole base paralleling the petiole surface from a very conspicuously indurated and antrorsely curved base, completely appressed further up on the petiole, coriaceous; adaxial face of the rachis, costae and costulae more or less densely tomentose with rather soft, crispate, brown, multicellular hairs; sparse and caducous, ciliate, soft, crispate, light brown scales on the

abaxial face of the costulae and segment midveins in young leaves; leaf otherwise glabrous.

Sori: very close to the midvein, contiguous, about 0.1 cm in diameter, covering the entire segment; indusia hemitelioid, i.e. scale-like and inserted at the costular face of the receptacle, with an entire to dentate rim, light brown, membranous to subcoriaceous, often obscured by the sporangia; receptacle columnar, conspicuously elongate, longer than the rim of mature indusia, with inconspicuous filiform paraphyses.

DISTRIBUTION

Madagascar, in the eastern rainforests from the north (Marojeje massif) to the south (Andohahela massif); endemic.

ECOLOGY

(50-)400-1300(-1400) m. Dense evergreen rainforests, also frequently on forest margins, in clearings or on roadsides.

REMARKS

The species is easily distinguished by its short, contiguous to distant, dark petiole scales, aphlebioid pinnae inserted near the petiole base and hemitelioid indusia. Detached pinna have been confounded with *C. boivinii*, although that species has a shorter receptacle and cup-shaped to asymmetric, but never truly hemitelioid indusia. Indusia of *C. boivinii* are always prominent and never completely concealed by the sporangia.

TYPIFICATION AND SYNONYMY

None of the sheets of *Meller s.n.* at K, one carrying a sterile apex and partly fertile middle pinnae and a second with two detached aphlebioid pinnae from the petiole base, carries the name of the species. As only the former sheet contains the manuscript remark “junghuhniana?” referenced in a remark following the protolog and as the protolog does not mention the aphlebioid basal pinnae, we choose the sheet carrying the sterile apex and partly fertile middle pinnae (K000009937) as the lectotype of *Hemitelia melleri* Baker. Indusium shape being variable in many tripinnate taxa and *C. melleri* having been occasionally misidentified, we consider it useful

to designate an epitype including characters of the petiole base, i.e. scales and aphlebioid pinnae, as well as complete sterile and fertile pinnae to illustrate the leaf dimorphism.

Hildebrandt 4176 is widely distributed and most sheets carry Hildebrandt's original label with the name “*Hemitelia glandulosa* Kuhn n. sp.”, most likely in Kuhn's writing. They are furthermore equivalent in carrying fertile middle pinnae. One sheet of the material seen at B, B200129546, is here designated as the lectotype of *Hemitelia glandulosa* Kuhn ex Baker. Although no petiole base is available for Hildebrandt's collection, the material is identical to *C. melleri* with respect to lamina cutting and indusium shape.

All sheets of *Perrier de la Bâthie 14746* seem to be located at P and are equivalent in carrying the determination “*Cyathea virescens* C.Chr. sp. nov.” in Christensen's handwriting. We here designate a 3-sheet lectotype for *C. melleri* var. *virescens* C.Chr. including a leaf apex, middle pinnae and the petiole with an aphlebioid pinna, P00418729-31. This taxon cannot be maintained as a distinct variety as it has been described from a young leaf with incompletely developed sori and a grass-green herbaceous (not coriaceous) lamina, characters that have been observed in young leaves of typical *C. melleri* during fieldwork. Considering all material seen of *C. melleri*, we cannot find a single morphological character to distinguish *Perrier de la Bâthie 14746*.

40. *Cyathea sechellarum* Mett. (Figs 40; 53B)

Annales Musei Botanici Lugduno-Batavi 1: 58 (1863); Baker, *Flora of Mauritius and the Seychelles*: 467 (1877); Christensen, *Transactions of the Linnean Society of London*, 2nd ser., Botany 7: 412 (1912); Tardieu, *Notulae Systematicae* 16: 156 (1960). — *Alsophila sechellarum* (Mett.) R.M. Tryon, *Contributions from the Gray herbarium* 200: 31 (1970). — Type: Îles Seychelles, 1841, *Pervillé 76a* (lecto-, L! [L0597849], here designated; isolecto-, B!, G!, K!, P!). — Seychelles, Mahé, Morne Seychellois National Park, summit of Morne Blanc, 04°39'24”S, 55°25'59”E, 650 m, *Janssen et al. 3226* (epi-, P! [3 sheets: P00589647-49], here designated; isoepi-, MO!, P! [3 sheets], SEY!)

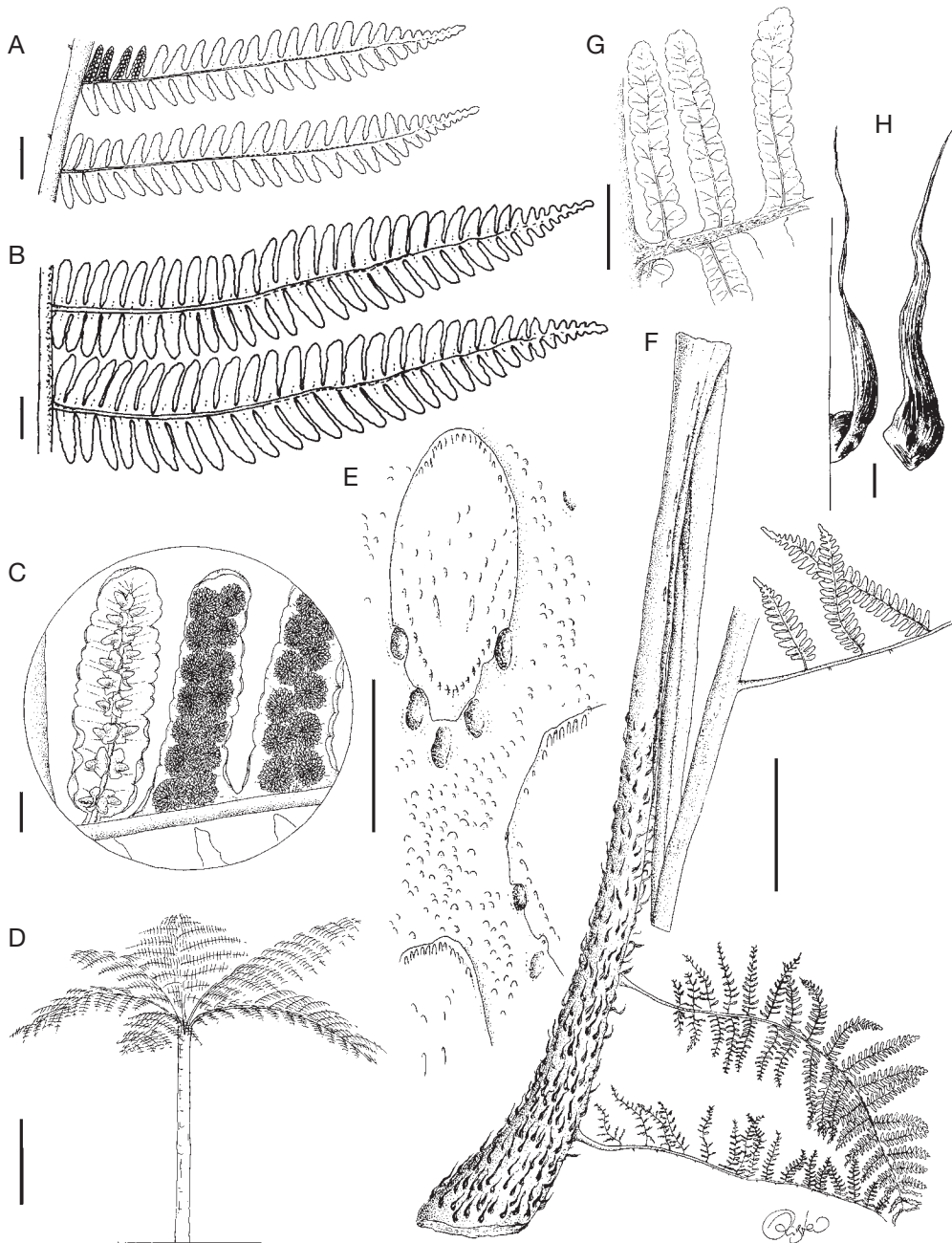


FIG. 39. — *Cyathea melleri* (Baker) Domin: **A**, fertile pinnules abaxially with a fragment of the costa, sori only partly indicated; **B**, sterile pinnules abaxially with a fragment of the costa; **C**, pinnule segments abaxially with a fragment of the costula (at the junction with the costa), sporangia partly removed to reveal the hemiteloid indusia; **D**, habit; **E**, leaf scars and trunk surface; **F**, basal part of the leaf (from the petiole base up to the first pinna pair), basal part in lateral view, folded middle part in adaxial and upper part in dorsal view, note the presence of a pair of reduced pinnae at 5–10 cm above the base of the petiole; **G**, pinnule segments adaxially with a fragment of the costula (at the junction with the costa), form with narrow segments; **H**, scales from the base of the petiole (left: lateral view; right: dorsal view). A–C, E, F, H, *Janssen et al.* 2569 (P); D, uncollected, photograph at P; G, *Rakotondrainibe et al.* 5866 (P). Scale bars: A, B, 1 cm; C, H, 0.1 cm; D, 1 m; E, F, 5 cm; G, 0.5 cm.

ADDITIONAL MATERIAL EXAMINED. — **Seychelles.** *Boivin s.n.* (P). — *Bouton 2072* (BM). — *Lister s.n.* (BM). — 1841, *Pervillé s.n.* (P[3], K). — *Pervillé 356bis* (L, paratype). — *S. coll. 38* (P). — *S. coll. s.n.* (B, K). Mahé, *Barkly s.n.* (BM). — Bois des hauts, IV.1848, *Boivin s.n.* (P). — 25.II.1909, *Gardiner s.n.* (K). — IX.1846, *Horne 203* (B). — IX.1871, *Horne 203* (K). — *Humboldt 48* (P), 158 (P). — Casse Dent, 04°38'S, 55°26'E, 600 m, 17.XI.2006, *Janssen et al. 3201* (MO, P, SEY). — *Idem*, 650 m, *Janssen et al. 3213* (G, MO, P, SEY). — Vingt Cinq Sous (NE Morne Jasmin), 04°37'S, 55°24'E, 450 m, *Janssen et al. 3247* (G, MO, P, SEY). — Morne Sechellois, 8.XI.1961, *Jeffrey 426* (K, P, SEY). — 1903, *Merian s.n.* (P). — 20.II.1840, *Pervillé 88* (P), 90 (P). — 7.III.1840, *Pervillé 156* (P). — 27.II.1882, *Thiebaut 48* (P). — Chemin allant de Port Victoria à la Forêt Noire, II.1876, *s. coll. s.n.* (P[2]). Silhouette, *Gardiner s.n.* (K).

FIELD OBSERVATIONS. — Trunk: HT up to 2(-5) m, DT 7-9 cm excluding, or 11-12 cm including the persistent petiole bases which often retain their scales, leaf scars usually concealed; trunk surface blackish brown, coarsely muricate; trunk base often thickened by rather laxly interwoven adventitious roots.

Petiole: with one row of white to light brown, close standing aerophores, 0.5-2 cm long, on either side; petiole bases sigmoid in young, almost straight in older plants.

Leaf scars: about 2 × 3 cm, ovate, not raised, spirally arranged.

Crown: with long, more or less erect petioles and widely arching rachises in young plants; with short petioles and spreading more or less horizontally in older plants.

Trunk apex: densely scaly, visible through the petiole bases.

Lamina: ovate to elliptic; LL 180 cm, WL 100-130 cm, FW 70-90 cm, NP 10-13.

DESCRIPTION

Petiole: 25-100 cm long, 3-4 cm in diameter; green to dark brown, abaxially sometimes reddish or almost black, distantly and sharply muricate, bearing a thin, light brown, caducous squamulate tomentum; 1 or 2 pairs of reduced pinnae, (10-)15-21 cm long, at (5-)15-25 cm from the petiole base, usually decaying well before the rest of the leaf, very rarely absent.

Lamina: bipinnate-pinnatisect to tripinnate, subcoriaceous, often only sparsely fertile, fertile-sterile dimorphism absent; shiny dark green above, dull light green to somewhat glaucous below, lamina base shortly attenuate, basal pinnae patent and more or less conduplicate; rachis of the same colour as the

petiole, becoming more or less green distally, very sparsely muricate.

Largest pinnae: up to 65 cm long, distant by 11-15(-18) cm, adjacent pinnae overlapping; costae and costulae green to light brown, distantly muricate.

Largest pinnules: 8-11 × (1-)1.5-2(-2.5) cm, adjacent pinnules slightly overlapping or distant, linear-oblong, their apex caudate; divided to the costula into broadly adnate segments, adjacent segments confluent from below the middle of the pinnules; pinnule segments 0.2-0.3 cm wide, spaced by less than their width, falciform, usually with a distinctly serrulate margin, apex acute; lateral veins in the segments once furcate.

Scales and hairs: scales present from the petiole base upwards to 40(-80) cm on the petiole, at its base imbricate, but usually not very dense, more or less caducous, narrowly triangular, (2-)2.5-3 × 0.2-0.3 cm, straight, with a slightly twisted and crispate apex, shiny light to dark brown, concolourous or with a slightly lighter margin, more or less appressed, but their apex usually recurved and patent to antrorse, conspicuously indurated at their point of attachment; light brown, broadly deltoid scales, up to 1.5 mm long, one cell layer thick and soft, with an irregular, long ciliate margin on the costulae and midveins of the segments, density variable according to the age of the leaf, a long apical hair may, in young scales, exceed the length of the scale body; filiform, crispate and branched, hair-like scales present on the midveins of the segments; adaxial face of the rachis and costae with scattered filiform scales and densely tomentose with light brown to stramineous, contorted to antrorse, multicellular hairs; adaxial face of the costulae with scattered hairs only.

Sori: very close to the midvein, contiguous, up to 0.1 cm in diameter, covering the entire pinnule segment, but usually restricted to its lower half; indusia shallowly cup-shaped, brown, subcoriaceous, at maturity with an entire to undulate-crenate rim, sometimes breaking up down to the base of the receptacle; receptacle columnar, distinctly longer than the rim of mature indusia, with inconspicuous filiform paraphyses shorter than the sporangia.

DISTRIBUTION

Seychelles: Mahé and Silhouette islands; endemic.

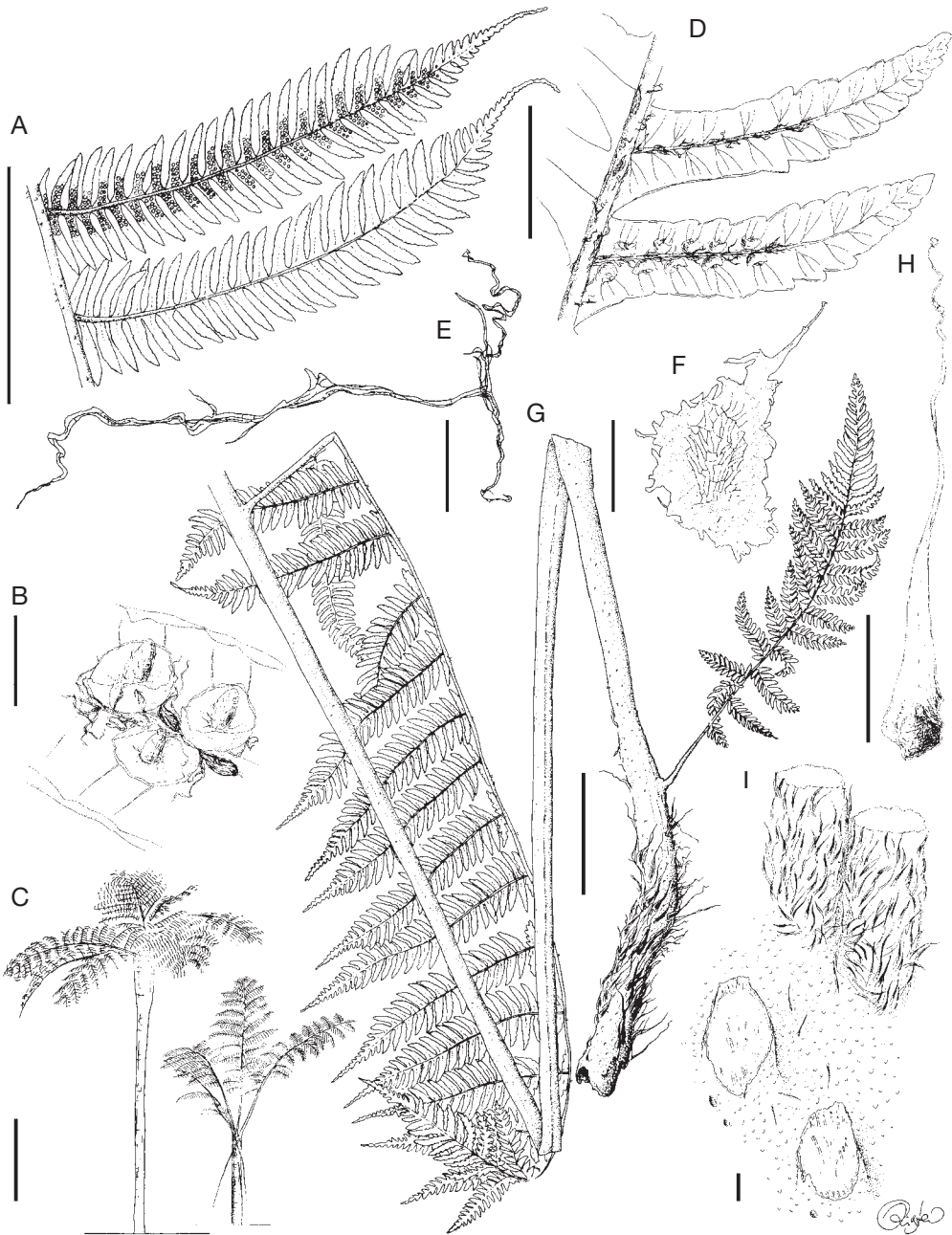


FIG. 40. — *Cyathea sechellarum* Mett.: **A**, pinnules abaxially with a fragment of the costa, sori omitted from one pinnule; **B**, sori, note the cup-shaped indusium and scaly indument on the segment midvein; **C**, habit (left: adult plant; right: young plant); **D**, pinnule segments abaxially with a fragment of the costula; **E**, filiform scale from the abaxial face of a segment midvein; **F**, deltoid scale from the abaxial face of a segment midvein; **G**, basal part of the leaf (from the petiole base up to the first pinna pair), lateral view, one half of the petiole pruned away by longitudinal section, note presence of a pair of reduced pinnae near the base of the petiole; **H**, scale from the base of the petiole; **I**, leaf scars and trunk surface, persistent dead petiole bases (above) removed from two scars (below). **A**, **B**, **D**, **G**, **H**, *Janssen et al.* 3226 (P); **C** (left), *Janssen et al.* 3247 (P), **C** (right), uncollected, photograph at P; **E**, **F**, *Janssen et al.* 3247 (P); **I**, *Janssen et al.* 3201 (P). Scale bars: **A**, **G**, 5 cm; **B**, 0.1 cm; **C**, 1 m; **D**, **H**, 0.5 cm; **E**, **F**, 0.5 mm; **I**, 1 cm.

ECOLOGY

300-900 m. Dense evergreen rain- and cloud forests as well as on forest margins. Usually not forming large populations.

REMARKS

Fragmentary material of this species is very near *C. boivinii* s.l. (Tardieu-Blot 1960) and *C. dregei* from Madagascar as well as to *C. excelsa* from the Mascarenes. *Cyathea sechellarum* differs from *C. boivinii* chiefly by its shorter and basally indurated petiole scales, the abundant scaly indument on the abaxial face of the costae and costulae and the absence of a fertile-sterile dimorphism. Furthermore, the margin of the segments of *C. sechellarum* is finely serrulate, while it is entire or crenulate in *C. boivinii* s.l. *Cyathea sechellarum* is distinct from *C. dregei* by its shorter and basally indurated petiole scales, larger pinnae and shallowly cup-shaped indusia with an entire rim at maturity. *Cyathea excelsa* has globular indusia, lacks reduced pinnae near the petiole base and has longer and denser petiole scales. In addition, the crown of *C. sechellarum* is usually smaller than in all of the aforementioned species to the exception of *C. dregei*. *Cyathea sechellarum* is very near *C. boivinii* var. *hildebrandtii* from Madagascar and the Comoros, which has broader, longer and darker petiole scales, pinnule segments with a rounded to obtuse apex and subtentire margin, very sparse or lacking soft, light brown ap-

pressed scales on the abaxial face of the costulae and midveins and a thicker trunk and larger crown.

Although young plants have been encountered and a considerable number of plants have been observed in the Morne Sechellois National Park, the species should be regarded as highly threatened due to its small area of distribution.

TYPIFICATION AND SYNONYMY

Pervillé 76a is a widely distributed collection. The specimen in "Herb. Lugd.-Bat." carrying Mettenius' handwriting (L, L0597849) consists of a fertile middle pinna and is chosen here as the lectotype. Its syntype, *Pervillé 356bis*, corresponds to a leaf apex and has been traced in L only. The original material lacks petioles and we consider it necessary to designate an epitype including the characteristic scales and reduced basal pinnae to provide an unambiguous definition of this taxon.

41. *Cyathea similis* C.Chr.

REMARKS

Globular coriaceous indusia dehiscing in lobes (except in var. *leptoderma*), an abaxially strongly glaucous lamina, absence of a conspicuous hairy and scaly lamina indument and scales usually persistent up to first pinna pair characterize this species.

KEY TO THE VARIETIES OF *CYATHEA SIMILIS*

1. Lamina very coriaceous; pinnule segments strongly concave with revolute margins; scales not reaching the first pinna pair, occasionally restricted to the petiole base; indusia very coriaceous, dark brown; (1100-)1600-2100 m, Marojejy 41c. var. *montana*
- Lamina subcoriaceous; pinnule segments flat to slightly concave; scales ascending on the petiole often to first pinna pair; indusia membranous to coriaceous, light to dark brown; up to 1600 m, North and Central Madagascar 2
2. Indusia subcoriaceous to coriaceous, light to dark brown, dehiscing in 2-3 lobes that are persistent in mature sori 41a. var. *similis*
- Indusia membranous, light brown to whitish, withering quickly and only degraded, lac-
erate lobes or a more or less collar-like rudiment persistent in mature sori
..... 41b. var. *leptoderma*

41a. *Cyathea similis* C.Chr. var. *similis*
(Figs 1F; 41; 46G; 53C)

Index Filicum: 195 (1905), nom. nov.; Christensen,

Dansk Botanisk Arkiv 7: 32, pl. 6 figs 21-23 (1932); Tardieu in Humbert, *Flore de Madagascar et des Comores, IV^e famille, Cyathéacées*: 30 (1951). — *Cyathea discolor* Baker, *Journal of the Linnean Society* 15: 412 (1876), nom. illeg.

non Bory, *Voyage autour du monde, Cryptogamie* 1: 281 (1828), nec Fée, *Mémoires sur les familles des fougères, Genera Filicum* 5: 353 (1850-52). — *Alsophila similis* (C. Chr.) R.M. Tryon, *Contributions from the Gray Herbarium* 200: 31 (1970). — Type: Madagascar, Antananarivo, *Pool s.n.* (holo-, K! [2 sheets: K000009915, -16]). — Madagascar, Toamasina, Andasibe, PN de Mantadia, sur piste commençant au P.K. 14 et continuant sur la crête, 18°49'30"S, 48°28'E, 930-1000 m, 12.XI.2004, *Janssen et al.* 2576 (epi-, P! [4 sheets: P00589653-56], here designated; isoepi-, P! [3 sheets], MO!, TAN!; one trunk surface mould at P!).

Cyathea albida Tardieu, *Bulletin de la Société botanique de France* 88: 680 (1941); Tardieu in Humbert, *Flore de Madagascar et des Comores, IV^e famille, Cyathéacées*: 28 fig. 4(4-5) (1951). — *Alsophila albida* (Tardieu) R.M. Tryon, *Contributions from the Gray Herbarium* 200: 29 (1970). — Type: Madagascar, massif du Tsaratanana et haute vallée du Sambirano, 1800-2000 m, XI-XII.1937, *Humbert 18241* (holo-, P! [3 sheets: P00422563-65]; iso-, P!).

ADDITIONAL MATERIAL EXAMINED. — **Madagascar.** Forêt d'Ankeramadinika, *Colin s.n.* (P). — Ambodiriana, 18°40'S, 44°44'E, 14.XII.1944, *Cours 1920* (K, P, MO, TAN). — Mahajanga, massif de l'Andringitra, Antsoabe, forêt Ambodipaiso, 17°18'30"S, 46°24'E, 12.I.1945, *Cours 2280* (G, MO, P, TAN). — Toamasina, de Sahalampy à Ampitanonoka, 17°46'S, 48°54'E, 1200 m, 18.I.1945, *Cours 2414* (K, P). — Antsiranana, Anjanaharibe-Sud, 14°42'30"S, 49°27'30"E, 1700 m, 24.XII.1950, *Cours 3848* (P). — Androndramanitra Rahobeava, 18°00'S, 48°47'E, 830 m, 10.III.1951, *Cours 4259* (P). — Antsiranana, Manongarivo, Andranomalaza, 14°00'S, 48°23'30"E, 1590 m, 22.III.1999, *Gautier et al.* 3640 (G, P). — Massif de l'Ankaratra, Mt. Tsiafajavona, 1700-2000 m, X.1933, *Humbert 11167* (P). — Antsiranana, massif du Manongarivo, 14°00'37"S, 48°25'23"E, 1150 m, 25.IX.2004, *Janssen et al.* 2389 (P). — *Idem*, 14°01'22"S, 48°25'03"E, 1614 m, 26.IX.2004, *Janssen et al.* 2393 (MO, P, TAN). — *Idem*, 14°01'33"S, 48°24'47"E, 1566 m, 27.IX.2004, *Janssen et al.* 2402 (MO, P, TAN). — Fianarantsoa, PN Ranomafana, forêt de Vohiparara, 21°14'03"S, 47°23'52"E, 1100-1150 m, 27.IV.2005, *Janssen et al.* 2835 (MO, P, TAN). — Mampakatombo, 9.VII.1937, *Jardin Botanique de Tananarive 2503* (P). — Périnet, forêt d'Analamazaotra, 18°56'S, 48°26'E, 5.XI.1970, *Keraudren-Aymonin et al.* 25393 (P). — Antsiranana, RN de Marojejy, along the trail to the Marojejy Est, 14°26'S, 49°46'E, 700-850 m, 10.II.1989, *Miller et al.* 3923 (P). — Antsiranana, Daraina, forêt d'Antsahabe, 20.I.2004, *Nusbaumer et al.* 1063 (P). — Mt. Tsaratanana, 14°02'30"S, 48°57'30"E, 2000 m, IV.1924, *Perrier de la Bâthie 16450* (P). — Fianarantsoa, cor-

ridor entre PN de Ranomafana et PN d'Andringitra, WNW d'Ikongo, 21°49'17"S, 47°24'55"E, 650 m, 19.XI.2000, *Rabarimanarivo 156* (P). — Fianarantsoa, PN de Ranomafana, Ranomena, 21°12'S, 47°27'E, 990 m, 3.XII.2000, *Rabarimanarivo et al.* 186 (P). — Antsiranana, massif du Manongarivo, Mt. d'Antsatrotro, 14°05'S, 48°24'E, 1350 m, 15.V.1992, *Rakotondrainibe 1713* (P). — Toamasina, Maroantsetra, Ambanizana, piste menant au sommet d'Ambohitsitondroinan'Ambanizana, 15°34'S, 50°00'E, 670 m, 5.XII.1993, *Rakotondrainibe et al.* 2043 (MO, P, TAN). — Antsiranana, RS d'Anjanaharibe-Sud, WSW de Befingotra, 14°44'42"S, 49°27'42"E, 1300 m, 4.XI.1994, *Rakotondrainibe et al.* 2339 (K, MO, P, TAN). — RNI 12 du Marojejy, NW de Manantenina, 14°26'S, 49°45'42"E, 760 m, 15.X.1996, *Rakotondrainibe 3376* (K, P, TAN). — *Idem*, 16.X.1996, *Rakotondrainibe 3407* (P, TAN). — *Idem*, 14°26'12"S, 49°44'30"E, 1260 m, 26.X.1996, *Rakotondrainibe 3563* (P, TAN). — *Idem*, 14°26'24"S, 49°44'30"E, 1520 m, 5.XI.1996, *Rakotondrainibe 3609* (MO, P, TAN). — Forêt de Betaolana, NW d'Ambodiangezoka, 14°32'18"S, 49°26'18"E, 800-950 m, 8.X.1999, *Rakotondrainibe et al.* 4845 (P). — *Idem*, 14°32'36"S, 49°25'30"E, 1200 m, 16.X.1999, *Rakotondrainibe et al.* 4925 (MO, P, TAN). — *Idem*, 1160 m, 16.X.1999, *Rakotondrainibe et al.* 5007 (P, TAN). — Antsiranana, massif d'Anjanaharibe-Sud, forêt d'Analabe, SW de Befingotra, 14°46'S, 49°26'30"E, 1120 m, 26.X.1999, *Rakotondrainibe et al.* 5018 (P, TAN). — *Idem*, 14°45'54"S, 49°25'55"E, 1650 m, 4.XI.1999, *Rakotondrainibe et al.* 5162 (K, MO, P). — Antsiranana, PN de Marojejy, SE de Doany, 14°26'12"S, 49°37'12"E, 1100 m, 28.X.2001, *Rakotondrainibe et al.* 6428ter (K, P, TAN). — Doany, Anjialavahely, forêt d'Ankarongameloka, 14°15'50"S, 49°26'17"E, 1170 m, III.2006, *Rakotovoao et al.* 2877 (P, TAN). — RNI du Tsaratanana, Marotolana, E de Beangona, 14°14'40"S, 48°39'50"E, 1550 m, 29.XI.2000, *Rasolohery 128* (MO, P, TAN). — Toamasina, PN de Zahamena, Ankosy, 17°30'14"S, 48°43'52"E, 1100-1330 m, 28.I.2001, *Rasolohery 233* (MO, P, TAN). — *Idem*, 17°41'S, 48°59'43"E, 650 m, 13.VI.2001, *Rasolohery 528* (MO, P, TAN). — Ambatovy, Ambohibary, 18°51'05"S, 48°19'21"E, 1042 m, 15.I.2005, *Razanatsoa et al.* 53 (P). — Andranobe, d'Andranobe à Bedinta, 15°40'54"S, 49°57'26"E, 500-700 m, XI.2001, *Sauquet et al.* 88 (P). — Moramanga et Anosibe, Chutes de la Mort, 18°56'S, 48°13'E, 1000 m, III.1968, *Stone et al.* 7898 (P). — Toamasina, Masaola peninsula, Ambizana, 15°38'S, 49°59'E, 300-700 m, 1.XI.1992, *van der Werff et al.* 12827 (MO, P). — Toamasina, Andasibe, forest of Mantadia, 18°55'S, 48°25'E, 1000-1200 m, 7.XI.1994, *van der Werff et al.* 13727 (MO, P).

FIELD OBSERVATIONS. — Trunk: HT up to 6(-8) m, DT 9-12 cm excluding, and up to 19 cm including the persistent petiole bases, which usually cover the trunk

at least in its upper part, more or less caducous below and the trunk then developing a mantle of adventitious roots gradually thickening towards its base; trunk surface blackish brown, densely and irregularly muricate, bearing caducous scales similar to those of the petiole.

Petiole: sometimes covered with a whitish waxy layer that can be wiped off easily; 1 or 2 more or less subcontinuous rows of light brown aerophores on either side; petiole base sigmoid, sometimes slightly inflated.

Leaf scars: usually concealed by persistent petiole bases or adventitious roots, 2.5-3.5 × 4-6 cm, elliptic to rhombic, about 3-7 orifices on their lower rim; spirally arranged.

Crown: large, more or less umbrella-shaped.

Trunk apex: densely covered with brown scales, concealed among the more or less close standing petioles; some dead leaves persistent and hanging from the apex, occasionally forming a dense skirt.

Lamina: elliptic to ovate; LL (120-)160-260(-310) cm, WL 120-155 cm, FW (40-)50-100 cm, NP (10-)12-17.

DESCRIPTION

Petiole: (25-)35-80(-90) cm long, 2.5-4 cm in diameter; green, abaxial face violaceous to dark brown; distantly and coarsely muricate; with a thin and caducous tomentum of brown squamules; never with a reduced pinna near the base.

Lamina: bipinnate-pinnatisect to tripinnate, subcoriaceous to coriaceous, fertile-sterile dimorphism absent; shiny light to dark green above, distinctly glaucous to whitish below, more strongly so in young leaves, alcohol treated specimens usually pale green below; lamina base shortly attenuate to truncate, basal pinnae reflexed or patent, sometimes slightly conduplicate; rachis of the same colour as the petiole.

Largest pinnae: (43-)55-78 cm long, distant by (10-)14-17 cm, adjacent pinnae contiguous to overlapping; costae and costulae green.

Largest pinnules: 8-11(-13.5) × 1.5-2.5(-3) cm, adjacent pinnules spaced by less than to about their width, linear-oblong to triangular, their apex shortly caudate to acute, divided down to the costula into broadly adnate segments, the first (rarely up to 4) proximal segment pair sessile, the bases of adjacent segments confluent from the middle or upper third of the pinnule, rarely below; pinnule segments (0.1-)0.2-0.3 cm wide, spaced by less than their width, more or less falciform, their margin entire to crenulate, rarely profoundly serrate, not or slightly revolute, their apex rounded to obtuse,

rarely acute, the proximal segment pairs sometimes deeply crenate; lateral veins in the segments once to rarely twice furcate, but up to three times in deeply crenate forms.

Scales and hairs: scales present from the petiole base upwards to (30-)50-60 cm on the petiole and rachis, at the petiole base moderately dense and overlapping, persistent, usually reaching the first pinnae both on the abaxial and adaxial face of the petiole, rarely caducous in the upper part of the petiole, narrowly triangular, (2-)3.5-5 × (0.1-)0.2-0.4 cm, straight, more or less contorted further up on the petiole, with a twisted and crispate apex, shiny light to dark brown with a distinct lighter margin, not appressed to the petiole, not indurated; adaxial face of the costae and costulae moderately tomentose with brown, crispate, soft, multicellular hairs and bearing scattered, brown, filiform scales; adaxial face of the rachis with scattered, caducous, shiny brown, filiform scales, up to 1.5 cm long; abundant appressed, hyaline to black, glandular trichomidia on the abaxial face of the lamina; very caducous, blackish, short deltoid scales, about 0.1 cm long, on the abaxial face of the costulae; leaf otherwise glabrous.

Sori: very close to the midvein, contiguous to rarely spaced by less than their width, about 0.1 cm in diameter, covering up to three quarters of the segment, but often only 1-3 pairs of sori near the segment base; indusia always globular, light to dark brown, subcoriaceous to coriaceous, at maturity dehiscing in 2 or 3 persistent lobes, connivent in coriaceous forms after the sporangia are shed; receptacle capitate to slightly elongate, shorter than the rim of mature indusia, with inconspicuous filiform paraphyses shorter than the sporangia.

DISTRIBUTION

Northern (Manongarivo, Tsaratanana) to southern Central (Ranomafana) Madagascar; endemic.

ECOLOGY

(500-)1000-1600(-2500) m. Dense evergreen rainforests.

REMARKS

Cyathea similis differs from *C. boivini* by its globular indusia, a lack of lamina dimorphism, the petiole

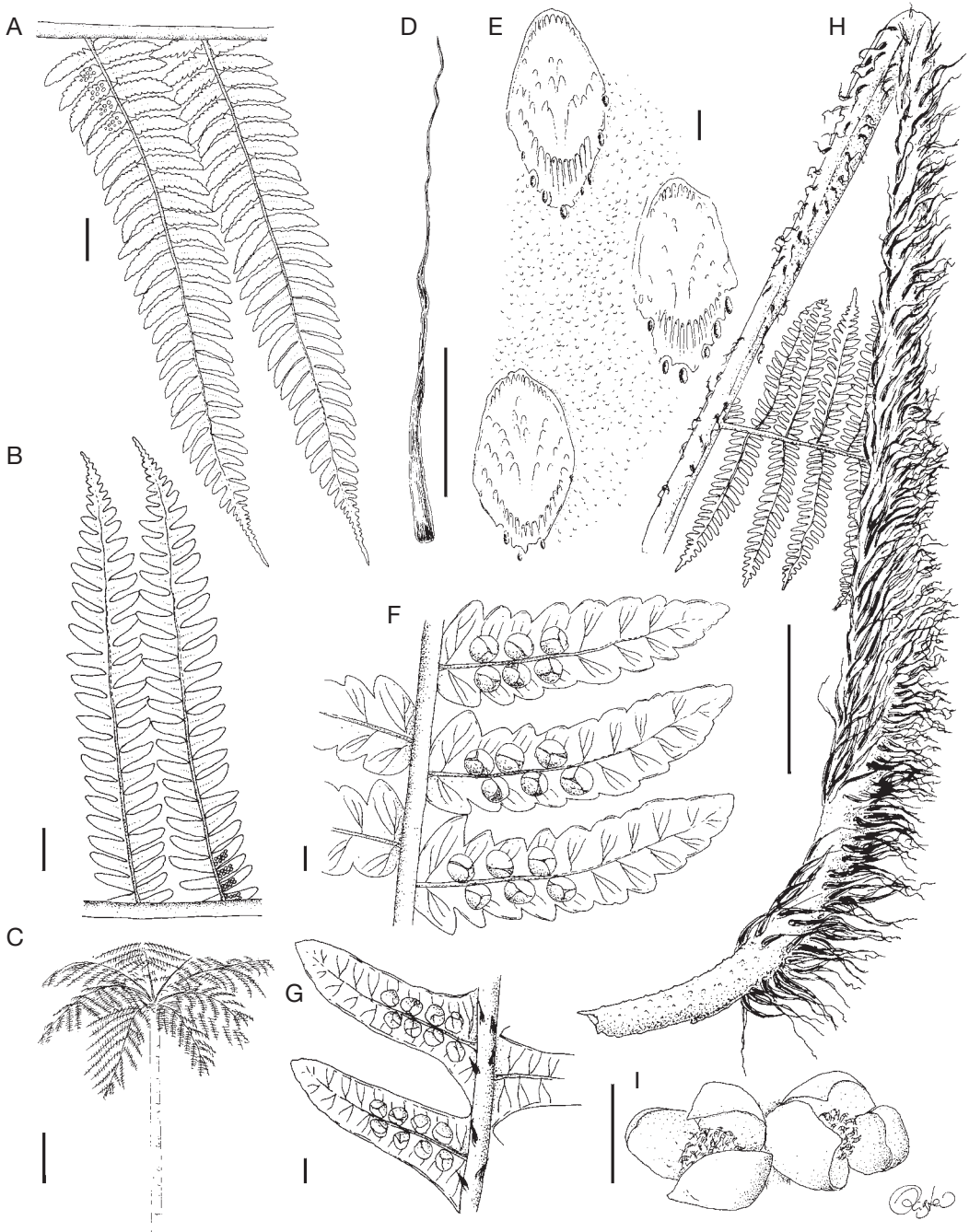


FIG. 41. — *Cyathea similis* C. Chr. var. *similis*: **A**, pinnules abaxially with a fragment of the costa, "albida"-form, sori only partly indicated; **B**, pinnules abaxially with a fragment of the costa, common form, sori only partly indicated; **C**, habit; **D**, scale from the base of the petiole; **E**, leaf scars and trunk surface; **F**, pinnule segments abaxially with a fragment of the costula, "albida"-form; **G**, pinnule segments abaxially with a fragment of the costula, common form; **H**, basal part of the leaf (from the petiole base up to the first pinna pair), lateral view, one half of the petiole pruned away by longitudinal section; **I**, mature sori with persistent, coriaceous, indusia dehiscent in lobes. A, F, Gautier *et al.* 3640 (P); B-E, G-I, Janssen *et al.* 2576 (P). Scale bars: A, B, D, E, 1 cm; C, 1 m; F, G, I, 0.1 cm; H, 5 cm.

scales being less dense and usually ascending to the first pinna pair, an always distinctly glaucous abaxial face of the lamina and complete absence of a loose indument of crispate, branched hairs. *Cyathea similis* differs from the Mascarene *C. excelsa* by its ascending petiole scales, rounded to obtuse, subentire apices of the pinnule segments and an abaxially distinctly glaucous lamina. See under *C. boivinii* for further discussion of the closely related tripinnate Madagascan species.

Like in *C. glauca* from la Réunion, distinct by its dense axial indument of intricate branched hairs and the narrowly triangular, very dense scales restricted to the petiole base, the abaxial face of the lamina of *C. similis* is covered with dense branched, rod-like wax particles that cause the glaucous colour. Such structures are also present in other Madagascan tripinnate species, but never as well-developed as in *C. similis*.

Juvenile plants have pinnate-pinnatifid laminas, which are distinctly glaucous below (cf. *Janssen et al.* 2835). Petiole scales are comparatively narrow and dark in specimens from the Manongarivo and Tsaratanana massifs, but transition to the typical form is gradual and all specimens have the typical indusia of *C. similis* and their lamina is strongly glaucous below. *Rabarimanarivo* 186 from Ranomafana has thin, but globular and persistent light brown indusia and pinnule segments with a strongly serrate margin. As serrate forms occasionally occur and do not have been admitted varietal status in other species, they are not recognized for *C. similis* either. The scales of *Rakotondrainibe* 4845, 5162 and *Rasolohery* 128 are more or less restricted to the base of the petiole and do not ascend to the first pinna pair, but indusia are globular and the lamina is distinctly glaucous below. Either this is an artefact of the collection process or scales may be more rapidly caducous in some plants of *C. similis*.

TYPIFICATION AND SYNONYMY

Two sheets of *Pool s.n.* are present at K, respectively carrying a sterile leaf apex and sterile pinnae taken near the leaf apex together with fertile pinnules presumably from the middle of the leaf. Both labels include the name *C. discolor* in Baker's writing. The tripinnate Madagascan species being

closely related, we designate an epitype including petiole scales to provide a full set of differential characters for this species, i.e. ascending persistent scales, globular indusia and glaucous abaxial lamina surface.

The serrate pinnule segments with somewhat distant sori dehisced in dark and very coriaceous, connivent lobes of *Gautier* 3640 from Manongarivo (Fig. 41A, F) are virtually identical to those of the type of *C. albida* Tardieu. The same collection includes a pinna with close sori and subentire margins illustrating transition to typical *C. similis* var. *similis*. Based on this evidence, we establish synonymy between *C. albida* and *C. similis* interpreting *C. albida* as an extreme morphotype linked to the species by gradual transition.

41b. *Cyathea similis* C.Chr. var. *leptoderma*

Rakotondr. & Janssen, var. nov.

(Figs 42A-C; 46G)

A typo differt indusiis membranaceis, dilute brunneis vel hyalinis, in statu juvenili globularibus, sed cito emarcescens, in soris maturis solum rudimentos exhibentibus (lobi lacerati vel collum basi receptaculi). Apex segmentorum pinnularum obtusus vel acutus.

TYPUS. — Madagascar, Fianarantsoa, RNI d'Andringitra, 40 km au sud d'Ambalavao, sur les berges d'un affluent de la rivière Sahavatoy, 22°13'22"S, 46°58'18"E, 1250 m, 24.V.1995, *Rakotondrainibe* 2703 (holo-, P! [3 sheets: P0059908-10]).

ADDITIONAL MATERIAL EXAMINED. — Madagascar. *Cowan s.n.* (BM). — Toamasina, Andasibe, RS d'Analamazaotra, Lac Vert, 18°56'S, 48°26'E, 930-950 m, 11.XI.2004, *Janssen et al.* 2571 (MO, P, TAN). — Fianarantsoa, PN Ranomafana, forêt de Talatakely, Ambanjapala, 21°15'54"S, 47°25'36"E, 1010 m, 26.IV.2005, *Janssen et al.* 2832 (MO, P, TAN). — *Idem*, forêt de Vohiparara, 21°14'10"S, 47°23'43"E, 1150 m, 27.IV.2005, *Janssen et al.* 2842 (MO, P, TAN). — *Idem*, N de Ranomafana, 21°12'S, 47°27'E, 1010 m, 3.XII.2000, *Rabarimanarivo et al.* 183 (P). — Fianarantsoa, RNI d'Andringitra, affluent de la rivière Sahavatoy, 22°13'22"S, 46°58'18"E, 1240-1280 m, 29.V.1995, *Rakotondrainibe* 2724 (P, TAN). — Toliara, Tolanaro, RNI d'Andohahela, NW d'Eminiminy, 24°34'15"S, 46°43'58"E, 1450 m, 19.XI.1995, *Rakotondrainibe* 3122 (MO, P, TAN). — Antananarivo, forêt d'Andranomay, SE d'Anjozorobe, 18°28'48"S, 47°57'18"E, 1300-1450 m, 15.XII.1996, *Rakotondrainibe*

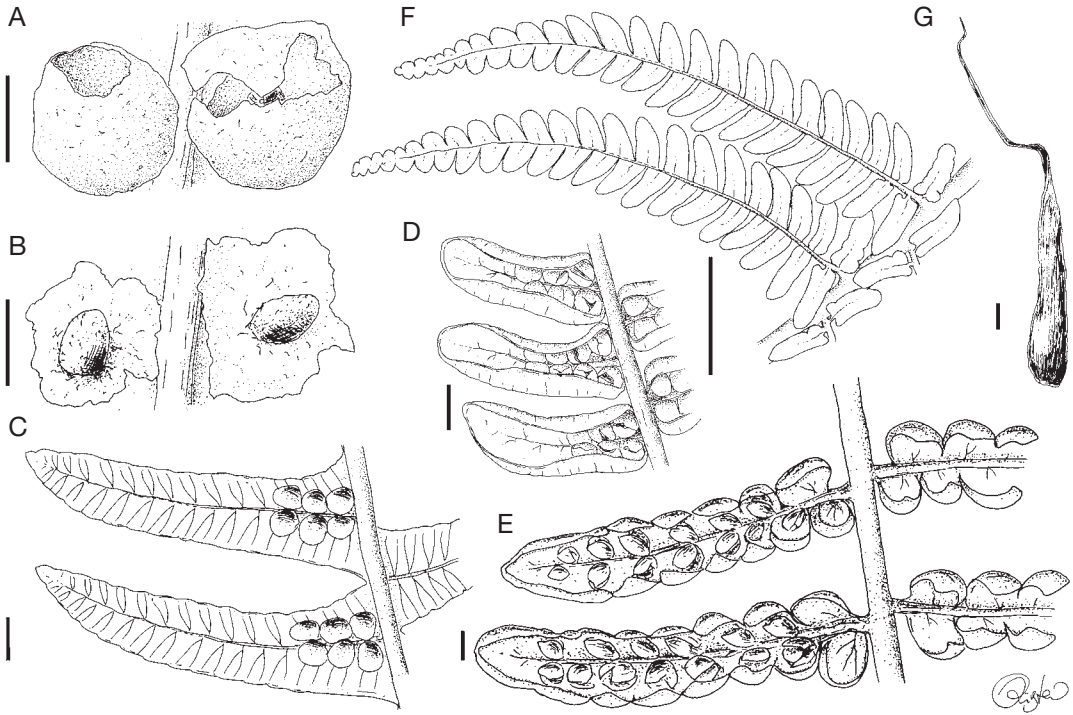


FIG. 42. — **A-C**, *Cyathea similis* var. *leptoderma* Rakotondr. & Janssen; **A**, young sori with a membranous, globular indusium; **B**, mature sori with a rudimentary indusium forming a collar-like structure at the base of the receptacle; **C**, pinnule segments abaxially with a fragment of the costula; **D-G**, *Cyathea similis* var. *montana* Janssen & Rakotondr.; **D**, pinnule segments abaxially with a fragment of the costula, common form; **E**, pinnule segments abaxially with a fragment of the costula, large and strongly crenate form; **F**, pinnules adaxially with a fragment of the costa; **G**, scale from the base of the petiole. **A-C**, *Rakotondrainibe* 2703 (P); **D, F, G**, *Guillaumet* 4063 (P); **E**, *Rakotondrainibe* 3615 (P). Scale bars: **A, B**, 0.5 mm; **C-E, G**, 0.1 cm; **F**, 1 cm.

3723 (P). — Fianarantsoa, Corridor reliant les réserves d'Andringitra et d'Ivohibe, ESE d'Angodongodona, 22°25'18"S, 46°53'54"E, 1150-1300 m, 3.XI.1997, *Rakotondrainibe et al.* 4279 (P, TAN). — Fianarantsoa, PN de Ranomafana, forêt de Vatoharanana, 21°17'24"S, 47°26'E, 1000-1100 m, 8.X.2000, *Rakotondrainibe et al.* 5957 (K, MO, P). — Forêt d'Andrambovato, bord de la rivière Tatamaly, 21°30'42"S, 47°24'36"E, 1000-1100 m, 13.X.2000, *Rakotondrainibe et al.* 5975 (K, P). — Forêt de Vinanitelo, SE de Vohitrafeno, 21°46'36"S, 47°20'48"E, 1000-1100 m, 29.X.2000, *Rakotondrainibe et al.* 6155 (P). — Toamasina, PN de Zahamena, Ambodivoahangy, 17°39'20"S, 48°54'22"E, 750 m, 4.X.2001, *Ratovoson et al.* 562 (MO, P). — Fianarantsoa, Ranomafana, 21°13'S, 47°27'E, 900 m, 10.X.1992, *van der Werff et al.* 12629 (MO, P). — *Idem*, 21°14'S, 47°24'E, 900 m, 11.X.1992, *van der Werff et al.* 12694 (MO, P).

DIFFERENTIAL FIELD OBSERVATIONS. — Trunk: HT up to 4 m.

DIFFERENTIAL DESCRIPTION

Indusia are globular when young, but light brown and membranous. Upon maturity of the sorus, they open with more or less irregular lobes and wither quickly, becoming translucent, light brown to whitish and reduced to lacerate lobes or a collar like structure surrounding the base of the receptacle. The receptacle is consequently slightly shorter to often longer than the rim of the mature indusium. The apex of the pinnule segments is obtuse to acute, not rounded.

DISTRIBUTION

Central (Andasibe) to Southern (Andohahela) Madagascar; endemic.

ECOLOGY

900-1300 m. Dense evergreen rainforests.

REMARKS

This variety has been established based on its membranous indusium as opposed to an at least subcoriaceous indusium with persistent erect lobes after dehiscence in var. *similis*. It is furthermore characterized by a southern distribution.

ETYMOLOGY

The epithet *leptoderma* refers to the very thin and quickly withering indusium of this taxon.

41c. *Cyathea similis* C. Chr.

var. *montana* Janssen & Rakotondr., var. nov.
(Figs 42D-G; 46G)

A typo differt segmentis pinnularum valde concavis et coriaceis, margine distincte revolutis, apice rotundata. 1-4 paria proxima segmentorum pinnularum distincte petiolulata, segmenta sequentes sessilia distantia, in dimidio superiore late adnata. Paleae petioli 3 cm longi et 0.2 cm lati, sordide brunneae vel atrobrunneae, in parte inferiore (10-30 cm), solum infra par primum pinnarum.

TYPUS. — Madagascar, RN du Marojejy, 2000 m, XI.1972, *Guillaumet 4063* (holo-, P! [P00418437]; iso-, P!).

ADDITIONAL MATERIAL EXAMINED. — **Madagascar.** Sommet du Marojejy, 14°25'S, 49°43'E, III.1949, *Cours 3574* (P). — Antsiranana, Marojejy, Beondroka, 14°25'S, 49°50'E, 1130 m, 13.XI.1989, *Deroin et al. 70* (P). — Massif de Marojejy, W de la rivière Manantenina, 14°29'S, 49°49'E, 1800 m, XII.1948, *Humbert 22671* (P). — *Idem*, 1850-2137 m, XII.1948, *Humbert 22755* (K, P). — *Idem*, 14°25'S, 49°43'E, 1850-2137 m, 1949, *Humbert et al. 23768* (P), *23781* (B, BR, K, MO, P). — Antsiranana, RN Marojejy, trail to the summit of Marojejy Est, 14°26'S, 49°46'E, 1300-1850 m, 11.X.1988, *Miller et al. 3562* (P). — *Idem*, NW de Manantenina, affluent de l'Andranomifototra, 14°26'24"S, 49°44'30"E, 1600 m, 5.XI.1996, *Rakotondrainibe 3615* (K, P, TAN). — *Idem*, 14°26'48"S, 49°45'E, 1900-1920 m, 13.XI.1996, *Rakotondrainibe 3665* (K, MO, P). — *Idem*, 2060 m, 16.XI.1996, *Rakotondrainibe 3689* (P, TAN).

DIFFERENTIAL FIELD OBSERVATIONS. — Trunk: HT up to 1 m, DT 7-8(-15) cm.

Lamina: NP 7-12.

DIFFERENTIAL DESCRIPTION

The largest pinnae are 20-60 cm long, pinnules are 5-13 × 0.7-2.5 cm, but usually much smaller than in var. *similis*. Adjacent pinnules are contiguous to spaced by less than their width. The pinnule segments are

strongly concave, very coriaceous, i.e. easily breaking when fresh, 0.1-0.2(-0.3) cm wide, their margin is more or less strongly revolute, their apex rounded. Pinnule segments are sometimes strongly reduplicate, most likely as a result of an open habitat; the lowermost 1-4 segment pairs are distinctly petiolulate, then sessile in the lower quarter of the pinnule and broadly adnate only in the upper part of the pinnule. The margin of the segments is entire, but may be profoundly lobed in some forms. The abaxial face of the lamina is very strongly glaucous in all specimens. Scales ascend up to 10-30 cm on the petiole and do not reach the first pinna pair. They are up to 3 × 0.2 cm in size, dark to blackish brown, slightly indurated at their base and inserted on relatively prominent projections of the coarsely muricate petiole. The petiole is somewhat thinner than in var. *similis* and a reduced pinna may be present near the base of the petiole, but never on all leaves of a single plant. In young leaves, a dense tomentum of intricate crispate hairs and scales is present on the main axes and on the lamina. It is caducous in older leaves.

DISTRIBUTION

Northern Madagascar: Marojejy massif; endemic.

ECOLOGY

(1100-)2000-2130 m. Dense evergreen rainforests of higher altitudes, ericoid and open ridge vegetation.

REMARKS

Even though several discriminative characters are available, we prefer assigning this taxon as a variety to *C. similis* instead of establishing it at specific rank, because due to its peculiar and restricted habitat it might correspond to an ecological modification.

ETYMOLOGY

The epithet *montana* has been chosen to reflect the taxon's apparent preference of high altitude habitats.

42. *Cyathea valdesquamata*

Janssen & Rakotondr., sp. nov.
(Figs 43; 46K; 53D)

Filix arborescens valde conspicua lamina bipinnato-pinnatisecta vel tripinnata basi longe attenuata pinnis

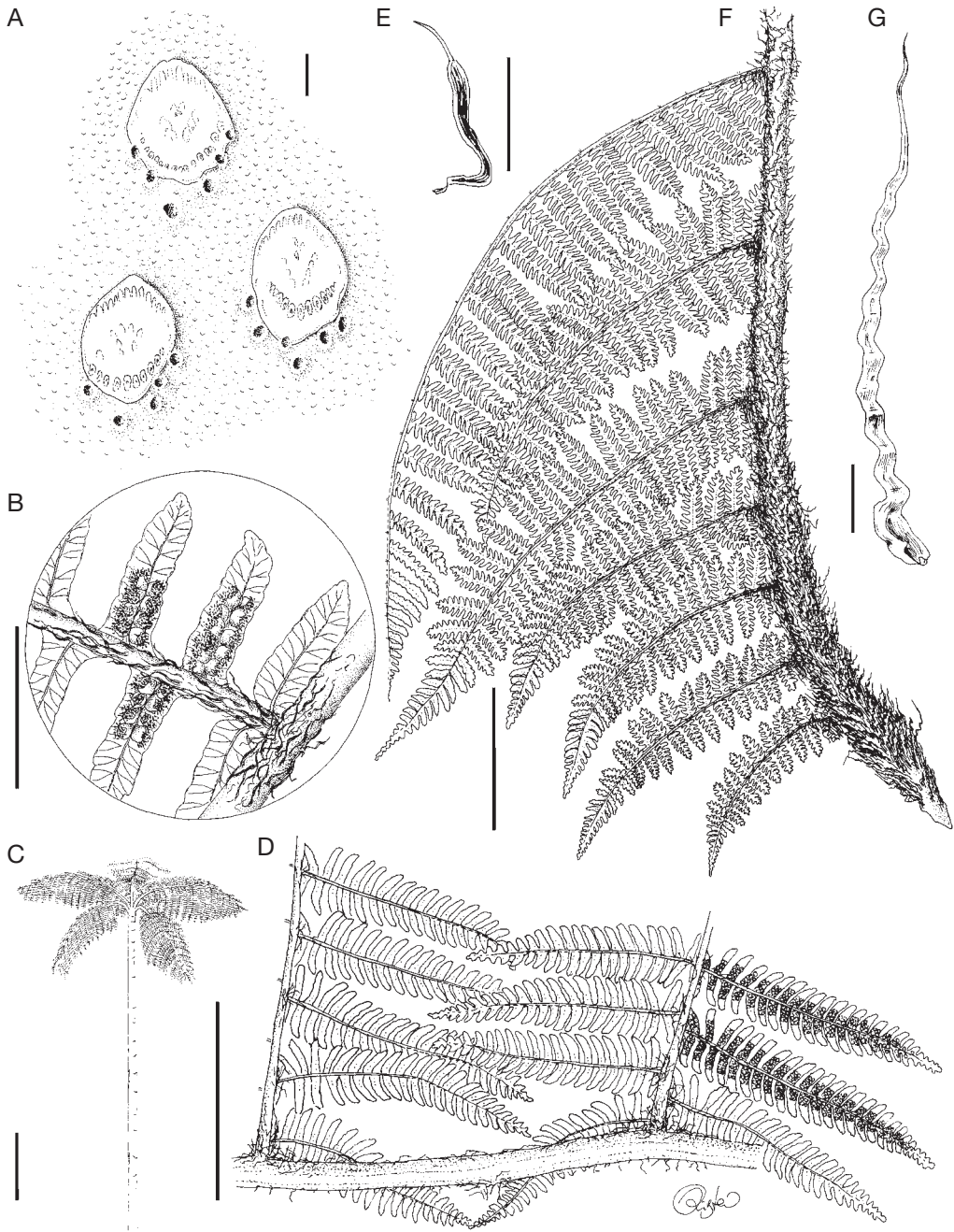


FIG. 43. — *Cyathea valdesquamata* Janssen & Rakotondr.: **A**, leaf scars and trunk surface; **B**, pinnule segments abaxially with a fragment of the costula (at the junction with the costa), note the dense scaly indument; **C**, habit; **D**, rachis fragment with the basal part of two pinnae, abaxial view, sori only partly indicated, note the close standing pinnules and the proximal pinnules overlapping the rachis; **E**, scale from the abaxial face of a costula; **F**, basal part of the leaf (from the petiole base up to the first seven pinna pairs), lateral view, one half of the petiole pruned away by longitudinal section; **G**, scale from the abaxial face of the base of the petiole. A, Janssen et al. 2883 (P); B-G, Janssen et al. 2907 (P). Scale bars: A, 1 cm; B, G, 0.5 cm; C, 1 m; D, F, 5 cm; E, 0.1 cm.

gradatim minuentibus fere ad basin petioli. Petiolus 5-10 cm longus, paleis anguste triangularibus vel filiformibus (3-4 cm longis et 0.1-0.2 cm latis basi petioli), nitide vel sordide brunneis, apice spina prominente (0.1 cm longa) coronata. Paleae adaxiales strictae, abaxiales distincte transverse plicatae, paleae in parte superiore rhachidis plusminusve crispatae. Pagina abaxialis rhachidis superioris, costarum et costularum sparse provisa paleis triangularibus vel filiformibus (usque ad 0.3 cm longis) spinis marginalibus et apicalibus prominentibus (ad 0.1 cm longis), praeterea paleolis reductis spinis similibus fere asterotriche dispositis terminantibus ("acaroid"). Indusia globularia, dilute brunnea, membranacea, in maturitate dehiscentia in 2-3 lobis. Receptaculum capitatum indusio maturo obtectum.

TYPUS. — Madagascar, massif du Tsaratanana, montagnes au N de Mangindrano, source du Maevarano, 14°08'49"S, 48°58'11"E, 2330 m, 11.V.2005, *Janssen et al.* 2907 (holo-, P! [4 sheets: P00589660-63]; iso-, G!, MO!, P! [2 sets of 3 sheets], TAN!; one trunk surface mould at P!).

ADDITIONAL MATERIAL EXAMINED. — Madagascar. Mahajanga, massif du Tsaratanana, N de Mangindrano, NW de Matsaborimaiky, 14°09'11"S, 48°57'27"E, 1950 m, 9.V.2005, *Janssen et al.* 2883 (MO, P, TAN), 2885 (MO, P), 2886 (P). — *Idem*, source du Maevarano, 14°08'49"S, 48°58'11"E, 2330 m, 11.V.2005, *Janssen et al.* 2904 (MO, P, TAN). — *Idem*, Ambohimirahavavy, 14°12'07"S, 49°05'46"E, 2128 m, 31.X.2005, *Rakotoivo et al.* 2374 (MO, P, TAN).

FIELD OBSERVATIONS. — Trunk: HT up to 7.5 m, DT 8-13 cm, rudimentary dead petiole bases persistent in its upper half or below the trunk apex only, caducous below and the leaf scars exposed; trunk surface muricate, dark brown.

Petiole: with 1 or 2 rows of white to light brown, 0.1-0.2 cm long aerophores; petiole base shortly sigmoid.

Leaf scars: 2-2.5 × 2-3.5 cm, rounded to ovate, raised, 5-7 orifices on their lower rim and below the scar; spirally arranged.

Crown: relatively small, more or less horizontal to umbrella-shaped, crown centre infundibuliform.

Trunk apex: densely scaly, concealed by the close standing petiole bases; some dead leaves persistent and hanging from the apex.

Lamina: widely elliptic to obovate; LL 140-220 (-330) cm, WL (75-)90-120 cm, FW 60-80(-110) cm, NP 14-21.

DESCRIPTION

Petiole: 5-10 cm long, 2-3 cm in diameter; green to stramineous, abaxial face brown to reddish brown, finely and densely muricate; with a caducous tomentum of brown, intricate squamules.

Lamina: bipinnate-pinnatisect to tripinnate, subcoriaceous, fertile-sterile dimorphism absent; shiny green to dark green above, pale green below, lamina base distinctly attenuate, the basal pinnae gradually reduced in size almost reaching the base of the petiole, 5-7 reduced basal pinna pairs contiguous to overlapping and usually sterile, patent and conduplicate; rachis of the same colour as the petiole, becoming green and smooth distally.

Largest pinnae: 50-60 cm long, distant by 9-11(-13) cm, adjacent pinnae overlapping; costae and costulae of the same colour as the rachis.

Largest pinnules: 6-8(-10) × 1.3-1.7(-3) cm, adjacent pinnules contiguous to spaced by less than their width, linear oblong to triangular, their apex acute to shortly caudate, conduplicate or horizontal, divided to the costula into broadly adnate segments, 0-1(-3) proximal pinnule pairs sessile and with a more or less crenate margin, the bases of adjacent segments confluent from the middle or from the upper third of the pinnules, rarely below; pinnule segments 0.2(-0.3) cm wide, spaced by less than to about their width, slightly falciform to straight, their margin flat, entire to crenulate, their apex rounded to obtuse; lateral veins in the segments once furcate.

Scales and hairs: scales present from the petiole base upwards to at least 50 cm on the petiole and rachis, but often up to the tip of the rachis, gradually thinning and decreasing in size, at the petiole base very dense and overlapping, persistent, narrowly triangular to filiform, 3-4 × 0.1-0.2 cm, adaxial scales straight, abaxial scales distinctly transversally plicate, scales further up on the rachis more or less crispate, appressed to the petiole or not and then antrorse, shiny to dull dark brown, not indurated, with a narrow light brown to whitish, erose margin and a very prominent, dark brown to black apical spine, up to 0.1 cm long; the petiole and rachis scales grade into triangular to filiform, shiny brown scales, 0.1-0.3 cm long, with prominent dark apical and marginal spines up to 0.1 cm long, and into small acaroid squamules with a reduced scale body and several dark brown to black, long, spiny projections, the latter scale types are dense to scattered on the abaxial surfaces of all costae and costulae; dark spines arising from an amorphous scale body can be found

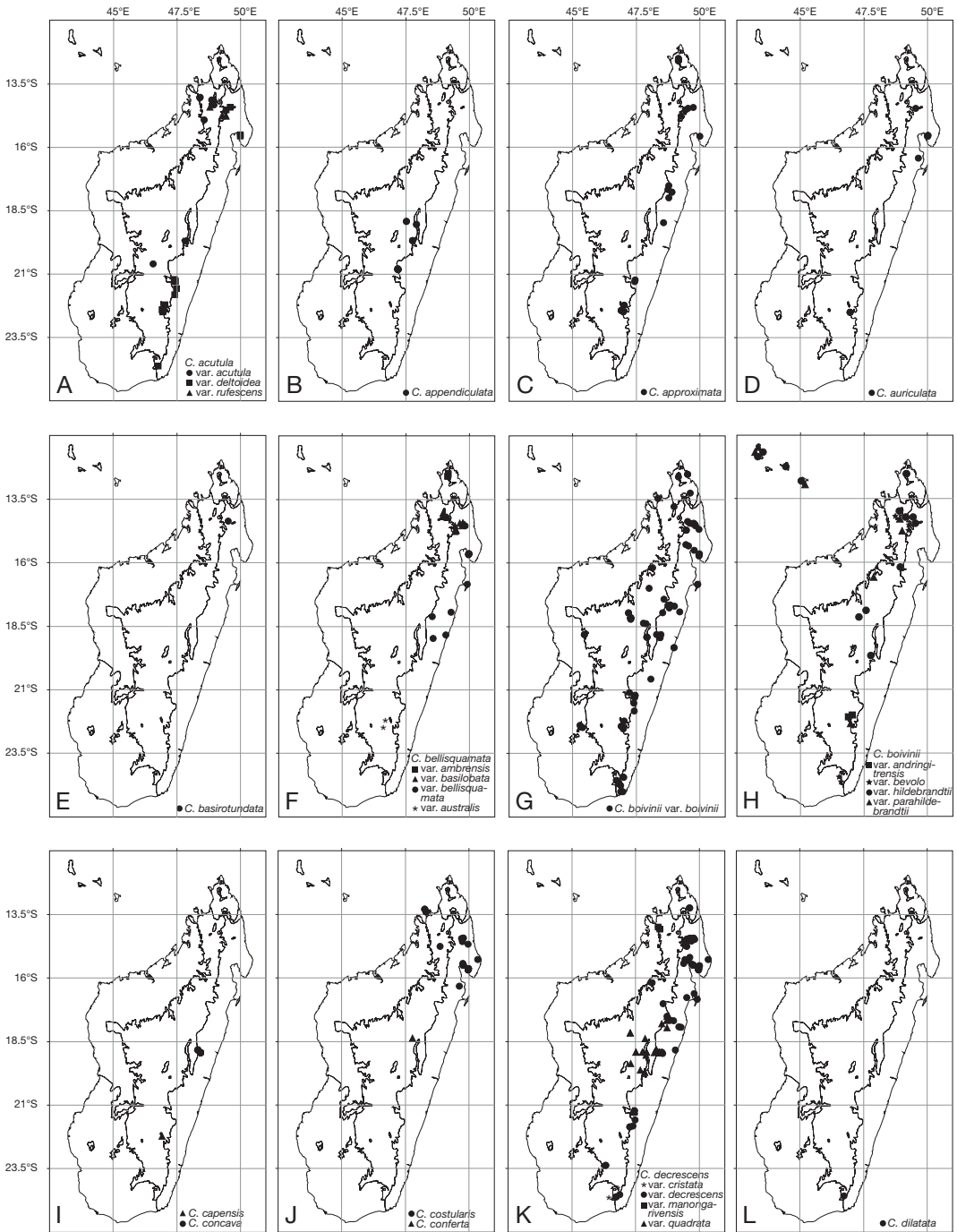


FIG. 44. — Distribution maps for Cyatheaaceae (genus *Cyathea*) of Madagascar and the Comoros. Species are arranged in alphabetical order.

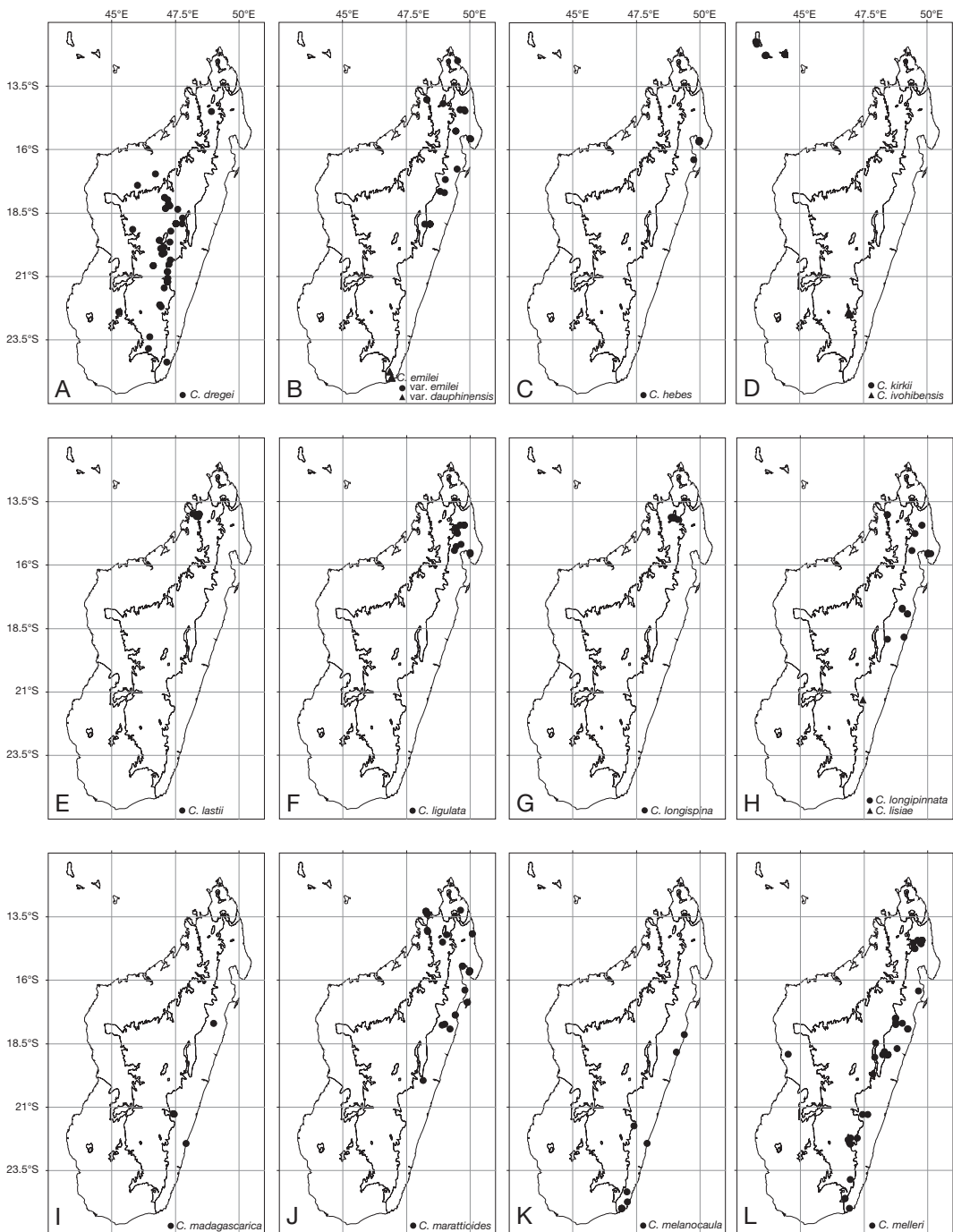


FIG. 45. — Distribution maps for Cyatheaaceae (genus *Cyathea*) of Madagascar and the Comoros. Species are arranged in alphabetical order.

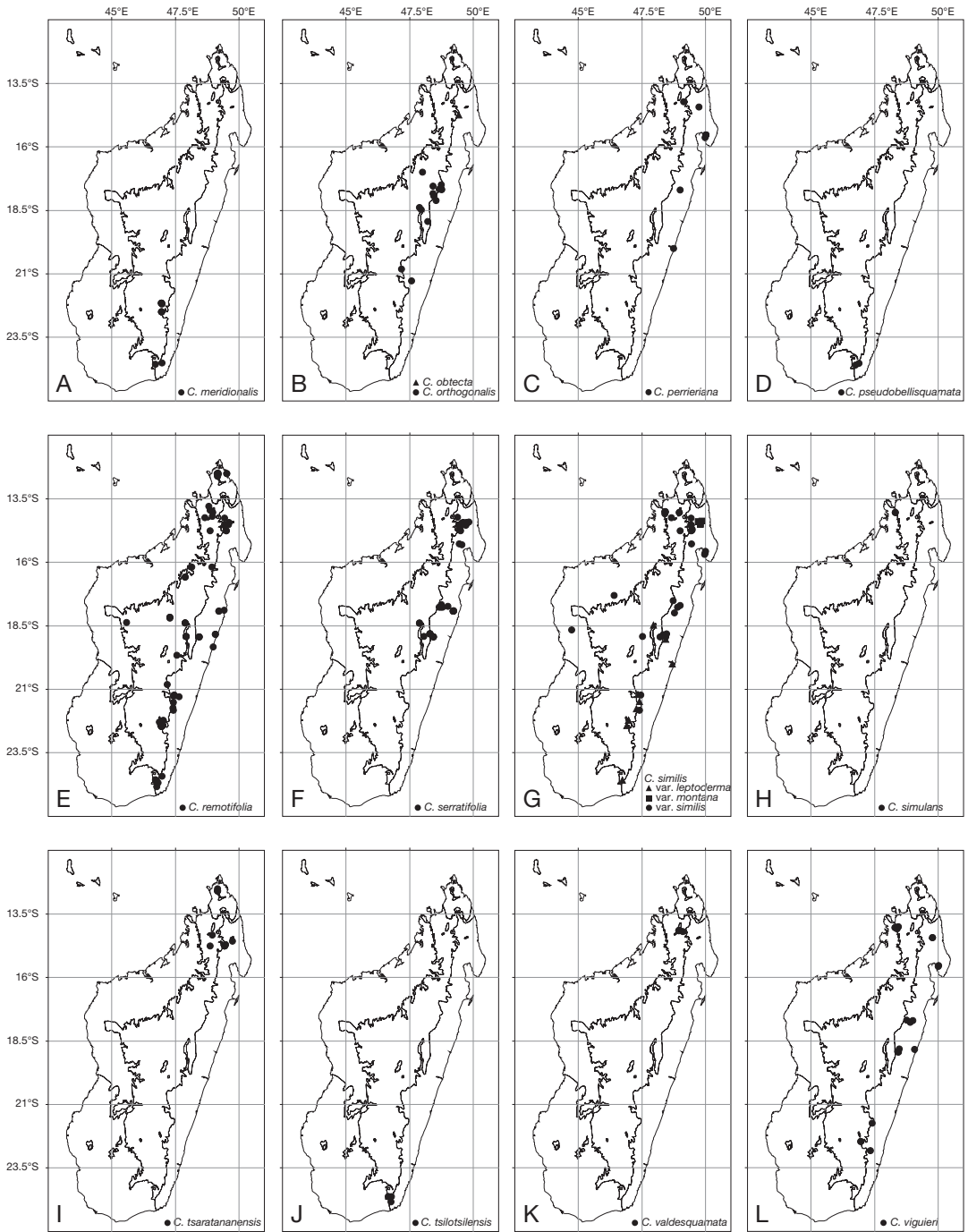


FIG. 46. — Distribution maps for Cyatheaaceae (genus *Cyathea*) of Madagascar and the Comoros. Species are arranged in alphabetical order.

on the abaxial face of the segment veins; adaxial face of the rachis and costae with scattered, crispate, shiny brown, filiform scales with prominent and dark apical spines; adaxial face of the costae and costulae more or less densely tomentose with stiff, contorted, stramineous, antrorse, multicellular hairs.

Sori: very close to the midvein, contiguous, about 0.1 cm in diameter, covering the entire segment except its apex or only its lower quarter, sori obliquely inserted, the mouth of the indusium pointing outwards; indusia globular, light brown, membranous, at maturity dehiscing in 2 or 3 lobes; receptacle capitate, shorter than the rim of mature indusia, with inconspicuous filiform paraphyses shorter than the sporangia.

DISTRIBUTION

Northern Madagascar: Tsaratanana massif; endemic.

ECOLOGY

1950–2330 m. Dense evergreen rainforests of higher altitude, often along streams or in wet valleys.

REMARKS

This is the only tripinnate species from the Western Indian Ocean region known to have gradually decrescent pinnules almost down to the base of the petiole. This together with the dense scaly indument makes *C. valdesquamata* a taxon, which is easily recognized in the forest and in herbarium specimens.

The species is phylogenetically closely related to the bipinnate Madagascan taxa (Janssen *et al.* 2008). It is treated together with the tripinnate species in group III in the present treatment in order to facilitate usage of the keys.

ETYMOLOGY

The epithet *valdesquamata* is chosen with reference to the dense scaly indument present and persistent on all major lamina axes of this species.

DOUBTFUL SPECIES

Cyathea goudotii Kunze

Botanische Zeitung (Berlin) 2: 283, in obs. (1844);

Moore, *Index Filicum*: 269 (1884), nomen. — Type: Madagascar, *Goudot s.n.* (holo-, LZ† in hb. Kunze).

REMARKS

Cyathea goudotii Kunze is based on a fragmentary differential description comparing a specimen in hb. Kunze (LZ) to *Sieber fl. mixt. exs. 304* (*Cyathea borbonica* Desv. var. *latifolia* (Hook.) Bonap.). Although this description only includes characters of the veins, it must nevertheless be regarded as a valid publication of the name.

Kunze's herbarium at LZ, including the holotype of *C. goudotii*, has been destroyed. We located three potential isotype specimens that might serve for lectotypification. The first, *Goudot s.n.* (G-DEL, and filed there as holotype of *C. goudotii*), includes the annotation “*Cyathea n. sp. Goudotii* Kze et affinitate *C. Burkei* Hook. sed ad specimina perfectiora desorbenda”, most likely in Kunze's hand. It contains a leaf apex of *Cyathea dregei* Kunze.

The second, *Goudot s.n.* (K!, nr. 27 in hb. T. Moore) has been marked “don de M. Delessert” and is thus most likely from the same collection as the specimen in G-DEL, although it has been determined as *C. boivinii* var. *humblotii* and cited as type of *C. goudotii* by Christensen (1932: 34). Pinnule size, however, points to *C. dregei*, but determination must remain doubtful for such a fragmentary specimen.

The third, *Goudot s.n.* (P!, in hb. Luerssen no. 10416), is without doubt a fragment of *C. decrescens* Mett. ex Kuhn. Luerssen indicates on the envelope containing one pinna with a rachis fragment, that this is the “real” *C. goudotii* (“Ist die echte *C. Goudotii* Kze.”). On the specimen it is stated that it has been taken from hb. Kunze and that it has therein been determined as *C. decrescens* by Mettenius (“*Cyathea Goudotii* Kze fragm. origin. hb. Kze. dort von metten. im hb. Kze. als decrescens bezeichnet. Madagascar: Goudot leg.”). Although this is second hand information and no autograph of Kunze is associated to it, this specimen is the most promising candidate for lectotypification.

In summary, bipinnate and tripinnate candidate specimens are available for the lectotypification of *C. goudotii* Kunze. In his diagnosis, Kunze compares *C. goudotii* to *Sieber fl. mixt. exs. 304*, a clearly bipinnate specimen. Kuhn (1868) notes the

similarity of *C. goudotii* to *C. borbonica* Desv., a clearly bipinnate taxon. It is hence likely that the bipinnate specimen in hb. Luerssen is part of the original material of *C. goudotii* and that Kunze's autograph became associated with the tripinnate specimen in G-DEL by error.

As this cannot be proven with certainty and as information on the specimen in hb. Luerssen is from second hand, we claim this case to be unsolvable with the evidence currently at hand and leave it to the judgment of future monographers whether the name *C. goudotii* Kunze can be lectotypified and replace the widely used name *C. decrescens* Mett. ex Kuhn.

Cyathea sp.

REMARKS

A putative new species with a pinnate-pinnatisect lamina with broadly adnate pinnules, about 5 × 0.8 cm, with acute to caudate and serrate apices, with sori spaced by about their width, with coriaceous, globular indusia and with narrow petiole scales about 3 cm long, twisted, shiny brown and ascending up to 10 cm on the petiole has been collected in Northern Madagascar (Antsiranana province, Daraina, forêt d'Antsahabe, 13°13'S, 49°33'E, 1019 m, 29.XI.2004, *Nusbaumer et al.* 2126 [G, G00086431]). The specimen includes a petiole with scales and (parts of) two pinnae. We currently refrain from describing this species, because the single specimen available is too fragmentary.

With the current keys, this taxon is most likely determined either as *C. bellisquamata* var. *basilobata* or as *C. emilei* var. *dauphinensis*. It differs from *C. bellisquamata* var. *basilobata* by its narrow petiole scales that are restricted to the base of the petiole (ascending to about 10 cm), by its acute to attenuate and serrulate pinnule apices and by its sori being spaced by about their width. It differs from *C. emilei* var. *dauphinensis* by its shiny and persistent petiole scales and its pinnules being broadly adnate to the costa also in the proximal half of the pinnae. Furthermore, the collection locality is geographically disjunct from *C. emilei* var. *dauphinensis*, which is restricted to the extreme South.

CONCLUSION

We described and reviewed the nomenclature of 57 taxa (42 species) of *Cyathea* sect. *Alsophila* on Madagascar, the Comoros and the Seychelles. This diversity has been made accessible to botanists and for conservation planning providing keys down to the varietal level supported by comprehensive illustrations. It is obvious from our treatment that intraspecific variability is high in some species and that several taxa are closely related. This is in agreement with the finding that the scaly tree ferns of the Madagascan region are a very young group, which originated in diversification bursts during the Pliocene and that currently most likely still undergoes rapid evolution (Janssen *et al.* 2008).

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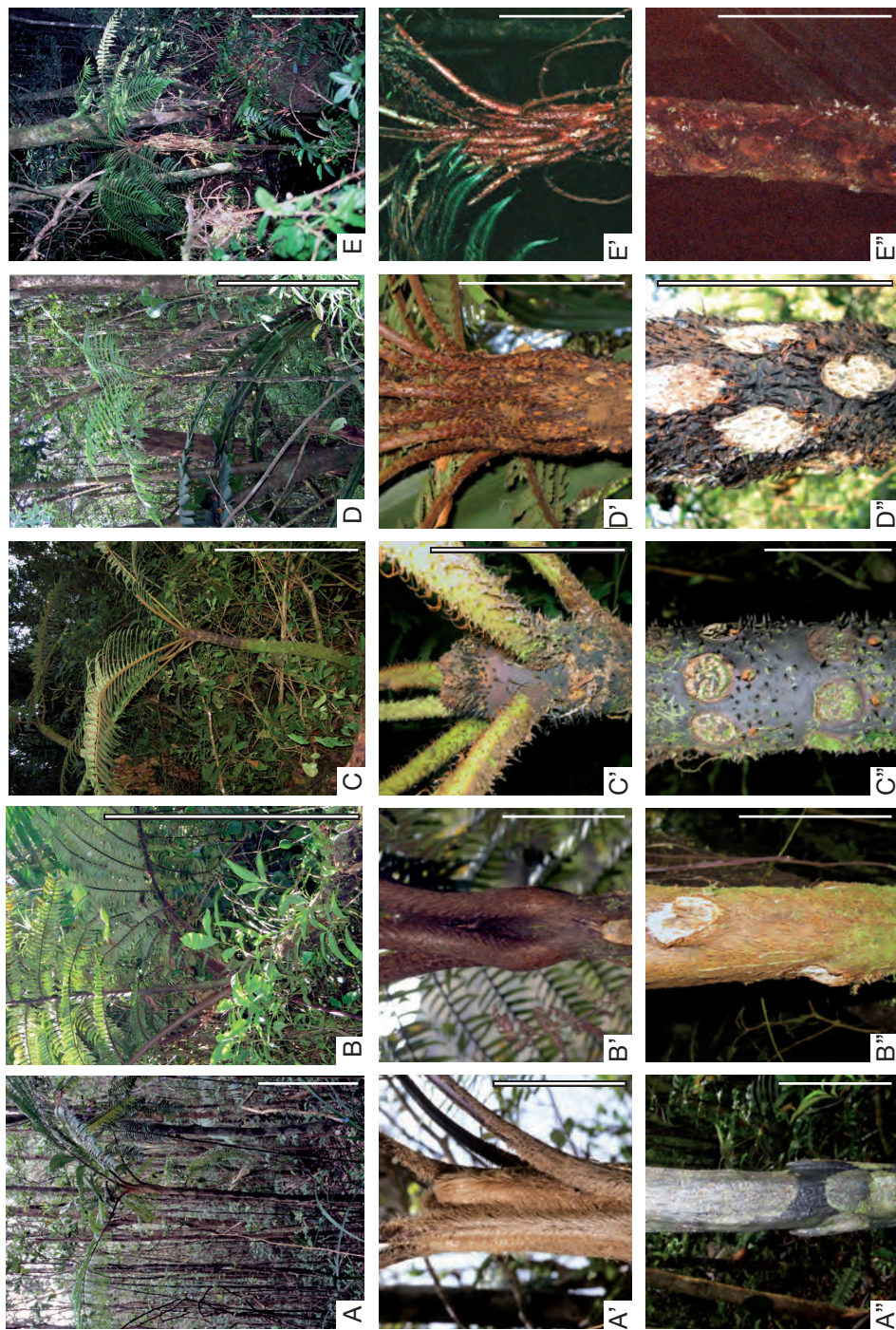


FIG. 47. — Photographic documentation of field characters in *Cyathea*: **A-E**, habit; **A'-E'**, trunk apex; **A''-E''**, trunk surface at breast height. **A-A''**, *Cyathea marattioides* Willd. ex Kaulf.; **B-B''**, *C. perriferiana* C.Chr.; **C-C''**, *C. auriculata* Tardieu; **D-D''**, *C. decrescens* Mett. ex Kuhn; **E-E''**, *C. ivohibensis* (C.Chr.) Janssen & Rakotondr. A, Janssen et al. 2488; A', B', uncollected; A'', Janssen et al. 2484; B, Janssen et al. 2504; B', Janssen et al. 2505; C-C'', Janssen et al. 2508; D, Janssen et al. 2521; D', Janssen et al. 2562; D'', Janssen et al. 2406; E, E', Janssen et al. 2790; E'', Janssen et al. 2794. Vouchers at P. Photos B-D, A'-D', A''-D'' by G. Rouhan (MNHN); all other photos by T. Janssen. Scale bars: A-E, 1 m; A'-E', A'', B'', D'', E'', 10 cm; C', C'', 5 cm.

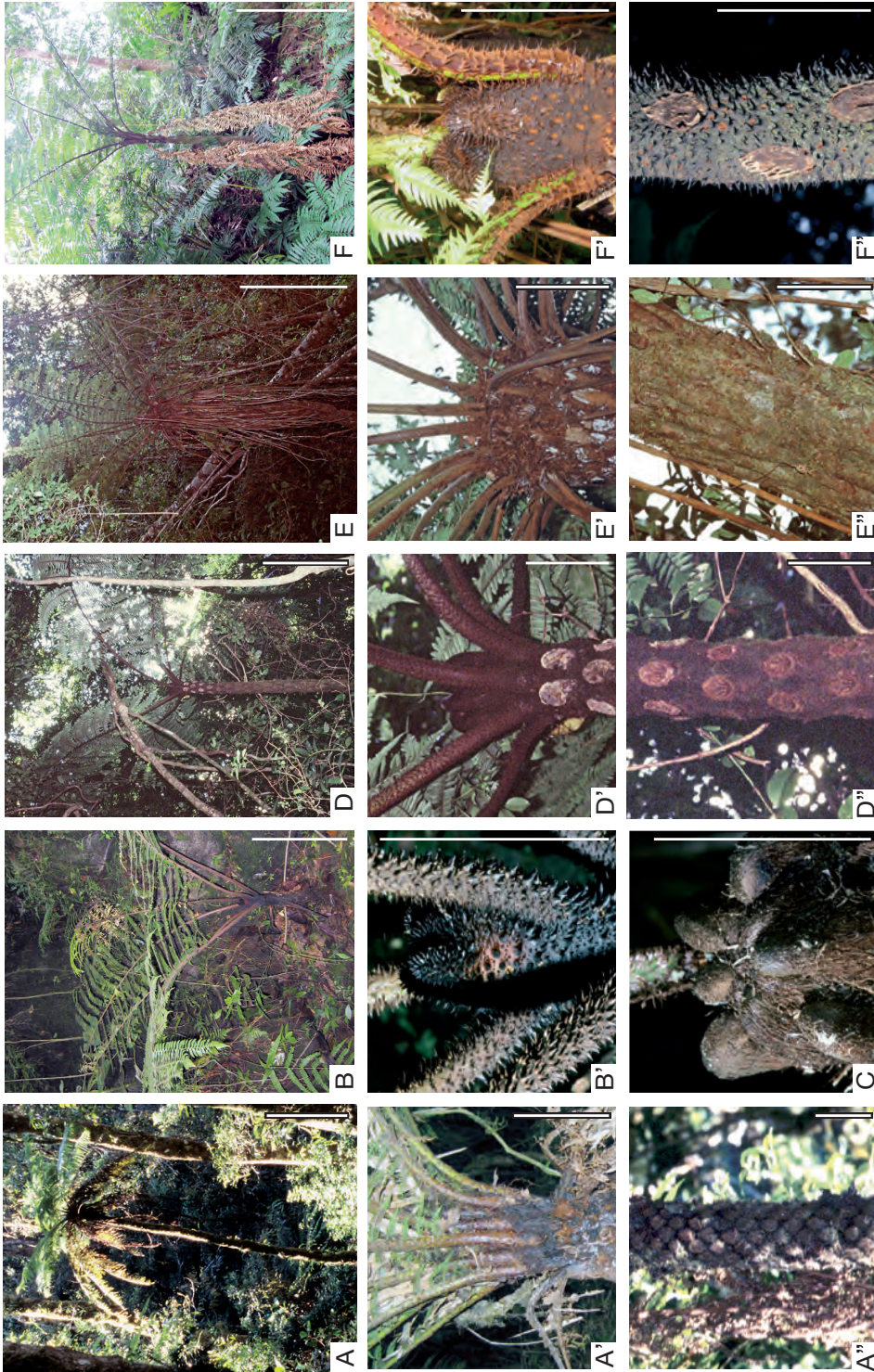


Fig. 48. — Photographic documentation of field characters in *Cyathea*: **A, B, D-F**, habit; **A', B', D', F'**, trunk apex; **A'', B'', D'', F''**, trunk surface at breast height. **A-A''**, *Cyathea meridionalis* Janssen & Rakotondr.; **B, B'**, *C. ligulata* Baker; **C**, trunk apex of *C. acutula* Tardieu var. *acutula*; **D-D''**, *C. acutula* Tardieu var. *deltoidea* Janssen & Rakotondr.; **E-E''**, *C. appendiculata* Baker; **F-F''**, *C. costularis* Bonap. **A, A'**, **E, E'**, uncollected; **A', Janssen et al. 2599**; **B, B'**, *Janssen et al. 2494*; **C, Janssen et al. 2401**; **D-D''**, *Janssen et al. 2788*; **E', E''**, *Janssen et al. 2764*; **F, Janssen et al. 2489**; **F'**, *Janssen et al. 2518*. Vouchers at P. Photos **B, C, F, A', B', F', F''** by G. Rouhan (MNH); all other photos by T. Janssen. Scale bars: **A, B, D-F**, 1 m; **C, A', B', D'-F', A'', D''-F''**, 10 cm.

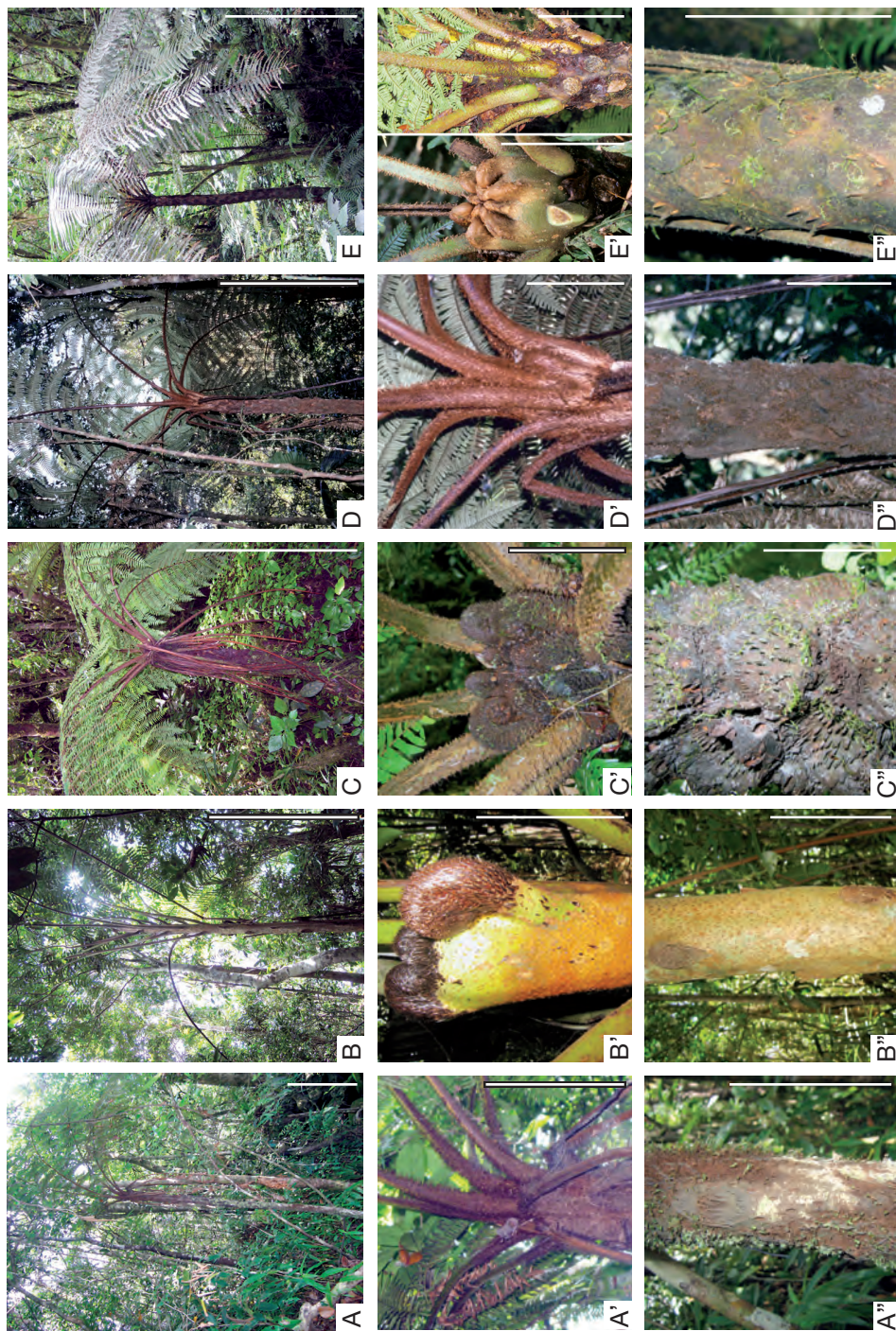


FIG. 49. — Photographic documentation of field characters in *Cyathea*: **A-E**, habit; **A'-E'**, trunk apex; **A''-E''**, trunk surface at breast height. **A-A''**, *Cyathea hebes* Janssen & Rakotondri; **B-B''**, *C. serratifolia* Baker; **C-C''**, *C. tsaratananensis* C.Chr.; **D-D''**, *C. viguieri* Tardieu; **E-E''**, *C. approximata* Bonap.; **E'**, left: apex of a form with distant petioles (apical view), right: apex of a form with close standing petioles (lateral view). **A-A''**, Janssen et al. 2519; **B, B'**, **C, C'**, **E-E'**, uncollected; **B'**, Janssen et al. 2538; **C''**, Janssen et al. 2446; **D-D''**, Janssen et al. 2575. Vouchers at P. Photos **A-A''**, **B-B''**, **C-C''**, **E, E'** right, **E''** by G. Rouhan (MNHN); all other photos by T. Janssen. Scale bars: **A-E**, 1 m; **A'-E'**, **D'-D''**, **E''**, 10 cm; **C''**, **E''**, 5 cm.



FIG. 50. — Photographic documentation of field characters in *Cyathea*: **A-E**, habit; **A'-E'**, trunk apex; **A''-E''**, trunk surface at breast height. **A-A'**, *Cyathea bellisquamata* Bonap.; **B-B''**, *C. emilei* Janssen & Rakotondr. var. *emilei*; **C-C''**, *C. emilei* var. *dauphinenensis* Janssen & Rakotondr.; **D-D''**, *C. longipinnata* Bonap.; **E-E''**, *C. longispina* Janssen & Rakotondr. **A-A'**, Janssen et al. 2522; **B, B'**, Janssen et al. 2580; **B''**, Janssen et al. 2567; **C, C'**, Janssen et al. 2612; **C''**, uncollected; **D-D''**, Janssen et al. 2507; **E, E'**, Janssen et al. 2908; **E', E''**, Janssen et al. 2915; **E', E''**, Janssen et al. 2916. Vouchers at P. Photos A-D, A'-D', A''-D'' by G. Rouhan (MNH); all other photos by T. Janssen. Scale bars: A-E, 1 m; A'-E', C'-E'', 10 cm; A'', B'', 5 cm.

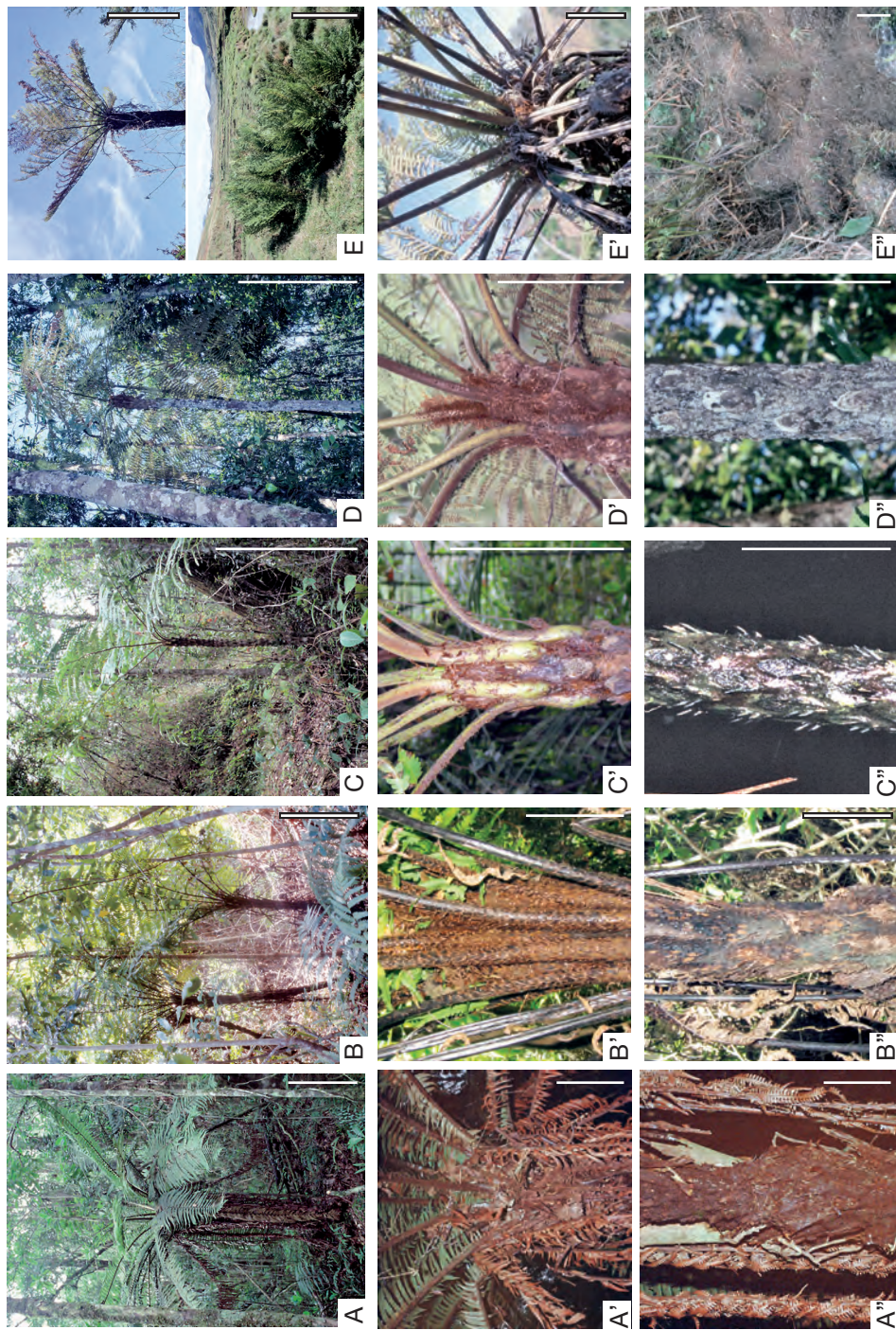


FIG. 51. — Photographic documentation of field characters in *Cyathea*: **A-E**, habit; **A'-E'**, trunk apex; **A''-E''**, trunk surface at breast height; **A-A''**, *Cyathea madagascariensis* Bonap.; **B-B''**, *C. melanocaula* Desv.; **C-C''**, *C. remotifolia* Bonap.; **D-D''**, *C. concava* Bonap.; **E-E''**, *C. dregelii* Kunze; **A'**, persistent dead petiole bases removed from the trunk in the upper half of the picture; **E**, erect habit (above), creeping habit (below); **E'**, branched creeping trunks. **A-A''**, Janssen et al. 2829; **B, B'**, Janssen et al. 2608; **C, C'**, Janssen et al. 2582; **C''**, Janssen et al. 2432; **D, D''**, Janssen et al. 2565; **D'**, Janssen et al. 2579; **E, E'**, Janssen et al. 2967; **E''**, Janssen et al. 2779. Vouchers at P. Photos **B', B''**, **C', C''** by G. Rouhan (MINHN); all other photos by T. Janssen. Scale bars: **A-E**, 1 m; **A'-E'**, **A''-E''**, 10 cm.

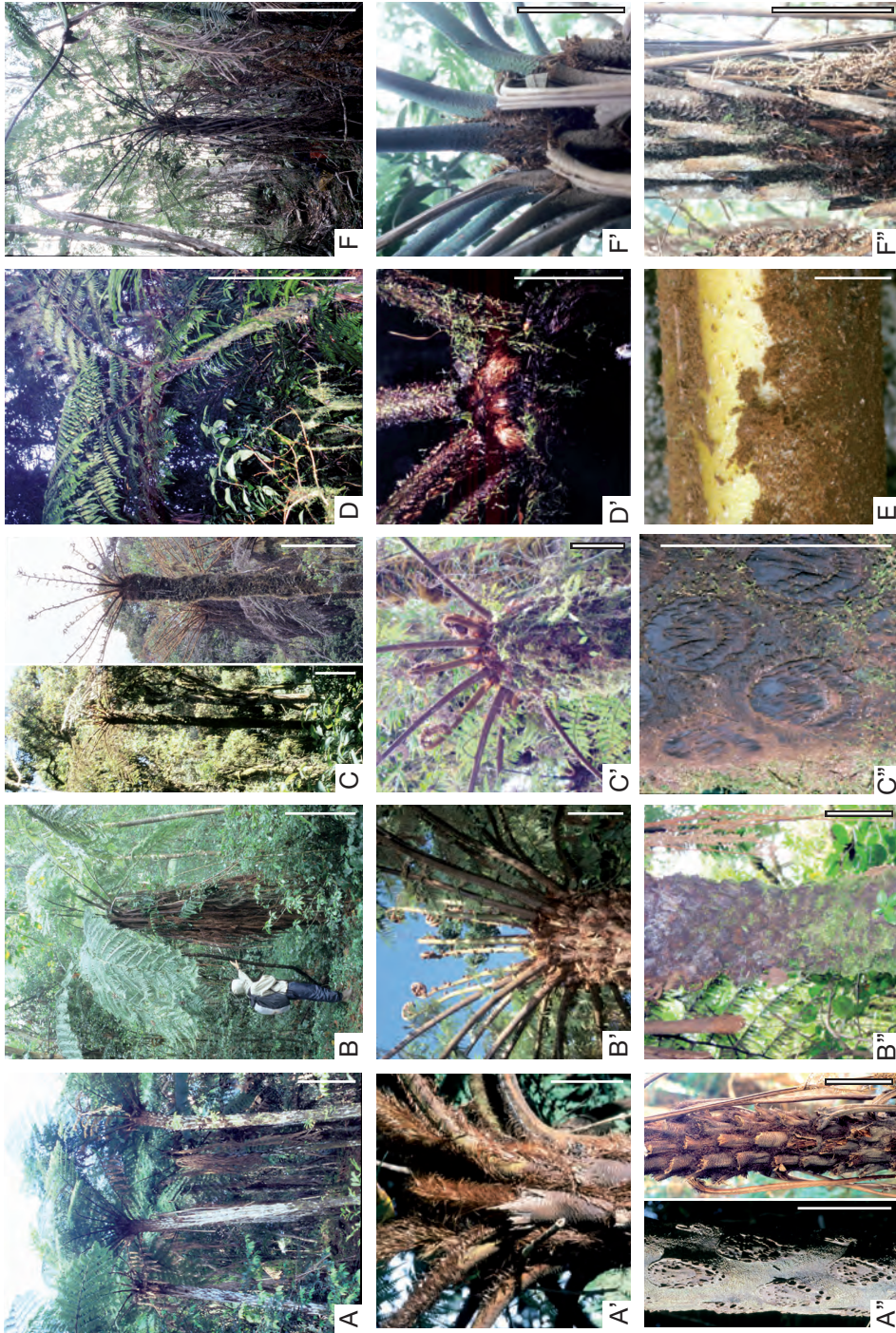


FIG. 52. — Photographic documentation of field characters in *Cyathea*: **A-D, F**, habit; **A'-D', F'**, trunk apex; **A''-D'', F''**, trunk surface at breast height; **A-A''**, *Cyathea boivinii* Mett. ex Kuhn var. *boivinii*; **B-B''**, *C. boivinii* var. *hildebrandtii* (Kuhn) Janssen & Rakotondr.; **C-C''**, *C. boivinii* var. *andringitrensis* Janssen & Rakotondr.; **D, D'**, *C. kirikii* Hook.; **F-F''**, *C. lastii* Baker; **A''**, the petiole bases are sometimes completely decayed on older trunks (left), but persistent in most trunks observed (right); **E**, *C. boivinii* var. *andringitrensis* Janssen & Rakotondr., dense tomentum of intricate squamules on the petiole; **A, A'**, *A''* (left), *C, C'*, uncollected; **A''** (right), Janssen et al. 2604; **B, Janssen et al. 2442**; **B'**, Janssen et al. 2464; **C'', Janssen et al. 2594**; **D, D'**, Labat et al. 3208; **E, Janssen et al. 2591**; **F-F''**, Janssen et al. 2431. Vouchers at P. Photos A', A'', B', B'', C-C'', E by G. Rouhan (MNHN); D, D' by J.-N. Labat (MINHN); all other photos by T. Janssen. Scale bars: A-D, F, 1 m; A'-D', F', A''-C'', F'', 10 cm; E, 1 cm.

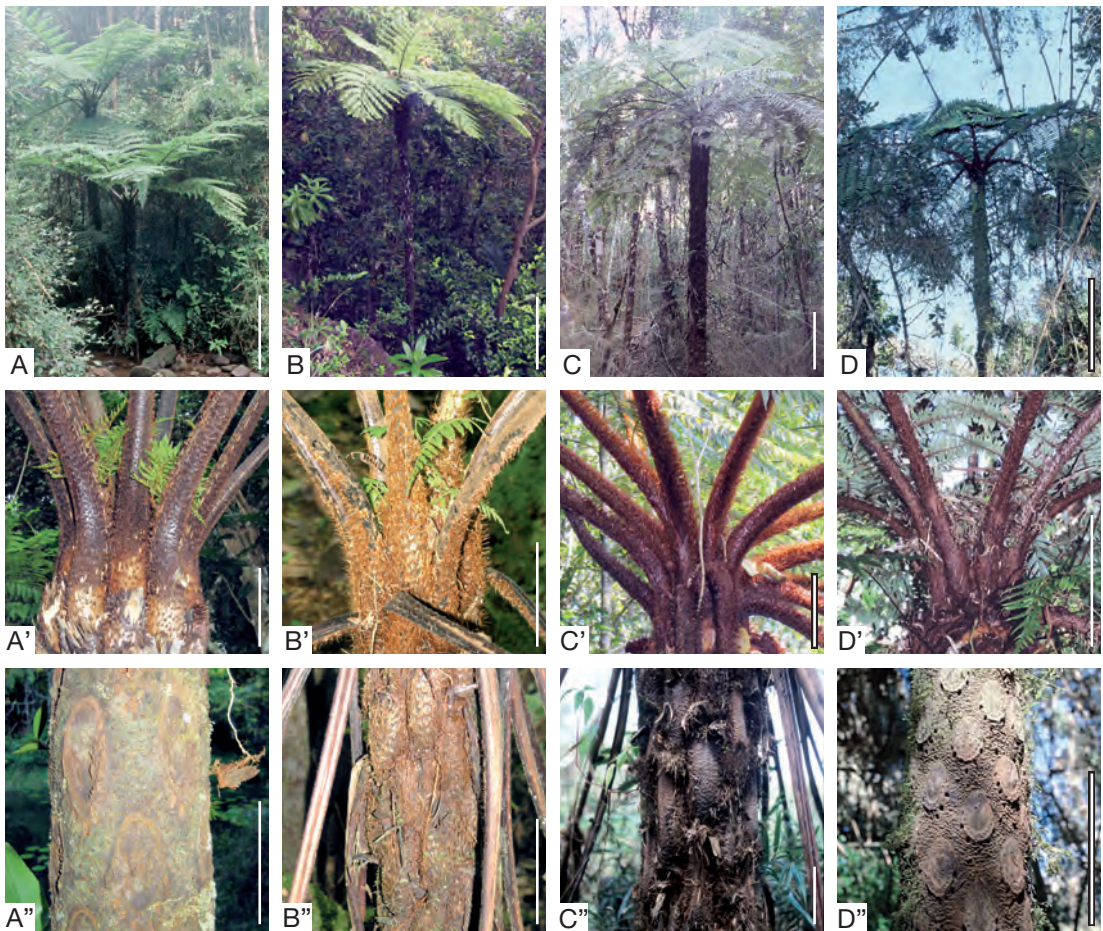


FIG. 53. — Photographic documentation of field characters in *Cyathea*: **A-D**, habit; **A'-D'**, trunk apex; **A''-D''**, trunk surface at breast height; **A-A''**, *Cyathea melleri* (Baker) Domin; **B-B''**, *C. sechellarum* Mett.; **C-C''**, *C. similis* C.Chr.; **D-D''**, *C. valdesquamata* Janssen & Rakotondr. A, A', B', B'', uncollected; A'', Janssen et al. 2569; B, Janssen et al. 3247; C, Janssen et al. 2402; C', Janssen et al. 2576; C'', Janssen et al. 2393; D, D'', Janssen et al. 2907; D', Janssen et al. 2904. Vouchers at P. Photos A'-A'', C' by G. Rouhan (MNHN); all other photos by T. Janssen. Scale bars: A-D, 1 m; A'-D', A''-D'', 10 cm.

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