

## New species and records of tree ferns (Cyatheaceae, Pteridophyta) from the northern Andes

Marcus Lehnert

Albrecht-von-Haller Institut, Abt. Systematische Botanik, Universität Göttingen,  
Untere Karspüle 2, 37073 Göttingen, Germany

e-mail: [mlehner1@uni-goettingen.de](mailto:mlehner1@uni-goettingen.de)

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### Abstract

Four new species of Cyatheaceae from Ecuador are described: *Alsophila conantiana* Lehnert, *Cyathea brucei* Lehnert, *C. moranii* Lehnert, and *C. sylvatica* Lehnert. Range extensions are documented for *Alsophila esmeraldensis* R.C. Moran and *Cyathea macrocarpa* (C. Presl) Domin.

**Keywords:** *Alsophila*; *Cyathea*; Andes; Colombia; Ecuador; Guayana Highlands

### Introduction

The pteridophyte flora of Ecuador is one of the richest in the world. About 1300 species have been registered (Jørgensen and León-Yáñez 1999), including 177 endemic species (Valencia et al. 2000). Though members of the tree fern family were collected and studied frequently in the past (Tryon 1970, 1971, 1976, 1986; Gastony 1973; Stolze 1974; Barrington 1978; Conant 1983; Tryon and Stolze 1989), new discoveries are still being made (Moran 1991, 1995a, 1998; Lehnert 2003, 2004). The complex taxonomy of the tree ferns, fragmentary collections, inadequate descriptions, and special descriptive vocabulary all contribute to our poor knowledge of this group. Hence, the list of published names is vast, as many widespread species have been described several times, based mainly upon the distances between the collection sites and not because of convincing differences in morphology. Tryon (1976) recognized this and synonymized many names for some widespread and rather variable species; yet he still had only a relatively small number of specimens at hand. Thus, character variability was poorly understood, and distributions often showed large gaps. Today, with more extensive collection activity, material is sufficient to show the true distribution and variability

of most species. These advances enable us to resurrect some species that had been united with others; they also allow several new species to be described.

### New species

#### *Alsophila conantiana* Lehnert, sp. nov.

(Fig. 1)

**Etymology.** This species is named for David S. Conant, Lyndon State College, Vermont, to honor his work on Cyatheaceae and especially *Alsophila*, from which my studies have greatly benefitted.

**Type.** Ecuador, Prov. Zamora-Chinchipe, new road Loja—Zamora, ca. 4 km E of pass “El Tiro”, ridge from white cross on left road side (towards the valley), study plot C6, 03°59’S, 79°08’W, 2500–2600 m, 07 Oct 2004, Lehnert 1415. Holotype: GOET; isotypes: LOJA, QCA, UC.

**Additional specimen examined.** Data as for types, except Lehnert 1414 (GOET, QCA, UC).

**Diagnosis.** Ab *Alsophila erinacea* (H. Karst.) D.S. Conant laminis valde tripinnatis indusiisque subsphaeropteroideis (vs. bipinnato-pinnatifidis vel parce tripinnatis et indusiis cyatheoideis urceolatisque vel

subsphaeropteroidis cum orificio latiore), ab *A. salvinii* Hook., *A. polystichoides* Christ et *A. tryoniana* (Gastony) D.S. Conant in presentia indusiorum firmorum persistentiumque (vs. indusiis tenuis fragilibusque vel absentia indusiorum) absentiaque alarum in parte distale pinnarum differt.

**Description.** Trunks to 4 m high and 11 cm diam., densely covered with thin lanceolate scales to 15 mm long, with black squamate spines 6–11 mm long, without old petiole bases, frond scars small, round and hardly visible between the scales; trunk apices overtopping the youngest whorl of fronds. Petioles to 110 cm long, dark brown to atropurpureous, with persistent scales and scurf of erect white flattish squamules with several dark apical setae; aphlebiae or aphlebioid basal pinnae absent. Petiole scales to 17 x 1 mm, linear to long-lanceolate (Fig. 1H), with differentiated margins of differently orientated and coloured cells, dark marginal setae to 0.7 mm long; large scales usually with only one apical seta (sometimes a second smaller apical seta present), no marginal setae, bicolorous with tan to brown centre and yellowish-white margins (Fig. 1H, right); smaller scales bicolorous with only a brown central stripe apically, or concolorous yellowish white (i.e., the colour of the margins of larger scales), some with small lateral setae (Fig. 1H, left). Lamina to 240 x 130 cm, tripinnate nearly throughout (except for distal fifth of pinnae and pinnules), opaque dark green adaxially, opaque pale green abaxially; broadly ovate, the apices abruptly reduced, pinna-like. Rachises and costae dark-brown to atropurpureous, inermous, scabrous by the insertions of small acaroid (i.e., round with many setae and often indurated center; see Conant 1983), stellate, and flattish squamules to 0.5 mm long, these present abaxially and adaxially, white pluricellular hairs only on distal parts abaxially, some larger scales, similar to those of the petiole, abaxially on costae; insertion of costa into rachis slightly raised abaxially, bearing a lunulate, flat to concave, brick-red pneumathode. Pinnae to 74 cm long, stalked to 2 cm, not green alate distally (Fig. 1A); basal ones reduced, more or less patent (Fig. 1B). Costules each with strongly raised adaxial ridge (Fig. 1D), stramineous to tan abaxially and adaxially, not green-alate between the distal segments (Fig. 1D, E); with white pluricellular hairs (0.5–0.7 mm, mainly medially and distally) and stellate, acaroid, and flattish setate scales (to 2 mm long, mainly basally) abaxially (Fig. 1G, left), no bullate scales present; pluricellular hairs adaxially either wholly castaneous or with white base. Pinnules (Fig. 1C) to 13 x 2.8 cm, sessile, pinnate nearly throughout, truncate basally, attenuate apically; segments (= tertiary leaflets) to 14 x 4 mm, free, sessile to petiolulate to 1 mm, oblong, the distal ones weakly falcate (Fig. 1C,

D, E); the margins subentire (to weakly crenate basally in the proximal segments), weakly convolute in fertile segments; midvein flat to weakly concave adaxially, glabrous or with 1–3 white pluricellular hairs (Fig. 1D), weakly to strongly convex abaxially, with acaroid to flattish setate scales (Fig. 1E); sterile and fertile veins mostly once-forked, basal ones sometimes 2-forked, distal ones often simple, yellowish to stramineous adaxially (Fig. 1D), blackish dark green abaxially, with white stellate hairs adaxially (in young leaves) (Fig. 1D), glabrous or with some acaroid squamules abaxially. Sori 1–8 per segment, costal, vein forks (Fig. 1E); indusia subsphaeropteroid, almost closed (rupturing at maturity into 3–4 parts and appearing urceolate to cyatheoid), firm, castaneous, with persistent small stellate squamules (Fig. 1F). Spores not examined.

**Remarks.** At first, I mistook this species for *Alsophila erinacea* (H. Karst.) D.S. Conant. Indeed, the two species share diagnostic features that distinguish them from other species of spiny Neotropical *Alsophila*. Their pinnae are not green-alate distally, the larger petiole scales of the abaxial side have only one apical and no lateral setae, and the indusia are firm, persistent, and lack hairs. *Alsophila conantiana* differs from *A. erinacea* in having wholly tripinnate laminae (vs. only sometimes tripinnate at the pinna bases), free tertiary segments (vs. always adnate), and subsphaeropteroid indusia (vs. predominantly cyatheoid to urceolate, only rarely some indusia subsphaeropteroid). Other more subtle differences lie in the fine indument of the lamina; e.g., the small flattish squamules of *A. erinacea* have longer and thinner hyaline processes and fewer setae (vs. many setae and rather short white cilia in *A. conantiana*). However, with just two specimens of *A. conantiana* at hand, I cannot assess the whole variability of the indument of the species.

*Alsophila cuspidata* (Kunze) D.S. Conant has subsphaeropteroid to sphaeropteroid indusia with stellate hairs that resemble those of *A. conantiana*. It can be distinguished by the distally alate pinnae (vs. non-alate in *A. conantiana*), petiole scales with several lateral setae (vs. none to few), acute segments (vs. obtuse), and occurrence at lower elevations (200–1500 m vs. 2500–2600 m).

Other tripinnate *Alsophila* species include *A. salvinii* Hook., *A. polystichoides* Christ, and *A. tryoniana* (Gastony) D.S. Conant from Central America. All three can be distinguished by their distally green-alate pinnae and their fugacious or absent indusia (vs. non-alate pinnae and persistent indusia). Conant and Cooper-Driver (1980) hypothesized that *A. polystichoides* and *A. tryoniana* are stabilized recombinants of a cross-breeding between *A. salvinii* and *A. firma* (Baker) D.S. Conant. This is supported by their co-occurrence: the

presumed parents occur from southern Mexico to Costa Rica, *A. firma* also extending along the western slope of the Andes through the Colombian Chocó to southern Ecuador. The putative hybridogenic species are restricted to Central America; both share the tripinnate fronds and bullate scales from their common ancestor *A. salvinii*. The recent discovery of *A. salvinii* in the Andes of northern Peru (van der Werff *et al.* 1966; MO, UC) raises the question of whether *A. conantiana* could be another hybrid, this time with *A. erinacea*, given the similarity to that species. *Alsophila salvinii* may occur in southern Ecuador as well, as the region still is scantily explored and close to the Peruvian site. However, apart from the free tertiary segments, there are only a few features that support this assumption. In ferns, aborted spores in sporangia that often do not open are usually a sign of hybrid origin. The fertile type specimen of *A. conantiana* has already shed most sporangia. The few remaining sporangia are open or were aborted at an early stage, which is not unusual for tree ferns. Thus we can conclude that at least most sporangia were well developed, but we cannot say anything certain about the spores. Even if they were well developed and viable, this does not rule out a hybrid origin of *A. conantiana*. Furthermore, *Alsophila conantiana* has hairs on the costae abaxially; the costae of *A. erinacea* usually have some hairs at least distally, those of *A. salvinii* are glabrous. Distinct laminar squamules (Fig. 1G, centre) occur in *A. salvinii* and *A. conantiana* (also in *A. polystichoides* and *A. tryoniana*), but are lacking in *A. erinacea*. Unfortunately, such scales are also present in *A. firma*, rendering this character ambiguous and worthless for analysis. The nearly closed subsphaeropteroid indusia of *A. conantiana* are not present in either presumed parent (*A. salvinii* is exindusiate, *A. erinacea* has cyatheoid to urceolate or subsphaeropteroid indusia that are never as closed as in *A. conantiana*). Thus *A. conantiana* appears to merit species status.

**Distribution.** Known only from the type locality in SE Ecuador. In moist montane forest at 2500–2600 m; found near a river at the bottom of a small ravine.

### ***Cyathea brucei* Lehnert, sp. nov.**

(Fig. 2)

**Etymology.** This species is named for Bruce Gray, co-collector of the type specimen.

**Type:** Ecuador, Prov. Zamora-Chinchipe, Campamento Miazzi, in forest and cliffs along Río Nangaritzza, ca. 04°18'S, ca. 78°40'W, 900 m, 19 Feb 1994, van der Werff *et al.* 13287. Holotype: QCNE; isotypes: MO, UC.

**Diagnosis.** A *Cyathea haughtii* (Maxon) R.M. Tryon indusiis nullis, laminis abrupte reductis pinnisque petiolulatis differt.

**Description.** Small trunkless fern. Rhizomes ascending, ca. 6 cm long, 1.5 cm diam. (Fig. 2A), hidden in a dense mass of old petiole bases and adventitious roots. Fronds to 32 cm long (Fig. 2A). Petioles inermous, brown to dark brown, scurf absent. Petiole scales 7–10 x 2–3 mm, lanceolate or ovate-lanceolate, concordantly whitish to stramineous (Fig. 2A), or sometimes with an irregular brown dot at the insertion point, or with larger, more basal scales strongly bicolored with irregular blackish streaks or central regions, scale margins differentiated, without marginal seta or teeth. Laminae widest at the middle, to 5 cm (Fig. 2A), dark green adaxially, pale gray-green abaxially, pinnate, abruptly to usually gradually reduced, ending in a small non-articulate pinna or pinnatifid apex. Rhachises inermous, non-alate, brown, with many red-brown, curved, pluricellular hairs to 1 mm adaxially and some small flatish scales adaxially towards the base. Pinnae sessile to petiolulate with stalks to 2 mm long (Fig. 2B), oblong, obtuse, shallowly lobed, the base rounded to cuneate, equilateral to subequilateral; the acroscopic basal lobe weakly pronounced in larger pinnae; the margins subentire to crenate. Costae (= midvein) glabrous (Fig. 2B). Veins glabrous, forked to pinnate, only the distalmost ones simple. Sori medial to suprmedial, medial on vein (Fig. 2B), exindusiate; receptacles small, globose, paraphyses red-brown, ca. 0.2 mm; spores not examined.

**Remarks.** *Cyathea brucei* is very similar to *C. haughtii* (Maxon) R.M. Tryon from northern Colombia (Fig. 2C). but *C. brucei* is exindusiate; *Cyathea haughtii* has small, appressed semicircular indusia. This indusial difference points out the untenability of generic delimitation between *Cyathea* (indusiate) and *Trichipteris* (exindusiate), as advocated by Tryon (1970). The differences in the pinnules (sessile and with rounded bases in *C. haughtii* vs. petiolulate and cuneate to rounded in *C. brucei*) may not be significant. However, presence vs absence of an indusium is normally regarded as a crucial difference between species of tree ferns; therefore I propose the recognition of *C. brucei* as a species. Nevertheless, both species must be closely related because they are identical in their ecology; both have been found only on vertical sandstone cliffs, a habitat that supports many narrowly ranging, specialized species. *Cyathea brucei* and related species, such as *C. falcata* (Kuhn) Domin, form a small group the distri-

bution of which is restricted to the Guayana Highlands and the northern Andes (Barrington 1978).

*Distribution.* Known only from the type locality in SE Ecuador, on sandstone cliffs along the Río Nangaritza.

***Cyathea moranii* Lehnert, sp. nov.**

(Fig. 3)

*Etymology.* This species is named for Robbin C. Moran, New York Botanical Garden, renowned pteridologist, prolific writer and collector, to honor his contributions to our knowledge of the Ecuadorian fern flora.

*Type.* Ecuador, Zamora-Chinchipe, new road Loja—Zamora, ca. 4 km E of pass “El Tiro”, ridge from white cross on left road side (towards the valley), 03°59'S, 79°08'W, 2500–2600 m, 03 Oct 2004, *Lehnert 1380*. Holotype: GOET; isotypes: LOJA, QCA, UC.

*Additional specimens examined.* Ecuador, Prov. Zamora-Chinchipe, Reserva Tapichalaca, sector Ventanillas, trail to study plots B2 and B3, 04°29'S, 79°07'W, 2550–2600 m, 02 Nov 2003, *Lehnert 1076* (GOET, QCA, UC); Reserva Tapichalaca, sector Ventanillas, 04°29'S, 79°07'W, 2520–2600 m, *Lehnert & Kessler 1270* (GOET, LOJA, QCA, UC); Estación Científica San Francisco, study plot A 9, along trail T1 above refuge, 03°59'30"S, 79°04'15"W, 2400 m, 11 Nov 2004, *Lehnert 1548* (GOET, LOJA, QCA, UC).

*Diagnosis.* Species ex grege *Cyathea platylepis* (Hook.) Domin statura media, truncis nudis, petiolis patentibus, segmentis angustis longisque; a *Cyathea holdridgeana* Nisman & L.D. Gómez atque *C. arnecornelii* Lehnert indusiis sphaeropteroides differt.

*Description.* Trunks to 4.5(–6) m high, 8–10 cm diam., inermous, without old petiole bases (Fig. 3A), petioles falling off cleanly, scars round to ovate, well spaced, slightly raised at their base; trunks densely covered with broad ovate scales; scales to 22 x 8 mm, bicolorous, dark brown to tan with grayish to white margins, to almost concolorous grayish light brown, their apex obtuse to long acute, differentiated margins fragile, without setae or teeth (Fig. 1B); trunk apices hemispherical, raised above the last whorl of green fronds, the young crosiers clearly visible (Fig. 3A), densely covered with scales like those of the trunks. Fronds arching. Petioles 30–110 cm long, inermous to sparsely scabrous, grayish brown to blackish, scurf abundant, consisting of appressed light brown, gray or whitish trichome-like, easily abraded squamules; petiole scales identical with trunk scales, present only at the very base of the petiole and soon caducous (Fig. 3B). Lamina 80–160 x 60–110 cm, bipinnate-pinnatifid to tripinnate at pinnule bases (Fig. 3E, F); light green to olivaceous adaxially, paler abaxially, opaque; apices gradually reduced (Fig. 3D). Rhachises inermous,

brown to stramineous, with scattered brown pluricellular hairs adaxially and appressed scurf like that of the petioles abaxially and adaxially. Pinnae to 36 cm long, sessile or stalked to 12 mm (Fig 3C), each with a darkened callus bearing a whitish planar pneumathode at the insertion to the rhachis. Costae inermous, brown to stramineous, adaxially with many tan to brown pluricellular hairs, abaxially appressed scurf of small (0.5 mm) lacerate squamules and larger flattish squamules, these papery, concolorous brown, margins entire; costae distally weakly green-alate. Pinnules to 75–135 x 12–30 mm, sessile to subsessile, rarely short-stalked to 3 mm, linear (Fig. 1F) to long-triangular (Fig. 1E), truncate basally, attenuate apically, ending in a deeply crenate tip (Fig. 1C, E, F); costules densely hairy adaxially with whitish to tan pluricellular hairs, only sparsely hairy distally on the abaxial side, but with few to many squamules and scales (Fig. 3G); mainly brown to tan, flattish (Fig. 3H) and bullate squamules (Fig. 3J) with whitish elongated tips (Fig. 3J), also some larger (1–5 mm) concolorous brown, papyraceous, weakly clathrate scales (Fig. 3G). Segments to 15 x 4 mm, sessile (Fig. 3G), adnate or free acroscopically and decurrent basiscopically (Fig. 3F), rarely truly free and then with deeply crenate margins (Fig. 3E); sinuses quadrangular, wide (Fig. 3G), reaching segment width at pinnule base (Fig. 3E, F); margins subentire to weakly crenate, tips obtuse; midveins with few to many pluricellular hairs (0.4–0.7 mm) adaxially and abaxially, hairs sparser or lacking on lateral veins (Fig. 3G); bullate scales like those on costules abaxially; fertile and sterile veins simple or forked, sometimes 2-forked free segments. Sori costal (Fig. 3G), in the fork of the midvein and a lateral vein; indusia sphaeropteroid, without or with a weak apical umbo, glabrous, tan, translucent, fragile, irregularly rupturing at maturity and persisting as cups or discs with irregular margins (Fig. 3G); paraphyses shorter than or equalling the sporangia, receptacles globose. Spores pale yellow, tetrahedral-globose, exospore deeply verrucate, often irregularly formed (Fig. 3K).

*Remarks.* The diagnostic characters of this species, e.g. petiole scales, petiole scurf and indusial shape, are regrettably easily lost by collecting and drying. The scales are persistent only on the trunks and crosiers; on petioles they are easily shed. The scurf is only loosely attached to the petioles, but the scurf squamules are intertwined to form a papery tissue; once this closed cover is ruptured, the scurf falls off in flakes. In dried specimens, the indusia are never observed in their original form; they are either cyatheoid or even hemitelioid when ruptured. This is important to know because the most closely related and similar species, *Cyathea holdridgeana* Nisman & L.D. Gómez (including *C. albomarginata* R.C. Moran) from Costa Rica and Pa-



nama, and *C. arnecornelii* Lehnert from Bolivia, have true hemitelioid indusia. All three species are similar in morphology and have the same habit (Fig. 3A). Their petioles are inermous, abscise cleanly, and are well spaced, allowing free sight of the apex and the crosiers (Fig. 3A). The frond scars on the trunk are markedly raised. The pinnules vary characteristically in dissection and width, ranging from rather narrow pinnatisect pinnules to basally pinnate pinnules with the costules narrowly green-alate between the segments (the stronger dissection prevails in shaded sterile plants). Vegetative reproduction by adventitious buds has not been observed or reported for any of the three species. Apparently all have the same spore type with a strongly verrucate exospore and without perispore (Fig. 3K).

The trunks are densely and persistently scaly in *Cyathea holdridgeana* (Rojas 1999) and *C. moranii* (Fig. 3A). In the latter species, I observed a regular growth of green algae and mosses between the scales below the last whorl of fronds; in Reserva Tapichalaca, Prov. Zamora-Chinchipe, Ecuador, undetermined filamentous cyanobacteria grow as a turquoise cover on the apical trunk scales of this species. In *C. arnecornelii*, the trunks are glabrous below the last whorl of fronds, or only sparsely scaly. This species, however, is closer to *C. moranii* in laminar indument. Both species have concolorous brown, flattish and bullate scales on lamina axes and veins abaxially. *Cyathea holdridgeana* evidently lacks bullate scales, and the larger flattish scales on the costules can be bicolorous (Moran 1991, as *Cyathea albomarginata*).

Under the light microscope, mature spores of *Cyathea moranii* show an exospore with irregular bumps, and there is no obvious perispore. Spores of *C. arnecornelii* have been examined with SEM (Lehnert 003, GOET), but the irregular shape and the lack of perine were interpreted to be due to their immaturity (Fig. 3K). The spores of *C. holdridgeana* have been described by Tryon (1976); the irregularity of the exospore was one criterion by which he considered the species to be a hybrid between *Cyathea divergens* Kunze var. *divergens* and *Trichipteris* (= *Cyathea*) *bicrenata* (Liebm.) R.M. Tryon. With *Cyathea moranii* now there are three species nearly identical in habit and with similar spore morphology. Evidently the irregular spores (Fig. 3K) are a feature shared by the three species, and not due to immaturity or abortion.

Other similar species are *Cyathea heliophila* R.M. Tryon from Ecuador and Colombia, and *C. xenoxyla* Lehnert from Colombia to Bolivia. *Cyathea heliophila* has persistently scaly trunks with elongate apices and without old petiole bases like *C. moranii*; it also shares the dissection pattern of the lamina (pinnatisect to pinnate pinnules with often long-tapering tip) and the sca-

le shape. It differs in the white scales (rarely with a brown basal spot), which are persistent on the petioles and trunks, in the firmer, darker laminae that are sparsely scaly, and in the longer, drooping fronds. The trunk apices of *C. heliophila* are characteristic, because the scales are moderately to strongly spreading (appressed in *C. moranii*, *C. arnecornelii*, and *C. holdridgeana*).

The widespread *Cyathea xenoxyla* Lehnert also sheds the petioles completely and has distantly placed petioles that do not hide the trunk apices and the crosiers, just as in *C. moranii* (Fig. 3A). Both species have the same indusial shape and variability (sphaeropteroid, fragmenting to cyatheoid, or even to hemitelioid). *Cyathea xenoxyla* differs in its spiny petioles and the vegetative reproduction by adventitious buds on the trunk (not present in *C. moranii*); scales are lacking on the trunks (scales present and persistent in *C. moranii*, *C. holdridgeana*, and *C. heliophila*, caducous in *C. arnecornelii*) and present only on the young crosiers.

**Distribution.** Endemic to the Prov. Zamora-Chinchipe in SE Ecuador, in moist montane forests at 2400–2600 m, mainly in sheltered side valleys and ravines.

### ***Cyathea sylvatica* Lehnert, sp. nov.**

(Fig. 4)

**Etymology.** The name refers to the type locality, the private nature reserve “El Bosque” (= the forest) near San Pedro de Vilcabamba, Ecuador, Prov. Loja (lat. *sylvaticus* = belonging to the forest).

**Type.** Ecuador, Prov. Loja, Reserva Protegida Privada “El Bosque”, near San Pedro de Vilcabamba, ca. 04°13’S, ca. 79°02’W, 2600 m, 07 Oct 1997, *Bussmann 1803*. Holotype: QCA; isotypes: ECSF, LOJA.

**Diagnosis.** *Cyathea* pygmaea truncum deficiens frondibus bipinnatis vel bipinnato-pinnatifidis, non plus ultra 20 cm longis, indusiis sphaeropteroides praestans.

**Description.** Trunks absent; rhizomes to 4 cm long, 15 mm diam. (Fig. 4A), with many adventitious roots. Petioles to 12 cm long, inermous, atropurpureous, with small gray pneumathodes to 2 x 0.4 mm, scurf lacking or rarely of scattered tan trichomidia. Petiole scales to 10 x 2.5 mm (Fig. 4D), concolorous orange-brown, lustrous, ovate-lanceolate, acute, with differentiated margins without setae or teeth. Laminae to 16 x 7 cm, bipinnate with the pinnules strongly crenate to pinnatifid, apices gradually reduced (Fig. 4A). Rhachises inermous, atropurpureous to brown basally, dark brown to stramineous apically, with many tan to whitish antrorse pluricellular hairs to 0.7 mm long adaxially, with scattered white hairs to 1.0 mm long and some entire flattish brown scales abaxially. Pinnae to 42 x 18 mm (Fig. 4A), broadly lanceolate, short acute to obtuse at tips, subsessile with stalks to 2 mm, pinnate basally, pinnatifid apically. Costae inermous (Fig. 4B), brown to

stramineous, densely hairy abaxially (Fig. 4C), scarcely so abaxially, with scattered trichomidia and flattish scales, narrowly green-alate between the pinnules; distal segments adnate and decurrent into costae. Pinnules to 9 x 5 mm, sessile (Fig. 4B, C), oblong, truncate to rounded basally, obtuse apically, margins deeply crenate to pinnatifid, strongly hairy adaxially with whitish pluricellular hairs 0.6–0.8 mm long (Fig. 4C), only few appressed brown trichomidia and flattish scales abaxially on costulae and veins (Fig. 4B). Fertile and sterile veins forked to pinnate (Fig. 4B, C). Sori costal, borne in forks of veins (Fig. 4B); indusia opaque brown, sphaeropteroid, without an umbo (Fig. 4B), gradually fragmenting at maturity, paraphyses few, much shorter than sporangia. Spores not examined.

**Remarks.** This small species appears to be most closely related to *Cyathea patens* H. Karst., a large species with trunks to 10 m. The two species are similar in indusial type, hairiness, and laminar texture. Even the dissection pattern of the lamina is similar, but modified according to the difference in size: medial and distal pinnae of *C. sylvatica* look like small pinnules of *C. patens*. However, the petiole scales of *C. sylvatica* seem to be constant in colour and shape (concolorous lustrous orange-brown, ovate-lanceolate) while in *C. patens* they vary from broadly to narrowly lanceolate and are generally duller in colour than in *C. sylvatica* (brown to dark brown, or if some orange-brown then not lustrous; also some of the longer scales are bicolorous with narrow whitish margins).

Juvenile plants of *Cyathea delgadii* Sternb. are similar to *C. sylvatica*, especially in the dark petioles and the lustrous scales, but they are generally less hairy and not known to be precociously fertile. The elevational distribution is also different: *C. delgadii* does not occur above 1200 m in Ecuador, whereas *C. sylvatica* grows only at 2600 m.

**Distribution.** Endemic; known only from the type locality in Ecuador, at 2600 m, growing in elfin forest.

## New records

### *Alsophila esmeraldensis* R.C. Moran

Nordic J. Bot. 15: 48–58. 1995.

This species was previously known only from Ecuador, Provs. Esmeraldas and Carchi. This is the first specimen from the Colombian Chocó (Map 1).

**Specimen examined.** Colombia, Dept. Valle, carretera Cali—Queremal-Buenaventura, 100 km al W de Cali, 280 m, 05 Nov 1972, Hagemann & Leist 1405 (COL).

### *Cyathea macrocarpa* (C. Presl) Domin Pteridophyta, 264. 1929.

Synonyms. See: Windisch 1978.

This species occurs mainly in the Guayana Highlands of Venezuela eastward to French Guiana (Windisch 1978). This first record from Ecuador represents a range extension of over 1400 km (Map 1).

**Specimen examined.** Ecuador, Prov. Morona-Santiago, trail Makuma—Mutinza, eastern foothills of Cordillera Cutucú, 02°10'S, 77°44'W, 660–750 m, 16 Nov 1995, Øllgaard & Navarrete 1486 (AAU, QCA).

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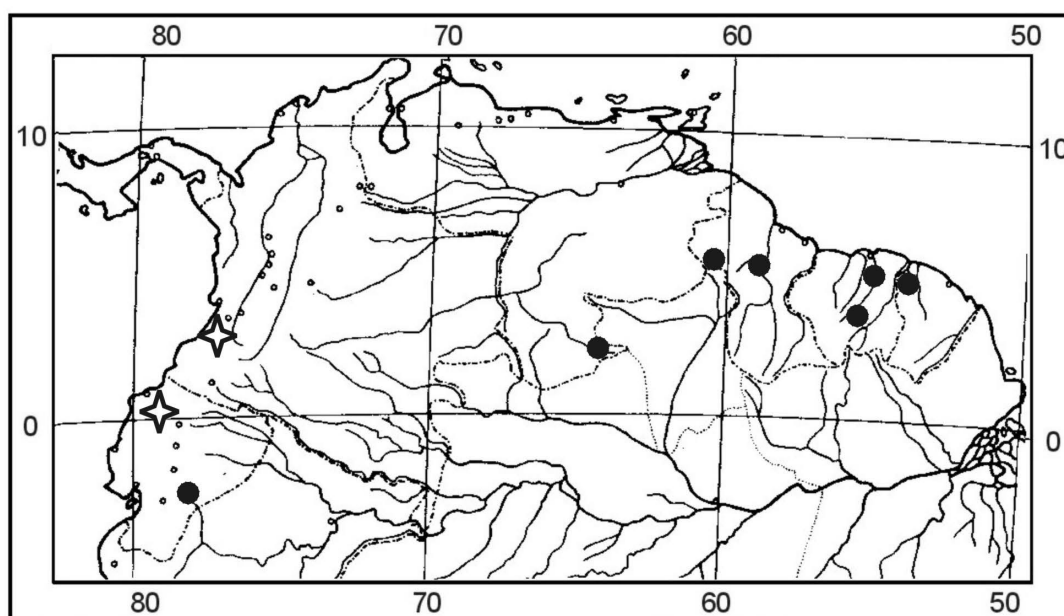
Field trips to Ecuador and herbarium visits to Aarhus, Denmark, and Berlin, Germany, were financed by the DFG project “Cryptogamic plant diversity of the *Purdiaea nutans* forest in southern Ecuador and its relationship to soil, climate, and vegetation structure”.

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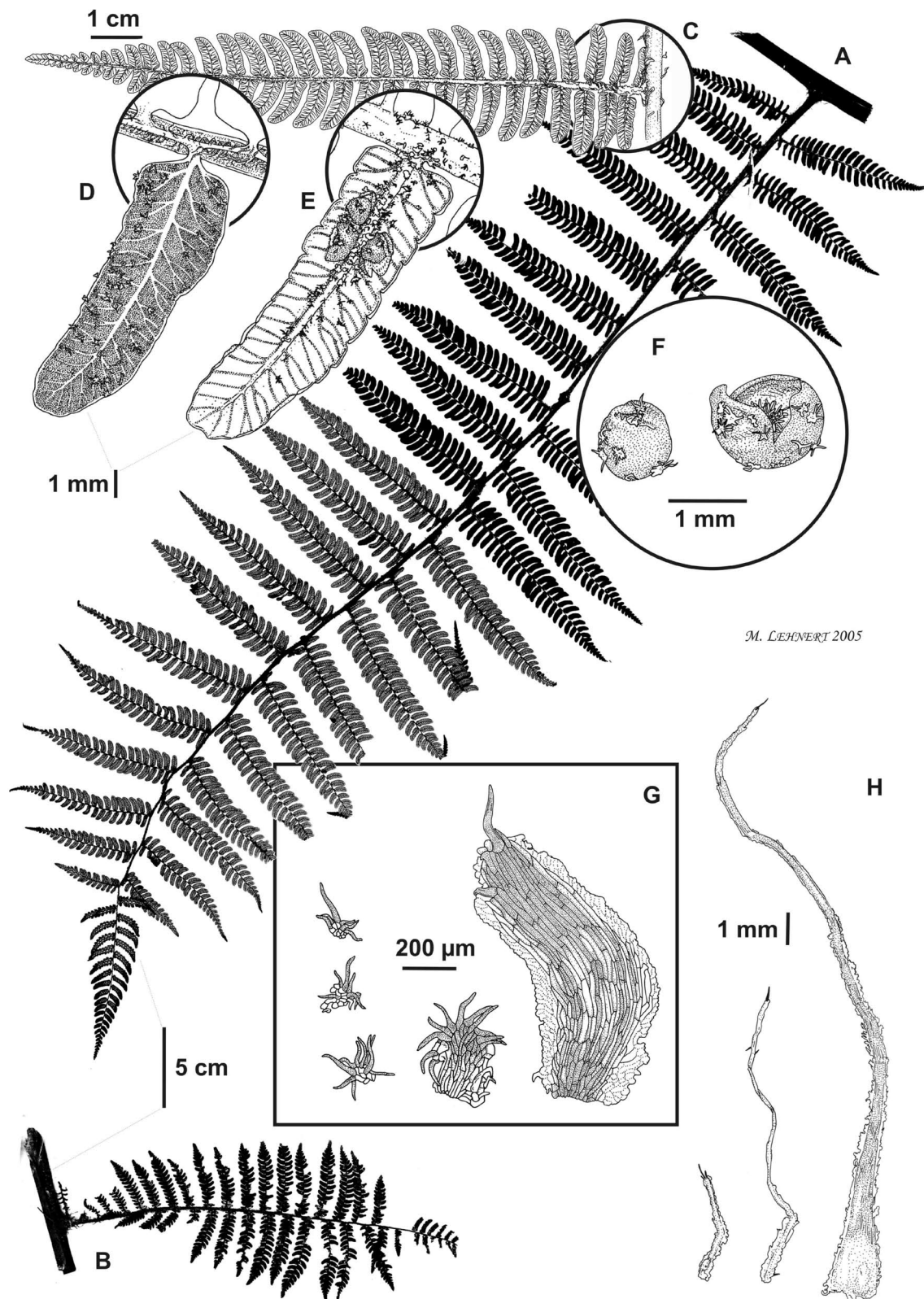
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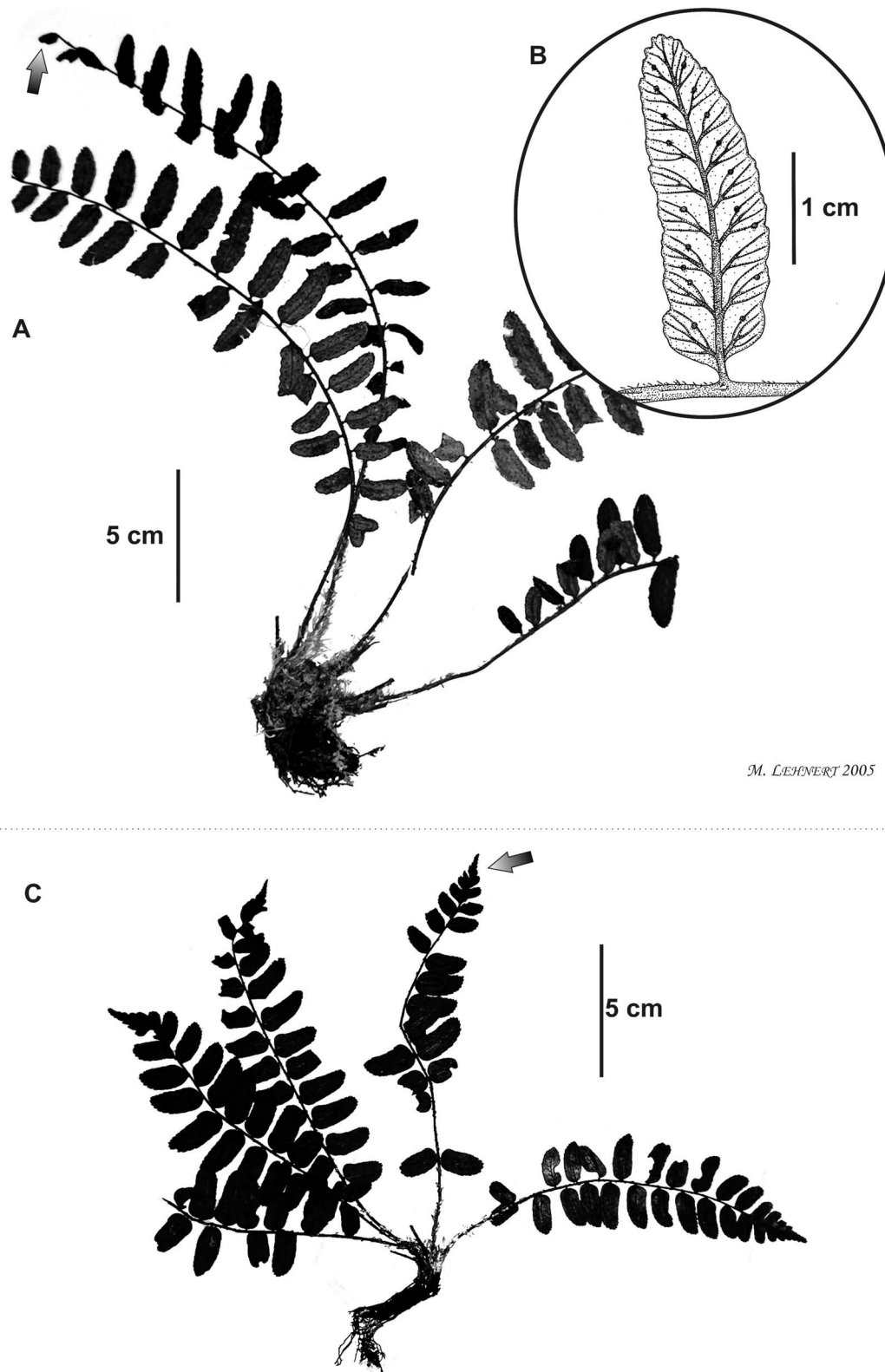
**Map 1:** Map of northern South America, showing distribution of *Alsophila esmeraldensis* (white stars) and *Cyathea macrocarpa* (black dots). Modified from Flora Neotropica base map, Utrecht, 1979.





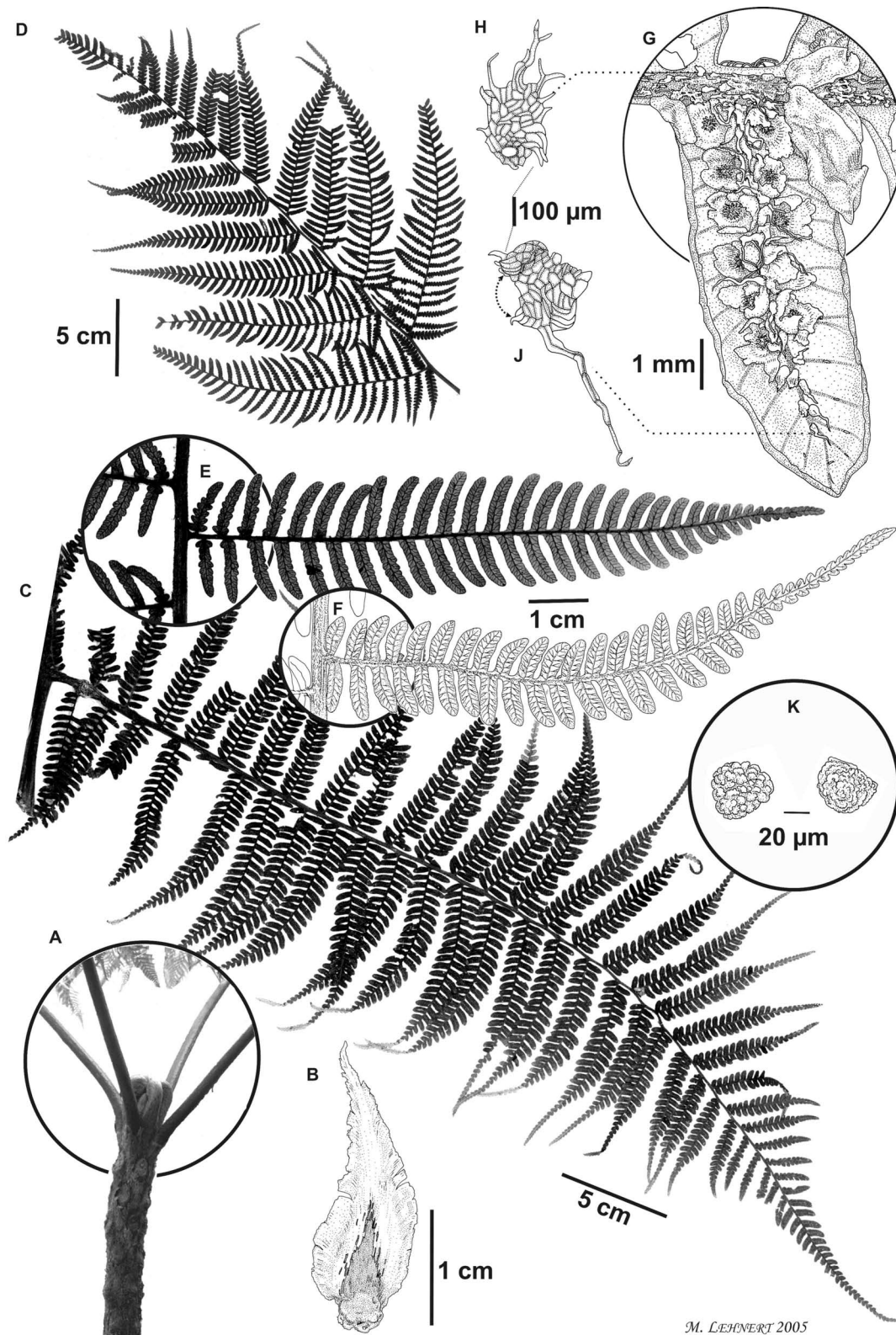
**Fig. 1:** *Alsophila conantiana*, sp. nov. (Lehnert 1415, GOET). (A) Medial pinna. (B) Basal pinna. (C) Basal pinnule of medial pinna, abaxially. (D) Distal segment of pinnule, adaxially. (E) Medial segment of pinnule, abaxially. (F) Indusia; left: entire, right: split open, showing receptacle with short paraphyses. (G) Squamules from pinnules; clockwise from right: large squamule from costule base, medium squamule from costules and midveins, small squamules found on all veins and axes abaxially. (H) Petiole scales.



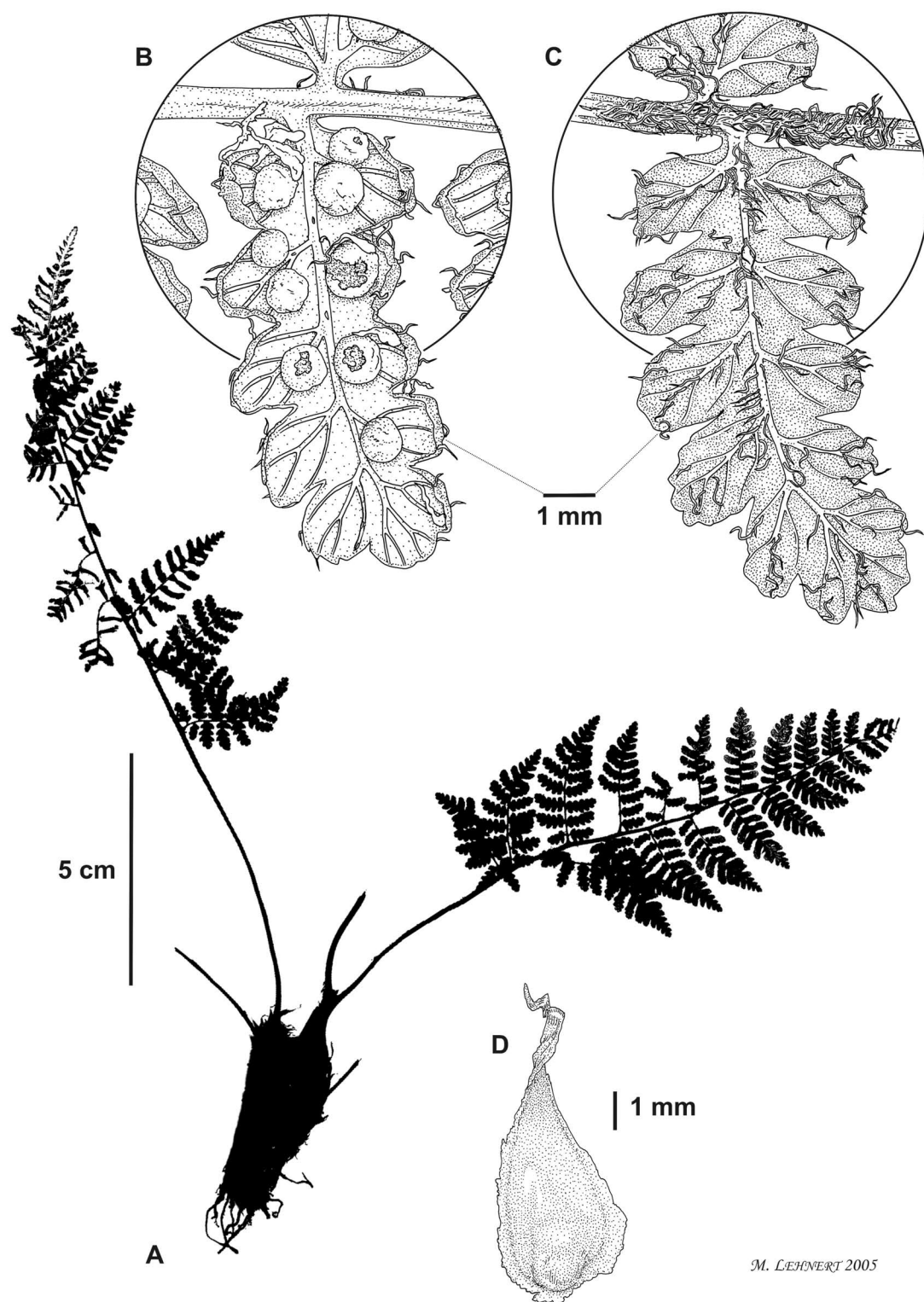


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**Fig. 2:** *Cyathea brucei*, sp. nov. (A, B; van der Werff et al. 13287, QCNE); *C. haughtii* Maxon (C; Haught 1957, COL). (A) Whole plant; arrow indicates apical segment. (B) Medial pinnule, abaxially. (C) Whole plant, arrow indicates pinnatifid apex.



**Fig. 3:** *Cyathea moranii*, sp. nov. (Lehnert 1380, GOET). (A) Trunk. (B) Petiole scale. (C) Medial pinna. (D) Lamina apex. (E) Large pinnule, abaxially; basal segments crenate. (F) Medium pinnule, adaxially; basal segments entire. (G) Pinnule segment, abaxially. (H) Peltately attached squamale from costule. (J) Subbullate squamale from midvein. (K) Spores. Dotted lines indicate corresponding parts.



**Fig. 4:** *Cyathea sylvatica*, sp. nov. (Bussmann 1803, QCA). (A) Whole plant. (B) Pinnule, abaxially, showing sphaeropteroid indusia. (C) Pinnule, adaxially, showing hairs. (D) Petiole scale.