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New species of scaly tree ferns (Cyatheaceae) from New Guinea, and new combinations for the family for Malesia

M. Lehnert[1,2] & R. Cámara-Leret[3]

Summary. After the revision of New Guinean material of tree ferns (Cyatheaceae, Dicksoniaceae) stored at the Royal Botanic Gardens Kew, we describe the following ten species of scaly tree ferns (Cyatheaceae) as new to science: *Alsophila calcicola, A. excelsior, A. indiscriminata, A. johnsii, A. nebulosa, A. novabritannica, A. parrisiae, A. sundueana* and *A. telefominensis*. All are species of the forest understory and have erect trunks 1 – 4 m tall. *Sphaeropteris kessleri* is the first species of the *Sarcopholis* clade of *Sphaeropteris* with only pinnate-pinnatifid fertile fronds and without a trunk. Five new combinations are made for Malesian Cyatheaceae (*Alsophila albidosquamata; A. brachyphylla; A. exilis, A. nothofagorum, Sphaeropteris mesosora*) and lectotypes are chosen for *A. buruensis, A. concinna, A. polyphlebia* and *A. rumphiana* (all synonyms of *S. felina*) and *S. ledermannii*.

Key Words. *Alsophila*, biogeography, diversity, Papua New Guinea, *Sarcopholis*-clade, *Schizocaena*-clade, *Sphaeropteris*, taxonomy.

Introduction

New Guinea is Earth's second largest island with 462,840 km^2 and hosts a large biodiversity in vast stretches of pristine tropical vegetation. Systematic scientific exploration started in the 19th century, and there were several large-scale expeditions in the first half of the 20th century, each bringing new discoveries of previously unknown plants and animals (Frodin & Gressitt 1982). Ferns are very well represented in New Guinea, and it is estimated that the island hosts up to 3000 spp. of ferns and lycophytes (Parris 2007). One group that – literally – stands out are the scaly tree ferns (Cyatheaceae), a family with c. 650 sp. worldwide (PPG1 2016), of which c. 125 sp. are estimated to occur on New Guinea. With their erect, trunk-like rhizomes and large crown of fronds, they often reach the forest canopy and can be seen from afar; they are also diverse and abundant in various sizes in the understory of the forest. In the Alpine grasslands of New Guinea, some specially adapted species dominate the landscape, an aspect only repeated on the island of Seram (Kato 1990).

The first account of all New Guinean tree ferns was given by Holttum in his treatment of Cyatheaceae for *Flora Malesiana* (Holttum 1963). Most species were only represented by a few collections, and Holttum had to admit uncertainties in the distinction of many species (Holttum 1963) due to the fragmentary state in which most specimens were preserved. Nevertheless, his work remains valid until today due to his incomparable insight. His subgenera and sections within *Cyathea* Sm. were recently confirmed to be monophyletic (Korall & Pryer 2014) and most of them are now formally recognised genera (*Cyathea, Alsophila* R.Br., *Gymnosphaera* Blume, *Sphaeropteris* Bernh.) (PPG1 2016; Dong & Zuo 2018). After Holttum, only a few scientists felt confident enough to recognise new taxa of New Guinean tree ferns, always backed up by first-hand experience with the plants in the field (Takeuchi 2007). With the growth of roads in Indonesia in the last ten years, expeditions have had easier access to remote sites, resulting in the recent discovery of new species of *Alsophila* (Lehnert *et al.* 2013; Lehnert 2016) and *Dicksonia* (Lehnert & Cámara-Leret 2018).

As a result of their size and visibility in the field, ornamental interest, and their diversity and known substrate specificity (Lehnert & Tejedor 2016), scaly tree ferns have received increased attention in conservation studies. High tree fern diversity may be a proxy for general high biodiversity and thus indicate areas with priority for protection (Tuomisto *et al.* 1995). Modern techniques of spatial modelling using available climatic and edaphic variables can be used for filling collection gaps in the distribution. A prerequisite for this is a minimum number of speci-

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[1] Nees-Institut für Biodiversität der Pflanzen, Rheinische-Friedrich-Wilhelms Universität Bonn, Meckenheimer Allee 170, D-53115, Bonn, Germany.
[2] Systematische Botanik und Mykologie, Ludwig-Maximilians-Universität, Menzinger Straße 67, D-80638, München, Germany. e-mail: mlehnert@uni-bonn.de
[3] Royal Botanic Gardens, Kew, Richmond, Surrey, TW9 3AE, UK.

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mens with trustworthy identification. As a start, we revised the bulk of unidentified material of tree ferns (Cyatheaceae and Dicksoniaceae) from New Guinea that had accumulated at the Kew herbarium since Holttum had passed away. Most of the material was assigned to known species, but it also became clear in direct comparison of the collections that several taxa are new to science. These are described based on light microscopic studies in the following systematic treatment. Except for one species, none of the new taxa have been observed in the field by the authors.

Results and discussion

We here describe nine new species of the genus *Alsophila* from New Guinea and New Britain; all belong to the *Alsophila* s.s. clade (Korall & Pryer 2014; PPG1 2016). With erect trunks 1 – 4 m tall they are all relatively small species of the forest understory but vary considerably in pinnule shape, size and dissection.

The only *Sphaeropteris* we describe herein belongs to the *Sarcopholis*-clade, which is characterised by having thickened scale bodies that are often fleshy, and relatively wide segments, at least compared to the *Sphaeropteris* s.s. clade. *Sphaeropteris kessleri* is the first species of the *Sarcopholis* clade to have only pinnate-pinnatifid fronds and no trunk; this habit can be found regularly in the *Schizocaena* clade, like *Sphaeropteris moluccana* (Desv.) R.M.Tryon and *S. alternans* (Hook.) R.M.Tryon in western Malesia (Holttum 1963).

We also make new combinations for four Australasian Cyatheaceae, and further update the synonymy of two species.

Systematic treatment

New species

1. Alsophila calcicola *Lehnert* **sp. nov.** Type: Indonesia, Papua Barat, Kebar Valley, E of Anjai 2 on ridge above Apni (Apoe) valley, 00°47'S, 133°04'E, 900 m, 10 May 1994, *R. J. Johns* 8266 *with S. Muljono, M. Jitmau, M. Warpur & M. Sagisolo* (holotype K-000853352/-000853353/-000853354/-000853355/-000853356/-000853357/-000853358/-000853359/-000853360/-000853361 [10 sheets]; isotype BO n.v.).

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Tree fern. *Trunk* to 1 m tall, c. 3 cm diam., with old petiole bases, due to these aculeate, with dark brown scales as on the petiole protruding between them. *Fronds* to 150 cm long, arranged in a tight spiral around the trunk, c. 5 – 6 green fronds forming a loose crown. *Petioles* brown to reddish brown, copiously aculeate, prickles to 1 mm long; with a line of remote elongate pneumathodes to 8 × 1.5 – 2 mm on each side, pale brown in dried material, continuing on lower rachis; scurf persisting, consisting of evenly distributed dissected squamellae and branched hairs 0.5 – 1 mm, without dark setae, smaller ones completely dark brown, larger ones paler with darker tips. *Petiole scales* persisting at petiole bases, to 16 × 1.5 – 2.2 mm, linear-lanceolate, weakly shiny, dark brown to blackish, with slightly paler narrow margins with weakly exserted cell rows; scales thickened at base, here with some surface outgrowths resembling small scales. *Laminae* 80 – 90 × 60 cm, bipinnate-pinnatifid, dark olive-green adaxially (when dried), paler olive-green abaxially, chartaceous to subcoriaceous; ± ovate-elliptic, basally not tapering, apices gradually reduced. *Frond axes* dark stramineous to brown abaxially, adaxially the same or darker, lower rachises sparsely muricate, otherwise axes smooth; costae basally with an inconspicuous brown pneumathode, flat, c. 2 × 1 mm; costae narrowly green-alate between the pinnules in distal half. *Pinnae* to 31.5 × 9 cm, broadly lanceolate, mostly sessile (some fertile pinnae with stalk 0.5 cm long), c. 8 – 10 pairs per frond, alternate, basal ones c. ⅓ the length of longest pinna, patent to weakly reflexed. Largest *pinnules* to 51 × 8 – 12 mm, pinnules oblong-lanceolate, with attenuate tips, sessile, with cuneate, slightly inequilateral bases, the outward side larger, 1 – 1.4 cm between costules, weakly dimorphic, the fertile ones slightly more incised (≤ ½ towards the costule) than sterile ones (≤ ⅓ towards the costule), segments/lobes to 16 × 3 mm, bluntly deltate to rounded, separated by acute sinuses to 2 mm wide, pinnule tips obtuse, margins weakly crenate, near tips also dentate. Midveins weakly raised on both sides, veins flat on both sides, yellowish brown adaxially, darker brown to blackish abaxially, contrasting dark with laminar tissue; basal basiscopic lateral veins arising from the costules and not from midveins like the rest of the lateral veins; fertile veins mostly simple in free pinnules, near pinna tips mostly forked. *Sori* subproximal to ± medial, 1 – 1.2 mm diam., covering most of the segment, indusia sphaeropteroid, greyish brown, irregularly fragmenting, a dark brown ring with irregular greyish brown margins persisting; receptacles globose to clavate, 0.3 – 0.5 mm diam., paraphyses straight, brown, much shorter than sporangia, 0.1 – 0.2 mm long. Spores not examined. *Hairs and scales*: frond axes adaxially and abaxially without multicellular hairs, except for remnants of pale scurf; veins without multicellular hairs on both sides, appressed, one-celled white trichomidia present on and between the veins abaxially; small ovate-lanceolate scales 0.5 – 1.5 × 0.2 – 0.5 mm, dark brown with paler margins and dark marginal setae abaxially at bases of costae

and costules, smaller pale brown to whitish squamules without dark setae on costules and midveins abaxially. Fig. 1.

RECOGNITION. A new species of *Alsophila* with thick dark scales, chartaceous to subcoriaceous laminae and most proximal basiscopic veins of the segment originating from the costule and not the midvein like the rest of the veins. In this regard it is superficially more similar to species of *Sphaeropteris* subg. *Schizocaena* sect. *Sarcopholis* sensu Holttum than to most other New Guinean *Alsophila* taxa. *Alsophila katoi* Lehnert & Coritico (= *Cyathea coriacea* M.Kato), which shares these peculiarities with *A. calcicola,* can be distinguished by the thick, entirely indurated petiole scales (vs most scale parts comparatively thin in *A. calcicola*), tapering lamina base (vs not tapering in *A. calcicola*) and less deeply incised pinnules (to ¼ towards the costules vs ⅓ to ½ towards the costules).

DISTRIBUTION. Known from a single collection from the Vogelkop Peninsula of New Guinea (Map 1).

SPECIMENS EXAMINED. INDONESIA. Papua Barat: Kebar Valley, E of Anjai 2 on ridge above Apni (Apoe) valley, 00°47'S, 133°04'E, 900 m, 10 May 1994, *R. J. Johns* 8266 *with S. Muljono, M. Jitmau, M. Warpur & M. Sagisolo* (holotype K-000853352/-000853353/-000853354/-000853355/-000853356/-000853357/-000853358/-000853359/-000853360/-000853361 [10 sheets]; isotype BO n.v.).

HABITAT. Reported from low ridge at 900 m, growing on limestone.

GLOBAL CONSERVATION STATUS. Data deficient (DD). More data are needed on the abundance and distribution of this species.

ETYMOLOGY. The epithet refers to the fact that the species grows on limestone.

LOCAL NAMES AND USES. None recorded.

NOTES. Looking at a global scale, limestone is not the preferred substrate for tree ferns. In the Neotropics, Cyatheaceae clearly avoid this bedrock (Lehnert & Tejedor 2016; Tejedor & Calatayud 2017). In the Paleotropics however there are some limestone areas where Cyatheaceae are abundant and form local endemics, most prominently on Seram (Kato 1990). In this particular case, Seram shares more species with New Guinea than with areas farther west. *Alsophila calcicola* shows the greatest similarity to *A. katoi*, a species described from Seram (as *Cyathea coriacea* M.Kato) and later found also on the Vogelkop Peninsula (Coritico *et al.* 2017).

2. Alsophila excelsior *Lehnert* **sp. nov.** Type: Indonesia, Papua Barat, N of Kebar, [c. 00°47'S, 133°03'E] 600 m, 13 May 1994, *R. J. Johns* 8349b (holotype K-000853362/-000853363/-000853364/-000853365/-000853366/-000853367/-000853368/-000853369/-000853370 [9 sheets]; isotype BO n.v.).

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Tree fern. *Trunks* to 3 m tall, otherwise unknown. *Fronds* to 340 cm long, c. 5 – 6 green fronds forming a loose crown. *Petioles* (35 –) 50 – 82 cm long, brown to reddish brown, copiously aculeate, prickles to 2 mm long; with a line of remote, elongate pneumathodes to 3 × 1 – 1.5 mm on each side, pale brown in dried material, continuing on lower rachis; scurf persisting, consisting of evenly distributed dissected squamellae and branched hairs 0.5 – 1 mm, without dark setae, smaller ones completely dark brown, larger ones paler with darker tips. *Petiole scales* persisting at petiole bases, to 16 × 1.5 – 2.2 mm, linear-lanceolate, weakly shiny, dark brown to blackish, with slightly paler narrow margins with weakly exserted cell rows; scales thickened at base, here with some laminar outgrowths resembling small scales. Laminae 140 – 280 × 130 – 150 cm, bipinnate-pinnatifid to bipinnate-pinnatisect, dark olive-green to blackish adaxially (when dried), paler olive-green abaxially, chartaceous to subcoriaceous; apex gradually reduced. *Frond axes* dark stramineous to brown abaxially, adaxially the same or darker, lower rachises sparsely muricate, otherwise axes smooth; costae basally with an inconspicuous brown pneumathode, flat, c. 2 × 1 mm; costae narrowly green-alate between the pinnules in distal half. *Pinnae* to 75 × 30 – 35 cm, broadly lanceolate, notably stalked, stalks mostly 2 – 4.5 cm long (in basal pinnae to 7 cm long), c. 9 – 10 pairs per frond, alternate to subopposite, basal ones c. ½ the length of longest pinna, ± patent (curved backwards but not entirely reflexed). Largest *pinnules* to 180 × 52 mm, pinnules triangular-lanceolate with attenuate tips, stalked notably by 10 mm to subsessile, with ± truncate to weakly cuneate, slightly inequilateal bases, the outward side larger, 2 – 3.5 cm between costules, segments to 30 mm long, weakly dimorphic, the fertile ones slightly narrower (3 – 4 mm wide) than sterile ones (to 5.5 mm wide), linear to long-deltate, separated by acute, parallel-sided sinuses to 2 mm wide, tips acute, margins crenate, near tips also serrate, in larger segments also weakly lobed. Veins raised on both sides, midveins strongly so, adaxially also ridged, lateral veins yellowish brown to dark brown adaxially, darker brown to blackish abaxially, contrasting dark with laminar tissue; basal basiscopic vein arising from the axil between midvein and costule, rarely directly from the costule; fertile veins mostly forked. *Sori* to 1 – 1.2 mm diam., ± medial, parallel to the margins, sitting in fork of vein; *indusia* sphaeropteroid, medium to greyish brown, irregularly fragmenting, a dark brown ring with irregular greyish brown margins persisting; receptacles globose to clavate, 0.3 – 0.5 mm diam., paraphyses straight, brown, much shorter than

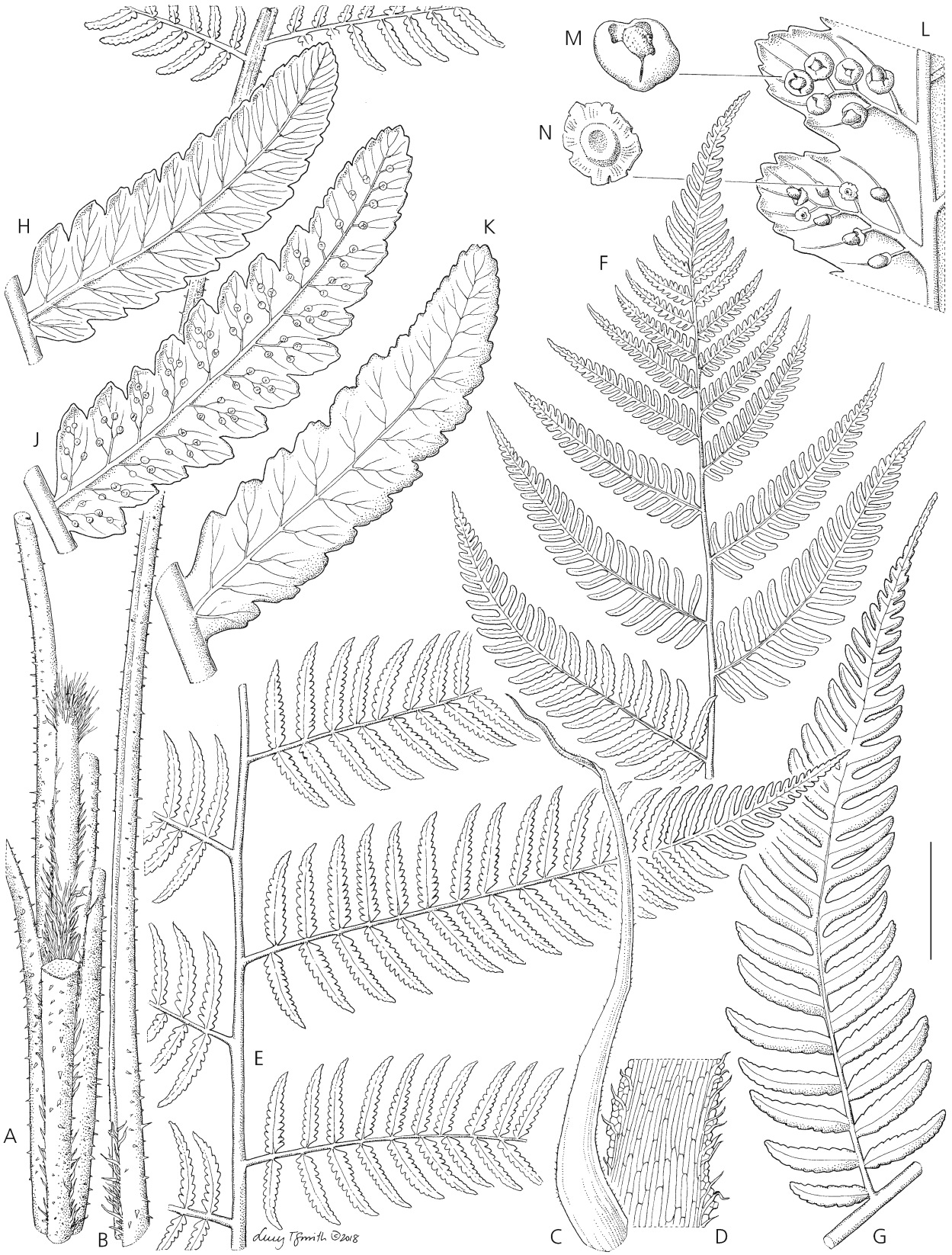
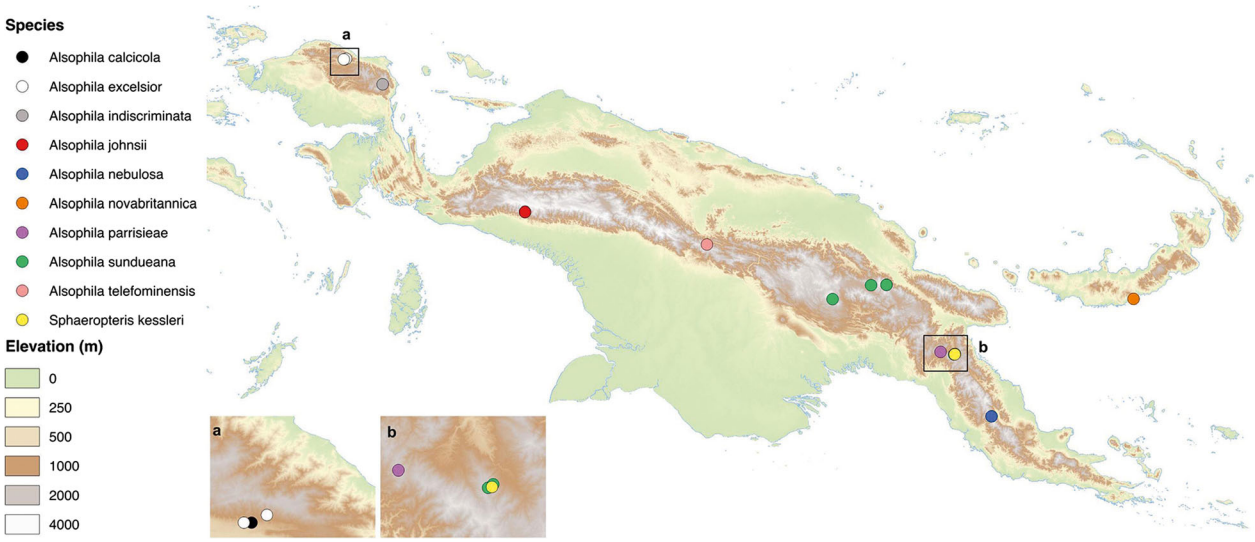


Fig. 1. *Alsophila calcicola*. **A** trunk apex; **B** petiole; **C** petiole scale; **D** detail of petiole scale margin; **E** mid-rachis pinnae; **F** apical pinnae; **G** pinnule; **H** abaxial sterile segment; **J** abaxial fertile segment; **K** adaxial fertile segment; **L** detail abaxial fertile segment; **M** sorus; **N** indusium. Scale bar: **A, B** 4 cm; **C** 4 mm; **D, M, N** 1.1 mm; **E, F** 6 cm; **G** 3 cm; **H** 1 cm; **J, K** 7.5 mm; **L** 3.3 mm. DRAWN BY LUCY T. SMITH.



Map 1. Distribution map of the newly described Cyatheaceae species.

sporangia, 0.1 – 0.2 mm long. Spores not examined. *Hairs and scales*: Frond axes adaxially with relatively sparse, reddish multicellular hairs 0.5 (– 1) mm long, antrorsely curved, sparser and largely missing in costules, or rachises (*R. J. Johns* 8362); abaxially without multicellular hairs, remnants of pale scurf persist especially in axils; veins without multicellular hairs on both sides, appressed, one-celled white trichomidia present on and between the veins abaxially; small brown to whitish squamules (0.5 – 1.5 × 0.2 – 0.5 mm) with dark setae abaxially on costules and midveins. Fig. 2.

RECOGNITION. Most similar to the Philippine species *Alsophila masapilidensis* (Copel.) R.M.Tryon and *A. latipinnula* (Copel.) R.M.Tryon regarding the broad long pinnules with notable stalks and the long curved acute segments, *Alsophila excelsior* differs in the fragile sphaeropteroid indusia that remain as hardly visible, small ring-like (=discoid) indusia when all sporangia are shed; *A. masapilidensis* has ± persisting hood-shaped indusia and *A. latipinnula* small scale-like indusia. The general appearance of *A. excelsior* is undocumented but presumably with a trunk covered in old, aculeate petiole bases, and without adventitious buds like in the most similar species. *Alsophila excelsior* occurs very close to *A. calcicola* and is identical to that species in many aspects. Petiole and petiole scale morphology, the shape and low durability of the indusia as well as the leathery laminar texture are identical. The main difference lies in the shape and dissection of the blade. *Alsophila excelsior* has more ovate-lanceolate blades with the basal pinnae only weakly reduced; the pinnae and most of the pinnules are notably stalked, and the pinnules are deeply incised by acute sinuses into pointed segments. In comparison, *A. calcicola* has elliptic blades with the basal pinnae strongly reduced in size, all pinnules are sessile and only weakly lobed with blunt tips. In the fine laminar indument, *A. excelsior* has some pale squamules with dark brown tips, some also with dark brown setae abaxially and some reddish multicellular hairs adaxially on the axes, which *A. calcicola* seems to lack.

DISTRIBUTION. Known from a single location on the Vogelkop Peninsula of New Guinea (Map 1).

SPECIMENS EXAMINED. **INDONESIA**. Papua Barat: Indonesia, Papua Barat, N of Kebar, [c. 00°47'S, 133°03'E] 600 m, 13 May 1994, *R. J. Johns* 8349b (holotype K-000853362/-000853363/-000853364/-000853365/-000853366/-000853367/-000853368/-000853369/-000853370 [9 sheets]; isotype BO n.v.); same locality, 13 May 1994, *R. J. Johns* 8362 (K!, LAE n.v.).

HABITAT. Reported from a limestone area at 600 m.

GLOBAL CONSERVATION STATUS. Data deficient (DD). More data are needed on the abundance and distribution of this species.

ETYMOLOGY. The name alludes to the eye-catching appearance of the specimens, and probably of the whole plant (Latin *excelsior* = exalted, excellent).

LOCAL NAMES AND USES. None recorded.

3. Alsophila indiscriminata *Lehnert* **sp. nov.** Type: Indonesia, Papua Barat, Manokwari, just above swamp to NW of Lake Anggi, [c. 01°19'S, 133°53'E,] 1800 m, 12 April 1994, *R. J. Johns* 8100 (holotype K-000856053 [7 sheets]; isotype BO n.v.).

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Tree fern. *Trunk* to 2 m tall, near apex with scales as on the petioles, otherwise unknown; adventitious buds

Fig. 2. *Alsophila excelsior*. **A** petiole; **B** petiole detail; **C** petiole prickle detail; **D** petiole scale; **E** pinna; **F** pinnule; **G** adaxial sterile segments; **H** detail hair adaxial sterile segment; **J** abaxial sterile segments; **K** abaxial fertile segments; **L** sori. Scale bar **A** 3 cm; **B, G, J, K** 7 mm; **C** 1.5 mm; **D, H** 3 mm; **E** 6 cm; **F** 2 cm; **L** 1.3 mm. DRAWN BY LUCY T. SMITH

not reported. *Fronds* to c. 200 cm long, 5 – 6 in a crown. *Petioles* 12 – 15 cm long, medium brown to dark stramineous, densely muricate, on each side with a line of well-spaced elliptic pneumathodes to 2 × 1.5 mm; scurf dense but easily abraded, pale orange-brown to whitish, squamellae to 0.5 mm long, erect and highly dissected or round with many marginal cilia, spreading, much longer than appressed scale body; adventitious pinnae absent but lower pinna pairs may be remote from each other, almost by length of petiole. *Petiole scales* persisting, to 18 × 2 – 2.5 mm, lanceolate, shiny, bicolorous castaneous to blackish brown with paler brown to whitish, relatively wide margins, with one large dark brown apical seta, smaller additional setae few and mainly near scale base. Laminae to c. 185 × 70 cm, bipinnate-pinnatifid to bipinnate-pinnatisect, elliptic, apex gradually reduced; adaxially dark green (black in dried specimens), weakly shiny, pale grey-green abaxially. *Frond axes* medium brown to dark stramineous, inermous; insertions of costae into rachis with two pneumathodes, basal one elliptic to 2 × 0.8 – 1 mm, distal one round, 1 – 1.5 mm diam.; costae narrowly green-alate between the adnate pinnules in distal parts, the alae arcuate. *Pinnae* to 34 × 9 – 10 cm, 9 – 10 pairs per frond, most pinnae stalked to 1 cm, alternate, not overlapping, ± patent, basal pinnae relatively long stalked to 2 cm, ± ⅓ the length of longest pinna, patent to weakly reflexed. Largest *pinnules* 50 × 8 – 10 mm, linear-lanceolate, with acute to short-attenuate tips, with ± cordate bases, sessile, 1.1 – 1.5 cm between the costules; basal segments never remote from the next; segments to 4.5 × 2 mm, not dimorphic, patent to weakly oblique, oblong, with margins repand, appearing entire but sharply crenate to serrulate, segment tips obtuse to rounded; sinuses acute, narrowly triangular, to c. 1 mm wide; 2.5 – 3 (– 4) mm between midveins; veins raised on both sides, lateral veins abaxially weakly so, midveins adaxially ridged; dull reddish brown on both sides, lateral veins abaxially also blackish, contrasting with laminar tissue; fertile veins simple or forked; all lateral veins rising from midvein. Sori subproximal to proximal, 0.8 – 1 mm diam., each with 35 – 50 sporangia, indusia small, discoid or ring-like, dark brown with whitish marginal lobes and long cilia, obscured in intact sori, mostly fragmented in over-mature sori; receptacles raised, globose to columnar, 0.2 – 0.3 mm diam., paraphyses few, clustered at tip of receptacle, flexuous, partially catenate, some scale-like, whitish to pale brown, slightly longer than sporangia (0.2 – 0.3 mm long). Spores tetrahedral globose, bright yellow. *Hairs and scales*: frond axes adaxially with spreading to antrorsely curved multicellular hairs 0.5 – 1 (– 1.5) mm long, dark reddish brown, concolorous or with paler tips, rather dense on rachis and costae, on costules becoming sparse, absent from midveins and lateral veins; frond axes abaxially with remnants of fine scurf, similar to that on petioles, in axils also some larger scales to 2 × 1 mm, whitish with darker reddish brown cilia, on costae and costules also flat to bullate squamules, pale brown to whitish, flat ones to 3 × 1 mm, with longer marginal setae, bullate ones 1 × 0.5 mm not including dark brown filiform tip; veins abaxially with whitish multicellular hairs to 1 mm long and 1 – 2-celled trichomidia to 0.5 mm long, none between the veins. Fig. 3.

RECOGNITION. A relatively small species of *Alsophila* with indusia ring-like in overmature sori, probably remnants of larger fragile indusia and subtle further distinguishing characters. *Alsophila tenuis* Brause differs from *A. indiscriminata* in having some hairs abaxially on axes and veins (vs abaxially axes glabrous, hairs only on midveins and veins in *A. indiscriminata*) and generally wider pinnules (13 – 15 mm in *A. tenuis* vs 8 – 10 mm in *A. indiscriminata*). *Alsophila horridula* (Copel.) R.M.Tryon is similar in indusium shape but with slightly larger pinnules (to 55 × 13 mm in *A. horridula* vs to 50 × 8 – 10 mm in *A. indiscriminata*) and with remote basal segments (vs without remote basal segments), and no hairs abaxially (vs abaxially hairs on midveins and veins).

DISTRIBUTION. Known only from the type locality in western New Guinea (Vogelkop Peninsula) near the Anggi Lakes (Map 1).

SPECIMENS EXAMINED. **INDONESIA**. Papua Barat: Manokwari, just above swamp to NW of Lake Anggi, [c. 01°19'S, 133°53'E,] 1800 m, 12 April 1994, *R. J. Johns* 8100 (holotype K-000856053 [7 sheets]; isotype BO n.v.).

HABITAT. Found in forest remnant, next to cultivated areas, at 1800 m.

GLOBAL CONSERVATION STATUS. Data deficient (DD). More data are needed on the abundance and distribution of this species.

ETYMOLOGY. The name refers to the indiscriminate appearance of the species, which at first glance looks like many other New Guinean tree ferns.

LOCAL NAMES AND USES. None recorded.

NOTES. In the treatment of Holttum (1963), *Alsophila indiscriminata* keys out to *A. tenuis*, whose lamina is more herbaceous (vs firmer in direct comparison in *A. indiscriminata*) and has flat margins (vs slightly curved or repand). *Alsophila tenuis* is also reported to have a slender decumbent trunk only 2 cm diam. We have no direct information about the trunk of *A. indiscriminata* but judging from the thickness of the petioles we would expect a trunk thicker than 2 cm.

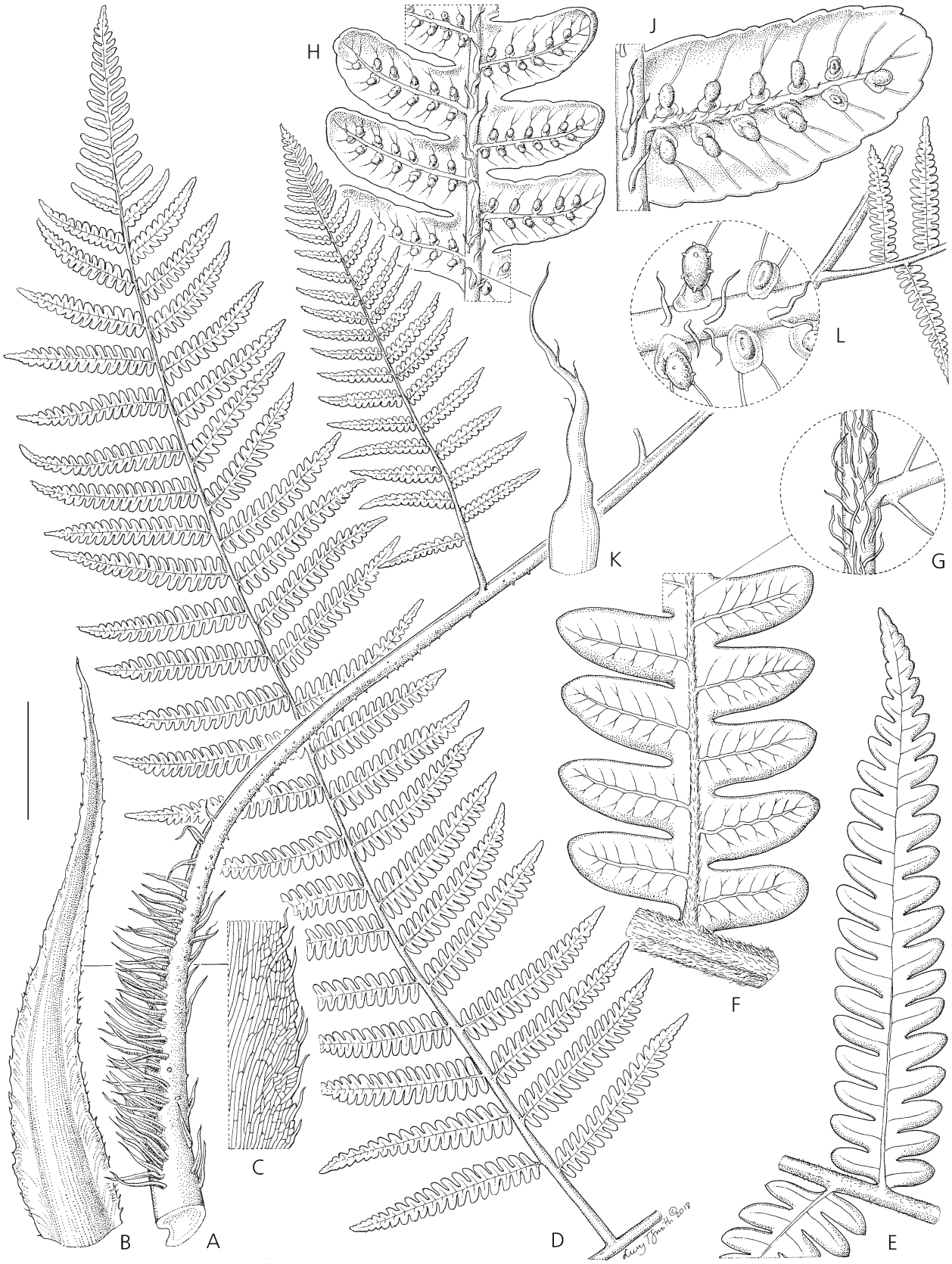

Fig. 3. *Alsophila indiscriminata*. **A** petiole; **B** petiole scale; **C** detail petiole scale margin; **D** pinna; **E** pinnule; **F** portion adaxial fertile pinnule; **G** detail of hairs on adaxial fertile pinnule; **H** abaxial fertile pinnule; **J** abaxial fertile segment; **K** detail of scale from abaxial pinnule; **L** detail of sori. Scale bar: **A, D** 3 cm; **B** 2.5 mm; **C, L** 0.8 mm; **E** 1 cm; **F, H** 4 mm; **G** 1.3 mm; **J** 1.6 mm; **K** 1.2 mm. DRAWN BY LUCY T. SMITH.

4. Alsophila johnsii *Lehnert* **sp. nov.** Type: Indonesia, Papua, Mimika Regency, PT-Freeport Indonesia Concession Area, army camp at mile 64 on main road, below army camp above Tembagapura [c. 04°09'S, 137°06'E, 2600 m], 1 Nov. 2000, *R. J. Johns* 10801 (holotype K [4 sheets]; isotypes BO n.v., BRI n.v., BRIT n.v., MAN n.v.).

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Tree fern. *Trunk* 1 – 1.5 m tall, near apex with scales as on the petioles, otherwise unknown; adventitious buds not reported. *Fronds* to c. 100 – 110 cm long. *Petioles* 23 – 38 cm long, medium brown to dark stramineous, densely muricate, on each side with a line of relatively close elliptic pneumathodes to 12 × 1.5 – 2 mm; scurf sparse, inconspicuous, pale brown, squamellae to 0.5 mm long, appressed, with irregular lacerate margins; adventitious pinnae absent. *Petiole scales* persisting, to 15 × 1.5 – 2 mm, lanceolate, shiny, bicolorous castaneous to blackish brown with paler brown to whitish, relatively wide margins, with one dark brown apical seta, small, often missing, additional setae absent. Laminae to c. 77 × 40 – 46 cm, bipinnate-pinnatifid to bipinnate-pinnatisect, elliptic, apex gradually reduced; adaxially dark green (dark olive to black in dried specimens), weakly shiny, pale grey-green abaxially. *Frond axes* medium brown to dark stramineous, inermous; insertions of costae into rachis with two pneumathodes, basal one elliptic to 2 × 0.8 – 1 mm, distal one round, 1 – 1.5 mm diam., also bases of costules with raised circular pneumathode; costae narrowly green-alate between the pinnules, the alae not arcuate, only visible in distal parts, also present but upturned in central parts. *Pinnae* to 34 × 4.5 – 6.2 cm, 9 – 10 pairs per frond, most pinnae stalked to 1.5 cm, subopposite to alternate, not overlapping, ± patent, basal pinnae relatively long stalked to 2 cm, ± ⅔ the length of longest pinna, patent to weakly reflexed. Largest *pinnules* 32 × 12 mm, triangular-lanceolate, with acute tips, with truncate to weakly cordate bases, sessile, 0.9 – 1.3 cm between the costules; basal segments never remote from the next; segments to 5 × 2.5 mm, not dimorphic, patent to weakly oblique, oblong, with margins repand, weakly crenate to subentire, appearing entire, segment tips obtuse to rounded; sinuses acute, narrowly triangular, to c. 1 mm wide; 3 (– 3.5) mm between midveins; veins raised on both sides, lateral veins abaxially weakly so, midveins adaxially ridged, dull reddish brown adaxially, lateral veins abaxially yellowish to blackish, weakly to strongly contrasting with laminar tissue; veins ending in the cartilaginous segment margin; basal lateral veins rising mostly from midvein, rarely sitting in the axils with the costules or directly on the costules; fertile veins mostly forked. Sori subproximal to proximal, 0.8 – 1 mm diam., each with 60 – 70 sporangia, indusia cyatheoid, dark brown, large, visible in intact sori, persisting in over-mature sori; receptacles raised, globose to columnar, 0.2 – 0.3 mm diam., paraphyses few, clustered at tip of receptacle, flexuous, partially catenate, some scale-like, dark brown, of the same length as sporangia (0.2 – 0.3 mm long). Spores tetrahedral globose, bright yellow. *Hairs and scales*: frond axes adaxially with spreading to antrorsely curved multicellular hairs 0.5 – 1 (– 1.5) mm long, dark reddish brown, concolorous or with paler tips, rather dense on rachis and costae, on costules becoming sparse, absent from midveins and lateral veins; frond axes abaxially with remnants of scurf, similar to that on petioles but generally paler, some appressed squamellae with pale lobes or short cilia, in axils also some larger flat scales, linear ones to 3 × 0.5 mm, ovate ones to 2 × 1 mm, dark brown, some with blackened centres, margins erose to lacerate, no marginal setae, on costules and midveins also bullate squamules, medium to dark brown, with collapsed cells, appearing weakly clathrate to ustulate, 1 × 0.5 mm with acute to subulate tip; veins lacking squamules. Fig. 4.

RECOGNITION. A small *Alsophila* similar to *A. crassicaula* R.M.Tryon (= *Cyathea ledermannii* Brause), both with small pinnules c. 23 – 32 × 8 – 12 mm and firm, cup-shaped indusia, but *A. johnsii* has the sinuses acute (vs more rounded in *A. crassicaula*) and the proximal segments not remote (vs basal segments remote, appearing free).

DISTRIBUTION. Known only from the type locality on the southern escarpment of the central range in New Guinea (Map 1).

SPECIMENS EXAMINED. INDONESIA. Papua Province: Mimika Regency, PT-Freeport Indonesia Concession Area, main road, below army camp at mile post 64, S of Tembagapura, [04°09'S, 137°06'E], 2600 m, 4 April 1999, *R. J. Johns* 10352 (BO n.v., BRI n.v., BRIT n.v., K [3 sheets], MAN n.v.), ibid., *R. J. Johns* 10353 (BO n.v., BRI n.v., BRIT n.v., K [3 sheets], MAN n.v.), *R. J. Johns* 10354 (BO n.v., BRI n.v., BRIT n.v., K [3 Sheets], MAN n.v.); ibid., army camp at mile 64 on main road, below army camp above Tembagapura, [c. 04°09'S, 137°06'E, 2600 m], 1 Nov. 2000, *R. J. Johns* 10801 (holotype K [4 sheets]; isotypes BO n.v., BRI n.v., BRIT n.v., MAN n.v.).

HABITAT. Reported from a landslide area in a cold air drainage zone at c. 2600 m.

GLOBAL CONSERVATION STATUS. Data deficient (DD). More data are needed on the abundance and distribution of this species.

ETYMOLOGY. Named for Robert J. Johns, collector of the type specimen.

LOCAL NAMES AND USES. None recorded.

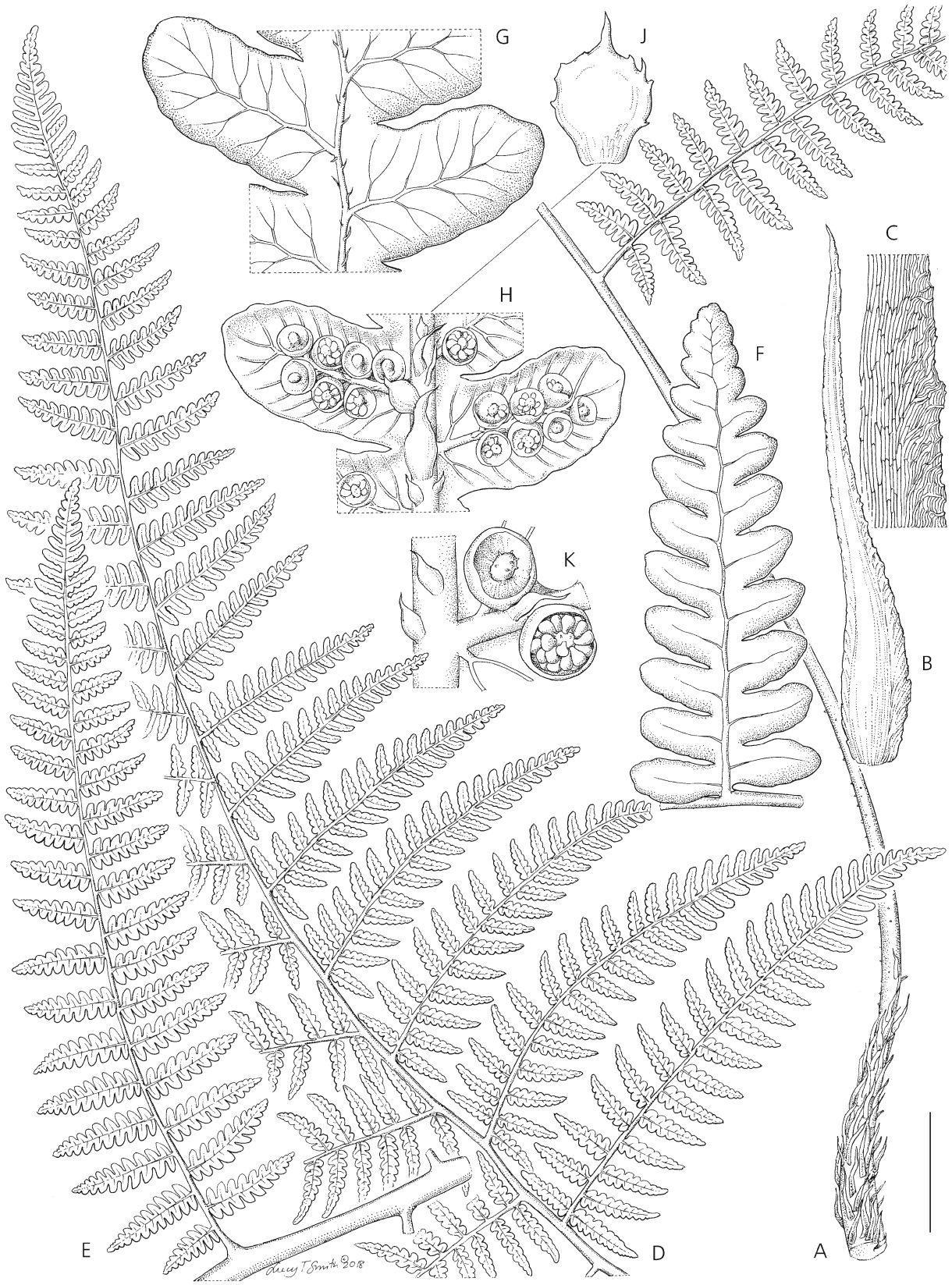

Fig. 4. *Alsophila johnsii*. **A** petiole and basal pinna; **B** petiole scale; **C** detail of petiole scale margin; **D** apical pinnae; **E** mid-rachis pinnae; **F** pinnule; **G** adaxial fertile segments; **H** abaxial fertile segments; **J** scale from abaxial fertile segments; **K** sori. Scale bar: **A, E, D** 3 cm; **B** 4 mm; **C** 0.8 mm; **F** 7 mm; **G, H** 3 mm; **J, K** 1.5 mm. DRAWN BY LUCY T. SMITH.

NOTES. In the treatment of Holttum (1963), this species keys out to *Alsophila crassicaula* (due to size, indument type, and shape of indusia) but *A. johnsii* has the segment margins repand (vs margins flat in *A. crassicaula*) and segments not constricted at base, thus its sinuses are acute and tapering (vs segments more constricted at base, making the sinuses wide). Also, *A. johnsii* is known only from southern New Guinea at 2600 m whereas *A. crassicaula* has been found only below 1000 m in the northern part of the island.

5. Alsophila nebulosa *Lehnert* **sp. nov.** Type: Papua New Guinea, Central, Subdistr. Tapini, Mt Scratchley, Repeater Station, 08°40'S, 147°30'E, c. 3350 m [11,000 ft], 7 May 1971, *M. Coode & P. Stevens* NGF-46347 (holotype K-000853124/-000853125/-000853126/-000853127; isotypes L n.v., LAE n.v.).

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Tree fern. *Trunk* to 3 m tall, 12 – 13 cm diam., without old petiole bases, leaf scars in vertical lines; adventitious buds not reported. *Fronds* to 130 cm long, 10 – 15 in a crown. *Petioles* c. 20 cm long, inermous, yellowish-brown, with copious scurf of pale brown to dark brown erect lanceolate squamellae to 0.5 mm long with many darker marginal setae; small (6 × 2 cm) adventitious pinnae either occurring irregularly near petiole base, varying from 0 – 2 per petiole, or completely absent in a given plant. *Petiole scales* easily shed, to 25 × 0.5 – 1 mm, linear, shiny, appearing concolorous castaneous, the yellowish to pale brown margins narrow, with one larger dark brown apical seta, additional setae may occur near base or on margins of shorter scales (<10 mm). Laminae to c. 110 × 65 cm, bipinnate-pinnatisect to tripinnate-pinnatifid, coriaceous, ovate-elliptic to broadly elliptic, apex gradually reduced; adaxially presumably matte dark green (black in dried specimens), pale grey-green abaxially, with mostly white granular deposit between midveins and margins, sparing out to the stomata (in dried specimens preserved mostly under the sori). *Frond axes* yellowish brown to stramineous, the costules somewhat darker, inermous; insertions of costae into rachis with elliptic pneumathode to 3.5 × 2 mm; costae narrowly green-alate between the pinnules in distal parts. *Pinnae* to 36 × 11 cm, 9 – 11 pinna pairs, most pinnae sessile, subopposite, weakly overlapping, ascending by 70 – 60°, basal pinnae ± ½ the length of longest pinna, relatively long stalked to 2 cm. Largest *pinnules* to 75 × 25 mm, lanceolate, with long-acute to short-attenuate tips, sessile, with truncate to weakly cuneate bases, basal segments free, sessile to subsessile with stalk 0.5 mm long, other segments adnate, connected by a narrow strand of green laminar tissue along the costules; segments to 11 mm long, weakly dimorphic, sterile segments or parts to 4.5 mm wide, with obtuse-deltate lobes, fertile ones to 2.5 mm wide, with rounded to emarginated lobes, the margins subentire, segment tips obtuse to acute; sinuses relatively wide, 1.5 – 2 mm; 4 – 5 mm between midveins; midveins weakly raised on both sides, blackish brown, contrasting with laminar tissue, lateral veins flat or abaxially weakly sunken, greenish to partially brown or blackish, not well contrasting with laminar tissue; fertile veins forked; all lateral veins rising from midvein. *Sori* proximal, (0.8 –) 1 – 1.2 mm diam., each with up to 100 sporangia, indusia hemitelioid, large, reaching ½ way around the base of receptacle, shiny dark brown when dry, ± translucent, visible in intact sori, remaining entire in over-mature sori; receptacles raised, globose, 0.2 – 0.3 mm diam., paraphyses few to many, straight, whitish to pale brown, shorter than sporangia. *Spores* not examined. *Hairs and scales*: frond axes adaxially with orange-brown to reddish brown (paler in distal parts of costules), spreading to antrorsely curved multicellular hairs to 0.5 (– 1) mm long, rather sparse on rachis, dense on costae and costules, sparse also on midveins, rare on lateral veins, absent abaxially; frond axes abaxially with ample but ephemeral fine scurf similar to that on petioles, containing many dark brown bullate squamules to 0.5 mm long, lacking darker marginal setae, with paler, acute to flaring tips, larger flat squamules to 1.5 mm long, dark brown with setae, persisting in axils towards rachis and costae; on costules only bullate squamules, on midveins grading into small flat, pale ovate-lanceolate scales without marginal setae, lateral veins abaxially without squamules or hairs. Fig. 5.

RECOGNITION. A species of high-elevation, *Alsophila nebulosa* bears a strong resemblance to *A. physolepidota* (Alston) R.M.Tryon regarding petiole scales (i.e. narrow, twisted, dark brown, appearing like hairs) and laminar dissection (i.e. closely set pinnules with elongate segments and bluntly crenate margins). From *A. physolepidota*, *A. nebulosa* differs in trunk morphology (petioles inermous, bases not long persisting on trunk, adventitious buds absent in *A. nebulosa* vs petiole with prickles, persisting on trunk, adventitious buds present in *A. physolepidota*) and in pinnule size (to 75 × 25 mm vs to 32 × 9 mm) but only slightly in the hemitelioid indusia (relatively large, reaching to ½ way around the receptacles vs relatively small, appressed, reaching to ⅓ of the way around the receptacles).

DISTRIBUTION. Known only from the type locality in Mt. Scratchley, in Papua New Guinea (Map 1).

SPECIMENS EXAMINED: PAPUA NEW GUINEA. Central Province: Subdistr. Tapini, Mt Scratchley, Repeater Station, [08°40'S, 147°30'E], c. 3350 m [11000 ft], 7 May 1971, *M. Coode & P. Stevens* NGF-46347 (holotype

Fig. 5. *Alsophila nebulosa*. **A** petiole; **B** detail of hairs on petiole; **C** petiole scale; **D** pinna; **E** abaxial sterile pinnule; **F** adaxial fertile pinnule; **G** abaxial fertile pinnule; **H** abaxial fertile segment; **J** sorus. Scale bar: **A** 3 cm; **B** 1.6 mm; **C** 5 mm; **D** 2 cm; **E, F, G** 7.5 mm; **H** 2 mm; **J** 0.8 mm. DRAWN BY LUCY T. SMITH.

K-000853124/-000853125/-000853126/-000853127; isotypes L n.v., LAE n.v.); ibid., *M. Coode & P. Stevens* NGF-46349 (K-000826797/-000826798/-000826799, L n.v., LAE n.v.).

HABITAT. At 3350 m in upper montane forests, reported only from the understory.

GLOBAL CONSERVATION STATUS. Data deficient (DD). More data are needed on the abundance and distribution of this species.

ETYMOLOGY. The epithet alludes to several characters of the species, firstly to the likely foggy (Latin *nebulosus*) habitat, secondly to the whitish lower surface, resembling a mist cast over the lamina; thirdly the relationship to other species is rather nebulous.

LOCAL NAMES AND USES. None recorded.

NOTES. In the treatment of Holttum (1963), *Alsophila nebulosa* keys out to *A. physolepidota*. From the description on the label, we deduce that *Alsophila nebulosa* is habitually similar to *A. wengiensis* Brause, with old petiole bases not cleanly shed, but rotting soon, revealing frond scars some distance below the crown, and with ± inermous petioles.

The colour of the lamina (adaxially dark green and abaxially pale grey) is very conspicuous and otherwise is only found among New Guinea tree ferns in *Alsophila pruinosa* (Rosenst.) R.M.Tryon. *Alsophila nebulosa* has more strongly lobed segment margins (incised ¼ to almost ½ way towards the midveins vs less than ¼, usually subentire in *A. pruinosa*) and hemitelioid indusia (vs indusia shallow cups). The laminar dissection of *A. nebulosa*, including the remote basal pinnae, are strongly reminiscent of *A. smithii* (Hook.f.) R.M.Tryon of New Zealand and *A. vieillardii* (Mett.) R.M.Tryon of New Caledonia, to which it may be related. *Alsophila smithii* differs mainly in the absence of bullate squamules on the laminae abaxially (vs dark brown bullate squamules present in *A. nebulosa*); *Alsophila viellardii* has larger, hood-shaped hemiteloid indusia that cover most of the intact sori (vs not hood-shaped in *A. nebulosa*) and has some hairs abaxially on the costae and costules (*A. vieillardii*) where *A. nebulosa* lacks hairs in general.

Alsophila nebulosa shares with *A. muelleri* (Baker) R.M.Tryon the type of petiole scales (i.e. dark brown, long-lanceolate), the coriaceous laminar texture and the large sori (to 1.2 mm diam., with up to 100 sporangia) but differs in having more strongly dissected laminae (bipinnate-pinnatisect to tripinnate-pinnatifid vs bipinnate-pinnatifid in *A muelleri*) and lacking hairs abaxially on the costae (vs at least distally sparsely hairy). *Alsophila nebulosa* may be mistaken for *A. dicksonioides* (Holttum) R.M.Tryon (Holttum 1963) but here the pinnules are smaller (to 35 × 6 mm in *A. dicksonioides* vs to 75 × 25 mm in *A. nebulosa*) with segment lobes revolute (vs only repand). *Alsophila nebulosa* presumably stays inside the closed forest, just like *A. physolepidota* and *A. wengiensis*, but *A. dicksonioides* and *A. muelleri* are more often found near the forest edge and in open Alpine grasslands.

6. Alsophila novabritannica *Lehnert* **sp. nov.** Type: Papua New Guinea, New Britain, Distr. Eastern New Britain, Subdistr. Gasmata, 2 miles E of Fullerborn Harbour, 06°10'S, 150°35'E, 100 m, 10 May 1973, *J. S. Womersley* NGF-41225 (holotype K-000826657).

http://www.ipni.org/urn:lsid:ipni.org:names:77196045-1

Tree fern. *Trunk* to 4 m tall, otherwise unknown; adventitious buds not reported. *Fronds* to 200 cm long. *Petioles* at least 25 cm long, densely muricate, yellowish-brown, with copious scurf consisting at petiole base of pale brown to dark brown erect lanceolate squamellae to 1 mm long with many darker marginal setae, in distal parts becoming paler, grading into white, dark-setate lacerate squamellae c. 0.5 mm long and smaller acaroid ones. *Petiole scales* persisting, to 16 × 3 – 4 mm, ovate-lanceolate, weakly shiny to matte dark brown with narrow differentiated margins paler brown to white with several dark brown marginal setae, largest scales on abaxial side of petiole thickened in brown centre, thin margins worn off, otherwise scales relatively thin with only bases indurated and thickened. *Laminae* to c. 170 × 125 cm, bipinnate-pinnatifid to bipinnate-pinnatisect, apex gradually reduced. *Frond axes* yellowish brown to stramineous, lower rachises muricate to scabrous, otherwise inermous; costae not green-alate between the pinnules in distal half. *Pinnae* to 62 × 18 – 24 cm, sessile to subsessile with stalks 1 cm long, c. 10 pinna pairs, alternate to subopposite, basal pinnae not seen. Largest *pinnules* to 120 × 25 mm, lanceolate to narrowly triangular, with short-attenuate tips, sessile, with truncate to weakly cuneate bases, pinnatifid to 1 – 2 mm towards the costule, basal segments not free; segments to 14 × 4.5 mm, the margins crenate, especially in larger basal segments, tips obtuse to acute; midveins raised on both sides, yellowish, lateral veins flat or adaxially weakly raised, greenish to partially brown or blackish, not well contrasting with laminar tissue; first basiscopic lateral vein in each segment rising from costule, not midvein; fertile veins forked. *Sori* medial, 1 – 1.2 mm diam., each with c. 40 sporangia, indusia sphaeropteroid with umbo, fragmenting to a deep urn, papery, pale brown, not translucent, receptacles raised, globose, 0.2 – 0.3 mm diam., paraphyses numerous but fragile, straight, orange to reddish, tortuous, of the same length as sporangia. *Spores* not examined. *Hairs and scales*: frond axes adaxially with dark reddish brown (rarely paler in distal parts of costules) antrorsely curved multicellular hairs to 0.5 (– 1) mm long, rather sparse on rachis, dense on costae and costules, hairs absent

abaxially and from both sides of veins; frond axes abaxially with ample fine scurf as on petioles, easily shed, on costules and midveins also with larger dark lanceolate squamules and brown to dark brown bullate squamules, 0.5 – 1 mm long, with dark brown setae, lateral veins without squamules or hairs but with appressed reddish brown trichomoidia. Fig. 6.

RECOGNITION. A species of *Alsophila* with sphaeropteroid indusia and relatively coarsely dissected laminae with large lanceolate to triangular pinnules (to 120 × 25 mm) in which the basal segments are pronounced and have a more strongly crenate margin. In these characters it matches *A. insulana* (Holttum) R.M.Tryon but differs in having the basal veins of a segment originating from the costule (vs originating from the midvein in *A. insulana*), firmer indusia (brown, opaque vs pale brown, translucent).

DISTRIBUTION. Known only from the type locality in New Britain (Map 1).

SPECIMENS EXAMINED. PAPUA NEW GUINEA. New Britain: Distr. Eastern New Britain, Subdistr. Gasmata, 2 miles E of Fullerborn Harbour, 06°10'S, 150°35'E, 100 m, 10 May 1973, *J. S. Womersley* NGF-41225 (holotype K-000826657).

HABITAT. In lowland rain forests at 100 m.

GLOBAL CONSERVATION STATUS. Data deficient (DD). More data are needed on the abundance and distribution of this species.

ETYMOLOGY. Named after the island of New Britain.

LOCAL NAMES AND USES. None recorded.

NOTES. *Alsophila novabritannica* is superficially identical to *A. insulana*, to which it keys out in the treatment of Holttum (1963), and we think both are closely related. The differences in the firmness of the indusia could be dismissed as intraspecific variation but that veins arise from the costules (as in *A. novabritannica*) rather than from the midveins (as in *A. insulana*) is such a rare and defining character in the genus *Alsophila* that we regard recognition as two different species as warranted. Little is known about the ecology of either species but we assume that both grow in the shaded understory of humid forests.

7. Alsophila parrisiae *Lehnert* **sp. nov.** Type: Papua New Guinea, Morobe, Ekuti Range, Wantut-Aseki Divide, [c. 04°09'S 137°06'E,] 2250 m, 29 May 1977, *B. S. Parris & J. P. Croxall* 6004 (holotype K-00826752/-00826753/-00826754/-00826755; isotype LAE n.v.).

http://www.ipni.org/urn:lsid:ipni.org:names:77196046-1

Tree fern. *Trunk* unknown; adventitious buds not reported. *Fronds* to c. 100 – 110 cm long. *Petioles* 23 – 38 cm long, medium brown to dark stramineous, sparsely verrucate, on each side with a line of well-spaced elliptic pneumathodes to 2 × 0.5 mm, inconspicuous in dried material; scurf sparse, inconspicuous, whitish, consisting of cobwebby branched hairs and lacerate squamellae; adaxially sparsely hairy with retrorse multicellular hairs 0.5 – 1 mm long, reddish brown; adventitious pinnae absent. *Petiole scales* persisting, 8 – 12 × 1 – 3.5 mm, lanceolate to ovate-lanceolate, matte, concolorous pale brown to whitish, margins relatively wide, with one dark brown apical seta, small, often missing, additional setae absent. *Laminae* c. 45 – 53 × 25 – 28 cm, bipinnate-pinnatifid, elliptic, widest in the middle, apex gradually reduced; adaxially dark green (black in dried specimens), pale grey-green abaxially. *Frond axes* medium brown to dark stramineous, inermous; insertions of costae into rachis with two pneumathodes, basal one elliptic to 2 × 0.5 – 0.8 mm, distal one round, 0.5 mm diam., also bases of costules with raised circular pneumathode; costae narrowly green-alate between the pinnules, the alae not arcuate. *Pinnae* to 17 × 4 – 4.4 cm, 9 – 10 pairs per frond, most pinnae stalked to 0.4 – 0.6 cm, mostly alternate, not overlapping, weakly to notably ascending by ± 60°, basal pinnae ± ⅓ the length of longest pinna, patent, straight to curved downwards. Largest *pinnules* 20 × 6 mm, oblong-lanceolate, with obtuse to rounded tips, with cordate bases, subsessile, short stalks to 1 mm long, 0.7 – 1 cm between the costules; basal segments not free and remote from the next, rounded to auriculate basiscopically; segments 3.2 × 2.5 mm, not dimorphic, patent to weakly oblique, oblong to rounded, with margins repand, weakly crenate to subentire, appearing entire, segment tips obtuse to rounded; sinuses acute, narrowly triangular, to c. 1 mm wide; 2 – 3 mm between midveins; veins flat or weakly raised on both sides, midveins adaxially not ridged; dull reddish brown adaxially, blackish green abaxially, weakly contrasting with laminar tissue; veins adaxially tapering out before cartilaginous segment margin; veins mostly simple; basal lateral veins rising from midveins. Sori subproximal to proximal, sitting on back of vein, 1 – 1.2 mm diam., each with c. 50 – 60 sporangia, indusia sphaeropteroid, with umbo, dark brown, persisting as fragments in over-mature sori; receptacles raised, globose to columnar, 0.2 – 0.3 mm diam., paraphyses few, clustered at tip of receptacle, flexuous, partially catenate, some scale-like, dark brown, of the same length as sporangia (0.2 – 0.3 mm long). Spores tetrahedral globose, pale orange-brown. *Hairs and scales*: frond axes adaxially with spreading to antrorsely curved multicellular hairs 0.5 – 1 (– 1.5) mm long, dark reddish brown, concolorous or with paler tips, dense on rachis and

Fig. 6. *Alsophila novabritannica.* **A** mid-rachis pinna; **B** apical pinnae; **C** petiole scales; **D** detail of petiole scale margin; **E** pinnule; **F** adaxial fertile segments; **G** hairs on adaxial fertile segments; **H** abaxial sterile segments; **J** abaxial fertile segments at pinnule base; **K** abaxial fertile segment; **L** scales on abaxial fertile segment; **M** sorus. Scale bar: **A, B** 6 cm; **C, F, H** 7 mm; **D, G** 1 mm; **E** 2 cm; **J** 1 cm; **K** 4 mm; **L** 1.5 mm; **M** 0.8 mm. DRAWN BY LUCY T. SMITH.

costae, on costules becoming sparse paler, sparse and mostly white on midveins and lateral veins; abaxially all axes and veins with copious white hairs to 2 mm long, the longest also partially or wholly red, spreading, flexuous; frond axes abaxially with some larger flat to bullate-based scales, linear ones to 4 × 0.5 mm, ovate ones to 2 × 1 mm, whitish, margins erose to lacerate, no marginal setae, on costules and midveins also bullate squamules, matte white to pale brown, 1 × 0.5 mm with acute to subulate tip; veins lacking squamules. Fig. 7.

RECOGNITION. With sphaeropteroid indusia, abundant long hair on the axes abaxially, and bullate scales and squamules on the abaxial laminar surface, *Alsophila parrisiae* is very similar to *A. geluensis* (Rosenst.) R.M.Tryon, but *A. parrisiae* has ovate-elliptic laminae with the basal pinnae somewhat reflexed and no remote small pinnae at the petiole base whereas *A. geluensis* varies between having a pair of small pinnae at the petiole base remote from the rest of the lamina or laminae tapering down to the petiole base. *Alsophila parrisiae* has also generally smaller fronds (to c. 100 – 110 × 25 – 28 cm in *A. parrisiae* vs to 230 × 50 – 90 cm in *A. geluensis*) and pinnules (to 20 × 6 mm vs 40 – 60 × 12 – 15 mm).

DISTRIBUTION. Known only from the type locality in eastern Papua New Guinea (Map 1).

SPECIMENS EXAMINED. PAPUA NEW GUINEA. Morobe: Ekuti Range, Wantut-Aseki Divide, [c. 04°09'S 137°06'E,] 2250 m, 29 May 1977, *B. S. Parris & J. P. Croxall* 6004 (holotype K-00826752/-00826753/-00826754/-00826755; isotypes LAE n.v.).

HABITAT. Growing in *Nothofagus* forest, at 2250 m.

GLOBAL CONSERVATION STATUS. Data deficient (DD). More data are needed on the abundance and distribution of this species.

ETYMOLOGY. Named for Barbara S. Parris (1945 –), collector of the type specimen.

LOCAL NAMES AND USES. None recorded.

NOTES. *Alsophila parrisiae* will key out to *A. geluensis* (Holttum 1963), a variable species with several synonyms, which Holttum (1963) thought to represent a species complex. The differences between the two species lie mainly in the size of the pinnules and presence/absence of pinnae at the petiole bases, as described in the diagnosis. *Alsophila parrisiae* is not identical to any of the synonyms of *A. geluensis*; the types of *Cyathea novoguineensis* Brause, *C. sepikensis* Brause and *C. subspathulata* Brause vary slightly in size of the pinnules but are all generally larger than those of *A. parrisiae*. Furthermore, they all have notably acute to attenuate pinnules tips whereas *A. parrisiae* has blunt to rounded pinnule tips.

There are many understory species of New Guinean *Alsophila* that have pale scales on rachises and petioles that become relatively suddenly dark brown at the very petiole base and on the trunk; scales with white bases and dark tips are found in the transition zone. *Alsophila geluensis* is the best example of this pattern; the same may also be found on the trunk of *A. parrisiae,* although not present in the type material.

8. Alsophila sundueana *Lehnert* **sp. nov.** Type: Papua New Guinea, Madang, Bundi, Plot 3T-P7, near Kiagimangi, 05°48.900'S, 145°09.475'E, 2700 m, 29 July 2014, *M. Lehnert* 2856 (holotype BONN; isotypes LAE, Z).

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Tree fern. *Trunk* 1.1 – 2 m tall, ascending to decumbent, 3 – 5 cm diam., old petiole bases persistent, due to these weakly aculeate, in larger plants rotting off; trunks dark brown to blackish, with scales as on the petioles; adventitious buds not present. *Fronds* to 170 cm long, 2 – 5 in a crown, arching to drooping from ascending petioles. *Petioles* 43 – 60 cm long, near base blackish and with few blunt prickles, in distal parts inermous, medium brown to dark stramineous, on each side with a line of well-spaced elliptic pneumathodes to 3 × 1.5 mm; scurf absent or few appressed castaneous squamellae to 0.5 mm long, without marginal setae; adventitious pinnae absent. *Petiole scales* relatively few in expanded fronds, easily shed, to 12 × 2.5 – 3 mm, lanceolate, shiny, appearing concolorous blackish brown, in backlight margins castaneous, relatively wide, with one larger dark brown apical seta, additional setae absent. Laminae to c. 110 × 50 – 80 cm, bipinnate-pinnatisect to tripinnate-pinnatifid, ovate, apex gradually reduced; adaxially dark green (black in dried specimens), weakly shiny, pale grey green to almost glaucous abaxially. *Frond axes* medium brown to dark stramineous, inermous; insertions of costae into rachis with elliptic pneumathode to 1.5 – 2 × 0.8 mm; costae narrowly green-alate between the pinnules in distal parts. *Pinnae* to 40 × 11 cm, 6 – 7 pinna pairs, most pinnae stalked to 1 cm, subopposite, not overlapping, ± patent, basal pinnae ± ½ the length of longest pinna, patent to weakly reflexed, relatively long stalked to 2 cm, the first basicopic pinnule usually missing. Largest *pinnules* 45 – 65 × 18 – 22 mm, triangular-lanceolate, with long-acute to attenuate tips, with ± cordate bases (basal segments often alternate), short-stalked to subsessile, stalks 1 – 2 mm long, 1.8 – 2.5 (– 3) cm between the stalks/costules; basal segments may be remote from the next and appear free, but are like other segments adnate, connected by narrow strand of green laminar tissue along the costules; segments to 12 × 4.5 mm, not dimorphic, oblique, oblong-deltate, distally weakly falcate, the margins shallowly but sharply crenate to serrulate, segment tips obtuse to acute; sinuses acute, relatively narrow, to c. 1.5 mm, between basal segments slightly wider and more trapezoid; 4 – 5 mm between

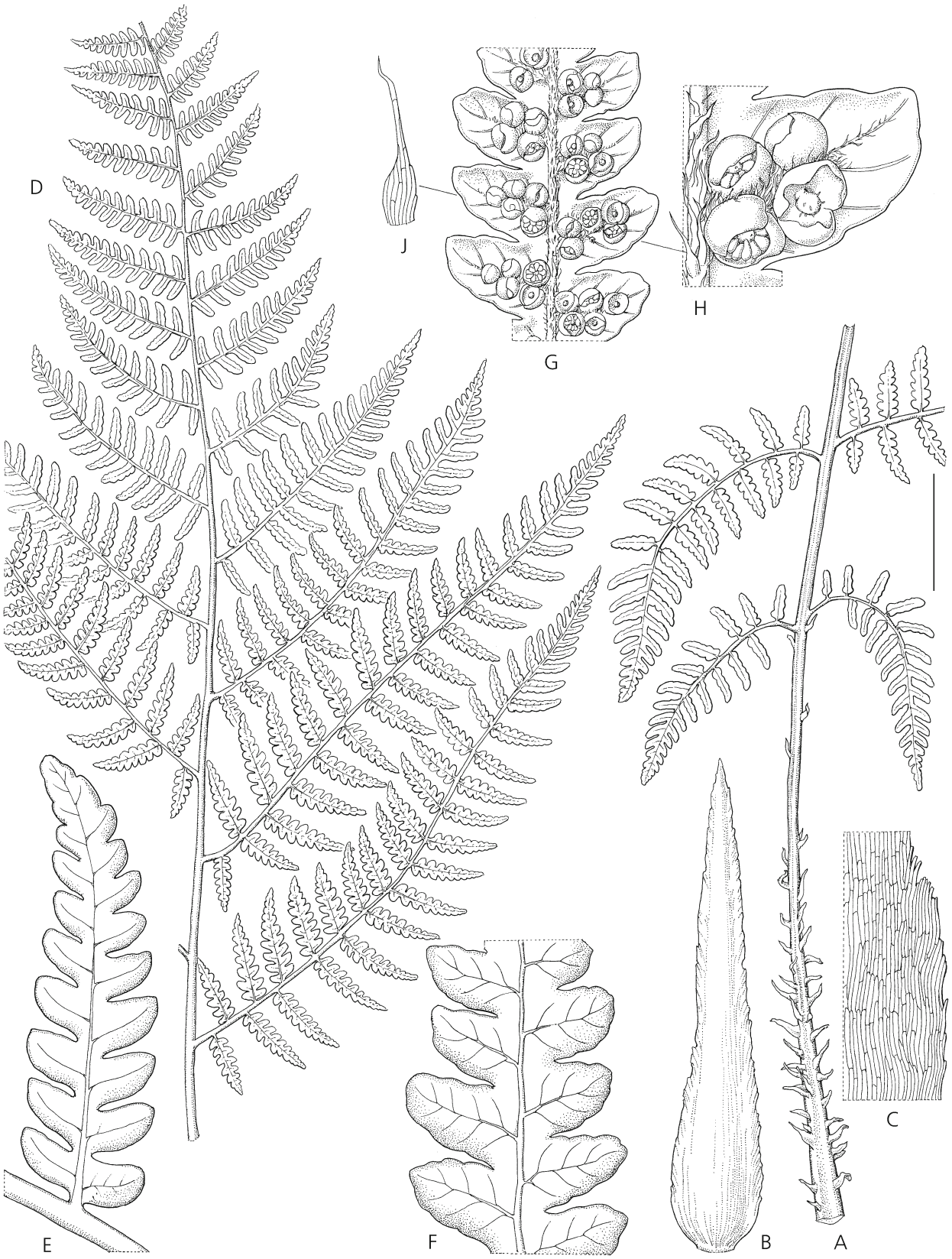

Fig. 7. *Alsophila parrisiae*. **A** petiole; **B** petiole scale; **C** detail of petiole scale margin; **D** pinnae; **E** pinnule; **F** adaxial fertile pinnule; **G** abaxial fertile pinnule; **H** detail of sori; **J** detail scale on abaxial fertile segment. Scale bar: **A, D** 3 cm; **B** 2.2 mm; **C, J** 0.8 mm; **E** 7 mm; **F, G** 4 mm; **H** 2 mm. DRAWN BY LUCY T. SMITH.

midveins; midveins weakly raised on both sides, dull orange-brown, contrasting with laminar tissue, lateral veins adaxially flat, dull orange-brown, abaxially weakly sunken, greenish to partially brown or blackish, not well contrasting with laminar tissue, veins ending in the cartilaginous segment margin; all lateral veins rising from midvein; fertile veins forked. Sori subproximal to proximal, 1 – 1.2 mm diam., each with 30 – 60 sporangia, indusia large discoid to shallowly cyatheoid, shiny dark brown when dry, ± translucent, visible in intact sori, remaining entire in over-mature sori; receptacles raised, globose, 0.3 – 0.5 mm diam., paraphyses few to many, straight, whitish to pale brown, shorter than sporangia. Spores tetrahedral globose, bright yellow. *Hairs and scales*: frond axes adaxially with dark reddish brown (paler in distal parts of costules) spreading to antrorsely curved multicellular hairs 1 – 1.5 mm long, rather dense on rachis and costae, on costules becoming sparse, absent from midveins and lateral veins; frond axes abaxially only with remnants of fine scurf, consisting of appressed dissected squamellae and branched hairs, reddish brown to castaneous, on costae and costules also flat to bullate squamules, reddish brown to castaneous, no marginal setae, flat squamules to 2 × 1 mm, bullate squamules 1 × 0.5 mm; appressed 1 – 2-celled trichomidia to 0.5 mm long, white or with red to black tip, scattered on and between the veins abaxially. Fig. 8.

RECOGNITION. A small *Alsophila* with decumbent trunk and arching fronds with few pinnae (6 – 7 pairs). By the dissection of the frond with triangular-lanceolate pinnules and oblique segments with pointed tips, *A. sundueana* is most similar to the Philippine species *A. latipinnula* and *A. masapilidensis,* but these have larger pinnules (to 65 × 22 mm in *A. sundueana* vs 80 – 120 × 18 – 40 mm in *A. latipinnula* and *A. masapilidensis*) and different indusia (discoid to cyatheoid vs hemitelioid). Another similar species is *A. excelsior*, which in frond dissection and in indusium type (discoid) matches *A. sundueana*, but this species is even larger (e.g. largest pinnules to 65 × 22 mm, stalked to 2 mm in *A. sundueana* vs to 180 × 52 mm, stalked to 7 mm in *A. excelsior*) and has more heavily armed petioles (inermous or with few blunt prickles vs copiously aculeate).

DISTRIBUTION. Eastern New Guinea (Map 1).

SPECIMENS EXAMINED. PAPUA NEW GUINEA. Chimbu Province: Jimi/Wahgi Divide, c. 8 km NE of Kerowagi, Bismarck Range, [c. 05°51'S, 144°54'E,], 2200 m, 9 Aug. 1981, *J. R. Croft & J. I. Marsch* 1380 (K). Madang Province: Bundi, Plot 3T-P1, near Kiagimangi, [05°48.900'S, 145°09.475'E], 2700 m, 28 July 2014, *M. Lehnert* 2855 (BONN), ibid., *M. Lehnert* 2856 (holotype BONN; isotypes LAE, Z). Morobe Province: Mt Kaindi, SW of Wau, below summit, along power line, [c. 07°23'S, 146°39'E], 2200 m, 29 Oct. 1983, *J. R. Croft* 1826 (K); Edie Creek, Mt Kaindi road, [07°20'S, 146°45'E], c. 2130 m [7000 ft], 1 Sept. 1965, *J. S. Womersley* NGF24667 (K). Southern Highlands Province: Subdistr. Ialibu, SE slopes of Mt Giluwe, W of Iaro R., [06°09'S, 143°58'E], 2500 m, 20 Nov. 1974, *J. R. Croft & N. M. U. Clunie* LAE65687 (K, LAE n.v.).

HABITAT. Scattered in the understory of tall forests, mainly along ridges, growing on slightly elevated terrain, like small ledges, humus covered rocks, tree roots and rotten trunks, at 2130 – 2700 m.

GLOBAL CONSERVATION STATUS. Least concern (LC). *Alsophila sundueana* is known from six collections and five localities. It has an EOO of c. 15,400 km^2, which falls within the threshold of Vulnerable in criterion B1. However, with more surveys it is suspected that more localities for this species will be found and the EOO is likely to increase. Furthermore, this species has a relatively large elevational range (2130 – 2700 m). Therefore, this species is assessed as Least Concern.

ETYMOLOGY. The name honours Michael Sundue (1975 –) of Burlington, Vermont, seasoned explorer, experienced botanist, a good colleague and friend.

LOCAL NAMES AND USES. None recorded.

NOTES. This species does not key out in the *Flora Malesiana* treatment (Holttum 1963) if all diagnostic characters are correctly interpreted. *Alsophila sundueana* seems to have very specific requirements to its habitat. Where ML observed it in the field, it was relatively common along paths and trails but mostly sterile.

9. Alsophila telefominensis *Lehnert* **sp. nov.** Type: Papua New Guinea, Sandaun/West Sepik, Telefomin Subdistr., Busilmin, Din R., 05°00'S, 141°05'E, 1500 m, 24 April 1974, *J. R. Croft* LAE-65866 (holotype K; isotypes BM n.v., BRI n.v., L n.v., LAE n.v., US).

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Tree fern. *Trunk* to 3 m tall, otherwise unknown; adventitious buds not reported. *Fronds* to 12 in a crown, to 160 cm wide, other dimensions unknown. *Petioles* sparsely aculeate, brown to reddish brown with an interrupted line of remote elongate pneumathodes on each side, white, continuing on lower rachis; scurf pale, at first very dense, eventually glabrescent, consisting of erect ovate squamellae to 1.5 × 1 mm, with many dark setae or with lacerate margins. *Petiole scales* only present in croziers, soon caducous in fully expanded fronds, ovate-lanceolate, to at least 16 × 1 – 1.5 mm, dull medium brown, one apical seta and few to many lateral setae to 2 mm long (especially near scale base), margins narrow with weakly exserted cell rows. Laminae to 160 cm wide, bipinnate-pinnatisect to tripinnate, dark green adaxially (dark olive when dried), paler grayish green abaxially; apex probably

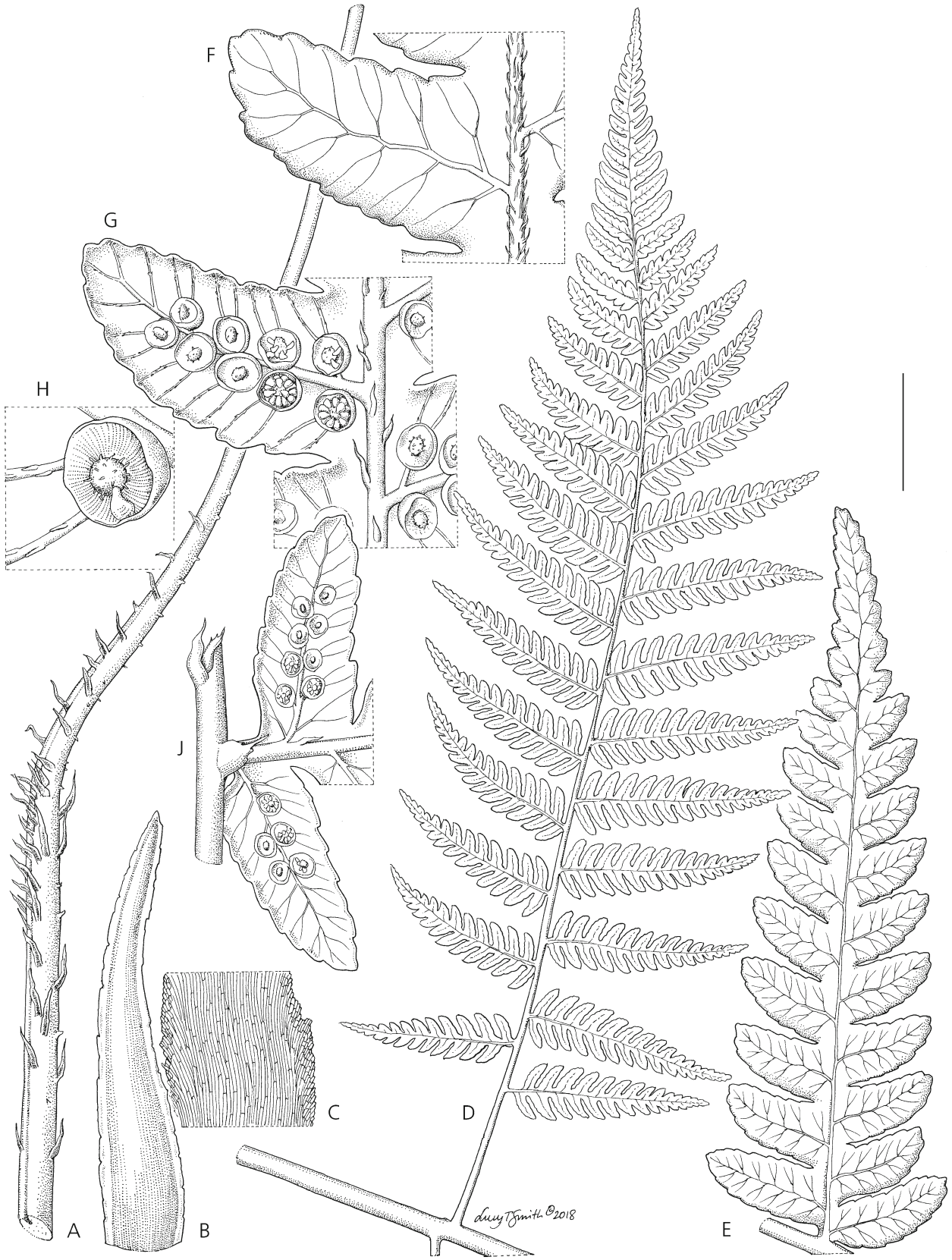

Fig. 8. *Alsophila sundueana*. **A** petiole; **B** petiole scale; **C** detail of petiole scale margin; **D** pinna; **E** pinnule; **F** adaxial fertile segment; **G** abaxial fertile segment; **H** sorus; **J** detail of scales at base of pinnule. Scale bar: **A, D** 3 cm; **B, F, G, J** 2.5 mm; **C, H** 0.8 mm. DRAWN BY LUCY T. SMITH.

gradually reduced. *Frond axes* dark brown, sparsely muricate; costae not green-alate between the pinnules in distal half. *Pinnae* to 80 × 30 cm, broadly lanceolate, subsessile, short stalk 0.8 cm inconspicuous due to reflexed basal pinnules. Largest *pinnules* to 145 × 30 mm, linear-lanceolate to narrowly triangular, with attenuate tips, sessile to subsessile, the stalk to 1 mm long and hidden between the segments, with truncate to cordate bases, c. 2.5 cm between stalks/costules, pinnules fully pinnate in lower half, segments to 16 × 3 mm, linear-oblong, in smaller segments the margins subentire, in larger segments coarsely crenate to inciso-serrate, tips acute, basal segments free, in larger pinnules reflexed over costa, otherwise segments slightly oblique, adnate, connected by an inconspicuous cartilaginous margin or thin strand of green laminar tissue, separated by wide sinuses to 4 mm wide (± equalling width of segments). Midveins weakly raised on both sides, veins flat adaxially, flat to weakly immersed and contrasting dark with laminar tissue abaxially; basal lateral veins arising from the midveins, tapering out before reaching the segment margins; fertile veins forked. *Sori* proximal, to 1 mm diam., each with c. 40 sporangia, deeply orange-brown in fresh material, indusia hemitelioid, small, hidden by intact sori, reaching ¼ or less around the receptacle, dark brown with white lacerate to ciliate distal margin, fragile, may be completely shed; receptacles globose, c. 0.3 mm diam., paraphyses, straight, white, shorter than sporangia, 0.1 – 0.2 mm long. Spores not examined. *Hairs and scales*: frond axes adaxially with pale reddish brown, sometimes translucent multicellular hairs, antrorsely curved 1 mm long, abaxially without hairs; frond axes abaxially with ample but evanescent fine scurf, consisting of white appressed flaky scales, some of them with one to several erect setae, also some pale brown, erect flat squamules <1 mm long with several to many dark marginal setae, generally sparser to absent on costules, some larger flat ovate scales to 4 × 2 – 3 mm, papyraceous, dull brown with blackish, often undulate marginal setae; costules and midveins also with few to many, bullate squamules, mostly 0.5 mm long, whitish, marginal parts maybe wholly or partially reddish brown, some larger bullate scales with dark apical setae; lateral veins abaxially with white appressed unicellular trichomidia, rarely with few bullate squamules as on the costules. Fig. 9.

RECOGNITION. A species similar to *Alsophila latipinnula* in the size and proportions of the pinnules, but the pinnules are sessile to subsessile (vs stalked to 7 mm in *A. latipinnula*) and the basal veins in the segments all coming from the midveins (vs basal veins mostly originating from the costules). *Alsophila telefominensis* differs from *A. weidenbrueckii* Lehnert and *A. archboldii* (C.Chr.) R.M.Tryon in paler scurf (whitish to pale brown vs reddish to orange brown), wider sinuses between segments (to 4 mm wide, often equalling segment width vs 0 – 2 mm wide, less than segment width in *A. weidenbrueckii* and *A. archboldii*) and much smaller indusia (hemitelioid, hidden intact sorus vs subsphaeropteroid to sphaeropteroid, persisting in overmature sori).

DISTRIBUTION. Known only from the type in western Papua New Guinea.

SPECIMENS EXAMINED. PAPUA NEW GUINEA. Sandaun/West Sepik: Telefomin Subdistr., Busilmin, Din R., 05°00'S, 141°05'E, 1500 m, 24 April 1974, *J. R. Croft* LAE-65866 (holotype K; isotypes BM n.v., BRI n.v., L n.v., LAE n.v., US).

HABITAT. Growing at 1500 m.

GLOBAL CONSERVATION STATUS. Data deficient (DD). More data are needed on the abundance and distribution of this species.

ETYMOLOGY. The name refers to the type locality.

LOCAL NAMES AND USES. None recorded.

NOTES. *Alsophila telefominensis* has several look-alikes in Malesia which all differ in having a more complete urn- to cup-shaped indusium (vs indusia hemitelioid in *A. telefominensis*). If the indusium shape is wrongly interpreted, the species may key out to *A. acuminata* (Copel.) R.M.Tryon or *A. latipinnula* from the Philippines, both with similarly large pinnules and remote segments (Holttum 1963).

10. Sphaeropteris kessleri *Lehnert* **sp. nov.** Type: Papua New Guinea, Morobe, Mt Kaindi Repeater Station, 4 km SW of Wau, 07°22'S, 146°41'E, 2100 m, 11 July 1979, *A. Kairo* 717 (holotype K-000856067/-000856067; isotypes BFC n.v., L n.v., LAE n.v.).

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Tree fern. *Trunk* absent, the rhizome creeping to weakly ascending, 2 – 2.5 cm diam., old petiole bases soon shed, leaving circular scars 5 mm diam., obscured by thick (1.5 – 2 mm wide) adventitious roots, thick indurated scales only near the apex; adventitious buds absent. *Fronds* to c. 100 – 110 cm long, c. 3 – 6 per crown. *Petioles* to 35 cm long, medium brown to dark stramineous, inermous, pneumathodes either absent (or inconspicuous in dried material); scurf sparse, inconspicuous, brown, squamellae to 0.5 mm long, erect, with subentire margins; adventitious pinnae absent. *Petiole scales* persisting at petiole bases but small, inconspicous, to 5.5 × 1.5 – 2 mm, ovate-lanceolate, curved, with indurated centres and narrow, thin, undifferentiated margins, matte, concolorous brown to blackish brown, without apical or lateral setae. Laminae to c. 67 × 22 (– 30) cm, pinnate-pinnatifid, linear-lanceolate, apex gradually reduced; adaxially dull dark

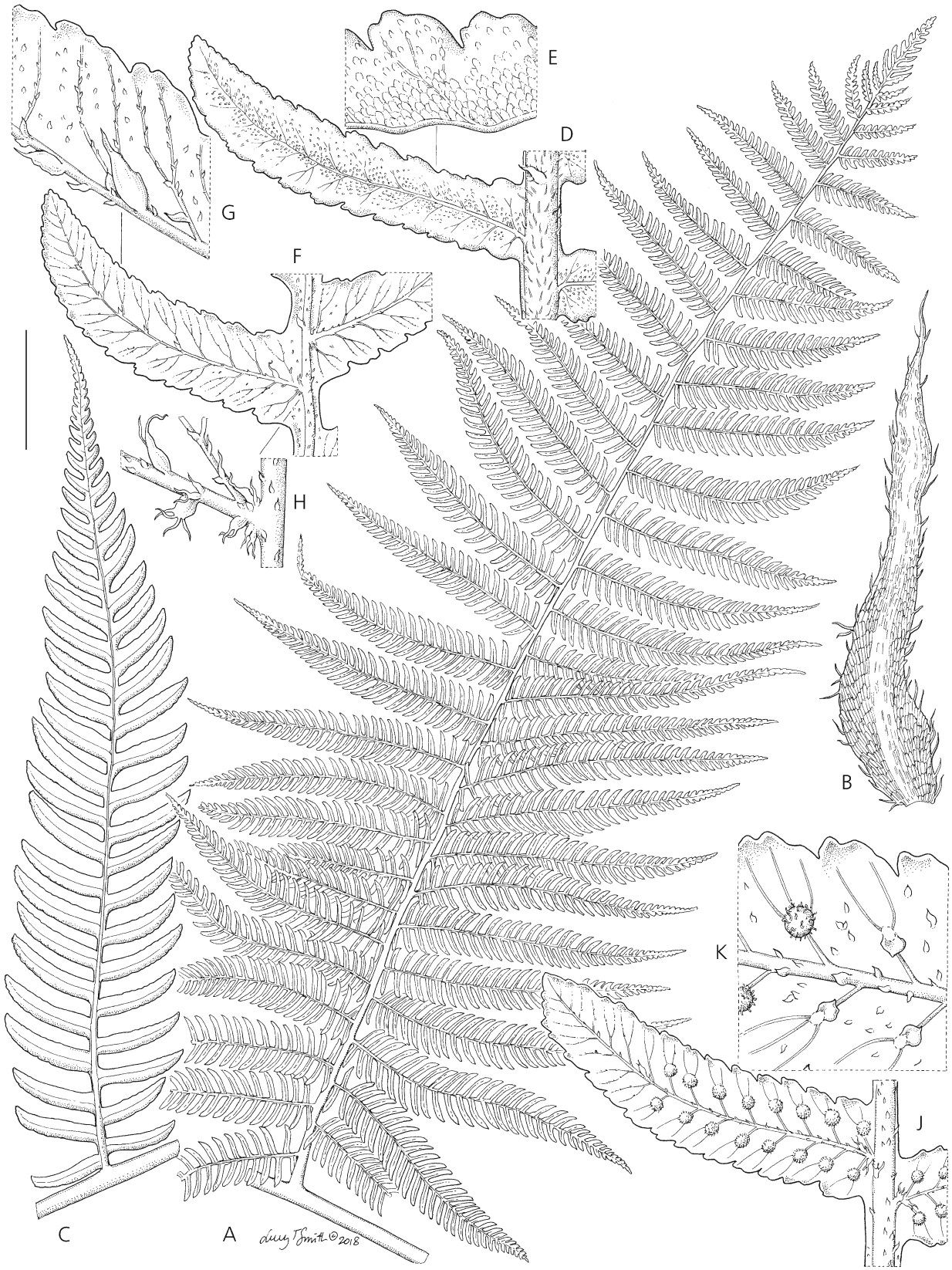

Fig. 9. *Alsophila telefominensis*. **A** pinna; **B** petiole scale; **C** pinnule; **D** adaxial sterile segment; **E** detail of adaxial sterile segment; **F** abaxial sterile segment; **G** detail of scales on abaxial sterile segment; **H** detail of scales at base of abaxial sterile segment; **J** abaxial fertile segment; **K** detail of sori and indusia. Scale bar: **A** 6 cm; **B** 2.5 mm; **C** 2 cm; **D, E, F, J** 5 mm; **G, H** 1.5 mm; **K** 4 mm. DRAWN BY LUCY T. SMITH.

green, paler green abaxially. *Frond axes* medium brown to dark stramineous, costae also blackish, inermous; insertions of costae into rachis without pneumathodes. *Pinnae* to 15 × 1.5 cm, linear-lanceolate with attenuate tips with bluntly serrate margins, 18 – 20 pairs per frond, most pinnae very short-stalked to 1.5 mm, alternate, not overlapping, ± patent, dimorphic, fertile pinnae incised to ½ way towards the costa, sterile pinnae incised to ¼ of the way towards the costa; basal pinnae not reduced, to 11 cm, ± the length of longest pinna, patent to weakly reflexed. Segments (= lobes) 5 – 6 mm wide between the sinuses, ± deltate, oblique, with acroscopically skewed acute tip, forming a coarsely crenate-serrate pinna margin; lobe margins flat, subentire, sinuses acute, triangular; 5 – 6 mm between midveins (= costules), veins raised on both sides, lateral veins abaxially weakly so, midveins adaxially ridged; veins dull reddish brown adaxially, lateral veins abaxially yellowish to blackish, weakly to strongly contrasting with laminar tissue; veins mostly simple, forked veins with branches mostly connivent to anastomosing with themselves; basal basiscopic lateral veins rising from costa, all veins ending above the sinus in the cartilaginous segment margin. Sori ± medial to supramedial in respect to the midveins and an imaginary parallel line going through the sinus, ± 1 mm diam., each with c. 40 – 60 sporangia, indusia sphaeropteroid, pale brown to brown, matte to weakly shiny, persisting in over-mature sori as deep cups or urns with lacerate margins; receptacles raised, globose to columnar, 0.3 – 0.4 mm diam., paraphyses few, flexuous, partially catenate, reddish brown, of the same length as or slightly longer than sporangia (± 0.3 mm long). Spores tetrahedral globose, pale orange. *Hairs and scales*: frond axes [rachis and costa] adaxially with antrorsely curved multicellular hairs 0.5 – 1 (– 1.5) mm long, dark reddish brown, concolorous or with paler tips, relatively sparse on rachis and costae, thinning out towards the frond periphery, hairs absent abaxially and from both sides of midveins and lateral veins; scurf or squamules absent; small reddish trichomidia to 0.5 mm long evenly distributed on and between veins abaxially. Fig. 10.

RECOGNITION. A species of the *Sarcopholis* clade of *Sphaeropteris,* with the typical thickened petiole scales, that is unique in having only pinnate-pinnatifid fronds (all others have at least fully bipinnate fronds).

DISTRIBUTION. Known only from the type in eastern Papua New Guinea (Map 1).

SPECIMENS EXAMINED. PAPUA NEW GUINEA. Morobe: Mt Kaindi Repeater Station, 4 km SW of Wau, 07°22'S, 146°41'E, 2100 m, 11 July 1979, *A. Kairo* 717 (holotype K-000856067/-000856067; isotypes BFC n.v., L n.v., LAE n.v.).

HABITAT. Growing at 2100 m.

GLOBAL CONSERVATION STATUS. Data deficient (DD). More data are needed on the abundance and distribution of this species.

ETYMOLOGY. Dedicated to Michael H. Kessler (1967 –), pteridologist and ecologist, supporter of fern studies in New Guinea.

LOCAL NAMES AND USES. None recorded.

NOTES. *Sphaeropteris kessleri* is the first known species of the *Sarcopholis* clade to have fertile fronds only pinnate-pinnatifid. There are several species of the *Schizocaena* clade of *Sphaeropteris* with a similar habit in western Malesia, such as *S. alternans* and *S. moluccana*. These have thinner, paler scales; the petiole scales of *S. kessleri* are hard to see because they are small, dark brown and confined to the petiole bases, which are often not preserved in specimens. The type collection of *S. kessleri*, however, includes a part of the rhizome with persisting petiole bases. Even in this material, very few scales are present, so they seem to be genuinely scant in this species.

In New Guinea, only *Alsophila lamoureuxii* (W.N.Takeuchi) Lehnert & Coritico has a laminar dissection like *S. kessleri*; both are actually almost identical in appearance but *A. lamoureuxii* has flat scales with differentiated margins (hence its placement in a different genus) and occurs at lower elevations (<1000 m).

New combinations

1. Alsophila albidosquamata (*Rosenst.*) *Lehnert*, **comb. nov.** Type: Papua New Guinea, hinterland of the Sattelberg, April 1913, *C. Keysser* 177 (holotype B-20_0135729).

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Cyathea albidosquamata Rosenst., *Repert. Spec. Nov. Regni Veg.* 12: 525 (Rosenstock 1913).
Sphaeropteris albidosquamata (Rosenst.) R.M.Tryon, *Contr. Gray Herb.* 200: 21 (1970).

DISTRIBUTION. Seram, New Guinea, New Ireland.

NOTES. We have molecular confirmation that this taxon belongs to *Alsophila* and not in *Sphaeropteris* (Lehnert *et al.*, unpublished data), where it was placed by Tryon (1970).

2. Alsophila brachyphylla (*Holttum*) *Lehnert*, **comb. nov.** Type: Malaysia, Sabah, S side Mt Kinabalu above Paka Cave, 06°04'N, 116°34'E. 3050 m, *E. F. Allen* s.n.

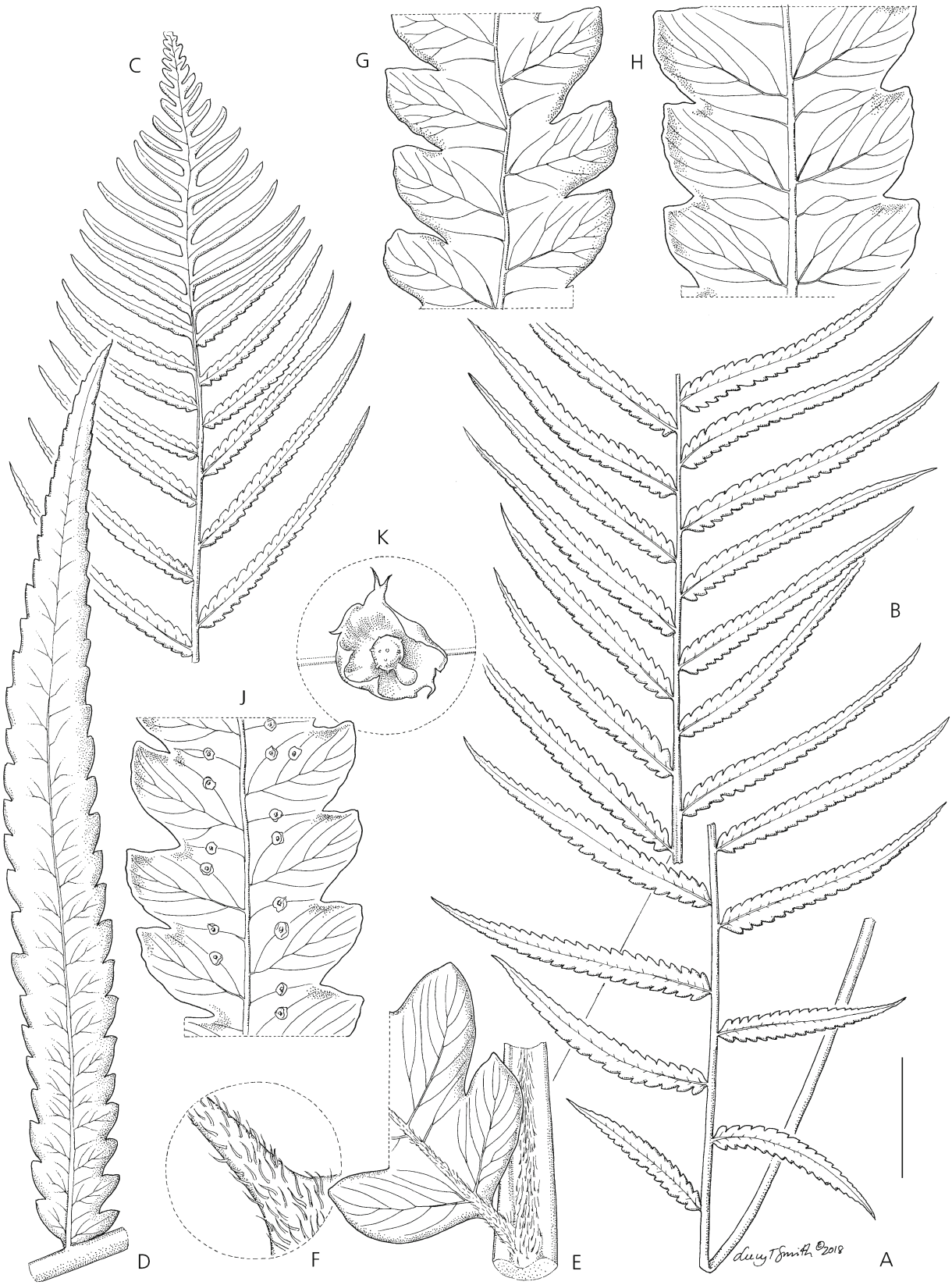

Fig. 10. *Sphaeropteris kessleri*. **A, B, C** parts of pinna; **D** pinnule; **E** detail of hairs on rachis; **F** detail of hairs; **G** portion of fertile adaxial pinnule; **H** portion of abaxial sterile pinnule; **J** abaxial fertile pinnule; **K** sorus. Scale bar: **A, B, C** 6 cm; **D** 2 cm; **E, G, H, J** 7.5 mm; **F** 1.6 mm; **K** 1.1 mm. DRAWN BY LUCY T. SMITH.

(holotype K!-000475297/-000475298/-000475299/000475300; isotype SING n.v.).

http://www.ipni.org/urn:lsid:ipni.org:names:77197836-1

Cyathea brachyphylla Holttum, *Gard. Bull. Singapore* 27: 181 (1974).

DISTRIBUTION. Borneo (Mt Kinabalu).

3. Alsophila exilis (*Holttum*) *Lehnert*, **comb. nov.** Type: Australia, Queensland, Cape York Peninsula, William Thompson Range, Mann Creek, *D. L. Jones et al.* 1212 (holotype K!- 000061782/-000061783/-000061784; isotype BRI).

http://www.ipni.org/urn:lsid:ipni.org:names:60478499-2

Cyathea exilis Holttum, *Kew Bull.* 41: 532 (1986).

DISTRIBUTION. Australia (Iron Range, northern Queensland).
NOTES. A small species very similar to the New Guinean *Alsophila physolepidota*, with prickly petioles and adventitious shoots, differs chiefly in the position of the sori (medial in *A. exilis* vs proximal in *A. physolepidota*).

4. Alsophila nothofagorum (*Holttum*) *Lehnert*, **comb. nov.** Type: Papua New Guinea, Western Highlands Distr., Kubor Range, side-slope in *Nothofagus* forest, 2775 m, 5 Sept. 1963, *R. Pullen* 5358 (holotype K-000826635!/-000826636!/-000826638!/-000826637! [4 sheets]).

http://www.ipni.org/urn:lsid:ipni.org:names:77197835-1

Cyathea nothofagorum Holttum, *Blumea* 14: 327 (1967).

DISTRIBUTION. New Guinea.

5. Sphaeropteris mesosora (*Holttum*) *Lehnert*, **comb. nov.** Type: Papua New Guinea, Eastern Highlands, Kainantu Subdistr., Aiyura, 1740 m, 14 Oct. 1957, *R. G. Robbins* 1032 (holotype L-1281206 [image!]).

http://www.ipni.org/urn:lsid:ipni.org:names:77197846-1

Cyathea mesosora Holttum, *Kew Bull.* 16: 57 (1962).
Alsophila mesosora (Holttum) R.M.Tryon, *Contr. Gray Herb.* 200: 35 (1970)

DISTRIBUTION. New Guinea including Normanby Island.

Lectotypifications

The following two species are also known under different epithets due to the change of genus concepts (Holttum 1963; PPG I 2016). We take the opportunity to repeat the synonymy (Holttum 1963) and update the typification as best as currently possible:

1. Sphaeropteris felina (*Roxb.*) *Pic.Serm.* (Pichi Sermolli 1991: 351). *Polypodium felinum* Roxb. (Roxburgh 1844: 496). *Cyathea felina* (Roxb.) C.V.Morton (1974: 344; as *C. felinum*). Type: Indonesia, Amboyna, [Ambon, Maluku, c. 03°39'S, 128°09'E] *W. Roxburgh* s.n. (lectotype G-00348335 [image!], selected by Morton (1974), putative isolectotype BR-0000006869489 ["Amboina, India, 1863"; image!]).
Alsophila concinna Baker (Hooker & Baker 1874: 459); not *Cyathea concinna* (Baker) Jenman (1891: 4). *Sphaeropteris concinna* (Baker) R.M.Tryon (1970: 22). *Cyathea eminens* Domin (1929a: 262). Type: Papua New Guinea, Louisiade Archipelago, 26 June 1849, *J. Macgillivray* 456 (lectotype K!-000803601, selected here).
Alsophila polyphlebia Baker (1876: 104), not *Cyathea polyphlebia* Baker (1883: 303). *Alsophila polyphlebia* Domin (1929b: 218). *Cyathea aruensis* Domin (1929a: 262). Type: Indonesia, Aru Island, Molucca Islands, Sept. 1874, *H. N. Moseley* s.n. (lectotype K!-000803487, selected here).
Alsophila sangirensis Christ (in Diels 1899: 138; Warburg 1900: 90). *Cyathea sangirensis* (Christ) Copel. (Copeland 1909: 37). Type: Indonesia, Molucca Islands, Sangihe Island, *O. Warburg* 16605 (B n.v.).
Alsophila scaberula Christ (in Schumann & Lauterbach 1901: 110). *Cyathea scaberula* Domin (1929a: 263). Type: Papua New Guinea: "Neuguinea, Samoahafen", 5 Aug. 1890, *C. A. G. Lauterbach* 729 (P-02142024 [image!], S-P-3447 [image!]).
Cyathea scabriseta Copel. (Copeland 1914: 2). *Alsophila scabriseta* (Copel.) Alderw. (Alderwerelt van Rosenburgh 1917: 73). Type: Papua New Guinea, "Papua", *C. King* 444 (holotype MICH-1190274 [image!]; isotype MICH-1191158 [fragment of the holotype]).
Alsophila okiana Alderw. (Alderwerelt van Rosenburgh 1916a: 4). *Cyathea okiana* (Alderw.) Alderw. (Alderwerelt van Rosenburgh 1918: 14). Type: Indonesia: "Boeroe" [Buru], Oki [c. 03°47'S, 126°50'E], *J. E. Teysmann* 1822 (holotype BO?, isotypes U-0007870 [image!], US-00134788).

Alsophila rumphiana Alderw. (Alderwerelt van Rosenburgh 1916b: 104). *Cyathea rumphiana* (Alderw.) Merr. (Merrill 1917: 63). Type: Indonesia. Ambon, "Hitoe messen" [Hitu Messing], 175 m, 14 Oct. 1913, *Robinson* 463 (lectotype, L-0051403, selected here, isolectotypes K-000706189/-000706190, MO-255951/-255952).

Alsophila buruensis Rosenst. (Rosenstock 1917: 1). *Cyathea buruensis* Domin (1930: 102). Type: Indonesia, Buru, 1859, *de Vriese* 145 (lectotype L!-0051395, selected here; isolectotypes K!-000706191, L!-0051396); excluded element *de Vriese* 431 (cited syntype, not located).

Alsophila scaberulipes Alderw. (Alderwerelt van Rosenburgh 1924: 2). *Cyathea scaberulipes* (Alderw.) Domin (1930: 174). Type: Indonesia, Papua [Irian Jaya], Prauwen bivouac, 21 Aug. 1920, *H. J. Lam* 868 (L!-0051398/-0051399, MICH-1191158 [fragment], U-0007313, US-00134799 [fragment]).

Cyathea brassii Copel. (Copeland 1929: 175). Type: Papua New Guinea, Aisa R., 15 May 1926, *L. J. Brass* 1421 (holotype A?, isotypes BRI!-AQ0024678, GH-00020810/-00020811[image!], MICH-1190210 [image!]).

DISTRIBUTION. Borneo to New Guinea and adjacent islands, south to Queensland, Australia.

NOTES. Many specimens still carry the names *Cyathea sangirensis* and *Sphaeropteris concinna*. Given the wide range and little understood variability of the species in the *Sphaeropteris* s.s. clade, some of the synonyms may be revalidated after a combined effort of field work and herbarium studies. We postpone the lectotypifcation of some synonyms because the material has not been studied yet.

It is stated in the introduction to Copeland's descriptions of *Cyathea scabriseta* (Copeland 1914) and *Cyathea brassii* (Copeland 1929) that they were based on one specimen sent to him or to the respective herbarium for determination. Following the arguments of McNeill (2014), we can thus claim that these specimens fulfill the requirements for holotypes, even if duplicates in other herbaria exist. Similarly, Alderwerelt van Rosenburgh (1916a) added "HB" after the specimen information in the description of *Alsophila okiana* and several other species, which may be an abbreviation for Herbarium Bogoriense (BO). Stafleu & Cowan (1979) state that most of Alderwerelt van Rosenburgh's herbarium is still in Bogor. If a specimen of *Teysmann* 1822 can be located there, it should be treated as holotype. Contrary to that, the publication of *A. rumphiana* gives the information that the collection is to be distributed without giving the then current location or any potential recipients. In this case a lectotypification is warranted.

2. Sphaeropteris ledermannii (*Brause*) *R.M.Tryon* (1970: 22). *Cyathea macrophylla* Domin (1930: 133), new name for *Hemitelia ledermannii* Brause (1920: 60). Type: Papua New Guinea, Sepik, Kaiserin-Augusta-Fluß-(Sepik-)Gebiet, Felsspitze, 1400 – 1500 m, Aug. 1913, *C. L. Ledermann* 12533 (lectotype B!-20_0135628/-20_0135631/-20_0135632 [3 sheets], selected here); excluded elements *C. L. Ledermann* 12533 (B!-20 _0055225; mislabelled = *Dryopteris ensipinna* var. *acuminata* Brause), *C. L. Ledermann* 12925b (cited as syntype, not located).

≠ *Cyathea ledermannii* Brause (1920: 56). = *Alsophila crassicaula* R.M.Tryon (1970: 33).

≠ *Alsophila ledermannii* Brause (1920: 76). = *Alsophila hornei* Baker (1879: 293).

DISTRIBUTION. New Guinea and adjacent islands.

NOTES. Presumably the largest species of the *Fourniera*-clade (Korall *et al.* 2007) with "trunks 4 – 5 m tall, thick as a man" (*Ledermann* 12533), and fronds to 7 m long. Not seen in the field but judging from descriptions and herbarium material similar in appearance to *Sphaeropteris atrospinosa* of the *Sphaeropteris* s.s. clade, with pale scales and large black prickles on trunk and petioles forming a good contrast.

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