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Authors: Poulsen, Axel Dalberg, Pomoso, Philip, and Magun, Thomas

Source: Willdenowia, 52(2) : 153-165

Published By: Botanic Garden and Botanical Museum Berlin (BGBM)

URL: https://doi.org/10.3372/wi.52.52201

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Willdenowia
Annals of the Botanic Garden and Botanical Museum Berlin

Three species of *Etlingera* (*Zingiberaceae*) recollected in the footsteps of Rudolf Schlechter in Papua New Guinea

Axel Dalberg Poulsen[1], Philip Pomoso[2] & Thomas Magun[3]

Version of record first published online on 23 June 2022 ahead of inclusion in August 2022 issue.

Abstract: The German botanist, F. R. R. Schlechter, collected three species of *Etlingera* around 1907 in "Kaiser-Wilhelmsland", now the northern part of Papua New Guinea. Based on these collections, Valeton described three new species in 1914 in *Geanthus*, but the types collected by Schlechter kept in the Berlin Herbarium were lost during the Second World War. Using a map published by Schlechter in 1911, it was possible to pin down where the types had been collected, and during fieldwork in November 2019 these species were recollected near their type localities. Two of the species had meanwhile been collected from several other places in Papua New Guinea. The current paper includes much improved descriptions and illustrations (ink drawings and a plate with colour photographs) of the three species. Lectotypes are designated for *E. densiuscula* and *E. grandiflora* and a neotype is designated for *E. vestita*.

Keywords: *Etlingera*, *Geanthus*, Papua New Guinea, Rudolf Schlechter, typification, Valeton, *Zingiberaceae*

Article history: Received 20 February 2022; peer-review completed 31 March 2022; received in revised form 12 April 2022; accepted for publication 26 April 2022.

Citation: Poulsen A. D., Pomoso P. & Magun T. 2022: Three species of *Etlingera* (*Zingiberaceae*) recollected in the footsteps of Rudolf Schlechter in Papua New Guinea. – Willdenowia 52: 153–165. https://doi.org/10.3372/wi.52.52201

Introduction

New Guinea harbours an impressive richness of plant species (Cámara-Leret & al. 2020) and several families, including the *Zingiberaceae*, are in need of revision. Currently, 204 species in 14 genera are listed for this family in New Guinea (Cámara-Leret & al. 2020). Although some of the 14 genera will be sunk in the near future, others are likely to be reinstated or described as new, especially once the recircumscription of the polyphyletic genus *Alpinia* Roxb. has been completed (Kress & al. 2007). Three-quarters of the new ginger species collected in New Guinea were first authored by T. Valeton (85 species), K. M. Schumann (35) and H. N. Ridley (31), and 85% of the 204 species were described more than 100 years ago, and since then no revision of the family or a single genus has been published.

Friedrich Richard Rudolph Schlechter (1872–1925) was a German botanist based in Berlin and is perhaps most famous for his taxonomic work on orchids. Schlechter spent two periods (1901–1902 and 1907–1909) in New Guinea (Van Steenis 1950), where he spent most of the time in search of rubber-producing plants (Schlechter 1911) but also contributed to the early documentation of the species richness of *Zingiberaceae* in Papua New Guinea. It is not known how many ginger species Schlechter collected there, but 40 of them are types, which makes him one of the most prolific collectors of types in New Guinea.

All Schlechter's collections of *Zingiberaceae* were made in what at that time was referred to as Kaiser-Wilhelmsland, the mainland part of German New Guinea. Today, this is the northern half of the mainland part of Papua New Guinea (PNG). Schlechter also visited the Bismarck Archipelago, another part of German New Guinea and PNG, but there is no evidence he collected any gingers there. Those of Schlechter's collections known to be types (incl. syntypes) comprise 36 ginger taxa currently placed in the following genera: *Alpinia* (3 species), *Amomum* Roxb. (1), *Etlingera* Giseke (3), *Pleuranthodium* (K. Schum.) R. M. Sm. (9) and *Riedelia* Oliv. (18 species and two varieties). Most of these (75%) were described by Valeton; the rest by Schumann.

All types in the Berlin herbarium, except that of *Riedelia longirostra* Valeton (*Schlechter 17127*), were lost when the building burned in 1943 in the fire caused by the bombing by allied planes. A dozen duplicates are still intact in the herbarium in Paris (P) and a few are in BR and E, but the destruction of the types in Berlin poses a taxonomic challenge, not least for revisions of gingers in New Guinea.

1 Royal Botanic Garden Edinburgh, 20A Inverleith Row, Edinburgh EH3 5LR, Scotland, United Kingdom.
2 National Forest Service, Madang Provincial Office, Madang, Papua New Guinea.
3 Forest Research Institute, Lae, Papua New Guinea.
Author for correspondence: Axel Dalberg Poulsen, apoulsen@rbge.org.uk

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The three species of *Etlingera* of which Schlechter collected the types were described in 1914 by Valeton, who placed them in the genus *Geanthus* Reinw. This genus name is illegitimate and a synonym, as pointed out by Burtt & Smith (1986) when reinstating *Etlingera*. Despite not having seen any of the type collections by Schlechter, this synonymy must have been sufficient evidence for Smith (1986) to place *G. densiusculus* Valeton, *G. grandiflorus* Valeton and *G. vestita* Valeton in *Etlingera*. This genus is the focus of an ongoing revision by the first author and is characterized by flowers with a staminal tube (Poulsen 2006). New Guinea currently harbours 19 species of this genus, including *E. frederikii* A. D. Poulsen, which is endemic to the island of Bougainville (Poulsen & Bau 2017), and *E. elatior* (Jack) R. M. Sm., the occurrence of which east of Wallace's Line is likely anthropogenic (Poulsen 2012). The revision of the genus *Etlingera* in New Guinea will undoubtedly lead to the description of several new taxa, but in order to conclude that these really are new, it is fundamental to fully understand those that have already been described. The aim of the present paper is to reach a better morphological understanding of the three species of *Etlingera*, the types of which were collected by Schlechter.

Material and methods

Fieldwork was conducted in Papua New Guinea during several expeditions since 2001 following standard botanical methods similar to those used in Poulsen 2012, bearing in mind that in order to maximize the diagnostic value of a ginger collection, flowers must be pickled immediately when discovered in the field. The variation in fruit morphology is also useful and also better preserved in a pickled collection (Poulsen 2006, 2012). The botanical terminology otherwise largely follow Beentje (2010) and indumentum types follow Hewson (1988). Herbarium material was studied from 11 herbaria (B, BM, BO, BR, E, FI, K, L, LAE, P, SING, herbarium codes according to Thiers 2022+). We used *Flora malesiana* volume 1 (Van Steenis 1950) to get an overview of Schlechter's travels in New Guinea and a wonderful foldout map entitled "Im Gebiete von Mittel-Kaiser-Wilhelmsland" in Schlechter (1911) (Fig. 1) to pin down the localities of his collections inland of Astrolabe Bay while simultaneously comparing the area to Google Earth (https://earth.google.com/). Schlechter (1911) also included two other maps of the Torricelli mountains and the Finisterre mountains, but these included very few place names and none matching those mentioned in the protologues or written on herbarium specimen labels. From the literature and labels, there are a few type localities (Djamu, Dischore, Njoruge at Ambo and Siu) of ginger types that could not yet be found on any maps, but these are not relevant to the present focus on the three species of *Etlingera*.

Results

Tracing *Etlingera* collections made by Schlechter

Despite intensive searches in several herbaria, it was only possible to find a few ginger collections made by Schlechter, and it soon became obvious that new collections made near the type localities would be desirable to get more details of their morphology. Even if the place names are known from the literature, they are often not possible to find on present-day maps. Schlechter's map (Fig. 1) was really useful for matching place names given in the original publications and on existing specimen labels. Table 1 includes seven localities, all in present-day Madang Province, Papua New Guinea, of which only two, Boroai and Mt Gati, are needed for finding type localities of the three species that are the focus of the present paper. In addition, the map includes five other type localities of gingers collected by Schlechter (presented in Table 1 for potential future use). The coordinates of these georeferenced localities were essential when setting targets for the fieldwork, and the collections made on 1 November 2019 all matched the protologues of the three species in question. Furthermore, all had a staminal tube confirming that their generic placement made by Smith (1986) was correct. These recent collections significantly contributed to a better understanding of the morphology of the three species below.

1. *Etlingera densiuscula* (Valeton) R. M. Sm. in Notes Roy. Bot. Gard. Edinburgh 43: 244. 1986 ≡ *Geanthus densiusculus* Valeton in Bot. Jahrb. Syst. 52: 56. 1914. – Type: NE New Guinea [Papua New Guinea], forest at Mt Gati, 600 m, *F. R. R. Schlechter 16789*, date unknown [presumably 1907] (B [assumed lost in Second World War]). – **Lectotype (designated here):** [icon] "*Geanthus densiusculus*" in Valeton in Bot. Jahrb. Syst. 52: 57, fig. 1A–C. 1914. – **Epitype (designated here):** Papua New Guinea, Madang Province, above Alibu village, at Waliango [stream], streamside in primary forest, 05°32'53"N, 145°42'13.6"E, 270 m, 1 Nov 2019, *A. D. Poulsen, T. Magun, P. Pomoso, J. Said & K. Kali 3189* (LAE; isoepitypes: B, E [4 sheets: E01024197, E01024198, E01024199, E01024200; pickled material]). – Fig. 2A–C, 3, 6A–D.

Description — Terrestrial herb. *Rhizome* long-creeping, 0.8–1.2 cm in diam., golden sericeous, scales to 4.7 cm long, narrowly ovate, sericeous at base; stilt roots absent (rarely with strong, ± vertical supportive roots). *Leafy shoots* 2–3.3 m long, 50–90 cm between neighbouring leafy shoots; base to 4.5 cm in diam., reddish brown, tomentose, sericeous at base; sheath reticulate especially in upper part, pale greenish brown sometimes tinged orange-brown, tomentose, margin ciliate; ligule 2–3(–10) mm long, apex truncate to retuse, ± splitting to become shallowly bilobed, pale green ± tinged red, coarsely pubescent, margin ciliate; petiole 3–10 mm long, ± tomentose adaxially; lamina narrowly elliptic to narrowly

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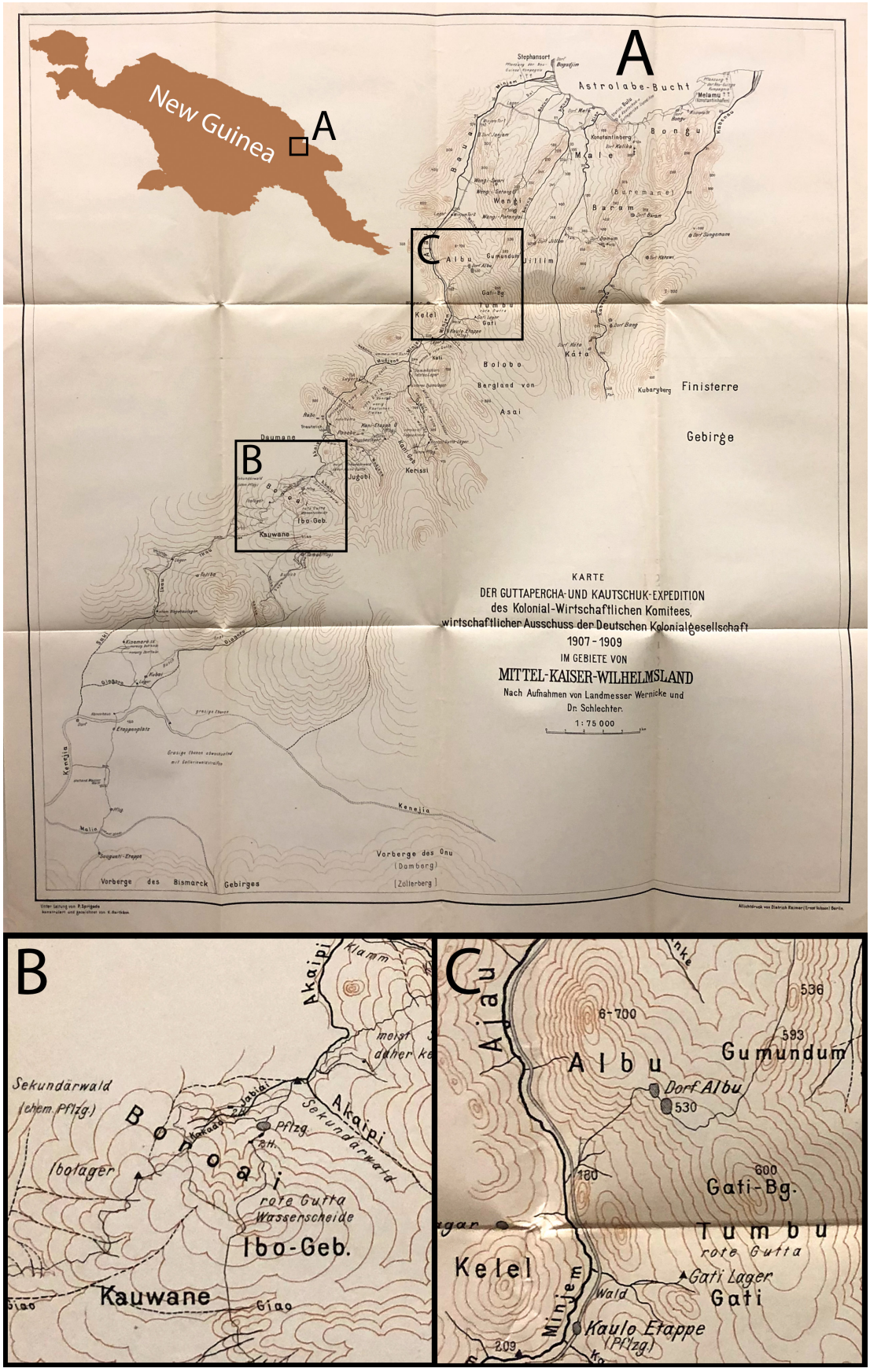

Fig. 1. Map of parts of the area SW of Astrolabe Bay (Schlechter 1911). – A: inset indicating the area in New Guinea. – B: area at Boroai enlarged; C: surroundings of Alibu village (“Dorf Albu”) and Mt Gati (“Gati-Bg.”) enlarged.

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Table 1. Place names found in the map "Im Gebiete von Mittel-Kaiser-Wilhelmsland" (Schlechter 1911) and georeferenced using overlay with Google Earth. Seven type localities are indicated in boldface.

On map of Schlechter (1911)	Alternative spelling	Source of alternative spelling	Feature	Latitude, longitude
Boroai			area SW of the point placed where the elevation is c. 600 m as written on Schlechter's label	05°38'57.01"S, 145°36'38.58"E
Ibo			mountain	05°39'59.30"S, 145°36'58.15"E
Kani	Kami	Valeton (1914) misreading the label (P00686680, P00686681, P00686682)	mountain range	05°38'44.19"S, 145°39'56.08"E
Bolobo	Balobo	Valeton (1914) misreading the label (P00686701, P00686702, P00686703)	general mountainous area, not clearly defined, mapped as "Bolobo Bergland von Asai"	05°37'08.22"S, 145°43'08.70"E
Gati			mountain	05°34'33.43"S, 145°42'59.10"E
Gati Lager			German storage hut set in a more general area also labelled Gati	05°34'53.56"S, 145°42'31.40"E
Male	**Malle**	label of Schlechter 16218 (P00686683, P00686684, P00686685) suggests that the name in the map should have a second "l"	area	05°30'33.90"S, 145°46'20.92"E
Bulu			German storage hut	05°29'27.98"S, 145°46'53.04"E

obovate, 41–68 × 8.5–12 cm, length/width ratio 4.3–4.8, smooth, mid-green adaxially, pale green or tinged pinkish brown abaxially, sometimes in diffuse bands, tomentose on midrib adaxially (at least near base), elsewhere glabrous or variously tomentose; base obtuse to cuneate; apex to 1.5 cm caudate; margin ciliate. *Flowering shoot* (5.5–)6.5–9(–14) cm long, arising from rhizome; peduncle 1–4.5 cm long, pubescent; peduncular bracts to 4.7 × 1.5 cm, upper longest and covering spike (reaching 5–10 mm short of apex of longest fertile bracts), narrowly ovate, canaliculate, cream to pale brown ± tinged red, bifid, margin membranous, ragged, ± puberulous at apex, shortly mucronate; spike at ground level, 5–8(–10) cm long (including flowers); receptacle 1–2 mm long, slightly convex, with (1 or)2 or 3(–5) flowers, 1(or 2) open at a time, flowers extending vertically 2.5–4.5 cm above bracts (apex of labellum distanced 3.5–7 cm from apex of supporting bract); spike (only including bracts) cylindric, ± flattened or angled, (2–)3–4.5 × 0.8–1.5 cm; sterile bracts absent; fertile bracts 2.3–5.5(–7) × 0.9–1.5 cm (when flattened), oblong to narrowly obovate, canaliculate, apex rounded to slightly emarginate, cucullate, shortly mucronate, ciliate, pale red, darker toward apex, slightly puberulous, at least at base; pedicel below insertion of bracteole, 1–1.5(–6) mm long, sericeous; bracteole 2–4.5 cm long, pale red, darker toward apex, with 2 fissures (rarely 1) of 0.4–1.2 cm, ± puberulous, more so at base and apex, apex 2-dentate, 1 tooth with a subapical mucro, apex c. 3 cm short of apex of calyx. *Flower* 6.5–10.5 cm long, red; calyx 4–6.8 cm long, reaching 7–18 mm short of base of anther and 20–26(–38) mm short of apex of corolla lobes, pale red, darker toward apex, with 1–3 fissures of 0.15–2.3 cm, ± puberulous, especially in lower 1/3, apex 3-toothed; floral tube 4.6–8.5 cm long, pale pinkish red, with very few appressed long hairs, tube inside with scattered hairs especially abaxially in staminal tube indumentum extending onto labellum; lobes red, glabrous or slightly ciliate at apex, reaching 8–22 mm beyond apex of stamen; dorsal lobe 22–39 × 7–12 mm, narrowly obovate, apex rounded, cucullate; lateral lobes 36–40 × 6–7 mm, narrowly obovate, apex rounded, cucullate, attached ± straight to tube, inserted 0–6 mm below dorsal lobe; staminal tube 8–19 mm long, cream to pink; labellum ± oblong, 26–35 × 12–17 mm, angled 150°–180° to floral tube, pink, ± villose abaxially in lower 2/3–3/4, lateral lobes clasping sides of but not covering stamen, margin revolute, central lobe appearing ± orbicular, apex rounded to truncate, sometimes retuse, margin ± crenate, extending 16–26 mm beyond apex of anther, margin revolute, crisped; stamen 7–10.5 mm long, cream to pale red; filament 1–2(–3) × 2–3.2 mm, pale pink; anther 6–9 × 3–4 mm, elongate, slightly broader just below apex, slightly spurred (< 1 mm), angled 140°–170°, pink at base, cream in upper part, anther crest slightly emarginate (0.3–1 mm), rarely truncate; thecae dehiscent from base to 0–1 mm from apex, pubescent; ovary 6–8 × 2.5–4.5 mm, oblong to narrowly ovoid, densely sericeous; epigynous gland 5–8 mm long, elongate, unevenly bilobed, split to base adaxially and c. 2 mm from apex abaxially, apex rounded to unevenly lobed; style 6.5–9.9 cm long, with

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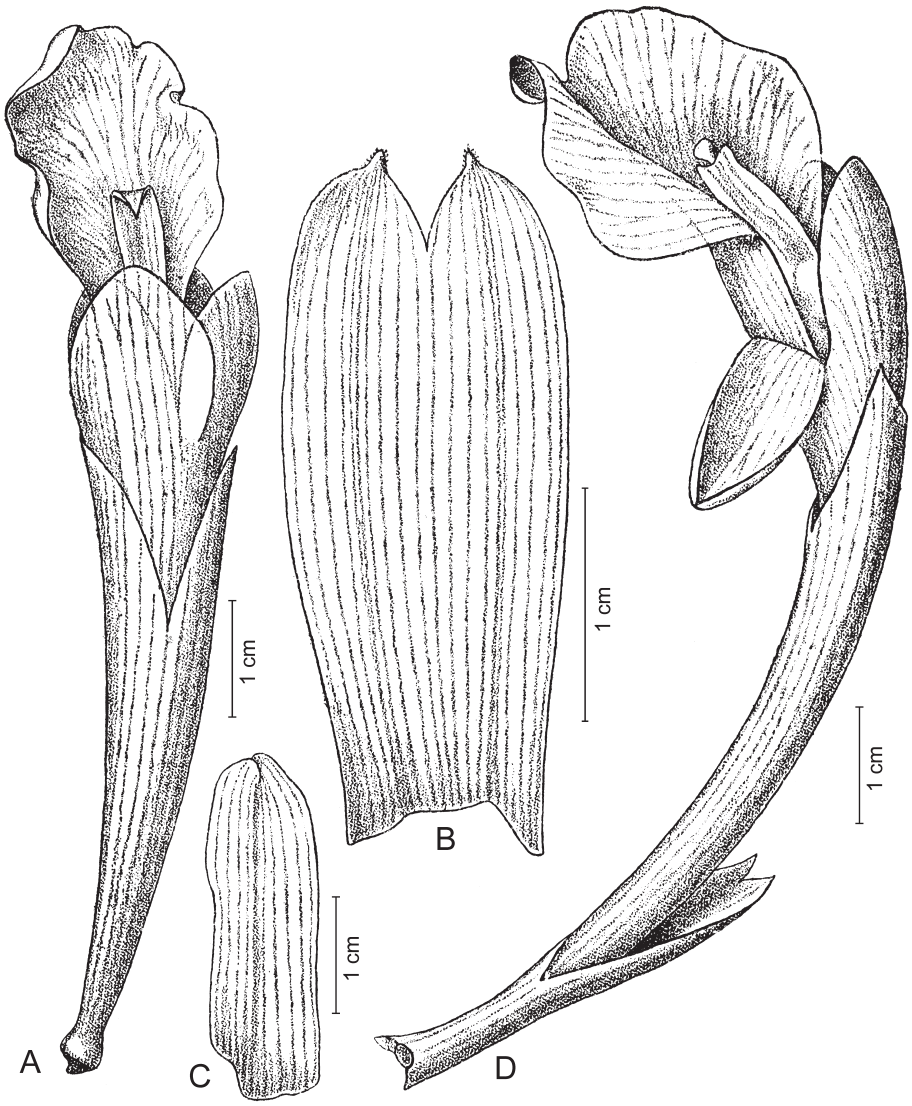

Fig. 2. Illustrations of two species of *Etlingera* reproduced from Valeton (1914: fig. 1). – A–C: lectotype of *E. densisucula*; A: flower; B: bracteole; C: bract. – D: lectotype of *E. grandiflora*, flower. – Scale bars: 1 cm, replacing the original fractional magnifications of the original published drawings.

a few hairs just below stigma; stigma 2–2.5 mm wide, cream (rarely tinged pink), club-shaped, flat-topped, ± verrucose, with scattered hairs, ostiole on a short tube-like extension, transversely elliptic, 1.4–1.8 mm wide, facing downward. *Infructescence* subterranean, 4–7 cm long, peduncle 1–4 cm long, head to 2.5 × 4 cm, semiglobose, flattened on 1 side, bracts and bracteole partly persistent, with 1 or 2 fruits per head; pedicel to 2 mm long. *Fruit* 1.4–2.2 × 1.5–2.2 cm, globose to ellipsoid, rounded-angular or flattened on 1 side, purple-brown, densely white-velvety, base of calyx remaining (3–9 mm long). *Seeds* 3–3.5 × 2–4 mm, flattened, verrucose.

Distribution and ecology — Papua New Guinea, known from eight localities in four provinces, thriving in primary lowland evergreen forest, 270–600 m elevation.

Conservation status — Least Concern (Poulsen 2020a).

Etymology — The specific epithet means "moderately dense", possibly referring to the flower head.

Vernacular name and uses — mbsang (Amung language, *Poulsen & al. 3189*), no uses informed, tastes sour-aromatic similar to *Etlingera elatior* (Jack) R. M. Sm.; momo waimamo (Nabak language, *Poulsen & al. 3129*), used as substitute for betel nut (*Areca cathechu* L.).

Remarks — Deciding that the species was new, Valeton (1914) mentioned that the flower is similar to other *Geanthus* species but that only the almost circular apex of the corolla lobe is peculiar. Furthermore, the very short bracteole and bracts, which are compressed into a dense rounded inflorescence, and the short peduncle are very characteristic of the species. At that time, few species had been collected, and following major exploration in the last 20 years (e.g. Poulsen 2006, 2012) it is known that a dense spike with a short peduncle is not rare in *Etlingera*.

Because all the herbarium collections are assumed to have been lost in Berlin and no duplicates could be found elsewhere, all that remains of the original material is the drawing published by Valeton (1914: 57, fig. 1A–C). This is, however, confusing in that the incision between the corolla lobes and the floral tube is extremely short and unlike any collections of *Etlingera* examined to date. Perhaps the flower examined was already dry or no attempt was made by the artist to investigate and draw where the lobes were attached to the floral tube. It would have helped tremendously if a single flower had been freed and the lobes spread out like in Fig. 3D here; in the original drawing only the apex of the anther is visible (Fig. 2A here). A further discrepancy is that Valeton described the anther as sessile, whereas in the material studied here the filament may in rare cases be up to 3 mm long. To make up for this ambiguity, an epitype (*Poulsen & al. 3189*), which contains all vegetative and fertile characters, is designated here. This was collected about 3.4 km from

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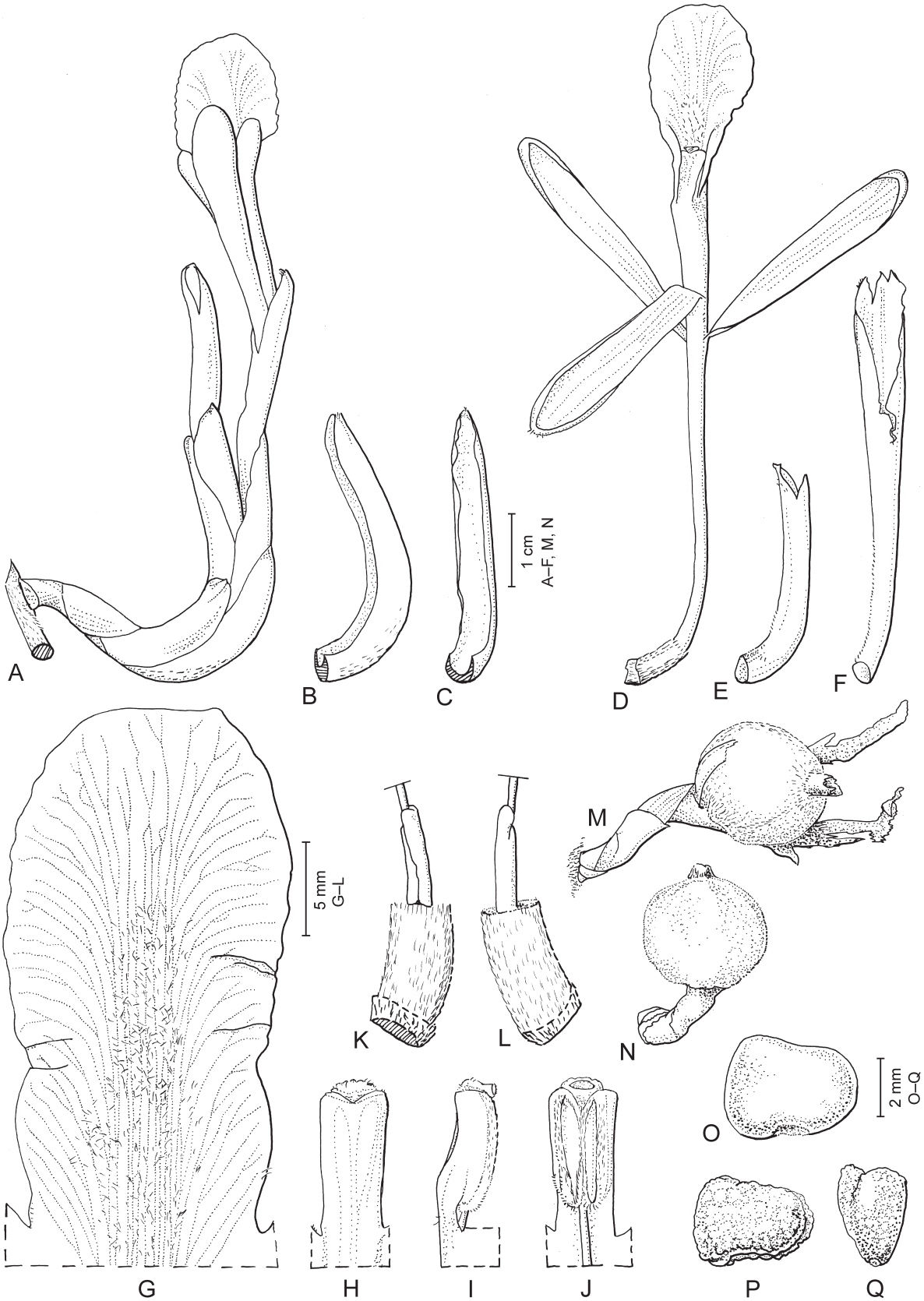

Fig. 3. *Etlingera densiuscula* – A: inflorescence with two flowers; B: fertile bract, lateral view; C: fertile bract, adaxial surface; D: flower, bracteole and calyx removed; E: bracteole; F: calyx; G: labellum, flattened, adaxial surface; H: stamen, adaxial surface; I: stamen, lateral view; J: stamen, abaxial surface; K: ovary and epigynous gland, adaxial surface; L: ovary and epigynous gland, abaxial surface; M, N: infructescences with one fruit each; O: seed with aril; P: seed with aril removed, view from side; Q: seed with aril removed, view from narrow end. – All from Poulsen & al. 3189 (E), isoepitype. – Drawn by Axel Dalberg Poulsen.

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the type locality at Mt Gati and includes not only flowers but also fruits, which are described here for the first time. The lengths of flower, bracteole, calyx and floral tube are highly variable, but the calyx is roughly twice as long as the bracteole.

Valeton (1914) did not mention a collection date for *Schlechter 16789*, but the year 1907 was inferred after placing several collections in sequence according to collection number.

Selected specimens — Papua New Guinea: Madang Province: Ramu Nickel Mine, 750 m, 5 Nov 2019, *Poulsen & al. 3193* (E, LAE). — Morobe Province: Oomsis, 325 m, 6 Apr 2017, *Poulsen & al. 3080* (E, LAE); above Kemen village, Masonaung, 1250 m, 4 Feb 2018, *Poulsen & al. 3129* (E, LAE). — Sandaun Province: Amanab, 320 m, 3 Apr 2016, *Poulsen & al. 2997* (E, CANB, LAE, SING); Nuku District, Yaguwak, 400 m, 23 Mar 2017, *Poulsen & al. 3070* (E, LAE). — Western Province: Tabubil, access road to Ok Tedi Mine, below Finalbin village, 800 m, 18 Apr 2008, *Poulsen & al. 2720* (E, LAE); road from Tabubil to Ok Ma, 800 m, 20 Apr 2008, *Poulsen & al. 2728* (E, LAE).

2. *Etlingera grandiflora* (Valeton) R. M. Sm. in Notes Roy. Bot. Gard. Edinburgh 43: 245. 1986 ≡ *Geanthus grandiflorus* Valeton in Bot. Jahrb. Syst. 52: 56. 1914. – Type: NE New Guinea [Papua New Guinea], in the forests at Baroai, 600 m, *F. R. R. Schlechter s.n.*, date unknown (B [assumed lost in Second World War]). – **Lectotype (designated here):** [icon] "*G. grandiflorus*" in Valeton in Bot. Jahrb. Syst. 52: 57, fig. 1D. 1914. – **Epitype (designated here):** Papua New Guinea, Madang Province, above Alibu village, Bauri (hill), open primary forest on shallow ridge in upper slope of valley, 05°32'05.86"N, 145°41'55.5"E, 400 m, 1 Nov 2019, *A. D. Poulsen, T. Magun, P. Pomoso, J. Said & K. Kali 3191* (LAE; isoepitypes: B, E [2 sheets: E01024195, E01024196; pickled material]). – Fig. 2D, 4, 6E–H.

Description — Terrestrial herb. *Rhizome* long-creeping, 0.5–1.2 cm in diam., sparsely hirsute to densely sericeous at base of leafy shoot, scales to 3.5 cm long, striate, sparely hirsute, pale brown, caducous; stilt roots absent. *Leafy shoots* to 2.7 m long, 50–70 cm between neighbouring leafy shoots, with up to 26 leaves per shoot; base to 4 cm in diam., dark green; sheath dark green, smooth, striate when dry, densely sericeous at base of lowermost sheaths only, margin glabrous; ligule to 7 mm long, entire, green, tomentose at base in centre, margin slightly ciliate; petiole to 20 mm long, slightly canaliculate, glabrous, ± burgundy; lamina narrowly elliptic, to 51 × 10.5 cm, length/width ratio 4–4.9, smooth, dark green sometimes almost iridescent blue adaxially, burgundy abaxially, ± villose on midrib abaxially, more so laterally and in upper 2/3; base ± cordate, oblique; apex acute to attenuate; margin ciliate, especially in upper 2/3. *Flowering shoot* to 12.5 cm long, arising from rhizome; peduncle subterranean, ascending, 1.7–2.5 cm long, pubescent, peduncular bracts 3–3.6 × 0.9–1.1 cm, upper longest and covering base of spike, narrowly obovate, pale rose turning dark brown when dead, ± sericeous near base, apex thickened, shortly mucronate, ciliate; spike half-embedded in soil and leaf litter, obconic, to 11 cm long (including flowers); receptacle elongate 6–28 mm long, axis pubescent, with (4–)8–13 flowers, flowers to 9 mm apart, 1 open at a time, flowers extending vertically 5.5–7.5 cm above bracts, ± spreading; spike (only including bracts) 5.2–6.2 × c. 2.5 cm; sterile bracts absent; fertile bracts 3.3–4.2 cm, canaliculate, oblong to slightly obovate, apex rounded to slightly retuse, slightly mucronate, slightly ciliate, pale rose, darker at apex, slightly sericeous at base; pedicel below insertion of bracteole, 1–1.5 mm long, sericeous; bracteole c. 4 cm long, pale red, with 2 fissures of c. 2.5 and c. 0.15 cm, with few appressed hairs at base, apex 2-dentate, teeth close together, ciliate. *Flower* to 11.5 cm long; calyx c. 5.3 cm long, reaching c. 18 mm short of apex of corolla lobes, pale red, with 2 or 3 fissures of 0.5–1.7 cm, glabrous, apex 3-dentate, sometimes 2 teeth close together, ciliate; floral tube c. 6.7 cm long, cream, with a few appressed hairs, tube inside with scattered hairs to 1.8 cm below point of insertion of corolla lobes on outside; lobes dark red, glabrous, reaching middle of anther; dorsal lobe c. 33 × 10 mm, narrowly obovate; lateral lobes c. 35 × 9 mm, narrowly obovate, attached angled to tube, inserted c. 1.5 mm below dorsal lobe; staminal tube c. 30 mm long, red; labellum erect, broadly ovate, 17.5–20 × 21–25 mm, pink, gradually paler toward margin, glabrous, lateral lobes fused with anther to 1.5 mm from base, erect on either side of anther, margin entire, revolute, central lobe rounded, revolute, extending 14–20 mm beyond apex of anther; stamen sessile; anther c. 9 × 4.2 mm, parallel-sided, angled c. 165°, pale red, anther crest retuse, centre c. 0.3 mm shorter than sides; thecae dehiscent for 8–8.5 mm from base to 0.5–1 mm below apex, sericeous; ovary c. 8 × 3.5 mm, flask-shaped; epigynous gland c. 8 mm long, bipartite, apex irregularly lobed, tomentose; style c. 7.4 cm long, with scattered hairs to 0.8 cm below stigma; stigma c. 2.5 mm wide, white, rounded pentangular, ± tomentose, ostiole transversely elliptic, c. 0.5 × 1.5 mm, facing downward. *Infructescence* not seen.

Distribution and ecology — Papua New Guinea, known only from two localities in Madang Province, primary lowland evergreen forest, 400–600 m elevation.

Conservation status — Endangered (Poulsen 2020b).

Etymology — The specific epithet means "large flowered" and Valeton (1914) emphasized the large flowers as a diagnostic character compared to other species from New Guinea that he knew at the time.

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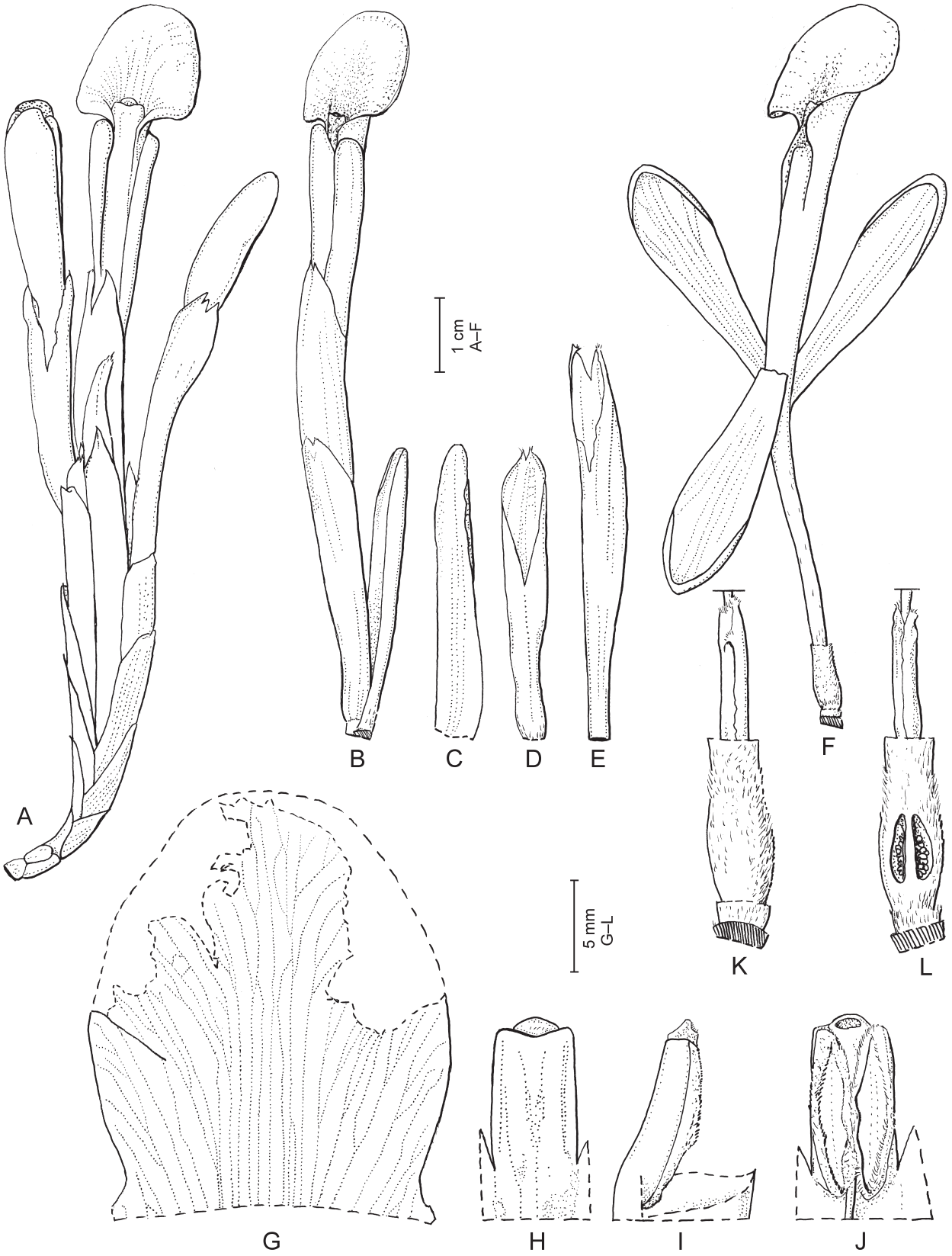

Fig. 4. *Etlingera grandiflora* – A: inflorescence with four flowers or buds; B: flower with supporting fertile bract; C: fertile bract, adaxial surface; D: bracteole; E: calyx; F: flower (bracteole and calyx removed); G: labellum, flattened, adaxial surface; H: stamen, adaxial surface; I: stamen, lateral view; J: stamen, abaxial surface; K: ovary and epigynous gland, adaxial surface; L: ovary and epigynous gland, abaxial surface. – All from Poulsen & al. 3191 (E), isoepitype. – Drawn by Axel Dalberg Poulsen.

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Vernacular name and uses — saru (Amung language, *Poulsen & al. 3191*), no uses informed.

Remarks — In the original description, Valeton (1914) wrote that the new species was incompletely known. He seems to have only had one flower and was guessing that the inflorescence is few-flowered like that of *Etlingera brevilabrum* that he himself had described from Borneo (as *Achasma brevilabrum* Valeton 1906). The recent collection, *Poulsen & al. 3191*, confirms this assumption and enables a more complete description of inflorescence and other parts, but the subterranean infructescence is yet to be collected. There is no doubt that *Poulsen & al. 3191* collected about 15 km NE of the type locality in the Baroai area matches the protologue (e.g. the flower being up to 11.5 cm long). Because the original material in B was destroyed, all that remains of the original material is the illustration of a flower (Valeton 1914: 57, fig. D) which is designated here as the lectotype. The ovary and lower part of the bracteole are completely missing in the drawing, and important diagnostic details of the stamen are not visible, making it ambiguous. *Poulsen & al. 3191* is therefore added as an epitype to fill the gaps.

The detailed study of the stamen shows a very unusual fusion of the lateral lobes of the labellum with the base of the anther. As more species of *Etlingera* will be known in greater detail in the near future, it will be interesting to see if this fusion also occurs in other species.

Like the type collection by Schlechter mentioned by Valeton (1914), the specimen *Schlechter 17110* (B 10 1022743) was collected in the forests at Baroai at c. 600 m, but the former is lacking a collection date and number, and *Schlechter 17110* is therefore not part of the original material. Consisting of a single ligulate leaf and two buds, this specimen is neither very informative nor beautiful. It was annotated "*Amomum* sp." but is clearly an *Etlingera* and several vegetative characters are actually in accordance with those of *E. grandiflora* but, without a fully opened flower, this identification is tentative. The petiole is pubescent beneath, but that was not mentioned in the protologue, nor is it found to be so in *Poulsen & al. 3191*.

A collection (*Poulsen & al. 3061*) from Sandaun Province (415 km NW of the type locality), shares many characters with *Etlingera grandiflora* as it is described above, but differs vegetatively by the leaves having: (1) a shorter petiole only tinged reddish beneath when young (not strongly burgundy, Fig. 6F); (2) an inflorescence with fewer flowers; and (3) a longer and more narrow labellum. Even though *Poulsen & al. 3061* seems to represent a separate taxon, the circumscription of this species may alter after more collections, including pickled flowers, have hopefully been made and examined in the future.

The colour of the mature leaves being strongly dark burgundy beneath is a rare character in *Etlingera*, but was described in *E. brachychila* var. *vinosa* A. D. Poulsen in Borneo and *E. purpurea* (Elmer) A. D. Poulsen in The Philippines. In the former species, the burgundy colour beneath may be more prominent when young (Poulsen 2006) but, according to Elmer (1919), the leaves of *E. purpurea* are coloured beneath regardless of their age. Therefore, this character seems of diagnostic value during fieldwork but useless for herbarium collections unless field observations are presented on the label. Unfortunately, Schlechter rarely wrote any information on his labels about the plants he collected, and Valeton (1914) only mentioned colours of the dry material.

3. *Etlingera vestita* (Valeton) R. M. Sm. in Notes Roy. Bot. Gard. Edinburgh 43: 250. 1986 ≡ *Geanthus vestitus* Valeton in Bot. Jahrb. Syst. 52: 55. 1914. – Type: NE New Guinea [Papua New Guinea], forest at Mt Gati, 600 m, *F. R. R. Schlechter 16850*, 19 Nov 1907 (B [assumed lost in Second World War]). – **Neotype (designated here):** Papua New Guinea, Madang Province, above Alibu village, at Waliango [stream], on steep slope above stream, primary forest, 05°32'55.9"N, 145°42'11.8"E, 290 m, 1 Nov 2019, *A. D. Poulsen, T. Magun, P. Pomoso, J. Said & K. Kali 3190* (LAE; isoneotypes: B, E [3 sheets: E01024192, E01024193, E01024194; pickled material]). – Fig. 5, 6I–L.

Description — Terrestrial herb. *Rhizome* short-creeping, 1–1.5 cm in diam., densely sericeous, scales to 3 cm long, ovate, pale reddish brown, pubescent at base; stilt roots raising rhizome up to 10 cm above ground, sometimes roots just supporting. *Leafy shoots* 1.75–3 m long, 5–15 cm between neighbouring leafy shoots; base to 3.5 cm in diam., pale yellow-green variously tinged reddish brown; sheath smooth, pale yellow-green tinged ± red, ± sericeous, margin glabrous; ligule 7–13 mm long, entire, mid-green, sparsely pale-brown-sericeous, caducous, margin ciliate at least when young; petiole 15–28 mm long, mid-green, canaliculate; lamina narrowly ovate to oblong, to 63 × 10 cm, length/width ratio 6.1–6.3, dark green adaxially, densely golden-sericeous abaxially except glabrous midrib; base obtuse, oblique, membranous, decurrent to petiole; apex tapering toward a caudate apex 2.5–3.5 cm long; margin ciliate to 1.4 mm long, ± ribbed. *Flowering shoot* 6–7(–15) cm long, radical, numerous in clusters along rhizome, sometimes on a separate branching inflorescence (lateral rhizome); peduncle ascending, 1.5–4.5(–11) cm long, white-sericeous, peduncular bracts 4.3–4.5 × 2.5–3.7 cm, increasing in length from base of peduncle, covering c. 3/4 of spike, narrowly ovate to ovate, concave, white with red margin, densely sericeous in centre, margin membranous, nearly glabrous, apex obtuse, margin inrolled; spike ovoid to cylindric, 5.5–6 cm long (including flowers), receptacle rounded, c. 0.5 cm long, with (5–)18–29 flowers, 1 or 2 open at a time; flowers extending vertically 0.4–1 cm above bracts (apex of labellum distanced 0.7–1.2 cm from apex of supporting bract); spike (only including bracts) ovoid to cylindric, 5–6 × (1.3–)2.5–3.5 cm; sterile

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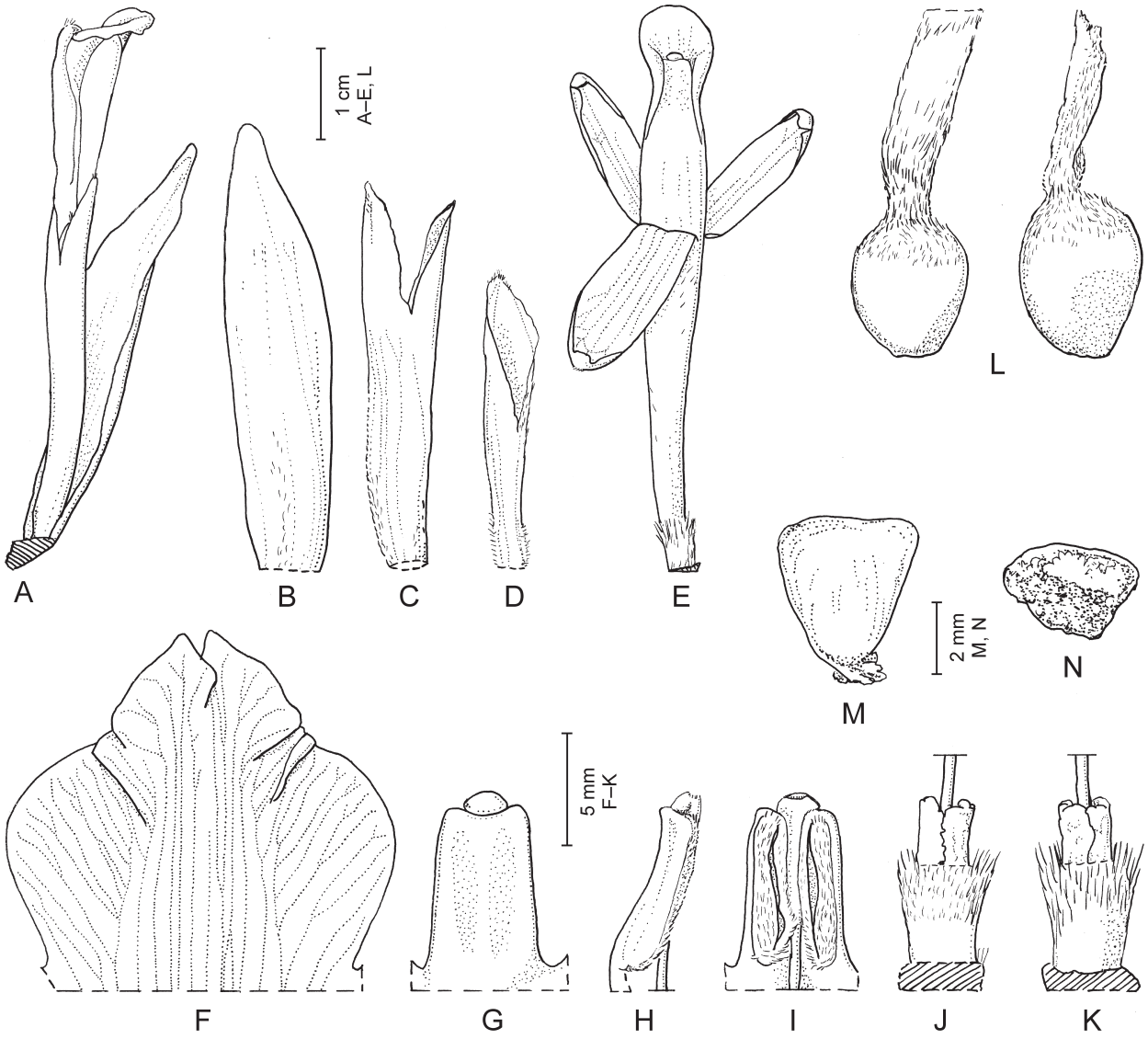

Fig. 5. *Etlingera vestita* – A: flower with supporting bract; B: fertile bract, abaxial surface; C: bracteole; D: calyx; E: flower (bracteole and calyx removed); F: labellum, flattened, adaxial surface; G: stamen, adaxial surface; H: stamen, lateral view; I: stamen, abaxial surface; J: ovary and epigynous gland, adaxial surface; K: ovary and epigynous gland, abaxial surface; L: fruits; M: seed with aril; N: seed with aril removed, view from side. – All from Poulsen & al. 3190 (E), isoneotype, except L–N: Poulsen & al. 3003. – Drawn by Axel Dalberg Poulsen.

bracts 2, 4–5 × 2.5–4 cm, ovate, concave, apex obtuse, margin inrolled, red or white with red margin, sericeous in centre; fertile bracts 4.5–6 × 1–3.5 cm, ovate (similar to sterile bracts), narrowly obovate, apex obtuse, appearing pointed due to inrolled margin, red to pale red, ± sericeous at least at base and along veins in centre, few hairs at apex; pedicel absent; bracteole 3.5–4.4 cm long, membranous, pale red, sometimes partly decayed from apex turning brown, with 2 fissures of 0.3–2.5 cm, sparsely sericeous at base and apex, apex 2-lobed. *Flower* 5.3–6.5 cm long, red; calyx 3.1–3.7 cm long, shorter than bracteole, reaching 19–22 mm short of apex of anther and c. 20 mm short of apex of corolla lobes, membranous white tinged pink at apex, with 1–3 fissures to 2 cm long, pubescent at base and apex, apex 3-toothed, sometimes close together appearing as one; floral tube 4.1–4.8 cm long, cream at base increasingly red toward apex, ± sericeous, tube inside glabrous; lobes red, slightly sericeous at base, reaching as long as or 1–2 mm longer than anther; dorsal lobe 19–23 × 7–10 mm, narrowly obovate, apex rounded, cucullate; lateral lobes 21–25 × 5–7 mm, oblong to narrowly obovate, apex rounded, cucullate, attached slightly angled to tube, inserted 0–3 mm below dorsal lobe; staminal tube 11–14 mm long, red, glabrous or slightly sericeous abaxially; labellum broadly ovate, 3-lobed, c. 15 × 15.5–18 mm, red to pinkish red, glabrous or with a few appressed hairs abaxially, lateral lobes rigidly erect on either side of anther, slightly pale at margin, central lobe apex 2-toothed, incision to 3 mm, extending 7–8 mm beyond anther, margin crisped; stamen sessile;

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Fig. 6. A–D: *Etlingera densisucula*; A: pseudostem with ligule and leaf base; B: inflorescence; C: labellum, stamen and stigma; D: infructescence. – E–H: *Etlingera grandiflora*; E: habit; F: pseudostem with ligule and leaf base; G: inflorescence; H: circular inset with close up of labellum, stamen and stigma. – I–L: *Etlingera vestita*; I: pseudostem with ligule and leaf base (lamina golden-sericeous beneath); J: young inflorescence; K: flowers; L: fruit. – A–D: Poulsen & al. 3189; E–H: Poulsen & al. 3191; I–K: Poulsen & al. 3190; L: Poulsen & al. 3003. – Photographs by Axel Dalberg Poulsen.

anther 7–8 × 3–5 mm, broadest at base, glabrous, angled 130°–150°, red, apex sometimes pale red, anther crest slightly retuse; thecae dehiscent 5–6 mm in centre from c. 1 mm above base to c. 1 mm below apex, densely pubescent; ovary 4–6 × 3–5 mm, cream, densely sericeous in upper 1/3–1/2; epigynous gland 3–3.3 mm long, bipartite

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or entire, slit adaxially only, apex truncate, warty; style 4.5–5.4 cm long, glabrous or with a few tufts of hairs in upper 2 mm; stigma 2–2.2 mm wide, cream to white, rounded pentagonal, scattered tomentose, ostiole transverse narrowly elliptic, 1.2–1.5 mm wide, facing downward to forward. *Infructescence* usually above ground, head to 3 × 3 cm, ovoid, hidden by persistent bracts, with up to 12 fruits per head; pedicel absent. *Fruit* 1.5–1.8 × 0.8–1.3 cm, obovoid, flattened, with persistent bracteole and calyx, cream, sericeous at apex. *Seeds* c. 2.5 × 2.5–4 mm, angular, apex curved to flat, dark brown.

Distribution and ecology — Papua New Guinea, known from five localities in three provinces, occurring in primary or secondary lowland evergreen forest, 70–515 m elevation.

Conservation status — Vulnerable (Poulsen 2020c).

Etymology — The specific epithet means "clothed" and Valeton (1914) was probably referring to the densely silky-haired, almost felted, abaxial surface of the leaf blade.

Vernacular name and uses — mbsang (Amung language, *Poulsen & al. 3190*), no uses informed, tastes slightly bitter; sukur yaulib or sukur pai (Aiku language; saingil means long, *Poulsen & al. 3063*), no uses informed, lamina smells of chocolate.

Remarks — Because no original material of *Etlingera vestita* is available, *Poulsen & al. 3190* is designated here as a neotype. This collection was collected 3.3 km from the type locality at Mt Gati and is a perfect match with the original description.

Valeton (1914) emphasized in the protologue that the species is characterized by the peculiar, appressed, silky hairs of the leaves. *Etlingera vestita* is indeed easily identified from any other known ginger in New Guinea by this most conspicuous silky-haired indumentum on the abaxial leaf surface. Often this indumentum appears silvery when the leaf is young and turning golden with age.

As with *Etlingera grandiflora*, Valeton (1914) compared *E. vestita* to *E. brevilabrum* from Borneo, but the former is recognizable due to the long silky hairs of the corolla. The latter species is restricted to Borneo and the Philippines and is vegetatively distinct by the red patches of the leaves and the whole flowering shoot is less rigid and subterranean apart from the flowers appearing above ground.

With the white and silky-haired centre of the bracts of the spike, the inflorescence of *Etlingera vestita* could easily be confused with the most common and widespread ginger species in lowland New Guinea, *Hornstedtia scottiana* (F. Muell.) K. Schum., but apart from the glabrous leaves of *H. scottiana*, a closer inspection of the flower of *E. vestita* will reveal the presence of a staminal tube, which is diagnostic for the genus *Etlingera*.

The architecture of the flowering shoots is highly unusual in *Etlingera vestita*, in that the spikes sometimes appear in clusters on a separate branching axis (resembling lateral rhizomes). In *Etlingera*, this has been seen previously only for *E. mendumiae* A. D. Poulsen from Sulawesi, Indonesia (Poulsen 2012). The African ginger *Aframomum letestuanum* Gagnep. also has a peculiar flowering shoot with up to 1 m long peduncles in which the axis is branched (Harris & Wortley 2018).

Selected specimens — Papua New Guinea: Morobe Province: near Bubia, 15 Apr 2002, *Takeuchi & Ama 16159* (E00171419, E00171420). — Sandaun Province: Amanab, 5 Apr 2016, *Poulsen & Topaiman 3003* (CANB, E, LAE [sheet no. 298592], SING); Nuku District, Yaguwak, 23 Mar 2017, *Poulsen & Topaiman 3063* (E, LAE); Nuku District, Asier village, 25 Mar 2017, *Poulsen & al. 3068* (E, LAE).

Author contributions

PP and TM helped with the logistic aspects of the fieldwork, export of collections and shipment of loans. ADP did the rest.

Acknowledgements

The first author would like to thank the National Research Institute, Forest Research Institute, Lae, the Madang provincial government and staff of the Madang Provincial Office of the National Forest Service, local guides and porters, especially Joshua Said and Kelly Kali, and the local community at Alibu. The National Research Institute processed the research permit and visa and the Forest Research Institute issued the export permit for duplicates. Funding for fieldwork was provided by The Material World Foundation, the Dansk Ekspeditionsfond, TK Foundation, "Det Asiatiske Kompagnis Almennyttige Fond", "Torben og Alice Frimodts Fond" and Carlsbergfondet. The Davis Expedition Fund, University of Edinburgh, Scotland, contributed both to the fieldwork and the time for the first author to write up this paper. Dr Michele Rodda shared his copy of Schlechter (1911). We also thank the keepers of several herbaria for giving permission to study or receive loans of their collections, especially Dr Robert Vogt and Katharina Rabe for finding and scanning collections by Schlechter in the Berlin herbarium, as well as the two reviewers, Lin Bai (Kunming) and Jana Leong-Skornickova (Singapore), for their comments on an earlier version of this paper. The Royal Botanic Garden Edinburgh (RBGE) is supported by the Scottish Government's Rural and Environmental Science and Analytical Services Division.

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Willdenowia

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Online ISSN 1868-6397 · Print ISSN 0511-9618 · 2020 Journal Impact Factor 0.985

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