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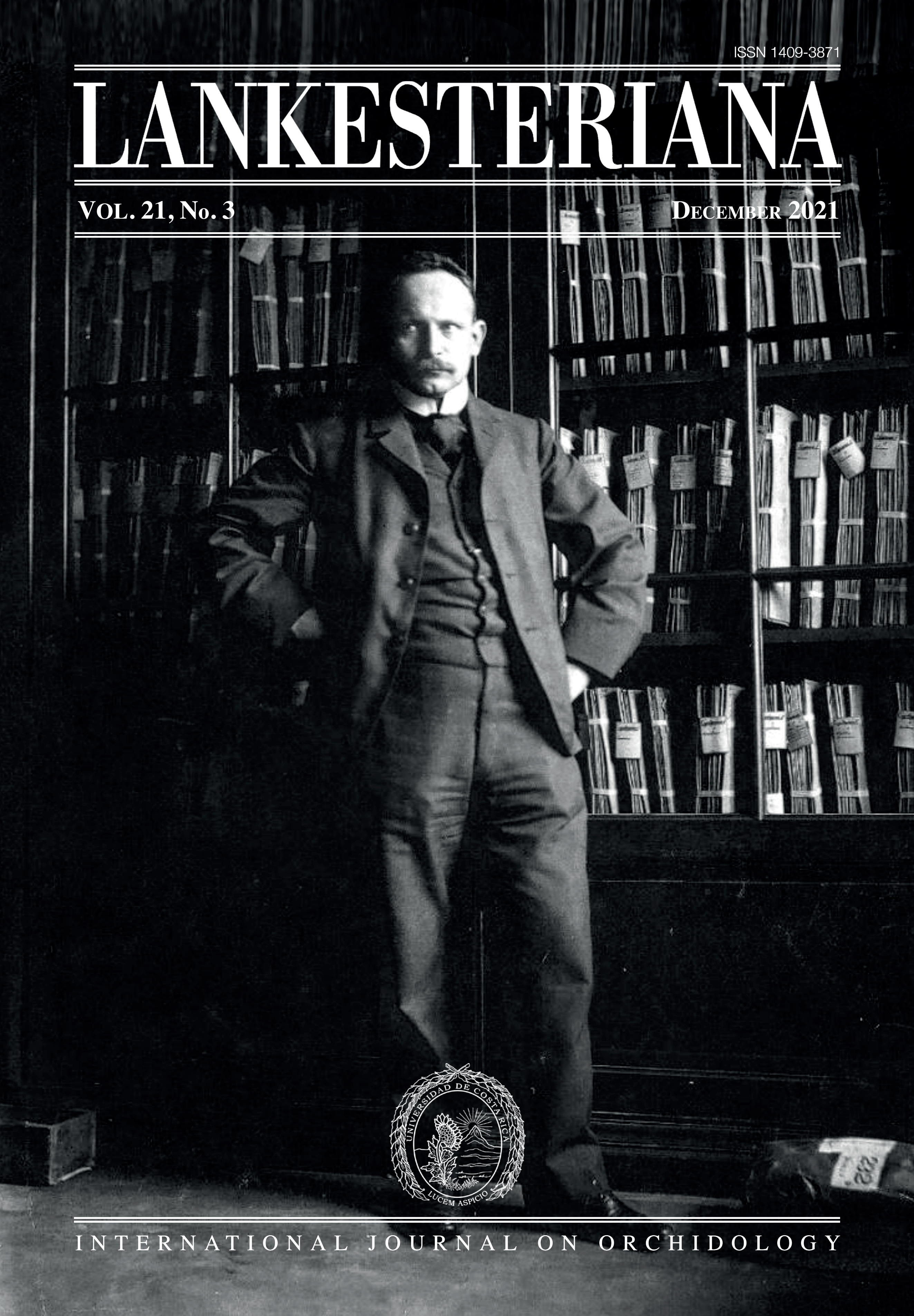

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LANKESTERIANA

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IN MEMORIAM

RUDOLF JENNY (1953–2021)

Rudolf Jenny at the 16th World Orchid Conference, Canada, 1999

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Rudolf was born on July 26, 1953, in Bern, Switzerland. As his father was head of the Swiss Federal nursery, Rudolf was exposed to a rich flora already at an early age and even built a herbarium with fern plants on his own. Soon, he discovered orchids in the greenhouses and developed a passion for these exotic plants, which never faded. As a trained chemist, Rudolf Jenny worked in the field of environmental and ozone technology until his retirement in 2008. As a hobby, Rudolf worked with orchids for more than 40 years and cultivated many tropical orchid plants in his large collection until 1995. Over many years, numerous trips took him to Central & South America for his studies on pollination techniques and taxonomy of orchids. He was especially fond of Costa Rica, where he took part in many expeditions with his friend Clarence K. Horich, to whom he also dedicated the orchid genus *Horichia* ("The Orchid", 1981). Furthermore, he dedicated other orchid genera like *Braemia* ("Die Orchidee", 1985) or *Lueckelia* ("Australian Orchid Review", 1999) to well-known orchid friends. Vice Versa, the orchid genus *Jennyella* was named after Rudolf, described by E.Lückel & H.Fessel ("Caesiana, Revista Italiana di Orchidologia", 1999).

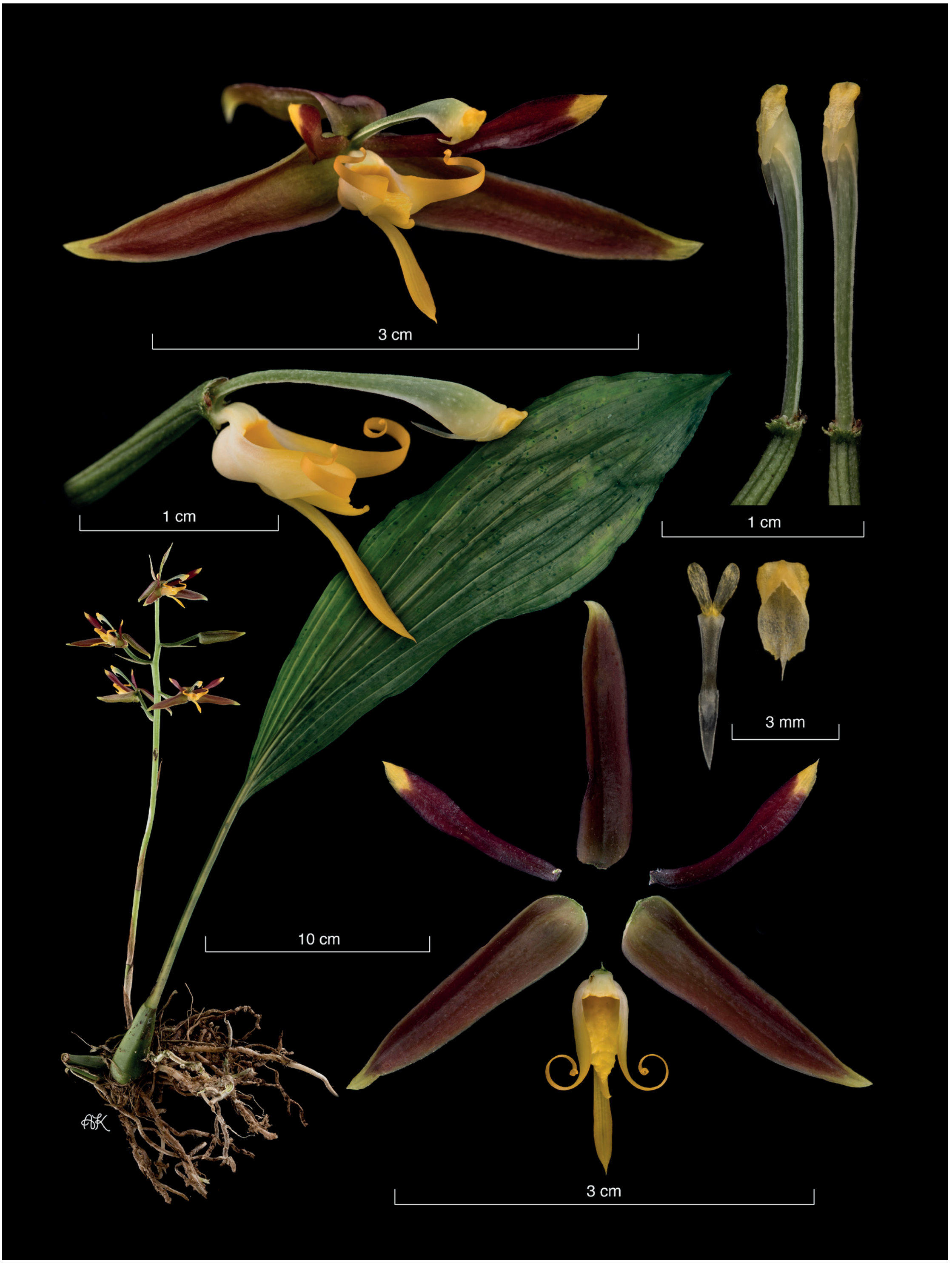
All together, Rudolf Jenny wrote more than 600 articles published in many well-known or-

Rudolf Jenny photographing a specimen of *Stanhopea wardii* at the Botanischer Garten Herrenhausen, Germany, EOC-Board meeting, 2 October 2015. Courtesy of Johan Hermans.

Teuscheria horichiana, a species endemic to Costa Rica and Panama, described by R. Jenny and G. Braem. Watercolour by Sylvia Strigari.

Rudolf Jenny at the Botanischer Garten Basel, Switzerland, EOC-Board meeting, 4 October 2013. From left to right: Carsten Hammer, Charlotte Dupont, Emil Lückel, Rudolf Jenny, and Clare Hermans. Courtesy of Johan Hermans.

Rudolf Jenny with Charlotte Dupont at the SFO-Office, Paris, France EOC-Board meeting, 25 October 2019. Courtesy of Johan Hermans.



Horichia dressleri, a monotypic genus and scarce species of Costa Rica and Panama, collected and described by R. Jenny in 1981. Rudolf made important contributions to the taxonomy of the Stanhopeinae subtribe. LCDP by A.P. Karremans.

Rudolf Jenny at the European Orchid Council around 2015-2017. Unknown photographer.

chid journals, including monographs on the genera *Gongora*, *Paphinia*, *Sievekingia,* and *Stanhopea*. He also wrote the three-part book series "... of men and orchids ..." about the background of orchid names and the stories behind the discoverers and researchers. However, the third part has not been published yet. As a regular participant and presenter at major orchid conferences such as the World Orchid Conference (WOC), the European Orchid Conference (EOC), and numerous other congresses, Rudolf was not only able to maintain his international relations but also to pursue his passion for photography. Rudolf was also the founder and owner of BibliOrchidea, the world's largest and freely accessible database of orchid literature with over 165,000 entries, covering more than 90% of the existing orchid literature. Rudolf Jenny was an honorary member of the German Orchid Society (DOG) and the European Orchid Council (EOC), where he held the position of Secretary General since 2010. He also supported the Jany Renz Herbarium of the University of Basel in Switzerland with his profound knowledge. In addition, Rudolf Jenny was an active member of the RHS Orchid Hybrid Registration Advisory Group (OHRAG) and a former member of the RHS Orchid Committee, both based in England. Rudolf was a pillar of strength for his wife Veronika Jenny-Keller and his two sons Lorenz and Christoph, an extremely generous person who was lacking in anything petty.

He loved spending his family vacation days in his small cottage in the mountains, and together they also enjoyed traveling to numerous countries. Until his last day, Rudolf was an interested and exciting conversationalist family man. He was networked with countless orchid specialists worldwide, gladly answered questions of all kinds, and was happy when he could help - a lively exchange that gave him much pleasure. Profit thinking was unknown to him. His *Gongora* monograph, which he had co-authored with Günter Gerlach, is nearly ready for print. Rudolf was excited about publishing his new work. Rudolf passed away completely unexpectedly on August 10, 2021.

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PITYPHYLLUM MERCEDES-ABARCAE (MAXILLARIINAE) A NEW SPECIES FROM ECUADOR

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Abstract. A new species of *Pityphyllum* from south-eastern Ecuador was found during an investigation of the orchids of the Cordillera del Cóndor. *Pityphyllum mercedes-abarcae* is described and illustrated. Information concerning its distribution, habitat, and phenology is provided. The new proposed taxon is morphologically similar to *P. pinoides*, from which it differs by the smaller plants, the spathulate petals with an erose margin in the middle third, lip flattened is square in the middle third, wedge in the basal third, and acute in the apical third with two small parallel calluses in the apical third, presents a slight cell thickening in the abaxial part of the apical third and elongated trichomes below the stigma.

Resumen. Una nueva especie de *Pityphyllum* del sureste de Ecuador fue encontrada durante una investigación sobre las orquídeas de la Cordillera del Cóndor. *Pityphyllum mercedes-abarcae* se describe e ilustra. Se proporciona información sobre la distribución, el hábitat y la fenología de esta especie. El nuevo taxón propuesto es morfológicamente similar a *P. pinoides* del cual se diferencia por las plantas más pequeñas, los pétalos espatulados con el margen eroso en el tercio medio. El labelo aplanado es cuadrado en el tercio medio, cuneado en el tercio basal y agudo en el tercio apical con dos pequeños callos paralelos en el tercio apical, presenta un ligero engrosamiento celular en la parte abaxial del tercio apical del labelo y tricomas alargados debajo del estigma.

Key Words/Palabras clave: Andean tepuis, Cordillera del Cóndor, *Pityphyllum pinoides*, taxonomía, taxonomy, tepuyes andinos

Introduction. *Maxillaria* Ruiz & Pav. (Ruiz & Pavón 1794) is one of the most diverse genera in the Orchidaceae, distributed from Florida (United States) and Mexico to Peru, Brazil, Bolivia, and northern Argentina, including the Antilles (Zambrano *et al*. 2020). Molecular phylogenetic studies of the Maxillariinae Benth. have been carried out to delimit the generic circumscriptions within the subtribe (Ojeda *et al*. 2003, Singer & Koehler 2003, Dathe & Dietrich 2006, Sitko *et al*. 2006, Whitten *et al*. 2007). Blanco *et al*. (2007) proposed a generic realignment of Maxillariinae recognizing 17 genera, including *Cryptocentrum* Benth., *Cyrtidiorchis* Rauschert, *Mormolyca* Fenzl, and *Pityphyllum* Schltr.

Pityphyllum, one of these segregate genera, consists of eight species distributed in the high Andes of Bolivia, Colombia, Ecuador, Peru, and Venezuela (Dodson 2003, Whitten *et al*. 2006). The genus was established in 1920 by Rudolf Schlechter based on two materials collected: *Pityphyllum laricinum* (Kranzl.)

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Schltr. collected by Weberbauer in Peru and *P. antioquiense* by F.C. Lehmann near Carolina del Principe in the Department of Antioquia, Colombia; it was revised by Sweet (1972) and then expanded by Whitten *et al*. (2006). The plants are characterized by its epiphytic, pendulous plants, a much-branched rhizome, small pseudobulbs covered by a tunic fused to the pseudobulb ("outer sheath") with several apical leaves, the diminutive flowers borne from the axils of rhizome bracts between the pseudobulbs, the column foot practically nonexistent, and the capsules with apical dehiscence (Whitten *et al*. 2006, Blanco *et al*. 2007). *Pityphyllum* species are scarce plants (Dunsterville & Dunsterville 1977), poorly represented in herbaria, and there are likely to be several undescribed species in this genus (Whitten *et al*. 2006). While investigating the orchids of the Cordillera del Cóndor, we found a new species of *Pityphyllum,* which we describe and illustrate here.

Material and methods. The description and illustrations of the new taxon were done from specimens collected during a comparative study on the orchids in an elevation gradient of the Cordillera del Cóndor. Some specimens were cultivated and photographed at the Vivero de Conservación La Paphinia in Zamora, Ecuador, under permits granted by the Ministerio del Ambiente de Ecuador. Photographs of individuals in flower were taken using a Panasonic® FZ300 camera with a Raynox DCR-250 mm lens. Prior publications on *Pityphyllum* were consulted and were compared to the new species described.

Taxonomic treatment

Pityphyllum mercedes-abarcae Vélez-Abarca & M.M.Jiménez, ***sp. nov.*** (Fig. 1–2, 4).

TYPE: Ecuador. Zamora Chinchipe: Cordillera del Cóndor flank, 1280 m, 24 Sep 2020, flowered in cultivation at 16 March 2020, *L. Vélez LV0068* (holotype: ECUAMZ!)

Diagnosis: Similar to *Pityphyllum pinoides* H.R.Sweet. from which it differs by the smaller plants, bearing pseudobulbs at very short intervals, the pedunculate flowers are produced from the rhizome at the base of immature pseudobulbs; the ovary is elongated; the petals are spatulate, slightly oblique at the base, the margin is erose in the middle third; the lip flattened is square in the middle third, wedge in the basal third and acute in the apical third with two small parallel calluses; it presents a slight cell thickening in the abaxial part of the apical third of the lip. Also, this species shows a unique character in *Pityphyllum*, the elongated trichomes under the stigma.

Plant up to 8 cm tall, epiphytic, sparsely branched, descending. *Roots* slender, white, flexuous, 0.4–0.5 mm in diameter. *Rhizome* slender, arcuate at the base, bearing pseudobulbs at very short intervals, 0.4–1.2 cm. *Pseudobulbs* yellowish-green, ovoid to narrowly ovoid, apically subobtuse, 5.8–8.3 × 2.1–2.6 mm, inserted obliquely in the rhizome, slightly furrowed longitudinally, covered with hyaline sheaths, not foliaceous, old pseudobulbs lose their apical leaves. *Leaves* semiterete, acicular, acute, coriaceous, glabrous, slightly curved, dorsoventrally flattened, 3–4 leaves emerging from the apex of the pseudobulb, 11.0–24.0 × 0.5– 0.7 mm. *Inflorescence* 1-flowered, produced from the rhizome at the base of immature pseudobulbs, pedunculated, 4.7 mm long; *floral bract* long-ovate, acuminate, elongated, scarious, pigmented with brown spots, enveloping the entire pedicel and ovary. *Ovary* elongated, semiterete, minutely furrowed, slightly curved at the apex, 4.6 × 0.5 mm. *Flower* white, semi-open, dorsal and lateral sepals unequal. *Dorsal sepal* narrowly elliptical, attenuate at the base, acute, 3.1 × 1.1 mm, concave in the proximal second third and convex in the distal third, 3-veined, minutely apiculate at the apex. *Lateral sepals* elliptical, constricted at the base, acute, concave below the middle, 3-veined, 3.0 × 1.2 mm, minutely apiculate at the apex. *Petals* spathulate, slightly oblique at the base, apex minutely apiculate, the margin erose in the middle third, 1-veined, 2.9 × 0.9 mm. *Lip* flattened is square in the middle third, wedge in the basal third and acute in the apical third, in its natural state it has a panduriform, trilobate, attenuate at the base, concave below the middle third with oblong, erect lateral lobes, apical lobe triangular with two small parallel calluses in the apical third, presents a slight cell thickening in the abaxial part of the apical third of the lip, apex shortly acuminate, recurved, 2.9 × 1.4 mm, inserted at the base of the column. *Column* claviform, slightly curved, 2.0–2.5 mm

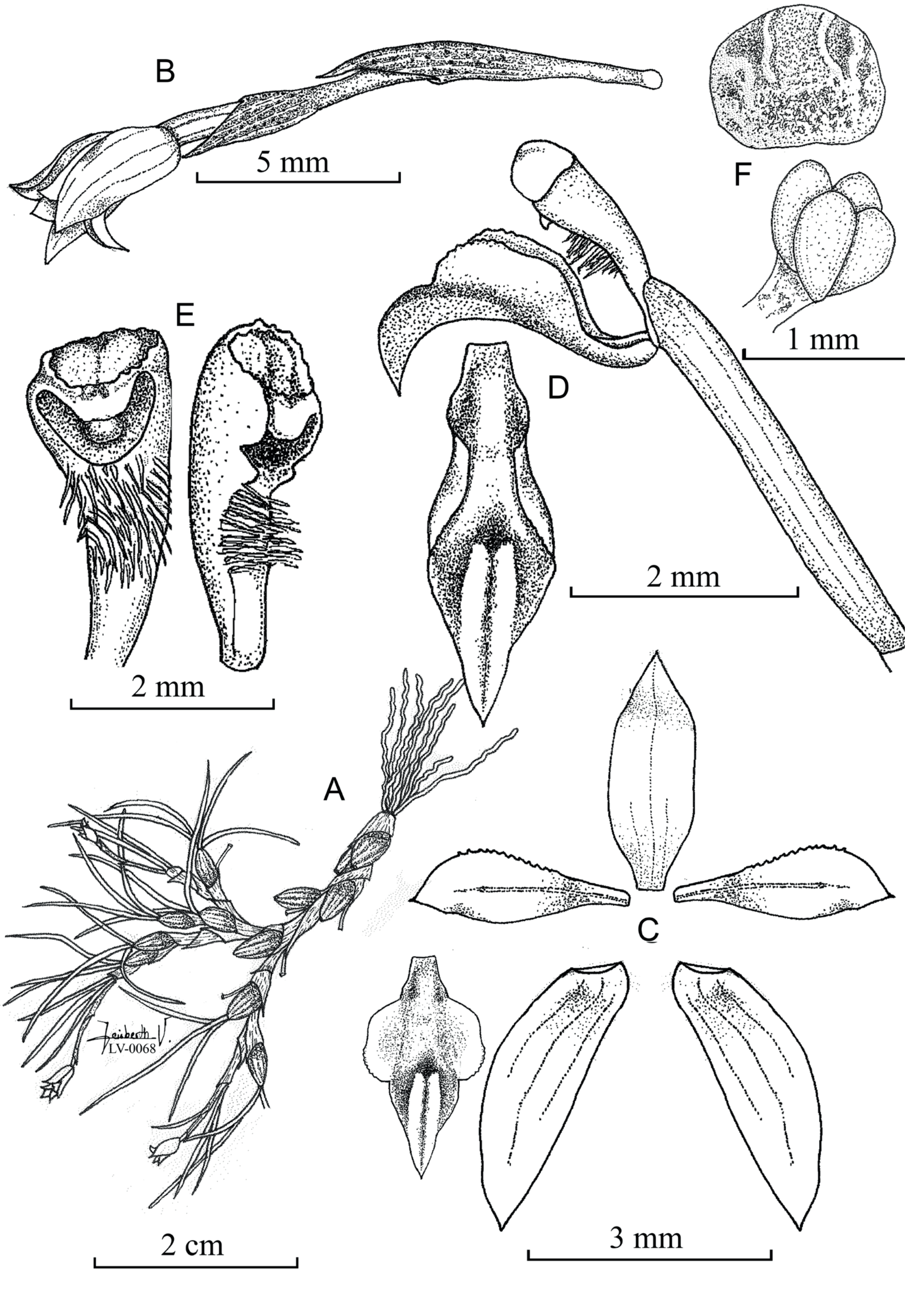

Figure 1. *Pityphyllum mercedes-abarcae* Vélez-Abarca & M.M.Jiménez. **A**. Habit. **B**. Inflorescence and flower in lateral view. **C**. Dissected perianth. **D**. Part of the peduncle, pedicel, ovary, column and lip in lateral view and lip ventral view. **E**. Column in ventral and oblique view. **F**. Anther cap and pollinarium Illustration by Leisberth Vélez Abarca, based on the holotype, L. Vélez *LV-0068* (ECUAMZ).

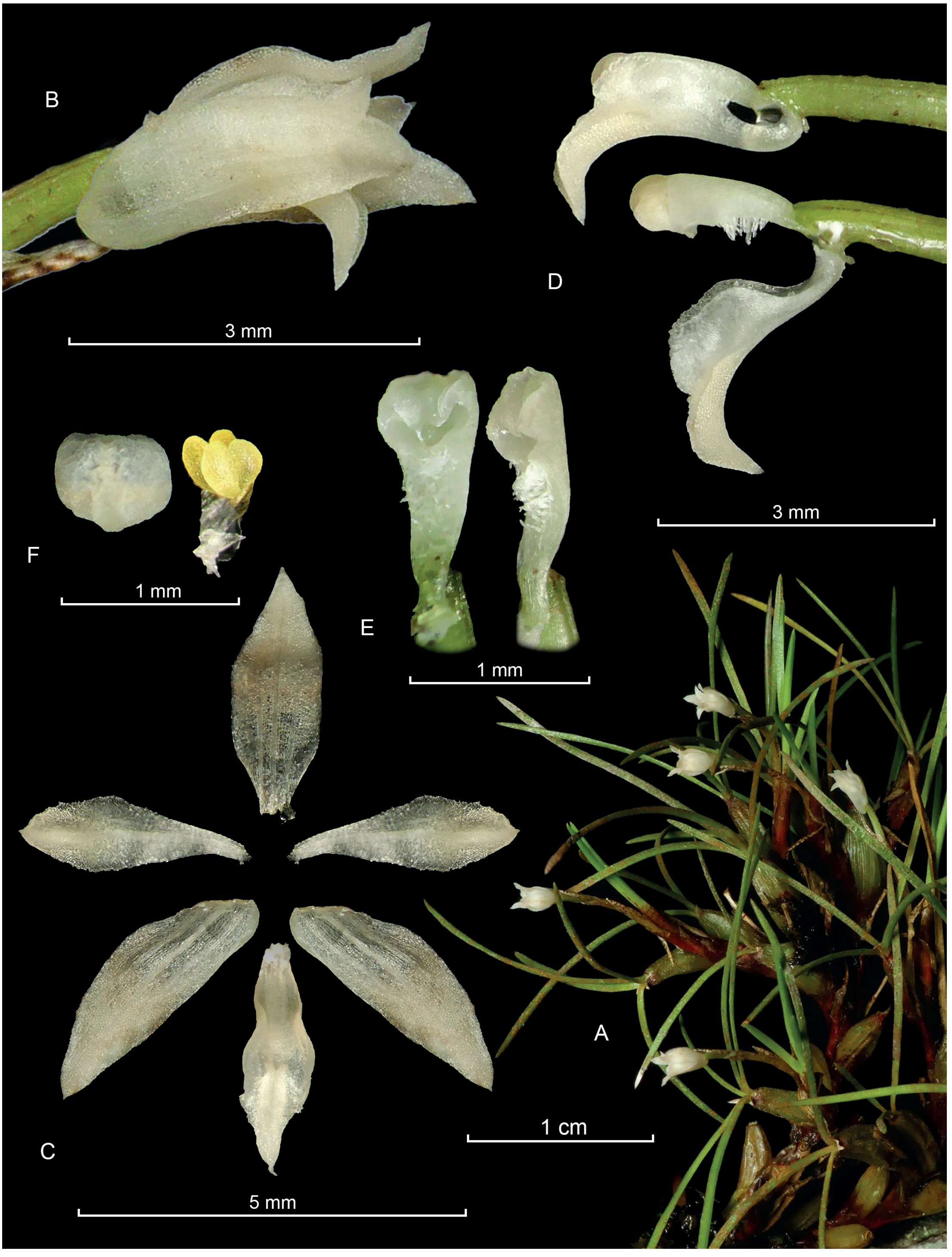

FIGURE 2. *Pityphyllum mercedes-abarcae* Vélez-Abarca & M.M.Jiménez. **A**. Habit. **B**. Flower, lateral view. **C**. Dissected perianth. **D**. Ovary, column, and lip, lateral view. **E**. Column, ventral and oblique view. **F**. Anther cap and pollinarium. Lankester Composite Dissection Plate by Juan Sebastián Moreno from photos by Marco M. Jiménez.

Figure 3. Holotype specimen of *Pityphyllum pinoides* H.R.Sweet, collected in Ecuador, Azuay, "*Quebradas leading into the río Collay, 3-8 km. north of Sevilla de Oro*" by W. H. Camp in 1945. Reproduced with the kind permission of the Harvard University Herbarium.

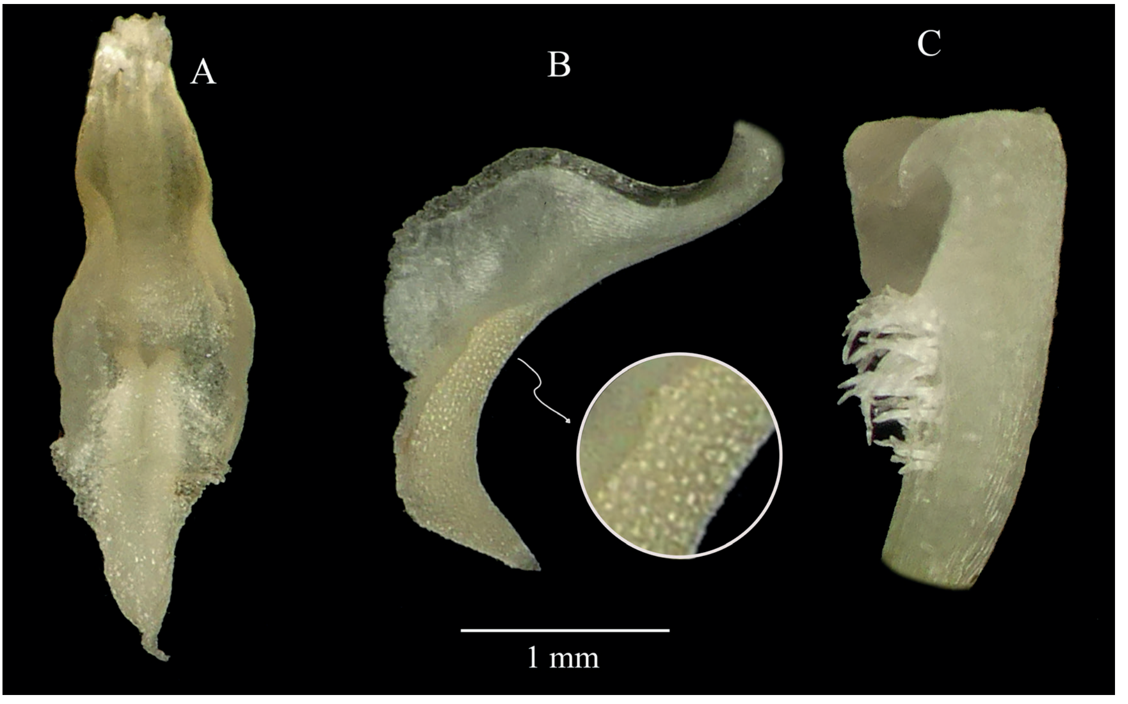

Figure 4. Column and lip in lateral view and lip ventral view of *Pityphyllum mercedes-abarcae* Vélez-Abarca & M.M.Jiménez. **A**. Two small parallel calluses in the apical third. **B**. Thin cell thickening in the abaxial part of the apical third of the lip. **C**. Elongated trichomes below the stigma. Photos by Marco M. Jiménez.

long, clinandrium with crenulated margin, glabrous, rostellum prominent, truncate, stigma bilobed, with elongate trichomes below. *Anther cap* apical, incumbent, yellowish-white, 7 mm wide. *Pollinarium* 0.6 mm long, with 4 obovate, yellow pollinia.

Paratype: Ecuador. Zamora Chinchipe: Cordillera del Cóndor flank, 04 June 2020, *M. Jiménez 1013* (paratype: HUTPL!).

Eponymy: Named after Mercedes Abarca, mother of the first author, in gratitude for her unconditional help, educational and moral teachings, and physical care.

Phenology: The species has been seen flowering in cultivation in March and April.

Distribution and habitat: The new species is known so far from south-eastern Ecuadorian sandstone plateaus of the Cordillera del Cóndor, in the canton of El Pangui, province of Zamora-Chinchipe, at about 1300 m in elevation. Given this, it could be a species of restricted distribution, although it may be found in neighboring Peru. Until now, a small population has been found inhabiting the mature forests at the borders of the tepui walls, with most trees covered in epiphytes, bryophytes, and lichens. Generally, *Pityphyllum mercedes-abarcae* inhabits the upper canopy of the trees as a descending epiphyte. However, it can be found in the understory on fallen tree branches parallel to the ground. It has not been found in disturbed forests. Consequently, we believe this species is particularly vulnerable to environmental changes, as this species is commonly associated with bryophytes, which are only abundant in preserved areas.

Pityphyllum mercedes-abarcae (Fig. 2) is similar to other species of the *Pityphyllum* genus characterized by the elongated, branched rhizomes covered by imbricate bracts and lacking a column foot (Dodson 2004). The most similar species is *P. pinoides* (Fig. 3); the two differ at first glance by their size, which is three times longer than *P. mercedes-abarcae* (up to 8 cm long vs. 30 cm in *P. pinoides*); the pseudobulbs are separated by shorter intervals in *P. mercedes-abarcae*, up to 1.2 cm apart (vs. 2 cm apart), the pseudobulbs smaller, 0.5–0.8 cm long, (vs. 1.2 cm long), the leaves are acicular (vs. linear),

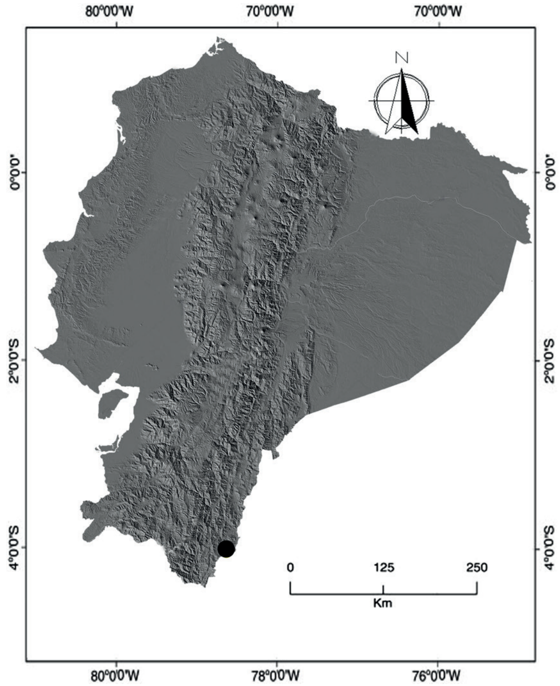

Figure 5. Distribution map of *Pityphyllum mercedes-abarcae* in Ecuador. Created by Leisberth Vélez Abarca.

narrower 0.5–0.7 mm (vs. 1 mm wide). The dorsal sepal is narrowly elliptical, attenuate at the base, concave in the proximal middle third and convex in the distal third, 3.1 × 1.1 mm (vs. narrowly lanceolate-elliptical, concave dorsal sepal, 3.5 × 1.0 mm); the lateral sepals are elliptical, acute, constricted at the base, 3.0 × 1.2 mm (vs. lateral sepals obliquely linear-lanceolate, subfalcate, up to 4.0 × 1.0 mm); the petals are spatulate, minutely apiculate at the apex, 2.9 × 0.9 mm (vs. narrowly lanceolate-elliptic petals, acute, up to 3.0 × 0.5 mm). In addition, *P. mercedes-abarcae* has erose margins in the middle third, a feature not observed in *P. pinoides*. Lip flattened is square in the middle third, wedge in the basal third and acute in the apical third with two small parallel calluses, attenuate at the base (Fig.4A), the apex is acuminate, 2.9 × 1.4 mm (vs. lip obovate, cuneate at the base, acute to sub-acuminate at the apex, up to 4.0 × 1.0 mm), *P. mercedes-abarcae* also has two unique characteristics that determine the species, presents a slight cell thickening in the abaxial part of the apical third of the lip (Fig. 4B) and elongated trichomes below the stigma in the abaxial side of the column (Fig. 4C).

Conservation status: *Pityphyllum mercedes-abarcae* has a very restricted distribution; so far only known from the canton of El Pangui (Fig. 5) in Zamora-Chinchipe, Ecuador. To date, it was found in primary forests near a mining area so that the forests will likely be destroyed. Also, there is not a study on the abundance of plants in the population. Hence, its population density is unknown, and it is impossible to categorize the species using IUCN criteria. The fact that there is only one known population in an unprotected area suggests that the species will face serious conservation problems in the future.

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TWO NEW SPECIES OF *ANDINIA* (PLEUROTHALLIDINAE) FROM THE CENTRAL CORDILLERA OF PERU

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ABSTRACT. Two new *Andinia* species are described, *A. barba-caprina* and *A. crassipetala*, both found during a botanical expedition to the montane forests of the Central Cordillera of the Peruvian Andes. They are compared with morphologically similar species, and Lankester Composite Dissection Plates (LCDP) are provided. *Andinia barba-caprina* is more similar to *A. tingomariana* but is distinguished by having obovate sepals with sparsely erose margins and the lip with narrowly obtuse, short basal lobes and a group of large hairs on the abaxial surface. *Andinia crassipetala* is distinguished from the two most similar species, *A. hernandoi* Est.Domínguez & S.Vieira-Uribe and *A. persimilis* (Luer & Sijm) Karremans & S.Vieira-Uribe for having thick, deltate and obtuse petals.

KEY WORDS/PALABRAS CLAVE: Andes Peruanos, *Andinia* subgénero *Andinia*, *Andinia* subgénero *Brachycladium*, *Andinia* subgenus *Andinia*, *Andinia* subgenus *Brachycladium*, Epidendroideae, Huánuco, Peruvian Andes

Introduction. The Pleurothallidinae subtribe, is the largest subtribe in the Orchidaceae family, with 5481 accepted species (Karremans & Vieira-Uribe 2020) distributed in the Neotropics. The genus *Andinia* (Luer) Luer (2000) is endemic to the tropical Andes. Its species are distributed from Colombia to Bolivia and can grow as epiphytes or terrestrial at mid to high elevations, from 1200 up to 3825 m of elevation (Wilson *et al*. 2017).

This genus has a complex taxonomic history, and its species have been placed in several different genera at different times. This was until Wilson *et al*. (2017) performed a molecular phylogenetic study and proposed five subgenera and two sections within the genus *Andinia*, including species that were previously treated as members of the genera *Masdevalliantha* Luer (1986), *Neooreophilus* Archila (2009), and *Xenosia* Luer (2004). Currently, *Andinia* has 77 recognized species (Karremans & Vieira-Uribe 2020), nine of them in subgenus *Aenigma* (Luer) Karremans & Mark Wilson, five in subgenus *Andinia*, 56 in subgenus *Brahcylcadium* (Luer) Karremans & S.Vieira-Uribe, four in subgenus *Masdevalliantha* (Luer) Karremans & Mark Wilson and finally subgenus *Minuscula* Karremans & Mark Wilson with three species.

In South America, during the last decade, seven new *Andinia* species have been described from countries such as Colombia: *Andinia lueri* S.Vieira-Uribe & Karremans (Vieira-Uribe & Karremans 2016), *A. obesa* S.Vieira-Uribe & Karremans (Vieira-Uribe & Karremans 2017), *A. auriculipetala* S.Vieira-Uribe & N.Gutiérrez (Vieira-Uribe & Gutiérrez 2020) and *A. hernandoi* Est.Domínguez & S.Vieira-Uribe (Vieira-Uribe & Domínguez Vargas 2020); from Ecuador:

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Andinia barbata J.Ponert, M.Portilla, Chumová & P.Trávn. (Ponert *et al*. 2020) and from Peru: *A. sunchubambensis* A.Doucette & Janovec (Doucette & Janovec 2016) and *A. tingomariana* A.G.Diaz & Mark Wilson (Díaz *et al*. 2018).

In Peru, a botanical expedition carried out by the authors in 2019 to the montane forests of the Mariano Dámaso Beraún and Chaglla districts in the Huánuco region, resulted in the discovery of two new *Andinia* species, one of them in the subgenus *Andinia* and the other in the subgenus *Brachycladium* sect. *Amplectentes*. Both species are described and illustrated here.

Material and methods. Specimens were recorded in situ using Canon® Rebel T3 and EOS 7D Mark II cameras equipped with a Canon EF 100mm f/2.8L Macro USM lens. Plants were dissected under an AY11230 Barska trinocular stereo microscope. Living floral and vegetative structures were photographed with an EOS 7D Mark II camera equipped with a Canon EF 100mm f/2.8L Macro USM and Raynox DCR-250 super macro snap-on lens. Obtained images were used to prepare Lankester composite dissection plates (LCDP) using Adobe Photoshop®.

Descriptions were prepared from living specimens, which have been then dried and flowers preserved in alcohol and glycerin. Specimens were deposited in USM herbarium.

Taxonomic treatment

Andinia barba-caprina Ocupa & S.Vieira-Uribe, ***sp. nov.*** (Fig. 1, 2B–C).

TYPE: Peru. Huánuco: Leoncio Prado Province, Mariano Dámaso Beraún district, Caserío Corazón de Jesús, 1,590 m, 21 October 2019, *Martel et al. 95* (holotype: USM-Spirit!).

Diagnosis: *Andinia barba-caprina* is morphologically similar to *A. tingomariana* A.G.Diaz & Mark Wilson, but is distinguished by having a sub-obovate dorsal sepal with slightly erose margins (*vs*. elliptical, entire), broadly obovate lateral sepals with slightly erose margin (*vs*. elliptical, ciliate) and the lip with narrowly obtuse, short basal lobes (*vs*. long basal lobes, oblong to narrowly triangular) and abaxially with a group of long hairs (*vs*. briefly ciliate).

Plant epiphytic, ascending, up to 3.5 cm tall. *Rhizome* up to 2.3 mm between ramicauls. *Ramicaul* abbreviated, terete, 3.1–3.4 mm long, enclosed by 2 tubular, ribbed sheaths. *Leaf* erect, elliptic, up to 13.9 × 3.7 mm, the apex emarginate with an abaxial mucro, the base cuneate into a petiole *ca*. 1 mm long. *Inflorescence* a lax, successively few flowered raceme up to 12 mm long including the slender peduncle, floral bracts conical, acute, 0.9 mm long, pedicels 2.4 mm long. *Ovary* yellowish green, terete, costate, 1.9 mm long. *Flowers* with the sepals yellow with a scarlet basal, central blotch; the petals scarlet-orange and the lip amber with scarlet margins; the column scarlet with a white and burgundy apex, the anther cap white and burgundy. *Sepals* 3-veined, puberulous, sparsely erose, shortly caudate, abaxially carinate along the central vein; *dorsal sepal* sub-obovate, shallowly concave, 5.5 × 3.3 mm, almost free; *lateral sepals* broadly obovate to elliptical, 5.3 × 3.5 mm connate for *ca*. 1.2 mm. *Petals* reniform, puberulous, sparsely long ciliate, unguiculate, obtuse, 0.6 × 1.3 mm. *Lip* sub-reniform and laterally constricted when expanded, 3-veined, puberulous, long ciliate, rounded, 1.8 × 1.8 mm expanded, with short, erect, narrowly obtuse basal lobes embracing the column, abaxially with a group of long hairs along the mid vein up to 1.8 mm long, adnate to the apical third of the column. *Column* terete, slightly dilated apically, microscopically pubescent, 2.9 mm long including the rostellum, anther apical, stigma apical, rostellum antrorse. *Pollinia* two, yellow, pyriform, with a viscidium. *Anther cap* elliptic, cucullate, white at the base, and vinaceous towards the top.

Etymology: The epithet *barba-caprina*, is the combination of the Latin words *barba* (beard) and *caprinus* (goat), in allusion to the tuft of long hairs hanging from the lower jaw of goats, commonly known as goat beard; in comparison to the long hairs near the base of the lip of this species.

Distribution, habitat and ecology: *Andinia barba-caprina* grows in secondary forests of the “yungas fluviales” ecoregion, distributed in the eastern side of the central cordillera of the Peruvian Andes, in caserío Corazón de Jesús, province of Leoncio Prado, Huánu-

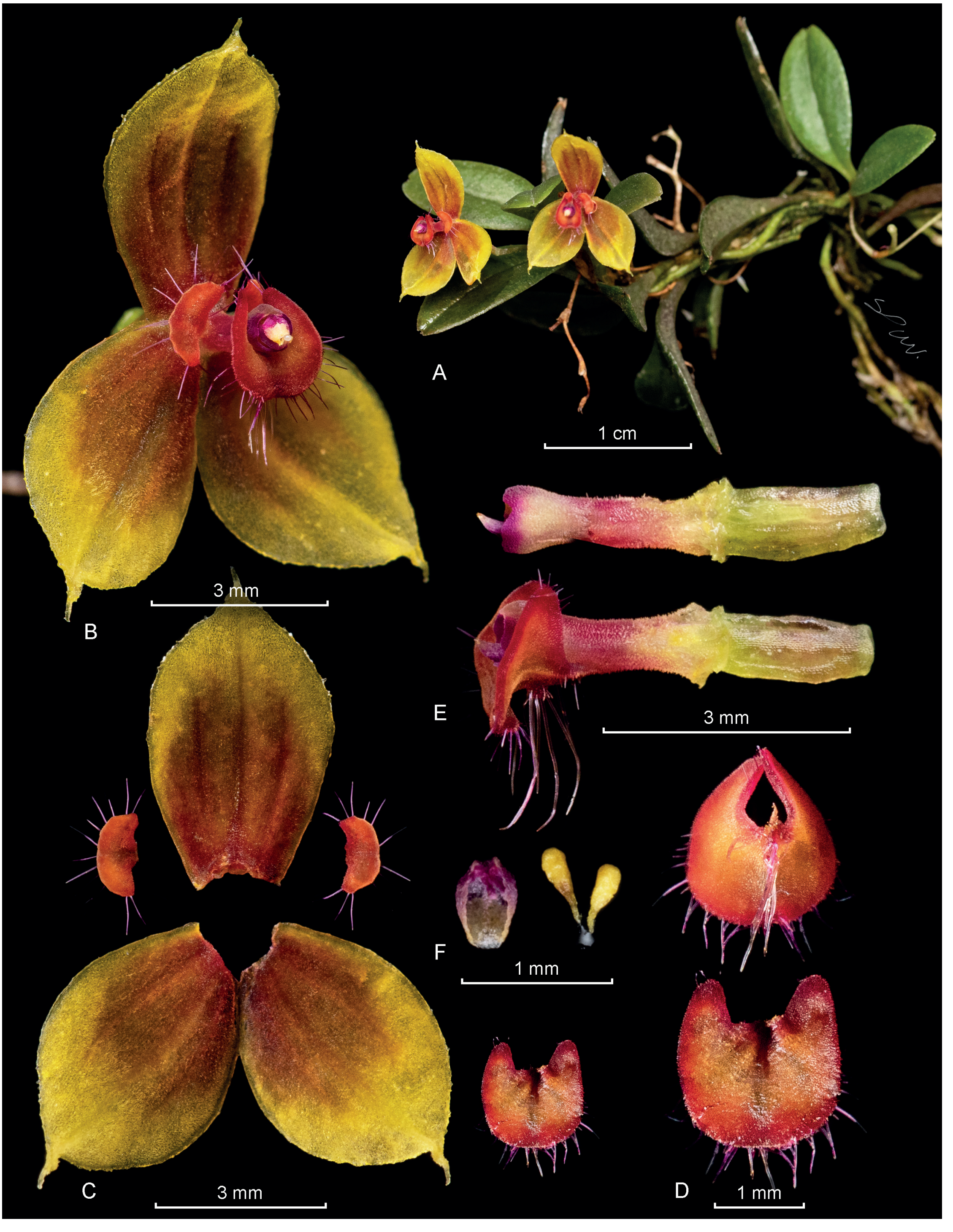

Figure 1. Lankester composite dissection plate of *Andinia barba-caprina* Ocupa & S.Vieira-Uribe. **A**. Habit. **B**. Flower. **C**. Dissected perianth. **D**. Lip, abaxial and adaxial view. **E**. Ovary and column with and without lip. **F**. Anther cap and pollinia. Photographed and prepared by S. Vieira-Uribe from the plant that served as type.

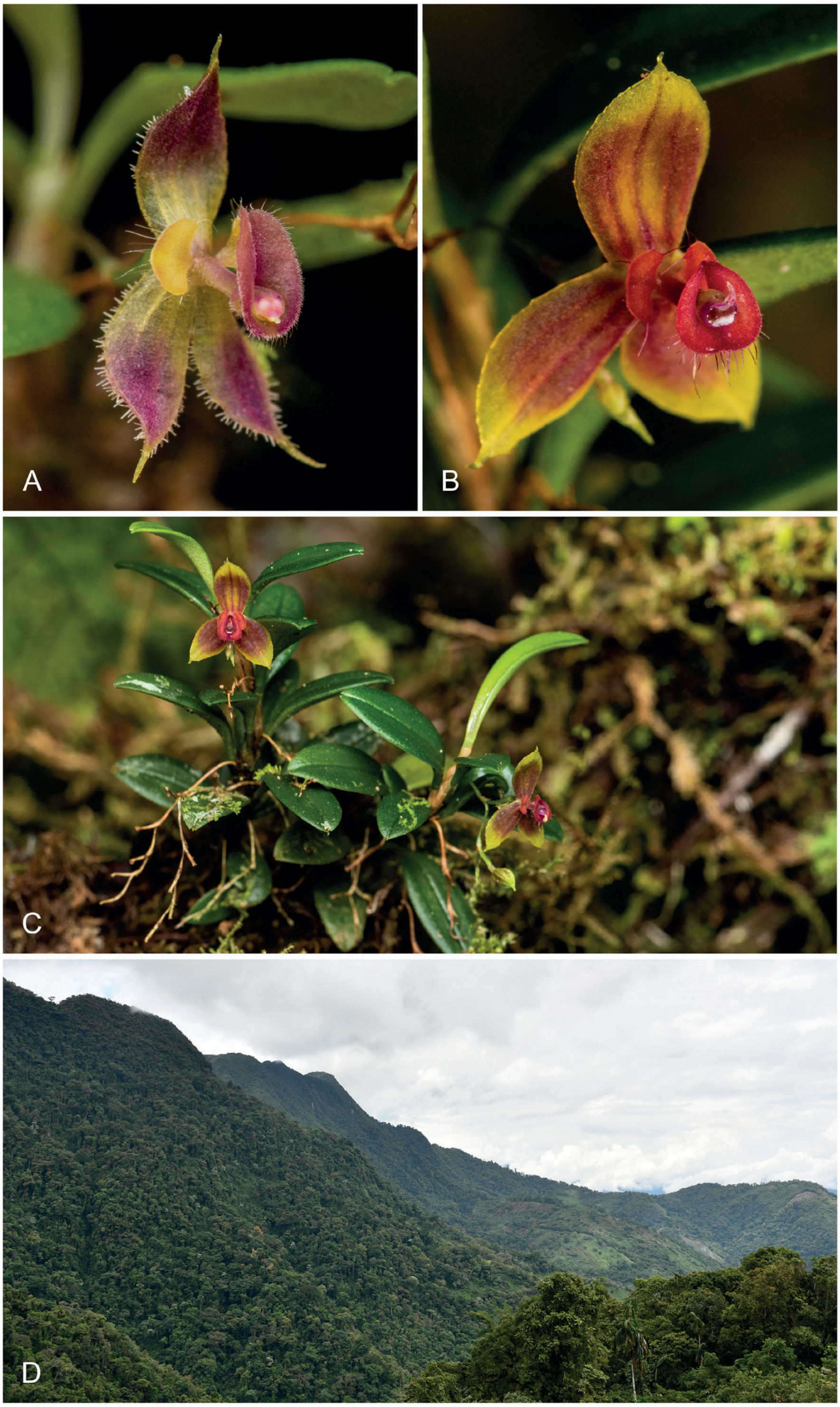

Figure 2. Comparison of species. **A**. *Andinia tingomariana*. **B**. *A*. *barba-caprina*. **C**. *A*. *barba-caprina* growing *in-situ*. **D**. Habitat of *A*. *barba-caprina*. Photographs by S. Vieira-Uribe (A–C) and Luis E. Yupanqui (D).

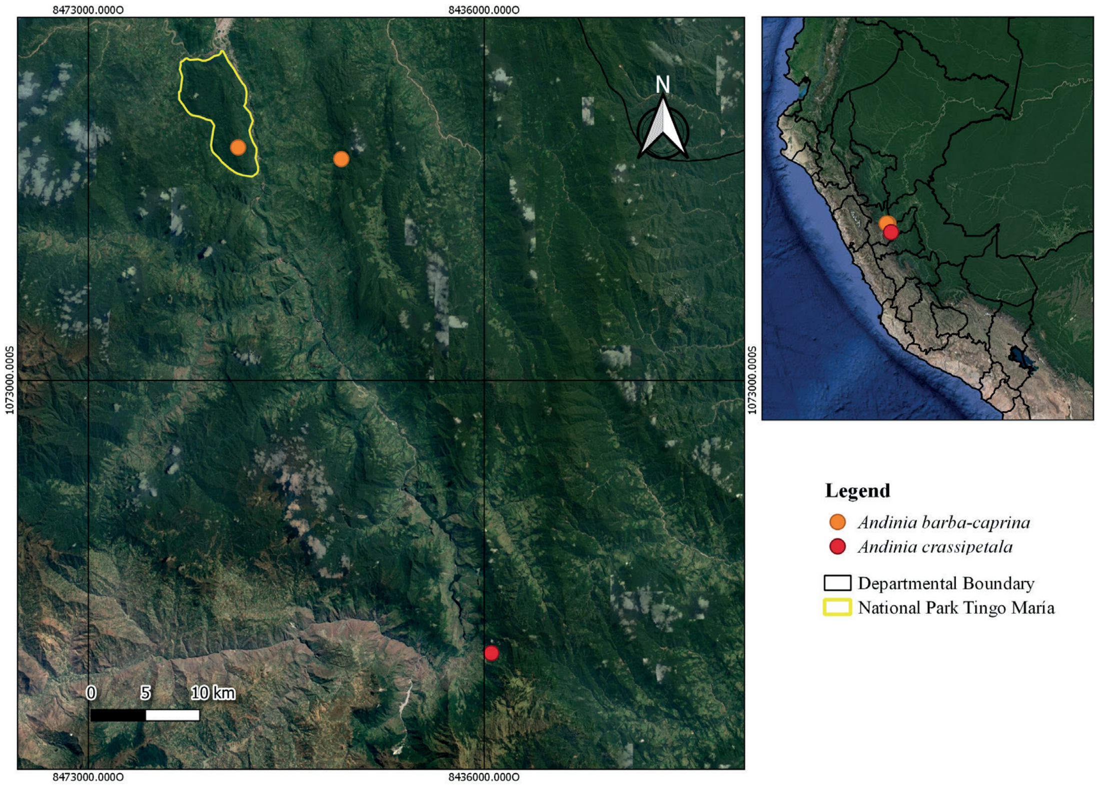

Figure 3. Map showing the localities of *Andinia barba-caprina* Ocupa & S.Vieira-Uribe and *A. crassipetala* S.Vieira-Uribe & Ocupa. Map prepared by L. Ocupa Horna.

co (Fig. 3), at an elevation of 1590 m. It has been found growing as an epiphyte in the bark of *Cyathea andina* Domin, in a very humid montane forest (Fig. 2D). It has also been reported in the Tingo María National Park, which is located within a steep area in the chain of mountains known as Bella Durmiente, 10 km from the locality of the type, where it grows as epiphyte on branches of bushes, in sympatry with *Andinia tingomariana*. It was observed that the flowering of this species occurs between September and October.

Andinia barba-caprina belongs to the *Andinia* subgenus and is most similar to the recently described *A. tingomariana*, both from a vegetative and floral point of view, sharing traits such as abbreviated ramicauls, erect leaves, reniform and puberulous petals with long ciliated margins and a column terete, microscopically pubescent and slightly dilated at the apex. However, *Andinia barba-caprina* is clearly distinguished from *A. tingomariana* by presenting yellow flowers with a central scarlet basal spot (*vs*. light yellow and apricot flowers), sub-obovate dorsal sepal with slightly erose margins (*vs*. eliptic, entire), broadly obovate lateral sepals with slightly erose margin (*vs*. elliptical, ciliate) and the lip with narrowly obtuse, short basal lobes (*vs*. long basal lobes, oblong to narrowly triangular) and abaxially with a group of long hairs (*vs*. briefly ciliate). (Fig. 2).

Andinia crassipetala S.Vieira-Uribe & Ocupa, ***sp. nov.*** (Fig. 4).

TYPE: Peru. Huánuco: Pachitea province, Chaglla district, Muña to Monopampa road, 2150 m, 19 October 2019, *Martel et al*. *96* (holotype, USM-Spirit!).

Diagnosis: *Andinia crassipetala* is most similar to *A. hernandoi* Est.Domínguez & S.Vieira-Uribe and *A. persimilis* (Luer & Sijm) Karremans & S.Vieira-Uribe, but is easily distinguished by having thick, deltate, ob-

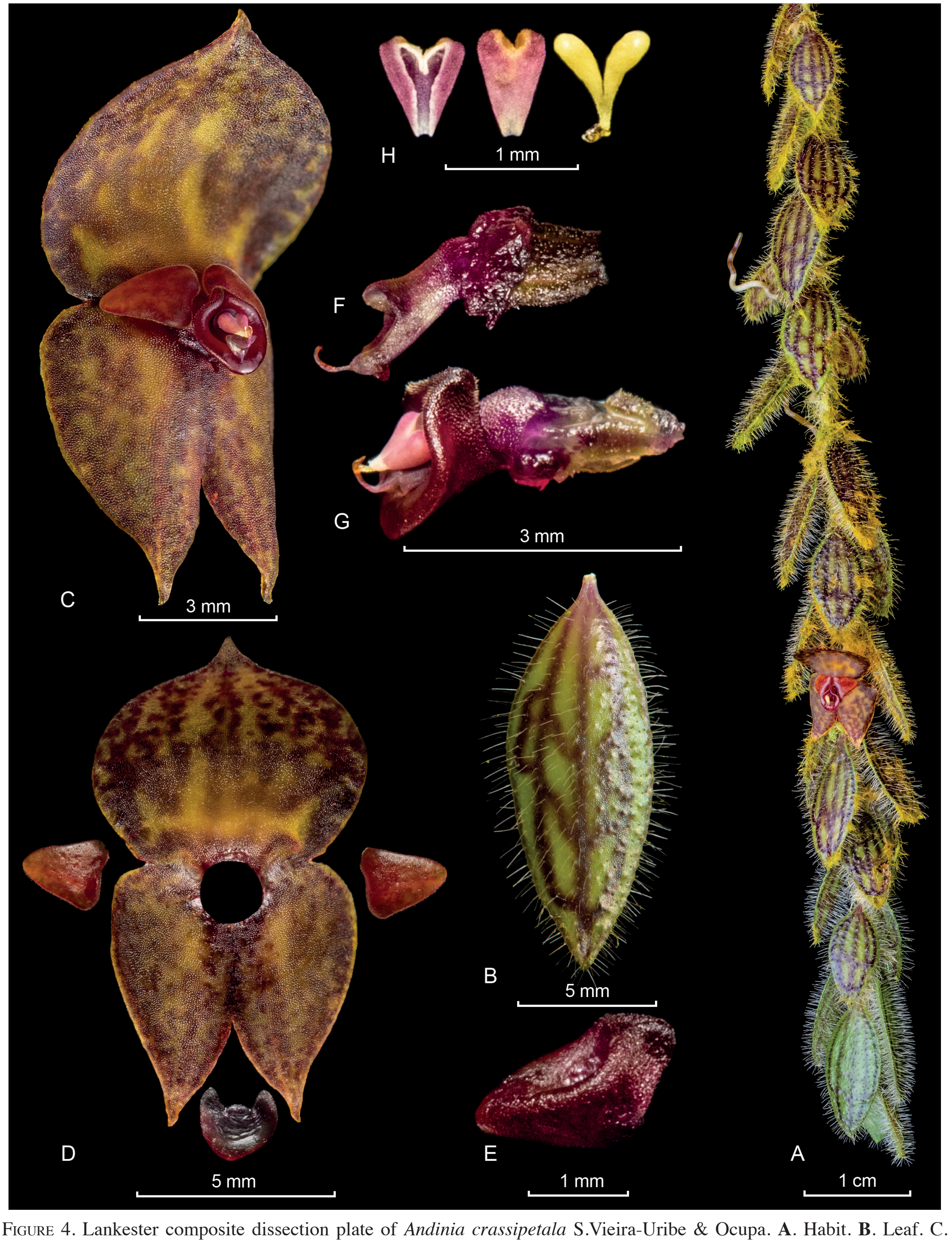

FIGURE 4. Lankester composite dissection plate of *Andinia crassipetala* S.Vieira-Uribe & Ocupa. **A**. Habit. **B**. Leaf. C. Flower, oblique view. **D**. Dissected perianth. **E**. Lip, side view. **F**. Ovary and column (anther cap absent), side view. **G**. Ovary, column and lip (anther cap present), side view. **H**. Anther cap and pollinia. Photographed and prepared by S. Vieira-Uribe from the plant that served as type.

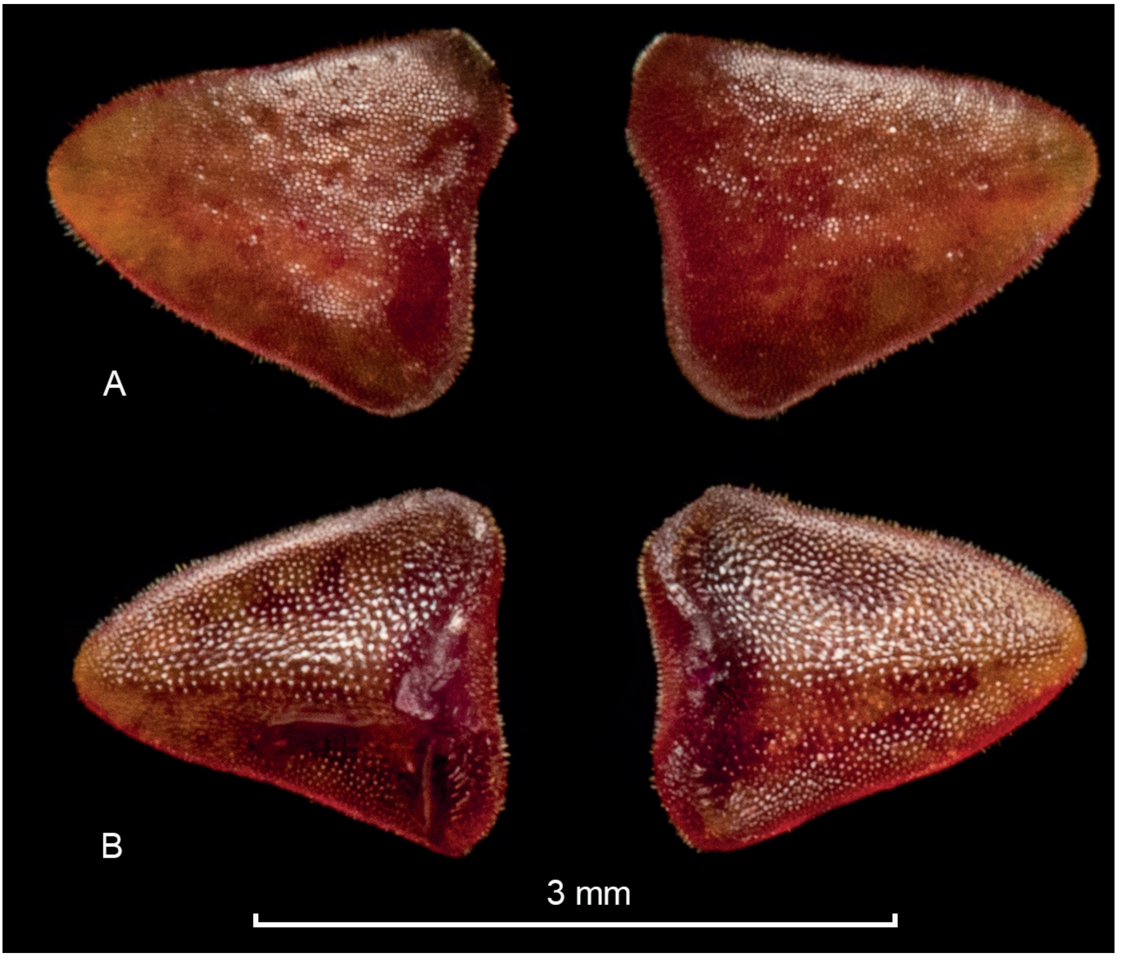

Figure 5. Detailed view of the petals of *Andinia crassipetala* S. Vieira-Uribe & Ocupa. **A**. Adaxial view. **B.** Abaxial view. Photographed and prepared by S. Vieira-Uribe from the plant that served as type.

tuse petals (*vs*. trifurcate in *A. hernandoi* and oblong-triangular, subacute in *A. persimilis*).

Plant epiphytic, pendent, long repent, up to 43 cm. *Stem* occasionally branching, 2.4–2.5 mm long between ramicauls, each segment enclosed by two infundibular, imbricating, membranaceous, pilose sheaths with pilose dilated ostia. *Roots* slender, *ca*. 0.5 mm in diameter. *Ramicauls ca*. 1 mm long, enclosed by a single, infundibular, membranaceous, pilose sheath with pilose dilated ostia. *Leaves* suffused with purple along the reticulate veins, lanceolate, thickly coriaceous, pilose, acute, 13.9–14.8 × 5.7–6.3 mm, the base narrowing into a petiole *ca*. 0.5 mm long. *Inflorescence* a congested, successive raceme of up to 2 flowers, placed above the leaf, *ca*. 4.3 mm long including the 1.8 mm long pedicel. *Floral bract* infundibular, membranaceous, pilose along the margins, *ca*. 1 mm long. *Ovary* costate, *ca*. 1 mm long. *Flowers* with saffron sepals irregularly spotted with maroon, orange-red petals and claret lip, the column vinaceous with a vinaceous anther cap suffused with amber and white. *Dorsal sepal* sub-orbicular, shallowly concave, marginate, acuminate, 5-veined, 5.7 × 7.0 mm, connate to the lateral sepals for about 1.5 mm. *Lateral sepals* ovate, slightly convex, marginate, acuminate, 3-veined, connate for about 2.4 mm into a bifid synsepal 6.6 × 6.2 mm when expanded. *Petals* deltate, thick, puberulous, the apex and basal lobes obtuse, 2.0 × 1.8 mm. *Lip* reniform, 3-veined, marginally and abaxially puberulous, rounded, 1.5 × 2.0 mm expanded, with short, erect,

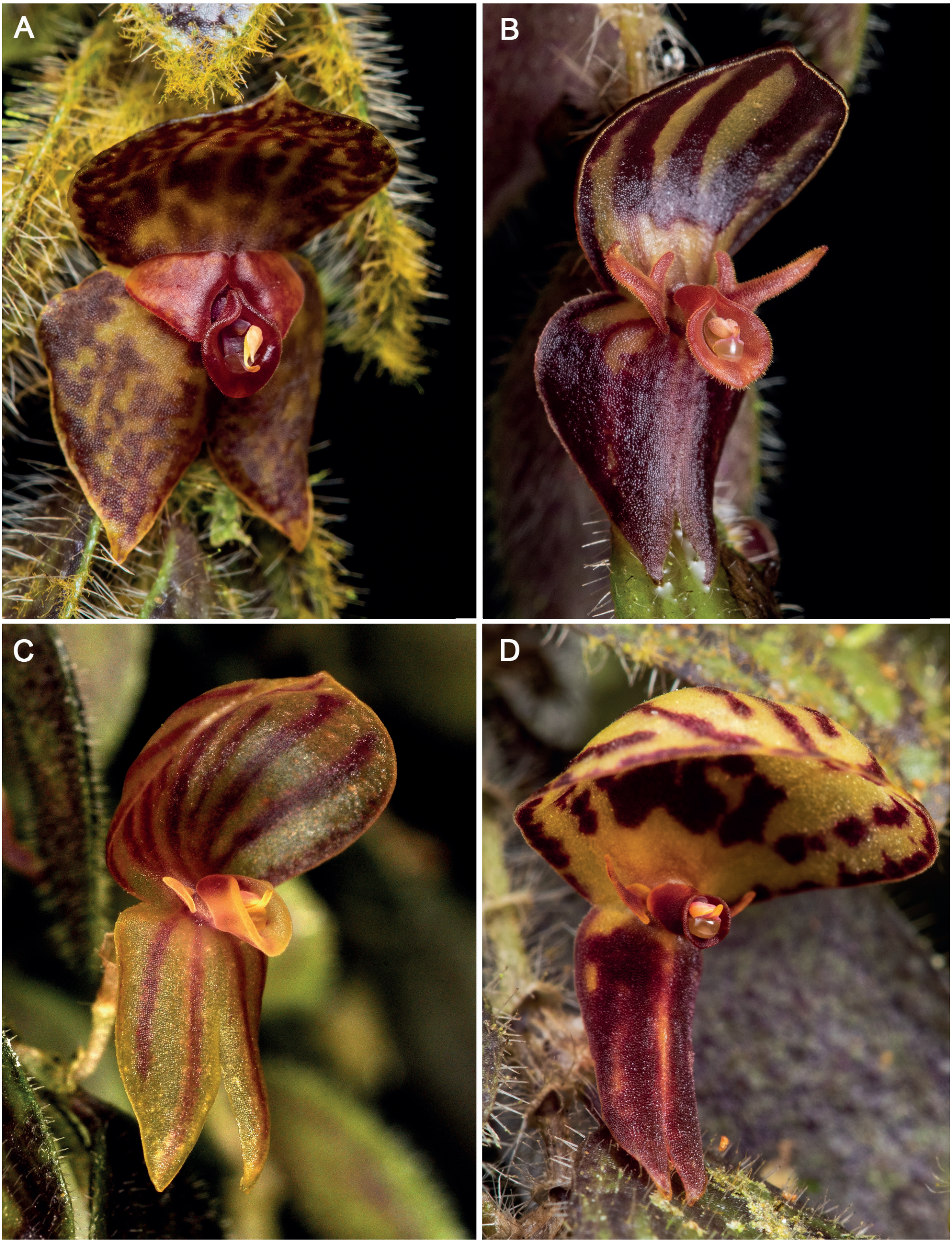

FIGURE 6. Comparison of *Andinia crassipetala* S.Vieira-Uribe & Ocupa with its most similar species. **A**. *A. crassipetala*. **B**. *A. hernandoi*. **C**. *A. persimilis*. **D**. *A. pilosella*. Photographs by S. Vieira-Uribe (A–B, D) and Ron Parsons (C).

obtuse basal lobes, embracing the column, adnate to the base of the column. *Column* terete, the anther and stigma apical, *ca*. 2.1 mm long including the antrorse, conspicuous rostellum. *Pollinia* two, yellow, obovoid, brought together by a drop-like viscidium. *Anther cap* cordate, cucullate.

Etymology: From the Latin *crassus* (thick) and *petalum* (petals), in reference to the distinctively thick petals (Fig. 5).

Distribution, habitat, and ecology: *Andinia crassipetala* has only been seen at the type locality (Fig. 3), where it was first seen and photographed by Stig Dalström and Steve Beckendorf in 2014, and in 2019, when the authors visited the same place and were able to find a few plants growing as epiphyte, together with *Dracula saulii* Luer & Sijm on the branches of a small tree, about 50 cm above the ground, in the edge of the secondary forest bordering the road to Monopampa village at an elevation of 2150 m.

Andinia crassipetala is most similar to *A. hernandoi* and *A. persimilis*, sharing with them pilose leaves, an orbicular or sub-orbicular and concave dorsal sepal, and a bifid synsepal, but is differentiated by having thick, deltate petals. The only other species with lanceolate, pilose leaves supposedly found in Peru is *Andinia pilosella* (Rchb.f.) Karremans & S.Vieira-Uribe (Luer 1994) but it is easily distinguished from *A. crassipetala* because it has an orbicular, deeply concave dorsal sepal that is considerably larger than the synsepal (*vs*. sub-orbicular, shallowly concave, acuminate dorsal sepal, similar in size to the synsepal) and glabrous, narrowly triangular to linear-oblong petals (*vs*. thick, puberulous, deltate petals) (Fig. 6).

Acknowledgments. We thank Steve Beckendorf of the Orchid Conservation Alliance, for sharing with us the first photos of *Andinia crassipetala*, when he discovered it in 2014, and Stig Dälstrom for sharing details of the locality. To Oscar Rivas from Huánuco, Peru, for transporting and guiding us during the expedition in the Huánuco region and Ron Parsons for providing the photo of *Andinia persimilis*. Finally, we also thank Carlos Martel for the samples collected by his person, with the collection permit with Resolution of the General Directorate No. 0096-2015-SERFOR-DGGSPFFS, granted by SERFOR.

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EXPLOSIVE RANGE EXPANSION OF *EULOPHIA GRAMINEA* (ORCHIDACEAE) IN PUERTO RICO AND THE WEST INDIES

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Abstract. *Eulophia graminea* Lindley (Orchidaceae), a native orchid of tropical and subtropical Asia, was first reported in the Western Hemisphere from populations in Miami, Florida, U.S.A. where it spread rapidly through the southern part of the state. Here we report the first record of this species for Puerto Rico and sightings in the Bahamas and Cuba, reflecting the rapid spread seen in southern Florida (U.S.A).

Resumen. *Eulophia graminea* Lindley (Orchidaceae), una orquídea nativa de Asia tropical y subtropical se informó por primera vez en el hemisferio occidental en poblaciones de Miami, Florida, EE. UU., donde se extendió rápidamente por la parte sur del estado. Aquí informamos el primer registro de esta especie para Puerto Rico y también avistamientos en las Bahamas y Cuba, lo que refleja la rápida propagación observada en sur de Florida (EE. UU.).

Key Words/Palabras clave: Caribbean, Caribe, Chinese Crown Orchid, especie invasora, invasive species, range expansion, rango de distribución, Grass-Leaved *Eulophia*, orchid, Orquídea Corona China

Introduction. Native orchid species do not often exhibit rapid range expansion (e.g., *Oncidium poikilostalix* (Kraenzl.) M.W.Chase & N.H.Williams, García-González *et al*. 2013; *Microtis media* R.Br., Bonnardeaux *et al*. 2007), but the incidence of non-indigenous orchids invading new regions has become more noticeable (Stern 1988, Ackerman 2007, 2017). Herein we report the continuation of a rapid range expansion by the non-indigenous species *Eulophia graminea* Lindley (Orchidaceae), a terrestrial orchid commonly known as the Chinese Crown Orchid or Grass-Leaved Eulophia. *Eulophia graminea* is native to Sri Lanka, India, Nepal, Pakistan, Kashmir, Myanmar, Thailand, Laos, Vietnam, Malaysia, Indonesia, Philippines, northward to subtropical China, Taiwan, and the Ryukyu Islands. Within its native range, it has considerable ecological amplitude growing in open areas, grasslands, beaches, lawns, roadsides, shrubby habitats, and in open forests at elevations from sea level to 1200 m (Pemberton *et al*. 2008, Ang *et al*. 2011, Orchid Species 2021).

In the last two decades, *E. graminea* has become naturalized in Australia, South Africa, and Florida, U.S.A. (Macrae 2002, O'Conner *et al*. 2006, Pemberton *et al*. 2008, PIER 2021). In just a few years, reports of *E. graminea* in southern Florida increased from five populations in Miami-Dade County in 2007 to 67 locations in seven counties in 2010 (Pemberton 2013). The orchid is now known from 18 Florida counties (Wunderlin *et al*. 2021) and has been discovered in the Bahamas on at least three different islands (Sandy Point, Abaco; near Grand Bahama airport, Grand Bahama; Governor's Harbour, Eleuthera; Michael Vincent and Ethan Freid, personal communications with JDA 2010, 2014, 2015, photos!), and in at least three provinces in Cuba (Camagüey, Oscar Loyola Hernández, personal communication with JDA 2018, photos! Santa Clara, Quemado de Güines, José Luis Gómez-Hechavarría, iNaturalist.org/photos/118262829!; Pinar del Río, José Lazaro Bocourt, personal communication with JDA 2020, photos!) (Fig.1A).

Eulophia graminea has strong colonizing abilities. In its native range, the grass-like plants occupy similar open, disturbed habitats as do *Spathoglottis plicata* Blume and *Arundina graminifolia* (D.Don) Hochr., both of which are also invaders on tropical islands and continental regions (Ackerman 2007, Ang *et al*. 2011, Kolanowska & Konowalik 2014). In native and

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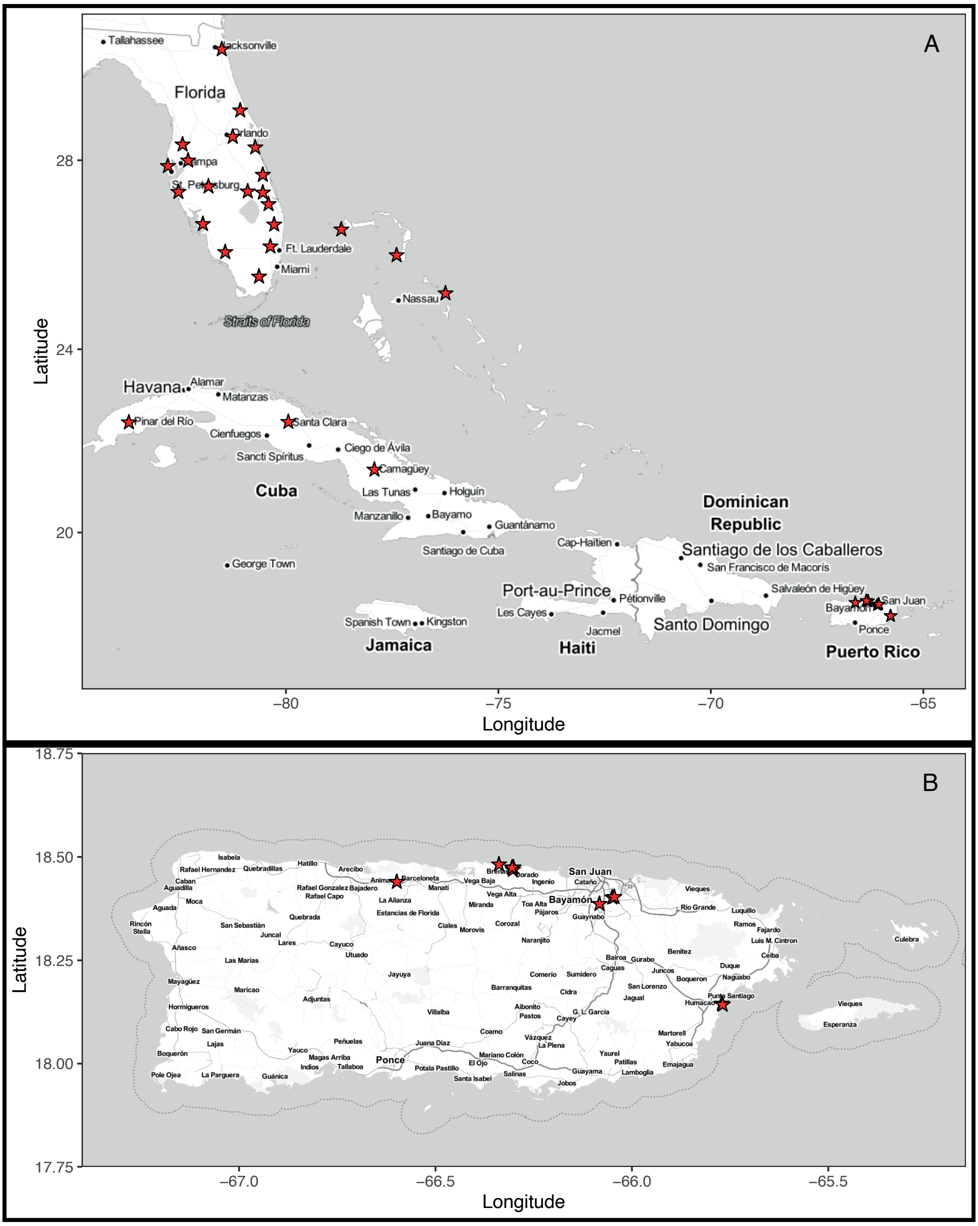

FIGURE 1. Distribution of *Eulophia graminea* in the Western Hemisphere. **A**. Distribution in Florida and the West Indies. We placed the stars in the center of the counties (Florida), islands (Bahamas), and provinces (Cuba) where *E. graminea* has been reported. **B**. Distribution within Puerto Rico. Placement of stars is based on coordinates of each locality. Maps were created with ggplot2, ggmap, and ggstar in R Studio Team (2021).

invaded habitats, *E. graminea* can occur in a variety of substrates from beach sands to garden wood-chip mulch, probably exploiting a wide variety of mycorrhizal fungi, including wood decaying fungi. Flowers sometimes self-pollinate and may bloom within one year of sowing *in vitro* (Chang *et al*., 2010). Pemberton *et al*. (2008) determined in Florida (U.S.A.), via bagging experiment, that *E. graminea* is indeed at least partially self-compatible. They estimated fruit set as 4.5% and 9.2% in two different populations in southern Florida. Despite their assertions of pollinator-dependency, they failed to observe any pollinator visits. While we have not made a concerted effort to observe pollination, we also have failed to see any visits during our casual visits to Puerto Rico populations. We found that the spurs contain a small amount of nectar (0.5 μl) making the low fruit set unusual for species offering a pollinator reward (Tremblay *et al*. 2005). When we collected inflorescences for vouchers and to check for nectar, we noticed that the pollinaria were easily dislodged. It remains to be seen whether or not autogamy involves natural perturbations, such as wind and rain, to dislodge the pollinia and contact the stigma as occurs in a few other orchids (Catling 1980, Fan *et al*. 2012, Suetsugu 2019), including the congeneric *E. maculata* (González-Díaz & Ackerman 1988, as *Oeceoclades maculata* (Lindley) Lindley; see discussion below).

Eulophia graminea was first discovered in Puerto Rico in 2018. Adolfo Rodríguez Velázquez, a graduate student at the University of Puerto Rico, Río Piedras, found a single plant in disturbed, secondary vegetation in the limestone region "mogotes" on the northern side of the island. While only one plant was discovered, there may have been more because they are difficult to detect since the leaves are fugacious, withering before the onset of anthesis. Two years later, Dr. Tamara Heartsill Scalley sent JDA photos of this orchid growing in thick Bermuda grass under street trees in the city of San Juan. At this site, we found ten inflorescences, averaging 12 flowers apiece. Half the inflorescences showed no signs of developing fruit. From the remainder, we estimated the average fruit set for the population was 10.6%. Since then, we have discovered a population in the municipalities of Dorado (Dorado Beach Hotel; Steve Maldonado Silvestrini and Christian Torres Santana, personal communications with JDA, 2020); Vega Alta (Sabana, Cerro Gordo, Ritirene observer, iNaturalist; accessed 21 April 2021); Humacao and two populations observed by us in San Juan on campus of the University of Puerto Rico, Río Piedras (Fig. 1B). The march of the species may become as fast as other naturalized orchids of Puerto Rico: *Eulophia maculata* (Lindl.) Reichb.f. (synonym: *Oeceoclades maculata* (Lindl.) Lindl.), *Spathoglottis plicata*, *Dendrobium crumenatum* Sw., and *Arundina graminifolia* (Ackerman 2007, Falcón *et al*. 2017, Foster & Ackerman 2021).

Should we be concerned that *E. graminea* is spreading rapidly? While invasive species are usually tagged in a negative fashion (Larson 2005), the spread of some non-indigenous species have little or no negative consequences, sometimes can be beneficial, and effects are often context dependent (Daehler 2003). Concerning orchids, roots of non-indigenous *Vanda tricolor* Lindl. were seen "nearly smothering" a native host tree (Oppenheimer 2006). *Epipactis helleborine* (L.) Crantz is perhaps the first non-indigenous orchid to invade North America, where it is considered a troublesome weed in lawns and gardens in some urban areas (Squirrell *et al*. 2001). Donald Dod (1986) reported that *E. maculata* in the Dominican Republic was an agricultural pest in sugar cane fields requiring heavy farm machinery to eradicate them. Several studies of invasive orchids have focused on whether or not they had negative consequences on native orchids; the results are usually equivocal (e.g., Bonnardeaux *et al*. 2007, Cohen & Ackerman 2009), but significant negative results can be subtle through various means, including apparent competition (Recart *et al*. 2013). While *E. graminea* can form dense monocultures (UF/IFAS 2021), we do not expect the invasion of *E. graminea* to be ecologically harmful on a large scale. Nevertheless, it is wise to monitor populations just as it would be for any non-indigenous species.

VOUCHERS: Puerto Rico. **Municipality of Arecibo**: Barrio Garrochales, Rd 682, Cambalache State Forest, 18.439461°, -66.598530°, moist limestone forest vegetation, elev. 100 m, Dec 2018, *A. Rodríguez Velázquez s.n*. (UPRRP). **Municipality of San Juan**: Río Piedras, Urbanization San Francisco, Avenue de Diego near intersection with Calle Verbena, 18.386124°, -66.082531°, elev. 26 m, growing under street trees of *Calophyllum antillanum* Britton, "Maria", in thick untended Bermuda grass (*Cynodon dactylon* (Linnaeus) Persoon 16 Jul 2020, *J. D. Ackerman 6080* (UPRRP). Loc. cit., 15 Jul 2020, *T. Heartsill s.n*. (UPRRP). Río Piedras, University of Puerto Rico, in front of the Julio García Díaz building, 18.401728°, -66.049554°, elev. 28 m, 16 Apr 2021 *N. González-Orellana s.n*. (UPRRP). **Municipality of Humacao**: Reserva Natural Efraín Archilla Díez, Camino de los Helechos, 18.145035°, -65.771287°, elev. near sea level, 23 Feb 2021, *N. González-Orellana s.n*. (UPRRP).

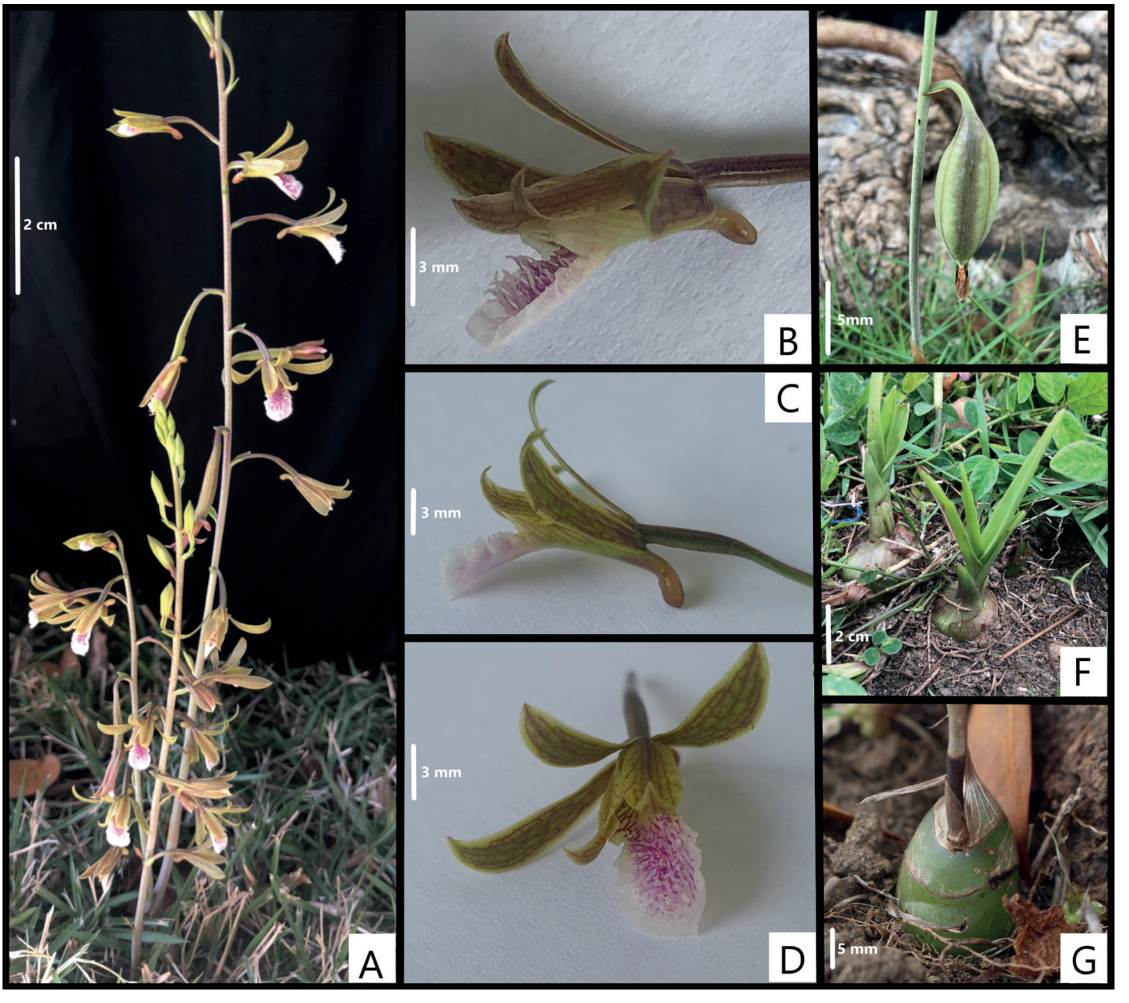

Figure 2. *Eulophia graminea*. **A**. Inflorescences. **B**. Flower, side view showing fleshy hairs on the mid lobe of the lip. **C**. Flower, side view, showing spur morphology. **D**. Flower, front view showing lip color patterns. **E**. Fruit. **F**. Pseudobulbs with leaves. **G**. Pseudobulb with base of an inflorescence. All photographs taken by James Ackerman and Normandie González from the University of Puerto Rico, Río Piedras population. Voucher: 16 Apr 2021, *N. González-Orellana s.n*. (UPRRP).

Description: The following is a description of *Eulophia graminea* based on material from Puerto Rico (Fig. 2 A–G).

Plants terrestrial, to 1 m. *Roots* from base of pseudobulb. *Stems* pseudobulbous, ovoid to globose, sometimes compressed, composed of 3–5 internodes, 2.3–5.0 cm in diameter. *Leaves* 2–6, distichous, enclosing the stem, blades conduplicate, linear, about 10 cm long, 10 mm wide, the first leaves are shorter. *Inflorescences* 1–2, lateral from the side of the pseudobulb, erect, 20–50 cm including peduncle; *peduncle* green to purple, glaucous, partially covered by 4–5 sheathing bracts; *raceme* few to many flowered, larger inflorescences sometimes sparsely branched panicle, *floral bracts* lanceolate, acuminate 4–9 mm long. *Flowers* resupinate; pedicellate ovaries 12–16 mm long; sepals and petals pale green, with maroon veins; dorsal sepal spreading, apically reflexed, oblanceolate, acuminate, 9–11 mm long 2.5 mm wide; lateral sepals similar, slightly asymmetrical 12 mm long, 2.5 mm wide; petals flanking the column, narrowly elliptic, acuminate, 8.5–10 mm long, 2.2–2.5

mm wide; lip trilobed, and basally provided with a spur bent downwards, swollen toward apex, 2.5–3.5 mm long, lip 10–11 mm long, the lower 7 mm forming a tube with the column, 3 prominent ridges extend to the base of the mid lobe, these flanked by about 3 angling ridges on each side, lateral lobes ovate-oblong, rounded, 2 mm long from bottom of sinus, mid lobe white, oval, 6.5 mm long and 4.5–5 mm wide, disc suffused purple, densely provided with seven rows of purple fleshy hairs to 1.5 mm long fading to white toward apex of lobe, margins white to pale purple, crisped. *Column* clavate 4 mm long, column foot 1 mm long, anther hinged, *pollinia* 4 in unequal pairs. *Fruit* a pendent ellipsoid capsule 18–21 long, 7–8.5 mm diameter.

There are now three species of *Eulophia* in Puerto Rico and the West Indies (Ackerman 1995, Ackerman & Collaborators 2014), one of which is native (*E. alta* (L.) Fawc. & Rendle) and the other two are not, *E. graminea* and *E. maculata*. The latter species, commonly known as *Oeceoclades maculata*, has been recently reinstated as a *Eulophia* by Chase *et al*. (2021) based on interpretation of phylogenetic and morphological works by Martos *et al*. (2014) and Bone *et al*. (2015). Although *Eulophia maculata* has been resident in the Western Hemisphere at least since the early 19th century, it is regarded as non-indigenous in the region and native to Africa and may have arrived in the ballast of slave ships (Stern 1988, Kolanowska 2013). The three can be distinguished by the following key:

Key to the Species of *Eulophia* in the West Indies

1. Leaves solitary from apex of pseudobulb, conspicuously mottled, leathery and persistent .... ***E. maculata***

1a. Leaves 3 or more, concolorous, relatively thin, persistent or early deciduous 2

2. Pseudobulbs poorly developed or absent, leafy at flowering; lip saccate; petals form a hood over the column; sepals erect vertically; lip margin pinkish purple to burgundy; inflorescences 70-150 cm tall, racemose .... ***E. alta***

2a. Pseudobulbs roughly globose, leafless at flowering; lip spurred; apices of sepals and petals spreading; lip margin white to pale purple; inflorescences generally are <70 cm but can reach to 100 cm, racemose or sometimes paniculate .... ***E. graminea***

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NOTES ON AUSTRALASIAN ORCHIDACEAE 7: UPDATES ON THE NOMENCLATURE OF *SULLIVANIA* (DIURIDEAE: DRAKAEINAE)

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Abstract. *Sullivania* F.Muell. (Orchidaceae) is recognised as a validly published genus having priority over *Paracaleana* Blaxell, and thirteen species (eleven described) in *Paracaleana* are here transferred to it.

Key words/Palabras clave: Australia, *Caleana*, *Caleya*, flora, nomenclatural adjustments, ajustes nomenclaturales, orchid, orquídea, *Paracaleana*

Introduction. *Sullivania* F.Muell. and *Caleana* R.Br. are sister genera within the subtribe Drakaeinae and molecular studies have confirmed their close ancestral relationship (Miller & Clements 2014, Peakall et al. 2021). Differences in their morphology (Blaxell 1972) and pollination syndromes (Cady 1965, Bower 2014) support their status as distinct genera. The same molecular studies also confirm that within *Sullivania* there are two distinct groups of species, those with narrowly linear leaves and those with ovate to ovate-lanceolate leaves. These two groups were formally recognised respectively as subgenera: *Sullivania* subg. *Sullivania* and *Sullivania* subg. *Tanychila* (D.L.Jones & M.A.Clem.) D.L.Jones & M.A.Clem. (Jones et al. 2002, Jones & Clements 2005).

There has been debate about the use of the generic name *Sullivania* as compared to *Paracaleana* Blaxell (Hopper & Brown 2006). In the Australian Plant Name Index (APNI 2021) the following definitive statement is provided about the status of the genus *Sullivania*: *Mueller cites this name as "Sullivania, F. v. Mueller, inedited" and provides a brief diagnosis. This was interpreted by Hopper & Brown, Austral. Syst. Bot. 19(3): 215 (2006), as being a provisional name and thus not validly published. However, as Mueller provided the place of publication for all other generic names in this work, his use of "inedited" is here interpreted as an indication that the name had not been previously published. The diagnosis provided is sufficient for valid publication of the name under ICN Art. 38.1 (Shenzhen Code, 2018).* The key interpretation here for validity of the name is the interpretation of 'inedited', which appears to indicate simply that the name was previously unpublished by Mueller, rather than an expression of taxonomic non-acceptance by Mueller. This is consistent with other usage of the word by Mueller.

On this basis, *Sullivania* (Mueller 1882) is the earliest validly published generic name available for the group of species included by some authors under the name *Paracaleana* (Blaxell 1972). *Paracaleana* is therefore considered a taxonomic synonym of *Sullivania* as first proposed by Jones and Clements (2005). Those species described in *Paracaleana*, but lacking combinations in *Sullivania*, require nomenclatural adjustments to facilitate their recognition and conservation by Federal and State agencies and are therefore transferred to *Sullivania* in this paper.

Taxonomic treatment

Sullivania F.Muell., J. Proc. Roy. Soc. New South Wales 15: 229 (1882). Type: *Caleya sullivanii* F.Muell., designated by Jones and Clements (2005).

Paracaleana Blaxell, Contr. New South Wales Natl. Herb. 4: 281(1972). Type: *Caleana minor* R.Br.

Sullivania* subgen. *Sullivania

Sullivania lyonsii (Hopper & A.P.Br.) D.L.Jones & M.A.Clem., ***comb. nov.***

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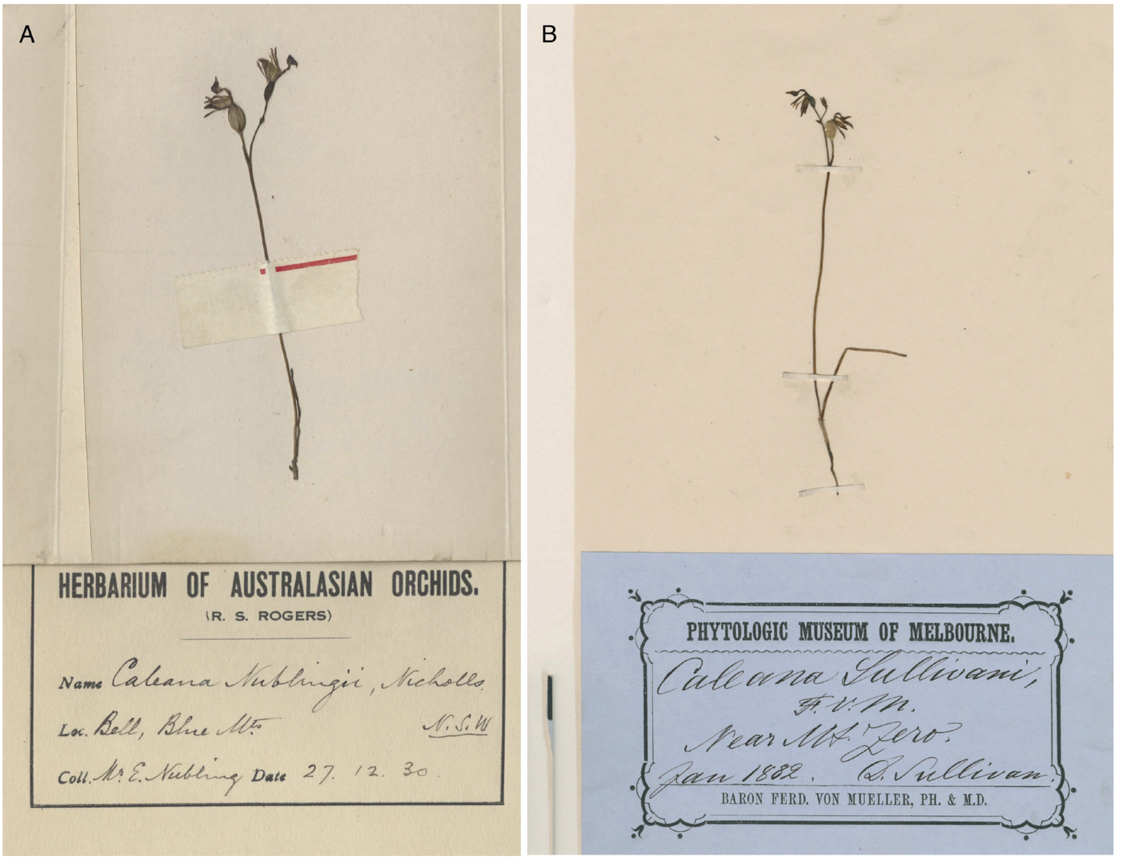

FIGURE 1. **A**. *Caleana nublingii* (= *Sullivania nublingii*), syntype (AD 966090281). **B**. *Caleya sullivanii* (= *Sullivania sullivanii*), holotype (MEL 39741).

Basionym: *Paracaleana lyonsii* Hopper & A.P.Br., Aust. Syst. Bot.19(3): 219-221, Figs 4, 5 (map) (2006). Fig. 2a.

Sullivania minor (R.Br.) D.L.Jones & M.A.Clem., The Orchadian 15(1): 36 (2005). Fig 2b.

Note: Developmental embryological research on plants of *S. minor* revealed that this species is a facultative apomict (Clements 1995). It is capable of producing seed through sexual or apomictic reproductive means, even in the same capsule. Seed produced through apomixis facilitates the production of potential new plants, even in the absence of suitable pollinators. Apomixis can also lead to the development, and possible continuance, of mutational forms, and it is thought both *S. nublingii* and *S. sullivanii* originated in this manner. Of the two, *S. nublingii* is the rarest – a small population having been found only once, in the Blue Mountains, New South Wales. However, *S. sullivanii* occurs in two main populations, approximately 400 km apart, one in the Grampians, Victoria and the second in the Mt Lofty Ranges, South Australia.

Sullivania nublingii (Nicholls) D.L.Jones & M.A.Clem., ***comb. nov.***

Basionym: *Caleana nublingii* Nicholls, Victorian Naturalist 48(1): 15, 17, plate (1931). Fig. 1a.

Sullivania sullivanii (F.Muell.) D.L.Jones & M.A.Clem., ***comb. nov***.

Basionym: *Caleya sullivanii* F.Muell., Chem. & Druggist, Austral. Suppl. 4(45): 68-69 (1882). Fig. 1b.

Sullivania* subgen. *Tanychila (D.L.Jones & M.A.Clem.) D.L.Jones & M.A.Clem., The Orchadian 15(1): 36 (2005).

Figure 2. **A**. *Sullivania lyonsii*. **B**. *Sullivania minor**. **C**. *Sullivania alcockii*. **D**. *Sullivania brockmanii*. **E**. *Sullivania dixonii*. **F**. *Sullivania disjuncta**. **G**. *Sullivania ferricola*. **H**. *Sullivania gracilicordata*. **I**. *Sullivania granitica*. J. *Sullivania hortiorum*. **K**. *Sullivania nigrita**. **L**. *Sullivania parvula*. **M**. *Sullivania terminalis*. **N**. *Sullivania triens*. **O**. *Caleana major*. All photos by G. Brockman except (B) and (O) by Z.Groeneveld. * indicates species previously transferred to *Sullivania* but included here for completeness.

Type species: *Paracaleana nigrita* (J.Drummond ex Lindl.) Blaxell

Sullivania alcockii (Hopper & A.P.Br.) D.L.Jones & M.A.Clem., ***comb. nov.***
Basionym: *Paracaleana alcockii* Hopper & A.P.Br., Aust. Syst. Bot.19(3): 222-223, Fig. 2, 6, 7 (map) (2006). Fig. 2c.

Sullivania brockmanii (Hopper & A.P.Br.) D.L.Jones & M.A.Clem., ***comb. nov.***
Basionym: *Paracaleana brockmanii* Hopper & A.P.Br., Aust. Syst. Bot.19(3): 223-225, Figs 2, 8, 9 (map) (2006). Fig 2d.

Sullivania disjuncta (D.L.Jones) D.L.Jones & M.A.Clem., The Orchadian 15(1): 36 (2005). Fig 2f.

Sullivania dixonii (Hopper & A.P.Br.) D.L.Jones & M.A.Clem., ***comb. nov.***
Basionym: *Paracaleana dixonii* Hopper & A.P.Br., Aust. Syst. Bot.19(3): 228-229, Figs 2, 12, 13 (map) (2006). Fig 2e.

Sullivania ferricola (A.P.Br. & G.Brockman) D.L.Jones & M.A.Clem., ***comb. nov.***
Basionym: *Paracaleana ferricola* A.P.Br. & G.Brockman, Nuytsia 30: 287-289, Fig. 1 (2019). Fig 2g.

Sullivania gracilicordata (Hopper & A.P.Br.) D.L.Jones & M.A.Clem., ***comb. nov.***
Basionym: *Paracaleana gracilicordata* Hopper & A.P.Br., Aust. Syst. Bot.19(3): 229-230, f.2, 14, 15 (map) (2006). Fig 2h.

Sullivania granitica (Hopper & A.P.Br.) D.L.Jones & M.A.Clem., ***comb. nov.***
Basionym: *Paracaleana granitica* Hopper & A.P.Br., Aust. Syst. Bot.19(3): 230-232, Figs 2, 16, 17 (map) (2006). Fig 2i.

Sullivania hortiorum (Hopper & A.P.Br.) D.L.Jones & M.A.Clem., ***comb. nov.***
Basionym: *Paracaleana hortiorum* Hopper & A.P.Br., Aust. Syst. Bot.19(3): 232-234, Figs 2, 18, 19 (map) (2006). Fig 2j.

Sullivania nigrita (J.Drummond ex Lindl.) D.L.Jones & M.A.Clem., The Orchadian 15(1): 36 (2005). Fig 2k.

Sullivania parvula (Hopper & A.P.Br.) D.L.Jones & M.A.Clem., ***comb. nov.***
Basionym: *Paracaleana parvula* Hopper & A.P.Br., Aust. Syst. Bot.19(3): 237-238, Figs 2, 23, 24 (map) (2006). Fig 2l.

Sullivania terminalis (Hopper & A.P.Br.) D.L.Jones & M.A.Clem., ***comb. nov.***
Basionym: *Paracaleana terminalis* Hopper & A.P.Br., Aust. Syst. Bot.19(3): 239-240, Figs 2, 25, 26 (map) (2006). Fig 2m.

Sullivania triens (Hopper & A.P.Br.) D.L.Jones & M.A.Clem., ***comb. nov.***
Basionym: *Paracaleana triens* Hopper & A.P.Br., Aust. Syst. Bot.19(3): 240-242, Figs 2, 27, 28 (map) (2006). Fig 2n.

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TWO NEW SPECIES OF *BULBOPHYLLUM* (ORCHIDACEAE) FROM THAILAND

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Abstract. Two new species of *Bulbophyllum* (Orchidaceae) are described: *B. sphenoglossum* (sect. *Lemniscata*) and *B. trigonanthum* (sect. *Reptantia*). Both species occur in Thailand.

Key words/Palabras clave: *Bulbophyllum* sect. *Lemniscata*, *Bulbophyllum* sect. *Reptantia*, orquídeas, orchids, Tailandia, Thailand

Introduction. During revision of *Bulbophyllum* for the Flora of Thailand, we found two undescribed species in the collection of spirit samples brought together by Gunnar Seidenfaden and stored in C. Both species are only known from rather fragmentary samples and the limited information with these samples. Nevertheless, the material is sufficient to establish their identity and describe their morphology in detail, even though the paragraphs on flower color and habitat preferences are somewhat stark and incomplete. The plant habits in figures 1 and 2 are drawn from assembled parts of the plants in the samples.

Taxonomic treatment

Bulbophyllum sphenoglossum J.J.Verm., Watthana & H.A.Pedersen, ***sp. nov***. (Fig. 1).

Bulbophyllum wallichii auct. Seidenfaden (1973): 234; (1979): 189 (both for specimen *GT 5488* only).

Not *Bulbophyllum wallichii* Rchb.f. (1861): 259.

TYPE: Thailand. Chiang Mai Prov.: Doi Pha Hom Pok, *Seidenfaden & Smitinand GT 9534* (holotype: C).

Diagnosis: A species of sect. *Lemniscata* Pfitz. (Pfitzer 1889 [1888–1889]: 179; see also Vermeulen *et al*. 2014: 31), characterized by 2-leaved pseudobulbs and deciduous leaves around anthesis. Resembles *B. wallichii* Rchb.f. because the two share the following set of character states: lowermost floral bract (ovate-)triangular; median sepal (long-)acuminate, margins distinctly erose-fimbriate; lateral sepals adnate along their lower margin; lip approximately glabrous adaxially, hirsute abaxially. Differs from *B. wallichii* by the lip, which is 3.4–5.5 mm long (vs. 2.2–2.7 mm), and which distally is only slightly convex on the adaxial side (vs. distinctly convex and with a callus).

Plant rather small, a clustered epiphyte, roots spreading. *Rhizome* 2.0–3.8 mm diam., sections between pseudobulbs 0.8–1.5 cm long. *Pseudobulbs* 2-leaved, depressed ovoid to depressed conical, apex often drawn-out, 1.5–3.3 × 1.6–2.8 cm. *Leaves* deciduous at anthesis, not seen. *Inflorescences* racemose, 8–28 cm long, 5–16-flowered; peduncle 6–22 cm long, not thickened, rachis 1.4–6.0 cm long, floral bracts (ovate-)triangular, 3.6–7.0 × 2.2–3.0 mm, acuminate; 3-veined. *Pedicel* and *ovary* 2.5–3.2 mm long. *Dorsal sepal* porrect, triangular, 6.4–8.0 × 1.8–2.9 mm, ratio length/width 3.2–3.6; (long-)acuminate, margins distinctly erose-fimbriate, adaxially hirsute distally, 3-veined. *Lateral sepals* similar but lower margins

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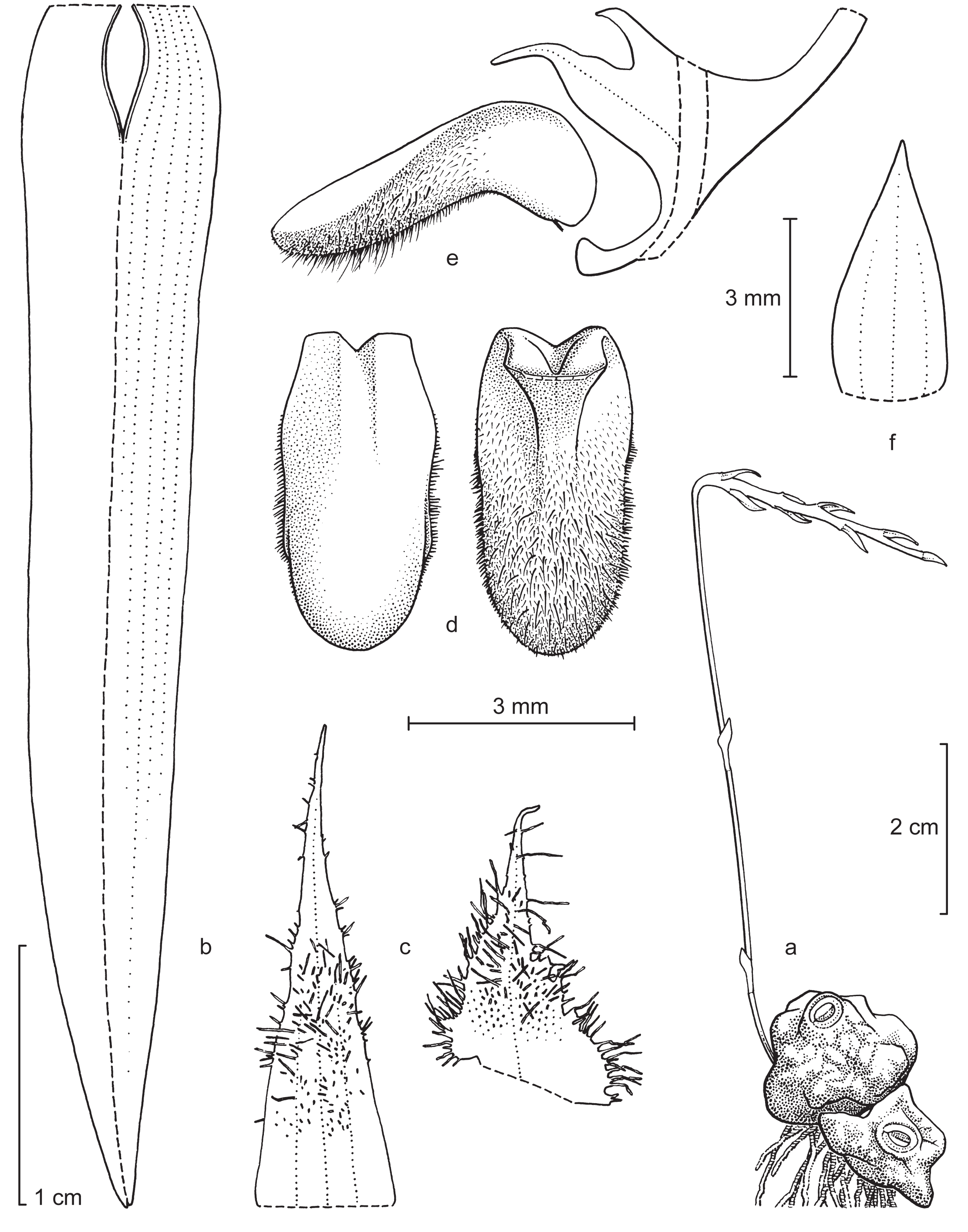

Figure 1. *Bulbophyllum sphenoglossum* J.J.Verm., Watthana & H.A.Pedersen. **a**. Habit. **b**. Lateral sepals. **c**. From left to right: median sepal, petal. **d**. Lip, left: adaxial side, right: abaxial side. **e**. Column and lip, lateral view. **f**. Floral bract. Drawn from *Seidenfaden & Smitinand GT 9534,* type (Drawn by © J.J. Vermeulen, from spirit material).

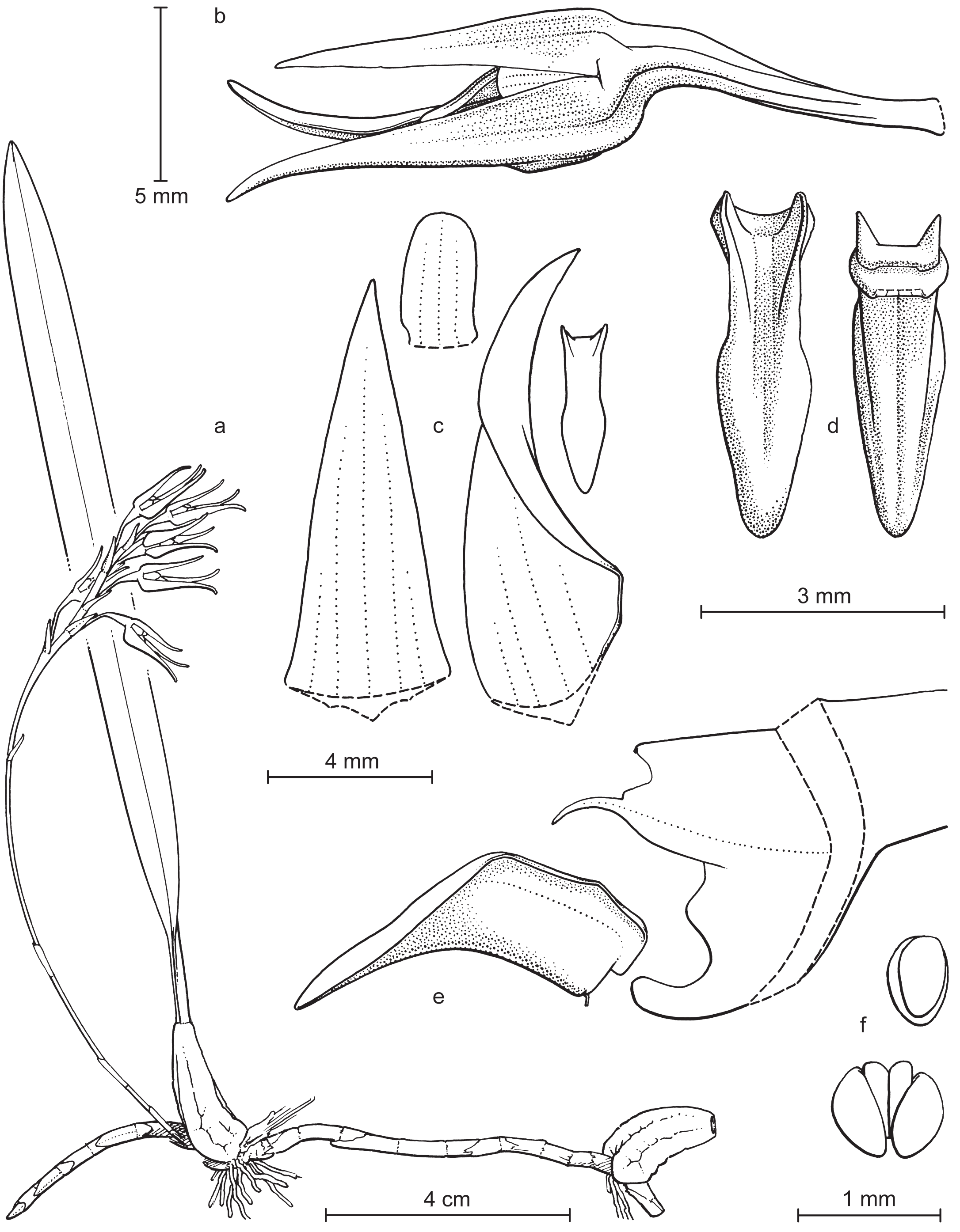

Figure 2. *Bulbophyllum trigonanthum* J.J.Verm., Watthana & H.A.Pedersen. **a**. Habit. **b**. Flower. **c**. Flower analysis, from left to right: median sepal, petal, lateral sepal, lip. **d**. Lip left: adaxial side, right: abaxial side. **e**. Column and lip, lateral view. **f**. Pollinia, above: one pair, below: two pairs. Drawn from: a. *Seidenfaden & Smitinand GT 3077*; b–f. *Seidenfaden & Smitinand GT 8927*, type (Drawn by © J.J. Vermeulen, from spirit material).

adnate except near base; oblique, ovate-oblong, 38–46 × 2.5–4.0 mm, ratio length/width 12.0–15.2; acute, margins entire; glabrous, 5-veined. *Petals* recurved, obliquely triangular, 2.8–3.8 × 1.9–2.0 mm, ratio length/width 1.4–2.0; acuminate, margins fimbriate; adaxially papillose to hirsute distally, 1-veined. *Lip* recurved, ovate-oblong, 3.4–5.5 × 1.4–2.3 mm, ratio length/width 2.0–2.5 (without spreading); rounded, margins entire, shortly ciliate distally; adaxially slightly concave proximally, slightly convex distally, surface glabrous; abaxially shortly hirsute and with scattered long hairs distally. *Column* including stellidia 2.8–3.0 mm long; foot stipitate before widened apex. Stellidia downwards falcate, triangular, 1.5–1.9 mm long, acute, lower margin with a slight wing.

Colours: Unknown.

Habitat and ecology: Unknown; elevation 1800 m.

Material examined: Thailand. Chiang Mai Prov.: Doi Pha Hom Pok (‘Doi Phaphompak’, ‘Doi Pahompok’), *Seidenfaden & Smitinand GT 9534* (C), *GT 9542* (C). Phitsanulok Prov.: Phu Soi Dao (‘Phu Mieng’), *Seidenfaden & Smitinand GT 5488* (C).

Etymology: The name is derived from Ancient Greek ‘σφήν’, wedge, and ‘γλῶσσα’ tongue, referring to the distally thinning lip.

Note: One sample found in the lot identified as *B. wallichii* in Seidenfaden (1979), and two more samples collected after this date.

Bulbophyllum trigonanthum J.J.Verm., Watthana & H.A.Pedersen, ***sp. nov.*** (Fig. 2)

Bulbophyllum luanii auct. Seidenfaden (1979): 109, fig. 69.

Not *Bulbophyllum luanii* Tixier in Guillaumin (1964): 396.

TYPE: Thailand. Loei Prov.: Phu Luang, Lon Tae, *Seidenfaden & Smitinand GT 8927* (holotype: C).

Diagnosis: A species of sect. *Reptantia* J.J.Verm. (in Pearce *et al*. 2001: 121; see also Vermeulen *et al*. 2014: 36), characterized by the racemose, synanthous inflorescences developing at the base of young shoots. Identified among species of this section (including *B. luanii* Tixier from the same section) by the adaxially sharply keeled sepals, which give the buds and hardly opened flowers a triangular appearance when observed frontally.

Plant rather small, a long-creeping epiphyte, roots spreading. *Rhizome* 1.6–3.6 mm diam., sections between pseudobulbs 3.4–6.0 cm long. *Pseudobulbs* ovoid to lenticular, 1.1–2.3 × 0.6–1.2 cm. *Leaves* persistent, blade elliptic-oblong, 5.2–12.4 × 0.5–1.1 cm, ratio length/width 8.4–15.2; obtuse; petiole 0.6–1.8 cm long. *Inflorescence* (rather) lax-racemose, 6.6–19.3 cm long, 3–12-flowered; peduncle 5.5–13.5 cm long; rachis 1.1–7.5 cm long, floral bracts 4.0–8.0 mm long. *Pedicel* plus *ovary* 9.0–12.0 mm long. *Dorsal sepal* porrect, triangular, 7.6–10.7 × 3.0–4.1 mm, ratio length/width 2.5–2.9; acute, margins entire; glabrous, 3–5-veined, midvein abaxially prominent as a sharp keel. *Lateral sepals* similar but distally recurved, 9.0–11.6 × 3.0–4.1 mm, ratio length/width 2.3–2.5; 4–5-veined. *Petals* porrect, oblong, 2.9–3.5 × 1.6–1.9 mm, ratio length/width 1.8–2.0; subtruncate to rounded, margins entire; glabrous, 3-veined. *Lip* recurved, (obovate-)oblong, 2.6–4.3 × 1.0–1.4 mm, ratio length/width 2.6–2.8 (without spreading); obtuse to subacute, margins entire; glabrous; adaxially concave in the basal half, with two high ridges close to the edge, apical half slightly convex. *Column* including stelidia 2.5–3.5 mm long. *Stelidia* triangular with (short-)subulate apex, 1.0–1.3 mm long, acute; upper margin proximally with small tooth or erose, lower with slight, rounded to subacute wing proximally.

Colours: Tepals yellow, stained red and with red veins; labellum yellow, stained red.

Habitat and ecology: Unknown. Elevation 1200–1300 m.

Material examined: Thailand. Loei Prov.: Phu Kradueng (‘Phu Krading’), *Seidenfaden & Smitinand GT 3061* (C), *GT 3077* (C), *GT 7943* (C); Phu Luang, Lon Tae, *Seidenfaden & Smitinand GT 8927* (C).

Etymology: The name is derived from Ancient Greek ‘τρίγωνος’, triangular, and ‘ἄνθος’, flower.

Note: Misidentified in Seidenfaden (l.c.) as *B. luanii* Tixier; the differences between the two species are given in the diagnosis.

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BULBOPHYLLUM KARBIANGLONGENSIS (EPIDENDROIDEAE), A NEW SPECIES FROM ASSAM, INDIA

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Abstract. A new epiphytic *Bulbophyllum* belonging to section *Cirrhopetaloides* is described from tropical mixed evergreen forests of Karbi Anglong (Assam, India) with coloured photographs and line drawings. It is allied to the *Bulbophyllum bicolor*, *B. venulosum,* and *B. blaoense*, but differs in the size and shape of pseudobulbs, the shape of the leaf blade, and flower size. A detailed description with corresponding color photos and information on the habitat is provided.

Key words/Palabras clave: *Bulbophyllum bicolor*, *Bulbophyllum blaoense, Bulbophyllum* sect. *Cirrhopetaloides*, Flora of India, Flora de India, plant taxonomy, taxonomía de plantas

Introduction. The genus *Bulbophyllum* Thouars (1822) is one of the largest plant genera in Orchidaceae, with over 2200 species distributed in the tropics and subtropics of the world (Vermeulen *et al*. 2014). Currently, more than 121 species have been recorded in India (Misra 2019). Gogoi (2019) reported 40 species of *Bulbophyllum* from the state of Assam. During a field trip to the forested area of Hamren of Karbi Anglong District of Assam on 14 March 2018, an unknown *Bulbophyllum* species was found without flowers, which could not be determined immediately. Therefore, the orchid was put in cultivation at the Regional Orchids Germplasm Conservation & Propagation Centre (Assam Circle), where plants flowered under observation on 20 May 2021. Unfortunately, the species could not be matched with any existing species in the region and adjacent areas.

Thorough morphological studies revealed that the new species belongs to *Bulbophyllum* section *Cirrhopetaloides* Garay, Hamer & Siegerist (Vermeulen *et al*. 2014). It is characterized by creeping rhizome; 1-leaved pseudobulbs; subumbellate raceme arising from the base of pseudobulbs; free dorsal sepal, entire, erose, fimbriate, ciliate, or paleate along the margin; lateral sepals glabrous, twisted at the base and adnate (entirely or in part) along one or both margins. Petals are denticulate or fimbriate along the margin; lip simple; stellidia usually shorter about half of the column length, usually with tooth above and wing below. Pollinia 4, without stipe. The section contains around 19 accepted species distributed from Sri Lanka, India, China, Taiwan, Japan, Myanmar, Thailand, Indochina, Peninsular Malaysia, Sumatra, Borneo, and the Philippines.

After careful examination and comparison with existing species with the help of available literature (Averyanov *et al*. 2015, Chen *et al*. 2009, Chowdhery 1998, Gale *et al*. 2010, Gogoi 2014a, 2014b, 2018, 2019, Gogoi & Yonzone 2013a,b,c, Hegde 1917, Hooker 1890, King & Pantling 1898, Lucksom 2007, Misra 2019, Pearce & Cribb 2002, Pradhan 1979, Rao 2010, Singh *et al*. 2019) and critical examination of herbarium specimens deposited in ASSAM, ARUN, CAL and type images present in K, E, and PE. As a result, it is confirmed to be a hitherto undescribed species. Hence, we describe the same here along with colour plates and line drawings. We also compare it with is closest allies, i.e., *B. bicolor* Lindl., *B. venulosum* J.J.Verm. & A.L.Lamb and *B. blaoense* Tich & Diep ex Aver. & Tich.

Materials and methods. The measurements and species description were made from living plants. Type is deposited at the Herbarium of the Orchid Research Centre Tipi, Arunachal Pradesh (OHT) and Herbarium of The Orchid Society of Eastern Himalaya (TOSEHIM), Regional Orchid Germplasm Conservation and

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Table 1. Diagnostic features of *Bulbophyllum blaoense, B. bicolor, karbianglongensis*, and *B. venulosum*.

Character	*B. blaoense*	*B. bicolor*	*B. karbianglongensis*	*B. venulosum*
Rhizome	Rigid, semi-woody, 0.2–0.3 cm in diameter	Several-noded rhizome 0.25–0.5 cm in diameter	Short, 0.5 cm diameter	0.15–0.25 cm diameter, 1.8–9.0 cm long
Pseudobulbs	Distant from each other 1–3 cm, broadly ovoid to almost globular or slightly oblate, 0.5–0.7 cm tall and wide, young enveloped by tubular sheaths	Distant from each other 3.5–5.5 cm, ovoid, 2–2.5 × 1.2–1.5 cm, prominently angled, enclosed in a basal sheath that withers with age	Clustered together, narrowly ovoid to conic, 1.5–2.5 × 0.8–1.8 cm, with 3 bracts sheathing towards the base	1.2–1.8 × 0.7–1.2 cm, distinctly 4 angled, ovoid to ellipsoid
Leaves	Sub-sessile, broadly lanceolate to narrowly ovate, 6–12 × 1.4–2.5 cm, acute to shortly unequally bilobed	Oblong, channeled, 11–16 × 2.5–4 cm, obtuse.	Elliptic-lanceolate, 15–17.5 × 1.4–1.6 cm, acute to acuminate, channeled.	Ovate, 3.1–12.5 × 2.6–4.3 cm
Inflorescence	Umbel, 7–12 cm long, 2– 5 flowers	Subumbellate, 5–7.5 cm long, with 3–6 flowers	Subumbellate, 15–19 cm long, 5–10 flowers	Subumbellate, 8–14 cm long, 4–9 flowers
Floral bracts	Slightly concave, acuminate, 0.3–0.4 × 0.1–0.1.5 cm	Narrowly-ovate, 0.5–0.7 × 0.15–0.2 cm	Lanceolate, acute, 0.4–0.5 × 0.1 cm	0.2–0.35 cm long
Flowers	Tepals dull pale yellow marked with purple-brown, purple-violet at apex; lateral sepals almost white striped with dull purple along nerves; lip adaxially light dull yellowish, little flushed with purple at the base, almost white spotted with light purple at abaxial surface	Tepals pale greenish-yellow with purplish-red to maroon dots and flecks forming lines on both surfaces, apex of dorsal sepals and petals tinged deep purplish-red	Tepals greenish yellow with purple nerves, lip dark red/purple with prominent median white band running from the base to the apex	Tepals white or slightly yellow, sometimes suffused purple proximally with purple nerves; petals with purple in the median area white towards the margins; lip white, spotted purple, or purple, white towards the margins and the apex
Dorsal sepal	Shortly attenuate, concave, 0.9–1.0 × 0.5–0.6 cm, margins denticulate and ciliate.	1.1–1.4 × 0.6–0.9 cm, apex acuminate, margins ciliate, seven nerves.	0.7–0.72 × 0.4–0.42 cm, entire, with 5 purple nerves, obtuse.	0.45–0.5 × 0.3–0.42 cm, porrect or recurved, acute to shortly acuminate, margins short fimbriae except near the base, with 5 purple nerves.
Lateral sepals	Narrowly triangular, elongate, oblique, connivent along upper apical half, 2.6–3 × 0.5–0.6 cm	Obliquely ovate-lanceolate, 1.9–2.5 × 0.6–0.8 cm, acute, lower margins connate at the base, seven nerves	Oblong, 1.2–1.3 × 0.25–0.3 cm, with 5 nerves, obtuse, connate along upper margin	Oblique, oblong, 1.4–2.0 × 0.3–0.45 cm, porrect, curved inwards at the base and connate along the upper margin
Petals	Ovate to broadly ovate, slightly oblique, triangular, acute to acuminate, 0.6–0.8 × 0.4 –0.5 cm, margins denticulate and ciliate, 5 nerves	Rotund-ovate, slightly oblique, 0.8–1.0 × 0.5–0.6 cm, apex rounded and mucronate, margins entire to minutely denticulate.	Obliquely ovate, 0.3-0.31 × 0.2–0.21 cm, acute to acuminate, margins minutely ciliate, keeled, 3 nerves with purple apex	Recurved, obliquely ovate-triangular, 0.42–0.55 × 0.22–0.33 cm, obtuse, margins fimbriate, papillose distally, 3 nerves
Lip	0.5–0.6 cm long, densely papillose on adaxial surface, not grooved	0.8 × 0.4–0.5 cm, not grooved	0.3 × 0.1 cm, base grooved, prominent median white ridge running from the base to the apex	0.32–0.4 × 0.19–0.25 cm, grooved, median ridge most of the length

Column	0.25 – 0.32 cm long, foot up to 0.7 cm long	ca. 0.3 cm long, foot 0.7–0.9 cm long	Column 0.15 cm long; foot 0.5 mm long	0.16–0.2 cm long; foot adaxially with a median tooth and 2 slight lateral wings at the apex
Stellidia	Mucronate, slender, with small triangular tooth above, broadly triangular wing below, apex obtuse	Subulate, slightly downcurved, with acute tooth above, triangular wing below, apex obtuse.	Slender, pointing forward, truncate tooth above, triangular wing bellow	Porrect, triangular, acute, with a small, pointing upward, deltoid, acute tooth along the upper margin and a slight, deltoid rounded wing along the lower.
Anther cap	Hemispheric, yellowish to yellowish-green	Ovoid	Subglobose, papillose, purple	Globose, purple
Distribution	Endemic to Vietnam	Hong Kong and Vietnam	India (Hamren of Karbi Anglong, Assam)	Endemic to Borneo

Propagation Centre (ASSAM), Assam. All the photos were taken with a Canon 6D Mark-II fitted with an EF 100 mm f/2.8L Macro USM lens. The terminology for the morphological description follows Beentje (2012).

TAXONOMIC TREATMENT

Bulbophyllum karbianglongensis K.Gogoi & R.Hondiqui, ***sp. nov.***

TYPE: India. Assam: Karbi Anglong District, Hamren, 500 m, 14 March 2018, (flowered in cultivation 20 April 2021), *K. Gogoi and R. Hondiqui 00953* (holotype: Orchid Herbarium Tipi; isotype: ASSAM, Herbarium of the Orchid Society of Eastern Himalaya), (Fig. 1–3).

DIAGNOSIS: *Bulbophyllum karbianglongensis* resembles *B. bicolor*, *B. venulosum*, and *B. blaoense* but differs in clustered, narrowly ovoid to conic pseudobulb; elliptic-lanceolate leaves; flowers greenish-yellow with purple nerves, lip dark red/purple with a prominent median white band running from the base to the apex, dorsal sepal ovate-oblong, entire; stellidia slender, pointing forward, truncate tooth above, winged bellow. Detailed morphological differences between these species are presented in Table 1.

Plants epiphytic, pseudobulbous, pseudobulbs borne on creeping rhizome. *Rhizome* stout, short, *ca*. 0.5 cm diameter. *Pseudobulbs* clustered together, narrowly ovoid to conic, 1.5–2.5 × 0.8–1.8 cm, 3 bracts sheathing towards the base, with a terminal leaf. *Leaves* single, elliptic-lanceolate, 15.0–17.5 × 1.4–1.6 cm, acute to acuminate, fleshy, petiolate; petiole 2 cm long, channeled. *Inflorescence* arising from the base of the pseudobulb, erect or sub-erect, longer than leaves, yellowish-green, bearing a subumbel of 5–10 flowers; peduncle slender, *ca*. 0.2 cm in diameter, 15–19 cm long, with 2 or 3 tubular sheaths; floral bracts greenish-yellow, lanceolate, 0.4–0.5 × 0.1 cm, acute, shorter than pedicel and ovary; pedicel (with ovary) *ca*. 1 cm long, slender. *Flowers* 1.4–1.5 × 0.5–0.4 cm, greenish-yellow with purple nerves. *Dorsal sepal* ovate-oblong, concave, entire, 0.70–0.72 × 0.42–0.42 cm, 5-veined, apex obtuse. *Lateral sepals* oblong, 1.2–1.3 × 0.25–0.30 cm, 5-veined, apex obtuse, base adnate to column foot, twisted near the base, connate along upper margin. *Petals* obliquely ovate, 0.30–0.31 × 0.20–0.21 cm, apex acute to acuminate, margins minutely ciliate, keeled, 3-veined, with purple apex. *Lip* dark red/purple with a prominent median white band running from the base to the apex, recurved, ligulate, 0.3 × 0.1 cm, fleshy, base grooved, attached to the column foot by a mobile joint, side lobes inconspicuous. *Column ca*. 0.15 cm, stellidia slender protruding forward, *ca*. 0.05 cm long, upper with small tooth for each side, the lower margin of column broadly winged; foot 0.15 cm, upcurved. *Pollinia* 0.05 cm, yellow, anther cap subglobose, papillose, 0.1 × 0.1 cm, purple.

FLOWERING PERIOD: May to June.

HABITAT: On tree trunks in tropical mixed evergreen forest at 400–500 m in Karbi Anglong, Assam.

DISTRIBUTION: India (Hamren of Karbi Anglong, Assam) (Fig. 1A).

ETYMOLOGY: The specific epithet refers to the “Karbi Anglong” district of Assam, in Northeast India, where the plant was collected.

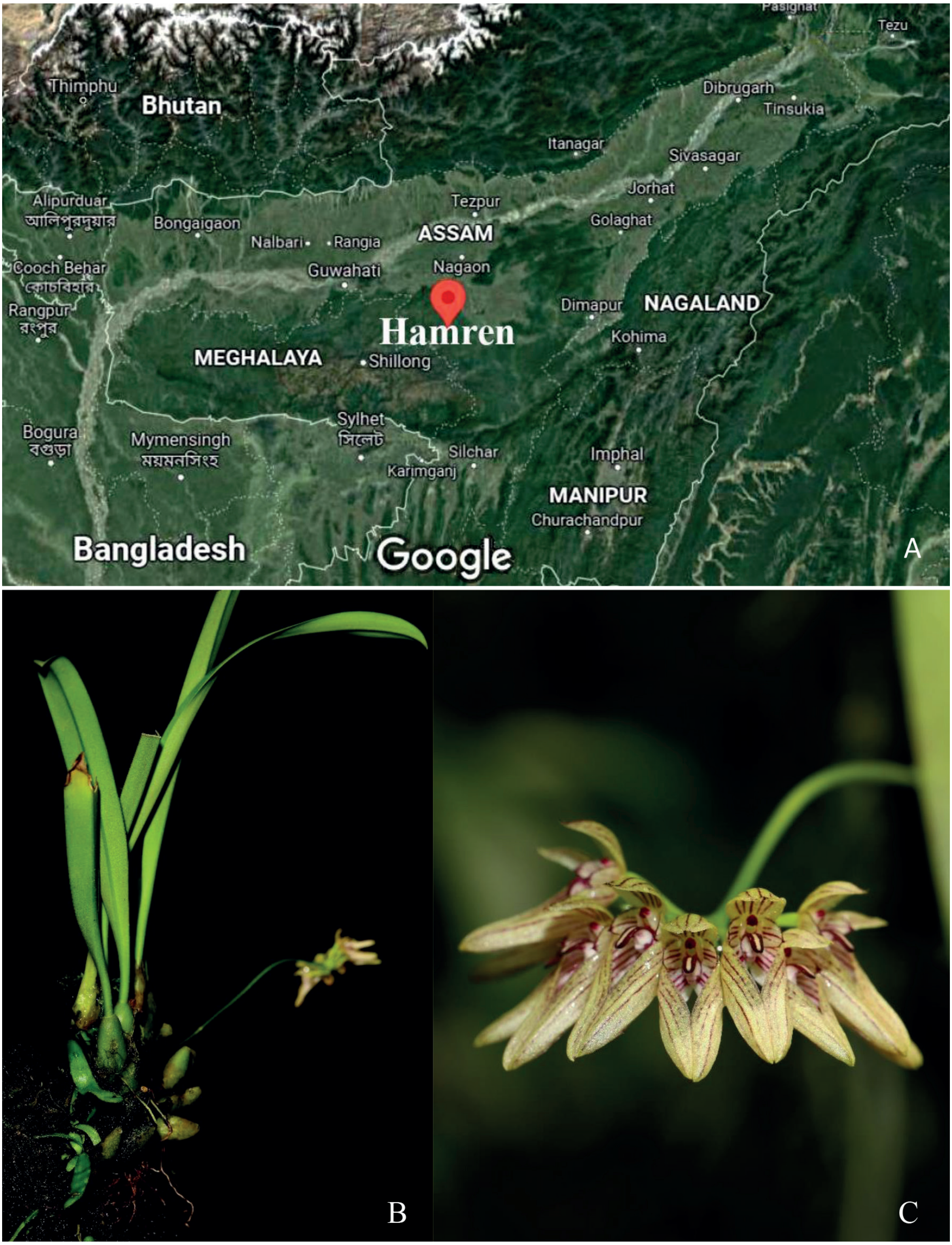

FIGURE 1. **A**. Distribution map of *Bulbophyllum karbianglongensis*. **B**. Habit of *Bulbophyllum karbianglongensis*. **C**. *Bulbophyllum karbianglongensis* inflorescence. Photos by K. Gogoi.

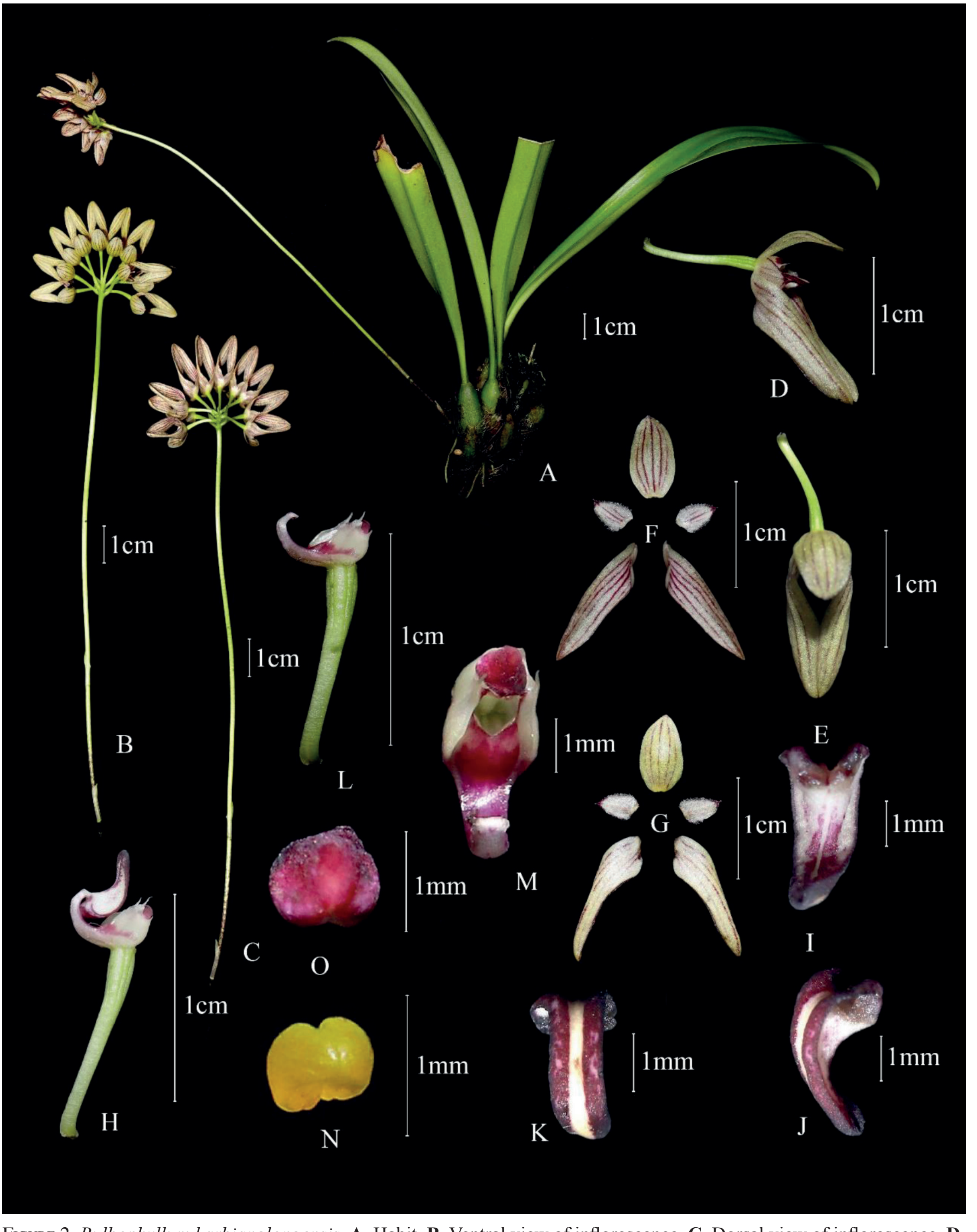

Figure 2. *Bulbophyllum karbianglongensis.* **A**. Habit. **B**. Ventral view of inflorescence. **C**. Dorsal view of inflorescence. **D**. Side view of flowers. **E**. Ventral view of flower. **F**. Ventral view of perianth. **G**. Dorsal view of perianth. **H**. Lip with ovary and column. **I**. Dorsal view of lip. **J**. Side view of lip. **K**. Ventral view of lip. **L**. Ovary with pedicel and column. **M**. Front view of column. **N**. View of pollinarium. **O**. Anther cap ventral view. Photos by K. Gogoi.

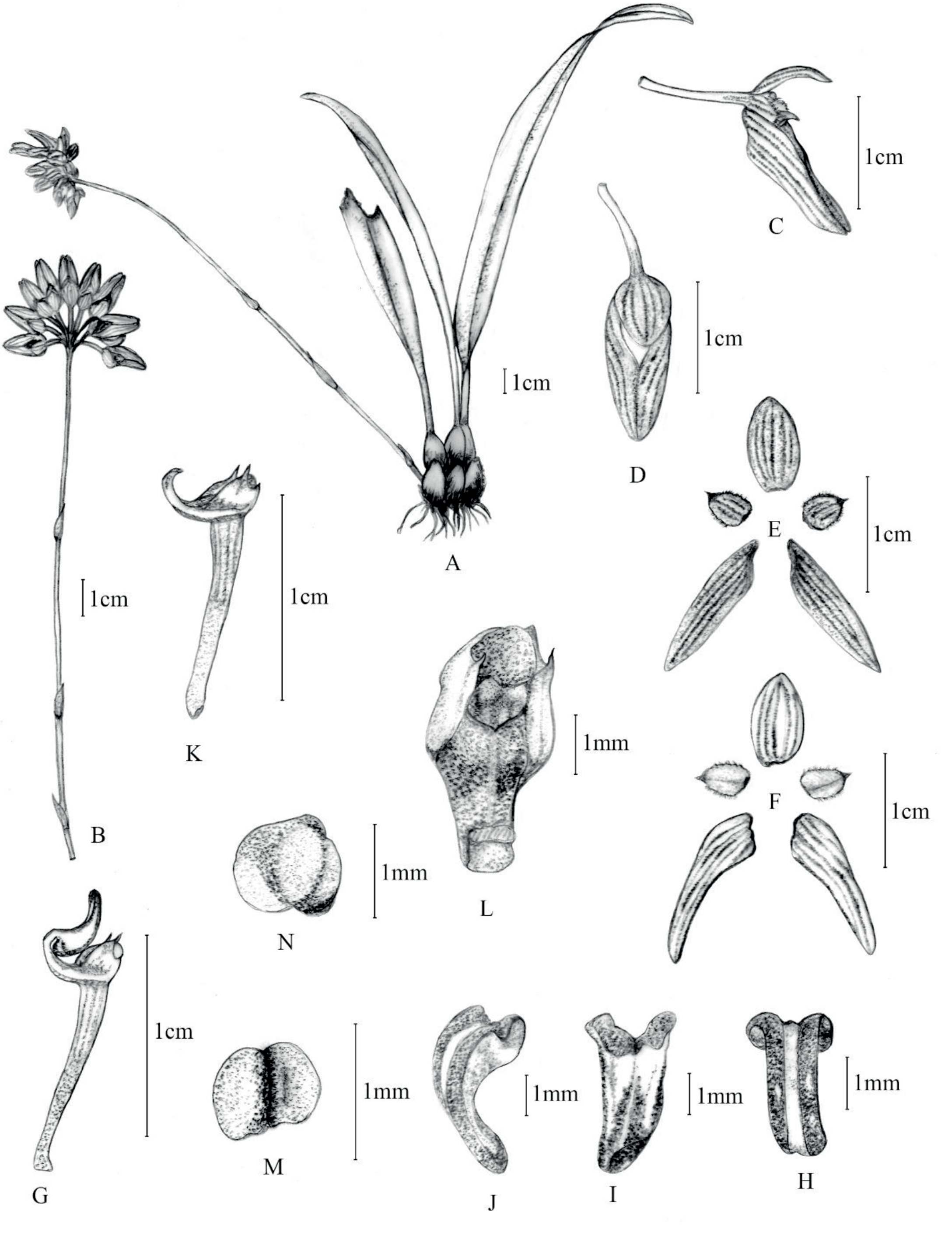

Figure 3. *Bulbophyllum karbianglongensis* **A**. Habit. **B**. Ventral view of inflorescence. **C**. Side view of flowers. **D**. Ventral view of flower. **E**. Ventral view of perianth. **F**. Dorsal view of perianth. **G**. Lip with ovary and column. **H**. Ventral view of lip. **I**. Dorsal view of lip. **J**. Side view of lip. **K**. Ovary with pedicel and column. **L**. Front view of column. **M**. View of pollinarium. **N**. Anther cap ventral view. Drawing by K. Gogoi.

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VIABILITY AND INFECTIVITY OF *CERATOBASIDIUM* SP. ENCAPSULATED IN ALGINATE BEADS UNDER DIFFERENT STORAGE CONDITIONS

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Abstract. Mycorrhizal fungi are important partners of orchids because they establish close symbiotic relationships with this group of plants, and its preservation is also important for the successful conservation of orchids. In the present study, the conservation of *Ceratobasidium* sp., a fungal symbiont, using encapsulation in alginate beads was tested over different times, temperatures of storage and dehydrated conditions. Osmotically dehydrated and air-dried beads were stored at room temperature (20 ± 2 °C), 4 °C, -20 °C and -80 °C. The fungal growth was verified after 4, 8, 26 and 96 weeks. A second test was carried out to evaluate the encapsulations of fungi as a form of inoculation in *Trichoceros antennifer* orchid to promote symbiosis and plants development. The results show that the encapsulation of *Ceratobasidium* in alginate beads is a viable strategy for its conservation, the beads are of easy manipulation and promote plant growth when inoculated in plant substrate. These results may be adopted as part of effective conservation strategies for mycorrhizal fungi and orchids.

Resumen. Los hongos micorrícicos son socios importantes de las orquídeas ya que establecen relaciones simbióticas estrechas con este grupo de plantas y su conservación es también importante para la conservación de las orquídeas. En este estudio, la conservación de *Ceratobasidium* sp*.,* un simbionte fúngico, usando encapsulación en perlas de alginato fue evaluada a diferentes tiempos, temperaturas de almacenamiento y formas de deshidratación. Cápsulas secadas al aire y deshidratación osmótica fueron almacenadas a temperatura ambiente (20 ± 2 °C), 4 °C, -20 °C y -80 °C. El crecimiento del hongo fue verificado después de 4, 8, 26 y 96 semanas. Una segunda prueba fue llevada a cabo para evaluar la encapsulación del hongo como una forma de inoculación para promover la simbiosis y el desarrollo en plantas de la orquídea *Trichoceros antennifer.* Los resultados sugieren que la encapsulación de *Ceratobasidium* en perlas de alginato, es una estrategia viable para su conservación, que las perlas son fáciles de manipular y que estimulan el crecimiento cuando se inoculan en el sustrato de las plantas. Este trabajo podría facilitar el diseño de estrategias de conservación de hongos micorrícicos y de las orquídeas asociadas.

Key words/Palabras clave: alginate encapsulation, encapsulación en alginato, *Ceratobasidium* sp., symbiotic fungal, hongos simbióticos, *Trichoceros antennifer*

Introduction. More than 85% of orchids in the world are in at least one category of endangerment (Wraith & Pickering 2018). Despite Orchidaceae being the most diverse family of vascular plants globally, they face various conservation problems (Reiter *et al*. 2016): climate change, habitat loss, unregulated extraction and the complexity of biotic and abiotic conditions necessary for their development, constitute the main threats (Swarts & Dixon 2009). Precisely, complex close symbiotic relationships between orchids with fungi, is one of the determining factors that guarantees the early seedling development (Sommerville *et al*. 2008). Endophytic fungi, both mycorrhizal and non-mycorrhizal, actively participate in the cycling of carbon (C), nitrogen (N), phosphorus (P), and increase the productivity and diversity of plants (van der Heijden *et al*. 2015) and help supply the reserve-depleted orchid seeds with carbohydrates (Suárez & Kottke 2016). Consequently, there is a need to develop tools that link the activity of mycorrhizal fungi with their orchid hosts, to guarantee

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biological interactions, ecological stability and favorable growth for both organisms that could in turn support their conservation (Teixeira da Silva *et al*. 2015).

Traditionally, *ex situ* conservation of orchids has relied on long-term storage of seeds at low temperatures, being this, the quintessential method for preservation (Jiang *et al*. 2017). However, there is generally no included symbiotic microorganisms (Wood *et al*. 2000), which undoubtedly presents ecological limitations and reduces the probability of survival when plants are reintroduced.

Fungi, including orchid symbionts, have been traditionally preserved in specific media culture, which face contamination risk, and morphological and physiological mutations. Another method most recently used is cryopreservation in liquid nitrogen, however this is an expensive and labor-intensive procedure (Ercole *et al*. 2013).

Similar studies (Homolka 2014, Saha *et al*. 2014, Yooyongwech *et al*. 2019) have shown that encapsulation prior to the storage of microorganisms at low temperatures, presents benefits such as space and required maintenance reduction, stability of genetic material, protection against biotic and abiotic stress (Vemmer & Patel 2013), and also improves their viability which can later contribute to the host plant species (Lalaymia *et al*. 2014, Pacheco *et al*. 2017). Furthermore, encapsulation of microorganisms can facilitate reintroduction strategies by facilitating transportation and handling of the different symbionts used to reintroduce orchids (Saiprasad & Polisetty 2003).

In Ecuador, even though it is one of the hot spots with the greatest diversity of orchids in the world (Pérez-Escobar *et al*. 2017), there are no records regarding the encapsulation of mycorrhizal fungi, however this encapsulation technique has been used for microorganisms (Ercole *et al*. 2013, Vemmer & Patel2013), seeds (Kulus & Zalewska 2014, Pierce & Belotti 2011), and as a mixture of both as well (Sommerville *et al*. 2008, Wood *et al*. 2000). Encapsulation is a process with multiple applications in various industries (Vemmer & Patel 2013), usually involving the use of sodium alginate at concentrations ranging from 1.5 to 3.5% v/v (Rodríguez *et al*. 2011).

The aims of the present work were: 1) to evaluate the viability of *Ceratobasidium* over time after storage at different temperatures in beads dried under different conditions 2) to evaluate encapsulation as an appropriate method to promote orchid-fungi symbiosis and thus a better survival and development of plants in substrate, since it is imperative that orchid conservation methods also deal with the preservation of associated fungi through simple field methods that promote plant-fungi interaction.

Materials and methods. The fungi used in this study was *Ceratobasidium* sp. Rogers (1935), which was previously isolated from the rhizosphere of a *Trichoceros antennifer* (Humb. & Bonpl.) Kunth. (1816) plant, its germination-promoting activity was verified in symbiotic germination tests and its identity was determined by molecular techniques. Genomic DNA was extracted from mycelia using Cenis (1992) method. As for the sequencing, the ITS regions were amplified with polymerase chain reaction (PCR) with the primers ITS1 and ITS4 (White *et al*. 1990). For molecular identification of the isolate, taxonomic assignments were made comparing the nucleotide sequences obtained with those deposited in the GenBank databases of the NCBI (National Center for Biotechnology Information).

The strain was re-isolated from plants used in a previous symbiotic germination test. For this, a portion of the root of plants grown by symbiotic germination and maintained under *in vitro* conditions was transferred to potato dextrose agar medium (PDA) at room temperature (20 ± 2°C). The cultures were multiplied several times by placing 0.25 cm^2 (0.5 × 0.5 cm) of PDA fungal culture on fresh PDA plates.

Encapsulation.— The encapsulation process was performed by ion gelation using the Nisco brand EncapsulatorVar DBasic2Go LIN-0227 with a syringe pump. Preliminary tests were carried out on the equipment for the optimization of conditions and sodium alginate concentrations.

Encapsulation was done using a 0.5 mm nozzle, at 100% pump force, 5 ml/min flow, 0.5 kHz frequency, 50% amplitude, 0,7 mm ± 2 mm drop height, 83.3 ± 0.1 μL bead volume at an operating temperature of 25°C.

Prior to operation, the encapsulator was disinfected by pumping 20 ml of 1% sodium hypochlorite solution followed by three rinses with sterile distilled water.

For the elaboration of beads, we used the mycelium collected from half a PDA Petri dish (90 mm) grown for 10 days at room temperature. After the mycelium was collected it was placed in 5 ml of 3% sterile sodium alginate and homogenized on a magnetic stirrer at 300 rpm for 1 hour. The mixture was then placed in a 20 ml syringe and injected into the encapsulator. Drops fell in a sterile 100 mM calcium chloride ($CaCl_2$) solution, which was kept stirring for 10 minutes.

Afterwards, the $CaCl_2$ solution was drained, leaving only the small beads. The beads were then divided into two groups. One group was placed in a sterile 0.75 M sucrose solution for osmotic dehydration for 22 hours at 130 rpm, and then air dried over tissue paper in a laminar flow hood continuously for 18 hours. The other portion of beads were placed directly inside the laminar flow hood for drying for 18 h.

Two post-encapsulation processes were tested (sucrose dehydration + air drying and only air drying).

Storage and in vitro viability test.— to assess fungal viability after encapsulation, five beads from each treatment were placed individually within 90 mm Petri dishes filled with potato agar dextrose (PDA), and then incubated at room temperature (20 ± 2 °C) as a control treatment. The remaining beads from each treatment were divided into four groups to be stored in sterile vials al at -80 °C, -20 °C, 4 °C and at room temperature (20 ± 2 °C) for the evaluation of their viability after 4, 8, 26 and 96 weeks of storage. For this, five beads from each treatment were placed individually in a Petri dish containing PDA, and the viability of the fungi was recorded after five days, also, the mycelium growth was registered by measuring the diameter of mycelium. The data was analyzed by R version 4.1.1 to determine statistical differences ($p < 0.05$) between storage times, drying treatment, and storage temperatures.

Symbiosis evaluation using encapsulates for inoculation under greenhouse conditions.— Fifty *T. antennifer* plants of a year and a half of age, were previously cultivated *in vitro* by the company Ecuagenera Cia. Ltda. were used for the test. The plants had variable sizes between 0.9 and 2.5 cm, and each plant was weighed and measured from the stem to the apex of the youngest leaf. The roots were washed with sterile distilled water and finally the plants were placed in plastic trays containing pine bark previously treated by the same company (cooked with lime and then washed until tannins are removed). Two beads containing the encapsulated fungi were placed in a total of 25 plants at a depth of one centimeter and very close to the root. The beads used were those that demonstrated their viability after 26 weeks of storage. The other 25 plants were grown under the same conditions, but no beads were placed in the soil, and thus constituted the control group.

All the plants were kept under a greenhouse, at around 20 °C and relative humidity of around 75%. Irrigation was carried out once a week, fertilizer Ecuagrow (NH_4NO_3 13%, $(NH_4)H_2PO_4$ 13%, KNO_3 13%, $MgSO_4$ 0.04%, $CuSO_4$ 0.03%, H_3BO_3 0.002% and polyolefin 5.5%) was applied thirty days after being planted in the substrate and every three months after the first fertilization. After 10 months, the number of live plants in each treatment (with and without fungi) was determined. From the plants that were alive, five were taken randomly from each group and were weighed and measured once again. The obtained data was analyzed with t-student test in R software version 4.1.1. To verify the presence of pelotons in the roots, a root tip sample was taken from each plant, cut into 0.5 cm segments and crushed using forceps, scalpel, and a little water. It was then observed under an Olympus SZ61 stereoscope at 4X and 10X magnification.

Results. *Storage and in vitro viability test*.—

After 4 and 8 weeks.— fungal growth was observed in all storage temperatures (-80 °C, -20 °C, 4 °C and at room temperature (20 ± 2 °C) in both post-encapsulation treatments which were a) sucrose dehydration + air dried and b) only air dried.

After 26 weeks.— the beads were tested again to verify their viability, fungal growth was observed under -80 °C, -20 °C and 4 °C storage temperatures in both post-encapsulation treatments, after five days of being placed in a sterile PDA Petri dish. At room temperature only the air-dried beads showed fungal growth and no growth was shown in the beads treated with sucrose + air drying at day five, however on the 8th day half of the beads presented fungal growth.

After 96 weeks.— the viability of fungi was registered again in -80 °C, -20 °C and 4 °C storage temperatures but there was no growth in the beads stored at room temperature in any of the drying treatments, even after 10 days after being placed in petri dishes (Fig. 1A–B).

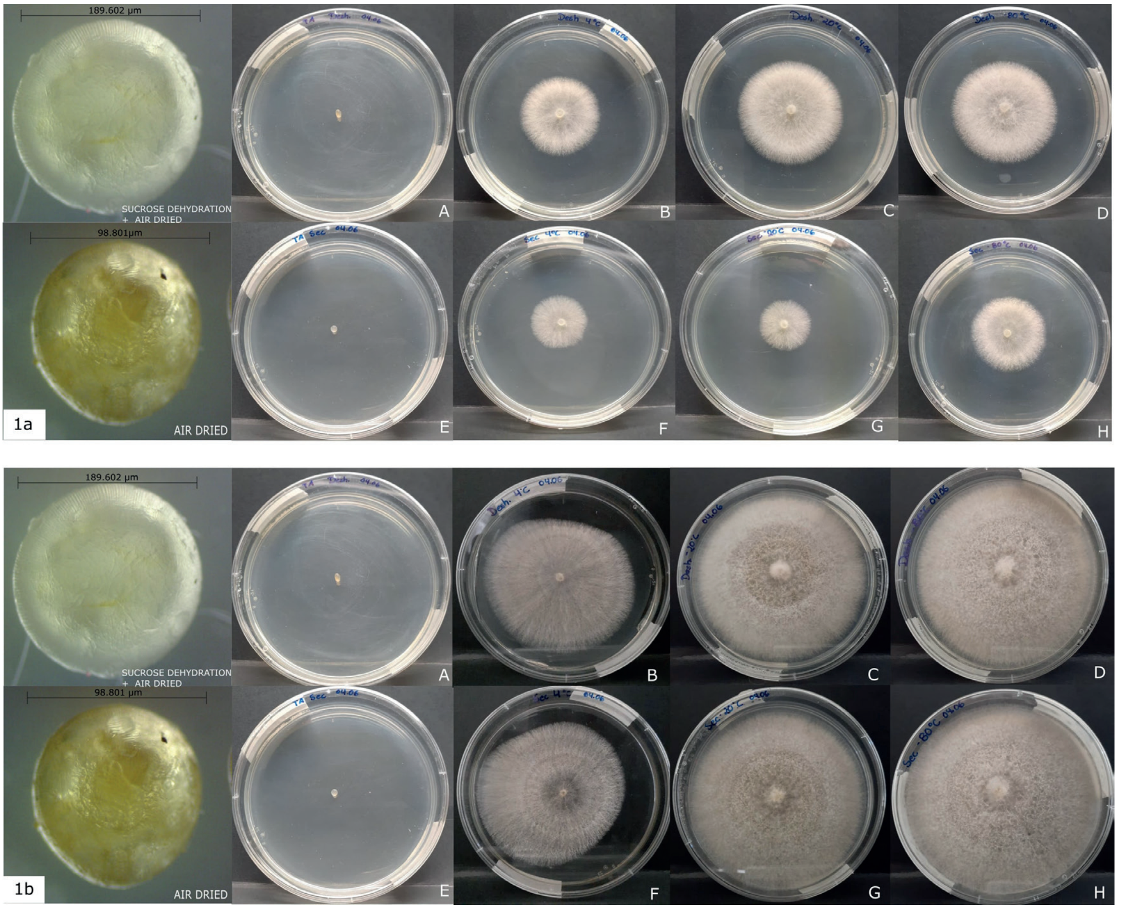

FIGURE 1. Viability of the fungi after 96 weeks of storage at different temperatures. **1a**. 5 days after sowing (A-D sucrose dehydration + air dried Bead length=189.602 μm) (E-H only air dried Bead length= 98.801 μm). **1b**. 10 days after sowing. Photographs by Diana Curillo.

In general, the growth of the fungi was more vigorous in the beads treated with sucrose + air-dried in the first five days. Additionally, the samples stored at 4°C showed comparatively less mycelial growth than the treatments stored at -20 °C and -80 °C after 10 days of growth (Fig. 1B)

The mycelial radial growth of *Ceratobasidium* was significantly larger ($p < 0.05$) at 26 weeks of storage than 96 weeks (Fig. 2). The data analyzed also revealed differences ($p < 0.05$) between the drying methods observing a greater mycelium growth in sucrose dehydrated beads + air drying (Fig. 1A, 2). Finally significant differences were found between the growth radio at a temperature of 4 °C and the storage temperatures of -20 °C and -80 °C with the same drying treatment (Fig. 1B).

Symbiosis evaluation using encapsulates for inoculation under greenhouse conditions.— In the group of plants that received the treatment with the beads containing the fungi, 14 live plants were registered, representing a survival rate greater than 50%, while in the control group, only 8 live plants were registered, which is about a 30% survival rate.

The average weight increase in the evaluated plants was 0.6 g for those who were inoculated in the beads and 0.3 g for the control group. The average height increase was 0.8 cm and 0.4 cm for the plants with and without fungi, respectively. As the data was analyzed it confirmed a statistically significant difference ($p < 0.05$) in weight and height, between the control group and plants inoculated with the beads (Fig. 3)

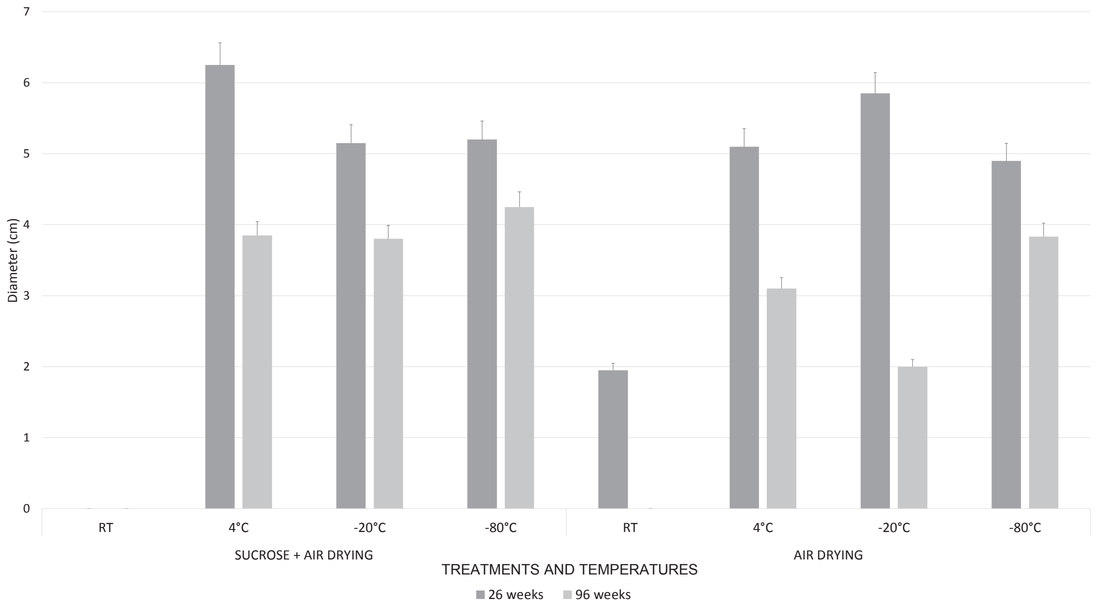

Figure 2. Mycelium growth of encapsulated *Ceratobasidium* in alginate beads after stored for 26 and 96 weeks at different temperatures, five days after sowing. Bars represent the mean ± standard error (n = 5).

Regarding the presence of pelotons, these could be observed in 4 of the 5 plants belonging to the experimental group (Fig. 4A–4B), meanwhile, no pelotons were observed for the control group.

Discussion. The results suggest that encapsulation in alginate beads might be a viable strategy for the conservation of *Ceratobasidium* for up to a period of about two years (96 weeks) at temperatures of 4, -20 and -80 °C and with the possibility of storage for longer periods. However, according to our results storage at room temperature is not viable after 26 weeks, and these results were similar to those reported by Kim *et al.* (2019), who showed low viability after six months of storage, and the complete loss of viability after longer periods of storage at 37 °C, showing that the viability of the fungal growth depends on the storage temperature of the beads.

Among the drying treatments following encapsulation, we observed that samples that underwent dehydration with sucrose showed lower viability after storage at room temperature for 26 weeks, which suggest that the air-drying treatment might be a favorable when the beads are stored in room temperature (20 ± 2 °C) for up to 26 weeks, However, there were no differences in the fungi viability between the other temperatures or storage periods. Similar results were obtained by Sommerville *et al.* (2008), who suggested that the sucrose used during the drying treatment provides an instant food source for the fungi encapsulated, which would explain the registered difference in our results after 26 weeks of storage at room temperature because the fungi remains active and keeps consuming its food source. The loss of viability (50%) of the fungi inside the dehydrate beads with sucrose and kept at room temperature for 26 weeks matches the results reported by Sommerville *et al.* (2008) in which they registered minimal or no *in vitro* fungal growth of the beads dried with sucrose after being stored at room temperature for three months.

Likewise, the greater growth diameter of the mycelium of the fungus in the pearls treated with sucrose + drying, can also be explained since an immediate source of food is available when the fungus is reactivated as soon as the beads are removed from the different storage temperatures, which does not happen with those beads subjected to only to air drying. The differences recorded between the mycelium growth diameters at 26 weeks and then at 96 weeks could be associated with the handling of the material during the establishment of the trials, because the pearls that were not seeded at 26 weeks could have suffered an effect of thawing and re-freezing by being in the same con-

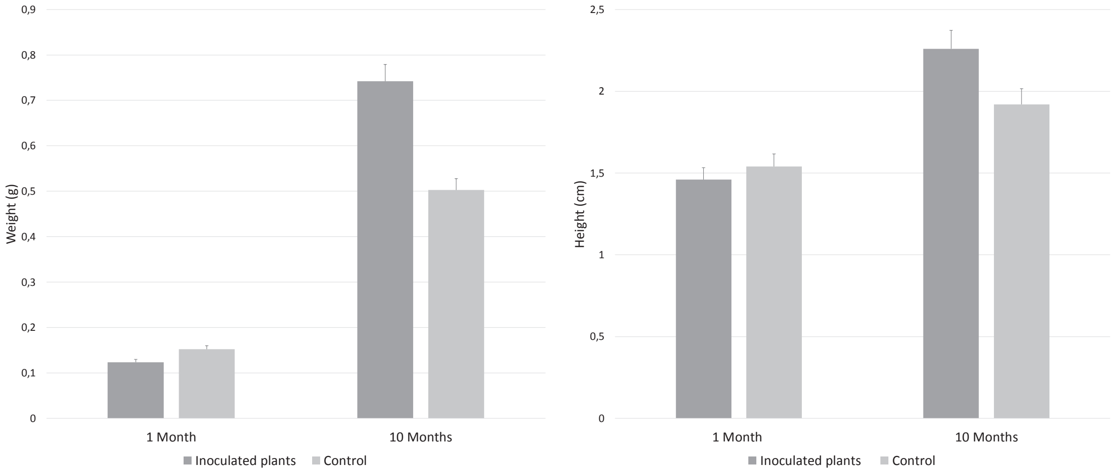

FIGURE 3. Effect of encapsulated *Ceratobasidium* beads in the weight and height of *T. antennifer* plants. Bars represent the mean ± standard error (n = 5).

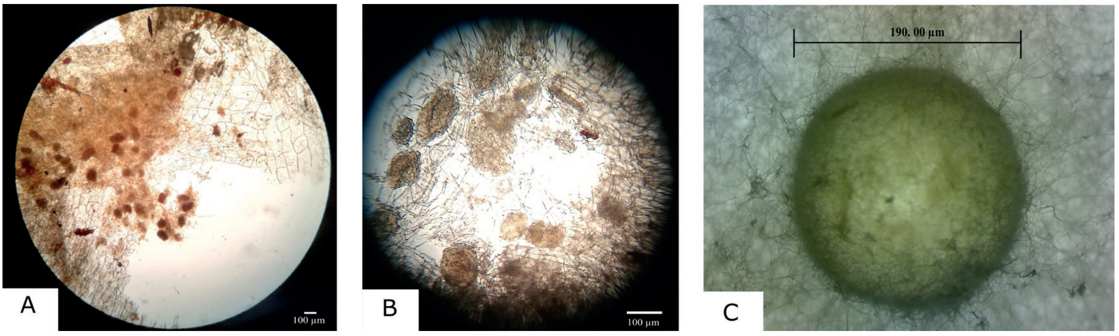

FIGURE 4. Presence of pelotons in plant roots. **A**. 4X magnification. **B**. 10X magnification. **C**. growth of hyphae from alginate beads in PDA medium. Photographs by Cesar Castro (A, B) and Diana Curillo (D).

tainer, however, the difference was reflected only in the mycelium development diameter, but not in its viability, which we interpret as a more vigorous growth.

In contrast to the work of Sommerville *et al*. (2008) we encapsulated the fungus alone (without including orchid seeds), which could be more convenient, since the parameters to be optimized during the process would focus on a single species. The results of our pilot study allowed to verify the symbiosis during the adaptation stage of the plants using encapsulates only of the fungus, which suggests that this method could be a good strategy to induce symbiosis.

Continuous recultivation could promote the adaptation of the fungi to laboratory conditions, with an impact on the genetic stability of new generations (Declerck *et al*. 2005).

Still the use of alginate beads could be considered as an alternative for the trade of other fungi of interest, since it has been reported that the storage of arbuscular mycorrhizal fungi in peat substrate decreases their infectivity over periods of time (Püschel *et al*. 2014). Lately, Zettler and Dvorak (2021) has published the efficiency of *Tulasnella colospora* (UAMH 9824) improve symbiotic germination after two decades of subculture, this argues against the concept of mycorrhizal fungi losing their symbiotic capacity after long periods of time of subcultures. In our study we verified the symbiosis in greenhouse conditions after inoculating orchids with *Ceratobasidium* that were previously stored for 26 weeks, demonstrating that the encapsulation method is not only efficient as a way to preserve the viability of the fungi but it also preserves its symbiotic capacity.

The preservation in alginate capsules allows easy handling field conditions and laboratory tests, because little space is required for their transportation and storage, the manipulation is simple, facilitates inoculation, quantification and protection of the fungi. In addition, it is an easy to implement technique and, although we used dedicated encapsulating equipment, the latter is not essential and could be done using standard pipettes normally found in most laboratories (Plenchette & Strullu 2003).

In conclusion, our evidence suggests that the storage of *Ceratobasidium* in alginate beads is an efficient storage method that allows the recovery of the fungi after 26 weeks at room temperature dried with air drying treatment and up to 2 years in a common refrigerator set at 4°C as well as in freezers set at -20 and -80°C.

Regarding the post encapsulation treatment, the dehydration with sucrose + drying with air flow, presented less viability after 26 weeks of storage at room temperature, but had no significant effect in its viability on the other temperatures (4, -20, -80 °C) or storage times (26 and 96 weeks). The growth diameter of the mycelium decreased after 96 weeks of storage at 4°C regardless of whether or not they are treated with sucrose, suggests an effect of the storage temperatures. It was also observed that sucrose accelerates growth during the first days of reactivation of the fungus at any of the evaluated temperatures. We also report that the capsules dried with sucrose + air flow are larger and easier to manipulate in the laboratory, if tweezers are used, while the pearls with just the drying treatment are much smaller, harder, and drier and could be more appropriate for inoculation in the field, however both could be used in the field and in the laboratory.

This methods for *Ceratobasidium* conservation could be replicable in other fungi of interest and has been suggested as a promising strategy for the developing large-scale fungal inoculation experiments and for the maintenance of collections (Plenchette & Strullu 2003).

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A NEW *LEPANTHES* (PLEUROTHALLIDINAE) FROM SOUTHWESTERN COLOMBIA

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Abstract. A new species of *Lepanthes* from southwestern Colombia is presented here. *Lepanthes farallonensis* belongs to the informal group "*manabina*", which comprises species with concave and commonly pubescent leaves, flowers resting on the adaxial side of the leaves, and the synsepal with short to long tails. *Lepanthes farallonensis* is similar to *L. smaragdina* in the broadly ovate dorsal sepal but differs in the conspicuously twisted upper lobes of the petals, outwardly bent and a depression at the center of the laminae of the lip.

Resumen. Se presenta una nueva especie de *Lepanthes* del suroeste de Colombia. *Lepanthes farallonensis* pertenece al grupo informal "*manabina*", un grupo de especies con hojas cóncavas y comúnmente pubescentes, con flores que descansan sobre el lado adaxial de la hoja y que poseen sinsépalos con caudas que van desde cortas a largas. *Lepanthes farallonensis* es similar a *L. smaragdina* en el sépalo dorsal, ampliamente ovado y se diferencia en poseerlos lóbulos superiores de los pétalos conspicuamente retorcidos, doblados hacia afuera y una depresión en la parte media de las láminas del labelo.

Key Words/Palabras clave: Colombian endemic orchids, orquídeas endémicas de Colombia, Farallones de Cali National Natural Park, Parque Nacional Natural Farallones de Cali, *Lepanthes smaragdina,* Valle del Cauca.

Introduction. *Lepanthes* Sw., with more than 1100 species, is one of the most diverse genera within the Pleurothallidinae Lindl., only surpassed by *Stelis* Sw. (Baquero *et al*. 2018, 2020, Karremans 2019, Karremans & Vieira-Uribe 2020). The genus is exclusively neotropical, distributed from Mexico to Bolivia as well as the West Indies, but its center of distribution is in the high Andes, especially in Colombia and Ecuador, between 1500 and 3000 m of elevation in moist forests on mossy twigs or small branches (Luer & Thoerle 2012). With more than 300 species (Moreno *et al*. 2020, Vieira-Uribe & Moreno 2019, Viveros *et al*. 2015), Colombia is one of the countries with the highest diversity in *Lepanthes* species, with almost 68% of these being endemic (Viveros *et al*. 2015).

Plants of *Lepanthes* produce stems (ramicauls) enclosed by tubular sheaths named lepanthiform sheaths and bearing a single leaf with a racemose inflorescence. Other characteristics of the genus are the usually transversely lobed petals, and the mid lobe of the lip usually forming a structure called the appendix, the base of the lip adnate to the underside of the footless column, and two hard pollinia (Luer & Thoerle 2012). Most *Lepanthes* species exhibit a caespi-

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tose or shortly reptant habit, and the few pollination observations suggest that flowers are pollinated by male fungus gnats which try to copulate with the appendix of the flowers, and by doing so, transporting the pollinia to the stigma of other flowers (Blanco & Barboza 2005). The fact that most species of *Lepanthes* flower on the underside of the leaves might be because male's fungus gnats expect to find females under the leaves, but even in species that flower at the adaxial side of the leaves, most present appendix structure beneath the column of their flowers (Blanco & Barboza 2005, Luer & Thoerle 2012).

Within the subgenus subgenus *Lepanthes* sect. *Lepanthes* subsect. *Lepanthes* (Luer 1996, Luer & Thoerle 2012), a group of species distributed in all three Andean ranges of Colombia and both ranges of Ecuador share certain morphological traits and might be related. The species of this informal group, which we here refer to as the "*manabina*" group (based in *Lepanthes manabina* Dodson), all have leaves that are concave centrally (deeply to slightly), with slightly to strongly recurved margins, microscopically to conspicuously pubescent adaxial surface, congested inflorescences with flowers resting on the adaxial side of the leaves , provided with shortly to long caudate synsepal and a very small and inconspicuous appendix (Dodson & Luer 2011, Luer 1996, Luer & Thoerle 2012) (Fig. 1).

Recently, in a high-elevation forest (2750 m of elevation) in the Farallones de Cali National Natural Park, the largest national park in southwest Colombia, a new species of *Lepanthes* was discovered and is described here.

Materials and methods. Two expeditions were carried out between 2019 and 2020 to the high-elevation forest of the Farallones de Cali National Natural Park, Colombia, where the new species was discovered. The new species was described following the botanical terminology by Lindley (1951). All original descriptions of related species were consulted for detailed comparisons (Luer 1996, Luer & Thoerle 2012). Flowers were dissected, measured, and photographed using a Celestron Handheld Digital Microscope Pro. Vegetative structures were measured from living plants and reproductive structures from fresh flowers and spirit material.

Lepanthes farallonensis Haelterman, Gal-Tar. & Zuluaga ***sp. nov.*** (Fig. 1A, 2, 3, 4A and C).

TYPE: Colombia. Valle del Cauca: Cali municipality, National Natural Park Farallones de Cali, locality Peñas Blancas, Finca la Cristalina, 2476 m, 2 November 2020, *R. Galindo-T & M. Espitia 1531* (holotype: CUVC 72981).

DIAGNOSIS: *Lepanthes farallonensis* is similar to *Lepanthes smaragdina* Luer & R.Escobar in the general shape of the flower (with broadly ovate sepals) but differs in the darker colored, pubescent leaves which are deeply concave centrally (*vs*. light green, minutely pubescent and shallowly concave centrally) with the base cuneate (*vs*. rounded), the lateral sepals longer and narrower with longer tails (5.2 × 2.6–3.7 mm *vs*. 4.00 × 4.30–4.75 mm wide in *L. smaragdina*), the petals with the subquadrate upper lobe twisted, outwardly bent, broader than the lower, subfalcate acute lobe (*vs*. petals with upper lobes oblong, obtuse and the lower lobes triangular, narrowly obtuse in *L. smaragdina*), the lip blades conspicuously depressed in the middle towards the inner margins, oblique in relation to the column axis, oblong with the upper end obtuse and rounded and the lower end acute and rounded *vs*. the lip blades not depressed, parallel in relation with the column axis, narrowly oblong with the upper and lower ends rounded in *L. smaragdina* (Fig. 1–4).

Plant medium in size, 9.5–11.0 cm tall, epiphytic, sympodial, caespitose; roots slender, 0.5–0.7 mm in diameter. *Ramicauls* erect or horizontal to pendent, slender, 3.7–9.0 cm enclosed by 7 to 10 minutely ciliate lepanthiform sheaths with a dilated ostia. *Leaf* erect, coriaceous, reticulated, juvenile leaves green adaxially and abaxially, glabrous, mature leaves glabrous to pubescent, green abaxially, dark green, suffused with purple adaxially, elliptical-ovate, acute, shortly acuminate, concave and sulcate, the margins revolute, slightly undulated, 3.0–4.5 cm long, 1.1–1.6 cm wide, with the base cuneate into a petiole 12.3–15.4 mm long, the apex mucronate, 1.2–3.1 mm long. *Inflorescence* up to 3, congested, secund, successively many-flowered, up to 9 flowers, up to 19 mm long including the peduncle, borne on top of the ramicaul, with the flowers above the leaf blade, peduncle 5.4–9.6 mm long; floral bracts

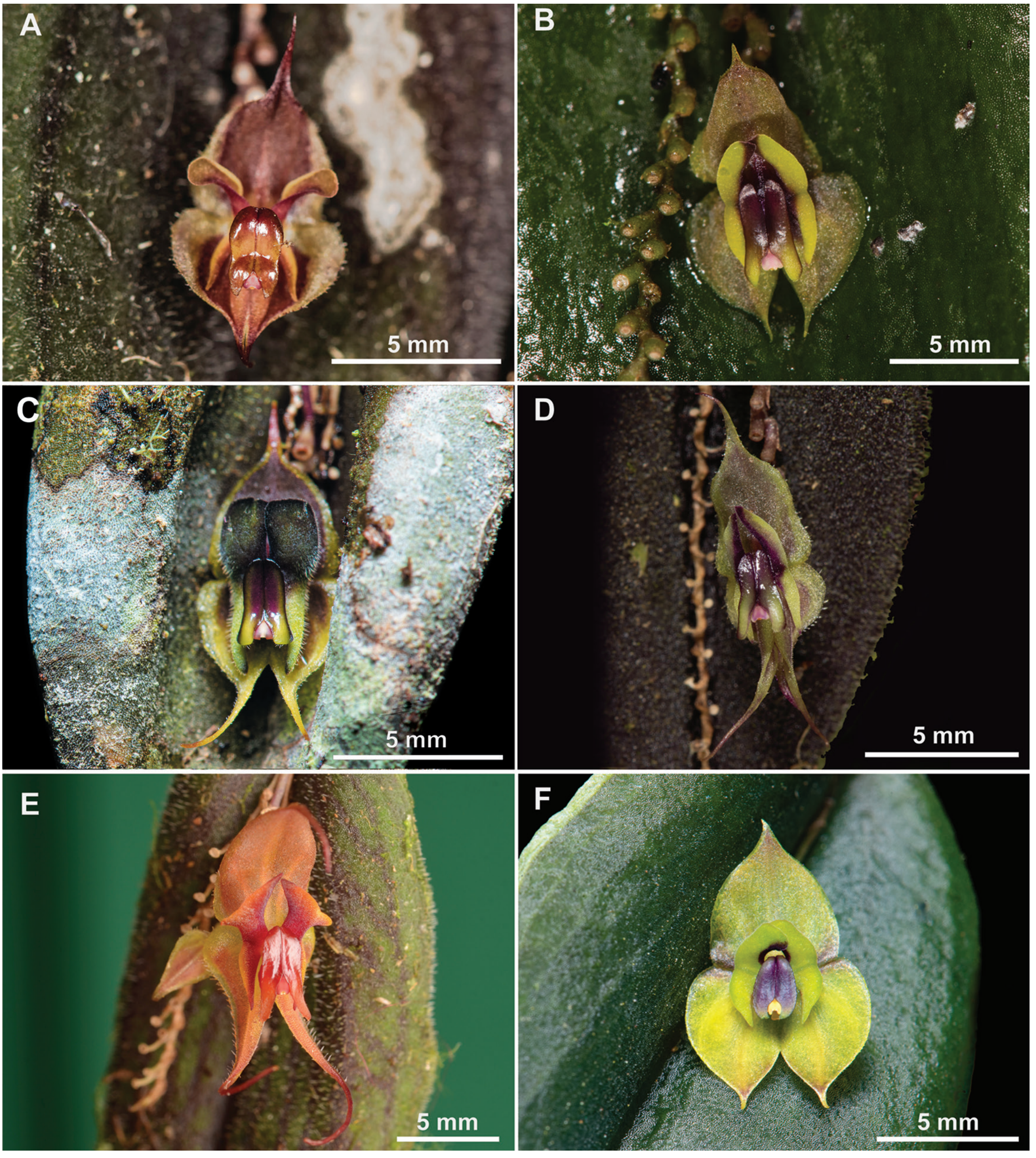

FIGURE 1. Flower comparison within some species in the informal “manabina” group. **A**. *Lepanthes farallonensis*, frontal view. **B**. *Lepanthes smaragdina*, frontal view. **C**. *Lepanthes manabina*, frontal view. **D**. *Lepanthes tomentosa*, frontal view. **E**. the Ecuadorian *Lepanthes dactylopetala*, frontal view. **F**. *Lepanthes ortiziana*, frontal view. Photos by Robinson Galindo-Tarazona (A, B, D), Sebastián Moreno (C, F), Luis E. Baquero (E).

minutely scabrous 0.9–1.5 mm long; pedicels 1.1–1.4 mm long. *Ovary* 3-costate, 3.2–3.5 mm long. *Sepals* rufous to liver-colored with ochroleucous margins and purple caudae, minutely pubescent within, carinate, margins with filiform papillae, the dorsal sepal widely ovate, acuminate, caudate, 5.2 mm long, 3.7 mm wide, 3-veined, connate to the lateral sepals for 2.6 mm, the lateral sepals broadly ovate, oblique, caudate, 5.2 mm long, connate 2.6 mm into a widely ovate synsepal, 2.3 mm wide together, each 2-veined, caudate, with overlapping caudae, 1.8 mm long. *Petals* yellow suffused with carmine, dark ochre color at the margin of the upper lobes, velvety, transversally bilobed, 0.3–0.9 mm long, 3.9 mm wide, the upper lobe subquadrate, twisted at the apex, outwardly bent, much broader than the lower lobe, the lower lobe sub-falcate, acute. *Lip* red-brown, the blades glabrous and shiny, oblique in relation to the column axis, bilaminate, 2.0–2.2 mm long, 0.5–0.8 mm wide, the blades conspicuously depressed in the middle towards the inner margins, oblong with the upper ends obtuse and rounded and the lower ends acute and rounded, the connectives short cuneate, narrow body, connate to the column, the appendix short broadly triangular, minutely trilobate. *Column* 1.9 mm long with the anther dorsal and the stigma ventral. *Anther cap* 0.6 mm wide. *Pollinia* 0.3 mm long.

Toponymy: *Lepanthes farallonensis* is named after the Farallones de Cali National Natural Park, where this species was discovered.

Habitat and ecology: *Lepanthes farallonensis* is endemic in the Valle del Cauca Department, growing in Andean cloud forest around 2750 m of elevation in the Farallones de Cali National Natural Park. This Park is the largest protected area in southwestern Colombia, with 196,430 ha, and a largely understudied and high biodiversity region with many new orchid species. It grows sympatrically with many other Pleurothallidinae orchids such as *Barbosella prorepens* (Rchb.f.) Schltr., *Brachionidium* sp., *Lepanthes speciosa* Luer & Hirtz, *Lepanthes tomentosa* Luer, *Masdevallia platyglossa* Rchb.f., *Platystele pamelae* Baquero & Zuchan, *Pleurothallis* spp., *Scaphosepalum swertifolium* (Rchb.f.) Rolfe, *Stelis* spp., as well as orchid species from other subtribes such as *Maxillaria* (*M*. cf. *embreei* Dodson, *M*. *platyloba* Schltr.,) and *Epidendrum* (*E. aurimurinus* Hágsater, E.Santiago & Gal.-Tar, *E. cylindraceum* Lindl.) (Fig. 5).

Phenology: *Lepanthes farallonensis* has been observed flowering in December in its native habitat, although it probably flowers all year round. The plants have successive inflorescences, which last for approximately two months each. That produce up to nine successive flowers, each ramicaul can produce up to three inflorescences.

Discussion. The Farallones de Cali region is particularly rich in species of *Lepanthes* of the informal *"manabina"* group, with eight different species growing in the area (*L. farallonensis, L. dodsonii* Luer, *L. foreroi* P.Ortiz, O.Pérez & E.Parra, *L. ortiziana* O.Pérez, E.Parra & Kolan., *L. manabina* Dodson, *L. smaragdina* Luer & R.Escobar, *Lepanthes sp. nov*. and *L. tomentosa* Luer, as well as a ninth species, *L. cincinnata* Luer & R.Escobar which grows further north in the same department (Valle del Cauca). Considering the number of species of *Lepanthes* belonging to this group, this area could be the center of radiation of these closely related species (Fig. 1).

Some of them, such as *Lepanthes manabina*, extend their distribution towards the northern departments in the Western Andes of Colombia and southern departments of the same mountain range, ending their distribution in the Western Andes of northern Ecuador. In addition, at least two species extend their distribution range to other mountain ranges in Colombia, *L. manabina* is known to occur in the Central Andes, and *L. tomentosa* is also found in the Central and Eastern Andes.

The shape of the petals of *Lepanthes farallonensis* is one of the main characters that easily distinguish this species from any other species of the *"manabina* group", the lower lobe being much narrower than the twisted upper lobe, resulting in the backside of the petals visible at their upper apical portion instead of showing their frontside as in most other known *Lepanthes* species (Fig. 2–4). Although an incurved process of the stigma has been observed and mentioned in the original description of *L. ortiziana* O.Pérez, E.Parra & Kolan. which belongs to the "manabina group" this was not observed in *L. farallonensis*. Although other species of *Lepanthes* like *L. elephantina* Luer & R.Escobar, *L. medusae* Luer & R. Escobar, and *L. tatamae* S.Vieira-Uribe & J.S.Moreno have upper lobes of the petals bent facing downwards, reminiscent of the petals of *L farallonensis*, none of them have twisted lobes, outwardly bent of the petals and flowers resting adaxially on the leaf. In addition, the lip of *L. farallonensis* is like the lip of *Lepanthes smaragdina*. However, the lip blades are conspicuously depressed in the middle towards the inner margins compared to the flat lip blades in all their extension in *L. smaragdina*. Also, the appendix of *L. farallonensis* is broadly triangular, while the appendix of *L. smaragdina* is triangular (Fig. 2–4).

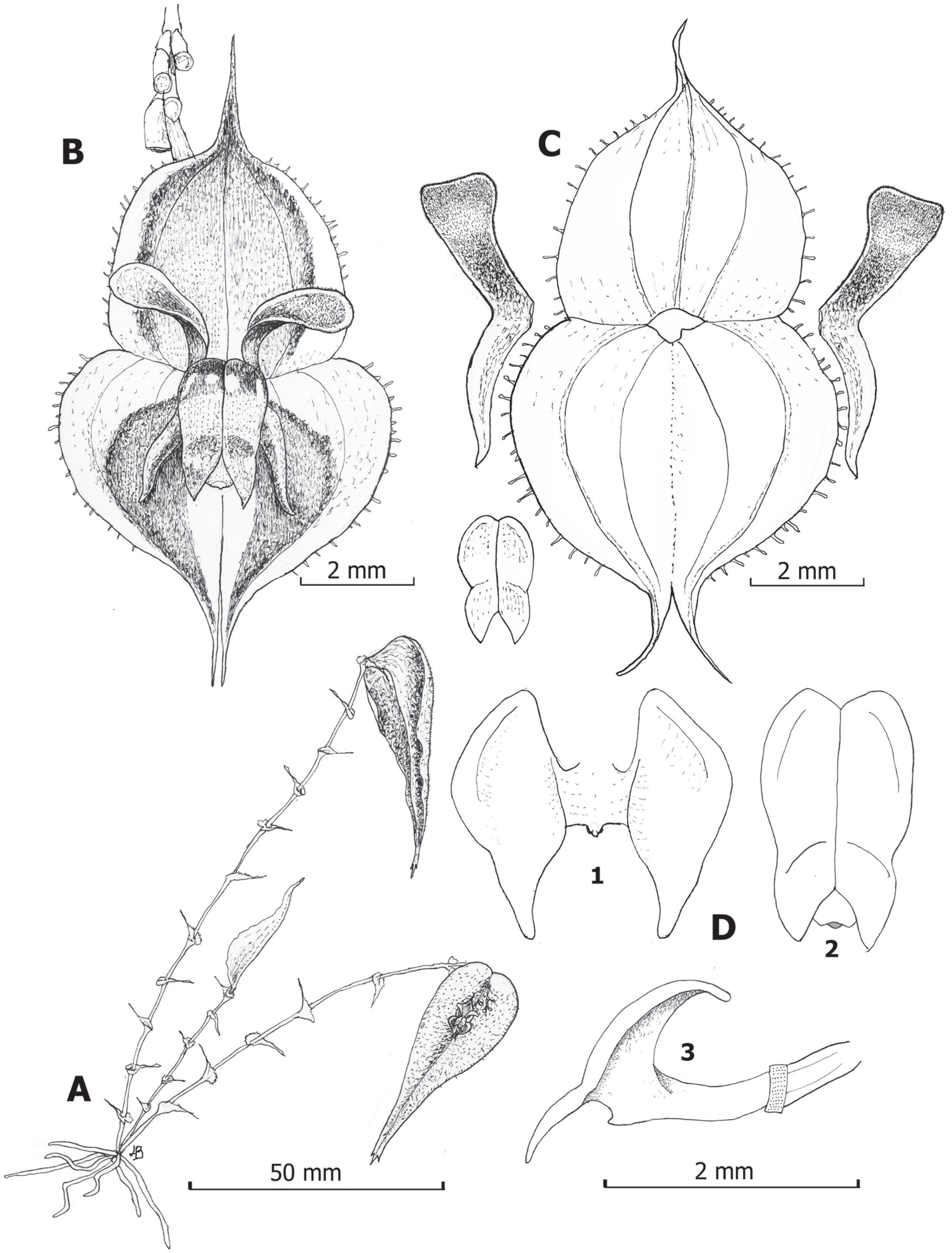

FIGURE 2. Illustration of *Lepanthes farallonensis* Haelterman, Gal-Tar. & Zuluaga. **A**. Habit. **B**. Flower. **C**. Dissected perianth. **D1**. Lip in expanded position, adaxial view. **D2**. Adaxial view of normal position of the lip. **D3**. Later view of the ovary, column and lip. Drawing by Luis E. Baquero from the holotype.

Figure 3. *Lepanthes farallonensis* Haelterman, Gal-Tar. & Zuluaga. **A**. Frontal view of the flower *in situ*. **B**. Leaf and flower *in situ*. **C**. Plant *in situ*. **D**. Lateral view of the lip and petals. Photos taken *in situ* by Robinson Galindo-Tarazona.

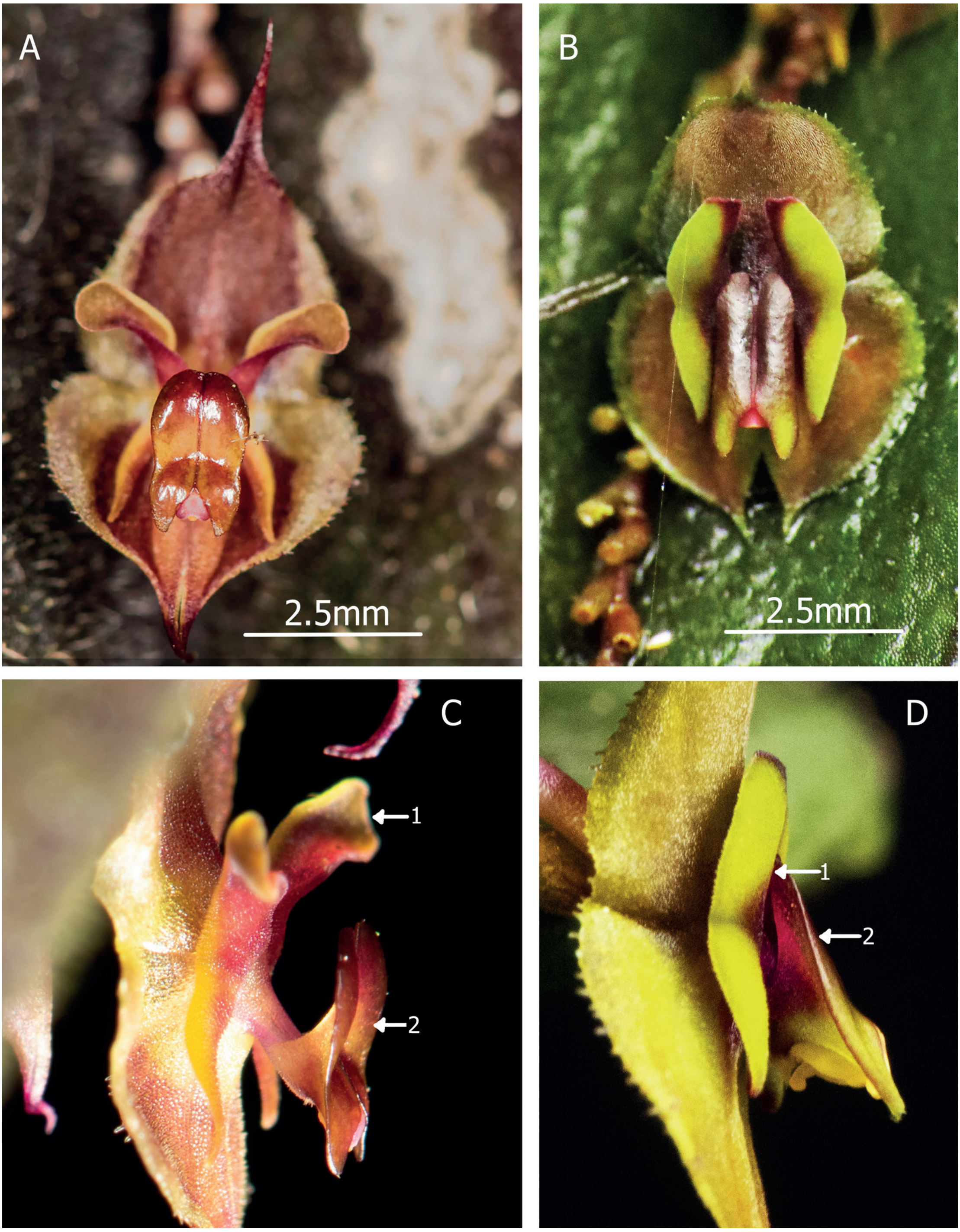

Figure 4. Comparison between *Lepanthes farallonensis* Haelterman, Gal-Tar. & Zuluaga and *Lepanthes smaragdina*. **A**. Frontal view of the flower of *L. farallonensis*. **B**. Frontal view of the flower of *L. smaragdina*. **C**. Lateral view of the flower of *L. farallonensis*: **C1**. Petal, **C2**. Lip. **D**. Lateral view of the flower of *L. smaragdina*: **D1**. Petal, **D2**. Lip. Photos taken *in situ* by Robinson Galindo-Tarazona.

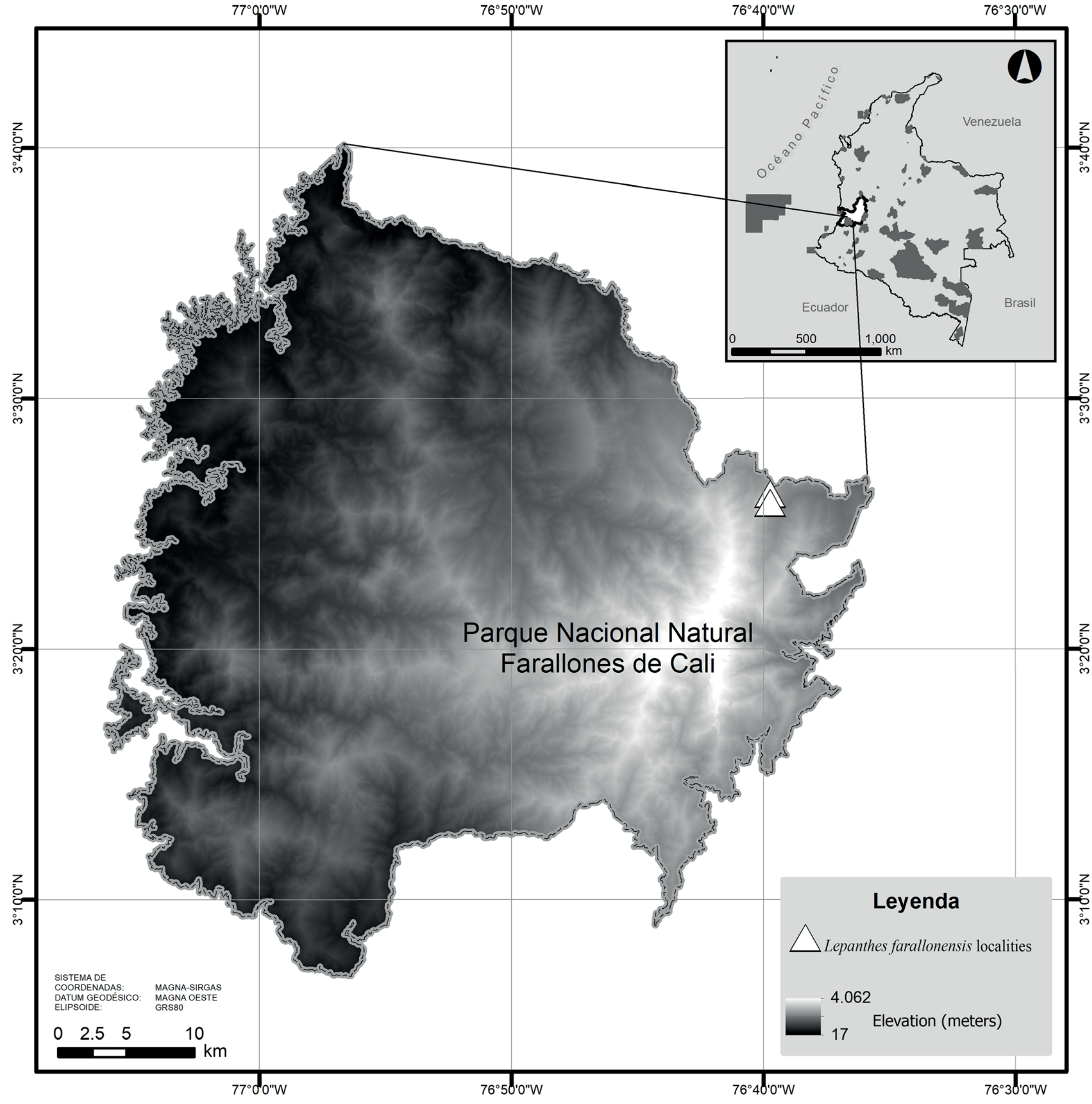

Figure 5. Distribution map of *Lepanthes farallonensis* Haelterman, Gal-Tar., & Zuluaga. Prepared by Robinson Galindo.

Conservation status: The only known population grows within the largest protected area from southwestern Colombia, The Farallones de Cali National Natural Park. So, it might be preserved from deforestation for a long time, and hopefully from illegal poaching. Nevertheless, climate change is a concern because moisture tends to disappear from lower areas and is pushed to higher elevations due to increasing temperatures. Therefore, climate change can cause a new threat to miniature orchid species such as *L. farallonensis*, which are highly sensitive to low humidity and heat excess.

Acknowledgments. We thank CELSIA for funding part of this research in the Farallones de Cali National Natural Park. To Farallones de Cali National Park for the collection permits extended to Robinson Galindo as a public authority of the National Park. We also thank Universidad de Las Américas (UDLA) for funding research of Luis E. Baquero R. To the Grupo Conserva Foundation for their logistical support and National Natural Parks of Colombia, especially Claudia Acevedo and Martha Espitia from the Farallones de Cali National Natural Park. Finally, we especially thank Melisa Alegria for her help with the measurements of the plant, Emmanuel Zapata for preparing the map of the species, and Sebastian Moreno for the pictures of *L. manabina* and *L. ortiziana*.

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TWO NEW ORCHID SPECIES (*CAMARIDIUM*: MAXILLARIINAE; *LEPANTHES*: PLEUROTHALLIDINAE) FROM THE PACIFIC SLOPE OF THE NORTHERN ANDES, COLOMBIA

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Abstract. The Northern Andean Cordillera in Colombia hosts unique, megadiverse, and fragile ecosystems, including wet tropical lowland, cloud forest, and paramo that are essential for climate regulation and the subsistence of human settlements. The Serrania de Los Paraguas on the Pacific slope of the western range of the Northern Andes, Colombia, is an ecosystem that needs to be preserved in the face of a major threat due to rapid deforestation. However, there have been very few explorations surveying its plant diversity in the area. Here, we describe two new orchid species to science from the genera *Camaridium* (*C. antonellii*: Maxillariinae, Cymbidieae) and *Lepanthes* (*L. valerieae*: Pleurothallidinae, Epidendreae) discovered during a floristic survey conducted in the region. *Camaridium antonellii* is similar to *C. inauditum* but differs in the fractiflex, ovate-elliptic, acute leaves, the flowers with pink sepals and petals, the lip white, distinctly three-lobed, spotted with purple on the lateral lobes and yellow-cream towards the apex, the mid-lobe ovate to transverse ovate and lanceolate sepals. *Lepanthes valerieae*, which is similar to *L. antennata*, differs in the long apical lobes of the petals, surpassing the dorsal sepal, the longer connectives > 18 mm, rounded lobes of the lip, and the oblong, flattened appendix. Illustrations, distribution maps, and photographs are provided.

Key words/Palabras clave: Andes, Chocó biogeographic region, Chocó biogeográfico, epiphyte diversity, diversidad de epífitas, Neotropical realm, región neotropical, new species, nuevas especies, Orchidaceae

Introduction. With *ca*. 30,000 plant species, the South American tropical Andes is the world's richest plant biodiversity hotspot (Myers *et al*. 2000, Mittermeier *et al*. 2011, Ulloa *et al*. 2017, Antonelli 2021, Pérez-Escobar *et al*. in press). For centuries, this hyper-diversity of the region has attracted the interest of botanists (Cuatrecasas 1958), geologists (Hoorn *et al*. 2010), naturalists (Humboldt 1820, Darwin 1846), and all range of scientists (Gentry 1982, Antonelli *et al*. 2009, Antonelli & Sanmartín, 2011, Pérez-Escobar *et al*. 2017a, 2019), yet knowledge gaps remain in understanding plant species diversity, its origin, and distribution (Antonelli *et al*. 2018a). This lack of understanding stems from the scarcity of floristic studies and botanical exploration in the region (Orejuela 2005), an urgent task that is sorely needed because of the constant threat of climate change and anthropogenic pressures on Andean ecosystems (Pérez-Escobar *et al*. 2009, Parra-Sánchez *et al*. 2016, Helmer *et al*. 2019).

The Orchidaceae are one of the most prominent floristic elements of the tropical Andes (Gentry & Dodson 1987, Pérez-Escobar *et al*. 2017a, Pérez-Escobar *et al*. in press). In particular, the western slope of the western range in the Northern Andean cordil-

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lera of Colombia and Ecuador exhibits higher levels of orchid endemism (Gentry 1982, Zotz 2013) and richness (Gentry & Dodson 1987) when compared with the rest of the tropical Andes. This high epiphyte diversity is attributed to the confluence of Andean and Chocoan landscapes at the Andean foothills (Richter *et al*. 2009), the high humidity at mid-range elevations (Küper *et al*. 2004), and rapid orchid diversifications boosted by biotic and abiotic factors such as Andean mountain building (Givnish *et al*. 2015, Pérez-Escobar *et al*. 2017a, 2019), migrant exchanges between biogeographical regions (Pérez-Escobar *et al*. 2017b, 2019, Antonelli *et al*. 2018b) and the evolution of plant-organism interactions (Ramírez *et al*. 2011, Givnish *et al*. 2015, Balbuena *et al*. 2020).

Despite the biological importance of the ecosystems nested in the western slope of the Northern Andes' western range (Amaya-Marquez & Marín-Gómez 2012), only a few floristic studies aimed at quantifying its orchid diversity have been conducted (Silverstone-Sopkin & Ramos-Pérez 1995, Misas-Urreta 2005, García-Ramírez & García-Revelo 2013). To date, 160 orchid species (of which five are endemic) in 37 genera have been recorded for selected protected areas in the region, including Serranía de los Paraguas and Cerro del Torrá. As an outcome of field expeditions conducted in 2018 in the Serranía del Paraguas (western slope of the western range in Northern Andes, Colombia, between Valle del Cauca and Chocó departments) aimed at expanding our knowledge on the orchid diversity of this locality. Populations of two morphologically distinctive species from the genera *Lepanthes* Sw. and *Camaridium* Lindl. were discovered, which we propose here as new.

Lepanthes Sw. is one of the most species-rich groups in the Neotropics with >1200 species and the third most diverse in Colombia with about 304 species. Most of the diversity of *Lepanthes* is recent and derived from rapid diversifications in the Andes and Central America (Pérez-Escobar *et al*. 2017a). In addition, most of the species have narrow distributions, restricted to specific mountain ranges. For example, ~98% of the species of Costa Rica and Panama (mainly in the Cordillera de Talamanca) are endemic and do not occur in the Andes or northern Central America. In Colombia, Moreno *et al*. (2019) identified the western range of the Northern Andes as one of the ten hotspots for *Lepanthes* in the country. They pointed out the need for floristic studies in the region.

Camaridium comprises about 80 species ranging from southern Florida (USA) and Mexico to Peru and southeastern Brazil. Most of the diversity is concentrated in Costa Rica and Panama, with >80% of the species. There are 18 species in Colombia, but new species frequently appear with more botanical exploration and reliable herbarium identifications (Rodríguez-Martínez & Blanco 2015). Also, floristic similarities between southern Central America and Chocó suggest that the number of species discovered within the Maxillarinae in the Northern Andes' western range of Colombia could increase (Kirby 2011, Pérez-Escobar *et al*. 2019).

Materials and methods. We collected living plants in field in March 2018 at Valle del Cauca, El Cairo municipality, Colombia. The descriptions and drawings were based on living specimens and herbarium material, following the terminology by Christenson (2013) and Luer (2011). Digital images were taken with a Nikon D7100 with a Nikon AF-D 50 mm f/1.8 lens. Sketches were prepared with a Leica® MZ7.5 stereomicroscope with a drawing tube and digitalized. A draft composite template was designed in Adobe Photoshop® CS6 and exported as a JPEG file. Then, we made the digital composite-line drawing (lines and stippling), uploading the template in Procreate illustration applications for iPad Pro tablet computer (Apple Inc.). The resulting drawing was exported as TIFF file at 800 dpi. The *Camaridium* species was prepared and inked in paper.

Taxonomic treatment

Camaridium antonellii O.Pérez & Bogarín, ***sp. nov.***

TYPE: Colombia. Valle del Cauca: El Cairo municipality, Cerro El Inglés, "Santicos" locality, epiphyte in disturbed forest, 2330 m, 25 March 2018, *O. Pérez-Escobar & A. Zuluaga 1987* (Holotype: CUVC). Fig. 1–2.

Diagnosis: *Camaridium antonellii* is similar to the Central American *C. inauditum* (Rchb.f.) M.A.Blanco, but differs in the fractiflex leaf-sheaths, ovate-elliptic, acute leaves, the flowers with dark pink to purple se-

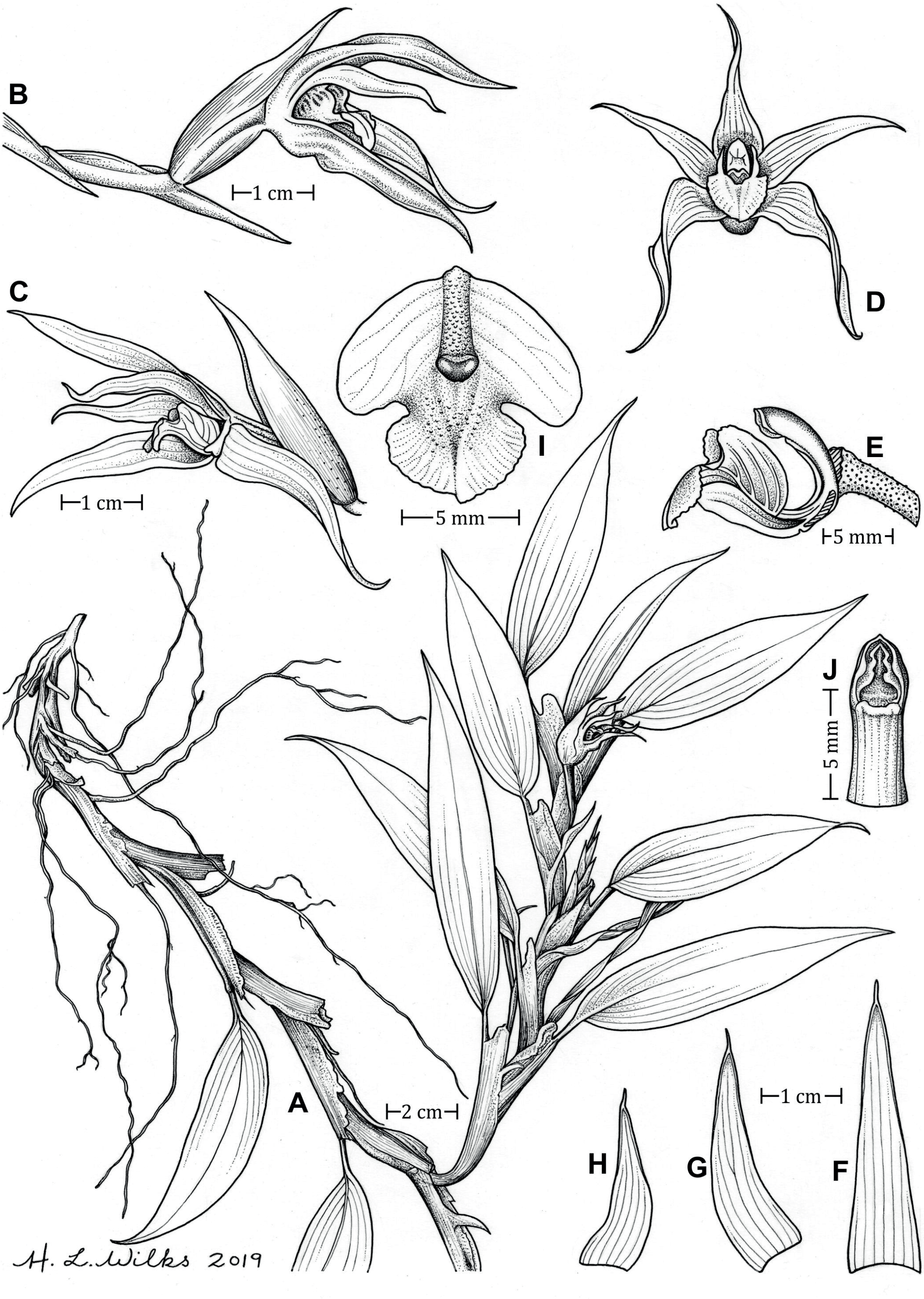

Figure 1. *Camaridium antonellii*. **A.** Habit. **B.** Flower in lateral position. **C** Flower in lateral position, exposing the lip. **D.** Flower in frontal position. **E.** Ovary, column and lip, lateral view. **F-G.** Dorsal, lateral sepal and petal in ventral position, respectively. **I.** Lip (ventral position). **J.** Column (ventral position). Drawn from the holotype by H. Wilks.

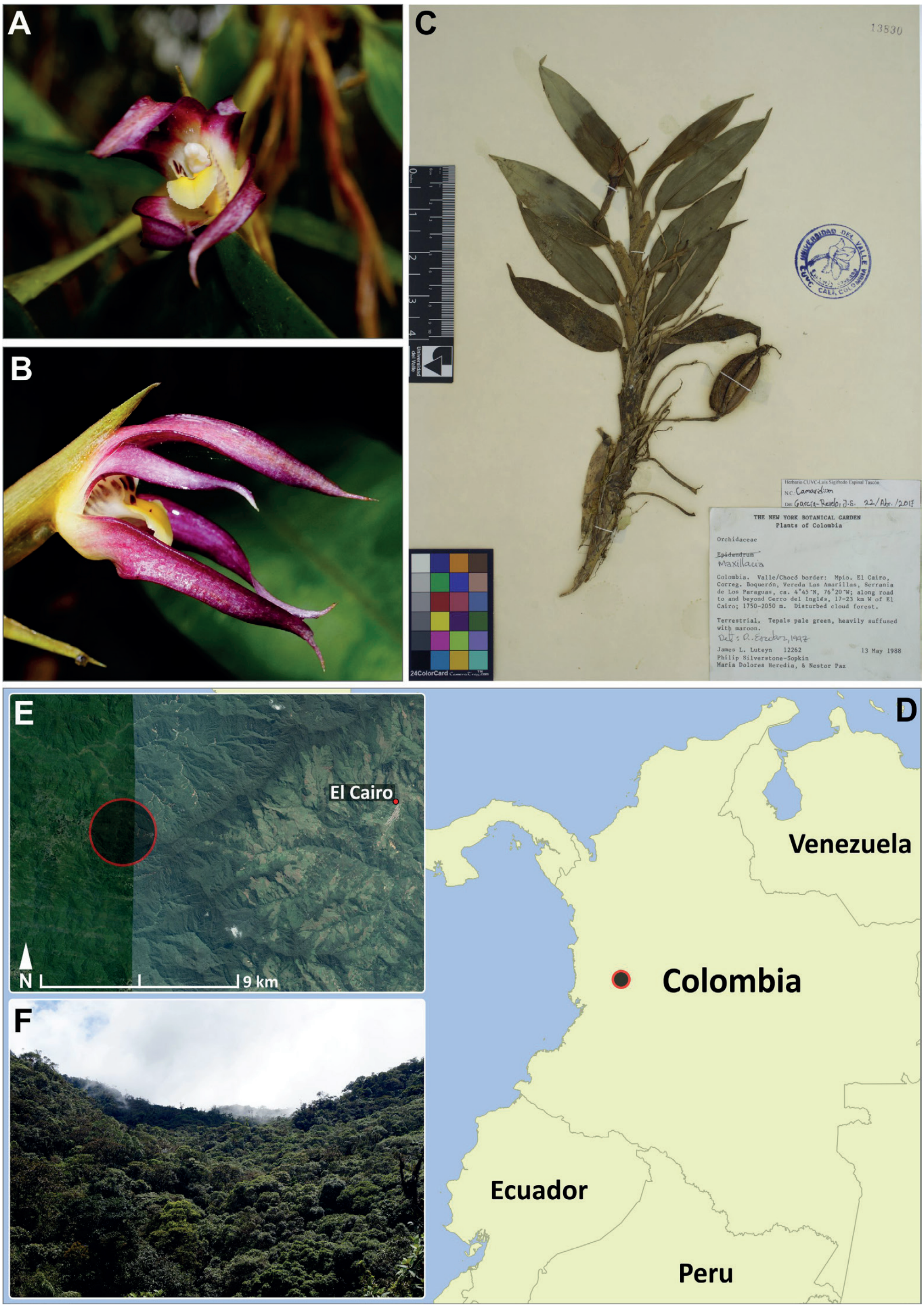

FIGURE 2. **A-B.** Flowers of *Camaridium antonellii* in Frontal and lateral position, respectively. **C** Pressed plant of *C. antonellii* bearing a dehiscent fruit (*Luteyn 12262* CUVC!). **D-E.** Type locality of *C. antonellii* and *Lepanthes valerieae* (enclosed in the black circle). **F.** Canopy view of cloud forests in Serrania del Paraguas (type locality). Photos: O. Pérez & Google Earth.

pals and petals, the distinctly three-lobed lip, white, spotted with purple on the lateral lobes and yellow-cream towards the apex, the mid-lobe ovate to transverse ovate, and lanceolate sepals.

Plant epiphyte, up to 44 cm tall. *Roots* white, 1 mm thick, lateral, profuse, produced from the base of the leaves and sprouting from the leaf sheaths. *Stems* sympodial canes, decumbent, flattened, with fractiflex leaf-sheaths, rarely branching towards the apex, without evident pseudobulbs. 22–26 cm long, 0.8–1.5 cm wide, entirely covered by the leaf sheaths. *Leaves* distichous, 5–11, monomorphic, the blade ovate-elliptic, coriaceous, deciduous, green, acute, minutely mucronate, the base invaginate, with a clear abscission line, pseudopetiolate, 7–12 × 2 cm; the petiole conduplicate and articulated with the leaf, coriaceous, cordate, winged, persistent on the stem after leaf's abscission. *Inflorescences* single-flowered, produced from the apical leaf sheath's axils, 1-many per axil, with flowers opening successively. *Peduncle* 16 mm long, with 2–4 distichous, conduplicate, acute, yellow-green pale, papyraceous bracts (including the floral bract), slightly verrucous towards the apex, the papillae pale brown, 31.1–32.2 × 12 mm, the floral bract extending over basal 1/3 of the dorsal sepal with the midrib stained with purple. O*vary* pedicellate, 14 mm long (including the pedicel), markedly verrucose in the distal half. *Flowers* resupinate; sepals and petals pink towards the distal two thirds, the margin slightly darker, the base white to pale yellow, immaculate; lip white with transverse purple blotches on the lateral lobes extending to the margins, pale yellow towards the apex, with a yellow callus; column white. *Sepals* narrowly triangular to lanceolate, acute, mucronate, fleshy; the dorsal sepal 36.7 × 9.0 mm, 7-veined, the lateral sepals falcate, 30.4 × 7.6 mm, 7-veined. *Petals* lanceolate, falcate, acute, mucronate, 22.2 × 7.1 cm, 6-veined. *Lip* sub-rhombic, three-lobed, slightly truncate at the base, with a prominent oblong, apically projected bifid callus extending from the base of the lip to the apical portion of the disc, 10.1 × 10.3 mm; lateral lobes obliquely elliptic, obtuse, erect, entire, 6.1× 4.0 mm; mid-lobe broadly ovate to transverse ovate, subtruncate, obtuse with a small mucron, margin sub-crenate, fleshy, 5.0 × 5.9 mm. *Column* arcuate, hemicylindrical, 7.8 × 2.8mm. *Anther* apical, *stigma* ventral. *Pollinia* not seen. *Fruit* oblong, 47 mm long.

EPONYMY: This new species honours Prof. Alexandre Antonelli, Director of Science at the Royal Botanic Gardens, Kew (UK) and mentor of the lead authors of this paper. Prof. Antonelli is one of the most prominent tropical plant biogeographers of the 21st century, whose contributions have revolutionized the understanding of the spatio-temporal dynamics of plant diversification in the American tropics, including orchids.

PHENOLOGY: Flowering was recorded from March to July. Fruits were recorded in May.

HABITAT AND ECOLOGY: Epiphyte, growing in primary forest, humid tropical forest (cloud forest), at 1700–2300 m elevation. Dense populations of *C. antonellii* of 15 or more individuals were reported growing on isolated trees. *Camaridium antonelli* is the only known representative of the genus growing in the type locality.

DISTRIBUTION: Endemic to the Chocó, Colombia, where it is only known from the type locality (Fig. 2D, E).

Discussion. *Camaridium antonellii* is similar to the Central American *C. inauditum* but differs in the fractiflex leaf-sheaths, ovate-elliptic, acute leaves (*vs.* two-ranked, oblong, obtuse), the flowers with pink sepals and petals (*vs.* ivory white), the distinctly three-lobed lip (*vs.* obscurely three-lobed), white, spotted with purple on the lateral lobes and yellow-cream towards the apex (*vs.* yellow and also light stained with brownish to the apex), the mid-lobe broadly ovate to transverse ovate (vs. ovate to elliptical), and the lanceolate sepals (*vs.* linear).

Some species of *Camaridium* and *Maxillaria* Ruiz & Pav., as defined by Whitten *et al.* (2007)but its current generic boundaries and relationships have long been regarded as artificial. Phylogenetic relationships within subtribe Maxillariinae sensu Dressler (1993, can be confused mostly because of the generalized plant habit. However, plants of *Camaridium* typically lack pseudobulbs in contrast to *Maxillaria s.s.,* which shows well-developed pseudobulbs with one apical, spatulate leaf. Nevertheless, some of these traits evolved several times across the Maxillariinae (in *Ornithidium* Salisb. ex R.Br., *Maxillaria* s.s., and the *M. variabilis* clades), their taxonomic value in generic delimitations is not useful. Therefore, Whitten *et al*. (2007)but its current generic boundaries and relationships have long been regarded as artificial. Phylogenetic relationships within subtribe Maxillariinae sensu Dressler (1993 suggested the combination of apical fruit dehiscence, absence of fibers in floral segments, and a floral bract that often exceeds the ovary to separate *Camaridium* from *Maxillaria*. Vegetatively, some species of *Maxillaria s.s*., such as *Maxillaria caveroi* D.E.Benn. & Christenson, *M. floribunda* Lindl., *M. platyloba* Schltr. and *M. sibundoyensis* Szlach., Kolan., Lipińska & Medina Tr. (Bennett & Christenson 1998, Bentham 1839, Schlechter 1921, Szlachetko *et al*. 2017) are similar to *C. antonellii,* mainly in plant habit and general flower appearance. However, plants of these species have traits typical of *Maxillaria* s.s. such as the tough perianth fibers, crested or ornamented anther cap (Blanco *et al*. 2007). If the broad generic concept of *Maxillaria* proposed by Schuiteman & Chase (2015) is accepted, then *C. antonellii* also differs from the species of the *M. platyloba* group (Christenson 2013) mainly by the pink sepals and petals, yellow-cream lip (*vs*. yellow or brown sepals and petals), lanceolate dorsal sepal (*vs*. linear, oblong) and the ovate to transverse ovate, acute lip (*vs*. ovate to elliptical, truncate, emarginate or obtuse).

Lepanthes valerieae O.Pérez, Jaramillo & Bogarín, ***sp. nov.***

TYPE: Colombia.Valle del Cauca, El Cairo municipality, Cerro El Inglés, 2300 m, 25 March 2018, *O.A. Pérez et al. 1981* (holotype: CUVC). Fig. 3–4.

Diagnosis: *Lepanthes valerieae* is most similar to *L. silverstonei* Luer, but it differs in the narrowly-elliptic to narrowly ovate leaves, < 1 cm wide, the filiform upper lobe of the petals surpassing the dorsal sepal length and the rudimentary ovate, sub-triangular lower lobe, and the triangular, concave appendix with a subcylindric, retuse almost glabrous apex. It is also similar to *L. antennata* Luer & Escobar; however, it is distinguished by the long apical lobes of petals, surpassing the dorsal sepal, the longer connectives > 18 mm, rounded lobes of the lip, and the oblong, flattened appendix.

Plant epiphytic, pendent, or suberect, up to 20 cm tall. *Roots* slender, flexuous, to 1 mm in diameter. *Ramicauls* slender, suberect, when young, mostly pendent at maturity, to 12 cm long, enclosed by 6–11 brownish, adpressed lepanthiform sheaths, the ostia minutely ciliate, acute. *Leaves* narrowly-elliptic to narrowly lanceolate, coriaceous, attenuate-acuminate, with recurved margins, 8.0 × 1.0 cm, the attenuate base narrowing into a petiole less than 3 mm long. *Inflorescence* racemose, distichous, glabrous, successively flowered, developed above the leaf, shorter than the leaves, up to 3.0 cm, long, peduncle 2.5 mm long, rachis 5 mm long. *Floral bracts* ovate, acuminate, 1 mm long. *Pedicels* 2 mm long, persistent. *Ovary* to 3 mm long, glabrous. *Flowers* with red sepals, the dorsal sepal yellowish tinted red, the lateral sepals with a yellow mid-vein, and light-yellow petals basally tinted red with reddish tips and yellow lip and column. *Dorsal sepal*, ovate, acute, concave, denticulate, abaxially with three ciliate keels, connate to the lateral sepals for about 1 mm, 4.8 × 2.5 mm. *Lateral sepals* oblong-ovate, acute, denticulate, abaxially with two ciliate keels, oblique, connate for about 3 mm, 5.0 ×3.2 mm. *Petals* transversally bilobed, minutely ciliate, 0.8 × 11.4 mm, the upper lobe filiform ovate at the base, filiform, 10.8 × 0.8 mm, the lower lobe introrse, ovate, sub-triangular, about 0.5 mm long. *Lip* bilobed, minutely pubescent, adnate to the column at the base, exceeding the column length, with oblong blades and rounded ends, embracing the column, 1.5 × 3.2 mm, with cylindrical connectives, 1.8 mm long, the narrow body, laminar, connate to the base of the column, appendix triangular, concave, with a subcylindric retuse, almost glabrous apex. *Column* cylindrical to 2.2 mm long, with a prominent, orbicular stigma with the margins papillose, anther apical, and stigma ventral. *Pollinia* two, obovoid. *Anther cap*, cucullate. *Fruit* not seen.

Eponymy: This species honors Valerie Anders for her passion for supporting science projects that celebrate the Anders' family legacy of exploring and expanding human knowledge. Her generosity has helped generations of paleobiologists worldwide, especially Latin

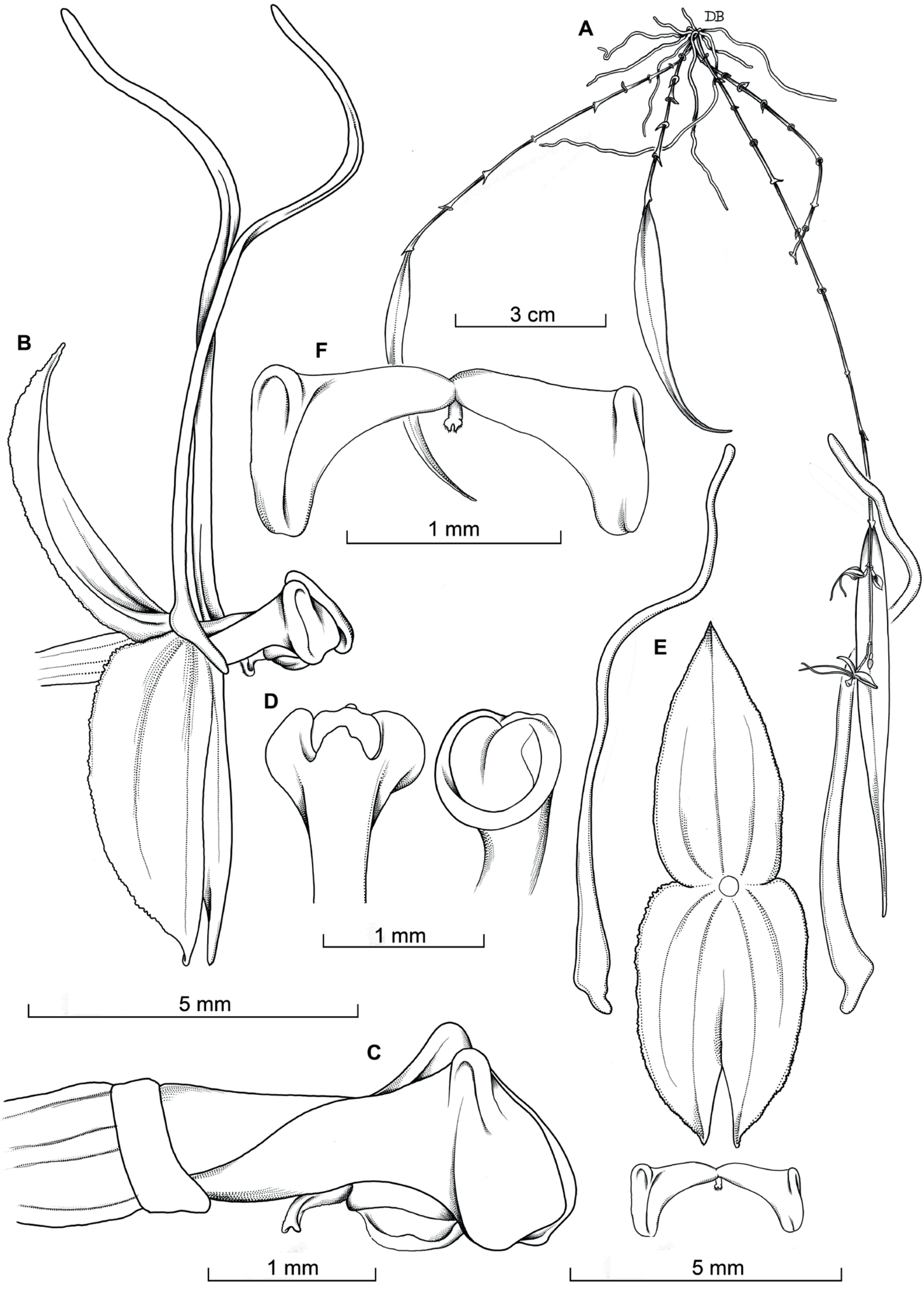

FIGURE 3. *Lepanthes valerieae*. **A.** Habit. **B.** Flower in natural position. **C.** Ovary, column and lip, lateral view. **D.** Column. **E.** Dissected perianth, flattened. **F.** Lip spread, adaxial view. Drawn from the holotype by D. Bogarín.

FIGURE 4. *Lepanthes valerieae*. **A.** Detail of ramicaul and leaf, bearing two inflorescences. **B.** Side position of a flower and flowers buds in development. **C.** Detailed view of the flower in lateral position. Photos: O. Pérez.

America, that seek to understand the evolution of life and landscapes in the Tropics.

PHENOLOGY: Flowering was recorded in March and April.

HABITAT AND ECOLOGY: Epiphyte, growing in primary humid tropical (cloud) forest on branches and twigs in the forest floor at 1700 m elevation. Two populations growing in bushes and distanced each other by about five meters were further reported. The type locality seems to be highly diverse in *Lepanthes* orchids. Here, at least ten different species (including *L. antennata*) were recorded in adjacent branches.

DISTRIBUTION: Endemic to the Chocó, Colombia, only known from the type locality (Fig. 2D, E).

Discussion. *Lepanthes valerieae* is also most similar to *L. silverstonei,* but it differs in the narrowly-elliptic to narrowly ovate leaves, < 1 cm wide (*vs*. ovate, > 2 cm wide), the filiform upper lobe of the petals surpassing the dorsal sepal length (*vs*. anguste-linear, shorter than the dorsal sepal) and the rudimentary ovate, sub-triangular lower lobe (*vs*. anguste-triangular, falcate) and the triangular, concave appendix with a subcylindric, retuse almost glabrous apex (*vs*. convex, with a pubescent, flabellate apex). *Lepanthes valerieae* also resembles *L. antennata* mostly in its filiform, long upper lobes of the lip; however, it is distinguished by the long apical lobes of petals, surpassing the dorsal sepal (*vs*. shorter or as long as the dorsal sepal), the longer connectives > 18 mm (*vs*. <1 mm long), rounded lobes of the lip and the oblong, flattened appendix (*vs*. triangular, concave).

Morphological variation in *Lepanthes silverstonei* has been documented in several other localities near the *locus typus* (Sebastian Vieira, *pers. com*. November 2020). Apparently, the petals of that species vary from filiform to bifid and shorter to more prolonged than the sepals. In addition, the phylogenetic relationships of *L. valerieae* with other morphologically similar species, including *L. antennata* and *L. licrophora* Luer & B.T.Larsen, remains to be tested. Thus, the description of *L. valerieae,* in addition to *L. antennata*, *L. licrophora,* and *L. silverstonei* (and its possible variations), provides new morphometrical resources to test hypothesis on *Lepanthes* species complexes (Bogarín *et al*. 2018). Such data, in cobinaiton with different lines of evidence such as DNA sequences will further enable the conduction of future integrated monographic work in the genus (Grace *et al*. 2021) but also comparative studies focusing on generic delimitations in the lineage and Pleurothallidinae overall (Bogarín *et al*. 2019). Also, given the intricate vegetative and reproductive morphology (Luer 2011, Bogarín *et al*. 2018) and rapid speciations characteristic of the genus (Pérez-Escobar *et al*. 2017a), phylogenomic (Bogarín *et al*. 2018, Pérez-Escobar *et al*. 2020, Peakall *et al*. 2021, Pérez-Escobar *et al*. 2021, Serna-Sánchez *et al*. 2021) and statistical morphometric approaches (Bateman *et al*. 2018, 2021) are needed to sort such species complexes.

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RUDOLF SCHLECHTER'S SOUTH-AMERICAN ORCHIDS VI. SCHLECHTER'S "NETWORK": BOLIVIA, PARAGUAY, CHILE, ARGENTINA, AND URUGUAY

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Abstract. The sixth and last chapter of this series about Rudolf Schlechter's South American network covers Bolivia, the last of the tropical Andean countries, and continues into the partly tropical and subtropical regions of South America: Paraguay, Chile, Argentina, and Uruguay. Although Bolivia has a high biodiversity and a large orchid flora, the remaining countries (except for parts of Paraguay and a small part of northern Argentina) have mostly terrestrial orchids and were historically visited only by a relatively few European botanists. The number of travellers mentioned in this chapter is therefore much lower than in previous ones. As in previous chapters, the biographies and accomplishments of these travellers are preceded by brief geographical and historical introductory outlines for each country. Again, a few figures, such as August Weberbauer, already mentioned in the last chapter, are omitted here.

Key Words/Palabras clave: biography, biografía, history of botany, historia de la botánica, Orchidaceae

Bolivia. The country is one of the two landlocked countries in South America (the other being Paraguay). It was named after Simón Bolivar (1783–1830) (Fig. 1), South America's great liberator and first President of Bolivia. It is bounded to the north and east by Brazil, to the south by Paraguay and Argentina, and the west by Chile and Peru. The country's topography includes the Eastern Andean Cordillera Oriental, which bisects Bolivia from south to north, and the Western Andean Cordillera Occidental, which runs along the border with Chile. The Cordillera Occidental features the extinct stratovolcano Nevado Sajama, at 6542 m (Fig. 2), Bolivia's highest peak.

Between the two mountain ranges lies the Altiplano, a highland plateau where Lake Titicaca is located. The lake is crossed by the border between Bolivia and Peru. To the east and north of the Cordillera Oriental are the valleys of the Yungas, a region of amazing scenic views, which slowly descends into the lowland plains of the Amazon Basin by what is called 'the most dangerous road in the world' (Fig. 3). The south-eastern part of the lowlands, on the border with Paraguay, is part of the Gran Chaco (Fig. 4), a sparsely populated hot and semi-arid natural region of the La Plata River Basin, divided between Bolivia, Paraguay, Argentina and Brazil.

Bolivia is thus a country of extremes, whose extremely high biodiversity is the result of the great number of microclimates ranging from the Altiplano, at over 4000 m, to the Amazon Basin and the lowlands of the Gran Chaco (Fig. 5).

Botanical exploration 1750–1800: The botanical exploration of Bolivia began with Joseph de Jussieu (1704–1779), who had taken part in the expedition of La Condamine to Ecuador between 1735 and 1747. After the expedition disbanded, he travelled to Lima before moving to La Paz, in Bolivia, in 1750 where he spent the next five years (Ossenbach 2020). De Jussieu's collections are mostly labeled *Perou*, but without exact provenance. Since Bolivia did not exist as an independent state at this time and was part of the Viceroyalty of Peru, we cannot determine if there were any Bolivian plants amongst his specimens. The Czech Thaddaeus Haenke (1761–1816), after leaving the expedition of Alessandro Malaspina in the port of El Callao in 1790, intended to cross the continent and meet Malaspina again in Buenos Aires or Montevideo. Instead, he stayed in Bolivia and remained there for the rest of his life. He died in the city of Cochabamba in 1816. A large part of his botanical collections were described by Carl B. Presl in *Reliquiae Haenkeanae* in 1839 (Presl 1830).

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FIGURE 1. Simón Bolívar (1783–1830), Liberator and first President of Bolivia. Unknown artist.

FIGURE 2. Nevado Sajama volcano with the Altiplano in the foreground. Photograph by Léo Guellec.

FIGURE 3. The road to los Yungas, the 'most dangerous in the world. Photograph by Coroico Tours.

FIGURE 4. The Gran Chaco. Photograph by Llosuna.

FIGURE 5. Map of Peru and Bolivia, 1836. By H.S. Tanner.

Figure 6. Henry Hurd Rusby (1855–1940). Botany Libraries of Harvard University. In Rossi-Wilcox, 1993: fig. 1.

Alcide D'Orbigny (1802–1857) botanized in Bolivia and border regions of Brazil for the Natural History Museum in Paris between 1830 and 1833. After him came Thomas Bridge (1807–1865), who arrived in Bolivia in 1844 and collected plants for the Kew Herbarium until 1846. Many new species found amongst his collections were described by Lindley in his *Folia Orchidacea* (Lindley 1852?). Hugh Algernon Weddell (1819–1877), a member of Castelnau's expedition, came from Brazil to Bolivia in 1845 and botanized in the country intermittently until 1851.

One of the most prolific orchid collectors in Bolivia was Gustave Mandon (1799–1867), who visited the country from 1848 to 1861. He collected a total of over 1800 specimens. The Orchidaceae were described in 1878 by Reichenbach *f.* in his *Orchideae Mandonianae* (Reichenbach 1878). Henry Hurd Rusby (1855–1940) collected in 1885 and 1886 and was instrumental in interesting Miguel [Michael] Bang (1853–1896) in continuing his work. Bang made large collections of orchids from 1886 until his death ten years later. The results were described by Rusby in a series of articles entitled *An enumeration of the plants collected in Bolivia by Miguel Bang*, published by the Torrey Botanical Club between 1893 and 1896.

Finally, Carl Ernst Otto Kuntze (1843–1907) visited Bolivia during his second South American journey in 1892. Alfred Cogniaux described a total of four new species among his Bolivian collections.

Henry Hurd Rusby (1855–1940), Miguel (Michael) Bang (1853–1895 [1897?]) and Robert Statham Williams (1859–1945) (collected 1885–1886, 1884–1895, and 1901–1902, respectively)

Sent in 1885 by Parke, Davis & Co., once America's oldest and largest drug maker, on an expedition to Peru and Bolivia to gather supplies of coca leaves, Henry Hurd Rusby (1855–1940) (Fig. 6) was one of the pioneers in the advancement of pharmacy and medicine.

Rusby had developed an early interest in botany and in 1871 began collecting plants in Essex County, New Jersey, under the guidance of C. H. Fuller. He was admitted to the Torrey Botanical Club and in 1880 was hired by the Smithsonian Institution to investigate the botany, natural history and archaeology of New Mexico. After returning from New Mexico in 1882, Rusby studied for a year at the College of Physicians and Surgeons of Columbia University and later at the Medical College of New York University, where he received a Doctorate in Medicine in 1884 (Rossi-Wilcox 1993: 1–4).

In January, 1885, Henry H. Rusby embarked in New York City for the port of Arica, in northern Chile. Over the next two years, he would cross the continent, botanizing in Peru and Bolivia before travelling down the Amazon to the Atlantic (Fig. 7). He returned to the United States with 45,000 botanical specimens, of which about 20% were new to science (Fig. 8).

Over the years Rusby would take part in several other expeditions to South America: in 1893 to the Orinoco Valley in Venezuela, in 1917 to the Magdalena River in Colombia, in 1919 to Bolivia and Brazil

FIGURE 7. Henry H. Rusby in the Amazon Region, 1886. NYBG Library Archive. In Williams & Fraser, 2008: fig. 2.

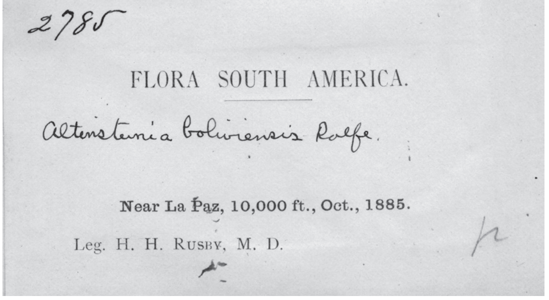


FIGURE 8. Henry Rusby herbarium label. Oakes Ames Orchid Herbarium, Harvard University.

again, and finally as leader of the Mulford Biological Expedition to the Amazon Basin in 1921. However, he had to abandon this last expedition due to ill health and returned to the United States in December of that year.

Rusby travelled from Chile to La Paz in March 1885. He returned briefly to Valparaiso in Chile but in June was back in the capital of Bolivia. There he collected in the region of the Yungas and around of the village of Sorata, about 150 kilometers northwest of La Paz. In the first months of 1886, he left Bolivia and continued through Brazil to the Atlantic.

In 1890, Dr. Rusby was one of the first scientists to be appointed to the staff of the newly founded New York Botanical Garden, an association he maintained until he died in 1940. Simultaneously, he occupied the position of Dean of the New York College of Pharmacy at Columbia University and was Vice-president and then President of the Torrey Botanical Club.

Among Henry Rusby's collections of orchids, Schlechter described two new species: *Elleanthus setosus* and *Habenaria yungasensis*. Rolfe determined as new to science *Liparis rusbyi*, *Oncidium rusbyi* (Fig. 9), *Pleurothallis rusbyi*, *Stelis rusbyi* (collected by M. Bang for Rusby), and the new orchid genus *Rusbyella* (the only orchid genus endemic to Bolivia) with its type species *Rusbyella caespitosa*. Other

Figure 9. *Oncidium rusbyi* Rolfe, as *Cyrtochilum cimiciferum* (Rchb.f.) Dalström. Photograph by Lourens Grobler.

Figure 10. *Rusbyella aurantiaca* G.Gerlach & T.Kramer, as *Cyrtochilum aurantiacum* (G.Gerlach & T.Kramer) Dalström.

species of this genus have been found in later years, among them *Rusbyella aurantiaca* by G. Gerlach and T. Franken (Fig. 10). Finally, Rolfe described *Oncidium rusbyi*.

Henry Hurd Rusby's expedition to Bolivia would bring additional results: during his time in La Paz he met Bang, who worked in the suburbs of the city (Fig. 11), and a few years later came into an agreement with him to make extensive botanical collections. Fifteen years later, Rusby was again instrumental in securing botanical collections from Bolivia for the New York Botanical Garden by arranging the South American expedition of Robert Statham Williams (1859–1945). Both events would result in substantial contributions to our understanding of the Bolivian orchid flora.

In his enumeration of the plants collected in Bolivia published between 1893 and 1896, Henry H. Rusby wrote about Bang: "The study of the Bolivian flora, as represented in the collections made by myself in the years 1885 and 1886, the enumeration of which is still proceeding in the pages of the Bulletin, proved so interesting to Dr. Britton and myself that we became very desirous of having the collections continued. An opportunity to gratify this desire was found in 1889, when Mr. Miguel Bang consented to carry on the work which I had begun. Mr. Bang is the son of a Danish clergyman, educated in gardening at Kew, who went to Bolivia somewhere about the year 1883, for the purpose of collecting and sending to England living orchids. The enterprise proving unsuccessful, Mr. Bang engaged in other pursuits in the vicinity of La Paz, where I met him in 1885, and formed the acquaintance from which the present arrangement has resulted. Since Mr. Bang began collecting, the work has been pushed as steadily as circumstances would permit. It was hoped that the proceeds from the sale of specimens would more than pay the expenses of collection, so that Mr. Bang might derive more or less profit from the enterprise; but unfortunately, such has not been the case. Despite every effort and economy, I have found it necessary to supply a considerable deficiency, while Mr. Bang has received nothing beyond

FIGURE 11. La Paz, ca. 1900. Unknown photographer.

his expenses. Indeed, owing to a lack of ready funds, it has not been possible to fully utilize the time in collecting." (Rusby 1893: 1).

No other biographical data are known about Miguel Bang. From his herbarium labels, Rolfe's descriptions and Rudolf Schlechter's brief historical account (Schlechter 1922), we gather that he collected from 1883 to 1890 in the vicinity of La Paz (the villages of Coripata and Coroico in the Yungas valleys are often mentioned). In 1891 we find him in Cochabamba, in 1892 in Tipuani and in 1893 at the Mapiri River. All these places are in the Department of La Paz.

By the time Bang met Henry Rusby, he had made already a substantial start on the classification of the Bolivian flora. He collected hundreds of new species and several unknown genera, described by H. H. Rusby in four separate instalments in the *Memoirs of the Torrey Botanical Club*. Bang's large collection of orchid specimens was studied and determined chiefly by R. A. Rolfe. Schlechter described additional species collected by Bang in his orchid flora of Bolivia (Schlechter 1922).

Duplicate sets from his herbarium were later distributed by Rusby and N. L. Britton to most of the main American and European herbaria. In his later

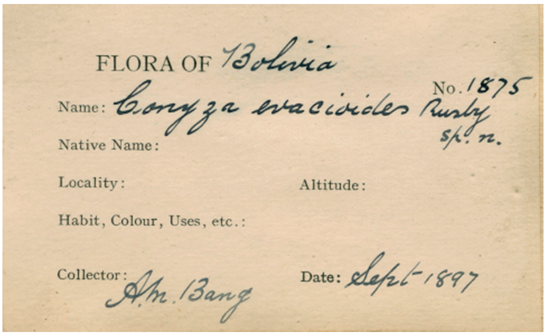


Figure 12. Herbarium label of *Coryza evacioides* Rusby, with collection date given as Sept. 1897. Kew Herbarium # 000221757.

Figure 13. *Epidendrum miguelii* Schltr. as *Epidendrum ibaguense* Kunth. Photograph by Arne and Bernd Larsen.

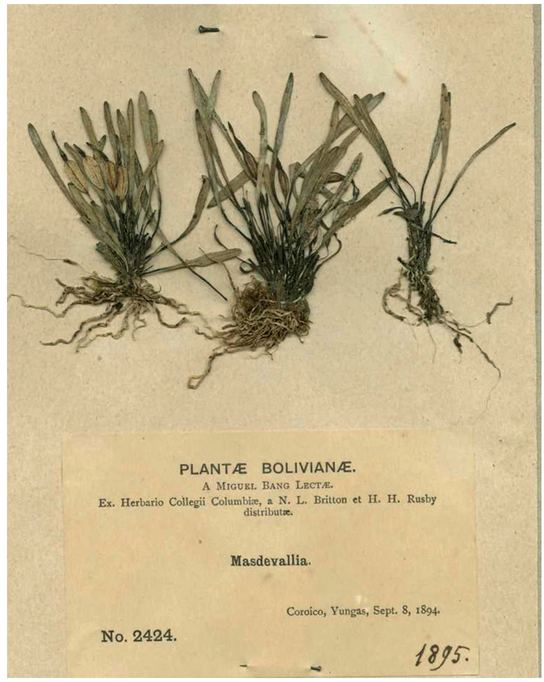


Figure 14. *Masdevallia bangii* Schltr. #2424 of a collection named *Plantae Bolivianae a Miguel Bang lectae.* Herbarium of Columbia University. Roy W. Squires.

Figure 15. *Scaphyglottis boliviana* Schltr. as *Scaphyglottis graminifolia* (Ruiz & Pav.) Poepp. & Endl. Photograph by Luis Pérez.

years, Bang worked as Curator of Municipal Parks in Cochabamba and remained active in gardening for the rest of his life. The date given for Bang's death is usually 1895, but there are specimens at Kew bearing his name and dated 1897 (Fig. 12).

Among the orchids collected by Bang, Schlechter described *Epidendrum miguelii* (Fig. 13), *Habenaria bangii*, *H. miguelii*, *Masdevallia bangii* (Fig. 14), *Pleurothallis dolichocaulon*, *P. rophalocarpa*, *Scaphyglottis boliviana* (Fig. 15), and *Zygopetalum bolivianum* (Fig. 16).

Rolfe had previously described a large number of species of Orchidaceae collected by Bang in Bolivia (Rusby 1907), amongst them: *Aganisia boliviensis, Epidendrum bangii*, *Masdevallia scandens* (Fig. 17), *Octomeria boliviensis*, *Pleurothallis britonni*, *Pterichis bangii*, and *Stelis bangii*.

Robert Statham Williams (1859–1945) (Fig. 18) is the last in our trilogy of collectors for the New York Botanical Garden. Williams was born in Minneapolis, Minnesota. An adventurous person and fascinated

FIGURE 16. *Zygopetalum bolivianum* Schltr. as *Zygopetalum intermedium* Lodd. ex Lindl. Photograph by Picasa.

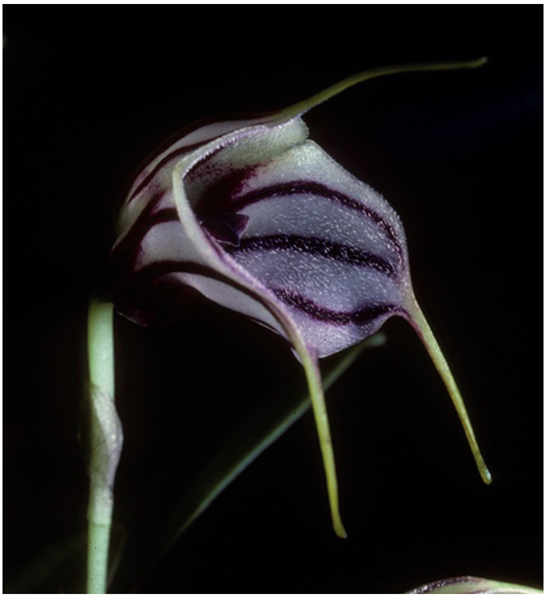


FIGURE 17. *Masdevallia scandens* Rolfe. Photograph by Rudolf Jenny.

by nature, he travelled to Montana as a young man, where, as a homesteader, he built the first cabin in what is today the city of Great Falls. He worked for twenty years as a businessman, miner and explorer and even served for short while as a rider for the Pony Express. It was during his time in Montana that he received a subvention from Columbia College, New York to collect bryophytes for Elizabeth Knight Britton.

In 1898, when the 'Gold Rush' began in the Yukon Territory in northwestern Canada, Williams joined one of the parties heading to the Klondike. He set himself up in business and made a small fortune. His spare time was spent collecting plants.

In 1899, Williams joined the newly created New York Botanical Garden, directed by Nathaniel Lord Britton (1859–1934). A few months later he brought his botanical collections to New York and, although the Museum Building was not finished and still lacked central heating, he spent the winter of 1899–1900 living and working in it. He would remain in the employment of the Botanical Garden until he died 45 years later.

In his early years with the Garden, he went on several botanical expeditions: Bolivia and Peru in 1901–1902, the Philippine Islands of Luzon and Mindanao in 1903–1905 and finally Panama in 1908. The rest of his life was spent studying mosses and publishing the results of his studies.

It is Williams' expedition to Peru and Bolivia which interests us here. It was significant as it was the first expedition to South America by a scientist on the staff of the New York Botanical Garden.

Martin Conway (1856–1937) (Fig. 19), a passionate British amateur naturalist and mountain climber, visited Peru and Bolivia in 1898–1900. He published a narrative of this expedition in 1901, under the title *Climbing and Exploration in the Bolivian Andes*. In it, he describes the journey from Lima to the Andes on the Oroya Railway (Fig. 20), and from there to Bolivia, where he climbed Mount Sorata and Mount Illimani.

With the idea of exploiting the country's vast mineral resources and its rubber production, he formed the Bolivia Company, which received the approval of the Bolivian Government to start operations in the country from 25 September 1900. Conway set up a team of British scientists to explore the Upper Amazon Basin in Eastern Bolivia but turned to the New York Botanical Garden for a botanical expert to form part of the expedition. Henry H. Rusby was involved in arranging the trip and Robert S. Williams was appointed to accompany the group. The number of plants later described by Rusby with the epithet *conwayi* suggests that Rusby was

Figure 18. Robert Statham Williams (1859–1945). In Dorr 1991: 12.

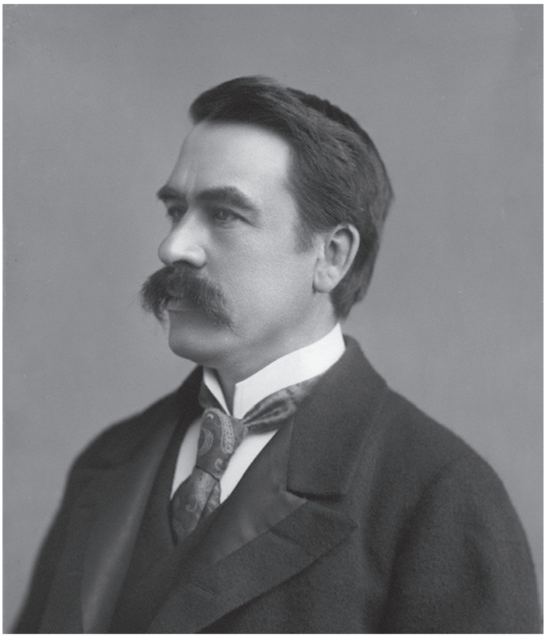


Figure 19. Sir Martin Conway (1856–1937). National Portrait Library.

Figure 20. Summit of the Oroya Railway. Photograph by M. Conway (1991: 48).

indebted to Conway. In later publications, Rusby often referred to Williams' trip as the "Conway Expedition".

Williams companions, namely, John W. Evans, geologist and head of the expedition, John Turle, mining engineer and G. N. Whatney, civil engineer, were all British subjects and members of the Bolivia Company. The group arrived at the Peruvian port of Mollendo on 4 August, 1901, took the train to Puno, crossed Lake Titicaca and continued by coach to La Paz, where they arrived on 14 August.

After two weeks in La Paz, planning for their first trip, the expedition went by mule over the Huallata Pass

FIGURE 21. Map of localities visited by Williams during his two trips. In Dorr, 1991: Figure 3.

(4300 m) to the town of Sorata, 2000 m lower. From Sorata they followed the main trail to Mapiri and on 11 September arrived in Tolapampa. Another two-day travel brought them to Mapiri, where their equipment was transferred to *cayapos* (rafts, created by lashing together a number of logs). In September and October, they floated down the Mapiri and Beni Rivers before arriving in San Buenaventura. Here they left the rivers, and after three long months of marching through the most difficult terrain arrived back in La Paz at the end of May 1902. This was Williams' first trip.

Here the party broke up: Evans and Whatney returned to London and only Turle remained with Williams in La Paz. At the request of the Bolivia Company, they went to the village of Apolo, northeast of La Paz, to Sorata again and keeping to the northwest of their first route returned to Apolo and thence to La Paz (Fig. 21). Williams was on his way back to New York by mid-October. In total, and according to his notebooks, Williams made 2981 numbered plant collections in Bolivia and Peru (Fig. 22).

In 1912 and again in 1922, Rudolf Schlechter described several new orchid species from Williams' botanical collections and named some in his honour: *Beloglottis boliviensis* Schltr., *Bulbophyllum bolivianum* Schltr. (Fig. 23), *Dichaea longa* Schltr. (Fig. 24), *Habenaria williamsii* Schltr., *Maxillaria boliviensis* Schltr., *Oncidium williamsii* Schltr., and *Trizeuxis andina* Schltr.

Williams is commemorated in botanical nomenclature by the genera *Williamsia* Merrill (1908) (Rubia-

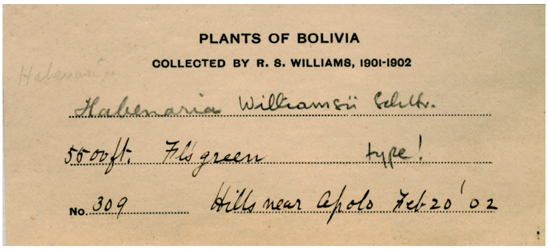


Figure 22. R. S. Williams' herbarium label. New York Botanical Garden.

Figure 23. *Bulbophyllum bolivianum* Schltr. as *Bulbophyllum weddelii* (Lindl.) Rchb.f. Photograph by Jay Pfahl.

Figure 24. *Dichaea longa* Schltr. Courtesy of Andreas Kay.

Figure 25. Otto August Buchtien (1859–1946). Archives of Rudolf Jenny.

ceae), and *Williamsiella* E. G. Britton (1909) (Pottiaceae), as well as by the names of many plant species.

Otto Buchtien (1859–1946) and Ernst Carl Franz Günther (1870–?) (collected 1906–1936, together with Günther 1923–1927)

"In 1922 I published my work on the orchid flora of Bolivia and I could write that the name of Dr. Buchtien would always be named in first place in the history of the botanical exploration of the country. After the here described new botanical successes, it becomes clear that nobody has ever done so much for the exploration of this Andean state". (Schlechter 1929: 28).

Otto August Buchtien (1859–1946) (Fig. 25) was born in Rostock, where he studied Natural History and Mathematics and received his doctorate in 1887. After working for a few years as a private teacher, in 1893 he travelled as a teacher to Chile, where he would stay for the following 13 years. He began his botanical collections in Valparaíso and continued to southern Chile (province of Valdivia). Another excursion took him over the Pass of Uspallata, at over 4000

FIGURE 26. Pass of Uspallata, ca. 1930

m (Fig. 26), to the Argentinian city of Mendoza and later to San Carlos de Bariloche, in the province of Rio Negro.

Buchtien collected a few terrestrial orchids in Chile and Argentina, among them *Codonorchis poeppigii* Lindl. from Valdivia (1887) (Fig. 27) and *Chloraea piquichen* Lindl. from San Carlos de Bariloche (1905). However, Buchtien's most important botanical collections were made after he was invited by the Government of Bolivia to organize the National Museum of Natural History in La Paz in 1906.

Covering almost 135,000 km^2, the Department of La Paz, one of the nine departments that form the Republic of Bolivia, extends from the heights of Lake Titicaca to the lowlands of the Amazon Basin. It has, therefore, a rich variety of climate and vegetation zones. As Director of the Museum, Buchtien had ample time to explore the region in all directions; during his thirty years in the country, he seldom ventured outside this area. He amassed a large collection of botanical specimens and from the first day the orchids were his favourites.

Albert Spear Hitchcock (1865–1935) (Fig. 28), a well-known botanist and specialist in grasses from Harvard University and the New York Botanical Garden, was sent to Peru and Bolivia in 1923 to study the grazing industry. In Bolivia he could not have found a better guide than Otto Buchtien, who he mentions in his report of the expedition (Hitchcock 1925).

One of Hitchcock and Buchtien's excursions took them to the region of the Yungas; Hitchcock wrote: "I had been in correspondence with Dr. Otto Buchtien, the well-known German botanist, long resident in Bolivia, who was then in southern Peru [Buchtien was at that time in Arequipa, on a collecting expedition with Ernst Karl Günther, see below]. I was fortunate in having his company on my next trip, which was to the Yungas, the montaña region lying to the north and east of La Paz

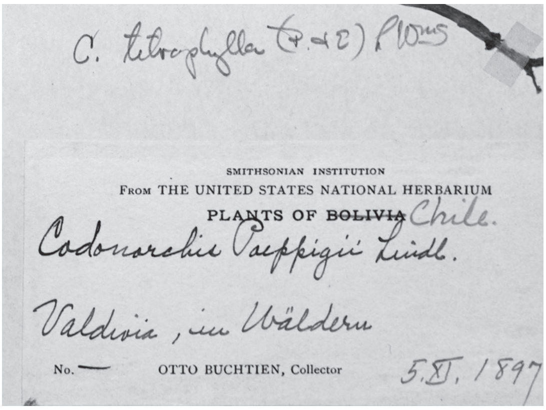


Figure 27. Buchtien herbarium label from Valdivia, Chile, 1897 (*Codonorchis poeppigii* Lindl.). United States National Herbarium.

over the eastern Cordillera. Sr. Aramayo, the director general of the Yungas railroad, aided very efficiently by furnishing passes for Dr. Buchtien and myself to Pongo and mules and a man for our trip through the Yungas […] Dr. Buchtien was widely acquainted in the region and we were able to stop at several plantations with his friends". Hitchcock had previously collected several orchids in British Guyana and Ecuador but no orchid specimens are known from his journey to Bolivia. He is remembered in *Epidendrum hitchcockii* Hágsater & Dodson and *Pleurothallis hitchcockii* Ames.

Buchtien's excursions were sponsored by the Ministry of Colonization, but when the available funds ran out in 1935 Buchtien had to abandon his position at the Museum, returning to Germany the following year. Perhaps through contacts established during the visit of Albert S. Hitchcock, Buchtien was able to sell his entire herbarium to the United States National Herbarium.

In 1910, Buchtien published an important work on the flora of the country, *Contribuciones a la Flora de Bolivia (Parte I)*. Further volumes were unfortunately never published. Only eleven orchid species were described here by F. Kränzlin, although Buchtien warned that at the time of publication many orchid specimens still awaited determination.

In 1908, Kränzlin described new species collected by Buchtien (*Neue und kritische Arten)* and again in 1928 (*Orchidaceae novae Bolivianae*).

Rudolf Schlechter determined an important number of Buchtien's orchids in 1912, under the title *Additamenta ad Orchideologiam Bolivianum,* which was followed in 1922 by additional specimens described in *Orchideenflora von Bolivia* and, posthumously, by *Orchidaceae Buchtienianae* in 1929.

Figure 28. Albert Spear Hitchcock (1865–1935). Unknown photographer.

Kränzlin and Schlechter described between them around one hundred and twenty new orchid species from Buchtien's collections. Among them, an important number were dedicated to Otto Buchtien; by Kränzlin: *Catasetum buchtienii* Kraenzl. (Fig. 29), *Cycnoches buchtienii* Kraenzl., *Houlletia buchtienii* Kraenzl., *Sigmatostalix buchtienii* Kraenzl. (Fig. 30), and *Xylobium buchtienianum* Kränzlin.

And by Schlechter: *Cyrtopodium buchtienii* Schltr. (Fig. 31), *Dichaea buchtienii* Schltr., *Encyclia buchtienii* Schltr., *Epidendrum buchtienii* Schltr., *Habenaria buchtienii* Schltr., *H. ottonis* Schltr., *Macradenia buch-*

FIGURE 29. *Catasetum buchtienii* Kraenzl. as *Catasetum barbatum* Lindl. Unknown photographer.

FIGURE 30. *Sigmatostalix buchtienii* Kraenzl. Archives of Rudolf Jenny.

FIGURE 31. *Cyrtopodium buchtienii* Schltr. as *Cyrtopodium virescens* Rchb. f. & Warm. Photographed *in situ* in Bolivia by José Luis Panozo.

FIGURE 32. *Buchtienia* sp. Photograph by Sylvio R. Pereira.

tienii Schltr., *Masdevallia buchtienii* Schltr., *Maxillaria buchtienii* Schltr., *Microstylis buchtienii* Schltr., *Notylia buchtienii* Schltr., *Octomeria buchtienii* Schltr., *Oncidium buchtienii* Schltr., *Physurus buchtienii* Schltr., *Pleurothallis buchtienii* Schltr., *Sobralia buchtienii* Schltr., *Stelis buchtienii* Schltr., and *Warmingia buchtienii* Schltr.

In addition, Schlechter described a new genus, which he named *Buchtienia*, with the type species *Buchtienia boliviensis* Schltr. (Fig. 32).

"A German merchant, Herr Günther, kindly took me under his wing and made me his guest during the time of my stay. He owns an India-rubber forest in the Mapiri district." (Conway 1901: 200). Ernst Carl Franz Günther (1870–?) (Fig. 33) had established himself in the 1890s in the village of Sorata, to the northeast of La Paz, where he bought the famous residence of the Richter family. Günther belonged to a class of rich merchants with interests in the rubber industry and in mining, among whom Günther and Otto Richter ranked among the most prominent. Ernst Carl Günther was the owner of the Hacienda San Carlos, a rubber plantation with over 200 workers. But he was also a successful merchant, and imported luxury goods from Europe to Bolivia, which involved transportation along dangerous roads from the Pacific port of Arica to the Bolivian highlands (Fig. 34).

Otto Buchtien must have met Günther in Sorata in the early 1920s. In 1922, Schlechter described *Dichaea buchtieni*, collected by Buchtien in San Carlos, Mapiri, undoubtedly a reference to Günther's hacienda. Herrera (1939: 28) mentioned that Günther and Buchtien collected in 1923 in the hills of Mollendo, near Areq-

Figure 33. Ernst Carl Günther (1870–?). Archives of Rudolf Jenny.

Figure 34. Road from Arica to La Paz, ca. 1910. Unknown photographer. Gismondi private collection.

uipa, Peru, which is coincident with Hitchcock's mentioning that Buchtien was in southern Peru at the time of his arrival in Bolivia (1923). And in his *Orchidaceae Buchtienianae* (1929), the majority of Buchtien's collections were labeled "Mapiri" or "San Carlos".

Buchtien was not only Günther's guest at Sorata, he also awakened in his countryman a love for nature and for orchids. In Buchtien's herbarium we find his own labels ("Dr. Otto Buchtien- Herbarium Bolivianum" (Fig. 35)) and a separate section of plants collected by Günther with the label "Ernesto Günther – Herbarium Bolivianum", but always with the note "legit. Buchtien" (Fig. 36). This was undoubtedly a special arrangement between Buchtien and Günther of which nothing further is known.

In the final months of 1898, Ernst Günther, in partnership with another German, Franz Rehder, founded the "Cervecería Alemana" ("German Brewery") in Arequipa, southern Peru. A long story of success followed, including the establishment of a new brewery, the "Cervecería Cusco", and the foundation of the "Corporación Cervesur" in 1926. Cervesur, managed by Günther's heirs, is today still in business and has become one of the most powerful corporations in Peru.

Despite his business commitments, Günther maintained his interests in Sorata and continued botanizing, organizing a very successful expedition in the first months of 1927, in the company of Otto Buchtien, to the district of Mapiri. The headquarters for this excursion was Günther's Hacienda San Carlos.

Several new orchid species were named in honour of Ernst Carl Günther. The first was *Pleurothallis guentheri* Schltr. (Fig. 37) collected around 1922–1923 and described by Schlechter in his *Orchidaceae Buchtenianae* in 1929.All others were described by Kränzlin because they were collected in the abovementioned expedition of 1927 after Schlechter's death; among them we find *Catasetum guentherianum* Kränzlin., *Epidendrum guentherianum* Kraenzl.. (Fig. 38), *Habenaria guentheriana* Kraenzl.., *Maxillaria guentheriana* Kränzlin., *Octomeria guentheriana* Kraenzl.., and *Stenoptera guentheriana* Kraenzl..

If you ever travel to Sorata, do not miss a visit to its town square. The city is proud of its beautiful gar-

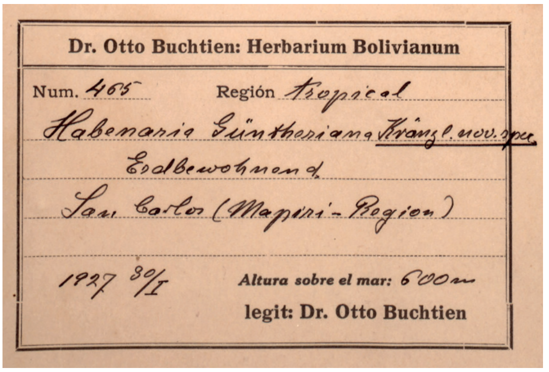

Dr. Otto Buchtien: Herbarium Bolivianum
Num. 465 Región tropical
Habenaria Güntheriana Kränzl. nov. spec.
Erdbewohnend
San Carlos (Mapiri-Region)
1927 30/I Altura sobre el mar: 600 m
legit: Dr. Otto Buchtien

FIGURE 35. Buchtien herbarium label, *Habenaria guentheriana* Kraenzl.

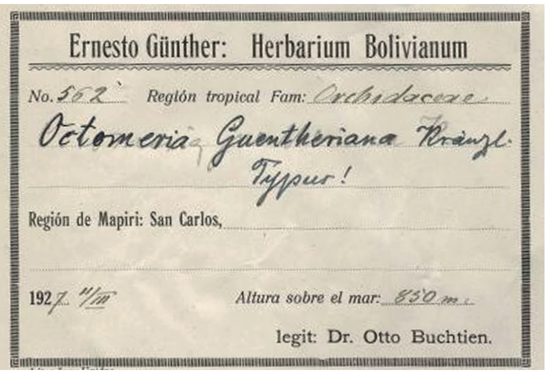

Ernesto Günther: Herbarium Bolivianum
No. 562 Región tropical Fam: Orchidaceae
Octomeria Guentheriana Kränzl.
Typus!
Región de Mapiri: San Carlos,
1927. 11/III Altura sobre el mar: 850 m.
legit: Dr. Otto Buchtien.

FIGURE 36. Günther herbarium label, *Octomeria guentheriana* Kraenzl.

FIGURE 37. *Pleurothallis guentheri* Schltr. (right) as *P. obovata* (Lindl.) Lindl. Xenia Orchidaeae, vol. 3: plate 247.

FIGURE 38. *Epidendrum guentherianum* Kraenzl. as *Epidendrum compressum* Griseb. Photograph by Ecuagenera.

dens. Once there, you will find on one of the corners an old, somewhat run-down but still beautiful building. It is the old mansion built by Otto Richter in the last decades of the 19th century and later acquired by Ernst Carl Günther; it is, therefore, better known nowadays as "Casa Guenther". It is today a boarding house named "Residencial Sorata"; a news reporter who once spent a holiday in the city called it "the hotel where history never sleeps" (Fig. 39).

Theodor Carl Julius Herzog (1880–1961) (collected 1907–1912)

Following a line of research like that of Dr. Otto Buchtien, Theodor Carl Julius Herzog (1880–1991) (Fig. 40) took upon himself the task of carefully studying and describing the different vegetation zones of Bolivia, especially in the regions on the eastern slopes of the Andes.

Figure 39. "Casa Guenther" in Sorata. In the foreground the gardens of the townsquare. Unknown photographer.

Herzog visited Bolivia twice. An Argentinian railroad company ('Sindicato del Ferrocarril del Oriente Boliviano') invited him in 1907 to take part as botanist in an otherwise purely economic expedition through eastern Bolivia. He took ship from Buenos Aires in March of that year to cross Paraguay to the Brazilian-Bolivian border at Puerto Suárez. He continued for several months through the province of Chiquitos until arriving in Santa Cruz in the month of June. He then travelled north to the Río Blanco, where he would report that the expected rubber and cinchona trees where not to be found. Having thus fulfilled his mission, he returned over the route from Cochabamba and Oruro to the Pacific port of Antofagasta. After travelling to Buenos Aires to deliver his report to the railroad company, he returned to Germany in February 1908.

His second expedition, this time financed by himself, extended from September 1910 to January 1912. Herzog travelled from Buenos Aires by train to Ledezma, the endpoint of the Argentinian Railroad, and continued on the Pilcomayo River over Villa Montes and Charagua to Santa Cruz, arriving in December 1910. He made Santa Cruz his headquarters for several months and explored the forest in the vicinity of the city until March 1911, when he left for Cochabamba (Fig. 41) to again explore the Cordilleras surrounding the city.

In September 1911, while in Cochabamba, Theodor Herzog met C. Seelig, a friend from Zürich - like Herzog an accomplished mountain climber - to explore the Cordillera of Quimsa Cruz, southeast of Lake Titicaca. Together, Herzog and Seelig climbed several Bolivia's highest peaks (Fig. 42).

In the first days of November, Herzog, back in La Paz, ended his expedition. He then travelled over Oruro again to Antofagasta, before returning to Germany with magnificent botanical collections in January 1912. The botanical results of Herzog's second Bolivian adventure were published in 1923 as *Die Pflanzenwelt der bolivianischen Anden und ihres östlichen Vorlandes* (= The vegetation of the Bolivian Andes and their eastern foreland) (Herzog 1923, Schlechter 1922: 12, Mägdefrau 1962: 74). Orchids in this work are mentioned only in a very general way as lists of those genera that can be found in the different vegetation zones.

Rudolf Schlechter described 29 new orchid species collected by Herzog in Bolivia in the second part of his *Additamenta ad Orchideologiam Bolivianam* in 1913. Schlechter's descriptions of Herzog's orchids continued

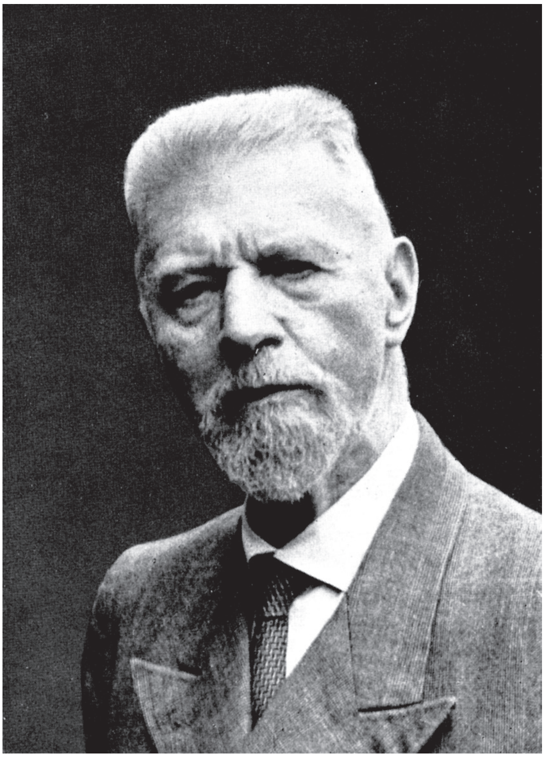


Figure 40. Carl Julius Theodor Herzog (1880–1961). From Mägdefrau, 1962: 76a.

in 1916 and were published in Leiden as *Die von Dr. Th. Herzog auf seiner zweiten Reise durch Bolivien in den Jahren 1910 und 1911 gesammelten Pflanzen* with the descriptions of 31 new orchids. We find again Herzog's orchids in 1922 in Schlechter's vol. V (Bolivia) of his *Orchideenfloren der Südamerikanischen Kordilleren-staaten*; an additional species, *Sarcoglottis herzogii*, was published in 1925 in Schlechter's long series *Orchidaceae novae et criticae* (Schlechter 1925). Over 60 new orchid species were collected by Herzog in Bolivia.

The greater part of Herzog's botanical collections was made in the provinces of Santa Cruz and Cochabamba (Fig. 43), on the eastern slopes of the Andes descending to the Amazon basin, at elevations between 250 and 3000 m.

Schlechter named a dozen new orchid species in honour of Theodor Herzog: *Epidendrum herzogii* (Fig. 45), *Habenaria herzogii*, *Masdevallia herzogii* (Fig.46), *Neodryas herzogii* (Fig. 47), *Oncidium herzogii* (Fig. 48), *Pachyphyllum herzogii*, *Physosiphon herzogii*, *Physurus herzogii*, *Pleurothallis herzogii*, *Sarcoglottis herzogii*, *Sobralia herzogii*, and *Stelis herzogii*. Carlyle Luer followed suit in 1998 with *Lepanthes herzogii*.

All of Herzog's new orchid species were collected during his second journey to Bolivia. His her-

Figure 41. Tramway in Cochabamba, ca. 1910. Photograph by Adolfo T. Zamudio.

Figure 42. Cordillera of Quimsa Cruz – Unknown photographer.

Figure 43. Valley of Cochabamba. Photograph by 'rafapc.'

FIGURE 45. *Epidendrum herzogii* Schltr. as *Epidendrum secundum* Jacq. Photograph by Jay Pfahl.

FIGURE 47. *Neodryas herzogii* Schltr. Photograph by Eric Hunt.

FIGURE 46. *Masdevallia herzogii* Schltr. as *Masdevallia bicolor* Poepp. & Endl. Unknown photographer.

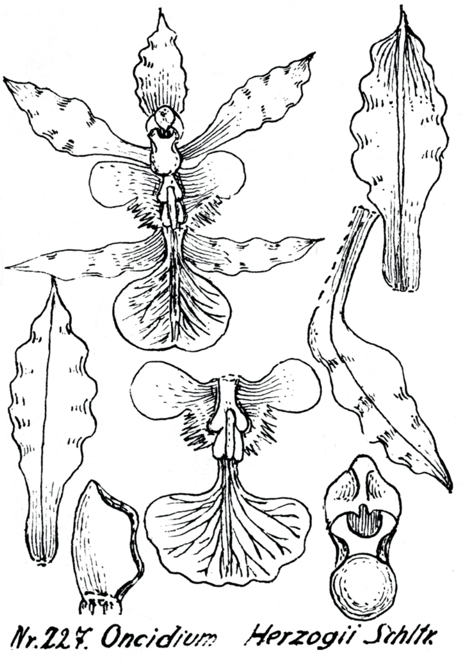


FIGURE 48. *Oncidium herzogii* Schltr. Analytical drawing by Schledchter in Schlechter & Mansfeld, 1929, plate 58, illustration 57.

Figure 49. *Cyrtopodium pflanzii* Schltr. From F. Hoehne's *Flora Brasilica*, plate 13.

Figure 50. *Encyclia pflanzii* Schltr. Photograph by Cecilia Kramer.

barium labels read: '*Plantae in itinere secundo per Boliviam lectae*'.

Theodor Herzog moved to Zürich in 1914, where he worked during World War I (WWI) as a private lecturer. In 1920, he was offered a position as Professor of Botany at the University of Munich, the place where he had received his doctorate in 1903. Finally, from 1925 to his retirement in 1948, he held the chairs of Botany and Bryology at the Friedrich-Schiller University in Jena. He passed away in Jena on 6 May 1961.

Karl Pflanz (1872–1925) (collected 1907–1925)

A relatively minor figure in this story, Karl Pflanz (1872–1925) belonged to the category of amateur botanists to whom Rudolf Schlechter so often resorted to obtain new orchid material from South America. Born on the island of Rügen, off the German Baltic coast, he was the son of a wealthy factory and farm owner. He worked as a merchant in Berlin, Paris, London and Hamburg before travelling to Mexico, where he worked on several cattle farms and coffee plantations. In 1904, he continued to Argentina to study cattle-breeding and took a position with an Argentinian-Chilean trading company in 1905. He travelled widely through Argentina and southern Chile before moving to Bolivia in 1906. In 1915, he was appointed German vice-consul in Villa Montes, in the department of Tarija in southern Bolivia. At the same time, he became a partner of the German trading company Staudt & Co. During the period of inflation after WWI, he established a foundation in Germany which sponsored young researchers in botanical studies.

Karl Pflanz made botanical collections in Argentina and Bolivia which mostly went to the Botanical Museum in Berlin. He drowned on 20 April 1925 while crossing the Río Piedras near Salta, Argentina. His last botanical collection consisted of 150 herbarium specimens from Villa Montes, received in Berlin a few months before his death (Anonymous 1825, Frahm & Eggers 2001).

Among Pflanz's botanical specimens, Rudolf Schlechter determined three new orchid species, all named in his honour: *Catasetum pflanzii*, *Cyrtopodium pflanzii* (Fig. 49), and *Encyclia pflanzii* (Fig. 50).

Figure 51. José Steinbach (1875-1930). Archives of the Steinbach family.

Figure 52. Amboro National Park. Unknown photographer.

Joseph (José) Steinbach (1875–1930) (collected 1913–1929)

José (Joseph) Steinbach (1875–1930) (Fig. 51), from the city of Lindlar, in the German state of North-Rhine Westphalia, went to South America in 1902, a member of a scientific expedition from the Museum of Sciences of the German Empire sent to explore northern Argentina. After two years he continued alone to Bolivia with the purpose of collecting objects of natural history, especially flora and fauna, and he would spend the next 25 years restlessly exploring that country. He established himself in the small village of Buena Vista, in the lowlands of the department of Santa Cruz, today the gateway to beautiful Amboro National Park (Fig. 52).

Steinbach, besides working as a farmer and cattle rancher, made a living by selling his natural history collections to museums and university herbaria around the world. Among his large botanical collections, more than 30 species were dedicated to him, including several orchids. He also collected zoological specimens in large numbers; the Carnegie Museum of Natural History in Pittsburgh acquired some 3000 bird skins from him in 1920. Steinbach's large collections remaining in Bolivia formed the basis of the Museum of Natural History in Cochabamba in 1930 (founded just before his death at the early age of 56); this comprised around 100,000 insects, a herbarium of 5000 different plant species, 800 birds, 140 reptiles and 100 mammals.

Having decided to spend the rest of his life in Bolivia, Steinbach married a Bolivian lady, Juana Moreno Jiménez, and raised a family of nine children. The family name is still well known in the country.

Steinbach gained considerable recognition both in Europe and the United States and corresponded extensively with scientists at the institutions to which he sent his collections. He became a member of the North American National Geographic Society in Washington, the Carnegie Museum of Pittsburgh and the American Museum of Natural History in New York.

The following orchid species were dedicated to José Steinbach: *Encyclia steinbachii* Schltr. (Fig. 53), *Epidendrum steinbachii* Ames (Fig. 54), *Fernandezia steinbachii* Ormerod., and *Stelis steinbachii* Luer. An avenue in the Bolivian city of Santa Cruz was named after him 'Avenida José Steinbach'.

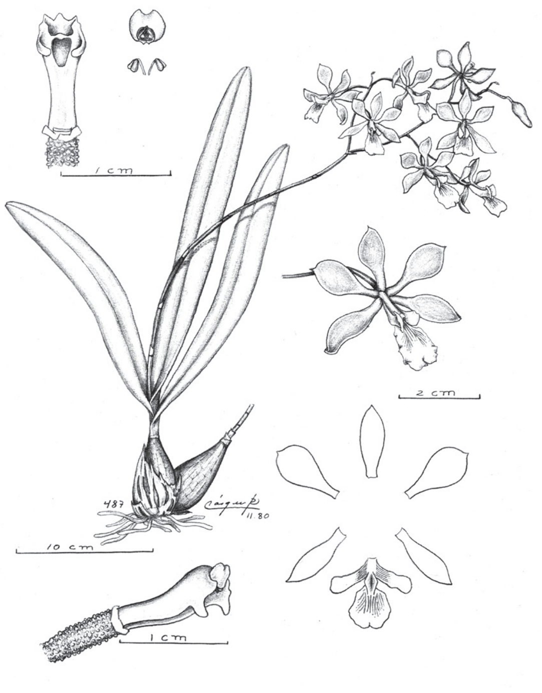


FIGURE 53. *Encyclia steinbachii* Schltr. Icones Plantarum Tropicarum, ser.2, vol.4, 1989, plate 323.

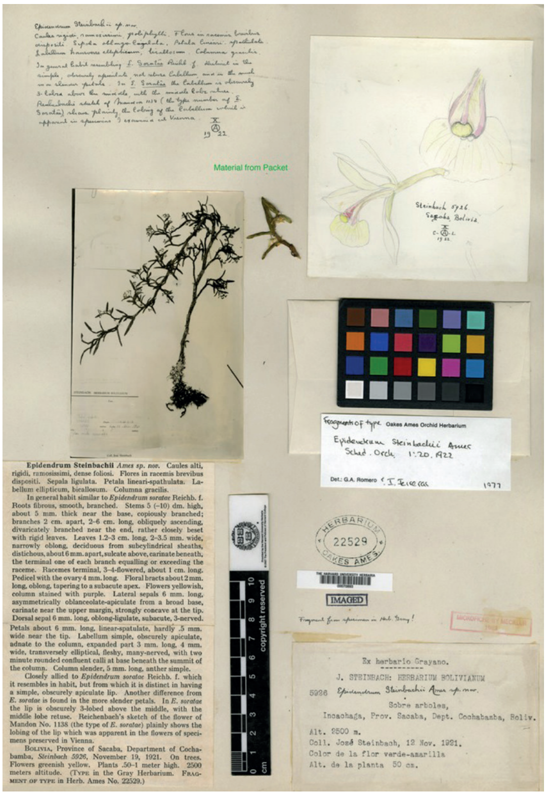


FIGURE 54. Holotype of *Epidendrum steinbachii* Ames. Harvard University Herbaria.

Paraguay

Paraguay and Bolivia are the only landlocked South American countries. Paraguay borders Brazil (north and east), Argentina (south) and Bolivia (north and west). The Paraguay River, which flows from north to south, divides the country into distinct eastern and western regions that gently slope toward the Paraguay River. The eastern region, known as the *Paraneña*, extends from the Paraguay to the Paraná River, which forms the border with Brazil and Argentina. It is home to about 95% of Paraguay's population and is a mixture of plateaux, rolling hills and fertile valleys. Most of the region lies below 300 m elevation with a few higher points reaching 700 m near the northern border with Brazil. Dense forests cover the plateau of Alto Paraná, which occupies about one third of the region and extends to the east to the Paraná River. The Saltos del Monday (= falls of the Monday River, a tributary of the Paraná) (Fig. 55), are one of its most attractive geographic landmarks.

The western region, the Chaco Plain or *Gran Chaco*, is a tract of flat and infertile scrub forest. Along the banks of the rivers there are grassy plains and clumps of palms, but the land becomes drier toward the west and is almost desert in the northwest. It is divided among eastern Bolivia, western Paraguay, northern Argentina and a portion of the Brazilian states of Mato Grosso and Mato Grosso do Sul, where it is connected to the *Pantanal*, the world's largest wetland area, the main part of which is located in Brazil but it extends into Paraguay and Bolivia (Fig. 56).

Paraguay straddles the Tropic of Capricorn and experiences both tropical and subtropical climates.

BOTANICAL EXPLORATION 1757–1885: Paraguay's geographical location, far from all trade and exploration routes during the 17th and 18th century, is the reason for it being virtually botanically unknown until the last decades of the 19th century. As to orchids, probably the earliest description of a new Paraguayan species was

Figure 55. Saltos del Monday, Department of Alto Paraná, Paraguay. Photograph by Dennis García.

Figure 56. The ‘Pantanal’. Photograph by Adriano Gambarini.

Figure 57. *Spiranthes paraguayensis* Rchb.f. as *Skeptrostachys paraguayensis* (Rchb. f.) Garay. Phorotograph by Julio Omar Barcala.

Figure 58. Emil Hassler (1864–1937). In Hochreutiner, 1939.

Reichenbach's *Spiranthes paraguayensis* (Reichenbach *f*. 1852: 230) (Fig. 57).

The first scientific explorer of Paraguay was Louis Antoine de Bougainville (1729–1811), who had to interrupt his circumnavigation of the globe in 1767 in the port of Montevideo, where one of his ships had to undergo repairs. He used the time to visit Paraguay and the Jesuit missions. A member of Bougainville's expedition was the French botanist Philibert Commerson (1727–1773), who would later discover some new orchids in Patagonia. Aimé Bonpland (1773–1858), Humboldt's companion during their famous expedition across northern South America, settled in the province of Mendoza in 1816, when it was a territory disputed by Argentina and Paraguay. Bonpland would dedicate himself mainly to the cultivation of *yerba mate* (*Ilex paraguariensis* A. St.-Hil.), still today the favourite drink of Paraguayans, Argentinians and Uruguayans. He remained in the region until his death in 1858. Agustin de Saint Hilaire (1799–1853) arrived in Rio de Janeiro in 1816 and remained in South America until 1821. During this time, he made several excursions to Paraguay and Uruguay, bud did not collect any new orchid species. After returning to France, Saint Hilaire published his *Histoire des plantes le plus remarquables du Brésil et Paraguay* (= History of the most noteworthy plants of Brazil and Paraguay) (Saint-Hilaire 1824). Unfortunately, only one of two planned volumes was ever published, and we must assume that the family Orchidaceae would have been included in the second one. Finally, Alexander Caldcleugh (1795–1858), merchant, miner, botanist and mineralogist, travelled across Brazil, Argentina, Uruguay, Paraguay, Chile and Peru between 1819 and 1821. No botanical collections from him are known from Paraguay.

Hassler, Emil (1861-1937) (collected 1895-1937)

Born in Aarau, in Swiss-German-speaking Switzerland, Emil Hassler (1861–1937) (Fig. 58) attended the elementary and secondary schools of his hometown and afterwards studied medicine in France. Before finishing his studies, he moved to Brazil, where he obtained his degree at the University of Rio de Janeiro (Hochreutiner 1939: 1). In 1884, he began practicing medicine in Cuiabá, the capital city of the state of Matto Grosso, where he soon began exploring the region pursuing his initial ethnographical interests. After three years in Cuiabá, Hassler moved to Paraguay in

FIGURE 59. Emil Hassler (1864–1937) in 1914. Photograph by R. Chodat.

FIGURE 60. From left to right: R. Vischer, E. Hassler, R. Chodat in Paraguay (1914). Unknwon photographer.

1887 to take a position as a physician at a hospital in San Bernardino, near the capital Asunción.

Hassler's interests soon turned to botany and his first collections were made in 1895 and 1896 (Vischer 1938). After a short interlude in Switzerland, he returned in 1897 to Paraguay settling in San Bernardino, where he built his first house in a suburb popularly known as the *Bierschlucht* (= Beer canyon) as it mostly housed German immigrants. He travelled regularly to Switzerland, where in 1898 he published the first part of his series *Plantae Hasslerianae* in the *Bulletin de l'Herbier Bossier* (Geneva); further parts were published through 1907 (Chodat & Hassler 1898).

Hassler's plants were determined by Robert Hippolyte Chodat (1865–1934), a Swiss botanist and phycologist, who was director of the botanical institute at the University of Geneva. Chodat established a close personal relationship with Hassler that lasted to the end of his life. In his botanical excursions, Hassler always travelled with his assistant Teodoro Rojas and often with German botanist Cornelius Osten. We will read of both further on in this chapter.

An important milestone in Hassler's life was the visit of Robert Chodat and his assistant William Vischer to Paraguay, in what was known as the *Mission scientifique Suisse au Paraguay*. Hassler had returned in the meantime to Switzerland but was happy to join his friends. From July 1914, over the following three months, Hassler, Chodat and Vischer explored the country in all directions (Fig. 59–60). They returned to Switzerland with a rich botanical collection which, as with most of Hassler's plants, was deposited at the herbarium of the Conservatory and Botanical Garden in Geneva.

In 1919, after WWI, Hassler returned to Paraguay, built a new home in San Bernardino, which he named *Villa Mon Repos* ('My resting place'); he would remain there for the rest of his days (Fig. 61) apart from occasional trips to Switzerland on short visits for scientific or medical purposes.

In 1921, Hassler took part in the foundation of the *Sociedad Científica del Paraguay* (Scientific Society of Paraguay), of which he became honorary President. In 1932, during the Chaco war between Paraguay and Bolivia, he established and directed a hospital for the wounded in San Bernardino and was awarded the honorary rank of a Colonel in the Paraguayan army. The hospital was closed in 1935 at the end of the war. Emil Hassler returned one last time to Switzerland before he died two years later in Asunción. He is buried in the cemetery of San Bernardino.

Figure 61. Hassler's *Villa Mon Repos* in 1987, two years before being demolished. Photograph by Lorenzo Ramella.

It is estimated that 90% of Paraguay's botanical species are represented in Hassler's collections. About 13,000 different species can be found there, with a total of some 60,000 specimens. Hassler's botanical collections constitute, without doubt, the foundation of scientific knowledge of the flora of Paraguay. A complete catalogue of these collection, including other collectors' related specimens from Paraguay, have been published as *Catalogus Hasslerianus* (Ramella & Perret 2008–2010); this includes many new species published in the *Plantae Hasslerianae* as well as in subsequent publications by Emil Hassler and others. Hassler's specimens were extremely well prepared and include all parts necessary for identification.

The Herbarium of the Geneva Conservatorium and Botanical Garden holds a total of 18,263 botanical specimens collected by Emil Hassler in Paraguay. Of these, a surprisingly low number are Orchidaceae: only 371 orchid specimens. However, 19 of these orchid specimens represent species which were new to science, 10 of which were named in honour of Hassler. They were mostly described by Alfred Cogniaux but a few of them were contributions by Rudolf Schlechter.

For 160 years Paraguay was a possession of the order of the Jesuits. They named it in Spanish 'Provincia Paraguaria' (in Latin *Paraqvaria*) and it was one of the southernmost provinces of the Viceroyalty of Perú. A beautiful map of the province was made in Rome by Giovanni Petroschi (1715–1766), which was dedicated to Francisco Retz (1673–1750), Superior General of the Society of Jesus. It bears the Latin inscription *Provincia Paraquariæ Soc, Jesu, anno 1732* (Fig. 62).

Figure 62. Map of the Jesuit Province of Paraguaria, 1732, by Giovanni Petroschi.

The name 'Paraguaria' has been used in scientific circles up to the present, and this is the reason for Hassler labelling his botanical specimens as *Plantae Paraguariensis* (Fig. 63).

Emil Hassler's new orchid species include: *Campylocentrum hasslerianum* Hoehne, *Cranichis hassleri* Cogn., *Epidendrum hassleri* Cogn. (Fig. 64), *Galeandra paraguayensis* Cogn. (Fig. 65, 66), *Habenaria amambayensis* Schltr. (Fig. 67), *H. hassleriana* Cogn. (Fig. 68), *H. integripetala* Cogn., *H. subfiliformis* Cogn., *Oncidium emilii* Schltr., *Oncidium hassleri* Cogn. (Fig. 69), *Pogonia hassleriana* Cogn. ex Chodat & Hassl., *Ponthieva hassleri* Schltr., *Sarcoglottis hassleri* Schltr., *Spiranthes hassleri* Cogn., *Stenorrhynchos albicans* Cogn., *S. pedicellatus* Cogn., *S. vaginatus* Cogn., *S. ventricosus* Cogn., and *Zygopetalum hasslerianum* Kränzlin.

Karl August Gustav Fiebrig (1969–1951) (collected 1902–1951)

Kränzlin was responsible for sowing some confusion when he published his *Orchidaceae andinae imprimis peruvianae Weberbauerianae* in 1906. It is only

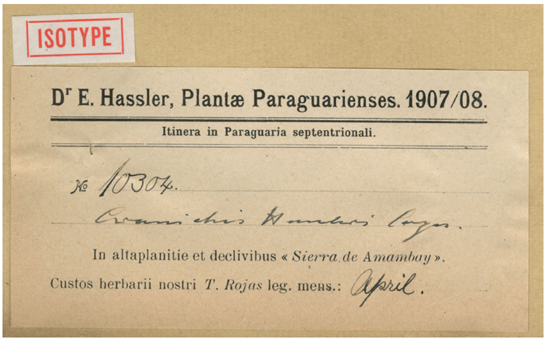


FIGURE 63. *Cranichis hassleri* Cogn. Hassler herbarium label, *Plantae paraguariensis* 1907–1908. MNHN Paris.

FIGURE 64. *Epidendrum hassleri* Cogn. Photograph by M.A. Campacci.

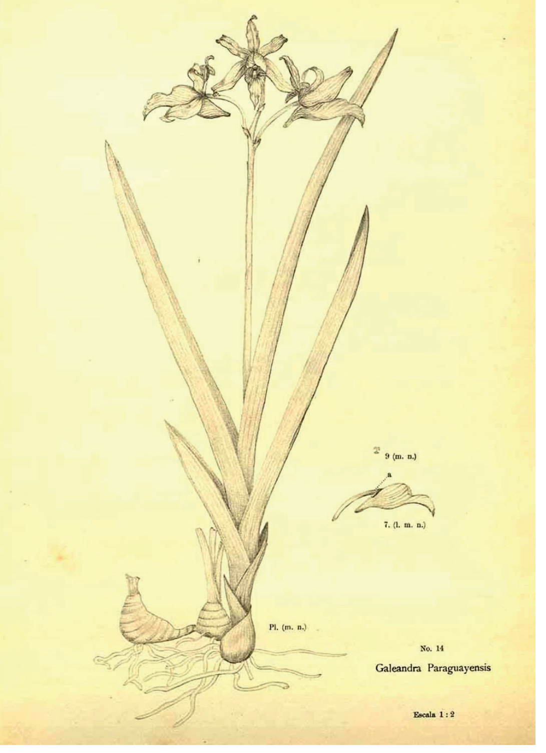


FIGURE 65. *Galeandra paraguayensis* Cogn. Drawing by F. Hoehne.

by chance that the reader will find in this article not only the description of new orchid species that were not collected by Weberbauer, but that were not even collected in Peru! Together with Weberbauer´s orchids we find five new species collected by Karl August Gustav Fiebrig (1902–1951) (Fig.70) in southern Bolivia.

Fiebrig studied natural history in Berlin under Adolf Engler, and it was Engler who sent him to South America in 1902 on a scientific expedition on behalf of the Botanical Garden and Museum of Berlin (Schuurmans Stekhoven 1955: 151). Fiebrig travelled across Paraguay to southern Bolivia, where he made his botanical collections. He also made important observations on the phytogeography of Bolivia, which he would publish in 1911 as *Ein Beitrag zur Pflanzengeographie Boliviens* (‘A contribution to the geography of plants in Bolivia’) (Fiebrig-Gertz 1911); this would serve Rudolf Schlechter in his description of the Bolivian orchid flora (Schlechter 1922). Like Kränzlin before him, Schlechter described seven new orchid species from Fiebrig’s Bolivian collections.

Amongst Fiebrig’s Bolivian orchids, described by Kränzlin, are: *Chloraea boliviana*, *C. calantha*, *C. fiebrigiana*, *C. ignea*, and *Stenoptera elegans*. Schlechter described *Aa fiebrigii*, *A. microtidis*, *A. sphaeroglossa*, *Galeandra fiebrigii* (Fig. 71–72), *Habenaria bermejoensis*, *H. leptantha*, *Liparis otophyllon* (Fig. 73), *Pelexia fiebrigi*, and *Pterichis boliviana* as new to science.

Afflicted by tuberculosis, Fiebrig remained in South America and moved to San Bernardino, in Paraguay, where he would live and work over the next thirty years.

Figure 66. Holotype of *Galeandra paraguayensis* Cogn. Herbarium of the Belgian National Botanical Garden.

Figure 67. *Habenaria amambayensis* Schltr. Photograph by G. Léotard.

The year 1910 was pivotal in determining his professional future. He received two offers simultaneously: the first was to work in East Africa for the German Colonial Office; the second, the Government of Paraguay offered him a chair at the 'Colegio Nacional' and at the Faculty of Medicine. Fiebrig decided to accept the Paraguayan offer, moved especially by an additional proposal by Paraguay's President, D. Manuel Franco, to establish a Botanical Garden and Zoo in the suburb of Trinidad, in Asunción, the capital.

The garden, designed in collaboration with his wife Anna Gertz, was finally inaugurated and opened to the public in 1914, during the Presidency of Eduardo Schaerer. It encompassed over 600 hectares and became soon a popular attraction (Fig. 74). Fiebrig gave the garden the Guaraní name *Yboty rendá*, 'the place of flowers', and remained in his position as Director until 1936. The University of the German city of Marburg awarded him an honorary doctorate in 1923 for his work in South America.

On the premises of the Botanical Garden stood the second residence of Carlos López, the original owner of the land. This was built around 1860 as a two-story structure called 'la Casa Alta' (the high house) (Fig. 75), to differentiate it from the original house built ca. 1845, a single-story structure aptly known as 'la Casa Baja' (the low house). While the 'Casa Baja' today houses the Natural History Museum, the 'Casa Alta' was occupied by the Herbarium, the collection of plants in spirits, and offices where Fiebrig, Hassler and Teodoro Rojas worked. It was also Fiebrig's residence. He contributed to the herbarium with a large collection of plants from Paraguay and neighbouring countries. In the following years the collections were

FIGURE 68. *Habenaria hassleriana* Cogn. Photograph by Martín Caballero.

FIGURE 69. *Oncidium hassleri* Cogn. as *Gomesa longipes* (Lindl.) M.W. Chase & N.H. Williams.

enriched by the contributions of Teodoro Rojas and Cornelius Osten.

For a short period, from 1934 to 1936, Fiebrig was also Director of the Paraguayan Department of Agriculture. He gave up this position to return to Germany as professor at the 'Ibero-Amerika Institute' in Berlin. After the war, in 1948, he returned to South America to work at the 'Instituto Miguel Lillo', a branch of the National University at Tucumán, Argentina, where he died on 25 October 1951.

FIGURE 70. Karl August Gustav Fiebrig (1869–1951). At the Ibero-America Institute in Berlin around 1940. Unknown photographer.

Karl Fiebrig's botanical work in Paraguay concentrated mainly of the expansion and consolidation of the Botanical Garden in Asunción. He certainly contributed to the flora of Paraguay with large numbers of herbarium specimens; there were, however, very few new species among them (Fig. 76). The International Plant Names Index shows only five plant species described by Fiebrig.

As to orchids, both the Geneva Herbarium and Ratmella & Perret's *Catalogus Hasslerianus* (vol. 1, 2008) show over a hundred orchid specimens collected by Fiebrig. Despite this, there was only one new orchid collected by him, originally described by Slazchetko (1995) as *Pelexia collocaliae* (Fig. 77).

Karl Fiebrig's *magnum opus*, a 2700 page-long manuscript on the vegetation of South America, remained unpublished after his death.

Teodoro Rojas Vera (1877–1954) (collected 1902–1954)

Born in Asunción, Teodoro Rojas Vera (1877–1954) (Fig. 78) was the son of Jose M. Rojas and Dolores Vera. He studied at national schools in Pilar and Limpio, near San Bernardino. After failing to gain admittance at the Colegio Nacional in Asunción, he returned to San Bernardino, where he worked at the local German Brewery.

In 1887, when Emil Hassler moved to work at the hospital in San Bernardino, Teodoro's mother went

Figure 71. Herbarium label of an isotype of *Galeandra fiebrigii* Schltr. Fiebrig determined this plant as *Galeandra beyrichii* Rchb. f. Royal Botanic Gardens Kew. The collection is from Fiebrig's first South American excursion to Bolivia.

Figure 72. *Galeandra fiebrigii* Schltr. as *Galeandra beyrichi* Rchb.f. Photograph by Luis Filipe Varela.

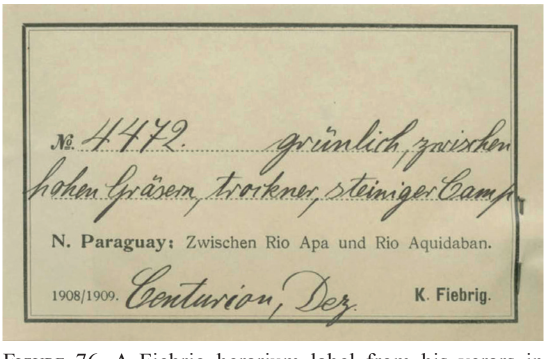
Figure 73. Isotype of *Liparis otophyllon* Schltr. Herbarium, Royal Botanic Gardens Kew.

to work as his housemaid and Teodoro, then only 11 years old, was hired by Hassler as gardener. This was the beginning of a long and close relation between the Swiss scientist and Teodoro Rojas, who would become one of Paraguay's most relevant botanists.

Ten years later, in 1897, Teodoro was invited by Hassler, then in Geneva, to study herbarium techniques at the Geneva Conservatorium and to research the large collections of the herbarium. He learned German and it is said that he always spoke it with a strong Swiss accent. After returning to Paraguay, he accompanied Hassler on numerous botanical expeditions across the country. His first herbarium specimens were prepared in 1906, during his participation in the Argentinian-Paraguayan Pilcomayo River Border Commission (Fig. 79).

Figure 74. Rose garden at the Botanical Garden in Asunción ca. 1920. In Junta Municipal de la ciudad de Asunción, 2014: 39. Unknown photographer.

FIGURE 75. ‘La casa alta’ (the high house). In Junta Municipal de Asunción, 2014: 12. Unknown photographer.



№ 4472 grünlich, zwischen hohen Gräsern, trockner, steiniger Camp

N. Paraguay: Zwischen Rio Apa und Rio Aquidaban.

1908/1909. Centurion, Dez. K. Fiebrig.

FIGURE 76. A Fiebrig herarium label from his yerars in Paraguay.

Teodoro Rojas collected for Hassler and took part in the botanical excursions with R. Chodat and W. Vischer in 1914. In 1915, he accompanied Cornelius Osten, a German botanist residing in Montevideo, on a long excursion along the Paraná River and to the Iguazú Falls.

In 1916, he was offered the position of Chief of the Botanical Section at the Botanical Garden of Asunción, of which Karl Fiebrig was the first director. Rojas organized the herbarium, including those of Hassler, Fiebrig and his own collections. While Fiebrig lived in the ‘Casa Alta’ of the Botanical Garden, Rojas moved with his family into a modest house only a few blocks away (Fig. 80).

Rojas continued exploring the country and increased his botanical collections, although the Botanical Garden entered a period of decline as a result of a series of military interventions that led to continuous changes in the Government of Paraguay. His career was overshadowed by military administrators. Fiebrig was deposed from the directorship and left Paraguay in 1936, never to return. In 1944, Teodoro Rojas moved to Argentina, where he worked for the Instituto Miguel Lillo, in Tucumán; he would be joined in 1948 by Karl Fiebrig.

Near the end of his life, Rojas returned to Paraguay, where in 1952 he was awarded the title of Doctor *Honoris Causa* by the University of Asunción. He passed away in Asunción on 3 September 1954. Since 1993, the scientific journal of the Department of Botany of the National University of Asunción carries de name *Rojasiana* in his honour.

A total of 79 orchid specimens collected by Rojas are deposited at the Geneva Herbarium as collected by ‘E. Hassler & T. Rojas’; among them is the type speci-

Figure 77. Type of *Pelexia collocaliae* Szlach. Herbarium oif the Geneva Consdervatorium and Botanical Garden.

men for *Epidendrum hassleri* Cogn. (Fig. 81). The last line at the bottom of the label reads in Latin: *Custos herbarii nostrii T. Rojas leg*. *mens April*, which translates as 'The curator of our herbarium T. Rojas collected this in the month of April'.

Other new orchids collected by Rojas and dedicated to him were *Bulbophyllum rojasii* L.O.Williams (Fig. 82), *Epidendrum rojasii* Cogn. (Fig. 83), *Microchilus rojasii* Ormerod, and *Vanilla rojasiana* Hoehne (Fig. 84) (Schinini 2005, 2010).

The Southern Cone

The Southern Cone (Fig. 85) is a geographic and cultural region, composed of the republics of Argentina, Chile and Uruguay, and in its broadest definition also Paraguay and the southernmost states of Brazil. The territory is located mostly south of the Tropic of Capricorn; to the west is the Pacific Ocean, and on the east is the Atlantic Ocean.

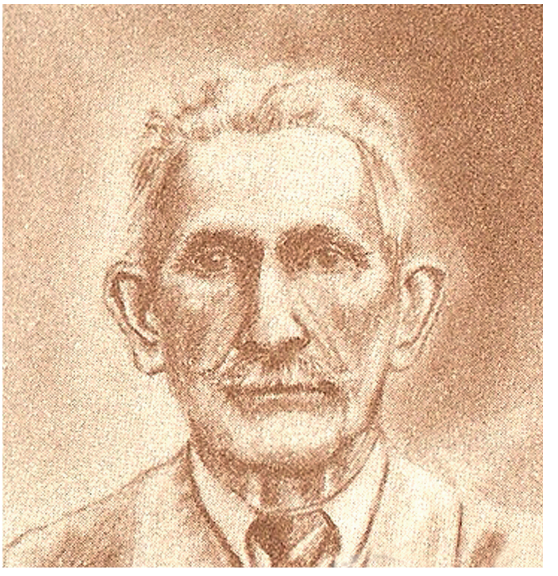


Figure 78. Teodoro Rojas Vera (1877–1954). Unknown artist.

Figure 79. Pilcomayo River. Unknown photographer.

In this chapter we will consider the Southern Cone in its strict definition, and include only Chile, Argentina and Uruguay because all other South American countries have been covered in this and the previous chapters of the series.

Geography: The southern cone of South America, with its tip pointed towards Antarctica, is a region of over 1.5 million square miles (more than 4 million km^2) that includes territory in the republics of Chile, Argentina and Uruguay. The Tropic of Capricorn crosses it in the north. By virtue of its position, it contains high western lands and low eastern lands of middle latitudes, with a

FIGURE 80. Teodoro Rojas and family in the Botanical Garden. Unknown photographer.

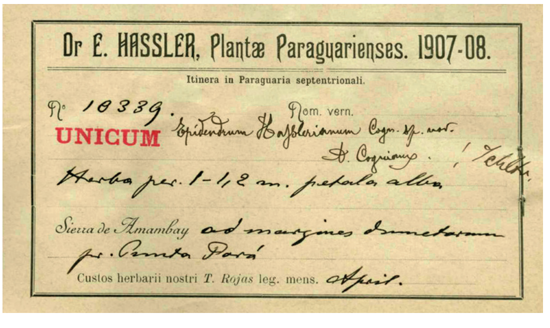


FIGURE 81. Herbarium label of *Epidendrum hassleri* Cogn. collected buy Hassler and Rojas. Geneva Herbarium.

marked influence from the Atlantic Ocean and a succession of climates from tropical in the north to cold in the extreme south. In the west rise the imposing Andean and associated mountain ranges. The cold waters of the Pacific bathe the coasts of Chile, forming deserts. The climatic and regional diversity provides abundant resources and various alternatives for the development of a complex biodiversity.

Towards the east, the 'pampas' or grasslands of the Southern Cone consist of temperate prairies and savannas, shared by Argentina and Uruguay. To the north of Argentina and bordering Uruguay and Bolivia, the Chaco region is a system of plains crossed by important river systems. To the south, Patagonia extends from the Colorado River to the region of Tierra del Fuego, which Argentina shares with Chile. South America's Arid Diagonal, a zone of arid and semi-arid climate, crosses from the desert of Atacama in northern Chile across the mountain chain of the Andes to the Atlantic coast of Patagonia.

In Chile, the central region south of Atacama has a Mediterranean climate and the desert gives way to fertile valleys that reach as far as the Region of the Lakes, with its capital Puerto Montt, in the south. Chilean Patagonia is very similar to its Argentinian counterpart, and both countries come together on Tierra del Fuego, on the shores of the Strait of Magellan.

BOTANICAL EXPLORATION: The botanical exploration of the Southern Cone began with the journey of Louis Éconché Feuillé (1660–1732), who collected plants between 1703 and 1711 around the Chilean city of Concepción. Several remarkable terrestrial orchids were collected by Feuillé in southern Chile (Fig. 86).

Figure 82. *Bulbophyllum rojasii* L.O.Williams as *Bulbophyllum tripetalum* Lindl. Photograph by Rudi Hromniak.

Figure 84. *Vanilla rojasiana* Hoehne as *Vanilla angustipetala* Schltr. Unknown photographer.

Figure 83. Type of *Epidendrum rojasii* Cogn. Reproduced with the kind premission of the Kew Botanic Gardens.

Figure 85. The Southern Cone. Unknown author.

Figure 86. *Epipactis vulgo piquichen* as named by Feuillé: *Chloraea piquichen* Lindl. Illustration by Louis Feuillé.

Figure 87. *Arethusa trifolia* illustrated by Sydney Parkinson, the artist of James Cook's expedition.

Daniel Carlsson Solander (1733–1782) sailed with Joseph Banks in 1768 as part of Captain James Cook's expedition to the South Pacific. They landed in Tierra del Fuego in 1769, where they collected a terrestrial orchid which they named *Arethusa trifolia* (= *Codonorchis lessonii* (Brogn.) Lindl.) (Fig. 87).

Philibert Commerson sailed as botanist in the expedition led by Louis Antoine de Bougainville , which set out from the French port of Nantes in 1767 to circumnavigate the globe. Their first stop was Rio de Janeiro, where Commerson discovered the beautiful *Bougainvillea spectabilis* Willd., a plant that would soon spread across the New and Old-World tropics and would thus perpetuate the name of the expedition's commander. The expedition sailed south to Montevideo and in 1767 was in Tierra del Fuego. They continued along the Strait of Magellan to Chilean Patagonia in 1768 and then set course to Taihiti. Commerson collected orchids in Brazil, Uruguay, southern Argentina and Chile. We remember him in *Bipinnula commersonii* Lindl., from Uruguay and *Chloraea commersonii* Brongn. from Chile.

José Pavón (1754–1844) was a member of the famous Spanish Botanical Expedition to the Viceroyalty of Peru between 1777 and 1788. Pavón travelled from Peru to Chile in 1782. He collected *Chloraea pavonii* Lindl., one of the most beautiful species of this terrestrial genus (Fig. 88).

Louis Neé (ca. 1734–1807) sailed as botanist with the expedition of Alessandro Malaspina to the Pacific. He made botanical collections on the way, among which we find *Epidendrum elongatum* Jacq. and *Oncidium oblongatum* Lindl. from Uruguay and a species of *Spiranthes* from Chile.

John Miers (1789–1879), a British mining engineer and amateur botanist, came to the Argentinian city of Mendoza in 1818 before settling for a while in Chile. Years later, in 1856, he published an enumera-

Figure 88. *Chloraea pavonii* Lindl. Illustration by José Brunete, one of the artists of the expedition. At the Royal Botanic Garden, Madrid, AJB, Div. IV, 1318.

Figure 89. *Chloraea incisa* Poepp. Collected by Poeppig near Antuco, Chile. In Poepp. & Endl., 1835–1854: plate I-54.

tion of the vernacular names given to several Chilean terrestrial orchids.

Carlo Giuseppe Luigi Bertero (1789–1831), having visited during a first expedition the Caribbean islands, crossed the Atlantic again in 1827 and settled in Chile, where he botanized in the surroundings of Valparaíso. Several species of Orchidaceae are kept at the Museum of Natural History in Santiago, among them two new species dedicated to him: *Asarca berteri* Rchb.f. and *Chloraea berteroana* Kränzlin.Hugh Cuming (1791–1865) travelled along South America's Pacific Coast in 1828, where he collected an important number of Chilean orchids, several of which were described as new to science by Lindley in his *Catalogue of the Orchideae in Mr. Cuming's collection of South American Plants* (Lindley 1834).

French Rear Admiral Jules Sébastien César Dumont d'Urville (1790–1842) sailed from the port of Toulon in 1822 with the mission of circumnavigating the globe. Part of the expedition was the pharmacist René-Primevère Lesson (1794–1849). The expedition touched at the Falkland Islands, where a new orchid species was collected: *Calopogon lessonii* Brongn. They continued to Chile, where again several orchid species were collected.

James MacRae (1800–1830) sailed from London in 1824 on the HMS *Blonde* to convey the remains of the Hawaiian monarchs back to their islands. King Kamehameha II and Queen Kamamalu had developed measles during an official visit to England and passed away only a few weeks after their arrival. During their return journey, the expedition stayed for several weeks in the vicinity of Concepción, in southern Chile. Macrae collected several orchid species from which Lindley described no less than six that were new to science.

In the southern suburbs of Buenos Aires, Argentina, the Scottish colony of Monte Grande was established in 1825. Among the 200 Scots selected to settle in the new colony was the gardener James Tweedy (1775–1862),

FIGURE 90. Village of Valdivia. By Claude Gay, in his *Atlas*, p. 6. (Gay 1854?)

who would be the first botanist to explore Argentina, in the first third of the 19th century. His excursions took him through Uruguay and northwards along the Brazilian coast to Rio de Janeiro, and later southwards to Patagonia until he reached Bahia Blanca. Next, he crossed the country westwards, to Tucumán and the cordilleras. On his return to Buenos Aires, Tweedie was surprised that his acquaintances did not recognize him, so rundown was his appearance after the hardships of his journey (Ossenbach 2020: 555–556). Several new orchids were collected by him, some named later in his honour: *Spiranthes bonariensis* Lindl. from Argentina and Uruguay, and *Octomeria tweediei* Luer & Toscano, and *Stelis tweediana* Lindl. from Brazil.

One of the most important botanical explorers of South America, Eduard Friedrich Poeppig (1798–1868) grew up in Leipzig, where he studied medicine. In 1822, he departed on an expedition to the Americas. After a few years in Cuba and the United States, he travelled to Chile in 1826 and went on to Peru and Brazil, being only the third European, after Francisco de Orellana in 1542 and Charles Marie de la Condamine in 1744, to travel the entire length of the Amazon. The account of his South American journey, *Reise in Chile, Peru und auf dem Amazonenstrome, während der Jahre 1827-1832*, was published in two volumes (Poeppig 1835,1836). His major botanical work, *Nova genera ac Species Plantarum quas in regno, Chiliensi, Peruviano, ac Terra Amazonica, anni 1827–1832 lectarum*, was published in three volumes between 1835 and 1854 . It describes 528 species, including 31 new genera and 477 new species, many of which were beautifully illustrated (Fig. 89). For the first two volumes he was aided by Austrian botanist Stephan Endlicher. From Chile, Poeppig and Endlicher described the new orchid genus *Gavilea* and 22 species of orchids new to science.

Claude Gay (1800–1873), after having abandoned the idea of studying medicine in Paris, went to Chile in 1828 to teach physics and natural history at a college in Santiago. He accepted a position as a researcher for the Chilean government in 1829 and in 1830 was one

Figure 91. *Chloraea gayana* A.Rich. By Claude Gay, in his *Atlas*, p. Fanerogamia 64.

of the founders of the National Natural History Museum. After a short trip to France, he returned to Chile in 1834 and began writing his multi-volume *Historia Física y Política de Chile*, published by the Chilean government between 1844 and 1871. An *Atlas* to this history was published in 1854, containing not only landscapes (Fig. 90) and scenes of daily life in Chile but also beautiful illustrations of the most relevant plants of Chile's flora (Fig. 91).

Gay travelled to Peru in 1839 and returned to France in 1843. Subsequently, he travelled throughout Russia and Tartary and in 1858 was sent by the French Academy of Sciences to the United States to study the mining system. In 1863, he travelled for the last time to Chile, where he would remain until his death ten years later. Besides *Chloraea gayana* A.Rich, illustrated here, *Asarca gayana* was dedicated.to him by Kuntze.

Charles Gaudichaud Beaupré (1789–1854) travelled between 1830 and 1832 to Brazil, Argentina and Chile, where he collected several species of *Chloraea*.

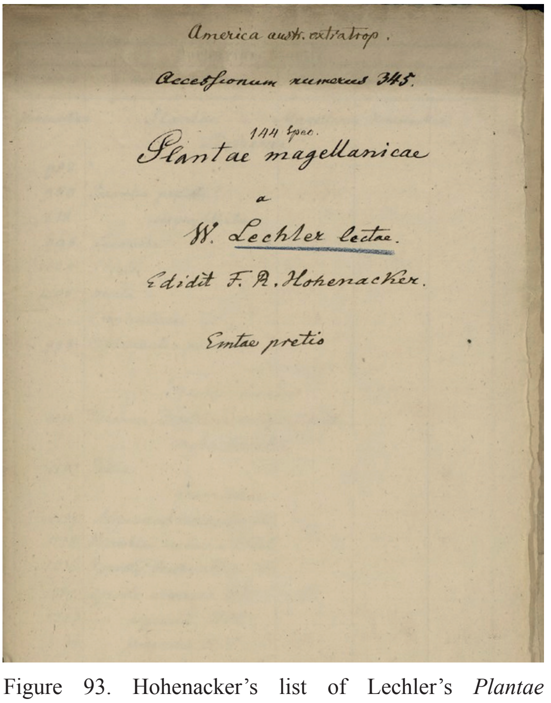
Rudolf Amandus Philippi (1808–1904) came to Chile in 1851, where he would stay for the rest of his life. He established himself in Valparaíso and from 1853 to 1897 occupied the post of Director of the National Natural History Museum, a position he passed on to his son Friedrich when he retired. At the same time, he was Professor at the National University and made extensive botanical explorations of the country. It is said that he collected some 20% of all vascular plants known to Chile. He has been recognized as one of Chile's great naturalists: his name lives on in the orchid species *Asarca philipii* Kuntze, *Chloraea philipii* Lindl., and *Epidendrum philippii* Rchb.f. He also described some 50 new orchid species from Chile. Rudolf's son Friedrich (Federico) Philippi (1836–1910) was, like his father, an avid botanical collector. Only a few orchid specimens are known from his son's collections, however, none of them new to science.

Between 1832 and 1835 Charles Robert Darwin (1809–1882) sailed aboard HMS *Beagle* (Fig. 92) along the costs of Argentinian Patagonia, Tierra del Fuego and the shores of the Strait of Magellan. After entering the Pacific, the *Beagle* sailed north along the coast of Chile. During his voyage, Darwin collected several orchids, among them: in Patagonia, *Chloraea gaudichaudii* Brongn. at Port Desire (Argentinian Patagonia), *Chloraea magellanica* Hook.f. and *Codonorchis lessonii* (Brogn.) Lindl. (Straits of Magellan and Tierra del Fuego); and *Bipinnula fimbriata* (Phil.) I.M: Johnst. (Valparaíso, Chile). A signed pencil drawing by Darwin graces the sheet of a *Gavilea* at Kew.

Philibert Germain (1827–1913), a French entomologist, arrived in Chile in 1850 and was named interim director of the National Natural History Museum until the appointment of Rudolf Amandus Philippi in 1853. Apart from a short interlude in France, Germain would live in Chile until the end of his life. He made important botanical collections and several new orchid species, such as *Habenaria germainii* were described by Philippi from Germain's specimens.

Willibald Lechler (1814–1856) collected in southern Argentina, the Falkland Islands and Southern Chile from 1850 to 1854. His plants were distributed in Europe by Swiss botanist Rudolph Friedrich Hohenacker (1798–1874), advertised as 'W. Lechler *plantae insularum Maclovianarum*', 'W. Lechler *plantae magellanicae*' (Fig. 93), and 'W. Lechler *plantae chilenses*'. From Lechler's collec-

FIGURE 92. *HMS Beagle* off the coast of Tierra del Fuego. Unknown artist.



America austr. extratrop.

Accessionum numerus 345.

144 spec.

Plantae magellanicae

a

W. Lechler lectae.

Edidit F. R. Hohenacker.

Emtae pretio

Figure 93. Hohenacker's list of Lechler's *Plantae magellanicae.*

tions Lindley described a new orchid which he named *Cholarea lechleri*.

Finally, two French expeditions explored southern South America: that of Paul Amédée Ludovic Savatier (1830–1891), on board the *Magicienne* (1877–1879), and that of Paul Auguste Hariot (1854–1917), Paul Daniel Jules Hyades (1847–1919) and Philippe Hahn (?–?) aboard the *Romanche* (1882–1883). They collected a few orchids in Tierra del Fuego and southern Chile

This list of botanical collectors in the Southern Cone does not pretend to be complete. A selection was made, taking into consideration those botanists who had shown especial interest in orchids.

Once leaving the tropics and travelling south into the subtropical climate of the Southern Cone, orchid diversity drops immediately. While the northern neighbours of Chile, Argentina and Uruguay count their orchid species by the thousands, the total number of Orchidaceae in these three countries barely reaches 300 species. This is perhaps one of the reasons why Rudolf Schlechter showed relatively little interest in this region.

Figure 94. Per Karl Hjalmar Dusén (1855–1926). Unknown photographer.

Figure 95. Otto Nordenskjöld (1869–1928). Unknown photographger.

Chile

Per Karl Hjalmar Dusén (1855–1926) (collected 1895–1897)

Per Karl Hjalmar Dusén's (1855–1926) (Fig. 94) first encounter with the South American flora took place between 1895 and 1897, when he was appointed as palaeontologist of the Swedish Expedition to the Magellan Territories led by Otto Nordenskjöld (1869–1928) (Fig. 95). In his report on the expedition Nordenskjöld wrote: "The interest that has manifested itself of late in exploration in Antarctic regions was the impulse that gave rise to the Swedish expedition to the Magellan territories in 1895. At a time when the eyes of the whole geographical world were turned towards that portion of the earth, it seemed only fitting that Sweden´s sons and explorers, who have had so important and extensive a share in opening up the north polar territories, should be prepared to participate in similar labours in the south, for we may confidently expect results obtained there to elucidate many of those already established for the north, placing them in their right light and showing their true value and application" (Nordenskjöld 1901).

Dusén sailed from Buenos Aires in October 1895, made a short land excursion in Puerto Madryn and continued to the Strait of Magellan, arriving in Punta Arenas, on Chile's southern coast, in November. Punta Arenas would be the expedition's headquarters. Several short journeys took Dusén to Admirality Sound, the Páramo Penísula and the village of Ushuaia before he sailed back to Europe in the summer of 1897.

Although Dusén's work was mainly of a paleontological nature, he also made botanical collections and published an interesting account of the Vascular plants of the Magellan Territories and a contribution to the Flora of eastern Patagonia (Dusén 1900). A total of three orchid species were mentioned in this work: *Chloraea commersonii* Brong. and *Chloraea magellanica* Hook. f., and *Codonorchis lessonii* (d'Urv.) Lindl.

Allthough Dusén would return once more to Patagonia in a new expedition in 1905 -without significant


ANALES
DEL
Museo Nacional de Chile
PUBLICADOS POR ORDEN DEL GOBIERNO DE CHILE

SEGUNDA SECCION
BOTÁNICA

Entrega Núm. 18, conmemorativa del Centenario de la Independencia

Orchidaceae Chilenses
Ensayo de una Monografía de las Orquídeas de Chile
POR
CARLOS REICHE
JEFE DE LA SECCION BOTANICA DEL MUSEO NACIONAL

Con 2 láminas y 54 figuras en 19 grupos intercalados en el texto

SANTIAGO DE CHILE
IMPRENTA, LITOGRAFIA I ENCUADERNACION BARCELONA
Moneda, entre Estado i San Antonio
1910

Mo. BOT. GARDEN
1911

FIGURE 96. Inside cover of Reiche's *Orchidaceae Chilenses*.

FIGURE 97. Karl Friedrich Reiche (1860–1929). Archives of Rudolf Jenny.

botanical results- he made his largest contributions to the orchidology of South America while living in Brazil between 1901 and 1916.

KARL (CARLOS) FRIEDRICH REICHE (1860–1929) (collected 1889–1911)

In the introduction to his series on the orchid floras of the South American Andean states, Schlechter wrote: "Since -not too long ago- a quite useful orchid flora of Chile was published by K. Reiche [Reiche 1910], I have decided not to write another account of the orchids of this country, especially since few noteworthy novelties could be expected (Schlechter 1919: 3). Schlechter was right: Reiche, in his *Orchidaceae Chilenses* of 1910 (Fig. 96) lists 75 different orchid species distributed in 7 genera. One hundred and seven years later, after many species were transferred back and forth from one genus to another and some fell into synonymity, Bevilacqua (2017), in her article about Chile's orchid flora, lists 72 species, in eight different genera. This is again an example of the well-known fact that while in the epiphytic world of tropical orchids dozens of new species are discovered and described every year, it often takes decades until a new species is found among the subtropical terrestrial orchids. Schlechter not only described *Microstylis reichei* among the orchids collected by Reiche during his time in Mexico, but used his work often as reference, which is the reason why Reiche is mentioned as an indirect member of Schlechter's network.

German botanist Karl Friedrich Reiche (1860–1929) (Fig. 97), or Carlos as he was known, was head of botany at the National Museum of Natural History in Santiago, Chile. He worked to organise the treasury of specimens deposited at the museum at this time, especially those from the collections made by Rudolf Amandus Philippi and his son Friedrich, by Claude Gay and by Carlo Luis Bertero during the better part of the 19^{th} century. Born in Dresden, Saxony, Reiche studied the natural sciences, gaining a Ph.D from the University of Leipzig in 1885. He occupied a position as Professor at the same university between 1886 and 1889. The Chilean government contracted him to teach mathematics, physical and natural sciences and illustration at the recently founded school in Constitución, about 260 km southwest of Santiago in the region of Maule. He took up this post in 1889 and from the first day began to study the Chilean

Figure 98. *Asarca littoralis* (Phil.) Reiche =*Gavilea littoralis* Phil. Photograph by pabloendemico.

Figure 99. *Chloraea lectopetala* Reiche. Photograph by Pato Novoa.

flora, a subject to which he would dedicate the next twenty years. Reiche undertook numerous excursions throughout the country, collecting specimens and conducting investigations for future publications. He was appointed as head of botany at the National Museum of Natural History in 1896 and moved to Santiago to work at their herbarium under the direction of Rudolph Amandus Philippi. Reiche began studying the ample collections contained there, including those of Philippi and his son Federico, preparing taxonomic revisions for what would be his most important work: the *Estudios críticos sobre la Flora de Chile*. With the help of Federico Philippi and F. Johow, he completed and published six volumes, but the work was interrupted when Reiche left Chile in 1911 (Turrill 1920: 63). Unfortunately, the treatment of the Chilean Orchidaceae was among those parts that were never completed.

In 1911, Carlos Reiche was chosen to be the next director of the museum, after the death of Federico Philippi the year before, but he turned this down since he did not agree with the policies set by the by the Chilean authorities of that time. Instead he accepted a post offered to him by the Mexican government. This was unfortunate because Reiche's knowledge of the museum and its collections was unparalleled at the time.

Reiche was professor of botany at the Mexican School of Higher Studies from 1911 to 1924, when he returned to Germany and took a position in Munich as a researcher at the Staatssammlung Museum. Aside from a brief return to Mexico in 1926 to complete his teaching and research, he remained in Munich and was named curator of the phanerogamic collections at the same museum in 1928, the year before his death. Reiche is commemorated in the epithet of the genus *Reicheella* Pax (Hectorellaceae).

In his *Orchidaceae Chilenses* of 1910, Reiche described several new orchids from Chile, namely *Asarca cardioglossa* Phil. ex Reiche, *Asarca grandulifera* var. *illapelina* Reiche, *A. littoralis* Reiche (Fig. 98), *Chloraea leptopetala* Reiche (Fig. 99), and *Chloraea viridiflora* var. *reticulata* Phil, ex Reiche.

In addition, Carlos Reiche illustrated the flowers of 17 Chilean orchids (Fig. 100) in the same work.

Figure 100. Plate I of Reiche, 1910: 1. *Asarca sinuata* Lindl., 2. *Chloraea ulanthoides* Lindl., 3. *Asarca odoratissima* Poepp. & Endl., 4. *Chloraea galeata* Lindl., 5. *Chloraea multiflora*, 6. *Chloraea cylindrostachya* Poepp., 7. *Chloraea fonckii* Phil., 8. *Chloraea disoides* Lindl., 9. *Chloraea grandiflora* Poepp., 10. *Chloraea nudilabia* Poepp.

However, the quality of the illustrations is not of the highest standard.

Little more can be said about Schlechter's network in Chile, besides the previously mentioned orchids collected by Per Hajlmar Dusén.

Argentina

The Faculty of Exact, Physical and Natural Sciences at the National University of Córdoba, Argentina (various collectors 1870–1896)

Domingo Faustino Sarmiento (1811–1888) (Fig. 101) served as President of the Republic of Argentina from 1868 to 1874. He gave great impulse to the modernization of the country. He paid special attention to the improvement of communications and built infrastructure that included 5000 km of telegraph lines across the country. He was also responsible for the construction of the so-called Red Line, a railway connecting the interior of the country with Buenos Aires to bring goods to its harbour and facilitate trade with Great Britain. Sarmiento's main achievement, however, concerned his promotion of education. He increased educational subsidies to the provincial governments and established over 800 educational institutions. By the end of his presidency over 100,000 children were attending school. In 1869, shortly after assuming the presidency, he passed a law enabling the Executive to hire up to twenty professors to teach sciences at the University of Córdoba (Acosta 2015: 75). Sarmiento approached Karl Hermann Konrad Burmeister (1807–1892) (Fig. 102), a German naturalist who was Director of the Public Museum of Buenos Aires, to take on the responsibility of engaging German scholars for this task.

Figure 101. Domingo Faustino Sarmiento (1811–1888). Unknown photographer.

Figure 102. Karl Hermann Konrad Burmeister (1807–1892). Unknown photographer.

Burmeister accepted and immediately began appealing to his contacts in Germany to convince a number of young German scientists to abandon their positions and travel to Argentina to create the new Science Faculty. The first to accept were Paul Lorentz (Botany), Carl Schultz-Sellack (Physics), Hendrik Weyenbergh (Zoology), Max Siewert (Chemistry), Christian August Vogler (Mathematics) and Alfred Stelzner (Mineralogy) (Fig. 103). They all arrived between 1870 and 1873, when the first students were received and teaching could begin (Fig. 104). Georg Hans Emmo Wolfgang Hieronymus (1846–1921) (Fig. 105) arrived in Córdoba in 1872 as assistant to Lorentz.

Soon after Lorentz arrived in Córdoba he was joined by Stelzner and, since the Faculty was not yet in condition to begin classes, they travelled north-east at the invitation of Federico Schickendantz (1837–1896) (Fig. 106), a German Chemist who had arrived in Argentina some ten years earlier and was a professor at the National College at Tucumán.

Born in Kahla, Saxony, Paul Günther Lorentz (1835–1881) originally studied Theology but changed his mind and went to the University of Munich, where he received his doctorate in Botany in 1860. He arrived in Córdoba in 1870. His first botanical excursion with Stelzner, which lasted five months, took him through the provinces of Santiago del Estero, Tucumán and Catamarca. Lorenz brought a large collection of vascular plants, which he sent to Grisebach for determination. Of these, 923 were published by Grisebach as *Plantae Lorentzianae* in 1874 (Grisebach 1874, Vervoorst 1972: 66). Only two orchids were mentioned in this work: *Oncidium batemannianum* Parment. and *Stenorrhynchus speciosus* Rich.

Lorentz lost his position at the University in Cordoba in 1874, after strong differences of opinion with the new Minister of Culture. Georg Nieronymus was named Professor of Botany in his place. Lorentz then moved to the small town of Concepción, on the banks of the Uruguay River. The new government under President Nicolás Avellaneda appointed him as professor at the local school, and he seemed to have regained a comfortable economic position. His health, however, had deteriorated and, although he was still able to publish a small

Figure 103. From left to right, standing: Paul Lorentz, Carl Schultz-Sellack, Hendrik Weyenbergh; sitting: Max Siewert, Christian August Vogler, and Alfred Stelzner

Figure 104. University of Córdoba, ca. 1875. Photograph by Academia Nacional de Ciencias, Argentina

work on the vegetation of the north-eastern regions of the province of Entre Ríos and took part in the 1879 expedition led by General Roca to the Río Negro, he never recovered. He died in Concepción in the first days of October 1881 (Stelzner 1882: 463–468).

Georg Hieronymus arrived in Cordoba in September 1872 at the age of 26. He had studied medicine and natural sciences at the universities of Zürich, Berlin and Halle before being chosen to assist Paul Lorentz, whose position he assumed after Lorentz was dismissed in 1874. During his years in Córdoba, he travelled a few times to Germany until in 1883 he decided to leave Argentina. He settled in the German city of Breslau and continued his botanical studies. He was later named curator of the Botanic Museum in Berlin under the direction of A. Engler. After difficult years during WWI, during which he lost his wife and his eldest son, he passed away in Berlin in January of 1921.

Immediately after the arrival of Hieronymus in Córdoba, Lorentz organized a second expedition with his new assistant. This would take them to the northwest for the next 16 months. Lorenz was again to visit the provinces of Catamarca and Tucumán, but this time Salta, Tarija and San Lorenzo as well. Just as after Lorentz's first expedition of 1871, the botanical collections were sent to Grisebach, who described 2,263 plants in a second work: *Symbolae ad floram Argentinae*, published in 1879 (Grisebach 1879). Several new orchid species described therein must be attributed to both Lorentz and Hieronymus. Among them we find: *Chloraea biserialis*. *Cranichis micrantha* (Fig. 107), *Sigmatostalix brachycion*, *Spiranthes saltensis* (Fig. 108), *Spiranthes sellilabris*, and *Stenorrhynchus argentinus*. *Aa lorentzi* was dedicated by Schlechter to Lorentz from a collection in the Sierra of Tucumán. Kränzlin dedicated *Habenaria hieronymi* to Hieronymus, and Cogniaux would follow with *Altensteinia hieronymi* and *Microstylis hieronymi*.

Although only a minor figure in this story, a final word must be said about Friedrich (Federico) Schickendantz (1837–1896). Born in Landau, in the Rhineland, he studied chemistry in Heidelberg, Munich and Oxford. He decided to go to Argentina in 1861, where he joined a mining company for a term of ten years. He taught physics and chemistry at the 'Colegio Nacional' of Tucumán, was director of 'Oficina Química Municipal' and became a member of the National Science Academy in Córdoba. He was about to take charge of the 'Oficina Química' in Mendoza when he died in 1896. Schickendantz developed a secondary interest in botany, specializing in cacti. He also amassed an herbarium of vascular plants from which Schlechter described and named in his honour the new orchid species *Aa schickendanzii*.

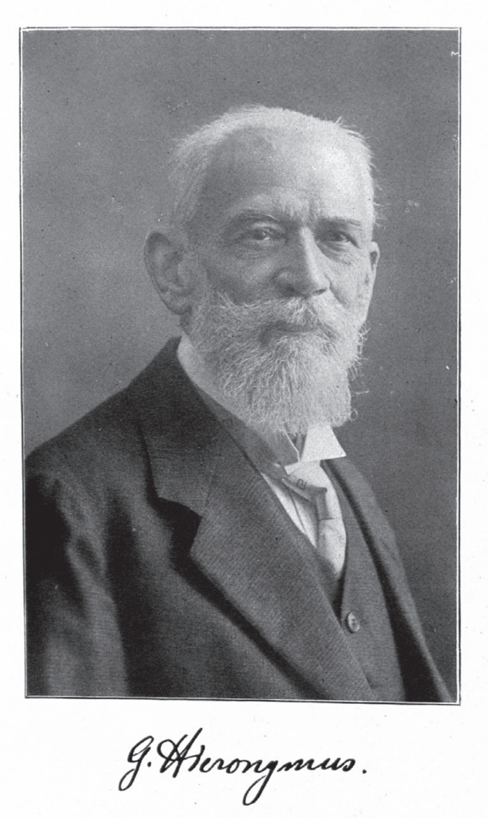


Figure 105. George Hieronymus (1846–1921). Unknown photographer.

Figure 106. Friedrich Schickendantz (1837–1896). Unknown photographer.

Carlos Luigi Spegazzini (1858–1926) (collected 1881–1925)

A leading figure in Argentinian natural history, Carlo Luigi Spegazzini (1858–1926) (Fig. 109) was born on 20 April 1858 in Bairo in Torino, northern Italy. He took courses at the school of Viticulture and Oenology in Conegliano (Venice), where he graduated in 1879. Thinking that botanical studies in Italy were well covered and completed by other botanists, he decided to explore other countries and sailed to Argentina and in December 1879, disembarking in Buenos Aires. In 1881, soon after his arrival, he took part in Lieutenant Santiago Boves' expedition to Tierra del Fuego. After numerous adventures, including swimming ashore with his botanical collections after a shipwreck, he returned to Buenos Aires in September 1882 with a collection of over 1100 botanical specimens.

In 1884, he was one of the founders of the La Plata National University. He took the position of Professor of Natural Sciences, Agronomy, Chemistry and Pharmacy and created the university's botanical garden and arboretum. Over the years, he would intensify his botanical collecting, taking part in over 20 expeditions, some of them taking him as far as Brazil, Paraguay and Chile.

The American mycologist William A. Turrill, who visited Spegazzini in his residence in La Plata in 1924, wrote this beautiful biographical note: "Dr Spegazzini is an old man, but strong in body, young in thought, and still full of the spirit of adventure. He has just returned from Tierra del Fuego, is planning to go to Europe next year, and promises me to come to the United States the following year 'if nothing happens'. He was born in a village in Italy and was a student of the fungi there before coming to Argentina. He has described a great many South American plants in various groups,

Figure 107. *Cranichis micrantha* Griseb. =*Cranichis candida* (Barbosa) Cogn. Photograph by Amerigo Docha Neto.

Figure 108. *Spiranthes saltensis* Griseb. as *Pelexia bonariensis* (Lindl.) Schltr. Photograph by Maria Ogrzewalska.

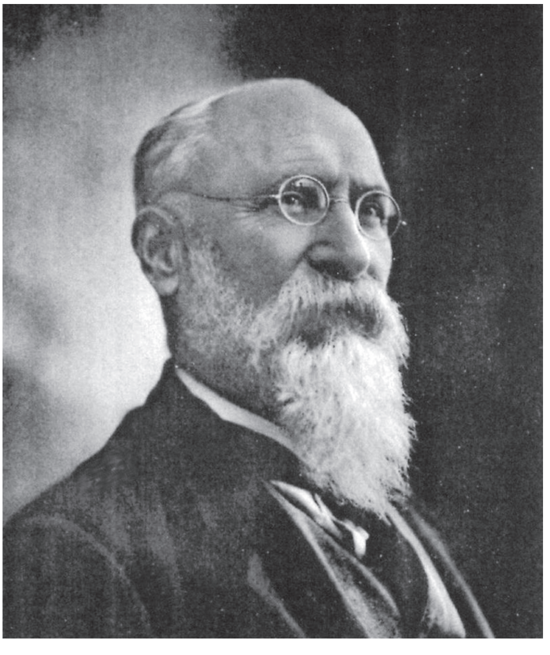


Figure 109. Carlo Luigi Spegazzini (1858–1926), in a photo taken on his 65th birthday. In Katina et *al*. 2020: 183.

but his work is poorly known elsewhere and few of his specimens have been seen by other botanists. ... The Doctor is exceedingly genial in manner and very kind-hearted. He and his son stayed with me all day long, showing me specimens, photographs and publications; giving me anything I wanted for our herbarium; taking me out to a sportsman's club for lunch; visiting the museum; and going on a short collecting trip in the woods.

Figure 110. *Chloraea chica* Speg. ex Kraenzl. Photograph by Bastian Gygli.

We talked French, German, English, Latin and Spanish indiscriminately and recklessly, keeping up a continuous flow of conversation lest our ignorance in certain languages be discovered" (Murrill 1924).

According to Katina *et al*. (2020), a total of 11 new orchid species were described by Spegazzini, many in co-authorship with Kränzlin: *Chloraea albo-rosea* Kraenzl. ex Speg., *Chloraea chica* Speg. ex Kraenzl. (Fig. 110), *Chloraea cholilensis* Speg. & Kraenzl., *Chloraea hookeriana* Speg. & Kränzlin. (Fig. 111), *Chloraea hystrix* Speg. & Kraenzl., *Chloraea phoenicea* Kränzlin. & Speg., *Chloraea pleistodactyla* Kränzlin. & Speg., *Chloraea praecincta* Speg. & Kraenzl., *Pleurothallis aurantio-lateritia* Speg. & Kraenzl., *Re-*

Figure 111. *Chloraea hookeriana* Speg. ex Kraenzl. as *Chloraea alpina* Poepp. Photograph by Hernán Tolosa.

Figure 112. *Leochilus spegazzinianum* Kraenzl. = *Gomesa brieniana* (Rchb.f.) M.W.Chase & N.H.Williams. Photograph by K.H.Senghas.

strepia cogniauxiana Speg. & Kränzlin. (Katinas *et al*. 2020: 197). *Epidendrum argentinense* Speg. & Kränzlin. was collected by his son Rutile A. Spegazzini.

Several other orchid species were named in Spegazzini's honour: by Kränzlin, *Chloraea spegazziniana*, *Habenaria spegazziniana*, *Leochilus spegazzinianus* (Fig. 112), and *Maxillaria spegazziniana*: and by L. O.Williams, *Pleurothallis spegazziniana*.

It may seem somewhat far-fetched to include Lorentz, Hyeronimus, Schickendantz and Spegazzini in Schlechter's 'network'. However, we consider that their botanical collections contributed to Schlechter's knowledge of the Argentinian orchids. Not only did Schlechter have the opportunity to study Grisebach's herbarium at Göttingen, but additional material reached him at the Berlin Botanic Garden through Kränzlin and Hieronymus. The species determined by Schlechter and dedicated to Lorentz and Schickendantz, as well as modifications of several of Kränzlin's determinations, such as the names *Aa hieronymi* (Cogn.) Schltr. and *Oncidium spegazzinianum* (Kraenzl.) Schltr., are proof of this.

The arrival in Argentina of European scientists in all disciplines was a phenomenon that began with President Sarmiento in 1864 and continued well into the first decades of the 20th century.

The story of Rudolf Schlechter's network of orchid collectors in South America is close to its end. We began with Schlechter's men in the southern states of Brazil and through 322 pages we travelled north across the Amazon basin and into the three Guyanas. We then turned west, across the mighty Orinoco and the Magdalena River through Venezuela and Colombia, turned southwest into Ecuador and Peru, and, after crossing the tropic of Capricorn in Bolivia and Paraguay, arrived finally in the southern cone, where we now will talk about Schlechter's collectors in Uruguay; after this we can consider the circle closed.

Uruguay

At just over 176,000 km^2, Uruguay is the smallest country in South America after Surinam. Only about 50

FIGURE 113. Cornelius Osten (1863–1936). In Legrand, 1936. Frontispiece.

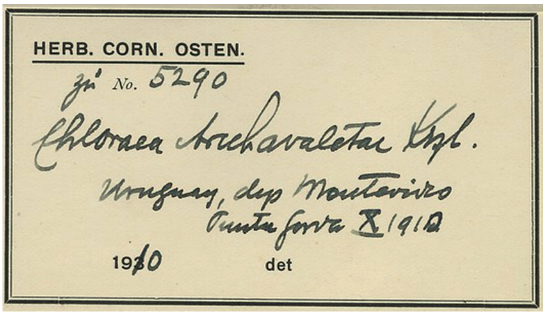


FIGURE 114. C. Osten's herbarium label of *Chloraea arechavaletae* Kraenzl. Harvard University Herbaria.

FIGURE 115. *Oncidium ostenianum* Schltr. =*Trichocentrum cepula* (Hoffms.) J.M.H.Shaw. Photo by Lidyanne Aona

different species of orchids in 13 genera can be found in its territory and only two noteworthy names of local botanists can be mentioned in relation to Schlechter's network. Both were of German origin.

CORNELIUS OSTEN (1863–1936) (collected 1885-1934)

The German botanist Cornelius Osten (1863–1936) (Fig. 113) was born in the northern German city of Bremen. He had shown a great passion for botany from childhood and at the age of 22 emigrated to South America, where he lived in the province of Buenos Aires, Argentina. He built a successful business as an import-export merchant, an activity he maintained throughout his life. In 1887, he moved to Uruguay which would become his country of adoption.

Osten took part in excursions to the Argentinian provinces of Córdoba and Mendoza with his brother, the astronomer Hans Osten, and started amassing a herbarium, which by 1907 already contained 2000 specimens. However, his most fruitful travels were in Paraguay with Emil Hassler and his student Teodoro Rojas in 1914–1915. He sent many duplicates of his collections to the museums of Berlin-Dahlem (where they first caught the attention of Rudolf Schlechter), Washington and Buenos Aires. Osten was known as extremely open-minded, always directing his efforts toward improving the quality of his knowledge in all areas of the sciences, arts and geography; he also had a good knowledge of classical languages. Cornelius Osten worked with the famous Spanish-born botanist José Arechavaleta (1838–1912), director of the Natural History Museum in Montevideo. Following Arechavaleta's death, Osten continued his *Flora Uru-*

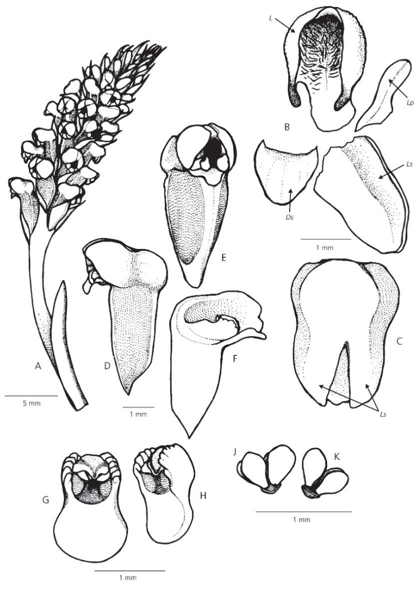


Figure 116. *Prescottia ostenii* Pabst. Drawing by R. Singer.

Figure 117. Wilhelm Gustav Franz Herter (1884–1958). Archives of Rudolf Jenny.

Figure 118. Downtown Montevideo, ca. 1920. Unknown photographer.

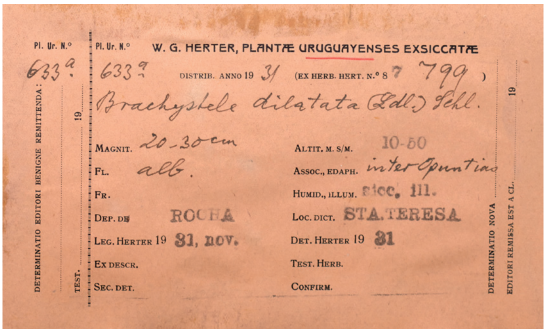

Pl. Ur. N.° 633ª
Pl. Ur. N.° 633ª W. G. HERTER, PLANTÆ URUGUAYENSES EXSICCATÆ
DISTRIB. ANNO 1931 (EX HERB. HERT. N.° 87799)
Brachystele dilatata (Ldl.) Schl.
DETERMINATIO EDITORI BENIGNE REMITTENDA: 19
MAGNIT. 20-30 cm ALTIT. M. S/M. 10-50
FL. alb. ASSOC., EDAPH. inter Opuntias
FR. HUMID., ILLUM. sicc. ill.
DEP. DE ROCHA LOC. DICT. STA. TERESA
LEG. HERTER 1931, nov. DET. HERTER 1931
EX DESCR. TEST. HERB.
TEST. SEC. DET. CONFIRM.
DETERMINATIO NOVA 19
EDITORI REMISSA EST A CL.

FIGURE 119. W. Herter's herbarium label of *Brachystele dilatata* (Lindl.) Schltr. From his herbarium.

guaya (Arechavaleta 1901), collaborating on this project with Wilhelm Herter, of whom we will talk later. Arechavaleta and Osten have been considered the two botanists who established the basis of botanical knowledge in Uruguay.

Osten was awarded an honorary doctorate by the University of Goettingen and commended for the prestige he had brought to German sciences in southern South America. By the time of his death, his herbarium, which he bequeathed to the National Museum of Natural History of Montevideo, numbered around 28,000 specimens (Legrand 1936: 8).

The Oakes Ames Orchid Herbarium at Harvard University holds a large number of orchids collected by Osten in Uruguay (Fig. 114). No new species are among them; however, Rudolf Schlechter and Guido Pabst dedicated to him *Oncidium ostenianum* (Fig. 115) and *Prescottia ostenii*, respectively (Fig. 116).

The plant genus *Ostenia* (Alismataceae) was named in honour of Cornelius Osten by Franz Georg Philipp Buchenau.

Herter, Wilhelm Gustav Franz (1884–1958) (collected 1907–1950)

Wilhelm Gustav Franz Herter (1884–1958) (Fig. 117) was a German botanist who lived in Uruguay for a large part of his life. Born in Berlin, Herter studied medicine and natural sciences in Freiburg im Breisgau, Berlin, Paris and Montpellier. In Berlin, he received a doctorate, submitting a thesis on the genus *Lycopodium* in 1908.

In 1907 and between 1909 and 1910, he spent short periods of time in Montevideo, Uruguay, as an assistant in the agronomy faculty at the University of Uruguay; between 1912 and 1913 he was at the Agronomic University of Porto Alegre, Brazil.

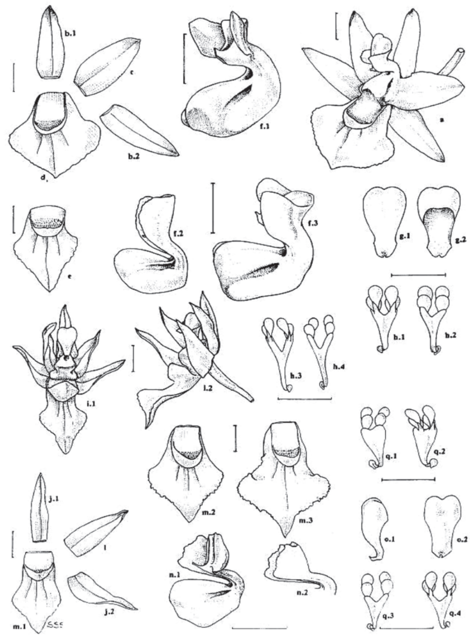


FIGURE 120. *Phymatidium herteri* Schltr. as *Phymatidium micophyllum* var. *herteri* (Schltr.) Toscano. Drawing by A. Toscano de Brito.

Herter worked as head of the grain processing laboratory at the Berlin Agricultural College during WWI, but in 1923 decided to return to Uruguay, where he made important botanical collections and worked with Cornelius Osten on the continuation of Arechavaleta's *Flora Uruguaya*. In 1925, Herter became a citizen of Uruguay and occupied different positions over the following years at the university and the ministries of education and public health, as well as at the Montevideo Botanical Gardens and Museum. Montevideo became his second home (Fig. 118). In 1927, he began the publication of his series *Estudios botánicos en la region uruguaya*, part of which was an inventory of the Uruguayan flora with C. Osten (Herter 1927-1957).

Herter not only taught botany but lectured students on Greek antiquity and promoted the study of mycology. He was happily married to Meta Puchert, who sometimes collected plants with him (Fig. 119) and founded the *Revista Sudamericana de Botánica*, which went through ten volumes.

Only one new orchid species, *Phymatidium herteri* Schltr. (Fig. 120), was described by Schlechter among the many specimens of Orchidaceae collected by Herter. Helped by the Uruguayan government, Herter travelled to Europe early in 1939 planning to visit the European herbaria to study their Uruguayan specimens. However, the outbreak of World War II (WWII) made it impossible for him to continue his work and to return to Uruguay. He spent the war as director of the Institute of Botany at the Jagiellonian University in Cracow, in occupied Poland. At the end of the conflict, as the German Reich retreated and abandoned Poland, Herter was held directly responsible for the considerable losses suffered in the field of Polish botany, in terms of both men and materials. Indeed, the Polish botanists Wladyslaw Szafer and Bogumit Pawlowski insisted that Herter be brought to account before the Polish courts in 1945, though this never occurred.

Immediately after the war, his wife having died in 1946, Herter returned to Uruguay but found himself without an occupation and made his living selling plants. In 1959, he was granted a retirement position by the Uruguayan government and named honorary consul in Bern, Switzerland. In 1954, he finally moved to Hamburg, where he died four years later.

Acknowledgements. Once more, many thanks to Mark Budworth, for his philological revision of the text. We assume that he is as glad as we are that this series has finally seen its end. To Franco Pupulin and the editorial staff of *Lankesteriana* and to all anonymous reviewers for their patience and encouragement during the publication of the six chapters of this series.

In memoriam: Rudolf Jenny (1953-2021)

In the last days of July, I was corresponding with Rudolf Jenny and going through the final observations of the editors of Lankesteriana to Chapter V of this series. Finally, early in August, the article was published, and Rudolf and I rejoiced about the outcome. We had started this project back in 2019, and at the start-line, had the optimistic idea that Schlechter's South American orchids would extend over one, two articles at the most. We were now nearing the end; after more than two years and close to 300 pages, the end seemed near, and we were already discussing new ideas for future publications. It was for me the culmination of more than 20 years working with Rudolf and learning from him, and we had big plans for the near future.

Some weeks later, my last e-mail to Rudolf came back with the laconic answer: "I am in the hospital and have no access to e-mails. I will answer as soon as I am back at home". And then came the sudden, tragic news about his death, at the still young age of 68. We had developed a good working agreement in which Rudolf was the untiring researcher while I did most of the writing. We would then go through our articles, reviewing and modifying the texts and the illustrations. But I did never fool myself: without Rudolf, all this would simply not have happened. His passion for orchid history was contagious, and 'Bibliorchidea', Rudolf's monumental brainchild, was an inexhaustible treasure chest of information. Unfortunately, all this had now come to an abrupt end.

I am mourning for Rudolf, as is the worldwide orchid community. He is and will remain irreplaceable. May this final article in the long series about Schlechter's South American network serve as a final homage to a man who was for me and for all who knew him a generous friend and an unforgettable teacher. May he rest in peace.

C. Ossenbach, December 2021.

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