

AULONEMIA DAVID-SMITHII AND A. RUBRALIGULATA
(POACEAE: BAMBUSOIDEAE: BAMBUSEAE: ARTHROSTYLIDIINAE):
TWO NEW SMALL-FLOWERED SPECIES FROM PERU

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ABSTRACT

Two new species of bamboo (Poaceae: Bambusoideae: Bambuseae: Arthrostylidiinae) are described from Peru. *Aulonemia rubraligulata* (Amazonas, Cajamarca, and Junín) has elongate, reddish inner ligules 20–45 mm long, foliage leaf blades 15–25 cm long and 0.7–2.3 cm wide, and pectinate-fimbriate sheath margins, while *A. david-smithii* (Pasco) has inconspicuous inner ligules, foliage leaf blades 25–38 cm long and 2.7–3.6 cm wide, the sheath margins with densely matted confluent fimbriae (these ultimately splitting) and terminal sheath fimbriae 10–15 mm long. A table is presented comparing the new species with their putative relatives *Aulonemia humillima* and *A. parviflora*. Scanning electron micrographs (SEMs) of the abaxial (lower) foliage leaf blade epidermis of both species are included, as is a key to the small-flowered Andean species of *Aulonemia*.

RESUMEN

Se describen dos nuevas especies de bambú (Poaceae: Bambusoideae: Bambuseae: Arthrostylidiinae) de Perú. *Aulonemia rubraligulata* (Amazonas, Cajamarca y Junín) tiene lígulas interiores alargadas, rojizas 20–45 mm de largo, hojas de follaje 15–25 × 0.7–2.3 cm y márgenes de la vaina pectinato-fimbriadas, mientras que *A. david-smithii* (Pasco) tiene lígulas interiores poco visibles, hojas de follaje 25–38 × 2.7–3.6 cm, los márgenes de la vaina con fimbrias confluentes densamente compactadas (estas divididas en última instancia) y fimbrias terminales de la vaina 10–15 mm de largo. Se presenta una tabla para la comparación de las nuevas especies con sus parientes putativos *Aulonemia humillima* y *A. parviflora*. Se incluyen imágenes de microscopía electrónica de barrido (SEM) de la epidermis abaxial de las hojas de ambas especies, así como una clave para el grupo de especies andinas de *Aulonemia* con espiguillas pequeñas.

KEY WORDS: Poaceae, Bambusoideae, Arthrostylidiinae, *Aulonemia*, Peru, neotropical bamboos

INTRODUCTION

The woody bamboo genus *Aulonemia* Goudot (Poaceae: Bambusoideae: Bambuseae: Arthrostylidiinae) exhibits its undescribed diversity throughout the Andes (Clark 1995; Judziewicz et al., 1999) in Venezuela (Judziewicz et al. 1991; Judziewicz & Riina 2006), Colombia (Clark & Londoño 1990; Clark et al. 1997, 2007; Judziewicz et al. 2013), Peru (Judziewicz & Tyrrell 2007) and Bolivia (Judziewicz & Clark 2011; Judziewicz et al. 2010, 2011).

Several Peruvian species are notable for their effuse panicles of small spikelets and presence of leaf sheath marginal fimbriae. *Aulonemia parviflora* (J. Presl) McClure (Húanuco, Cusco) has robust foliage leaf blades (21–)35–52 cm long and (3–)3.7–5.8 cm wide that are strongly tessellate abaxially, and extraordinarily long, pale brownish inner ligules 40–80 mm long, and papery, confluent, non-splitting fimbriae on its foliage leaf sheath margins. On the other hand, *A. humillima* (Pilg.) McClure (Loreto or San Martín) has much smaller

non-tessellate foliage leaf blades 8–17 cm long and 0.7–1 cm wide with sheath margins bearing regularly spaced, discrete (non-confluent) marginal fimbriae, terminal sheath fimbriae 35–50 mm long, and inconspicuous inner ligules.

To this group of “small-spikeleted” taxa with marginal leaf sheath fimbriae may now be added two new Peruvian species (Table 1). *Aulonemia rubraligulata* Judz. & Geisthardt (Amazonas, Cajamarca, and Junín) has elongate, reddish inner ligules 20–45 mm long, foliage blades 15–25 cm long and 0.7–2.3 cm wide (that are not at all tessellate), and pectinate-fimbriate sheath margins, while *A. david-smithii* Judz. & Waas (Pasco) has inconspicuous inner ligules, foliage leaf blades 25–38 cm long and 2.7–3.6 cm wide, sheath margins with densely matted confluent fimbriae (these ultimately splitting) and terminal sheath fimbriae 10–15 mm long. Neither of these taxa is accounted for in treatments of Peruvian grasses (Tovar 1993; Brako & Zarruchi 1994).

KEY TO THE ANDEAN SPECIES OF *AULONEMIA*
WITH MARGINAL FIMBRIAE AND EFFUSE PANICLES OF SMALL, SLENDER SPIKELETS

1. Foliage leaves with inner ligules less than 1 mm long, the sheath summit with fimbriae 10–50 mm long
 2. Foliage leaf blades 25–38 cm long, 2.7–3.6 cm wide, the sheath margins with initially confluent (but ultimately splitting and matting) fimbriae; terminal sheath fimbriae 10–15 mm long; Dept. Pasco, 910 m _____ ***A. david-smithii*** Judz. & Waas
 2. Foliage leaf blades 8–17 cm long, 0.7–1 cm wide, the sheath margins with regularly spaced, discrete, marginal fimbriae; terminal sheath fimbriae 35–50 mm long; Dept. San Martín, 1200 m _____ ***A. humillima*** (Pilg.) McClure
1. Foliage leaves with inner ligules 20–80 mm long, the sheath summit efimbriate
 3. Foliage leaves blades (21–)35–52 cm long, (3–)3.7–5.8 cm wide, strongly tessellate abaxially; inner ligules 40–80 mm long, pale brownish; foliage leaf sheath margins with numerous papery, confluent, non-splitting fimbriae; Dept. Cusco and Huánuco, 1900–2100 m _____ ***A. parviflora*** (J. Presl) McClure
 3. Foliage leaves blades 15–25 cm long, 0.7–2.3 cm wide, not tessellate; inner ligules 20–45 mm long, reddish; foliage leaf sheath margins with numerous discrete (non-confluent) pectinate fimbriae; Dept. Amazonas, Cajamarca, and Junín, 1500–2200 m _____ ***A. rubraligulata*** Judz. & Geisthardt

Plant parts were measured using a mm ruler, and a portion of the abaxial leaf blade epidermis (from the central, non-marginal part of a well-developed blade) from one sample of both species was examined using air-dried, uncoated, untreated material in a Hitachi S3400 scanning electron microscope; specimens were examined from the following herbaria: F, K, MO, NY, P, US, UWSP, and WIS.

Aulonemia david-smithii Judz. & Waas, sp. nov. (Figs. 1–3). TYPE. PERU. PASCO. Prov. Oxapampa: W side of Cordillera de San Matías between Iscosacin and summit, 10°11'S, 75°12'W [probably 75°06'W according to Google Earth; 75°12' would place specimen in lowland forest at 325 m], 910 m, 22 Jun 1982, cloud forest with heavy bryophyte cover on ground and all plants, 2 m, in flower, David N. Smith 2045 (HOLOTYPE: MO!; ISOTYPE: US!).

Bamboo 2 m tall; culms apparently less than 5 mm in diameter, glabrous. Midculm branching pattern and culm leaves not seen. Foliage leaves glabrous and smooth; sheaths strongly keeled, the midnerve prominent near the summit, the margins papery, chartaceous, and prominently cross-puckered on the lower leaves, on the upper leaves the sheath margins breaking up into very dense, curling, orangish-brown, prominent fimbriae 3–5 mm long, each fimbria attenuate into a mass of intertwining excelsior-like, finely hispid apices; sheath summit lacking auricles, but with erect, brownish, hispidulous fimbriae 10–15 mm long; outer ligule varying from an indurate rim ca. 1 mm long to (one one side) an ovate, stramineous, shiny flange 2–4 mm long; inner ligule not evident, not large if present; pseudopetioles 2–4 mm long; blades 25–38 cm long, 2.7–3.6 cm wide, linear-lanceolate, erect, the apex long-acuminate, the base obtuse and symmetrical, moderately strongly tessellate below (abaxially), the margins scabrous and cartilaginous. Peduncle short or included in the uppermost leaf sheath. Inflorescence up to 25 cm long, 20 cm wide, an open ovoid panicle with smooth branches; primary branches ascending at a 45° angle, triquetrous, the secondary and tertiary branches triquetrous to capillary. Spikelets (all immature and not well-developed) at least 15 mm long, linear, sparsely flowered, greenish, awnless, glabrous; glumes linear-lanceolate, awnless, the lower glume at least 1 mm long, the upper glume at least 2 mm long, short-aristate, 3–5-nerved; lowest floret apparently sterile, lacking a palea, upper florets fertile, apparently 1–3, the lemmas 3.5–6 mm long, lanceolate, acute; paleas 1.8–3 mm long; flowers and fruits not seen.

Leaf micromorphology, abaxial surface (Smith 2045, MO). Terminology follows Ellis 1979; Fig. 3. Costal zones.—Spaced ca. 250 µm apart.

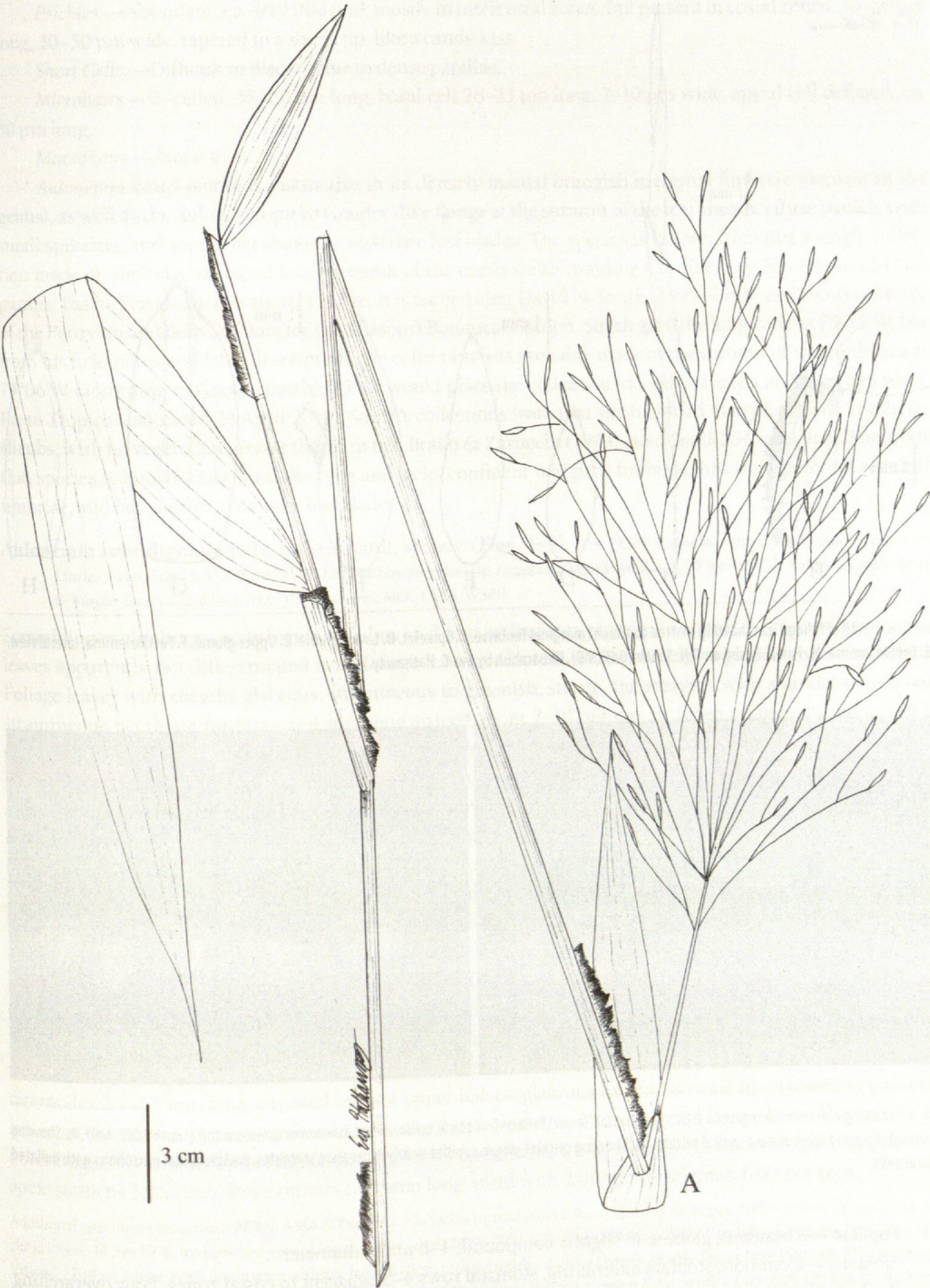


FIG. 1. *Aulonemia david-smithii*. A. Foliage leaf complement and inflorescence. Based on D.N. Smith 2045 (MO). Illustration by Eva C. Hathaway.

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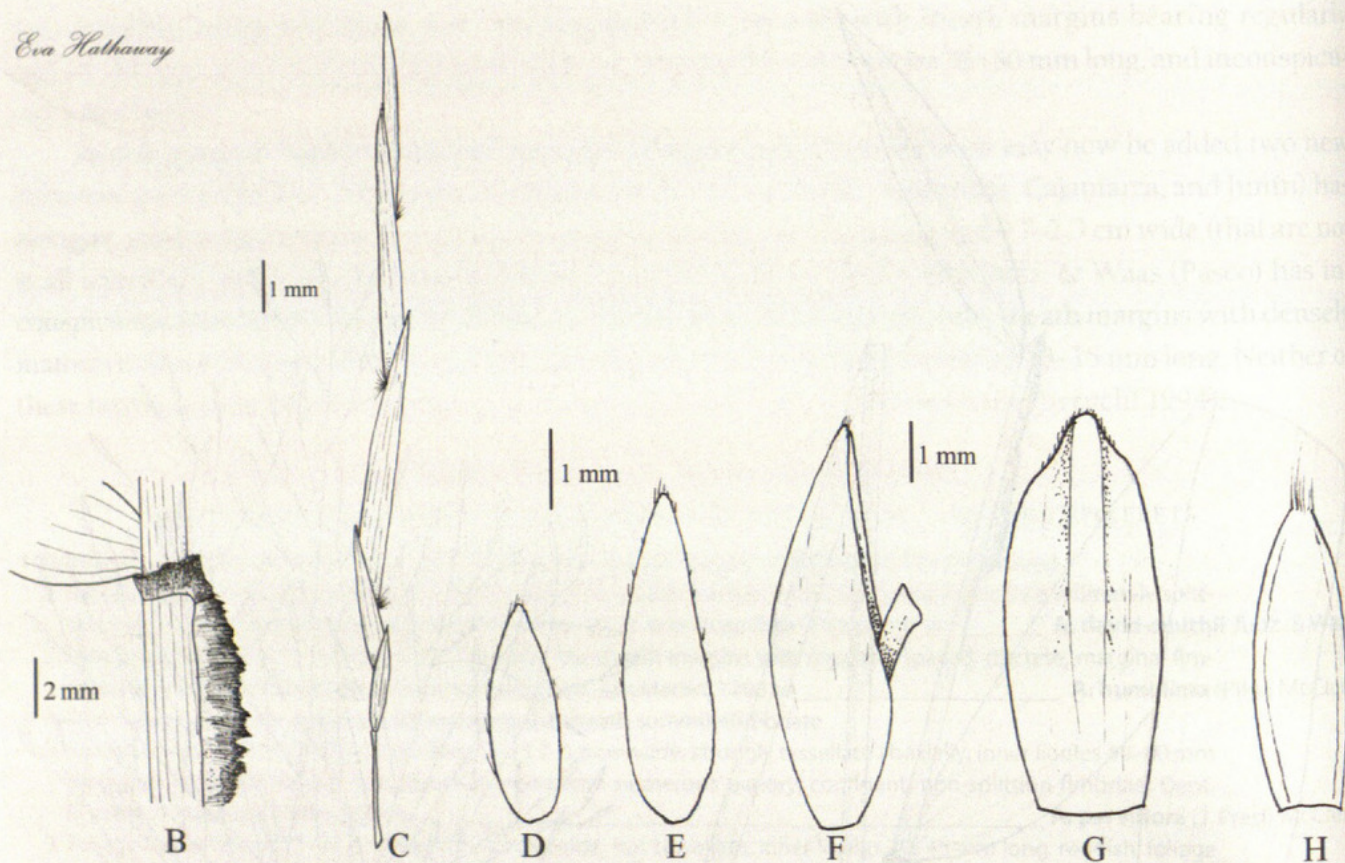


FIG. 2. B. Detail of foliage leaf showing matted confluent marginal fimbriae. C. Spikelet. D. Lower glume. E. Upper glume. F. Fertile lemma, lateral view. G. Fertile lemma. H. Palea. Based on *D.N. Smith 2045* (MO). Illustration by Eva C. Hathaway

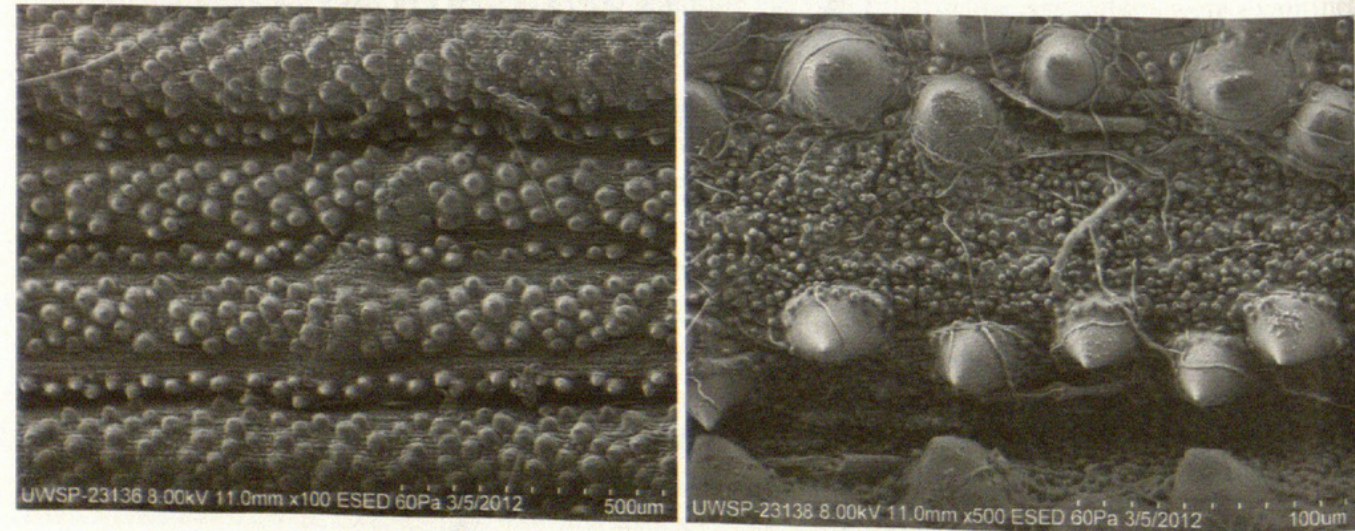


FIG. 3. Scanning electron micrographs (SEMs) of abaxial (lower) foliage leaf blade epidermis of *Aulonemia david-smithii* (*Smith 2045*, MO). A. Showing four costal zones and abundant conical prickles. B. Showing prickles, dense papillae nearly concealing stomates, and bicellular microhairs with deflated apical cells.

Papillae.—Abundant; globose to slightly compound; 4–6 μm in diameter.
Stomata.—Common; stomata alternating; stomatal rows 4–5, adjacent to costal zones. Four overarching branched papillae present at each of the corners, giving the stomatal apparatus a plus sign (+) shape.
Interstomatal cells.—ca. 20–30 μm long, outline indeterminate; papillae present, abundant, globose to slightly compound, uniform in size.
Long Cells.—Dimensions difficult to discern due to dense papillae.

Prickles.—Abundant, ca. 4/10,000 μm^2 ; mostly in intercostal zones, but present in costal zones; 30–50 μm long, 30–50 μm wide, tapered to a sharp tip, like a candy kiss.

Short Cells.—Difficult to discern due to dense papillae.

Microhairs.—2-celled, 55–60 μm long; basal cell 28–33 μm long, 7–10 μm wide; apical cell deflated, ca. 30 μm long.

Macrohairs.—None seen.

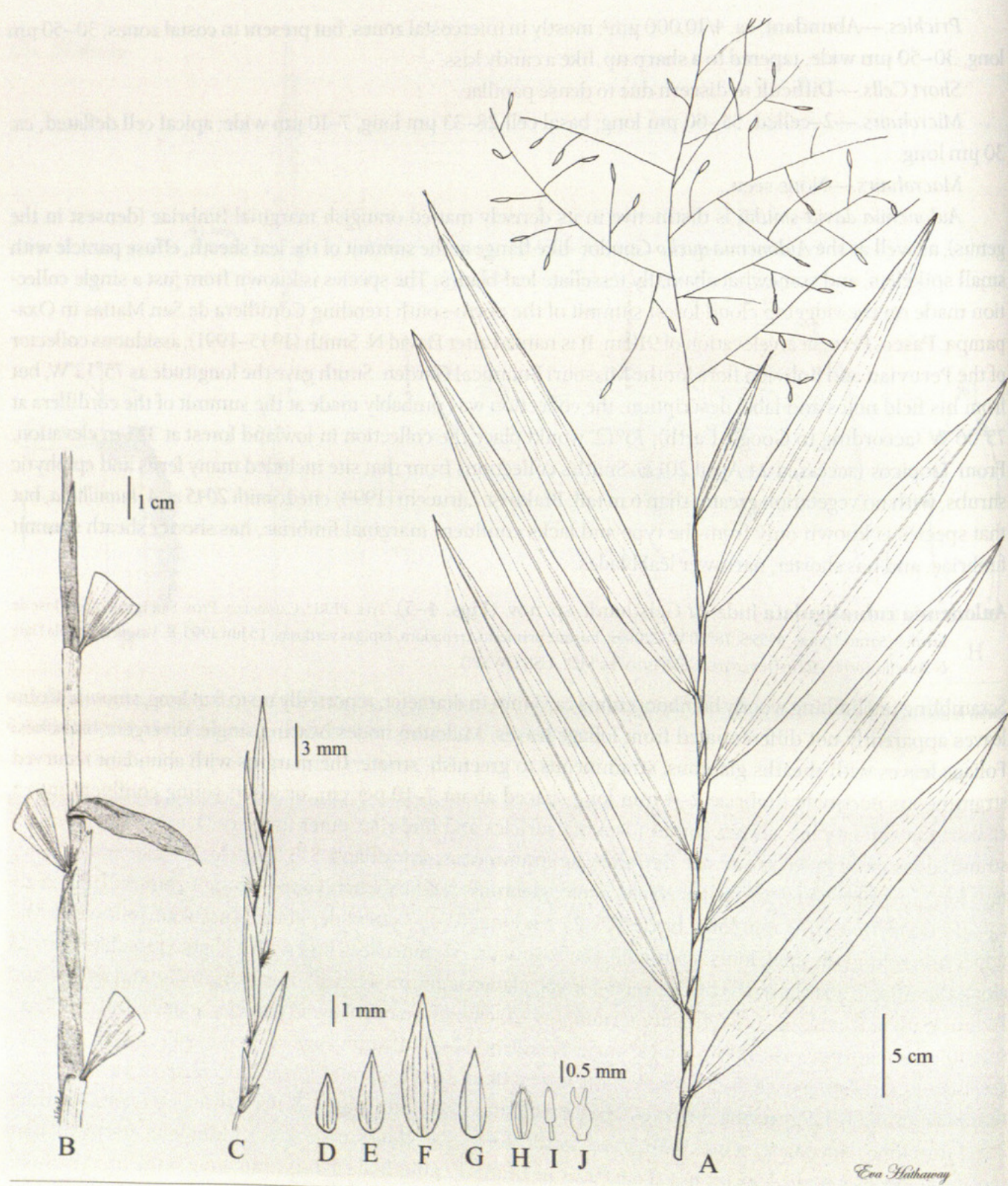
Aulonemia david-smithii is distinctive in its densely matted orangish marginal fimbriae (densest in the genus), as well as the *Aulonemia queko* Goudot-like flange at the summit of the leaf sheath, effuse panicle with small spikelets, and somewhat abaxially tessellate leaf blades. The species is known from just a single collection made on the ridgetop cloud forest summit of the north-south trending Cordillera de San Matías in Oaxapampa, Pasco, Peru, at an elevation of 910 m. It is named after David N. Smith (1945–1991), assiduous collector of the Peruvian and Bolivian flora for the Missouri Botanical Garden. Smith gave the longitude as 75°12'W, but from his field notes and label description, the collection was probably made at the summit of the cordillera at 75°06'W (according to Google Earth); 75°12' would place the collection in lowland forest at 325 m elevation. From Tropicos (accessed 24 April 2012), Smith's collections from that site included many ferns and epiphytic shrubs, with no vegetation greater than 6 m tall. Brako & Zarucchi (1994) cited *Smith 2045* as *A. humillima*, but that species is known only from the type and lacks confluent marginal fimbriae, has shorter sheath summit fimbriae, and has shorter, narrower leaf blades.

Aulonemia rubraligulata Judz. & Geisthardt, sp. nov. (Figs. 4–5). TYPE. PERU. CAJAMARCA: Prov. San Ignacio: San José de Lurdes, Santo Tomas, 4°55'S, 78°50'W, 2200 m, bosque primerio, trepadora, espigas verdosas, 15 Jun 1995, R. Vásquez, Camilo Díaz & Aurelio Torres 20216 (HOLOTYPE: USM; ISOTYPES: MO!, US!, UWSP!).

Scrambling or climbing woody bamboo; culms ca. 3 mm in diameter, reportedly up to 8 m long, smooth. Culm leaves apparently not differentiated from foliage leaves. Midculm nodes bearing single, divergent branches. Foliage leaves with sheaths glabrous, stramineous to greenish, striate, the margins with abundant recurved stramineous pectinate fimbriae 2–4 mm long spaced about 7–10 per cm, or when young confluent into a stramineous membrane; sheath summit lacking auricles and fimbriae; outer ligule ca. 1 mm long, indurate, chartaceous membrane; sheath summit lacking auricles and fimbriae; outer ligule ca. 1 mm long, indurate, stramineous, prolonged on one side into an ovate stramineous, shiny flap 1.5–3.5 mm long; inner ligule 20–45 mm long, membranous, linear-lanceolate, acute, glabrous, reddish when young fading to stramineous with age; pseudopetioles 2–3 mm long; blades 15–25 cm long, 0.7–2.3 cm wide, linear-lanceolate, reflexed or the upper ascending, the apex long-acuminate, the base acute, symmetrical, and with a slight crassulate hastula along the midrib abaxially, the blades concolorous, glabrous, antrorsely scabrous marginally, and etessellate. Peduncle up to 8 cm long. Inflorescence terminal, 8–20 cm tall, an open, ovoid panicle; branches all capillary, smooth, the main ones ascending at a 45° angle. Spikelets (12–)17–25 mm long, ca. 2 mm wide, linear, delicate, greenish to reddish, loosely 5–8-flowered, the lowest floret sterile; glumes linear-lanceolate, acute, glabrous, the lower glume 1–1.5 mm long, 1-nerved, the upper glume 2–2.5 mm long, 1–3-nerved; lowest (sterile) lemma 2.5–3 mm long, lanceolate, acute, 1–3-nerved; fertile florets 4–7, the lemmas 4.6–5.3 mm long, narrowly lanceolate, acute, 5–7-nerved, glabrous except for a fine beard of callus hairs 0.3–0.4 mm long at the base; rachilla internodes 2.7–3.3 mm long, exposed in their upper halves, glabrous except for some fine ascending puberulence in the exposed portions; paleas usually slightly shorter than and concealed by the lemmas; uppermost floret frequently smaller and rudimentary; lodicules 3, rhombic, 1.2–1.5 mm long, 3-nerved, pubescent at the apex; stamens 3, the immature anthers ca. 1 mm long; pistil with 2 immature stigmas; fruit not seen.

Additional specimens examined: **PERU. AMAZONAS:** ca. 12–18 km by trail E of La Peca, Serranía de Bagua, 1800–1950 m, lower montane cloud forest, 14 Jun 1978, in disturbed area of forest, Gentry et al. 22898 (MO, US). **CAJAMARCA: Prov. San Ignacio:** troche limite con “La Unión,” 2200 m, 1 Nov 1995, dominante, alcanza hasta 6–8 m, espigas rojizas, Camilo Díaz & Aurelio Torres 7828 (MO, US, UWSP). **Prov. Ignacio:** localidad Jorge Chávez, 5°S, 78°55'W, 2000 m, 19 Mar 1997, primary forest, J. Campos & S. Corrales 3567 (MO, US, UWSP). **JUNÍN:** Pichis trail, Porvenir, 1500–1900 m, 3–4 Jul 1929, dense forest, Killip & Smith 25959 (NY, US).

Leaf micromorphology, abaxial surface (Díaz & Torres 7828, UWSP). Terminology follows Ellis 1979; Fig. 5. Gentry et al. 22898 (MO) was also examined and exhibited a similar micromorphology.



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FIG. 4. *Aulonemia rubraligulata*. A. Foliage leaf complement and inflorescence. B. Detail of culm showing portions of three foliage leaves, each with a prominent inner ligule. C. Spikelet. D. Lower glume. E. Upper glume. F. Fertile lemma, dorsal view. G. Palea. H. Lodicule. I. Stamen. J. Pistil. A–B based on Díaz & Torres 7828 (MO), C–G based on Campos & Corrales 3567 (UWSP). Illustration by Eva C. Hathaway

Costal zones.—Spaced ca. 200 μ m apart.

Papillae.—Abundant in intercostal zones, absent in costal zones; globose to slightly compound; 3–6 μ m in diameter.

Stomata.—Common; stomata alternating; stomatal rows 4–6, adjacent to costal zones. Four overarching branched papillae present at each of the corners, giving the stomatal apparatus a plus sign (+) shape.

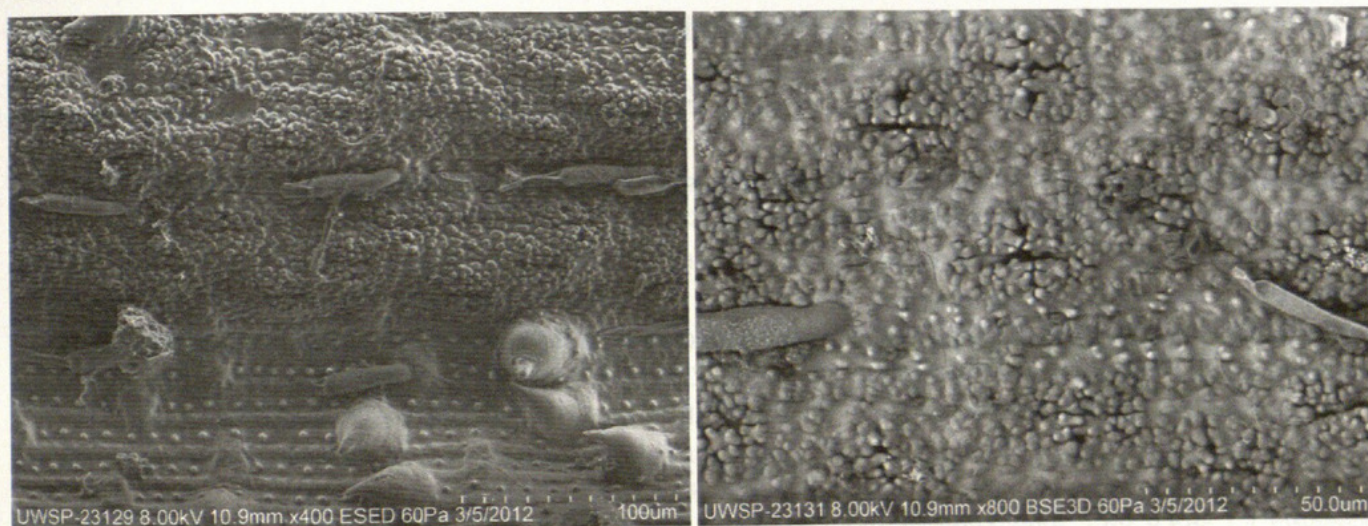


FIG. 5. Scanning electron micrographs (SEMs) of abaxial (lower) foliage leaf blade epidermis of *Aulonemia rubraligulata* (Díaz & Torres 7828, UWSP). **A.** Showing papillose intercostal zones and non-papillose costal zone. **B.** Showing prickles, dense papillae nearly concealing stomates, and bicellular microhairs with deflated apical cells.

Interstomatal cells.—Ca. 40–50 μm long, outline indeterminate; papillae present, abundant, globose to slightly compound, uniform in size.

Long Cells.—Dimensions difficult to discern due to dense papillae.

Prickles.—Common, ca. 3–4/10,000 μm^2 ; 35–45 μm long, 40–50 μm wide, tapered to a sharp tip, like a candy kiss.

Short Cells.—Difficult to discern due to dense papillae.

Microhairs.—2-celled, 75–80 μm long; basal cell 45–50 μm long, 7–10 μm wide; apical cell deflated, ca. 30 μm long.

Macrohairs.—None seen.

Aulonemia rubraligulata is endemic to cloud forests in northern and central Peru at elevations from 1500–2000 m; it may eventually be found in neighboring Ecuador, since one collection is only 8 km from the border of that country. The prominent reddish (when fresh) inner ligule 20–45 mm long is unique in the genus and prompted the specific epithet. Tovar (1993) cited Killip & Smith 25959 as *A. humillima*, but that species is known only from the type, is smaller of stature, has inconspicuous ligules, elongate leaf sheath summit fibrillae and smaller spikelets with fewer florets.

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