

# A New Subsection of *Anthurium* Section *Calomystrium* (Araceae) and Five New Species from Colombia and Ecuador

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## ABSTRACT

Subsection *Rupicola*, a new subsection of *Anthurium* section *Calomystrium* is proposed, encompassing nine rupicolous species. Descriptions and a key are provided for these species including: *A. antrophyoides* Killip, from Ecuador and Colombia, *A. chochoense* Croat and *A. antioquiense* Engler from Colombia, as well as *A. amnicola* Dressler, and *A. sytsmae* Croat from Panama. Five species, *A. palacioanum* Croat and *A. werffii* Croat from Ecuador, and *A. chochoense* Croat, *A. callejasii* Croat, and *A. vanderknaappii* Croat, from Colombia, are described as new. Members of this group were previously thought to belong in section *Porphyrochitonium* because of their generally lanceolate leaf blades, and stems with short internodes. However, lack of distinct glandular punctations on blade surfaces and the ability to interbreed readily with other members of section *Calomystrium* indicate that this new group belongs in section *Calomystrium*, and has evolved without conspicuous posterior lobes typical of section

*Calomystrium*, owing to their rupicolous habitat.

## KEY WORDS

Araceae, *Anthurium*, section *Calomystrium*, Colombia, Ecuador, Panama, new species, taxonomy, new subsection, subsection *Rupicola*.

## INTRODUCTION

In his revision of *Anthurium* for Panama (Croat, 1986), the senior author recognized an unusual group of rare species occurring only on rocks in rapidly moving streams. These species were first believed to belong to section *Porphyrochitonium* despite the lack of foliar glandular punctations typical of *Porphyrochitonium*. This group of species shared with section *Porphyrochitonium* their small stature, short, slender internodes, and lanceolate to oblong-elliptic blades. It was therefore assumed that these species were members of section *Porphyrochitonium* that had lost their glandular punctations. Of this group discussed in the Panama revision (Croat,

1986), only *Anthurium rupicola* Croat has proven upon further investigation to be an actual member of *A.* section *Porphyrochitonium*. *Anthurium rupicola* is the only species in section *Porphyrochitonium* thus far, that takes on a rupicolous habit. However, because of their streamlined shape, more species in section *Porphyrochitonium* could be expected to be rupicolous owing to the fact that they could grow in swiftly moving water without being dislodged. Breeding studies by H. Kamemoto (pers. comm.) and others have shown that some typical members of the small rupicolous group discussed here, e.g., *Anthurium antioquiense* and *A. amnicola*, readily interbreed with typical members of section *Calomystrium* such as *A. andreanum* André. This offers strong evidence that species comprising this small rupicolous group are actually members of section *Calomystrium* that have lost the cordate blades with prominent posterior lobes that are typical of this section. Anyone who has tried to carry a potted plant of typical members of sect. *Calomystrium* (with their prominent posterior lobes that regularly hook themselves on to other plants) down the narrow aisles of a greenhouse will realize that such plants would not survive long on a rock in a rapidly moving stream. The tough posterior lobes act much like anchors, catching on anything with which they come in contact. It is hypothesized that the small

group of rupicolous species, all believed to be rare, arose from the more typical members of the section by progressively adapting to a rheophytic life form along and eventually into the bed of streams, where they occur on rocks, much like *Spathiphyllum quindiuense* Engler. This group is sufficiently distinct from other more typical members of section *Calomystrium* with prominently cordate leaf blades to warrant subsectional recognition. The name *Rupicola* meaning "thriving among or inhabiting rocks", is proposed for this subsection. The terminology and descriptive terms in the present paper follow (Croat & Bunting, 1979). The new subsection *Rupicola* is characterized as follows:

***Rupicola*** Croat, subsect. nov. TYPE: *Anthurium antioquiense* Engl. Das Pflanzenr. IV. 23B. 174. 1905.

Differt a sect. typica per lamina plus minusve lanceolata, habitu rheophyta.

A key to *A. amnicola*, *A. antioquiense*, and *A. antrophyoides* was provided by Dressler (1980) and a key to the Panamanian species, *A. amnicola* and *A. sytsmae*, was compiled by Croat (1986). Below, these previous keys are expanded to include all nine species in subsection *Rupicola* emphasizing the main differences among the species.

#### KEY TO SPECIES OF SECTION *CALOMYSTRIMUM* SUBSECTION *RUPICOLA*

1. Leaves with single midrib, either lacking a pair of basal veins or with a single pair of basal veins (one on either side of the midrib) promptly merging with the margin.
2. Spathe flamingo-orange; spadix orange. . . . . *A. vanderknaapii* Croat.
2. Spathe lanceolate or elliptic, usually green, sometimes white or lavender-purple; spadix purplish, whitish or greenish.
  3. Leaf blades more than 30 cm long, broadest well above the middle; collective veins arising from just above the base; tertiary veins not prominulous; Colombia, Antioquia, ca. 200 m. . . . . *A. callejasti* Croat
  3. Leaf blades less than 22 cm long, broadest at about the middle; collective veins arising from one of the primary lateral veins in the middle or lower third of blade; tertiary veins prominulous; Central Panama and NE Ecuador, 200–550 m.
  4. Spadix green; berries early emergent, tapered and pointed at the apex, initially obovoid and green, maturing red-orange; cataphylls persisting as

- thin, yellow-brown fibers; Central Panama, 200–400 m. . . . *A. sytsmae* Croat
4. Spadix yellow; berries emerging mature, globose and purple; fibers of weathered cataphylls very persistent; NE Ecuador, 500–550 m. . . . .  
 . . . . . *A. werffii* Croat
1. Leaves with 3 to 9 veins (including the midrib) at the base of the leaf blade and with one or more pairs of basal veins extending all the way to the apex.
5. Leaves rhombic or ovate-rhombic, broadest well below the middle; basal veins 7–11 veins at base of leaf blade (3–5 basal veins per side) or with basal veins lacking; spadix white.
6. Leaf blades rhombic, drying subcoriaceous, dark brown on upper surface; spathe white; Colombia, slopes of western Andes in Valle Department, 0–250 m. . . . . *A. antrophyoides* Killip
6. Leaf blades ovate-rhombic, drying moderately thin, greenish to grayish yellow-brown on upper surface (if the weak submarginal veins are included); spathe green; Ecuador, slopes of eastern Andes in Napo Department, 1800 m. . . . . *A. palacioanum* Croat
5. Leaves lanceolate or elliptic, with 3 veins at base of leaf blade (midrib and a single pair of basal veins); spadix white or lavender.
7. Primary lateral veins numerous, sometimes not distinguishable from interprimary veins; cataphylls weathering into persistent fibers; spathe green; spadix white at anthesis. . . . . *A. chochoense* Croat
7. Primary lateral veins 3–5 pairs per side; cataphylls deciduous with only their papery bases remaining or persistent and intact, never fibrous; spadix dark violet-purple, yellowish or pink at anthesis.
8. Spathe ovate, lavender to purplish violet; spadix dark violet-purple; flower scent spicy, but not smelling of mint; fruits almost purple; stems 4–6 mm diam.; cataphylls soon deciduous, only their papery bases remaining; Central Panama, Coclé Province. . . . . *A. amnicola* Dressler
8. Spathe lanceolate, usually white, rarely lavender; spadix lavender; flower scent minty; fruits green or white; stems 12–15 mm diam.; cataphylls 5–11 cm long, persisting intact, drying reddish brown. . . . .  
 . . . . . *A. antioquiense* Engler

***Anthurium amnicola*** Dressler, Aroidaeana 3: 55. 1980. *Anthurium lilacinum* Dressler non Bunting, Selbyana 2: 300. 10 Jan. 1979 (Dec. 1978), non Bunting, Dec. 1975. Type: PANAMA. Colón: along tributary between Caño Rey and San Lucas, S of Coclé del Norte, 19 Aug. 1972, on boulders, 1.5–2 m above river, *R. L. Dressler 4210* (holotype, US; isotypes, MO, PMA, SEL). Figures 1A, 1B.

Rupicolous; stems to 30 cm long, 4–6 mm diam.; roots few, less than 2 mm diam.; **cataphylls** very thin, 4–5 cm long, drying reddish brown, persisting intact. LEAVES erect-spreading; **petioles** 6–11 cm long, subterete, shallowly sulcate adaxially; geniculum 1–2 cm long, incon-

spicuous; **blades** subcoriaceous, semi-glossy, elliptic to elliptic-lanceolate, gradually acuminate at apex, narrowly acute to rarely obtuse at base, 7–14.5 × 1.2–3.7 cm, usually broadest near the middle; upper surface sparsely and inconspicuously glandular-punctate; lower surface epunctate; **midrib** acutely raised above and below, sunken toward apex above; basal veins 1 to 2 pairs, weakly sunken; **primary lateral veins** 3 to 4 per side, more or less obscure; collective vein arising from the first basal vein, 3–4 mm from the margin. INFLORESCENCE erect; **peduncle** terete, 6–26 cm long; **spathe** subcoriaceous, pale lavender (B & K purple 6/5), ovate, 2.6–4.2 × 1.5–2.2 cm, abruptly acuminate to cuspidate at apex, rounded to attenuate at base, inserted



Fig. 1. A–B. *Anthurium amnicola* Dressler. (SEL # 76-0053-002). A. Habit. B. Inflorescence, close-up. C–D. *Anthurium antioquiense* Engl. (Hammel 15431A). C. Habit. D. Inflorescence, close-up.

at 45° angle on peduncle; stipe 3–7 mm long; **spadix** violet-purple, tapered toward apex, 0.8–2 cm × 4–5 mm. Flowers rhombic to more or less 4-lobed, 1.9–2.2 × 3–3.2 mm, inner margins ± straight; pistil weakly raised; stigma linear, ca. 0.4 mm long; lateral

stamens emerging first, the alternates following slowly; anthers white, ca. 0.6–0.7 mm long, 1 mm wide, held at edge of tepals; pollen white. INFRUCTESCENCE with globose, whitish berries, 4–4.5 mm diam., mesocarp gelatinous; seeds 1 to 2,

green, ovoid, slightly flattened, 2.5–3 × 2–2.5 mm.

*Anthurium amnicola* is endemic to Panama at 140 to 900 m in western Colón, Coclé, and Veraguas Provinces in areas of *Premontane rain forest* (P-rf) or *Tropical wet forest* (T-wf) life zones (Holdridge *et al.*, 1971). Robert Dressler, original collector of the type plant, now reports the species has been collected farther south near the coast in the same river systems where the type specimen was collected.

The species is distinguished by its small size, narrowly oblong-elliptic, gradually acuminate leaves that dry pale and are only obscurely glandular-punctate, and especially by its narrowly to broadly ovate, pale lavender spathe, and short, stubby, dark violet-purple spadix and whitish berries. The species is unusual in being weakly glandular-punctate only on the upper surface. Even these punctations are not easy to see.

*Anthurium amnicola* is most closely related to *A. antioquiense* Engl., which occurs in northern Colombia. *Anthurium antioquiense* has a similar habitat, habit, and similar epunctate leaf blades. *Anthurium antioquiense* differs from *A. amnicola* in having a white spathe and lavender spadix. *Anthurium amnicola*'s habitat and leaf blades are also similar to those of *A. sytsmae*. *Anthurium sytsmae* differs in having a green lanceolate spathe, a green spadix, and green fruits. *Anthurium rupicola* Croat also occurs on rocks in streams in Coclé Province, and might be confused with *A. amnicola*, but it is a typical member of *A. sect. Porphyrochitonium* differing in having conspicuously dark glandular-punctate blades. In addition, it has a green, lanceolate spathe, white spadix, and violet-purple to red berries.

Additional specimens seen—PANAMA. **Coclé:** Alto Calvario, *Folsom* 3155 (MO, RSA, SCZ); 5900 (MO); vic. El Copé, *Antonio* 3620 (MO, PMA); *Folsom* 3265 (CAS, F, MO, SEL, US); 4941 (DUKE, GH, MO); 8280 (MO); 8637 (MO); *Folsom & Collins* 6517 (MO, NY, PMA, RSA, SEL, US); *Hammel* 809 (MO); 2366 (MO); 4116

(MO); *Maas et al.* 2724 (MO, U); El Valle Market, near La Mesa, *Folsom* 2664 (MO); Caribbean side of divide at El Copé, 200–400 m, *Hamilton & Davidse* 2632 (MO); 2746 (B, US). **Colón:** Coclé del Norte, originally collected by Robert Dressler (Selby 76–0053–002), vouchered 9 Jan. 1992, as *Ingram* 1228 (SEL). **Veraguas:** 3 mi. from Agricultural school on road to Río Calovebora, along stream, *Antonio* 2057 (MO).

*Anthurium antioquiense* Engler, Das Pflanzenr. IV. 23B. 174. 1905. Type: COLOMBIA. Antioquia: Guadal, 300 m, *Kalbreyer* 1381 (B, K). Figures 1C, 1D.

Rupicolous herb; stems to ca. 25 cm long, creeping; **internodes** short, 1.0–1.5 cm diam.; roots dense, descending; **cataphylls** 5–11 cm long, persisting intact, drying reddish brown; **petioles** ca. half as long as blades, 5–19 cm long, 2–4 mm diam., narrowly and obscurely sulcate, semiglossy; **blades** narrowly lanceolate-elliptic, 10–27 × 2–5.5 cm, 3.6–9.6 times longer than broad, glossy to semiglossy on both surfaces, moderately bicolorous; **midrib** convex on both surfaces, slightly paler above, bluntly acute and slightly paler below; **primary lateral veins** 3–4(–6) per side, primary lateral veins and collective veins etched above, weakly raised below; basal veins 3, the lateral pair prominently extending to the base. INFLORESCENCES erect; **peduncles** (6.5–) 12–31 cm long, ca. 2 mm diam.; **spathe** white, rarely reported as lavender (*Hammel et al.* 15431), or lightly suffused with lavender (*Ingram* 873), erect-spreading, oblong-elliptic, acuminate, 2.5–4 (–7) cm × 6–14 mm at middle; **spadix** lavender to pinkish purple, stipitate 4–6 mm, narrowly cylindrical, 1.5–3 (–5) cm × 3–4 mm, sweetly fragrant. Flowers produce a mint-like aroma (fide *Hammel* 15431). INFRUCTESCENCE white to green; **berries** not seen.

*Anthurium antioquiense* is endemic to Colombia, known principally from Antioquia in the Central Cordillera from near sea level to 1300 m, mostly below 1000 m. It

has been collected in areas of *Tropical moist forest* transition to *Premontane* (T-mf/P), *Premontane wet forest* (P-wf), *Tropical moist forest/Tropical wet forest* transition zone and also *Tropical wet forest* transition to *Premontane* (T-wf/P).

Additional specimens seen—COLOMBIA. without locality, 900–1000 m, *Kalbreyer 1381* (K). **Antioquia:** without locality, *Croat 77270* (MO); Mun. Cocorná, *Serna 2774* (US); *Bro. Daniel 2774* (US); Road to Chocó, from Cocorna to Caldera, *Romero-Castaneda 1498* (COL); Vereda La Piñuela, road to San Francisco, *Cañas 383* (MO); along stream draining into Puchiná Reservoir, (Selby 89–0038), *Ingram 876* (SEL); Mun. San Luis, Vereda Manizales, 12 km from San Luis-San Carlos, Río Dormilón, *Callejas et al. 4242* (MO, VEN, WU); Medellín-Bogota Hwy., vereda La Josefina, Cañon de la Quebrada La Salada, *Hoyas & Hernandez 773* (MO); Región Santa Clara, *Callejas 3256* (MO); *Rentería et al. 2841* (MO); Quebrada Cristalina, *Ramírez et al. 103* (MO); *Ramírez et al. 981* (COL); *Ramírez & López 626* (COL, MO); 3.6 km from San Luis on road to San Francisco, *Betancur et al. 632* (COL, MO); Parque ecológico, Cañon del Río Claro, *Cogollo & Moreno 1160* (COL, JAUM, MO); *Cogollo & Borja 547* (MO); Mun. San Francisco, Correg. Aquitania, Río Venado, *Fonnegra et al. 4211* (COL, K, L, MO, QCA, SAR, TEX); Mun. San Carlos, Correg. El Jordán, embalse Puchiná-ISA, *Velásquez et al. 191* (MO); Vereda Santa Barbara, *de Escobar et al. 8367* (MO); ISA-Alto Samana, 3.8–4.3 km beyond turn off to the Presa Puchiná, Quebrada Quebradón, *MacDougal & Velasquez 4134* (MO, NY, US); Caño Negro, draining into Puchiná reservoir, *Hammel et al. 15431* (MO); Correg. Alto Samaná, Jardín-Miraflores, Quebrada La Miranda, *Callejas et al. 8530* (MO, NY); Mun. Anorí, Sitios El Río and Bramadero, km 1–9 above the Anorí-Dos Bocas Rd., NE of the town of Anorí, *Callejas et al. 8700* (MO, NY); **Valle:** Río Cajambre, Barco, *Cuatrecasas 17158* (US).

Cultivated collections—COLOMBIA. **Antioquia:** Cultivated by Coloborquideas, vouchered 21 May 1983 as *Croat 56778* (MO); Lyon Arboretum 81.495, originating from Wilson Botanical Garden, vouchered as *Nagata 2795* (MO); New York Botanical Garden, 1383/78 (MO); without exact locality, originally collected by Bruce McAlpin, Selby 78–1568, vouchered 25 Jan. 1986 as *Christenson 1144* (SEL); hort. ex Donselman, Selby 79–1554, vouchered 7 Mar. 1991 as *Ingram 873* (SEL); Cult. Anthuriumselecties, Bleiswijk, Holland, collected in 1990 by Nic van der Knaap and Nick van Rosmalen, vouchered 4 Sep. 1992 as *Croat 74034* (MO).

***Anthurium antrophyoides*** Killip, J. Wash. Acad. Sci. 16:565. 1926. Type: COLOMBIA. Valle: along Río Caballete near jct. with Río Dagua at Santa Rosa, 200 m, 22 Sep. 1922, *Killip 11555* (NY, US). Figures 2A, 2B.

Plant terrestrial, to ca. 50 cm tall; caudex 4–10 × 1–2 cm; **cataphylls** persisting intact, 7–9 cm long; **petioles** subterete, 14–33 cm long, sulcate adaxially; briefly sheathed at base; **blades** rhombic-ovate-lanceolate, 10–28 × 4.5–12 cm, with a triangular long-acuminate apex, abruptly cuneate-narrowed to petiole, suboblique, coriaceous, bright green and semiglossy to shiny above with minute and dense white punctations, light yellowish green and slightly paler and semiglossy below; [basal veins 7–11 (3–5 pairs per side), the outermost pair of veins reaching to within 0.3 mm of the margin in the lower half, extending to base of acuminate apex and anastomosing with second pair of basal veins, the second pair reaching to about 1.5 mm from the margin just above middle, and extending to apex, the 2 inner pairs of basal veins and the primary lateral veins anastomosing with the second pair of basal veins above middle; **primary lateral veins** 3 to 5 pairs per side, scarcely more conspicuous than the interprimary veins, arising at 10–20° angle. INFLORESCENCE erect; **peduncle** subterete, light green, 9–17 cm long; **spathe** white or green, some-



Fig. 2. A–B. *Anthurium antrophyoides* Killip. (Croat 56789). A. Habit. B. Inflorescence, close-up. C–D. *Anthurium callejasii* Croat. (Croat 77270). C. Habit. D. Inflorescence, close-up.

times waxy, elliptic,  $4\text{--}9.3 \times 2.3\text{--}3$  cm, acute rounded at apex and abruptly caudate-acuminate (acumen 1 cm long); stipe 1 cm long; **spadix**  $1\text{--}3 \times 0.5$  cm, erect, white to cream or pale green; perianth segments equal, about  $0.8\text{ mm} \times 1\text{ mm}$ .

*Anthurium antrophyoides* occurs in Colombia (Valle and Cauca) and Ecuador (Napó) at 100–400 m.

According to Engler's revision of *Anthurium* in *Das Pflanzenreich*, this species is most similar to *A. weberbaueri* Engl. in venation and general shape of the leaves.

The leaves of *A. antrophyoides*, however, are acute at base, not obtuse; the spathe is proportionately much broader, and the peduncles are shorter than the leaves, while in *A. weberbaueri* they exceed the leaves, and the flowers are smaller. Comparison of the type specimen of *A. antrophyoides* with type material of *A. weberbaueri* at Berlin (B) has been made by Killip. The leaves of *A. antrophyoides* also bear a very close resemblance to the fronds of the tropical African fern *Antrophyum mannianum* Hook.

Additional specimens seen—COLOMBIA. **Valle:** Cali-Buenaventura, km 104, Río Tatabro, *Idrobo & Kyburz 1769* (US); Bajo Anchicaya, *W. A. Kyburz 2* (NY, UC, US); vic. Santa Rosa, Río Caballete, *Killip 11555* (GH, US); Mun. Buenaventura, Correg. Bendiciones, rd. to Aguaclara, Calima medio, *Devia & Prado 2384* (MO); Correg. Cordoba, San Cipriano, Res. Nat. del Río Escalerete, *Devia et al. 3943* (MO); Río Agua Claro, ca. 40 km from Pacific Ocean, *Winters 9886* (US); ECUADOR. **Napo:** Río Granadilla, Codo Alto, *Jaramillo et al. 12681* (COL, HUA, QCA).

Cultivated collections—COLOMBIA. without locality, *Croat 56789* (COL, JAUM, MO); **Cauca:** Río Timbiquí, *Lehmann 8634* (F, US). **Valle:** Buenaventura area, Selby 81-2578, *Plowman 14109* (SEL); Selby 81-2578, 25 Jan. 1986, *Christenson 1150* (SEL). ECUADOR. Without locality, cult. by Tom Fennel, Florida, 1980, *Fennel A* (MO).

***Anthurium callejasii* Croat, sp. nov.**

Type: COLOMBIA. Antioquia: Mun. Taraza, Finca Callejas, ca. 200 m, originally collected by Bruce McAlpin, received from New York Botanical Garden 1383/78c, vouchered 5 Oct. 1994 as *T. B. Croat 77270* (holotype, MO-04660293, isotypes, K, HUA, US). Figures 2C, 2D.

Internodia 1–5 cm diam.; cataphylla persistentia intacta; petiolus 17.5–26 cm longus, 2–2.5 (–4) mm lata; lamina linearis-oblancoolata, 30–33 (44) cm longa, 3.5–4 (–5) cm

lata; nervi primarii laterales obscuri; spatha viridis; spadix atro-violascens-purpureus.

**Internodes** 1–1.5 cm diam., shorter than broad; **cataphylls** persisting reddish brown and intact; **petioles** 17.5–26 cm × 2–2.5 (4) mm, drying slightly ribbed, light green to medium brown; geniculum terete; **blades** 30–33 (–44) cm long, 3.5–4 (–5) cm wide at widest point, widest just above the middle, linear oblanceolate, subcoriaceous, weakly glossy and slightly bicolorous, drying grayish olive-green above, paler silvery green below; **midrib** convex paler and dark-green speckled above, convex and moderately paler below; **primary lateral veins** and collective veins equally obscure, all arising at ca. 50° angle. INFLORESCENCE erect-spreading; **peduncle** 26–33 cm long, 1–1.5 mm diam.; **spathe** green, spreading and recurled under, drying medium brown to slightly reddish brown, 4–6 mm wide, lanceolate; **spadix** green pre-anthesis, soon turning dark violet-purple, matte, 3–7 cm long, drying medium brown to reddish brown, drying ca. 3 mm diam.

*Anthurium callejasii* is known only from the type locality. It is distinguished by linear-oblanceolate, green-drying blades with a single pair of collective veins arising somewhat above the base, and by the green spathe and spadix. It can be compared with *A. systmae* and *A. werffii*, both of which differ in having shorter blades (less than 22 cm long), being broadest at about the middle, and by having the collective veins arise from one of the primary lateral veins from the middle of the blade to the lower third of the blade as well as with prominently reticulate tertiary veins. In contrast, *A. callejasii* has blades broadest well above the middle with the collective vein arising just above the base of the blade, and obscure tertiary veins.

***Anthurium chochoense* Croat, sp. nov.**

Type: COLOMBIA. Chocó: vic. of “La Equis” mine, short road N of Bolívar-Quibdó Highway, around km 182–183, 300 m, 31 Oct. 1983, *A. Juncosa 1175* (holotype, MO-3158418, isotypes, B, COL, JAUM, K, US). Figure 3A.

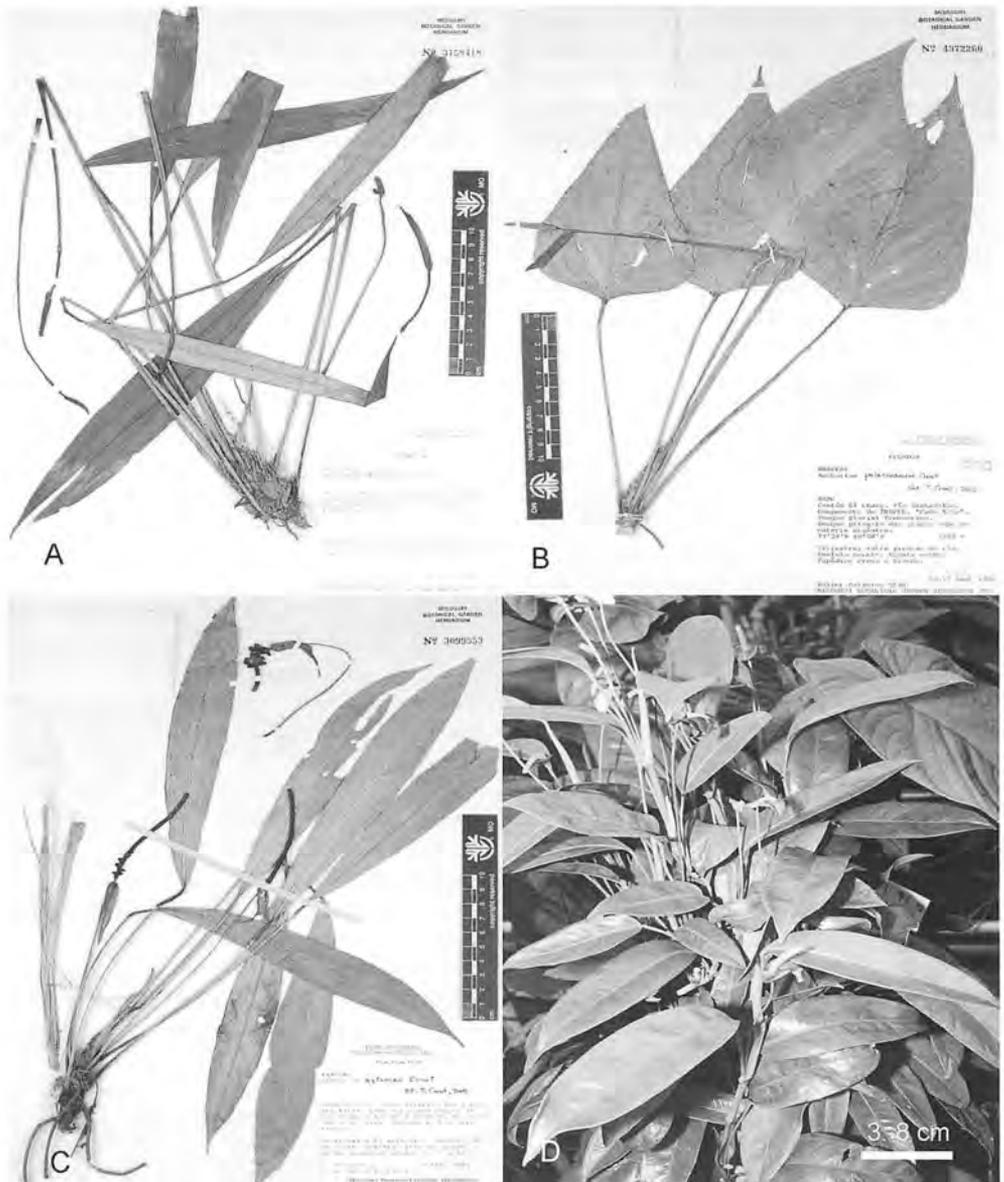


Fig. 3. A. *Anthurium chochoense* Croat. (*Juncosa* 1175). Herbarium type specimen. B. *Anthurium palacioanum* Croat. (*Palacios* 5580). Herbarium type specimen. C. *Anthurium sytsmae* Croat. (*Davidse & Hamilton* 23578). Herbarium type specimen. D. *Anthurium vanderknaapii* Croat. (*Croat* 90341). Habit.

Herba rupicola; internodia brevía, 8–15 mm diam.; cataphylla 5.5–6.5 cm longa, persistentia in fibras soluta; petiolus subteres, leviter sulcatus, 8–23 cm longus; lamina foliorum oblongo-elliptica, 21–28 cm longa, 1.5–2. cm lata; nervi

primarii laterales numerosi, debiles; pedunculus 30–53.5 cm longus; spatha anguste lanceolata, viridis, 3.5–4 cm longa, 5–8 mm lata; spadix 3.7–6.0 cm longus, 3–6 mm diam., luteus, sessilis; baccae albae.

Rupicolous herb; stems short; **internodes** short, 8–15 mm diam.; roots numerous; leaf scars hidden by cataphylls; **cataphylls** 5.5–6.5 cm long, briefly intact, then weathering into fine, pale fibers; **petioles** subterete, weakly sulcate adaxially, 8–23 cm long, 0.5–0.7 the length of the blades; geniculum 8–15 mm long, drying darker than surface; **blades** subcoriaceous, narrowly oblong-elliptic, gradually acuminate at apex, narrowly acute at base, 21–28 × 1.5–2.7 cm, broadest usually at the middle; upper surface dark green and iridescent, lower surface yellow-green, both surfaces drying matte to weakly glossy, epuncate on the upper surface, inconspicuously and densely pale-punctate on the lower surface (punctations irregularly shaped, raised, but not apparently glandular); **midrib** convex and concolorous above, drying prominently raised, narrowly raised and paler below, drying raised and irregularly ridged; **primary lateral veins** many, not at all distinguishable from the interprimary veins upon drying, departing midrib at 20–50° angle, straight or weakly curved to the collective veins, weakly sunken above and about as prominent as collective veins, raised below and more prominent than primary lateral veins, drying prominently raised on both surfaces; interprimary veins numerous, drying prominulous on both surfaces; collective veins drying raised on both surfaces, generally more prominent than the lateral veins, not loop-connecting the primary lateral veins. INFLORESCENCE erect-spreading, usually several per plant at flowering; **peduncle** terete, 30–53.5 cm long, 2–3 mm diam.; **spathe** green, subcoriaceous, narrowly lanceolate, 3.5–4 cm × 5–8 mm, broadest usually just above the base, abruptly to gradually acuminate at apex, acute at base, inserted at 45° angle on peduncle; **spadix** white at anthesis, becoming green post-anthesis, weakly tapered to apex, 3.7–6.0 cm × 3–6 mm near the base, 2–3 mm diam. near the apex. Flowers subquadrangular, 2.0–2.2 × 1.4–1.6 mm, 5–6 flowers visible in the principal spiral; tepals semiglossy, the lateral tepals 2–2.2 mm wide, the inner margin thin,

broadly rounded, outer margin obtusely 2–3-sided. INFRUCTESCENCE not seen, but berries white (fide *Idrobo 1901*).

*Anthurium chocoense* is endemic to Colombia, known only from the Department of Chocó. All collections have been found either on rocks in streams or rooted at the margins of streams. Flowering plants have been collected in February, April and July.

The species is easily confused with *Anthurium rupicola* Croat, a species from Panama in section *Porphyrochitonium* having remarkably similar features including the size and shape of blades, spadix and spathe color, as well as similar persistent pale cataphylls. However, *A. chocoense* lacks the typical glandular-punctate lower blade surfaces characteristic of section *Porphyrochitonium*. Instead, *A. chocoense* has irregularly shaped, pale, somewhat raised, non-glandular punctations. *Anthurium chocoense* also differs from *A. rupicola* in having sessile, rather than the usually stipitate spadices of *A. rupicola*, and numerous barely weak primary lateral veins (barely distinguishable from the interprimary veins) rather than 8–10 distinguishable primary lateral veins. All the lateral veins of *A. chocoense* are also more prominently raised upon drying than the veins of *A. rupicola*.

The species was first collected in 1955 by Jesus Idrobo. All collections are known from the Department of Chocó, hence the name *A. chocoense*.

Additional specimens seen—COLOMBIA. **Chocó:** Condoto vic., *Idrobo 1901* (COL); Mun. Quibdó; Corr. de Bebará, sector La Calle, in Río Bebará, *Córdoba 331* (MO); *441* (CHOCO, COL); *492* (COL); Corr. de San Francisco de Ichó, Río Necorám, *Galeano & Bernal 429* (HUA); Correg. Guayabal, Río Hugón, *Forero & Jaramillo 2791* (COL).

*Anthurium palactioanum* Croat, **sp. nov.**

Type: ECUADOR. Napo: Cantón El Chaco. Río Granadillo, Campamento de INECEL, "Codo Alto", 0°08'S, 77°28'W, 1300 m, *W. Palacios*

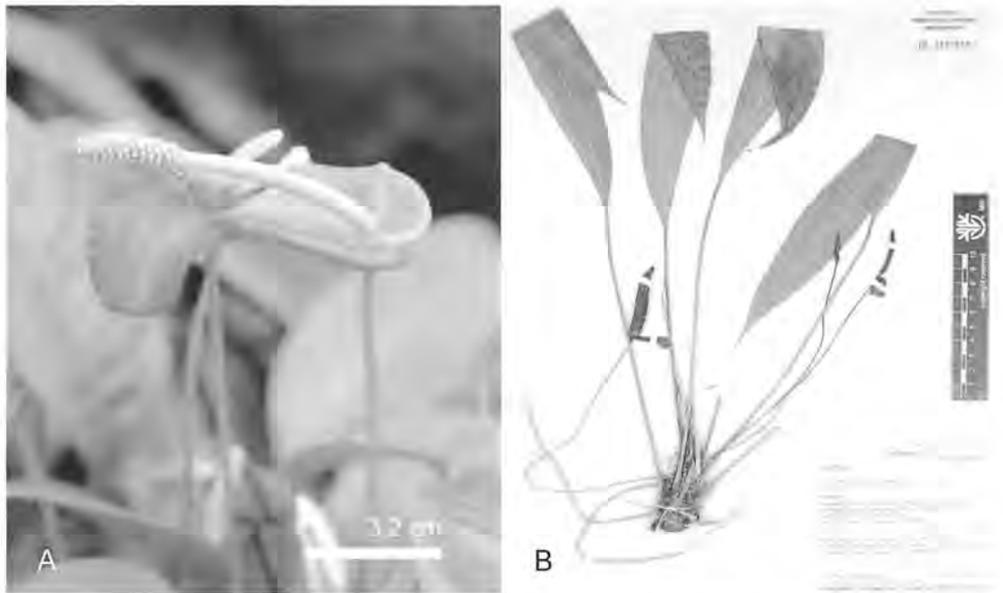


Fig. 4. A. *Anthurium vanderknaapii* Croat. (Croat 90341). Inflorescence, close-up. B. *Anthurium werffii* Croat. (van der Werff et al. 11981). Herbarium type specimen.

5580 (holotype, MO-4372260; isotypes COL, K, QCNE, US). Figure 3B.

Planta rupicola; internodia brevia, 1 cm diam.; cataphylla 5.5 cm longa, non persistentia; petiolus 11–19 cm longus, teres; lamina 13.5–18 cm longa, 9.5–12 cm lata, nervi primarii laterales 4 utroque; pedunculus 31 cm longus; spatha oblongo-lanceolata, 4.3 cm longa, 1 cm lata.

Rupicolous; stems short; **internodes** short, ca. 1 cm diam.; roots moderately few, drying 1.5 mm diam.; **cataphylls** to 5.5 cm long, light reddish brown, intact with pale fibers at base, apparently deciduous; **LEAVES** erect to spreading; **petioles** 16–19 cm long, drying ca. 3 mm diam., terete, slightly longer than the blades; geniculum 1.5 cm long, as thick as petioles; **blades** subcoriaceous, epunctate, ovate-rhombic, 13.5–18 × 9.5–12 cm, gradually acuminate at apex, broadly obtuse to almost truncate at base, drying greenish to grayish yellow-brown above, gray-green to pale yellow-brown below; **midrib** and basal veins moderately raised on drying; basal veins 3–4 (–5) pairs, all free to the base or sometimes with the lowermost

fused 5–7 mm to the adjacent pair of basal veins; **primary lateral veins** 4 pairs per side, arising at 25–30° angle; collective veins arising from the 1st basal vein, sometimes weakly loop-connected with the 2nd basal vein. **INFLORESCENCE** held slightly above the leaves; **peduncle** robust, 31 cm long; **spathe** green, oblong-lanceolate, erect-spreading to reflexed, 4.3 cm long, ca. 1 cm wide, narrowly acuminate, inserted at an acute angle; **spadix** 4.7 cm long, stipe 1.5 mm long, spadix proper 3.2 cm long, drying 6 mm diam., white to cream, tapered to a blunt apex. Flowers ca. 4 per spiral, 1.4–1.7 × 2.0–2.2 mm; tepals with a few raphide cells; lateral tepals 1.6 mm wide, the inner margin broadly rounded. **INFRUCTESCENCE** not seen.

*Anthurium palacioanum* is endemic to Ecuador, known only from two localities in Napo Province, one at the type locality in Canton El Chaco, the other in Canton Archidona on the Hollín-Loreto Road. The species usually occurs on rocks in rapidly flowing streams at 800–1980 m elevation in *Premontane rain forest* (P-rf). The species is named in honor Walter Palacios, formerly an employee of the Herbario Nacional

and one of the finest plant collectors in the history of collecting in Ecuador. Walter has collected many interesting plants and new species, including this species.

Additional specimens seen—ECUADOR.

**Napo:** Codo Alto, Río Granadillo, *Jaramillo et al. 12681* (COL, HUA, MO); Cantón Archidona, Hollín-Loreto Rd., Río Ruataraco, 2 hrs. by foot to Aldea Guagua Sumaco, *Cerón & Factos 7441* (MO).

***Anthurium sytsmae*** Croat, Monogr. Syst. Bot. Missouri Bot. Gard. 14: 185–186. 1986. Type: PANAMA. Coclé: area between Caño Blanco del Norte, Caño Sucio and Chorro del Río Tife, 8.42'19"–8.43'06"N, 80.36'30"–80.38'W, 200–400 m, evergreen forest, 3 Feb. 1983, *G. Davidse & C. W. Hamilton 23578* (holotype, MO-3099553; isotypes, K, PMA). Figure 3C.

Rupicolous; 35–50 cm tall; stems ca. 10 cm long; roots moderately few, descending, ca. 3 mm diam.; **cataphylls** 6–9 cm long, narrowly pointed at apex, thin, soon weathering to slender, pale brown fibers and persisting loosely at uppermost nodes, eventually falling. LEAVES erect to spreading; **petioles** 13–18 cm × 2–3 mm, narrowly sulcate; geniculum 1.3–1.5 cm long; **blades** subcoriaceous, oblong-oblancoolate, 19–25 × 3–4.5 cm, gradually acuminate at apex (the acumen 1–2 cm long, apiculate ca. 1 mm), narrowly acute at base, epunctate below, drying yellowish brown, sparsely and obscurely glandular-punctate above, drying grayish brown; **midrib** raised below, weakly raised above; **primary lateral veins** 5–7 pairs per side, prominently ascending, departing midrib at 15–30° angle, drying scarcely more prominent than the interprimary veins; reticulate veins drying prominulous on upper surface, prominent on lower surface; collective vein arising from one of the primary lateral veins in the middle to lower third of the blade. INFLORESCENCE erect, usually longer than the petioles; **peduncles** 13–16 cm long; **spathe** oblong-lanceolate, 2.7–4.7 cm × 5–10 mm, green, at first

erect, becoming prominently reflexed, narrowly acuminate at apex (the acumen 1–6 mm long, inrolled), inserted at ca. 45° angle; **spadix** stipitate 2–3 mm, greenish brown (probably at anthesis), narrowly oblong, scarcely or not at all tapered, 7.4–9.5 cm × 3 mm (dried), bluntly rounded at apex. Flowers rhombic, 2.2–2.5 × 1.9–2.2 mm, the sides gradually sigmoid; 3 flowers visible in the principal spiral, 5–6 flowers visible in the alternate spiral; tepals drying glossy, lateral tepals 1.3–1.4 mm wide, inner margins convex, thin; pistils not at all emergent, green; stigma slit-like, 0.3 mm long, the space between the tepals 0.3–0.4 mm wide; staminal emergence not studied, stamens apparently retracting (at least upon drying); anthers 0.3 mm long; thecae oblong-ovoid, slightly divaricate. INFRUCTESCENCE spreading; spathe persistent; **berries** green, obovoid, round at apex, 6.5–9 × 4.5–5.5 mm, periderm thick, lacking obvious raphide cells; seeds 2, 4.5–5 × 2–2.8 mm, somewhat flattened, enveloped in a gelatinous substance.

*Anthurium sytsmae* is endemic to Panama in the Coclé and Bocas del Toro Provinces occurring in *Tropical wet forest* (T-wf). It is known only from rapidly flowing streams at 200–400 (850–950) m where it grows on rocks along the stream margins or in the spray basin of waterfalls.

The species is closely related to *A. amnicola*, which is also only sparsely and obscurely punctate on the upper surface, as well as *A. antioquiense* Engl., from Colombia, which is only sparsely punctate.

This species was the third riparian species to be discovered in rapidly flowing streams on the Caribbean slope of Coclé Province (the other two being *Anthurium rupicola* and *A. amnicola*). It differs from both of these species in that it has prominent reticulate venation. Although this venation is closest to that of *A. amnicola*, the latter species has an ovate, pale lavender spathe and a much shorter, violet-purple spadix. It differs from *A. rupicola* because the collective vein arises from one of the primary lateral veins in the middle of the blade. *Anthurium rupicola* has the collective vein arising from the base

of the blade. *Anthurium sytsmae* also lacks the leaf punctations that are clearly present in *A. rupicola*.

*Anthurium sytsmae* has been collected in flower and fruit in February and is named for Kenneth Sytsma who made the first collection in 1982.

Additional specimens seen—PANAMA. **Coclé:** *Davidse & Hamilton 23639* (MO); vic. of waterfall of Río Tife, base of Cerro Tife, *Knapp 3699* (MO, US); between Caña Susio and waterfall at base of Cerro Tife, ca. 4 hr. hike, *Sytsma 2544*. **Bocas del Toro:** Gualaca-Chiriquí Grande, along the oil pipeline N of Continental Divide, in forest W of pipeline rd. at end of driveable rd., *Hammel et al. 14703* (B, MO, PMA).

*Anthurium vanderknaapii* Croat, **sp. nov.** Type: COLOMBIA. Valle: Dagua, originally collected by Arend de Willde, 1996, cultivated at Anthura, Inc., Bleiswijk, Holland, vouchered Mar. 2003, as *T. B. Croat 90341* (holotype, MO-5864048; isotypes, B, CAS, COL, GB, K, NY, US). Figures 3D, 4A.

Terrestris, rupicola, ad 1.5 m; internodia 2–6 (–7) cm longa, 5–8 mm diam.; cataphylla 5–8.5 cm longa, persistens semi-intactum; petiolus 4–9 (–13.5) cm longus, ca. 2 mm diam.; lamina lanceolata, (8)13–14(19) cm longa, (2.8)3–4.5 (–6.3) cm lata; nervi primarii laterales ca. 5–7 per utroque; pedunculus 14–17.5 cm longus, 1.5–2 mm diam.; spatha late ovata, 4–4.5 cm longa, 2.5–3.8 cm lata, subcordata, rubra-aurantiacus: spadix aureus vel aurantiacus, 3.5–6.5 cm long, 4–6 mm diam. anthesis, ad 1.7 cm diam. per anthesis.

Terrestrial, rupicolous, 1.5 m tall; **internodes** 2–6 (–7) cm long, to 5–8 mm diam., medium to dark green, semiglossy; roots a few at each node; **cataphylls** 5–8.5 cm long, turning reddish brown, sharply 1-ribbed near apex, persisting semi-intact at upper nodes; **petioles** 4–9 (–13.5) cm long, ca. 2 mm diam., subterete to weakly and narrowly flattened, weakly sulcate adaxially, medium dark green and semiglossy

and obscurely densely short-lineate, drying light to medium reddish brown; geniculum 5–15 mm long, scarcely thicker, obtusely C-shaped to sharply C-shaped, **blades** subcoriaceous, dark green and moderately glossy above, slightly paler to slightly less glossy below, drying dark green to olive-green above, slightly paler yellow-green below, lanceolate, (8–)13–14(–19) cm long, (2.8–)3–4.5 (–6.3) cm wide at middle; **midrib** raised and paler (drying concolorous) above, drying narrowly raised and slightly paler yellow below; **primary lateral veins** ca. 5–7 pairs per side, weakly etched above, slightly darker and flat below. INFLORESCENCE erect; **peduncle** 14–17.5 cm long, 1.5–2 mm diam., drying dark reddish brown, slightly ribbed; **spathe** broadly ovate, 4–4.5 cm long, 2.5–3.8 cm wide at widest point, almost as broad as long, subcordate, emerging white, soon becoming red-orange, then greenish in age, drying reddish brown, weakly glossy above, semiglossy below; **spadix** bright golden-yellow to orange, 3.5–6.5 cm long, 4–6 mm wide before anthesis, up to 1.7 cm wide at anthesis, ageing to a dirty pink, drying dark brown to dark reddish brown. Flowers 5–6 per spiral, square, the margins straight on the principal spiral, weakly sinuate on the perpendicular margins; tepals weakly glossy; pollen yellow; berries orange-red; seeds 2.25 mm long, 1.5 mm diam.; mesocarp juicy.

*Anthurium vanderknaapii* is endemic to Colombia, known only from two localities, the type locality on the western slope of the Cordillera Occidentale, as well as near Manizales in the Cordillera Central. The species is recognized by its elongate internodes, lanceolate, eglandular blades, broadly ovate red-orange spathe, and golden-yellow spadix. No other species of *Anthurium* appears to be confused with this species and none have this combination of characters. It is placed within section *Calomystrum* because of its colorful spathe and spadix, characteristic of this section, and placed within the subsection *Rupicola* due to its original collection near Dagua in an area of many streams and rock outcrops.

This new species is named for Nic van der Knaap, owner of Anthura, Inc., Bleiswijk, Holland, where the type plant was vouchered by the senior author. Anthura, Inc. is the world's largest breeder of ornamental *Anthurium*, and has contributed immeasurably to the worldwide interest and popularity in ornamental aroids. Nic van der Knaap has been benefactor of the International Aroid Society being one of only a few financial sponsors of the VIII International Aroid Conference in St. Louis.

Additional specimens seen—COLOMBIA. **Caldas:** Manizales, collected and cultivated by Marta Posada de Robledos, Medellín, Colombia, vouchered 28 Apr. 1983 as *Croat 56358* (MO).

***Anthurium werffii*** Croat, **sp. nov.** Type: ECUADOR. Esmeraldas: border between Carchi and Esmeraldas, ca. 20 km past Lita on road Lita-Alto Tambo, 0°45'4"N, 78°15'4"W, 550 m, *H. van der Werff, B. Gray & G. Tipas 11981* (holotype, MO-3870548; isotypes, B, CAS, COL, F, K, NY, QCA, QCNE, US). Figure 4B.

Planta epilithica; internodia brevia, 1 cm diam.; cataphylla 5–7 cm longa, persistentia in fibras tenues soluta; petiolus 11–23 cm longus, teres aut leviter sulcatus; lamina subcoriacea, oblongo-oblancheolata, 15–23 cm longa, 2–3.5 cm lata, epunctata; nervi primarii laterales 5–7 utroque; nervi collectivi e nervis primariis lateralibus medio vel triente inferiore laminae exorientes; inflorescentia erecta; pedunculus 8–22 cm longus; spathe viridis, oblongo-lanceolata, 2–2.5 cm longa, 6–8 mm lata; spadix viridis, stipitata 2–3 mm, 1.5–3.5 cm longa, 3 mm diam.; baccae purpureae.

Epilithic; stems ca. 5 cm long; **internodes** short, less than 1 cm diam.; roots moderately few, ca. 3 mm diam.; **cataphylls** 5–7 cm long, soon weathering into thin, yellow-brown, persistent fibers, 1–2 of the uppermost persisting intact, dark brown. LEAVES erect, soon spreading to reflexed; **petioles** 11–23 cm × 2 mm, terete or slightly sulcate; geniculum 1–

1.5 cm long, drying darker than petiole; **blades** narrowly oblong-elliptic, reticulate-veined, epunctate, about the same length as the petioles, subcoriaceous, oblong-oblancheolata, 15–23 × 2–3.5 cm, gradually acuminate at apex (acumen 1–1.5 cm long, apiculate 2 mm), narrowly acute at base, drying yellowish green; **midrib** weakly raised above, round raised below; **primary lateral veins** 5–7 pairs per side, prominently ascending, departing midrib at 20–30° angle, drying yellow below (otherwise tertiary veins nearly as prominent); basal veins 1 pair, rising from the base, collective vein arising from primary lateral veins in the middle to lower third of the blade; INFLORESCENCE erect, much shorter to slightly longer than petioles (12–25 cm); **peduncles** 8–22 cm long, slender; **spathe** oblong-lanceolata, 2–2.5 cm × 6–8 mm, spreading to reflexed, acute to acuminate at apex, green tinged with purple, inserted at ca. 45° angle; **spadix** stipitate (stipe 2–3 mm long), spadix yellow or green, cylindrical to slightly tapered toward apex, 1.5–3.5 cm × 3 mm at anthesis. Flowers square, 1.7–2.0 × 1.8–2.0 mm, the sides perpendicular to spirals, sigmoid; 3 or 4 flowers visible in both principal and alternate spiral; lateral tepals 1.0 × 0.7 mm, inner margins convex; pistils not emergent. INFRUCTESCENCE erect; spathe persistent; **berries** globose, round at apex, 4.7 × 3 mm, each purple on upper third, without visible raphide cells, bilocular; seeds one per locule, 3 × 1.6 mm, 1.4 mm thick, with small transparent mucilage at micropylar end.

*Anthurium werffii* is known only from the Pacific slope of Ecuador in Esmeraldas Province at (200) 500–550 m in *Tropical rain forest* (T-rf) and *Tropical wet forest* (T-wf). This species grows principally on rocks or trees along and within streams.

The species is named for Henk van der Werff, curator at the Missouri Botanical Garden, who made the first collection of the species and the type specimens. Henk, harking back to his Dutch background, has an interest in bringing interesting plants into cultivation.

Additional specimens seen—ECUADOR.

**Esmeraldas:** Río Negro, 2 km from El Placer, *Palacios 6921* (CAS, MO, QCNE); San Lorenzo Cantón, Res. Etnica Awá, Parroquia Ricaurte, Centro Pambilar, *Aulestia & Aulestia 1058* (CAS, MO, QCNE); Parroquia Mataje, Centro Mataje, *Aulestia et al. 488* (MO); up Río Palaví from Awá Indian encampment, *Hoover et al. 4115* (MO, QCA); *4167* (MO, QCA); *4176* (MO, QCA); Res. Cotacachi-Cayapas, Río Tigre, *Cornejo & Bonifaz 6499* (GUAY, MO).

## CONCLUSION

These nine moderately to highly endemic *Anthurium* species occur as rupicolous stream bed epiliths. In an earlier treatment, the senior author assigned three of these species to section *Porphyrochitonium* on account of their punctate leaves (Croat, 1986). Although leaf punctations are clearly present in *A. rupicola* they are quite sparse and inconspicuous in *A. amnicola* and *A. antioquiense*, and, on second examination of *A. sytsmae*, appear entirely absent in that species. Leaf punctations are also absent from *A. antrophyoides*, *A. palacioanum*, and from one of the new species, *A. werffii*. There is now evidence from breeding programs with some species in this complex, especially *A. amnicola*, that all of these species are actually members of section *Calomystrium*. *Anthurium amnicola* will not cross with members of section *Porphyrochitonium*, but it does cross readily with members of section *Calomystrium*. Many typical members of section *Calomystrium* have glandular punctations, but until now no lanceolate-bladed species were considered members of this section. These

rupicolous species seem to have evolved blade shapes that can withstand the tremendous shearing pressures of rushing water in those relatively brief periods when streams rise following heavy rain storms. It is curious that *A. rupicola* is the only species in section *Porphyrochitonium* occurring on rocks that has made the transition into streams. Other species in the section *Porphyrochitonium* occur as epiphytes or are terrestrial understory forest species. Since *Anthurium* section *Calomystrium* provides the bulk of the species used in the cut flower industry these lanceolate species of *Calomystrium* may be important members of breeding programs. Already *A. amnicola* has played a very important role in providing a lavender-colored spathe in hybrids.

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