Two new Andean genera for the tribe Spathicarpeae (Araceae)

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Two new Andean genera for the tribe *Spathicarpeae (Araceae)*

Abstract

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Two unispecific Andean genera are described as new to science in the tribe *Spathicarpeae (Araceae)* and illustrated, based on two species formerly placed in the genus *Asterostigma*. The genus *Incarum* is erected to accommodate *A. pavonii* that occurs in Andean Peru, Bolivia and Ecuador, and the new combination *Incarum pavonii* is validated. The genus *Croatiella* is erected to accommodate *A. integrifolium* from Ecuador and the new combination *Croatiella integrifolia* is validated. *Incarum* is considered related to the Andean genera *Gorgonidium* and *Spathantheum,* whereas *Croatiella* seems to be an isolated lineage within the core *Spathicarpeae*. The arguments to support these new genera come from cpDNA sequence data, as well as from biogeographical and morphological aspects.

The neotropical genus *Asterostigma* Fisch. & C. A. Mey. was formerly known as having nine species, most of them distributed in coastal Brazil, but including two species with an Andean distribution (Gonçalves 1999). *Asterostigma* along with *Gorgonidium* Schott, *Spathantheum* Schott, *Mangonia* Schott, *Taccarum* Brongn. ex Schott, *Gearum* N. E. Br., *Spathicarpa* Hook. and *Synandrospadix* Engl. form the wholly neotropical tribe *Spathicarpeae* (sensu Mayo & al. 1997). For a taxonomic revision of this tribe (Gonçalves, in prep.), its members and putative allies have been evaluated by means of cpDNA phylogeny and morpho-anatomical studies (unpubl. data). The results of this broad survey will be published elsewhere, but one result is that the two species of *Asterostigma* with an Andean distribution have been shown to be sufficiently different from all other genera in the tribe (and also from each other) to represent two separate genera, which are here described as new to science.

Incarum E. G. Gonç., **gen. nov.**
Typus: *Incarum pavonii* (Schott) E. G. Gonç.

Herba geophytica. *Caulis* tuberosus hypogeous, globosus vel subglobosus. *Folium* solitarium, lamina pinnatipartita, venatio reticulata. *Inflorescentia* 1-2, ante foliis producens, erecta sub anthesi;

pedunculus quam petiolo longior vel paullo brevior; *spatha* erecta leniter constricta ad medium; *spadix* ad spatham basaliter adnatus, parte femina densiflora, parte mascula densiflora sine staminodia ad basim. *Flores* unisexuales nudi, flores masculi (synandria) 2-3-andricis non nisi ad basim connatis, thecae subglobosae, deshiscentes ad apicem rima longitudinali; *flores* feminei cum 4-6 staminodiis obpyramidalibus libris valide papillosis ad apicem, ovarium ovoideum, 4-5-loculare, ovulum solitarium orthotropum ad basim loculi insertum. *Infructescentia* cum spatha persistens, baccae carnosae densiter dispositae. *Semina* cum testa nitida, endospermium copiosum.

Geophytic herb. *Stem* hypogeous, tuberous, globose to subglobose. *Leaf* solitary, erect; petiole with very short sheath, leaf blade pinnatipartite, venation reticulate. *Inflorescences* solitary or in pairs, appearing before the leaf, erect at anthesis; *peduncle* longer or a little shorter than the petiole; *spathe* erect, weakly differentiated into tube and lamina, lower part convolute; *spadix* adnate to the spathe in the basal portion of the female zone; female flowers densely arranged, male zone with no sterile flowers in basal portion. *Flowers* diclinous, naked; *male flowers* (synandria) 2-3-androus, anthers subsessile, only fused at base, thecae subglobose, dehiscing by an apical longitudinal slit; *pollen* inaperturate, gemmate, ± globose to ellipsoid; *female flowers* surrounded by 4-6 obpyramidal free staminodes strongly papillate at apex, ovary ovoid, 4-5-locular, each locule with a single orthotropous ovule, placentation basal. *Infructescence* partially covered by the remaining spathe, berries densely arranged, fleshy, seeds with smooth testa, endosperm copious. Chromosomes $2n = 34$ (J. Bogner, pers. comm.)

Distribution. – The genus *Incarum* is, as far as known, unispecific and occurs in the Peruvian, Bolivian and Ecuadorian Andes. It grows at 1200-3300 m on eastern Andean slopes or in inter-Andean valleys.

Note. – The generic placing of *Asterostigma pavonii* has never been controversial. Since its description by Schott in 1860, no other aroid researcher has tried to place this species into a genus other than *Asterostigma*. When Engler revised *Asterostigma* for his "Pflanzenreich" (Engler 1920), he segregated *A. riedelianum* in its own section *Rhopalostigma,* but kept *A. pavonii* together with all extant species in *A.* sect. *"Euasterostigma"* (= *Asterostigma*). The illustration of *A. pavonii* prepared by Schott does not have an analysis of the flowers such as gynoecium sections. This may indicate that Schott did not study the ovules of the type material; in fact, according to the protologue he had only seen a dried specimen in Boissier's herbarium (now in Geneve).

Incarum differs from *Asterostigma* by the following characters: (1) ovules are orthotropous in *Incarum* vs. anatropous in *Asterostigma;* (2) leaf blade is exclusively pinnatipartite in *Incarum* vs. essentially tripartite with each of the lobes once again pinnate in *Asterostigma;* (3) pollen grains (see Grayum 1992) are ± globose to ellipsoid and gemmate in *Incarum* (Fig. 2) vs. oblong with a psilate exine in *Asterostigma;* (4) synandrium in *Incarum* incompletely fused (usually only at base) with the connectives of each stamen separated from each other vs. stamens are fused up to the connectives, which form a flat or convex entire surface in *Asterostigma*; (5) thecae elliptic in *Incarum,* dehiscing by an apical vertical slit vs. approximately square in outline dehiscing by a transversal apical slit; and in all *Asterostigma* species; (6) seedling leaves exclusively cordate in *Incarum* vs. sagittate to tripartite in *Asterostigma*.

The reconstructed phylogeny (using both cpDNA markers *matK* and *trnL-F* and morphology) shows *Incarum* in a clade together with the Andean *Gorgonidium* and *Spathantheum,* as the sister group of all *Gorgonidium* species. *Incarum* differs from *Gorgonidium* by the presence of staminodes with conspicuously papillate connectives and the short synandrium filaments. It also differs by the very slender habit.

Etymology. – Since *Incarum* is so far known only from Andean Peru, Bolivia and Ecuador, it is named in honour of the Inca Civilization (+ *arum,* from the Greek αρου, an ancient name for *Arum*), whose history was abruptly interrupted by the European colonizers. Most collections of this genus have been made nearby to Inca ruins, especially in the vicinity of Machu Picchu.

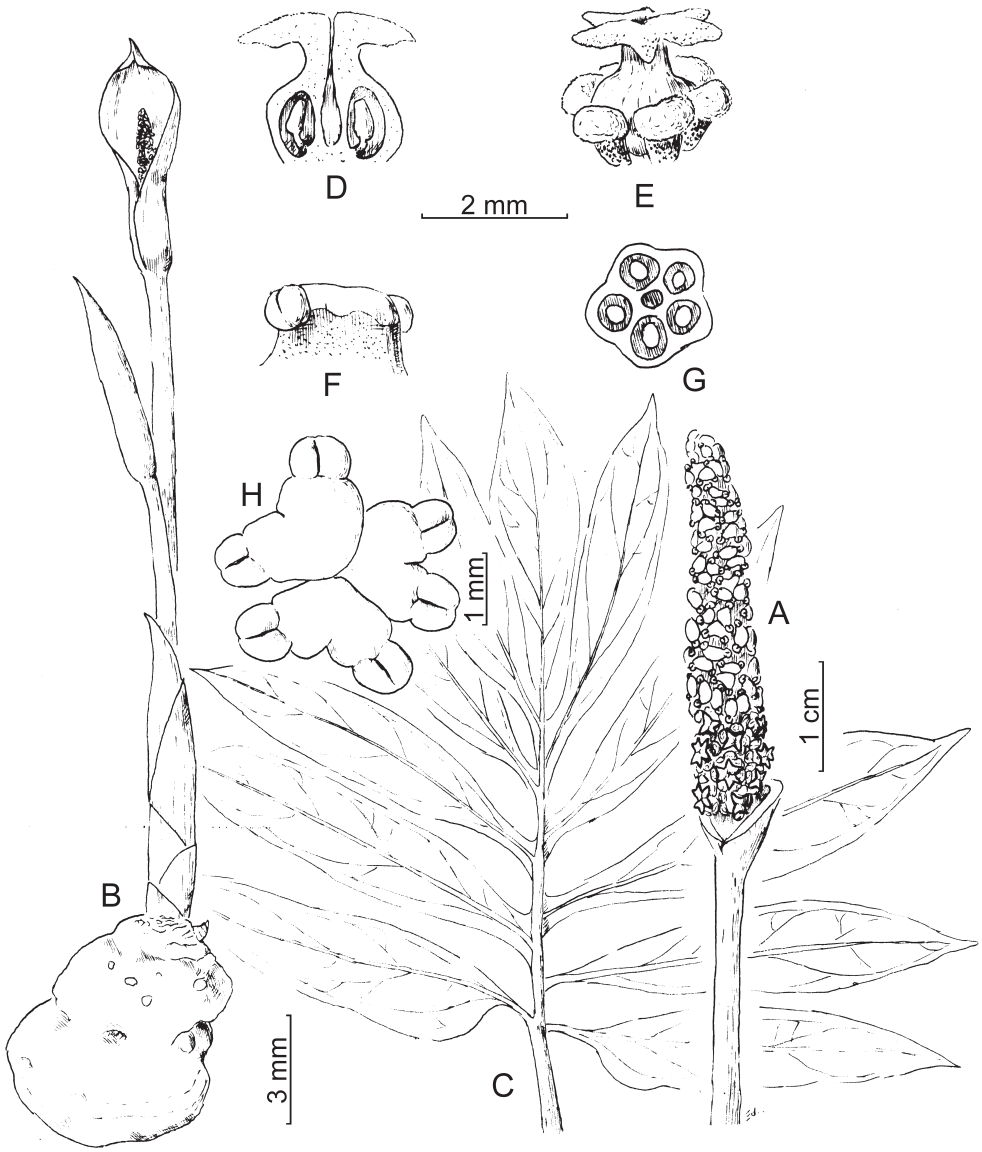

Fig. 1. *Incarum pavonii* – A: spadix (spathe removed); B: flowering tuber; C: leaf blade; D: gynoecium, longitudinal section; E: female flower, surrounded by staminodes, side view; F: stamen, side view; G: ovary, cross section; H: synandrium, top view. – Drawn by the author after *Hetterscheid H.AR. 136* (A, C-H) and *Weigend s.n.* (B).

Incarum pavonii (Schott) E. G. Gonç., **comb. nov.** ≡ *Asterostigma pavonii* Schott, Prodr. Syst. Aroid.: 339. 1860. – Holotypus: Peru, *Pavon s.n.* (G!) – Fig. 1-2.

Geophytic herb. *Stem* tuberous, subglobose, 5-7 × 3.5-5 cm, bearing numerous long tubercles. *Leaf* solitary, petiole 21-45 × 0.5-1 cm, leaf blade ovate in outline, pinnatipartite, 25-30 × 30-45 cm, lateral lobes 12-20 × 3-6 cm, oblanceolate. *Inflorescence* 1-4 per leaf axil; *peduncle* 10-35 × 0.3-

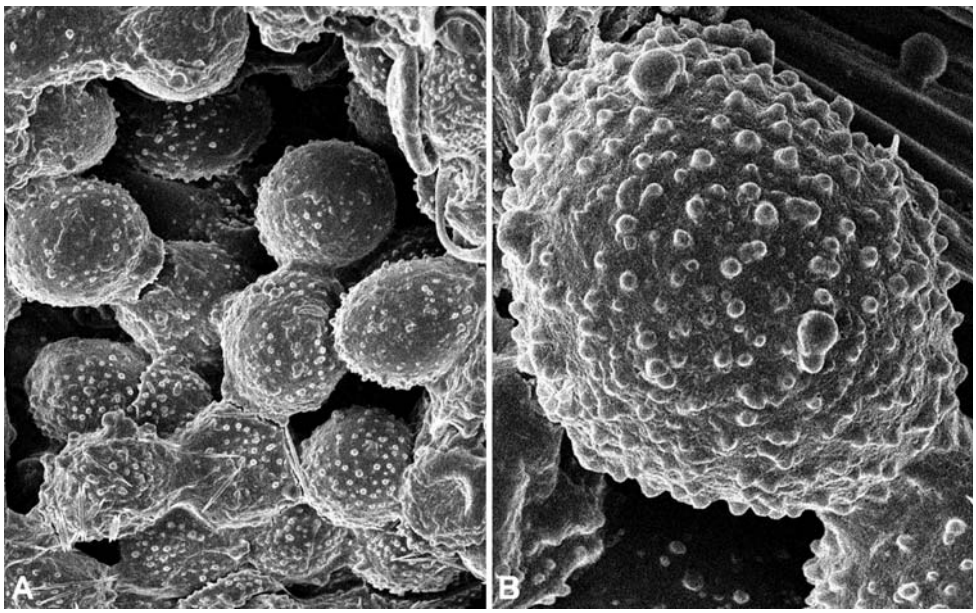

Fig. 2. Pollen of *Incarum pavonii* – SEM photographs by M. Hesse, Vienna, from the J. Bogner collection.

0.5 cm, shorter than the petiole; *spathe* boat-shaped, weakly constricted at middle, 4-9 × 2-3 cm, green outside, purple inside, apex long-acuminate; *spadix* 1.5-6 cm long, female portion 0.5-1.4 × 0.3-0.5 cm, adnate to the spathe for up to 25 % of its length, male portion 1-4.5 × 0.3-0.5 cm, apex rounded. *Male flowers* 2-3-androus, 2 × 2 mm, stamens only fused at base, sessile, connective poorly developed, flattened, thecae round, 0.4-0.5 × 0.4-0.5 mm, yellow, dehiscing by a longitudinal apical slit; *pollen* ± globose to ellipsoid, inaperturate, 32 × 27.5 µm, exine gemmate; *female flowers* surrounded by 4-6 staminodes, white at apex, reddish at base, 0.8-1.2 × 0.3-0.7 mm, stigma star-shaped, reddish, with 4-5 triangular lobes, 1.8-2 mm in diam., style 0.3-0.5 × 0.5 mm, ovary 1.2-1.3 × 1.5-1.8 mm, 4-6-loculed, ovules orthotropous. *Infructescence* partially covered by the persistent spathe; *berries* fleshy, densely arranged, 1-1.2 × 0.8-1.4 cm, subprismatic, slightly furrowed, yellowish green; *seed* ovoid to ellipsoid, 7-8 × 3.5-4.5 mm, testa smooth, finely punctuate, endosperm copious, embryo differentiated.

Distribution. – *Incarum pavonii* ranges from northwestern Bolivia to Peru, with a single occurrence known in southeastern Ecuador.

Further specimen seen. – BOLIVIA: LA PAZ: Nor Yungas, along road between Unduavi and Caranavi, 34.8 km E of Unduavi, 16.3 km SW of Yolosa, 2389 m, 27.11.1982, *Croat 51578* (MO); Nor Yungas, 4.5 km below Yolosa, then 13.7 km W on road up Río Huarinilla, 1200 m, 16°12'S, 67°65'W, 25.1.1983, *Solomon 9400* (MO); Nor Yungas, Parque Nacional Cotapata, camino hacia Hormuni Bajo, 16°12'S, 67°62'W, 1600 m, 23.11.2000, *Kromer & Acebey 1742* (MO). — EQUADOR: MORONA SANTIAGO: On the path from La Florida to Amarillas, c. 4500-5000 ft., 3°27'S, 78°50'W, 17.10.1979, *Thompson 349* (MO). — PERU: AMAZONAS: Prov. Chachapoyas, Strasse von Balsas nach Leimabamba, c. 2000 m, *Weigend* (M); Luya Province, Camporredondo, Fundo Cedro, 2450-550 m, 26.5.1989, *Díaz & al. 3566* (MO). – CUSCO: Province of Convención, between Sta. Tereza and Machu Picchu along the rail road between Quillabamba and Cusco, 12°15'S, 72°38'W, 29.12.1980, *Croat 50968* (MO); Urubamba, Machu Picchu, 0.5 km north of the union of the Sayacmarca and Aobamba rivers, 2175 m, 13.10.1982, *Peyton & Peyton 1494* (MO); Machu Picchu, s.d., *Hetterscheid H.AR. 136* (L). – HUANCAVELICA: Huancavelia, Rio Mantaro, 1600-1700 m, 1909-1914, *Weberbauer 6567* (MO); ad Pozuzo, *Ruiz & Pavon 6* (B). – PASCO: Prov. Oxa-

pampa, 12 km SE of town, road over shoulder of Cerro Pajonal to Villa Rica, 2500-2800 m, 1997, *Weigend & Dostert 97/81* (M).

Croatiella E. G. Gonç., **gen. nov.**
Typus: *Croatiella integrifolia* (Madison) E. G. Gonç.

Herba geophytica. *Caulis* tuberosus hypogeous, elongatus, tuber novum supra antecedentem productum. *Folium* solitarium lamina cordata, integra, venatio reticulata. *Inflorescentia* solitaria, erecta sub anthesi; pedunculus quam petiolo longior vel paullo brevior; *spatha* erecta, cymbiformis non constricta ad medium; *spadix* ad spatham basaliter adnatus, parte femina densiflora, parte mascula densiflora sine staminodia ad basim. *Flores* unisexuales nudi, flores masculi (synandria) 3-6-andricis usque ad medium connatis, theca elliptica, ad medium deshiscens rima longitudinali; *flores* feminei cum 4-5 staminodiis quadrangularibus libris papillosis ad apicem, ovarium ovoideum, 4-5-loculare, ovulum solitarium orthotropum ad basim loculi insertum. *Infructescentia* ignota.

Geophytic herb. *Stem* hypogeous, tuberous, with 3-6 connected tubers forming an elongated structure. *Leaf* solitary, erect; *petiole* with a long sheath, blade ovate-cordate, venation reticulate. *Inflorescence* solitary(?); spathe erect, not at all constricted at middle; *spadix* adnate to the spathe at the basal portion of the female zone; female and male flowers densely arranged, male zone with no sterile flowers in basal portion. *Flowers* diclinous, naked; *male flowers* (synandria) 3-6-androus, filaments fused up to the middle, thecae elliptic, dehiscing by a slit at the middle; *pollen* inaperturate, psilate, oblong; *female flowers* surrounded by 4-6 obpyramidal free staminodes, papillate at apex, ovary ovoid, 4-5-locular, each locule with a single orthotropous ovule, placentation basal. *Infructescence* unknown. Chromosome number unknown.

Eponymy. – This new genus is named in honour of Dr Thomas Bernard Croat, aroid specialist and one of the most intrepid plant collectors I have ever met. No aroid researcher has collected so intensively in Latin America, yielding probably much more than 18 000 aroid collections in approximately 40 years of field work. More than half of this number was also brought to cultivation as living collections. Along with his important collections (including that one of *Croatiella intermedia* used for our phylogenetic studies), Dr Croat also published regional and country based taxonomic accounts for the *Araceae,* describing more than 600 new species.

Note. – In his description of *Asterostigma integrifolium,* Madison (1976) does not discuss its inclusion in *Asterostigma,* only pointing out the idiosyncratic presence of entire leaves. Probably, the only aspect used for its inclusion in *Asterostigma* was the presence of the star-shaped stigma. However, the star-shape is common in the tribe *Spathicarpeae,* occurring also in *Gorgonidium, Spathantheum* and *Asterostigma*. To a lesser extent, the shallowly lobed stigma in *Mangonia* is not so different. Star-shaped stigmas seem to have arisen more than once in the tribe (Gonçalves, unpubl. data) and they may not be even homologous in structure. Thus, the presence of a star-shape stigma is not reliable for generic placement. More important, the presence of orthotropous ovules as well as the morphology of the synandria is a serious impediment for the inclusion of the species concerned in *Asterostigma* (which has anatropous ovules). The synandria in Brazilian *Asterostigma* species are rather homogeneous, with stamens completely fused up to the connectives, which are entire (not furrowed as in *Croatiella*), usually convex or rarely flat at the apex. Synandria are incompletely fused in *Croatiella* so the connectives seem strongly furrowed (or clearly lobed) at apex. Moreover, the thecae are square or nearly so in *Asterostigma,* dehiscing by a transversal apical slit, whereas they are elliptic in *Croatiella*, dehiscing by a longitudinal median slit.

The genus *Croatiella* is here defined by the combination of geophytic habit, entire leaves, female flowers with compact and apically truncate staminodes, orthotropous ovules, a star-shaped stigma and male flowers forming an incompletely fused synandria, elliptic thecae opening by a longitudinal slit and oblong pollen grains with psilate exine. This combination of features does not allow its inclusion in any of the established genera of the tribe.

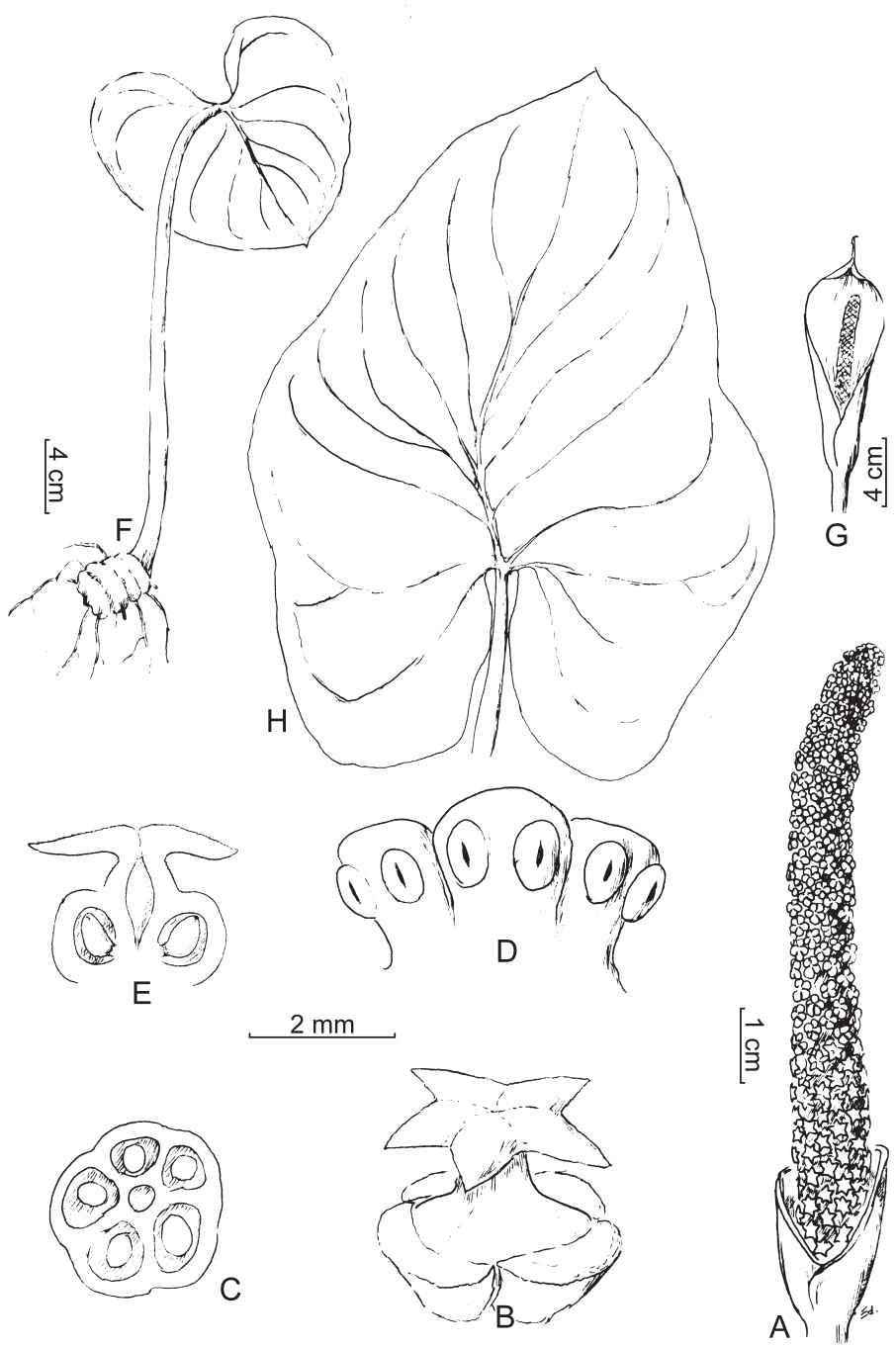

Fig. 3. *Croatiella integrifolia* – A: spadix (spathe removed); B: female flower, side view; C: ovary, cross section; D: synandrium, lateral view; E: gynoecium, longitudinal section; F: vegetative habit; G: inflorescence; H: leaf blade. – Drawn by the authors after *Dodson & Thien 810* (A-E, H); *Rawlins 204* (F) and *Madison 2942* (G).

Mangonia also has entire leaf blades but differs from *Croatiella* by its anatropous ovules (2-4 in each locule) and a long apical appendix with synandrodes.

Synandrospadix differs from *Croatiella* by the elongate, completely connate filaments of the synandria, apically fused thecae, presence of bisexual flowers between the female and male flowers, and triangular, flattened staminodes surrounding the gynoecia.

Spathantheum and *Spathicarpa* differ mainly from *Croatiella* by the spadix completely adnate to the spathe.

Taccarum differs from *Croatiella* by the bipinnately lobed leaf blade, as well as by the presence of anatropous ovules and oblong thecae.

Gorgonidium differs by the presence of pinnately or bipinnately lobed leaf blade, as well as by the flask shaped gynoecium, which is usually at least 2 times longer than broad.

The unispecific *Gearum* differs from *Croatiella* by the pedatipartite leaf blade, the seeds without endosperm and with a remarkably large embryo.

Phylogenetic studies on the tribe *Spathicarpeae* using both DNA and morphological and anatomical features (Gonçalves & al., unpubl. data) have shown that *Croatiella* is a somewhat isolated lineage within the tribe, only weakly clustering with the core geophytic *Spathicarpeae (Synandrospadix, Spathicarpa* and the clade *Taccarum+Asterostigma).*

Croatiella integrifolia (Madison) E. G. Gonç., **comb. nov.** ≡ *Asterostigma integrifolium* [*"integrifolia"*] Madison in Phytologia 35: 101. 1976. – Holotypus: Equador, Loja, 14 km E of Loja along road to Zamora, foggy elfin forest, 2600 m, *M. Madison 2942* (SEL!) – Fig. 3.

Evergreen terrestrial herb. *Stem* tuberous, usually with 3-6 connected tubers forming an elongated structure, 3-7 × 2-5 cm. *Leaves* solitary, petiole 21-100 × 0.5-0.8 cm, sheath conspicuous, 11-20 cm long; *leaf* blade cordate, chartaceous, 24-30 × 20-25 cm, drying brown to yellowish brown, anterior division 20-22 × 22-24 cm, primary lateral veins 4-5 per side, fusing in an irregular and inconspicuous collective vein, apex obtuse, posterior divisions 5-8.5 × 22-24 cm, basal vein denuded for 0.8-1.5 cm. *Inflorescence* erect, 1 per leaf axil; *peduncle* 18-40 × 0.5-0.7 cm, shorter than the petiole; *spathe* 12-13.5 × 2-4 cm, pale green and slightly glaucous outside, cymbiform, only shallowly convolute at base, oblanceolate, apex long-acuminate; *spadix* up to 6 cm long, female portion 2-3 × 0.8-1 cm, adnate to the spathe for approximately 1/3 of its length, sterile male portion absent, fertile male portion 4-6 × 1-1.2 cm, round at apex. *Male flowers* (synandria) 3-6-androus, anthers partially or completely fused, filaments 1-1.5 × 2-3 mm, thecae globose, opening by a longitudinal slit, pollen grains inaperturate, oblong, exine psilate; *female flowers* surrounded by 4-5 reddish staminodes, stigma 5-6-lobed, 2-2.5 mm in diam., lemon yellow, lobes triangular, style as long as half of the ovary length, ovary subglobose, locules 5-6, uniovulate, ovules orthotropous, funicles densely covered by secretory trichomes. *Infructescence* unknown.

Distribution. – Croatiella integrifolia is only known from the Zamora River valley, eastern Ecuador, on the eastern slope of the Andes. It occurs between 2800-3150 m in cloud forest and seems to be common locally along the edges of roads. The species is rather poorly known ecologically, but is said to be evergreen. Recent attempts to cultivate the species have failed.

Ecuador: Loja: El Paso, carretera Loja-Zamora, limite provincial, 2450-2600 m, 17.2.1998, *Ulloa 556* (MO); Cerro Villanaco, c. 7 west of the City of Loja, 8000-8500 ft, 9.10.1944, *Camp E-685* (MO); Carretera Loja-Zamora, colecciones desde K16 a 24, area de vegetación nublada y lluviosa, 2600-3280 m, 15.8.1983, *Jaramillo 5787* (MO); km 12-14 road to Zamora, near top of pass, wet, windy and cold, 2800 m, 28.9.1961, *Dodson & Thien 810* (MO). – Morona Santiago: Parque Nacional Sangay, along road between Cebas & Zuñak, between Atillo and the current end of the road, c. 20 km E of the summit and limit with Chimborazo Province, 18.4 km beyond the guard station, 2468 m, 2°12'S, 78°24'W, *Croat & al. 86273* (MO); Parque Nacional Sangay, along road between Gualaceo and Limón, 38.3 km E of Gualaceo (from last bridge on S of town, 3022 m, 3°00'S, 78°36'N, *Croat & al. 86435* (MO). – Zamora-Chinchipe: 36 km northwest of Zamora, 2730 m, 29.10.1987, *Rawlins & al. 204* (MO, K).

Acknowledgements

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