EFIMBRIATE, HERBACEOUS ARISTOLOCHIAS IN BRAZIL AND NORTHWEST SOUTH AMERICA [1], [2]

THOMAS M. BAZZOLO [3]

and

HOWARD WM. PFEIFER [4]

SUMMARY

In this paper, four species of *Aristolochia* are taxonomically revised for Brazil, Colombia and Venezuela: they are treated as a unit because they are the only herbaceous, efimbriate, perennial species native to this region. Described in the literature as more than a dozen taxa, they have never been comprehensively reviewed as a unit before. Our treatment includes full synonymy, specimens studied, discussions of relationships and maps of known distributions utilizing materials loaned to us by more than 35 herbaria.

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[3] 327 Riverside Avenue, Torrington, Connecticut.

[4] Botany Section, Biological Sciences Group, U-42, University of Connecticut, Storrs, Connecticut 06268.

INTRODUCTION

The genus *Aristolochia* is a large and varied assemblage of plants, considered by numerous authors (notably Ahumada, 1967; Duchartre, 1864; Hochne, 1927, 1942; Humboldt *et al.*, 1815-25; Klotzsch, 1859; Masters, 1875; Pfeifer, 1966; Planchon, 1891; and Schmidt, 1935). The largest genus in the Aristolochiaceae, it includes 600 to 700 species. *Aristolochia* is found predominantly in tropical and subtropical areas. Although some species occur in temperate regions, few can survive freezing temperatures. Areas containing many endemic species are Brazil and the Island of Santo Domingo (Pfeifer, 1966). Typically, it is a genus of tropical, woody lianas.

The four species studied here are the only perennial herbs in *Aristolochia,* in the areas mentioned. Historically confused because of superficially similar gross morphologies, they have never been dealt with in a taxonomic revision and were imperfectly known by the early monographers who dealt with the genus comprehensively. The species are a distinctive group and are distinguished from all other Brazilian and northwestern South American aristolochias by their herbaceous habitat and small leaves and flowers. With the exception of the forest-inhabiting *Aristolochia curviflora,* the plants treated here grow in dry savannah and open, rocky slopes. This is in contrast to the forest habitat and woody, lianoid habit usually associated with the other Brazilian aristolochias. Those included here, range from southern Bahía, westward through the Federal District and into campos of central Matto Grosso, and extending southeast to the heavily collected areas near Belo Horizonte. (See fig. 1).

The eastern portion of this distribution is an area of upland savannah receiving 150-320 cm of rainfall annually (Carlson, 1936). To the west, in the Matto Grosso, where annual rainfall diminishes, the plants must be able to withstand seasonally severe dry conditions. Perhaps as a result, the more western individuals of *Aristolochia claussenii* are recorded as flowering from October to April, thus avoiding the dry months of June and July.

One species, *Aristolochia curviflora,* occurs only in the forests of southern Río Grande do Sul. *Aristolochia nummularifolia,* from Colombia and Venezuela, is included because of its similarity to the southeastern Brazilian species.

COMPARATIVE MORPHOLOGY

All species studied here are perennial herbs whose stems arise from a thinckened, woody tap-root. *Aristolochia claussenii* and *A. nummularifolia* also have fusiform root tubers. Individual plants are low growing, rarely reaching 0.5 m in height. Erect when young, some older plants may sprawl for two meters, thus both erect and scandent individuals may be found within a single species.

Though all of the species here have entire leaves, these are variable in shape and somewhat in vestiture: all are glabrescent. Leaf shapes vary somewhat within a species and frequently on the same stem. The shape of leaves produced may be dependent on their time of initiation during the growing season. We feel this is a chief reason for their confused taxonomy. *Aristolochia smilacina* for example, produces thin, triangulate leaves early in the growing season but later leaves are more elongate and thickened and are abaxially tomentose.

The flowers are quite similar. All are small; the utricles are usually less than 1 cm in diameter. Other Brazilian species bear flowers with a utricle of more than 5 cm in diameter. Total calyx lengths here are 2.5-4.5 cm.

The calyx always provides the most reliable characters in *Aristolochia* for the delineation and separation of species and is frequently essential for accurate identification. The overall shape of the calyx limb is the best diagnostic feature. All of the species considered here are unilabiate; the limb is a simple expanded structure devoid of fimbria, lobes, or other appendages. The limb of several is dark purple-brown in color, which may fade or be lost in drying. Externally, the calyces are glabrous, except in the glandular-tomentose flowers of *Aristolochia curviflora.*

Mature flowers, as mentioned, must always be used to insure correct identification. The general outline of the calyx, especially the limb, may change significantly through ontogeny. The utricle may attain its mature size before the limb. During its development, the limb may elongate and undergo a proportional narrowing; the variable nature of the flower before maturation has been the source of much confusion. Synonymous taxa have been described by authors studying immature flower buds. Immature flowers of different species, furthermore, may be quite similar; *Aristolochia claussenii* and *A. nummularifolia,* species with distinctly different mature flowers, possess similar flower buds. This may be a reason for their being treated as conspecific in the past (Hoehne, 1942). Consequently, the key provided is based on details of mature flowers, when that character is utilized.

At the base of the flower utricle lies the gynostemium. It is a stalked, coroniform structure of six stigmatic lobes in these species, with an equal

number of adnate anthers. It undergoes a series of radical structural changes during its maturation and functional life (Pfeifer, 1966), hence it is not a reliable taxonomic character here, except in numbers of parts.

KEY TO THE SPECIES

A. Leaves coriaceous, narrowly triangulate, usually much longer than wide. Calyx limb 15-18 mm long, lanceolate, acute. Southern Brazil . . . . 1. A. SMILACINA

A. Leaves membranaceous, cordate to orbiculate, as long as wide.

B. Calyx limb 30 mm long, distinctly curved forward to erect, the leaves suborbiculate, shallowly subsagittate-cordate at the base. Southern Brazil . . . . . 2. A. CURVIFLORA

B. Calyx limb less than 20 mm long, erect or curved backward, the leaves broadly cordate, deeply cordate at the base.

C. Leaves 3.5-5.0 cm long, 3.0-4.5 cm broad, the calyx limb narrowly ovate, obtuse. Minas Gerais . . . . . 3. A. CLAUSSENII

C. Leaves 1.5-3.0 cm long, 1.5-3.0 cm broad, the calyx limb linear-lanceolate, truncate to subemarginate. Colombia and Venezuela . . . . . 4. A. NUMMULARIFOLIA

DESCRIPTION OF THE SPECIES

1. **Aristolochia smilacina** (Klotzsch) Duchartre, *in* DC. Prod. 15-1: 459. 1864. Figs. 1, 2.

Howardia smilacina Klotzsch, Monatsber, Königl. Preuss. Akad. Wiss. Berlin. 1859: 620. 1859. Type: Brazil: "In Brasilia", *Sello 1101* (¡B, BR!, CGE!)

A. gracilis Duchartre, *in* DC. Prod. 15-1: 460. 1864, *ex char.* Type: Brazil: Minas Gerais: *St. Hilaire 2198* (P).

A. saxicola Hoehne, Arch. Bot. São Paulo. 1: 9. *t.* 2. 1925, *ex ic.* Type: Brazil: Minas Gerais: Miguel Burnier, entre peregulho dos campos seccos e ricos de minério, 27 Jan 1921, *Hoehne 5152* (SP).

Procumbent to scandent, perennial, tap-rooted herbs. Leaves petiolate, thick, sagittate-cordate to narrowly triangulate-cordate, narrowly acute to acuminate, glabrous above, sparsely to densely tomentose beneath, the petioles 1-2.5 cm long, the blade 5-10 cm long, 2.5-3.5 cm broad. Flowers solitary, axillary, geniculate, glabrous, dark purple-brown, 3.5-4.5 cm long. Pseudostipules absent. Utricle obovoid, 1.0-1.5 cm long, 0.8-1.2 cm in diameter, the syrinx a small, inequilateral flap, the tube straight, 1 cm long, 2 mm in diameter, the limb one-lobed, ovate-lanceolate, obtuse to acuminate, 1.4-1.8 cm long, 0.5-06 cm broad. Gynostemium stipitate, coroniform, 3 mm high, 3 mm wide, the tetraloculate anthers six, equidistant, laterally sessile on the six stigmatic lobes. Fruits ellipsoid, 2.3 cm long, 0.8-1.0 cm in diameter. Seeds numerous, flat, triangulate, revolute, smooth above, 3 mm long, 2.75 mm wide, 1 mm thick.

Specimens examined: BRAZIL. Goias: Cristalina; *Irwin, Sousa & Reis dos Santos 9873,* CONN; *13647,* NY. Minas Gerais: Belo Horizonte; *Black 51-11639,* IAN. Betim; *Barreto 10676,* R. Caraca; *Barreto s. n., 20 Apr 1933,* R. Imbiruçu; *Heringer s. n., 10 Jun 1959,* HB. Jaboticatubas; *Barreto 10491,* R. Lagoa Santa; *Heringer 7283,* NY; *Hoehne 6148,* SP; *6149,* R. Mariana, *Seriera 3035 & Salest 3871,* HB. Montes Claros; *Irwin, Reis dos Santos, Sousa & Fonseca 23809,* CONN. Morro de São Sabastião; *Alves 6892,* R. Ouro Prêto; *Macedo 2837,* SP. Paracatu; *Heringer s. n., 3 Jun 1960,* HB. Paraopeba; *Heringer s. n., 21 Sep 1955,* HB. São João Del Rei; *Duarte 5149,* F (2), HB. Serra de Bocaina; *Heringer 2496,* SP. Serra do Cipó; *Heringer & Castellanos 21998,* HB, R. Serra do Ouro Branco; *Porto 1240,* SP. Serra do Senhein; *Silveira 950,* R. *Loc. ignot.: Sello 1101,* BR, CGE.

The flowers of *Aristolochia smilacina* are large in comparison with other species in this complex. The leaf variation and specimens bearing immature flower buds have caused confusion. Young plants, even with mature flowers, are characterized by thin, triangulate leaves. The leaves produced by the plants later in the season are elongate, thickened and strongly revolute with a polished texture above and often possess mature or dehisced fruits.

This species is found at elevations of 1.100 to 1.300 meters. It is common in the uplands of south-central Brazil in the grassy open savannahs. Flowering from November to late June, *Aristolochia smilacina* can easily be recognized by mature flowers.

2. **Aristolochia curviflora** Malme, Ark. Bot. 1: 545. *t. 32. f. 5.* 1904. Lectotype: Brazil: Rio Grande do Sul: Cachoeira, in campis arenosis, siccis, apricis nec non in arenosis siccis, subnudis ad viam ferream, 3 Jan 1902, *Malme 916* (S!). Figs. 2, 3.

Low, suberect, perennial herbs. Leaves petiolate, membranaceous, suborbiculate, narrowed slightly to the shallowly subsagittate-cordate base, rounded

to emarginate at the apex, glabrous above, weakly tomentose beneath, the petiole 3-5 mm long, the blade 1.5-2.5 cm long, 1.5-2.0 cm broad. Flowers solitary, axillary, geniculate, glandular-tomentose, about 4.5 cm long. Pseudostipules absent. Utricle obovate-gibbous, 8 mm long, 6-7 mm in diameter, the syrinx a small, inequilateral flap, the tube curved forward, gradually widening into the limb, 8 mm long, 3 mm in diameter at the base, expanding to 4 mm diameter, the limb one-lobed, the lobe lanceolate, emarginate, 3 cm long, 1 cm broad at the base. Gynostemium sessile, coroniform, 2.5 mm high, 3 mm wide, the tetraloculate anthers six, equidistant, laterally sessile on the six stigmatic lobes. Fruits unknown.

Specimens examined: BRAZIL. Rio Grande do Sul: Cachoeira do Sul; *Malme 916,* S.

In the original description of *Aristolochia curviflora,* Malme cited two of his own collections, *Malme 916* & *Malme 1305.* His description fits *Malme 916,* which bears several stems with mature flowers: it is here designated the lectotype. The specimen of *Malme 1305,* which we have not seen, is therefore a syntype.

Aristolochia curviflora is said to inhabit areas of low elevation (100 meters) and regions of wet tropical forests; unfortunately, it is known only from the type collection. Its glandular-tomentose hairs are unique in this group; this feature, in combination with the distinctly forward-curved calyx limb, assures positive identification.

3. **Aristolochia claussenii** Duchartre, Ann. Sci. Nat. Bot. sér. 4. 2: 57. 1854, *ex char.* Type: Brazil: Minas Gerais: ubi vulgo dicta Jarinha do campo, *Claussen s. n.* (FI, G, P, W). Figs. 2, 4.

   A. pusilla Pohl *ex* Duchartre, *in* DC. Prod. 15-1: 466. 1864, *pro syn.*

   A. pyrenea Taubert, Bot. Jahrb. Syst. 21: 426. 1896, *ex char.* Type: Brazil: Goias: Habitat in locis Cerrados dictis montium Serra dos Pyreneos, *Ule 3088* (R).

   A. exigua Lindman, Bull. Herb. Boissier, sér. 2. 1: 525. *t. 7. f. a-d* 1901, *ex ic.* Type: Brazil: Matto Grosso: espinheiros inter Cuyabá et Santa Cruz da Barra, loco saxoso, arido, in dumeto vel silvula "cerradâo" dicta, *Regnell A3009* (S, UPS).

   A. cordifolia Glaziou, Bull. Soc. Bot. France. 58: Mem. 3f: 577. 1911. Type: Brazil: Minas Gerais: Serra do Lenhiero, dans le campo, *Glaziou 17209* (¡B, BR, K!, P).

   A. claussenii Duchartre subsp. *pyraneae* (Taubert) Hoehne, Mem. Inst. Oswaldo Cruz. 20: 130. *t. 58.* 1927, *sphalm.* = *A. pyrenea* Taubert (also spelled "*pyrineae*", "*pyrenae*" *in loc. cit.* Hoehne).

Erect to procumbent perennial herbs. Roots ligneous with fusiform swellings. Leaves petiolate, membranaceous, broadly cordate, obtuse to rounded at the apex, deeply cordate at the base, minutely punctate beneath, the petiole 0.5-1.5 cm long, the blade 3.5-5.0 cm long, the blade 3.5-5.0 cm long, 3.0-4.5 cm broad, minutely puberulent. Flowers solitary, axillary, geniculate, glabrous, dark purple-brown, about 2.4 cm long. Pseudostipules absent. Utricle ovoid-gibbous, 4 mm long, 3.5-4.0 mm in diameter, the syrinx a small, inequilateral flap, the tube straight, 2-4 mm long, 1-2 mm in diameter, the limb one-lobed, gradually expanding from the tube, the lobe narrowly oblong to narrowly ovate, obtuse, 15-18 mm long, 5-6 mm broad. Gynostemium short-stipitate, coroniform, 1.5 mm high, 2 mm wide, the tetraloculate anthers six, equidistant, laterally sessile on the six stigmatic lobes. Fruits globose, 1.25-1.5 cm long, 0.75 cm in diameter. Seeds few, pyramidal, revolute, tuberculate above, 3 mm long, 2.5 mm wide, 1 mm thick.

Specimens examined: BRAZIL. Bahía: Cancela; Black 54-17904, IAN. Rio Roda Velha; *Irwin, Grear, Sousa & Reis dos Santos 14907,* CONN. Distrito Federal: Chapada de Contagem; *Irwin, Sousa & Reis dos Santos 9234,* NY; *9587,* NY; *11607,* CONN. Sobradinho; *Irwin, Sousa & Reis dos Santos 10120,* NY. Goias: Belo Horizonte: *Magalhães 715,* IAN. Chapada dos Veadieros; *Irwin, Grear, Sousa & Reis dos Santos 12778,* NY. Niguelãndia; *Irwin, Anderson, Steiber & Lee 34937,* NY; *Macedo 4404,* HB (2). Paraiso; *Irwin, Maxwell & Wasshausen 21642, CONN,* NY. Serra do Caiapó; *Irwin & Soderstrom 7629,* NY. Serra dos Pirineus; *Irwin, Anderson, Steiber & Lee 34129,* CONN; *Irwin, Sausa & Reis dos Santos 10751,* CONN; *Irwin, Maxwell & Wasshausen 18778,* NY (2); *Ule 383,* R. (2), (incorrectly cited by Hoehne as co-type of *A. claussenii* Duchartre subsp. *pyrenea* [Taubert] Hoehne). Serra do Rio Preto; *Irwin, Sousa & Reis dos Santos 10405,* NY; *10472,* CONN. *Spec. loc. ignot.; Glaziou 22031,* K. Matto Grosso: Cuiabá; *Hoehne 3363,* R; *3365, R; 3366,* R. Serragem; *Kuhlmann 194,* R. Minas Gerais: Paraopeba; *Heringer 3738,* HB; *11319,* NY. Serra do Lenheiro; *Glaziou 17209,* K, (Type of *A. cordifolia* Glaziou, *nom. nud.).* Várezea da Palma; *Heringer 9582,* HB. *Spec. loc. ignot.; Claussen s. n.,* CGE.

The developmental changes in the flower buds of *Aristolochia claussenii* may be responsible for the synonymous taxa. The perianth of young flowers appears to be unequally weakly bilabiate with a broadly ovate, emarginate limb. (Lindman, in his description of *A. exigua,* describes the limb as "sub-bilabiate"). At maturity, however, the limb elongates, becoming narrowly ovate and acute. Taubert and later Hoehne, not recognizing this, treated older narrow-limbed flowers as distinct taxa. All inhabit the same region in southern Goias and the Federal District.

Aristolochia claussenii is frequent in dry uplands of southern Goias at elevations near 1.000 and 1.200 meters. It has been most commonly collected on open, rocky slopes. *A. claussenii* can be separated from the other species by its cordate leaves with small, pubescent hairs above and minute, punctate dots beneath. It is in flower from October through April.

4. **Aristolochia nummularifolia** H.B.K. Nov. Gen. et Sp. Pl. 2: 147. t. *110*. 1817, *ex ic.* Fig. 5.

   A. emarginata Willd. *ex* Duchartre, *in* DC. Prod. 15-1: 466. 1864, *pro syn., non* Klotzsch 1859.

   A. tenera Pohl *ex* Duchartre, *in* DC. Prod. 15-1: 466. 1864, *ex char.* Type: Colombia: Bogotá: Llanos de San Martín, ad 300 met. altitudinem, *Triana s. n.* (W).

Erect or rarely procumbent, perennial herbs. Roots diffuse, ligneous, with fusiform swellings. Leaves petiolate, membranaceous, broadly cordate to subreniform, rounded at the apex, deeply cordate at the base, glabrescent above, glabrous beneath, minutely punctate, the petiole 5-8 mm long, the blade 1.5-3.0 cm long, 1.5-3.0 cm broad. Flowers solitary, axillary, rectilinear, glabrous, about 2.5 cm long. Pseudostipules absent. Utricle ovoid to globose, 4.5 mm long, 4.0 mm in diameter, the syrinx absent, the tube straight, 5-6 mm long, 1-2 mm in diameter, the limb one-lobed, the lobe linear to oblanceolate, truncate to subemarginate, gradually expanding from the tube, 13-15 mm long, 4 mm broad. Gynostemium globose, short-stipitate, 2 mm high, 2 mm wide, the tetraloculate anthers six, equidistant, laterally sessile on the six stigmatic lobes. Fruits oblate to globose, 1.1-1.4 cm long, 0.7-0.8 cm in diameter. Seeds numerous, flat, triangulate, subrevolute, tuberculate above, 3 mm long, 2.5-3.0 mm wide, 1 mm thick.

Specimens examined: COLOMBIA. Arauca: Casanare; *Ariste A396,* US. Cravo Norte; *Soejarto 467,* COL. Boyacá: Orocué; *Lehmann 8774,* K (2). Meta: Barranca de Upía; *Barriga 5107A,* COL. *Loc. ignot.:* Matabubosa; *Cuatrecasas 4238,* US. VENEZUELA. Amazonas: Puerto Ayacucho; *Gentry & Berry 14464,* VEN, CONN. Medio y Alto Orinoco; *Pannier & Lehruabe 896,* VEN; *921,* VEN. Anzoátegui: Mapire; *Lasser 784,* US, VEN. Apure: Las Piedras; *Vélez 2517,* VEN. Bolívar: El Carmen; *Vélez 2516,* VEN. Santa Rita: *Williams 13418,* F, US, VEN (2). Guárico: Parmana: *Croizat 213,* F; *Tamayo 4068,* US, VEN.

Aristolochia nummularifolia is found at low elevations of 100 to 150 meters in Colombia and Venezuela. The distribution of this species of the Orinoco basin appears to follow river valleys: it is known to occur in the wet sand and clay soils in the borders of gallery forest. Individuals may become suffrutescent. This species flowers from February to August.

In the original account of *Aristolochia nummularifolia,* Kunth describes the calyx limb as acute. Judging from the plate, the flowers were described from immature flower buds. The calyx limb is proportionately shorter and broader when in bud. Immature flowers of *A. nummularifolia* may be confused with immature flowers of *A. claussenii.* Hoehne treated *A. nummularifolia* as a synonym of *A. claussenii,* but expressed doubt over its proper position. The reniform-orbiculate, punctate leaves of *A. nummularifolia* are distinctive while the flowering time, habitat preference, and above all, the greatly disjunct distributions serve to distinguish *A. nummularifolia* from *A. claussenii.*

The bitter, fusiform roots are used in native folk medicine. Information from collectors suggests that an infusion made with water or wine is used as a purgative, while decocted plants are used as a cure for snakebite.

SPECIES INCERTAE SEDIS

Duchartre, in 1854 (Ann. Sci. Nat. Paris. sér. 4. 2: 69) described *Aristolochia gardneri,* based upon a collection of Gardner (# 2299). Its label reads "Habitat Piahauy in America meridionali", dated 1840, as quoted by Duchartre. The type is in the Webb Herbarium at Florence (FI); an isotype has been located at Cambridge (CGE!). While it is herbaceous, may be efimbriate and Brazilian, because it is described from fruiting material we are unable to place it satisfactorily.

George Gardner (1812-1849), who collected in "Piauhy Campos" (Piauí state, Northeast Brazil) beginning early in 1839, furnished us with an excellent specimen, although without flowers. Its leaves are thin-membranaceous, ovate-triangulate, broadly cordate at the base, glabrous, about 10 cm long and 5 cm broad. Fruits, 3 cm long, are carried singly and erect in the upper leaf axils of the 30 cm tall plants. The two stems of the Cambridge isotype arise from a common base.

It is not keyable here, and not referrable to any of the taxa accepted here; nor can it be adequately described without flowers.

FIGURE 1. *Aristolochia smilacina.* Habit and utricle detail. *(Macedo, 2837).*

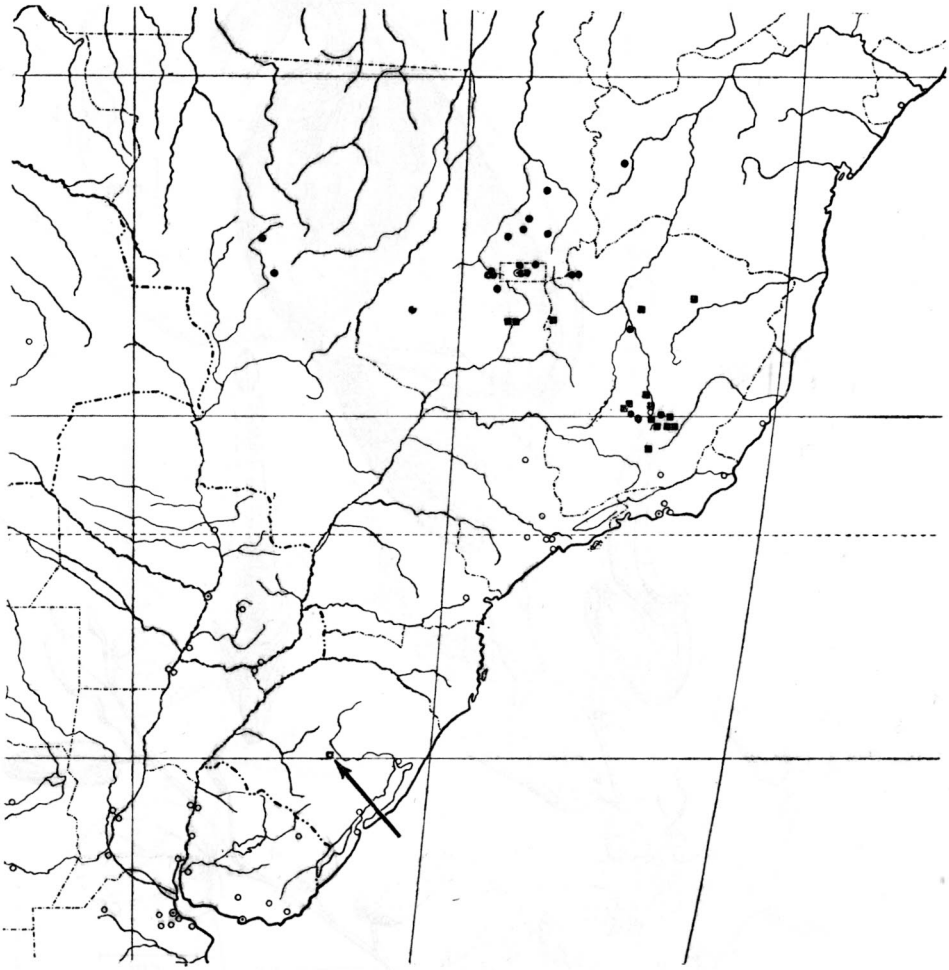

FIGURE 2. Known distribution of *Aristolochia smilacina* (square dots), *Aristolochia curviflora* (open square dot at arrow), and *Aristolochia claussenii* (round dots), in southern Brazil.

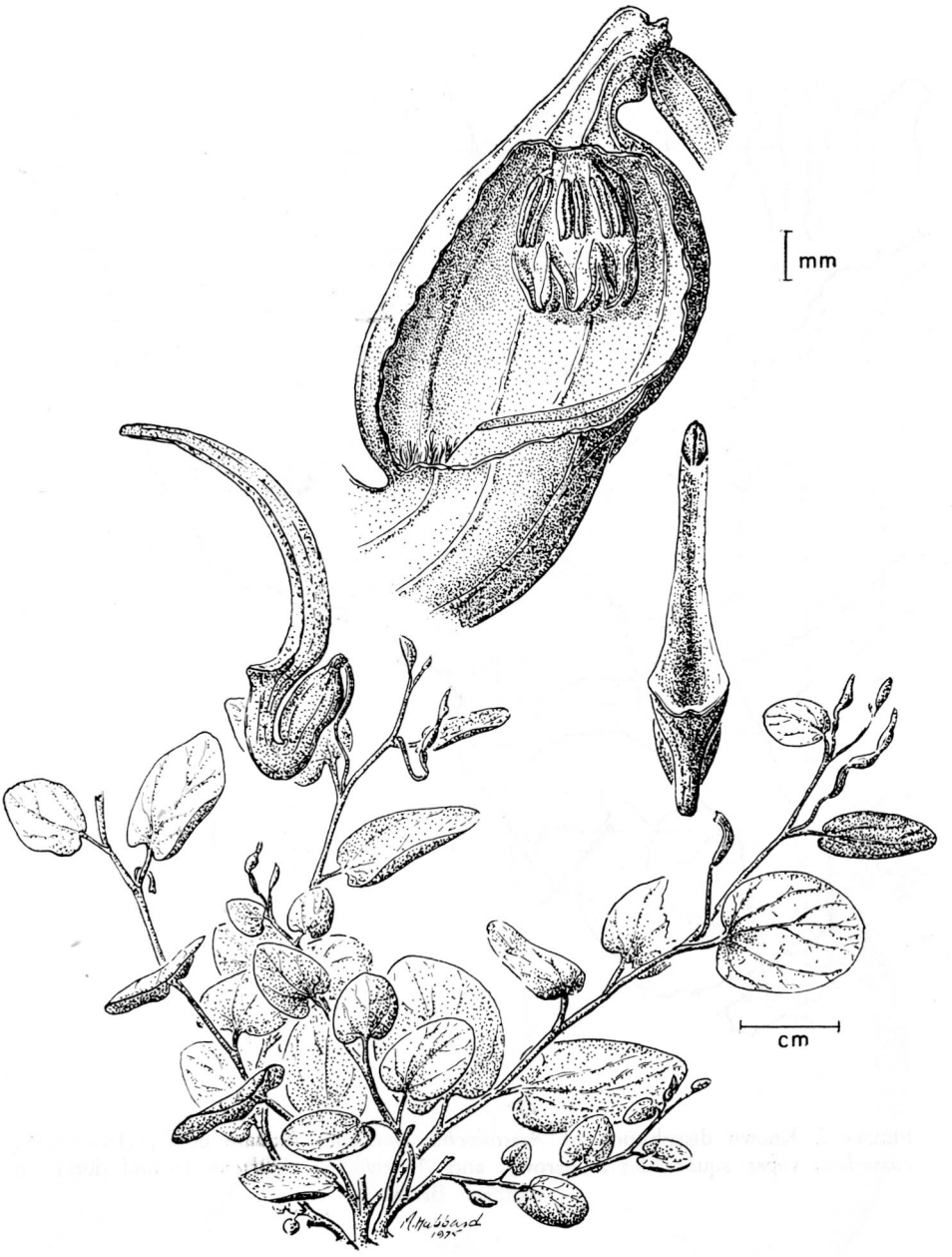

FIGURE 3. *Aristolochia curviflora*. Habit and utricle detail. *(Malme, 916, typus)*.

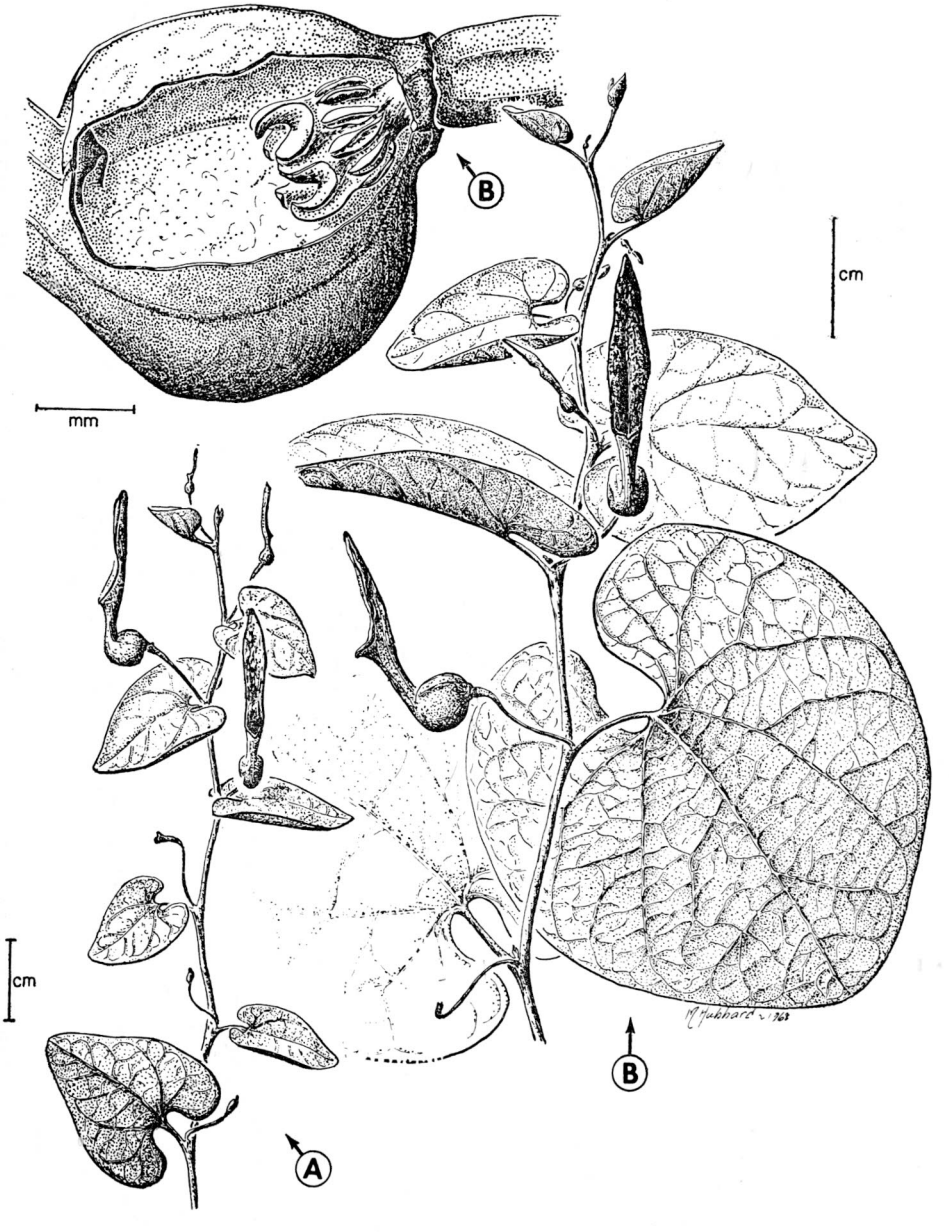

FIGURE 4. *Aristolochia claussenii*. Two habit details and utricle detail. (A, *Irwin & Sousa, 10405;* B, *Irwin & Soderstrom, 7629).*

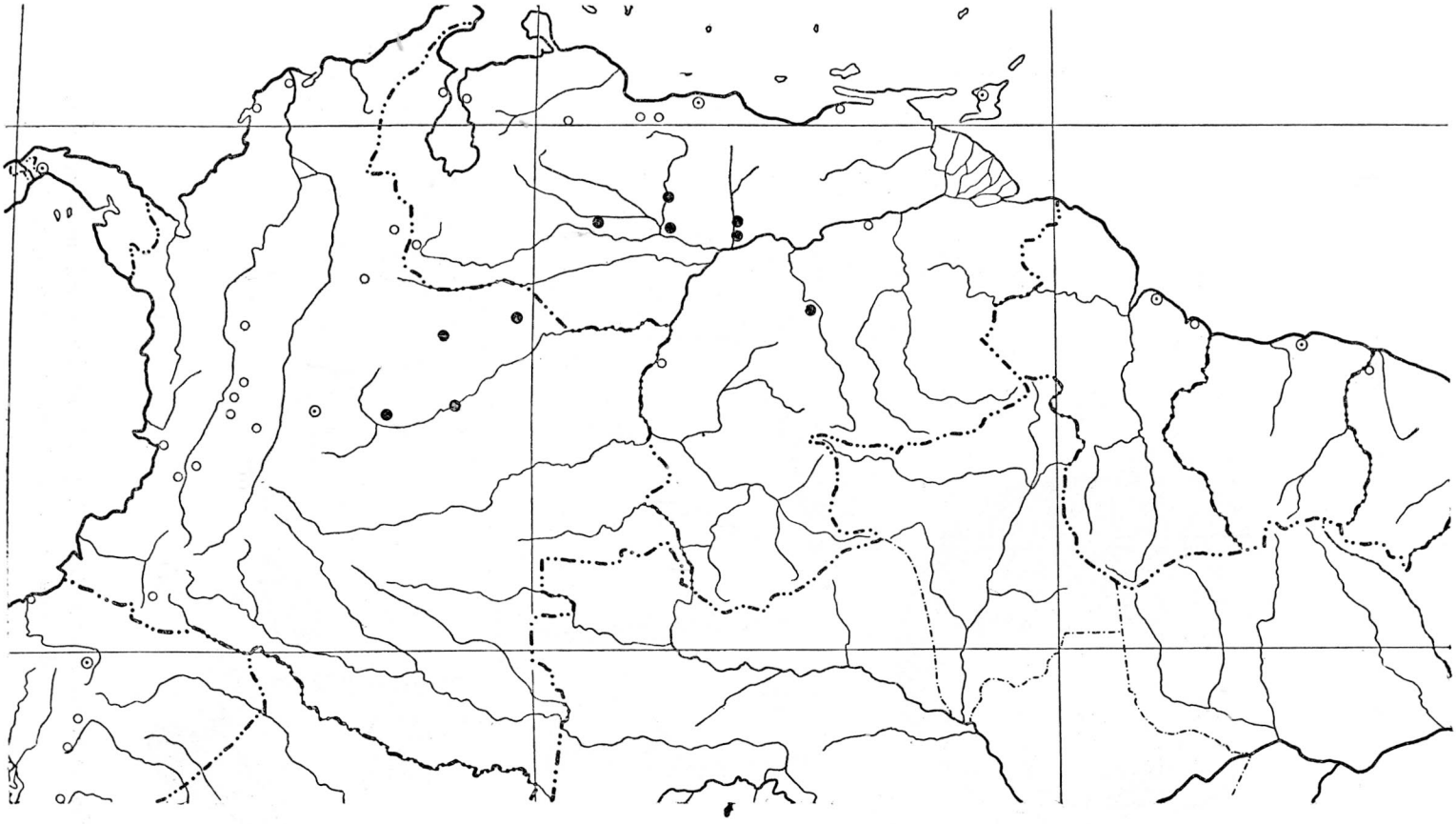

FIGURE 5. Known distribution of *Aristolochia nummularifolia* in Colombia and Venezuela.

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