

THE GENUS *CANNA* IN NORTHERN SOUTH AMERICA

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1. INTRODUCTION

Since KRÄNZLIN's monograph (1912) very little taxonomical work on the genus *Canna* has been done. The work is now very much out of date also because cytological and pollenmorphological methods have become available since.

The present work has been inspired by the problems pertaining to the genus as occurring in Suriname. It was expanded to cover northern South America, South to the Amazon River, and includes also some West Indian material.

2. MATERIAL AND METHODS

About 500 herbarium specimens were studied from the following herbaria: Herbario Nacional de Venezuela, Caracas (VEN); Rijksherbarium, Leiden (L); Royal Botanic Gardens, Kew (K); New York Botanical Garden (NY); Muséum National d'Histoire Naturelle, Laboratoire de Phanérogamie, Paris (P); Instituut voor Systematische Plantkunde, Utrecht (U); United States National Herbarium, Washington (US).¹

Besides, living material was studied in the botanical garden "Sandwijk" at Utrecht; this was grown from seeds received from the Botanical Gardens of Berlin (Dahlem), Göttingen, Palermo, Lisbon, Hamburg, Liverpool (City Garden), Englefield Green (Surrey), Oporto, and Copenhagen. These seeds were treated according to methods described by OOMEN (1949) and TÄCKHOLM & DRAR (1969). The testa was filed in one place until the white endosperm was barely visible. After a 24-hr period of soaking in water the seeds were put in wet soil. Germination followed within 10 days, and the first plants flowered after 4½ months. This material was also used for cytological and pollenmorphological studies.

3. SYSTEMATIC TREATMENT

3.1. History

Already before Linnaeus Cannaceae are mentioned in the literature. Because of the limited scope of the present treatment the pre-Linnaean literature is not reviewed here. Linnaeus recognized the species *C. angustifolia*, *C. glauca*, and *C.*

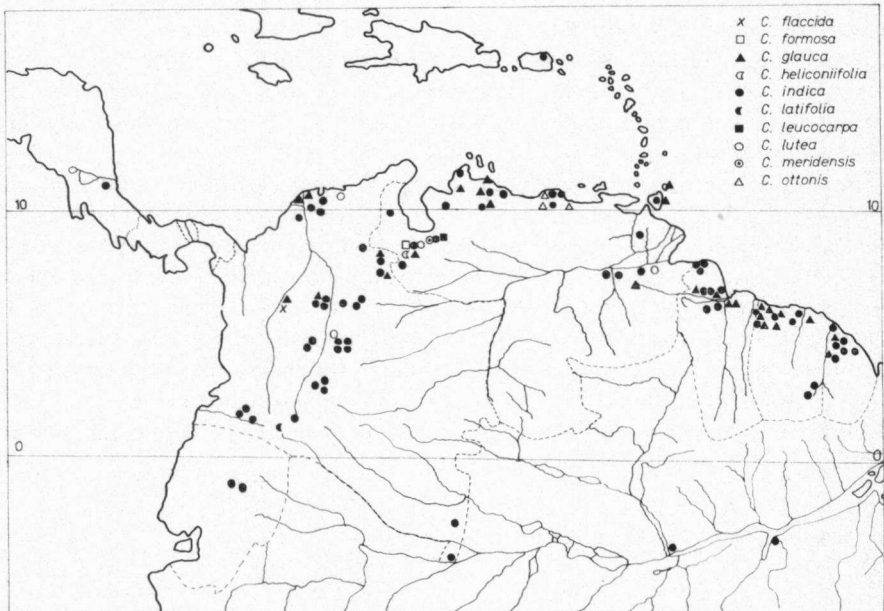
¹ In a forthcoming study the senior author will attempt to locate and critically identify as many type specimens as possible.

indica. *C. indica* turned out to be a large and heterogeneous group including many taxa described as separate species by later authors, among others ROSCOE (1828), VON HOFFMANNSEGG (1826), BOUCHÉ (1833, 1844), HORANINOW (1862), and KRÄNZLIN (1912).

The genus is very popular as an ornamental and its widespread cultivation has resulted in numerous cultivars and garden-hybrids, which has led to the description of such forms as species (Horaninow reached 100). KRÄNZLIN (1912) recognized 51 species, which number is still too high (see, i.a., WOODSON 1945), and the present authors suspect that a new revision will result in a reduction to about 25 species.

3.2. Geographical distribution

The main center is tropical and subtropical America. In Africa there occurs only one species, *C. bidentata* (KRÄNZLIN 1912 and KOEHLIN 1964). According to HEPPER (1968) *C. bidentata* is synonymous with *C. indica*. From Asia KRÄNZLIN (l.c.) cites the following species: *C. chinensis*, *C. humilis*, *C. orientalis*, *C. reeversii*, *C. siamensis*, and *C. speciosa*. In northern South America the species are distributed as shown on map 1.



Map 1. Geographical distribution of *Canna* in northern South America and adjacent areas.

3.3. Some important taxonomic characters of the plants in the present area

The terminology used here follows the one proposed in *Taxon* (11: 145–156, 245–247, 1962). The colour indications are based on MUNSSELL, Student Charts, 1929.

Leaf consisting of sheath and lamina. Typical shapes are ovate and ovate-trullate. The ovate shape more or less passes into an elliptic or oblong one. The lamina is divided by the well-developed costa into two unequal parts. The tip is obtuse to somewhat acuminate. The base varies from attenuate (no sharp distinction between lamina and sheath) to rotundate. The leaf is green in most species, but glaucous in species with ovate-trullate leaves (*C. glauca* and *C. flaccida*). See Plate 1, figs. 1a, 1b, and 1c.

Flower. *Sepals* always 3, ovate, convex, acute, free, imbricate, mostly green, sometimes pale yellow or light red, always covered by a ceraceous indument, persistent. See plate 1, fig. 3. *Petals* always 3, two equal, one usually smaller, all narrowly oblong, acuminate, cucullate, colour varying from green or yellow to red, erect like the sepals (except in *C. flaccida* where they are pendent), usually connate at the base to form a tube. See plate 1, fig. 4. *Staminodes* 2, 3, or wanting. In the past this has been used as one of the key characters for distinguishing subgenera and sections:

Subgenus *Distemon*, no staminodes; *C. meridensis* and *C. ottonis*.

Subgenus *Canna*, 2 or 3 staminodes.

Section *Bialatae* – 2 staminodes; *C. indica* and *C. lutea*.

Section *Trialatae* – 3 staminodes; *C. flaccida*, *C. formosa*, *C. glauca*, *C. heliconiifolia*, *C. indica*, *C. latifolia*, and *C. leucocarpa*.

In a single cultivated specimen the authors observed both flowers with two and flowers with three staminodes. In species which should belong to Kränzlin's section *Bialatae* very often some rudimentary staminodes are found at the base of the two well-developed staminodes or the labellum. It seems therefore very doubtful whether the sections *Bialatae* and *Trialatae* can be maintained. For the differences in shape see plate 1, figs. 5a, 5b, 5c, 5d, and 5e. The colour is yellow or reddish, or yellow spotted with red, or vice versa. The staminodes are free or adnate to the petals to form a tube. *Labellum*. In subgenus *Distemon* it is straight to slightly curved, in subgenus *Canna* markedly and spirally curved, pendent, protruding from the flower. See plate 1, figs. 6a, 6b, and 6c. Colour as in the staminodes. *Style* fleshy, free or connate with the petaloid part of the stamen and with the staminodes to form a tube. *Stamen*. The anther consists of a fertile part and a sterile, petaloid part. The fertile theca is connate with the petaloid part for at the most half of its length. See plate 1, figs. 7 and 7a.

3.4. Chromosome counts

Table 1 lists the counts of *Canna* as found in the literature. The senior author made roottip counts of cultivated material of the following species: *C. bidentata* Bert., *C. cinnabarina* Bouché, *C. discolor* Lindl., *C. flaccida* Salisb., *C. glauca* L., *C. indica* L., *C. iridiflora* R. & P., *C. lagunensis* Mill., *C. lanuginosa* Roscoe, *C.*

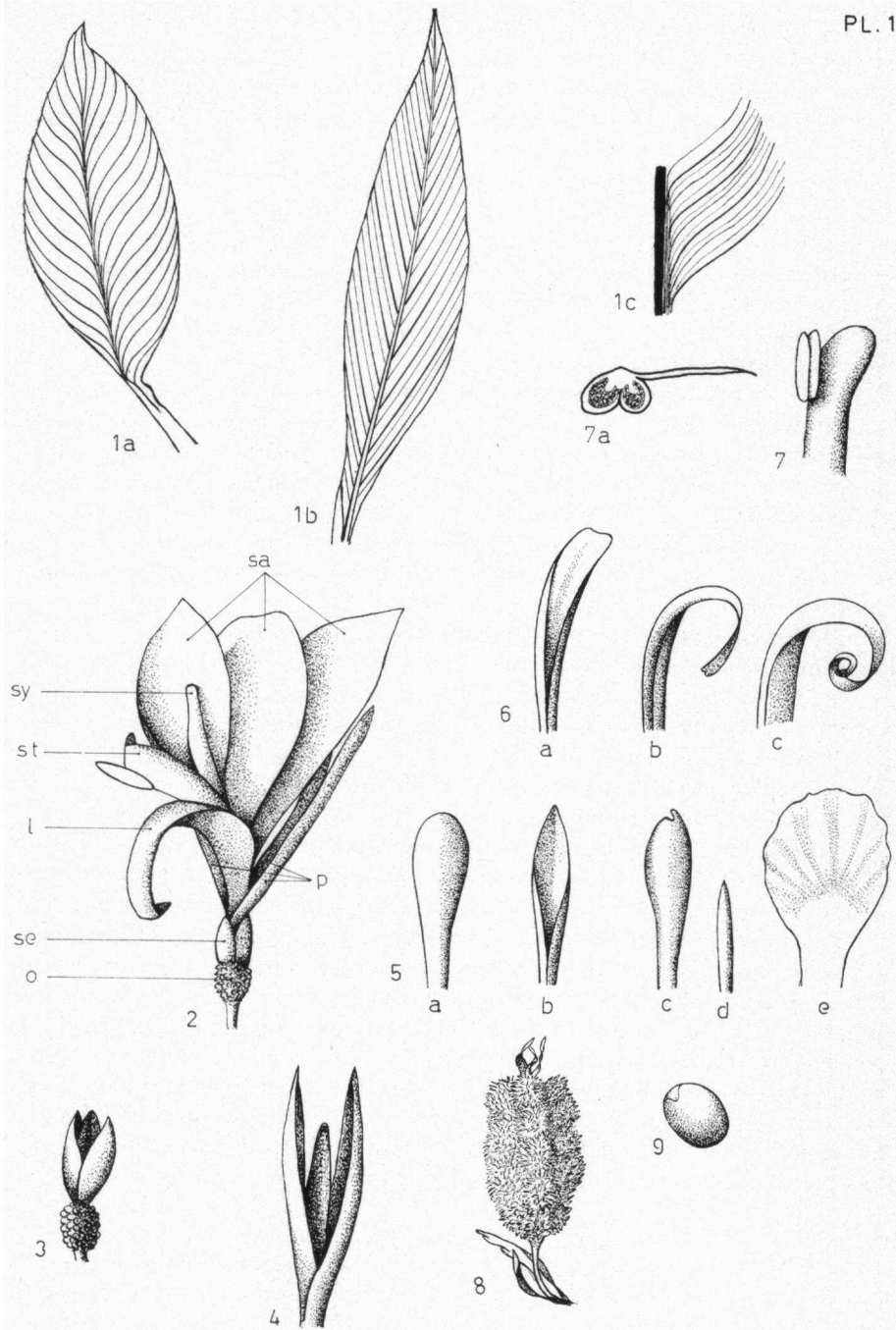


Table 1. Chromosome counts in *Canna* (from the literature).

	n	2n	Reference
<i>C. discolor</i>	9		Offerijns 1935
<i>C. edulis</i>		18	Satō 1960; Simmonds 1954
		27	Venkatasubban 1946
<i>C. flaccida</i>		18	Belling 1931
<i>C. glauca</i>	9	18	Honing 1928; Satō 1960
<i>C. humilis</i>	9		Offerijns 1935
		18	Oomen 1949
<i>C. indica</i>	9	18	Honing 1928; Satō 1960
	9	27	Belling 1925
<i>C. limbata</i>		18	Honing 1928
		36	Honing 1928
<i>C. lutea</i>		18	Oomen 1949

latifolia Mill., *C. lutea* Mill., *C. speciosa* Roscoe, and *C. warszewiczii* Otto & Dietr. All counts yielded $2n = 18$.

3.5. Pollen morphology

3.5.1. Material and methods

Only a few species have been investigated. They were selected from the area studied and from the subgenera and sections distinguished by Kränzlin. These are *C. glauca*, *Lanjouw & Lindeman 1528* (U); *C. indica*, *Bro. Ariste-Joseph s.n.* (P); *C. latifolia*, *herb. Bondam s.n.* (L); *C. lutea*, fresh material, *Cantonspark, Baarn No. 6491*; *C. ottonis*, *Steyermark 91627* (VEN).

The preparation of the pollen grains with the commonly used acetolysis method as described by ERDTMAN (1960) proved to be inadequate for *Canna*. The acetolysis mixture dissolved not only the protoplasm, but also the pollen wall completely during the chemical treatment. In another experiment the pollen grains were treated with a solution of KOH 10% and here the protoplasm appeared to be resistant, but the pollen wall again was dissolved completely. The results were better when the material was boiled in water only, but even then the wall of the grains sometimes disappeared. The best method for studying *Canna* pollen proved to be the following: 1. Take fresh material of living plants. 2. Put the pollen grains in a mixture of water and glycerine and a little phenol. 3. Centrifuge, decant and place the tube upside-down on a filter paper for about 24 hrs. at room temperature to drain and dry. 4. Mount according to the method described by REITSMA (1969).

The photographs were taken with a Leitz Ortholux microscope combined

Plate 1. Foliar and floral characters of *Canna*. 1a. ovate shape; 1b. narrowly ovate shape; 1c. detail of venation. 2. Flower. o = ovary; se = sepals; p = petals; l = labellum; st = stamen; sy = style; sa = staminodes. 3. Detail of ovary and sepals. 4. Detail of petals. 5. Staminodes. 6. Labellum. 6a. subgenus *Distemon*; 6b, c. subgenus *Canna*. 7. Stamen. seen from aside; 7a. transverse section. 8. Capsule. 9. Seed.

with a Leitz Orthomat, using an obj. plan Fl. öl 70: 1/1.30 and a Leitz interference green filter Al 546 on Agfa Agepe film, rated at 12° Din.

3.5.2. Description of the pollen grains.

The pollen grains are inaperturate and spherical in shape. The wall is relatively thick and provided with small spinules. The diameter of the grains without spinules varies from 55–77 μ and the thickness of the wall varies from 4–8 μ . The spinules have a conical shape and their basis diameter is about as large as their length. They are scattered over the surface of the pollen grains and are not arranged in an ordinate pattern.

Table 2 lists the average measurements taken from different species, arranged according to KRÄNZLIN (1912).

Table 2. Pollen characters of some *Canna* species.

	size in μ	wall in μ	Spinules	
			diameter in μ	length in μ
Subgenus <i>Distemon</i> . <i>C. ottonis</i>	65	6	3.5	3
Subgenus <i>Canna</i>				
Section <i>Bialatae</i> . <i>C. lutea</i>	55	5	3	2.5
Section <i>Trialatae</i>				
Subsection <i>Glaucae</i> . <i>C. glauca</i>	62	4	3	2.5
Subsection <i>Coccineae</i> or <i>Indiceae</i> . <i>C. indica</i>	60	5	3	3
Subsection <i>Elatae</i> . <i>C. latifolia</i>	77	8	3	2.5

3.5.3. Discussion

Interpretation of the wall: As the wall of the *Canna* pollen grains shows a remarkable reaction to different chemicals it seems worth-while to discuss this matter. According to ERDTMAN (1969): "The exine is the outer, very resistant (also acetolysis-resistant) layer of a pollen or spore wall (sporoderm)" and: "The intine is the inner, usually not very resistant (e.g., not acetolysis-resistant) layer of a pollen wall (sporoderm)". If defined in this way an exine cannot be present in the walls of *Canna* pollen grains. The wall is not acetolysis- or KOH-resistant and therefore perhaps consists mainly of intine material. Another possibility is that the wall is the intine itself, which is modified. In order to investigate the actual structure of the pollen wall (exine and intine), the use of an electron microscope is required.

Sterility of pollen grains: It is doubtful whether the grains without protoplasmic content (NAIR 1960 and OOMEN 1949) must be considered sterile. They are probably artifacts because they only appear after several treatments. It is remarkable that they have not been found by us in fresh material of *C. lutea* and *C. indica*.

Importance for taxonomy: According to NAIR (1960 and 1962) pollen grains

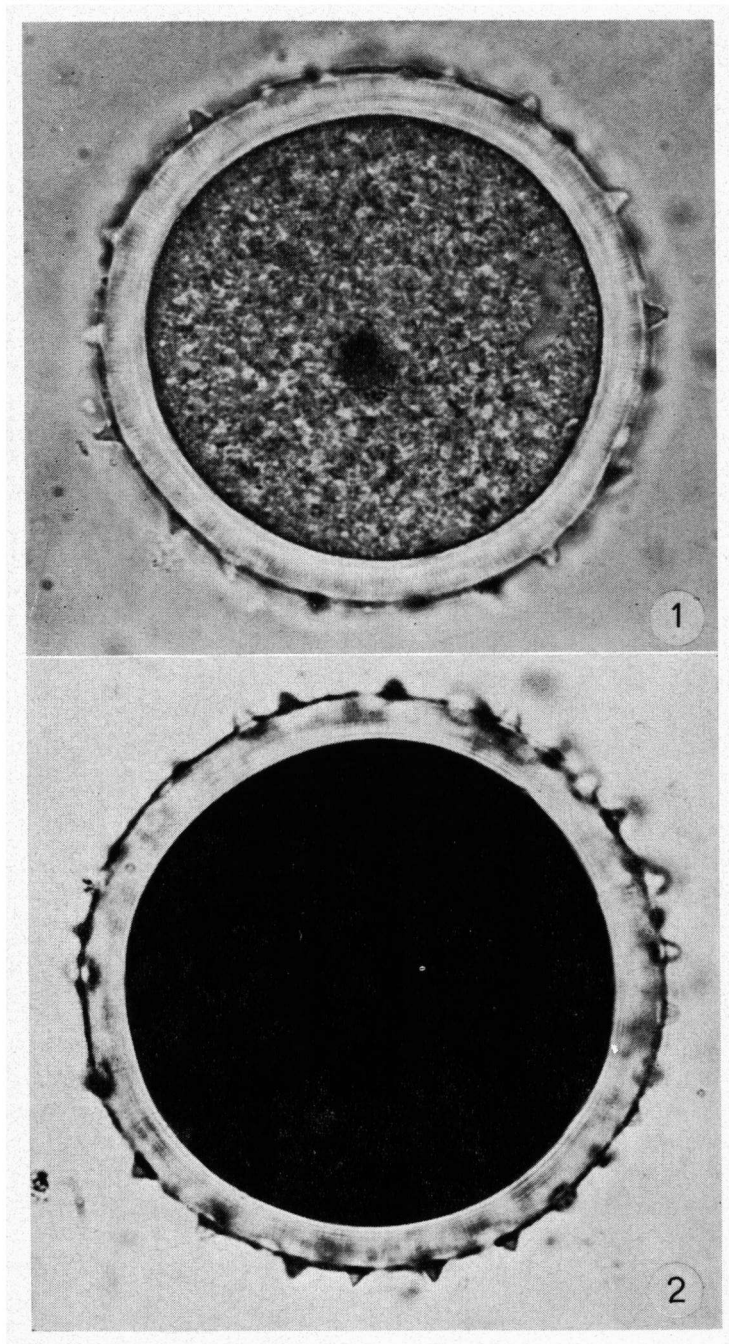


Plate 2. Pollen grains of *Canna*. 1. *C. lutea*; 2. *C. glauca*. $\times 300$.

are very important for the taxonomy of horticultural varieties of *Canna*. He noted differences in size and shape and in some cases also observed pores.

From the results given in *table 2* it is clear that the pollen grains of American *Canna* species do not yield much additional information on the taxonomy of *Canna*.

3.6. Description of *Canna*

Canna Linnaeus, Sp. Pl. 1. 1753.

Distemon Bouché, Linnaea 18: 494. 1844.

Eurystylus Bouché, l.c. 485. 1844.

Perennial rhizomatous herbs. Leaves consisting of an open sheath and a large, asymmetric lamina; ligule wanting. Inflorescence terminal, racemiform or paniculate, bracteate, the bracts usually subtending a single flower or a monochasium of two flowers. Flowers bisexual, asymmetric. Sepals 3, imbricate, free, foliaceous or petaloid. Petals 3, unequal, connate at the base or sometimes free. Stamen one, petaloid, with a solitary marginal theca, more or less adnate at the base to the fleshy style and a petaloid anterior staminode, the labellum. Posterior staminodes 0–3, showy, mostly connate at the base with the labellum, style, and stamen to form a tube. Ovary inferior, trilocular, surface spiny-fimbriate or verrucose, ovules numerous, axillary, anatropous. Fruit a rather large tuberculate or spiny-fimbriate capsule, mostly longitudinally loculicidally dehiscent; seeds numerous, globose, very hard, black or dark brown.

About 25 species of which c. 18 in tropical and subtropical America and c. 7 in Africa and Asia. The specimen examined here were mainly collected in swampy localities or along watercourses, up to about 3000 m altitude.

3.7. Key to the species occurring in northern S. America

1. Staminodes, except labellum, none Subgenus *Distemon*
 2. Flowers reddish; leaves narrowly ovate; style adnate for half of its length to the petaloid part of the stamen 1. *C. meridensis*
 2. Flowers red; leaves ovate to elliptic; style free 2. *C. ottonis*
1. Staminodes, except labellum, two or three Subgenus *Canna*
 3. Staminodes two
 4. Flowers yellow, usually spotted with orange or red; staminodes equal in length; no rudimentary staminodes present 3. *C. lutea*
 4. Flowers red; staminodes unequal in length; rudimentary staminodes present 8. *C. indica*
 3. Staminodes three
 5. Flowers curved, orange; lamina long-petiolate, dark green, somewhat paler along the veins and beneath, narrowly elliptic to ovate, base gradually decurrent into the petiole. Bracts absent . . . 4. *C. leucocarpa*
 5. Flowers not curved
 6. Flowers yellow; leaves glaucous (in living plants)
 7. Staminodes obovate-elliptic, 8–10 cm long; labellum linear, 0.7 cm wide, spotted with salmon pink; petals erect . . . 5. *C. glauca*

7. Staminodes broadly obovate, 9–11 cm long; labellum broadly obovate, 8–9 cm wide; petals sharply reflexed 6. *C. flaccida*
6. Flowers not yellow; leaves not glaucous.
 8. Labellum orange or red, not suffused with yellow
 9. Staminodes red, free; petals erect; bracts very small or absent
9. *C. latifolia*
 9. Staminodes orange to red; staminodial tube as long as or longer than that of the petals; petals spreading; bracts 1–1.5 cm
10. *C. heliconiifolia*
 8. Labellum red, suffused with yellow towards the base. Lamina narrowly elliptic to narrowly ovate, gradually and continuously narrowed towards the sheath; flowers red or reddish; staminodes obovate, unequal, about 4 cm long 7. *C. formosa*
 8. Labellum yellow spotted with red. Lamina elliptic to ovate, abruptly decurrent into the sheath; flowers orange to red, sometimes suffused with yellow at the base; staminodes narrowly obovate to obovate, often unequal 8. *C. indica*

I. Subgenus *Distemon* (Bouché) Kränzlin

Staminodes other than labellum none. Sometimes one, two, or three rudimentary staminodes present. Labellum erect.

1. *Canna meridensis* Kränzlin in Engler, Pflanzenreich IV. 47: 30, fig. 5. 1912. Distribution: Only found in Venezuela, Mérida, by Moritz. Venezuela: Mérida, Moritz 236, 1286 (according to Kränzlin). These are the only collections so far known. For a description see Kränzlin (l.c.). A duplicate specimen of Moritz 1286 from Paris was seen by authors, but this proved to have 3 staminodes and therefore does not agree with the diagnosis of subgenus *Distemon*. In the present authors' opinion it belongs to *C. indica*.

2. *Canna ottonis* (Bouché) Kränzlin in Engler, Pflanzenreich IV. 47: 32. 1912. *Distemon ottonis* Bouché, Linnaea 18:494. 1844; Horaninow, Prodr. Scitam. 14. 1862.

Plants to 2 m tall. Lamina ovate to elliptic, rounded or gradually narrowed to the base (sheath), acute to slightly acuminate at the apex, 28–70 × 10–25 cm, glabrous. Inflorescence racemiform, branched, bearing several pairs of shortly pedicellate or sessile flowers. Sepals pale red, narrowly oblong-ovate, 1.5–2.5 × 0.4 cm, acute. Corolla red, 6.5–8.5 cm long; tube 1.5–2.5 cm long, the lobes narrowly oblong to subulate, acuminate, erect. Labellum linear, erect, red, 4–6 × 0.5–0.7 cm. Stamen red, 4–6 × 0.6 cm, theca adnate for half of its length to the petaloid part. Style red, 4–6 × 0.4 cm, adnate for half of its length to the petaloid part of the stamen. Ovary ellipsoid to obovoid. Capsule ellipsoid, 4 × 2.5 cm.

Distribution: Venezuela; reported from Brazil by Kränzlin.

Venezuela. Distr. Federal: Chacaito, near Caracas, *Pittier 9941* (NY, VEN). Guárico: Near Platillon, in the neighbourhood of San Juan de Los Morros, *Rivero & Esteves s.n.* (VEN). Miranda: Sebucan, near Los Dos Caminos, *Pittier 11897* (US, VEN); between Petare and Guarenas, *Steyermark 91627* (VEN).

II. Subgenus *Canna*

Subgenus *Eucanna* Baker, Gard. Chron. 1:43. 1893.

Staminodes other than labellum two or three. If staminodes two, very often a third, rudimentary staminode present. Labellum reflexed and more or less curved.

3. *Canna lutea* Miller, Gard. Dict. ed. 8. no. 4. 1768; Roscoe, Trans. Linn. Soc. 8: 338. 1807; Bot. Mag. t. 2085. 1819; Roemer & Schultes, Syst. Veg. 1: 12. 1822; Loddiges, Bot. Cab. 7: t. 646. 1822; Bot. Reg. t. 773. 1824; Roscoe, Monandr. Pl. t. 18. 1828; Bouché, Linnaea 8: 147. 1833; 18: 489. 1844; Horaninow Prodr. Scitam. 15. 1862; O. G. Petersen in Martius, Fl. Bras. 3 (3): 71. 1890; Baker, Gard. Chron. 1: 164. 1893; Kränzlin in Engler, Pflanzenreich 4. 47: 39, fig. 3. 1912; Woodson, Ann. Missouri Bot. Gard. 32: 75. 1945.

Canna aurantiaca Roscoe, Monandr. Pl. t. 21. 1828; Bouché, l.c. 153; l.c. 491. Plants 1–2.5 m tall, glabrous throughout. Lamina ovate to narrowly elliptic, 15–60 × 10–30 cm, the base rounded or abruptly and shortly decurrent into the sheath, apex acute to very shortly acuminate. Inflorescence racemiform or branched at the base, bearing several very shortly pedicellate or sessile, solitary or paired flowers. Sepals green-yellow (5.0 GY 8/4), ovate to narrowly ovate, 0.5–1.5 × 0.5 cm. Corolla yellow (7.5 Y 8/8), 4–5 cm long, tube about 0.8 cm long, the lobes narrowly oblong-ovate, about 3.5 cm long, acuminate. Stamino-des 2, yellow spotted with orange or red (7.5 YR 7/10 + 10.0 R 6/10), narrowly obovate, spathulate, equal, apex emarginate, 4–6 × 0.4–0.8 cm Labellum yellow, spotted with red (7.5 YR 7/10 + 10.0 R 6/10), linear to narrowly oblong, smaller than the staminodes, apex emarginate. Stamen yellow (7.5 YR 7/10), anther about 1 cm long, dirty white. Style yellow (7.5 YR 7/10), not spotted with red. Capsule obovoid, 3–3.5 × 1.5–2 cm.

Distribution: Tropical and subtropical America.

Colombia. Magdalena: Sta. Marta, 3 miles S. of Mamalcoa, *H. H. Smith 2321* (K, L, NY, P, US).

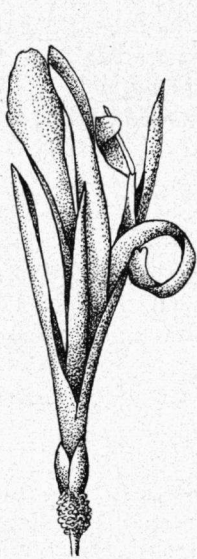
Venezuela, Carabobo?: *Funck & Schlim 719* (P). Delta Amacuro: Río Orinoco, *Holt & Gehriger 274* (US). Mérida: Tovar, *Fendler 2168* (K).

Brazil. Rio de Janeiro: *Glaziou 13236, 787* (P).

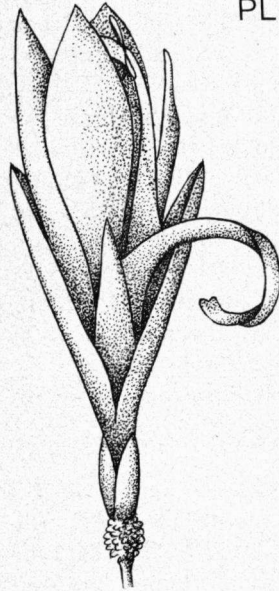
Cult.: *Hort. Bot. "Cantonspark", Baarn 6457* (U).

Attention is drawn to a paper by OOMEN (1949) in which crosses between what he identified as *C. humilis* and *C. aureo-vittata* (= *C. lutea*) are described. He came to the conclusion that these "species" behaved as varieties of one species. It may be suspected that a similar result would be obtained with other species not yet investigated.

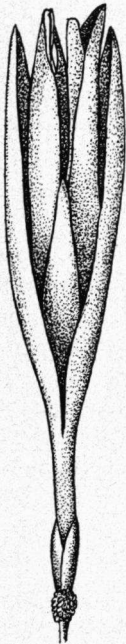
4. *Canna leucocarpa* Bouché, Linnaea 18: 493. 1844; Horaninow, Podr. Scitam 17. 1862.



C. lutea Mill.



C. heliconiifolia Hort. Berol.



C. ottonis
(Bouché) Kränzlin



C. indica L.

Plate 3. Flowers of *Canna* species.

Plants to 2 m tall. Lamina dark green, somewhat paler along the veins and beneath, $55-80 \times 12-24$ cm, narrowly elliptic to narrowly ovate, apex acuminate, base gradually decurrent into the petiole (12 cm long). Inflorescence racemiform, simple, bearing several sessile flowers. Bracts absent. Flowers orange, 4–7 cm long, curved. Sepals orange-red, narrowly ovate to ovate, 1.4×0.6 cm. Corolla orange-yellow, 6 cm long, tube about 1.5–2 cm long, the lobes narrowly ovate to narrowly elliptic, $4-5 \times 0.8-1$ cm, acute, erect. Stamínodes 3, orange, obovate-elliptic, $4-5 \times 1.4-1.8$ cm, apex emarginate, tube 2–2.3 cm long. Labellum orange, 4×1 cm, almost erect, somewhat curved, apex emarginate. Stamen orange, anther 0.8–1 cm long, adnate for half of its length to the petaloid part. Style erect, connate at the base with the staminodes to form a tube. Capsule obovoid, $2.5 \text{ cm} \times 1 \text{ cm}$.

Distribution: Venezuela, reported from British Guiana by Kränzlin.

Venezuela. Mérida: between La Mesa and Jají, *Wessels Boer 1846* (U).

5. *Canna glauca* Linnaeus, Sp. Pl. 1: 1. 1753; Roscoe, Trans. Linn. Soc. 8: 339. 1807; Redouté, Liliac. 6: t. 354. 1810; Bot. Mag. t. 2302. 1822; Roscoe, Monandr. Pl. t. 7. 1828; Bouché, Linnaea 8: 158. 1883; 18: 487. 1844; O. G. Petersen in Martius, Fl. Bras. 3 (3): 72. 1890; Baker, Gard. Chron. 1: 70. 1893; Kränzlin in Engler, Pflanzenreich 4. 47: 54. 1912; Woodson, Ann. Missouri Bot. Gard. 32: 76. 1945; Lemée, Fl. Guy, Franc. 1: 350. 1955.

Canna angustifolia Linnaeus, Sp. Pl. 1: 1. 1753.

Canna stricta Bouché, Linnaea 12: 144. 1838.

Plants 0.7–2 m tall. Sheaths 13.5–17 cm long, linear-triangular. Lamina narrowly angular-ovate to narrowly ovate, $28-60 \times 6-12$ cm, gradually narrowed to the base, with distinct lateral veins, glabrous, glaucous on both sides, apex acuminate. Inflorescence racemiform, simple, bearing several pairs of shortly pedicellate flowers. Sepals pale yellow, darker towards the apex, narrowly elliptic to elliptic, $1-1.5 \times 0.5$ cm wide. Corolla sulfureous-yellow, 5–8.5 cm long, tube about 1–1.5 cm long, the lobes narrowly ovate to subulate, acuminate, erect. Stamínodes 3, pale yellow, narrowly obovate-elliptic, $8-10 \times 1.5-2$ cm. Labelum yellow spotted with salmon pink, linear, 4–5 cm long. Stamen yellow, anther 5–8 mm long, adnate over $\frac{1}{3}-\frac{1}{2}$ of its length to the petaloid part. Style erect, lemon-yellow, paler at the apex. Capsule irregularly ellipsoid, $4-5 \times 2-3$ cm.

Distribution: West Indies, Central America, South America to Argentina.

Cuba: *Otto 102* (P).

Tobago: Frenchfield, *Eggers 5555* (L, P).

Trinidad: Caroni River, *Kuntze 1154* (NY, US).

Colombia. Atlantico: Barranquilla, *Bro. Elias 1537* (US). Bolívar: Area of del Sinu, 15 km of Montería, Zainum, *Molina & Barkley 19B0084* (US). Magdalena: Sta. Marta, *H. H. Smith 2323* (K, L, NY, P, US), 2324 (NY). Santander: California, *Killip & Smith 17095* (NY).

Venezuela. Amazonas: Río Orinoco, *Holt & Gehriger 274* (NY). Aragua: Maracay, *Vogl 783* (NY). Barinas: Guacas-Guasualito, *Aristeguieta & Agostini 4139* (VEN). Bolívar: along road between Tumeremo and Guasipati, *Steyermark 89717* (US, VEN). Guárico:

San Juan de los Morros, *Farenholtz* 487 (U). Mérida: Tovar, *Allart* 403 (NY), *Fendler* 1491 (K, NY).

Guyana: Mon Repos, East Coast Demerara, *Harrison* 527 (K), 1676 (NY, U); Georgetown, near Peter's Hall, *Hitchcock* 16646 (NY, US); Demerara, *Parker s.n.* (K); Roraima, *Schomburgk* 860 (K, P).

Suriname: W of Paramaribo, *Jonker-Verhoef & Jonker* 181 (U); Hertenrits, N of Wageningen, *Jonker-Verhoef & Jonker* 587 (U); Paramaribo, *Kramer & Hekking* 2292 (U), *Kuyper* 11 (U); Lower Saramacca River near "Catharina Sophia", *Lanjouw* 273 (U); West Coronie Swamp. *Lanjouw* 1073 (U); Coronie, *Lanjouw & Lindeman* 1528 (NY, U); Lower Suriname R., pl. Guineesche Vriendschap, *Soeprato* 283 (U); Nickerie, Pr. Bernhardpolder, *SOML* 11 (U).

French Guiana: Kourou, *Benoist* 1470 (P); without loc., *Mélinon* 204 (P).

Brazil. Ceará: Rio Coco NW of Cajazairas, *Drouet* 2312 (NY). Rio de Janeiro: without locality, *Glaziou* 13237, 14327 (P).

Paraguay: Zanja Moroti, *Carnier* 1140 (U); Dept. San Pedro, Alto Paraguay, Primavera, *Woolston* 1034 (U).

6. *Canna flaccida* Salisb. Icon. Stirp. Rar. 3. t. 2. 1791; Redouté, Liliac. 2: 107. 1805; Roscoe, Trans. Linn. Soc. 8: 339. 1807; Loddiges, Bot. Cab. 6: 562. 1821; Roemer & Schultes, Syst. Veget. 1: 13. 1822; Roscoe, Monandr. Pl. t. 6. 1828; Bouché, Linnaea 8: 158. 1833; O. G. Petersen in Martius, Fl. Bras. 3 (3): 74. t. 17. 1890; Baker, Gard. Chron. 1: 196. 1893; Kränzlin in Engler, Pflanzenreich 4. 47: 49, fig. 9. 1912; Woodson, Ann. Missouri Bot. Gard. 32: 76. 1945.

Eurystylus flaccidus (Salisb.) Bouché, Linnaea 18: 485. 1844; Horaninow, Prodr. Scitam. 18. 1862.

Plants 1–2 m tall, glabrous. Lamina glaucous, narrowly elliptic to narrowly ovate, 20–50 × 8–12 cm, base gradually and continuously narrowed into the sheath, apex acute to somewhat acuminate, glaucous. Inflorescence racemiform, simple, bearing a few pairs of sessile flowers. Sepals pale yellow, narrowly oblong-elliptic, 2–3 × 0.4–0.6 cm. Corolla yellow, 10–12 cm long, the tube about 4 cm long, the lobes narrowly oblong-elliptic, 6–8 cm long, sharply reflexed at the base. Stamines 3, yellow, broadly obovate, 9–11 × 8–9 cm. Labellum yellow, broadly obovate, about 10 × 8–9 cm. Capsule irregularly ellipsoid, 5–6 × 4–4.5 cm.

Distribution: Southern part of the US and West Indies, Panama, and Colombia. USA. Florida: Eustis, Lake County, *Nash* 1654 (P); Jacksonville, *Curtiss* 6413 (P).

Colombia. Antioquia: Medellín, Armenia, *Toro* 627 (NY).

Closely related to *C. glauca*. Both have glaucous leaves. *C. flaccida* can be distinguished mainly by its very large stamines and labellum.

7. *Canna formosa* Bouché, Linnaea 18: 491. 1844; Koch, Berlin. Allgem. Gartenzeitung 385 t. 41. 1855 (not seen); Kränzlin in Engler, Pflanzenreich 4. 47: 61. 1912.

Plants about 1 m tall. Lamina narrowly obovate to narrowly elliptic (narrowly trullate), about 45 × 6–10 cm, base gradually decurrent into the sheath, apex acuminate. Inflorescence racemiform bearing several pairs of pedicellate flowers; pedicels 0.5–1 cm long. Bracts broadly obovate, 0.7 × 0.5 cm. Sepals 1–1.5 cm long, free, acuminate, elliptic. Corolla 3–4 cm long, the lobes free, acuminate. Stamines 3, red, obovate, unequal, mostly one larger, 2.5–4 × 0.5–0.8 cm,

apex emarginate or normal. Labellum red flushed with yellow towards the base, narrowly oblong-elliptic, $2.5-4 \times 0.5$ cm, apex strongly revolute. Stamen as long as the staminodes, theca adnate for half of its length to the petaloid part. Style shorter than the stamen. Ovary broadly ellipsoid. Capsule not seen. Distribution: Venezuela to Brazil.

Brazil. Rio Grande do Sul: Rio Pardo, *Archer* 4423 (NY).
Venezuela. Mérida: Col. Tovar, *Allart* 403 (US, VEN).

8. *Canna indica* Linnaeus, Hort. Upsal. 1. 1748; Spec. Pl. 1: 1. 1753; Aiton, Hort. Kew. ed. 1. 1: 1. 1789 (excl. B); Bot. Mag. t. 454. 1799; Roemer & Schultes, Syst. Veget. 1: 11. 1822; Bot. Reg. t. 776. 1823; Roscoe, Monandr. Pl. t. 1. 1828; Bouché, Linnaea 8: 155. 1833; Horaninow, Prodr. Scitam. 16. 1862; Baker, Gard. Chron. 1: 43. 1893; Kränzlin in Engler, Pflanzenreich 4. 47: 59. 1912; Woodson, Ann. Missouri Bot. Gard. 32: 77. 1945; Lemée, Fl. Guy. Franç. 1: 350. 1955.

Canna coccinea Miller, Gard. Dict. ed. 8. no. 3. 1768; Link, Enum. Pl. Hort. Berol. 1. 1: 1. 1821; Roemer & Schultes, Syst. Veg. 1: 11. 1822; Loddiges, Bot. Cab. t. 739. 1823; Roscoe, Monandr. Pl. t. 11. 1828; Bouché, Linnaea 8: 145. 1833; 18: 490, 1844; Horaninow, Prodr. Scitam. 16. 1862; O. G. Petersen in Martius, Fl. Bras. 3 (3): 68, t. 15. 1890; Baker, Gard. Chron. 1: 70. 1893; Kränzlin in Engler, Pflanzenreich 4. 47. 60. 1912; Lemée, Fl. Guy. Franç. 1: 351. 1955.

Canna indica Linnaeus *Patens* Aiton, Hort. Kew. ed. 1. 1: 1. 1789

Canna patens (Aiton) Roscoe, Trans. Linn. Soc. 8: 338. 1807; Bot. Reg. 3: 206. 1817; 7: 576. 1821; Roscoe, Monandr. Pl. t. 4. 1828; Loddiges, Bot. Cab. t. 1693. 1830; Bouché, Linnaea 8: 160, 1833; 18: 488. 1844; Horaninow, Prodr. Scitam. 15. 1862; Baker, Gard. Chron. 1: 43. 1893.

Canna aurea-vittata Loddiges, Bot. Cab. t. 449. 1820.

Canna edulis Ker-Gawler, Bot. Reg. t. 775. 1823; Bot. Mag. t. 2498. 1824; Roscoe, Monandr. Pl. t. 15. 1828; Bouché, Linnaea 8: 157. 1833; 18: 492. 1844; Horaninow, Prodr. Scitam. 17. 1862; O. G. Petersen in Martius, Fl. Bras. 3(3): 69. 1890; Baker, Gard. Chron. 1: 70. 1893; Kränzlin in Engler, Pflanzenreich 4. 47: 64. 1912.

Canna limbata Roscoe, Bot. Reg. t. 771. 1823; Monandr. Pl. t. 9. 1828; Bouché, Linnaea 8: 161. 1833; 18: 488. 1844; Kränzlin in Engler, Pflanzenreich 4. 47: 62, fig. 13. 1912.

Canna surinamensis Bouché, Linnaea 18: 491. 1844.

Plants to 3.5 tall. Lamina narrowly ovate to narrowly elliptic, to $60 \times 15-27$ cm, base rounded or gradually decurrent to the sheath, apex acute to somewhat acuminate, sometimes shortly petiolate. Inflorescence racemiform, mostly simple, bearing several paired or solitary, shortly pedicellate flowers. Bracts broadly obovate, $1-2 \times 1$ cm wide, apex acute to emarginate. Sepals ovate to narrowly ovate, $1-1.5 \times 0.4-0.9$ cm, apex acute. Corolla pale red to yellow, 4-5 cm long, tube about 1 cm long, the lobes linear, $3-4 \times 0.3-0.6$ cm, apex acuminate. Staminodes 3, reddish, spatulate, $4-6 \times 1-1.5$ cm, sometimes very un-

equal in length, or only 2 clearly visible, apex acute or emarginate. Labellum yellow spotted with red, narrowly oblong-obovate, 4–5 × 0.5–0.8 cm, apex emarginate. Stamen 4–5 cm long, sterile part involute, theca adnate for a third of its length to the sterile part. Style 4–5 cm long, reddish. Capsule broadly ovoid, 3 × 2.5 cm.

Distribution: very common in South America. Also naturalized in the US, Europe, and South-east Asia.

Mexico. Puebla: Chila, *Andrieux* 82 (P).

Puerto Rico: La Vega near Río de Mameyes, *Eggers* 819 (P).

Trinidad: Caroni, *Britton* 2323 (US).

Colombia. Amazonas: Loretoyacu River, *Schultes* 6612 (US). Antioquia: Medellín, *Archer* 67 (US), *Toro* 120 (NY); Cisneros, *Killip* 35576 (US). Boyaca: NW of Bogotá, *Lawrance* 210 (K, NY, US). Cauca: Popayan, *Lehmann* 5735 (US). Cundinamarca: Bogotá, *Triana* 675 (273) (US); La Mesa, *Fernández & Mora* 1384 (US). El Valle: Río Julia, near Julina, *Dryander* 2008 (US); Huila: between Alchamira and Florencia, *Vogel* 128 (US); Magdalena: Sta. Marta, Jiracasaca, *Schlim* 937 (K); Sta. Marta, *H. H. Smith* 2322 (NY); Nariño: between Mocoa and Sachamates, *Cuatrecasas* 11397 (US); Samaniego, *Fernández & Mora* 1149 (NY); Norte de Santander: between Pamplonita and Chinacota, Río Pamplonita Valley, *Killip & Smith* 20763 (NY, US); Chitaga, between Chorro Colorado and Bata, *Cuatrecasas, Schultes & Smith* 12241 (U, US); Santander: Puerto Olaya, opposite Puerto Berrio, Río Magdalena, *Fassett* 25367 (NY, US); La Picota, Fungeto, *García* 3072 (US); Bucaramanga, *Killip & Smith* 15448 (NY); Río Surata Valley, between El Jaboncilla and Surata, *Killip & Smith* 16446 (NY); California, *Killip & Smith* 17095 (US); ravine of Ramo, along road from Zapatoca to San Vicente, *Langenheim* 3292 (US). Tolima: La Plata, *Lehmann* 6382 (K, US); La Trinidad, Libano, *Pennell* 3307 (NY, US).

Venezuela. Bolívar: Sta. Elena, *Lasser* 1551 (VEN); Carapo, *Tate* 73 (US). Carabobo: Valencia, *Pittier* 9048 (NY, US). Delta Amacuro: Orinoco delta, Río Manamo, *Bond, Gillin & Brown* 156 (NY, US); Sta. Catalina, Lower Orinoco, *Rusby & Squires* 387 (K, NY). Distr. Federal: Caracas, *Lawrance s.n.* (K), *Rose* 21802 (US); Gardens of Caracas, *Lasser* 3503 (VEN). Falcón: Sierra de San Luis, between Curimagua and Uria, *Steyermark* 99080 (VEN). Mérida: Tovar, *Fendler* 1493 (K); *Lasser & Foldats* 4277 (VEN); Mérida, *Moritz* 1286 (P), *Reed* 99 (US); E of Tobay, *Reed* 466 (US). Miranda: Los Teques, *Pittier* 11591 (NY, P, US, VEN). Tachira: San Cristobal, *Broadway* 453 (NY, US). Zulia: without loc., *Mocquers* 951 (US).

Guyana: Pomeroon District, Cart Market, Momka R., *de la Cruz* 1144, 4007 (NY, US); Bartica, Essequibo R., *de la Cruz* 1955 (NY, US); Pomeroon R., *de la Cruz* 2901 (NY, US); Waini R., *de la Cruz* 3749 (NY, US); Wanama R., *de la Cruz* 3887 (NY); NW district, Arakaka (?), *de la Cruz* 4304 (NY, US); Georgetown, *Warren s.n.* (US).

Suriname: Paramaribo. *Hekking* 838 (U); Republiek, *Lanjouw & Lindeman* 172 (NY, U); Lower Marowijne R., Bigiston, *Lanjouw & Lindeman* 1963 (K, NY, U); Marowijne R., *Palmer-Jones* 124 (U); Litani R., Taponté, *Rombouts* 757 (U); Cottica R., pl. Sommeldijk, *Soeprato* 34 (U); Lower Suriname R., pl. Zoelen, *Splitgerber* 436 (L); Upper Suriname R., Waktibasoe, *Tresling* 31 (U); Lower Suriname R., pl. Aurora, *Tresling* 141 (U).

French Guiana: St. Laurent du Maroni, *Benoist* 763 (P); Cayenne, *Broadway* 834, 900, 928 (NY, US); Mont Cépéron, *Lemée* 7149 (P); Mana, on the river Jacques, *Sagot* 579 bis (P); Cayenne, *Sagot s.n.* (P).

Brazil. Amazonas: Taperinha near Santarem, *Ginzberger & Zerny* 395 (W); Manaus, Río Negro, *Labroy* 144 (P); Minas Gerais: *Claussen* 176 (P); Pará: without loc., *Poeppig s.n.* (P); Río Grande do Sul; San Leopoldo, *Eugenio* 90 (NY).

Ecuador. Prov. Napo-Pastaza: El Angel, *Rivet* 390 (P); Puyo, *Skutch* 4438 (US).

Bolivia: Vera Cruz, *d'Orbigny* 941 (P).

Cult.: Bot. Gard. UCV, Caracas, *Labiente 3* (VEN); Hort. Bot. "Sandwijck", Utrecht *S 69-71* (U); "Cantonspark", Baarn *CB 6321* (U).

In the course of the present investigation it proved impossible, with the available material, to make a clear distinction between *C. indica*, *C. coccinea*, *C. edulis*, and *C. limbata*, because the colour of the flower and the shape of the apex of the staminodes appeared to be extremely variable. The following combinations were observed:

- 1) staminodes 3, nearly equal in length, top rounded or retuse to emarginate.
- 2) staminodes 3, unequal in size, top retuse to emarginate.
- 3) staminodes 3, 2 equal in size and shape, one clearly smaller, top of the larger ones retuse.
- 4) staminodes 2, nearly equal in size and shape, top emarginate, additional small staminodes present, varying in size.

(3) and (4) were seen in one living plant. This was probably also seen by ROEMER & SCHULTES (1817) as may be concluded from their remark "Rarius occurrit corolla 5 partita..."; by "corolla" they apparently meant both petals (3) and staminodes. Since it can be assumed that only the numbers of staminodes may vary, they most likely saw 2 staminodes.

The original description of *C. edulis* (KER-GAWLER, Bot. Reg. t. 775. 1823) and a second one in Bot. Mag. (t. 2498. 1823) are accompanied by different illustrations. Both plates and the description match *C. coccinea*, and consequently *C. edulis* should be put into the synonymy of that name. In view of the above, notwithstanding the lack of sufficient living material, the present authors are convinced that *C. limbata* and *C. coccinea*, too, are synonymous with *C. indica*.

The following species have been described from the area studied, but according to WOODSON (1945) and HEPPER (1968) must also be regarded as conspecific with *C. indica*: *C. sylvestris*, *C. warszewiczii*, and *C. bidentata*.

9. *Canna latifolia* Miller, Gard. Dict. ed. 8. no. 2. 1768; Loddiges, Bot. Cab. 7: t. 634. 1822; Roscoe, Monandr. Pl. t. 4. 1828; Regel & von Herder, Index Sem. Hort. Bot. Petrop. 84. 1866; O. G. Petersen in Martius, Fl. Bras. 3 (3): 70. 1890; Baker, Gard. Chron. 1: 70. 1893; Kränzlin in Engler, Pflanzenreich 4. 47: 67, fig. 5a, 5b. 1912.

Plants 3–4 m tall, woolly. Lamina distinctly petiolate, ovate to elliptic, to 70 cm long, to 35 cm wide, the base gradually decurrent into the sheath, apex acute to slightly acuminate. Inflorescence racemiform, branched, bearing several sessile pairs of flowers. Bracts very small, often absent. Sepals green, reddish at the base, 1.5–2 × 0.5 cm. Corolla red, 4.5–6 cm long, tube about 1 cm long, the lobes narrowly oblong-ovate, 3.5–5 × 0.4–0.8 cm. Staminodes 3, deep red, narrowly obovate-spathulate, 5.5–8 × 0.6–0.8 cm, apex entire or emarginate. Labellum deep red, narrowly oblong-elliptic, about 5 × 0.4 cm, apex emarginate. Stamen yellow, 4.5 cm long, theca 1 cm long. Style shorter than the labellum, deep red. Capsule obovoid, very large, to 9 × 4 cm.

Distribution: Colombia.

Colombia. Nariño: West Andes of Tuquerres, *Lehmann 5295* (K).

10. *Canna heliconiifolia* (Hort. Berol. ex) Bouché, *Linnaea* 8: 164. 1833; 18: 493. 1844; Horaninow, *Prodr. Scitam.* 17. 1862; Hemsley, *Biol. Centr. Amer.* 3: 311. 1884; Kränzlin in Engler, *Pflanzenreich* 4. 47: 67, fig. 15D-F. 1912.

Canna xalapensis (Hort. Berol. ex) Bouché, l.l.c.c. 163 and 493; Horaninow, l.c. 17.

Plants to 2.5 m tall. Lamina petiolate, oblong to elliptic, 50–60 × 20–25 cm, gradually narrowed to the base and sheath, apex acuminate. Inflorescence racemiform to paniculate, bearing several pairs of shortly pedicellate flowers. Bracts 1–1.5 × 1 cm. Sepals green, 0.8–1 cm long, subulate to narrowly ovate, unequal in length. Corolla 4 cm long, the lobes narrowly oblong-elliptic acuminate, spreading. Staminodes 3, orange to red, narrowly obovate-spathulate, connate below the middle, 6 cm long, 0.7 cm wide, apex acute. Labellum orange to red, narrowly oblong-elliptic, 4.5 × 0.5 cm, apex strongly involute. Stamen 4.5 cm long, sterile part involute, theca 1.5 cm long. Style 4.4 cm long, red. Capsule ellipsoid, 3.5 × 2.5 cm.

Distribution: Texas and Venezuela.

USA. Texas: Río San Antonio, *Matthes 231* (P).

Venezuela. Mérida: Tovar, *Fendler 1492* (K).

Just as in *C. latifolia* only few plants could be studied. Both species are closely related. *C. lambertii*, according to Kränzlin's description, should be placed near *C. heliconiifolia* and *C. latifolia*, but no material of it was seen. The only Colombian collection available, a specimen of *H. H. Smith 3221* (sub *C. discolor*), which probably should be *2321*, identified by Kränzlin as *C. lambertii*, appears to be referable to *C. lutea*.

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