NEW TAXA OF **ERYTHROXYLUM** (ERYTHROXYLACEAE) FROM THE AMAZON BASIN.

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SUMMARY

Three new species of ***Erythroxylum*** *from Amazonia are described:* ***Erythroxylum nelson-rosae*** *Plowman,* **E. schunkei** *Plowman and* **E. tucuruiense** *Plowman. An emended description is given for* **E. ligustrinum** *DC., previously known from a single collection from French Guiana; it is here cited from Brazil for the first time. A new variety,* **E. ligustrinum** *var.* **carajasense** *Plowman, is also described. A provisional list of all* ***Erythroxylum*** *species occurring in Amazonia and peripheral areas is appended.*

INTRODUCTION

My continuing taxonomic studies of South American Erythroxylaceae have been greatly enhanced by recent collections from Amazonian Brazil, Venezuela and Peru. Because species of **Erythroxylum** are easily overlooked, they are generally undercollected and poorly represented in herbaria compared to their frequency in nature. Recently, this has been remedied to some extent by field workers and colleagues who have sought to collect both fertile and sterile herbarium material. These collections have provided a significantly better basis for delineating the complex array of taxa occurring in Amazonia and for understanding their relationships.

Most Amazonian species of **Erythroxylum** occur not in rain forest habitats **per se** but rather in a variety of more open habitats dispersed throughout the Amazonian forest. These include riverbanks and forest margins, rock outcrops, **campina** and **campinarana** white-sand areas, as well as patches of **cerrado** which adjoin and form a mosaic with forests along the southern boundary of Amazonia. These open habitats frequently occur as islands in large expanses of forest. Populations have become isolated in these islands with subsequent development of geographically restricted endemics such as **E. cordato-ovatum** Huber, **E. campinense** Amaral Jr., and **E. hypoleucum** Plowman.

I have tallied 40 species of **Erythroxylum** for the Amazon basin and adjacent areas, such as the **cerrados** on the southern edge and the Guayana highlands in the north (but excluding the Orinoco drainage and species restricted to the foothills of the

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Andes). These species are listed with their synonyms and types in the appendix.

A number of taxonomically difficult, wide-ranging, polymorphic species have yet to be adequately analyzed. For example, **E. macrophyllum** Cav. **sens. lat.**, extends from Mexico to Brazil and Bolivia and has numerous local forms, several of which have been named as species. This complex is well represented in Amazonia with a number of distinct varieties as well as a high degree of variability. Other problems arise with several distinctive collections which probably represent new species, but for which the material is too incomplete for description and adequate interpretation. I expect the number of species occurring in this large area to increase to possibly fifty if botanical exploration of Amazonia continues at the present pace. Continued collecting in Amazonia is essential to resolve these complex taxonomic problems and cannot be overemphasized.

Three taxa described here are known primarily from endangered habitats and may soon be considered endangered themselves: **E. tucuruiense** from the Tucuruí Dam area and **E. nelson-rosae** and **E. ligustrinum** var. **carajasense** from Serra dos Carajás. All were first recognized as a result of new collections arising from the Projeto Flora Amazônica. The novelties reported here reflect in a small way the success of the Projeto Flora in generating the materials essential to floristic, ecological and monographic studies of Amazonian plants, and this success has been demonstrated repeatedly by discoveries in other plant groups (e.g., Prance, 1983, and elsewhere in this volume).

1. **Erythroxylum ligustrinum** DC. descr. emend.

Low SHRUB or TREE to 10 m tall. TRUNK to 10 cm in diameter. BARK on trunk dark brown, longitudinally fissured, 2 mm thick, reddish brown within; wood light tan in color. BRANCHES storied, horizontal, plagiotropic. BRANCHLETS lying in one plane, distichous, consisting of both long and short shoots, diverging 55° - 90° from axis, flattened toward apex, becoming terete with age, 1 - 2 mm in diameter, greyish or reddish brown, smooth, somewhat shiny and wrinkled longitudinally, without lenticels. INTERNODES on long shoots 3 - 30 mm long, on short shoots 0.5 - 1 mm long. RAMENTA (cataphylls) distichous, produced at base of new long shoots, covering stem for 3 - 6 mm, 2 mm wide, in form similar to but slightly larger than stipules, to 2.5 mm long, turning dark brown. STIPULES persistent, appressed to stem, triangular-ovate to ovate, 0.7 - 2 mm long, membranaceous, drying straw-colored, estriate, apically rounded, 3-setulose, the lateral setae flattened, to 0.7 (1.5) mm long, the medial seta filiform, to 0.5 mm long, evanescent, the keels subalate, membranaceous, the margins entire. LEAVES deciduous, scattered along long shoots or 2 - 3 produced at apex of short shoots, distichous, short-petiolate, the lamina plane or lightly undulate, variable in shape, lanceolate, broadly to narrowly elliptic, oblong, or suborbicular, apically rounded, obtuse or acute, if acute the tip itself obtuse, basally broadly to narrowly cuneate or rounded, 13 - 82 mm long, 9 - 32 mm wide, membranaceous, light to medium green adaxially, pale glaucous green

abaxially (**in statu vivo**), dull on both surfaces, abaxially elineate and without distinct central panel, the adaxial midrib thin, nearly flat or slightly raised, obtuse in cross section, yellowish green; abaxial midrib yellowish, drying reddish or yellowish brown, the lateral nerves (12) 14 - 17 (20), diverging 45 - 85° from midrib, irregularly sinuous, anastomosing 1 - 4 mm from margin, the veinlets rather openly to closely reticulate. PETIOLE 1.5 - 3.0 mm long, 0.5 - 0.8 mm in diameter, subterete, drying dark brown. FLOWERS produced on new shoots in axils of ramenta or leaves, 1 - 3 flowers per node, white, cream or greenish, subsessile or frequently short pedunculate, the peduncle flattened against axis and adnate to it for more than half its length, 0.5 - 2.0 mm long, diverging up to 30° from axis in fruit, persistent. BRACTEOLES 2 per flower, conspicuously produced at apex of peduncles, triangular to broadly ovate, concave, 0.3 - 0.8 mm long, membranaceous, the apex abruptly long acuminate, the acumen (seta) 0.3 - 0.5 mm long. PEDICEL slender, 5-ribbed, 3 - 6 mm long, 0.4 - 0.5 mm in diameter, thickened slightly at apex. CALYX 1.0 - 1.5 mm long, divided 1/2 to 3/4 its length, the lobes triangular-ovate, 0.6 - 1.0 mm long, apically acute or acuminate, the tip itself obtuse. PETAL lamina spreading or somewhat ascending, concave, ovate-oblong to narrowly triangular-ovate, 1.5 - 3 mm long, 0.8 - 1.7 mm wide, apically rounded and often incurved, the claw broad, 0.5 - 1.2 mm long, the ligule 1.0 - 1.5 mm long, bilobate with a short, truncate anterior-medial flap between the lobes, the lobes each consisting of two auricles, the shorter anterior auricle 0.5 - 0.7 mm long, the longer posterior auricle 1.0 - 1.5 mm long. STAMINAL CUP 0.8 - 1.3 times length of calyx, 0.7 - 1.0 mm long, the margin variably 10-crenulate. BRACHYSTYLOUS FLOWERS: filaments 2.5 - 3.0 mm long, the anthers 0.4 mm long; styles free, 0.7 - 1.3 mm long; stigmas obliquely depressed-capitate, 0.2 - 0.5 mm long. DOLICHOSTYLOUS FLOWERS: antisepalous filaments 0.6 - 1.0 mm long, the anthers 0.4 - 0.5 mm long; antipetalous filaments 1.2 - 1.7 mm long, the anthers 0.3 - 0.5 mm long (slightly smaller than antisepalous anthers); styles 2.0 - 3.5 mm long, basally connate 0.7 - 1.5 mm; stigmas obliquely depressed-capitate, 0.25 - 0.4 mm long. OVARY subglobose to ovoid; apically rounded, 1.5 - 1.8 times length of staminal cup, 1.0 - 1.5 mm long. DRUPE narrowly ovoid, 5.5 - 12.0 mm long, 3.0 - 3.2 mm in diameter, red at maturity, the apex acute, slightly oblique, short-apiculate and bearing the connate remnant of styles, the mesocarp 0.3 - 0.5 mm thick, the endocarp oblong-ellipsoid or oblong-ovoid, terete, longitudinally veined, unilocular, the endosperm occupying ca. 30 - 50% of locule. EMBRYO chlorophyllous, 3.8 - 5.0 mm long; cotyledons ovate-oblong, apically rounded, 3.3 - 4.2 mm long, 1.6 - 2.5 mm wide, 0.3 - 0.7 mm thick; radicle 0.7 - 1.2 mm long.

Key to the Varieties of **Erythroxylum ligustrinum**

1. Leaf blades lanceolate, oblong or narrowly elliptic, apically obtuse or acute, usually more than 45 mm long; staminal cup slightly longer than calyx.....
.....1a. var. **ligustrinum**
1. Leaf blades broadly elliptic to suborbicular, apically rounded, usually less than

45 mm long; staminal cup equaling or a little shorter than calyx.....
.....1b. var. **carajasense**

1a. **Erythroxylum ligustrinum** var. **ligustrinum** (Fig. 1)

Erythroxylum ligustrinum DC. Prodr. 1: 574. 1824. Delessert, Icon. Select. 3. t. 28. 1838.

Leaf blades lanceolate, oblong or narrowly elliptic, apically obtuse or acute, rarely rounded, usually more than 45 mm long; calyx less than 1.2 mm long; staminal cup a little longer than calyx.

TYPE: "Cayenne". 1766 - 1769. **J.-B. Patris s.n.** (holotype, G-DC; photographs CAY, F 1933908, MG, NY, U; holotype fragments, G, P; IDC microfiche 800. 231: I. 8).

ADDITIONAL SPECIMENS EXAMINED: FRENCH GUIANA: Montagnes de la Trinité: Inselberg Nord Ouest, savane roche sur versant sud, 400 m alt., 17 Jan 1984 (fr), **J. J.** de **Granville et al. 6106** (CAY, F), haute forêst sommitale, 500 m, **6107** (CAY, F); sommet NE, 25 Jan 1984 (fr), **J. J. de Granville et al. 6278** (CAY, F). BRAZIL: AMAPÁ: Macapá, Curiau de Dentro, 17 Jan 1980 (fl), B. **Rabelo 285** (NY). PARÁ: Mosqueiro, Praia do Murubira, 21 Jan 1923 (fl), **A. Ducke** s.n. RB **17573** (F, GH, RB); Município de Maracanã, ca. 73 air km NE of Castanhal, savanna adjoining the village of Martins Pinheiro, Campo Martins Pinheiro, ca. 0°52'S, 47°35'W, alt. 50 m, 6 Apr 1980 (fr), **G. Davidse et al. 17961** (F, MG, MO, NY, US); km. 136 - 131 da Rodovia Belém-Brasília, 17 Jan 1960 (young fr), E. **Oliveira 383** (IAN, UB); Município de Tucuruí: km. 25 south of Represa Tucuruí on road (BR 422) to Breu Branco, approx. 3°52'S, 49°44'E, alt. 90 m, 15 Mar 1980 (st), **T. Plowman, N. A. Rosa & C. S. Rosário 9579** (F, MG, MO, NY, US); 16 Mar 1980 (st), **9626** (F, MG, MO, NY, US); km. 15.6 east of Represa Tucuruí (Rio Tocantins) along new road (PA 263), approx. 3°45'S, 49°39'W, alt. 70 m, 19 Mar 1980 (st), **T. Plowman, N. A. Rosa & C. S. Rosário 9785** (F, MG, MO, NY, US); 12 km. north of town of Tucuruí along road to Cametá, approx. 3°36'S, 49°44'W, alt. 50 m, 21 Mar 1980 (st), **T. Plowman, N. A. Rosa & C. S. Rosário 9878** (F, MG, MO, NY, US). MARANHÃO: Island of São Luiz, Estrada do Tirical, Feb - Mar 1939 (fl), **R. Fróes 11550** (A, G, MICH, MO, NY, SP, U, US).

DISTRIBUTION: Var. **ligustrinum** occurs in French Guiana and in the easternmost part of Amazonia in the Brazilian states of Amapá and Pará and extends south to the island of São Luiz. Since the type collection (without locality) in the late 1760's, this species was not found in French Guiana until 1984, when three collections were made in the Montagne de la Trinité.

ECOLOGY: Var. **ligustrinum** generally grows in the understory or margins of thin forest on sandy or rocky soil. Near Tucuruí, Pará, it occurs in non-sclerophyllous forest of medium stature on white sand, locally known as **campinarana**. In this habitat, var. **ligustrinum** characteristically is found growing with **E. tucuruiense** Plowman (see below). Neither of these taxa occurs in closely adjacent habitats of open white-sand **campina** or high forest on lateritic soils. Var. **ligustrinum** has also been collected in gallery forest bordering white sand savanna and near beaches in the Amazon estuary. In the Montagne de la Trinité in French Guiana, it has been found in forest on the

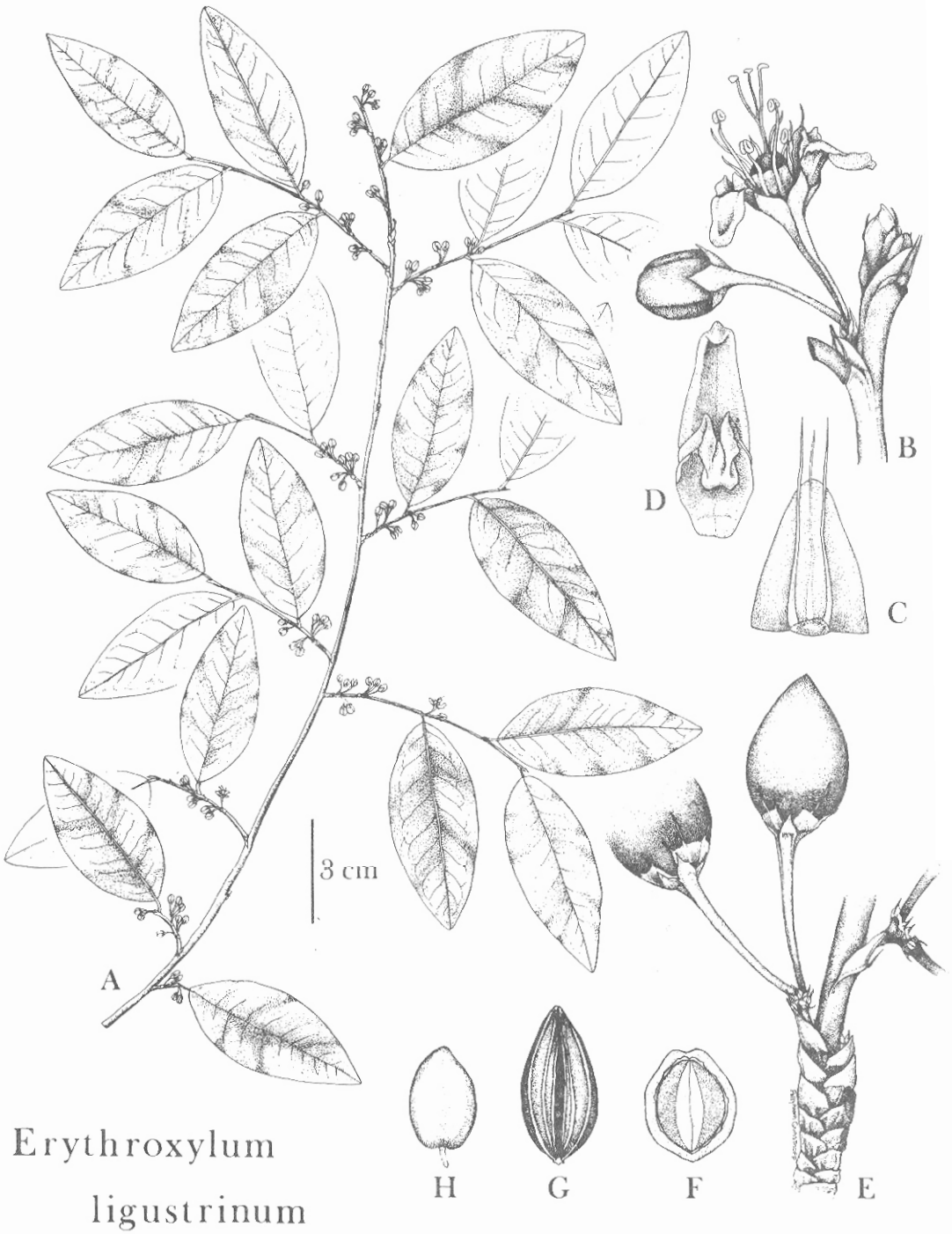


Fig. 1. **Erythroxylum ligustrinum** DC. var **ligustrinum**. A, habit, flowering branch, X 0.52; B, detail of flowering twig with long-styled flower, X 4.4; C, stipule, X 15; D, petal, X 9.5; E, detail of fruiting twig, X 3.9; F, cross section of fruit, X 5.2; G, endocarp, X 4.4; H, embryo, X 2.9. (A, B, C & D from **Ducke s.n. RB 17573**; E, F, G & H from **Davidse et al. 17961**).

summit and rocky slopes and in rocky savannas up to 500 m elevation.

PHENOLOGY: In Brazil, this variety flowers in January and February and fruits until April; in French Guiana, the three modern collections were in fruit in late January.

1b. **Erythroxylum ligustrinum** var. **carajasense** Plowman, var. nov. (Fig. 2).

Foliorum laminae late ellipticae vel suborbiculares, apice rotundatae, plerumque quam 45 mm breviores; calyx quam 1.2 mm longior; urceolus stamineus calycem aequans vel quam calyx paulo brevior.

Leaf blades broadly elliptic to suborbicular, apically rounded, usually less than 45 mm long; calyx more than 1.2 mm long; staminal tube equaling or a little shorter than the calyx.

TYPE: Brazil: Estado Pará, Serra dos Carajás, Serra Norte, ca. 25 km east of AMZA Exploration Camp. ca. 6°S, 50°15'W. In scrub on slope, on "Canga" formation. Shrub 1 m high; calyx green; petals and stamens white. 16 Oct 1977 (fl), **C. C. Berg** & **A. J. Henderson BG 572** (holotype, MG 59147; isotypes, F 1774552, NY, RB 195074, UEC 4459).

ADDITIONAL SPECIMENS EXAMINED: BRAZIL: PARÁ: Serra dos Carajás: 25 - 30 km NW of Serra Norte mining camp, approx. 5°55'S, 50°26'W, 5 Dec 1981 (fr), **D. C. Daly et al. 1724** (F, MG, NY); 2 km. west of AMZA camp N-5, 6°04'S, 50°08'W, 13 May 1982 (fl), **C. R. Sperling et al. 5636** (F, MG, NY).

ETYMOLOGY: Var. **carajasense** is named for the Serra dos Carajás, where it may be endemic.

DISTRIBUTION: Known only from the type locality.

ECOLOGY: Var. **carajasense** grows in open scrub vegetation on slopes in the Serra dos Carajás at ca 700 m elevation. It appears to be restricted edaphically to ferrous rock outcrops. This variety, along with other edaphically endemic taxa, may be considered to be threatened with extinction because of the massive surface mining operations planned for the ore-bearing soils at Serra dos Carajás.

PHENOLOGY: Flowering in October, fruiting in December.

RELATIONSHIPS: **Erythroxylum ligustrinum** was until recently a "lost" species. Only by examining older specimens in Brazilian herbaria and as a result of recent Projeto Flora Amazônica and Centre ORSTOM expeditions has it been possible to determine the identity of De Candolle's **E. ligustrinum**.

The collections show some variation as detailed in the description. The drawing published by Delessert (1838) shows the petals to be apically acute, as is also suggested by the IDC microfiche of the type. However, it will be necessary to examine the holotype at G-DG to assess the correctness of the drawing.

Although different collections of this species vary appreciably in leaf shape and size, they all show uniformly the formation of a definite, short peduncle bearing the flowers. This structure is developed in a number of other species, such as **E. steyermarkii** Plowman (Plowman, 1982); but the peduncle is especially evident in **E. ligustrinum** and serves to distinguish it from related species.

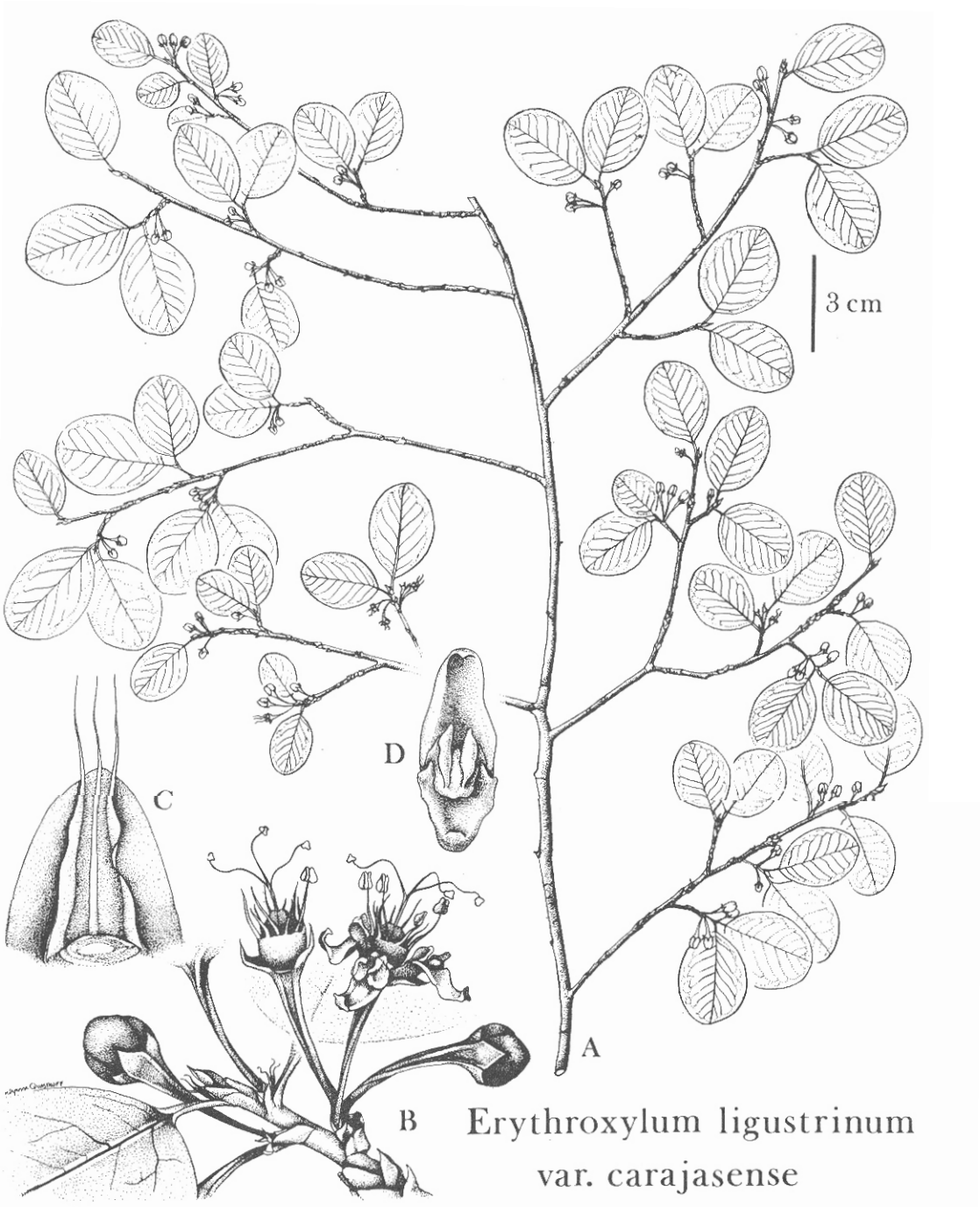


Fig. 2. **Erythroxylum ligustrinum** DC. var **carajasense** Plowman. A, habit, flowering branch, X 0.52; B, detail of flowering branch, X 5.1; C, stipule, X 4.4; D, petal, X 8.5. (A - D from **Berg BG 572**).

I have named the unusual small-leaved specimens from Serra dos Carajás as a distinct variety; when, and if, these plants are better known through larger suites of specimens, the Carajás material may prove to represent an ecotypical, rather than genetic, variant.

Erythroxylum ligustrinum var. **grandifolium** Sagot, described in 1881 from a collection from Maroni, French Guiana, is in fact a synonym of **E. kapplerianum** Peyr.

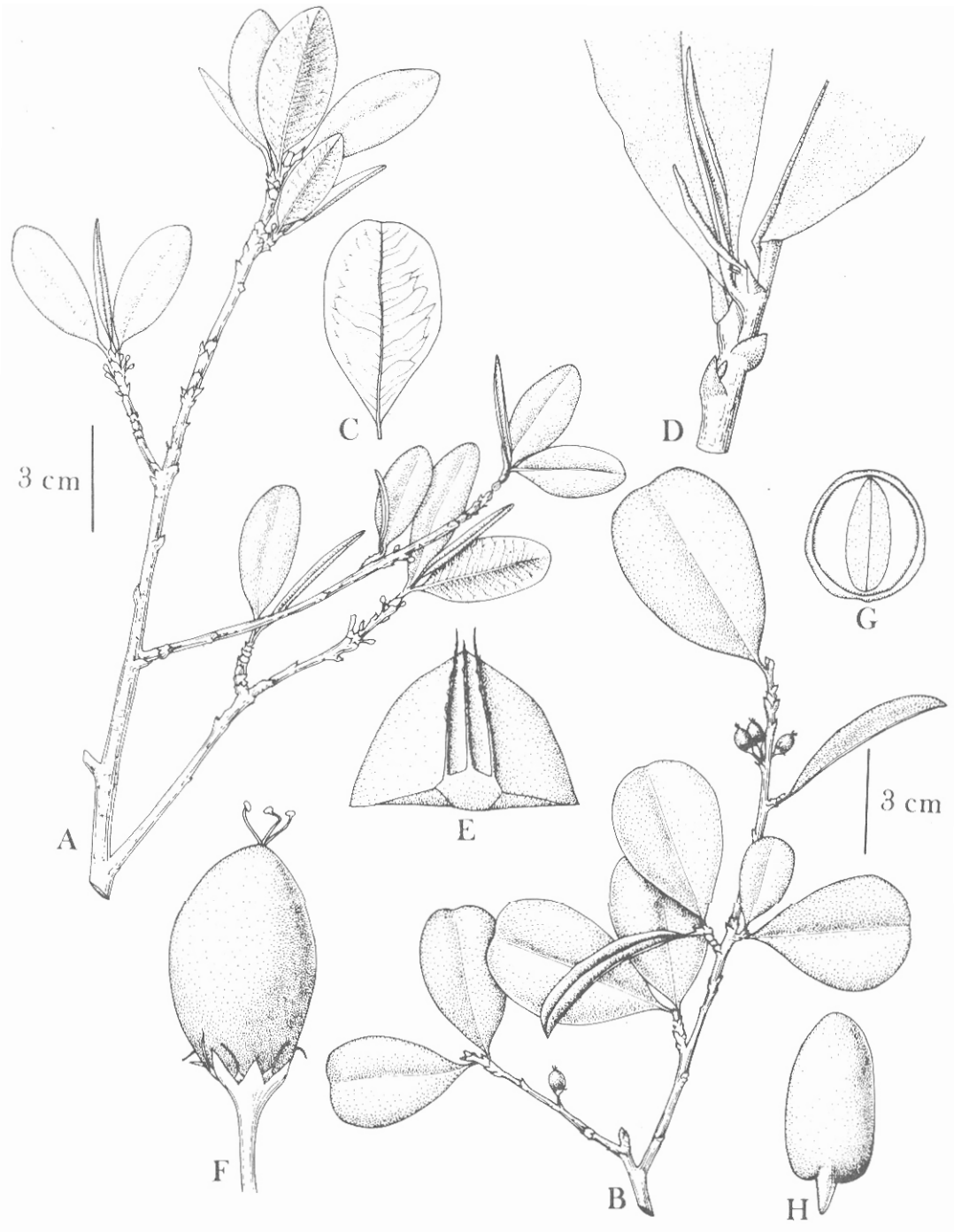
Erythroxylum ligustrinum was included by Schulz (1907) in his section **Archerythroxylum**. Schulz apparently failed to notice the connate styles in the type material which he examined. If he had, he would have placed the species in his section **Microphyllum**, an unnatural grouping of twelve mostly unrelated species. Until more information is available, I will retain **E. ligustrinum** in the large neotropical section **Archerythroxylum**.

2. **Erythroxylum nelson-rosae** Plowman, sp. nov. (Fig. 3).

Frutex. Stipulae persistentes, triangulari-ovatae, estriatae, apice bisetulosae, nigrescentes. Folia breviter petiolata, decidua; laminae obovatae vel cuneiformes, apice rotundatae vel retusae, chartaceae. Flores 3 - 8 in axillis ramulorum annotinorum producti. Petali lamina ovata, rotundata. Urceolus stamineus calycem fere aequans, ad marginem integer. Drupa ellipsoidea vel ovoidea, apice rotundata, endocarpio ellipsoideo, tereti, apice acuto, uniloculari, endospermio praesente.

Ab **Erythoxylo pruinoso** O. E. Schulz et **E. tortuoso** Mart. foliis minoribus, obovatis vel cuneiformibus et stipulis apice non fimbriatis differt.

SHRUB 1.0 - 2.5 m tall. BRANCHLETS weakly differentiated into long and short shoots, rather stout and straight, diverging 40° - 70° from axis, terete, flattened toward apex, 2 - 3 mm diameter, light to dark brown, smooth. INTERNODES 2 - 20 mm long on long shoots, 1 mm long on short shoots. RAMENTA (cataphylls) few at base of long shoots or rather dense along short shoots, covering branchlets for 5 - 10 mm, somewhat firmer than foliar stipules, turning black with age. STIPULES persistent, appressed to stem, triangular to ovate, 1.8 - 3.0 mm long, firmly membranaceous, estriate, turning black with age, apically obtuse, 2- to 3-setulose, the two lateral setae flattened, somewhat fimbriate, 0.5 - 0.8 mm long, sometimes with a shorter, slender, medial seta, the setae evanescent, the keels subalate, bristly, the margin minutely erose. LEAVES deciduous, 1 - 3 produced at tips of short shoots or scattered along extension shoots, short-petiolate, the lamina plane, broadly obovate or cuneiform, apically rounded or retuse, basally cuneate, 30 - 60 mm long, 19 - 38 mm wide, firmly chartaceous, drying dark brown adaxially, yellowish brown abaxially, elineate, midrib prominulous, slightly depressed in the lamina, half-elliptic in cross section, drying ferruginous on both surfaces, the lateral nerves 15 - 18 per side, diverging 55° to 65° from midrib, rather straight and parallel, prominulous abaxially, the veinlets finely reticulate. PETIOLE 2 - 3 mm long,



Erythroxylum nelson-rosae

Fig. 3. **Erythroxylum nelson-rosae** Plowman. A, habit, flowering branch, X 0.5; B, habit, fruiting branch, X 0.5; C, leaf showing venation, X 0.5; D, tip of twig showing stipules, X 2.1; E, stipule, X 14; F, fruit, X 4.6; G, cross section of endocarp, X 5.2; H, embryo, X 5.6. (A, D & E from **Berg & Henderson BG 457**; B, C, F, G & H from **Daly et al. 1719**).

1 mm in diameter, somewhat compressed dorsiventrally, canaliculate. FLOWERS in leaf axils of last season's shoots, 3 - 8 flowers per node, white. BRACTEOLES 2 per flower, broadly ovate to suborbicular, concave, 1.0 - 1.5 mm long, scarious, apically rounded or apiculate, 1-setulose. PEDICEL slender, pentangular, 2 - 4 mm long, 0.7 - 1.5 mm in diameter. CALYX 1.5 - 2.0 mm long, divided 2/3 its length, the lobes ovate, apically short-acuminate or acute, 1.0 - 1.3 mm long. PETAL lamina ovate in outline, rounded and somewhat incurved at apex, ca. 2 mm long, ca. 1.3 mm wide. STAMINAL CUP slightly shorter than calyx, 0.7 - 1.0 mm long, the margin entire. BRACHYSTYLOUS FLOWERS not seen. DOLICHOSTYLOUS FLOWERS: antisepalous filaments ca. 1.0 - 1.3 mm long; antipetalous filaments ca. 2.2 - 3.0 mm long; style ca. 3 mm long; stigma depressed capitate, 0.3 mm long. OVARY ellipsoid. DRUPE ellipsoid or ovoid, apically rounded, 6.5 - 7.5 mm long, 3.2 - 3.5 mm in diameter, the mesocarp 0.2 mm thick, the endocarp ellipsoid, terete, apically acute, unilocular, the endosperm occupying ca. 2/3 of locule. EMBRYO chlorophyllous, 5.5 mm long; cotyledons oblong-ovate, apically rounded, 4.3 mm long, 2.3 mm wide, 0.5 mm thick; radicle 1.2 mm long.

TYPE: Brazil, Estado Pará, Serra dos Carajás, 25 - 30 km NW of Serra Norte mining camp. Approx. 5°55'S, 50°26'W. Hilly scrub on ferrous outcrop. Shrub or tree to 2.5 m, fruits yellow. Frequent. 5 Dec 1981. **D. C. Daly, R. Callejas, M. G. da Silva, E. L. Taylor, C. Rosário & M. R. dos Santos 1719** (holotype, MG 89706; isotypes, F 1910388, GH, K, MO, NY, US).

ADDITIONAL SPECIMEN EXAMINED: BRAZIL: PARÁ: Serra dos Carajás, Serra Norte, near AMZA Exploration Camp, ca. 6°00'S, 50°26'W. Scrub on iron containing crust. Shrub 1 m high; flowers white. 11 Oct 1977. **C. C. Berg & A. J. Henderson BG 457** (F 1774558, MG 59034, RB 196586).

ETYMOLOGY: It is my pleasure to name this species for Nelson A. Rosa, botanical technician at the Museu Goeldi in Belém, Brazil. Senhor Rosa has accompanied many Projeto Flora Amazônica expeditions and has served as leader on several others. The Projeto has benefited greatly from his extensive knowledge of the Amazonian flora. His enthusiasm, amiable companionship and logistical expertise in the field is greatly appreciated by all who have had the pleasure of working with him.

DISTRIBUTION: **Erythroxylum nelson-rosae** has been collected only in the Serra dos Carajás, State of Pará, Brazil.

ECOLOGY: So far as is known, this species grows only in open scrub formations on ferrous rocky soils in the Serra dos Carajás.

PHENOLOGY: **E. nelson-rosae** has been collected in flower in mid-October and in fruit in early December.

RELATIONSHIPS: **Erythroxylum nelson-rosae** belongs to section **Archerythroxylum**. It is related to two species from the Brazilian **cerrados**: **E. pruinosum** O. E. Schulz from the states of Mato Grosso, Goiás and southern Piauí; and **E. tortuosum** from Mato Grosso, Goiás, Minas Gerais and São Paulo. These three species form a complex that still is not well understood. Only the bizarre, tortuously branched **E. tortuosum** is well represented in herbaria. So far only two collections of **E. nelson-rosae** are known, one with

young flower buds and one with mature fruits. Future collections of this species, including good flowering material and observations of growth habit, will help clarify the relationships in this complex. The main differences among these species are summarized in Table 1.

Table 1. Comparison of **Erythroxylum nelson-rosae**, **E. pruinosum** and **E. tortuosum**.

	E. nelson-rosae	E. pruinosum	E. tortuosum
bark on branches	thin, not corky	moderately corky	thick corky
leaf shape	obovate-cuneiform	oblong-elliptic or oblanceolate	oblanceolate
leaf length	30 - 60 mm	61 - 100 mm	85 - 215 mm
stipule length	1.8 - 3 mm	1.0 - 1.5 mm	3.5 - 4 mm
stipules & bracteoles	subentire	subentire to fimbriate	densely fimbriate
location of flowers	last season's branchlets	last season's branchlets	sunken nodes on corky branches
pedicel length	2 - 4 mm	4 - 6 mm	6 - 10 mm

3. **Erythroxylum schunkei** Plowman, sp. nov. (Fig. 4)

Frutex. Ramuli tenues, distichi. Ramenta nulla. Stipulae persistentes, estriatae, longissime 3-setosae. Folia persistentia, breviter petiolata; laminae lanceolatae vel oblongo-ellipticae, apice obtusae, retusae vel acutae, mucronulatae, margine undulatae, basi cuneatae vel obtusae, elineatae. Flores 1 (raro 2) in axillis ramulorum hornotinorum producti. Petali lamina concava, ovata. Urceolus stamineus calycem aequans, ad marginem irregulariter 10-crenulatus. Drupa ovoidea, endocarpio ellipsoideo, tereti, apice apiculato, maturitate uniloculari, endospermio nullo.

SHRUB 1 - 3 m. tall. BARK on branches more or less smooth, longitudinally striate, reddish brown to greyish. BRANCHLETS slender, leafy, distichous, weakly differentiated into long and short shoots, diverging 30° - 65° from axis, strongly flattened toward apex, becoming terete with age, 1 - 2 mm in diameter, reddish brown, more or less smooth; lenticels scattered, elongate, thin, 0.3 - 0.7 mm long. INTERNODES 3 - 12 mm long on long shoots, 0.5 - 1.5 mm long on short shoots. RAMENTA (cataphylls) not present. STIPULES persistent, appressed to stem, ovate to triangular-ovate, 1.5 - 2.5 mm long, firmly membranaceous, estriate, drying reddish brown, apically truncate, 3-setulose,

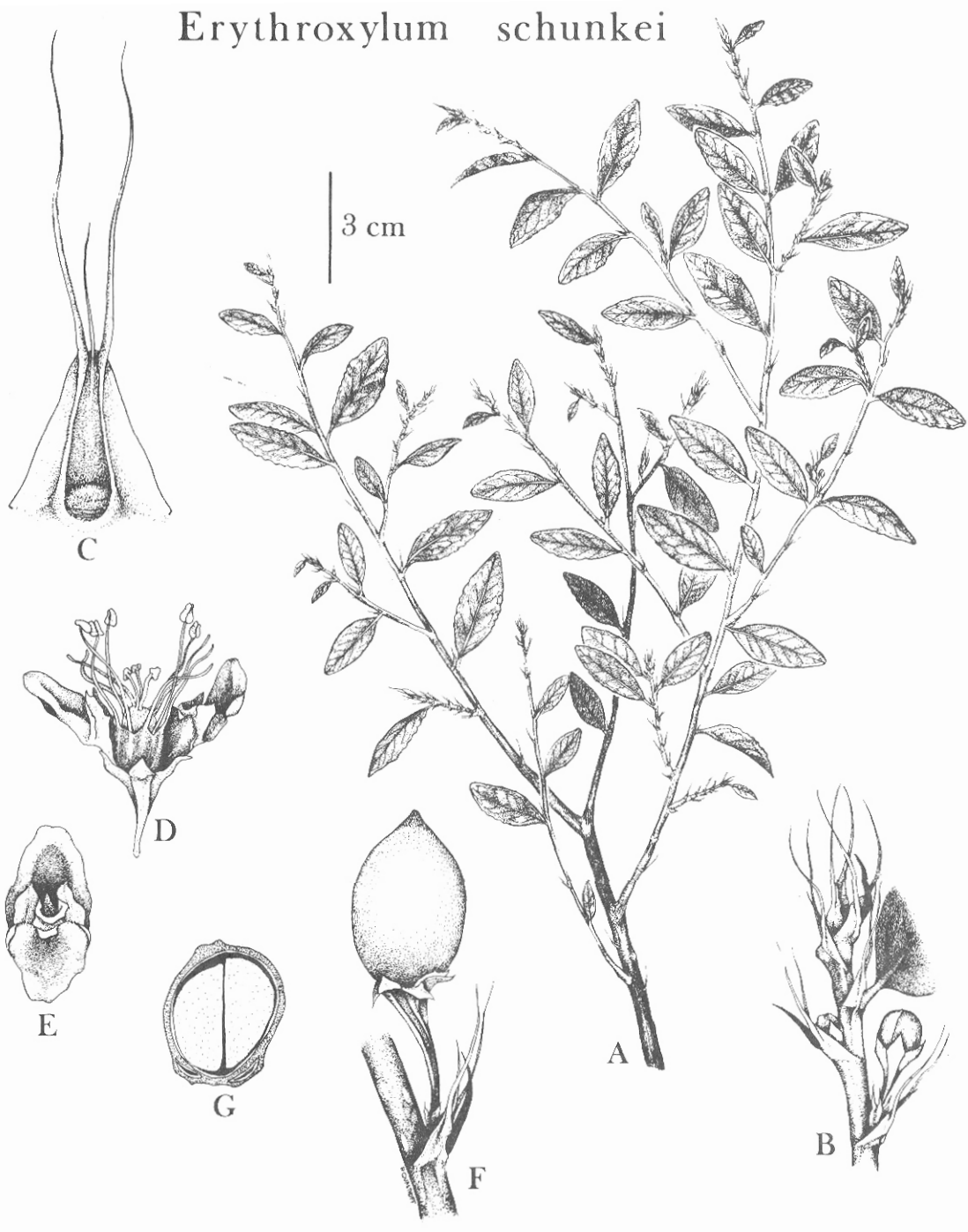


Fig. 4. **Erythroxylum schunkei** Plowman. A, habit, flowering branch, X 0.55; B, tip of flowering twig, X 3.1; C, stipule, X 13; D, short-styled flower, X 6.2; E, petal, X 9.2; F, fruit, X 3.4; G, cross section of fruit, X 3.1. (A - E from **Schunke 2188**; F & G from **Schunke 1192**).

the 2 longer lateral setae subterete, stoutly filiform, 2.0 - 5.5 mm long, the medial seta finely filiform, 1.0 - 2.5 mm long; stipules with 2 strong lateral keels and 1 weak medial nerve. LEAVES persistent, scattered along branchlets or somewhat congested on weak lateral shoots, distichous, briefly petiolate, the lamina plane, lanceolate to oblong-elliptic, apically obtuse to retuse or acute, mucronulate with mucron 0.2 - 0.7 mm long, undulate at margin, basally cuneate to obtuse, 30 - 55 mm long, 10 - 21 mm wide, chartaceous, drying dark greyish green adaxially, ochreous green abaxially, rather shiny adaxially, dull abaxially, elineate with no central panel discernible, the adaxial midrib prominulous, knife-edged in cross-section, light brown, the abaxial midrib drying ferruginous to ochreous, the lateral nerves 7 - 11 per side, diverging 45° - 75° from midrib, rather straight to arching, prominulous adaxially, less distinct abaxially, the veinlets reticulate, faint. PETIOLE 1.0 - 2.2 mm long, 0.5 - 0.8 mm in diameter, subterete, shallowly canaliculate, drying ferruginous. FLOWERS in axils of new shoots, solitary or rarely 2 per node, white, inserted on a very short peduncle 0.5 mm long. BRACTEOLES 2 per flower, broadly ovate, 0.7 - 1.0 mm long, membranaceous, apically obtuse or truncate, 1-setulose, the seta 0.8 - 1.3 mm long. PEDICEL pentangular, 2.0 - 4.5 mm long, 0.3 - 0.5 mm in diameter, thickened toward apex. CALYX 1.0 - 1.5 mm long, the lobes triangular to ovate, 0.8 - 1.0 mm long, apically acuminate, the margin lighter in color when dried. PETAL lamina spreading, concave, ovate in outline, 1.8 - 2.0 mm long, 1.2 mm wide, rounded at apex, the claw 0.6 mm long, the ligule 1.0 - 1.2 mm long, bilobate, the lobes 1 mm long, with one longer posterior and one smaller anterior lobule. STAMINAL CUP equaling or slightly longer than calyx, 1.0 - 1.2 mm long, the margin irregularly 10-crenulate. BRACHYSTYLOUS FLOWERS: filaments 2.0 mm long, anthers rounded-cordiform, 0.5 mm in diameter; ovary ellipsoid, apically rounded, 1.5 times length of staminal cup, 1.5 mm long. DOLICHOSTYLOUS FLOWERS: unknown. DRUPE ovoid, apically apiculate when dried, 8 - 10 mm long, 5 - 6 mm in diameter, "brown" (*fide* Schunke 1192), *the mesocarp* 0.3 mm thick, the endocarp ellipsoid, slightly falcate, terete, apically apiculate, unilocular with 2 vestigial aborted locules; endosperm absent. EMBRYO 7.5 mm long; cotyledons elliptical, 6.7 mm long, 3.7 mm wide, 2 mm thick, apically rounded; radicle 0.8 mm long, 0.4 mm in diameter.

TYPE: Peru, Dept. Huánuco, Prov. Pachitea, Dist. Honoria. Bosque Nacional de Iparia. Región "bosque seco tropical" (sensu Tosi, 1960) a lo largo del Río Pachitea cerca del campamento Miel de Abeja (1 km. arriba del pueblo de Tournavista o unos 20 km arriba de la confluencia con el Río Ucayali). En bosque alto en la Carretera Miel de Abeja, km 4.2. Arbusto 1 m, flores blancas. N.v. "coquilla." Alt. 300 - 400 m, 4 Oct 1967, **J. Schunke V. 2188** (holotype, F 1688195; isotype, GH).

ADDITIONAL SPECIMEN EXAMINED: PERU: HUÁNUCO: Prov. Pachitea, Dist. Honoria. Bosque Nacional de Iparia, en bosque alto en la Carretera Miel de Abeja. N.v. "coquilla." Alt. 300 - 400 m, 26 Oct 1966, **J. Schunke V. 1192** (F, NY, US).

ETYMOLOGY: **Erythroxylum schunkei** is named in honor of the Peruvian plant collector José Schunke Vigo. Third generation member of a famous family of natural history collectors, Schunke has dedicated himself for more than 25 years to documenting the

rich flora of Amazonian Peru with excellent, well-prepared spceimens. In addition he has assisted innumerable botanists traveling in Peru with his technical expertise and extensive knowledge of the flora.

DISTRIBUTION: Known only from the type locality.

ECOLOGY: **Erythroxylum schunkei** grows in the lower Río Pachitea region, classified as "moist tropical forest" according to ONERN (1976), and not as "dry tropical forest" as indicated by the label data that cites Tosi (1960). The species is an element of the forest understory. The leaves of both known collections of **E. schunkei** bear abundant foliicolous lichens. The following lichen species from the leaves of **E. schunkei** have been identified by R. C. Harris at the New York Botanical Garden: **Calenia** cf. **phyllogena** (Müll. Arg.) Sant., **Gyalectidium filicinum** Müll. Arg., **Porina epiphylla** (Fee) Fee, **Porina nitidula** Müll. Arg., **Porina papillifera** (Stirt.) Schilling, **Strigula elegans** Fee, and **Trichothelium epiphyllum** Müll. Arg.

PHENOLOGY: **Erythroxylum schunkei** was collected in flower and fruit during October.

COMMON NAME: This species is known locally as "coquilla," meaning "little coca" in Spanish, in reference to its congener **Erythroxylum coca** Lam., the coca plant of commerce.

RELATIONSHIPS: **Erythroxylum schunkei** has only one close relative: **Erythroxylum ulei** O. E. Schulz. The latter is a common species of secondary and primary, moist and dry tropical forests, distributed from Colombia south to Bolivia along the eastern slopes of the Andes, in certain inter-Andean valleys and extending into the Amazon Basin as far as westernmost Brazil (Amazonas, Acre). **Erythroxylum schunkei** is superficially very similar to **E. ulei** and perhaps has been derived from it. The superficial similarity is increased by the frequent occurrence of foliicolous lichens on both species. **Erythroxylum schunkei** is immediately distinguished by its very much longer stipular setae. Table 2 summarizes the most important features that distinguish the two species:

Table 2. Comparison of **Erythroxylum schunkei** and **E. ulei**.

	E. schunkei	**E. ulei**
leaf shape	lanceolate to oblong-elliptic	ovate to broadly elliptic, rarely lanceolate
adaxial midrib	sharply acute in cross-section	slightly raised, blunt or only broadly acute in cross-section
leaf margin	undulate, not revolute	plane, somewhat revolute
lateral stipular setae	stout, terete, persistent, 2.0 - 5.5 mm long	slender, flattened, evanescent, 0.5 - 0.8 mm long
margin of staminal cup	irregularly 10-crenulate	truncate (entire)

Erythroxylum ulei was placed by Schulz (1907) in his section **Leptogramme**, an artificial assemblage of five unrelated species. Both **E. schunkei** and **E. ulei** apparently are best placed in the large neotropical section **Archerythroxylum** until the sectional alignments of the family can be thoroughly revised.

4. **Erythroxylum tucuruiense** Plowman, sp. nov. (Fig. 5)

Frutex vel arbuscula. Ramenta (cataphylla) disticha, imbricata, ad apices ramulorum annotinorum producta. Cataphylla stipularia cymbiformia, crustacea, straminea, estriata, partim caduca. Foliorum stipulae minores, tenuores, adpressae, estriatae, fimbriatae, 2- vel 3-setulosae. Folia breviter petiolata, decidua; laminae forma variabiles, oblongo-ovatae, anguste ellipticae, lanceolatae vel obovatae, apice obtusae, retusae vel acutae, apice ipso obtusae, basi acuminatae vel cuneatae, membranaceae. Flores pauci, longipedicellati, in ramulis hornotinis in ramentorum axillis infra folia producti. Petali lamina elliptica, ligula bilobata munita. Urceolus stamineus fere calycem aequans, margine valde 10-denticulatus. Drupa ellipsoidea, apice rotundata, endocarpio ovoideo, apice acuto, tereti, uniloculari, endospermio producto.

SHRUB or TREELET to 6 m tall. TRUNK single, to 3 cm diameter. BARK thin, 1 - 2 mm thick, smooth or verruculose, light greyish brown without, pale brown within. BRANCHES erect-spreading, smooth, dark greyish to reddish brown. BRANCHLETS weakly distichous, without short shoots, straight, diverging 50° - 80° from axis, apically laterally compressed, 1 - 2 mm in diameter, smooth, greyish to reddish brown. INTERNODES 3 - 30 mm long. RAMENTA consisting of 5 - 8 congested, imbricate cataphylls (modified stipules without leaf blades), produced at end of season at apex of twigs as a laterally compressed, apical bud, 5 - 8 mm long, 2 - 3 mm wide. Individual stipular CATAPHYLLS 1.5 - 5.5 mm long, 2 - 3 mm wide, cymbiform, yellowish green, drying straw-colored, thin-crustaceous, the distal cataphylls (subtending the flowers) caducous, the proximal cataphylls persisting; the spinule (leaf rudiment) 1.2 - 1.5 mm long, flattened, slightly incurved, light reddish brown, caducous. FOLIAR STIPULES tardily caducous, smaller and thinner than ramenta, erect or appressed to stem, ovate to oblong-ovate, sometimes cymbiform, 2.0 - 6.5 mm long, membranaceous to sub-crustaceous, estriate, pale tan and dull abaxially, shiny and ferruginous adaxially, apically obtuse, 2- or 3-setulose, with 2 longer, lateral setae and one shorter, medial seta (sometimes absent), the setae 0.5 - 2.5 mm long, fimbriate, evanescent, the keels sometimes ferruginous-fimbriate, the margins fimbriate, becoming entire. LEAVES deciduous, 1 - 3 produced scattered along new twigs, weakly distichous, short-petiolate, the lamina plane or weakly convex with venation adaxially depressed in lamina, variable in shape, oblong-ovate to narrowly elliptic or lanceolate, rarely obovate, apically obtuse, retuse, or acute, if acute the tip itself obtuse, basally acuminate or cuneate, 35 - 94 mm long, 13 - 45 mm wide, membranaceous, adaxially medium to dark green (**in statu vivo**), abaxially pale glaucous green,

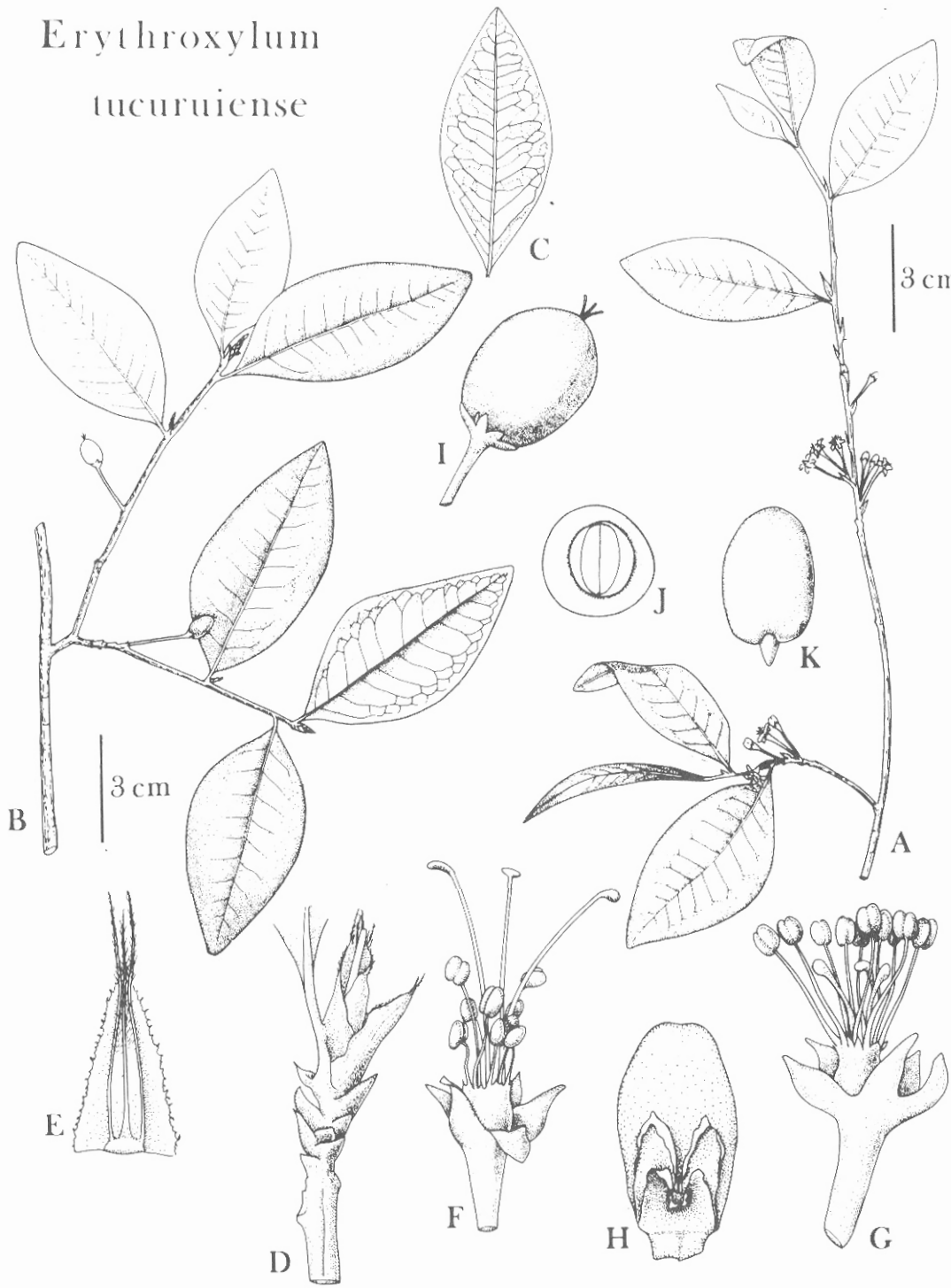


Fig. 5. **Erythroxylum tucuruiense** Plowman. A, habit, flowering branch, X 0.51; B, habit, fruiting branch, X 0.51; C, leaf, X 0.51; D, tip of twig showing stipules, X 4.3; E, stipule, X 4.3; F, long-styled flower, X 7.1; G, short-styled flower, X 7.1; H, petal, X 9.2; I, fruit, X 2.5; J, cross section of fruit, X 2.5; K, embryo, X 3.4. (A & G from **Froes 23580**; B, C, I, J & K from **Plowman et al. 9872**; D, E, F & H from **Daly et al. 1020**).

adaxially dull to slightly shiny, abaxially dull, elineate, the adaxial midrib raised slightly, flat or rounded in cross-section, the abaxial midrib drying straw-colored, the lateral nerves 10 - 12 per side, diverging 50° - 80° from midrib, straight to arching, slightly more prominent adaxially, the veinlets finely reticulate. PETIOLE short, 1.5 - 3.0 mm long, 0.5 - 1.0 mm in diameter, canaliculate. FLOWERS in axils of caducous, distal cataphylls on successive nodes produced towards base of newly produced shoots, white. BRACTEOLES 2 per flower, tardily caducous, linear to subulate, sometimes cymbiform or falcate, 1.0 - 1.2 mm long, membranaceous, apically obtuse, short-setulose with one, evanescent seta. PEDICEL filiform, pentangular in cross section, 8 - 13 mm long, 0.5 - 1.0 mm in diameter, somewhat thickened at apex. CALYX 1.5 - 2.0 mm long, divided 2/3 - 5/6 its length, the lobes ovate, thick, subcoriaceous, somewhat convex, apically acute to acuminate, 0.8 - 1.5 mm long, longitudinally striate when dried, with 3 - 5 prominulous nerves. PETAL lamina elliptic in outline, apically rounded, 2.5 - 2.8 mm long, 1.5 mm wide, the claw 0.5 mm long, the ligule 1.5 - 2.0 mm long, bilobate with two ovate, rounded auricles. STAMINAL CUP 0.8 - 1.2 times the length of calyx, 1.3 - 1.8 mm long, denticulate at margin with 10 narrow, apically rounded "teeth." BRACHYSTYLOUS FLOWERS: filaments 2.4 - 2.7 mm long; anthers broadly ellipsoid, 0.5 - 0.6 mm long; styles free, 1.5 - 2.0 mm long; stigma depressed capitate, somewhat elongate, 0.3 - 0.4 mm long. DOLICHOSTYLOUS FLOWERS: antisepalous filaments 0.7 - 0.9 mm long, the anthers ellipsoid, 0.6 mm long; antipetalous filaments 1.8 - 2.0 mm long, the anthers ellipsoid, 0.6 mm long; styles free, 4 mm long; stigmas depressed capitate, somewhat elongate, 0.4 mm long. OVARY oblong-ellipsoid, apically rounded or truncate, 0.75 - 0.80 times length of staminal cup, 1.0 - 1.5 mm long. DRUPE ellipsoid, apically rounded, size when fresh 9 mm long, 6 mm in diameter, shiny, bright red, the mesocarp 1 mm thick, the endocarp ovoid, terete, apically acute, light straw-colored with dark reddish brown markings, unilocular, the endosperm occupying ca. 1/3 of locule. EMBRYO 6 mm long; cotyledons broadly elliptic, convex, 5.5 mm long, 3.5 mm wide, 1 mm thick; radicle 0.5 mm long.

TYPE: Brazil, Estado Pará, Estrada de Ferro Tocantins, Breu Branco. Shrub 1.20 cm [sic], white flowers. Secondary forest, terra firme, high land, sandy soil. 29 Sept 1948 (fl), **R.L. Fróes 23580** (holotype, IAN 42232).

ADDITIONAL SPECIMENS EXAMINED: BRAZIL: PARÁ: Estrada de Ferro de Alcobaça, Estação Breu Branco. Beira de campina na mata baixa, 2 Jan 1951 (fl), **A. Ducke s.n.** (MG 15599); Breu Branco, 40 km south of Represa Tucuruí along highway BR 422, approx. 3°55' S, 49°44'W, alt. 90 m, 17 Mar 1980 (st), **T. Plowman, N. A. Rosa & C. S. Rosário 9661** (F, MG, NY, US); km 25 south of Represa Tucuruí on road (BR 422) to Breu Branco, approx. 3° 52'S, 49°44'W, alt. 90 m, 15 Mar 1980 (st), **T. Plowman, N. A. Rosa & C. S. Rosário 9553** (F, MG, NY), 16 Mar 1980 (fr), **9645** (F, MG, MO, NY, US); 15.6 km east of Represa Tucuruí (Rio Tocantins) along new road (PA-263), approx. 3°45'S, 49°39'W, alt. 70 m, 19 Mar 1980 (st), **T. Plowman, N. A. Rosa & C. S. Rosário 9787** (F, MG, MO, NY, US), **9789** (F, MG, MO, NY, US); 12 km north of town of Tucuruí along road to Cametá, approx. 3°36'S, 49° 44'W, alt. 50 m, 21 Mar 1980 (fr), **T. Plowman, N. A. Rosa & C. S. Rosário 9872** (F, MG,

MO, NY, US), **9874** (F, MG, MO, NY, US); approx. 18 km east of Tucuruí and Rio Tocantins by BR 263, approx. 3°30'S, 49°32'W, 28 Oct 1981 (fl), **D. C. Daly et al. 1020** (F, MG, NY, US).

ETYMOLOGY: **Erythroxylum tucuruiense** is named after the Municipality of Tucuruí on the Tocantins River in eastern Pará, Brazil.

DISTRIBUTION: Known only from the basin of the lower Tocantins River from Breu Branco northward to 12 km north of the town of Tucuruí, State of Pará, Brazil.

ECOLOGY: **Erythroxylum tucuruiense** apparently grows only in a type of **campinarana** vegetation, a rather open, low-stature, non-sclerophyllous forest on white sand soils. Fieldwork with the Projeto Flora Amazônica during 1980 in the lower Tocantins Valley indicated that **E. tucuruiense** does not extend into immediately adjacent open **campina** habitats nor into adjacent areas of high forest on latosols. Although similar habitats are found in other parts of the Amazon basin, **E. tucuruiense** has been found only in the lower Tocantins region, where it is frequently found growing with **E. ligustrinum** var. **ligustrinum**. The latter, however, has an appreciably wider area of distribution.

Completion of the Tucuruí Dam in 1984 and subsequent flooding of an area exceeding 2000 km^2 has eliminated most of the known habitat of this species, including the type locality at Breu Branco. Additional fieldwork in the area is necessary to evaluate the current status of this endemic species as a result of flooding a large portion of the lower Tocantins Valley.

PHENOLOGY: **Erythroxylum tucuruiense** has been collected in flower from late September until early January, during the onset of the rainy season. Flowering accompanies the production of a new flush of leaves. Ripe fruits are produced in March when the leaves are fully mature.

RELATIONSHIPS: **Erythroxylum tucuruiense** apparently belongs to sect. **Archerythroxylum**, a large group which is especially well represented in Brazil. However, it seems not to have any close relatives within this group. The curious dimorphism in the stipules (ramenta vs. foliar) sets this species apart from other members of the section. In this character, **E. tucuruiense** superficially resembles **E. strobilaceum** Peyr. (syn. **E. warmingii** Peyr.), known only from two collections from Lagoa Santa (Minas Gerais). In **E. strobilaceum**, however, the stipules are "striated" (indicating sclerified vascular bundles), and this species must be placed in section **Rhabdophyllum**.

RESUMO

Três espécies de ***Erythroxylum*** *da Amazônia são descritas como novas:* ***Erythroxylum nelson-rosae*** *Plowman,* ***E. schunkei*** *Plowman e* ***E. tucuruiense*** *Plowman. Uma descrição ampliada é apresentada para* ***E. ligustrinum****, previamente conhecida de uma só coleta na Guiana Francesa e citada aqui, para o Brasil, pela primeira vez. Descreve-se também uma variedade nova:* ***E. ligustrinum*** *var.* ***carajasense*** *Plowman. As novas taxa da Amazônia brasileira foram coletadas recentemente como parte do Projeto Flora Amazônica; elas*

ocorrem em habitats atualmente ameaçados pelo desenvolvimento hidroelétrico e de extração de minério. Anexa-se uma lista provisória de todas as espécies de ***Erythroxylum*** *que ocorrem na Amazônia.*

ACKNOWLEDGMENTS

I would like to express my gratitude to Ghillean T. Prance for inviting me to participate in the Projeto Flora Amazônica under NSF Grant INT78-23341, during which field studies reported here were conducted. I am especially grateful to those colleagues and assistants in the field who were instrumental in helping me accomplish my objectives. I would like to thank the curators of the numerous herbaria cited here for providing access to their collections and for sending specimens on loan for what seems an inordinate period of time. Without their patience in this matter, I could make little progress in understanding the neotropical species of **Erythroxylum**.

I am indebted to Dr. F. E. Vermeulen of Utrecht for supplying me with valuable background data on J.-B. Patris' itinerary in French Guiana; to Mrs. I. Haesler of the Botanisches Staatssammlung, Munich, for locating the correct date of publication of Martius's work on **Erythroxylum**; to Dr. R. C. Harris of the New York Botanical Garden for identifying the foliicolous lichens; to Dr. G. Bocquet of the Geneva Herbarium for supplying photographs of the holotype of **E. ligustrinum**; and to Dr. Rolf Singer of Field Museum for correcting the Latin diagnoses. I would also like to thank the two artists, Pollyanne Quasthoff and Marlene Werner, who patiently prepared the illustrations. Drs. Michael Dillon, M. J. Huft, B. Boom and Bruce Nelson provided helpful suggestions for improving the manuscript.

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APPENDIX: Provisional list of species of Erythroxylum occurring in the Amazon Basin and peripheral areas.

The following compilation is provided as a provisional working list of species of **Erythroxylum** that are found in the Amazon Basin and "peripheral" areas. It is by no means a definitive listing, since a number of species and species groups from Amazonia have yet to be studied in depth. However, I believe that even a provisional listing will be of use to persons working in the Amazon region. No compilation of South American species of **Erythroxylum** has been available since Schulz's now outdated treatment for **Das Pflanzenreich** (Schulz, 1907).

I have included species that are found in adjacent upland areas on the southern boundary of Amazonia, as well as species of the Guyana Highlands on the northern boundary. For convenience, I have excluded species that are restricted to the Orinoco drainage, the Guianas, or the eastern Andes.

Synonyms are listed only if they apply to Amazonian plants or if they have been misapplied to Amazonian species. I have typified each name and designated lectotypes where necessary; I have examined all specimens cited in the listing. My study of types, especially of the older collections, is continuing, and there will undoubtedly be future refinements in the typification of these species. I have included the geographical distribution of each recognized species or variety. General ranges by country are listed if a taxon is wide ranging; if the range is more restricted, the state(s) or department(s) within each country is given.

1. **Erythroxylum amazonicum** Peyr. in Mart. Fl. Bras. 12(1): 167. 1878. Syntypes: **Spruce s.n.** ("Erythroxylon (4)"), Brazil, Amazonas, Manaus, Jan 1851 (lectotype designated here, M, F neg. 55563; isotypes, BM, CGE, E, G, GH, K, LE, NY, OXF, P); **Spruce s.n.** ("Erythroxylon (5)"), Brazil, Amazonas, Manaus, Dec 1850 - Mar 1851 (isolectoparatypes, BM, G, GH, LE, M, NY, OXF, P). Amazonian parts of Colombia, Venezuela, Ecuador, Peru, and Brazil, and in the Guianas.

2. **Erythroxylum amplum** Benth. in Hook. London. J. Bot. 2: 372. 1843. Type: **Schomburgk 1027**, Brazil, Amazonas, near Barcellos, 1839, (most duplicates mislabeled "Brit. Guiana"), (holotype, K; isotypes, BM, CAS, E, G, K, L, NY, P, U, W). Brazil (Amazonas, Pará), Peru (Loreto).

3. **Erythroxylum anguifugum** Mart. Flora 21, Beibl. 2(4): 84. 1838. Type: **Manso s.n., Herb. Fl. Bras. 265**, Brazil, Mato Grosso, prope Cuyabá in Morro de Ernesto, 1830 - 1832, (holotype, M, F neg. 19454; isotypes, BR, E, F, G, GH, K, L, LE, MO, NY, OXF, P).

E. anguifugum Mart. var. **riparium** O. E. Schulz in Engl. Pflanzenr. 4 (134): 109. 1907. Syntypes: **Gardner 3055**, Brazil, Goiás, (lectotype designated here, K;

isotype, OXF); **Pilger 798**, Brazil, Mato Grosso, "am oberen Parantinga", (lectoparatype, B, destroyed).

E. alemquerense Huber, Bol. Mus. Goeldi 5: 419. 1909. Syntypes: **Ducke** s.n., Brazil, Pará, "Alemquer" [sic], 27 Dec 1903, (lectotype designated here, MG 4915, F neg. 45847; isotypes, B, destroyed, F neg. 12605, RB); **Ducke s.n.**, Brazil, Pará, Óbidos, 20 Dec 1907, (isolectoparatypes, MG 9174b, RB).

E. herzogii O. E. Schulz, Feddes Repert. Spec. Nov. Regni Veg. 7: 57. 1909. Type: **Herzog 456**, Bolivia, Prov. Velasco, Pampa de Yaguarú, Aug 1907, (holotype, B, destroyed; lectotype designated here, Z, F neg. 58974).

E. luculentum Macbride, Candollea 5: 372. 1934. Type: **L. Williams 2788**, Peru, Loreto, La Victoria, 24 Aug 1928, (holotype, F, F neg. 52563).

4. **Erythroxylum barbatum** O. E. Schulz in Engl. Pflanzenr. 4(134): 21. 1907. Syntypes: **Glaziou 10353**, Brazil, "Rio de Janeiro" (collection made by another collector, probably from Ceará), (lectotype designated here, P; isotypes, C, K); **Glaziou 10387**, Brazil, "Rio de Janeiro" (collection made by another collector, probably from Ceará), (isolectoparatypes, C, K, P). Brazil (Pará, Maranhão, Goiás, Piauí, and Ceará).

5. **Erythroxylum campinense** A. Amaral Jr., Acta Amazonica 6 (2): 213. 1976. Type: **Prance et al. 18722**, Brazil, Amazonas, rodovia Manaus-Caracaraí, km. 61, 3 Aug 1973, (holotype, INPA 42035; isotypes, GH, NY). Brazil (Amazonas).

6. **Erythroxylum cataractarum** Spruce ex Peyr. in Mart. Fl. Bras. 12 (1): 149. 1878. Type: **Spruce 2614**, Brazil, Amazonas, Rio Uaupés, prope Panuré, Nov 1852, (lectotype designated here, K; isotypes, C, CGE, E, F, G, GH, LE, NY, OXF, P, W). Brazil (Amazonas), Colombia (Guainía, *Meta*, *Vaupés*), *and Venezuela* (*Guárico*, *Apure*, *Amazonas*).

7. **Erythroxylum citrifolium** St. Hil. Fl. Bras. Mer. 94. 1829. Type: **St. Hilaire C[1] 755**, Brazil, Goiás, Vila Boa, 1816 - 1821, (holotype, P, F neg. 35186; isotypes, MPU, P). Widely distributed from Nicaragua to Brazil and Bolivia.

E. gomphioides Planch. & Linden ex Triana & Planch. in Ann. Sci. Nat. Bot. ser. 4, 18: 341. 1862. Syntypes: **Linden 1418**, Venezuela, Mérida, (lectotype designated here, P; isotypes; BM, BR, CGE, F, G, GENT, K, LE, W); **Goudot s.n.**, Colombia, Valle de Magdalena, (isolectoparatypes, P, F neg. 35192).

E. micranthum Bong. ex Peyr. in Mart. Fl. Bras. 12 (1): 164. 1878. Type: **Riedel 1537**, Brazil, Pará, Santarém, Nov 1828, (lectotype designated here, LE; isotypes, BR, OXF).

E. paraense Peyr. in Mart. Fl. Bras. 12 (1): 164. 1878. Type: **Spruce s.n.**, Brazil, Amazonas, Manaus, Oct 1851, (lectotype designated here, M; isotypes, BM, CGE, E, F, GH, K, LE, NY, OXF, P, W).

E. acutifolium Peyr. in Mart. Fl. Bras. 12 (1): 166. 1878. Type: **Hostmann & Kappler 1263**, Surinam, Surinam River, 1842, (lectotype not yet designated; iso-

types, CGE, F, F neg. 55455, G, MO, W).

E. **duckei** Huber, Bol. Mus. Goeldi 5: 416. 1909. Type: **Ducke s.n.**, Brazil, Pará, Rio Cuminá, Dec 1906, (holotype, MG 7907, F neg. 45844; isotypes, B, destroyed, F neg. 12615, RB).

8. **Erythroxylum coca** Lam. var. **ipadu** Plowman, Bot. Mus. Leafl. Harvard Univ. 27: 45. 1979. Type: **Plowman, Schultes & Tovar 6663**, Peru, Loreto, Río Ampiyacu, Puca Urquillo, 5 Apr 1977, (holotype, ECON; isotypes, F, GH, K, MO, S, US, USM). Colombia (Vaupés, Amazonas), Peru (Loreto), and Brazil (Amazonas, Pará).

9. **Erythroxylum cordato-ovatum** Huber, Bol. Mus. Goeldi 5: 418. 1909. Type: **Ducke s.n.**, Brazil, Pará, Faro, 9 Sept 1907, (holotype, MG 8686, F neg. 45845; isotypes, B, destroyed, F neg. 12611, RB). Brazil (Amazonas, Pará).

10. **Erythroxylum daphnites** Mart. Beitr. Erythroxylon. 83. 1840. Abh. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. 3: 363. 1841. Type: **Pohl (2133)**, Brazil, Goiás, "Rio Claro, Cavalcante, Trahiras," 1817 - 1821, (lectotype designated here, M; isotypes, BR, W). Brazil (Pará to Minas Gerais and Mato Grosso), and Bolivia.

11. **Erythroxylum divaricatum** Peyr. in Mart. Fl. Bras. 12 (1): 146. 1878. Syntypes: **Schomburgk 925**, Guyana, Rupununi River, Apr 1843, (lectotype designated here, W; isotypes, CGE, G, K, NY, P, W); **Schomburgk 1270**, Guyana, Rupununi River, Apr 1843, (lectoparatype, B, destroyed, F neg. 12614). Brazil (Pará, Roraima), Venezuela (Amazonas, Bolívar), and Guyana.

12. **Erythroxylum fimbriatum** Peyr. in Mart. Fl. Bras. 12 (1): 162. 1878. Type: **Martius s.n.**, Brazil, Amazonas, Ega, Dec 1819, (holotype, M, F neg. 19459). Costa Rica, Colombia and Venezuela to Bolivia and Brazil.

13a. **Erythroxylum gracilipes** Peyr. in Mart. Fl. Bras. 12 (1): 159. 1878. Type: **Spruce 3068**, Venezuela, Amazonas, Río Casiquiare near San Carlos, Aug 1853, (lectotype designated here, BR; isotypes, BM, K, MPU, P, S, W). Colombia and Venezuela to Bolivia and Brazil.

13b. **Erythroxylum gracilipes** Peyr. var. **exareolatum** O. E. Schulz in Engl. Pflanzenr. 4 (134): 82. 1907. Type: **Martius s.n.**, Brazil, Amazonas, Ega, Dec 1819, (holotype, M, F neg. 19463). Brazil (Amazonas).

14. **Erythroxylum hypoleucum** Plowman, Bot. Mus. Leafl. Harvard Univ. 29. 280. 1983. Type: **Steyermark & Bunting 102807**, Venezuela, Amazonas, Maroa, 20 Apr 1970, (holotype, F; isotypes, MO, VEN). Brazil (Amazonas) and Venezuela (Amazonas).

15. **Erythroxylum impressum** O. E. Schulz in Urb. Symb. Antill. 5: 202. 1907. Syntypes: **Hart 917**, Trinidad, (lectotype designated here, K); **Kuntze 919**, Trinidad, (lectoparatype, B, destroyed, NY, F neg. 55519); **Otto 985**, Venezuela, Bolívar, Upata (isolectoparatypes, B, destroyed, F neg. 12623, W). Venezuela (Amazonas, Bolívar), Trinidad, and Guyana.

16. **Erythroxylum kapplerianum** Peyr. in Mart. Fl. Bras. 12 (1): 159. 1878. Type: **Kappler 2116**, Surinam, (lectotype designated here, M, F neg. 19464; isotypes, L, P, W). Venezuela (Amazonas, Bolívar), the Guianas, and Brazil (Amapá, Pará, Amazonas, Rondônia).

E. **ligustrinum** DC. var. **grandifolium** Sagot, Ann. Sci. Nat. Bot. ser. 6, 11: 179. 1881. Type: **Sagot s.n.**, French Guiana, Maroni, Jul 1857, (lectotype designated here, P; isotypes, K, P, W).

E. **mapuerae** Huber, Bol. Mus. Goeldi 5: 421. 1909. Type: **Ducke s.n.**, Brazil, Pará, Rio Mapuera, 2 Dec 1907, (holotype, MG 9007, F neg. 45843; isotypes, B, destroyed, F neg. 12629, RB).

17. **Erythroxylum laetevirens** O. E. Schulz in Engl. Pflanzenr. 4 (134): 42. 1907. Type: **Blanchet 3155**, Brazil, Bahia, São Antônio, 1840, (holotype, B, destroyed; lectotype designated here, K; isotypes, F, G, F neg. 26400, K, OXF, W). Brazil (Maranhão, Ceará, Bahia).

18. **Erythroxylum lenticellosum** Huber, Bol. Mus. Goeldi 5: 420. 1909. Type: **Ducke s.n.**, Brazil, Pará, Rio Ariramba, 21 Dec 1906, (holotype, MG 8051, F neg. 45846; isotypes, B, destroyed, F neg. 12625, RB). Venezuela (Amazonas) and Brazil (Pará).

19. **Erythroxylum leptoneurum** O.E. Schulz in Engl. Pflanzenr. 4 (134): 101. 1907. Syntypes: **Spruce s.n.**, Brazil, Pará, Caripi juxta Pará, Aug 1849, (lectotype designated here, M, F neg. 19465; isotypes, CGE, GH); **Martius s.n.**, Brazil (lectoparatype, M); **Newman s.n.**, Brazil, (lectoparatype, G); **Gardner 3049**, Brazil, Goiás, Natividade, Nov 1939, (lectoparatype, K). Brazil (PA, MA, GO, MT, RO) and French Guiana.

20a. **Erythroxylum ligustrinum** DC. Prodr. 1: 574. 1824. Type: **Patris s.n.**, "Cayenne," 1766 - 1769, (holotype, G-DC; isotype, G, P). French Guiana and Brazil (Pará).

20b. **Erythroxylum ligustrinum** DC. var. **carajasense** Plowman, var. nov. Type: **Berg & Henderson BG 572**, Brazil, Pará, Serra dos Carajás, 16 Oct 1977, (holotype, MG 59147; isotypes, F, NY, RB, UEC). Brazil (Pará).

21. **Erythroxylum macrocnemium** Mart. Beitr. Erythroxylon. 122. 1840. Abh. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. 3: 402. 1841. Type: **Poeppig (46)**, Peru, Huánuco, Cuchero,

1829, (lectotype designated here, W; isotypes, LE, W). Peru (San Martín, Loreto).

22. **Erythroxylum macrophyllum** Cav. Diss. 401. t. 227. 1789. Type: **Stoupy s.n.**, "Cayenne", (holotype, MA, F neg. 19348). Widely distributed from Mexico to Brazil.

E. lucidum Kunth in H.B.K. Nov. Gen. Sp. 5: 138. 1822. Type: **Humboldt & Bonpland 1714**, Colombia, inter La Mesa et Honda, Jun 1801, (holotype, P; isotypes, B, F neg. 12626, P).

E. floribundum Mart. Beitr. Erythroxylon. 118. 1840. Abh. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. 3: 398. 1841. Type: **Martius s.n.**, Brazil, Pará, May 1820, (holotype, M, F neg. 19461; isotypes, G, K, L, M).

E. laurinum Planch. & Linden ex Triana & Planch. in Ann. Sci. Nat. Bot. ser. 4, 18: 341. 1862. Type: **Triana s.n.**, Colombia, Meta, Villavicencio, Feb 1856, (lectotype designated here, BM; isotypes, BM, BR, COL, G, K, P, US).

E. filipes Huber, Bol. Mus. Goeldi 5: 415. 1909. Type: **Ducke s.n.**, Brazil, Pará, Rio Trombetas, Oriximiná, 8 Dec 1906, (holotype, MG 7878, specimen lost?; isotype, RB).

23. **Erythroxylum mucronatum** Benth. London J. Bot. 2: 372. 1843. Type: **Schomburgk 766**, Guyana, Pirara River, 1839, (holotype, K, F neg. 55744; isotypes, BM, CGE, K, NY, P, W). Widely distributed from Colombia to the Guianas, south to Bolivia and Brazil.

E. **comosum** O. E. Schulz in Engl. Pflanzenr. 4 (134): 32. 1907. Type: **Ule 6531**, Peru, Loreto, Cerro de Escalera, Nov 1902, (holotype, B, destroyed; lectotype designated here, K; isotypes, G, L).

E. kirkianum O. E. Schulz, Feddes Repert. Spec. Nov. Regni Veg. 30: 179. 1932. Type: **Killip & Smith 30189**, Brazil, Amazonas, Manaus, 17 Oct 1929, (holotype, NY, F neg. 55524; isotypes, F, US).

E. **venezuelense** Steyermark, Fieldiana, Bot, 28 (2): 271. 1952. Type: **Steyermark 60371**, Venezuela, Bolívar, Quebrada O-paru-má between Santa Teresita de Kavanayén and Rio Pacairao, 20-21 Nov 1944, (holotype, F, F neg. 52565; isotype, NY).

E. albertianum J.G. Kuhlmann & W.A. Rodrigues, Publ. Inst. Nac. Pesq. Amaz. Bot. 5: 3. 1957. Type: **W. A. Rodrigues 83**, Brazil, Amazonas, Manaus, 12 Sep 1954, (holotype, INPA).

24. **Erythroxylum nelson-rosae** Plowman, sp. nov. Type: **Daly et al. 1719**, Brazil, Pará, Serra dos Carajás, 5 Dec 1981, (holotype, MG 89706; isotypes, F, GH, MO, NY, US). Brazil (Pará).

25. **Erythroxylum oreophilum** (O. E. Schulz ex Pilger) Steyermark & Maguire, Mem. New York Bot. Gard. 17: 445. 1967. Type: see below under basionym. Venezuela (Bolívar) and Brazil (Roraima).

E. **vernicosum** O. E. Schulz var. **oreophilum** O. E. Schulz ex Pilger, Notizbl. Bot. Gart. Berlin-Dahlem 54: 142. 1914. Type: **Ule 8402**, Brazil, Roraima, Rio Branco, Serra de Mairary, Feb 1909, (holotype, B, destroyed; lectotype designated here, K; isotypes, G, L, MG).

26. **Erythroxylum pruinosum** O. E. Schulz in Engl. Pflanzenr. 4 (134): 76: 1907. Syntypes: **Burchell 8195**, Brazil, Goiás, São Bento to Rio Cangalho, 1828 - 1830, (lectotype designated here, K); **Burchell 7931**, Brazil, Goiás, Cavalcante to Ribeirão Gambá, 1828 - 1830, (lectoparatype, K); **Gardner 2790**, Brazil, Piauí, Serra da Batalha, Sept 1839, (isolectoparatypes, BM, K); **Weddell 2694**, Brazil, Goiás, Sertão d'Amaroleité, Sept - Oct 1844, (isolectoparatypes, F, P). Brazil (Goiás, Piauí, Mato Grosso).

27. **Erythroxylum recurrens** Huber, Bol. Mus. Goeldi 5: 417. 1909. Type: **Ducke s.n.**, Brazil, Amazonas, Rio Negro, Barcellos, 25 Jun 1905, (holotype, MG 7199, F. neg. 45842; isotypes, B, destroyed, F neg. 12642, RB). Venezuela (Amazonas, Bolívar) and Brazil (Amazonas, Pará).

28. **Erythroxylum roraimae** Klotzsch ex O. E. Schulz in Engl. Pflanzenr. 4 (134): 104. 1907. Syntypes: **Schomburgk 545**, Guyana, Roraima, (lectotype designated here, K; isotypes, B, destroyed, BM, CGE, F, G, K); **Schomburgk 618**, Guyana, Roraima, (isolectoparatypes, F, G, K, MO, P); **Schomburgk 952**, Guyana, Roraima River, Nov 1842, (lectoparatype, B, destroyed, F neg. 12644); **Versteeg 721**, Surinam, Tapanahoui River, (lectoparatype, not located). Venezuela (Amazonas), Colombia (Amazonas); Guyana, Surinam, and Brazil (Amazonas, Amapá).

29. **Erythroxylum rufum** Cav. Diss. 404. 1789. Type: **Dupuy s.n.**, Santo Domingo, (holotype, P-JU). Greater Antilles, Venezuela to French Guiana and northern Brazil.

30. **Erythroxylum ruizii** Peyr. in Mart. Fl. Bras. 12 (1): 152. 1878. Type: **Ruiz s.n.**, Ecuador, Guayaquil, 1799, (holotype, B, destroyed, F. neg. 12645; lectotype designated here, G; isotypes, F, MA, OXF). Ecuador and Peru (Loreto).

31. **Erythroxylum schomburgkii** Peyr. in Mart. Fl. Bras. 12 (1): 148. 1878. Syntypes: **Schomburgk 517**, Guyana, Cotinga River, (lectotype designated here, K; isotypes, BM, F, G, OXF, P, U, W); **Schomburgk 796**, Guyana, Cotinga River, (lectoparatype, B, destroyed, F neg. 12646). Guyana and Brazil (Roraima).

32. **Erythroxylum schunkei** Plowman, sp. nov. Type: **J. Schunke V. 2188**, Peru, Huánuco, Parque Nacional de Iparia, Río Pachitea, 1 km arriba del pueblo de Tournavista, 4 Oct 1967, (holotype, F 1688196; isotype, GH). Peru (Huánuco).

33. **Erythroxylum spruceanum** Peyr. in Mart. Fl. Bras. 12 (1): 160. 1878. Type: **Spruce**

2417, Brazil, Amazonas, Rio Uaupés, Panuré, Aug 1852, (lectotype designated here, K; isotypes, BM, CGE, E, F, G, GH, LE, NY, OXF, P, W). Colombia (Vaupés), Venezuela (Amazonas), and Brazil (Amazonas).

34. **Erythroxylum squamatum** Swartz, Prodr. 75. 1788. Type: **Swartz s.n.**, "West Indies," (lectotype designated here, S; isotype, UPS). Lesser Antilles, Colombia to the Guianas, south to Bolivia and Brazil.

E. aristigerum Peyr. in Mart. Fl. Bras. 12 (1): 157. 1878. Syntypes: **Spruce (129)**, Brazil, Pará, Santarém, Nov 1849 - Mar 1850, (lectotype designated here, M; isotypes, BM, CGE, G, F neg. 26393, OXF, W); **Spruce (176)**, same locality and date, (lectoparatype, not located).

E. bahiense Peyr. in Mart. Fl. Bras. 12 (1): 160. 1878. Type: **Blanchet 2331**, Brazil, Bahia, Ilhéus, 1835, (lectotype designated here, LE; isotypes, F, G, K, NY, OXF, P, W).

E. aristigerum Peyr. var. **bahiense** (Peyr.) O. E. Schulz in Engl. Pflanzenr. 4 (134): 103. 1907. Syntypes: see above under **E. bahiense**.

E. trinerve Huber, Bol. Mus. Goeldi 5: 417. 1909. Type: **Ducke s.n.**, Brazil, Pará, Rio Ariramba, 21 Dec 1906, (holotype, MG 8035; isotypes, B, destroyed, F neg. 12652, RB).

35. **Erythroxylum suberosum** St. Hil. Pl. Usuell. Bras. t. 69. fig. A. 1828; Fl. Bras. Mer. 95. 1829. Syntypes: **St. Hilaire C 617**, Brazil, Minas Gerais, Corgo de Mathias, (lectotype designated here, P, F neg. 35187; isotype, MPU); **St. Hilaire C 143bis**, Brazil, Minas Gerais, (lectoparatype, P); **St. Hilaire C 1899**, Brazil, Minas Gerais, (lectoparatype, P). Venezuela (Bolívar), Brazil to Paraguay and Bolivia.

E. testaceum Peyr. in Mart. Fl. Bras. 12 (1): 170. 1878. Syntypes: **Schomburgk (764)**, Guyana, Taiutu River, 1840, (lectotype designated here, M; isotypes, BM, CGE, G, NY, OXF, P, W); **Spruce s.n.**, Brazil, Pará, Santarém, Nov 1849, (isolectoparatypes, BM, CGE, K, M, P, W).

36. **Erythroxylum subglaucescens** Peyr. ex O. E. Schulz in Engl. Pflanzenr. 4 (134): 98. 1907. Type: **Gardner 3056**, Brazil, Goiás, Natividade, Nov 1839, (holotype, B, destroyed, F neg. 12648; lectotype designated here, K; isotypes, BM, CGE, F, G, OXF, P). Brazil (Goiás, Piauí).

37. **Erythroxylum subracemosum** Turcz. Bull. Soc. Imp. Naturalistes Moscou 31: 390. 1858. Type: **Gardner 3053**, Brazil, Goiás, Natividade, Oct 1839, (lectotype not yet designated; isotypes, B, destroyed, F neg. 12649, BM, CGE, E, F, G, GH, K, OXF, P, W). Brazil (Rondônia to Maranhão, south to São Paulo), Bolivia, and Peru (San Martín).

38. **Erythroxylum tucuruiense** Plowman, sp. nov. Type: **Fróes 23580**, Brazil, Pará, Rio

Tocantins, Breu Branco, 29 Sept 1948, (holotype, IAN 42232, F neg. 59823). Brazil (Pará)

39. **Erythroxylum ulei** O. E. Schulz in Engl. Pflanzenr. 4 (134): 62. 1907. Syntypes: **Ule 6346**, Peru, San Martín, Tarapoto, Sept 1904, (lectotype designated here, K; isotype, B, destroyed, F neg. 12653, G, L); **Matthews 2022**, Peru, (isolectoparatypes, BM, CGE, F, G, K, NY, OXF, P, W); **Poeppig s.n.**, Peru, San Martín, Tocache, (lectoparatype, W); **Triana s.n.**, Colombia, Cauca Valley, (isolectoparatypes, BM, K, P). Colombia to Bolivia and westernmost Brazil (Acre and Amazonas).

Erythroxylum tessmannii O. E. Schulz, Notizbl. Bot. Gart. Berlin-Dahlem 9: 263. 1925. Type: **Tessmann 3163**, Peru, Loreto, Río Ucayali, middle Aguaytía, 5 Sept 1923, (holotype, B, destroyed, F neg. 12651; lectotype designated here, NY; isotypes, G, S).

Erythroxylum venosum Rusby, Mem. New York Bot. Gard. 7: 270. 1927. Type: **Rusby 1564**, Bolivia, Rurrenabaque, 7 Oct 1921, (holotype, NY; isotypes, GH, US).

40. **Erythroxylum vernicosum** O. E. Schulz in Engl. Pflanzenr. 4 (134): 106. 1907. Syntypes: **Schomburgk 379**, Guyana, Pirara River, 1841 - 1842, (lectotype designated here, K; isotypes, BM, CGE, G, OXF, P, U, W); **Schomburgk 639**, same locality (lectoparatype, B, destroyed, F neg. 12654). Venezuela (Bolívar), Brazil (Roraima), and Guyana.

Erythroxylum squamatum Sw. var. **emarginatum** Peyr. in Mart. Fl. Bras. 12 (1): 158. 1878. Type: lectotype same as for **E. vernicosum**.