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A REVISION OF HOLARRHENA R. BR. (APOCYNACEAE)

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INTRODUCTION

The present publication is a monograph of the genus *Holarrhena*. The genus occurs in tropical Africa and tropical Asia. The present author had the opportunity to study *H. floribunda* in the field in West Africa and collected in Ivory Coast. In addition this publication is based on a study of the available herbarium material.

HISTORY OF THE GENUS

The genus *Holarrhena* was proposed by ROBERT BROWN in 1811, based on a single species, *Carissa mitis* Vahl, described in 1790. A second combination in the genus was proposed by G. DON in 1837. This species has a rather complicated history. In 1678 VAN RHEEDE TOT DRAAKENSTEIN depicted and described this plant as *Codaga-pala* in his famous Hortus Indicus Malabaricus. Van Rheede's plate is cited in the protologue of *Nerium antidysentericum* L. of 1753, otherwise based on a specimen in Herb. Hermann, which, at present, is accepted as *Wrightia antidysenterica*. This combination was effected by ROBERT BROWN in 1811, citing the Hermann specimen as type. BUCHANAN-HAMILTON consolidated

FIG. 1. The '*Codaga-pala*' of VAN RHEEDE TOT DRAAKENSTEIN 1678. Hortus Indicus Malabaricus 1: t. 47.

this interpretation by proposing the name *Echites pubescens* for the Van Rheede element, while G. DON transferred it to *Holarrhena* in 1837 after consulting WALLICH's catalogue. The third combination in *Holarrhena* was effected by DURAND & SCHINZ in 1896 based on *Rondeletia floribunda* G. Don of 1834 (*Rubiaceae*). After the description of *H. curtisii* by KING & GAMBLE in 1908, more than 50 combinations have been proposed on *Holarrhena* but in the present publication only four species have been upheld.

GEOGRAPHICAL DISTRIBUTION

The genus *Holarrhena* is restricted to tropical Africa, Southern continental Asia and Sri Lanka. The most widely distributed species, *H. pubescens*, occurs in open forests and savannas in Eastern and Southeastern Africa and in Southern Asia, with a markedly discontinuous area. *H. curtisii* occurs in tropical continental Southeastern Asia, completely within the distribution of *H. pubescens*. *H. floribunda* occurs in open forests and savannas from Senegal to Zaïre, while *H. mitis* is endemic in Sri Lanka.

HABIT, GROWTH AND FLOWERING SEASONS

All *Holarrhena* species are deciduous (under)shrubs or trees. They shed their leaves at the end of the dry season. New leaves appear at the beginning of the rainy season. The flowers appear shortly after the leaves. The flowering period is rather short; the fruits mature some months after the flowering season, usually at the end of the dry season.

H. floribunda, *H. mitis* and *H. pubescens* show the architectural model of Troll (HALLÉ & OLDEMAN 1970: 125; – & TOMLINSON 1978: 242). As the present author observed, in savannas *H. floribunda* can survive bush fires by producing sucker shoots from burned-down stumps. When such shoots are not damaged by fire for several years, they show once more Troll's model and in this way several treelets can originate from a single stump.

VERNACULAR NAMES

Only names occurring on herbarium labels and covering a single species are listed. Doubtful or obscure names have been omitted.

H. curtisii:

Cambodia: *(daeum) tuk das.*
Thailand: *kood kok; lun mok; lut tanong; num nom sio; sap kun.*

H. floribunda:

Cameroun: Ewondo: *nom-ekouk.*
Central African Republic: Cissongo: *molo-mondimbo.*
Ghana: Ashanti: *slae.*
Guinea-Bissau: Bijagó: *ete-éxi.*
Guinea (Conakry): Fulani: *indama;* Malinké: *indama, kounajana;* Susu: *yaté, yeté.*
Ivory Coast: Attié: *pri, sohoué;* Baoulé: *sébé, sèbé.*
Mali: Bambara: *fou-fou, kouma jui.*
Nigeria: Hausa: *bakim mayu, bakim mutum, ga(m)ma(n) sauwa;* Ibo: *okemba.*
Senegal: Diola: *fournatiaf;* Lebou; *saoulou;* Madinka: *tiariko;* Malinké: *dierin-dierine;* Wolof: *salahal, soonlow, soulali.*
Sierra Leone: Loko: *mats*; Madinka: *nono kende;* Mende: *boboneh, bubuwi, nookwi, nukoi, nukui;* Temne: *a-mat(s), an-watia, ka-mat, kabore;* Yalunka: *kenyekhigina.*
Upper Volta: Mossi: *jabarawgo.*
Zaïre: Kikongo: *kimbuki, kinzenze, ya koko;* Zandé: *bagu.*

H. mitis:

Sri Lanka: *genu-dena-mal, kir(r)i-walla(-gass).*

H. pubescens:

Africa:
Kenya: Kiboni: *kepako;* Lamu & Kiswahili: *mtimeupe.*
Malawi: Nyanja: *c(h)ipeta, kachamba, t(h)ombosi;* Yao: *chiwimbe, mkwale, mvumbamvula, nfiriti.*
Moçambique: Chindao: *muashu, rutshene;* Portuguese: *quina.*
South Africa: Afrikaans: *koorspeul;* English: *jasmine tree;* Longa: *kahla-kahla;* Venda: *khàthàkhàthàné, muhatu.*
Zambia: Kilungu: *chipipa.*
Asia:
Burma: *khleng-kong.*
India: Arabian & Persian: *lissan al asafeer;* Bengali: *kurchi;* English: *bitter oleander, dysentery rosebay, easter tree, oval leaved rosebay;* Hindi: *kura, kurchi;* Lushai: *thlengpa;* Malay: *codaga-pala;* Portuguese: *herba malabarica, herbas contra camaras;* Uriya: *kuruni.*
Thailand: *mok man, mok yai.*

USES

There is an impressive amount of publications on this subject. All species contain numerous alkaloids. Only the most important applications are men-

tioned here. Dr. N. G. BISSET (School of Pharmacy, University of London) publishes more data on this subject with this paper.

Of *H. pubescens* the bark and less often the seeds are widely used as anti-dysenteric medicine. The other species have the same property but are less often used. Additionally *H. pubescens* was used by the Portuguese in Moçambique as a tonic and febrifuge. The wood of all species (except *H. curtisii)* is locally used as timber of low quality.

RELATIONSHIP TO OTHER GENERA

Holarrhena shows a clavuncula which is completely free from the anthers and therefore it is placed in the *Plumerioideae*, although it resembles several genera in *Apocynoideae (Echitoideae)* by its aestivation, which is turned to the right, and by its seeds with a coma, resembling *Compositae* fruits. However, there are two other genera in the *Plumerioideae*, *Carruthersia* and *Spirolobium*, that have seeds with a coma, and the former shows an aestivation turned to the right as well. Most genera of the *Plumerioideae* have seeds lacking a coma, contained in sappy fruits in the *Carisseae*, or in capsules in a.o. the *Plumerieae*. In the latter tribe the seeds are often winged, but exceptionally they may bear a coma. This is the case in *Alstonia*, which shows seeds with a coma at both extremities. After considering the data stated above, the present author has decided to support PICHON's (1950) view regarding the position of *Holarrhena:* it belongs to the subtribe *Holarrheninae* of the tribe *Plumerieae (Alstonieae)* of the subfamily *Plumerioideae*, while *Alstonia* is referred to the *Alstoniinae* of the same tribe. In PICHON's publication the *Holarrheninae* are composed of *Carruthersia*, *Holarrhena* and *Spirolobium*.

CYTOLOGY

Holarrhena pubescens: 2n = 22 (SEN & ROY TAPADAR 1957: 19; RAGHAVAN 1957: 294–298; ROY TAPADAR 1964: 103–138; DATTA & MATTI 1972: 9–19; in all these cases: no voucher specimens preserved).

Holarrhena floribunda: 2n = 20 (MIÈGE & JOSSERAND 1972: 283–292; no voucher specimen preserved).

GENUS DIAGNOSIS

Holarrhena R. Br. 1811: 62; G. Don 1837: 78; De Candolle 1844: 413; Schumann 1895b: 137; Stapf 1902: 161–162; Ridley 1923: 349; Pichon 1950: 157–158; Codd 1963: 263.

Type species: *H. mitis* (Vahl) R. Br.

Heterotypic synonym: *Physetobasis* Hassk. 1857: 104–105; 1859: 258. Type

species: *Physetobasis macrocarpa* Hassk. (= *H. pubescens* (Buch.-Ham.) Wall. ex G. Don.

Deciduous undershrubs, shrubs or trees up to 25 m high, with abundant white latex in bark, branches, leaves and fruits. Branches unarmed, terete, sulcate when dry. Branchlets terete, sulcate when dry. Stipules intrapetiolate and often obscure or none. *Leaves* opposite or subopposite, those of a pair equal, shortly petiolate, without colleters in the axils; petiole glandular near the base; blade simple, medium green, paler beneath, entire; on each side 5–25 secondary veins which are curved towards the margin, anastomosing; tertiary venation more or less conspicuous, reticulate. *Inflorescences* terminal and/or seemingly axillary, cymose, many-flowered, rather lax or dense. Bracts entire, linear, acute at the apex, without colleters in the axils. *Flowers* 5-merous, sweet-scented, actinomorphic or with only sepals unequal, fragrant. Calyx persistent under the fruit. *Sepals* green, free or connate at the extreme base only, subequal or sometimes unequal, valvate, much shorter than the corolla, narrowly elliptic to linear, outside pubescent with glandular and/or ordinary hairs or glabrous, ciliate, with 0–10 colleters inside at the base which are alternating with them, narrowly elliptic to triangular. *Corrolla* in the mature bud salver-shaped; tube white or less often greenish white, cylindrical, slender, wider near the base and apex; on both sides variously pubescent or almost glabrous, inside, however, at the base always glabrous and at the throat always pubescent; lobes white, in the bud contorted and overlapping to the right, narrowly triangular to narrowly elliptic. *Stamens* included, inserted at the base of the corolla tube; filaments very short, pubescent at the base only; anthers introrse, elliptic or narrowly elliptic, glabrous, basifixed, rounded at the base, mucronate at the apex; cells two, discrete, parallel, dehiscent throughout by a longitudinal slit. *Pistil* glabrous or partially or entirely pubescent; ovary superior, carpels two, connate at the extreme base only, ovoid, gradually narrowed into the style; disk none; style cylindrical, slightly split at the base, somewhat laterally compressed towards the apex, reaching the insertion of the stamens, composed of two connate strands; clavuncula ovoid, mostly with 2 longitudinal indented lines; stigma mostly bifid; placentas adaxial; ovules numerous in 4–8 rows. *Fruit* composed of two scarcely spreading mericarps, which are follicular, slender, more or less constricted between the seeds, dehiscent along an adaxial line of dehiscence; wall thinly coriaceous, outside smooth or sulcate when dry, glabrous, sometimes with lenticels or white-dotted or -spotted. *Seeds* numerous, in two or more rows, linear to very narrowly oblong, striate, grooved, glabrous, with a dense tuft of hairs at the apex which is 3–6 × as long as the seeds; embryo large, surrounded by very scanty endosperm; cotyledons broad, complicate, larger than the short straight radicle.

Distribution: 4 species in Africa and Asia.

Note: The sections cited by PICHON (1950) are not maintained here, as they are artificial.

KEY TO THE SPECIES

1. Leaves papery when dry, mostly acuminate or acute at the apex; fruits pendulous; shrub or tree, 0.60–15(–25) m 2
   Leaves chartaceous when dry, mostly rounded or emarginate at the apex; fruits erect at least when young; (under)shrub, 0.30–2.50 m. South-eastern continental tropical Asia . . . . . 1. **H. curtisii**
2. Leaves ovate to elliptic, 1–3.3 × as long as wide; corolla lobes 2–5 × as long as wide 3
   Leaves narrowly elliptic, 3–5 × as long as wide, corolla lobes 6–10 × as long as wide. Sri Lanka . . . . . 3. **H. mitis**
3. Corolla 12–19 mm long, tube 6.5–9 mm long, lobes 7–11.5 × 2.2–3.5 mm; inflorescence very dense; fruits 30–60 cm long; branches and fruits with few lenticels. West and Central Africa . . . . . 2. **H. floribunda**
   Corolla 20–38 mm long, tube 9–19 mm long, lobes 10–24 × 3–8 mm; inflorescence rather lax; fruits 20–37.5 cm long; branches and fruits often with many lenticels. Eastern and Southern Africa, Southern Asia . . . . . 4. **H. pubescens**

Note. See '*H. congolensis*'.

SPECIES DESCRIPTIONS

1. **Holarrhena curtisii** King & Gamble 1908: 446–447; Pitard 1933: 1171; Craib 1939: 450. **Fig. 2, p. 7; Map 1, p. 9.**

Type: Thailand: Trang, *Curtis 3392* (K, lectotype).

Heterotypic synonyms: *H. pulcherrima* Ridley 1911: 130–131. Type: Malay Peninsula: Perlis, Kanga, *Ridley 14982* (K, lectotype; isotype: BM).

H. latifolia Ridley 1911: 131. Type: Thailand: Bangtaphan, *Keith 19/3/90* (type not seen, probably not preserved).

H. densiflora Ridley 1911: 131–132; Craib 1939: 450. Syntypes: Thailand: Bangtaphan, *Keith s.n.*; Thailand: Between Singgora and Nongchik, *St. V. B. Down s.n.* (syntypes not seen, probably not preserved).

H. similis Craib 1913: 70; Pitard 1933: 1172. Type: Thailand: Lampun, Me Ta, *A. F. G. Kerr 2548* (BM, lectotype; isotypes: E, K).

Undershrub or shrub, 0.30–2.50 m high. Shoots tufted from a perennial root-stock. Branches pale grey to dark grey, often lenticellate or white-dotted or -spotted; branchlets pale grey to brown, pubescent. *Leaves:* petiole pubescent, 0.5–6 mm long; blade ovate to elliptic or narrowly so, 2–3.3 × as long as wide, 2.3–9.7 × 1.2–4.4 cm, acuminate, rounded or emarginate at the apex, cuneate or rounded at the base, chartaceous when dry, pubescent above, more densely so beneath; that in the leaves of the first pair or the first two pairs of a branchlet often suborbicular, rounded, obtuse or emarginate at the apex and smaller; on

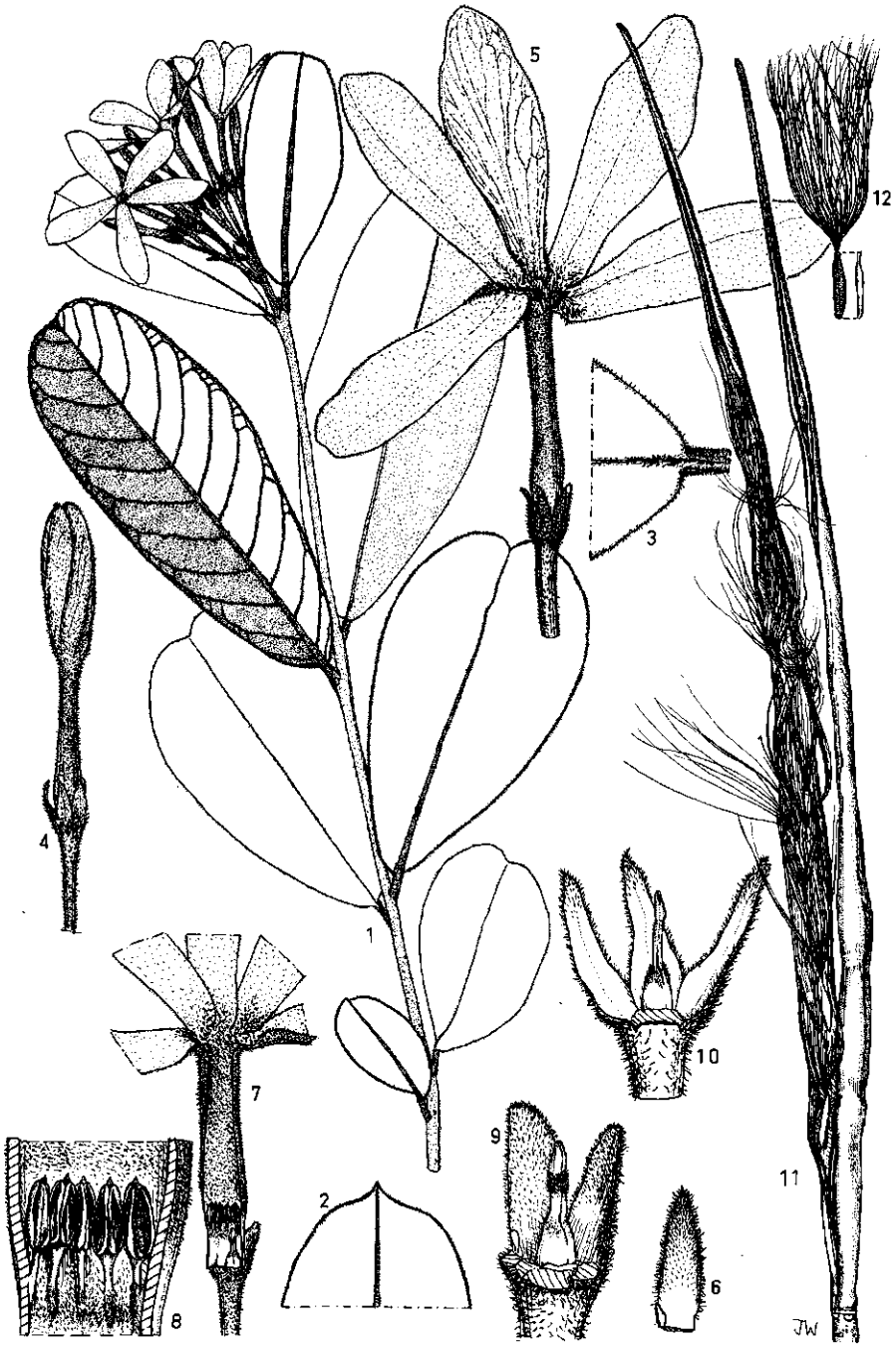


FIG. 2. *Holarrhena curtisii*: 1. flowering branch, $\frac{2}{3}\times$; 2. apex of leaf, $\frac{2}{3}\times$; 3. part of upper surface of leaf, 2×; 4. flower in bud, 2×; 5. flower, 2×; 6. sepal inside with colleter, 6×; 7. part of flower showing stamens and pistil, 2×; 8. part of corolla with stamens, 8×; 9–10. part of calyx with pistil, 6×; 11. fruit, $\frac{2}{3}\times$; 12. seed, $\frac{2}{3}\times$. – (1, 3. *Van Beusekom & Phengkhlai 1245*; 2. *A. F. G. Kerr 5693*; 4–9. *Garrett 293*; 10. *d' Orleans s.n. (received 23 June 1892)*; 11–12. *Couderc annis 1883–1885)*.

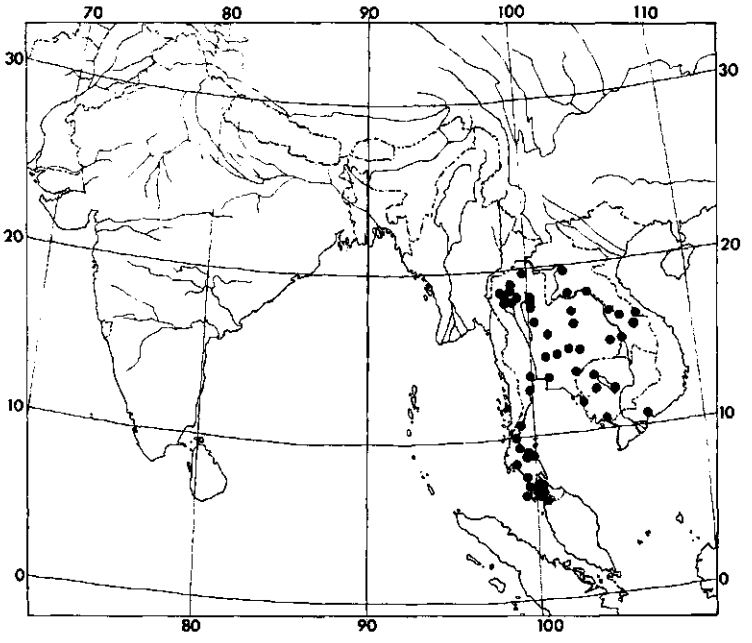
each side 9–15 secondary veins. *Inflorescences* terminal, less often seemingly axillary or leaf-opposed, lax. Peduncle, branches and pedicels pubescent; peduncle 0.5–1.6 cm long; bracts linear, 2.0–5.0 mm long, pubescent on both sides; pedicels 0.6–1.6 cm long. *Sepals* green, elliptic to narrowly so, 1.9–6.3 × as long as wide, 2.2–6.9 × 0.8–2.0 mm, free or up to 0.5 mm connate at the base, outside pubescent with ordinary and some glandular hairs, inside less pubescent with ordinary hairs only, mostly glabrous at the base for 0.5–3 mm, ciliate, with 0–10 colleters inside at the base which are alternating with them. Colleters narrowly elliptic to triangular, 1–3 × as long as wide, 0.2–0.5 × 0.1–0.2 mm. *Corolla* in the mature bud 4.4–11.8 × as long as the calyx, 20–34 mm long; tube white or less often greenish-white, 2.3–6.9 × as long as the calyx, 12–22 mm long, 0.5–2.0 mm in diameter, inside densely pubescent with ordinary and also some glandular hairs, except for the basal 1.1–2.1 mm; lobes white, narrowly triangular, 0.8–1.3 × as long as the tube, 2.4–4.4 × as long as wide, 10–23 × 3–6 mm, recurved, pubescent and ciliate or entirely glabrous. *Stamens* inserted at 1.8–2.0 mm from the base of the tube, anthers 1.3–3.0 × as long as the filaments, narrowly triangular, 1.2–2.2 mm long, with a 0.2 (–0.5) mm long mucro. *Pistil* 2.3–2.6 mm long; ovary 0.9–1.2 × 0.5–0.7 mm, glabrous or shortly pubescent at the apex; style 0.5–1.0 × 0.2–0.3 mm, pubescent or less often glabrous at the base; clavuncula 0.5–1.0 × 0.2–0.3 mm, pubescent or glabrous; stigma 0.1–0.3 mm long, shortly pubescent or glabrous. *Fruits* pale to dark brown; carpels erect, at least when young, 11–33 cm long, 3–8 mm in diameter, outside sometimes with a few lenticels or white-dotted or -spotted. *Seeds* 8–14 mm long with a dense, 25–45 mm long tuft of hairs at the apex. Cotyledons 1.8–2.8 mm long.

Distribution: Southeastern, continental, tropical Asia.

Ecology: Mangrove swamps, savannas and in open forest such as: deciduous mixed forest, bamboo forest, scrub woodland or open places in dense forest (a.o. *Dipterocarpaceae*-forest). Altitude: 0–400 m.

A selection of the about 100 specimens examined:

THAILAND: Chiang Mai: Ban Ngiu Thao (fl., fr. Mar.) *Winit 238* (BM, K); along Ban Bo Luang-Hot road (fl. June) *Van Beusekom & Phengkhlai 1245* (AAU, E, K, L, P). Chiang Rai: Doi Pui (fl. June) *Garrett 293* (A, BM, E, K, L). Lamphun: Doi Kai Khia (fl. July) *Winit 397* (K); Me Li (= Li Nam Mae R.) (fr. Aug.) *Winit 398* (K); Me Ta (bud, fl. Apr.) *A. F. G. Kerr 2548* (BM, E, K, lectotype of *H. similis*). Phrae: near Rawng Kwang (= Rong Kwang) (fr. Feb.) *A. F. G. Kerr 2357* (BM, E, K, paratype of *H. similis*); Den Jaya (= Den Chai) (fl. Oct.) *Franck 477* (A, BR, C, COI, L, P). Uttaradit: Huai Nam Pat (fl. Apr.) *Phengkhlai 141* (L, P). Phitsanulok: Muang Jom (fl., fr. Mar.) *A. F. G. Kerr 5693* (BM, K, P, UC). Udon Thani: Ban Na Lat (fl.) *Smiles s.n.* (K, paratype). Phetchabun: Nong Phai (fl., fr. May) *Smitinand 10887* (E, K, L, P). Khon Kaen: 45 km N. of Khon Kaen (fl. Mar.) *Sørensen et al. 2193* (K). Sara Buri: Thap Kwang (fl. May) *Smitinand 10893* (K, L, P). Nakhon Ratchasima: Pak Chaung (fl. May) *A. F. G. Kerr 20450* (BM, K); Korat (fl. May) *Bourke, May 1924* (BM, UC). Buriram: Ban Chum Saeng (bud, fl. May) *Noe 157* (A, AAU, E, L). Sisaket: Kantharom (fl. June) *Smitinand 1596* (K). Ubon Ratchathani: Warin (fl. June) *Lakshnakara 882* (BM, K). Prachin Buri: Aranyaprathet (fl., fr. May) *A. F. G. Kerr 19322* (A, BM, E, K, P). Chon Buri: Si Racha (fl. May) *A. F. G. Kerr 4250* (BM, K). Prachuap Khiri Khan: Hua Hin (fl. Aug.) *Marcan 375* (BM, K); ibid. (fl., fr. Jan.) *A. F. G. Kerr 8322* (BM, E. K, P); ibid. (fl. Apr.) *Ladell 205* (K). Chumphon: Bang Son (fl. Mar) *Put 1487* (AAU, BM, E, K); Sapli (= Saphli Sathani) (fl. May) *Haniff & Nur 4272* (K); 15 km N. of Chumphon (fl. Aug.) *Larsen et al.*



MAP 1. *Holarrhena curtisii.*

1445 (AAU, L, P); Lansuan (fl., fr. June) *Put 1681* (BM, K). Phangnga: Nop Pring (fl. Mar.) *A. F. G. Kerr 18531* (AAU, BM, K). Surat Thani: Naung Wai (fl. Mar.) *A. F. G. Kerr 12266* (BM, K, P); Konchanadit (fl. Aug.) *A. F. G. Kerr 13094* (AAU, BM, E, K, P); Ban Na (fl. Sep.) *Yuang 44* (BM, K). Trang: Trang (fl., fr. Mar.) *Curtis 3392* (K, lectotype); ibid. (fl., fr. Mar.) *Kunstler 1402* (K, paratype); ibid. (fl. Mar.) *Vanpruk 648* (E, K). SATUN: Adang Islands (fl., fr. Apr.) *Ridley 15864* (BM, K). Songkhla: Sadao (fl. July) *A. F. G. Kerr 15889* (AAU, BM, K, P); U Taphao Khlong (fl. May) *A. F. G. Kerr 3688* (BM, K); Rattaphum (fl. June) *Smitinand 11028* (K, L, P); Padang Besar (fl. Dec.) *A. F. G. Kerr 13583* (BM, E, L, P).

MALAYSIA: Malay Peninsula: Perlis (fl. Nov.) *Henderson 22935* (K); ibid. (fl. Mar.) *Ridley 14981* (BM, K, paratype of *H. pulcherrima);* ibid. (fl., fr. Mar.) *Ridley 14982* (K, lectotype of *H. pulcherrima);* Kedah, Kuala Nerang (fl. July) *Corner 31519* (K).

LAOS: Nuang Pakxan (fl. Mar.) *A. F. G. Kerr 20739* (BM, K); Ban Tha Ngon Na (= Ban Na) (fl. May) *Talbot de Malahide 13* (A, BM); ibid. (fl. Apr.) *Talbot de Malahide 145* (BM); km 85 route Savannakhet-Quangtri (fr. Jan.) *Poilane 11602* (P); Muang Phin (fr. Jan.) *Poilane 11483* (P). Sin. loc.: (fl.) *d'Orleans s.n. (received 23 June 1892)* (P); (fr.) *Spire, Dec. 1903* (P).

CAMBODIA: Between Angkor Wat and Sisophon (fl., fr. July) *Sørensen et al. 7306* (E, K); Kol Totung (fl. July, fr. Oct.) *Martin 10* (L, P); Kompong-chhnang (fr. Mar.) *Chevalier 31949* (P); ibid. (fl. June) *Godefroy-Leboeuf 189* (B, K, P, paratype); Kampot (fl. Mar.) *Geoffray 444* (P); ibid. (fl., fr.) *Pierre 174, July 1874* (L, P).

VIETNAM: Baria (fl., fr.) *Pierre 174, Aug. 1867* (K, NY, P); ibid. (fl., fr.) *Pierre 174, July 1866* (A, NY, P); ibid. (fl., fr.) *Pierre 4486* (A, BR, L, MO, NY, P); ibid. (fl. July) *Pierre 5243* (A, BR, NY, P); Sin. loc.: (fl. Mar.) *Couderc annis 1883-1885* (P, UC); (fl. Sept.-Nov.) *Thorel 1409* (B, K, P).

Note. Unfortunately the present author was unable to trace the types of *H. latifolia* and *H. densiflora*. However, the descriptions are clearly based on material which must belong to *H. curtisii* according to the present state of affairs and consequently *H. latifola* and *H. densiflora* are reduced to synonyms here.

2. **Holarrhena floribunda** (G. Don) Dur. & Schinz 1896: 190; Schumann 1898: 122; Durand & Schinz 1909: 346; Schmit 1950; Huber 1963: 68–69; Keay, Onochie & Stanfield 1964: 382, pl. 165; Berhaut 1967: 124; 1971: 385, pl. 384.

Fig. 3, p. 11; Phot. 1, p. 10; Phot. 2, p. 12; Map 2, p. 13.

Basionym: *Rondeletia floribunda* G. Don 1834: 516.

Type: Sierra Leone: Sin. loc., among bushes in the lowlands, *G. Don s.n.* (BM, holotype; isotypes: CGE, K).

Heterotypic synonyms: *H. ovata* A. DC. 1844: 414; Stapf 1902: 163–164; Chevalier 1920: 418. Type: Guinea (Conakry): Rio Nunez, *Heudelot 795* (De Candolle erroneously *1795)* (G-DC, holotype; isotypes: G, K, OXF, P, TCD). Homotypic synonym: *H. floribunda* var. *tomentella* Huber 1962: 437; 1963: 69.

H. africana A. DC. 1844: 138; Bentham 1849: 450; Oliver 1877: 44; Wulfsberg 1880; Schumann 1895b: 138; Morris (?) 1896: 47–48; Stapf 1902: 164; Chevalier 1920: 417; Aubréville 1936: 170, pl. 308; Dalziel 1937: 372; De la Mensbrugge 1966: 324, pl. 325. Type: Sierra Leone: Sin. loc., *Smeathmann?* (G-DC, holotype).

H. wulfsbergii Stapf 1902: 164; De Wildeman 1903a: 68; Durand & Schinz 1909: 346; Chevalier 1920: 418; Aubréville 1936: 170; Dalziel 1937: 372; Aubréville 1950: 443–444. Type: Togo: Badja, *Schlechter 12969* (L, lectotype; isotypes: BM, BR, G, K, P, Z).

Shrub or tree, (0.50–)2–25 m high, often regrowing from burned-down stumps. Trunk 5–30 cm in diam. Bark in young trees nearly smooth and more or less distinctly lenticellate, later rough and corky, longitudinally fissured, pale grey to dark brown; innerbark pale buff with green outerlayer; wood soft. Branches lenticellate or not, grey to dark brown; branchlets lenticellate or not, grey to brown. *Leaves:* petiole pubescent, 0.5–7(–10) mm long; blade ovate to elliptic or narrowly so, 1.3–3 × as long as wide, 2–14 (–19) × 2.3–8(–11) cm, acuminate or acute at the apex, cuneate or rounded at the base, herbaceous when living, papery when dry, above pubescent to glabrous, beneath more densely pubescent all over or only on the main veins or also glabrous; that in the leaves of the first

PHOT. 1. *Holarrhena floribunda (De Kruif 25).*

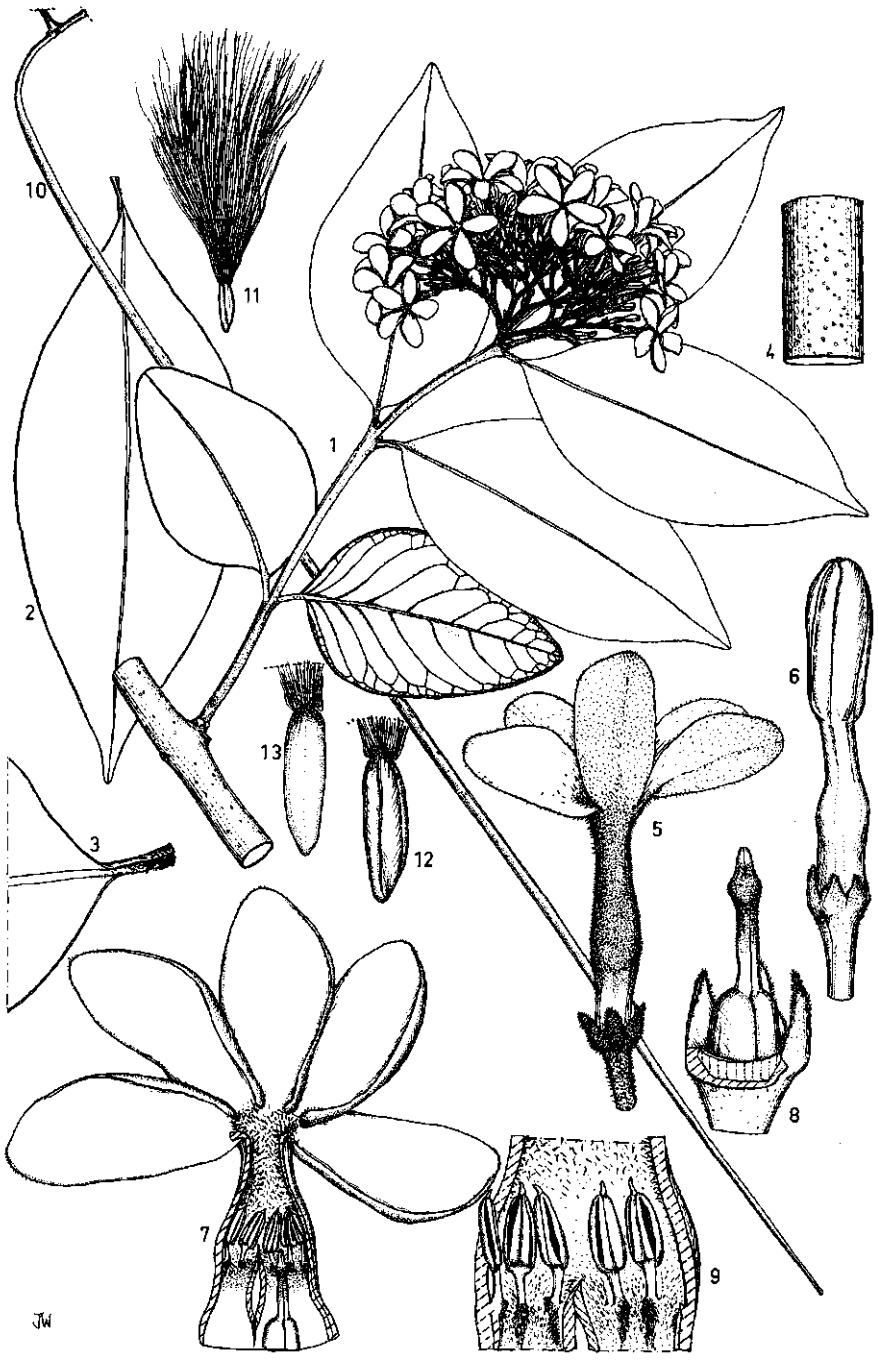


FIG. 3. *Holarrhena floribunda*: 1. flowering branch, $\frac{2}{3}\times$; 2. leaf, $\frac{2}{3}\times$; 3. leafbase with petiole from above, $2\times$; 4. part of branch, $\frac{2}{3}\times$; 5. flower, $4\times$; 6. flower in bud, $4\times$; 7. part of corolla showing stamens and pistil, $4\times$; 8. part of calyx with pistil, $8\times$; 9. part of corolla with stamens, $8\times$; 10. fruit, $\frac{2}{3}\times$; 11. seed, $\frac{2}{3}\times$; 12–13. detail seed both sides, $2\times$.– (1, 5. *Sanford 6780*; 2, 11–13. *De Koning 6555*; 3–4, 6–9. *Leeuwenberg 9664*; 10. *Espirito Santo 208*).

PHOT. 2. *Holarrhena floribunda (De Kruif 444).*

pair or the first two pairs of a branchlet often suborbicular, rounded or obtuse at the apex and smaller; on each side 5–14 secondary veins. *Inflorescences* usually seemingly axillary or leaf-opposed, sometimes terminal, rather dense. Peduncle, branches and pedicels pubescent, glabrescent but never entirely glabrous; peduncle 0.5–1.3 cm long, bracts linear, 1.0–2.1 mm long, pubescent on both sides; pedicels 0.4–0.8 cm long. *Sepals* green, elliptic, subequal, 1–3.6 × as long as wide, 1.1–4.4 × 0.6–2.0 mm, free or up to 1 mm connate at the base, outside pubescent with ordinary and some glandular hairs, inside pubescent with ordinary hairs only, glabrous at the base for 0.5–1.0 mm, ciliate, with 0–10 colleters inside at the base which are alternating with them. Colleters narrowly elliptic to triangular, 1.5–3 × as long as wide, 0.2–0.3 × 0.1–0.2 mm. *Corolla* in the mature bud 3–11 × as long as the calyx, 12–19 mm long; tube white or sometimes greenish–white, 2–5 × as long as the calyx, 6.5–9 mm long, 0.5–1.5 mm in diameter, outside pubescent with ordinary and some glandular hairs, except for the basal 0.5–3.1 mm, sometimes entirely glabrous, inside pubescent from the throat to the insertion of the stamens with an indumentum which is dense in the throat, which gradually diminishes downwards and may be again more dense near the insertion of the stamens, and which is composed of ordinary and glandular hairs; lobes white, narrowly triangular, 0.6–1.5 × as long as the tube, 2–5 × long as wide, 7.0–11.5 × 2.2–3.5 mm, recurved, pubescent and ciliate or entirely glabrous. *Stamens* inserted at 2.1–3.0 mm from the base of the tube; anthers 1.5–3.1 × as long as the filaments, narrowly triangular, 1.1–1.7 mm long, with a 0.1–0.4 mm long mucro. *Pistil* 2.5–4 mm long; ovary 0.9–1.5 × 0.5–1.0 mm, glabrous or

sometimes shortly pubescent at the apex; style 1.0–1.8 × 0.2–0.3 mm, shortly pubescent at the apex or glabrous; clavuncula 0.4–1.1 × 0.3–0.5 mm, shortly pubescent or less often glabrous; stigma 0.1–0.4 mm long, shortly pubescent or less often glabrous. *Fruits* pale grey to dark brown; carpels pendulous, 30–60 cm long, 5–7 mm in diameter, outside sometimes with a few lenticels or white-dotted or -spotted, *Seeds* 11–16 mm long with a dense, 40–60 mm long tuft of hairs at the apex. Cotyledons 2.5–3.1 mm long.

Distribution: West and Central Africa.

Ecology: Deciduous forests, open places in more dense forests, woodlands, and savannas, on clay, sand or rocky outcrops; alt. 0–1000 m.

A selection of the about 500 specimens examined:

SENEGAL: Sangalkam (fl., fr. Aug.) *Berhaut 718* (BR, P, Z); Rufisque (fl., fr. May) *Leprieur anno 1826* (G, P, TCD).

GAMBIA: Sin. loc. (fr. Feb.) *Dawe 40* (FHO, K).

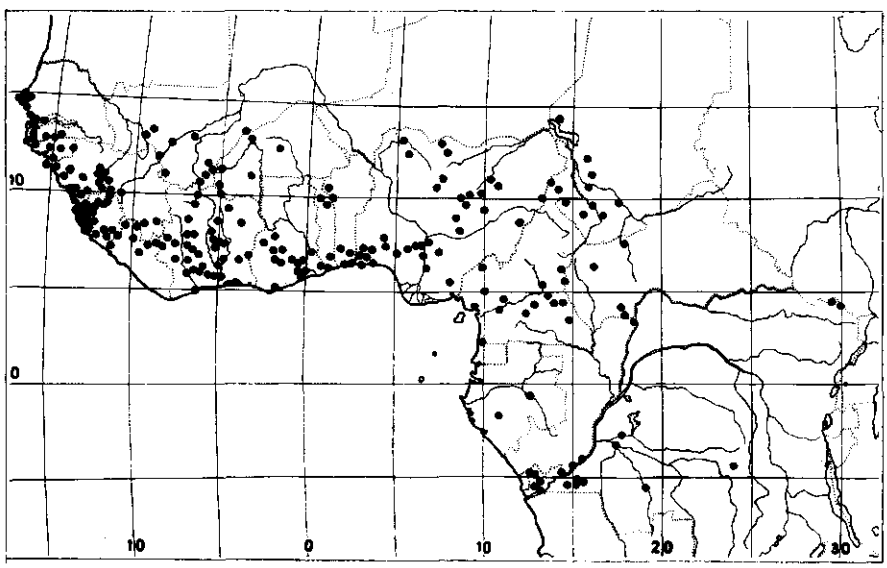
GUINEA-BISSAU: Ilha Formosa, Abu (fl. Apr.) *Espírito Santo 1978* (COI, K, MO, P); Farim (fl., fr. June) *Espírito Santo 2393* (COI, K, LISU, P); Bafata (fl., fr. July) *Espírito Santo 208* (COI, LISU).

GUINEA (CONAKRY): Rio Nunez (fl.) *Heudelot 795* (G, G-DC, K, OXF, P, TCD, type of *H. ovata*): Boké (fl. Apr.) *Paroisse 47* (FHO, P); Dalaba (fl. Mar.) *Dalziel 8402* (E, K, P, PRE); Friguiagbé (fr. Aug.) *Chillou 606* (BR, COI, K, P, PRE); Timbo (fl., fr. Feb.) *Pobéguin 140* (A, K, P); Macenta (fr, Oct.) *Baldwin 9793* (K, MO): Beyla (fr. Oct.) *Adam 28104* (C, MO).

MALI: Kita (fr, Mar.) *Dubois 203* (P, S); between Kangaba and Kindolé (fl. June) *Chevalier 857* (BR, G, K, P); Bamako (fl. June) *Waterlot 1122* (P); between Ouassada and Dandéla (fl., fr. Mar.) *Chevalier 620* (BR, K, P); ibid. (fl. Mar.) *Chevalier 621* (COI, G, L, W, Z); Kléla, 40 km N. of Sikasso (fl. May) *Demange 2087* (P).

SIERRA LEONE: Porto Loko (fl. Apr.) *Morton 1296* (K, MO, WAG); Freetown, Mt. Aureole (fl. Jan.) *Dalziel 971* (K, Z); Kenema (fr. Aug.) *Edwardson* 123 (BM, FHO, MO); Sin. loc. *G. Don s.n.* (BM, CGE, K, type); Sin. loc. *Smeathmann?* (G-DC, type of *H. africana*).

LIBERIA: Voinjama (fr. Oct.) *Baldwin 9883* (K); Gbarnga (fr. Sept.) *Baldwin 13279* (K, MO); Mt.



MAP 2. *Holarrhena floribunda.*

Nimba (fr. Dec.) *Adam 16477* (P).

IVORY COAST: Boyo, km 53 road Boundiali-Tingréla (fr. Oct.) *De Kruif 620* (UCI, WAG); Kakpin, Comoë National Park (fl. Apr.) *De Kruif 27* (UCI, WAG); Djebonoua, km 19 road Bouaké-Yamassoukro (fl. Apr.) *De Kruif 25 & 26* (UCI, WAG); km 5 road Seguéla-Worofla (fr. Oct.) *De Kruif 444* (UCI, WAG); km 44 road Bouaké-Yamassoukro (fr. Aug.) *De Kruif 274* (UCI, WAG); 5 km NW. of Duékoué, along road to Man (fl. Apr.) *Leeuwenberg 3888* (WAG); Issia (fl., fr. Feb.) *De Koning 6555* (WAG); Orumboboka (fr. July) *Aubréville 64* (BR, P, K).

UPPER VOLTA: 22 km S. of Ouahigouya (fl. June) *Leeuwenberg 4393* (B, BR, K, MO, P, PRE, WAG); 10 km S. of Tougan, N. of Diouroum (fl. June) *Leeuwenberg 4376* (B, BR, MO, P, PRE, UC, WAG); Gampéla, 10 km N. of Ouagadougou (fl., fr. Aug.) *Chevalier 24610* (P); Diébougou (fl.) *Aubréville 2732* (BR, P); Sindou (fl. Apr.) *Laferrere 102* (K, MO).

GHANA: N. of Busumkyekye, along Mampong-Ejura road (fl. Mar.) *Leeuwenberg 11990* (WAG); 3 km S. of Dzake Peki, 7 km N. of Asikuma (fl. Mar.) *Leeuwenberg 11194* (WAG); Ho, Togoland (fl. Mar.) *Dalziel 156* (C, E, K, PRE); Kumasi (fl. Mar.) *Vigne 1648* (A, BM, FHO, K); 4 km NE. of Dodowa, NW. of Aiyikuma (fl. Feb.) *Leeuwenberg 11911* (WAG); Asuboi (fl. Feb.) *Leeuwenberg 11046* (WAG); 30 km E. of Secondi (fl. Apr.) *Morton A489* (K); Aburi (fl. Mar.) *Brown 682* (K, paratype of *H. wulfsbergii)*; Sin. loc. (fl. May) *Brown 326* (K, paratype of *H. wulfsbergii)*.

TOGO: 5 km S. of Kandé (fl., fr. May) *Hakki et al. 980* (B); Niamtougou (fl. Mar.) *Sanford 6780* (MO); Badja (fl. June) *Schlechter 12969* (BM, BR, G, K, L, P, Z, lectotype of *H. wulfsbergii)*.

BENIN REPUBLIC: Birni (fl. May) *Aubréville 95D* (P, WAG); Boguila, Abomey (fl. Feb.) *Chevalier 23192* (P); Sin. loc., Adja Ouéré (?) (fl.) *Le Testu 122* (A, BM, BR, FHO, FI, K, LISC, MO, NY, P, S, UC).

NIGERIA: Sokoto State: W. of Sokoto (fr. Nov.) *Dalziel 370* (K, P). Kwara State: Along Ajaokuta-Okene road (fl. Apr.) *Daramola & Osanyinlusi FHI 90198* (PRE). Oyo State: Ibadan (fl., fr. June) *Hambler 10* (B, BR, K, P); km 1 Ife-Ondo road (fl. Mar.) *Leeuwenberg 11235* (WAG). Ogun State: Abeokuta (fl.) *Barter 3334* (K, paratype of *H. wulfsbergii)*; ibid. (fl.) *Irving s.n.* (K, paratype of *H. wulfsbergii)*. Lagos State: Lagos (fr.) *Denton s.n.* (K, paratype of *H. wulfsbergii)*; ibid. (fl. Oct.) *Moloney anno 1883* (K, paratype of *H. wulfsbergii)*; ibid. (fl. Mar.) *Rowland, 12 Mar. 1814* (P, paratype of *H. wulfsbergii)*; Ikorodu (buds, Mar.) *Schlechter 12296* (BR, K, Z, paratype of *H. wulfsbergii)*. Ondo State: Idanre (fl., fr. Nov.) *Brenan & Keay 8655* (FHO, K). Kaduna State: Katsina (fl. Mar.) *Meikle 1355* (BR, K, P); Yashi Forest Reserve near Yashi (fl. July) *Keay & Okeke FHI 37775* (FHO, K). Bauchi State: Dukka (fr. Dec.) *De Leeuw 54* (WAG). Plateau State: Wamba (fl. Mar.) *Thornewill 42* (FHO, K). Bendel State: Illushi, E. of Ubiaja (fl. Mar.) *Lowe 1280* (K, P, UCI). Anamba State: Obosi (fl. Apr.) *Chesters 131* (FHO). Cross River State: Nsan, Calabar (fl. May) *Smith 51* (FHO).

TCHAD: Niellim (fl. June) *Chevalier 8525* (BR, K, P); Golé (fl., fr. July) *Fotius 1594* (P); Ndélé (fl. Apr.) *Chevalier 8019* (BR, G, K, P).

CAMEROUN: Djinglia, 12 km NNE. of Mekolo (fr. Sept.) *Letouzey 6836* (BR, K, P); Chutes d'Ekom, Nkam R. (fl. Apr.) *Leeuwenberg 9664* (WAG); Nguélémendouka (fl. Nov.) *Breteler 2103* (A, BR, K, LISC, M, P, U, UC, WAG, Z); between Letta and Viali (fl., fr. Feb.) *Letouzey 2977* (K, P); Moloundou (fl. Mar.) *Mildbraed 4616* (HBG).

CENTRAL AFRICAN REPUBLIC: Iro R. (fl. July) *Chevalier 8767* (P); Bozoum (fl. Apr.) *Tisserant 3295* (BM, P); km 20 Mbaïki-Boda road (fr. Nov.) *Badré 301* (P); Boukoko (fl. Mar.) *Le Testu 2501* (B).

GABON: Haut-Ogooué, Lastoursville Region (fl. Dec.) *Le Testu 7803* (BM, BR, LISC, P); ibid. (fl., fr. Nov.) *Le Testu 8540* (BM, BR, LISC, P); Mouila (fl. Nov.) *Le Testu 5053* (BM, P).

CONGO (BRAZZAVILLE): Chutes de la Foulakari, Plateau des Catarades (fl. Oct.) *Sita 1857* (P); between Mpioka and Manyanga, Boko Region (fl. Nov.) *Trochain 80 bis* (P).

ZAÏRE: Bandundu: Nioki (fl., fr.) *Flamigni 7084* (BR, P). Bas-Zaïre: Parc de la Nkula, INEAC-Luki (fr. Sept.) *Wagemans 856* (BR, W); INEAC-Luki, Vallée de la Minkudu (fr. Aug.) *Toussaint 2444* (BR, FHO, K, P). Kinshasa: INEAC-M'Vuazi (buds, Oct.) *Dubois 75* (BR, K); ibid., Forêt de Nkolo (fl. Dec.) *Devred 412* (BR, K); Dila (fl. Oct.) *Compère 691* (BR, K). Haut-Zaïre: Parc National de la Garamba (fl. Mar.) *Troupin 507* (BR, K); ibid. (fr. Aug.) *Troupin 1728* (BR, K, UC).

SUDAN: Summit of Mt. Otogo (fl. Dec.) *Meyers 13605* (K).

ANGOLA: Cabinda: Pungo Mongo (fr. Jan.) *Gossweiler 6155* (LISJC); Nkanda, Mbaku (fr. Jan.) *Gossweiler 9062* (LISJC); Buco Zau (fl. Nov.) *Gossweiler 6822* (BM, LISJC).

3. **Holarrhena mitis** (Vahl) R. Br. 1811: 62; De Candolle 1844: 413; G. Don 1837: 78; Thwaites 1860: 194; Hooker f. 1882: 645; Huber 1973: 14.

Fig. 4, p. 16; Map 3, p. 17.

Basionym: *Carissa mitis* Vahl 1790: 44, pl. 59.
Type: Sri Lanka: *König s.n.* (BM, holotype; isotype: L).

Shrub or tree, 4–15 m high. Trunk 5–20 cm in diameter. Bark smooth, whitish, without lenticels; wood soft. Branches slender, drooping, dark purplish-brown, with inconspicuous lenticels; branchlets glabrous. *Leaves:* petiole glabrous, 2–8 (–15) mm long; blade narrowly elliptic, 3–5 × as long as wide, (0.5–)1–3 × (1–) 2–13 cm, acuminate, acute or sometimes obtuse at the apex, cuneate at the base, papery when dry, glabrous; on each side 5–15 secondary veins. *Inflorescences* usually seemingly axillary or leaf-opposed, sometimes terminal, rather lax. Peduncle, branches and pedicels pubescent; peduncle 0.5–0.9 cm long, bracts linear, 1.1–2.8 mm long, pubescent or less often glabrous on both sides; pedicels 0.3–1.5 cm long. *Sepals* pale green, narrowly elliptic to linear, subequal or sometimes unequal, 1.5–15 × as long as wide, 1–7 × 0.5–1.8 mm, free or up to 1 mm connate at the base, outside pubescent with ordinary and also some glandular hairs, inside pubescent with ordinary hairs only all over, or only at the apex, ciliate, with 0–5 colleters inside at the base which are alternating with them. Colleters 1–2 × as long as wide, narrowly elliptic to triangular, 0.2 × 0.1 mm. *Corolla* in the mature bud (3–)5–20(–30) × as long as the calyx, 20–35 mm long; tube white, 2–10(–20) × as long as the calyx, 9–13 mm long, 0.5–1.5 mm in diameter, outside pubescent with ordinary and some glandular hairs except for the basal 1.0–1.5 mm, inside pubescent from the throat to the insertion of the stamens with an indumentum which is dense in the throat, which gradually diminishes downwards and may be again more dense near the insertion of the stamens, and which is composed of ordinary and some glandular hairs; lobes white, 1–2 × long as the tube, linear, 6–10 × as long as wide, 11–15 × 1.5–2.8 mm, pubescent and ciliate. *Stamens* inserted at 1.5–1.8 mm from the base of the tube; anthers 1.5–2.2 × as long as the filaments, narrowly triangular, 1.1–1.3 mm long, with a 0.1–0.2 mm long mucro. *Pistil* 2.2–2.5 mm long; ovary 0.8–1.2 × 0.5–0.8 mm, pubescent at the apex; style 0.5–0.7 × 0.2–0.3 mm, glabrous; clavuncula 0.3–0.7 × 0.2–0.3 mm, glabrous; stigma 0.1–0.2 mm long, glabrous. *Fruits* pale grey to dark brown; carpels pendulous, 30–45 cm long, 3–4 mm in diameter, outside sometimes with a few inconspicuous lenticels. *Seeds* 6–11 mm long, with a dense, 25–40 mm long tuft of hairs at the apex. Cotyledons 1.5–2.5 mm long.

Distribution: Endemic in Sri Lanka.

Ecology: Open places in forests, both in the humid and in the dry zone. Alt. 0–800 m.

Most of the specimens examined:

SRI LANKA: North Central Province: Gunner's Quoin, Polonnaruwa Distr. (fl. Oct.) *Herb. Peradeniya 493* (UPS). Eastern Province: Batticaloa (fl. Aug.) *Petch, 16 Aug. 1922* (A). Central

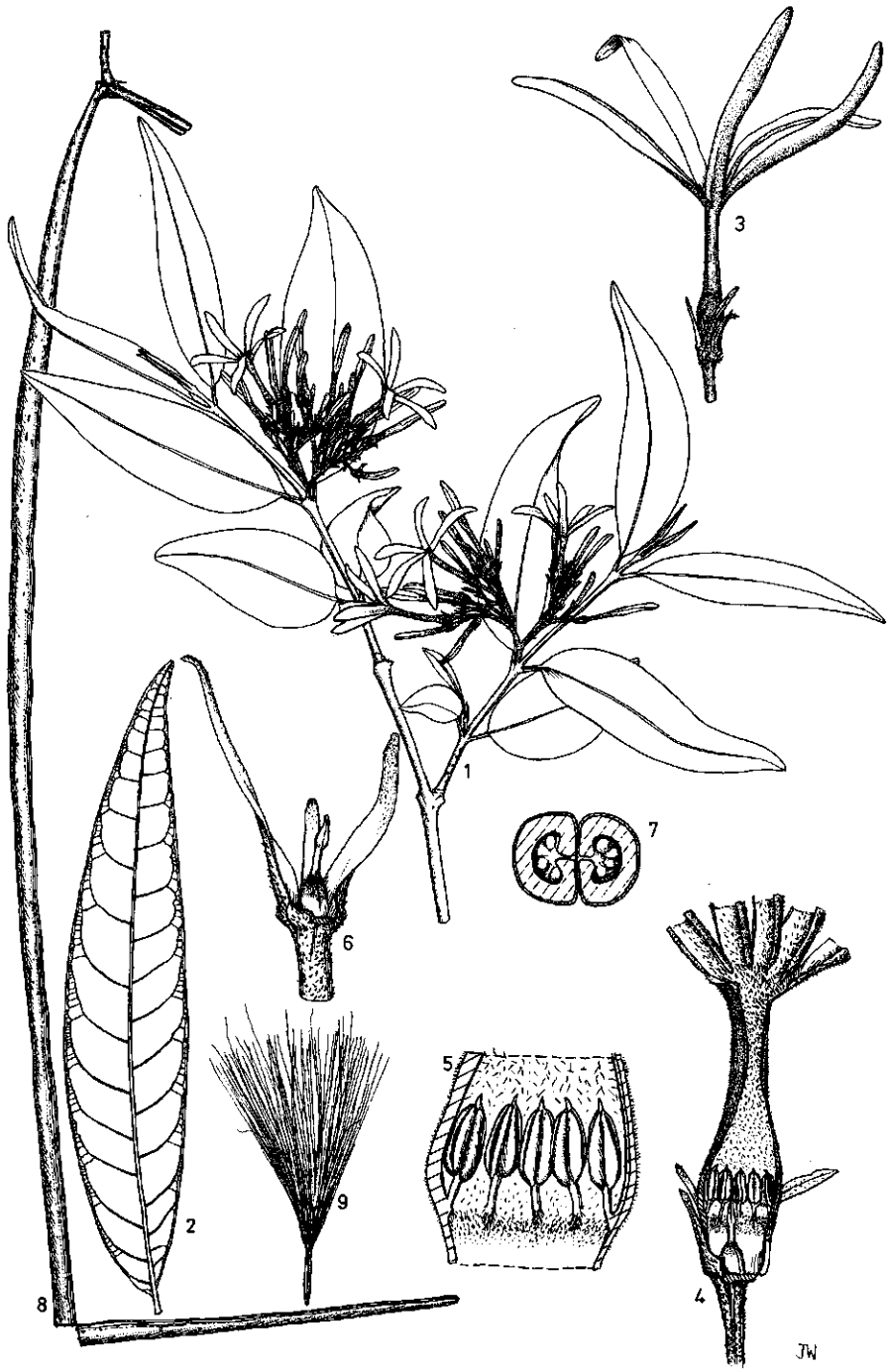
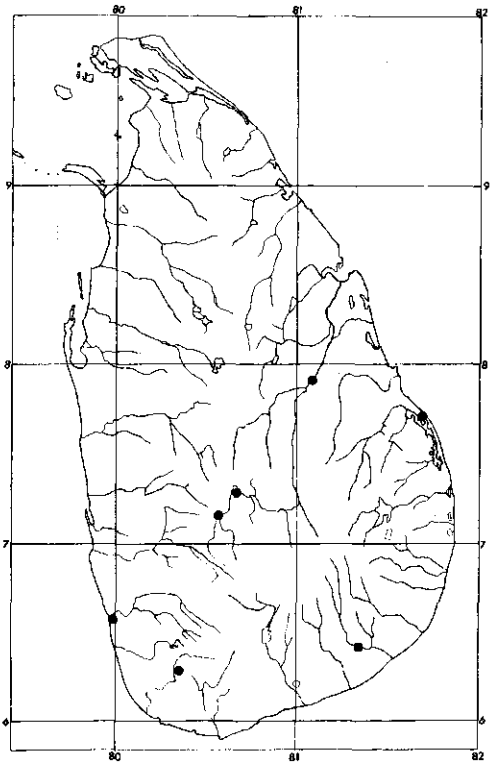


FIG. 4. *Holarrhena mitis:* 1. flowering branch, $\frac{2}{3}\times$; 2. leaf beneath, $\frac{2}{3}\times$; 3. flower, $2\times$; 4. part of flower showing stamens and pistil, $4\times$; 5. part of corolla with stamens, $8\times$; 6. part of calyx with pistil, $6\times$; 7. transverse section of ovary, $20\times$; 8. fruit, $\frac{2}{3}\times$; 9. seed, $\frac{2}{3}\times$:–(1–2, 8–9. *Macrae anno 1851;* 3–7. *Bernardi 15507).*



MAP 3. *Holarrhena mitis.*

Province: Hillcrest, Kandy Distr. (fl. Feb.) *Worthington 4625* (BM); Gampola, Tembillyalla, Kandy Distr. (fl. Feb.) *Worthington 4539* (BM). Uva Province: Kataragama Peak, Monaragala Distr. (fl. Oct.) *Bernardi 15507* (G, K, MO, Z); ibid. (fl. Oct.) *Huber 34* (BM, K, MO). Southern Province: Kalutara, Kalutara Distr. (fl.) *Macrae anno 1851* (FI); E. of Hiniduma, Galle Distr. (fl. May) *Jayasuriya et al. 793* (K, MO); Sin. loc. (fl.) *König s.n.* (BM, L, type); Sin. loc. (fl., fr.) *Thwaites CP756* (BM, BR, G, K, LE, P).

CULT.: Ivory Coast: Sofalco plantations near Abobo (fl. Dec.) *Leeuwenberg 10709* (L, WAG, introduced from Sri Lanka); Sri Lanka: Hort. Peradeniya (fl. May) *Hallier, 1 May 1903* (HBG).

4. **Holarrhena pubescens** (Buch.-Ham.) Wall. ex G. Don 1837: 78; De Candolle 1844: 413–414; Codd 1963: 263; Palgrave 1977: 786, pl. 262; Killick 1977: 4, pl. 1758.

Fig. 5, p. 19; Fig. 6, p. 20; Map 4, p. 22; Map 5, p. 23.

Basionym: *Echites pubescens* Buch.-Ham. 1822: 521–525 (not: Hook. & Arnott 1841: 34).

Type: Burma: Ava, Canoungaklay, *Buchanan-Hamilton s.n.* (BM, lectotype).

Homotypic synonyms: *Chonemorpha pubescens* (Buch.-Ham.) Sweet 1839: 458. *H. antidysenterica* var. *pubescens* (Buch.-Ham.) Steward & Brandis 1874: 326.

Heterotypic synonyms: *H. antidysenterica* (L.) Wall. ex A. DC. 1844: 413, partly as to specimens in K-WALL; Hook. f. 1882: 644; Schumann 1895b: 134,

138; Cooke 1904: 133; King & Gamble 1908: 445; Craib 1912: 130; Ridley 1923: 349; Craib 1939: 448; Pitard 1933: 1169; Cowen 1950: 75; Biswas 1956: 67–68. pl. 32. Type: 'Codaga-pala', Van Rheede tot Draakenstein 1678: t. 47. except for the fruit. This plate erroneously has been cited by Linnaeus 1753: 209 with *Nerium antidysentericum*, of which the other elements belong to *Wrightia antidysenterica* (L.) R. Br. according to the present day opinion (see Ngan 1965: 166). Homotypic synonyms: *Echites antidysenterica* (L.) Roxb. 1810: 166, partly, as for the above cited type. *Chonemorpha antidysenterica* (L.) G. Don 1837: 76; 1840–1843: t. 439. *H. codaga* G. Don 1837: 78; Wight 1848: t. 1297; De Candolle 1844: 414.

H. malaccensis Wight 1848: t. 1298. Type: Malacca, *Wight s.n.* (K, holotype).

H. febrifuga Klotzsch 1862: 277; Schumann 1895a: 137; 1895b: 315; Stapf 1902: 162; De Wildeman 1903b: 101; Durand & Schinz 1909: 345; Engler 1910: 392, pl. 329; Codd 1951: 154; Palgrave 1957: 26; Dale & Greenway 1961: 47. Types: Moçambique: Tete, Sena, *Peters s.n.* (holotype not seen, destroyed in B; no isotypes seen); Moçambique: Tete, Nyampanda, *Gillett 17510* (WAG, neotype; iso-neotypes: K, L, SRGH).

H. tettensis Klotzsch 1862: 278. Types: Moçambique: Tete, Sena, *Peters s.n.* (holotype not seen, destroyed in B; no isotypes seen); Moçambique: Namagoa, Milange road, 30–40 km from Mocuba, *Faulkner 488* (BR, neotype; iso-neotypes: COI, K, S, SRGH).

H. glabra Klotzsch 1862: 279. Types: Moçambique: Tete, *Peters s.n.* (holotype not seen, destroyed in B; no isotypes seen); Moçambique: Niassa, Monapo, km 11 of Namialo-Meserepane road, *Torre & Paiva 9272* (LISC, neotype).

H. antidysenterica var. *glabra* Steward & Brandis 1874: 326. Type: not designated.

H. febrifuga var. *glabra* Oliver 1875: 108. Type: Tanzania: Khutu, Mbwiga, *Speke & Grant, Nov. 1860* (K, holotype).

H. macrocarpa (Hassk.) Villar 1880: 130. Basionym: *Physetobasis macrocarpa* Hassk. 1857: 104. Type: not designated; India: Pondichery, Hortus Pondicheriensis, *Perrottet 323* (L, neotype; iso-neotypes: B, G, NY, P, W).

H. fischeri Schum. 1895a: 316; 1895b: 137. Type: Tanzania: Uniamwezi, Usuri, *Fischer 378* (holotype not seen, destroyed in B; lectotype: K, fragment).

H. febrifuga forma *grandiflora* Stapf ex De Wild. 1903b: 101; Durand & Schinz 1909: 346. Type: Zaïre: Lukafu, *Verdick 103* (Stapf and Durand & Schinz erroneously *133)* (BR, holotype).

H. antidysenterica var. *macrantha* Kerr ex Craib 1939: 449. Type: Thailand: Kanburi (= Kanchanaburi), *Marcan 951* (K, holotype; isotype: BM).

H. glaberrima Markgraf 1950: 28. Type: Tanzania, Morogoro, Uluguru Mountains Westside, Miombo Forest, *Schlieben 3326* (M, holotype; isotypes: B, BM, BR, G, LISC, P, PRE, Z).

Shrub or tree, 0.60–18 m high. Trunk 12–25 cm in diameter. Bark smooth and more or less distinctly lenticellate or rough and corky, longitudinally fissured, pale to dark grey; innerbark pale buff, with green outerlayer, with much white

FIG. 5. *Holarrhena pubescens:* 1. flowering branch, $\frac{2}{3}\times$; 2. part of branch with lenticels, $\frac{2}{3}\times$; 3. bark, $\frac{2}{3}\times$; 4. flower, $2\times$; 5. part of flower with stamens and pistil, $2\times$; 6. sepal inside with colleters, $6\times$; 7. sepal inside with colleter, $8\times$; 8. part of calyx with sepals, $4\times$; 9. part of corolla with stamens, $8\times$; 10. fruit, $\frac{2}{3}\times$; 11. seed, $\frac{2}{3}\times$. – (1. *Pawek 7734;* 2. *Thulin & Mhoro 1256;* 3–4. *Leeuwenberg 10867;* 5–6, 8–9. *Leeuwenberg 10866;* 7. *Squires 778;* 10. *Lawton 1212;* 11. *Harmand 23*).

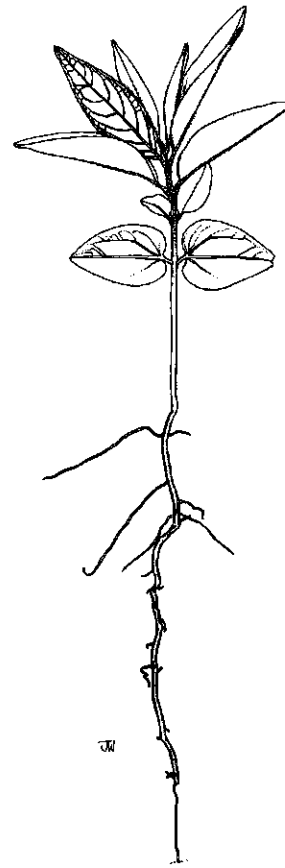


FIG. 6. *Holarrhena pubescens*: seedling, 3 months, $\frac{2}{3}\times$. – *(Fanshawe 9068)*.

latex; wood soft. Branches lenticellate; branchlets pubescent or less often glabrous. *Leaves* very variable in shape and size; petiole pubescent or less often glabrous, 0.2–12 mm long; blade ovate to elliptic or narrowly so, 1–3.3 × as long as wide, 1.7–19.5 × 1.3–11.2 cm, acuminate or acute at the apex, cuneate or rounded at the base, papery when dry, pubescent to glabrous on both sides: if hairy mostly more so beneath; blade in the leaves of the first pair or the first two pairs of a branchlet often suborbicular, rounded or obtuse at the apex and smaller; on each side 5–25 secondary veins. *Inflorescences* usually seemingly axillary or leaf-opposed, sometimes terminal, rather lax. Peduncle, branches and pedicels pubescent or less often glabrous; peduncle 0.9–1.7 cm long; bracts linear, 1.5–4.5 mm long, pubescent or less often glabrous on both sides; pedicels 0.3–3 cm long. *Sepals* green, elliptic to linear, subequal or sometimes unequal, 1–20 × as long as wide, (1–)2–12 × 0.5–1.7 mm, free or up to 1 mm connate at

the base, outside pubescent with ordinary and also some glandular hairs all over or only at the apex, less often entirely glabrous, inside pubescent with ordinary hairs only all over or at the apex and then the basal 0.5–3 mm glabrous, or less often entirely glabrous, ciliate, with 0–10 colleters inside at the base which are alternating with them. Colleters 1.3–3 × as long as wide, narrowly elliptic to triangular, 0.2–0.4 × 0.1–0.3 mm. *Corrolla* in the mature bud 2–13 × as long as the calyx, 20–38 mm long; tube white 1.2–5.5 × long as the calyx, 9–19 mm long, 0.5–20 mm in diameter, outside pubescent with ordinary and also some glandular hairs except for the basal 0.5–3 mm, sometimes entirely glabrous, inside pubescent from the throat to the insertion of the stamens with an indumentum which is dense in the throat, which gradually diminishes downwards and may be again more dense near the insertion of the stamens, and which is composed of ordinary and some glandular hairs; lobes white, narrowly triangular, 0.9–1.7 × as long as the tube, 2–5 × as long as wide, 10–24(–30) × 3–8 mm, recurved, pubescent and ciliate or glabrous. *Stamens* inserted at 1.5–2.5 mm from the base of the tube; anthers 0.8–5 × as long as the filaments, narrowly triangular, 0.8–1.8 mm long, with a 0.1–0.3 mm long mucro. *Pistil* 1.8–3.1 mm long; ovary 0.7–1.2 × 0.5–1.0 mm, glabrous; style 0.3–1.2 × 0.2–0.3 mm, shortly pubescent at the apex or entirely glabrous; clavuncula 0.3–1.2 × 0.2–0.5 mm, shortly pubescent or less often glabrous; stigma 0.1–0.3 mm long, shortly pubescent or glabrous. *Fruits* pale grey to dark brown; carpels pendulous, 20–37.5 cm long, 2–9 mm in diameter, outside sometimes with many lenticels or white-dotted or -spotted. *Seeds* 9–16 mm long, with a dense, 25–45 mm long tuft of hairs at the apex. Cotyledons 2–3 mm long.

Distribution: Eastern and Southern Africa, Southern Asia.

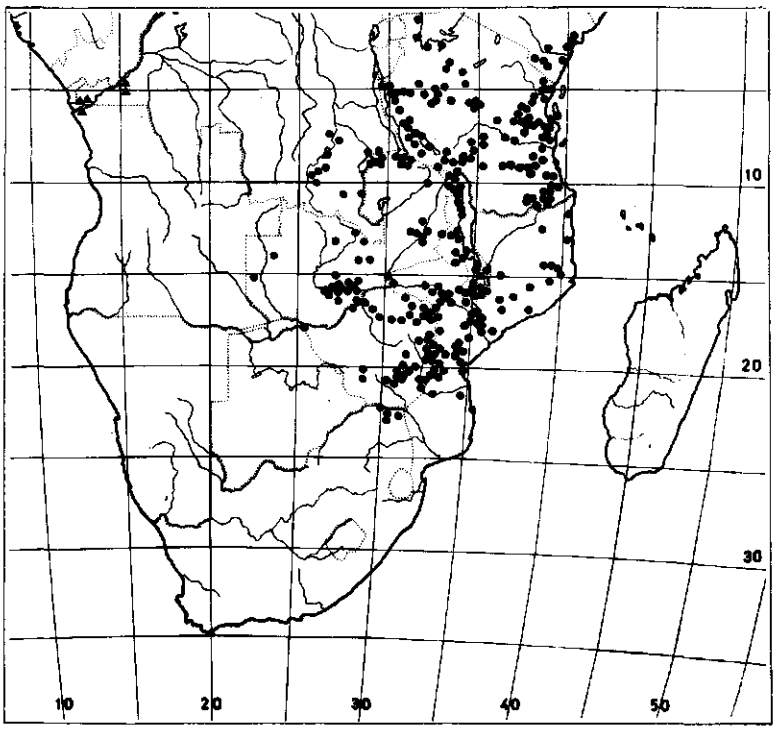
Ecology: Deciduous mixed forests, bamboo forests, scrub woodlands, savannas, or open places in heavy forests, on clay, sand or rocky outcrops. Alt. 0–1500 m.

A selection of the about 750 African and 650 Asian specimens examined:

ZAÏRE: Bas-Zaïre: between Tchoa (= Tshoa) and Boma (fl. Nov.) *Cabra 3* (BR, K, type of '*H. congolensis*'). Shaba: Parc National de l'Upemba, Mabwe (fl. Dec.) *J. de Wilde 692* (BR, K); Musosa (fl. Oct.) *Bredo 3521* (BR); Haut Lomami (fl. Sept.) *Leistner 1471* (M, PRE); Lukafu (fl. Oct.) *Verdick 103* (BR; type of *H. febrifuga* forma *grandiflora*).

KENYA: Coast: Mambosasa (fl., fr. Feb.) *Graham 316* (A, BM, FHO, K); Taita Hills (fl. Nov.) *Bally 13610* (BR, G, K); Sokoke (fl. Jan.) *Dale 1073* (BR, FHO, P).

TANZANIA: Lake Province: Mbarika, Mwanza Distr. (fl. Sept.) *Tanner 991* (BR, K, MO, NY, UC, WAG); ibid. (fr. May) *Tanner 1475* (B, BR, K, LISC, S, UC). Tanga Province: Segoma Forest Reserve, Korogwe Distr. (fl. Nov.) *Faulkner 4304* (C, K, MO, P); Mashewa Usambara (fr. Aug.) *Holst 8837* (COI, HBG, K, LE, M, P, W, Z); Kideliko, Handeni Distr. (fl., fr. Apr.) *Faulkner 1426* (B, BR, K, S). Western Province: Ikuu Distr. (fl. Jan.) *Bullock 2287* (B, BR, K, S); ibid. (fl. Jan.) *Bullock 2316* (B, BR, K, S). Central Province: Manyomi, near Kilimatinde (fl. Dec.) *Burtt 5399* (BM, BR, FHO, K); Usur (=Ussure) (fl.) *Fischer 378* (K, lectotype of *H. fischeri*); km 30 Manyoni-Dodoma road (fl. Nov.) *Leeuwenberg 10866* (WAG); ibid. (fl., fr. Nov.) *Leeuwenberg 10867* (WAG). Eastern Province: Mtibwa Forest Reserve, Morogoro Distr. (fl. Nov.) *Semsei 1503* (B, BM, BR, FHO, K, MO); Mbwiga, Khutu (= Ukutu) (fl. Nov.) *Speke & Grant anno 1860* (K, type of *H. febrifuga* var. *glabra*); Morogoro (fl. Nov.) *Milne-Redhead & Taylor 7368* (B, BR, K,



MAP 4. • *Holarrhena pubescens*, Western part of area. ▲ *Holarrhena floribunda* × *Holarrhena pubescens*.

LISC); Uluguru Mts. (fl. Jan.) *Schlieben 3326* (B, BM, BR, G, K, LISC, M, MO, P, PRE, Z). Southern Highlands Province: SW. Ruaha National Park, Iringa Distr. (fl.) *Greenway & Kanuri 14812* (K, M, MO, PRE); Madibira (fl. Sept.) *Thulin & Mhoro 1256* (K, UPS). Southern Province: Lutamba-lake, Lindi Distr. (fl. Oct.) *Schlieben 5440* (B, BM, BR, G, LISC, M, P, PRE, S, Z); W. of R. Mbangala, Masasi Distr. (fl. Dec.) *Milne-Redhead & Taylor 7679* (B, BR, K, LISC). Zanzibar: Mahonda (fl. Jan.) *Sacleux 2214* (P); ibid. (fl. Jan.) *Sacleux 2215* (P).

ZAMBIA: Chiengi (fl. Oct.) *Bullock 1244* (BR, K); Mbesuma Ranch, Kasama Distr. (fl. Dec.) *Astle 1061* (SRGH); Kitwe (seedling, Dec.) *Fanshawe 9068* (K); ibid. (seedling, Sept.) *Fanshawe 9303* (K); Jumbe (fl., fr. Oct.) *Robson 81* (BR, BM, LISC, PRE, SRGH); Luangwe R. near Beit Bridge (fr, Apr.) *White 2401* (BR, FHO, K); Nega-Nega near Kafue (fl. Nov.) *West 3455* (K, LISC, SRGH, PRE); Mazabuka Research Station, Mazabuka (fr. Apr.) *Lawton 1212* (FHO, SRGH); Mapanza, Choma (fl., fr. Oct.) *Robinson 2474* (K, M, PRE, SRGH); Kariba North Access road, Mazabuka Distr. (fl. Dec.) *Goodier 437* (BR, K, LISC, P, PRE, SRGH).

MALAWI: W. of Karonga (fl. Jan.) *Pawek 7734* (MO); 40 km S. of Karonga (fl. Jan.) *Robinson 3128* (K, M, MO, PRE, SRGH); near Sani Hill (fl., fr. Nov.) *Benson 599* (BM, BR, K, LD, PRE, SRGH); between Lake Nyasa Hotel and Senga Bay Hotel (fr. Feb.) *Robson 1639* (BM, BR, K, LISC, PRE, SRGH); Fort Johnston (fl., fr. Nov.) *Jackson 1378* (BM, BR, FHO, K).

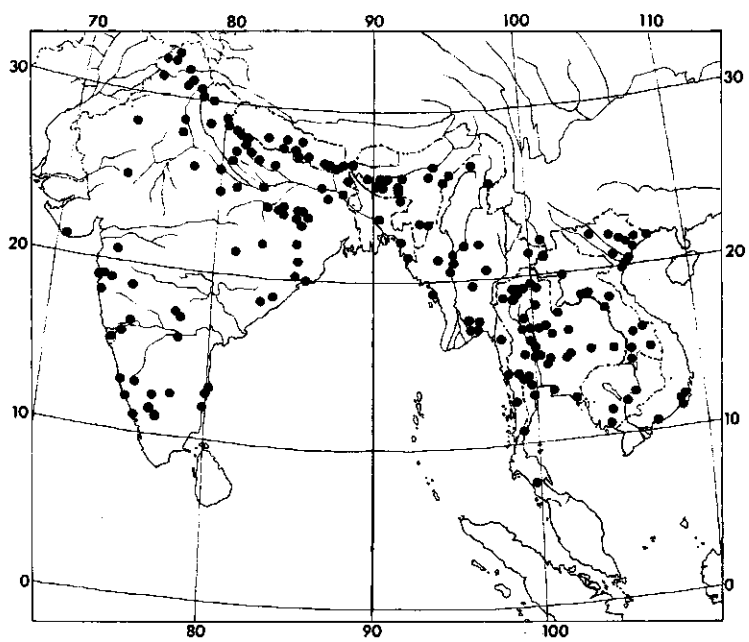
ZIMBABWE: Mzarabani, Darwin Distr. (fr. Apr.) *Bingham 1449* (BR, LISC, M, PRE, SRGH); Mazoe dam (fl. Jan.) *Müller 215* (L, LISC, PRE, SRGH); M'tarazi Falls (fl., fr. Nov.) *Chase 1319* (BM, COI, K, LISC, SRGH); Bangara Falls (fl. Dec.) *Wild 4372* (BR, K, MO, PRE, S, SRGH); Beit Bridge (fl. Nov.) *Davies 377* (MO, SRGH).

MOÇAMBIQUE: Niassa: Metangula (fl. Oct.) *Mendonça 738* (LISC). Cabo Delgado: Mouth of M'salo (= Rio Messalo) (fl. Nov.) *Allen 110* (FHO, K, STE). Nampula: Namialo, Monapo (fl.

Nov.) *Torre & Paiva 9272* (LISC, neotype of *H. glabra)*. Zambezia: Namagoa, Mocuba Distr. (fl. Nov.-Dec.) *Faulkner 328* (BR, G, K, LD, PRE, SRGH); Milange road, 30–40 km from Mocuba (fl. Nov.) *Faulkner 488* (BR, COI, K, S, SRGH, neotype of *H. tettensis)*. Tete: Tette (= Tete) (fr. Feb.) *Kirk anno 1859* (K, LE); Nyampanda (fl. Oct.) *Gillett 17510* (K, LISC, SRGH, WAG, neotype of *H. febrifuga)*; Sena (fr. Feb.) *Kirk anno 1859* (K, LE). Manica e Sofala: Vila Paiva de Andrada (fl. Oct.) *Gomes e Sousa 4733* (COI, K, LISC, PRE); Chibabava (fl., fr. Dec.) *Swynnerton 209a* (BM, K, SRGH). Gaza: Massangena (fr. July) *Smuts 358* (BM, K, NY, PRE).

South Africa: Transvaal: Kruger National Park, near Punda Maria (-Ruskamp) (fl. Nov.) *Lang 32126* (B, K, NH, PRE).

India: Himachal Pradesh: Dalhousie (fl. June) *Stewart 2117* (A, K, MO, NY). Punjab: Pathankot (fr. Feb.) *Stewart 974* (K, NY). Hayana: Malabar (fl., fr.) *Stocks s.n.* (BM, FI, G, LD, M, NY, P, S, W). Delhi: Delhi (fr. Dec.) *Kuntze 7267* (NY). Gurajat:Gir forest, 5 km N of Sasan (fl. May) *Hodd 75* (K). Madhya Pradesh: Gwalior (fl. Mar.) *Maries anno 1890* (BM); ibid. (fr. Aug.) *Maries anno 1890* (BM); Dorhora (= Duhara), Chhatapur Dt. (fl.) *Wallich 1672L part a* (K-WALL); Rai Pur (fl., fr. Sept.) *Sant Bam Chamla 28* (G). Maharashtra: Borivli National Park (fl. June) *Hepper 4400* (K); Matheran (fl., fr. Apr.) *Meebold 2997* (G). Andhra Pradesh: Vicarabad, 85 km W. of Hyderabad (fr. Feb.) *Van der Maesen 3136* (WAG); Secunderabad (fl.) *Campbell 332* (E). Goa: Bardez, *Noronha 20* (LISC). Mysore: Belgaum (fl. Feb.) *Ritchie 447* (K); Shiradi (fl. Apr.) *Saldanha 13273* (K, MO); Mangalore (fl.) *Hohenacker anno 1849* (A, B, BM, BP, FI, G, HBG, K, L, M, MPU, P, S, UC, UPS, W, Z). Kerala: Taliparamba (fl. Apr.) *Anstead 20101* (A). Tamil Nadu: Madras (fl. July) *Gamble 16532* (HBG, K); ibid. (fl. Oct.) *Wight 1875* (A, G, K, L, LE, S); Hosur, Salem Distr. (fl. June) *Kanoth Yeshoda 146* (A, B); Pondichery (fl. Aug.) *Lacour anno 1864* (P); Coimbatore (fl.) *Miers 15428* (BM). Uttar Pradesh: Dehra Dun (fl. May) *Singh 337* (NY, S); ibid. (fl.) *Wallich 1673.1.a* (K-WALL); Shrinagar, Garwhal Dt. (fr.) *Wallich 1673.4* (K-WALL); Kumaon (= Almora & Pithoragarh Dts.) (fl.) *Wallich 1673.3* (K-WALL); Moradabad (fl. July) *Thomson 217* (K); Rampur (fr.) *Wallich 1673.1.b* (K-WALL). Bihar: Monghur (fl. Apr.) *Wallich 1673H* (K-WALL): Banka, Bhagalpur Dt. (fr. Nov.) *Wallich 1673H* (K-WALL); Rajmahal (fr. Aug.) *Wallich 1672.3* (K-WALL); Kuju, 38 km S. of Hazaribagh (fl., fr. May) *F. H. W. Kerr 2104B*



Map 5. *Holarrhena pubescens*, Eastern part of area.

(BM, L). Orissa: Angul Distr. (fr. Dec.) *Lace 2580* (E, WAG); between Salur and Koraput (fl. May) *Rao 18407* (L). West Bengal: Darjeeling (fl.) *Cowan s.n.* (E); between Siliguri and Kurseong (fl. Apr.) *Kanai & Murata, 29 Apr. 1960* (BM). Sikkim: Sukna (fr. Dec.) *Ribu & Rhomoo 3281* (L); Sin. loc. (fl., fr. May) *Hooker f., 12 May 1850* (A, BM, FI, G, K, L, M, P, W). Assam: Goalpara, *Wallich 1672L. a* (K-WALL); Tura, Garo Hills (fl. Mar.) *Koelz 25013* (L, UC). Mizoran: Lushai Hills, Koladyne R., *Parry 503* (K).

Nepal: Rapti Valley, near Ghorai (fr. Oct.) *Polunin et al. 5938* (BM, UPS); Churia Hills (fr. Aug.) *Williams & Stainton 8247;* Noakole (= Nawakot) (bud, fl.) *Wallich 1673.2* (BM, G, K-WALL); Rawa Khola (fl., fr.) *Dobremez 276* (BM, G); Dharan Bazar, Biratnagar (fl. Apr.) *Stainton 44* (BM, UPS).

Bangladesh: Sylhet (fl.) *Pierre 227* (L, P); ibid. (fl.) *Wallich 1672.2* (BR, K-WALL); Dacca (fl., fr, Apr.) *Clarke 6783* (BM); Chittagong (fl.) *Wallich 1672.1* (K-WALL, W) Cox's Bayas (fl., fr. Apr.) *Sinclair 2922* (E).

Burma: Haka (fl. Apr.) *Dickason 7590* (A, E, L); Kyaukpyu (fl. May) *Wallace 84* (BM, K); Mount Popa (fr. Nov.) *Dickason 6639* (A, E, K, L); Ava, on the R. Irrawaddy (fl. Apr.) *Wallich 1673.5* (K-WALL); Ava, Canoungaklay (fl.) *Buchanan-Hamilton s.n.* (BM, lectotype); Ava, Loungyee (fl.) *Buchanan-Hamilton s.n.* (BM, paratype); Pegu (fl. Apr.) *Meebold 2993* (G); Rangoon (fr.) *Lelland s.n.* (P. L, W); Martaban (fl.) *Wallich 1673.6* (K-WALL); Tavoy, Tenasserim (fr.) *Wallich 1673.7* (G, K-WALL); Mergui (fl. Mar.) *Meebold 14843* (BP, Z).

China: Yünnan: Che-li (fr. Aug.) *Wang 77682* (A); ibid. (fr. Sept.) *Wang 78076* (A). Sin. loc., West-Tibet (fl., fr.) *Falconer s.n.* (Fl. K, L, LE, M, P, S, W).

Thailand: Chiang Mai: Doi Suthep (fl. Apr.) *A. F. G. Kerr 1129* (BM, K, P). Chiang Rai: S. of Chiengkhan (fl., fr. Apr.) *Garrett 146* (BM, K, L). Lampang: Ban Den (fr. Nov.) *A. F. G. Kerr 4538* (BM, K, P). Phetchabun: Phetchabun (fl., fr. Mar.) *A. F. G. Kerr 20344* (BM, E, K, L, P). Nakhon Phanom: Dawn Tan (fl., fr. May) *A. F. G. Kerr 21523* (BM, E, K, L, P, paratype of *H. antidysenterica* var. *macrantha);* Takli (fr. Nov.) *Put 2094* (BM, E, K, L, P). Kanchanaburi: Kanburi (= Kanchanaburi) (fl.) *Marcan 951* (BM, K, lectotype of *H. antidysenterica* var. *macrantha).* Phet Buri: Cha Am (fl. June) *Lakshnakara 400* (K, L, P); Chumphon (fl. Mar.) *Put 1474 (K, L, P).*

Laos: Attopeu (fl. Mar.) *Harmand 1316* (B, HBG, P); Lao Bao (fl. Nov.) *Poilane 1326* (P); Cam Mon (= Ban Khammouan) (fr.) *Spire 34* (K, type of *H. perotii);* ibid. (fr.) *Spire 36* (LE, type of *H. pierrei);* Borikhane (fl., fr. Mar.) *A. F. G. Kerr 20753* (BM, K, P); Sin. loc., borders of Mê-Khong (fr.) *Harmand 23* (FHO, HBG, K, P).

Cambodia: Kamchay, Kampot (fl. May) *Pierre 4424* (NY, P); Mt. Chereer, Samrong-tong (fl. May) *Pierre 4422* (NY, P, UC); Kratié (fl. Mar.) *Chevalier 31850* (P).

Vietnam: Baria (fr. Nov.) *Pierre 1892B* (HBG, K, NY, P); Dalat (fl., bark sample) *Squires 778* (A, BM, BR, G, K, M, MO, P, S); Ca Na (fl. Mar.) *Poilane 5713* (FHO, K, P); Cho-Ganh, Ninh Binh (fl. Sept.) *Petelot 1444* (P, UC); Thu Duc (fl., fr. Nov.) *Pierre 1829* (L, MO, NY, P); Tam Dao (fl. Apr.) *Petelot 4916* (P); Lang-than (fl., fr.) *Thorel 1041* (B, FHO, HBG, K, NY, P, UC).

Cult.: India: Bot. Garden Calcutta (fl.) *Pierre 3585* (NY); ibid. (fl.) *Pierre 3989* (NY); ibid. (fl.) *Pierre 4424 anno 1863* (P); ibid. (fl., fr.) *Wallich 1672.4* (BM, K, L, LE, M); Bot. Garden Pondichery (fl., fr.) *Perrottet 323* (B, G, L, NY, P, W, neotype of *H. macrocarpa).* Indonesia: Bot. garden Bogor (fl. Mar.) *Hallier C65a* (G); ibid. (fl. Feb.) *Hallier C65b* (L). Malaysia: Malay Peninsula: Sin. loc. (fl.) *Wight anno 1848* (K, type of *H. malaccensis).* Mauritius: Royal Bot. Gardens Pamplemousses (fl. Jan.) *Gueho 10543* (MAU); ibid. (fl. Jan.) *Vanghan 11701* (MAU); ibid. (fr. May) *Vanghan 10758* (MAU). U.S.A.: Plant Introduction Station, Miami, Florida (fl. June) *Gillis 10936;* (S); ibid. (fl. July) *Gillis 11405* (BM, S).

Notes. Buchanan-Hamilton cites in his protologue of this species a manuscript he wrote in 1795, which the present author has consulted in the British Museum. In this manuscript he cites three specimens with their localities, two of which are both mounted on a single sheet preserved in the British Museum. With the manuscript a drawing is preserved as well which doubtlessly is based on material of *H. pubescens.* Of the two specimens the present author designates

here the one collected at Canoungaklay as lectotype. BUCHANAN-HAMILTON also observed that LINNEAUS erroneously based his *Nerium antidysentericum* on a mixture and that ROXBURGH followed LINNAEUS in this respect. STEWARD & BRANDIS did not cite any specimen with their *H. antidysenterica* var. *glabra* which is based on a plant with glabrous leaves. As they did not annotate any specimen the type remains unknown. The present author has not come across any specimens of *H. pubescens* that are entirely glabrous from Asiatic origin, and therefore he hesitates to provide the variety with a neotype.

'H. CONGOLENSIS'

H. congolensis Stapf 1898: 306; De Wildeman & Durand 1899: 37–38; Durand & Schinz 1909: 345 (except for *Gillet 155*).

Type: Zaïre: Lower Congo, between Boma-Lundi and Tchoa (= Tshoa), *Cabra 3* (K, holotype; isotype: BR).

All plants referred to '*H. congolensis*' are found in the neighbourhood of the mouth of the Congo River (Cabinda, Boma, Kinshasa), considerably outside the area of *H. pubescens*. Some of them belong to either *H. floribunda* (e.g. *Gillet 155*) or *H. pubescens* (e.g. *Cabra 3*, the type of *H. congolensis*) while some other specimens appear to be rather intermediate between *H. floribunda* and *H. pubescens*:

ZAÏRE: Bas-Zaïre: Kiobo, Luki Reserve (fl. Dec.) *Wagemans 1856* (BR, K). Kinshasa: Kimuenza (fl.) *Gillet anno 1900* (BR); Kimpako (fl. Feb.) *Vanderijst anno 1909* (BR); ibid. (fl. Nov.) *Vanderijst 13628* (BR).

ANGOLA: Cabinda: Sumba, Peco (fl.) *Gossweiler 8689* (K); ibid. (fl. Nov.) *Gossweiler 8975* (K, LISJC).

The present author supposes that plants of *H. pubescens* have been cultivated by the Portuguese (See FICALHO 1884) at the mouth of the Congo River, and may have escaped and hybridized with *H. floribunda*. Evidence for this point of view can be gleaned from the facts that *H. pubescens* was known to the Portuguese of Moçambique under the name of 'Quina' as a tonic and a febrifuge implicating a reasonable grade of application implying the necessity of its culture. In India the Portuguese referred to *H. pubescens* as 'Herbas contra camaras' or 'Herba malabarica'. The bark and seeds of *H. pubescens* were articles of commerce in India as well as in Europe because of their antidysenteric value. In this particular region, i.e. the mouth of the Congo River, specimens of *H. pubescens* are found outside the area of the species, while outside this region but within the area of *H. floribunda* intermediates or specimens of *H. pubescens* have never been reported.

NOMINA NUDA

H. angustata Pierre ex Schmit 1950: 12. = *H. curtisii* King & Gamble.

H. crassifolia Pierre ex Planchon 1894: 196. = *H. curtisii* King & Gamble.

H. crassifolia var. *montana* Pierre ex Spire 1906: 144. = *H. curtisii* King & Gamble.

H. perotii Spire 1906: 142; Chevalier 1948: 115–120. = *H. pubescens* (Buch.-Ham.) Wall ex G. Don. Specimen cited: *Spire 34* (K).

H. pierrei Spire 1906: 142; Chevalier 1948: 115–120. = *H. pubescens* (Buch.-Ham.) Wall. ex G. Don. Specimen cited: *Spire 36* (LE).

H. villosa Ait. ex Loudon 1830: 641. = *H. pubescens* (Buch.-Ham.) Wall. ex G. Don.

EXCLUDED SPECIES

H. affinis Hook. & Arn. 1841: 198. = *Anodendron affine* (Hook. & Arn.) Druce *(Apocynaceae)*.

H. daronensis Elmer 1912: 1455 (erroneously published as *Halorrhena daronensis*). = *Kibatalia daronensis* (Elmer) Woodson *(Apocynaceae)*.

H. landolphioides A. DC. 1844: 414. = *Alafia scandens* (Thonn.) De Wild. *(Apocynaceae)*.

H. (?) madagascariensis Baker 1885: 424. = *Mascarenhasia arborescens* DC. *(Apocynaceae)*.

H. microterantha Schum. 1903: 183; De Wildeman 1903c: 515. (No type designated. The plant described is a liana with coagulating latex, so can 't belong to *Holarrhena*).

H. pauciflora Ridley 1911: 132. = *Spirolobium cambodianum* Baill. *(Apocynaceae)*.

H. procumbens (Blanco) Merrill 1905: 59. = *Aganosma acuminata* (Roxb.) G. Don *(Apocynaceae)*.

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PHYTOCHEMISTRY OF HOLARRHENA R. BR.

N. G. BISSET

The bark and seeds of *H. pubescens* have long been used in India for the treatment of amoebic dysentery. They owe their amoebicidal properties to the presence mainly of conessine. This compound is the most important representative of a series of steroidal alkaloids which belong to the conanine type and which also occur in other species of the genus, both Asian and African. In the leaves, on the other hand, the steroidal alkaloids present are mostly 5α-pregnane and/or pregn-5-ene derivatives with amino groups at the 3- and/or 20- positions; some of the alkaloids are identical with those found in *Funtumia* species. The fact that in many of these substances there is an oxygen or nitrogen function at position 18 has led to a detailed study of their chemistry aimed at their utilization as starting materials for the production of pharmaceutical steroids such as the corticosteroid aldosterone and related compounds. Also present in the leaves of certain species – *H. pubescens*, *H. mitis*, *H. curtisii* – are various aminoglycosteroids; these substances contain an amino-sugar and in some of them, e.g. holarosine and holacurtine, the steroidal part of the molecule is a cardenolide, such as is more usually present in the cardiac glycosides of genera like *Acokanthera (Plumerioideae)*, *Nerium* and *Strophanthus (Apocynoideae)*, and *Thevetia (Cerberoideae)*, and in others, e.g. the holantosines, the oxygenated side-chain is rather different.

Progesterone and pregnenolone have been isolated from the leaves of *H. floribunda*, and these compounds are known to be involved in the biosynthesis of the steroidal alkaloids and also of the cardenolides.

The occurrence of these various steroidal derivatives in *Holarrhena* is of considerable chemotaxonomic interest, for genera of the *Plumerioideae* are known especially for their indole alkaloids while genera of the *Apocynoideae* frequently contain steroidal (cardiac) glycosides and steroidal alkaloids. *Holarrhena*, currently placed in the *Plumerioideae* but having chemical constituents usually associated with the *Apocynoideae*, appears to be in a somewhat anomalous position. PICHON has pointed to the fairly close relationship between certain members of his *Nerieae* and of his *Holarrheninae*, and he has made the suggestion that the *Holarrheninae* could be considered as having given rise to the *Apocynoideae (Echitoideae)*. The distribution of the steroidal compounds discussed above may also be considered to reflect this relationship.

The non-alkaloidal constituents of the genus have been investigated in very much less detail.

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REGISTER

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