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A REVISION OF FARQUHARIA STAPF AND FUNTUMIA STAPF (APOCYNACEAE)

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INTRODUCTION

The present publication is a monograph of the genera *Farquharia* and *Funtumia*. It is based on the study of herbarium material and living plants as the author had the opportunity to study flowering and fruiting plants in the field of all species involved.

HISTORY

Farquharia was described by STAPF in 1912 with a single species *F. elliptica*. Independantly CHEVALIER proposed the nomina nuda *Alafia jasminiflora* (1920) and *Alafia mirabilis* for the same taxon. HUTCHINSON and DALZIEL (1931) erroneously referred *Alafia jasminiflora* to the genus *Holalafia* as they did not notice the clearly apocarpous ovary in the specimen collected by CHEVALIER. PICHON (1949) created the new genus *Aladenia* for *Holalafia jasminiflora*, unaware of STAPF's name *Farquharia elliptica*. BRENAN (1952) demonstrated that *Farquharia elliptica* had priority over all the other names mentioned above.

STAPF (1899) proposed the genus *Funtumia* for 3 African species, formerly accommodated in the genus *Kickxia* Blume, i.e. *K. africana* Benth. (1879), *K. elastica* Preuss (1899) and *K. latifolia* Stapf (1898), segregating them from the Asian *Kickxias*. The present author accepts only the species *Funtumia africana* (Benth.) Stapf and *Funtumia elastica* (Preuss) Stapf.

ETYMOLOGY

Farquharia is dedicated to J. H. J. FARQUHAR, who collected the type in Nigeria.

The name *Funtumia* is derived from 'funtum', one of the Ashanti names of *Funtumia elastica*.

GEOGRAPHIC DISTRIBUTION

Farquharia occurs in tropical Africa from Ivory Coast to Zaïre. The area of distribution of *Funtumia* which overlaps that of *Farquharia* is much larger. It extends from Senegal to Tanzania and Zimbabwe.

RELATIONSHIP TO OTHER GENERA

According to PICHON (1950) *Farquharia* and *Funtumia* belong to the tribe *Nerieae*. PICHON subdivided the *Nerieae* in 9 subtribes in the following sequence: *Adeniinae*, *Neriinae*, *Beaumontiinae*, *Strophanthinae*, *Mascarenhasiinae*, *Ala-*

fiinae, *Kibataliinae*, *Wrightiinae* and *Malouetiinae*. Although the present author agrees with PICHON's circumscription of the subtribes, he prefers to arrange them differently:

1. *Adeniinae* with the only genus *Adenium*.
2. *Neriinae* with 5 genera as with PICHON.
3. *Beaumontiinae* with *Beaumontia* and *Vallaris*.
4. *Wrightiinae* with *Wrightia* and *Pleioceras*.
5. *Strophanthinae* with *Strophanthus*.
6. *Alafiinae* with *Farquharia* and *Alafia*.
7. *Kibataliinae* with *Kibatalia* and *Funtumia*.
8. *Mascarenhasiinae* with *Mascarenhasia*.
9. *Malouetiinae* with *Malouetia* and *Malouetiella*.

Moreover the sequence of the genera within the subtribes *Beaumontiinae*, *Alafiinae* and *Kibataliinae* should be altered as well:

The floral characters in the *Wrightiinae* resemble those of the *Beaumontiinae* and *Strophanthinae* much more than those of the *Kibataliinae* and *Malouetiinae*.

The similarity in flowers justify a position of the genus *Alafia* much closer to *Kibatalia*, while *Farquharia* is more like *Strophanthus*: colleters on the petiole as in *Farquharia* occasionally occur in *Strophanthus*, while the hairs on connectives and filaments adhere to the style in both genera and a deciduous basal coma is present in *Farquharia* as well as in *Strophanthus*. Consequently *Alafia* changes its position with *Farquharia* within the *Alafiinae* while *Kibatalia* changes with *Funtumia* within the *Kibataliinae*.

In their vegetative characters *Farquharia* and *Alafia* are much alike, both genera are lianas. However, *Farquharia* bears colleters on the petiole which are absent in *Alafia*, while *Alafia* has intrapetiolar stipules which *Farquharia* lacks. The generative characters of both genera resemble each other as well: the almost similar stamens are subsessile and the connectives are coherent with the clavuncula or style, the ovary of *Farquharia* is apocarpous as well as the ovaries of most of the species of *Alafia* and both genera lack a disk. The presence of a short apical beak on the seed is used by PICHON (1954) to define the subtribe *Alafiinae*. However the present author discovered a basal coma which is absent in *Alafia*. PICHON mentions as supplementary difference the style, which is smooth in *Alafia* and blistered in *Farquharia*.

The genera *Kibatalia* and *Funtumia* originally formed the genus *Kickxia*, which more or less indicates their relationship. *Funtumia* was segregated from the Asian genus *Kickxia* by STAPF in 1899. *Kickxia* Blume (1848) was changed in *Kibatalia* G. Don (1837) as it was homonymous with *Kickxia* L.. According to STAPF *Funtumia* and *Kibatalia* can easily be distinguished by the following characters:

- The inflorescences of *Kibatalia* are one- or few-flowered, while those of *Funtumia* are usually many-flowered and congested.
- The corolla of *Kibatalia* is funnel-shaped, not salver-shaped, and comparatively large. The tube of *Kibatalia* is constricted near the middle, while it is inflated at that level in *Funtumia*.

- The staminal cone of *Kibatalia* is usually exserted, while it is completely included in *Funtumia*.
- The placentas of *Kibatalia* are free and remain free from the adaxial wall of the carpel. Those of *Funtumia* are free, but fuse with the adaxial wall when the fruit develops.
- The follicles of *Kibatalia* are more or less parallel, but they spread and form an obtuse angle in *Funtumia*.

The present author is able to confirm the first three differences, but he is in doubt about the validity of the last two. However he discovered the following complementary differences:

- The inflorescenses of *Kibatalia* are more or less umbellate, while *Funtumia* has racemes.
- The pedicels of *Kibatalia* are much longer in comparison to the flowers than is the case in *Funtumia*.
- The style of *Kibatalia* is longer than that of *Funtumia* in comparison to the corolla-tube.

These characters confirm STAPF's proposal to segregate the genera. However *Funtumia* and *Kibatalia* show many resemblances:

- Both genera are trees with a similar habit.
- Domatia in the axils of the secondary veins are generally present.
- The inflorescences alternate in the axils of the subsequent opposite leaves.
- The very similar stamens are coherent with the clavuncula.
- The ovary is apocarpous and a well developed disk is present.
- The seeds have an apical beak which is covered with long straight hairs.
- The cotyledons are folded in the seed.

Funtumia is often confused with *Mascarenhasia*. The architecture, leaves and fruits of both genera resemble each other. Both have abundant latex, the similar anthers are coherent with the clavuncula and the fruit consists of two more or less clavate follicles. Even the corollas show remarkable resemblances.

On the basis of the above enumerated characters the author proposes to move the subtribe *Mascarenhasiinae* to the position indicated above. However, as in *Mascarenhasia* the seeds lack the for *Kibataliinae* characteristic beak, the present author prefers to maintain PICHON's *Mascarenhasiinae*.

The *Malouetiinae* resemble the *Kibataliinae* and *Mascarenhasiinae* in having leaves with domatia, and in the position and shape of the flowers, but their seeds lack the coma.

GENUS/SPECIES DIAGNOSIS OF FARQUHARIA

Farquharia elliptica Stapf 1912: 278, 279; Brenan 1952: 453; Pichon 1954: 131, 132; Huber 1963: 74.

Fig. 1; Phot. 1, 2; Map 1.

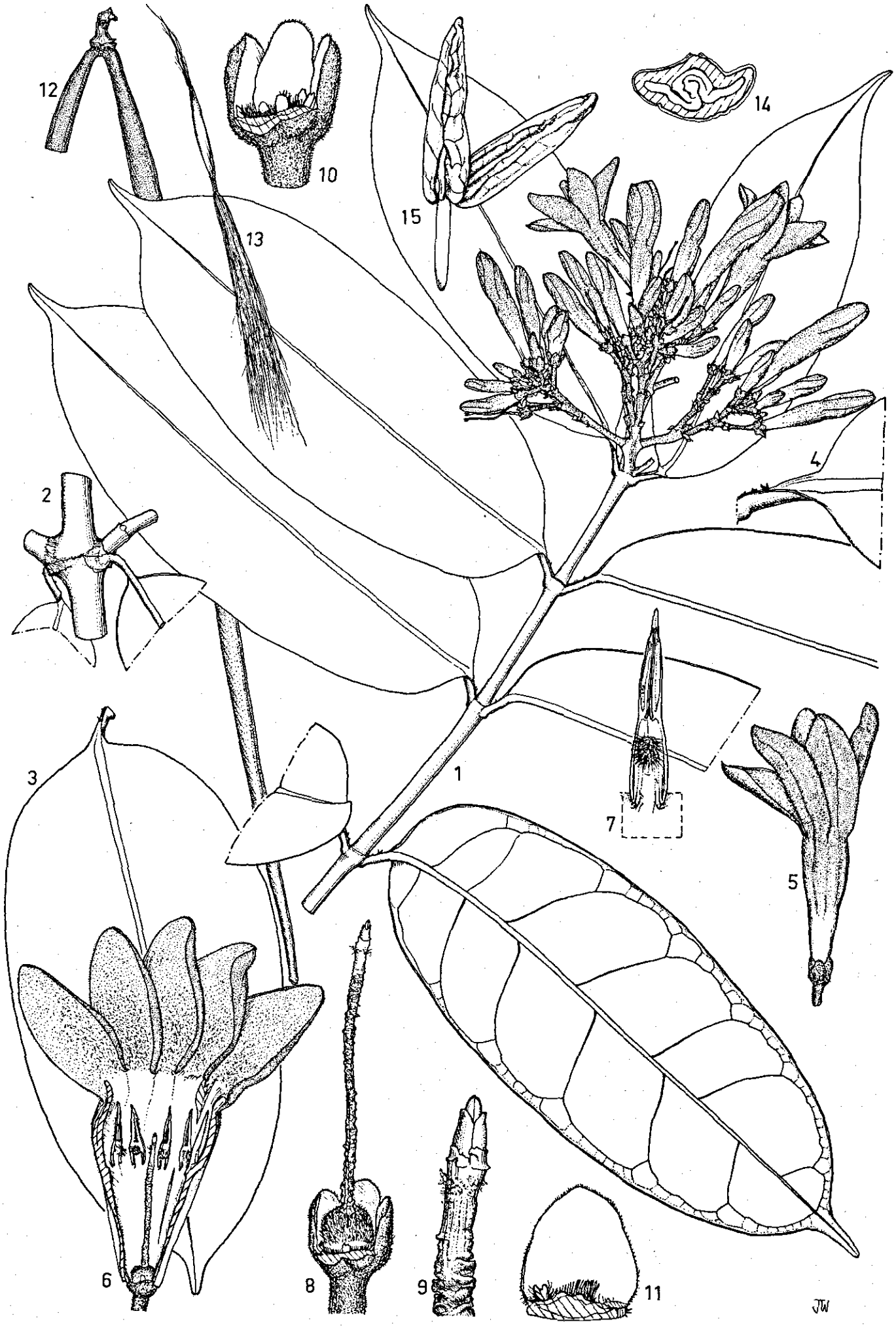
Type: Nigeria, Bendel State, Mogumu, *Farquhar 8* (K, holotype).

Heterotypic synonyms: *Holalafia jasminiflora* Hutchinson and Dalziel 1931:

43; Hutchinson and Dalziel 1937a: 338; Pichon 1949: 61. Type: Ivory Coast, Mbasso, *Chevalier 17606* (P, lectotype; isotypes: BR (photo), K, LISC (photo), NY (photo), WAG). Homotypic synonym: *Aladenia jasminiflora* (Hutch. et Dalz.) Pichon 1949: 61, 62; Brenan 1952: 453.

Liana at least 20 m long. Trunk at least 6.5 cm in diameter; bark pale brown to grey, shallowly longitudinally fissured, with large oval lenticels; wood pale brown to white; colourless or white, not sticky sap in bark and wood; branches terete, reddish-brown or green, lenticellate; branchlets terete, smooth, glossy, green. *Leaves* opposite, petiolate; stipular lines present; petiole canaliculate above, rounded beneath, 3–8 mm long, bearing 1 to 3 rows of pale brown colleters, glabrous; blade coriaceous, elliptic, ovate, narrowly elliptic or narrowly ovate, 1.7–4 × as long as wide, 4.5–15.5 × 1.5–6 cm, acuminate at the apex, cuneate at the base or decurrent into the petiole, entire and slightly revolute at the margin, glabrous, glossy and green above, paler and dull beneath; midrib somewhat impressed above, prominent beneath; secondary veins 3–10, inconspicuous. *Inflorescence* a dense terminal panicle with 10–100 flowers, 3–6 × 3–11 × 3–11 cm; major branches opposite, bracts triangular, 1.2 × 1.2 mm; branches, bracts and pedicels minutely puberulous with rusty-brown hairs or practically glabrous. *Flowers* 5-merous, actinomorphic, fleshy, practically scentless; mature buds nearly fusiform. *Sepals* free, ovate, 1.4–2.9 × 1.3–2.7 mm, obtuse at the apex, pubescent outside, glabrous inside and with a single row of colleters and hairs at the base; colleters 5–11 in each flower, 0.1–0.5 mm long. *Corolla* white, pale green outside at the base, pale yellow and turning brown in the throat, infundibuliform; tube 10–21 × 3.8–5.6 mm, widened at 53–88% from the base of the tube, slightly constricted at the throat, puberulous to glabrous outside, inside glabrous or sometimes pubescent just below the insertion of the stamens; lobes overlapping to the right, 0.5–1 × as long as the tube, 8.8–15.4 × 2.3–7.8 mm, elliptic or oblong, puberulous or glabrous on both sides, sometimes pubescent at the inside near the base. *Stamens* pale white, included, 5.2–7.6 × 0.8–1.4 mm, inserted at 40–70% of the base of the tube; filament very short, up to 0.5 mm long, ventrally pubescent or glabrous, dorsally glabrous; anthers narrowly triangular to oblong with sterile basal appendages adnate to the connective and a very short sterile apical tip, 2-celled, introrse with

FIG. 1. *Farquharia elliptica* Stapf: 1. flowering branch, 2/3 × ; 2. branching: the axis on the left side becomes dominant and continues the growth in length, while the main axis ends in an inflorescence, 2/3 × ; 3. leaf, 2/3 × ; 4. petiole with 3 rows of colleters, 2 × ; 5. flower, 1 × ; 6. opened flower showing stamens and pistil; the connectives are detached from the style, 1⅓ × ; 7. stamen, 4 × ; 8. pistil; corolla and 2 sepals removed; 3 × ; 9. clavuncula and stigma; the hairs on the upper part of the style are remnants of the hairs of the connectives, 8 × ; 10. detail of the whorl of colleters and hairs between the calyx and corolla, 4 × ; 11. sepal with colleters and hairs at the base, 6 × ; 12. fruit, 1/3 × ; 13. seed, nearly ripe, 2/3 × ; 14.transverse section of the seed, 4 × ; 15. embryo, 2 × . – (1–4. *Zwetsloot 23*; 5–11. *Zwetsloot 23*, spirit material; 12–13. *Versteegh & Den Outer 600; 14–15. Thollon 141*).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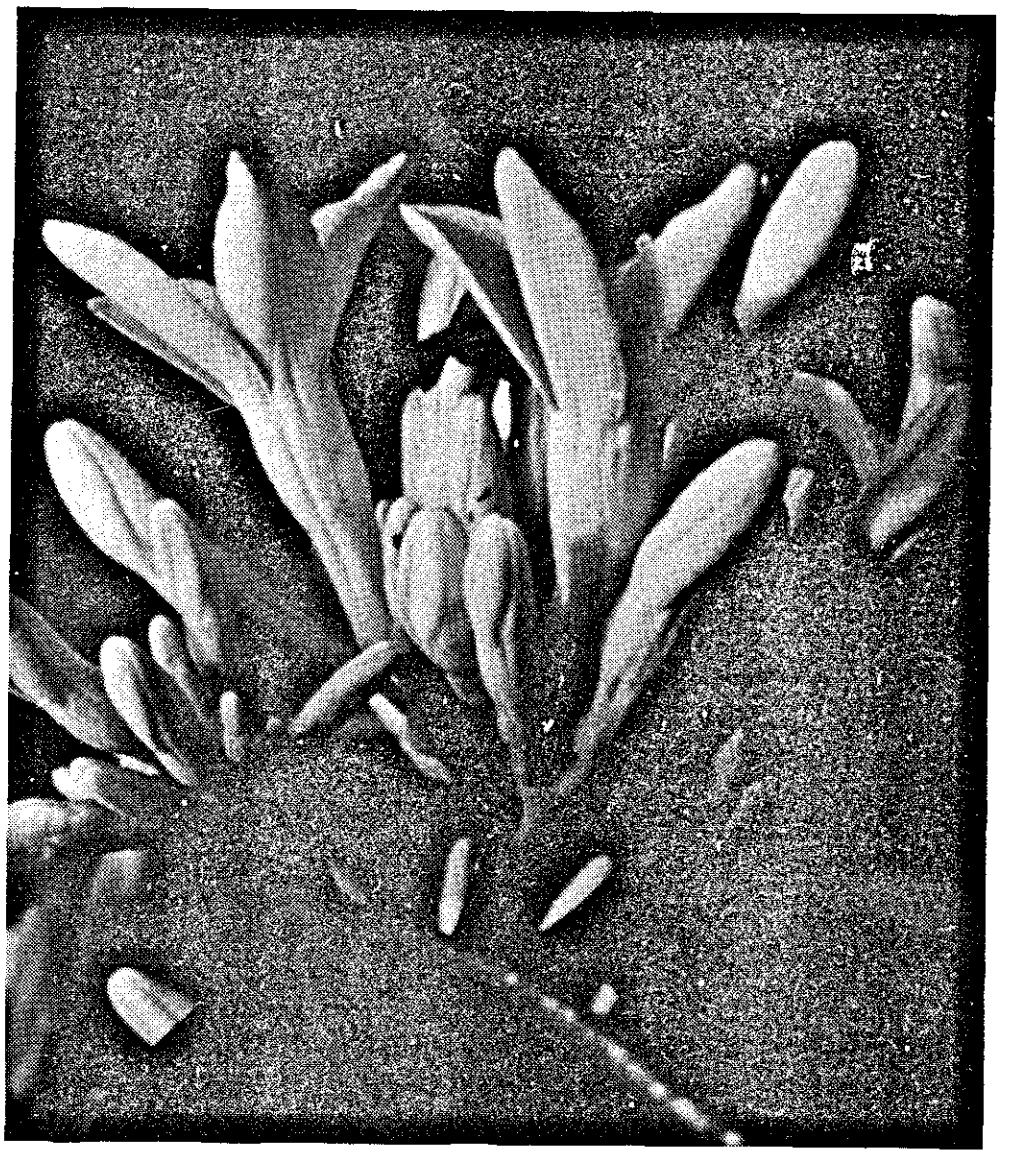
a 1.7–3.3 mm long fertile portion; connective 5–7.5 mm long, ventrally pubescent with hairs coherent with the style just below the clavuncula, dorsally appressed-pubescent. *Pistil* 10–16 mm long; ovary globose, superior or sometimes nearly hemi-inferior, 0.8–2.2 × 0.8–2.1 × 0.8–2.1 mm, composed of two almost free carpels at the apices united by the base of the style, villose with rusty-brown hairs, sometimes glabrous at the base; carpels sometimes retuse at the apex; style 8–13 × 0.2–0.4 mm, not split at the base, blistered, coherent with the hairs of the connective; clavuncula cylindrical, sometimes with two longitudinal grooves, 0.5–0.9 × 0.2–0.5 × 0.2–0.5 mm; stigma conical, bipartite, 0.1–0.4 × 0.05–0.3 × 0.05 × 0.3 mm. Placenta adaxial, 2-lobed. Ovules 80–170, pendulous. *Fruit* composed of two follicles which are connate at the base; follicles almost cylindrical, straight or somewhat recurved, 22–42 cm long and 2–3.7 cm in circumference, acuminate at the apex, adaxially dehiscent; wall woody, outside puberulous with rusty-brown hairs, smooth and glabrous inside. *Seed* fusiform, 1.5–2.5 × 0.2–0.4 cm, with an apical and deciduous basal coma, with a longitudinal ridge from the base to the apex, on which the hilum is situated; the apical coma consists of a short beak with 3–3.5 cm long straight or slightly curved hairs; basal coma much shorter with about 2 cm long hairs; micropyle apical; endosperm surrounding the embryo, which is straight and somewhat shorter than the seed itself; cotyledons oblong, rounded at the base and obtuse at the apex, folded in the seed.

Note: The author doubts the presence of white sticky latex, which is reported by some collectors. LEEUWENBERG and the author himself merely observed a colourless and not sticky juice in bark and wood.

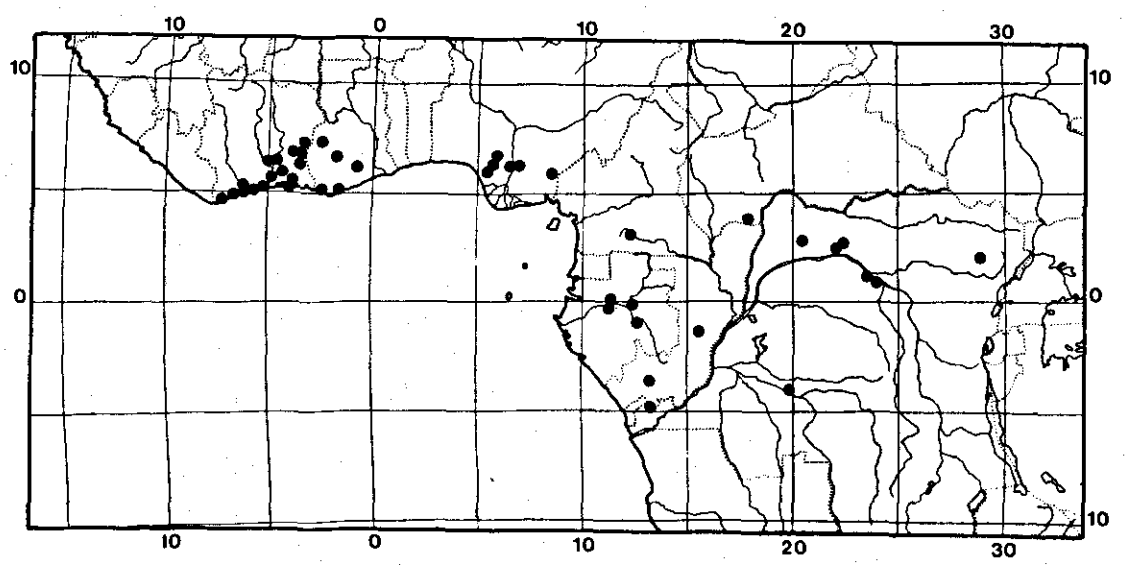
PHOT. 2. *Farquharia elliptica* Stapf, inflorescence. – (*Zwetsloot 23*).



PHOT. 1. *Farquharia elliptica* Stapf, inflorescence. – (*Zwetsloot 23*). All photographs by H. J. C. ZWETSLOOT.

Distribution: Tropical Africa, from Ivory Coast to Zaïre.

Ecology: Moist forests, often on sandy soil. Alt. 0–850 m. In Congo it occurs in periodically flooded riverine forests.



MAP 1. *Farquharia elliptica* Stapf

Vernacular names:

NIGERIA: *onanisankianmen* (Benin) (teste: *Farquhar 8*).

CAMEROUN; *nkon* (Bulu) (teste: *Bates 1454*); *holo holo* (Mbala) (teste: *Periquet 158*).

CENTRAL AFRICAN REPUBLIC: *molo-mokangakanga* (Lisongo) (teste: *Tisserant 2374*).

CONGO: *balalé* (env. of Komono and Sibili) (teste: *Chevalier s.n.*).

ZAÏRE: Prov. Equateur: *buku-luku* (env. of Bohutu) (teste: *Robyns 1040*); *moheuge* (env. of Yambata) (teste: *De Giorgi 1760*): *moubala* (env. of Yambata) (teste: *Montchal 1*); *imekok* (env. of Yambata) (teste: *Bany 37*); *mokoko* (Budja), *mundele* (Libati) (teste: *De Giorgi 1651*); *bomo* (env. of Dundusana) (teste: *Reygaert 253*). Prov. Kivu: *nondo* (Kitembo) (teste: *Troupin 12577*).

Uses:

In Cameroun the leaves are eaten as a vegetable (teste: *Periquet 158*) while the juice is of medicinal use (teste: *Bates 1454*). In Zaïre the macerated leaves are used against hart-deseases (teste: *Reygaert 253*), and the fibres of the bark provide material for fishing nets (teste: *De Giorgi 1054*).

Specimens examined:

IVORY COAST: Béréby (fl. Nov.) *Oldeman 633* (BR, K, WAG); ibid. (fl. May) *Pobéguin 46* (P); Koboa Miagni, km 31 Monogaga-San Pédro Road (fl. Mar.) *Leeuwenberg 12068* (WAG); Monogaga (fl.) *Geerling and Bokdam 2411* (BR, MO, WAG); km 20 Monogaga-Sassandra Road (fl. Apr.) *Zwetsloot 23* (UCI, WAG); km 15 Sassandra-San Pédro Road (fl. Nov.) *Breteler 6056* (WAG); Sassandra (fl. Nov.) *Guillaumet 1623* (UCI); ibid. (fr. Apr.) *De Koning 1286* (WAG); km 37 Sassandra-Lakota Road, *Zwetsloot 38* (UCI, WAG); 50 km NEE of Sassandra (fl., fr. Nov.) *Breteler 6123* (WAG); Morénou near Akabilékrou (fl. Dec.) *Chevalier 22507* (K, P); Forêt de Krokun (fl. Dec.) *Miège and Aké Assi 1211* (UCI); km 95 new Road Abidjan-Ndouci (fl. Oct.) *De Kruif 372* (WAG); Bouroukrou (fl. Jan.) *Chevalier 16644* (P); ibid. (fr. Jan.) *Chevalier 16742* (P); Mbasso, Bas-Comoé (fl., fr. Mar.) *Chevalier 17606* (BR, K, LISC (photo), NY (photo), P, WAG, lectotype of *Holalafia jasminiflora* L; For. d'Abouabou (fl. Nov.) *Aké Assi 4424* (ABI); ibid. (fl. Dec.) *Aké Assi 4515* (UCI); ibid., *Aké Assi 4722* (UCI); ibid., (fl. Jan.) *Leeuwenberg 2359* (BR, K, WAG); 40 km NE of Abidjan (fl. Feb.) *Leeuwenberg 2718* (WAG); Bingerville, *Chevalier 16583bis* (P); Abengourou (fl. Dec.), *Aké Assi 9386* (UCI); ibid. (fl. May), *Bégué 3108* (P); ibid (fl. Apr.) *Miège and Aké Assi 475, 805* (UCI); 20 km NW of Abengourou (fr. July) *Versteegh and Den Outer 600* (U, WAG); Assikasso, *Chevalier 22582* (P); Kossom (?); *Spichiger s.n.* (G).

GHANA: Asukese For. Res. (fl. Mar.) *Enti GC 39282* (K); Ndumfri (fl. Apr.) *Lock 46708* (MO); Daboase to Subri For. Res. (fl. Jan.) *Hall and Abbiw GC 45121* (MO); Kumasi (fl. May) *Vigne 2011* (K, P); Kade (fl. Jan.) *Enti GC 42028* (K, MO, P).

NIGERIA: Bendel State: Owan For. Res. (fl., fr. Feb.) *Brenan et al. FHI 8987* (K); Sapoba, *Kennedy 3104* (FHI); Ute (fl. Apr.) *A. P. D. Jones 3112* (FHI); Mogumu (fl. Mar.) *Farquhar 8* (K, type); Anambra State: Onitsha (fl., fr. May) *A. P. D. Jones 1667* (FHI); ibid., *Baldwin 13748* (MO); Ululubu (fl. Jan.) *Thomas 2245* (K); sin. loc. (fl. June) *No. B.R. 10* (K). Cross River State: Okuni (fr. July) *Latilo FHI 31860* (K). Sin. loc.: *Chesters OBS 156* (K); *Kitson s.n.* (BM).

CAMEROUN: Bitye (fl. Oct.) *Bates 1454* (BM); sin. loc., *Périquet 158* (P).

GABON: 10 km NE of Lalara (fl. Sep.) *Breteler and De Wilde 410/1978* (WAG); Bangania, *Thollon 141* (P); 10 km S of Makokou, *Florence 44* (WAG); Lastoursville, *Le Testu 7078* (BM, P, WAG), (fl. Apr.) *7201* (BM, P, WAG), (fl. June), *7415* (BM, BR, P).

CENTRAL AFRICAN REPUBLIC: Boukoko (fl. Feb.) *Tisserant 2374* (P).

CONGO: Ile M'Bamou (fl. Nov.) *F. Hallé 1683* (P); ibid., *Sita 2012* (P), (fl. July) *2179* (P); Komono-Sibili Road (fl. Apr.) *Chevalier s.n.* (P); Région Moutampa (fl. Oct.) *Sita 1886* (P).

ZAÏRE: Prov. Bas-Zaïre: Tshela (fl., fr. Aug.) *Breyne 2724* (BR); Lubue, *Luja 281* (BR). Prov. Equateur: Bohutu (fl. Nov.) *Robyns 1040* (BR, K); Likimi (fl. July) *Gilbert 1633* (BR, MO, K); ibid. (fl. Nov.) *De Giorgi 1512* (BR); Dundusana (fl. July) *De Giorgi 1054* (BR); ibid., *Mortehan 218* (BR); ibid., *Reygaert 253* (BR); ibid. (fr. Apr.) *Vermoesen 241* (BR); Yambata, *Bany 37* (BR); ibid. (fl. Jan.), *De Giorgi 1651* (BR), (fl. Mar.) *1760* (BR); ibid., *Montchal 1* (BR). Prov. Haut-Zaïre: Barumbu, *Claessens 629* (BR). Prov. Kivu: Irangi (fl. Apr.) *Troupin 7280* (BR), (fl. July) *12577* (BR). Sin. loc.: *Vanderyst 1923* (BR).

ARCHITECTURE OF FARQUHARIA

The author observed TROLL's model as described by HALLÉ and OLDEMAN (1970) in the specimen of which he took herbarium material.

NONIMA NUDA REFERRING TO FARQUHARIA

Alafia jasminiflora A. Chev. 1920: 423. = *Farquharia elliptica* Stapf. Specimen cited: *Chevalier 17606*.

Alafia mirabilis A. Chev. 1920: 423. = *Farquharia elliptica* Stapf. Specimen cited: *Chevalier 22507*.

PHYTOCHEMICAL SCREENING OF FARQUHARIA ELLIPTICA LEAVES

T. A. VAN BEEK

A leaf sample of *Farquharia elliptica* was investigated for the presence of alkaloids (1), saponins (1), flavonoids (1), anthraquinones (1), tannins (1), sterols/triterpenes (1), cyanogetic glycosides (1), cardiac glycosides (2), leucoanthocyanins (2) and coumarins (3) according to methods described by others (1, 2, 3).

The reactions for saponins, sterols/triterpenes and tannins were positive, all others were found negative.

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1. A. BOUQUET, Travaux et documents de L'O.R.S.T.O.M. no. **13** (1972).
2. M. DEBRAY, M. JACQUEMIN, R. RAZAFINDRAMBAO, Travaux et documents de L'O.R.S.T.O.M. no. **8** (1971).
3. N. R. FARNSWORTH, J. Pharm. Sci. **55**, 225 (1966).

GENUS DIAGNOSIS OF FUNTUMIA

Funtumia Stapf 1899: 2, 3; 1901: 2694; Jumelle 1903: 381–389; Aubréville 1936: 168, 170, pl. 306; 1959: 199, 200; Duchesne 1938: 231; Pichon 1950: 51, 69.
Type species: *F. elastica* (Preuss) Stapf.

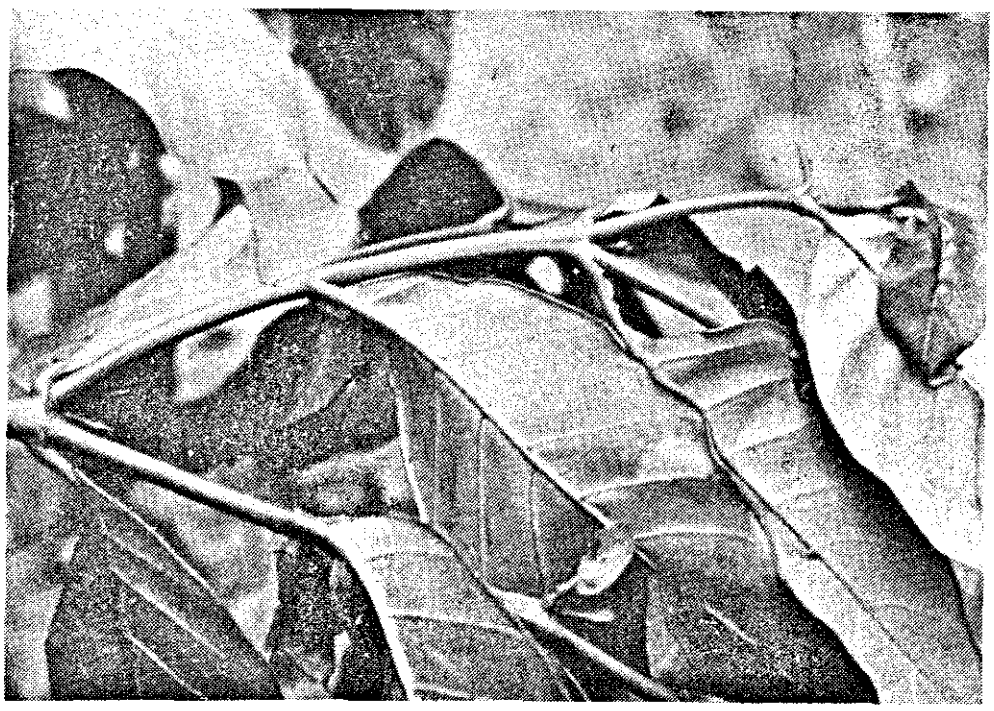
Evergreen trees or shrubs, trunk mostly straight, cylindrical; bark smooth, sometimes with a few orbicular lenticels, greenish-brown to grey; white sticky latex in bark and pith; wood light, soft; branches terete, smooth, sometimes lenticellate, sulcate when dry, very dark brown; branchlets smooth, terete or laterally compressed with a longitudinal groove below the ocrea. *Leaves* opposite, petiolate, those of a pair connate into a short ocrea, with many small colleters in two or three rows in the axils; petiole canaliculate above; blade ovate, elliptic or oblong, decurrent into the petiole, acuminate at the apex, entire, glabrous and bright green above, paler green beneath; often domatia in the axils of the secondary veins; secondary veins slightly impressed above, prominent beneath; tertiary veins inconspicuous; margin undulate and revolute. *Inflorescences* congested, terminal and axillary, cymose, much shorter than the leaves; peduncle terete, short; bracts ovate or elliptic, often with small colleters in the axils. *Flowers* 5-merous, actinomorphic, fleshy, fragrant. *Sepals* free, thick, ovate or nearly so, obtuse or subacute at the apex, often membranaceous and minutely ciliate at the margin, inside with a single row of colleters at the base. *Corolla*: tube ventricose at the middle, inside thickened at the throat, densely hirto-pubescent from the insertion of the stamens to the level of the apex of the ovary, with an indumentum which gradually becomes thinner and shorter; lobes in the bud overlapping to the right, often auriculate at the left, entire, recurved. *Stamens* included; filaments very short or absent, thick, ventrally densely hirto-pubescent, dorsally glabrous; anthers narrowly triangular with a very short tip at the acuminate apex, sagittate at the base, glabrous, 2-celled, introrse, dehiscent throughout by a longitudinal slit; connective dorsally appressed pubescent, ventrally at the base stiffly coherent with the clavuncula. *Pistil*: ovary composed of 2 almost free carpels which are at the apices united by the base of the style; placenta adaxial, 2-lobed; style not split at the base, with two longitudinal grooves, thickened below the clavuncula; clavuncula coherent with the connectives, grading into the stigma, together ovoid; stigma conical, surrounded by an exudate. *Disk* 5-lobed: lobes truncate or acute, minutely toothed at the apex. Ovules pendulous, 200–350 in each carpel. *Fruit* composed of two follicles which are connate at the base, green and glossy when young, turning grey-brown and woody when maturing, striate; follicles adaxially flattened and there dehiscent, abaxially convex, sometimes slightly curved; wall woody, thick, grey-brown outside, smooth and yellowish-brown inside. *Seed* slender, beaked at the apex, grain itself fusiform; beak at least above the middle with long straight hairs which envelop the seed in the fruit, with a narrow longitudinal ridge from the base to the beak, on which base the narrow hilum and apical micropyle are situated, testa rugose; endosperm white, surrounding the embryo; embryo

white, straight, about 0.9 × as long as the seed; cotyledons folded in the seed; radicle relatively short, about 0.2 × the length of the embryo. *Seedling* with ovate cotyledons which are cordate at the base and acute at the apex.

Distribution: 2 species in tropical Africa from Senegal to Tanzania and Zimbabwe.

ARCHITECTURE OF FUNTUMIA

Both species in *Funtumia* show the same architectural model. It can be characterized by an modular structure and an indistinct differentiation in an orthotropic stem and plagiotropic branches. Each module bears one pair of opposite leaves and may end its growth in an apical inflorescence (Fig. 2B: c). After the apical meristem of a module has ceased functioning, one or two new meristems develop in the axils of the leaf pair. If one module develops it will push aside the inflorescence, rendering the inflorescence apparently lateral (Fig. 2C; Phot. 4). If two modules develop, initially they seem to be equivalent, but one will become dominant and continue the stem, while the other will bear the aspect of a proper branch (Fig. 2B; Phot. 3). According to PRÉVOST (1967) both meristems originate in the axil of a single leaf of a pair, but the present author could not support this view when observing living plants. Branching is correlated with flowering or in sterile stages with abortion of the apex. The branches seem to alternate on the main stem (Phot. 5). They show an indistinct plagiotropic differentiation by substitution. The development of these branches follows a similar pattern as the main stem.



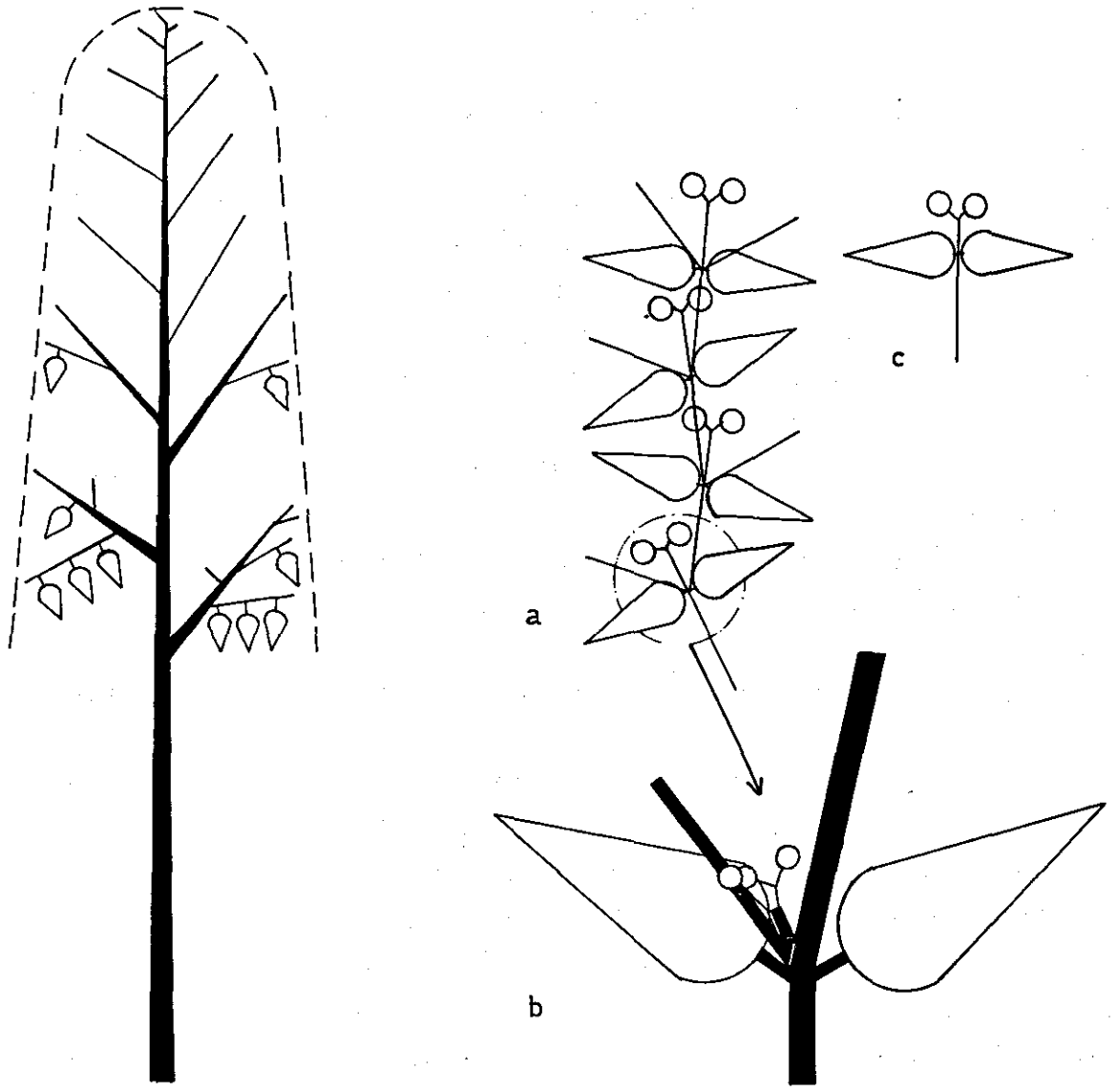
PHOT. 3. *Funtumia elastica* (Preuss) Stapf: Branching, two meristems develop in the axils of a leaf pair. Notice the undeveloped apical inflorescences. – (*Zwetsloot 31*).

PHOT. 4. *Funtumia africana* (Benth.) Stapf: One meristem develops in the axils of a leaf pair, the developing inflorescence is pushed aside. – (*Zwetsloot 29*).

The architectural model as described above agrees well with the model of KWAN KORIBA and disagrees with that of PRÉVOST as defined by HALLÉ and OLDEMAN (1970).

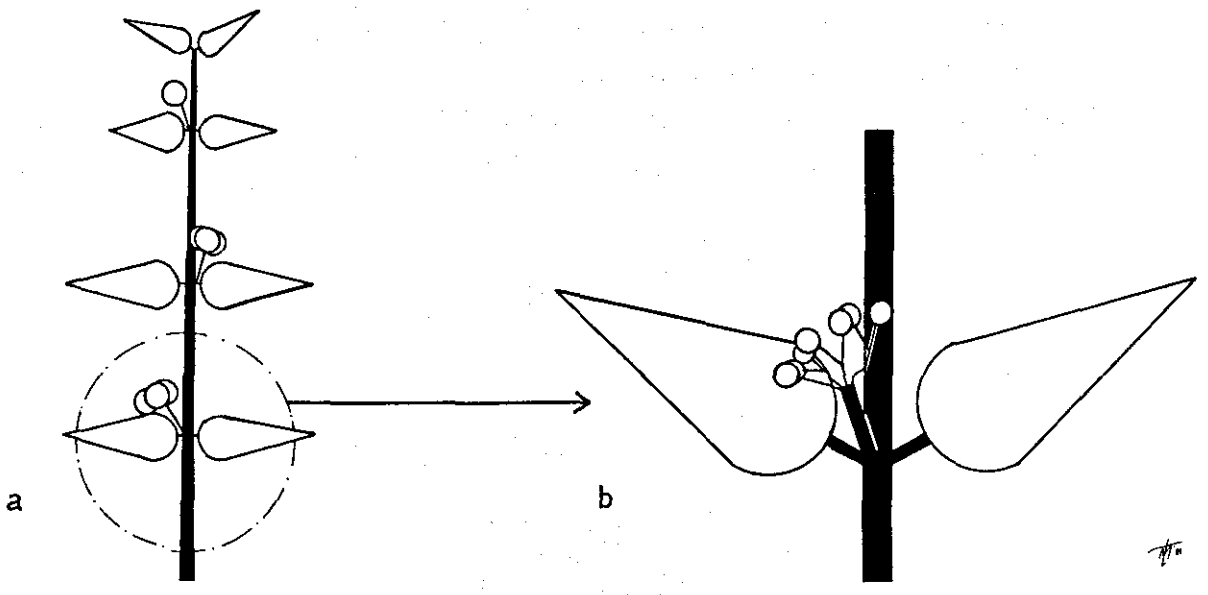
PHOT. 5. *Funtumia elastica* (Preuss) Stapf: Top of tree. Notice the alternating branches (*Zwetsloot 31*).

FIG. 2. Architecture of *Funtumia* Stapf



A. habit, schematic.

B. two meristems develop in the axils of a leaf pair: a, b. one becomes dominant and continues the stem; c. one single module with one pair of leaves and an apical inflorescence.



C. one meristem develops in the axils of a leaf pair and pushes the inflorescence aside.

DISCUSSION OF THE DELIMITATION OF THE SPECIES OF FUNTUMIA

The present author distinguishes two species within *Funtumia* Stapf: *F. africana* (Benth.) Stapf and *F. elastica* (Preuss) Stapf. *F. elastica* is not very variable and has never been subdivided. It has always been considered as clearly distinct from the other species, here reunited in *F. africana*. *F. africana* is much more variable and has been considered to represent several species. STAPF published in 1898 *Kickxia latifolia* as a new species, distinguishing it from *K. africana* by its wider leaves with a rounded base, by the corolla lobes which were much shorter than the tube and by its minutely puberulous, white corolla. Careful analysis of herbarium specimens and spirit material showed that such characters represent the extremes of a wide range of variation:

- within a single plant the leaf base may vary from rounded to cuneate;
- the length of the corolla lobes varies from much shorter to much longer than the tube;
- the corolla may be entirely puberulous or glabrous, or it may show a puberulous tube and glabrous lobes.

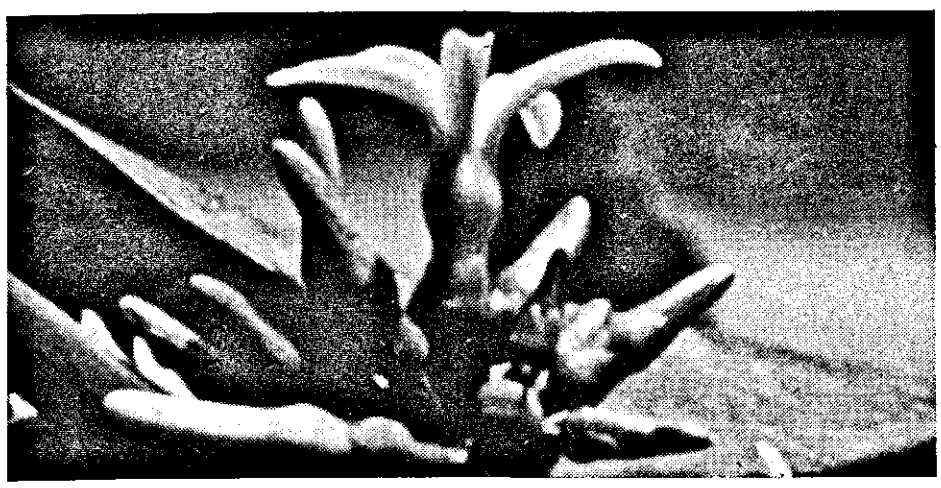
The above listed characters vary independantly from each other. Completely puberulous corollas with lobes shorter than the tube occur, as well as with lobes longer than the tube. The same is observed in glabrous corollas.

SCHUMANN distinguished in 1900 the species *Kickxia scheffleri* Schum. from Tanzania and *Kickxia zenkeri* Schum. from Cameroun. DE WILDEMAN described in December 1900 two new species in *Kickxia*: *K. gilletii* and *K. congolana*, both from Kisantu in Zaïre. The characters used to segregate these four species were the shape of the leaves, the shape and length of the disk and the size of the flowers. They also turned out to be not tenable. They show continuous transitions from the one extreme to the other. Already in 1901 STAPF reported the similarity of *Kickxia zenkeri* and *Funtumia africana*.

In the conception of the present author all these taxa belong to a single species, *Funtumia africana*, that was described by BENTHAM in 1879 as *Kickxia africana*. The resulting two species in *Funtumia* can clearly be distinguished by a single character: the indumentum of the ovary; it is always glabrous in *F. elastica* and always pubescent in *F. africana*. All other characters show an overlap to a certain degree. Nevertheless it is quite possible to recognize both species as separate units by studying their characteristics in combination. The most important differences between the two species are enumerated in Table 1.

TABLE 1: Most important differences between *F. africana* and *F. elastica*.

	F. africana	*F. elastica*
domatia	No pits. A tuft of straight hairs, which vary in number. The hairs may be arranged in such a way that they give the impression of indistinct cavities. Often absent.	Pits, sometimes with a more or less densely ciliate margin. In herbarium specimens the pits may be closed, due to drying. Rarely absent.
petiole and branchlets	minutely pubescent or glabrous.	always glabrous.
mature bud	usually cylindrical and obtuse at the apex.	apical portion conical, acute or subacute at the apex.
calyx	1.5–4 mm long, glabrous or puberulous.	3–5 mm long, glabrous.
corolla	pale green to creamy, glabrous or puberulous.	white, glabrous.
lobes	shorter or longer than the tube, obliquely ovate or narrowly oblong, sometimes auriculate.	shorter than the tube, triangular and distinctly auriculate.
ovary	pubescent.	glabrous.
style	glabrous or sometimes minutely puberulous.	glabrous.
fruit: follicle	almost fusiform, 8.5–32 cm long, 1.4–5.1 cm in circumference; tapering, apex acute or acuminate, sometimes subobtuse.	more or less clavate, 8–19 cm long, 3.6–8 cm in circumference; not tapering, apex obtuse, sometimes acute.
seed: testa	sometimes puberulous.	glabrous.
latex	coagulating not easily.	coagulating easily.



PHOT. 6. *Funtumia africana* (Benth.) Stapf, flowering branch. – (*Zwetsloot 6*).

KEY TO THE SPECIES OF FUNTUMIA

Domatia, if present, in the axils of the secondary veins, not consisting of pits, but only of a tuft of straight hairs; ovary pubescent; fruit almost fusiform, 8.5–32 cm long, 1.4–5.1 cm in circumference, tapering towards the acute or rarely subobtuse apex;

mature buds 8.5–22 mm long, obtuse or acute at the apex; sepals 1.5–4 mm long; corolla lobes sometimes auriculate, shorter or longer than the tube, 5–15 mm long and obtuse or acute at the apex; corolla outside glabrous or puberulous . . . . . **F. africana**

Domatia, if present, in the axils of the secondary veins consisting of pits which may have a more or less densely ciliate margin; ovary glabrous; fruit more or less clavate, 8–19 cm long, 3.6–8 cm in circumference, not tapering, with an obtuse or subacute apex;

mature buds 7–17 mm long, acute or subacute at the apex; sepals 3–5 mm long; corolla lobes auriculate, shorter than the tube, 3–7 mm long, acute at the apex; corolla outside glabrous . . . . . **F. elastica**

Note: for statistical keys for flowers and fruits is referred to page 34–37.

SPECIES DESCRIPTIONS OF FUNTUMIA

Funtumia africana (Benth.) Stapf 1899: 2, 3; 1901: 2696, 2697; 1904: 190; Schlechter 1900a: 236; Jumelle 1903: 381–392; De Wildeman 1905: 550–574; Luc 1908: 19, 20; Chevalier 1909: 40, 41, 46, 122, 123; 1910b: 6; 1920: 423; Irvine 1930: 200; 1961: 621; Proctor Cooper & Record 1931: 106; Aubréville 1936: 168; 1959: 199, 200; Kennedy 1936: 205, 206; Hutchinson & Dalziel 1937b: 371; Walker & Sillans 1961: 81, 82; Keay, Onochie & Stanfield 1964: 384; Huber 1963: 74; Kunkel 1965: 116, 117; Voorhoeve 1965: 63; Berhaut 1967: 123; 1971: 381, 382; Savill & Fox 1967: 48, 49; Ayensu 1978: 48.

Fig. 3; Phot. 4, 6, 7, 8; Map 2.

Basionym: *Kickxia africana* Benth. 1879: 1276; Planchon 1894: 80; Stapf 1894: 90; Anonymus 1895: 241–247; Lecomte 1897: 12–19, 41–47, pl. 1, 2; Schumann 1897: 217–221; Warburg 1897: 99–103; 1902: 200–207; Jumelle 1898: 68–73, 95, pl. 10; Preuss 1899a: 353–360; 1899b: 65–71; Schlechter 1900a: 63, 236–249; 1900b: 28–31, 109–120, 324–332; De Wildeman 1900a: 633, 634; 1900b: 743–748.

Types: Equatorial Guinea: Fernando Poo, Bagru R., *Mann 817* (K, lectotype; isotypes GH, P); Nigeria: Rivers State, Bonny, *Kalbreyer 82* (K, paratype).

Heterotypic synonyms: *Kickxia latifolia* Stapf 1898: 307; Preuss 1899a: 353–360; Schlechter 1900a: 63, 64, 125, 236, 307; 1900b: 28–31; De Wildeman 1900a: 633, 634; 1900b: 743–748; De Wildeman & Durand 1900: 41–43; 1901: 157; Warburg 1902: 200–207, pl. 16. Type: Zaïre, Prov. Equateur, Bangala, *Dewèvre 867* (BR, lectotype; isotype: K). Homotypic synonym: *Fun-*

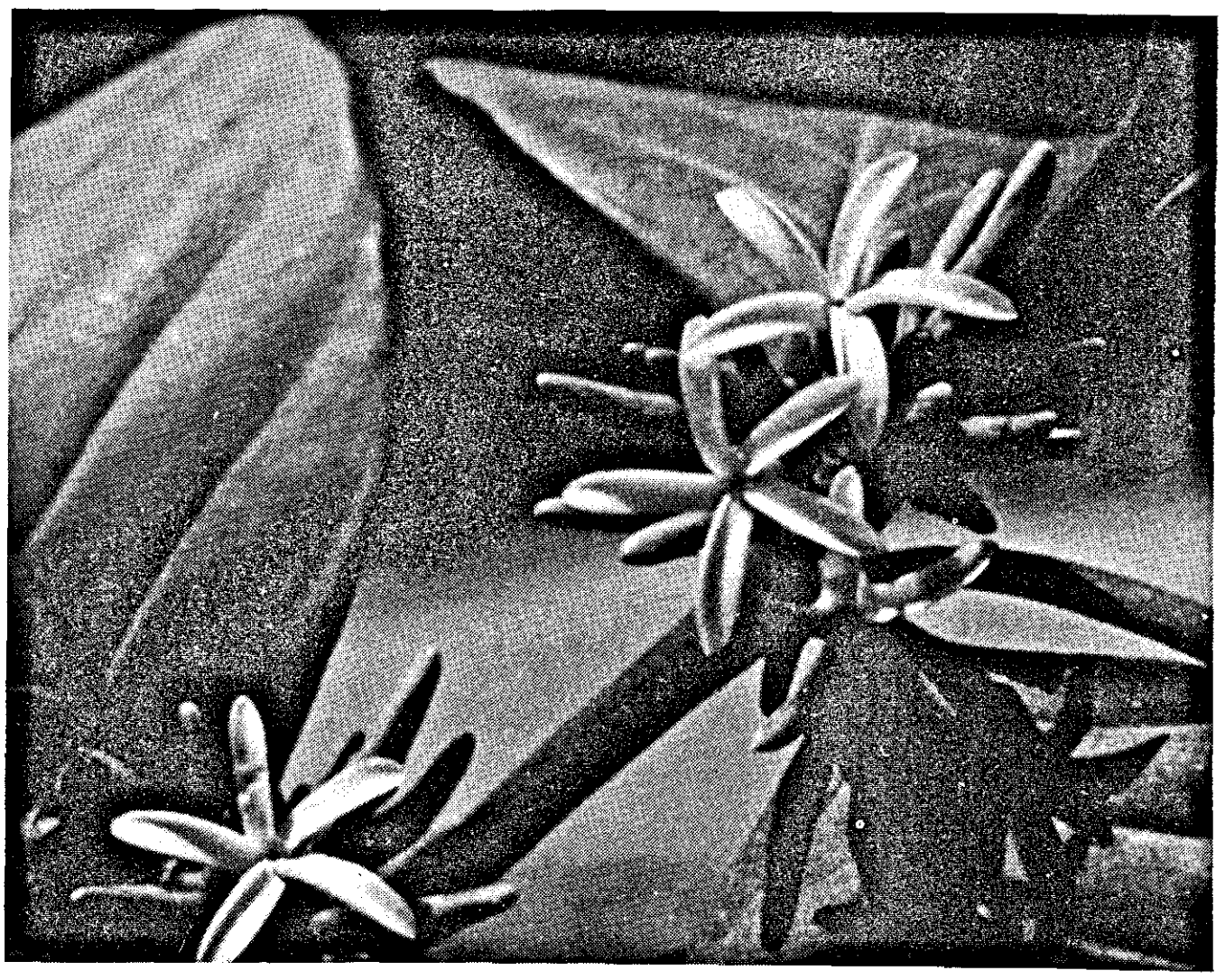
tumia latifolia (Stapf) Stapf 1899: 2, 3; 1901: 2694; 1904: 192; Jumelle 1903: 381–392; De Wildeman 1905: 550–574; Vermoesen 1931: 129, 130; Duchesne 1938: 231; Aubréville 1936: 168–170, pl. 306; 1959: 200, pl. 323; Eggeling & Dale 1951: 28; Gomes e Souza 1960: 143, 145, 150, 159, 160; 1967: 653–655; Dale & Greenway 1961: 46; De La Mensbrugge 1966: 320–325.

Kickxia scheffleri Schum. 1900: 81; De Wildeman 1900b: 745–748; Stapf 1901: 2694, 2695. Type: Tanzania, Derema, *Scheffler 176* (B, holotype; isotypes: BM, E, EA, K, P, Z). Homotypic synonym: *Funtumia scheffleri* (Schum.) Jumelle 1903: 381–392.

Kickxia zenkeri Schum. 1900: 81; De Wildeman 1900b: 747, 748; Stapf 1901: 2694, 2695. Type: Cameroun, Bipindi, *Zenker 2280* (holotype not seen, destroyed in B; lectotype: K; isotypes: BM, BP, COI, E, G, HBG, MO, P, S, W, WU, Z). Homotypic synonym: *Funtumia zenkeri* (Schum.) Jumelle 1903: 381–392.

Kickxia congolana De Wild. 1900b: 745–748; Stapf 1901: 2694, 2695. Type: Zaïre, Prov. Bas-Zaïre, Kisantu, *Gillet 387* (BR, holotype; isotype: K). Homotypic synonym: *Funtumia congolana* (De Wild.) Jumelle 1903: 381–392.

Kickxia gilletii De Wild. 1900b: 744–748; Stapf 1901: 2694, 2695. Type: Zaïre, Prov. Bas-Zaïre, Kisantu, *Gillet 886* (BR, holotype; isotype: K). Homotypic synonym: *Funtumia gilletii* (De Wild.) Jumelle 1903: 381–392.



PHOT. 7. *Funtumia africana* (Benth.) Stapf, flowering branch. – (*Zwetsloot 6*).

Tree or shrub up to 30 m high. Trunk up to 50 cm in diameter; bark smooth, sometimes with a few orbicular lenticels or finely fissured in both directions, greenish-brown to grey, mottled; latex not coagulating easily; branchlets glabrous or minutely pubescent. *Leaves*: petiole 0.3–1.5 cm long, glabrous or minutely pubescent; blade subcoriaceous to coriaceous, 1.5–4 × as long as wide, 5–32 × 1.7–17 cm; often puberulous on the midrib; secondary veins 6–13, mostly parallel; domatia consisting of a tuft of straight hairs, which varies in density, sometimes absent; margin slightly undulate and somewhat revolute. *Inflorescence* 3–40-flowered, 2–2.5 × 1.5–4.5 × 1.5–4.5 cm; pedicels 3–15 mm long, glabrous or puberulous; bracts obtuse or acute at the apex, 0.9–2 mm long with colleters in the axils. *Flowers*: mature buds pale green, cylindrical to slightly conical, 8.5–22 mm long, obtuse to subacute at the apex. *Sepals* triangular to broadly ovate, 1.5–4 × 1.8–3 mm, outside glabrous or puberulous; 5–50 colleters which vary in shape and size, even in a single flower, 0.3–1 mm long. *Corolla*: tube very pale green to creamy, almost cylindrical, ventricose at 40–75 % from the base, 1.7–5 × as long as the calyx, 1.3–3.6 × as long as wide, 5.8–10 × 2.5–5 mm, glabrous to puberulous outside; lobes creamy, recurved, 0.5–1.6 × as long as the tube, obliquely ovate to narrowly oblong, sometimes auriculate, 1–5.5 × as long as wide, 5–15 × 2–5 mm, obtuse or acute at the apex, glabrous to puberulous on both sides, sometimes inside pubescent near the base. *Stamens* 1.1–4.5 × 0.6–1.5 mm, inserted at 38–75 % from the base of the tube; anthers 1–4.5 × 0.6–1.5 mm with a 1.1–2.2 mm long fertile portion; connective 1.8–4 mm long, dorsally appressed pubescent with 0.25–0.5 mm long hairs. *Pistil* 4–7 mm long; ovary almost cylindrical to subglobose, slightly 5-lobed at the apex, 1.2–2 × 0.9–2 × 0.9–2 mm, pubescent at the apex, indumentum gradually deminishing towards the base; style 1.2–3 × 0.2–0.35 mm, glabrous or with a few erect hairs; clavuncula and stigma 0.9–2.4 × 0.3–1.1 mm; stigma surrounded by an exudate. *Disk* 5-lobed: lobes 0.4–1.6 mm long, shorter than or rarely as long as the ovary. *Fruit*: follicle almost fusiform, 8.4–32 cm long and 1.4–5.1 cm in circumference, acuminate to acute at the apex, rarely subobtuse, sometimes slightly curved; flat adaxial side 0.6–3.6 cm wide. *Seed* 3.5–7.5 × 0.2–0.6 cm; beak1.6–6cm long with 3.2–9 cm long hairs; glabrous basal portion of the beak 0–1.1 cm long; testa rugose, sometimes puberulous. *Seedling*: hypocotyl puberulous.

Note: Slight butresses are reported from Uganda by EGGELING (1951), but the present author did not observe their presence in Ivory Coast.

FIG. 3. *Funtumia africana* (Benth.) Stapf: 1. flowering branch, 2/3 × ; 2. domatium in the axil of a secondary vein, 4 × ; 3. flower, 2 × ; 4. longitudinal section of the flower, 4 × ; 5. opened fruit, 2/3 × ; 6. transverse section of the fruit, 2/3 × ; 7. detail of the haired beak, 2 × ; 8. detail of seed, 2 × . – (1–2. *Zwetsloot 28*; 3–4. *Zwetsloot 28*, spirit material; 5–8. *Zwetsloot 21*).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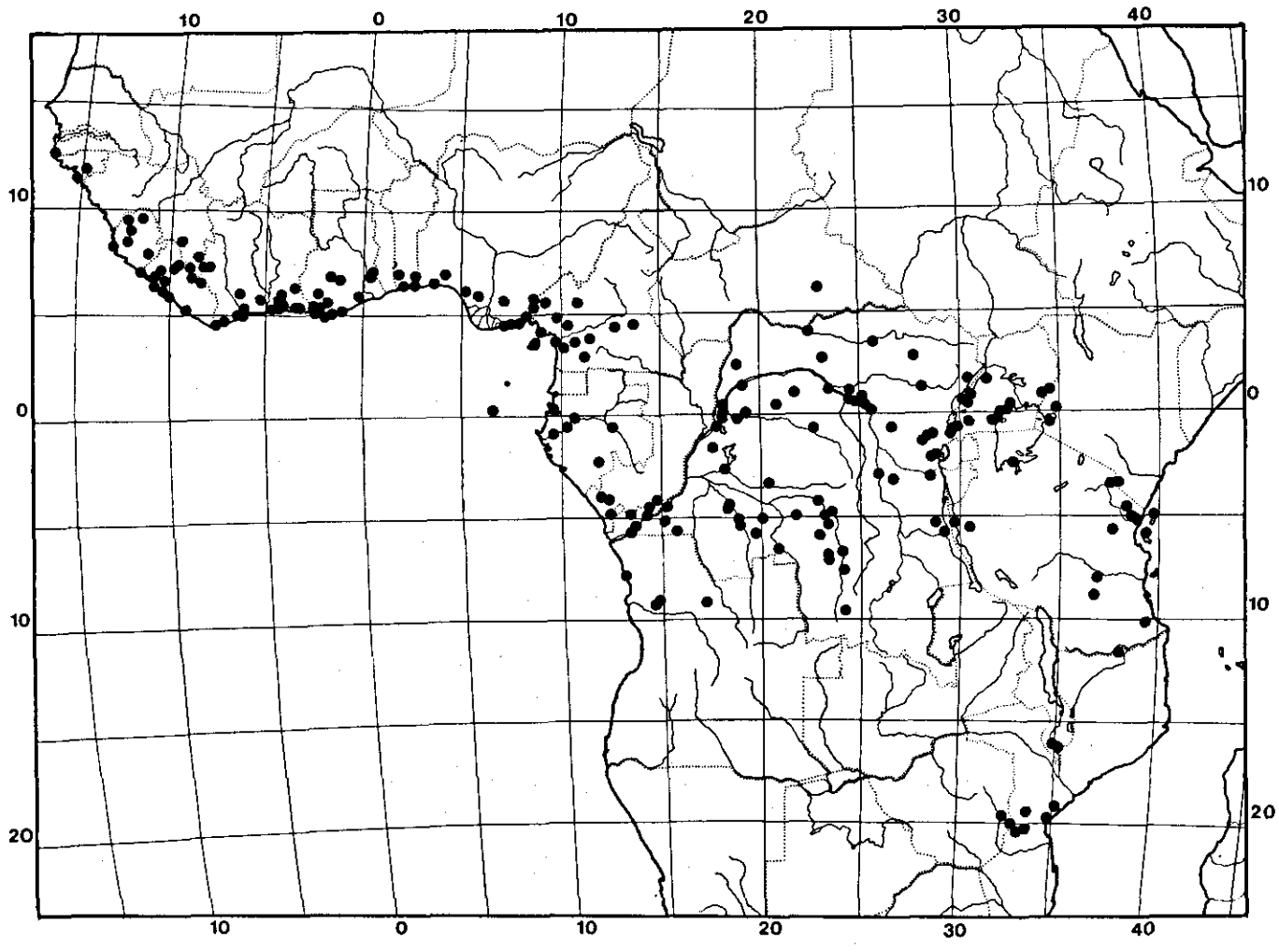


MAP 2. *Funtumia africana* (Benth.) Stapf

Distribution: Tropical Africa from Senegal to Tanzania and South to Zimbabwe and Moçambique.

Ecology: Moist light or secondary forest, in savanna area in gallery forests. Alt. 0–1300 m.

Uses: The latex does not yield a good rubber, but was formerly used as a rubber adulterant and now sometimes as bird lime. The wood provides material for making stools, plates, ladles, combs, shoes, bowls, carved figures and light carpentry (IRVINE 1961: 621). Medicinal uses include powdered dry leaves for fire burnes, leaves, bark and twigs against constipation, the roots for curing a weak bladder (AYENSU 1978: 48), the pounded roots, in palm-wine and water, for incontenence of the urine and the bark and leaves as an enema for assisting conception (IRVINE 1961: 621). Additionally IRVINE (1961) mentiones the seeds as an adulteration for *Strophanthus* seeds and the floss of the seeds as a stuffing for cushions.

Vernacular names:

SENEGAL: *ba kanali* (Floup), *budikédo* (Foula) (BERHAUT 1971: 382).

GUINEE-BISSAU: *tcharaki-fêro* (teste: *Espírito Santo 435*).

SIERRA LEONE: *bobo* (Mende) (teste: *Deighton 679*); *boboi, buboi, gboboi, bobo, watia, kawatia* (AYENSU 1978: 48); *yete, ekita, nunda* (teste: *Thomas 5383*).

LIBERIA: *bu-ay-boh* (Bassa (AYENSU 1978: 48).

IVORY COAST: *pésin* (Attié), *pri* (Attié of Potou Lagoon), *manan* (= rubber), *wale* (Bondoukou) (CHEVALIER 1909: 122); *pousso oué* (env. of Abidjan) (teste: *Aubréville 32*); *pé-sain, krokué, sohué* (Attié), *pwo* (Abé), *poyu* (Abé), *afomuondu* (Apoll.), *wala, manan-wala* (Bondoukou), *adiakoi, adiakua* (Ebrié) (HUTCHINSON & DALZIEL 1937b: 371).

GHANA: *osese* (Twi, Ashanti), *osesew* (Fanti), *osese* (Ga, Krobo), *kpomi* (Ewe, Krepi, Awuna), *kpomli* (Ewe) (IRVINE 1930: 200); *okae, mama* (Ashanti) (IRVINE 1961: 621, 622).

NIGERIA: *okeng* (lagos state) (JUMELLE 1903: 383); *ire* (Yoruba), *bassa-bassa* (Benin) (KENNEDY 1936: 205); *ako iré* (Yoruba), *anyan* (Bini), *mba-miri* (Ibo), *nkwame* (Boki) (KEAY, ONOCHIE & STANFIELD 1964: 384); *ayon, anyon* (Benin), *male funtum, white ofruntum* (HUTCHINSON & DALZIEL 1937b: 371).

CAMEROUN: *okeng* (Fantis) (PREUSS 1899: 66); *ngôn* (Yaoundé, Bassa), *egon* (Pahouin) (Teste: *Fleury in herb. Chevalier 33286*).

GABON: *n' goué-yo-naye* (M'pongoué), *m'gomabam* (Pahouin) (LECOMTE 1897: 44); *ety* (Pahouin) (teste: *Fleury in herb. Chevalier 26585*); *eté, ngong-mebang* (Fang), *otanda* (Mitsongo, Ivéa), *mokanda-kanda* (Bavové, Apindji), *dutumba* (Éshira, Bavarama, Bavungu, Bapumu), *létomba* (Banzabi), *mulilimba* (Bavili), *létótó* (Bakélé), *onèmbu-nèmbu* (Orungu), *ngèga* (Nkomi) (?), *onom-onomyè* (Mpongwè) (WALKER & SILLANS 1961: 82); *bebende* (teste: *Sargos 41*).

SÃO TOMÉ: *pau cadeira, pau visco* (LECOMTE 1897: 18).

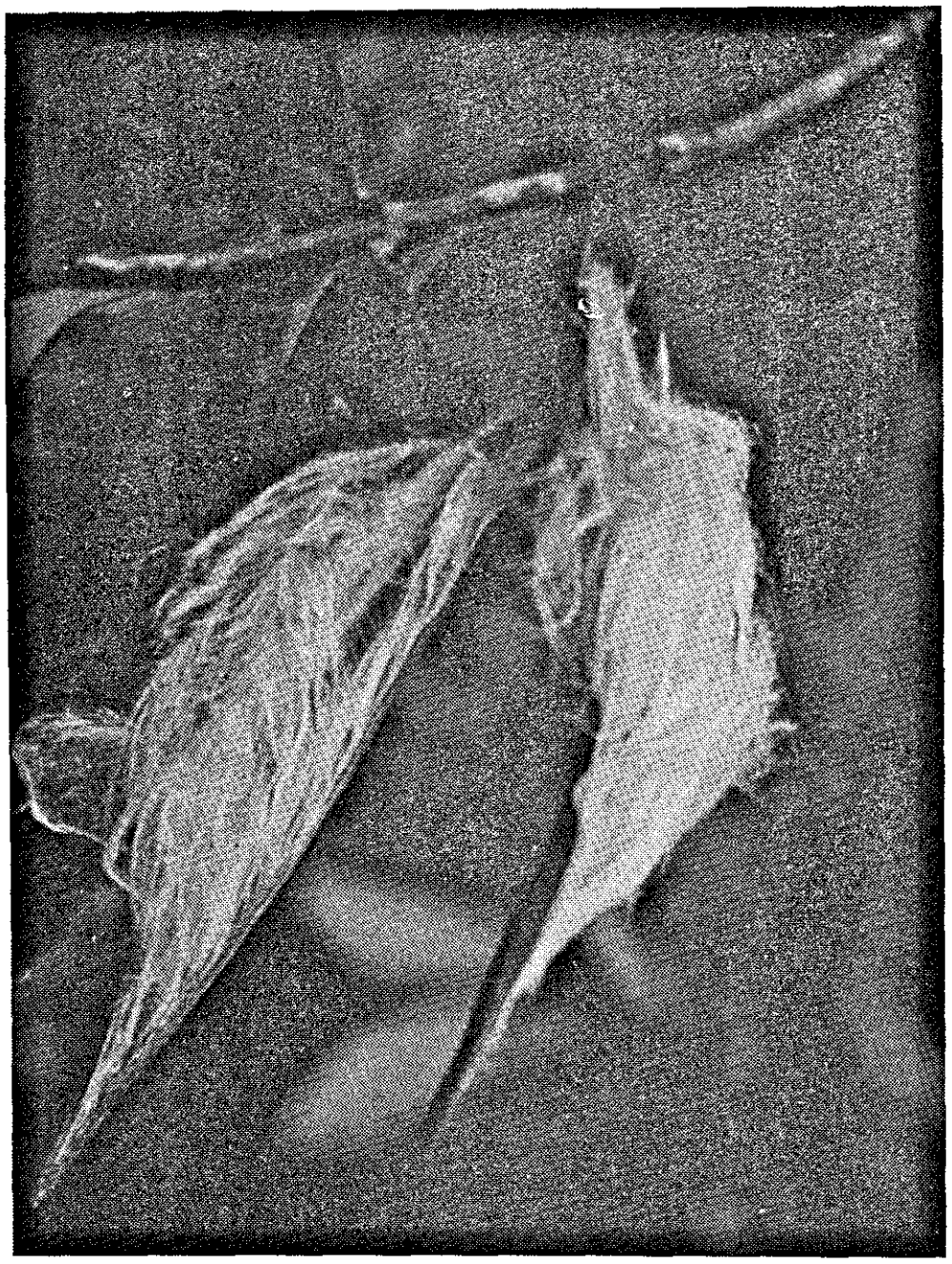
ANGOLA: *alsyra* (env. of Buco Zau) (Teste: *Gossweiler 7328*); *linhumbo* (env. of Belize, Mayombe) (teste: *Gossweiler 7590*).

ZAÏRE: *dimbu-dimbu, ndimbu-dimbu* (Kiombe), *bolle* (env. of Kisantu), *mobole, moboli* (env. of Sankuru), *bobole* (env. of Moki), *busumba* (env. of Bumbuli), *bole, mbole, nbole* (Kundu, Mongo), *bosuma, isote* (env. of Lulonga), *boli, dembo, mabe, mariguongo* (env. of Bangala), *bohole* (Mongo), *wembe* (Turumbu), *osuma* (env. of Kisangani), *bongon* (Mangbetu), *kimbaki* (env. of Kisantu), *mazi mazi* (Kiombe), *usumba* (Tshitetela, Kiswahili), *mulumba* (env. of Maniema) (DUCHESNE 1938: 231); *busumba* (env. of Bumbuli), *dembo, abe* (env. of Giri) (DE WILDEMAN 1905: 573–574); *iswété* (Mongo) (teste: *Coulon 11*); *mangbongno* (env. of Bambesa) (teste: *Gerard 2907*); *ngusale nguhale* (Kinyanga) (teste: *Troupin 3768 Gutzwiller 2572*); *gbanga* (Arranbe), *buole, borombo* (env. of Boyeka) (teste: *Dubois 163*); *mumbulimusumba* (Kirega), *lusumba* (Kisongola), *usumba* (Kikusu, Kiswahili) (teste: *Gaillez 220*); *bosombo* (Lotundo), *ntoma* (Gombés) (teste: *Gorbatoff 28*); *mowa* (Kirega, Kitembo) (teste: *Troupin 10923, Gutzwiller 2357*); *murembo* (Kinande), *mubeya* (Kinyanga) (teste: *Troupin 2465*); *utshumba* (env. of Forama) (teste: *Tondeur 103*).

UGANDA: *munyamatunga* (Lunyankole), *munyamagozi* (Lukiga), *musanda* (Lunyoro), *nkago* (Lusoga) (EGGELING 1951: 28); *namakagy zimbaru* (Bugisha) (teste: *Brasnett 1*).

KENYA: *mutondo* (Kakamega), *bastard wild rubber* (DALE & GREENWAY 1961: 46).

TANZANIA: *nwale* (Tongwe) (teste: *Itani & Izawa 50*); *kilimboti* (Kishamba)



PHOT. 8. *Funtumia africana* (Benth.) Stapf, open fruit. – *Zwetsloot 21*).

(teste: *Mgaza 462*); *mfijufiju* (Swahili) (teste: *Lyne 118*); *kaku* (Ki-Tongwe) (teste: *Itani 81*); *mboreti* (Kishambaa) (teste: *Peter 58194*); *mueyue*, *karungurungu*, *karerembe* (Ki-Tongwe (teste: *Suzuki 25*, *246*, *268*).

MOÇAMBIQUE: *inhampuepua* (Cheringoma) (GOMES E SOUZA 1967: 653); *muri* (Maconde) (teste: *Gomes e Souza 4516*).

Geographic variation

The variation of *F. africana* is partly correlated with its geography. Certain forms occur mainly in particular parts of the area of distribution. Some of these forms have been regarded as distinct species in the past. As the transitions between these forms are always continuous the present author refrains from delimitating subspecies or varieties. He confines himself to indicate some characters that show a distinct correlation with the geography:

– Indumentum of the corolla. In West Africa the corolla is usually glabrous, although minutely puberulous corollas occur there. The same applies to

Cameroun, Gabon and Zaïre in the province Bas-Zaïre. However in Angola, Central and East Zaïre the corolla is more frequently puberulous, while in Uganda, Kenya, Tanzania, Zimbabwe and Moçambique the corolla is always puberulous.

– Fruit. In West Africa, Cameroun, Congo and Angola, the fruit is always quite narrowly fusiform with an acute or acuminate apex. But in Zaïre, Uganda, Kenya, Tanzania and Moçambique the fruit may be shorter and thicker and as such it may resemble that of *F. elastica*.

A selection of the about 600 specimens examined:

SENEGAL: Emay, Basse Casamance (fl. Sep.) *Berhaut 7388* (BR, M, P).

GUINÉE-BISSAU: Cubisseque (fl., fr. Aug.) *Espírito Santo 2166* (BR, COI, K, LISC, LISJC, M, MO, P, WAG); Bafatá (fl., fr. Aug.) *Espírito Santo 3302* (BR, COI, LISC, LISJC, M, MO, P, WAG).

GUINEA: Macenta (fl. Apr.) *Jacques-Félix 862* (P).

SIERRA LEONE: Port Lokko (fl. Dec.) *Thomas 5820* (P); Kukuna (fr. Jan.) *Scott Elliot 4506* (BM, BR, K, MO); Yonibana (fr. Nov.) *Thomas 4732* (W); Ronietta (fl. Nov.) *Thomas 5611* (EA); Njala (fr. Sep.) *Small 391* (BR, K, P); Kabala)fl. July) *Glanville 249* (K); Kambui Forest. *T.E.E. 196* (FHO).

LIBERIA: Bomi Hills, *Dillewijn 39* (WAG); Zorzor-Gbarnga Road, W of St. Paul's R. (fl., fr. July) *Bos 2143* (K, WAG); Devilbush-Duport (fr. Jan.) *Voorhoeve 777* (BR, WAG); Boporo (fl. Dec.) *Baldwin 10623* (NY); Kakata (fl. Jan.) *Jansen 1733* (WAG); Dukwai R., *Cooper 468* (A, BM, FHO, GH, K, NY, US); Grand-Bassa, St. Johns R. (fl. June) *Dinklage 1835* (B, WU); 30 km N of Buchanan (fl. Feb.) *Jansen 1910* (WAG); Bonuta (fr. Oct.) *Linder 888* (A, K); Gbanga (fr. Sep.) *Linder 743* (A, K, LE); Sinoe Basin, *Whyte 1904* (K); Ganta (fr. Jan.) *Baldwin 14055* (K, MO, US); Ganta-Tapita Road near Gloie Town (fl., fr. Jan.) *Bos 2664* (BR, K, P, WAG); Mt. Nimba (fr. Feb.) *Adam 20840* (K, MO, UPS).

IVORY COAST: 14 km WSW of Toulepleu, *Beentje 923* (WAG); 25 km WSW of Man (fl. May) *Beentje 350* (WAG); Trépo, *Chevalier 19439* (P); Tabou, *De Koning 2374* (WAG); 64 km N of Sassandra (fl. Jan.) *Leeuwenberg 2614* (BR, FHO, K, L, UC, WAG); 25 km W of Sassandra (fl., fr. Apr.) *Zwetsloot 21* (UCI, WAG); km 19 Gagnoa-Soubré Road (fl. Apr.) *Zwetsloot 29* (UCI, WAG); Trépoint (fl. Apr.) *Zwetsloot 28* (UCI, WAG); 9 km E of Divo (fl. May) *Zwetsloot 39* (UCI, WAG); 9 km N of Cosrou (fl. May) *Leeuwenberg 4254* (BR, K, L, MO, P, WAG); Dabou (fl., fr. May) *Jolly 169* (K, P); 17 km W of Abidjan (fl. June) *W. de Wilde et al. 295* (BR, K, P, UC, WAG, Z); Yapo (fl., fr. Apr.) *Zwetsloot 9* (UCI, WAG); 25 km N of Abidjan (fl. May) *Versteegh and Den Outer 37* (BR, MO, U, WAG); Yakassé Mé (fl., fr. Apr.) *Zwetsloot 6* (UCI, WAG), *7* (UCI, WAG); 2 km S of Aghien (bud. June) *Beentje 497* (WAG); Zaranou, *Chevalier 17617* (K, P); Aboisso (fl. Apr.) *Chevalier 16305bis* (FI, P, WAG); 1 km E of Maféré (fl. Mar.) *Leeuwenberg 12018* (WAG).

GHANA: Fure Headwaters For. Res., *Foggie 127* (FHO); Benso-Subiri For. Res., *Deaw 312* (MO); Axim (bud Feb.) *Irvine 2251* (E); Ankobra Junction (fl. Feb.) *Kitson 1021* (K); 7 km N of Agoua Junction (fr. Mar.) *Leeuwenberg 11134* (GC*, WAG); Owabi (fl. Apr.) *Andoh 4180* (A, BM, BR, FHO, K); Prah R. (fl., fr. Dec.) *W. Johnson 925bis* (K); Ofin Head Water (fl. Apr.) *Vigne 1905* (FHO); Agoge (fl. Apr.) *Adams 2615* (P); between Abandzi and Saltpond Junction (fr. Feb.) *Leeuwenberg 11110* (GC*, WAG); Koforidua (fr. Dec.) *W. Johnson 434* (K); Amedjove (bud Apr.) *Schlechter 12979* (BR); Hohoë District (fl., fr. Nov.) *St. Clair-Thompson 3676* (FHO).

BENIN: Boguila near Abomey (fl. Feb.) *Chevalier 23190* (P); Torikada, *Poisson 24 Jan. 1901* (P); Bokoutou For. Res. near Porto Novo, *Chevalier 22868* (P); Pobé, *Adjanohoun 93* (P); Adja Ouéré (?) (fl. Jan.) *Le Testu 103* (BM, BR, FHO, LISC, MO, NY, P, S, UC, WAG).

NIGERIA: Lagos State: Lagos, *Batten-Poole 100* (K). Oyo State: 2 km W of Osho Enclave, Omo and Shasha For. Res., *Jones and Onochie FHI 17270* (FHO). Bendel State: Okomu For. Res. (fl. Dec.) *Brenan 8532* (BM, FHO, K, P); Sapoba (fl. July) *Kennedy 345* (BM, FHO, K). Imo State: Orlu (fr. Oct.) *Emwiogbon and Onyeachusim FHI 65880* (K, WAG). Rivers State: Bonny (fr. Aug.) *Kalbreyer 82* (K, paratype). Cross River State: Opobo (fr. Sep.) *Holland 157* (BR); Nkama, km

128 Calabar-Mamfe Road (fl. Apr.) *Van Meer 1341* (WAG); Old Calabar, *Holland 5* (K); Oban Group For. Res. (fl. Apr.) *Van Meer 1373* (WAG); Ajosso on the Ikom-Mamfe Road (fl. Feb.) *Latilo and Oguntayo FHI 67659* (K, WAG); km 117 Calabar-Mamfe Road (fl. Feb.) *Onyeachusim and Latilo FHI 54098* (BR, K, WAG).

CAMEROUN: Victoria, *Zahn 1911* (HBG); env. of Foumban (fl. Feb.) *Jacques-Félix 3044* (P, WAG); Mamfe (fl. Dec.) *Baldwin 13823* (K, MO); 3 km E of Eboné, a village on km 11 of Nkongsamba-Loum Road (fr. Sep.) *Leeuwenberg 8303* (WAG); Ndokmen II, 13 km E of Yingui (fr. Jan.) *Leeuwenberg 9104* (WAG); env. of Douala, *Fleury in herb. Chevalier 33286* (P); Bipindi, *Zenker 2280* (BM, BP, COI, E, G, HBG, K, MO, P, S, W, WU, Z, type of *K. zenkeri*;), *2280a* (BM, BR, G, GH, HBG, LISC, NY, WAG), *2534* (A, B, BM, BP, BR, COI, E, G, GOET, HBG, K, L, M, MO, P, S, W, WU, Z); Eseka (fr. Dec.) *Bamps 1327* (BR, K, WAG); 15 km S of Ebolowa (fr. Feb.) *W. de Wilde et al. 2017* (BR, P, WAG); Yaoundé, *Preuss 1382* (A, BM, BR, E, EA, K, MO, P, S, US, W, WAG, WU); between Letta and Viali, *Letouzey 2987* (K, P).

CENTRAL AFRICAN REPUBLIC: Yalinga (fl., fr. Apr.) *Le Testu 3820* (BM, BR, P, WAG).

EQUATORIAL GUINEA: Fernando Poo: Bokoko (fr. Oct.) *Mildbread 6889* (HBG), *6889a* (HBG); Bagru R. (fl. Apr.) *Mann 817* (GH, K, P, type).

SÃO TOMÉ: Porto Méqué (fr. Sep.) *Chevalier 13765* (P); Boa Entrado, *Chevalier 13498* (BR, P, K).

GABON: Libreville, *Klaine 662* (B, BM, BR, K, P); Tchibanga (fl. Nov.) *Le Testu 1880* (BM, BR, E, L, LISC, MO, P, US, WAG); Ngounie R. (fl. Nov.) *Le Testu 2201* (BM, BR, LISC, P); 10 km S of Mokokou (fl. Dec.) *Hladik 1899A* (P), *1899C* (US); Lastoursville (fr. Jan.) *Le Testu 7880* (BM, LISC, P), (fl. Nov.) *7621* (BM, LISC, P, WAG).

CONGO: Kouilou, *Sargos 41* (P); Kakamoeka (fr. Aug.) *Lecomte 21 aug. 1893* (P); near Dimonika (fl. Dec.) *Cusset 779* (P); Mayombe, *Lecomte E62* (P); between Renéville and Mbamou, *Chevalier 27608* (P).

ANGOLA: Mayombe (fl. Jan.) *Gossweiler 6087* (BM, BR, COI, LISJC); Buco Zau (fr. Aug.) *Gossweiler 6604* (BM, COI, K, LISJC, LISU); Ambriz, *Monteiro et al. 398* (LISC); Golungo Alto (fl. Oct.) *Gossweiler 4400* (BM, COI, K); Loanda (fl. Oct.) *Gossweiler 4393* (BM, COI, K); Quela, *Nolde 417* (BM).

ZAÏRE: Prov. Bas-Zaïre: Lundu, *Goossens 1318* (BR); Luki (fl. Nov.) *Maudoux 197* (BR); ibid. (fr. Sep.) *Toussaint 2450* (BR, C, P, K); Seke Banza, *Breyne 3110* (BR); Temvo, *Vermoesen 1830* (A, BR, G, K, MO, S, US, Z); Kisantu, *Gillet 387* (BR, K, type of *K. congolare*), (fl., fr. Dec.)*886* (BR, K, type of *K. gilletii*); Mvuazi (fl. Nov.) *Devred 47* (BR, K); Kimuenza (fl. July) *Evrard 6409* (BR, MO); Kingoma, *Pauwels 1927* (BR); Kimvula, *Pauwels 272* (BR); Bundu (fl.) *Jansens 7 Sep. 1909* (BR); Kutu (fl.) *E. Laurent 7 Nov. 1903* (BR); Madibi (fl.) *Sapin July 1906* (BR); Lusubi (fl. June) *Lescrauwaet 66* (BR); Ipamu (fl. July) *Vanderijst 9950* (BR); Kiyaka (fl. July) *Devred 2350* (BR, WAG); Bumbuli, *Serv. de l'Agric., lettre 311, 5 Aug. 1907* (BR); Kompani (fl. Mar.) *Compère 1661* (BR). Prov. Kasai: Bienge (fr.) *Sapin Oct. 1907* (BR); Loange, *Gentil 26* (BR); Bena Longo (fl. June) *Dechamps 153* (BR, NY); Olombo (fl., fr.) *E. Laurent 22 Nov. 1903* (BR); Lusambo (fl. Apr.) *Luja 308* (BR); Babadi (fl., fr. Apr.) *Gentil 76* (BR); Bena Dibele (fr. July) *Flamigni 157* (BR); Kamenbele (fr. Jan.) *Liben 2262* (BR, WAG); Mwena Ditu (fl., fr. July) *Risopoulos 1161* (BR); Thielen-St. Jacques (fr. Feb.) *Lescrauwaet 344* (BR); Lubi (fr. Sep.) *Lescrauwaet 174* (BR); Sangaie (fl., fr. Nov.) *Gillardin 483* (BR); Gandajika (fr. Dec.) *Liben 2090* (BR, WAG). Prov. Equateur: Irebu, *Serv. de l' Afric., lettre 691, 26 Oct. 1903* (BR); Wendji (fl. July) *Lebrun 754* (BR, WAG); Eala (fl., fr. Oct.) *Coûteaux 107* (BR, K, NY); ibid. (fl. Mar.) *Corbisier 752* (BR, K, P); Boyeka (fl. June) *Louis 2182* (BR, S, U, US); Lulonga (fl. Aug.) *Casteels 13* (BR); Bomboma, *De Giorgi 48*[1] (BR); Bangala (fl. May) *Dewèvre 867* (BR, K, lectotype of *K. latifolia*); Djoa (fl., fr. May) *Evrard 4089* (BR); Momboyo R. (fl. Aug.) *Pynaert 279* (BR); Bolima (fl. Oct.) *Hulstaert 467* (BR); Befale (fl. Mar.) *Evrard 3641* (BR); Bodala, *Coulon 11* (BR); Yongo (fl. Nov.) *Evrard 5266* (BR); Yalisenga (fl. Dec.) *Evrard 5326* (BR, K). Prov. Shaba: Tshifunga, *Schmitz 5299* (BR); Kaniama (fl. Aug.) *Herman 2041* (BR, P); Mulolwa, *Delvaux 454* (BR); Mahila, 90 km N of Kalemie, *Delvaux 703* (BR); Kalemie, *Delvaux 742* (BR, WAG). Prov. Haut-Zaïre: Titule (fl. Apr.) *Lebrun 2713* (BR, WAG); Mobwasa, *Reygaert 498* (BR); Barumbu (fl. Jan.) *M. Laurent 1792* (BR); Yambuya, *Solheid 57* (BR); Yangambi (fl., fr. Feb.) *Germain 155* (BM, BR, K, MO, P); Romée (fl. Jan.) *M. Laurent 1791* (BR); km 22 Kis-Bengamisa Road, *Bokdam 3652* (WAG); 5 km N of Kisangani (bud Feb.) *Bokdam 3071* (WAG); Wanie Rukula (fl. Jun.) *Lisowski 52626* (BR, POZ); Bambesa (fl. May) *Leemans 2907*

(BR); Nala (fl. May) *Van Rijsselberghe 2* (BR); Tshopo (fl. Nov.) *Lisowski 15098* (BR, POZ). Prov. Kivu: km 37 Elundu-Kindu Road (fl. July) *Gaillez-Mahin 59* (BR); Lubutu (fl. Apr.) *Bokdam 4103* (WAG); Pangi, *Michelson 353* (BR); Irangi (fl. July) *Troupin 3768* (BR, K); Itebero, *Troupin 2465* (BR, K, WAG); Musenge (fl. Feb.) *Léonard 2118* (BR); betweeen Masisi and Walikale (fl. Mar.) *Lebrun 5191* (BR, WAG); Ilunga (fl. Dec.) *Pierlot 623* (BR); Kembe (fl. June) *Pierlot 2233* (BR); Ngandu (fl. July) *Léonard 4898* (BR, WAG); Shabunda (fl. Aug.) *Pierlot 735* (BR); Bwemba (fl. Oct.) *Pierlot 2630* (BR); Bunyakiri (fl. Apr.) *Gutzwiller 1769* (BR, WAG); Mutongo, *Gutzwiller 2792* (BR, WAG); Ruzanza (fl. Feb.) *Babault 15 Feb. 1936* (P); Rutshuru (fl. Mar.) *Ghesquière 3877* (B, K, LISJC); Makwera (fr. May) *Ghesquière 6671* (BR); Kisharo (fl. June) *Pierlot 3023* (BR, WAG).

UGANDA: U 2: Kigezi, Ishasha Gorge (fl. May) *Purseglove 3442* (K); Fort Portal (bud Aug.) *Eggeling 3102* (K); Toro (bud. Apr.) *Bagshawe and Camb 1011* (BM); Ankole, *Dawe 419* (K); Budongo For. (fl. Apr.) *Harris 82* (K). U 4: S. Kibale For. (fl. Dec.) *Loveridge 240* (K); Masaka near Buwunga (fl. July) *Lye and Mani 3478* (UPS); NW side of Lake Nabugabo (fr. Oct.) *Drummond and Hemsley 4728* (BR. K); Mawokota Distr., *Dawe 236* (K); Hama Distr., *Bagshawe and Camb 1511* (BM, FHO); Mabira For. (bud. Mar.) *Dawkins 553* (EA, BM). U 3: Balakeki near Bubalu (fr. Sep.) *Harris 29* (EA, K); Mt. Elgon (fl. Apr.) *Snowden 871* (A, K, NY, P).

KENYA: Nyanza basin (fl., fr. Aug.) *Moon 568* (K); Kakamega For. (fr. Sep.) *Maas Geesteranus 6240* (BR, COI, G, K, L, S, UC, WAG, Z); Yala R. (fl. Apr.) *Dale 802* (A, BM, FHO, MO, US); Taveta For. (fl. Nov.) *Dale 3754* (EA, BR, K).

TANZANIA: T 4: Kigoma, *Itani and Izawa 50* (EA). T 1: Ukerewe (fl. Apr.) *Watkins 240, FHI 2686* (EA, FHO). T 6: Ulanga Distr., *Haerdi 6672* (P). T 2: Moshi (fl. Nov.) *Lewis 239* (K). T 3: Derema, Usambara Mts., *Scheffler 176* (B, BM, E, EA, K, P, Z, type of *K. scheffleri*); Lunguza For. Res. (fl. Mar.) *Mgaza 462* (K); Amani (fl. June) *Scheffler 416* (A, BM, K, P, Z). T 8: Rondo Plateau, *Semsei 726* (K). Pemba Island: Ngezi For., *Lyne 118* (K). Zanzibar: Dunga, *Lyne 97* (K).

MALAWI; Chambapele, *Jopham 587* (FHO); Cholomwani, Cholo Distr. *Jopham 699* (FHO).

ZIMBABWE: Melsetter Distr. (fl. Nov.) *Drummond 5024* (K, LISC, LMA, S, SRGH); Haroni-Makusupini For. (fr. Dec.) *Wild et. al. 6615* (BR, FHO, K, LISC, SRGH); ibid. (fl. Nov.) *Simon and Ngoni 1294* (K, LISC, SRGH).

MOÇAMBIQUE: Mafuce For. (fl. Nov.) *Dawe 508* (K); Amatongas For. (fl. Nov.) *M. Johnson 50* (K); ibid. (fl., fr. Feb.) *Andrada 1039* (LISC, LMU); Dondo, 29 km from Beira (fl., fr. Aug.) *W. Johnson 300* (K); Chiniziua, Beira Dist. (fl. Apr.) *Gomes e Sousa 4363* (COI, FHO, FI, K, LISC, LMA, M, P, SRGH); Chomba (fl. Nov.) *Gomes e Sousa 4516* (COI, K, LMA, LMU, MO, SRGH).

*Not seen by the author, annotated by LEEUWENBERG.

Some of the cultivated specimens examined:

GUINEA: Conakry (fr. Feb.) *Chevalier 12727* (P).
BENIN: Porto Novo, *Poisson* (K, P).
PRINCIPE: Esperança (fl. Dec.) *Exell 696* (BM).
ZAÏRE: Eala (fl. June), *M. Laurent 1794* (BR).
TANZANIA: Amani (fl. Jan.), *Peter 581* (WAG).
TRINIDAD: Botanic Gardens (fl., fr. June) *Hart 6811* (K).
THE NETHERLANDS: Wageningen (fl. July) *Van Setten 193* (WAG).

Funtumia elastica (Preuss) Stapf 1899: 2, 3; 1901: 2694, 2695: 1904: 191; Schlechter 1900a: 99, 236–249, 307; De Wildeman 1902: 74–76; 1903b: 274–278; 1905: 550–574; 1906: 62, 63; Jumelle 1903: 381–392; Chevalier 1904: 346; 1909: 124–126; 1910b: 6, 8; 1912: 24; Luc 1908; Irvine 1930: 200; 1961: 621,622; Aubréville 1936: 168–170, pl. 306; 1959: 200, pl. 323; Kennedy 1936: 205, 206; Hutchinson & Dalziel 1937b: 371, 372; Robyns 1947: 79; Eggeling & Dale 1951: 27;

Andrews 1952: 392; Taylor 1960: 95, 96, pl. 17; Walker & Sillans 1961: 81, 82; Huber 1963: 74, pl. 216; Kunkel 1965: 116, 117; Voorhoeve 1965: 63; Mensbrugge 1966: 320–325; Savill & Fox 1967: 48, 49, pl. 12; Ayensu 1978: 47, 48.
Fig. 4; Phot. 3, 5, 9; Map 3

Basionym: *Kickxia elastica* Preuss 1899: 353–360, pl. 1; De Wildeman 1900a: 633, 634; 1900b: 743–748; Warburg 1902: 200–207, pl. 15.
Type: Cameroun, Yaoundé, *Preuss 1381* (holotype not seen, destroyed in B; lectotype: K; isotypes: BM, BR, E, MO, P, W).

Tree or shrub up to 35 m high. Trunk up to 50 cm in diameter; bark smooth, sometimes with a few orbicular lenticels, greenish-brown to grey, mottled; the white latex rolls easily into balls; branchlets glabrous. *Leaves*: petiole 0.2–1.5 cm long, glabrous; blade coriaceous, 1.4–3.5 × as long as wide, 6–27 × 1.5–10 cm, beneath sometimes with a few hairs on the midrib; domatia consisting of pits, often with a ciliate margin, sometimes absent; margin undulate and revolute; 6–12 secondary veins on each side of the midrib. *Inflorescence* congested, terminal and at the same time axillary, 3–35-flowered, 2–2 × 1.5–4 × 1.5–4 cm; pedicel 2–8 mm long, glabrous. *Flowers*: mature buds pale green, apical portion conical, 7–17 mm long, acute or subacute. *Sepals* elliptic to broadly ovate, 3–5 × 2.1–4.5 mm, glabrous on both sides; 6–20 0.2–1 mm long colleters which are variable in shape and size. *Corolla*: tube very pale green to white, ventricose at 43–67% from the base, 1.4–2.8 × as long as the calyx, 1.6–2.5 × as long as wide, 5.5–10.5 × 3–5.5 mm, glabrous outside; lobes white, triangular to ovate, distinctly auriculate, 0.35–0.85 × as long as the tube, 1.4–2.7 × as long as wide, 3–7 × 2–4 mm, sometimes minutely ciliate at the margin, glabrous on both sides or sometimes inside near the base pubescent. *Stamens* 2.7–4 × 1–2 mm, inserted at 37–57% from the base of the tube, subsessile; anthers 2.2–4 × 1–2 mm with a 1.1–2.3 mm long fertile portion; connective 2.4–3.5 mm long, dorsally appressed-pubescent with 0.3–0.5 mm long hairs. *Pistil* 4–6 mm long; ovary subglobose, 1.1–2 × 1–2.4 × 1–2.4 mm, glabrous; style 1.5–3 × 0.15–0.4 mm, glabrous; clavuncula and stigma ovoïd, 1.1–2.6 × 0.4–1 mm; stigma conical, surrounded by an exudate. *Disk*: lobes 1.1–2.1 mm long, truncate, longer than the ovary or rarely as long as the ovary. *Fruit*: follicles almost clavate, 8–19 cm long, 3.6–8 cm in circumference, subacute or acute at the apex, sometimes slightly curved; flat adaxial side 2.4–5.2 cm wide, mostly with raised edges. *Seed* 4.5–7 × 0.3–0.4 cm; beak 3–5 cm long with straight 4.5–7 cm long hairs; glabrous basal portion of the beak 0.5–1.3 cm long; testa rugose, glabrous. *Seedling* glabrous.

FIG. 4. *Funtumia elastica* (Preuss) Stapf: 1. flowering branch, 2/3 ×; 2. domatia in the axils of secondary veins, 4 ×; 3. longitudinal section of flower, 4 ×; 4. opened fruit, 2/3 ×; 5. seed, 2/3 ×; 6. transverse section of the seed, 4 ×; 7. cotyledons, 2 ×. – (1–2. *Zwetsloot 32*; 3. *Zwetsloot 32*, spirit material; 4–7. *Leeuwenberg 11979*).


5
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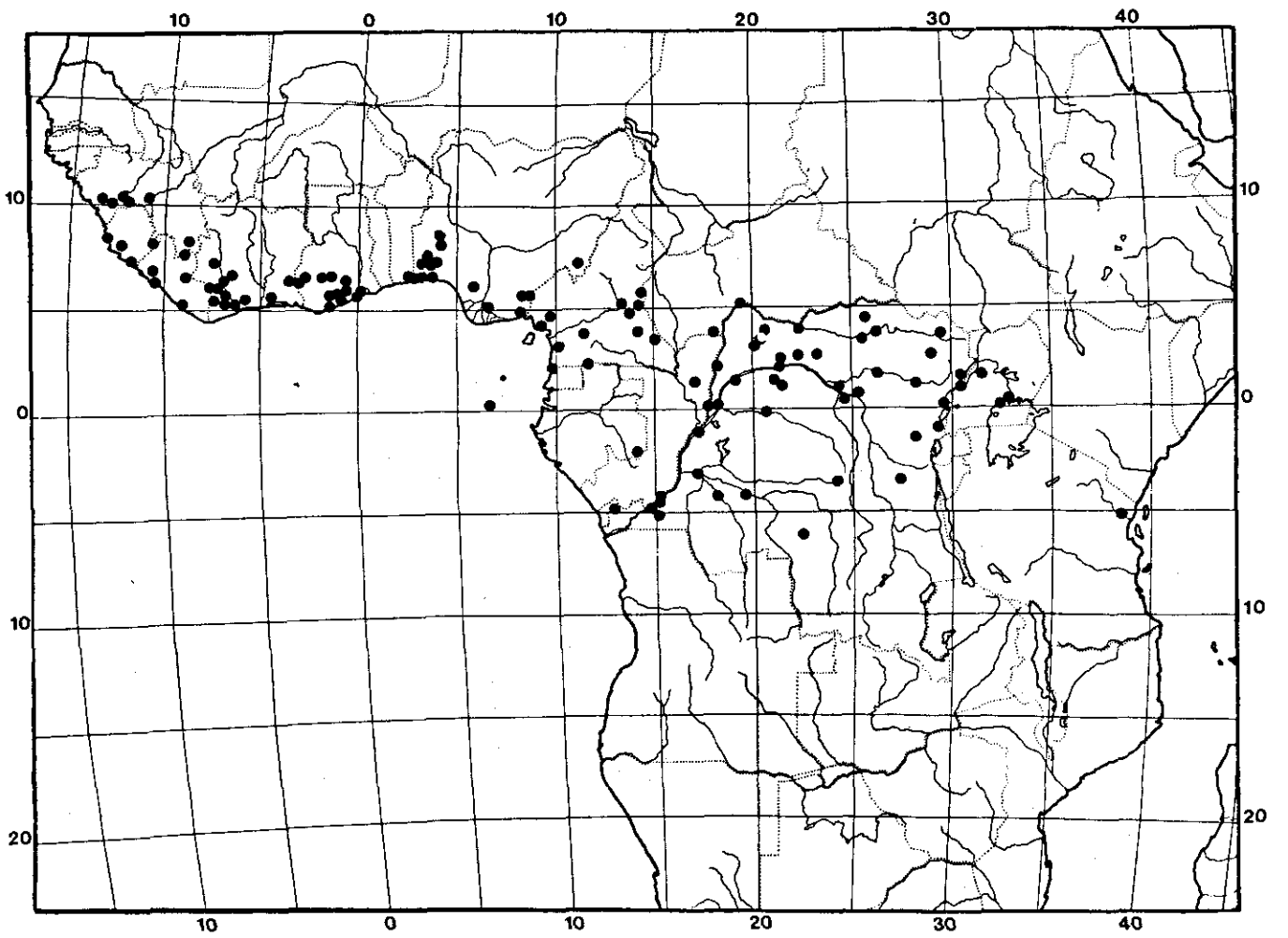
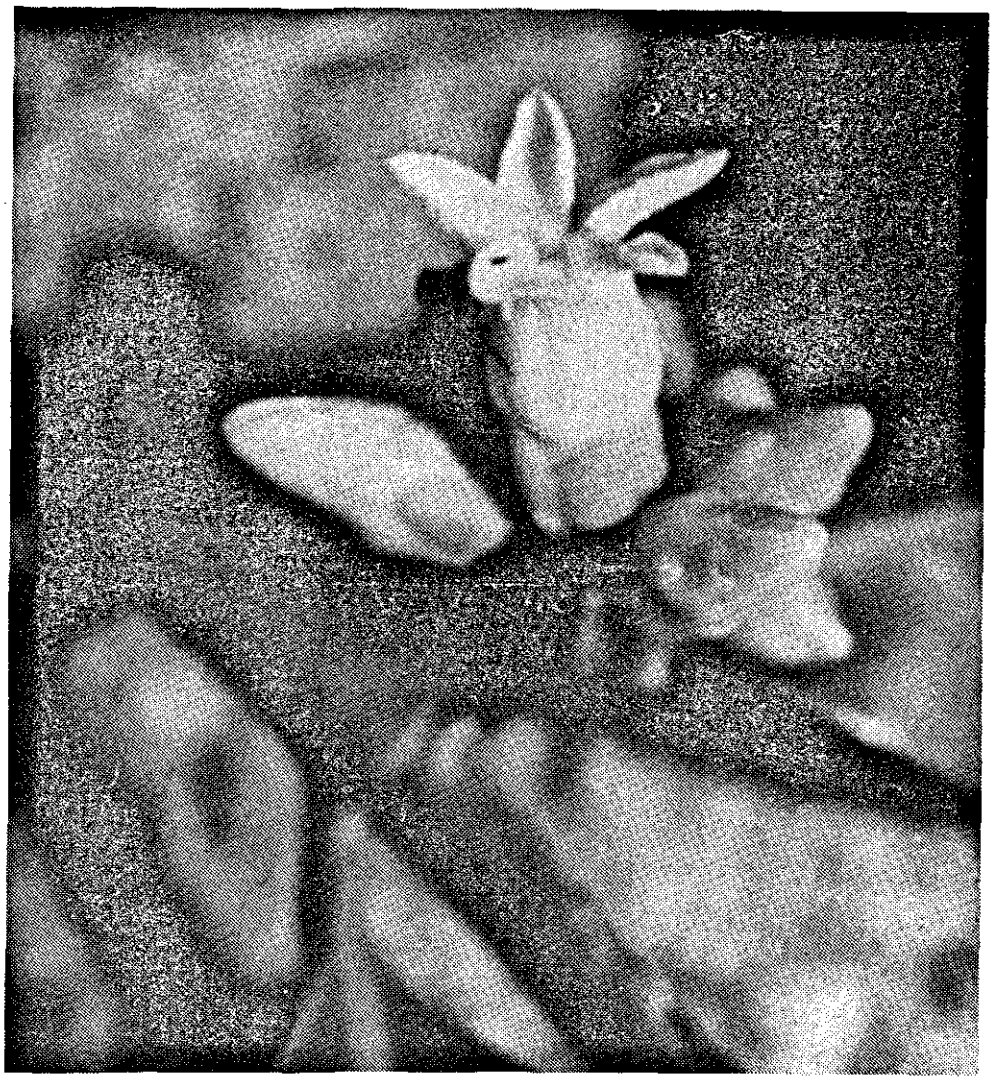
1



MAP 3. *Funtumia elastica* (Preuss) Stapf

Distribution: Tropical Africa from Senegal to Tanzania.
Ecology: Secondary, evergreen and deciduous forests. Alt. 0–1200 m.

Uses: It is regarded as a valuable rubber tree. The latex coagulates easily and yields about one-third of its weight of pure rubber, which is of a high quality. It is called 'Lagos silk rubber'. Because of its low output per hectare per annum it could not compete with *Hevea brasiliensis*. Notwithstanding large plantations have been established in Ghana, Nigeria and Cameroun and it was introduced in many tropical countries outside Africa (PURSEGLOVE 1968: 628). The latex provides a medicine against male impotence (AYENSU 1978: 49). The wood is used for making stools (IRVINE 1961: 622), for carving images and making boxes (IRVINE 1930: 200), for making paddles and domestic tools (WALKER & SILLANS 1961: 82) and it is proposed as match stick wood as it burns readily (DALE & GREENWAY 1961: 47). In Ghana the bark serves as a remedy for piles and in Ivory Coast it is an ingredient in Guéré arrow poisons (IRVINE 1961: 622). The steeped bark is used against jaundice (AYENSU 1978: 49). The seeds are employed as an adulterant of *Strophanthus* seeds. The floss of the seed has been found to be capable of being spun and is often used locally to stuff cushions (HUTCHINSON & DALZIEL 1937: 372).



PHOT. 9. *Funtumia elastica* (Preuss) Stapf, inflorescence. – *(Zwetsloot 32).*

Vernacular names:

SIERRA LEONE: *boboi, buboi, gboboi, watia, lel-boi* (AYENSU 1978: 49).

LIBERIA: *si gilli* (Mano) (HUTCHINSON & DALZIEL 1937b: 371).

IVORY COAST: *efurumundu* (Agni), *ofuntum* (Apollonien), *pé chi* (Attié), *po yu dua* (Fanti), *twi* (Néyau), *uruba su* (Bété), *bébéti* (env. of Cavally R.), *dorosé popülü* (Plapo) (CHEVALIER 1909: 124); *wolobatou* (Oubi) (teste: *Adjanohoun & Aké Assi 55*); *fumundu* (Agni), *amane dua* (= rubber tree) (HUTCHINSON & DALZIEL 1937b: 371).

GHANA: *funtum, fruntum* (Ashanti) (teste: *Vigne 126, 1513*); *ofruntum* (Twi, Fanti, Ashanti), *funtum* (Krepi), *efunmundum* (Nzima, Aowin) (IRVINE 1930: 200); *guni, puni* (Krepi) (HUTCHINSON & DALZIEL 1937b: 371); *frummundu, fummundu, potombo, ofrundum* (AYENSU 1978: 49).

NIGERIA: *chigban ete* (Nupe), *ire* (Yoruba), *anyan* (Bini), *mba* (Ibi), *nkwame* (Boki) (KEAY, ONOCHIE & STANFIELD 1964: 385); *ayon, anyon, ainyo, bassa-bassa* (Benin), *mini-ema* (Ekpaffia), *aba-oji* (Nsokpo), *amamakake* (Abuan), *abakwa* (Engenni) (HUTCHINSON & DALZIEL 1937b: 371); *araba* (Benin) (teste: *T. Smith 21*).

CAMEROUN: *dinjongo* (Bakd.), *manjongo* (Bakw.), *ebongo manjongo* (Duala) (HUTCHINSON & DALZIEL 1937b: 371); *ndamba* (Yaoundé, Bassa) (teste: *Benoît 83*).

EQUATORIAL GUINEA: *emvila* (teste: *Tessmann 590*).
CENTRAL AFRICAN REPUBLIC: *mondembo* (env. of Mbaïki) (teste: *Badré 335*).
SÃO TOMÉ: *pau cadeira* (teste: *Espírito Santo 132*).
GABON: *ete, eti, ngong-meban* (Fang), *otanda* (Mitsogo, Ivéa), *mokanda-kanda* (Bavové, Apindji), *dutumba* (Eshira, Bavarama, Bavungu, Bapumu), *létomba* (Banzabi), *mulilimba* (Bavili), *létoto* (Bakélé), *onembu-nembu* (Orungu), *ngega* (Nkomi) (?), *ngwè-y'onaï, onomonomyè* (Mpongwè) (WALKER & SILLANS 1961: 82).
ZAÏRE: *limu* (env. of Bokala), *mobuli* (env. of Lukolela, Bokala and Rua), *mondunga* (Lingala), *montone, osuma* (env. of Lulonga), *ireh* (Haussa), *bwombwo, dembo, demboganete, embuimatei, itola, mariguongo, megwongwo, mombongo, mongwongo, mosale, musali* (env. of Bangala, Ubangi R.), *bombwoke* (env. of Bengamisa), *bongbwo* (Prov. Haut-Zaïre), *alongu, mongu* (Babira), *tondefere* (env. of Poko), *bole* (env. of Bokala), *mussale* (env. of Giri) (DUCHESNE 1938: 231; DE WILDEMAN 1905: 573–574); *ndimbo* (Ngwaka) (teste: *Evrard 421*); *mangwongo, magbombo* (env. of Yambata) (teste: *De Giorgi 1777*); *nikwongwo* (Kimbuba), *aloku* (Batwa) (teste: *J. de Wilde 3*); *mondiandembo* (Pama) (teste: *Toka 198*).
UGANDA: *nkago* (Luganda), *musanda* (Lunyoro), *Lagos rubber tree, African wild rubber* (EGGELING 1951: 27); *kwongo* (Kuamba) (teste: *St. Clair-Thompson E5231*).
SUDAN: *belingnur* (Abakayo) (ANDREWS 1952: 392).

A selection of the about 360 specimens examined:

GUINEA: Beilia, *Pobéguin 1952* (P); Kindia, *Jacques-Félix annis 1929–1932* (P); Dalaba, *Caille s.n.* (P); Mamou, *Chevalier 20377* (P); Timbo, *Chevalier 12451* (P); Mt. Ntongon, *Chevalier 20918* (P, WAG); N'Zérékoré (fr. Sep.) *Baldwin 13308* (K, MO, US).
SIERRA LEONE: km 100 Freetown-Lunsar Road (fr. Jan.) *Cole and Jarr EAC 35* (GC*, K*, SL*, WAG); Mano, *Thomas 10559* (BM); Njala (fl. Apr.) *Deighton 1159* (BM, K, MO); Panguma Distr., *Received from the Superial Institute 1* (K).
LIBERIA: 6 km S of Bomi Hills (fl. July) *Van Meer 88* (MO, WAG); Paynesville, *Voorhoeve 210* (WAG); Sinoe R. about 40 km from the coast, *Anonym. s.n.* (K); Zuole (bud Jan.) *Voorhoeve 792* (WAG); Mt. Nimba (fl. Feb.) *Adam 20941* (K, MO, UPS).
IVORY COAST: Cavally R., *Chevalier 15841* (P); 5–9 km E of Tienkùla (fl. Mar.) *Bernardi 8398* (A, K, M, P, S, WAG); Forêt de Koléahinou, *Miège and Aké Assi 3996* (ABI); Man-Kouibli Road, *Portères Dec. 1929* (P); For. Res. of Soubré (fr. Feb.) *Bamps 2073* (Br, K, P, WAG); 8 km W of Soubré (fl., fr. May) *Zwetsloot 31* (UCI, WAG); 18 km S of Soubré (fl., fr. Apr.) *Geerling and Bokdam 2500* (BR, MO, WAG); Touadji, km 45 Soubré-San Pédro Road (fl. May) *Zwetsloot 32* (UCI, WAG); km 35 Sassandra-Lakota Road (fl. May) *Zwetsloot 37* (UCI, WAG); 8–10 km E of Daloa (fl. Mar.) *Bernardi 8494* (G, K, P); 56 km N of Sassandra (fl., fr. Jan.) *Leeuwenberg 2604* (BR, FHO, K, L, P, UC, US, WAG, Z); km 95 new Abidjan-N'Douci Road (fr. Oct.) *De Kruif 384* (WAG); 25 km E of Abengourou, *Versteegh and Den Outer 612* (U, WAG).
GHANA: Kwapon (bud Dec.) *Oldeman 762* (BR, K, LD, MO, P, WAG, Z); 10 km N of Wiamoasi (fr. Feb.) *Leeuwenberg 11979* (GC*, WAG); between Kumasi and Kwadaso, *Cudjoe 540* (BR, WAG); Bobiri For. Res. (fl. Feb.) *Leeuwenberg 11975* (GC*, WAG); Assuantsi, *Baldwin 14024* (MO, US); Aburi (fr. July) *Chevalier 13836* (P); M'Praeso (fl. Apr.) *Beveridge 3282* (BM, BR, K, MO); Atewa Range (fl. Feb.) *Leeuwenberg 11072* (GC*, WAG); Mampong Hills (fl., fr. Nov.) *W. H. Johnson 255* (K).

BENIN: Ita Djebou (fr. Nov.) *Van der Zon 196* (WAG); Porto Novo (fl. Jan.) *Chevalier 22880* (P, WAG).

NIGERIA: Lagos State: Lagos, *Punch s.n.* (E, K); Mamu, *Olubi s.n.* (K). Ogun State: Oban Distr., *Talbot 1466* (BM, K, Z); Olokemeji Res. (fr. Feb.) *Ross 86* (K); about 50 km ENE of Ijebu Ode (fl. Apr.) *Van Meer 700* (WAG). Oyo State: km 167 Ibadan-Abeokuta Road (fr. Sep.) *Emwiogbon FHI 45521* (BR); Ibadan For. Res. (fl. Dec.) *Onochie FHI 7501* (K); Busogboro (fl., fr. Apr.) *Onyeachusim and Olorunfemi FHI 46004* (FHO, K); Ibadan (fl., fr. Dec.) *Meikle 867* (BR, K, P); between Ife and Ibadan (fl., fr. Dec.) *Keay FHI 28291* (K); Olowo, *Chizea FHI 23980* (FHO); between Sjebu and Ode, *Chukwuogo FHI 4652* (BR, FHO, K, P); Gambari (bud May) *Van Eijnatten* 1511 (WAG). Bendel State: Sapobo For. Res. (bud Feb.) *Emwiogbon FHI 45324* (K). Rivers State: Ahoada District (fl. Jan.) *MBA (?) O.C. 43* (FHO). Cross River State: Calabar (fl. Jan.) *T. Smith 21* (BR, FHO); Abarogba (fl. Jan.) *Holland 158* (K); Iyamoyong (fl. Apr.) *Binuyo FHI 41214* (BR, FHO, K, WAG); between Insofan and Obeyon, *Holland 243* (K). Gongola State: River Nwum For. Res. (fl., fr. Apr.) *Chapman 4830* (K).

CAMEROUN: Victoria, *Maitland 319* (K); Mundame, *Connan (?) 62* (E); Bipindi (fl. Aug.) *Zenker 188* (A, B, BR, C, G, LD, MO, P, U, UC, US, WAG); ibid. (fl., fr. Dec.) *Krukoff 167* (MO, NY); Yaoundé (fl. Oct.) *Preuss 1381* (BM, BR, E, K, MO, P. W, type); Deng Deng, *Jacques-Félix 4682* (P); km 21 Bertoua-Deng Deng Road (fl. June) *Nana 102* (P); km 94 Bertoua-Deng Deng Road (bud Oct.) *Nana 310* (P); Iombel Bakossi, Kumba Division (fl. Feb.) *Forteh 3* (FHO); 55 km S of Batouri (fr. July) *Letouzey 5544* (P); Yokadouma (fl. Apr.) *Hédin 578* (P).

GABON: Nkogo, Ogoué R. (bud. Aug.) *Fleury in herb. Chevalier 26401* (P); N'Tem R. basin, *Cottes s.n.* (P).

EQUATORIAL GUINEA: Campo Bay (fl. Nov.) *Tessmann 590* (K).

SÃO TOMÉ: Quinta da Graça (fl. Jan.) *Espírito Santo 132* (BM, COI, K, LISJC, LMA, NY).

CENTRAL AFRICAN REPUBLIC: Boukoko (fl. Oct.) *Tisserant 331* (BM, P); km 17 Mbaïki-Boda Road (fl., fr. Dec.) *Badré 335* (P); Bangui (fl. Dec.) *Chevalier 10919* (P), (fl. July) *11041* (P).

CONGO: Brazzaville, *Pobéguin 11* (P); Komo R. (fr. June) *Chevalier 26927* (P).

ZAÏRE: Prov. Bas-Zaïre: Kizu (fl. Oct.) *Vanderijst 26791* (BR); Kisantu (fr. Sep.) *Carlier 253* (BR, K); Lazaret du Sacré Coeur (fr.) *Vanderijst 1 Nov. 1911* (BR); Bokala (fl., fr.) *Gillet Aug. 1902* (BR); Luano (fr. Apr.) *Lescrauwaet 29* (BR); Manghe (fl.) *E. Laurent 15 Nov. 1903* (BR); Hemptinne St. Benoît, *Vanderijst 23697* (BR). Prov. Equateur: Mompoto (fl., fr. July) *Toka 198* (BR); Eala (fl., fr. Dec.) *Leemans 584* (B, BR, K, MO); Bandaka (bud Mar.) *Flamigni 73* (BR); Imese (fl.) *E. Laurent 23 Dec. 1903*(BR); Bangala (fl., fr. Dec.) *De Giorgi 25* (BR); Bunsu (fr.) *Van der Auwermeulen 1 Oct. 1909* (BR); Likimi (fl. Mar.) *Goossens 4069* (BR); Bongabo (fr. Oct.) *Gilbert 1860* (BR); Boyasegese, *Evrard 421* (BR); Busanga (fr. Sep.) *Gorbatoff 28* (BR); Ekutschi, *Serv. de l'Agric., lettre 805, 29 May 1903* (BR); Bolombo, *Serv. de l'Agric., lettre 178* (BR); Lisala (fl. May) *Goossens 4670* (BR); Yambata (fl. Apr.) *De Giorgi 1777* (BR, K); Ngali, *Thonner 13* (BR); Dundusana (fl. Oct.) *Mortehan 624* (BR). Prov. Kasai: Katako-Kombe (fr.) *Serv. de l'Agric., lettre 854, 5 Nov. 1904* (BR); Manghay (fr.) *A.C.H.C., lettre 125, 3 Apr. 1908* (BR). Prov. Haut-Zaïre: Between Libenge and Zongo (fr. Nov.) *Lebrun 1609* (BR, WAG); Uele R. (fl. Dec.) *Dewulf 418* (BR); Mobwasa (bud June) *Lemaire 408* (BR); Romée (fl.) *M. Laurent Jan. 1906* (BR); Ngazi, *Louis 14811* (BR); Bengamisa (fl., fr. Nov.) *Louis 626* (BR, WAG); Bambesa, *Pittery 184* (BR); Digba-Ango (fr. Feb.) *Gérard 5642* (BR, WAG); Mombele (fr. July) *Gilbert 1652* (BR, P, WAG); Panga (fl.) *Serv. de l'Agric., lettre 159, 6 May 1901* (BR); Penghe (fl., fr. Jan.) *Bequaert 215* (BR); Gombari (fr. Feb.) *Seret 476* (BR); Faradje (fl. Aug.) *Lebrun 3473* (BR, K, LMA); Kawa, *Vanderben 1265* (BR, K). Prov. Kivu: between Masisi and Walikale (fl., fr. May) *Lebrun 5228* (BR); Urega (fl. July) *Lebrun 5756* (BR, WAG); Parc Nat. Virunga, Semliki R. (fl. June) *J. de Wilde 3* (A, BR, C, K, LISC, MO, WAG); Mwenda (fl. Dec.) *J. de Wilde 4* (BR, C, K).

SUDAN: Mongalla, Azza forest (fl., fr. Feb.) *Turner 138* (K).

UGANDA: U 2: Semliki Forest, *Dawe 654* (K); Budongo (fr. Sep.) *Styles 88* (FHO, K), U 4: Kampala (fl. Dec.) *Wilson 214* (UC); Kirerema (fl. Oct.) *Dümmer 377* (BOL, P, US, Z); Mabira For. Res. (fl. Nov.) *Styles 228* (FHO, K).

TANZANIA: T 3: Muheza, along the road to Amani, *Perdue and Kibuwa 8484* (K, UPS); Amani (bud) *Rohrer 5 Dec. 1910* (Z).

* Not seen by the author, annotated by LEEUWENBERG.

Some of the cultivated specimens examined:

SIERRA LEONE: Botanic Gardens, Fourah Bay College (fr. Mar.) *Morton 1747* (K, MO, WAG).
IVORY COAST: ORSTOM, Adiopodoumé (fr. Apr.) *Zwetsloot 10* (UCI, WAG).
GHANA: Aburi, *Chevalier 13882* (P).
BENIN: Porto Novo (bud Oct.) *Le Testu 1* (BM).
NIGERIA: Lagos State (bud July) *Chevalier 13925* (P).
CAMEROUN: Bipindi (fl. Aug.) Zenker 188 (A, B, BR, C, G, LD, MO, P, U, UC, US, WAG).
SÃO TOMÉ: Água Cóco, *Espírito Santo 4773* (LISC, LISJC).
ZAÏRE: Prov. Bas-Zaïre: Kisantu, *Gillet 3130* (BR); ibid., (fl. Nov.) *Callens 3786* (BR); Kwamouth (fr.) *E. Laurent 26 Oct. 1903* (BR). Prov. Equateur: Bangala (fl., fr.) *Serv. de l'Agric., lettre 268, 9 Mai 1903* (BR); Dundusana (bud Jan.) *Mortehan 1121* (BR); Eala (fl. May) *Vermoesen 2310* (BM, BR, FHO, NY, P, S). Prov. Haut-Zaïre: Yangambi, *Bolema 1065* (BR, WAG).
ANGOLA: Loanda (fl. Apr.) *Gossweiler 5633* (BM, COI, LISJC, LISU).
UGANDA; Entebbe Botanic Gardens (fl. Nov.) *Dawkins 669* (EA, FHO).
TANZANIA: Amani (bud Nov.) *Ruffo 290* (EA, BR, LISC).
SRI LANKA: Along Peradeniya-Kandy Road (fl. Apr.) *Kostermans 24551* (Z).
INDONESIA: SUMATRA: Riouw, Muara Padjanki (bud Apr.) *Buwalda 6493* (NY).
SAMOA: Upolu (bud Nov.) *Whistler 1093* (B).
CUBA: Havana, *Ekman 18995* (S).
GRENADA: Annantale, *Broadway 3797* (K).
GUYANA: *Anderson 334* (K).
HAÏTI: Petionville, Massif de la Selle (fl. June) *Ekman 7087* (S).
JAMAICA: Kingston, *Gagzo 1905* (HBG, Z).
PORTO RICO: (fl.) *Aetland May 1926* (MO).
TRINIDAD: St. Ana's (fl. Sep.) *Broadway 5076* (BM, G, MO); Maracas Valley, *Simmonds 15429* (K).
MARTINIQUE: *Stehle 7224* (UC).
DOMINICA; St. Paul (fl. Feb.) *Wasshausen 395* (B).
UNITED STATES: New York Botanical Garden, *Taylor 18773* (NY).

Note; *F. elastica* is naturalised in Trinidad, Martinique and Sumatra.

SOMATIC CHROMOSOME NUMBERS IN FUNTUMIA

J. C. ARENDS & F. M. VAN DER LAAN

The chromosome number for the two species of *Funtumia* as recognized in this monograph is 2n = 22. The chromosomes have been observed in cells of squashed root tips after pretreatment in 8-hydroxyquinoline, fixation in acetic-alcohol and staining in aceto-orcein. The somatic metaphase plates of *F. africana* and *F. elastica* are shown in figures 5 and 6 respectively. An earlier report of 2n = 24 for *F. africana* by the authors (1979, Taxon 28 (4): 637) appears to be incorrect. This report was obtained from sectioned root tips fixed in Ivory Coast by DE KONING. The pertaining slide was analyzed again and it is concluded that some of the relatively long chromosomes have very distinct, somewhat extended centromeric regions.

It is obvious that such chromosomes can easily be interpreted as two smaller chromosomes, thus leading to a misinterpretation. In the pictured cell of *F. africana* (figure 5) which resulted from squash preparation some of the chromo-

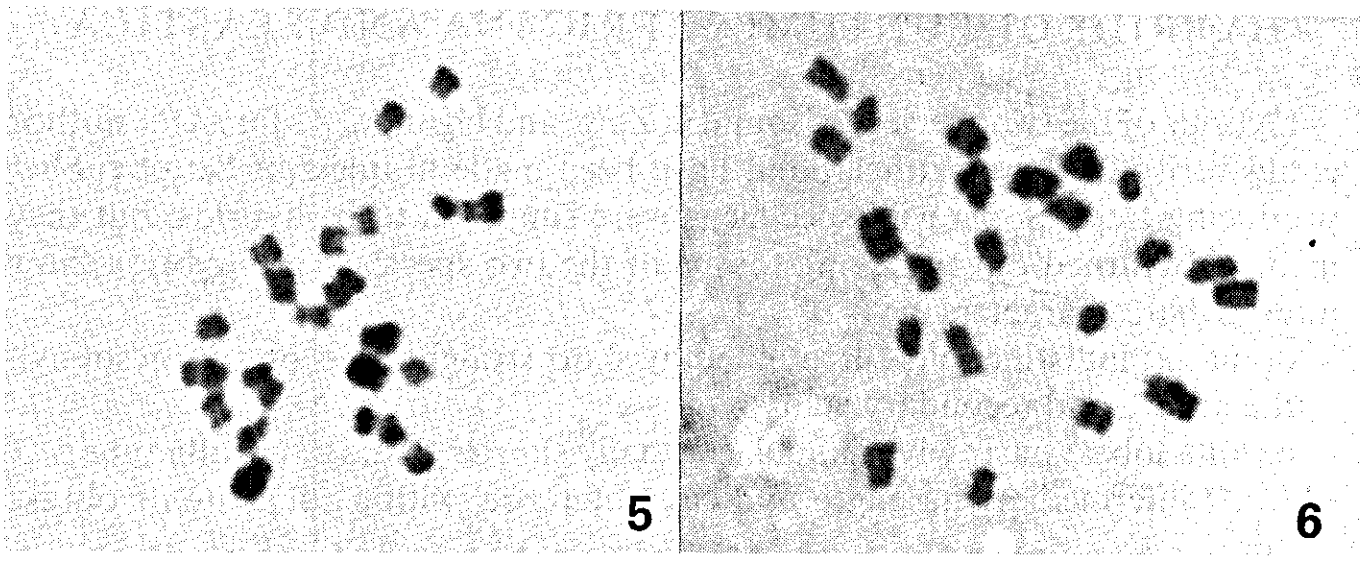


FIG. 5 and 6. Metaphase chromosomes in root tip cells of *Funtumia*. FIG. 5: *F. africana*, 2n = 22 (slide 8–25; plant voucher *Van Setten 193* WAG). FIG. 6: *F. elastica*, 2n = 22 (slide 5–81; plant voucher *Leeuwenberg 11979* (WAG). Magnification 300 ×.

somes with distinct centromeres can be seen also. The two species cannot be separated on the basis of their karyotypes, as these are similar. The number of 2n = 22 for *Funtumia* was already recorded by MANGENOT & MANGENOT (see FEDEROV, 1969, Chromosome numbers of flowering plants).

PHYTOCHEMISTRY OF FUNTUMIA

N. G. BISSET

The species of this genus contain in their leaves, bark, and seeds steroidal alkaloids which are mostly derivatives of 5α-pregnane and/or pregn-5-ene containing amino groups at the 3- and/or 20-positions, e.g. funtumine and related bases. Such substances are suitable starting materials for the (hemi)synthesis of therapeutically important steroids, e.g. oestrane and androstane compounds, and the discovery that the leaves of the widely occurring *F. africana* (*F. latifolia*) have a very high content of the alkaloids (up to about 4%) has led to their exploitation on an industrial scale particularly in France and Belgium.

Similar steroidal alkaloids are found in other genera of the *Apocynaceae* – *Holarrhena* (q.v.), *Kibatalia*, *Malouetia*, etc.

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HYBRIDS OF FUNTUMIA AFRICANA AND ELASTICA

Hybrids of the two species are found in Zaïre and Uganda. As far as the author could verify they are artificial and have been made in quest of better rubber producing trees. Some wild specimens were supposed to be hybrids, but they invariably turned out to belong to one of the two species. True hybrids show intermediate characters in:

- domatia: indistinct pits surrounded by short straight hairs on the mesophyl, the midrib and secondary veins;
- corolla lobes: narrowly triangular, usually shorter than the corolla tube;
- fruit: intermediate in length and circumference, with a subacute or obtuse apex.

The ovary of the hybrids analysed was always pubescent.

ZAÏRE: Prov. Bas-Zaïre: Bokala (fl., fr. Apr.) *M. Laurent 640* (BR); Kwamouth (fr.). *E. Laurent Sep. 1903* (BR); ibid. (fl., fr. Apr.) *H. Laurent* 643 (BR). Prov. Kasai: Manghay (fl., fr.) *E. Laurent 15 Nov. 1903* (BR). Prov. Equateur: Eala (fl., fr. June) *M. Laurent 1795* (BR).

UGANDA: *Christy 15 Mar. 1920* (K); Entebbe (fl. Oct.) *Eggeling 2316* (K).

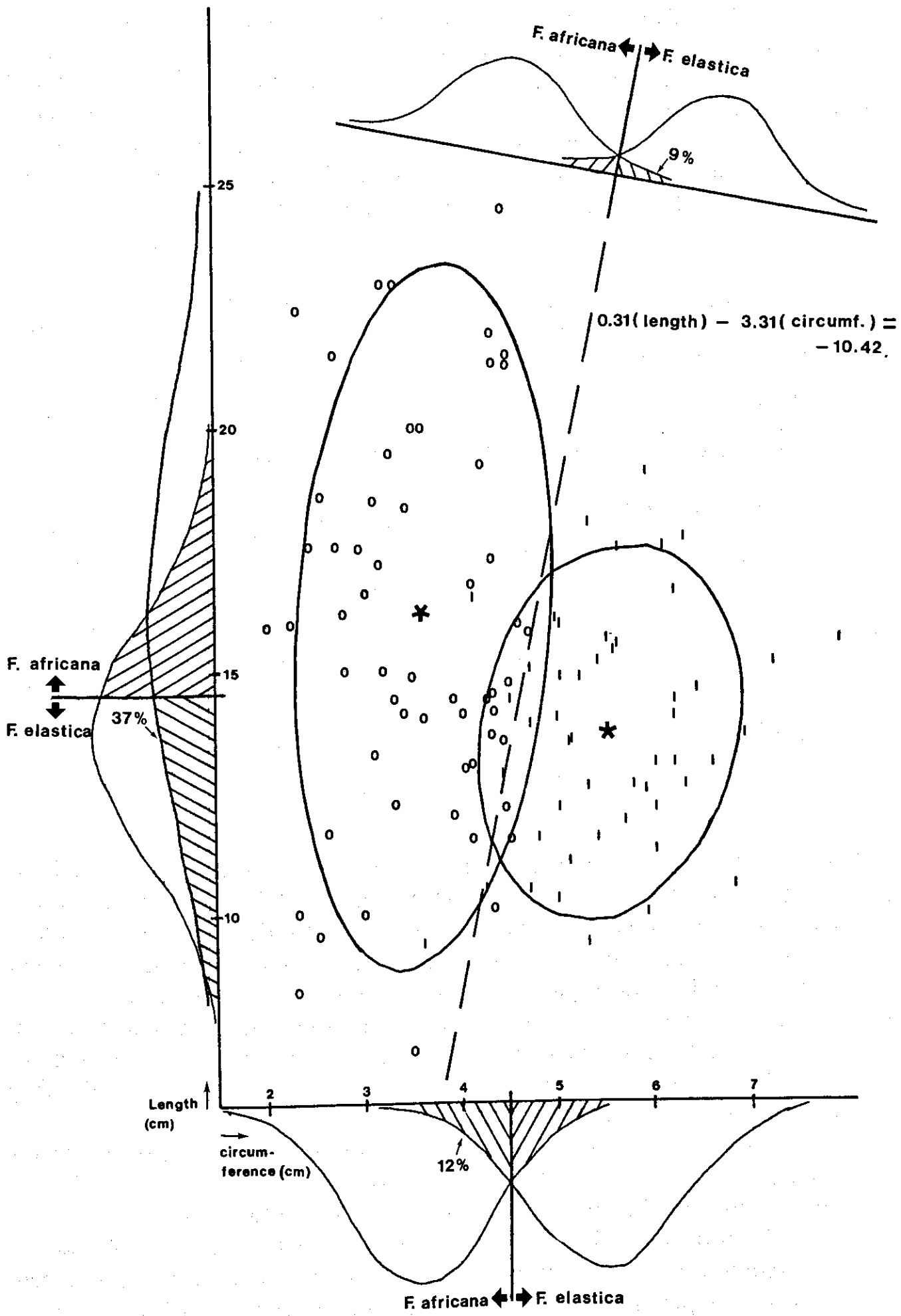
STATISTICAL KEYS (FUNTUMIA)

The two species in *Funtumia* can clearly be distinguished by one single character: the indumentum of the ovary. Unfortunately this character is not very useful in a field key as it is hardly observable without a magnifying glass. A field key requires more easily perceivable characters. Moreover the identification of fruiting or even vegetative specimens is desirable. This necessitates the construction of keys based on fruit and vegetative characters. However all these characters show such an overlap that is impossible to base a well working key on each of them separately. But by studying a combination of these characters it is possible to get a key, which identifies specimens with more certainty. Keys are derived by a statistical method called 'discriminant analysis'. These statistical keys are based on a sample from herbarium specimens and spirit material.

The method applied to the sample was described by BAHADUR & ANDERSON in 1962 as a modification of the method introduced to the botanical world by FISHER in 1936. The mathematical background is not the scope of this monograph, but interested readers are referred to the authors mentioned above and CORSTEN (1964), COOLEY & LOHNES (1966), GIRI (1977) and ZWETSLOOT (1981).

Fig. 7 Linear discriminant function for two fruit characters: length and circumference. The normal curves belonging to the characters of both species are drawn along the horizontal and vertical axes. The percentage of the area under the curves which is hatched, represents the probability of misidentification, which is equal for both species. The line with the equation: $0.31 \times (\text{length}) - 3.31 \times (\text{circumference}) = -10.42$ divides the swarm of specimens in two parts: specimens on the one side are identified as *F. africana*, on the other as *F. elastica*.

o = *F. africana*
| = *F. elastica*
* = centroïds


F. africana
F. elastica
9%
0.31(length) – 3.31(circumf.) =
– 10.42
25
20
15
10
F. africana
F. elastica
37%
Length
(cm)
circum-
ference (cm)
2
3
4
5
6
7
12%
F. africana
F. elastica

The method is only suitable for continuous characters: characters that can be measured, such as length, width and circumference. For a legitimate application each single character should have a normal distribution, but moreover the simultaneous distribution of the, say, p characters should be a p-variate normal one. Normality is a disputable assumption. There are several statistical tests on normality of single characters. All characters used were tested with the test of SHAPIRO & WILK (1965). The results are shown in Table 2.

TABLE 2. Results of the test of SHAPIRO & WILK on normality of some flower and fruit characters. At a sample size n the test statistic W can support lack of normality at the significance levels < 0.05, 0.05–0.10 and > 0.10, denoted by *, (*), –, in the column on the right side.

	character	species	n	W	
Flower:	sepal length	F. afr.	48	0.98	–
		F. ela.	24	0.93	(*)
	length of corolla tube	F. afr.	48	0.93	–
		F. ela.	24	0.96	–
	length of corolla lobe	F. afr.	48	0.95	–
		F. ela.	24	0.91	*
Fruit:	length	F. afr.	50	0.98	–
		F. ela.	48	0.98	–
	circumference	F. afr.	50	0.95	*
		F. ela.	48	0.99	–
	width of adaxial side	F. afr.	50	0.97	–
		F. ela.	48	0.97	–

A test on the multivariate normality of p characters is more difficult to perform and has been omitted. Despite some significant deviations of normality the method of BAHADUR & ANDERSON was applied to the data with the restriction of equal losses for both species: a wrong identification is considered equally bad for both species. In contrast with FISHER's method, the covariance matrices of both species may be unequal: spread and correlation of the characters in both species may be different. The unequality of the covariance matrices is demonstrated in Fig. 7 by the different shape and size of the swarm of points belonging to specimens of *F. africana* (0) and *F. elastica* (I).

The resulting keys, so called 'linear discriminant functions' have the following properties:

- They are interpretable in only one way and there are two possible outcomes. Doubt about the identification is impossible: either *F. africana* or *F. elastica*.
- The maximum probability of misidentification of both species is minimized. As a result the probabilities of misidentification are equal for both species.
- The probability of misidentification can be estimated.

To identify a specimen, the result of a simple arithmetical function of measured characters has to be compared with a computed critical value:

TABLE 3.
A. Flowers: x_1 = sepal length (mm), x_2 = length of corolla tube (mm), x_3 = length of corolla lobes (mm), a = *F. africana*, e = *F. elastica*.

discriminant function	critical value	if lower then	if larger then	prob. of misidentification
$-5.42x_1 + 0.20x_2 + 1.72x_3$	–5.87	e	a	0.03–0.04
$-3.99x_1 + 0.99x_2$	–5.21	e	a	0.12–0.16
$-5.30x_1 + 1.77x_3$	–6.73	e	a	0.03–0.04
$-0.59x_2 + 1.46x_3$	3.84	e	a	0.15–0.16
x_1	3.20	a	e	0.17–0.19
x_2	7.70	e	a	0.37–0.45
x_3	5.70	e	a	0.17

B. Fruits: x_1 = length (cm), x_2 = circumference (cm), x_3 = width of the adaxial side (cm), a = *F. africana*, e = *F. elastica*.

discriminant function	critical value	if lower then	if larger then	prob. of misidentification
$0.29x_1 - 4.30x_2 + 1.61x_3$	–10.55	e	a	0.05–0.09
$0.31x_1 - 3.31x_2$	–10.42	e	a	0.05–0.10
$0.33x_1 - 3.94x_3$	– 6.49	e	a	0.13–0.14
$2.84x_2 + 0.86x_3$	15.51	a	e	0.09–0.11
x_1	14.50	e	a	0.36–0.40
x_2	4.50	a	e	0.11
x_3	2.90	a	e	0.16–0.17

if $b_1x_1 + b_2x_2 + b_3x_3 + \ldots\ldots + b_px_p \geqslant c$ then: *F. africana*, otherwise *F. elastica*,

where $b_1,\ldots\ldots,b_p$ are computed coëfficients, $x_1,\ldots\ldots,x_p$ are the measured values of characters and c is the critical value.

In Fig. 7 the resulting key for two fruit characters, the length and circumference, is shown: the line with the equation:

$$0.31 \times (\text{length}) - 3.31 \times (\text{circumference}) = -10.42$$

divides the two dimensional space in two parts: a specimen on the one side of the line is identified as *F. africana*, on the other side as *F. elastica*. The probability of misidentification of this key is between 5 and 9 %. The key runs as follows:

if $0.31 \times (\text{length}) - 3.31 \times (\text{circumference}) \geqslant -10.42$, then *F. africana*, otherwise *F. elastica*.

A taxonomist who is not used to work with figures might be upset by a key of this kind, but the use of simple arithmetic is not uncommon in plant taxonomy: ratios are generally accepted in plant descriptions and keys.

These discriminant functions are derived for flowers and fruits. The analysis of vegetative parts did not result in useful keys of this kind, as the estimated probabilities of misidentification were to high. The results are shown in Table 3. The most favourable key combines a low probability of misidentification with a low number of characters.

In particular this kind of discriminant functions is fit to solve the problem of construction a key with overlapping characters. The author intends to emphasize their advantages: the minimized probability of misidentification at a fixed number of characters, the relative arithmetical simplicity, and the reproducebility. As disadvantage can be mentioned the laborious calculations to derive the key, the assumption of normality and the impossibility of using other than continuous characters. For keys with discrete characters, such as colour or type of indumentum, the reader is referred to GOLDSTEIN & DILLON (1978) and ZWETSLOOT (1981).

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REGISTER

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