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REVISION OF ATROXIMA STAPF AND CARPOLOBIA G. DON (POLYGALACEAE)

F. J. BRETELER and A. A. S. SMISSAERT-HOUWING

Laboratory of Plant Taxonomy and Plant Geography, Agricultural University, Wageningen, The Netherlands

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CONTENTS

1. INTRODUCTION

Atroxima STAPF and *Carpolobia* G. DON represent two small genera of the *Polygalaceae*, both confined to tropical Africa. They are closely related and well distinguished from the other *Polygalaceae* in Africa.

To the single character used so far to separate *Atroxima* and *Carpolobia*, i.e. absence or presence of endosperm, some others could be added, giving *Atroxima* a sounder basis as a distinct taxon. Pollen morphological and cytological research also may contribute to this.

The morphology of the inflorescence, the flower, and the seedling is briefly discussed as well as the phylogeny of the genera and species. So far no data are available on the pollinators of the different species. Research on this subject might reveal if the hypothesis outlined in paragraph 6, holds as a possible explanation for the peculiar distribution of *Carpolobia alba* in its relation to *Carpolobia lutea*.

Of the five species described in *Atroxima* only two could be maintained as distinct. In *Carpolobia* four species out of thirteen could be maintained.

2. HISTORY AND TAXONOMIC POSITION OF THE GENERA

Atroxima and *Carpolobia* belong to the tribe *Polygaleae*. They share the following characters: 5 herbaceous sepals, 5 well-developed petals, 5 fertile stamens, a 3-celled ovary, and a more or less drupaceous fruit.

In 1831 G. DON founded the genus *Carpolobia*. He described four species, all from Sierra Leone, of which two were later recognized by BENTHAM (1842, 1849) as belonging in the *Papilionaceae* and described in *Baphia* and *Bracteolaria* (= *Baphia*) by HOOKER F. (1849). The resemblances between flowering branches of *Carpolobia* and *Baphia*, although of superficial nature, are indeed striking and have been referred to in the combination *Baphia polygalacea* (HOOK. F.) BAK.

Some more recently described species from West Africa (e.g. *C. glabrescens*) proved to be synonymous with DON's species. From East Africa and Madagascar four species have been described and these fit well within the variable taxon *C. goetzei* GUERKE.

The genus *Atroxima* was proposed by STAPF in 1906, describing four species, of which two had been described previously in *Carpolobia*. STAPF founded his genus on the following characters: subequal petals, fruit hard with a crustaceous pericarp, and exalbuminous seeds. After examining all species concerned the endosperm character is the only one which holds on the generic level. One species has indeed fruits with a hard crustaceous pericarp, but the other one has fruits as in *Carpolobia*. The petal character is valid in relation to DON's West-African species, but less so when compared with the East-African *C. goetzei*, and it fails for the Central-African *C. gossweileri*, a species which was first

described in *Atroxima*. However, for the delimitation of the two genera some other characters could be added. The two *Atroxima* species are lianoid and entirely glabrous in their vegetative parts, whereas all *Carpolobia* species are shrubs or trees, never scandent, and always hairy in their vegetative parts. Moreover, the indumentum of the seeds in *Atroxima* is juicy, and perfectly dry in *Carpolobia* (see also under Phylogeny).

For both genera no indication was given by the authors which species they intended as type. In 1967 HUTCHINSON mentioned for *Carpolobia*, *C. alba* and for *Atroxima*, *A. liberica* as lectotype.

3. MORPHOLOGY

3.1. THE INFLORESCENCE

The inflorescence of *Carpolobia* and *Atroxima* resembles a raceme and usually it is described as such. However, the presence of 'branched racemes' as may be observed sometimes in *Atroxima* and occasionally also in *Carpolobia*, merits further attention.

When a 'branched raceme' is observed in *Carpolobia*, the lateral branch is usually short and single-flowered and may conveniently be recognized by the larger bract subtending it. Such short lateral branches are often fused to some extent, sometimes entirely so, with the main axis. This concaulescence situates the flower of the lateral branch on the main axis of the inflorescence and this may explain the aberrant sequence of flowering as compared to a true raceme, i.e. from base to top, with flowers opening, out of order, later than some subsequent ones.

This phenomenon of concaulescence occurs also in *Carpolobia* where the main axis of the inflorescence partly fuses with the supporting leafy branch, as already observed in *Polygala* by CHODAT (1896: 325). The lateral raceme-like branches of this main axis thus appear to originate from different, independent, axillary buds placed in a serial position. The bracts subtending these lateral branches are again larger than the floral bracts and usually early caducous. The large 'empty' bracts at the base of an inflorescence as often observed in *C. goetzei* and also in *C. gossweileri*, may indicate that the expected lateral branch has not developed.

In *Atroxima* the main axis of the inflorescence does not fuse with the supporting leafy branch, and the lateral branches of the inflorescence originate from its very base. These branches are usually raceme-like, but may sometimes branch again.

This leads to the conclusion that, although the inflorescences of *Atroxima* and *Carpolobia* look like racemes, they represent in fact branched inflorescences of paniculate or corymbose nature.

3.2. THE FLOWER

Investigation of the aestivation of the calyx and the corolla in *Atroxima* and *Carpolobia* revealed that two self-reflective aestivation types occur in these genera, both with an imbricate calyx and a contorted corolla, the corolla lobes covering each other clockwise or counter clockwise (fig. 1: A–B). In all species both types always occur within the same inflorescence in more or less the same frequence. There is no evidence of any fixed station of these aestivation types, i.e. they occur very much mixed. The position of the upper large sepals (4 and 5) in fig. 1: A always indicates a clockwise contorted corolla, the position as in fig. 1: B the counter clockwise corolla. At anthesis the contorted position of the petals is disturbed and usually both edges of the keel petal may be found covered by the lateral petals.

Simultaneous occurrence of these two aestivation types can be explained when accepting the derivation of these raceme-like indeterminate inflorescences from a compound inflorescence with determinate lateral units of dichasia, for in dichasia the diagrams of two opposite flowers of the same order are each others images.

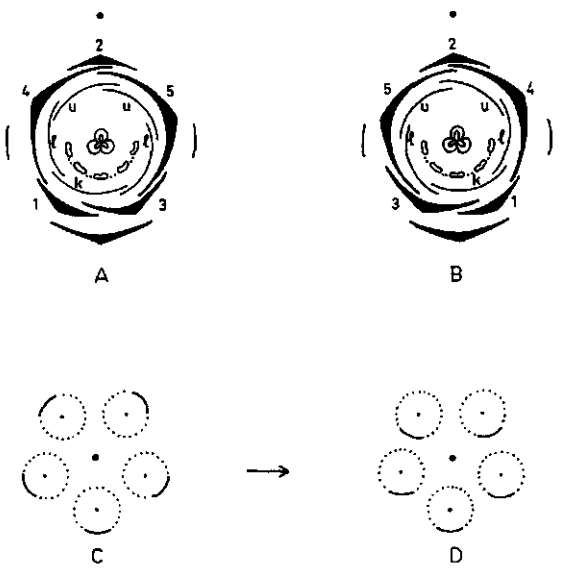


FIG. 1. A–B. The two flower diagrams of *Atroxima* and *Carpolobia:* 1, 2, 3, 4, 5 = sepal sequence; k = keel petal; l = lateral petal; u = upper petal. C. Transverse section of an inflorescence (schematically) showing the original abaxial position of the keel petal *(Atroxima* and *Carpolobia).* D. As C, but with the actual position of the keel petal. (See text p. 8).

3.3. The seedling

Of only two species the seedlings are known*, namely of *Atroxima liberica* and of *Carpolobia lutea*. The seedlings of the former expose their thick, green cotyledons just above the ground, a hypocotyl is lacking. Between the cotyledons and the first normal leaves some bracts (cataphylls) are produced on the epicotyl.

In *Carpolobia lutea* the hypocotyl is well-developed, up to ca. 6 cm long and winged. The foliaceous cotyledons, at first folded together and covered by the hairy seed-coat, are suborbicular, rather large and long persistent.

Seedlings of the remaining species of both genera are needed to see whether the presence or absence of a hypocotyl is constant within each genus.

4. FLOWER BIOLOGY

All species of both genera show a remarkable twist of their flowers. When analyzing flowers to investigate the aestivation type it was remarked that the keel petal is usually not found in a strict abaxial position. Its position varies from abaxial to lateral and adaxial. This is achieved by the twist of the pedicel. Whether this twist (seen from above) occurs clockwise or counter clockwise is in *Carpolobia* rather closely related with the aestivation type. A clockwise aestivation of the corolla usually means that the flower twists counter clockwise on its pedicel and in the opposite direction for the counter clockwise aestivation type.

This peculiar twist of the flowers most likely has an important function in pollination. In fig. 1:C a transverse section of an inflorescence is drawn schematically, showing its central axis and simplified diagrams of five flowers with the keel petal in the original, abaxial position. Pedicel twist, however, causes the position of the keel petal to change in such a way that they all face the same side (fig. 1:D). As the axis of the inflorescence is usually found in a more or less horizontal position on the living plant, all keel petals take up a position in which the ventral side faces upwards, a situation which must be convenient for visiting insects (see also photograph 1).

In this position the concave keel petal, which harbours the stamens and style, is protected against rain by the upper petals, which, at least in *C. alba*, are very thick in their central part and form an effective roof. In *C. lutea* the upper petals are spreading and the keel petal itself protects the enclosed organs as the margins are neatly folded together, not leaving the slightest slit (see photograph 1).

A specimen of *C. lutea* has been flowering in the Wageningen conservatory for a number of years, and it always failed to produce any fruits. Thus self-sterility might hold for the other species of both genera as well. The presence of nectar filling the lower part of the calyx at anthesis, as was observed in the

* After the manuscript went to the printer, seedlings have been grown and collected at Wageningen *(J. van Veldhuizen no. 176)* of *Leeuwenberg 11304* from Nigeria. They fit the description of the *C. lutea* seedlings.

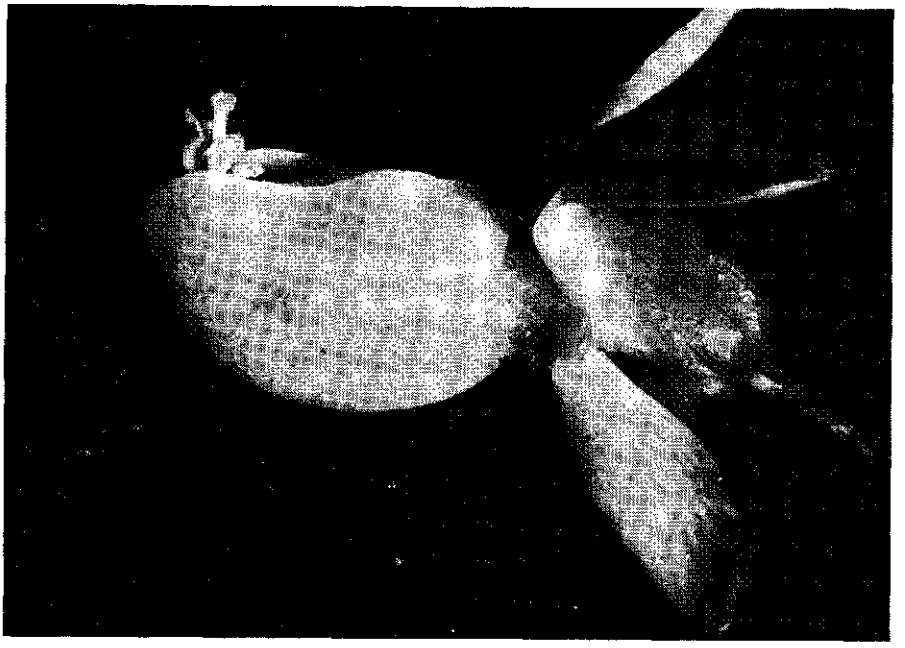
PHOT. 1. *Carpolobia lutea.* Inflorescence showing position of keel petal. *(Breteler 7533;* phot. H. C. D. DE WIT).

Wageningen *C. lutea* specimen, might indicate cross fertilisation by insects. A visiting insect in search of nectar will, when landing on the flower of *C. lutea*, automatically press down the keel petal, cause its margin to separate and produce the anthers and stigma. Unavoidably pollen will be deposited on the insects abdomen and thus making the cross pollination possible (see photographs 2 and 3).

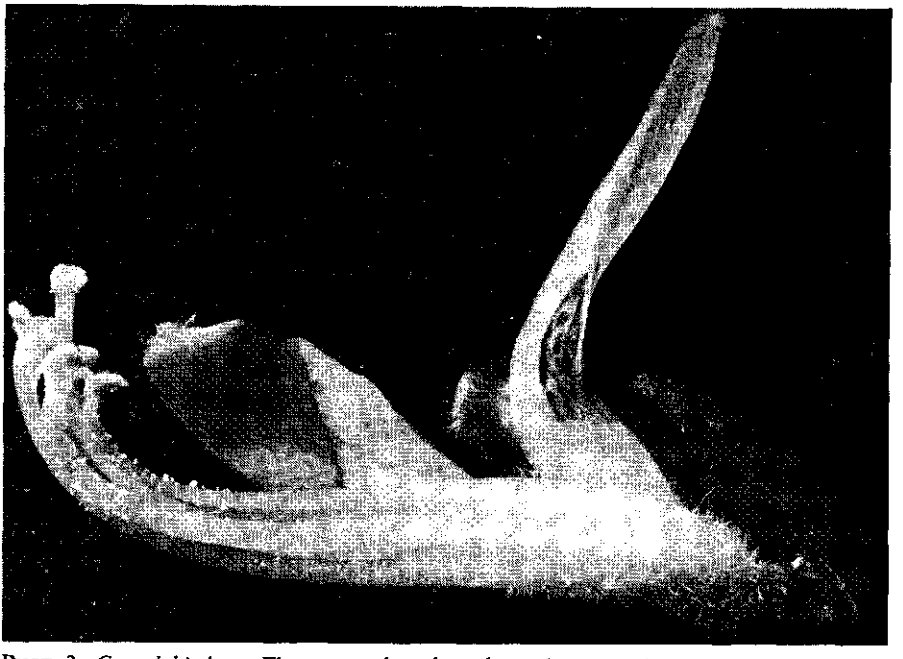
In all the other *Carpolobia* species and in the *Atroxima* species the generative apparatus is well included in the flower and covered by the upper petals. Here a visiting pollinator has to enter the flower from the top and this may indicate its identity, at least its behaviour, to be different from that of *C. lutea.* It might be possible that the conspicuous mottling on the inside of the spreading upper petals of *C. lutea* as compared to the coloration on the outside of the subappressed upper petals in the other species, contributes to different behaviour patterns of the respective pollinators.

5. PHYLOGENY

The presence or absence of endosperm in the seeds is generally considered to be of importance whether a taxon will be classified as primitive or advanced. In this respect the genus *Atroxima*, having seeds without endosperm and with



PHOT. 2. *Carpolobia lutea.* Flower of which the keel petal has been pressed down. *(Breteler 7533;* phot. H. C. D. DE WIT).



PHOT. 3. *Carpolobia lutea.* Flower, sepals and petals partly removed. Basal part of calyx with nectar. *(Breteler 7533;* phot. H. C. D. DE WIT).

thick cotyledons, should be regarded as well advanced and the genus *Carpolobia*, with foliaceous cotyledons embedded in abundant endosperm, as primitive. However, this endosperm character is considered to be of doubtful quality in *Polygalaceae*, not only because it may vary from one species to another within the same genus as is the case in *Polygala* (CHODAT, 1896:328), but it may also change from presence into absence in the same species in the very ultimate fase of maturation of the seed as happens in *Xanthophyllum* (VAN DER MEYDEN, personal communication). Nevertheless it has proven to be a constant character in *Carpolobia* and *Atroxima*.

When considering *Atroxima* advanced, based on the endosperm character, another character supports this, as the lianoid habit in this genus may well be considered as an advanced character. In *Carpolobia* 3 species have the habit of a shrub or treelet, the fourth *(C. gossweileri)* may reach the dimensions of a medium-sized tropical forest tree (up to 30 m tall).

There are a few other characters, of secondary importance, which are correlated with those mentioned above. The first of these can be observed in the seed indumentum. The group of 3 *Carpolobia* species mentioned above, has dry, ordinary hairs on its seeds. In *Atroxima* the seed indumentum consists of an erect, dense pallisade of hairs with a wide lumen filled with juice. In *C. gossweileri* a mixture is found, i.e. dry, ordinary hairs and juicy hairs. Another secondary character is found in the flower: partly fused filaments in *Carpolobia*, completely united ones in *Atroxima*. In this respect *C. gossweileri* may be characterized as the most advanced *Carpolobia* species and is found, here again, in an intermediate position between *Carpolobia* and *Atroxima*. It is illustrative that EXELL, having only flowers available, described *C. gossweileri* as belonging to *Atroxima*.

Considering this character of the androecium, two opposite tendencies of floral development may be distinguished in these two closely related genera. The one with a protruding generative apparatus, accompanied by an equally protruding keel petal and smaller, spreading other petals is represented by *C. lutea* (fig. 6:6 and 8). The other with a smaller generative apparatus included within the floral envelope, accompanied by a smaller keel petal (equal to or smaller than the other ± appressed petals) is represented by the *Atroxima* species (e.g. fig. 2:3). These two tendencies are further illustrated when inspecting the length of the fused part between staminal sheath and upper petals in relation to the total length of stamens. This is very short in *C. lutea* (fig. 6:10) and very long in *C. gossweileri* (fig. 5:7) and in *Atroxima* species (fig. 2:3). Here again *C. gossweileri* tends towards *Atroxima*. *C. goetzei* (fig. 4:11) seems to be intermediate between the two extremes, whereas *C. alba* (fig. 3:9) shows strong tendencies towards *C. lutea*. It is difficult to say which of the last two species may be considered the most primitive one. Chromosome studies as well as pollen morphological investigations may reveal characters and tendencies which elucidate this question.

6. DISTRIBUTION WITH SPECIAL REFERENCE TO CARPOLOBIA ALBA

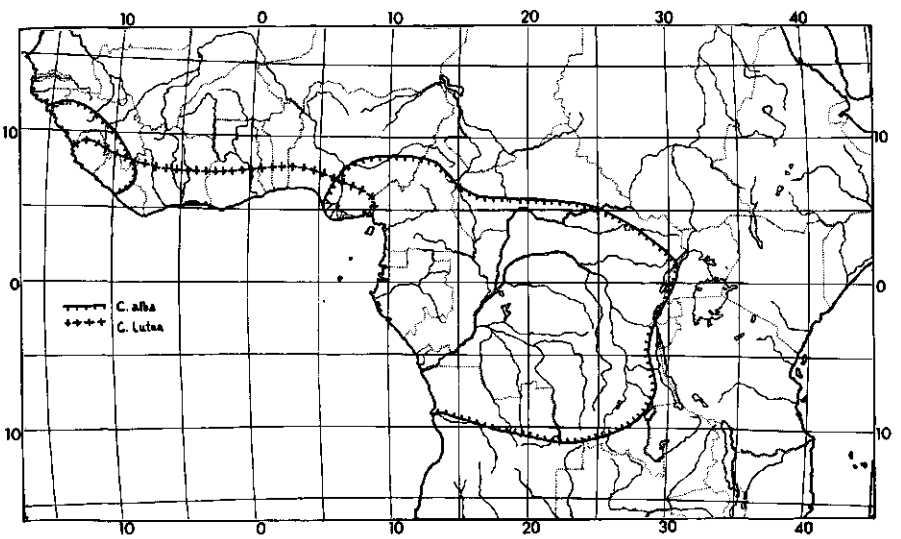
The two *Atroxima* species are almost sympatric. There is a slight indication that *A. liberica* (map 3) prefers the wetter part of the tropical rain forest whereas the records of *A. afzeliana* may point to a greater ecological tolerance of this species (map 2).

Both species have not been collected as frequently (especially in Ghana and Nigeria) as those *Carpolobia* species which occur in the same area. Whether these *Atroxima* species are indeed less frequently present is not known, but it may be observed in general that species with a lianoid habit, although frequently present in the forest, are far less frequently collected. Moreover, such species do not occur or are at least rarely found in fertile stages in the secondary vegetation of roadsides where the *Carpolobia* species often have been collected.

In *Carpolobia* 3 species are confined to the tropical rain forest area with some outposts in gallery forests of the savannah area. Of these *C. gossweileri* has a narrow distribution in western Central Africa. *C. goetzei* is largely East-African with one record from Madagascar.

C. alba has a very peculiar distribution (map 4). It is present in West Africa from Guinea eastwards almost as far as the border between Liberia and Ivory Coast. It is absent in the latter country as well as in Ghana, Togo and Dahomey. It appears once more in the eastern part of Nigeria and it is the only common species in Central Africa. In the gap between Liberia and eastern Nigeria, *C. lutea* (map 7) is the only species present, overlapping in the West and in the East the separate areas of *C. alba* (see map 1).

The western and eastern specimens of *C. alba* have been compared very



MAP 1. Distribution of *Carpolobia alba* and *Carpolobia lutea*.

carefully, but not any distinctive morphological or ecological character could be found. A gap in the distributional area of West-African species is not uncommon. In such cases the famous Dahomey-gap appears, which is, however, much smaller than the gap in the distribution of *C. alba*, and does not include Ivory Coast and Western Ghana. There are also disjunct area's in species (e.g. *Duparquetia orchidacea* BAILL.) which are confined to the very wet parts of the African rain forest as occur in Liberia and in Eastern Nigeria, Cameroun and Gabon.

Quite often the actual known area of distribution, as based on the available herbarium specimens, will change considerably when intensive collecting is done in area's where the species has not been collected before. This could hardly be the case with *C. alba* as Ivory Coast is rather well explorated and *C. lutea* is very well collected in the large gap. Both species share a similar habit and ecology, they have equally showy flowers and fruits and they are flowering and fruiting at the same time.

There must be another cause why *C. alba* is absent in such a large area where the growing conditions for this species appear to be favourable, or at least do not differ from those in the area where the species is frequently collected.

As has been observed in the preceding paragraph, *C. alba* is most closely related to *C. lutea*. The area of distribution of *C. lutea* is flanked on either side by that of *C. alba*. If one accepts that *C. lutea* has evolved from *C. alba* or that both share the same ancestor(s), *C. alba* or the common ancestor(s) may have occupied the entire area now occupied by both species together.

Originally, i.e. early in their evolutionary history, the morphological differences between the two species must have been very small and likely their pollinator(s) must have been the same. The actual important difference for pollinator(s) between the flowers of the two species is found in the upper petals: subappressed in *C. alba*, spreading in *C. lutea*. Both species have a well developed keel petal of which the large upper part is connected by a kind of hinge to the narrow claw.

In view of this situation one could suppose that pollinators originally visiting both taxa, may have developed a preference to the more open flower of *C. lutea* with easier accessible nectar, and gradual neglect of the flower type of *C. alba*. This would lead to mechanical separation of both taxa and eventual disappearance through discrimination by the pollinator(s) of the less favoured *C. alba*. It is also imaginable that the pollinator(s), used to the easy way of getting the nectar from *C. lutea* flowers, still visited *C. alba* flowers in search for nectar by landing upon the upper petals and thus not serving any more as pollinator.

In the areas where at present both species occur together, the number of records of *C. lutea* is much higher than that of *C. alba*. In Sierra Leone for instance, *C. alba* has been collected 7 times and *C. lutea* 12 times. However, in the area North and West of this country, e.g. in Guinea and Guiné Bissau, *C. alba* has been collected 11 times and *C. lutea* but once. The same can be observed on the eastern border of *C. lutea*, namely in Nigeria. In this country

the latter species has been collected 64 times, but mainly west of the Niger-Benue R., only 8 records originate from the part east of this border. *C. alba* counts 16 records from Nigeria of which 11 from the south-eastern part bordering Cameroun. These figures show that in the transition zones where both species occur together, *C. lutea* dominates *C. alba* and they suggest that the latter is in a less favourable position, causing a decline in number of individuals which may lead to extinction of the species.

Field observations are needed to see whether the hypothesis outlined above is acceptable as the explanation why *C. alba* has such a remarkable disjunct area of distribution.

7. KEY TO THE GENERA

1. Lianas, or lianescent shrubs, glabrous in their vegetative parts. Filaments completely, or nearly completely united into a sheath. Seed with juicy 'hairs' and without endosperm. Cotyledons thick, fleshy. . . . . **Atroxima**

2. Shrubs, treelets or trees, vegetative parts at least partly hairy. Filaments partly, at most for $^4/_5$ of total length of stamens, united into a sheath. Seed, at least partly, with ordinary hairs, and with copious endosperm. Cotyledons foliaceous. . . . . **Carpolobia**

8. TAXONOMIC TREATMENT OF ATROXIMA

8.1. Description of the genus

Atroxima Stapf, 1905: 85; Hutchinson & Dalziel, 1927: 99; Chevalier, 1938: 277; Keay, 1954: 109; Petit, 1958: 284; Hutchinson, 1967: 342.

Type species: *A. liberica* Stapf (lectotype, designated by Hutchinson, see History and taxonomic position).

Lianas or lianescent shrubs. Branches, branchlets, and leaves glabrous. Stipules present and glandlike or absent. *Leaves* alternate. *Inflorescences* axillary, racemose, sometimes branched. *Bracts* and *bracteoles* small, long-persistent. *Sepals* 5, the 2 inner larger. *Petals* 5, subequal in length, the median petal concave, ovate-triangular, abruptly tapering into a claw, the others narrowly elliptic; the basal parts of all petals adnate to the staminal sheath. *Stamens* 5; filaments completely, or nearly completely united into a sheath which is open adaxially; anthers opening by 2 valves apically. *Ovary* 3-locular, with 1 pendulous ovule in each locule. Stigma small, capitate. *Fruit* a drupaceous berry, 1–3-seeded. *Seeds* densely covered with juicy, erect, coherent hairs, which have usually disappeared in dried fruits; endosperm none; cotyledons thick, fleshy.

Distribution: 2 species in West and Central Africa.

8.2. Key to the species

Leaves cuneate to rounded at base; petiole 5–10 mm long; racemes up to 10(14) cm long; fruit subglobose, ca. 2–3 cm in diam., usually with a rough skin; pericarp in dried state hard, crustaceous. . . . . **A. afzeliana**

Leaves obtuse to subcordate at base; petiole 3–5(7) mm long; racemes up to 5(7.5) cm long; fruit slightly 3-lobed, up to 4(5) cm in diam. with a smooth and shiny surface; pericarp in dried state leathery and wrinkled. . **A. liberica**

8.3. Atroxima afzeliana (Oliv. ex Chod.) Stapf (Fig. 2: 14–17, Map 2)

A. afzeliana (Oliver ex Chodat) Stapf, 1905: 86; Chevalier, 1920: 44; Hutchinson & Dalziel, 1927: 99; Chevalier, 1938: 277; Keay, 1954: 109; Petit, 1955: 336 (in synonymy).

Basionym: *Carpolobia afzeliana* Oliver ex Chodat, 1896: 343; Oliver, 1868: 136 (nom. illeg.); Engler, 1915: 839; De Wildeman, 1919: 292.

Type: Sierra Leone, sin. loc., *Afzelius s.n.* (holotype: BM).

A. macrostachya (Chodat) Stapf, 1905: 86; Hutchinson & Dalziel, 1927: 99. Basionym: *Carpolobia macrostachya* Chodat, 1896: 343; 1897: 117; Engler, 1915: 839. Type: Sierra Leone, near Kabusa, *Scott Elliot 5475* (lectotype: K).

A. zenkeri Stapf, 1905: 86. Type: Cameroun, Bipindi, *Zenker 1240* (holotype: K; isotypes: BM, E, L, M, P, W, WU, Z).

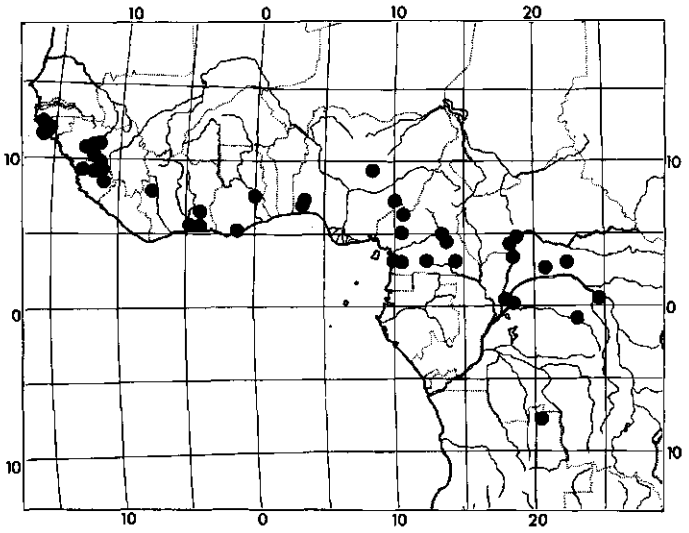
A. liberica Auct. non Stapf, Chevalier, 1920: 44.

A. congolana Petit, 1955: 335, p.p. (see notes); 1958: 284, p.p. Type: Zaïre, Eala, *Corbisier Baland 1187* (holotype: BR; isotypes: K, P).

Diagnostic characters: Liana, or lianescent shrub. Petiole 5–10 mm long. Leaves thinly coriaceous, elliptic to ovate-elliptic, (3.5)4.5–12(15.5) × (1.5)2–5(6.5) cm, cuneate to rounded at base. Inflorescences up to 10(14) cm long; peduncle and rhachis more or less puberulous. Fruit usually subglobose, ca. 2–3 cm in diam., usually with a rather rough skin; pericarp hard, crustaceous.

Description: Liana, lianescent shrub, sometimes a shrub. *Bark* rather smooth. *Leaves:* petiole canaliculate above, 5–10 mm long; blade thinly coriaceous, elliptic to ovate-elliptic, sometimes narrowly so, (1.5)2–3(4) times as long as wide, (3.5)4.5–12(15.5) × (1.5)2–5(6.5) cm, cuneate to rounded at base, acuminate at top, the acumen 0.5–1.5(2) cm long; the midrib slightly impressed above, prominent beneath, with 5–7(11) main lateral nerves on each side of the midrib; the veinlets slightly prominent above, more conspicuously so beneath. *Inflorescences* 1–4 per axil, sometimes branched, up to 10(14) cm long, ca. 10–20-flowered; peduncle and rhachis more or less puberulous; bracts and bracteoles ovate-triangular or narrowly so, 0.5–1.5(3) mm long,

puberulous. *Pedicel* 3–4(5) mm long, puberulous. *Sepals* suborbicular to ovate, concave, top rounded, 1.5–5(6) × 1.5–5(6) mm (the largest (1.7)2–2.5(3) times as long as the smallest), the outer three fleshy, up to 0.5 mm thick at base, glabrous or nearly so outside, inside glabrous or minutely puberulous. *Petals* 8–12 mm long, the keel petal 3–4 mm wide, the other petals 1.5–3(4) mm wide, top rounded or acutish; the top of all petals and the basal part of the upper petals outside puberulous, the upper petals also puberulous inside, the other ones often partly so. *Stamens* 4–6(7) mm long; free part of the filaments at most 0.5 mm long; the staminal sheath puberulous inside, at least partly so. *Pistil* sessile, 4.5–7.5 mm long, glabrous; ovary subellipsoid to subglobose, up to 1.5 mm long; style slightly curved. *Fruits* subglobose, sometimes stipitate and/or apiculate, ca. 2–3 cm in diam., 1–3-seeded, orange at maturity; pericarp in dried state hard, crustaceous, usually with a rough surface or pustulate; endocarp thin, glossy inside. *Seeds* subellipsoid, up to 13 mm long, 5–10 mm in diam., the layer of juicy 'hairs' (measured in dried fruits) 0.5–1 mm thick.



MAP 2. *Atroxima afzeliana.*

Distribution: West and Central Africa.

Ecology: Rain forest, semi-deciduous forest, gallery forest.

Specimens examined:

GUINÉ BISSAU. Formosa I., *Alves Pereira 3770* (BR); Granga de Safim, *Espirito Santo 1233* (COI, K, LISC, WAG); Cacheu, *Espirito Santo 1316* (COI, LISC); between Calequissa and Canchungo, *Espirito Santo 1319* (BR, COI, FI, LISC, M); Bissau, *Espirito Santo 1867* (COI, K, LISC); Formosa I., *Espirito Santo 1967* (COI, FI, M, WAG); S. Joao *Espirito Santo 2040* (BR, COI, K, LISC, P, WAG).

GUINEA. Kollangui, *Chevalier 12207* (P); *12208* (P); Labé, *Chevalier 12388* (P); between Ditinn and Diaguissa, *Chevalier 12684* (P); between Ditinn and Labé, *Chevalier 12888* (K,

G, P); Fouta Djallon, *Chevalier 18034* (P); *Caille in Chevalier 18045* (P); Diaguissa, *Caille in Chevalier 18082* (P); Dalaba, *Caille in Chevalier 18219* (P); *Chevalier 20283* (P); Fouta Djallon, *Heudelot 712* (P, labeled: '*Carpolobia Francheti* CHOD., Det. CHOD.') (See also *Heudelot 712* under *C. alba!*); near Pita, *Jacques-Félix 662* (P); Dinguiraye, *Maclaud 62* (P); Kogou, *Maclaud 401* (P); Pita, *Pobéguin s.n.* (P); plateau de Dalaba, *Pobéguin s.n.* (P); *1425* (P); *2055* (P).

SIERRA LEONE. Sin. loc., *Afzelius s.n.* (BM, holotype of *A. afzeliana*); Musaia, *Deighton 4516* (K, P); Baiama, *Deighton 6086* (B, K, P); Mt. Loma, *Jaeger 4005* (K, P); Kofiu, *Scott Elliot 4618* (K); Talla Hill plateau, Ninia, *Scott Elliot 4897* (BM, K); near Kabusa, *Scott Elliot 5474* (K); sin. loc., *Smythe 91* (K); Bumbuna, *Thomas 3425* (K); *3892* (K); sin. loc., *Thomas 3856* (K).

IVORY COAST. N. of Aghien, *Beentje 515* (WAG); km 6 Kotobi – Nguinou, *Breteler 6182* (WAG); Bingerville, *Chevalier 17351* (P); near Zagoué, *Chevalier 21571* (P); 15 km E. of Abidjan, *J. de Wilde 3158* (K, WAG); Ebrié Lagoon, *W. de Wilde 513* (BR, K, P, WAG, Z); *513A* (BR, K, P, WAG, Z); sin. loc., *Hedin s.n.* (P); Ebrié, *Jolly 40* (P); Bingerville, *Jolly 327* K, P, Ebrié Lagoon, *Oldeman 169* (BR, K, G, P, WAG, Z); 25 km W. of Dabou, *Versteegh & Den Outer 554* (WAG).

GHANA. Elmina, *J. B. Hall 1339* (K); Ankajul, *J. B. Hall 2834* (K); near Cape Coast, *J. B. Hall 3429* (K); Shiare-Chyllinga Rd, *Morton 4084* (K, WAG).

NIGERIA. Sardauna, *Daramola FHI 62343* (K); Jemaa, *Keay FHI 37236* (K, P); *Olorunfemi FHI 55131* (K); Ibadan, *Onochie FHI 32236* (K); Abeokuta, *Onochie & Jones FHI 14529* (K, P); Ijebu, *Tamajong FHI 20289* (K, P).

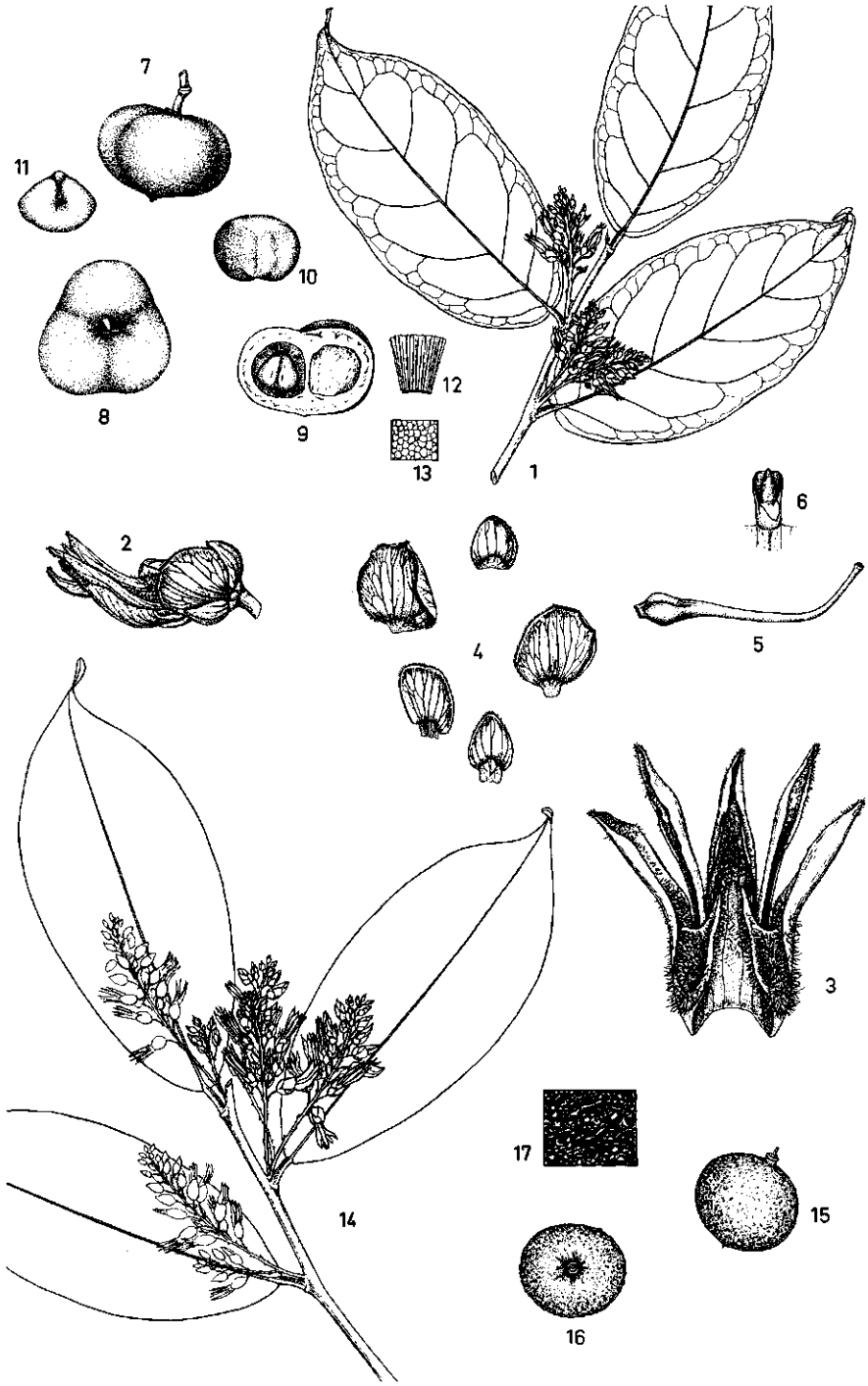
CAMEROUN. Bitye, *Bates 1224* (BM); 36 km N. of Kribi, *Bos 6027* (WAG); Ebaka, *Breteler 1435* (BR, K, LISC, P, WAG); near Yoko-Betugu, *Breteler 2205* (BR, FI, K, LISC, M, P, WAG); Bangwa, *W. de Wilde c.s. 2504* (P, WAG); km 63 Yokadouma-Lomié, *Letouzey 5354* (BR, HBG, K, LISC, P, WAG); Ndogtima Nyong, *Letouzey 12877* (BR, P, WAG); 10 km N.E. of Nkambe, *Letouzey 13203* (P, WAG); Bipindi, *Zenker 1112* (BM, E, K, L, M, P, W, WU, Z); *1240* (BM, E, K, L, M, P, W, WU, Z, type of *A. zenkeri*); *1654* (BM, COI, E, G, K, M, P, W, WU, Z); *2227* (B, BM, BR, COI, E, G, K, L, M, P, W, WU, Z); *2227a* (BM, E, G, K, P, W, WU, Z); *4687* (B, BM, BR, COI, G, K, L, M, P, W, Z); *4710* (B, BM, BR, COI, G, K, L, LISC, M, P, W, Z); *4711* (BM, BR, G, K, L, M, P, W, Z); *4856* (BM, BR, E, G, K, L, M, P, W, Z).

CENTRAL AFRICAN REPUBLIC. Boukoko, *Equipe Tisserant 371* (BM, BR, P); *2396* (P); *2595* (P); Yalinga, *Le Testu 4254* (P); *4450* (P).

ZAÏRE. Loka, *Bruneel s.n.* (BR); Eala, *Corbisier Baland 1187* (BR, K, P, type of *A. congolana*); Likimi, *Evrard 1865* (BR, K); Eala, *Evrard 3735* (BR); Yalisenga, *Evrard 5338* (BR, K); Yongo, *Evrard 5559* (BR, K); Yangambi, *Germain 7299* (BR); Eala, *Ghesquière 3353* (B, BR, K); between Libenge and Zongo, *Lebrun 1685* (B, BM, BR, K, P); Yangole, *Louis 11933* (BR); Dundusana, *Mortehan 708* (BR); Eala, *Pynaert 573* (BR, K); *650* (BR); *896* (BR).

ANGOLA. Lunda, Mutatachimba, *Martins 90* (P).

Notes: The first record of *C. afzeliana*, the basionym of *A. afzeliana*, is by OLIVER (1868). He mentioned a specimen collected in Sierra Leone by AFZELIUS, gave a short description, suggested the epithet '*afzeliana*', but expressed his doubt whether this specimen 'may be an undescribed *Carpolobia*, or perhaps a new generic type'. By this expression of doubt, this cannot be considered a valid publication of the combination *C. afzeliana*. CHODAT (1896) validated the name, when he mentioned it with reference to OLIVER's description in his treatment of the *Polygalaceae* in ENGLER's Die natürlichen Pflanzenfamilien. In the same article CHODAT published validly *Carpolobia macrostachya*, of which he gave a more detailed description in 1897 with indication of the type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material (*Scott Elliot 4618, 4897, 5474)* also collected in Sierra Leone. Of these syntypes *Scott Elliot 5474* has been designated lectotype. KEAY (1954) placed *A. macrostachya* into synonymy of *A. afzeliana* and his decision is fully supported.

Although the basic names *C. afzeliana* and *C. macrostachya* have been published simultaneously, the name *A. afzeliana* has to be used as KEAY's (l.c.) choice has to be followed, notwithstanding his reasoning. A fortunate circumstance, because this happens to be the more generally applied one.

The original diagnosis of *A. zenkeri* shows no differences by which this species can be separated from *A. afzeliana*, and analysis of the type *(Zenker 1240)* confirms that they are conspecific.

PETIT (1955) based *A. congolana* on a mixture of *A. afzeliana* and *A. liberica*. The fruiting specimens, *Louis 9570, 12083*, and *12682* show the coriaceous fruit-wall and belong to *A. liberica*. The type *(Corbisier Baland 1187)*, however, and all other paratypes with flowers and/or immature fruits only, belong to *A. afzeliana*. Consequently, *A. congolana* must be considered as a synonym of *A. afzeliana*.

Some field notes, especially of the earlier collected specimens, describe *A. afzeliana* as a shrub or treelet e.g. the type material of *A. macrostachya* and the specimens collected by CHEVALIER. STAPF described the genus *Atroxima* as shrubs or treelets. HUTCHINSON (1927) repeated this, and KEAY (1954) described *A. afzeliana* as 'a glabrous shrub or tree with sweeping branches, sometimes scandent'.

These differences regarding the habit of *A. afzeliana* are most probably due to inaccurate observation. All recent collectors describe the habit as a liana, or a few times as a lianescent shrub.

8.4. ATROXIMA LIBERICA STAPF (FIG. 2: 1–13, MAP 3)

A. liberica STAPF, 1905: 85; 1906: 578; HUTCHINSON & DALZIEL, 1927: 99; KEAY, 1954: 109.

Type: Liberia, Sinoe Basin, *Whyte s.n.* (holotype: K).

A. congolana PETIT, 1955: 355 p.p.; 1958: 258 p.p.

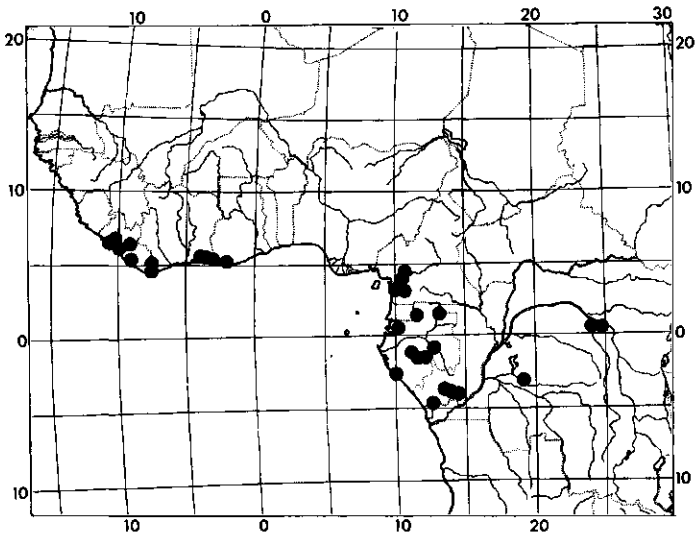
Diagnostic characters: Liana up to 6 cm in diam. Petiole 3–5(7) mm long. Leaves usually coriaceous, (5)7–14(18) × (2)3–7(9) cm, obtuse to subcordate at base. Racemes up to 5(7.5) cm long, mostly glabrous. Fruit 3-lobed,

FIG. 2. *Atroxima liberica:* 1. flowering branchlet, ½ ×; 2. flower, 3 ×; 3. corolla and stamens, 4½ ×; 4. sepals, 3 ×; 5. pistil, 6 ×; 6. anther, 12 ×; 7–8. fruit, ½ ×; 9. longitudinal section of fruit, ½ ×; 10–11. seed, ½ ×; 12. juicy indumentum of seed; 13. as 12, but seen from above. (1–6. *Bos 2256*; 7–9. *Breteler 5932;* 10–13. *Breteler 7364.*)

Atroxima afzeliana: 14. flowering branch, ½ ×; 15–16. fruit, ½ ×; 17. detail of fruit wall. (14. *Espirito Santo 1316;* 15–17. *Bos 6027.*)

with an impressed base and with a smooth, shiny surface. Pericarp, when dried, leathery, wrinkled.

Description: Liana up to 6 cm in diam. *Bark* of stem rough, of twigs smooth. *Leaves:* petiole canaliculate above, 3–5(7) mm long; blade coriaceous, sometimes thinly so, elliptic, oblong-elliptic or sometimes ovate-elliptic, (1.5)2–3 times as long as wide, (5)7–14(18) × (2)3–7(9) cm, obtuse to subcordate at base, sometimes rounded, acuminate at apex, the acumen up to 2 cm long; the midrib slightly impressed above, prominent beneath, with (4)5–8(10) main lateral nerves on each side of the midrib, nervation above slightly prominent, more conspicuously so beneath. *Inflorescences* 1–2(4) per axil, occasionally branched, up to 5(7.5) cm long, and up to ca. 25(40)-flowered; peduncle 3–10 mm long; peduncle and rhachis glabrous, sometimes sparsely puberulous; bracts and bracteoles ovate-triangular, sometimes narrowly so, 0.5–1(3) mm long, ciliate. *Pedicel* 3–6 mm long, glabrous, or sometimes sparsely puberulous. *Sepals* fleshy, especially the 3 outer, which may be up to 1 mm thick at base, concave, ovate to suborbicular, top rounded or obtuse, 2–6.5 × 1.5–6(7.5) mm, the largest 1.5–2.2(3) times as long as the smallest; glabrous or nearly so outside, inside minutely puberulous, at least partly so, margins ciliate. *Petals* 7–11(14) mm long, the keel petal 3–4 mm wide, the other petals 1.5–3 mm wide, all petals puberulous on top outside, the upper petals puberulous inside, the other petals often partly and minutely so. *Stamens* 4.5–7(9) mm long; filaments free for 0–0.5(1) mm; the staminal sheath puberulous inside. *Pistil* sessile, 5–6(10) mm long, glabrous; ovary subellipsoid to subglobose, ca. 1 mm long; style slightly curved. *Fruits* orange, smooth and



MAP 3. *Atroxima liberica.*

shiny at maturity, usually depressed subglobose (see note), slightly 3-lobed, not or slightly apiculate, with an impressed base, up to 4(5) cm in diam. and to 3.5 cm high, 1–3-seeded; exocarp firm, in dried state leathery and wrinkled, ca. 0.2 mm thick; mesocarp fleshy, 1–5 mm thick; endocarp thin, membranaceous, glossy inside. *Seed* subellipsoid, up to 18 mm long, and 8–13 mm in diam.; the juicy 'hairs' erect, up to 2 mm long.

Distribution: West and Central Africa.

Ecology: Rain forests, semi-deciduous forests.

Specimens examined:

LIBERIA. Suen, *Baldwin jr. 10462* (K, WAG); Genna Tanyehun, *Baldwin jr. 10744* (K); Mecca, *Baldwin jr. 10794* (K, WAG); Greenville, mouth of Sinoe R., *Baldwin jr. 11568* (K, WAG); Louisiana, ca. 16 km E. of Monrovia, *Bos 2256* (BR, WAG); Fishtown, *Dinklage 2111* (B); *2118* (B, P); near Monrovia, *Dinklage 2990* (Z); *Kunkel 232* (WAG); *Linder 989* (K, P); Moala, *Linder 1361* (K, P); 5 km N. of Tapita, *Van Meer 459* (WAG); Sinoe Basin, *Whyte s.n.* (K, type of *A. liberica*).

IVORY COAST. Forêt du Téké, *Bamps 2393* (BR, WAG); Forêt de la Bébasso, *Bamps 2430* (BR); 6 km N. of Anyama, *Beentje 313* (WAG); 5 km N.N.W. of Nganda-nganda, *Beentje 611* (WAG); Yapo Nord, *Bernardi 8642* (P, G); 47 km from Comoe bridge on Abidjan-Aboisso Rd, *Breteler 5910* (WAG); 5 km Ayamé-Abengourou Rd, *Breteler 5932* (WAG); 24 km N. of Abidjan, *Breteler 6073* (WAG); 10 km N.W. of Grabo, *Breteler 7364* (WAG); Grabo, *Chevalier 19622* (P); Forêt du Banco, *Cremers 660* (BR, P); *De Koning 1157* (WAG); *2828* (WAG); *2881* (WAG); *2903* (WAG); *3057* (WAG); *3402* (WAG); *3455* (WAG); *5863* (WAG); *6321* (WAG); *6787* (WAG); *s.n.* (VI) (WAG); *s.n.* (VII) (WAG); *s.n.* (VIII) (WAG); *Jansen 1002* (WAG); *Leeuwenberg 2673* (BR, K, L, WAG, Z); Forêt de l'Abé, *Nozeran s.n.* (MPU); Forêt de Yapo, *Nozeran s.n.* (MPU); Forêt du Banco, *Raynal 13638* (BR, K, P); near Aboisso, *Thijssen 278* (WAG); Forêt du Yapo, *Van der Burg 463* (WAG).

GHANA. Ancobra Est., *Akpabla 817* (K); Tarkwa Distr., Neung F. R., *Enti 513* (BR).

CAMEROUN. Near Kribi, *Bos 5429* (WAG); Dékouma, *Fleury 33137* (P); 30 km E.N.E. of Edéa, *Letouzey 12406* (P); Barombi, *Preuss 400* (BM, labeled '*Carpolobia preussii* GÜRKE); Bipindi, *Zenker 2847* (BM); *3008* (B, BM, BR, COI, E, G, K, L, M, P, W, WU, Z); *3505* (BM, K, WU); *3863* (BM); *4257* (BM, E, G, K, W, WU).

GABON. Gamba, *Breteler & Van Raalte 5680* (WAG); km 23 Moanda-Franceville, *Breteler 6783* (WAG); near Etéké, *Hallé & Cours 6025* (P); Bélinga, *Hallé & Le Thomas 146* (P); Monts de Cristal, route de Kinguélé, *Hallé & Villiers 4492* (P); *4642* (P, WAG); Monts de Cristal, 5 km W. of Méla, *Hallé & Villiers 5208* (K, P); Moucongo, *Le Testu 6335* (P); Louba, *Le Testu 8248* (BM, BR, P); Idembe, *Le Testu 8264* (BM, P); Oyem, *Le Testu 9499* (P).

CONGO. 20 km S. E. of Sibiti, *Farron 4529* (P); near Bangou, *Sita 250* (P); Mouyou distr., *Sita 3043* (P).

ZAÏRE. Sin. loc., *Andrews 1057* (BR, K); Yabwesu-Ogela, *Germain 8782* (BR); Taketa, *Jans 1108* (BR, WAG); 20 km E. of Yangambi, *Louis 9570* (BM, BR); *12083* (BR); Yangambi, *Louis 12682* (B, BM, BR, K, LISC, P).

ANGOLA. Cabinda, Buco Zan, *Gossweiler 6552* (BM, COI, LISU).

CULT. Ivory Coast. Adiopodoumé, *Cremers 404* (BR); *443* (BR); *645* (BR); *De Koning 3133* (WAG); *3233* (WAG); *3237* (WAG); *3432* (WAG); *3544* (WAG); *3783* (WAG); *3793* (WAG). Netherlands. Wageningen, *Breteler 7521* (WAG).

Notes: STAPF (1905) based *A. liberica* on *Whyte s.n.*, a flowering specimen without fruits. As appears from his genus diagnosis, he supposed, that *A. liberica* had similar hard crustaceous fruits as the other *Atroxima* species proposed by him. In the flora treatments of HUTCHINSON & DALZIEL and of KEAY this is followed. KEAY separates *A. liberica* from *A. afzeliana* mainly by the length of the petiole, the shape and venation of the leaf, and length and indumentum of the racemes. These differences overlap each other and are not always useful for separating the two species. PETIT (1955) was the first to indicate some *Atroxima* specimens with a coriaceous fruitwall and with glabrous seeds (until then the seeds of *Atroxima* were described as being puberulous). He erroneously attributed all Zaïre specimens to a new species *A. congolana*, which he separated from *A. afzeliana* by such coriaceous fruits and glabrous seeds (see also notes under *A. afzeliana*). Analysis of some recently collected specimens, which doubtlessly belong in *A. liberica*, and have both flowers and fruits (while all other *Atroxima* material usually has either flowers or fruits) proves that these coriaceous fruits are characteristic for *A. liberica* and constitute the main character to distinguish this species from *A. afzeliana*. Investigation of fresh fruits of *A. liberica* revealed the true nature of the indumentum of the seeds. It consists of juicy, coherent, erect hairs, which have almost disappeared in dried, mature fruits. This may explain why PETIT described the seeds of his *A. congolana* as being glabrous.

Exceptionally the fruits may be strongly apiculate as could be observed on a specimen collected by LETOUZEY *(no. 12406)*, who described the fruits as follows: 'globoïdes, ± trigones et mamelonés, avec fort bec conique, orange, de 4 cm environ, luisant'.

8.5. EXCLUDED SPECIES

A. gossweileri EXELL = *Carpolobia gossweileri* (EXELL) PETIT.
Note: For details see under *C. gossweileri* and also under Phylogeny.

9. TAXONOMIC TREATMENT OF CARPOLOBIA

9.1. DESCRIPTION OF THE GENUS

Carpolobia G. DON, 1831: 370, p.p.; BENTHAM, 1842: 104; BENTHAM & HOOKER, 1862: 139; OLIVER, 1868: 135; CHODAT, 1896: 343; 1897: 117; STAPF, 1905; 85; ENGLER, 1915: 838; HUTCHINSON & DALZIEL, 1927: 98; CHEVALIER, 1938: 276; KEAY, 1954: 108; PETIT, 1958: 281; HUTCHINSON, 1967: 341.

Type species: *C. alba* G. DON (lectotype, see paragraph History and taxonomic position).

Falya DESCOINGS, 1957: 171; 1961: 33; BRETELER, 1969: 375. Type species: *F. leandriana* DESCOINGS (= *C. goetzei* GUERKE).

Shrubs, treelets or trees, at least partly hairy in their vegetative parts. Stipules absent, when present glandlike or conical-truncate. *Leaves* alternate. *Inflorescences* axillary, racemose, seriate. *Bracts* and *bracteoles* small, usually long persistent. *Sepals* 5, unequal, the two inner larger. *Petals* 5, subequal in length, slightly or strongly unequal in shape, when strongly so the median petal concave-galeate; the basal parts adnate to the staminal sheath. Fertile *stamens* 5(4), at the base united into a sheath for ½–¾ of their length, open at the adaxial side; staminodes 0–3; anthers opening by two valves apically. *Ovary* 3-locular, with 1 pendulous ovule per locule. Stigma small, capitate. *Fruit* a drupaceous berry, more or less lobed, 1–3-seeded. *Seeds* densely long-hairy, with copious endosperm; cotyledons foliaceous.

Distribution: Tropical Africa, 4 species.

9.2. KEY TO THE SPECIES

1a. Ovary and fruit hairy; tree up to 28 m tall. Western Central Africa. . . . . **C. gossweileri**

b. Ovary and fruit glabrous, shrub or treelet up to 5 m tall. Throughout Tropical Africa. 2

2a. The largest (upper) sepals at least half as long as the petals, usually longer; the keel petal not much broader than the other ones and not provided with a distinct kink between claw and limb, the latter not galeate (see fig. 4:13); seed with straight hairs, at least partly so. Eastern Central Africa, East Africa, Madagascar. . . . . **C. goetzei**

b. The largest (upper) sepals at most half as long as the petals, usually shorter; the keel petal much broader than the other ones, provided with a distinct kink between claw and limb, the latter galeate; seed either with strongly waved or with straight hairs. West- and Central Africa. 3

3a. Limb of keel petal as long as the claw, 2.5–4 mm wide when folded; the upper petals thick and fleshy in the central part, ± appressed, adnate to the staminal sheath for half the total length of stamens; seed usually with waved hairs. West- and Central Africa. . . . . **C. alba**

b. Limb of keel petal distinctly longer than the claw, (3.5)4–5.5(6.5) mm wide when folded; the upper petals thin, not fleshy, sharply bent upwards at anthesis, adnate to the staminal sheath for ¼ of total length of stamens; seed with straight hairs. West Africa. . . . . **C. lutea**

9.3. CARPOLOBIA ALBA G. DON (FIG. 3, MAP 4)

C. alba G. DON, 1831: 370; BENTHAM, 1842: 104; 1849: 224; OLIVER, 1868: 135; CHODAT, 1896: 343; 1897: 118; SCHLECHTER, 1900: 295; ENGLER, 1915: 838; CHEVALIER, 1920: 43; HUTCHINSON & DALZIEL, 1927: 99; 1928: 27; BURTT DAVY, 1932: 257; AUBRÉVILLE, 1936: 1; EXELL, 1936: 18; CHEVALIER, 1938: 276; ROBERTY, 1954: 187; KEAY, 1954: 108; AUBRÉVILLE, 1959: 5.

Type: Sierra Leone, sin. loc., *G. Don s.n.* (holotype: BM; isotype: K).

C. parvifolia (OLIVER) STAPF, 1906: 578; CHEVALIER, 1920: 44; 1938: 276; HUTCHINSON & DALZIEL, 1927: 99; PROCTOR COOPER & RECORD, 1931: 23. Basionym: *C. alba* G. DON var. *parvifolia* OLIVER, 1868: 136. Type: Nigeria, Old Calabar, *Mann 2297* (lectotype: K; isotype: P).

C. glabrescens HUTCHINSON & DALZIEL, 1927: 99; 1928: 26; KENNEDY, 1936: 24; KEAY, 1954: 108; PETIT, 1958: 281. Type: Fernando Po, *Mann 78* (holotype: K; isotype: P).

C. delvauxii PETIT, 1955: 335; 1958: 282. Type: Zaïre, Mulolwa, *Delvaux 456* (holotype: BR).

Diagnostic characters: Shrub or treelet up to 5 m tall. Leaves papery, ovate-elliptic to obovate-elliptic, very variable in size, 1.5–12.5(15) × 1–5(6.5) cm. Limb of keel petal galeate, as long as the claw, 2.5–4 mm wide when folded. Upper petals ± appressed, adnate to the staminal sheath for half of the total length of stamens. Hairs of seed usually waved.

Description: Shrub or treelet up to 5(10?) m tall. *Bark* of stem and branches rather smooth. *Branchlets* tomentose or puberulous, glabrescent. Stipules absent, or present as a dark, glandlike, sometimes slightly elevated, glabrous spot. *Leaves:* petiole 1.5–2.5(3) mm long, tomentose or puberulous; blade papery, ovate-elliptic to obovate-elliptic, sometimes narrowly so, (1.5)2–3 times as long as wide, very variable in size, 1.5–12.5(15) × 1–5(6.5) cm, cuneate, rounded, or sometimes obtuse at base, more or less acuminate, sometimes obtuse at apex, the acumen up to 1 cm long; glabrous or nearly so above except for the tomentose-puberulous midrib, beneath tomentose-puberulous especially so on the midrib or nearly glabrous; main lateral nerves (3)4–7(9) on each side of the midrib, rather obscure above, prominent beneath, midrib impressed above, at least in the lower part, prominent beneath. *Inflorescences* 1–2 per axil, up to 3 cm long, (1)2–5(7)-flowered; peduncle and rhachis puberulous; bracts and bracteoles ovate-oblong – narrowly triangular, 0.5–1 mm long, puberulous. *Pedicel* (3)4–6(7) mm long, puberulous. *Sepals* ovate-elliptic to obovate-elliptic, concave, (3)4–8 × 2–5(6) mm, the largest (1.2)1.5–2(2.5) times as long as the smallest, top obtuse or acute, sometimes emarginate, glabrous or puberulous outside, more densely so towards base and top, glabrous or minutely puberulous inside, the margin ciliate. *Petals* unequal in shape, subequal in length, (12)13–18(19) mm long, the keel petal galeate, abruptly tapering into the claw, 2.5–4 mm wide when folded; the upper

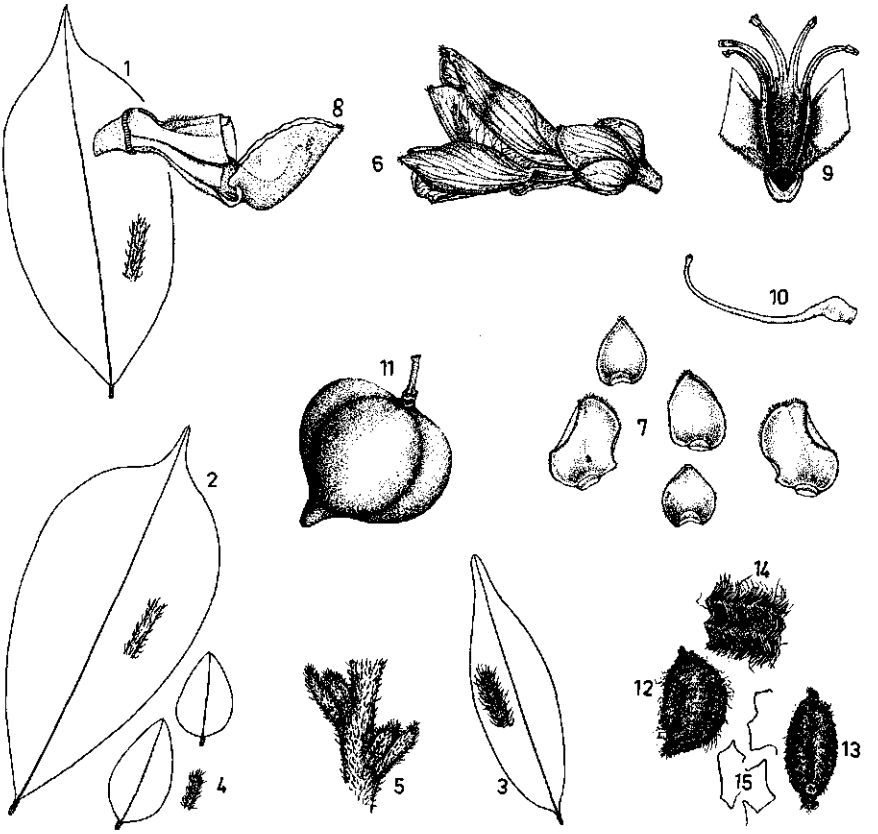
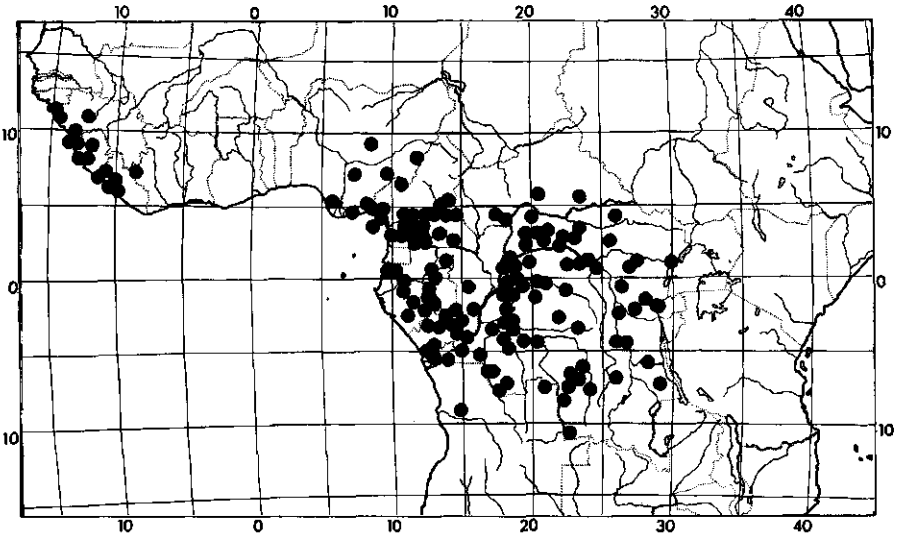


FIG. 3. *Carpolobia alba:* 1–4. leaves with detail of midrib beneath, $\frac{1}{2}\times$; 5. detail of inflorescence showing bracts and bracteoles, $5\times$; 6. flower, $2\times$; 7. sepals, $2\times$; 8. keel petal with hinge, $2\times$; 9. staminal sheath, $2\times$; 10. pistil, $2\times$; 11. fruit, $1\times$; 12–13. seed, $1\times$; 14–15. detail of seed indumentum. (1. *Breteler 797;* 2. *Letouzey 12233;* 3. *Olorunfemi FHI 55666;* 4. *Talbot 3193;* 5–15. *Breteler 6915.*)

petals oblong, the lateral ones narrowly obovate, 2–4(5.5) mm wide; the keel petal puberulous outside, or only so along the fold or only near the top, inside sometimes puberulous near the top; basal part of the upper petals always puberulous on both sides; each petal with stiff hairs on the basal part of the free and overlapping edges; the apices ciliate. *Stamens* curved, 11–14 mm long, glabrous, free for 3–5 mm (i.e. $\frac{1}{4}$–$\frac{1}{3}$ of the total length of the stamens); the staminal sheath for 5–7 mm adnate to the upper petals (i.e. for ca. half the length of the stamens); sometimes 1 or 2 staminodes present. Disc rimlike, usually very obscure. *Pistil* shortly stipitate, 11–15 mm long, glabrous; ovary subellipsoid, obscurely 3-lobed, gradually tapering into the curved style. *Fruits* smooth, yellow to orange at maturity, subglobose to subovoid, slightly

3-lobed, up to 2.5 cm long and 2 cm in diam., shortly stipitate, apiculate, the apex up to 3(7) mm long, glabrous, 1–3-seeded; exocarp thin; mesocarp 2–5 mm thick, fleshy; endocarp thin. *Seeds* subellipsoid to subovoid, flattened, 6–12 mm long, 3–8 mm in diam., densely covered with rusty-brown, 1–2 mm long, usually waved hairs.



MAP 4. *Carpolobia alba.*

Distribution: West and Central Africa. No records from Ivory Coast, Ghana, Togo and Benin Republic (see paragraph 6).

Ecology: Rain forest, semi-deciduous forest, gallery forest.

Specimens examined:

GUINÉ BISSAU. Between Fulacunda and Buba, *Espirito Santo 2255* (BR, COI, FI, K, M, LISC, P, WAG); Catio-Cacine, *Raimundo & Guerra 766* (BR).

GUINEA. Kindia, *Chevalier 13369* (P); Friguiabé, *Chillou 1926* (P); 30 km from Conakry, *Dalziel 8071* (E, K, P); sin. loc., *Farmer 193* (BM, K); Fouta Djallon, *Heudelot 712* (BM, BR, G, K, P) (see also *Heudelot 712* under *A. afzeliana*); near Kindia, *Jacques-Félix 16* (P); 495 (P); near Boké, *Paroisse 15* (P); Los Is., *Pobéguin 1202* (P).

SIERRA LEONE. Sin. loc., *Barter s.n.* (K); sin. loc., *Don s.n.* (BM, K, type of *C. alba*); Kambui F. R., *Jordan 2011* (B, K, P); Leli R., *Thomas 3108* (K); Bumbuna, *Thomas 3696* (P); sin. loc., *Thomas 9726* (K).

LIBERIA. Siato, *Adam 16328* (P); Nimba Mt., *Adam 21000* (K); Granfield-Nimba, *Adam 27399* (BR); *27554* (BR); Nimba Mt., *Adames 735* (K, P); Ba, on Mano R., *Baldwin jr. 10699* (K, WAG); Duport, *Bos 1844* (WAG); near Monrovia, *Cooper 13751* (BM, K); Monrovia, *De Wit 9095* (WAG); *Dinklage 2808* (B, HBG, P, Z); *2899* (P, Z); Gibi Mt., *Jansen 1719* (WAG); 22 mls N. of Buchanan, *Jansen 1904* (WAG); Yeh R., *Linder 996* (K, P).

NIGERIA. Ankpa Distr., *Daramola FHI 38045* (K); 4 mls N. of Mando, *Keay FHI 25876* (K, P); Zobolo, *Kitson s.n.* (BM); sin. loc., *Kitson s.n.* (BM); Ikpai Distr., *Latilo & Oguntayo FHI 67777* (K); Calabar, *Mann 2297* (K, P); Jemaa, *Olorunfemi FHI 55666* (K, P); Bopo, *Onochie 9308* (BM); Oban F. R., *Onochie & Latilo FHI 36316* (K); Ikpai Distr., *Onyeahusim & Latilo FHI 54224* (BR, K); Wukari, *Peal 156* (K); Oban, *Talbot 1404* (BM, K); Eket, *Talbot 3193* (BM, BR); Old Calabar, *Thomson 65* (E, K, paratype of *C. parvifolia*).

CAMEROUN. Sin. loc., *Annet 350* (P); Eséka, *Bamps 1417* (BR, K, WAG); Bitye, *Bates 935* (BM); Kumba Distr., *Binuyo & Daramola FHI 35492* (K, P); 15 km N. of Kribi, *Bos 3744* (WAG); 18 km E. of Kribi, *Bos 3862* (WAG); 16 km N. of Kribi, *Bos 4658* (WAG); 14 km E. of Kribi, *Bos 5014* (WAG); 10 km E. of Kribi, *Bos 5578* (WAG); 20 km E. of Kribi, *Bos 5808* (WAG); 18 km S.E. of Kribi, *Bos 6111* (WAG); near Kribi, *Bos 6251* (WAG); *6813* (WAG); Ottôtomo Res., 50 km from Yaoundé, *Bos 6917* (WAG); 36 km Kribi-Campo, *Bos 7139* (WAG); ca. 25 km E. of Kribi, *Bos 7161* (WAG); near Bertoua, *Breteler 797* (BR, FI, K, LISC, M, P, WAG); near Goyoum on Sanaga R., *Breteler 928* (FI, K, LISC, M, P, WAG); 20 km N. of Bétaré Oya, *Breteler 1170* (K, LISC, M, P, WAG); near Nguélémendouka, *Breteler 2132* (BR, K, LISC, M, P, WAG); near Oveng, 27 km from Sangmélima, *Breteler 2669* (BR, K, LISC, M, P, WAG); 16 km Ebolowa-Minkat, *J. de Wilde 7915* (WAG); 50 km S.W. of Eséka, *W. de Wilde c.s. 1553* (P, WAG); 5 km S. of Mbalmayo, *W. de Wilde c.s. 1808* (WAG); 5 km S. of Kribi, *W. de Wilde 2102* (WAG); Grand Batanga, *Dinklage 800* (HBG); *1121* (HBG, K); *1158* (HBG, P, WAG); *1421* (HBG, P, WAG); Campo, *Dinklage 1435* (HBG); Grand Batanga, *Dinklage 1486* (HBG); near Kribi, *Farron 7161* (P); Nanga Eboko, *Hedin 52* (P); gare de Mayaka, *Hedin 1831* (P); sin. loc., *Hedin s.n.* (P); between R. Kam and R. Kirimi, *Hepper 1462* (K, P, WAG); Lolodorf, *Jacques-Félix 9193* (P); near Victoria, *Leeuwenberg 6952* (B, BR, K, P, WAG); Makak, *Letouzey 1135* (P); Mobaga, *Letouzey 1499* (BR, G, HBG, K, LISC, P, WAG); confluent Tia & Sanaga, *Letouzey 153* (P); Bamelap, *Letouzey 1676* (P); near Ngoubi, *Letouzey 1718* (P); between Beliga and Moyenam, *Letouzey 2704* (P); near Deng Deng, *Letouzey 3467* (BR, K, P, WAG); 20 km N. of Betaré Oya, *Letouzey 3569* (P); 60 km E.S.E. of Kribi, *Letouzey 4108* (P); 40 km S.S.E. of Batouri, *Letouzey 4850* (P); 32 km E.N.E. of Djoum, *Letouzey 8327* (BR, P, WAG); border of Kom R., 25 km E. of confluence with Ntem R., *Letouzey 10099* (HBG, K, P, WAG); 80 km S.S.W. of Yokadouma, *Letouzey 12233* (BR, HBG, K, P, WAG); Ndong-Elang, *Meurillon 722* (P); border of Sanaga R. near Nanga Eboko, *Mézili 71* (COI, G, HBG, P, WAG); Lomié, *Mildbraed 5146* (HBG); W. of Lomié, *Mildbraed 5283* (HBG); 22 km E. of Ebolowa, *Mildbraed 5688* (HBG); Fenda, 58 km E. of Kribi, *Mildbraed 5990* (HBG); 45 km E. of Grand Batanga, *Mildbraed 6079* (HBG); 60 km N.E. of Yaoundé, *Mildbraed 8107* (K); 15–35 km N.E. of Victoria, *Mildbraed 10503* (K); *10604* (K); 43 km from Kribi, Zingui Rd., *Mpom 28* (P); km 67 Bertoua-Ndemba II, *Nana 4302* (P); Bopo, Kumba Div., *Onochie 9308* (K, P); sin. loc., *Preuss 468* (BM, COI); 24 km S.W. of Ambam, *J. & A. Raynal 9925* (P); 19 km S. of Ambam, *J. & A. Raynal 10077* (P); 40 km W.S.W. of Ebolowa, *J. & A. Raynal 10453* (P); 29 km N.N.E. of Bafia, *J. & A. Raynal 10668* (P); 45 km N.-N.E. of Nkambé, *Satabié 68* (P); Njoke, *Schlechter 12864* (G, P, Z); Johann-Albrechtshöhe, *Staudt 460* (COI, G, K, P, WU, Z); *834* (BM, BR, G, W); Victoria, *Versuchsanstalt Landeskultur 667* (B); Bipindi, *Zenker 16* (B, G, WAG); *1016* (BM, BR, E, G, K, L, M, P, W, WU, Z); *1106* (BM, E, K, P, WU); *1588* (B, BR, COI, E, G, K, L, M, P, W, WU, Z); *2787* (B, BM, BR, COI, E, G, K, L, M, P, W, WU, Z); *2869* (B, BR, COI, E, G, K, L, M, P, W, WU, Z); *3016a* (K, WU); *3656* (BM, BR, E, G, K, L, M, P, W, WU); *3842* (BM, E, G, K, W, WU); *3883* (BM, E, G, K, WU); *4159* (BM, BR, COI, E, G, K, L, M, P, W, WU, Z); *4443* (B, BM, BR, COI, E, G, K, L, M, P, W, WU, Z); *4489* (BM, BR, E, G, K, L, M, W, WU); *4866* (B, BM, BR, COI, G, L, M, P, W, Z); *s.n.* (BR, FI, P).

EQUATORIAL GUINEA. Fernando Po, *Mann 78* (K, P, type of *C. glabrescens*); Rio Muni, Nkolentangan, *Tessmann 225* (HBG, K); Rio Muni, *Tessmann 924* (K).

GABON. Cristal Mts, *Aubréville 124* (P); near Lastoursville, *Breteler 6654* (WAG); 60 km S.S.W. of Moanda, *Breteler 6915* (WAG); Diobomagola, *Fleury in Chevalier 26130* (P); *26144* (P); Cristal Mts, Mela, *Hallé 863* (P); Oyem, *Hallé 1296* (P); 10 km S.W. of Ndjolé, *Hallé 1837* (P); 6 km N.E. of Mékambo, *Hallé 2621* (P); Bélinga, *Hallé 3197* (P); Cristal Mts,

Hallé & Villiers 4809 (P); Libreville, *Klaine 211* (P); *463* (P); *922* (P); *1049* (P); *1636* (P); *1873* (K, P); Tchibanga, *Le Testu 1466* (BM, BR, P); Nyanga region, *Le Testu 2281* (BM, P); Moucighé, *Le Testu 5930* (BM, BR, P); Lastoursville, *Le Testu 7029* (BM, BR, P); Moloumbi, *Le Testu 8208* (BM, P); Munda, Sibange Farm, *Soyaux 304* (K, P); Onong, *Touret 156* (P); St. Martin, *Walker 8* (P); Sindara, *Walker 55* (P).

CONGO. Kimpélé, *Bouquet 609* (P); near Mayoko, *Bouquet 1424* (P); Komono, *Bouquet 1888* (P); Lékana, *Bouquet 2452* (P); Bas Oubangui, Youmba, *Chevalier 10993* (P); Achouka, *Dybowski 65* (P); near Kakamouka, border of Kouilou R., *Farron 4989* (P); Plateau Batéké, *Makany 1780* (P); *1789* (P); Plateau Batéké, Ngo F., *Sita 3068* (P); Kindamba Distr., near Massina and Mingali, *Sita 3233* (P).

ANGOLA. Dundo, Luachimo R., *Barros Machado 170* (LISC); *187* (LISC); Cazengo, Queta-Monte Belo R., *Gossweiler 701* (BM, K); *1640* (COI); *5257* (BM, COI); *5638* (BM); Mayumbe, Buco Zan, *Gossweiler 6744* (BM, LISU); Cabinda, Belize, *Gossweiler 6979* (BM, COI, LISU); Mayumbe, Caio-Hombe, Lufo R., *Gossweiler 7860* (BM, BR, COI, K, LISU); Dundo, Luachimo R., *Gossweiler 13598* (BM, K); Chitato, *Gossweiler 13924* (K), *14014* (BM); *14087* (BM, COI, K, LISC, P); *Fontinho in Gossweiler 14255* (BM, COI, K, LISC, P); Golungo Alto, *Welwitsch 996* (BM, COI, G, K, LISU, M, P); near Trombeta, *Welwitsch 997* (BM, LISU); Barrancos da Pedra Songue, *Welwitsch 1004* (BM, LISU); Capopa R., near Sange, *Welwitsch 1239* (BM).

ZAÏRE. Avakubi, *Bequaert 1945* (BR, K, WAG); Irumu, *Bequaert 2713* (BM, BR); *2863* (BR); Lubutu-Kirundu, *Bequaert 6881* (BR); Bosodula, *Bilderling 46* (BR); Yangambi, *Bolema 216* (BR, K); *Delaude in Breyne 2846* (BR); Lokelenge, *Bruneel 47* (BR); Basankusu, *Bruneel s.n.* (BR); Bolombo R., *Bruneel s.n.* (BR); Panzi, *Callens 2724* (BM, BR); Kinkasi, *Callens 3732* (BM, BR, K); *3750* (BR); Zongo, *Callens 4160* (BR, K); Kakuluba, *Callens 4274* (BR); Kisantu, *Callens 4828* (BR); Eala, *Claessens 28* (BR); Sabuka, *Claessens 89* (BR); Mogandjo, *Claessens 689* (BR); Gunda à Esanga, *Collart 106* (BR, K); Kinsuka, *Compère 824* (BR); Zaza, *Compère 1089* (BR, WAG); Lukolela, *Croegaert 21* (BR); Lemfu, *De Brouwer s.n.* (BR); Likimi, *De Giorgi 125* (BR); *135* (BR); *1484* (BR); 1540 (BR, K); Yambata, *De Giorgi 1610* (BR, K); Mulolwa, *Delvaux 456* (BR, type of *C. delvauxii*); Gunda à Esanoja, *Derkinderen 106* (BR); Kinganga, *Devred 1272* (BR, K); Kiyaka-Kwango, *Devred 2179* (BR); *2528* (BM, BR, K, M); Baudouinville-Kapona, *Devred 3601* (BR, K); Bokondji, *De Wanckel 29* (BR); Nyangwe, *Dewèvre 1048* (BR, WAG); *1048-b* (BR); Bas Uele, *Dewulf 423* (BR); Kundu, *Dubois 240* (BR, WAG); Tshuapa, *Dubois 639* (BR, WAG); Yangambi, *Dubois 738* (WAG); Boyabakuda-Bogula, *Evrard 326* (BR); Boketa, *Evrard 647* (BR, K); Mogandjo, *Evrard 2184* (BR); Wenga, *Evrard 2754* (BR); Emengeye, *Evrard 2783* (BR, LISC, WAG); Bongoy, *Evrard 3278* (BR); Befale, *Evrard 3540* (BR); Bolomba, *Evrard 3608* (B, BR); Eala, *Evrard 3709* (BR); Bikoro, *Evrard 3871* (BR, M); Bomandja, *Evrard 4977* (BR); Yalikungu, *Evrard 5141* (BR, K); *5397* (BR, K); Bomongo-Ebeka, *Evrard 5932* (BR); Selenge, *Flamigny 6072* (BR); Buna, *Flamigny 6436* (BR); Kaniama, *Gathy 1633* (BR); Djuma R., *Gentil s.n.* (BR); Tukpwo, *Gérard 430* (BR); *2065* (BR, L); Madabu (Zobia), *Gérard 2123* (BR); *2760* (BR); Digba-Ango, *Gérard 5665* (BR, K); Coquilhatville, *Germain 1798* (BM, BR); Itsambu, *Germain 2595* (BR); Ruzizi plain, Lemera Rd., *Germain 7219* (BR); Léopold II lake, *Gilbert 14425* (BR); *14435* (BR); Djuma, *Gillet 2302* (BR); *2723* (BR); *2783* (BR); Bokuma, *Goossens 2757* (BR, K, WAG, Z); Ivulu, *Goossens 2773* (BR, K, Z); Boende, *Goossens 2846* (BR, K); Eala, *Goossens 3093* (BR); Likimi, *Goossens 4288* (BR); Budjala, *Goossens 4294* (BR); Likimi, *Goossens 4724* (BR); *6248* (BR); Iwea (Boende), *Gorbatoff 47* (BR); Mwene-Ditu, *Hardy 5* (BR), *8* (BR, K, WAG); Kaniama, *Herman 2168* (BR, K); Bokuma, *Hulstaert 270* (BR); *645* (BR); Bokete, *Hulstaert 1215* (BR); Bokoro, *Jans 592* (BR); *704* (BR); *712* (BR); Eala, *Laurent 1275* (BR); Limbutu, *Laurent 1830* (BR); Bokuma, *Lebrun 1292* (BR, W); between Bokatola and Bikoro, *Lebrun 1429* (BR); Bikoro, *Lebrun 1465* (BR, K, M); Businga, *Lebrun 1996* (B, BR, K); *2034* (BR, K); Banyville, *Lebrun 2089* (BR, WAG); Kole, *Lebrun 6313* (BR, K, P); *6443* (BR, K); Eala, *Leemans 285* (B, BR); Likimi, *Lemaire 115* (BR); *147* (BR); Kabunga, *A. Léonard 1729* (BR, K, M, WAG, Z); Nzowo, *A. Léonard 3847* (BR, K, M, W); Luamba, *A. Léonard 3882* (BR, K, WAG); Walikale, *A. Léonard 4672* (BR, K); Mutambo, *A. Léonard 5662* (BR, K); Lupaya, *A.*

Léonard 5719 (BR, K, WAG); Kamisuku, *A. Léonard 5992* (BR, K, WAG, Z); Eala, *J. Léonard 238* (BR); Coquilhatville, *J. Léonard 243* (BR); Mpotia, *J. Léonard 579* (B, BM, BR, K, LISC, M, P); Kateba R. (Luisa T.), *Liben 3306* (BR); Tuzule, *Liben 2974* (BR, K); Yangambi, *Louis 478* (BR); *738* (BR); *833* (BM, BR); *901* (B, BR, K, P); Eala, *Louis 2045* (BR, WAG); Yangambi, *Louis 2897* (BR, K); *3539* (BR); *3618* (BM, BR, K); *6535* (B, BM, BR, M); *6699* (BR, COI, FI); *7564* (B, BR, K, P); *7694* (BR, EA, K, P, WAG); Ngazi, *Louis 7745* (BR, WAG); Yangambi, *Louis 8329* (BR); *8590* (BR); *9455* (BR); *9547* (BR, K, W); *12827* (B, BR, FI, WAG); *12941* (BR); *13019* (BR); Yaluwe, *Louis 13352* (BR); Yangambi, *Louis 13686* (BR, EA); *13780* (BR, K); *14665* (BR, P); Sankuru, *Luja s.n.* (BR); Likimi, *Malchair 33* (BR, WAG); *55* (BR, K, WAG); *406* (BR); Yangambi, *Michiels 29* (BR); Dundusana, *Mortehan 1019* (BR, K); *1047* (BR); Kaniama-Ht. Lomane, *Mullenders 2240* (BR); Kapanga, *Overlaet 671* (BR); near Walikale, *Pierlot 1694* (BR); Kabenga, *Pierlot 3315* (BR); Eala, *Pynaert 616* (BR); *638* (BR); *862* (BR); Leverville, *Reniers 71* (BR); Mwene-Ditu, *Risopoulos 1157* (BR); Mobwasa, *Reygaert 1255* (BR); Booke, *Robin 14* (BR); Lukombe, *Sapin s.n.* (BR); Kamunza, *Schmitz 5570* (BR, K); Monsole, *Seret 937* (BR); Eala, *Staner 1412* (BR, COI, FI, G, L, WAG); Bikoro, *Thonnet 140* (BR); Lukolela, *Toka 205* (BR); Luki, *Toussaint 2441* (BR, K, P); Irangi, km 110 Kavumu-Walikale, *Troupin 3888* (BR, K, M); *3924* (BR, K); *3930* (BR, K); *3943* (BR, COI, K, L); *3950* (BM, BR, K); *3960* (BM, BR, K); *3982* (BR, K); *10173* (BR); *12153* (BR); La Kulu, *Van den Brande 363* (BR); *693* (BR); Ipamu, *Vanderyst 10284* (BR, WAG); *10589* (BR); *10695* (BR); *10914* (BR, WAG); *10943* (BR); *10996* (BR); *11146* (BR); Kamtsha, *Vanderyst 11173* (BR); Ipamu, *Vanderyst 12151* (BR); Kasongo Lunda, *Vanderyst 16100* (BR); Panzi-Temvo, *Vanderyst 17066* (BR); Panzi, *Vanderyst 17124* (BR); *17172* (BR); *17233* (BR); Panzi-Manzengele, *Vanderyst 17325* (BR); Chielen, *Vanderyst 22091* (BR); *22098* (BR); Eala, *Vermoesen 2170* (BR); Dilolo, *Young 124* (BM, BR, COI, LISC, Z).

CENTRAL AFRICAN REPUBLIC. Yalinga, *Le Testu 2600* (P); *4419* (BM, BR, P); *4749* (P); Bambari, *Tisserant 379* (P); *1366* (BM, BR, P); Boukoko, *Equipe Tisserant 684* (BM, BR, P); *1375* (BM, BR, P); *1683* (BM, P); *1970* (BM, BR, P); *2441* (BM, BR, P).

Notes: OLIVER (1868) based *C. alba* var. *parvifolia*, the basionym of *C. parvifolia*, on two specimens collected in Nigeria: *Mann 2297* and *Thomson 65*. These specimens have indeed rather small leaves, which is also seen in other material collected in this area. These small-leaved specimens, however, fit well within the wide variation in leaf size within *C. alba*. Therefore KEAY (1954) is followed, who treated *C. parvifolia* as a synonym of *C. alba*. *Mann 2297* (K) has been designated lectotype.

HUTCHINSON & DALZIEL (1928) based *C. glabrescens* on *Mann 78*, collected on Fernando Po. This specimen was already mentioned by OLIVER (1868), who named it *C. alba*. The authors (1927) separated *C. glabrescens* from *C. alba* by the subequal sepals and a shorter and less dense indumentum on branchlets and leaves. According to KEAY (l.c.) these species have a different area of distribution: *C. alba* occurring from Senegal to Nigeria, *C. glabrescens* from Cameroun to Angola and E. Zaïre. Examining all material either named *C. alba* or *C. glabrescens*, always very unequal sepals could be observed, even on the type specimen of *C. glabrescens*, and no other floral difference could be found by which to separate it in two taxa. The density of the indumentum, especially on the leaves, is very variable. It varies from almost tomentose to nearly glabrous, but its occurrence does not correlate with different geographical areas. It is therefore impossible to maintain *C. glabrescens* as a distinct taxon.

PETIT (1955) based *C. delvauxii* on a single specimen: *Delvaux 456*. According to the description it differs from *C. glabrescens* in having larger flowers and glabrous seeds. Considering the type specimen the flower size fits well within the variation of *C. alba*. The fruits are young and immature. Fruits of *Carpolobia* in this stage of maturity always have such 'glabrous' seeds, which means that the indumentum has not yet developed. Consequently *C. delvauxii* is synonymous with *C. alba*.

9.4. CARPOLOBIA GOETZEI GUERKE (FIG. 4, MAP 5)

C. goetzei GUERKE, 1900: 417; ENGLER, 1915: 839; BRENAN & GREENWAY, 1949: 454; MEIKLE, 1951: 337; PETIT, 1958: 283.

Type: Tanzania, near Dar es Salaam, *Goetze 4* (lectotype: K; isotype: BM).

C. conradsiana ENGLER, 1915: 839; BRENAN & GREENWAY, 1949: 454; EXELL, 1960: 304. Type: Tanzania, Ukerewe I., *Conrads 5730* (neotype: K; isotype: EA).

C. suaveolens MEIKLE, 1951: 337. Type: Moçambique, Lugela, Namagoa Estate, *Faulkner 106* (holotype: K; isotypes: BR, FI, P).

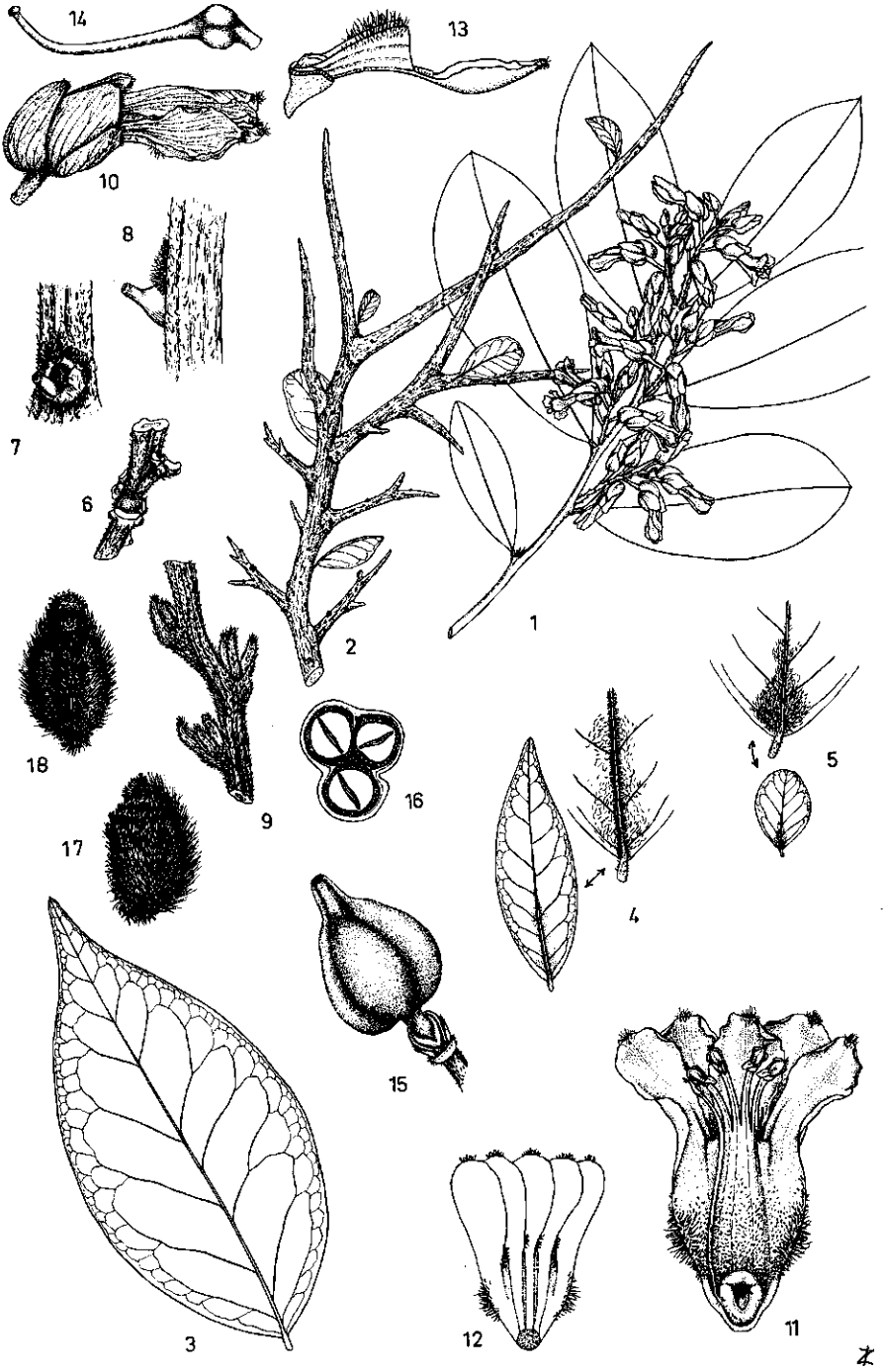
C. leandriana (DESCOINGS) BRETELER, 1969: 375. Basionym: *Falya leandriana* DESCOINGS, 1957: 171; 1961: 33. Type: Madagascar, Sambirano, Nosy Faly, *Perrier de la Bâthie 18746* (holotype: P).

C. alba G. DON var. *zanguebarica* CHODAT, 1897: 118. Type: Tanzania, Dar es Salaam, *Kirk 119* (lectotype: K).

Diagnostic characters: Shrub, or sometimes a small tree, up to 5 m tall. Leaves papery to thinly coriaceous, ovate to elliptic or obovate-elliptic, very variable in size, (1.5)2.5–12(18) × (1)1.5–6(7.5) cm. Small upper sepal strongly concave, boat-shaped. Petals subequal in shape, the median petal slightly concave to rather flat, gradually tapering into the claw, not much broader than the other ones. Seeds usually with straight hairs.

Description: Shrub, or sometimes a small tree, up to 5 m tall. *Bark* of main trunk and branches rather smooth. *Branchlets* puberulous, glabrous, or glabrescent. Stipules absent, or visible as a dark, glandlike, glabrous spot, which is usually slightly elevated, or sometimes even conical-truncate, up to 1 mm

FIG. 4. *Carpolobia goetzei:* 1. flowering branchlet, ½×; 2. small-leaved branchlet, ½×; 3. leaf undersurface, ½×; 4–5. leaf undersurface (½×) with enlarged basal part; 6. part of rhachis with glandular stipules, 5×; 7–8. glandular stipule, 5×; 9. part of rhachis with bracts and bracteoles, 5×; 10. flower, 2×; 11. corolla with staminal sheath, 3×; 12. abaxial side of corolla, schematically; 13. keel petal with part of upper petals, 2×; 14. pistil, 3×; 15. fruit, 2×; 16. transverse section of fruit, 2×; 17–18. seed, 2× (1, 10–14. *Faulkner 3765;* 2. *Mogg 28562;* 3. *Magogo & Glover 269;* 4. *Bullock 1345;* 5, 7–8. *Perrier de la Bâthie 18746;* 6. *Polhill & Paulo 715;* 9. *Eggeling 196;* 15–18. *Shabani 196*.)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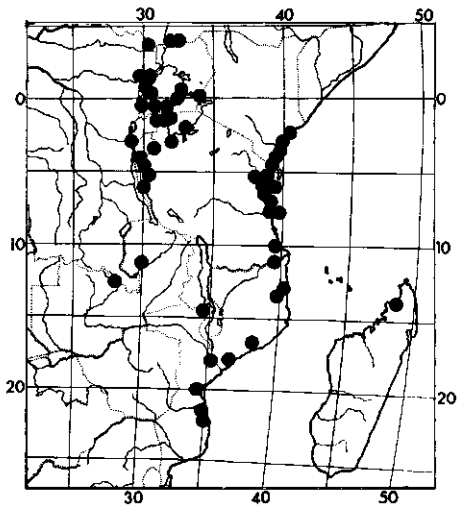
high. *Leaves:* petiole (1)1.5–3(4) mm long, puberulous to glabrous; blade papery – thinly coriaceous, obovate to elliptic, or ovate-elliptic, sometimes narrowly so, 1.5–3(3.5) times as long as wide, very variable in size, (1.5)2.5–12(18) × (1)1.5–6(7.5) cm, obtuse, rounded or cuneate at base, more or less acuminate, sometimes acute, or rounded at top, the acumen up to 2 cm long, the midrib sparsely puberulous above, beneath with rather long, reddish-brown hairs on midrib often extending on the basal part of the blade, or the leaves entirely glabrous; midrib slightly impressed above, at least in the basal part, prominent beneath; the (3)5–10(12) main lateral nerves prominent beneath, slightly so above, often hardly to distinguish from the minor lateral nerves. *Inflorescences* 1–2(3) per axil, up to 3.5 cm long, 2–9(20)-flowered; peduncle up to 3 mm long; peduncle and rhachis pubescent. Bracts and bracteoles often soon deciduous, triangular, 0.5–1.5 mm long, pubescent or nearly glabrous, the basal ones often sterile, rather stiff, up to 3(4) mm long. Pedicel 2–6(8) mm long, puberulous. *Sepals* ovate-elliptic, (3)4–10 × (2)3–6 mm, the largest up to two times as long as the smallest, the upper one boat-shaped, the two inner ones oblique at base, concave, top obtuse or emarginate, glabrous or puberulous outside, more densely so towards base and top, inside glabrous or puberulous, the margins ciliate. *Petals* subequal in size, (10)12–15(18) × 2–4(5) mm, a little different in shape, the median petal slightly concave to rather flat, narrowly obovate-spathulate, gradually tapering into the claw, the other ones narrowly elliptic, each petal with hairs on the basal part of the free and overlapping edges, and on the apices, the basal part of the upper petals always puberulous inside. *Stamens* (7)9–12(14) mm long, the free parts slightly curved, ca. 2–4 mm long (i.e. $\frac{1}{5}$–$\frac{1}{3}$ of total length of stamens); staminal sheath for 4(6)–8 mm connate with the upper petals (i.e. for $\frac{1}{2}$–$\frac{3}{4}$ of total length of stamens); base of staminal sheath sometimes minutely



MAP 5. *Carpolobia goetzei.*

puberulous inside; often 1–2 staminodes present; seldom with a few hairs on the anthers. Disc well-developed, especially so at the abaxial side, glabrous, or rarely with a few hairs. *Pistil* (7)10–13(15) mm long, glabrous; ovary shortly stipitate, obscurely 3-lobed, 1–2 mm long, style curved. *Fruit* orange (or red?) at maturity, in dried state ovoid-ellipsoid, usually lobed, up to 1.5(2) cm long, 1–3-seeded, shortly stipitate, often apiculate, apex up to 2.5 mm long; exocarp thin; mesocarp fleshy; endocarp thin. *Seeds* subellipsoid, flattened, 7–9(10) mm long, 3–6(7.5) mm in diam., densely covered with usually straight, rusty-brown, ca. 1 mm long hairs, subappressed towards the hilum.

Distribution: Southern Sudan, Eastern Zaïre, Uganda, Kenya, Tanzania, Zambia, Moçambique, Madagascar.

Ecology: Semi-deciduous forest, gallery forest, savannah woodland, on rocky dry ground, or, as often reported, on sandy soils or along rivers. Alt. up to 1.350 m.

Specimens examined:

ZAÏRE. Lesse, *Bequaert 3110* (BR); Ituri F., Mutoni, *Claessens s.n.* (BR); Kurukwata, *Gérard 3624* (BR); *3644* (BR, K).

SUDAN. Haut Uele, Kurukwata, *Hoyle 781* (BM); Lotti, Torit Distr., *Jackson 1275* (K); *Smith 31* (K); Acholi Hills, Laboni F., *Snowden 1682* (BM, K).

UGANDA. Buvuma I., *Bagshawe 664* (BM), Mbanga R., Toro, *Bagshawe 1062* (BM); Entebbe, *Brown 244* (K); *Chandler 2097* (B, BR, K); *Dawe 975* (K); 2 mls E. of Entebbe, *Dawkins 382* (EA, K); Mukono, *Dümmer 305* (BM, Z); Nambigiruwa, *Eggeling 196* (BR, EA, K); sin. loc., *Eggeling 3380* (B, BR, K, P); Ruizi R., *Jarrett 97* (EA); *239* (EA, K); *436* (EA, K); Kyantsore I., Kagera R., *Lang Brown 166* (EA); Bale, *Lye & Katende 5896* (EA); Entebbe, *Maitland 273* (K); *315* (K); Buhrasa, *Maitland 373* (K); Entebbe, *Maitland 596* (K); Bwamba, Toro, *Mukasa in Eggeling 5428* (EA); Masaka, *Synge 1167* (BM); S. Maramagambo, *Synnott 173* (EA); Kasyoka, *Synnott 439* (EA); S. Maramagambo, *Synnott 422* (EA).

KENYA. Shimoni, *Archer 335* (EA); Mombasa, *Boivin s.n.* (P); Hadu, *Dale 1076* (EA); Mida, *Donald 449* (E, EA); 12 mls S.W. of Kwale, *Drummond & Hemsley 1135* (EA, FI, K); Port Victoria, *Glasgow 46/48* (EA); Arabuko, *Graham 2329* (EA, K); N. of Jadini, *Greenway 9643* (B, EA, K); Mele, *Kässner 226* (BM); Makoni, *Kässner 400* (BM, K); Tivi, *Lady Muriel Jex-Blake* 1902 (K); near Jadini, *Lucas, Jeffrey & Kirikka 259* (B, BR, K); Longomwagandi F., Shimba Hills, *Magogo & Glover 269* (BR, K, WAG); N. of Sokoke, *Musyoki & Hansen 1002* (K); Sabaki, *Polhill & Paulo 715* (B, BR, EA, K); Utwani F., *Rawlins 211* (EA, K); *233* (EA, K); Giryama & Tsimba Mts, *Tailor s.n.* (BM); Arabuko F., *Tweedie 3188* (K); Ukunda, *Verdcourt 3954* (BR, EA, K).

TANZANIA. Tanga Prov., *Bally 6956* (EA); Uvinsa, *Bullock 3233* (K); Lindi Distr., *Busse 2982* (EA, G); Rubya, *Carmichael 750* (K); near Kigoma, *Clutton-Brock 496* (EA); Ukerewe I., *Conrads 164* (BR, K); *471* (BR, EA, K, M); *5298* (BR, EA, K); *5341* (EA); *5342* (EA); *5730* (EA, K, neotype of *C. conradsiana*); *5732* (EA); 5 mls S.E. of Ngomeni, *Drummond & Hemsley 3510* (B, EA, K); near Nyakisasa, *Eggeling 6649* (EA, K); Lake prov., *Farquhar 19* (BM); Pangani, *Faulkner 535* (BR, K); Machni, Tanga- Pangani Rd., *Faulkner 1593* (B, BR, K, LISC); Kange, *Faulkner 1855* (B, BR, K); Zanzibar, Kismi Kazi, *Faulkner 2723* (K); Pongwe-Maweri, *Faulkner 3709* (BR, K); Pongwe-Maromi, *Faulkner 3765* (EA, K); Kibaha, *Flock 1* (EA); near Nungwe, *Forest Herbarium 3217 (478)* (EA); Dar es Salaam, *Goetze 4* (BM, K, type); Mafia I., Baleni, *Greenway 5186* (EA, K); Mafia I., Chunguroma, *Greenway 5360* (EA, K); S. of Kigoma, *Hani 33* (EA); Bogandika, *Haarer 2168* (K); Ukerewe, *Harris 2684* (K); Kungwe Mts, *Harley & Newbould 4453* (BR, K); Kasieha, *Jefford, Juniper &*

Newbould 2731 (B, BR, K); Dar es Salaam, *Kirk 119* (K, type of *C. alba* var. *zanguebarica*); sin. loc., *Kirk 119 bis* (K); Zanzibar, *Lyne 36* (K); Rubondo, *Ludanga 2027* (EA); Bana F.R., *Mfinanga 23* (EA, K); *Mgaza 780* (BR, EA); Ngomeni, *Mohamed 14827* (EA); Kisarawe Distr., Kisiju, *Paulo 160* (EA, K); Kasakela valley, *Pirozynski 371* (EA, K); Mkuti R., *Proctor 311* (BR, EA, K); 6 mls N. of Kibondo, *Proctor 372* (EA, K); E. of Mabira, *Proctor 1006* (EA, K); Kwaluguru, *Proctor 2909* (EA, K); Bana F.R., *Ruffo 123* (EA, K); Tanga, *Sacleux 576* (P); Mafia I., Kilindoni, *Schlieben 2692* (B); Lutamba lake, *Schlieben 5210* (B, BM, BR, EA, G, HBG, LISC, M, P, Z); Msubugwe F.R., *Semsei 2252* (BR, EA, K); Kikoka F.R., *Semsei 3734* (EA, K, WAG); Rondo F.R., *Shabani 42* (EA, K); Banda F.R., *Shabani 196* (EA, K); Korogwe, Kwamwalukanga F.R., *Shabani 610* (EA, K); Mwera, *Tanner 2221* (B, BR, K, WAG); Pangani, *Tanner 3383* (BR, K); Boza, Madanga, *Tanner 3469* (K); Tanga, *Tanner 3490* (B, BR, K); Madanga, *Tanner 3506* (B, BR); Zanzibar, *Toms 53* (K); Zanzibar, Cave-Wells, *Vaughan 1488* (EA, K); Zanzibar, *Vaughan 1540* (K); Zanzibar, Kizimkazi, *Vaughan 1806* (EA, K).

ZAMBIA. Broken Hill, *Brenan & Trapnell 7904* (BR, EA, K); *7906* (K); Bulaya-Mwewe, *Bullock 1345* (BR, K); Chingola, *Fanshawe 2407* (BM, BR, K); *2605* (BM, K); *2670* (K); Lake Chishi, *Fanshawe 4905* (K); Chingola, *Fanshawe 5265* (K).

MOÇAMBIQUE. Lugela, *Faulkner 106* (BR, FI, G, K, type of *C. suaveolens*); Namagoa, *Faulkner 110* (K); Zambesia, 2.5 km of Mualama, *Grandvaux Barbosa & Carvalho* 4337 (K); Nangade, *Mendonça 980* (BM, BR, COI, EA, K, LISC, WAG); between Porto Amélia and Mecufi, *Mendonça 1090* (K); Bazaruto I., *Mogg 28562* (LISC); *28848* (LISC); *29058* (LISC); Antonio Enes, *Mogg 32366* (LISC); *32457* (LISC); *32463* (LISC); *32522* (LISC); 12 km S.E. of Sengo, *Müller & Pope 2044* (K, LISC); Madanda F., *Swynnerton 1750* (BM); Mindimba (?) Hills, *Stocks s.n.* (K).

MADAGASCAR. Sambirano, Nosy Faly, *Perrier de la Bâthie 18746* (P, type of *Falya leandriana*).

Notes: CHODAT (1897) was the first taxonomist who distinguished this taxon and he named it *C. alba* var. *zanguebarica*, citing two specimens, *Kirk 119* and *Wakefield s.n.*, of which the former is designated lectotype. According to his description the variety differs from *C. alba* var. *alba* by larger, more cucullate upper sepals, a far less distinct keel petal, and a more apiculate fruit. The first two characters are indeed the most important ones to distinguish this taxon. GUERKE, who described it as *C. goetzei* in 1904, also mentions these characters in part. Of the syntypes cited by GUERKE, i.e. *Stuhlmann 6386, 6529, 8992*, and *Goetze 4*, only duplicates of the last one could be traced; consequently it is designated lectotype. The lectotypes of both names originate from the surroundings of Dar es Salaam and represent the same taxon. Considering the importance of the shape of the keel petal in delimitating the species of *Carpolobia*, together with characters of the sepals and seed indumentum, this taxon is best treated as representing a distinct species.

When ENGLER (1915) published *C. conradsiana*, the locality Ukerewe was mentioned, but no specimens were cited. CONRADS collected on Ukerewe Island in the Victoria Lake in the period 1912–1931 (Index Herbariorum II, Collectors A-D: 136). At present extant CONRAD material is kept mainly in EA and K. It is dated 1929 or even 1930. As the original material has been lost at Berlin, and duplicate material could not be traced, a neotype is designated, namely *Conrads 5730*, collected on Ukerewe Island.

ENGLER distinguished his species by the presence of both a hairy midrib and hairy sepals, which elements are, according to ENGLER, glabrous in *C. goetzei*.

These two characters are of a quantitative nature and prove to be very variable as comparison of the available material learns. The hairiness of the lower leaf surface may even vary from densely hairy to glabrous or nearly so within one specimen e.g. *Fanshawe 2407, 2607, Brenan & Trapnell 7904, 7906, Bullock 1345,* and *Mendonça 980.* Therefore *C. conradsiana* has been reduced into synonymy.

Examination of the type of *C. suaveolens* fully justifies EXELL's decision to treat it as a synonym of *C. conradsiana.* Consequently it is now reduced to a synonym of *C. goetzei.*

Carpolobia leandriana is based on a specimen collected on Madagascar, which DESCOINGS (1957) judged to represent a new monotypic genus in the *Dichapetalaceae.* BRETELER (1969) recognized it as a *Carpolobia* and considered it to be a new species on account of 'the small coriaceous leaves with typical indumentum beneath, the conical, truncate, glanduliferous stipules, and the rather equal corolla lobes'. These characters fall within the variability of *C. goetzei.* The type of Madagascar resembles the specimens *Swynnerton 1750* and *Mendonça 1080* both from Moçambique and *Fanshawe 2605* from Zambia, all with (comparatively) small leaves.

9.5. CARPOLOBIA GOSSWEILERI (EXELL) PETIT (Fig. 5, Map 6)

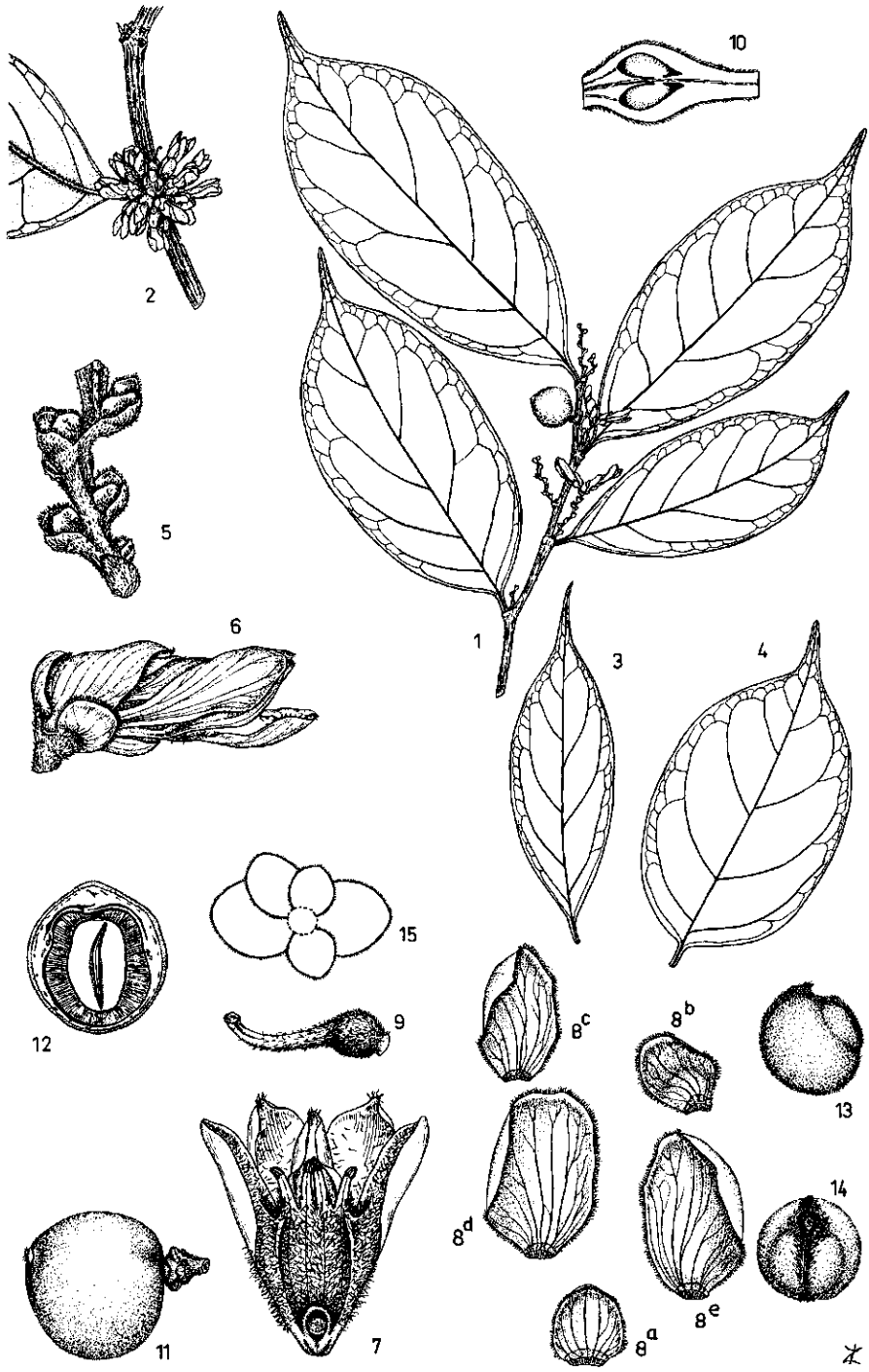
C. gossweilerí (EXELL) PETIT, 1958: 281.

Basionym: *Atroxima gossweilerí* EXELL, 1936: 18; EXELL & MENDONÇA, 1937: 88.

Type: Angola, Cabinda, M'bulu Hills, source of N'Zanza River, Chiloango, *Gossweiler 7805* (holotype: BM; isotypes: COI, K, LISU).

Diagnostic characters: Tree up to 28 m tall. Leaves papery to thinly coriaceous, oblong-elliptic, or ovate- to obovate-elliptic, caudately acuminate, (5)7–14(19) × (1.5)2.5–6.5(7.5) cm. Bracts and bracteoles suborbicular. Pedicel (0.5)1–3 mm long. Petals subequal in shape and size, (4.5)6–9(13) mm long. Fertile stamens 4(5). Pistil and fruit tomentellous.

Description: Tree up to 28 m tall, sometimes a shrub. *Bark* of stem and branches greyish, rather smooth. *Branchlets* glabrous or sparsely puberulous when young. Stipules usually absent, sometimes present as a dark glandlike spot. *Leaves:* petiole (2)3–4(5) mm long, often canaliculate above, glabrous or glabrescent; blade papery to thinly coriaceous, ovate-elliptic – obovate, sometimes broadly or narrowly so, 2–3(4.5) times as long as wide, (5)7–14(19) × (1.5)2.5–6.5(7.5) cm, cuneate or rounded at base, usually caudately acuminate at top, the acumen up to 2 cm long; glabrous, or with a few short hairs on the midrib beneath; midrib slightly impressed above, at least in the basal part, prominent beneath, the (3)5–7(10) main lateral nerves prominent beneath, slightly so above. *Inflorescences* 1–2(4) per axil, (2)4–9(50)-flowered, up to 1.5(5) cm long, often short with the flowers crowded in the axil; peduncle and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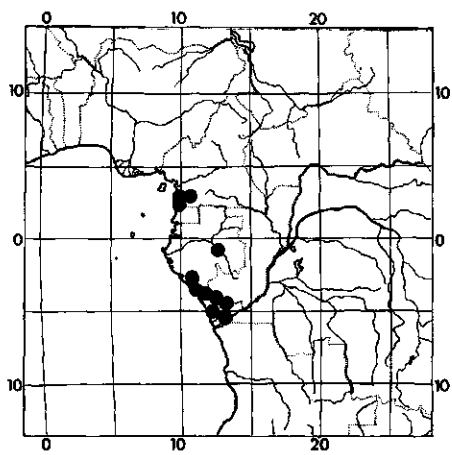
rhachis puberulous. Bracts and bracteoles suborbicular, sometimes elliptic, concave, 1–1.5 mm long, puberulous at least on the margin; the basal ones often sterile, oblong or subulate, 1.5–3(5) mm long, glabrous. *Pedicel* (0.5)1–3 mm long, puberulous. *Sepals* suborbicular or broadly ovate-elliptic, 1.5–5 × (1)1.5–4 mm, the largest 2–2.5(3) times as long as the smallest, glabrous, or with a few short hairs on both sides, the margins ciliate. *Petals* subequal in shape and size, narrowly obovate-elliptic, (4.5)6–9(13) × 1.5–2.5(3) mm, the median petal rather flat, the upper ones somewhat firmer than the other; all petals glabrous outside except for their ciliate lower margins and top (Fig. 5: 6–7), sparsely puberulous inside, the upper petals more densely so. *Stamens* (3–)4(–5), sometimes 1–2(3) staminodes present, 5–7(9) mm long, free for 1–2(2.5) mm (i.e. for $\frac{1}{5}$–$\frac{1}{3}$ of their length); the staminal sheath ca. 4–7(8.5) mm long, almost completely adnate to the upper petals, puberulous inside. Disc rimlike, interrupted adaxially. *Pistil* very shortly stipitate, (4)6–8.5(11) mm long, puberulous except for the apical part of the style; ovary subellipsoid, gradually tapering into the gently curved style. *Fruit* orange at maturity, subglobose to slightly 3-lobed, very shortly stipitate, sometimes slightly apiculate, up to 1.8 cm in diam., tomentellous, 1–3-seeded; exocarp up to 1 mm thick, hard and somewhat crustaceous in dried state; mesocarp rather firm, yellowish; endocarp thin. *Seeds* subellipsoid, somewhat flattened, 8–11 mm long, 5–8 mm in diam., densely covered with 1–2 mm long, erect, grey to yellowish brown hairs, which are partly juicy.



MAP 6. *Carpolobia gossweileri.*

FIG. 5. *Carpolobia gossweileri:* 1. flowering and fruiting branchlet, $\frac{1}{2}\times$; 2. branchlet with glomerule like inflorescence, 1×; 3–4. leaves, upper surface, $\frac{1}{2}\times$; 5. part of rhachis with bracts and bracteoles, 5×; 6. flower, 5×; 7. corolla with stamens, 5×; 8a–e. sepals, 5×; 9. pistil, 5×; 10. longitudinal section of ovary, 10×; 11. fruit, 2×; 12. cross section of fruit, 2×; 13–14. seed, 2×; 15. calyx schematically, outside. (1, 5–14. *Breteler 6680;* 2. *Le Testu 8301;* 3. *Zenker 107;* 4. *Zenker 1159.*)

Distribution: S.W. Cameroun, Gabon, Congo, Cabinda, W. Zaïre.

Ecology: Rain forest.

Specimens examined:

CAMEROUN. 11 km N. of Kribi, *Bos 5684* (WAG); 18 km S.E. of Kribi, *Bos 6108* (WAG); *6124* (WAG); Campo area, km 26 Ipono-Dipikar I., *J. de Wilde 8331* (WAG); km 15 Kribi-Ebolowa, *J. de Wilde 8678* (WAG); Campo area, Dipikar I., *J. de Wilde 8697* (WAG); Grand Batanga, *Dinklage 928* (HBG); *1059* (HBG); Bipindi, *Zenker 107* (B, WAG); *403* (B, BR, FI, P, WAG); *1159* (BM, E, L, M, P, W, WU, Z); *3091* (B, BM, BR, E, K, L, M, P, W, WU, Z); *3378* (BM, BR, COI, E, K, L, M, P, W, WU, Z); *3529* (B, BM, BR, E, K, L, M, P, W, WU, Z); *4001* (BM, BR, COI, E, K, L, M, P, W, WU, Z).

GABON. Near Lastoursville, *Breteler 6680* (WAG); Mayombé Bayaka, *Le Testu 2094* (BM, BR, P); near Lastoursville, *Le Testu 7082* (P); *7624* (P); *8301* (BM, BR, P).

CONGO. Ndoumou Mts, *Bouquet 1756* (P); Mayombe, Sounda, *Bouquet 1923* (P); Mayombe, Tshikanou, *Koechlin 2633* (P); near Bougolo (Pointe Noire), *Sita 1315* (P); sin. loc., *Thollon s.n.* (P).

ANGOLA. Cabinda. Mayombe, M'Bulu Hills, *Gossweiler 7805* (BM, COI, K, LISU, type).

ZAÏRE. Luki F.R., *Compère 35* (BR, K); *Donis 2147* (BR); near Tshobo, *Goossens 1420* (BR); sin. loc., *Nannan 118* (BR).

Note: It is not surprising that EXELL described this species in *Atroxima*, as he had no fruiting material at his disposal. The smaller flowers of *C. gossweileri* indeed resemble those of *Atroxima* very much, but characters of the seed definitely refer this species to *Carpolobia*.

9.6. CARPOLOBIA LUTEA G. DON (Fig. 6, Map 7)

C. lutea G. DON, 1831: 370; BENTHAM, 1842: 104; 1849: 224; BENTHAM & HOOKER, 1862: 139; OLIVER, 1868: 136; CHODAT, 1896: 343; ENGLER, 1915: 839; HUTCHINSON & DALZIEL, 1927: 99; PROCTOR COOPER & RECORD, 1931: 23; BURTT DAVY, 1932: 257; AUBRÉVILLE, 1936: 1; KENNEDY, 1936: 24; CHEVALIER, 1938: 277; KEAY, 1954: 109; AUBRÉVILLE, 1959: 5.

Type: Sierra Leone, sin. loc., *G. Don s.n.* (holotype: BM; isotype: K).

C. caudata BURTT DAVY, 1932: 257. Type: Ghana, Kwahu Prasu, *Vigne 1619* (holotype: K; isotype: BM).

Diagnostic characters: Shrub or treelet, up to 3 m tall. Leaves papery, from ovate to obovate, very variable in size, (1)1.5–12(14.5) × 1–4.5(6) cm. Keel petal strongly concave-galeate, breadth-length ratio (when folded) $\frac{1}{3}$ or more, the other petals ca. 2–3 mm shorter. The upper petals adnate to the staminal sheath for ca $\frac{1}{4}$ of the total length of the stamens. Hairs of seed straight.

Description: Shrub or treelet, up to 3 m tall. *Branchlets* puberulous, glabrescent with age. Stipules absent or present as a dark, glandlike, glabrous, sometimes somewhat elevated spot. *Leaves:* petiole 1.5–2.5 mm long, puberulous; blade papery, from ovate to obovate, sometimes narrowly so,

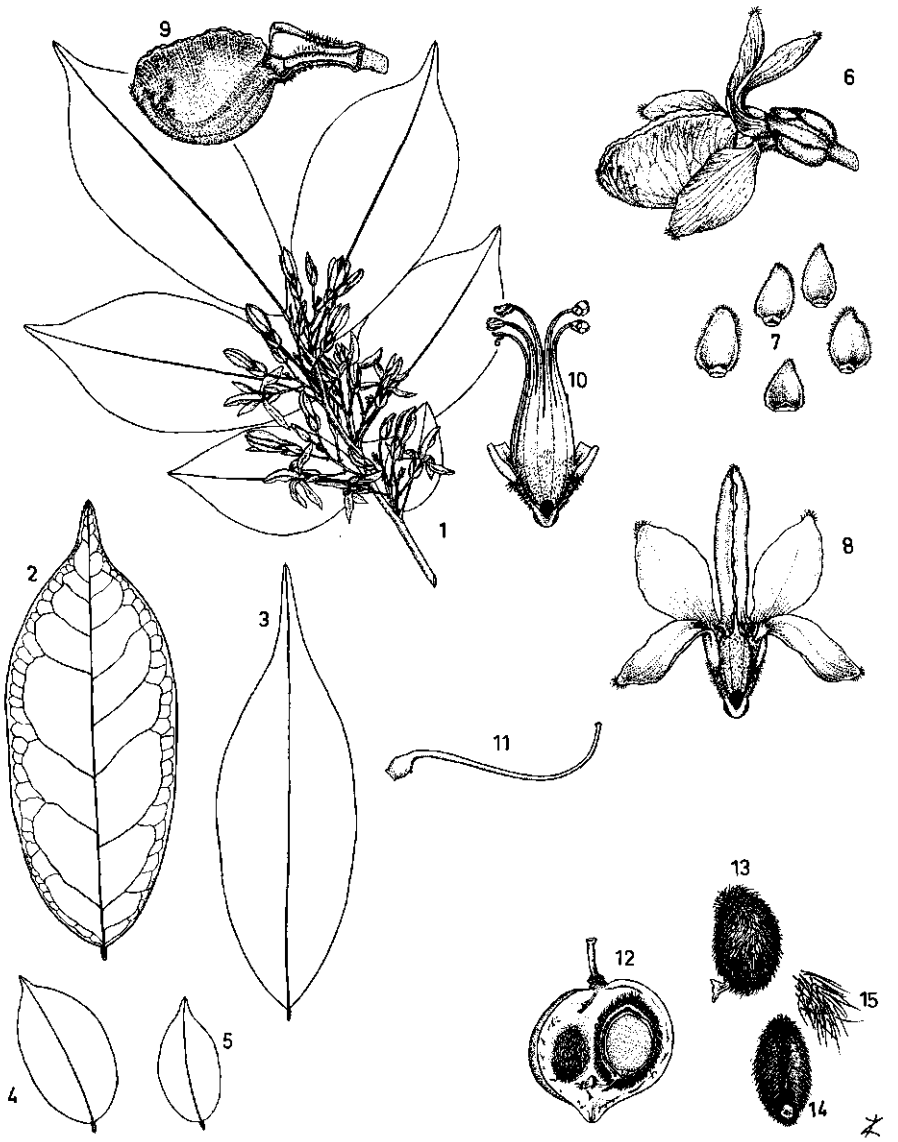
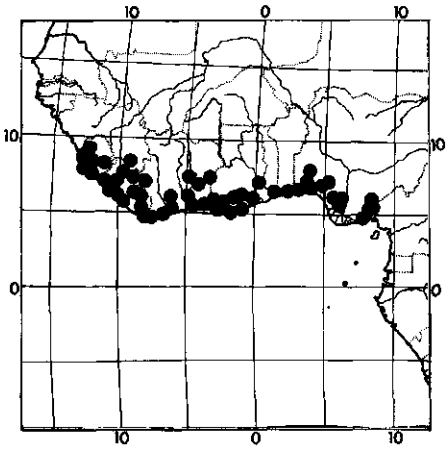


FIG. 6. *Carpolobia lutea:* 1. flowering branchlet, ½ ×; 2. leaf upper surface, ½ ×; 3–5. leaves, ½ ×; 6. flower, 2 ×; 7. sepals, 2 ×; 8. corolla, 2 ×; 9. keel petal with hinge, 2 ×; 10. staminal sheath, 2 ×; 11. pistil, 2 ×; 12. longitudinal section of fruit, 1 ×; 13–14. seed, 1 ×; 15. detail of seed indumentum. (1. *J. de Wilde 3105;* 2. *J. de Wilde 591;* 3. *Gruys 13;* 4. *Bos 2568;* 5. *Bos 2776;* 6–15. *Breteler 7466.*)

(1)1.5–2.5(4) times as long as wide, very variable in size, (1)1.5–12(14.5) × 1–4.5(6) cm, rounded or obtuse, sometimes cuneate at base, obtusely acuminate, sometimes acute or obtuse at top, the acumen up to 1.5(2) cm long, often mucronate; glabrous above, except for the shortly puberulous midrib, beneath more or less puberulous; the midrib slightly impressed above, at least in the basal part, prominent beneath, with (3)4–9(11) main lateral nerves on each side of the midrib, which are inconspicuous above and prominent beneath. *Inflorescences* 1–2 per axil, up to 3 cm long, 2–7(9)-flowered; peduncle 3(5) mm long, peduncle and rhachis puberulous; bracts and bracteoles minute, oblong-subulate, 0.5–1(1.5) mm long, puberulous. *Pedicel* (3)4–6(7) mm long, puberulous. *Sepals* ovate-elliptic, (2)2.5–5 × (1)1.5–2.5 mm, the largest up to 1.5 times as long as the smallest, acute or obtuse at top, puberulous to nearly glabrous outside, glabrous inside, the margin ciliate. *Petals* unequal, the median petal strongly concave-galeate, abruptly tapering into the claw, 10–17 mm long, (3.5)4–5.5(6.5) mm wide (when folded); the upper and lateral petals narrowly obovate, ca. 2–3 mm shorter than the keel petal, 1.5–3.5 mm wide; the adnate basal part of all petals puberulous outside, inside only thus on the basal part of the upper petals; the apices of all petals ciliate. *Stamens* strongly curved, 9–15 mm long, free for 3–7 mm (i.e. for $\frac{1}{3}$–$\frac{1}{2}$ of total length of stamens), the sheath for 2.5–3.5 mm adnate to the upper petals (i.e. for $\frac{1}{4}$ of total length of stamens); basal part of sheath more or less puberulous inside; sometimes 1–2 staminodes present. *Pistil* very shortly stipitate, 10–17 mm long glabrous; ovary subellipsoid, obscurely 3-lobed, gradually tapering into the strongly curved style. *Fruit* orange at maturity, smooth, subglobose in outline, up to 2 cm in diam., 3-lobed, very shortly stipitate, sometimes apiculate; exocarp thin; mesocarp sweet and fleshy; endocarp thin. *Seeds* subellipsoid to ovoid, slightly flattened, 8–12 mm long, 4–8 mm in diam., densely covered with rusty-brown, up to 2 mm long, straight hairs, subappressed towards the hilum.



MAP 7. *Carpolobia lutea.*

Distribution: W. Africa, from Guinea to Nigeria.

Ecology: Rain forest, semi-deciduous forest.

Specimens examined:

GUINEA. Sérédou, *Adam 11996* (P).

SIERRA LEONE. Regent Peninsula, *Cole 180* (K, WAG); sin. loc., *Dalziel 1024* (BM, BR, K); Njala, *Deighton 3365* (K, P); *3380* (K); near Taiama, *Deighton 3449* (K, P); near Njala, *Deighton 3531* (K, P); Tikonko (Dama), *Deighton 3888* (K); Jama, *Deighton 4728* (K); near Njama (Kowa), *Deighton 5770* (K, P); sin. loc., *Don s.n.* (BM, K, type of *C. lutea*); Rokupr, *Jordan 230* (K); Kasewe F.R., *Morton 1525* (K, WAG); Rokomp, *Morton & Jarr 3518* (K, WAG); Fourah Bay College, *Morton & Jarr 4135* (K); Rokel R., Lunsar Rd., *Morton & Cole 4176* (K); Layah, *Scott Elliot 4654* (K); Gola F., *Small 620* (K, P); Kamah, *Thomas 316* (K); Obompa, *Thomas 2237* (K); Yonibana, *Thomas 4744* (W); sin. loc., *Thomas 8357* (K); *9929* (K); *s.n.* (BR).

LIBERIA. Ganta, *Adam 27795* (BR); Boporo Distr., *Baldwin jr. 10256* (K); Sasstown, *Baldwin jr. 11602* (K); Bomi Hills, *Baldwin jr. 14076* (K); N. of Zorzor, *Bos 2568* (BR, K, WAG); Tapita, *Bos 2710* (K, WAG); Tobli, Tapita-Chien Rd., *Bos 2776* (K, WAG); near Zwedru, *Bos 2860* (WAG); N.E. of Bomi Hills, Gola Nat. F., *J. de Wilde & Voorhoeve 3834* (K, WAG); Grozierville, *Dinklage 2469* (B); Monrovia, *Dinklage 2727* (B); sin. loc., *Harley s.n.* (WAG); 20 km N.E. of Monrovia, *H. Jansen 774* (WAG); 10 km N.W. Chien, *H. Jansen 1270* (WAG); 7 km N. of Bomi Hills, *H. Jansen 2259* (WAG); Monrovia, *Proctor Cooper 165* (BM, K); sin. loc., *Straub 513* (BR); S. of Tapita, Krahn Bassa F., *Van Harten 318* (HBG, K, WAG); Bomi Hills-Mano R. Rd, *Van Meer 360* (WAG); Tapita-Zwedru Rd, *Van Meer 433* (WAG); 28 km W. of Tapita, *Voorhoeve 164* (BR, WAG); Zorzor, *Woelfel 23* (WAG).

IVORY COAST. Lamto, *Aké Assi 9800* (G); Abidjan, *Aubréville 179* (BM, BR, P); Agboville, *Aubréville 1916* (B, BR, P); *1923* (B, BR, K, P); Yapo F., *Bamps 1856* (BR); near Ayamé, *Bamps 2031* (BR); Téké F., *Bamps 2305* (BR, K); Bébasso F., *Bamps 2522* (BR, K, P); 79 km N.N.E. of Sassandra, *Beentje 52* (WAG): near Jacqueville, *Beentje 658* (WAG); *675* (WAG); 16 km S.W. of Toulepleu, *Beentje 939* (WAG); 2 km N.E. of Basobli, *Beentje 956* (WAG); Banco F., *Bernardi 8084* (G, K, P, WAG); Banco F., *Breteler 5214* (WAG); S.E. of Agboville, *Breteler 5348* (WAG); W. of Fresco, *Breteler 5363* (WAG); km 8 Aboisso-Ayamé Rd, *Breteler 5924* (WAG); Sassandra-Gagnoa Rd, Davo R. crossing, *Breteler 6140* (WAG); km 59 Grabo-Tabou Rd, *Breteler 7360* (WAG); km 9 Aboisso-Mamféré Rd, *Breteler 7435* (WAG); 12 km E. of Yakassé Mé, *Breteler 7466* (WAG); near Bingerville, *Chevalier 15299* (P); near Sassandra, *Chevalier 16493* (P); Bouroukrou, *Chevalier 16573* (P); Accrediou, *Chevalier 17114* (P); W. of Sassandra, *Chevalier 19221* (P); near Danané, *Chevalier 21268* (P); *21279* (P); Attié, *Chevalier 22659* (P); near Grand Bassam, *Chevalier 34251* (P); Adiopodoumé, *Cremers 344* (BR); Banco F., *De Koning 999* (WAG); *1017* (WAG); *1047* (WAG); *1079* (WAG); *1553* (WAG); *1848* (WAG); *1939* (WAG); *2032* (WAG); *2225* (WAG); *2593* (WAG); Adiopodoumé, *De Koning 4942* (WAG); Banco F., *De Koning 6450* (WAG); Adiopodoumé, *De Koning s.n.* (I, II, III, IV, V) (WAG); *J. de Wilde 122* (WAG); near Abidjan, *J. de Wilde 379* (WAG); Rocher d'Issia, *J. de Wilde 479* (B, WAG); Yapo F., *J. de Wilde 591* (WAG); Adiopodoumé, *J. de Wilde 3105* (BR, K, WAG); Banco F., *W. de Wilde 3131* (BR, K, P, WAG, Z); Adiopodoumé, *W. de Wilde 443* (K, P, WAG); *443-a* (BR, K, P, WAG, Z); Boulay I., Ebrié Lagoon, *W. de Wilde 512* (BR, K, P, WAG, Z); Adiopodoumé, *W. de Wilde 1097* (BR, K, P, WAG); Banco F., *De Wit 9037* (WAG); Agnieby, *Fleury in Chevalier 33072* (P); near Grand Bassam, *Fleury in Chevalier 33113* (P); between Grand Bassam and Aboisso, *Geerling & Bokdam 1955* (WAG); 5 km N.E. of Monogaga, *Geerling & Bokdam 2451* (WAG); Adiopodoumé, *Gruys 13* (BR, WAG); near Grand Bassam, *F. Hallé 242* (P); Bassam-Port Bouet Rd, *Hedin s.n.* (P); Dabou, *Jolly 6* (P); *83* (P); *99* (P); *173* (P); Adiopodoumé, *Leeuwenberg 1750* (B, BR, COI, K, L, LISC, P, WAG, Z); 60 km N. of Sassandra, *Leeuwenberg 2838* (BR, COI, K, L, P, WAG, Z); between Abidjan and Grand Bassam, Abouabou F., *Leeuwen-*

berg 4980 (WAG); Banco F., Martineau *234* (P); *301* (BR, P); *301bis* (P); Assinie, *Nozeran s.n.* (MPU); Adiopodoumé, *Nozeran s.n.* (MPU); Banco F., *Oldeman 449* (BR, K, WAG); 12 km E. of Béréby, *Oldeman 584* (BR, K, P, WAG); Banco F., *Oldeman 956* (K, WAG); 12 km N. of Ndouci, *Oldeman 978* (BR, K, P, WAG); Dabou, *Pobéguin 4* (P); sin. loc., *J. & A. Raynal 13600* (BR, K, P); Grand Bassam, *Roberty 12254* (G); 12271 (G); Adiopodoumé, *Roberty 12316* (G, Z); *12367* (G, Z); *15488* (G); Bonoua-Aboisso Rd, *Thijssen 289* (WAG); Ndouci, *Thijssen 382* (WAG); ca. 55 km S. of Lakota, *Van der Burg 150* (WAG); Man-Douékoué Rd, Crossing Ko R., *Van der Burg 486* (WAG); Adiopodoumé, *Versteegh & Den Outer 716* (WAG).

GHANA. Nkwanta, *Chipp 335* (K); sin. loc., *St. Clair-Thompson 3944* (BR); Kumasi-Kwadaso, *Cudjae 587* (BR, WAG); Aburi, *Deighton 3390* (K); Ankasa F.R., *Enti G. C. 42628* (WAG); Akwapim, *Irvine 1151* (E, K); Axim, *Irvine 2185* (E); Begoro Falls, *Morton 1827* (K, WAG); Aduamoa, Kwahu, *Morton 2448* (K); Gbadzeme, *Morton & Dokosi 4148* (K, WAG); Kwadaso, *Obeng-Darko 5038* (K); 90 km W. of Kumasi, *Oldeman 805* (B, BR, G, K, P, WAG, Z); Saraha, *Vigne 255* (BM, K); Afiafia, *Vigne 984* (P); Kwahu Prasu, *Vigne 1619* (BM, K, type of *C. caudata*).

TOGO. Near Lomé, *Warnecke 473* (BM, P).

BENIN REPUBLIC (DAHOMEY). Cohoué, *Chevalier 22780* (BR, K, P); Porto Novo, *Chevalier 23343* (P); *23346* (P); sin. loc., *Le Testu 137* (BM); *Poisson 118* (P)

NIGERIA. Iwo-Oyo Distr., Oba Hill F.R., *Adebusuyi FHI 40942* (K, WAG); Ibadan, Gambari F.R., *Adebusuyi FHI 48064* (WAG); Umdike, *Ariwado 573* (K); Lagos, *Barter 2149* (K); Eppah, *Barter 3263* (K); Abeokuta, *Barter 3354* (K); Lagos, *Bels 73* (BR, FI); Ibadan, Gambari F.R., *Bernardi 8726* (G); Orosun Mt., Akure, *Brenan c.s. 8672* (BM, K, P); Sapoba, *Brenan 8933* (BM, K, P); Okumu F.R., *Brenan & Richards 9059* (BM, K, P); 9 km W. of Otta, *Brown & Opayemi 962* (BR, WAG); 90 mls Abeokuta-Ibadan Rd, *Burtt 5* (K); Lagos, *Dalziel 1040* (E, K); Iyekuselu, *Daramola FHI 44293* (K, WAG); Okumu F.R., *Ebuade 9122* (K); Ife, *Evrard 6948* (BR); Akure F.R., *Gbile c.s. FHI 20554* (K); Erinodo, *Gledhill 863* (K, M, P, WAG); Ibadan, Kupalo, *T.H.R. Hall FHI 27464* (WAG); Ibadan Rd, *Head 66* (K); Ibadan, Gambari F.R., *Hepper 2276* (K); Okumu F.R., *Jones 9129* (K, P); Sapoba, *Kennedy 424* (K); sin. loc., *Kennedy 2587* (BM, BR); *2639* (K); near Lagos, *Killick 208* (K); Ikom-Mamfe Rd, crossing Cross R., *Latilo & Oguntayo FHI 67636* (K); W. of Ikorodu, *Leeuwenberg 11216* (WAG); 6 km N. of Ehor, Ehor F.R., *Leeuwenberg 11243* (WAG); *11248* (WAG); N.E. of Warri, *Leeuwenberg 11297* (WAG); 1 km W. of Iju Otta, *Leeuwenberg 11339* (WAG); Sapoba, *Lowe 1704* (K); Benin, *Maggs 103* (BM, K); Old Calabar R., *Mann 2298* (K); near Sapoba, *Meikle 578* (K, P); *626* (B, BR, K, P); near Ibadan, *Meikle 1155* (K, P); *1156* (K); *1157* (K); Lagos, *Millen 30* (K); near Lagos, *Moloney s.n.* (K); near Ibadan, *Newberry 22* (K); *Newberry & Etim 187* (K); Idame F.R., Ondo Prov., *Okorie 2614* (K); near Sapoba, *Olorunfemi c.s. FHI 43864* (BR, K); Ikpai Distr., Orem F.R., *Onyeachusim & Latilo FHI 54272* (BR, K); Ijebu Prov., Shasha F.R., *Richards 3463* (BM); near Benin, *Richards 5055* (K); Okumu F.R., *Ross 102* (BM); Shasha F.R., Ijebu Prov., *Ross 3121* (BM); near Lagos, *Rowland s.n.* (K, P); between Ibadan and Abeokuta, *Schlechter 13030* (BR, G, K, L, P, Z); W. Nigeria, sin. loc., *Swarbrick 2954* (E); *2960* (E); Oban, *Talbot 419* (BM, K); Eket Distr., *Talbot 3235* (BM); Ijebu, *Tamajong FHI 21000* (K); Obompa, *Thomas 2237* (K); Benin, *Unwin 34* (K); 18 mls N. of Calabar, *Van Meer 1640* (WAG).

CULT. Ivory Coast (seedlings). Adiopodoumé, *De Koning 2152* (WAG); *2521* (WAG); *2942* (WAG); *3059* (WAG); *3187* (WAG); *3427* (WAG); *3360* (WAG); *3613* (WAG); *3644* (WAG); *3648* (WAG).

CULT. Netherlands (mainly seedlings). Wageningen, *Breteler 7523* (WAG); *7524* (WAG); *7525* (WAG); *7526* (WAG); *7533* (WAG); *s.n.* (WAG); *De Bruijn 1932* (WAG).

Note: The characters by which BURTT DAVY distinguished his species fall within the variability of *C. lutea*, hence KEAY's decision is fully supported.

9.7. Excluded species

C. afzeliana Oliver ex Chodat, 1896: 343 = *Atroxima afzeliana* (Oliver ex Chodat) Stapf (see p. 15).

C. dubia G. Don, 1831: 370 = *Baphia capparidifolia* Bak. subsp. *polygalacea* Brummitt, 1965: 163–172.

C. macrostachya Chodat, 1896: 343; 1897: 117 = *Atroxima afzeliana* (Oliver ex Chodat) Stapf.

C. versicolor G. Don, 1831: 370 = *Baphia nitida* Lodd. (see Lester-Garland, 1921: 230).

C. zenkeri Guerke MS = *Atroxima afzeliana* (Oliver ex Chodat) Stapf.

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B – Berlin, Germany: Botanisches Museum.
BM – London, Great Britain: British Museum (Natural History).
BR – Brussel, Belgium: Nationale Plantentuin.
COI – Coimbra, Portugal: Botanical Institute of the University of Coimbra.
E – Edinburgh, Great Britain: Royal Botanic Garden.
EA – Nairobi, Kenya: The East African Herbarium.
FI – Firenze, Italy: Herbarium Universitatis Florentinae, Istituto Botanico.
G – Genève, Switzerland: Conservatoire et Jardin botaniques.
HBG – Hamburg, Germany: Staatsinstitut für allgemeine Botanik und Botanischer Garten.
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LISC – Lisboa, Portugal: Centro de Botánica da Junta de Investigações do Ultramar.
LISU – Lisboa, Portugal: Institute of Botany, Faculty of Science.
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MPU – Montpellier, France: Institut de Botanique, Université de Montpellier.
P – Paris, France: Muséum National d'Histoire Naturelle, Laboratoire de Phanérogamie.
W – Wien, Austria: Naturhistorisches Museum.
WAG – Wageningen, Netherlands: Laboratory for Plant Taxonomy and Plant Geography.

WU – Wien, Austria: Botanisches Institut und Botanischer Garten der Universität Wien.

Z – Zürich, Switzerland: Botanischer Garten und Institut für Systematische Botanik der Universität Zürich.

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12. INDEX OF SCIENTIFIC NAMES

Synonyms in *italics*. Principal entries in **bold face**.