

Synopses of Fruit and Seed Characters

Swartzieae (1.01–1.15)

Genus: *Swartzia* J.C.D. von Schreber

Phylogenetic Number: 1.01.

Tribe: Swartzieae.

Group: *Swartzia*.

Species Studied—Species in Genus: 55 spp.—ca. 133 spp.

Fruit a legume; unilocular; $2\text{--}34 \times 1\text{--}9 \times 1\text{--}2.5$ cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight or curved (slightly); not plicate; not twisted; symmetrical or asymmetrical; oblong, elliptic, ovate, circular, or moniliform; when asymmetrical with 1 straight and 1 curved suture, both sutures parallelly curved, or both sutures nearly straight; widest near middle or D-shaped; not inflated or inflated; terete or compressed; without or with beak; straight; with solid beak the same color and texture as fruit; short tapered, rounded, or tapered at apex; apex aligned, oblique, or right-angled with longitudinal axis of fruit; short tapered or rounded at base; base aligned, oblique, or right angled with longitudinal axis of fruit; with the apex and base uniform in texture; ligneous, leathery, or fleshy; seed chambers externally invisible or visible; with the raised seed chambers not torulose. Fruit margin not constricted or constricted; constricted along both margins; without or with sulcus; plain. Fruit wings absent. Fruit stipitate or substipitate; with the stipe up to 30 mm long. Fruit with all layers dehiscent or indehiscent (especially fleshy fruit); splitting along sutures. Dehiscence of valves along both sutures or 1 suture; apical and down; passive or active; with valves enrolling. Replum invisible. Epicarp dull; monochrome or multicolored; mottled or bichrome (because of tan lenticels); brown (various shades and combinations with other colors), black, yellow, or orange; with black or tan (lenticels) overlay; glabrous or pubescent and indurate; with 1 type of pubescence; puberulent, tomentose (minutely), sericeous, or peltate (densely micropuberulent); with pubescence gray or red; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; smooth or not smooth; with elevated features; not veined or veined; reticulately veined; not tuberculate; wrinkled (to reticulate), verrucose-rugose, ribbed, rugose, shagreen, or tessellate; not exfoliating; without cracks. Mesocarp thick; surface not veined; 1- or 2-layered; without balsamic vesicles; without fibers; solid

or firm-walled open empty cells; with vitreous layer over solid layer; ligneous. Endocarp dull; monochrome or mottled; tan; with mottling (dark); with purple overlay; smooth; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1–12; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long or measured; up to 40 mm long (longer ones dangle seeds from dehiscent fruits); of 1 length only; flattened or filiform; straight or contorted. Aril present or absent; fleshy; marginal hilar, caplike, flat from apex to near base, marginal around seed, or leaflike and attached to marginal hilum; fimbriate; covering less than 1/2 or 1/2 to nearly all of seed; white, cream, or red.

Seed $2\text{--}70 \times 2\text{--}60 \times 8.5\text{--}18$ mm; overgrown, 1 seed filling entire fruit cavity or not overgrown; not angular or angular; asymmetrical; C-shaped, irregular, ovate, quadrangular, reniform, rhombic, or circular; terete or compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa present (often not firmly surrounding embryo); not adhering to endocarp; glossy or dull; not modified by a bloom; colored; monochrome or mottled; with frequent mottles (white mottles over brown in *S. panamensis* G. Benham); brown to pale, grayish brown, cream, gray, olive, or black; with brown (dark) overlay; glabrous; not smooth or smooth; with elevated or recessed features; wrinkled; pitted with small separate pits; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe visible or not visible; from hilum to near base of seed and terminating (or going one-half way around seed); not bifurcating; lighter than testa; tan; flush. Hilum fully concealed or visible; concealed by aril; without faboid split; larger than punctiform or punctiform; up to 20 mm long; with curved, straight, or angular (more or less) outline; circular, wedge-shaped, oblong (and some up to 3/4 diameter of seed), or linear (and some up to 3/4 diameter of seed); marginal according to or subapical to radicle tip; recessed; not within corona, halo, or rim or within halo. Hilum halo color lighter than testa. Lens not discernible. Endosperm absent. Cotyledons smooth or not smooth; rugose or wrinkled; both outer faces convex or outer face of 1 cotyledon flat and other cotyledon convex; both the same thickness or 1 thicker than the other; both more or less of equal length or 1 longer than other; not folded or with both folded; sufficiently or not sufficiently folded for inner face to touch itself; portions of inner folded face unequal; margin entire 180 degrees from base of radicle; similar

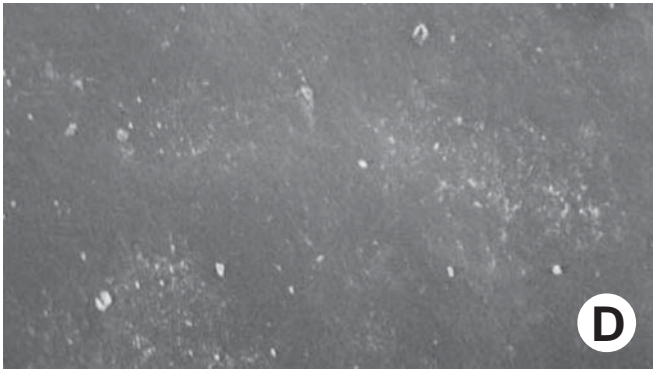
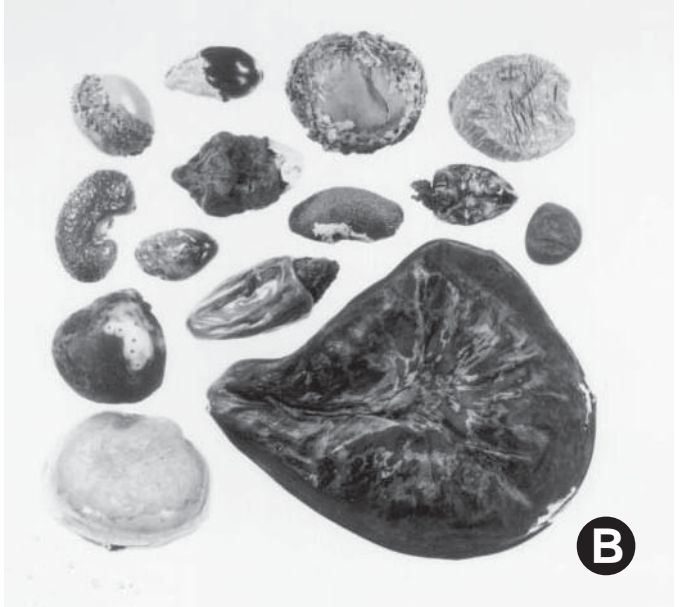
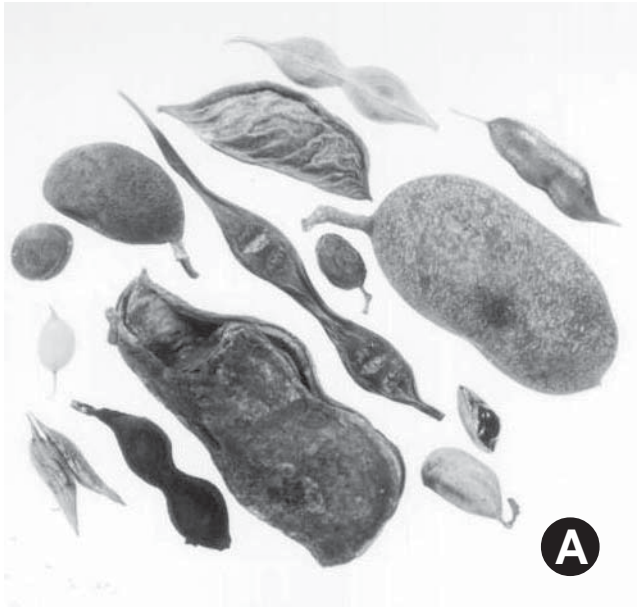
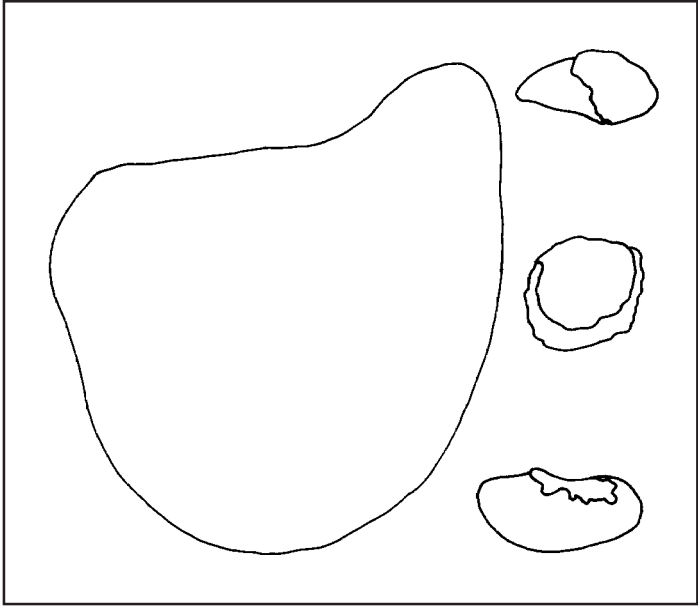
at apex; partially or completely concealing radicle (if radicle differentiated); entire over radicle; without lobes; with the interface division terminating at base of radicle or in radicle tissue; without margins recessed; dark reddish to dark greenish brown or green (dark brownish); inner face flat or concave (at least 1 cotyledon); glabrous around base of radicle. Embryonic axis parallel; parallel to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated or not differentiated from cotyledon; triangular (when developed); lobe tip straight; straight with embryonic axis; centered or not centered between cotyledons (radicle outside 1 cotyledon and inside other, therefore junctions for each cotyledon different); less (much less) than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Neotropics.

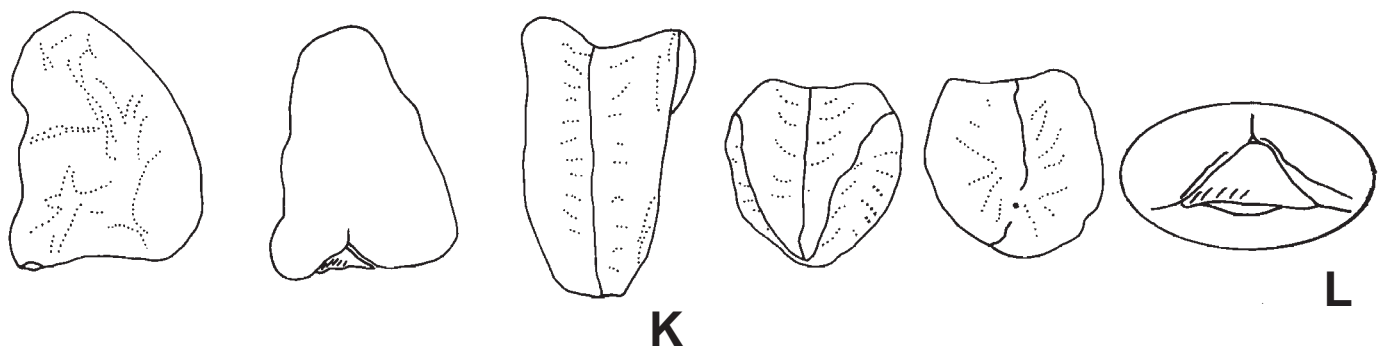
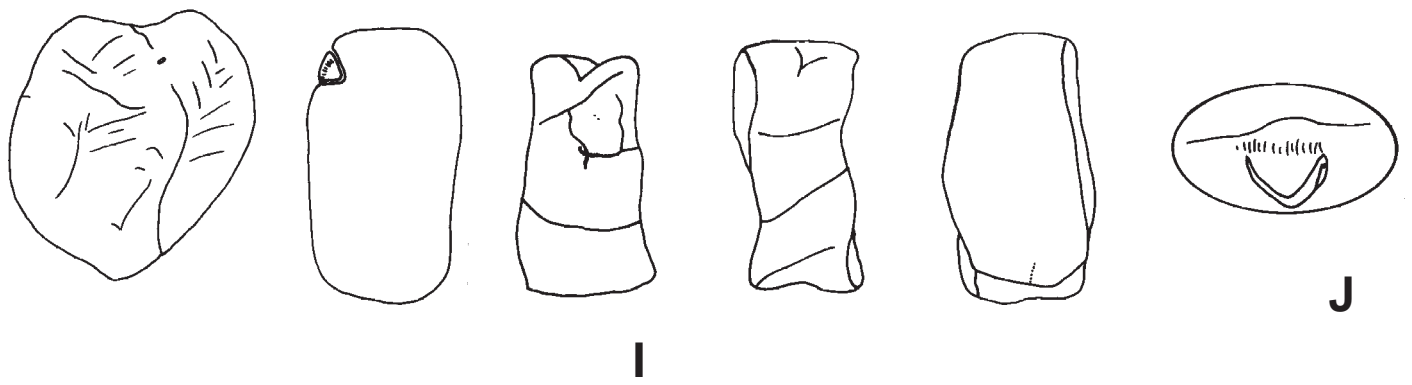
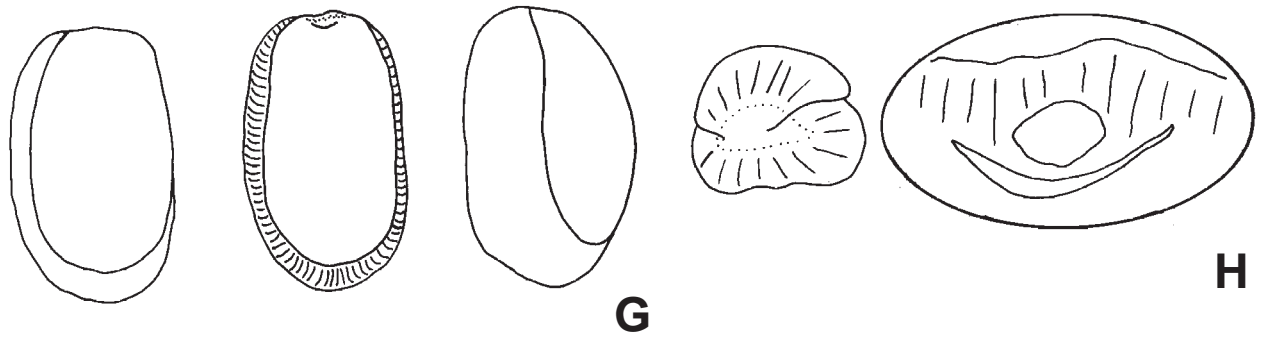
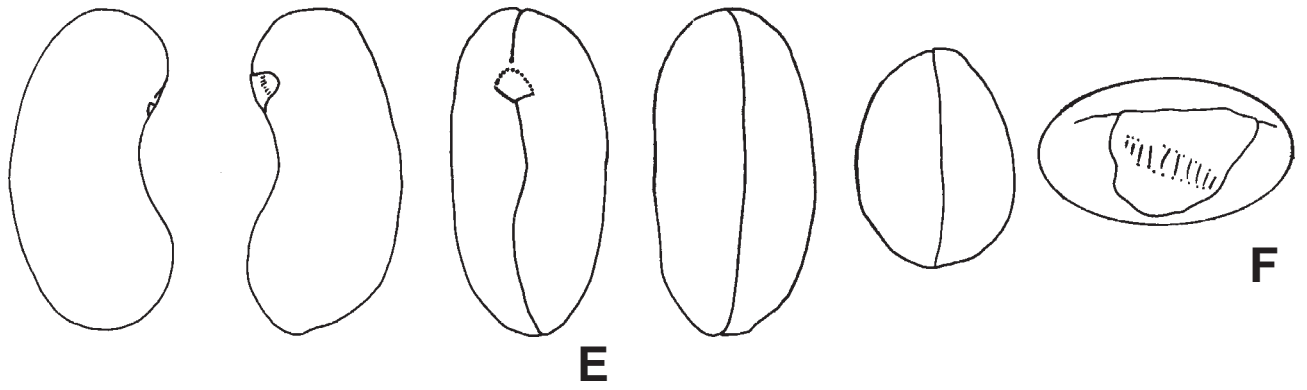
Notes: Swartzieae has been assigned to Caesalpinioideae (Cowan 1968), Swartzioideae (Candolle 1825a,b; Corner 1976), and Faboideae (Bentham 1865, Hutchinson 1964, Cowan 1981a). In 1968, Cowan (1968) was unable “finally to resolve the sub-familial relationship of *Swartzia*,” but in 1981 he (Cowan 1981a) placed it in the Faboideae and stated, “... features appear to support the arrangement adopted here with the Swartzieae representing a relatively less-advanced position in the Papilionoideae [Faboideae]. This conclusion is now supported by wood anatomy ..., by nodulation proclivity ..., and by chemistry ...; chromosome numbers of n=8, 10 or 14 ..., as well as pollen morphology ..., do not negate this conclusion.” In the most recent assessment of the Fabaceae, Polhill (1994a,b) maintained Swartzieae as a basal tribe of Faboideae, “transitional to the Caesalpinioideae.” He transferred four genera from Sophoreae (2) into Swartzieae, *Amburana* (1.15), *Ateleia* (1.13), *Cyathostegia* (1.14), and *Holocalyx* (1.12), and arranged the genera in four groups corresponding to clades in Herendeen’s (1995) cladistic analyses. Herendeen carried out cladistic analyses using morphological characters of all Swartzieae genera, 19 genera of Sophoreae, and 3 Caesalpinioideae genera. He concluded that Swartzieae is polyphyletic and that it should be disbanded and its genera transferred to Sophoreae. Preliminary *rbcL* data (Doyle et al. 1997) supported his conclusions. Our seed data neither support nor refute the overall outlines of Herendeen’s cladograms; they are discussed below for a few genera. Ferguson and Skvarla (1991) reported on the pollen morphology of

Aldina and *Swartzia* (1.01), and the nine other genera of Swartzieae are covered in Ferguson and Skvarla (1988). Their data are summarized in a computer-generated key in Vezey et al. (1991). The pollen data for the tribe should be compared with our seed-fruit morphological data. The New World species of *Swartzia* were monographed by Cowan (1968). Kooposhian (1963) noted that most external and internal seed characters are faboidlike. The caesalpinoid seed feature is the simple hilum with a single epidermis layer and no tracheid bar. Corner (1951) noted that a “bony ridge” is visible and simulates the tracheid bar in the subhilum. Based on seed and fruit characters, *Swartzia* was a heterogeneous genus. Clearly *S. madagascariensis* A.N. Desvoux and *S. fistuloides* H.A.T. Harms (both African) belong in the subfamily Faboideae. The key character is the presence of a faboid split in the hilum, coupled with the presence of a raphe, lens, and bent embryonic axis. *Swartzia madagascariensis* and *S. fistuloides* were so clearly not members of the genus *Swartzia* that they were transferred to the new genus *Bobgunnia* (1.01A), which was established as a result of this study (Kirkbride and Wiersema 1997). Even omitting these species from *Swartzia* and unlike most other faboid genera, it is impossible to represent *Swartzia* with one internal seed drawing. Some seeds of *Swartzia* discolored the dissection fluid.

Swartzia: *S. simplex* (O.P. Swartz) C.P.J. Sprengel (*C–D*),
S. spp. (*A–B*). *A*, Fruits ($\times 0.4$); *B*, seeds ($\times 0.8$); *C–D*,
testa ($\times 50$, $\times 1000$).



Swartzia (con.): *S. latifolia* G. Bentham var. *sylvestris* R.S.
Cowan (*I-L*), *S. oraria* R.S. Cowan (*G-H*), *S. simplex*
(O.P. Swartz) C.P.J. Sprengel (*E-F*). *E, G, I, K*,
embryos ($\times 2, \times 2.5, \times 2.5, \times 2.6$); *F, H, J, L*,
embryos ($\times 8, \times 11, \times 10, \times 9$).



Genus: *Bobgunnia* J.H. Kirkbride & J.H. Wiersema

Phylogenetic Number: 1.01A.

Tribe: Swartzieae.

Group: Swartzia.

Species Studied—Species in Genus: 2 spp.—2 spp.

Fruit a legume; unilocular; 6–30 × 1.3–1.8 × 1.2–1.6 cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight, curved (to slightly so), or S-curved; not plicate; not twisted; symmetrical; linear; not inflated; terete; without or with beak (up to 2 mm long); straight; with solid beak the same color and texture as fruit; rounded at apex; apex aligned with longitudinal axis of fruit; rounded or short tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; ligneous; seed chambers externally invisible. Fruit margin not constricted; with or without sulcus; plain. Fruit wings absent. Fruit stipitate; with the stipe up to 10 mm long. Fruit indehiscent. Replum invisible. Epicarp dull; monochrome; dark reddish brown; glabrous; eglandular; without spines; not smooth; with elevated features; not veined; not tuberculate; faintly warty; not exfoliating; without cracks. Mesocarp thick; surface not veined; 1- (*B. fistuloides* (H.A.T. Harms) J.H. Kirkbride & J.H. Wiersema) or 2-layered (*B. madagascariensis*); without balsamic vesicles; without fibers; with reniform canals; with empty space (with or without spongy tissue) within solid layer; ligneous. Endocarp glossy; monochrome; tan; nearly smooth; septate; with septa (and mesocarp tissue) thicker than paper, firm; with septa eglandular; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 4–20 (determined from fruit length); length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only; assumed triangular; straight. Aril absent or present; dry; tiny rim-aril; tan.

Seed 6–8 × 4–6 × 3–3.5 mm; not overgrown; not angular; asymmetrical; reniform or oblong; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; glossy; not modified by a bloom; colored; monochrome; tan or brown (dark reddish); glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe from hilum through lens to base of seed and terminating; not

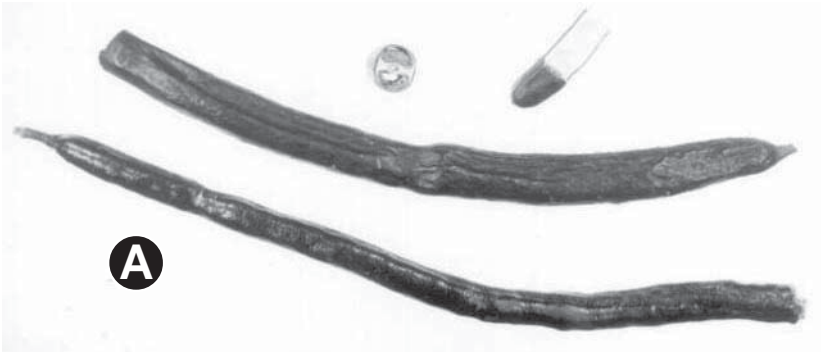
bifurcating; darker than testa; reddish brown; flush. Hilum partially or fully concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 0.5 mm long; with curved outline; circular; between cotyledon and radicle lobe; recessed; within rim. Hilum rim color of or darker than testa. Lens discernible; equal to or greater than 0.5 mm in length; 1 mm long; with margins curved; elliptic; not in groove of raphe; adjacent to hilum; up to 1.7 mm from hilum; mounded; dissimilar color from testa; darker than testa; reddish brown; not within corona, halo, or rim. Endosperm thick; not pluglike and not resembling tip of radicle; covering entire embryo; adnate to embryo. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; tan; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle bulbous; lobe tip curved; deflexed and parallel to cotyledon width; centered between cotyledons; 1/2 to nearly length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Eastern tropical to western tropical Africa and then to southern Africa.

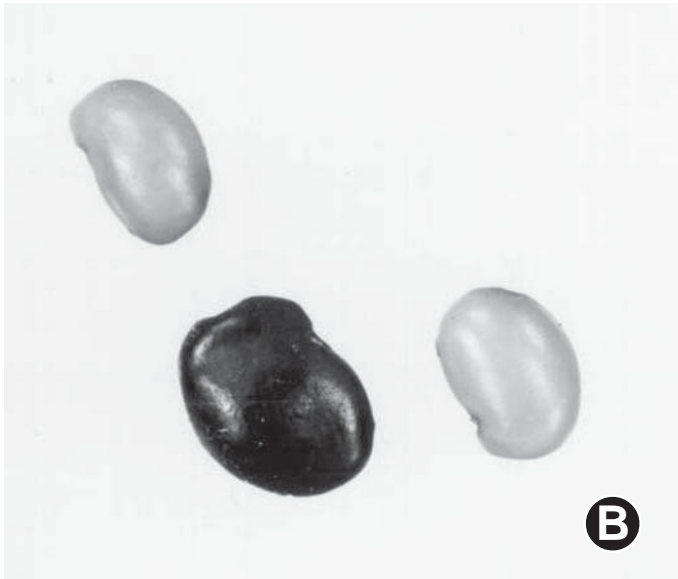
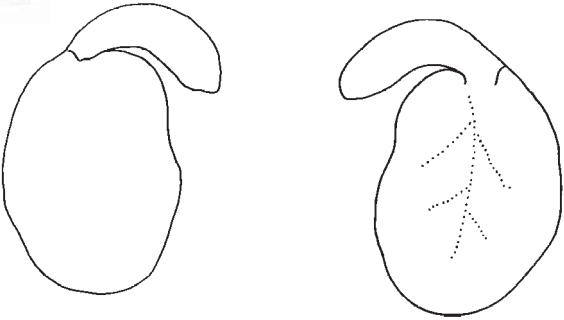
Notes: *Bobgunnia fistuloides* (H.A.T. Harms) J.H. Kirkbride & J.H. Wiersema and *B. madagascariensis* were once placed in *Swartzia*, but their seeds and fruits are so incompatible with *Swartzia* that they were moved to a new genus by Kirkbride and Wiersema (1997). These species are clearly members of subfamily Faboideae.

Bobgunnia: *B. madagascariensis* (A.N. Desvaux) J.H. Kirkbride & J.H. Wiersema (A–E). A, Partial fruits, fruit in transection, and fruit in partial longitudinal section (× 0.4); B, seeds (× 3.4); C–D, testa (× 50, × 1000); E, embryos (× 6).

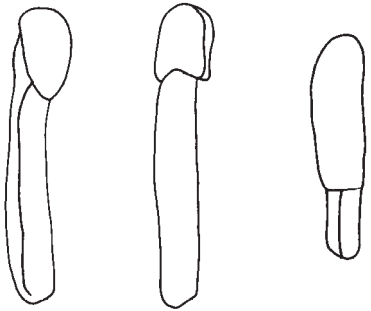
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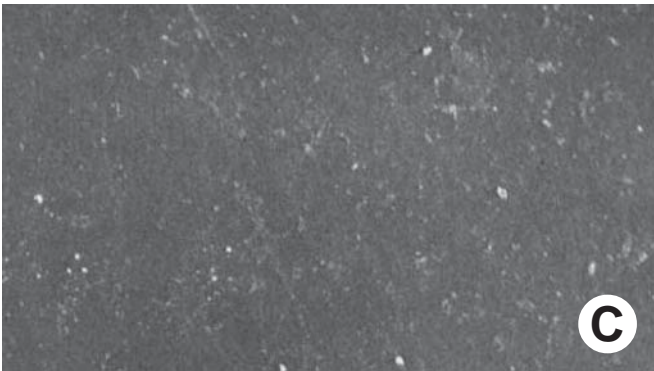
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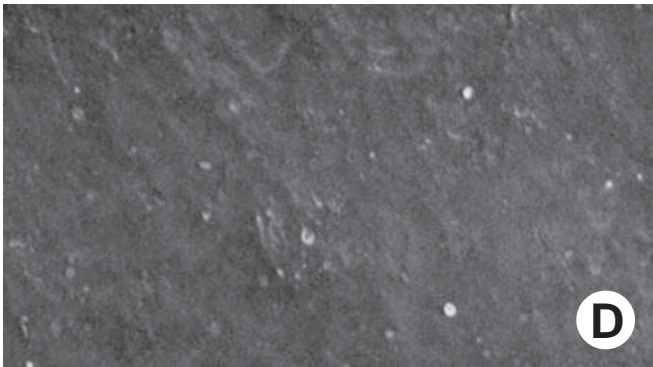
B



E



C



D

Genus: *Bocoa* J.B.C.F. Aublet

Phylogenetic Number: 1.02.

Tribe: Swartzieae.

Group: Swartzia.

Species Studied—Species in Genus: 6 spp.—7 spp.

Fruit a legume; unilocular; $0.8\text{--}3 \times 0.8\text{--}2.5 \times 0.8\text{--}2$ cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; obliquely elliptic, ovate, circular, or rhombic; when asymmetrical, both sutures parallelly or unequally curved; not inflated; terete or compressed; without or with beak (1–2 mm long); straight; with solid beak the same color and texture as fruit; short tapered or rounded at apex; apex aligned or oblique with longitudinal axis of fruit; short tapered at base; base aligned or oblique with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit substipitate or nonstipitate. Fruit with all layers dehiscent; splitting along sutures. Dehiscence of valves along both sutures; apical and down; passive. Replum invisible. Epicarp dull; monochrome; reddish to greenish brown or tan; glabrous to pubescent and indurate; with 1 type of pubescence; rarely puberulent; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; usually veined; reticulately veined; not tuberculate; scaly tessellate; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous. Endocarp dull; monochrome; reddish brown or tan; smooth; septate or nonseptate; with septa thin (tissue paper-like), flexible; with septa eglandular; coriaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seed 1; length parallel with fruit length. Funiculus measured; 1.5–3 mm long; filiform; straight. Aril absent or present (in *B. prouacensis* J.B.C.F. Aublet and *B. viridiflora* (A. Ducke) R.S. Cowan); fleshy; laciniate; covering less than 1/2 of seed; white.

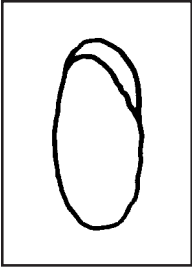
Seed $8\text{--}27 \times 3.5\text{--}13 \times 2.7\text{--}13$ mm; not overgrown; not angular; asymmetrical; oblong or ovate; terete or compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus;

without umbo on seed faces. Testa not adhering or partially adhering to endocarp; dull or glossy; not modified by a bloom; colored; monochrome; yellowish brown, tan, or black; glabrous; smooth or not smooth; with elevated features; wrinkled; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible; without faboid split; punctiform; subapical to radicle tip; flush; not within corona, halo, or rim. Lens not discernible. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; reddish brown; inner face flat; glabrous around base of radicle. Embryonic axis oblique or parallel; oblique or parallel to length of seed; with a joint evident between the radicle and the cotyledons. Radicle triangular; deflexed and parallel to cotyledon width; centered between cotyledons; less (much less) than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

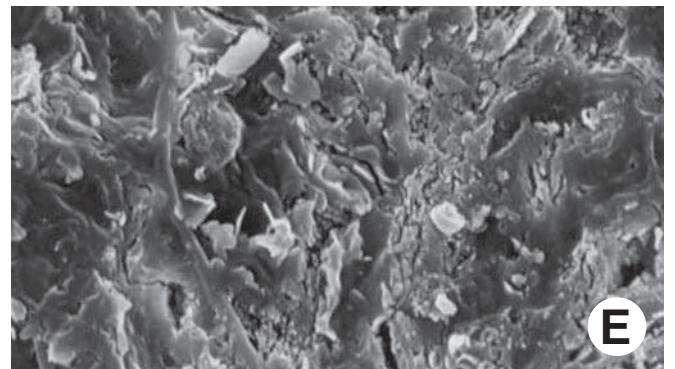
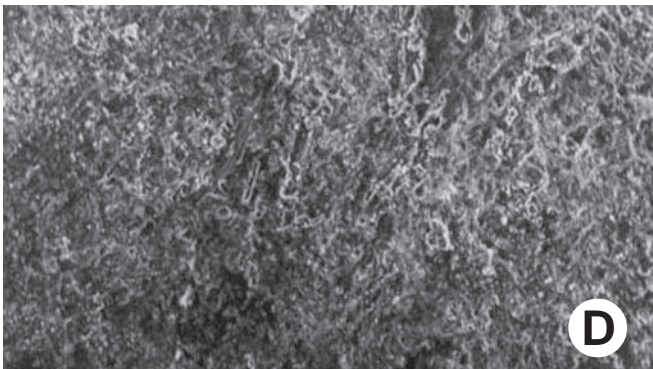
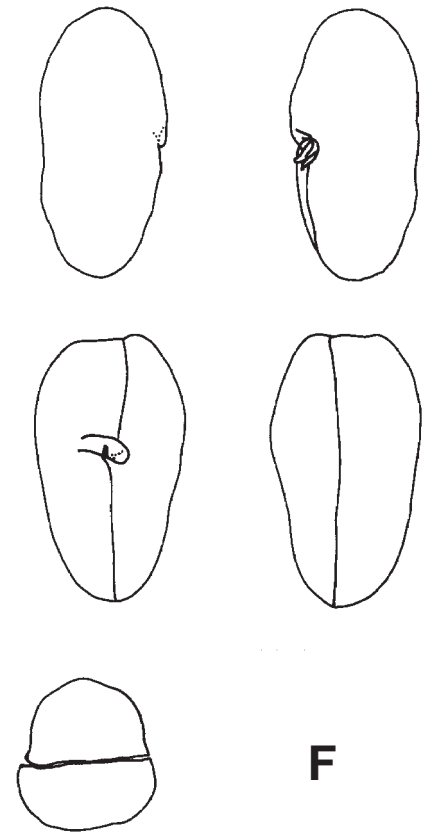
Distribution: Eastern Peru, eastern coastal and Amazonian Brazil, Guyana, and French Guiana.

Notes: Cowan (1974) revised *Bocoa*. Herendeen (1995), in his cladistic analyses of Swartzieae genera, split *Bocoa* into two species groups “to reduce character polymorphism”: (1) those species with opposite leaflets, colpus membrane coarse granular, and arillate seeds and (2) those with alternate leaflets, colpus membrane fine granular, and nonarillate seeds. In unweighted cladistic analyses, the first group was in a clade with *Swartzia* (1.01) and *Candolleodendron* (1.03), and the second was at the base of a clade consisting of *Baphiopsis* (1.05) and six Sophoreae (2) genera. In weighted cladistic analyses, both *Bocoa* groups were part of the clade including *Swartzia* and *Candolleodendron*. The cotyledonary and embryonic structures of *Bocoa* are similar to those of *Baphiopsis* and different from those of *Swartzia*, suggesting that *Bocoa* belongs to the clade with *Baphiopsis* and the six Sophoreae genera.

Bocoa: *B. mollis* (G. Bentham) R.S. Cowan (*B*), *B.* spp. (*A*).
A, Fruits ($\times 2$); *B*, fruits and seeds ($\times 2.3, \times 3$).



Bocoa (con.): *B. mollis* (G. Bentham) R.S. Cowan (*D–E*), *B. viridiflora* (A. Ducke) R.S. Cowan (*F*), *B. spp.* (*C*).
C, fruits and seeds ($\times 2.3$, $\times 3$); *D–E*, testa ($\times 50$,
 $\times 1000$); *F*, embryos ($\times 1.5$).



Genus: *Candolleodendron* R.S. Cowan

Phylogenetic Number: 1.03.

Tribe: Swartzieae.

Group: Swartzia.

Species Studied—Species in Genus: 1 sp.—1 sp.

Fruit a legume; unilocular; $2-6.5 \times 1.3-3 \times 0.7-1.3$ cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical or asymmetrical; oblong (ovate); when asymmetrical with both sutures nearly straight; not inflated; compressed; without beak; short tapered at apex; apex aligned with longitudinal axis of fruit; rounded at base; base oblique with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally invisible. Fruit margin not constricted or constricted; slightly constricted along both margins; without sulcus; plain. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscent; splitting along sutures. Dehiscence of valves along both sutures; passive. Replum invisible. Epicarp dull; monochrome or multicolored; mottled; reddish brown or tan (reddish); with brown (dark reddish) overlay; glabrous; eglandular; without spines; not smooth; with elevated features; not veined; not tuberculate; verrucose-rugose; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous. Endocarp dull; monochrome or streaked; reddish brown or tan (reddish); with brown (reddish) overlay; smooth; nonseptate; coriaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 4–11; length transverse to fruit length; touching; in 2 or more series. Funiculus measured; up to 27 mm long; of 2 different lengths; filiform; contorted, S-curved, or curved. Aril fleshy; leaflike and attached to marginal hilum; covering less than 1/2 of seed; dark reddish brown.

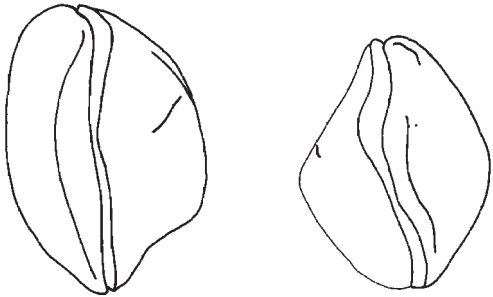
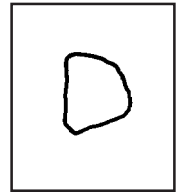
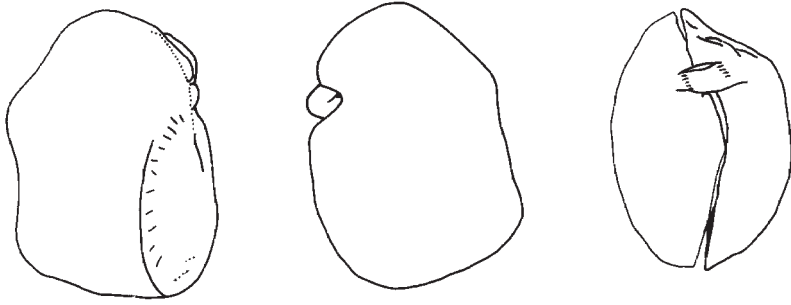
Seed $10-18 \times 9-12 \times 6-10$ mm; not overgrown; angular; asymmetrical; irregular, rectangular, or triangular; quadrangular or compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; with umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome or streaked; with frequent streaks; dark reddish brown; with brown (lighter reddish) overlay; glabrous; not smooth; with elevated features; reticulate (radiating from hilum); chartaceous. Fracture lines

absent. Rim absent. Wings absent. Raphe not visible. Hilum fully concealed or visible; concealed by aril; without faboid split; larger than punctiform; 3–5 mm long; with straight outline; oblong; marginal according to or subapical to radicle tip; flush; within halo. Hilum halo color (black) darker than testa. Lens not discernible. Endosperm absent. Cotyledons not smooth; wrinkled; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; reddish brown; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle triangular; deflexed and parallel to cotyledon width; centered between cotyledons; less (much less) than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: French Guiana.

Notes: Cowan (1966, 1977) described and illustrated fruits and seeds.

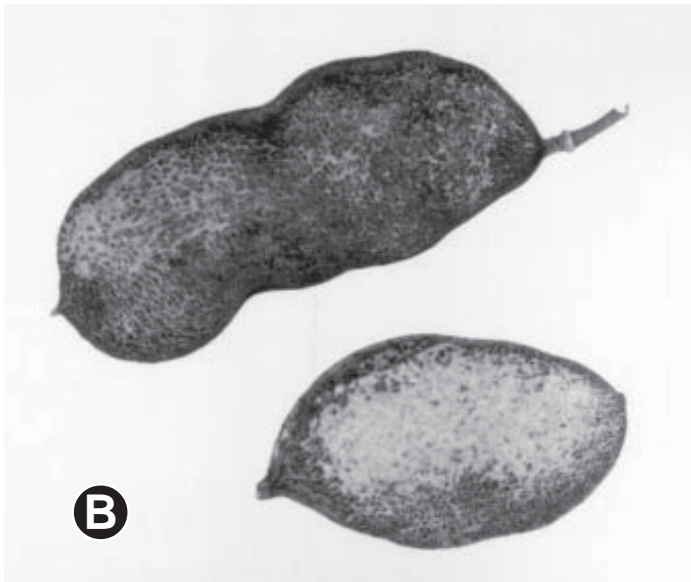
Candolleodendron: *C. brachystachyum* (A.-P. de Candolle) R.S. Cowan (A-F). A-B, Fruit ($\times 1.8$, $\times 1.2$); C, seeds ($\times 2.9$); D-E, testa ($\times 50$, $\times 1000$); F, embryos ($\times 2$).



F



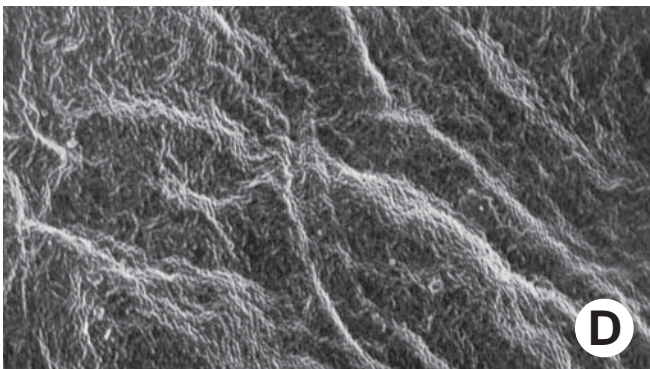
A



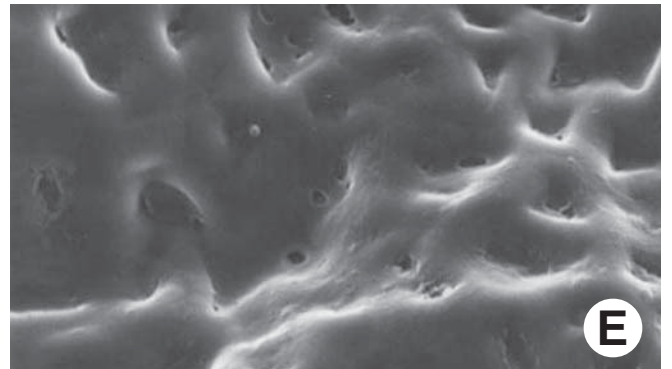
B



C



D



E

Genus: *Aldina* S.F.L. Endlicher

Phylogenetic Number: 1.04.

Tribe: Swartzieae.

Group: *Aldina*.

Species Studied—Species in Genus: 6 spp.—ca. 15 spp.

Fruit a legume; unilocular; $2.5\text{--}12 \times 1.8\text{--}6 \times 2\text{--}6.8$ cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical; obovate; not inflated; terete or compressed; without beak; rounded at apex; apex aligned with longitudinal axis of fruit; rounded or short tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; ligneous or fleshy; seed chambers externally invisible. Fruit margin not constricted; without or with sulcus; plain. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscing (tardily); splitting along sutures. Dehiscence of valves along both sutures; passive or active; with valves revolute. Replum invisible. Epicarp dull; monochrome; brown; glabrous or pubescent and indurate; with hairs appressed; with 1 type of pubescence; with pubescence gray; with pubescence uniformly distributed; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; not veined; not tuberculate; wrinkled or lenticular (tan); not exfoliating; without cracks. Mesocarp thick; 1-layered; without balsamic vesicles; without fibers; solid or spongy; ligneous (to subligneous) or coriaceous. Endocarp concealed by adnate testa; nonseptate or subseptate; with septa thicker than paper, firm; with septa eglandular; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1–4; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only; assumed thick; straight. Aril absent.

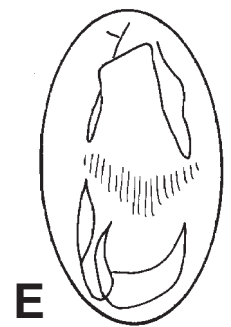
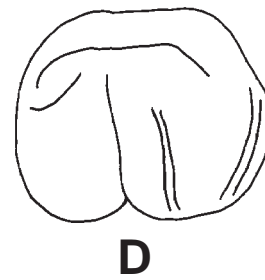
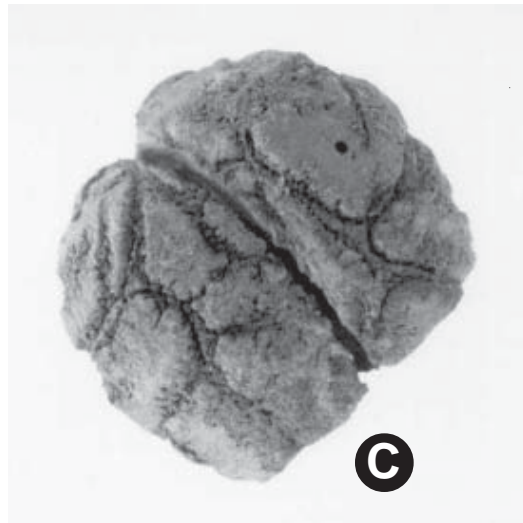
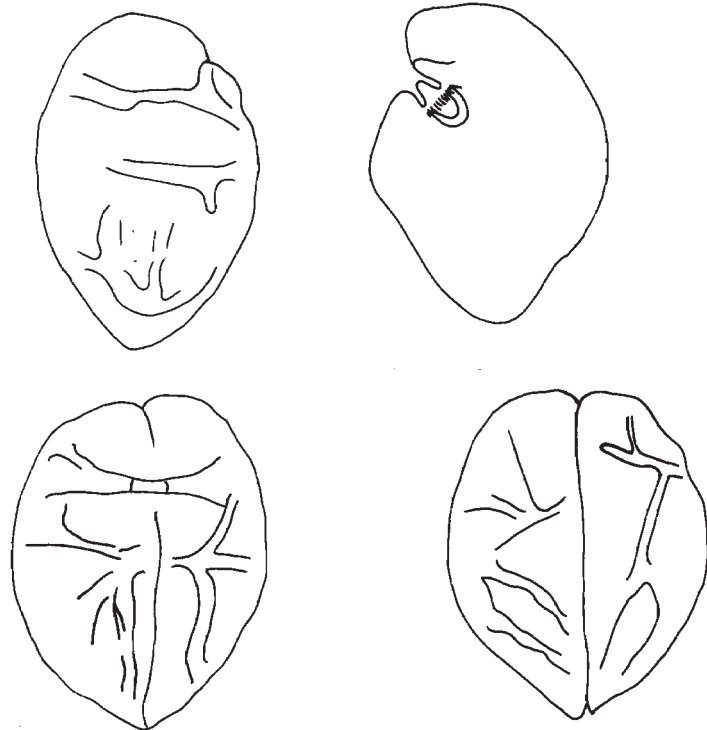
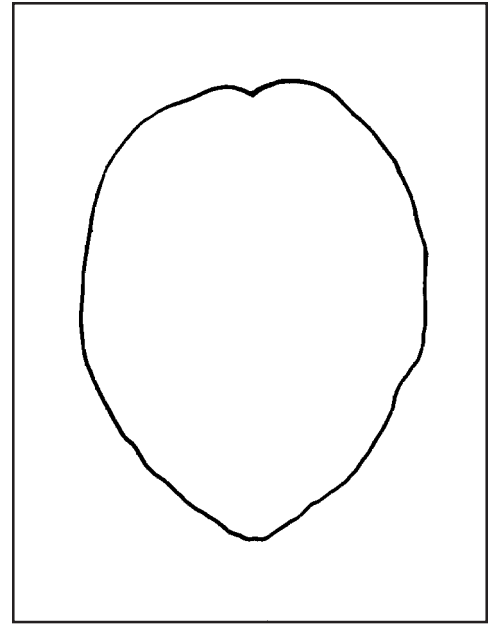
Seed $35\text{--}60 \times 30\text{--}50 \times 22\text{--}40$ mm; overgrown, 1 seed filling entire fruit cavity (including more than 1 seed per fruit); not angular or angular; symmetrical; sub circular, elliptic, or triangular; terete or compressed; with surface ridged or grooved; with grooves oblique; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa absent; partially adhering to endocarp. Endosperm absent. Cotyledons not smooth; 5–7-branched grooves (from veins of testa) on each face; both outer faces convex;

both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; brown; inner face flat; glabrous around base of radicle. Embryonic axis straight; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle triangular; lobe tip curved; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Venezuela, Guyana, and upper Amazon basin.

Notes: Cowan (1953) monographed *Aldina* and noted that fruit were known for very few taxa.

Aldina: *A. latifolia* R. Spruce ex G. Bentham (A–E). A–B, Fruits ($\times 0.7$); C, seed ($\times 1.1$); D, embryos ($\times 0.7$); E, embryo magnified ($\times 3$).



Genus: *Baphiopsis* G. Bentham ex J.G. Baker

Phylogenetic Number: 1.05.

Tribe: Swartzieae.

Group: Aldina.

Species Studied—Species in Genus: 1 sp.—1 sp.

Fruit a legume; unilocular; $3.5\text{--}4 \times 2 \times 1.9$ cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; broadly oblong; when asymmetrical with 1 straight and 1 curved suture or both sutures parallelly curved; widest near middle or D-shaped; not inflated; compressed; without or with beak; straight; with solid beak the same color and texture as fruit; short tapered at apex; apex oblique with longitudinal axis of fruit; short tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit substipitate. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down (only a short way down); passive. Replum invisible. Epicarp dull; monochrome; dark reddish brown; glabrous; eglandular; without spines; not smooth; with elevated features; not veined; not tuberculate; faintly wrinkled; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous. Endocarp dull; monochrome; brown; smooth (but with oblique short tears); nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1(–2); length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only; thick; straight. Aril absent.

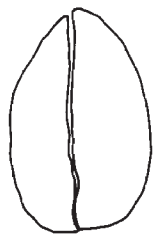
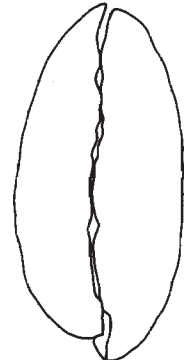
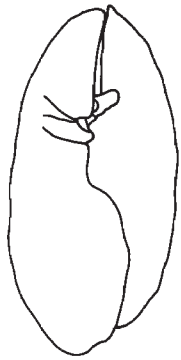
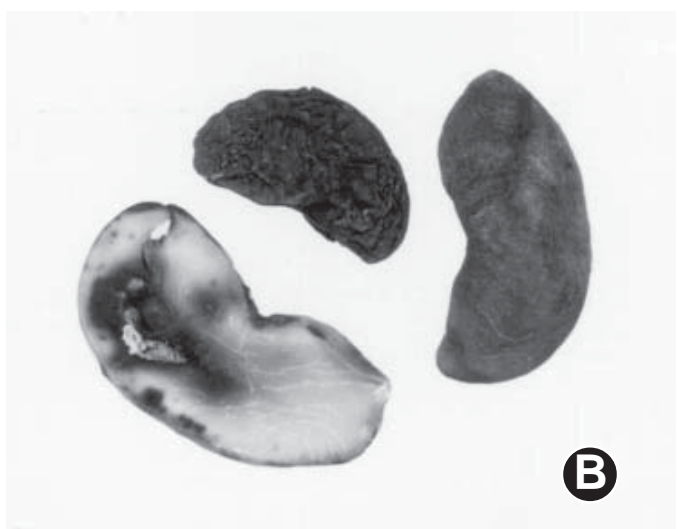
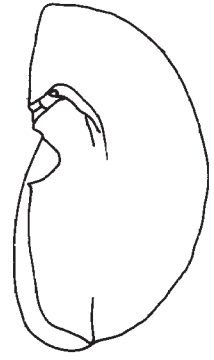
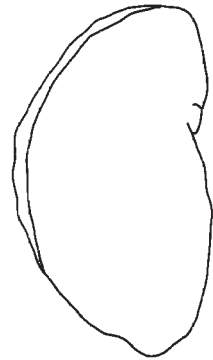
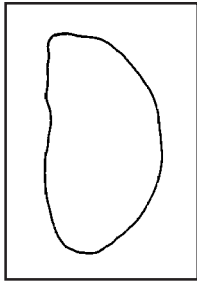
Seed $22\text{--}35 \times 13\text{--}17 \times 7.5\text{--}15$ mm; overgrown, 1 seed filling entire fruit cavity; not angular; asymmetrical; D-shaped; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; reddish brown; glabrous; not smooth; with elevated features; wrinkled; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible; without faboid split; punctiform; marginal according to radicle tip; flush; not within corona, halo, or rim. Lens not discernible. Endosperm

absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; completely concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; brown; inner face flat; glabrous around base of radicle. Embryonic axis straight; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle triangular; deflexed and parallel to cotyledon width; centered between cotyledons; less (much less) than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

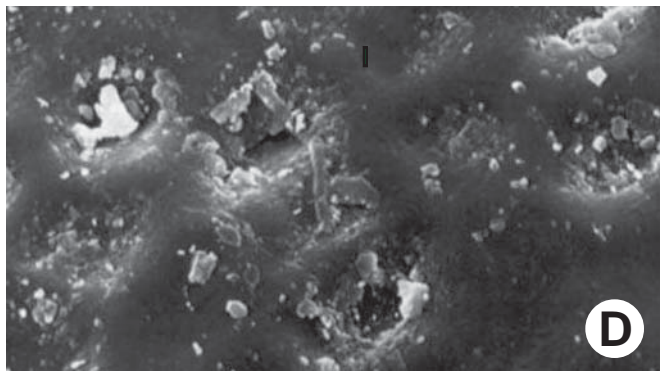
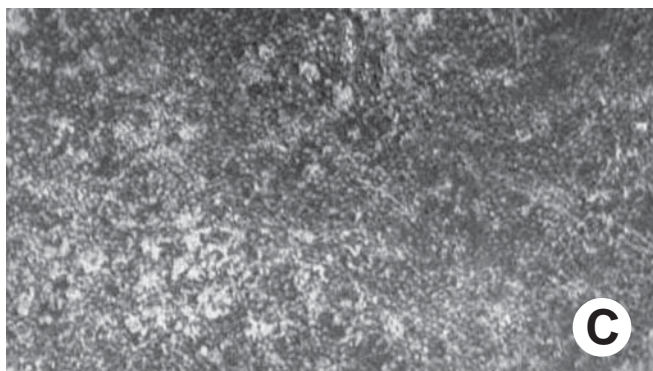
Distribution: Tropical Africa.

Notes: Yakovlev (1977) presented notes on *Baphiopsis*. We studied only one fruit and two seed samples. Dehiscence of the one available fruit of *B. parviflora* started from the apex and proceeded a few millimeters down each suture. After dehiscence had stopped, the valves were broken apart. Additional fruits are needed to fully elucidate the manner of dehiscence. The seeds turned the dissection fluid an amber color.

Baphiopsis: *B. parviflora* G. Bentham ex J.G. Baker (A–E). A, Fruit ($\times 1.8$); B, seeds ($\times 1.4$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 1.5$).



E



Genus: *Cordyla* J. de Loureiro

Phylogenetic Number: 1.06.

Tribe: Swartzieae.

Group: Aldina.

Species Studied—Species in Genus: 4 spp.—5 spp.

Fruit a legume; unilocular; 4–10 × 3–3.5 × 2.5–3.5 cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical or symmetrical; subcircular, ovate, or oblong; when asymmetrical, both sutures parallelly curved, both sutures nearly straight, or 1 straight and 1 curved; widest near middle or D-shaped; not inflated; terete; without or with beak; declined; with solid beak the same color and texture as fruit; rounded or tapered at apex; apex aligned, oblique, or right-angled with longitudinal axis of fruit; short tapered at base; base aligned or oblique with longitudinal axis of fruit; with the apex and base uniform in texture; ligneous (when fresh, pulpy within the fruit between the seeds (Capuron, 1968)); seed chambers externally invisible or visible. Fruit margin not constricted or constricted; slightly constricted along both margins; without sulcus; plain. Fruit wings absent. Fruit stipitate or substipitate; with the stipe up to 20 mm long. Fruit assumed indehiscent. Replum invisible. Epicarp dull or glossy; monochrome; dark reddish to greenish brown; glabrous; eglandular; without spines; not smooth; with elevated features; not veined; not tuberculate; ribbed; not exfoliating; without cracks. Mesocarp thick; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid or fleshy; ligneous (or subligneous). Endocarp present (but testa fused to endocarp); nonseptate; coriaceous; not exfoliating; separating with mesocarp from epicarp; entire. Seeds 1–8; length parallel with or oblique to fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only; thick; straight. Aril absent.

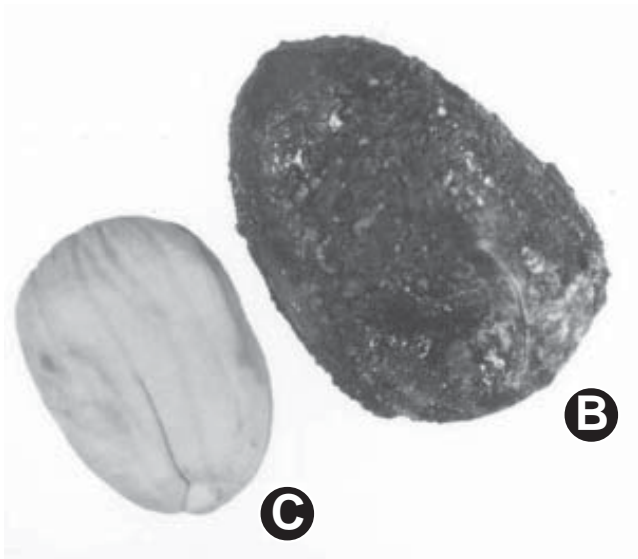
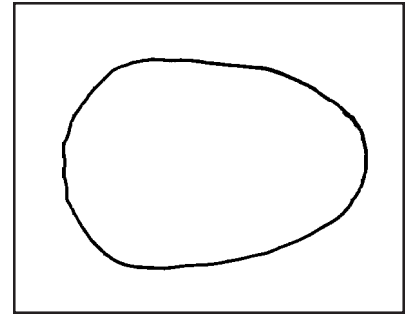
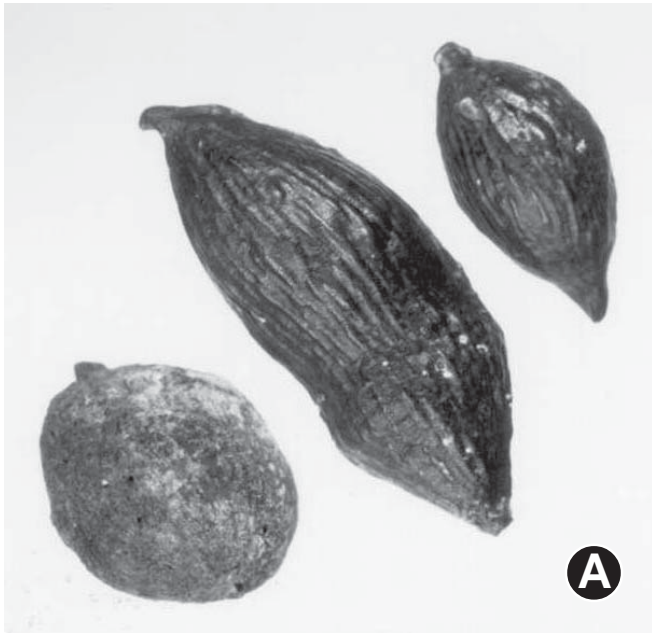
Seed 20–30 × 15–22 × 9–16 mm; not overgrown; angular; asymmetrical; ovate or reniform; compressed or terete; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa absent; partially adhering to endocarp. Endosperm absent. Cotyledons not smooth; somewhat wrinkled; both outer faces convex; both the same

thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; completely concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; reddish tan or brown (reddish); inner face flat; glabrous around base of radicle. Embryonic axis straight; parallel to length of seed; without a joint evident between the radicle and the cotyledons. Radicle triangular; lobe tip straight; straight with embryonic axis; centered between cotyledons; much less than 1/2 length of cotyledons. Plumule well developed; glabrous.

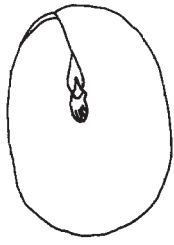
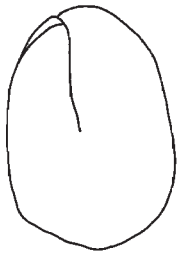
Distribution: Tropical Africa and Madagascar.

Notes: Capuron (1968) described and illustrated the fruit of *C. haraka* R. Capuron. In Herendeen's (1995) cladistic analyses, *Cordyla* and *Mildbraediendron* (1.07) formed a well-defined clade supported by five characters. Within Swartzieae and Sophoreae (2) some of their seed structures are also unique; that is, they have well-developed, straight embryos at the center of the cotyledons which are deeply divided almost to their center.

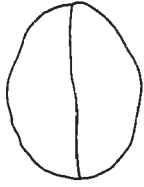
Cordyla: *C. africana* J. de Loureiro (B–F), *C. spp.* (A). A, Fruits (× 1.1); B, D, seed with endocarp functioning as testa (× 1.5, × 2.2); C, seed without endocarp (× 1.5); E–F, endocarp (× 50, × 1000).



Cordyla (con.): *C. africana* J. de Loureiro (*G–H*). *G*, embryos ($\times 1$); *H*, embryo magnified ($\times 4$).



G



H

Genus: *Mildbraediodendron* H.A.T. Harms

Phylogenetic Number: 1.07.

Tribe: Swartzieae.

Group: Aldina.

Species Studied—Species in Genus: 1 sp.—1 sp.

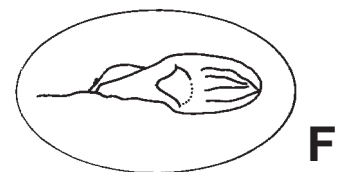
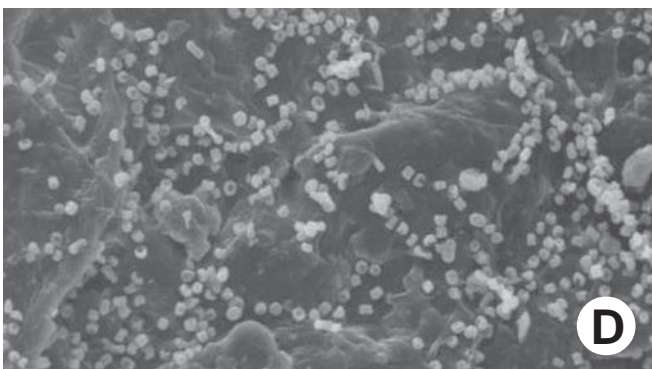
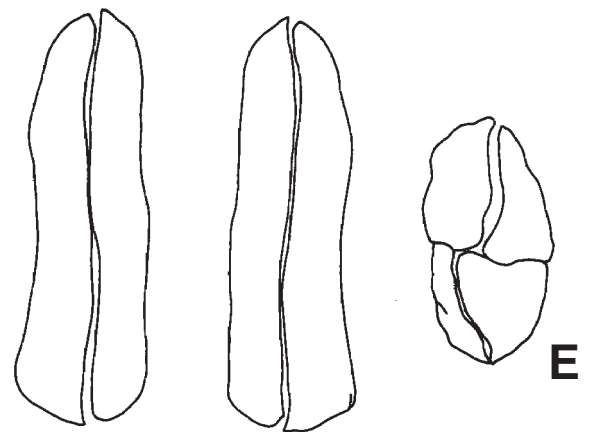
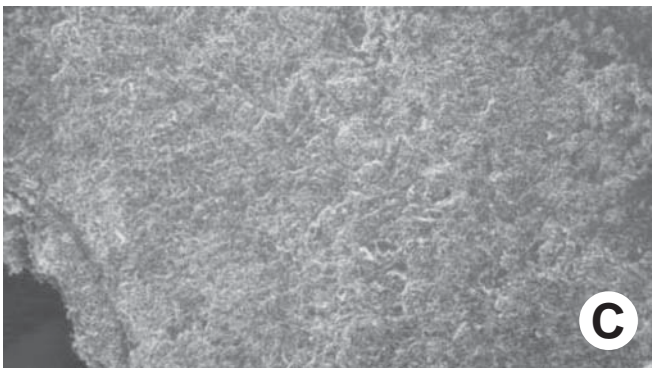
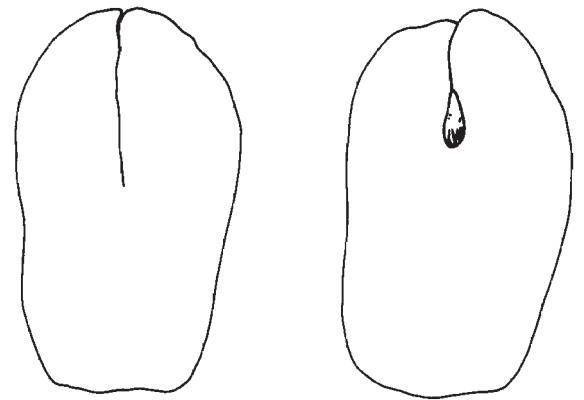
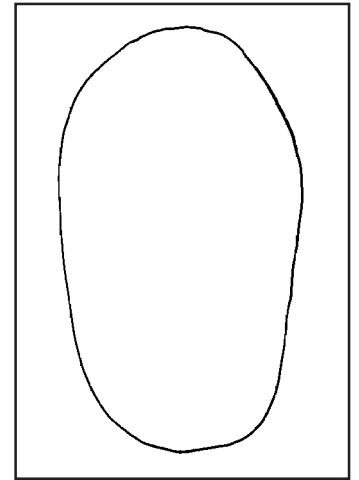
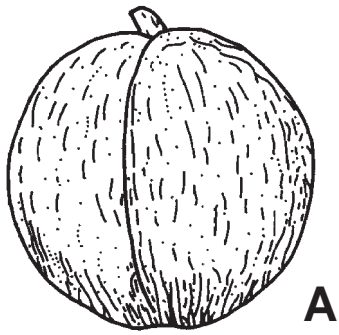
Fruit a legume; unilocular; 10 × 10 × 10 cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical; circular; not inflated; terete; without beak; rounded at apex; apex aligned with longitudinal axis of fruit; rounded at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; leathery or coriaceous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit stipitate; with the stipe 5–6 mm long. Fruit indehiscent. Replum invisible. Epicarp dull; monochrome; without spines; not tuberculate. Mesocarp present. Seeds 1–5; length transverse to fruit length; touching or neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long. Aril absent.

Seed 55 × 35 × 15 mm; not overgrown; not angular; oblong; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa absent; not adhering to endocarp. Endosperm absent. Cotyledons not smooth; 4–6 grooves on each face; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; completely concealing radicle; split over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; tan; inner face flat; glabrous around base of radicle. Embryonic axis straight; parallel to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip straight; straight with embryonic axis; centered between cotyledons; less than 1/2 length of cotyledons. Plumule well developed; glabrous.

Distribution: Tropical Africa.

Notes: We had no fruits available for study. Aubréville (1970) has a sketch of the fruit in his figure 74. See *Cordyla* (1.06) for discussion of Herendeen's cladistic analyses.

Mildbraediodendron: M. excelsum H.A.T. Harms (A–F). A, Fruit (× 2, after Aubréville 1970: 305, t. 74); B, seed with endocarp functioning as testa (× 1.8); C–D, endocarp (× 50, × 1000); E, embryos (× 1); F, embryo magnified (× 3).



Genus: *Lecointea* A. Ducke

Phylogenetic Number: 1.08.

Tribe: Swartzieae.

Group: *Lecointea*.

Species Studied—Species in Genus: 2 spp.—4 spp.

Fruit a legume; unilocular; $2.4\text{--}3.7 \times 1.5\text{--}4 \times 1\text{--}4$ cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical; circular, elliptic (oblong), or oblong; not inflated; compressed or terete; without or with beak; straight; with solid beak the same color and texture as fruit; rounded at apex; apex aligned with longitudinal axis of fruit; short tapered or rounded at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; fleshy (when fresh) or leathery (upon drying); seed chambers externally invisible. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit substipitate. Fruit indehiscent. Replum invisible. Epicarp dull; monochrome; green (when young) or brown (purplish); glabrous; eglandular; without spines; not smooth; with elevated features; not veined; not tuberculate; wrinkled; not exfoliating; without cracks. Mesocarp thick; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous. Endocarp glossy; monochrome; reddish brown; spongy; subseptate; with septa thicker than paper, firm; coriaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds (1–2); length parallel with or transverse to fruit length; touching or neither overlapping nor touching; in 1 series. Funiculus measured; 2 mm long; of 1 length only; thick; straight. Aril absent.

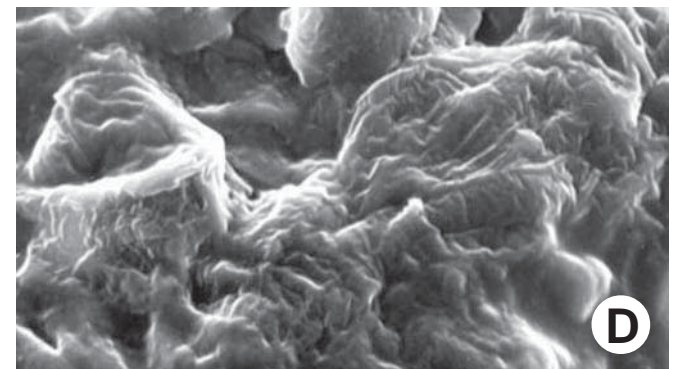
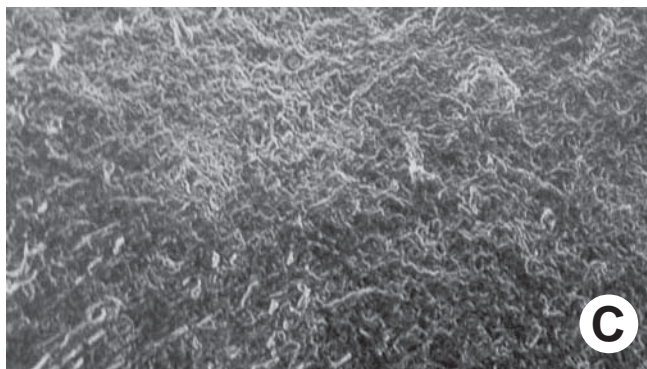
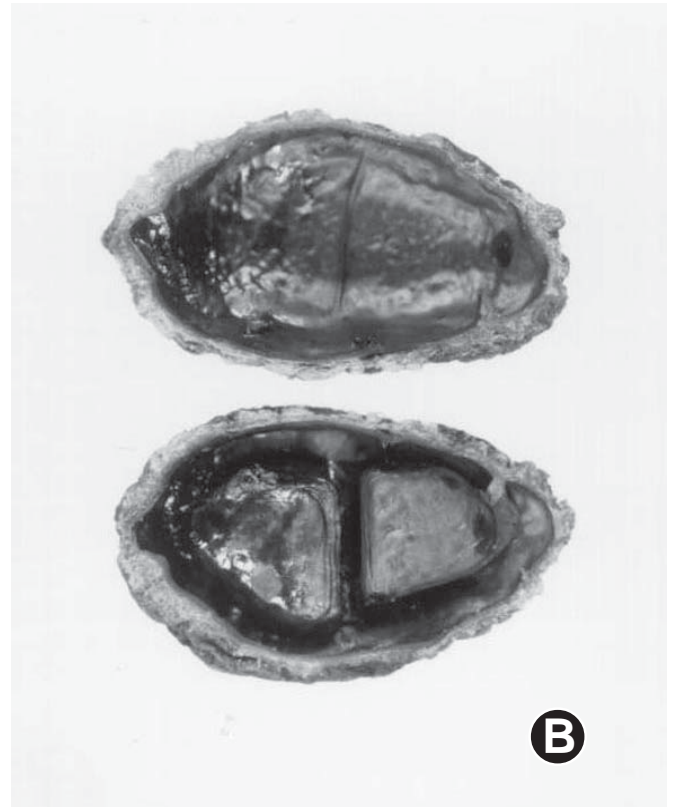
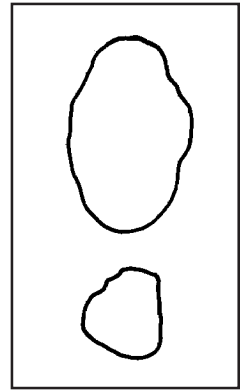
Seed $8\text{--}30 \times 4\text{--}15 \times 3.5\text{--}8$ mm; overgrown, 1 seed filling entire fruit cavity; angular or not angular; asymmetrical; circular, D-shaped, elliptic, oblong, ovate, or reniform (rarely); compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull or glossy (because of exudates from endocarp); not modified by a bloom; colored; monochrome; reddish brown; glabrous; not smooth; with elevated features; veined (oblique and parallel) or shagreen; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible; without faboid split; larger than punctiform; up to 20 mm long; with angular outline; irregular; subapi-

cal to radicle tip; flush; not within corona, halo, or rim. Lens not discernible. Endosperm absent. Cotyledons without lobes; with the interface division terminating at base of radicle. Embryonic axis without a joint evident between the radicle and the cotyledons.

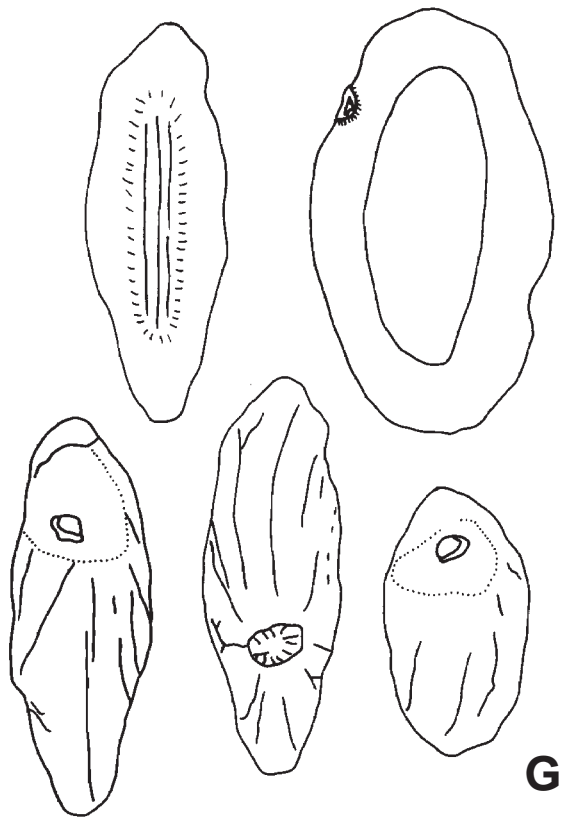
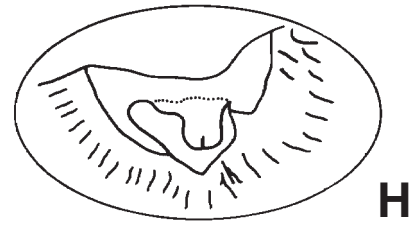
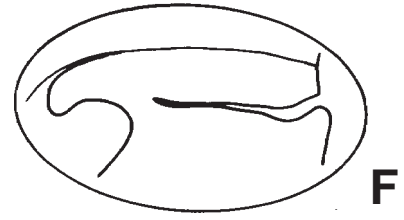
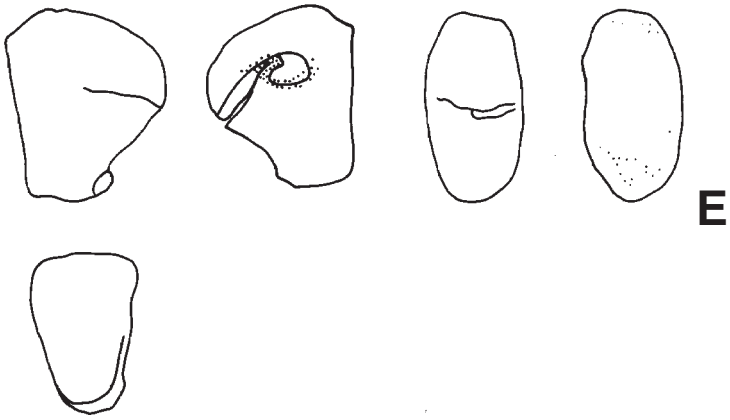
Distribution: Honduras (1 sp.) and Brazil (Amazonia, 3 spp.).

Notes: Yakovlev (1976) revised the genus and transferred the Central American *Zollernia tango* P.C. Standley into *Lecointea*. Barneby (1989) reviewed the South American species of the genus. He synonymized *Beliceodendron* C.L. Lundell, of which *B. tango* (P.C. Standley) C.L. Lundell is the type species, with *Lecointea*, and proposed that *L. tango* may be synonymous with *L. amazonica*. The cotyledonary and embryonic structures of *L. amazonica* (Cid & Ramos 2941 (U.S. National Seed Herbarium)) and *L. tango* (Gentle 7043 (U.S. National Seed Herbarium)) are very different from each other and from the remainder of the Faboideae. In *L. amazonica* the embryo is in the center of the cotyledons with a small cavity at its radicular end (figs. E, F). One cotyledon is much smaller than the other one, and the larger cotyledon completely surrounds the smaller one. In *L. tango*, the cotyledons are apparently fused along their entire margins approximately 1/4 of their width, and tightly appressed at their centers, but not fused (fig. G). On the funicular side of the fused cotyledons, there is a small discoid structure approximately 2 mm in diameter and 0.6 mm in thickness within which the embryo is located (figs. G, H). On the inner side of the discoid structure, there is a small cavity into which the rudimentary plumule projects. Herendeen (1995) proposed that *Lecointea* belongs to a clade also including *Holocalyx* (1.12), *Harleyodendron* (1.09), *Exostyles* (1.10), and *Zollernia* (1.11) and that *Lecointea* is most closely related to *Holocalyx*. The seeds of *Holocalyx* are anomalous in Sophoreae (2) with their fused cotyledons and rudimentary embryo. The reduced embryo of *L. amazonica* and the fused cotyledons of *L. tango* are somewhat similar to those of *Lecointea* and therefore support Herendeen's hypothesis.

Lecointea: *L. amazonica* A. Ducke (A–D). A, Fruits ($\times 2.2$); B, seeds in situ ($\times 2$); C–D, testa ($\times 50$, $\times 1000$).



Lecointea (con.): *L. amazonica* A. Ducke (*E–F*), *L. tango*
(P.C. Standley) G.P. Yakovlev (*G–H*). *E, G*, embryos
($\times 2$); *F, H*, embryo magnified ($\times 5, \times 13$).



Genus: *Harleyodendron* R.S. Cowan

Phylogenetic Number: 1.09.

Tribe: Swartzieae.

Group: Lecointea.

Species Studied—Species in Genus: 1 spp.—1 sp.

Fruit a legume; unilocular; $8.5 \times 5 \times 5$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical or symmetrical; ovate; when asymmetrical with both sutures nearly, parallelly curved; not inflated; terete; without beak; rounded at apex; apex aligned with longitudinal axis of fruit; rounded at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; fleshy (oily and fragrant); seed chambers externally invisible. Fruit margin not constricted; with sulcus (slightly constricted along 1 suture); plain. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscent; splitting along suture. Dehiscence of valves along 1 suture; passive. Replum invisible. Epicarp dull; monochrome; green (when fresh); glabrous; eglandular; without spines; smooth; not veined; not tuberculate; not exfoliating; without cracks. Mesocarp thick; surface not veined; 1-layered; without balsamic vesicles; without fibers; fleshy (white). Endocarp dull; translucent; monochrome; smooth; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 2; length parallel with or transverse to fruit length; touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only; assumed triangular; straight. Aril absent.

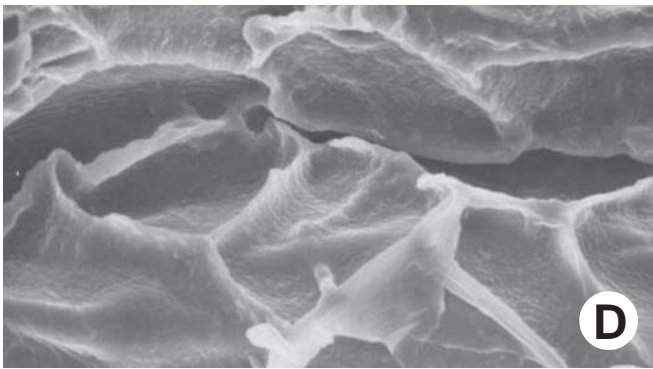
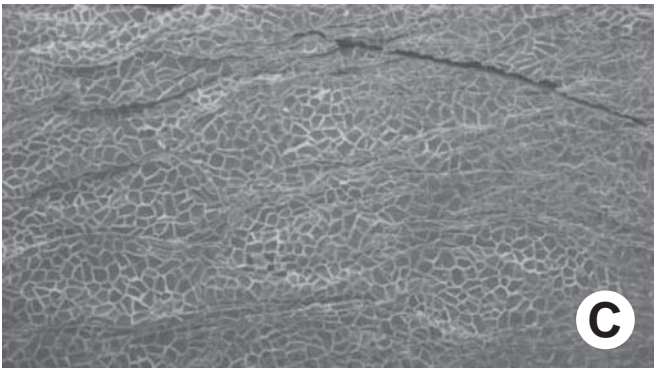
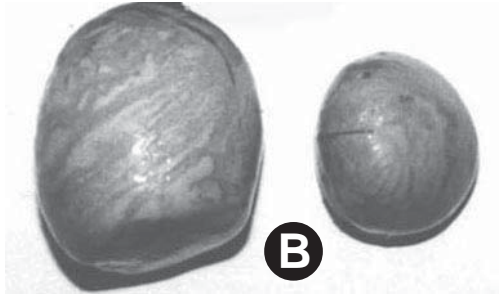
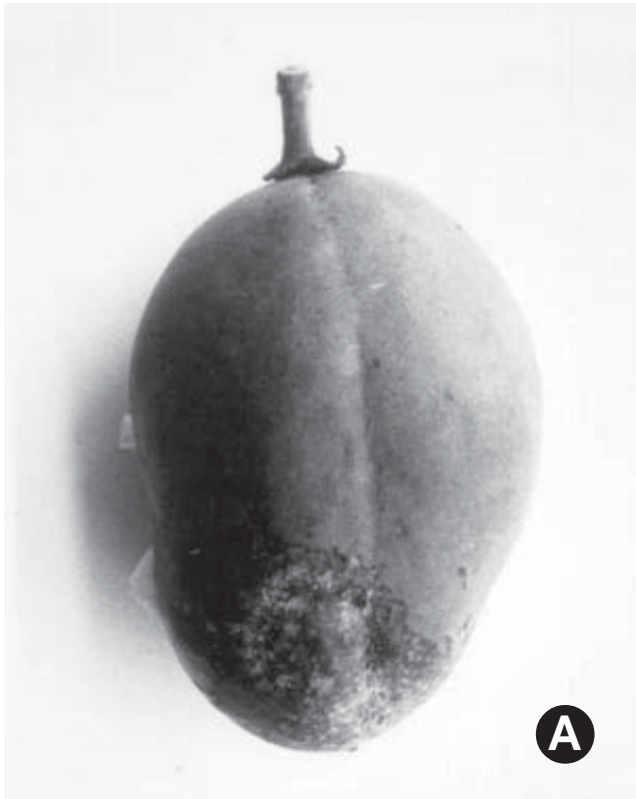
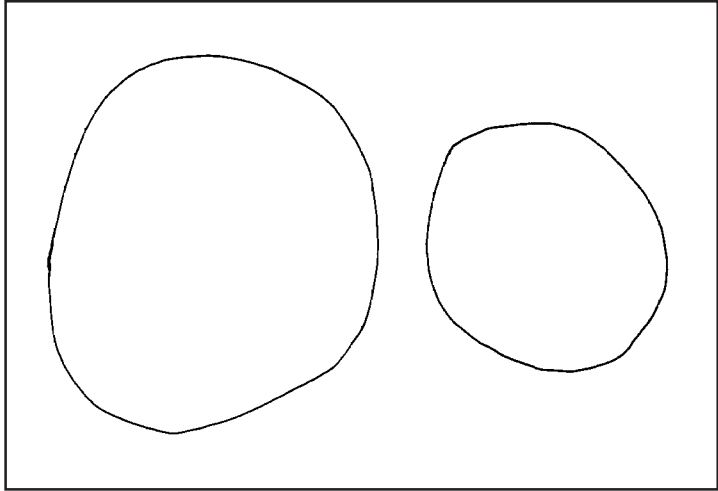
Seed $35\text{--}50 \times 25\text{--}35 \times 25\text{--}35$ mm; overgrown, 1 seed filling entire fruit cavity; not angular or angular; asymmetrical; ovate or irregular; terete; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; streaked; reddish brown; with tan (lines) overlay; glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible; without faboid split; larger than punctiform; 5 mm long; with curved or straight outline; apparently oblong; apical at apex of radicle tip; flush; not within corona, halo, or rim. Lens not discernible. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or

less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; with the interface division terminating at base of radicle; without margins recessed; tan; inner face flat; glabrous around base of radicle. Embryonic axis without a joint evident between the radicle and the cotyledons. Radicle centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Brazil (Bahia: Atlantic coast).

Notes: Cowan (1979) founded the genus and published photographs of the fruit and seed in situ.

Harleyodendron: *H. unifoliolatum* R.S. Cowan (A–D) from Cowan (1979). A, Fruit ($\times 0.8$); B, seeds ($\times 0.7$); C–D, testa ($\times 50$, $\times 1000$).



Genus: *Zollernia* M.A.P. zu Wied-Neuwied & C.G.D. Nees
von Esenbeck

Phylogenetic Number: 1.11.

Tribe: Swartzieae.

Group: Lecointea.

Species Studied—Species in Genus: 3 spp.—ca. 12 spp.

Fruit a nutlet or legume (only *Z. magnifica* A.M. de Carvalho & R.C. Barneby); 1.4–1.7 × 1–1.3 or 8–15.5 × 0.7–1 or 4.5–5.5 cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight or curved (slightly); not plicate; not twisted; asymmetrical; circular, ovate, or oblong; when asymmetrical with both sutures parallelly curved; not inflated; compressed or terete; without or with beak; straight; with solid beak the same color and texture as fruit; rounded or short tapered at apex; apex oblique or right-angled with longitudinal axis of fruit; rounded or short tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; ligneous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit substipitate or nonstipitate. Fruit indehiscent. Replum invisible. Epicarp dull; monochrome; reddish brown; glabrous or pubescent and indurate; with 1 type of pubescence; densely puberulent; with pubescence golden or brown (reddish); with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; not veined; not tuberculate; shagreen or wrinkled; not exfoliating; without cracks. Mesocarp thick (filling up valves and forming a cavity in each valve); surface not veined; 1-layered; without balsamic vesicles; without fibers; solid (but porous); subligneous. Endocarp dull; monochrome; tan; faintly rugose; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1–6 (Carvalho and Barneby 1993); length oblique to fruit length; neither overlapping nor touching or touching; in 1 series. Funiculus less than 0.5 mm long or measured; ca. 2.7 mm long (*Z. magnifica*); of 1 length only; triangular or filiform; straight. Aril absent.

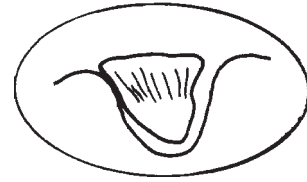
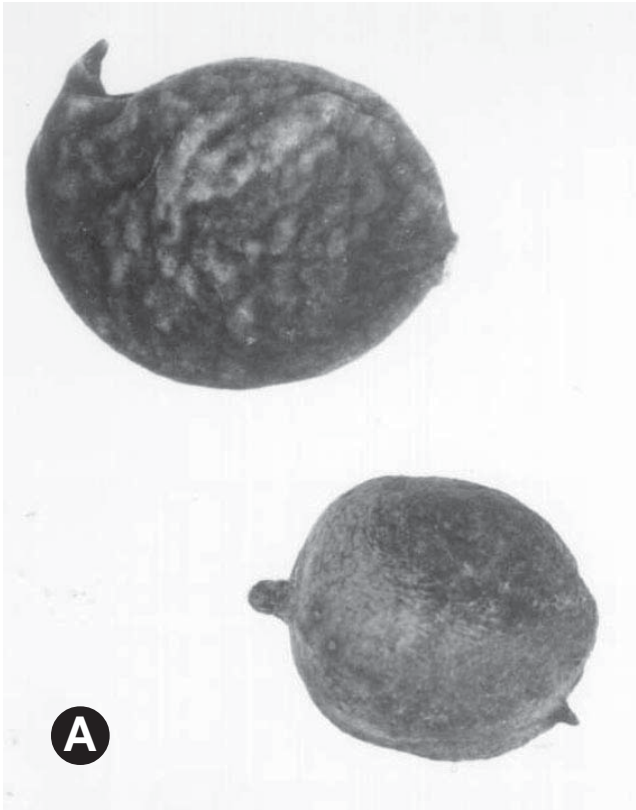
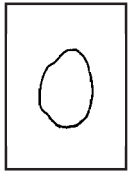
Seed 10–11 or 36 × 7 or 22 × 5.5–6 or 16 mm; angular; asymmetrical or symmetrical; ovate or elliptic (terminal seeds at each end of *Z. magnifica* fruit obtusely conical); compressed; with surface smooth; without

visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; reddish brown; glabrous; not smooth or smooth; with elevated features; shagreen; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe from hilum through base of seed and up the other side; not bifurcating; color of testa; somewhat recessed. Hilum visible; without faboid split; punctiform; subapical to radicle tip; flush; not within corona, halo, or rim. Lens not discernible. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; tan; inner face flat; glabrous around base of radicle. Embryonic axis oblique; weakly oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle truncate; weakly oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

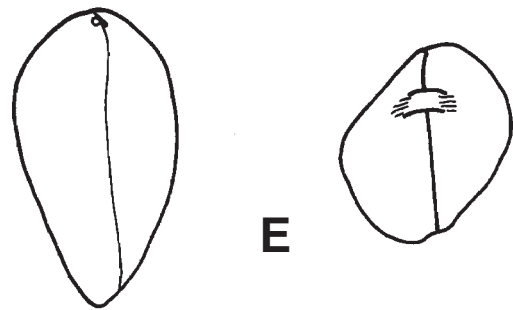
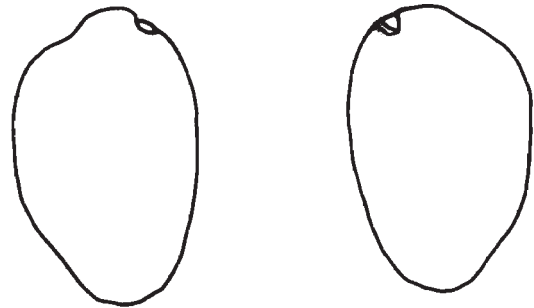
Distribution: Central America, Guianas, and Brazil.

Notes: Mello filho and Andrade (1967) studied the Amazonian species, and Yakovlev (1976) revised the genus. Carvalho and Barneby (1993) treated the species of Bahia, Brazil.

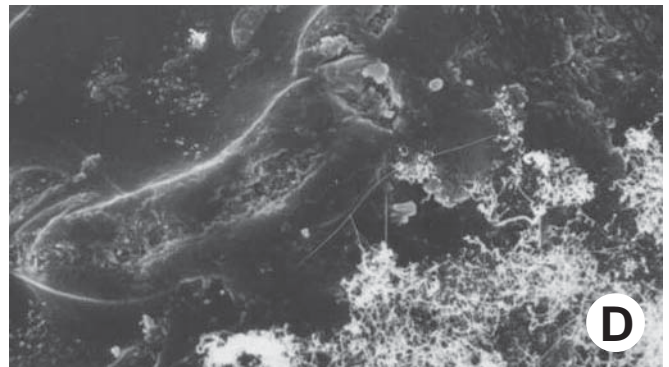
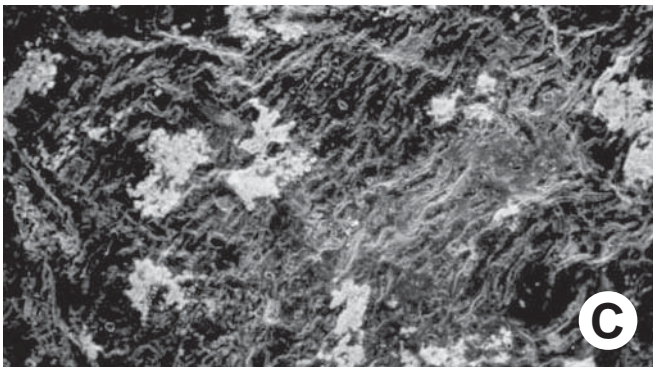
Zollernia: *Z. ilicifolia* (A.T. Brongniart) J.R.T. Vogel (B, E, F), *Z. kanukuensis* R.S. Cowan (C–D), *Z. spp.* (A). A, Fruits (× 3.5); B, seed (× 5.7); C–D, testa (× 50, × 1000); E, embryos (× 4); F, embryo magnified (× 18).



F



E



Genus: *Holocalyx* M. Micheli

Phylogenetic Number: 1.12.

Tribe: Swartzieae.

Group: Lecointea.

Species Studied—Species in Genus: 1 sp.—1 sp.

Fruit a legume (breaking between seed chambers into “articles”) or nutlet; unilocular; $1.4\text{--}2.2 \times 1.2\text{--}1.7 \times 1.2\text{--}2.7$ cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical; ovate to circular; inflated; terete; without or with beak; straight; with solid beak the same color and texture as fruit; rounded at apex; apex aligned with longitudinal axis of fruit; rounded at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; fleshy (in literature) or ligneous (drying). Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit substipitate or nonstipitate; with the stipe 0–2 mm long. Fruit indehiscent. Replum invisible. Epicarp dull; monochrome; brown (dark when dry) or yellow (when ripe); glabrous; eglandular; without spines; not smooth; with elevated features; not veined; not tuberculate; wrinkled (when dry); not exfoliating; without cracks. Mesocarp thick; surface not veined; 1-layered; without balsamic vesicles; when dry solid or fleshy (in life); ligneous (when dry). Endocarp dull; monochrome; black; scurfy; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seed 1. Aril absent.

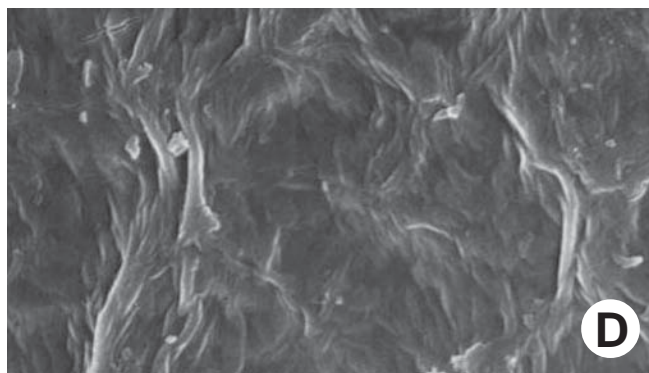
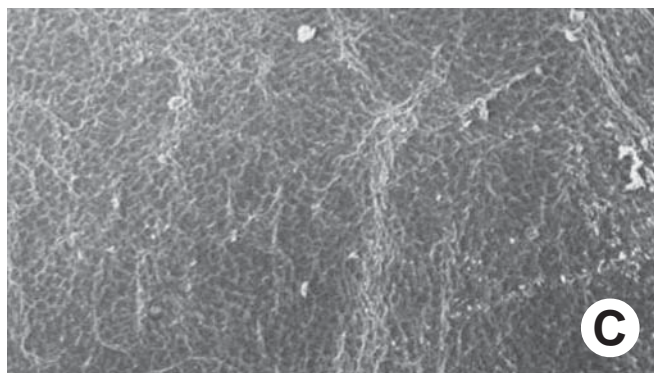
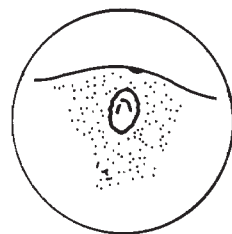
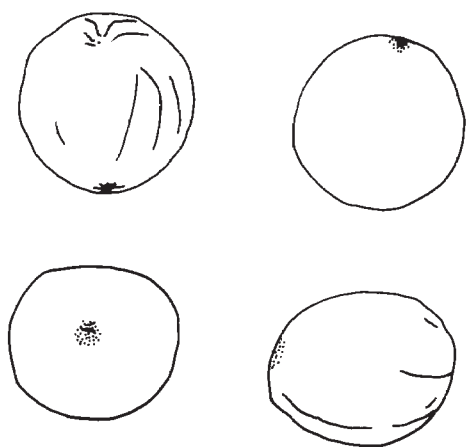
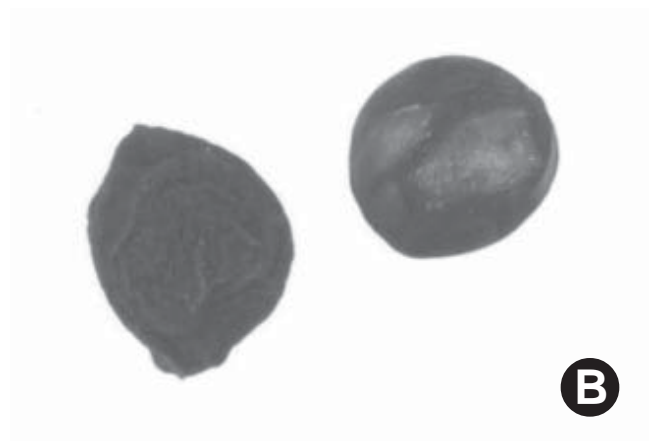
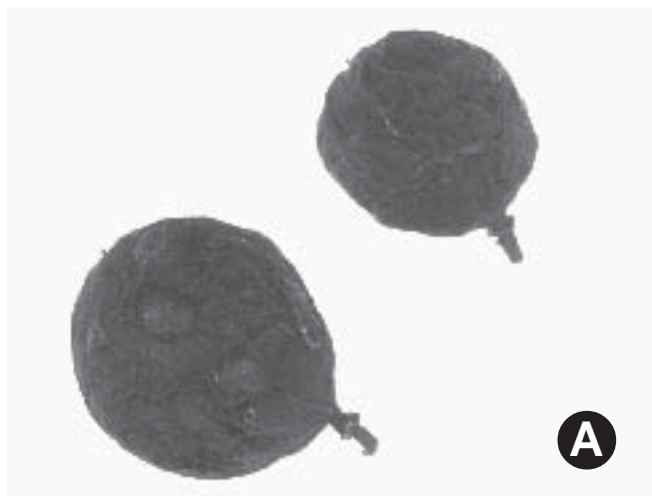
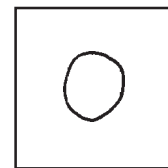
Seed $8.9\text{--}16 \times 8\text{--}15 \times 7\text{--}13$ mm; not overgrown; not angular; symmetrical; circular; terete; with surface wrinkled; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Cuticle absent. Testa not adhering or partially adhering to endocarp; dull; not modified by a bloom; colored; monochrome; brown; glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe from hilum to near base of seed and terminating; not bifurcating; darker than testa; darker brown; flush. Hilum partially concealed; concealed by funicular remnant; without faboid split; larger than punctiform; ca. 4 mm long; with straight outline; narrowly oblong; subapical to radicle tip; flush; not within corona, halo, or rim. Lens discernible; equal to or greater than 0.5 mm in length; ca. 3 mm long; with margins straight;

linear; not in groove of raphe; adjacent to hilum; ca. 3 mm from hilum; flush; same color as testa; brown; not within corona, halo, or rim. Endosperm absent. Cotyledons not smooth; 5–7-branched grooves (from veins of testa) on each face; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; completely concealing radicle; entire over radicle; without lobes; without margins recessed; yellow or brown; inner face flat; glabrous around base of radicle. Radicle not differentiated from cotyledon.

Distribution: Southeastern Brazil, Paraguay, and northeastern Argentina.

Notes: Polhill (1994a,b) transferred this genus from the Sophoreae (2) following Herendeen’s (1995) cladistic analysis. The cotyledons are fused along their edges for more than half of their length starting from the region of the embryonic axis. The embryonic axis is poorly developed and has an area of differentiating cells. Herendeen (1995) proposed that *Holocalyx* belongs to a clade that includes *Lecointea* (1.08), *Harleyodendron* (1.09), *Exostyles* (1.10), and *Zollernia* (1.11) and that *Holocalyx* is most closely related to *Lecointea*. Its rudimentary embryo and fused cotyledons are similar to those of *L. amazonica* and *L. tango*, respectively, which supports Herendeen’s hypothesis.

Holocalyx: *H. balansae* M. Micheli (A–F). A, Fruits ($\times 1.9$); B, seeds ($\times 3.4$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 2$); F, embryo magnified ($\times 10$).



Genus: *Ateleia* (A.-P. de Candolle) G. Benth

Phylogenetic Number: 1.13.

Tribe: Sophoreae.

Group: *Ateleia*.

Species Studied—Species in Genus: 5 spp.—16 spp.

Fruit a legume; unilocular; $1.5\text{--}3.7 \times 1\text{--}1.8 \times 0.2\text{--}0.3$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; reniform to irregular; when asymmetrical with 1 straight and 1 curved suture or both sutures unequally curved; widest near middle or D-shaped; not inflated; flattened; without beak; rounded at apex; apex oblique with longitudinal axis of fruit; short tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; embellished; with wing. Fruit wing 1; 1–3 mm wide; sutural; on 1 suture. Fruit stipitate; with the stipe 5–10 mm long. Fruit indehiscent. Replum invisible. Epicarp dull; monochrome; tan to yellow; glabrous or pubescent but soon deciduous; with 1 type of pubescence; pilose; with pubescence golden; with pubescence uniformly distributed or with apical pubescence different from basal pubescence; with apical 3/4 glabrous and basal 1/4 pilose; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; reticulately veined; not tuberculate; not exfoliating; without cracks. Mesocarp thin; surface uniformly veined; 1-layered; without balsamic vesicles; spongy; chartaceous. Endocarp dull to glossy; monochrome; tan to yellow; smooth; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1(–2); length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; ca. 1 mm long; of 1 length only; flattened; straight. Aril dry; rim-aril; crenate; white.

Seed $4\text{--}10 \times 2.5\text{--}7.5 \times 2\text{--}4.5$ mm; not overgrown; not angular; asymmetrical; reniform to C-shaped; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; reddish brown to brown or black; glabrous; smooth or not smooth; with elevated features; slightly rugose;

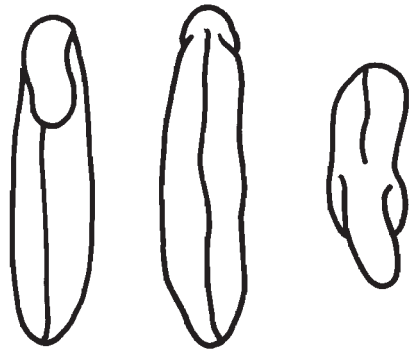
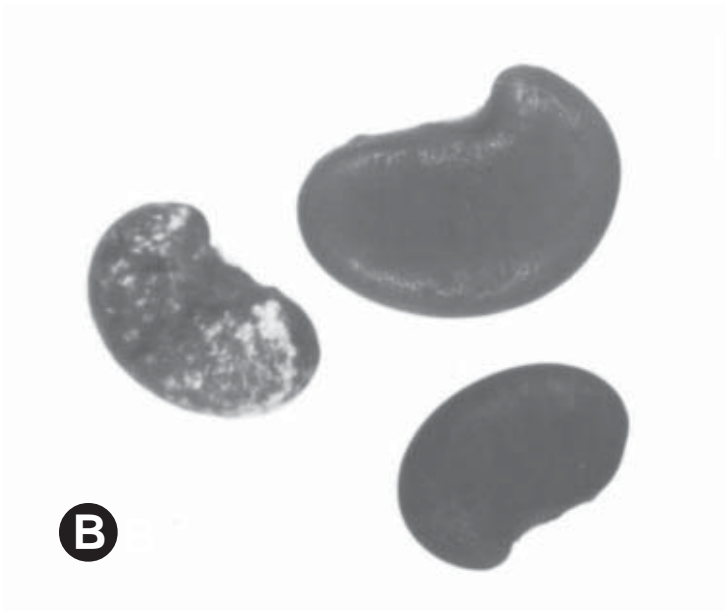
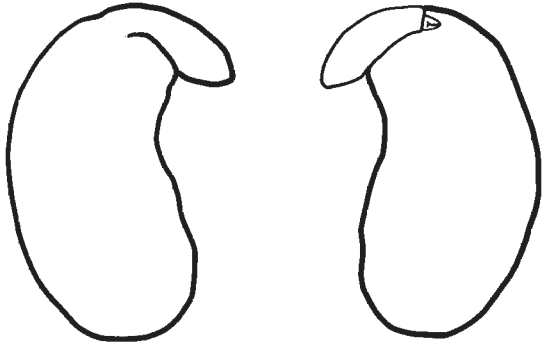
chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum partially concealed; concealed by funicular remnant; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 0.6–1.3 mm long; with curved outline; elliptic to oval; apical according to radicle tip but marginal according to seed length; recessed; within rim. Hilum rim color lighter than testa. Lens discernible; less than 0.5 mm or equal to or greater than 0.5 mm in length; up to 0.7 mm long; with margins straight or curved; diamond-shaped or circular; not in groove of raphe; adjacent to hilum; 1 mm from hilum; mounded; similar color as testa; lighter or darker than testa; brown; not within corona, halo, or rim. Endosperm thick to thin; covering entire embryo; adnate to embryo. Cotyledons not smooth; slightly sulcate; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; partially concealing radicle; slightly notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; yellow or tan; inner face slightly concave or flat; glabrous around base of radicle. Embryonic axis oblique; perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip curved; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary or moderately developed; glabrous.

Distribution: Mexico, West Indies, Central America, and South America.

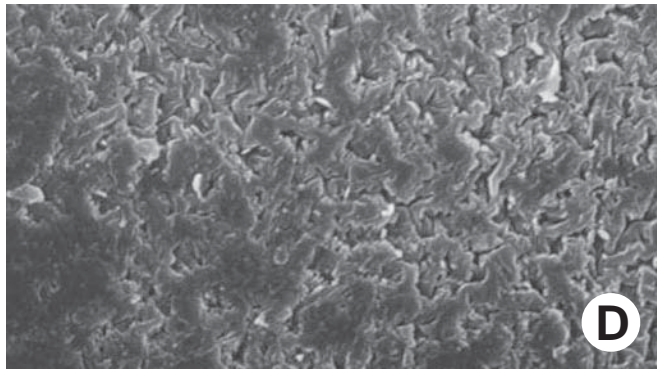
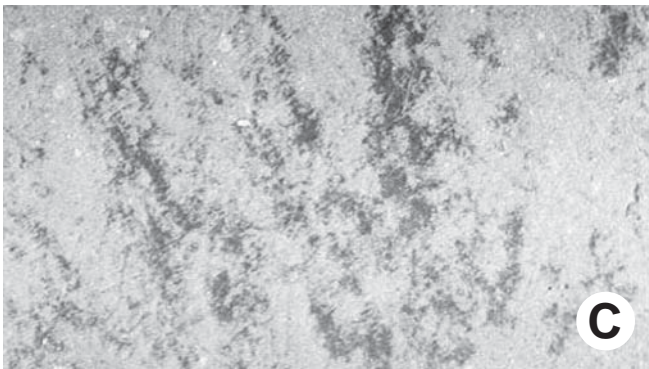
Notes: Polhill (1994a,b) transferred this genus from the Sophoreae (2) following Herendeen's (1995) cladistic analysis.

Ateleia: *A. herbert-smithii* H.F. Pittier (C–E), *A. spp.* (A–B). A, Fruits ($\times 1.8$); B, seeds ($\times 7.1$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 5$).

3



E



Genus: *Cyathostegia* (G. Bentham) R.W. Schery

Phylogenetic Number: 1.14.

Tribe: Sophoreae.

Group: Ateleia.

Species Studied—Species in Genus: 1 sp.—2 spp.

Fruit a legume; unilocular; $3.5\text{--}4.1 \times 0.8\text{--}1.3 \times 0.2\text{--}0.3$ cm; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; slightly curved; not plicate; not twisted; asymmetrical; when asymmetrical with 1 straight and 1 curved (nearly) suture; widest near middle or D-shaped; not inflated; flattened or compressed; with beak; straight; with solid beak the same color and texture as fruit; half rounded at apex; apex aligned with longitudinal axis of fruit; tapered at base; base aligned or oblique with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit stipitate; with the stipe 10–13 mm long. Fruit with all layers dehiscent; splitting along suture. Dehiscence of valves along 1 suture; apical and down; active. Replum invisible. Epicarp dull; monochrome; brown or orange; pubescent and indurate; with 1 type of pubescence; puberulent; with pubescence golden or brown; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; reticulately veined; not tuberculate; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; solid; chartaceous. Endocarp dull; mottled; tan; with mottling (dark); with brown overlay; smooth; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1–2; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 1.2 mm long; of 1 length only; flattened; straight. Aril dry; rim-aril; entire; tan.

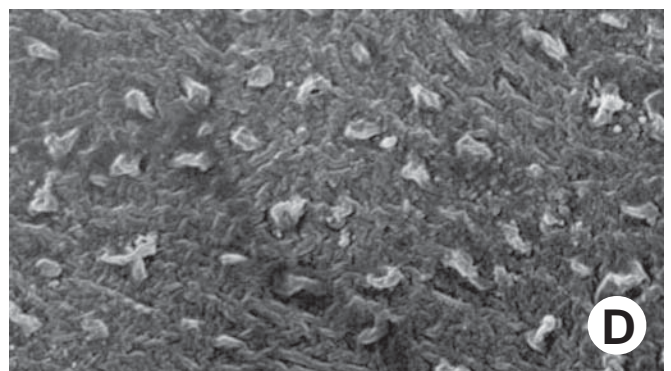
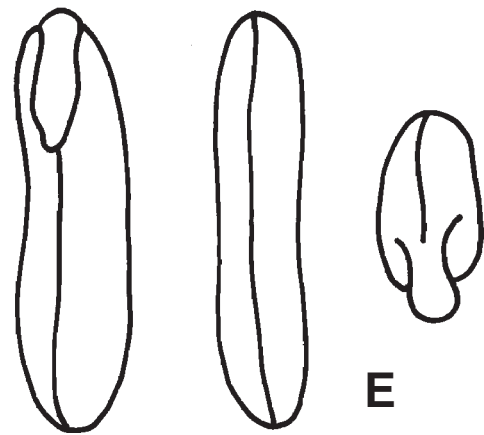
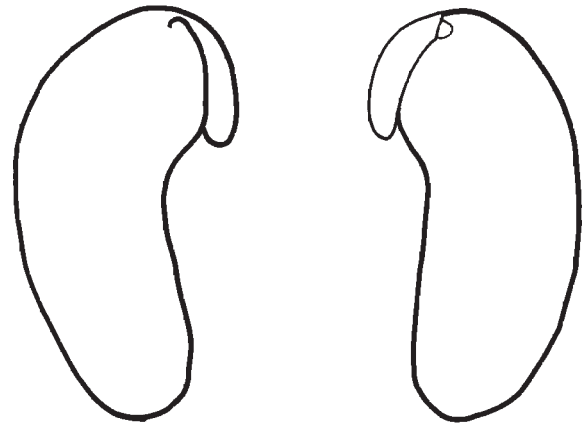
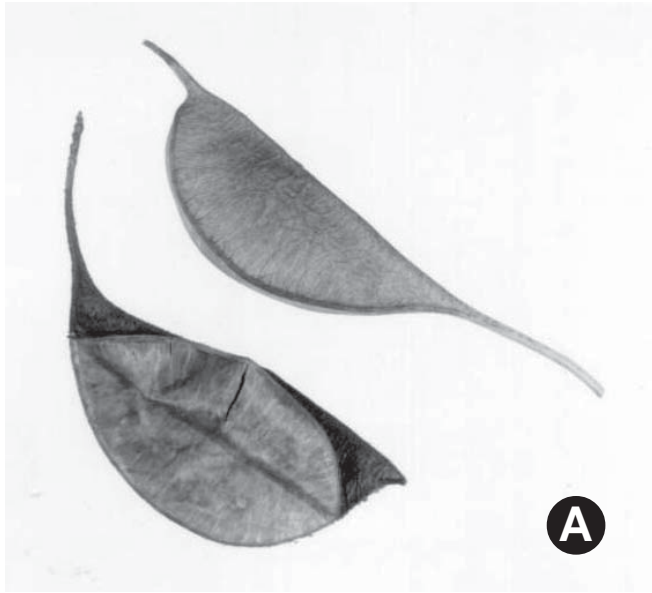
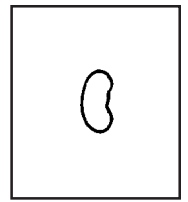
Seed $7.5\text{--}11 \times 4\text{--}7 \times 2.2\text{--}3.2$ mm; not overgrown; not angular; asymmetrical; reniform; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; brown; glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe from hilum through lens and

terminating before base of seed; not bifurcating; darker than testa; darker brown; flush. Hilum visible; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 1–1.5 mm long; with curved outline; circular or elliptic; marginal according to radicle tip; flush; not within corona, halo, or rim. Lens discernible; equal to or greater than 0.5 mm in length; 1–2.5 mm long; with margins straight; diamond-shaped; not in groove of raphe; adjacent to hilum; 1–1.3 mm from hilum; flush; similar color as testa; darker than testa; brown; not within corona, halo, or rim. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; yellow; inner face flat; glabrous around base of radicle. Embryonic axis parallel; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip straight; with 90 degree turn; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Peru and Ecuador.

Notes: Polhill (1994a,b) transferred this genus from the Sophoreae (2) following Herendeen's (1995) cladistic analysis.

Cyathostegia: C. matthewsii (G. Bentham) R.W. Schery (A–E). A, Fruits ($\times 2$); B, seeds ($\times 4.8$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 5$).



Genus: *Amburana* C.A.W. Schwacke & P.H.W. Taubert

Phylogenetic Number: 1.15.

Tribe: Sophoreae.

Group: Ateleia.

Species Studied—Species in Genus: 2 spp.—2 spp.

Fruit a legume; unilocular; $5.5\text{--}11 \times 1.5\text{--}2.1 \times 0.5\text{--}1.1$ cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; linear to oblong or samaroid; when asymmetrical with both sutures parallelly or unequally curved; not inflated; flattened; without beak; rounded at apex; apex aligned with longitudinal axis of fruit; short tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; leathery; seed chambers externally visible; with the raised seed chambers not torulose. Fruit margin not constricted; plain. Fruit wings absent. Fruit substipitate (from literature) or nonstipitate. Fruit with all layers dehiscent; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves reflexing. Replum invisible. Epicarp dull to semiglossy; monochrome; dark brown; glabrous; eglandular; without spines; not smooth; with elevated features; not veined; not tuberculate; rugose and wrinkled; not exfoliating; without cracks. Mesocarp thick; 2-layered; without balsamic vesicles; without fibers; with solid layer over solid layer; ligneous (to subligneous). Endocarp dull and glossy; monochrome or monochrome and mottled; tan to white; with mottling above and below seed chambers; with brown overlay; rugose; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1–2; length parallel with fruit length; overlapping; in 1 series. Aril absent.

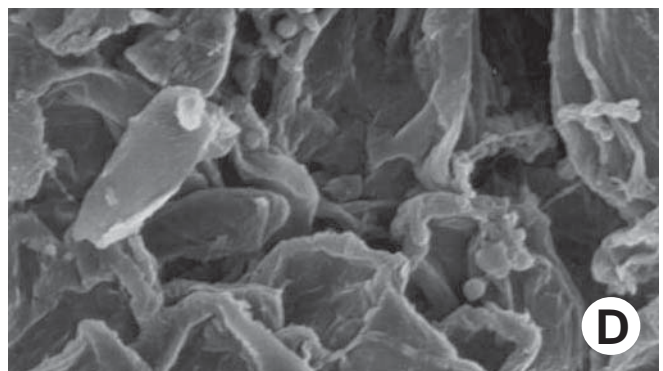
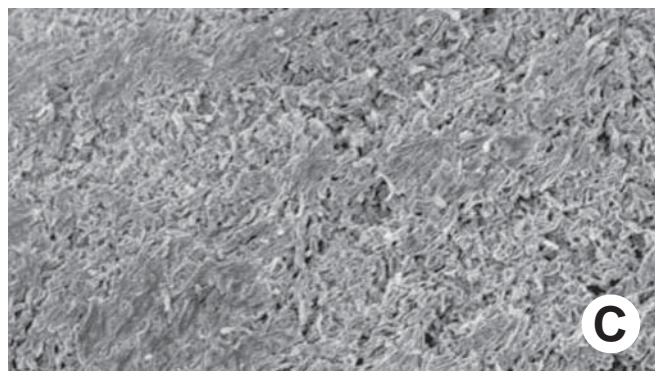
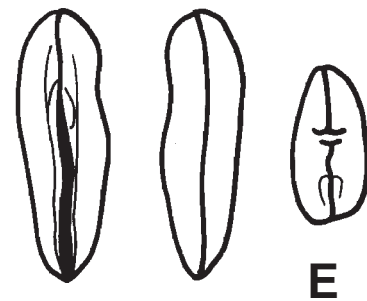
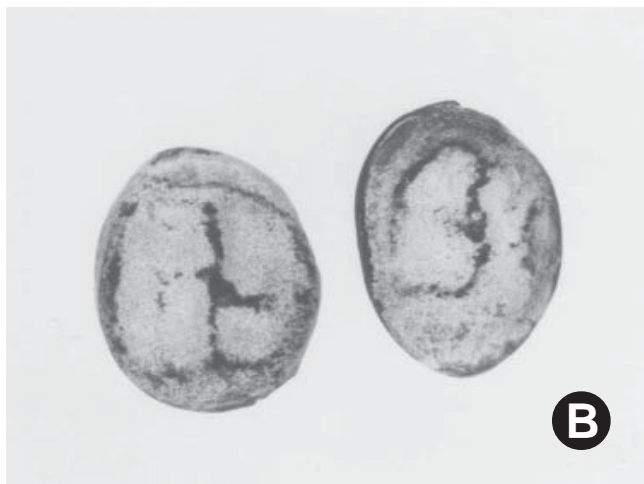
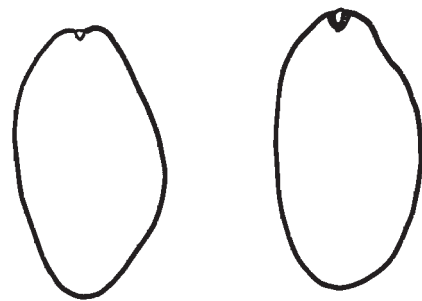
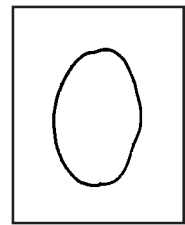
Seed $45\text{--}66 \times 11\text{--}20 \times 4\text{--}6.5$ mm; not overgrown; not angular; asymmetrical; samaroid; flattened; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering or partially adhering to endocarp (in a fine layer); dull; modified by a bloom; colored; mottled; with infrequent mottles; brown or tan; glabrous; not smooth; with elevated features; wrinkled; chartaceous. Fracture lines absent. Rim absent. Wing at 1 end. Raphe from hilum through lens to base of seed and bifurcating; bifurcating at base of seed with each arm going up antiraphe side turning (U-shaped) down

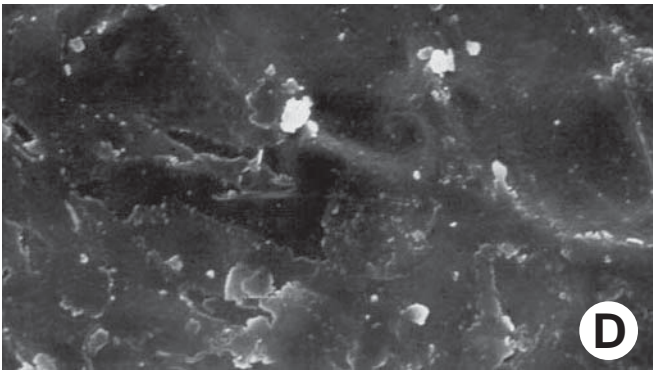
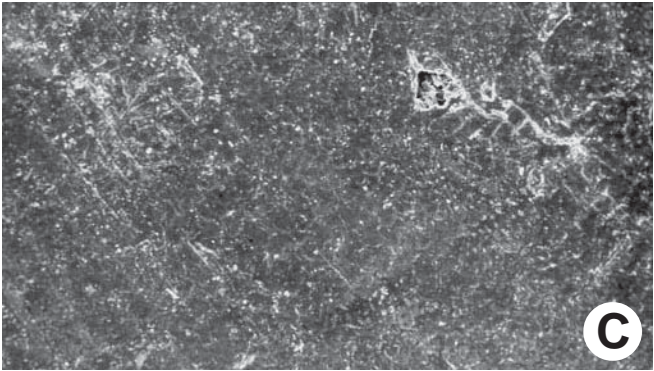
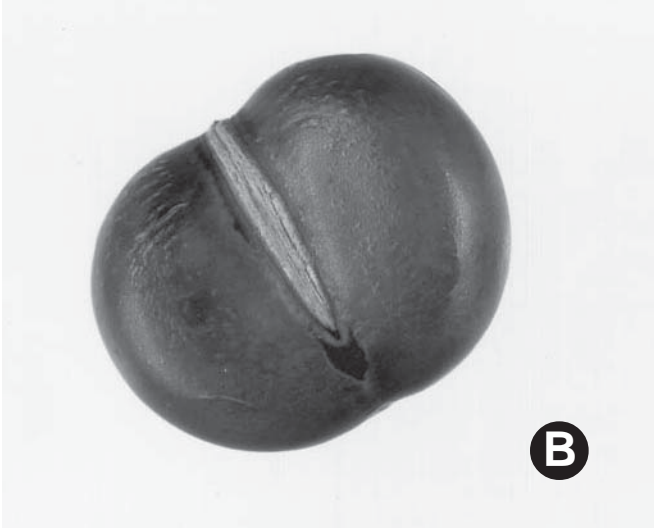
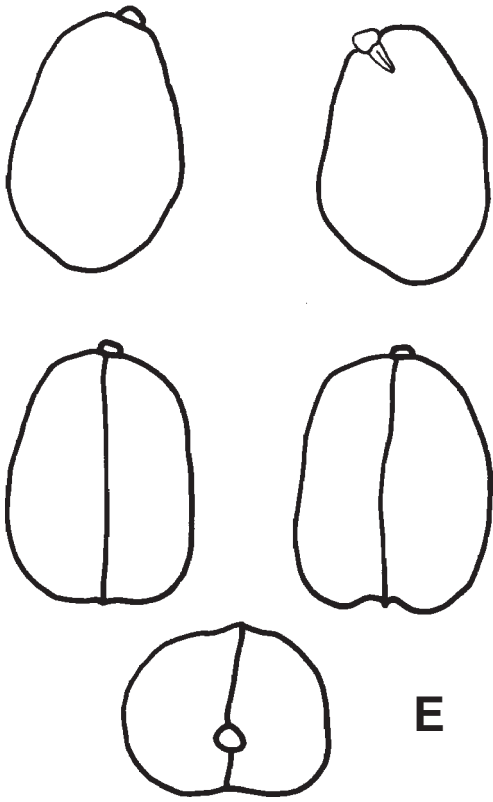
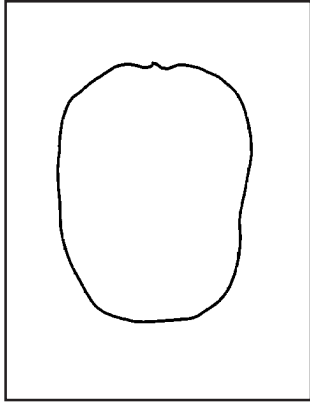
and approaching bifurcation; color of testa; brown; raised. Hilum partially or fully concealed; concealed by funicular remnant; without faboid split; larger than punctiform; 1–2 mm long; with curved outline; oval; subapical to radicle tip; recessed; within rim. Hilum rim color of testa. Lens discernible; equal to or greater than 0.5 mm in length; ca. 1 mm long; with margins curved; circular; in groove of raphe; confluent with hilum; recessed; same color as testa; brown; within rim. Lens rim color of testa. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; with lobes; with lobes touching (auriculate); without basal groin formed by lobes; with the interface division terminating at base of radicle; without margins recessed; tan; inner face flat; glabrous around base of radicle. Embryonic axis straight or oblique (slightly); parallel to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; triangular; lobe tip straight; straight with embryonic axis or oblique to cotyledons (slightly); centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Northeastern Brazil to southeastern Peru and northern Argentina.

Notes: Polhill (1994a,b) transferred this genus from the Sophoreae (2) following Herendeen's (1995) cladistic analysis.

Amburana: *A. cearensis* (F.F. Allemão e Cysneiro) A.C. Smith (*B–E*), *A. spp.* (*A*). *A*, Fruits ($\times 0.9$); *B*, seeds ($\times 3.1$); *C–D*, testa ($\times 50$, $\times 1000$); *E*, embryos ($\times 2$).





Genus: *Alexa* C.H.B.A. Moquin-Tandon

Phylogenetic Number: 2.12A.

Tribe: Sophoreae.

Group: Angylocalyx.

Species Studied—Species in Genus: 5 spp.—9 spp.

Fruit a legume; unilocular; $11\text{--}40 \times 2.2\text{--}7.5 \times 2\text{--}5$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical; linear; not inflated; compressed to terete; without beak; short tapered to rounded at apex; apex aligned or oblique with longitudinal axis of fruit; long tapered or tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; ligneous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit stipitate or nonstipitate; with the stipe up to 20 mm long. Fruit with all layers dehiscent; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome or multicolored; mottled; brown; with brown overlay; pubescent and indurate or pubescent but soon deciduous; with 1 type of pubescence; tomentose to velutinous; with pubescence brown; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; not veined; not tuberculate; ribbed; not exfoliating or exfoliating in part; with or without cracks; cracking oblique to fruit length. Mesocarp thick; surface not veined; 2-layered; without balsamic vesicles; without fibers; with solid layer over solid layer; ligneous. Endocarp dull; monochrome or mottled; brown, tan, or yellow; with mottling over seed chambers; with brown overlay; pithy or scurfy; septate; with septa thin (tissue paper-like), flexible or thicker than paper, firm; with septa eglandular; chartaceous or pulpy; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds (1–)3–16; length oblique to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; ca. 5 mm long; thick; triangular. Aril fleshy; irregularly marginal hilar; crenate; covering less than 1/2 of seed; dark brown to black.

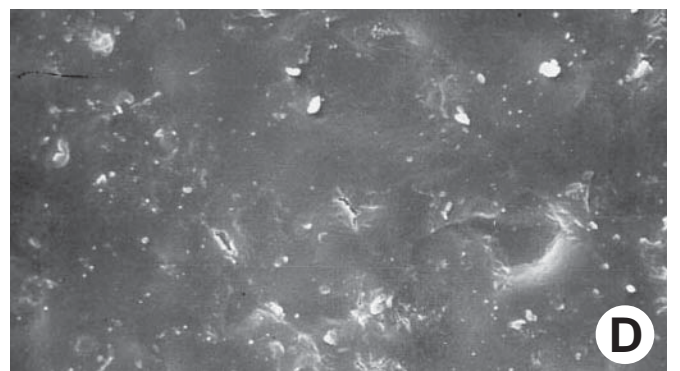
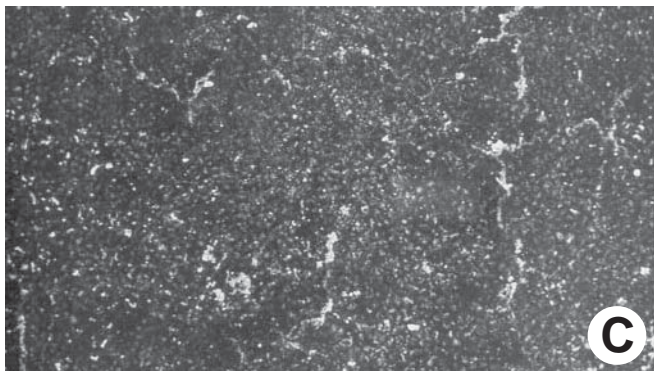
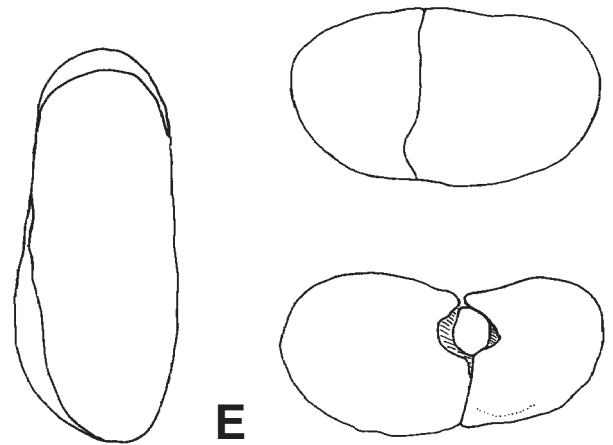
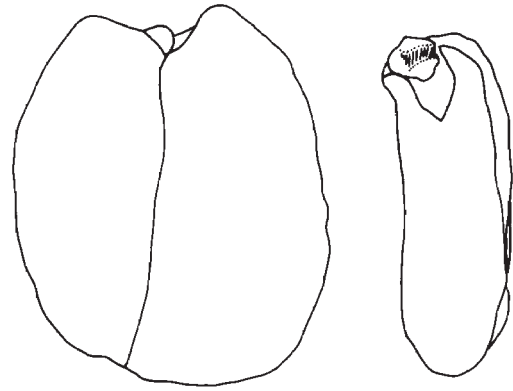
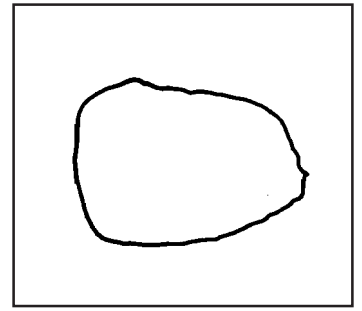
Seed $20\text{--}38 \times 12\text{--}38 \times 10.5\text{--}16$ mm; not overgrown; not angular; symmetrical; circular, oblong, or ovate; compressed to terete; with surface smooth; without

visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; glossy to dull; not modified by a bloom; colored; monochrome; brown to dark brown; glabrous; not smooth; with elevated features; wrinkled; chartaceous. Fracture lines absent or present; transverse. Rim absent. Wings absent. Raphe visible or not visible; from hilum through lens and terminating before base of seed; not bifurcating; color of or darker than testa; brown; flush or raised. Hilum partially or fully concealed; concealed by funicular remnant or aril; without faboid split; larger than punctiform; 3–9 mm long; with curved or angular outline; oval; triangular; apical at apex of radicle tip or subapical to radicle tip; flush; within rim or not within corona, halo, or rim. Hilum rim color lighter than testa. Lens not discernible. Endosperm absent. Cotyledons not smooth; slightly wrinkled; both outer faces convex; both the same thickness or 1 thicker than the other; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially or not concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; with 1 margin recessed; recessed on same side as hilum (terminal radicle); white to tan; inner face flat, with central ridge on 1 and central groove on other, or wavy; glabrous around base of radicle. Embryonic axis straight; parallel to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip straight or curved; straight with embryonic axis; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Tropical South America.

Notes: Ramírez (1995) revised the genus. The cotyledons are of distinctly different sizes.

Alexa: *A. confusa* H. Pittier (C–E), *A.* spp. (A–B). *A.*, Fruits ($\times 0.4$); *B.*, seeds ($\times 1.2$); *C–D.*, testa ($\times 50$, $\times 1000$); *E.*, embryos ($\times 2$).



Genus: *Angylocalyx* P.H.W. Taubert

Phylogenetic Number: 2.13.

Tribe: Sophoreae.

Group: *Angylocalyx*.

Species Studied—Species in Genus: 3 spp.—7 spp.

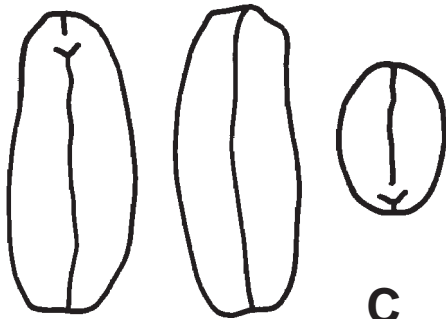
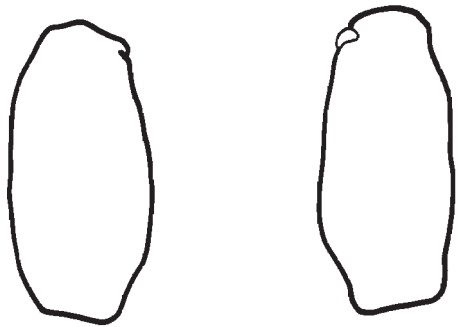
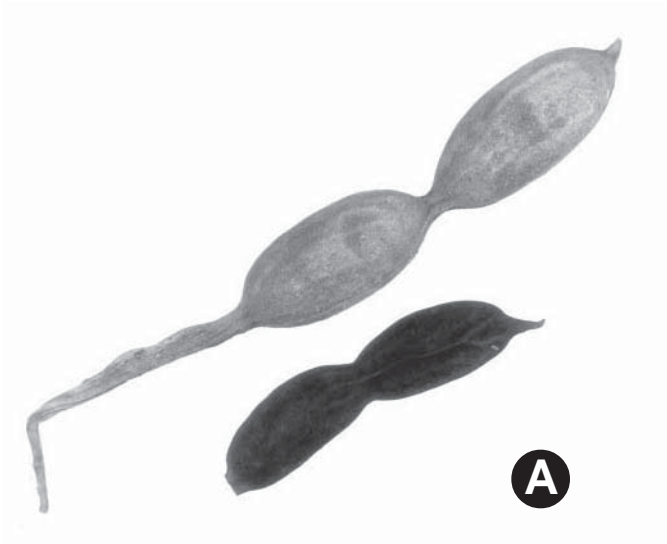
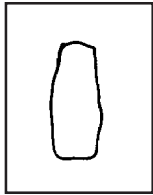
Fruit a legume (superficially resembling a loment); unilocular; $5-20 \times 0.8-2.6 \times 0.7-2$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight to curved (to slightly curved); not plicate; not twisted or twisted; asymmetrical or symmetrical; moniliform, falcate and moniliform, or C-shaped and moniliform; when asymmetrical with both sutures parallelly curved; not inflated; terete; with beak; straight or hooked; with solid beak the same color and texture as fruit; tapered at apex; apex aligned, oblique, or right-angled with longitudinal axis of fruit; tapered at base; base aligned or oblique with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous to ligneous; seed chambers externally visible; with the raised seed chambers torulose. Fruit margin constricted along both margins; plain. Fruit wings absent. Fruit stipitate or substipitate; with the stipe 4–25 mm long. Fruit indehiscent. Replum invisible. Epicarp dull; monochrome; brown; glabrous or pubescent and indurate; with 1 type of pubescence; velutinous; with pubescence brown; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; not veined; not tuberculate; rugose and wrinkled or wrinkled; not exfoliating; without cracks. Mesocarp present or absent; thin; surface not veined; 1-layered; without balsamic vesicles; solid; coriaceous to chartaceous. Endocarp dull; monochrome; tan; smooth, cracked, or transversely wrinkled; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp or to epicarp; entire. Seeds 2–7; length parallel with fruit length; neither overlapping nor touching; in 1 series.

Seed $15-20 \times 9-10 \times 8-9$ mm; not overgrown; not angular; symmetrical; elliptic; terete; with surface wrinkled; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa absent (fused to endocarp). Endosperm absent. Cotyledons not smooth; wrinkled and pitted; both outer faces convex; both the same thickness or 1 thicker (slightly

than the other; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; tan to brown to orange; inner face flat; glabrous around base of radicle. Embryonic axis right angled; oblique or perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; triangular; lobe tip straight; deflexed and parallel to cotyledon width; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Tropical Africa.

Angylocalyx: *A. oligophyllus* (J.G. Baker) E.G. Baker (*C*), *A. spp.* (*A–B*). *A*, Fruits ($\times 0.9$); *B*, seeds ($\times 2.9$); *C*, embryos ($\times 2$).



C

Genus: *Xanthocercis* H.E. Baillon

Phylogenetic Number: 2.14.

Tribe: Sophoreae.

Group: Angylocalyx.

Species Studied—Species in Genus: 2 spp.—3 spp.

Fruit a legume; unilocular; $2.7\text{--}5.4 \times 1.5\text{--}2.2 \times 1\text{--}2.1$ cm; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical; elliptic to fusiform; inflated or not inflated; terete; with or without beak; straight to declined; with solid beak the same color and texture as fruit; rounded or short tapered at apex; apex aligned or oblique with longitudinal axis of fruit; short tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit stipitate or substipitate; with the stipe 1–7 mm long. Fruit indehiscent. Epicarp dull; monochrome; green to yellow; with surface texture uniform; glabrous; eglandular; without spines; not smooth; with recessed features; pitted; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; chartaceous. Endocarp dull; opaque; monochrome; white; fibrous; without adhering pieces of testa; nonseptate; coriaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seed 1; length parallel with fruit length. Funiculus measured; ca. 1 mm long; thick; straight. Aril dry; rim-aril; cream.

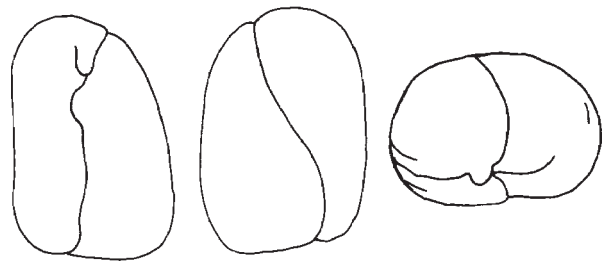
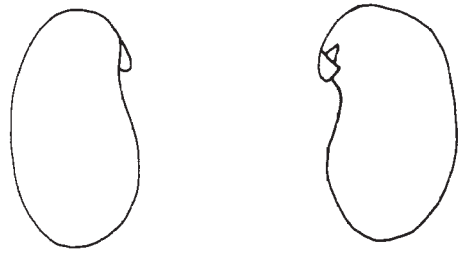
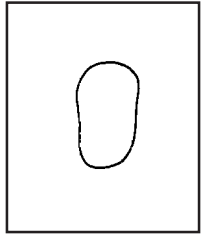
Seed $14\text{--}21 \times 10\text{--}15 \times 8\text{--}12$ mm; not overgrown; not angular; symmetrical or asymmetrical; oblong to ovate or irregular; terete; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle not exfoliating; not inflated; not wrinkled. Testa with or without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; dull; not modified by a bloom; colored; monochrome or mottled; with infrequent mottles; black, blue, or brown (dark when mottled); with brown overlay (lighter); glabrous; smooth or not smooth; with elevated features; wrinkled; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe visible or not visible; from hilum through lens to base of seed and terminating; not

bifurcating; color of testa; flush or raised (slightly). Hilum visible; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 2–2.5 mm long; with curved outline; elliptic to fusiform; apical according to radicle tip but marginal according to seed length; recessed; within halo. Hilum halo color lighter than testa. Lens discernible; equal to or greater than 0.5 mm in length; 3–4 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; flush; same or similar color as testa; lighter than testa; brown; within halo. Lens halo color lighter than testa. Endosperm thin; covering entire embryo; adnate to testa and embryo. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; with both folded or not folded; sufficiently folded for inner face to touch itself; portions of inner folded face unequal; margin entire 180 degrees from base of radicle; similar at apex; partially concealing or not concealing radicle; notched at radicle; without lobes; with or without margins recessed; with both margins recessed; yellow; inner face flat; glabrous around base of radicle. Embryonic axis straight; oblique or parallel to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous or triangular; lobe tip straight; straight with embryonic axis; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

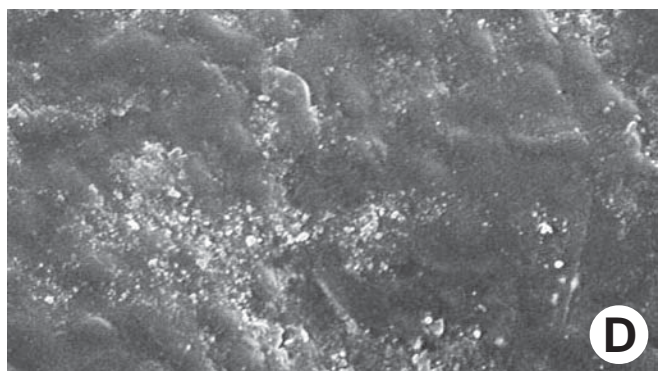
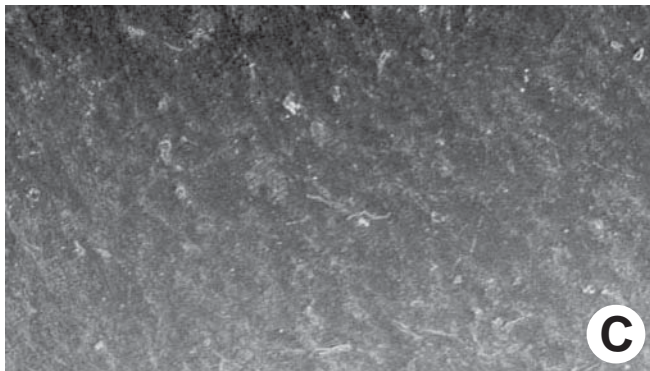
Distribution: Northern Madagascar (1 sp.) and south-central to southern Africa (1 sp.).

Notes: Van der Maesen (1997) described a new species from Gabon, *X. rabiensis* L.J.G. van der Maesen, which was included in the species count.

Xanthocercis: *X. zambesiaca* (E.G. Baker) N. Dumaz-le-Grand (C–E); *X.* spp. (A–B). A, Fruits ($\times 1.5$); B, seeds ($\times 2.4$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 2$).



E



Genus: *Ormosia* G. Jackson

Phylogenetic Number: 2.15.

Tribe: Sophoreae.

Group: *Ormosia*.

Species Studied—Species in Genus: Ca. 26 spp.—ca. 100 spp.

Fruit a legume; unilocular; $1.5\text{--}13 \times 1\text{--}7 \times 0.5\text{--}3$ cm; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical or asymmetrical; elliptic, ovate, irregular, or obliquely obovate; when asymmetrical with 1 straight and 1 curved suture or both sutures unequally curved; widest near middle or D-shaped; inflated or not inflated; compressed or terete; with beak (short) or without beak; straight or declined; with solid beak the same color and texture as fruit; rounded or short tapered at apex; apex oblique with longitudinal axis of fruit; rounded, tapered, or short tapered at base; base aligned or oblique with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous, leathery, or ligneous; seed chambers externally visible. Fruit margin constricted or not constricted; constricted along both margins; without sulcus; plain or embellished; with thickened sutural areas. Fruit wings absent. Fruit stipitate or substipitate; with the stipe up to 10 mm long. Fruit with all layers dehiscent or indehiscent; splitting along sutures. Dehiscence of valves along both sutures or 1 suture; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; black, brown, or red; with surface texture uniform; glabrous, glabrate, or pubescent and indurate; with hairs erect or appressed; with 1 type of pubescence; puberulent, strigose, or villous; with pubescence brown or golden; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; smooth or not smooth; with elevated features; not veined; not tuberculate; papillose, rugose, or wrinkled; not exfoliating; without or with cracks; cracking oblique to fruit length. Mesocarp thick; surface not veined; 3-layered; without balsamic vesicles; without fibers; with spongy layer over vitreous over solid layer; ligneous or coriaceous. Endocarp dull; opaque; mottled; tan; with mottling (dark); with brown overlay; smooth and scurfy; without adhering pieces of testa; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1–6;

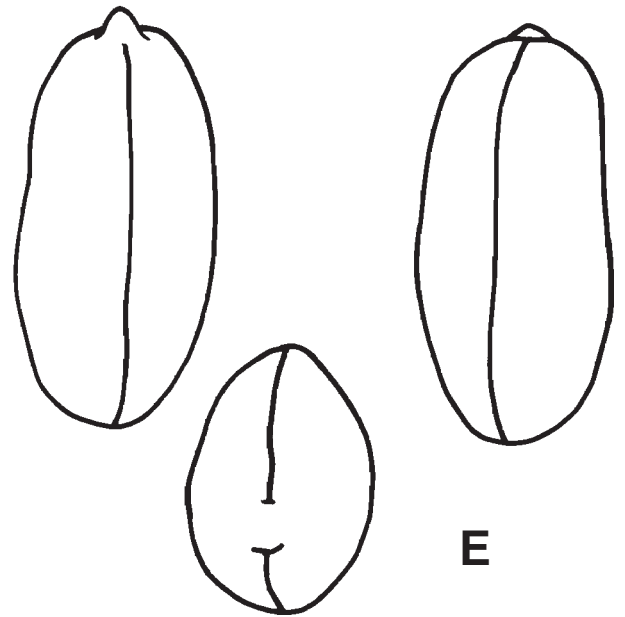
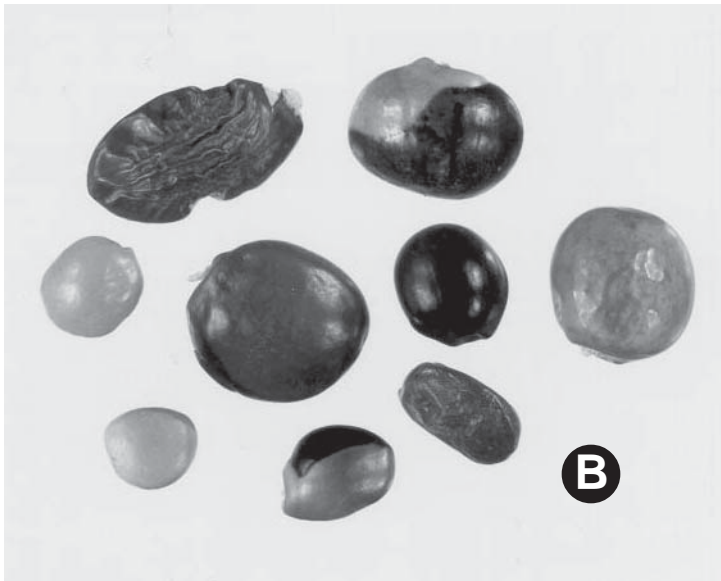
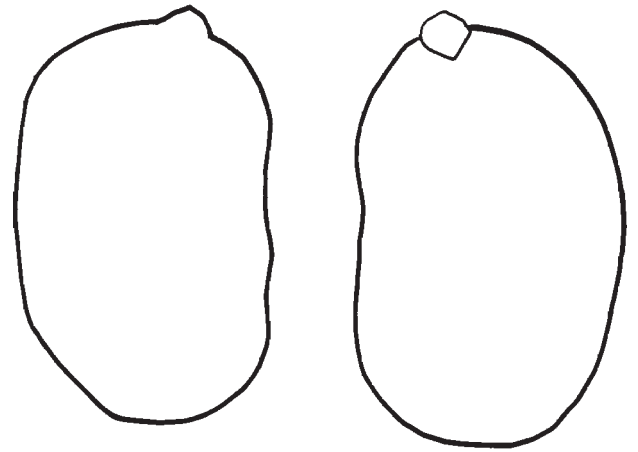
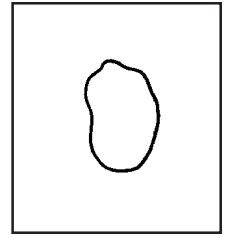
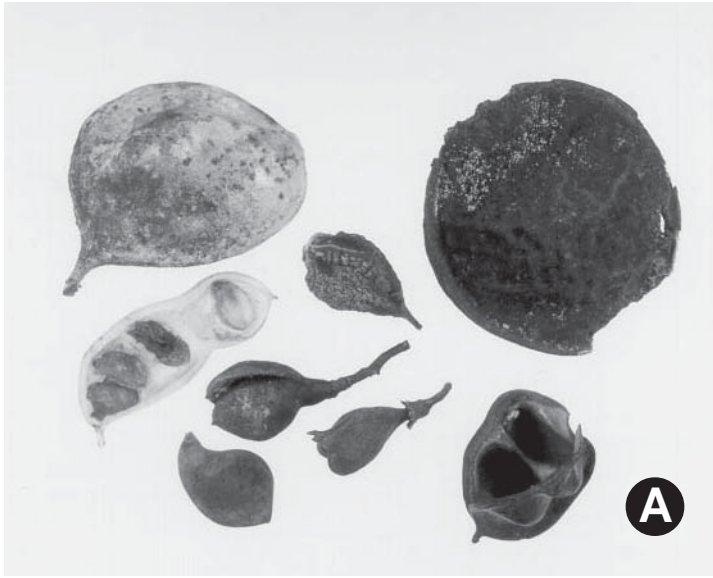
length parallel with, oblique to, or transverse to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 1.5–2.5 mm long; of 1 length only; thick; curved. Aril dry; rim-aril; cream or tan.

Seed $6\text{--}40 \times 6\text{--}40 \times 5\text{--}20$ mm; not overgrown; not angular or angular; symmetrical or asymmetrical; circular, elliptic, irregular, oblong, or ovate; terete or compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle not exfoliating; not inflated; not wrinkled. Testa without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; dull or glossy; not modified by a bloom; colored; bichrome, monochrome, or mottled; with infrequent mottles; red, black, orange, red and black, or orange and black; with black overlay; glabrous; smooth; coriaceous to chartaceous. Fracture lines absent or present; irregular. Rim absent. Wings absent. Raphe visible or not visible; from hilum to near base of seed and terminating; not bifurcating; color of testa; flush or raised. Hilum visible or partially concealed; concealed by aril or funiculus; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 1–45 mm long; with curved or straight outline; elliptic or linear; subapical to radicle tip or apical according to radicle tip but marginal according to seed length; flush or recessed; within rim. Hilum rim color of testa. Lens discernible; equal to or greater than 0.5 mm in length; up to 3.5 mm long; with margins straight; linear; not in groove of raphe; adjacent to hilum; 1 mm from hilum; flush; similar color as testa; darker than testa; darker red; within rim. Lens rim color of or lighter than testa. Endosperm trace; restricted to region of embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; white to pink or yellow; inner face flat or wavy; glabrous around base of radicle. Embryonic axis straight; oblique, parallel, or perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip straight; oblique to cotyledons or straight with embryonic axis; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary or moderately developed; glabrous.

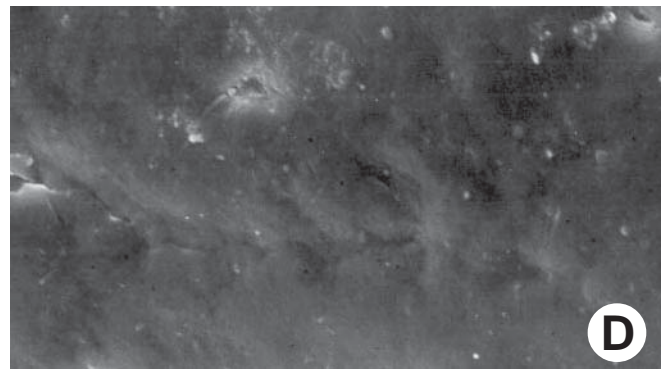
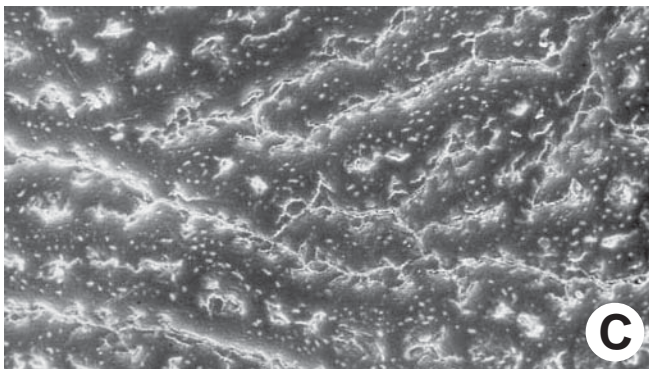
Distribution: Tropical and eastern South America and eastern Asia to northeastern Australia.

Notes: Other faboid species with red and black bichrome seeds include *Abrus precatorius* (5.01), whose seeds are deadly poisonous, and *Rhynchosia pyramidalis* (10.80), whose seeds are not poisonous.

Ormosia: *O. panamensis* G. Bentham (*C–E*), *O. spp.* (*A–B*).
A, Fruits ($\times 0.5$); *B*, seeds ($\times 1.4$); *C–D*, testa ($\times 50$,
 $\times 1000$); *E*, embryos ($\times 3$).



E



Genus: *Haplormosia* H.A.T. Harms

Phylogenetic Number: 2.16.

Tribe: Sophoreae.

Group: Ormosia.

Species Studied—Species in Genus: 1 sp.—1 sp.

Fruit a legume; unilocular; 5–9.5 × 4–5 × 0.9–1 cm; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; obliquely obovate; when asymmetrical with both sutures unequally curved; not inflated; flattened; with beak; straight; with solid beak the same color and texture as fruit; rounded at apex; apex aligned or oblique with longitudinal axis of fruit; rounded at base; base oblique with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous. Fruit margin not constricted; without sulcus; embellished; with upper sutural ridges and thickened sutural areas (lower suture). Fruit wings absent. Fruit stipitate; with the stipe 5–8 mm long. Fruit with all layers dehiscent (from literature); splitting along sutures. Dehiscence of valves along both sutures. Replum invisible. Epicarp dull; multicolored; mottled; brown; with brown (lighter and darker) overlay; glabrous; eglandular; without spines; not smooth; with elevated features; reticulately veined; not tuberculate; not exfoliating; without cracks. Mesocarp thin; surface not veined; 3-layered; with balsamic vesicles; without fibers; with solid layer over 2 distinct solid layers; coriaceous. Endocarp dull; monochrome; tan; fibrous; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seed 1; length oblique to fruit length. Funiculus measured; ca. 5 mm long; filiform; slightly S-curved. Aril absent.

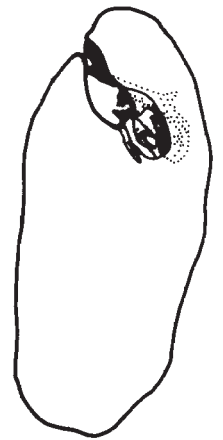
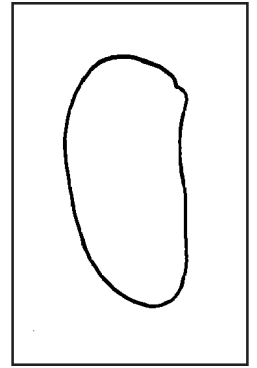
Seed 38 × 18 × 7 mm; not overgrown; not angular; symmetrical; elliptic; compressed; with surface wrinkled; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; transparently colored; monochrome; brown; glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe from hilum through lens to base of seed and terminating; not bifurcating; darker than testa; dark brown; raised. Hilum partially concealed; concealed by funicular remnant; without faboid split; larger than punctiform; 3–4 mm long; with

curved outline; fusiform; subapical to radicle tip; recessed; within rim. Hilum rim color darker than testa. Lens not discernible. Endosperm absent. Cotyledons not smooth; wrinkled; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; completely concealing radicle; split over radicle; with lobes; with lobes touching (auriculate); with basal groin formed by lobes; with the interface division terminating at base of radicle; without margins recessed; brown; inner face flat; pubescent around base of radicle. Embryonic axis oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; triangular; lobe tip straight; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule well developed; pubescent.

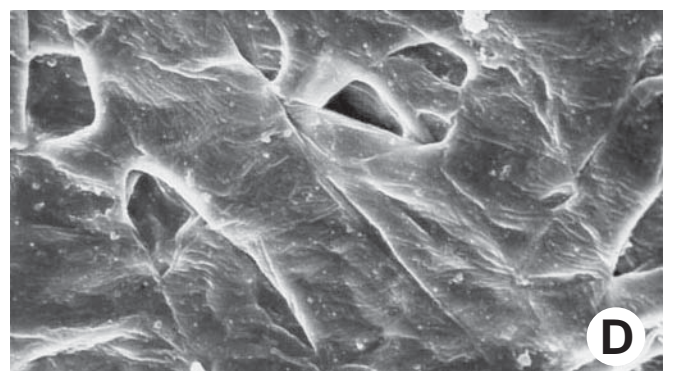
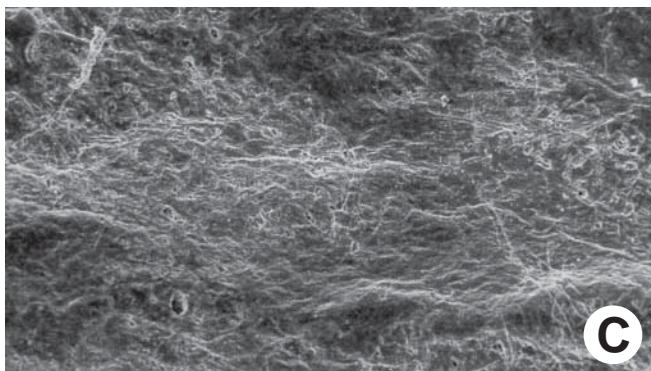
Distribution: Sierra Leone to Gabon.

Notes: More fruits and seeds should be studied.

Haplormosia: *H. monophylla* (H.A.T. Harms) H.A.T. Harms (*A*, *C–E*), *H.* spp. (*B*). *A*, Fruit (× 1.2); *B*, seed (× 2.8); *C–D*, testa (× 50, × 1000); *E*, embryos (× 1.5).



E



Genus: *Pericopsis* G.H.K. Thwaites

Phylogenetic Number: 2.17.

Tribe: Sophoreae.

Group: Ormosia.

Species Studied—Species in Genus: 4 spp.—4 spp.

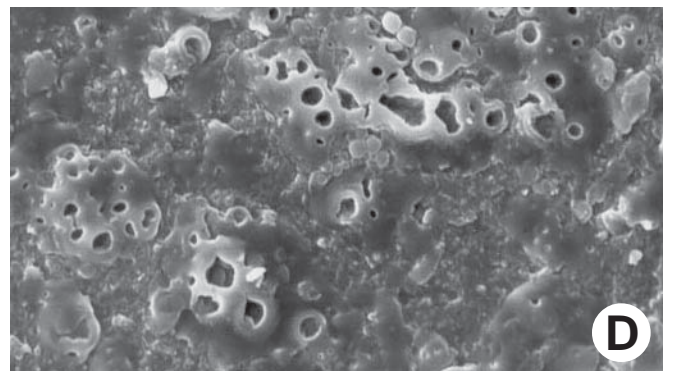
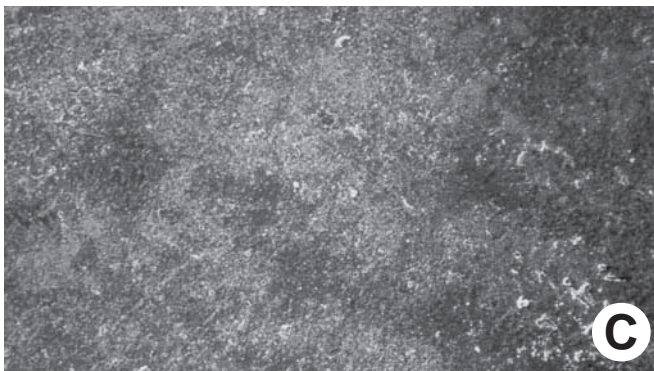
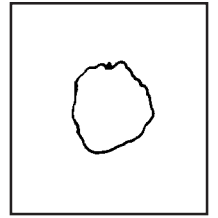
Fruit a legume; unilocular; $7-24 \times 2-4 \times 0.4-0.7$ cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical; circular, elliptic, fusiform, or linear; not inflated; compressed or flattened; with or without beak; straight; with solid beak the same color and texture as fruit; rounded or short tapered at apex; apex aligned or oblique with longitudinal axis of fruit; rounded or short tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally visible or invisible; with the raised seed chambers not torulose. Fruit margin not constricted or constricted; slightly constricted along both margins; without sulcus; embellished; with wings. Fruit wings 2; 2–4 mm wide; sutural; on both sutures. Fruit stipitate or substipitate; with the stipe up to 6 mm long. Fruit indehiscent. Epicarp dull; monochrome or multicolored; mottled; brown; with brown (darker) overlay; with surface texture uniform; glabrous or pubescent but soon deciduous; with hairs erect; with 1 type of pubescence; sparsely villous; with pubescence white; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; veined or not veined; reticulately veined; not tuberculate; dotted; not exfoliating; without or with cracks (tiny); cracking oblique to fruit length. Mesocarp thin; surface not veined; 1- or 2-layered; without balsamic vesicles; without fibers; solid or with solid layer over solid layer; coriaceous. Endocarp dull; opaque; monochrome; brown; smooth; without adhering pieces of testa; septate; with septa thicker than paper, firm; with septa eglandular; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1–6; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 0.5–1 mm long; of 1 length only; filiform; straight. Aril present or absent; dry; rim-aril; cream, tan, or yellow.

Seed $9-16.5 \times 7-13.5 \times 2.5-5$ mm; not overgrown; angular or not angular; symmetrical or asymmetrical;

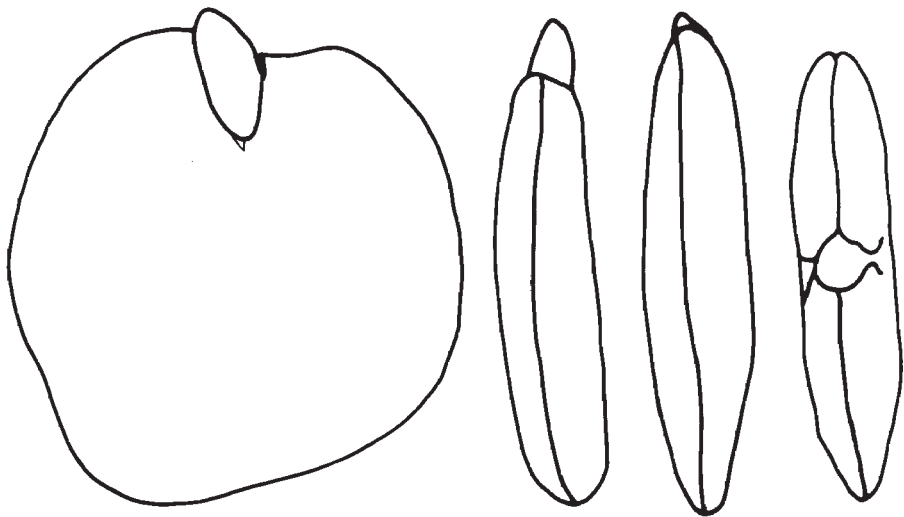
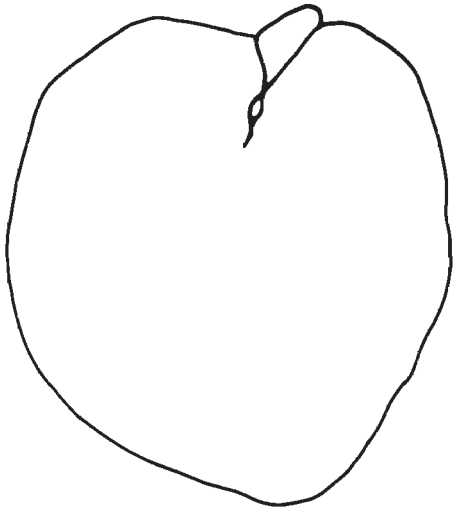
elliptic, irregular, oblong, or ovate; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle not exfoliating; not inflated; not wrinkled. Testa without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; glaucous; not modified by a bloom; colored; monochrome or mottled; with frequent mottles; brown or orange; with brown overlay; glabrous; smooth; chartaceous. Fracture lines absent. Rim present or absent; wing-like around seed (very narrow). Wings absent. Raphe from hilum through lens to base of seed and terminating or hilum through base of seed and up the other side; not bifurcating; color of testa; flush or raised. Hilum partially concealed; concealed by aril remnant or funiculus; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 0.5–2.5 mm long; with curved outline; elliptic; subapical to radicle tip; recessed; within halo. Hilum halo color darker than testa. Lens discernible; equal to or greater than 0.5 mm in length; 1.5–3.5 mm long; with margins straight; narrowly diamond-shaped; not in groove of raphe; confluent with or adjacent to hilum; 0.5 mm from hilum; slightly mounded; same or similar color as testa; darker than testa; reddish brown; not within corona, halo, or rim. Endosperm present or absent; thin; covering entire embryo; adnate to testa. Cotyledons smooth or not smooth; 1–3 grooves on each face or wrinkled; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire or not entire 180 degrees from base of radicle; wavy; similar at apex; partially concealing radicle; notched at radicle or split over radicle; with lobes; with lobes touching (auriculate); with basal groin formed by lobes; with the interface division terminating at base of radicle; without margins recessed; tan or yellow; inner face flat; glabrous around base of radicle. Embryonic axis oblique or straight; oblique or parallel to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous or linear; lobe tip straight or curved; oblique to cotyledons or straight with embryonic axis; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Africa (3 spp.) and Ceylon to New Guinea and Micronesia (1 sp.).

Pericopsis: *P. elata* (H.A.T. Harms) M.S. Knaap-van Meeuwen (C–D), *P. spp.* (A–B). A, Fruits ($\times 0.8$); B, seeds ($\times 2.6$); C–D, testa ($\times 50$, $\times 1000$).



Pericopsis (con.): P. elata (E). E, embryos (× 5).



E

Genus: *Baphia* A. Afzelius ex C. Loddiges

Phylogenetic Number: 2.18.

Tribe: Sophoreae.

Group: *Baphia*.

Species Studied—Species in Genus: 10 spp.—ca. 45 spp.

Fruit a legume; unilocular; $3.2\text{--}20 \times 1\text{--}5 \times 0.4\text{--}0.8$ cm; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight or curved (to slightly curved); not plicate; not twisted; asymmetrical; falcate, fusiform, moniliform, or oblong; when asymmetrical with 1 straight and 1 curved suture or both sutures parallelly curved; widest near apex; not inflated; flattened or compressed; without or with beak; straight or hooked; with solid beak the same color and texture as fruit; tapered or rounded at apex; apex aligned, oblique, or right-angled with longitudinal axis of fruit; long tapered at base; base aligned or oblique with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous to ligneous; seed chambers externally visible or invisible; with the raised seed chambers not torulose. Fruit margin constricted or not constricted; slightly constricted along both margins; without sulcus; plain or embellished; with thickened sutural areas or wings. Fruit wings absent or present (rarely); 2; 1 mm wide; sutural; on 1 suture. Fruit nonstipitate. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome or multicolored; mottled; black, brown (to purplish brown), or gray; with brown overlay; with mottling over seed chambers; glabrate, pubescent and indurate, or pubescent but soon deciduous; with hairs erect or appressed; with 1 type of pubescence; puberulent, tomentose, or villous; with pubescence gray or brown; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; smooth or not smooth; with elevated features; veined or not veined; reticulately veined; not tuberculate; papillose to rugose; not exfoliating; without or with cracks; cracking oblique or transverse to fruit length. Mesocarp thick or thin; surface not veined; 1- or 2-layered; without or with balsamic vesicles; without fibers; solid or with solid layer over solid layer; ligneous to coriaceous (including subligneous). Endocarp dull; monochrome or bichrome; brown, gray, purple, or brown and gray; smooth, cracked, floury-

filamentous, smooth and floury-filamentous, pithy and smooth, or rugose; nonseptate; chartaceous or pulpy; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1–5; length parallel with, oblique to, or transverse to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 0.5–3 mm long; of 1 length only; flattened; straight, contorted, or triangular. Aril dry; 2-lipped rim-aril; entire; with tongues (or flap-like) on lips of 2-lipped rim-aril; with 1 tongue or flap on 1 lip of 2-lipped rim-aril or 2 tongues or flaps, 1 on each lip of 2-lipped rim-aril; ivory or tan.

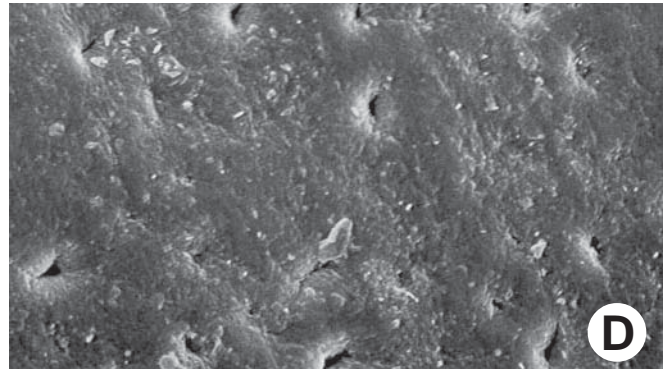
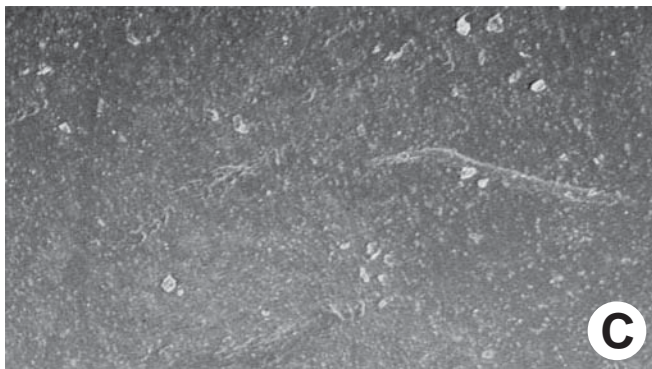
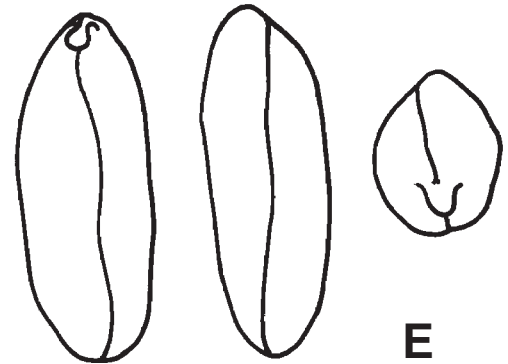
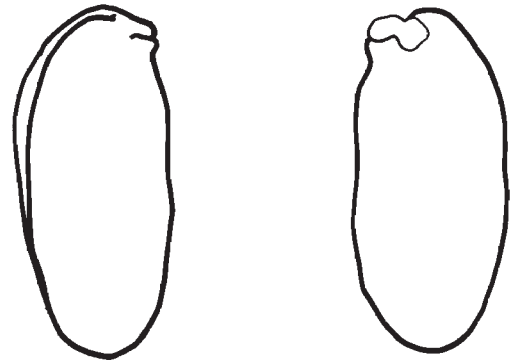
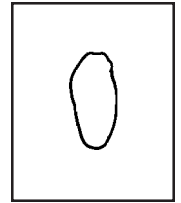
Seed $10\text{--}25 \times 6\text{--}20 \times 2\text{--}5$ mm; not overgrown; not angular; symmetrical or asymmetrical; circular, elliptic, or irregular; compressed or flattened; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull to glossy; not modified by a bloom; colored; monochrome or bichrome; black, brown, red (to brick red), or black and red (to brick red); glabrous; smooth or not smooth; with elevated features; wrinkled; chartaceous to coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe visible or not visible; from hilum through lens to base of seed and terminating or bifurcating; bifurcating at base of seed with each arm going up antiraphe side and then turning (U-shaped) down and approaching bifurcation; darker than testa; black; raised. Hilum partially or fully concealed; concealed by aril; without faboid split; larger than punctiform; 1–1.5 mm long; with curved outline; circular to elliptic; apical at apex of radicle tip, subapical to radicle tip, or apical according to radicle tip but marginal according to seed length; recessed; within corona or not within corona, halo, or rim. Hilum corona color darker than testa. Lens discernible or not discernible; equal to or greater than 0.5 mm in length; 1–1.5 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; mounded; similar color as testa; darker than testa; black or brown; within corona or not within corona, halo, or rim. Lens corona color darker than testa. Endosperm present or absent; trace; covering at least 1/2 of embryo, but not entire embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; partially concealing radicle; notched at or split over radicle; without or with lobes; with lobes overlapping or touching (auriculate); with or without basal groin formed by lobes; with the interface division terminating at base of radicle; without margins recessed; tan; inner face flat; glabrous around base of radicle. Embryonic axis oblique or right angled;

oblique or perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip straight or curved (slightly); deflexed and parallel to cotyledon width or oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary to moderately developed; glabrous.

Distribution: Tropical Africa with 1 sp. in Natal and 1 sp. extending into Madagascar.

Notes: *Baphia* was revised by Soladoye (1985), and we are following his species count, not that of Polhill (1981b).

Baphia: *B. capparidifolia* J.G. Baker (C–E), *B. spp.* (A–B).
A, Fruits ($\times 0.8$); B, seeds ($\times 2.5$); C–D, testa ($\times 50$, \times
1000); E, embryos ($\times 3$).



Genus: *Airyantha* R.K. Brummitt

Phylogenetic Number: 2.19.

Tribe: Sophoreae.

Group: Baphia.

Species Studied—Species in Genus: 2 spp.—2 spp.

Fruit a legume; unilocular; $3\text{--}4.5 \times 0.9\text{--}1.2 \times 0.5\text{--}1$ cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; curved, 0.5-coiled, or 1-coiled; not plicate; not twisted; asymmetrical; moniliform and coiled, moniliform and falcate, or irregular; when asymmetrical with both sutures parallelly or unequally curved; not inflated; compressed; with beak; straight; with solid beak the same color and texture as fruit; tapered or short tapered at apex; apex oblique with, right-angled with, or almost reaching longitudinal axis of fruit; long tapered or tapered at base; base oblique or right angled with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally visible; with the raised seed chambers not torulose. Fruit margin constricted along both margins; without sulcus; embellished; with thickened sutural areas. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; brown; pubescent and indurate; with 1 type of pubescence; tomentose to velutinous; with pubescence brown; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; smooth; not veined; not tuberculate; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous. Endocarp dull; streaked; brown or tan; with dark streaking over seed chambers (some seed chambers); with brown overlay; smooth and fibrous; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds (1–)2–7; length parallel with fruit length to oblique to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 2 mm long; of 1 length only; flattened; triangular. Aril dry; rim-aril; fimbriate; ivory.

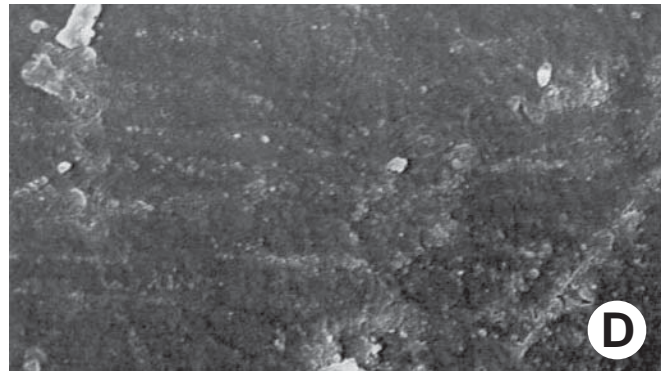
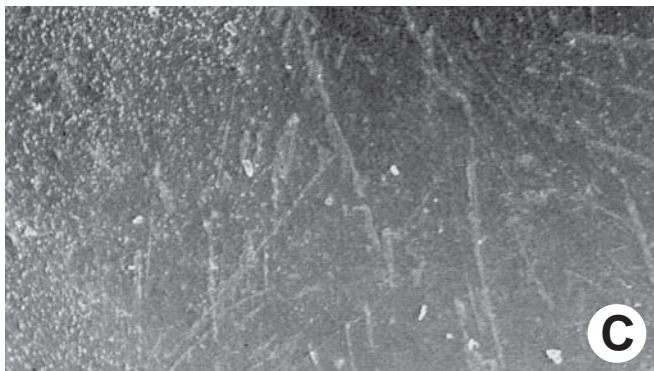
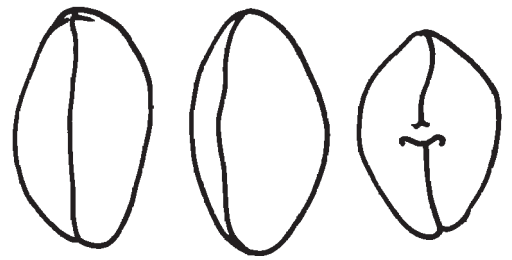
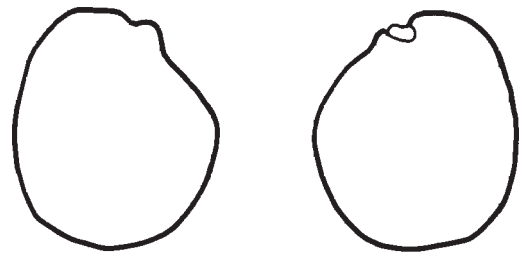
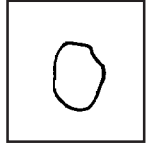
Seed $8\text{--}12 \times 6\text{--}9.5 \times 5\text{--}7.5$ mm; not overgrown; not angular; symmetrical or asymmetrical (slightly); circular to ovate; compressed to terete (sub); with

surface smooth; with or without visible radicle and cotyledon lobes; without external groove between radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Cuticle absent. Testa not adhering to endocarp; glossy; not modified by a bloom; colored; monochrome; purplish black to red; glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum fully concealed; concealed by aril; without faboid split; larger than punctiform; 0.8–1.2 mm long; with curved outline; elliptic; subapical to radicle tip; flush or recessed; not within corona, halo, or rim. Lens not discernible or discernible; less than 0.5 mm or equal to or greater than 0.5 mm in length; 2.5 mm long; with margins straight; linear; not in groove of raphe; adjacent to hilum; 1.7 mm from hilum; recessed; similar color as testa; darker than testa; reddish black or brown; not within corona, halo, or rim. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness or 1 thicker than the other; both more or less of equal length; not folded; margin entire or not entire 180 degrees from base of radicle; notched and wavy; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; tan; inner face wavy; glabrous around base of radicle. Embryonic axis oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; triangular; lobe tip straight; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Guinea-Congo (1 sp.) and Borneo (1 sp.).

Notes: Brummitt (1968) described and discussed *Airyantha*.

Airyantha: *A. borneensis* (D. Oliver) R.K. Brummitt (C–E), *A. spp.* (A–B). A, Fruits ($\times 2$); B, seeds ($\times 4.9$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 3$).



Genus: *Dalhousiea* N. Wallich ex G. Bentham

Phylogenetic Number: 2.20.

Tribe: Sophoreae.

Group: Baphia.

Species Studied—Species in Genus: 2 spp.—3 spp.

Fruit a legume; unilocular; 5.5–9.5 × 1.5–4.5 cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight or curved (slightly); not plicate; not twisted; asymmetrical; falcate to fusiform or irregular; when asymmetrical with both sutures parallelly or unequally curved; not inflated; compressed; without beak; tapered at apex; apex oblique with longitudinal axis of fruit; tapered at base; base oblique with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; embellished; with thickened (slightly) sutural areas. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; multicolored; mottled; black or brown; with black or brown overlay; with mottling over seed chambers; glabrous; eglandular; without spines; not smooth; with elevated features; veined or not veined; reticulately veined; not tuberculate; striate; exfoliating in part or not exfoliating; with cracks; cracking oblique to fruit length. Mesocarp thick; surface not veined; 2-layered; without balsamic vesicles; without fibers; with solid layer over solid layer; coriaceous. Endocarp dull; monochrome; dark brown; smooth and floury-filamentous; nonseptate; chartaceous and pulpy; exfoliating in part; remaining fused to mesocarp and epicarp; entire. Seeds 1–3; length oblique to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 1–2.5 mm long; of 1 length only; flattened; triangular. Aril fleshy; marginal hilar; entire; covering less than 1/2 of seed; tan.

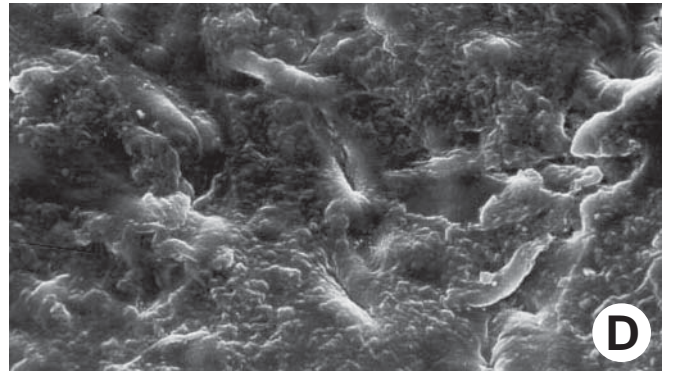
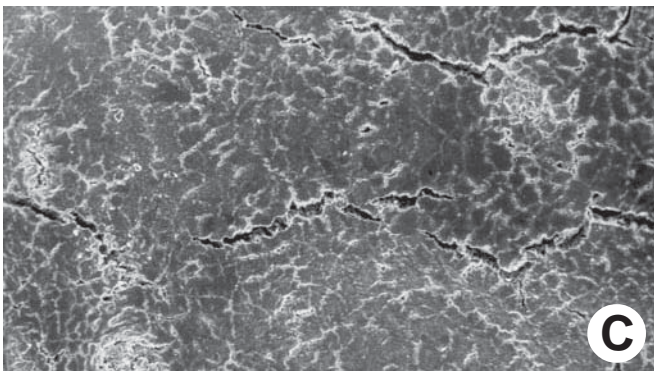
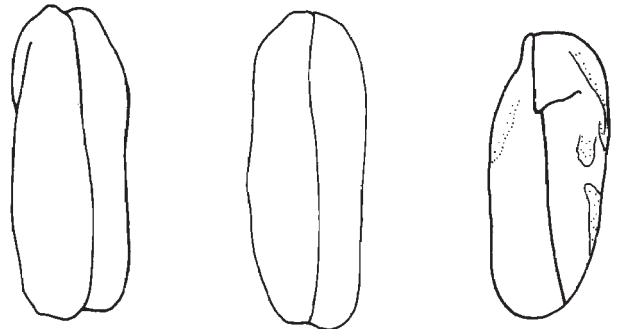
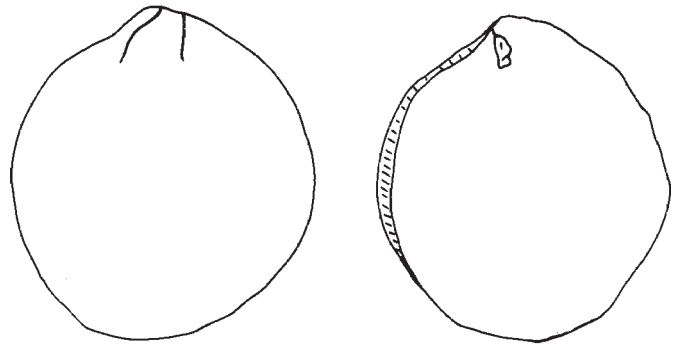
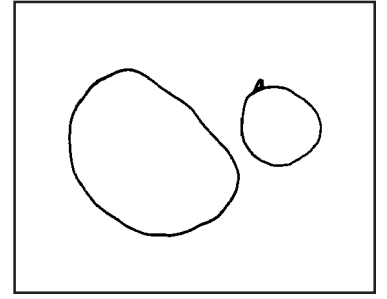
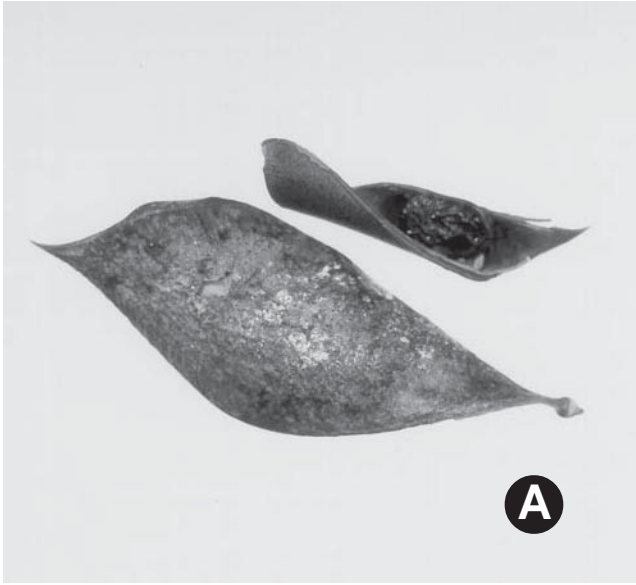
Seed 12–25 × 10–24 × 2.5–11 mm; not overgrown; not angular; symmetrical or asymmetrical; ovate or irregular; compressed or flattened; with surface wrinkled; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull or dull and glossy; not modified by a bloom; colored; monochrome; black to brown (dark); glabrous; not smooth; with elevated

features; wrinkled; coriaceous or chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe from hilum through lens and terminating before base of seed; not bifurcating; color of testa; raised. Hilum fully concealed; concealed by funicular remnant and aril, funicular remnant, or aril; without faboid split; larger than punctiform; 1.7–2 mm long; with curved outline; circular or elliptic; apical at apex of radicle tip; flush; not within corona, halo, or rim. Lens discernible; equal to or greater than 0.5 mm in length; 1.5–3 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; flush; same color as testa; black or brown; not within corona, halo, or rim. Endosperm absent. Cotyledons not smooth; wrinkled; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; completely concealing radicle; split over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; orange; inner face flat; glabrous around base of radicle. Embryonic axis straight; parallel to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip straight; straight with embryonic axis; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Western tropical Africa (1 sp., around the Gulf of Guinea) and northeastern India and Bangladesh (2 spp.).

Notes: Only one seed was studied internally.

Dalhousiea: *D. bracteata* (W. Roxburgh) R.C. Graham ex G. Bentham (*C–E*), *D.* spp. (*A–B*). *A*, Fruits (× 0.9); *B*, seeds (× 2); *C–D*, testa (× 50, × 1000); *E*, embryos (× 2).



Genus: *Bowringia* J.G. Champion ex G. Bentham

Phylogenetic Number: 2.21.

Tribe: Sophoreae.

Group: Baphia.

Species Studied—Species in Genus: 2 spp.—4 spp.

Fruit a legume; unilocular; $2.5\text{--}3.6 \times 1.6\text{--}2 \times 0.8\text{--}1$ cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight to curved (slightly); not plicate; not twisted; asymmetrical; harp-shaped or irregular; when asymmetrical with both sutures unequally curved; inflated; terete; with beak; straight or hooked; with solid beak the same color and texture as fruit; short tapered or rounded at apex; apex aligned or oblique with longitudinal axis of fruit; tapered or short tapered at base; base aligned or oblique with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; plain or embellished; with thickened sutural areas. Fruit wings absent. Fruit stipitate or substipitate; with the stipe 1–5 mm long. Fruit with all layers dehiscent; splitting along sutures. Dehiscence of valves along 1 suture (and partially along second margin) or both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome or multicolored; mottled; tan to brown to green; with brown overlay; glabrate; eglandular; without spines; not smooth; with elevated features; reticulately veined; not tuberculate; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; fleshy; chartaceous. Endocarp dull; monochrome; brown to tan to yellow; scurfy; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1–2; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 1–3 mm long; of 1 length only; thick; straight to triangular. Aril fleshy; thick and marginal hilar; lacinate or crenate; covering less than 1/2 of seed; ivory, olive, or tan.

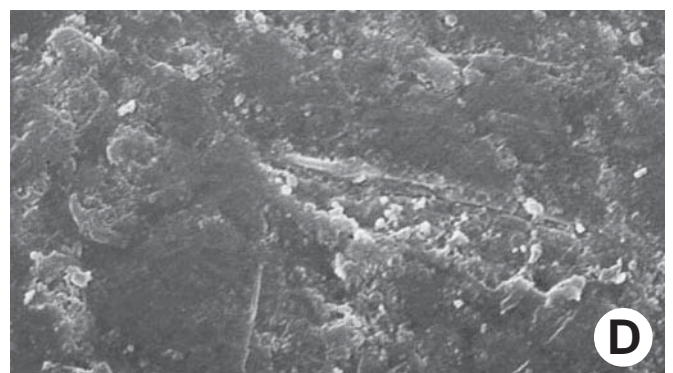
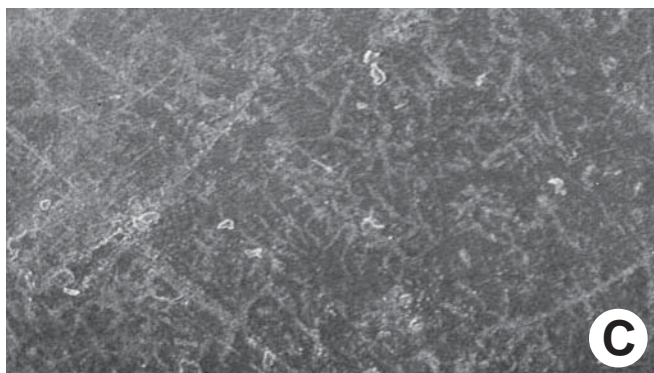
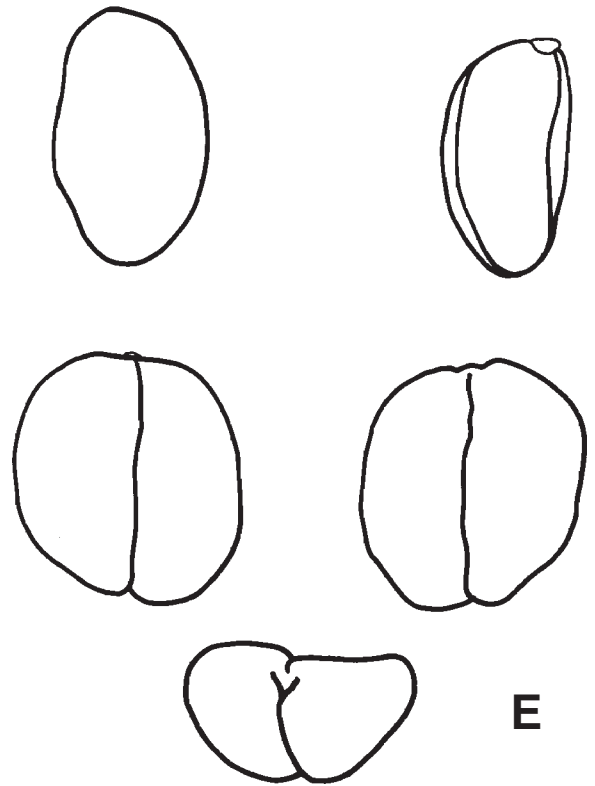
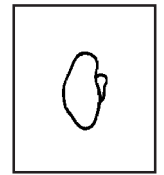
Seed $11\text{--}17.5 \times 8\text{--}12 \times 5\text{--}9$ mm; not overgrown; not angular; symmetrical; elliptic to circular to bilobed, cicerlike (slightly); terete; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; glossy; not modified by a bloom; colored; monochrome or streaked; with infrequent streaks; red to

brown to black (purplish); with black overlay; glabrous; smooth or not smooth; with elevated features; wrinkled; subcoriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum partially or fully concealed; concealed by funicular remnant or aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 3.5–4.5 mm long; with curved or straight outline; elliptic or oblong; marginal according to radicle tip; recessed; within corona. Hilum corona color darker than testa. Lens discernible; equal to or greater than 0.5 mm in length; 2 mm long; with margins straight; linear; not in groove of raphe; adjacent to hilum; 1 mm from hilum; flush; similar color as testa; darker than testa; black, brown, or red (dark); not within corona, halo, or rim. Endosperm absent. Cotyledons smooth or not smooth; slightly wrinkled; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; with 1 or both margins recessed; recessed on same side as hilum (terminal radicle); yellow or tan; inner face flat; glabrous around base of radicle. Embryonic axis straight; parallel to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; triangular; lobe tip straight; straight with embryonic axis; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Western Africa (2 spp.), eastern Madagascar (1 sp.), and southern China (1 sp.).

Notes: Polhill (1981b) noted that *Bowringia* radicles resemble those of *Leucomphalos* (2.23). Brummitt (1968) also discussed the delimitation and relationships of *Bowringia*. Hall (1974) keyed the four species.

Bowringia: *B. callicarpa* J.G. Champion (A, C–E), *B. spp.* (B). A, Fruits ($\times 2.4$); B, seeds ($\times 3$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 3$).



Genus: *Baphiastrum* H.A.T. Harms

Phylogenetic Number: 2.22.

Tribe: Sophoreae.

Group: Baphia.

Species Studied—Species in Genus: 1 sp.—1 sp.

Fruit a legume; unilocular; 18–20 × 12–14 × 10–13 cm; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight to curved (slightly); not plicate; not twisted; asymmetrical; oblong, ovate, or irregular; when asymmetrical with both sutures parallelly or unequally curved; not inflated; terete; with beak; straight or hooked; with solid beak the same color and texture as fruit; rounded or emarginate at apex; apex oblique or right-angled with longitudinal axis of fruit; rounded or truncate at base; base oblique with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous. Fruit margin without sulcus; plain. Fruit wings absent. Fruit substipitate; with the stipe ca. 2 mm long. Fruit with all layers dehiscent; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp obscured by dense pubescence; pubescent and indurate; with 1 type of pubescence; velutinous; with pubescence brown; with simple hairs; pliable; without spines; not tuberculate. Mesocarp thin; surface not veined; 2-layered; without balsamic vesicles; without fibers; with solid layer over spongy layer; coriaceous. Endocarp dull; streaked; reddish brown; with tan overlay (over seed chambers); cracked and hairy; with hairs scattered over endocarp; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seed 1; length parallel with fruit length. Funiculus measured; ca. 2 mm long; thick; contorted. Aril fleshy; annular or hippocrepiform rim-aril (wide); fimbriate; covering less than 1/2 of seed; olive.

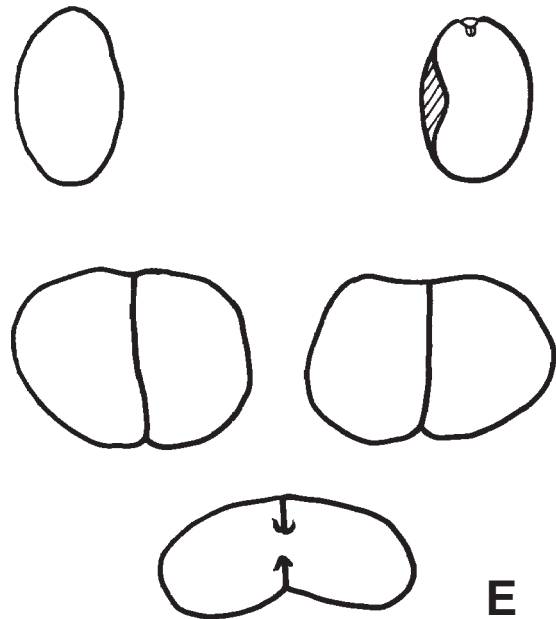
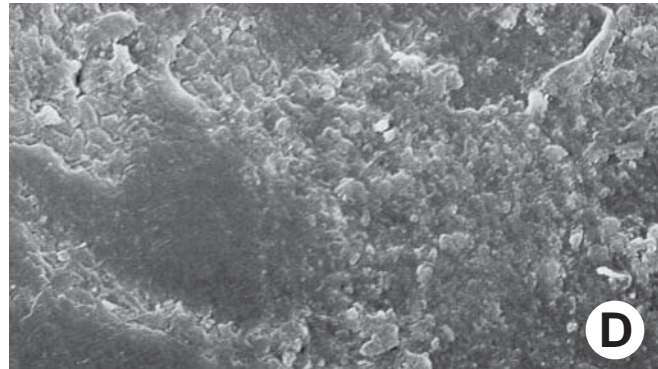
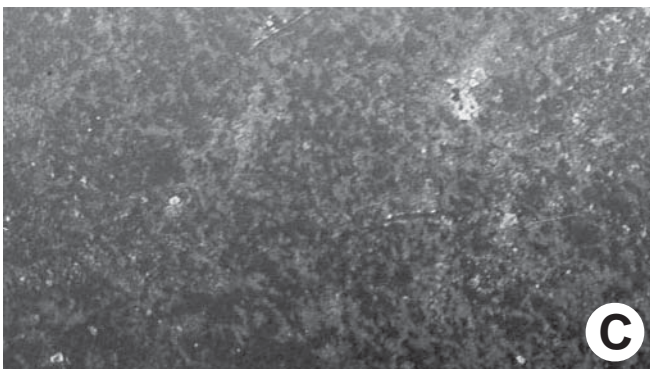
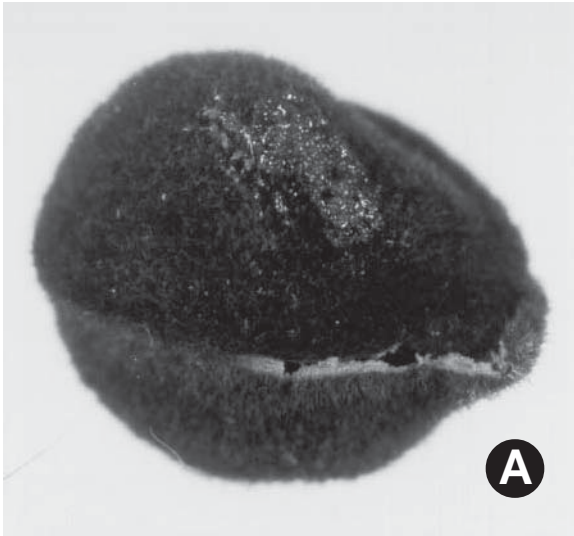
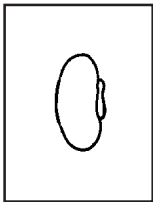
Seed 11–12 × 8–9 × 6–7 mm; not overgrown; not angular; symmetrical; elliptic; terete; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; glossy; not modified by a bloom; colored; monochrome; dark red; glabrous; smooth; chartaceous. Fracture lines irregular. Rim absent. Wings absent. Raphe not visible. Hilum partially concealed; concealed by aril; with faboid split; with the

lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 4–6 mm long; with curved outline; elliptic to circular; marginal according to radicle tip; recessed; not within corona, halo, or rim. Lens discernible; equal to or greater than 0.5 mm in length; 2–3 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; flush; similar color as testa; darker than testa; dark red; not within corona, halo, or rim. Endosperm absent. Cotyledons smooth; both outer faces convex; 1 thicker (slightly) than the other or both the same thickness; both more or less of equal length; not folded; margin not entire 180 degrees from base of radicle; completely concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; with 1 margin recessed; recessed on same side as hilum (terminal radicle); tan; inner face flat; glabrous around base of radicle. Embryonic axis straight; parallel to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; triangular; lobe tip straight; straight with embryonic axis; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Cameroon, Gabon, and Zaire.

Notes: The delimitation of *Baphiastrum* was discussed by Brummitt (1968).

Baphiastrum: *B. boonei* (E.A.J. Wildeman) P. Vermeulen ex E.A.J. Wildeman (C–E), *B. brachycarpum* H.A.T. Harms (A), *B. spp.* (B). A, Fruits (× 4.3); B, seeds (× 4.1); C–D, testa (× 50, × 1000); E, embryos (× 2).



Genus: *Leucomphalos* G. Bentham ex L.D. Planchon

Phylogenetic Number: 2.23.

Tribe: Sophoreae.

Group: Baphia.

Species Studied—Species in Genus: 1 sp.—1 sp.

Fruit a legume; unilocular; $2.5\text{--}3.5 \times 1.3\text{--}1.7 \times 0.9\text{--}11$ cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; curved; not plicate; not twisted; asymmetrical; harp-shaped or irregular; when asymmetrical with 1 straight and 1 curved (nearly) suture or both sutures unequally curved; widest near middle or D-shaped; inflated; terete; with beak; hooked; with solid beak the same color and texture as fruit; short tapered at apex; apex oblique or right-angled with longitudinal axis of fruit; tapered or short tapered at base; base oblique or right angled with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; embellished; with thickened sutural areas. Fruit wings absent. Fruit stipitate; with the stipe ca. 5 mm long. Fruit with all layers dehiscent; splitting along sutures. Dehiscence of valves along both sutures or 1 suture (and partially along the other); apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; orange to brown (reddish); glabrate; with 1 type of pubescence; strigose; with pubescence white; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; transversely veined relative to fruit length; not tuberculate; dotted; not exfoliating; without cracks. Mesocarp thin; 1-layered; without balsamic vesicles; solid; coriaceous. Endocarp dull; monochrome to mottled (slightly); tan; with mottling (dark); with brown overlay; veined; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1–2; length parallel with to oblique to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; ca. 3 mm long; of 1 length only; partially filiform and thick; straight. Aril fleshy; scurfy marginal hilar; fimbriate; covering less than 1/2 of seed; creamy yellow.

Seed $13.5\text{--}20 \times 8\text{--}15 \times 7\text{--}10$ mm; not overgrown; not angular; symmetrical; elliptic to bilobed, cicerlike; compressed to terete (sub); with surface smooth;

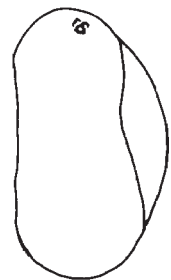
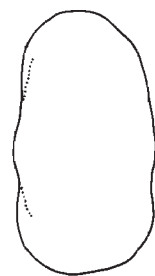
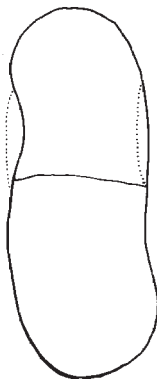
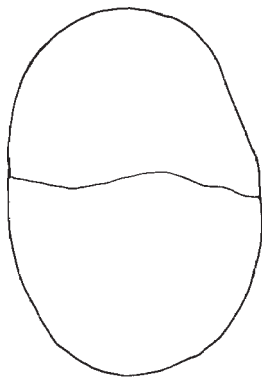
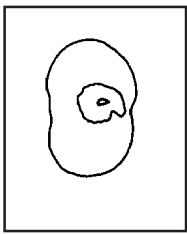
without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; glossy; not modified by a bloom; colored; monochrome or bichrome; reddish to purplish black or red and black (reddish to purplish); glabrous; not smooth; with elevated features; wrinkled; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe from hilum through lens to base of seed and terminating; not bifurcating; color of testa; reddish to purplish black; slightly raised. Hilum fully concealed; concealed by funicular remnant and aril; larger than punctiform; 2.5–4 mm long; with curved outline; elliptic; marginal according to radicle tip; flush; not within corona, halo, or rim. Lens discernible or not discernible; equal to or greater than 0.5 mm in length; ca. 4 mm long; with margins straight; linear; not in groove of raphe; adjacent to hilum; ca. 1 mm from hilum; slightly mounded; same color as testa; brown; not within corona, halo, or rim. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; completely concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; with 1 margin recessed; recessed on same side as hilum (terminal radicle); tan; inner face flat; glabrous around base of radicle. Embryonic axis straight; parallel to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip straight; straight with embryonic axis; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Gulf of Guinea to Ivory Coast.

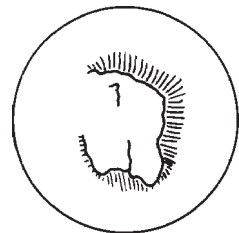
Notes: Polhill (1981b) noted that *Leucomphalos* radicles resemble those of *Bowringia* (2.21). Brummitt (1968) also commented on *Leucomphalos*. Only one seed was studied internally.

Leucomphalos: *L. capparideus* G. Bentham ex L.D.

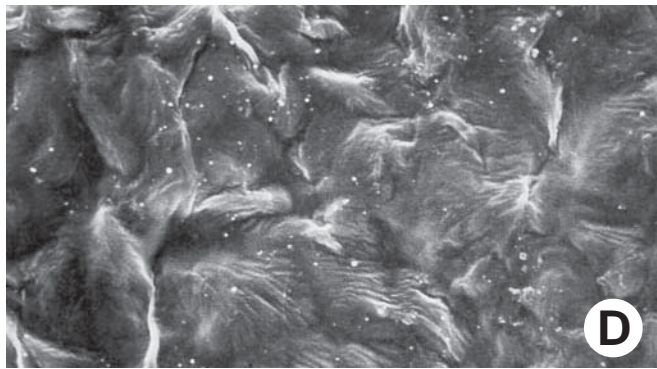
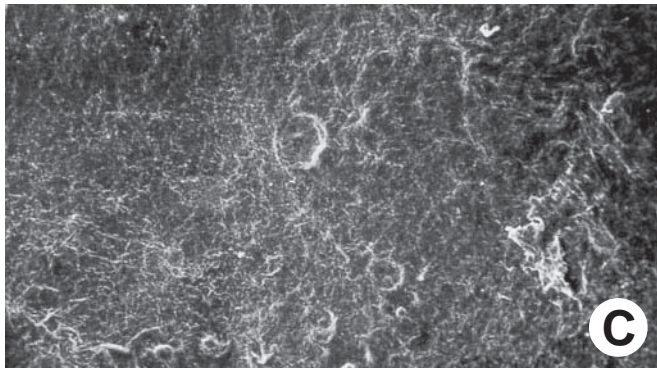
Planchon (A–F). A, Fruits ($\times 2.1$); B, seed ($\times 3.4$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 3$); F, embryo magnified ($\times 24$).



E



F



Genus: *Dussia* C.W.L. Krug & I. Urban ex P.H.W. Taubert

Phylogenetic Number: 2.24.

Tribe: Sophoreae.

Group: *Dussia*.

Species Studied—Species in Genus: 4 spp.—10 spp.

Fruit a legume; unilocular; 3–12 × 2–5.5 cm; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical; elliptic or fusiform; not inflated; compressed; without beak; rounded to tapered at apex; apex aligned with longitudinal axis of fruit; rounded to tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous to ligneous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit substipitate to stipitate; with the stipe 1–5 mm long. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; probably medial and up and down; active; with valves enrolling. Replum invisible. Epicarp dull (obscured by indument); pubescent and indurate; with 1 type of pubescence; velutinous to villous; with pubescence golden or brown (rust-brown to orangish); with pubescence uniformly distributed; with simple hairs; stiff; with hair bases plain; apparently eglandular; without spines; not smooth; with elevated features; not veined; not tuberculate; rugose or verrucose-rugose; not exfoliating; without cracks. Mesocarp thick; surface not veined; 2-layered; without balsamic vesicles; without fibers; with solid layer over solid layer or empty space (with or without spongy tissue) within solid layer; coriaceous to ligneous. Endocarp dull; mottled; pale yellow; with mottling (dark); with black overlay; rugose; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1–2; length parallel with fruit length; in 1 series. Funiculus measured; 8 mm long; of 1 length only; flattened; long triangular. Aril absent.

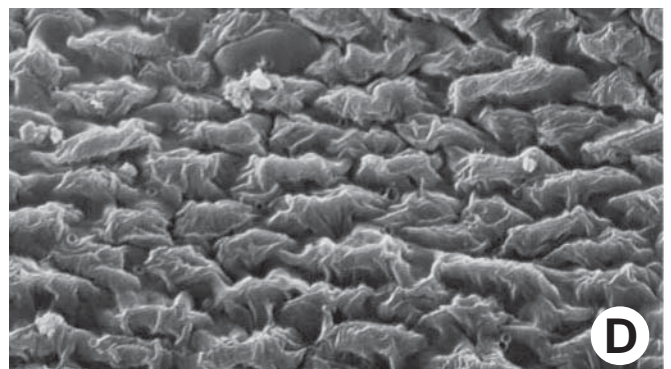
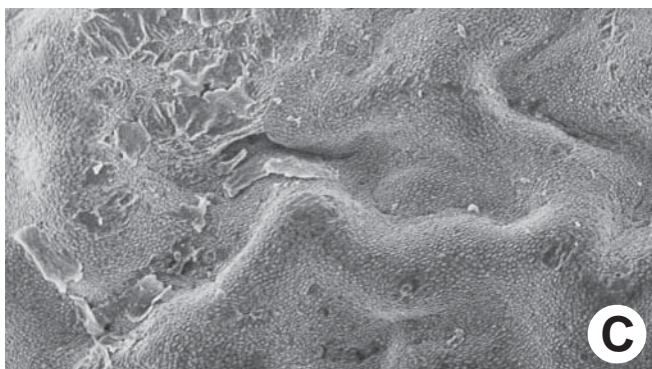
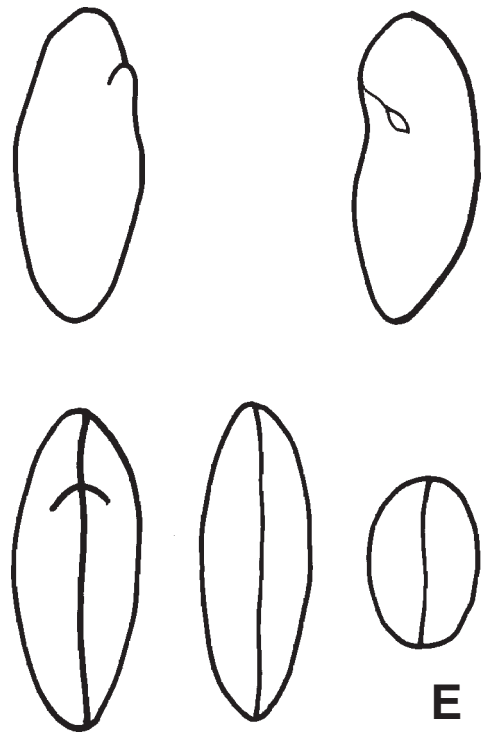
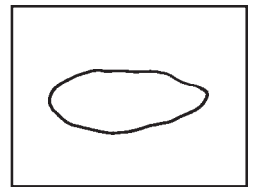
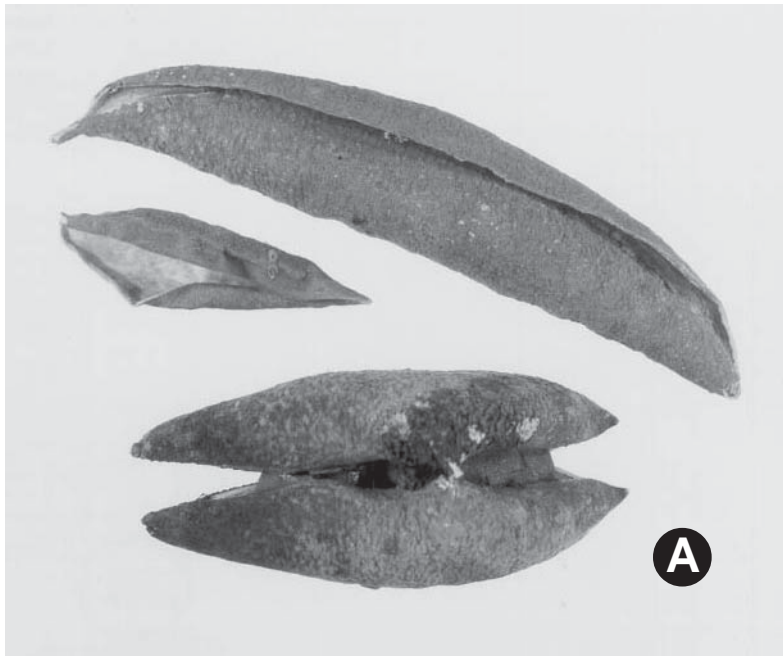
Seed 20–45 × 10–20 × 10–20 mm; not overgrown; angular; symmetrical; mitaform to irregular; terete; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome or mottled; with infrequent mottles; brown or red (dark); with black overlay;

glabrous; not smooth; with elevated features; rugose; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe from hilum to near base of seed and terminating; not bifurcating; color of testa; raised. Hilum fully concealed; concealed by funicular remnant; without faboid split; larger than punctiform; 2–5 mm long; with curved outline; elliptic to fusiform; apical according to radicle tip but marginal according to seed length; recessed; within rim. Hilum rim color darker than testa. Lens not discernible. Endosperm absent. Cotyledons not smooth; finely rugose; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin not entire 180 degrees from base of radicle; notched; similar at apex; completely concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; green to tan; inner face wrinkled; glabrous around base of radicle. Embryonic axis oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle not differentiated from cotyledon; bulbous; lobe tip straight; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Southern Mexico, Antilles, and Central America to Peru and Brazil (Amazon basin).

Notes: Rudd (1963) monographed *Dussia*. Some information was taken from that source.

Dussia: *D. lehmannii* H.A.T. Harms (C–E), *D.* spp. (A–B). A, Fruits (× 1); B, seeds (× 1.5); C–D, testa (× 50, × 1000); E, embryos (× 2).



Genus: *Clathrotropis* (G. Bentham) H.A.T. Harms

Phylogenetic Number: 2.26.

Tribe: Sophoreae.

Group: Dussia.

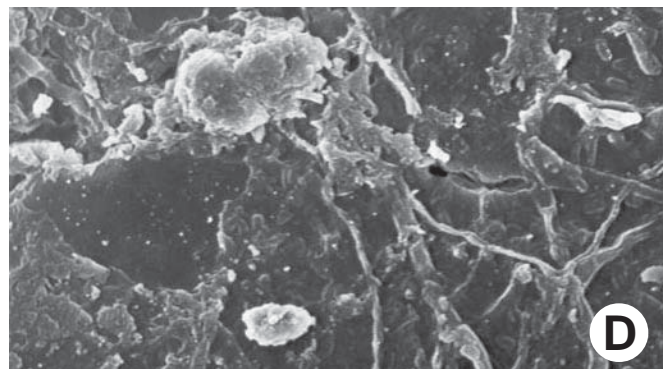
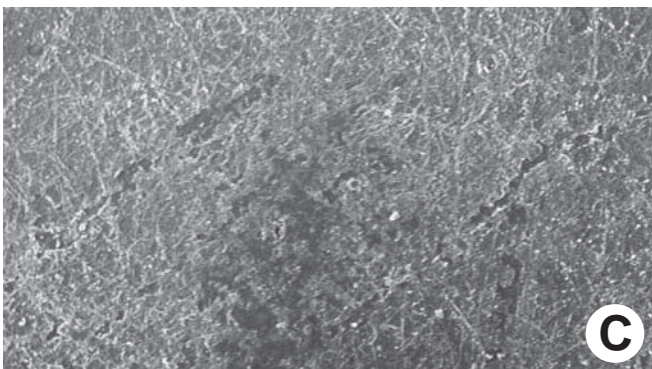
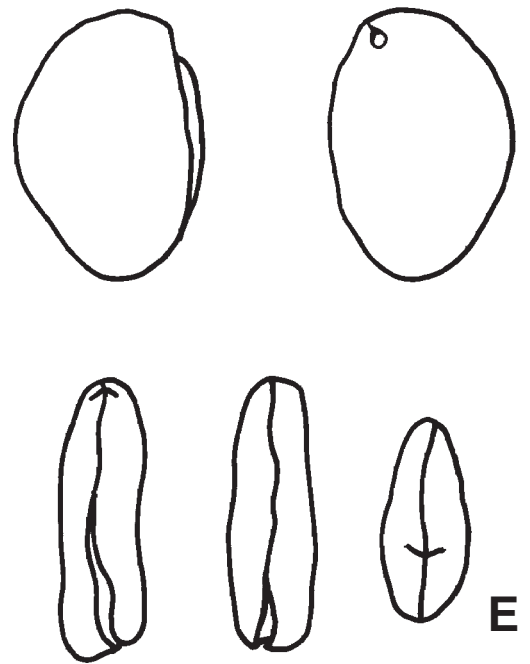
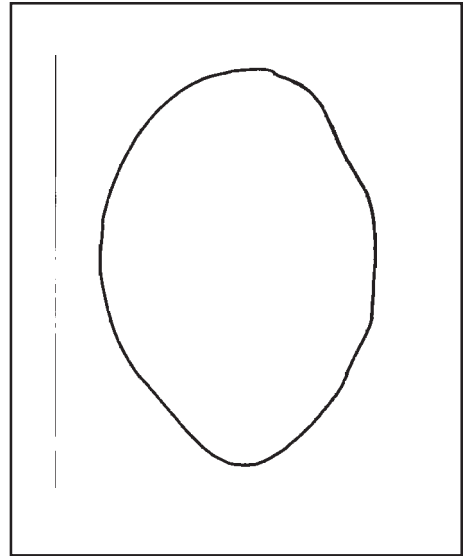
Species Studied—Species in Genus: 3 spp.—6 spp.

Fruit a legume; unilocular; $3.8\text{--}20 \times 2\text{--}7 \times 0.5\text{--}3$ cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical or asymmetrical; fusiform or obliquely obovate; when asymmetrical with 1 straight and 1 curved suture or both sutures unequally curved; widest near middle or D-shaped; not inflated; compressed or flattened; without or with beak (short); straight; with solid beak the same color and texture as fruit; rounded at apex; apex aligned, oblique, or right-angled with longitudinal axis of fruit; rounded or tapered at base; base aligned or oblique with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous or leathery; seed chambers externally invisible. Fruit margin not constricted; without sulcus; plain or embellished; with ridges. Fruit wings absent. Fruit nonstipitate to substipitate to stipitate; with the stipe up to 10 mm long. Fruit with all layers dehiscent; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull or glaucous; monochrome; brown; with surface texture uniform; glabrous or pubescent and indurate; with hairs erect; with 1 type of pubescence; velutinous; with pubescence brown; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated or recessed features; obliquely veined relative to fruit length or reticulately veined; not tuberculate; pitted; not exfoliating; without cracks. Mesocarp thick; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous. Endocarp dull; opaque; monochrome; brown; smooth and spongy; without adhering pieces of testa; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1–2; length parallel with to oblique to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; ca. 2 mm long; of 1 length only; flattened; straight to triangular. Aril present or absent; fleshy; 2-lipped rim-aril; entire; covering less than 1/2 of seed; with tongues (or flap-like) on lips of 2-lipped rim-aril; with 1 tongue or flap on 1 lip of 2-lipped rim-aril; brown.

Seed $17\text{--}70 \times 17\text{--}38 \times 1.5\text{--}16$ mm; not overgrown; not angular or angular; symmetrical or asymmetrical; D-shaped, elliptic, or irregular; compressed to flattened; with surface smooth or wrinkled; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle not exfoliating; not inflated; not wrinkled. Testa without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; dull to glossy; not modified by a bloom; colored; monochrome; brown; glabrous; not smooth; with elevated features; wrinkled; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe visible or not visible; from hilum through lens to base of seed and terminating; not bifurcating; color of testa; brown; raised. Hilum partially concealed; concealed by aril or funicular remnant; larger than punctiform; 2–5 mm long; with curved outline; elliptic; apical according to radicle tip but marginal according to seed length; flush; not within corona, halo, or rim. Lens not discernible. Endosperm absent. Cotyledons not smooth; ruminant to wrinkled; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin not entire 180 degrees from base of radicle; notched; similar at apex; completely or partially concealing radicle; notched at or split over radicle; with lobes; with lobes touching (auriculate) or not touching; without basal groin formed by lobes; with the interface division terminating at base of radicle; without margins recessed; brown; inner face flat; glabrous around base of radicle. Embryonic axis oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip straight; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary to moderately developed; glabrous.

Distribution: Tropical South America.

Clathrotropis: *C. brachypetala* (E.L.R. Tulasne) A. Kleinhoonte (*C–E*), *C. nitida* (G. Bentham) H.A.T. Harms (*A*), *C. spp.* (*B*). *A*, Fruits ($\times 1.5$); *B*, seeds ($\times 1$); *C–D*, testa ($\times 50$, $\times 1000$); *E*, embryos ($\times 0.7$).



Genus: *Diploptropis* G. Bentham

Phylogenetic Number: 2.27.

Tribe: Sophoreae.

Group: Dussia.

Species Studied—Species in Genus: 5 spp.—12 spp.

Fruit a legume or nutlet; unilocular; $4.5-12 \times 2-5 \times 0.1-0.5$ or 2 (ca.) cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight to curved (slightly); not plicate; not twisted; symmetrical to asymmetrical (slightly); oblong to elliptic to circular (nearly); when asymmetrical with both sutures parallelly curved; not inflated; flattened; without or with beak (very short); straight; with solid beak the same color and texture as fruit; rounded to emarginate at apex; apex aligned or oblique with longitudinal axis of fruit; rounded at base; base aligned or oblique with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous to coriaceous; seed chambers externally visible; with the raised seed chambers not torulose. Fruit margin not constricted; without sulcus; embellished; with thickened sutural areas. Fruit wing absent or present; 1; 3 mm wide; sutural; on 1 suture. Fruit stipitate or substipitate; with the stipe 1–6 mm long. Fruit apparently indehiscent. Replum invisible. Epicarp dull; multicolored; mottled; golden yellow; with brown overlay; glabrous or pubescent and indurate; with 1 type of pubescence; short strigose; with pubescence brown; with pubescence uniformly distributed; with simple hairs; stiff; with hair bases swollen; eglandular; without spines; not smooth; with elevated features; veined or not veined; reticulately veined; not tuberculate; sparsely papillose or lenticular and rugose; not exfoliating; without cracks. Mesocarp thin to thick; surface not veined; 1-layered; without balsamic vesicles; solid; chartaceous. Endocarp dull; monochrome or mottled; tan; with mottling (dark); with brown overlay; smooth or smooth and floury-filamentous; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1–2; length oblique or transverse to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; up to 2 mm long; of 1 length only; flattened; straight. Aril absent.

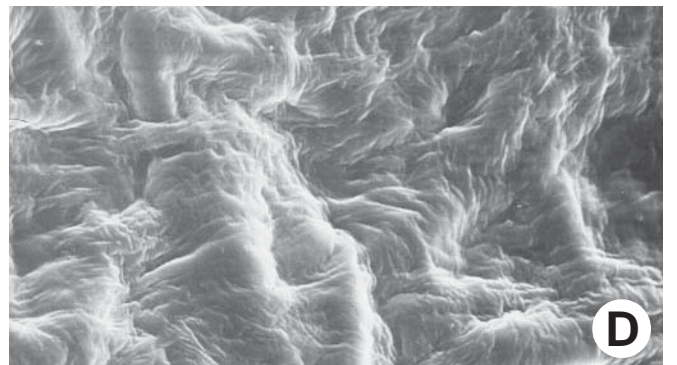
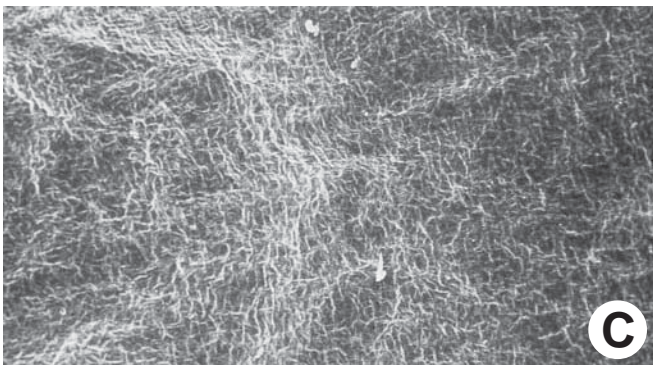
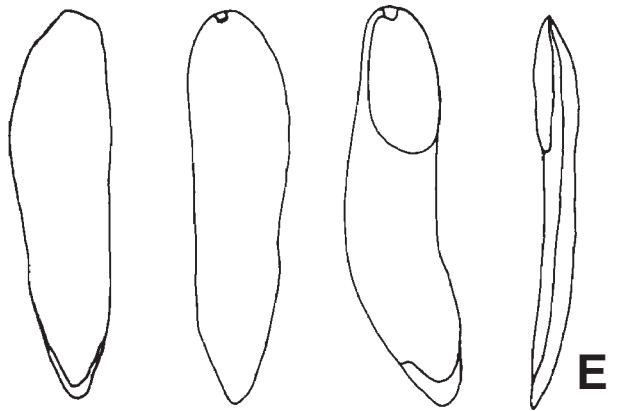
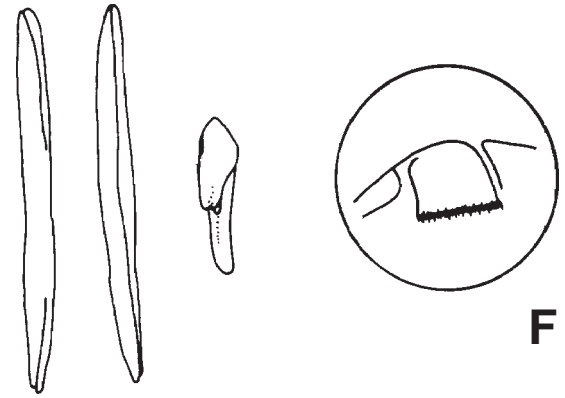
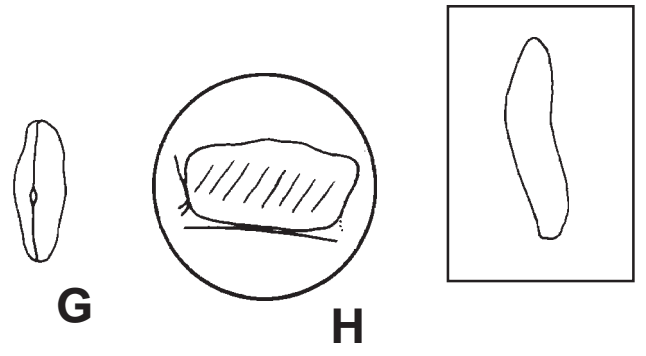
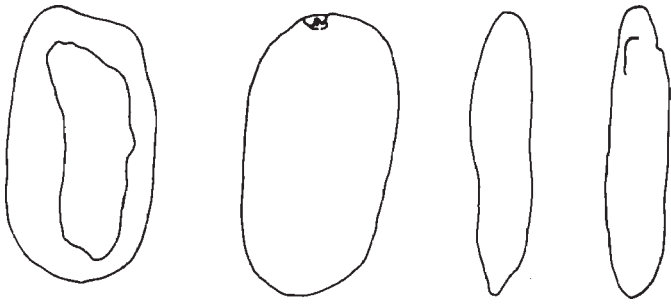
Seed $13-27 \times 6-8 \times 2.3-3$ mm; not overgrown; angular or not angular; asymmetrical; irregularly elliptic or

irregular; compressed, flattened, or mounded on 1 side and straight on other side; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering or partially adhering to endocarp; dull; not modified by a bloom; colored; monochrome or mottled; with infrequent mottles; black to brown; with black overlay; glabrous; not smooth; with recessed features; striate; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible; without faboid split; larger than punctiform; 1–1.5 mm long; with angular or straight outline; irregular or linear; apical at apex of radicle tip; flush; not within corona, halo, or rim. Lens not discernible. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; green or brown; inner face with central ridge on 1 and central groove on other; glabrous around base of radicle. Embryonic axis straight; parallel to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip straight; straight with embryonic axis; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Amazon basin of Venezuela, Peru, northern Brazil, and the Guianas.

Notes: Herendeen and Dilcher (1990) described fossil fruits of *Diploptropis* and compared them with fruits of extant species. Lima (1985) presented a key to the genus and recognized 12 species, 5 more than Polhill (1981b). We had three intact seeds of *Diploptropis peruviana*. The first seed that we dissected had three cotyledons (figs. E, F). They were all the same width. Two were approximately the same length, and the third one was about one third as long as the other two. The second seed of *D. peruviana* had two cotyledons approximately the same length (figs. G, H).

Diploptropis: *D. peruviana* J.F. Macbride (B–F), *D. purpurea* (L.C.M. Richard) G.J.H. Amshoff (G–H), *D.* spp. (A). A, Fruits ($\times 0.6$); B, seed ($\times 4.3$); C–D, testa ($\times 50$, $\times 1000$); E, G, embryos ($\times 2$, $\times 3$); F, H, embryo ($\times 10$).



Genus: *Bowdichia* K.S. Kunth

Phylogenetic Number: 2.28.

Tribe: Sophoreae.

Group: Dussia.

Species Studied—Species in Genus: 2 spp.—4 spp.

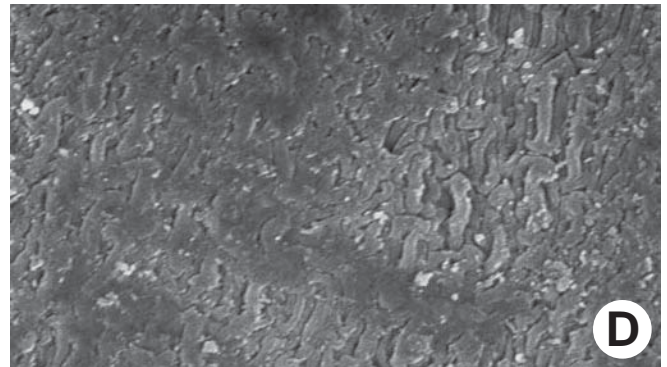
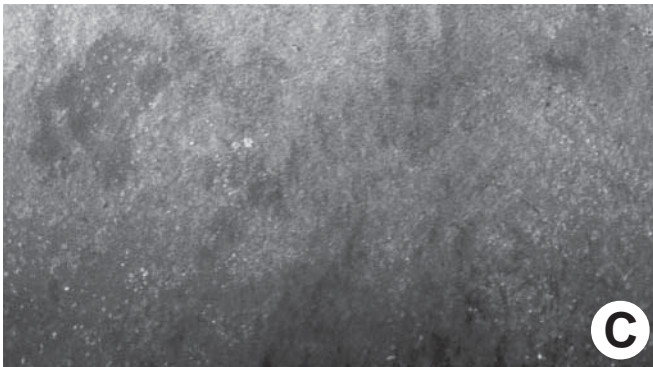
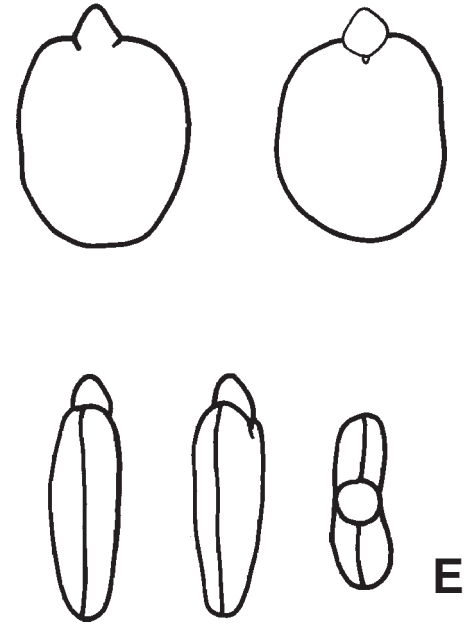
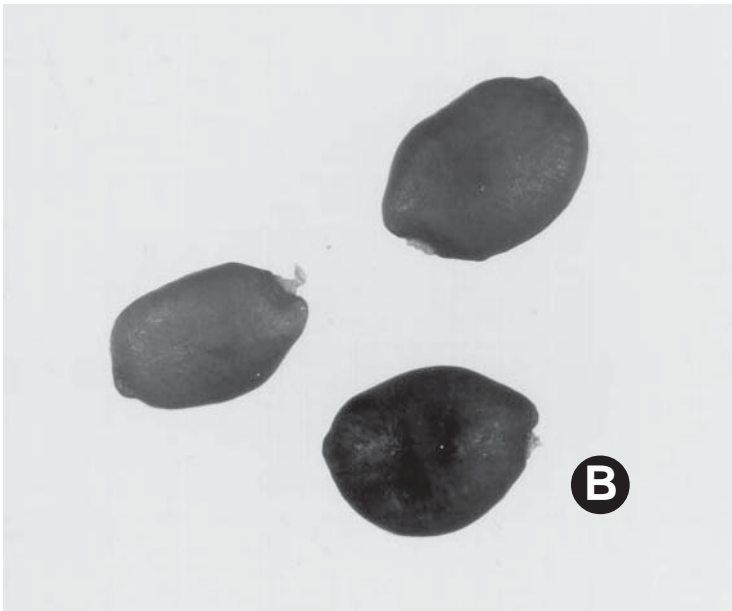
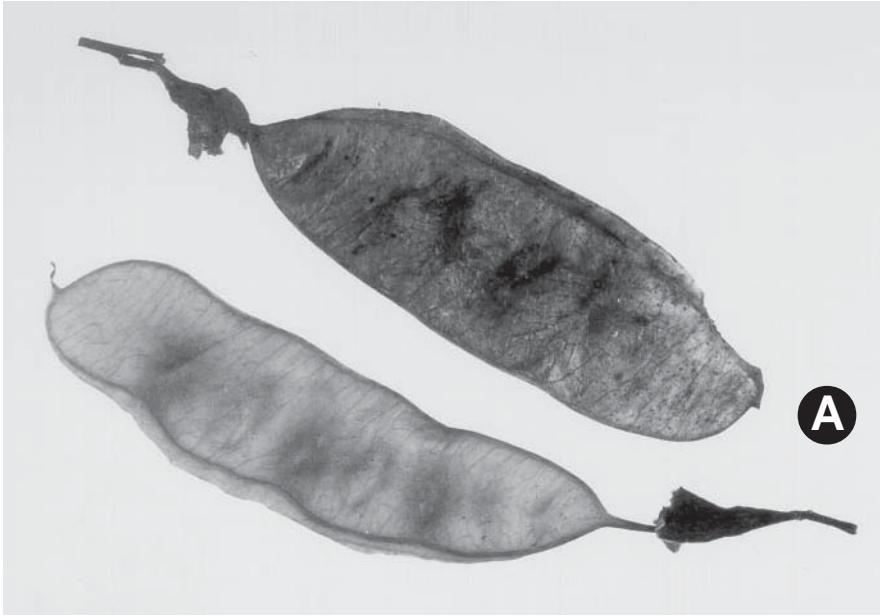
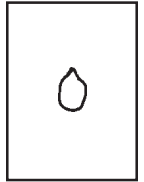
Fruit a legume; unilocular; $3.8-6 \times 1-1.5 \times 0.2-0.3$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight or curved (slightly); not plicate; not twisted; symmetrical to nearly symmetrical; elliptic to oblong; not inflated; flattened; with beak; coiled or hooked; with papery fragile beak up to 1 cm long; rounded at apex; apex aligned or oblique with longitudinal axis of fruit; rounded at base; base aligned or oblique with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous; seed chambers externally visible; with the raised seed chambers not torulose. Fruit margin constricted or not constricted; slightly constricted along both margins; without sulcus; embellished; with wing. Fruit wing 1; 1–2 mm wide; sutural; on 1 suture. Fruit stipitate; with the stipe 5–7 mm long. Fruit indehiscent. Replum invisible. Epicarp dull; multicolored; mottled; brown or tan; with brown overlay; glabrous; eglandular; without spines; not smooth; with elevated features; reticulately veined; not tuberculate; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; chartaceous. Endocarp dull; mottled; tan; with mottling (dark); with brown overlay; smooth and floury-filamentous; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 2–5; length transverse to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 1–1.5 mm long; of 1 length only; filiform; straight. Aril dry; rim-aril; entire; ivory.

Seed $4.5-8 \times 3-5 \times 1.6-3.5$ mm; not overgrown; not angular; symmetrical; elliptic to ovate; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; red to brown; glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe from hilum through lens and terminating before base of seed; not bifurcating; darker than testa; black; flush. Hilum

partially concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 0.5–0.8 mm long; with curved outline; circular; apical at apex of radicle tip to subapical to radicle tip; recessed; within rim. Hilum rim color of testa. Lens discernible; equal to or greater than 0.5 mm in length; ca. 1 mm long; with margins straight; linear; in groove of raphe; adjacent to hilum; ca. 1 mm from hilum; flush; similar color as testa; darker than testa; dark red; not within corona, halo, or rim. Endosperm thick or thin; covering entire embryo; adnate to testa. Cotyledons smooth; both outer faces convex or outer face of 1 cotyledon concave and other cotyledon convex; both the same thickness; both more or less of equal length; not folded; margin entire or not entire 180 degrees from base of radicle; notched; similar at apex; not concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; yellow; inner face with central ridge on 1 and central groove on other; glabrous around base of radicle. Embryonic axis straight; parallel to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip straight; straight with embryonic axis; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Venezuela to central Brazil.

Bowdichia: *B. virgilioides* K.S. Kunth (B–E), *B. spp.* (A). A, Fruits ($\times 1.9$); B, seeds ($\times 6.3$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 5$).



Genus: *Uleanthus* H.A.T. Harms

Phylogenetic Number: 2.29.

Tribe: Sophoreae.

Group: Dussia.

Species Studied—Species in Genus: 1 sp.—1 sp.

Fruit a legume; unilocular; 23–28 × 2.5–4 cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; irregularly fusiform; when asymmetrical with both sutures unequally curved; not inflated; compressed; with beak; declined; with solid beak the same color and texture as fruit; tapered at apex; apex aligned to oblique with longitudinal axis of fruit; long tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit substipitate. Fruit with all layers dehiscent; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; brown; with surface texture uniform; pubescent and indurate; with hairs appressed; with 1 type of pubescence; sparsely sericeous; with pubescence golden; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; reticulately veined; not tuberculate; not exfoliating; with cracks; cracking oblique to fruit length. Mesocarp thick; surface uniformly veined; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous. Endocarp dull; opaque; mottled; yellow; with dark brown overlay; scurfy and smooth; without adhering pieces of testa; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 5–8 (from literature); length transverse to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; ca. 4 mm long; of 1 length only; thick; contorted. Aril fleshy; marginal hilar; entire; covering less than 1/2 of seed; brown.

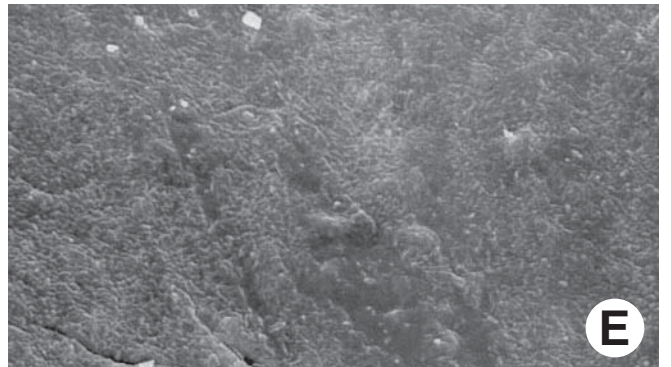
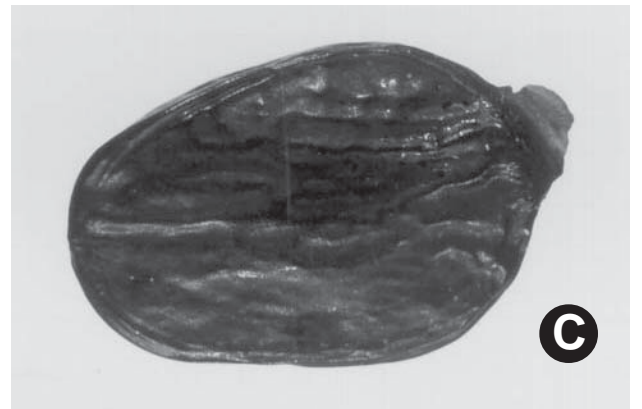
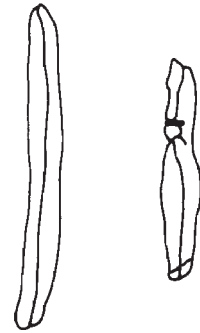
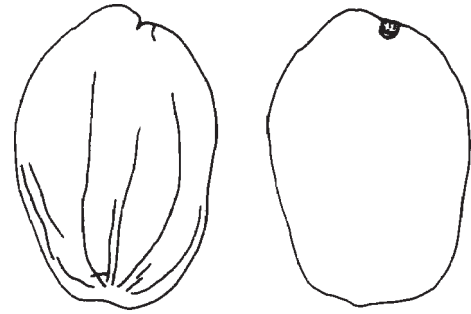
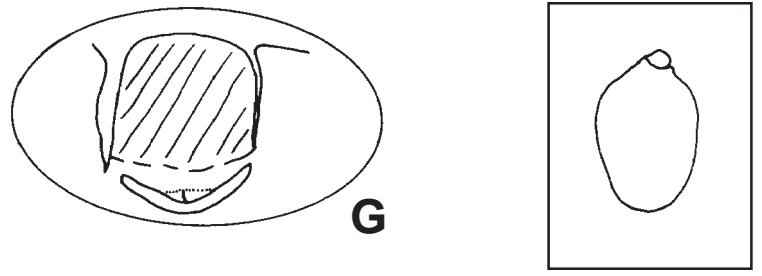
Seed ca. 20 × ca. 14 × ca. 3.5 mm; not overgrown; not angular; symmetrical; ovate; flattened; with surface wrinkled; with grooves longitudinal; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle not exfoliating; not inflated; not wrinkled. Testa without pieces of adhering epicarp; not

adhering to endocarp; free from endocarp; dull to glossy; not modified by a bloom; colored; mottled; with infrequent mottles; brown; with darker brown overlay; glabrous; not smooth; with elevated features; wrinkled. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum fully concealed; concealed by funicular remnant; with faboid split; with the lips of the faboid split lighter colored than the rest of the hilum and therefore conspicuous; larger than punctiform; ca. 4.5 mm long; with curved outline; elliptic; apical at apex of radicle tip; raised; within rim. Hilum rim color darker than testa. Lens not discernible. Endosperm absent. Cotyledons not smooth; 5–7-branched grooves (from veins of testa) on each face; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin not entire 180 degrees from base of radicle; notched; similar at apex; not concealing radicle; notched at radicle; with lobes; with lobes not touching; without basal groin formed by lobes; with the interface division terminating at base of radicle; without margins recessed; tan; inner face flat; glabrous around base of radicle. Embryonic axis straight; parallel to length of seed; with a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; truncate; lobe tip straight; straight with embryonic axis; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Amazon basin.

Notes: Only one seed and part of one valve were available for study.

Uleanthus: *U. erythrinoides* H.A.T. Harms (A–G). A–B, Fruit (× 0.8); C, seed (× 3.2); D–E, testa (× 50, × 1000); F, embryos (× 2); G, embryo (× 15).



Genus: *Panurea* R. Spruce ex G. Bentham

Phylogenetic Number: 2.30.

Tribe: Sophoreae.

Group: Dussia.

Species Studied—Species in Genus: 1 sp.—1 sp.

Fruit a legume; unilocular; 16–19 × 3.5–4 cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight or curved (slightly); not plicate; not twisted; asymmetrical; fusiform; when asymmetrical with both sutures nearly straight; not inflated; compressed; without beak; tapered at apex; apex oblique with longitudinal axis of fruit; tapered at base; base aligned or oblique with longitudinal axis of fruit; with the apex and base uniform in texture; appearing ligneous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; embellished; with thickened sutural areas. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscent; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; multicolored; mottled; brown; with brown (darker) overlay; appearing glabrous; without spines; apparently smooth; not veined; not tuberculate; with cracks; cracking oblique to fruit length. Seed length oblique to fruit length. Aril dry; rim-aril; crenate; brown.

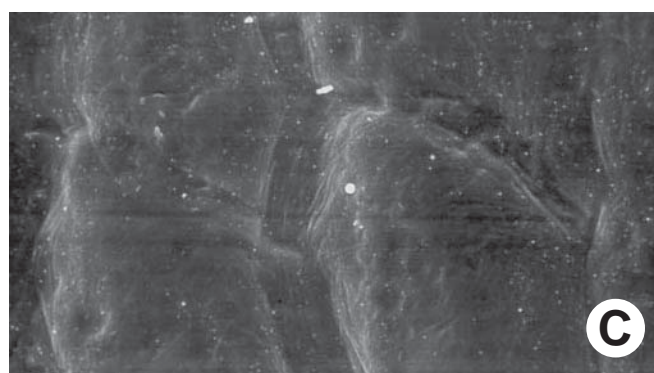
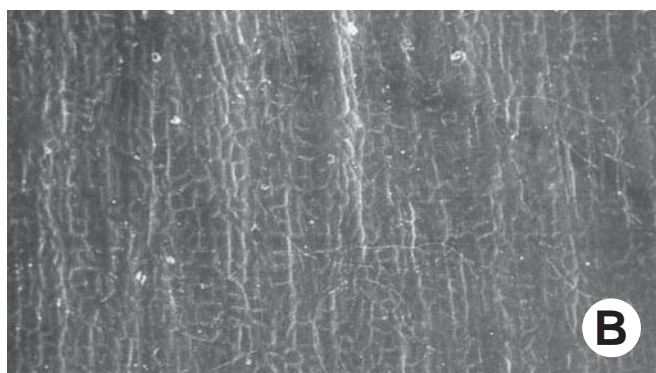
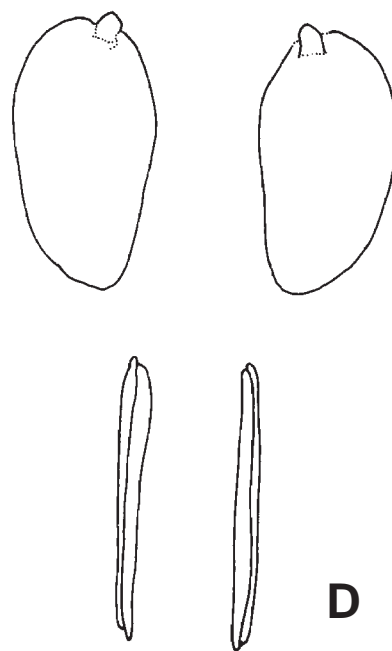
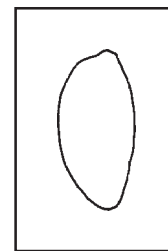
Seed ca. 20 × ca. 12 × ca. 2 mm; not overgrown; not angular; symmetrical; elliptic; flattened; with surface wrinkled; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; black; glabrous; not smooth; with elevated features; ridged longitudinally more than once; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe from hilum through base of seed and up the other side; not bifurcating; color of testa; raised. Hilum fully concealed; concealed by aril; without faboid split; larger than punctiform; ca. 2 mm long; with curved outline; elliptic; apical at apex of radicle tip; recessed; within rim. Hilum rim color of testa. Endosperm absent (presumably). Cotyledons smooth; both outer faces flat; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; without lobes; with the interface division terminating at base of radicle; without margins

recessed; dark brown; inner face flat; glabrous around base of radicle. Embryonic axis parallel; parallel to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip straight; straight with embryonic axis; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Colombia and Brazil.

Notes: Our data are taken from a photographed herbarium specimen and a single damaged seed.

Panurea: P. longifolia R. Spruce ex G. Bentham (A–D). A, Fruit (× 0.6); B–C, testa (× 50, × 1000); D, embryos (× 2).



Genus: *Monopteryx* R. Spruce ex G. Bentham

Phylogenetic Number: 2.31.

Tribe: Sophoreae.

Group: Dussia.

Species Studied—Species in Genus: 1 sp.—3 spp.

Fruit a legume; unilocular; 11–20 × 3–5.5 cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; falcate; when asymmetrical with both sutures parallelly curved; not inflated; flattened; without beak; tapered at apex; apex oblique with longitudinal axis of fruit; tapered at base; base oblique with longitudinal axis of fruit; with the apex and base uniform in texture; leathery to ligneous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; embellished; with wings. Fruit wings 4; ca. 3.5 mm wide; sutural; on both sutures. Fruit stipitate; with the stipe up to 17 mm long. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; multicolored; mottled; brown; with brown (darker) overlay; with surface texture uniform; glabrous; eglandular; without spines; smooth; not veined; not tuberculate; not exfoliating; with cracks; cracking oblique to fruit length. Mesocarp thick; 3-layered; without balsamic vesicles; without fibers; with vitreous layer over 2 distinct solid layers; ligneous to coriaceous. Endocarp dull; opaque; monochrome; brown; scurfy and smooth; without adhering pieces of testa; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seed 1.

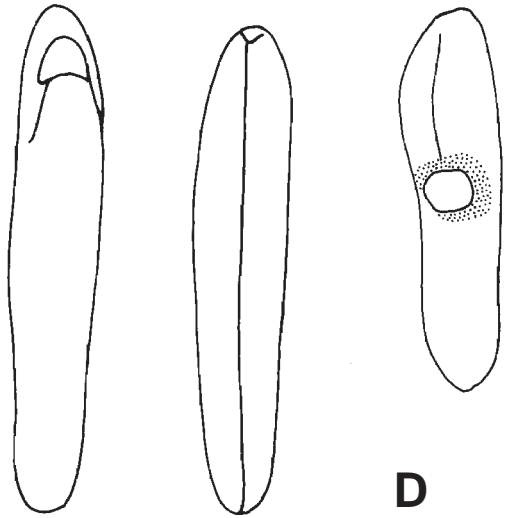
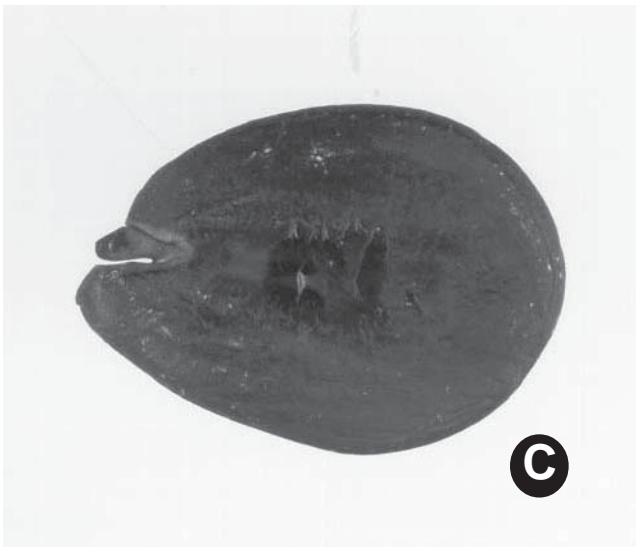
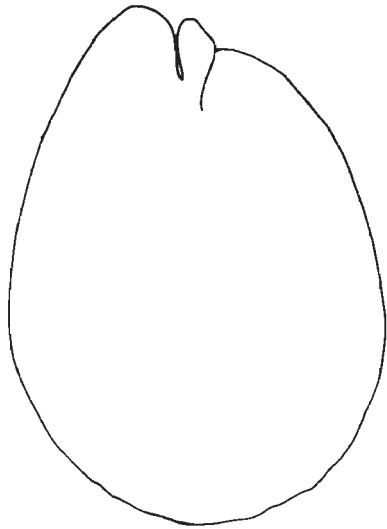
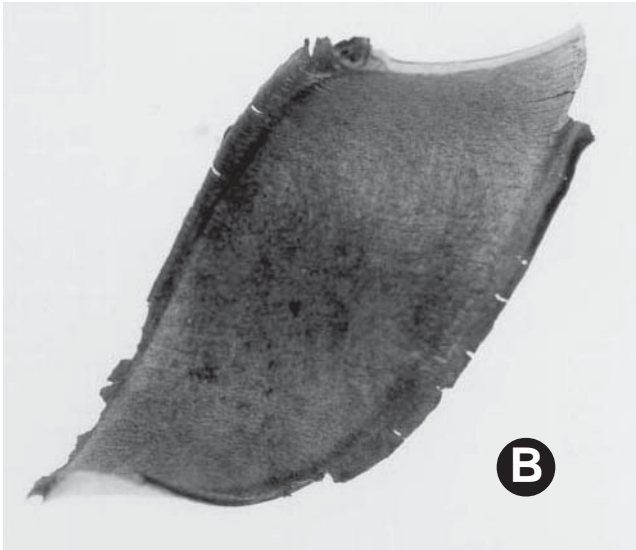
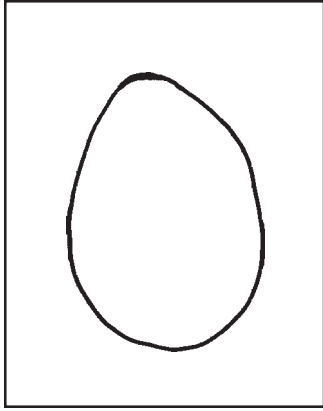
Seed ca. 35 × ca. 25.5 × ca. 5.5 mm; not overgrown; not angular; symmetrical; ovate; flattened; without umbo on seed faces; without medial ridge on each face. Testa absent (probably fused to endocarp). Cotyledons not smooth; wrinkled; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; with lobes; with lobes not touching; without basal groin formed by lobes; with the interface division terminating at base of radicle; without margins recessed; brown; glabrous around base of radicle. Embryonic axis straight; parallel to length of seed; without a joint evident between the radicle and the

cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip straight; straight with embryonic axis; centered between cotyledons; less than 1/2 length of cotyledons.

Distribution: Brazil and Venezuela.

Notes: Only part of one fruit and one seed without testa were studied.

Monopteryx: *M. uaucu* R. Spruce ex G. Bentham (A–D). A–B, Fruit (× 1.2); C, seed (× 1.6); D, embryos (× 2).



Genus: *Spirotropis* E.L.R. Tulasne

Phylogenetic Number: 2.32.

Tribe: Sophoreae.

Group: Dussia.

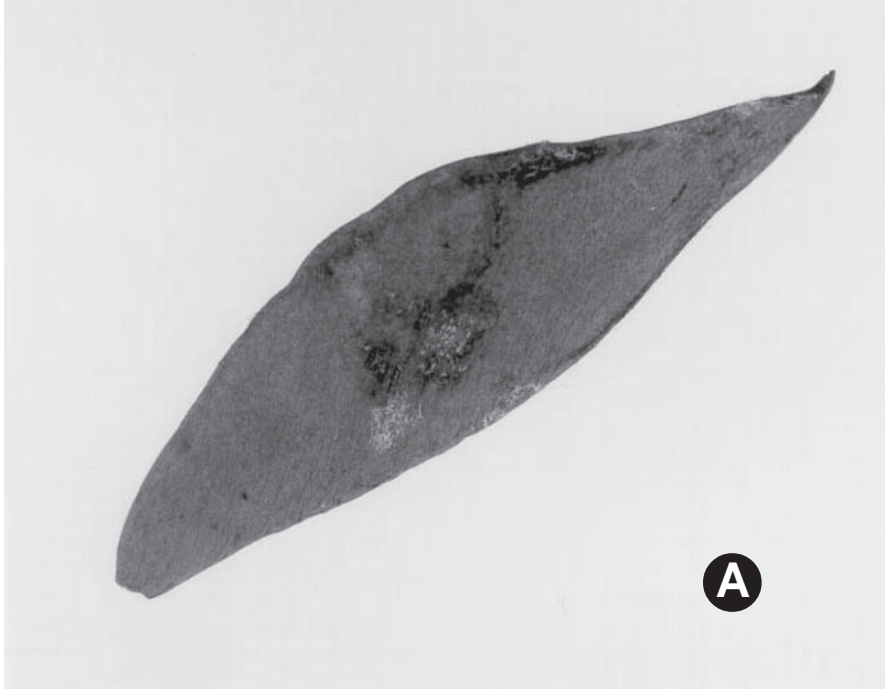
Species Studied—Species in Genus: 1 sp.—1 sp.

Fruit a legume; unilocular; 8–9 (immature) × 2–2.5 (immature) × 2–3 (immature) cm; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; obliquely fusiform; when asymmetrical with both sutures parallelly curved; not inflated; flattened; with beak; straight; with solid beak the same color and texture as fruit; tapered at apex; apex aligned with longitudinal axis of fruit; tapered at base; base oblique with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit nonstipitate. Fruit indehiscent (reported in literature). Epicarp dull; monochrome; brown; with surface texture uniform; pubescent and indurate; with hairs erect to appressed; with 1 type of pubescence; villous; with pubescence golden; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; not veined; not tuberculate; wrinkled; without cracks. Mesocarp absent. Endocarp glossy; monochrome; tan; smooth; without adhering pieces of testa; nonseptate; coriaceous; not exfoliating; remaining fused to epicarp; entire. Seeds 1–2.

Distribution: Northeastern South America.

Notes: Only immature fruits were studied. No seeds were available.

Spirotropis: *S. longifolia* (A.-P. de Candolle) H.E. Baillon
(A). A, Fruit (× 1.3).



Genus: *Dicraeopetalum* H.A.T. Harms

Phylogenetic Number: 2.33.

Tribe: Sophoreae.

Group: Sophora.

Species Studied—Species in Genus: 2 spp.—3 spp.

Fruit a legume; unilocular; $2-8.2 \times 1-1.6 \times 0.1-0.35$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical or asymmetrical; elliptic or falcate (slightly); when asymmetrical with both sutures nearly straight; not inflated; flattened; without or with beak (short); straight; with solid beak the same color and texture as fruit; rounded at apex; apex aligned, oblique, or right-angled with longitudinal axis of fruit; tapered at base; base aligned or oblique with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous; seed chambers externally visible or invisible; with the raised seed chambers not torulose. Fruit margin not constricted or constricted (rarely); constricted along both margins; without sulcus; plain. Fruit wings absent. Fruit substipitate. Fruit indehiscent. Replum invisible. Epicarp dull; monochrome or multicolored; mottled; brown; with brown (darker) overlay; with surface texture uniform; pubescent and indurate; with hairs erect or appressed; with 1 type of pubescence; puberulent; with pubescence golden; with pubescence uniformly distributed; with simple or glandular hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; reticulately veined; not tuberculate; not exfoliating; without cracks. Mesocarp thin; 1-layered; without balsamic vesicles; without fibers; solid; chartaceous. Endocarp dull; opaque; monochrome; tan; floury-filamentous and smooth; without adhering pieces of testa; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1–2; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only; filiform; straight. Aril dry; very slight rim-aril; without tongue (or flap-like) on lips of 2-lipped rim-aril; white.

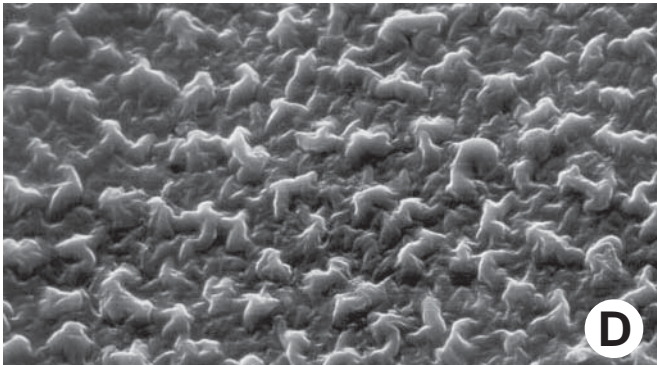
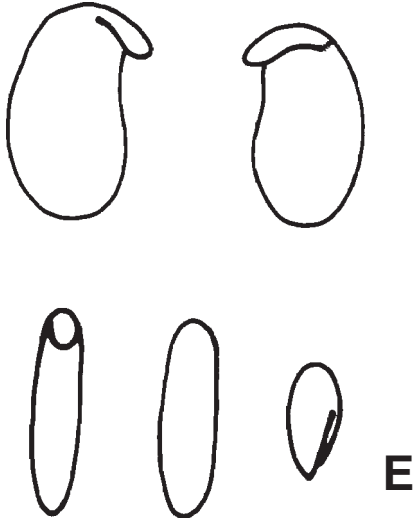
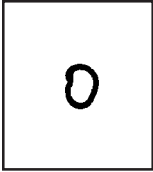
Seed $5-6 \times 3.5-4 \times 1.8-2.2$ mm; not overgrown; not angular; symmetrical; elliptic or reniform; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on

seed faces; without medial ridge on each face. Cuticle not exfoliating; not inflated; not wrinkled. Testa without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; dull; not modified by a bloom; colored; monochrome or mottled; with frequent mottles; brown; with brown (darker) overlay; glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe from hilum through lens to base of seed and terminating; not bifurcating; darker than testa; brown; flush. Hilum visible; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 0.5–1 mm long; with curved outline; elliptic; apical according to radicle tip but marginal according to seed length; recessed; within rim. Hilum rim color darker than testa. Lens discernible; equal to or greater than 0.5 mm in length; 0.8–2.5 mm long; with margins straight or curved; narrowly triangular or ovate; not in groove of raphe; confluent with hilum; recessed; similar color as testa; darker than testa; brown; not within corona, halo, or rim. Endosperm absent. Cotyledons smooth or not smooth; sulcate; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; yellow; inner face flat; glabrous around base of radicle. Embryonic axis oblique; perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip curved; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Ethiopia to northern Kenya and southern Madagascar.

Notes: Polhill (1981b) noted that *Dicraeopetalum* perhaps is congeneric with *Lovanafia* M. Peltier (2.33), and Yakovlev (1977) and Polhill (1994a,b) included *Lovanafia* in *Dicraeopetalum*. We also have included *Lovanafia* (a native of Madagascar) in *Dicraeopetalum*.

Dicraeopetalum: *D. capuronianum* (M. Peltier) G.P. Yakovlev (C–E); *D. spp.* (A–B). A, Fruits ($\times 1.4$); B, seeds ($\times 5.4$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 4$).



Genus: *Neoharmsia* R. Viguier

Phylogenetic Number: 2.34.

Tribe: Sophoreae.

Group: Sophora.

Species Studied—Species in Genus: 2 spp.—2 spp.

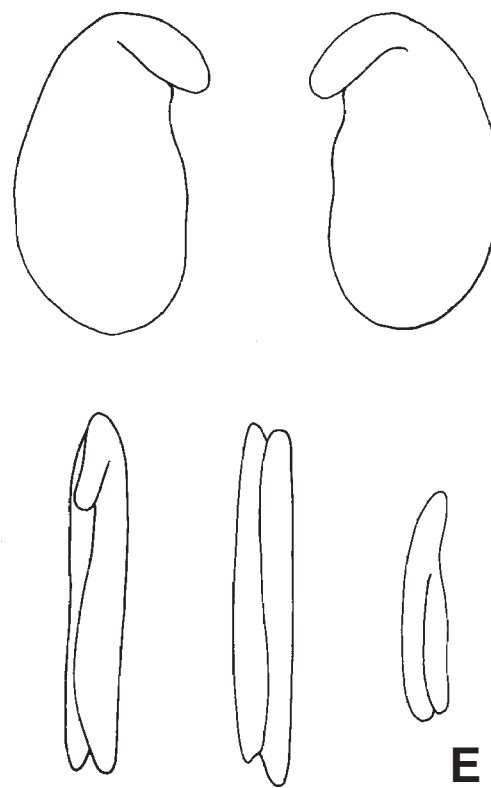
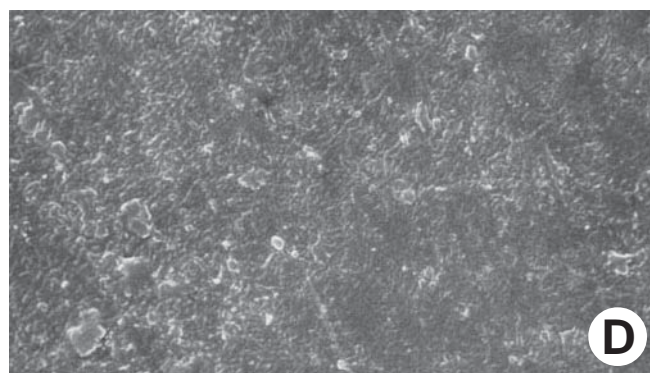
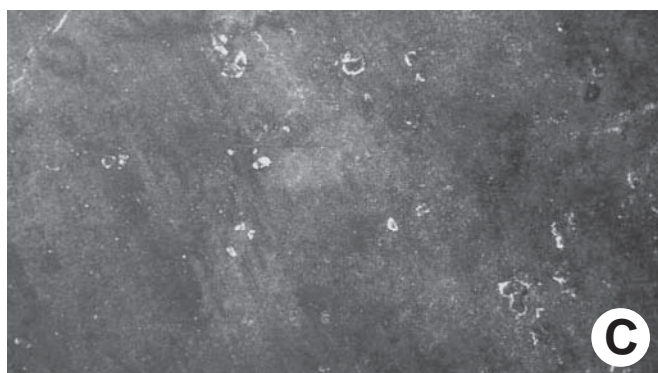
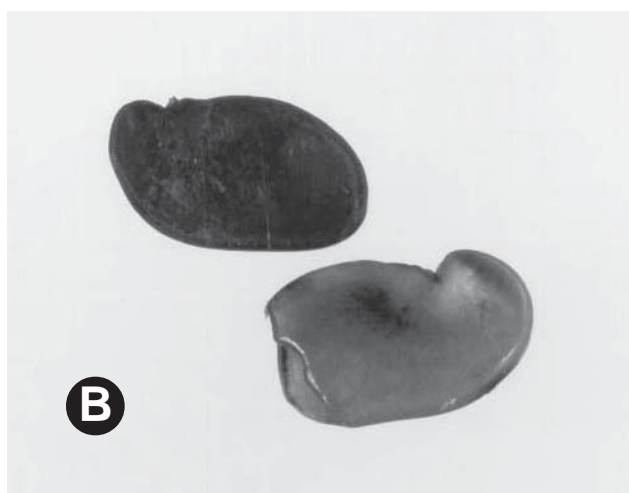
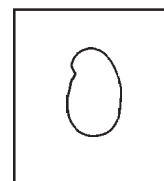
Fruit a legume; unilocular; $7.5\text{--}20 \times 1.4\text{--}1.6 \times 2\text{--}3$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; slightly curved; not plicate; not twisted; slightly asymmetrical; fusiform or linear (nearly); when asymmetrical with both sutures parallelly curved or nearly straight; not inflated; flattened; with beak; straight; with papery fragile beak up to 1 cm long; tapered at apex; apex oblique with longitudinal axis of fruit; tapered at base; base oblique with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally invisible. Fruit margin constricted (by aborted ovule) or not constricted; slightly constricted along both margins; without sulcus; embellished; with thickened sutural areas. Fruit wings absent. Fruit stipitate; with the stipe 6–10 mm long. Fruit with all layers dehiscent; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; multicolored; mottled; brown; with brown (darker) overlay; glabrous; eglandular; without spines; not smooth; with elevated features; reticulately veined; not tuberculate; finely rugose; not exfoliating; without cracks. Mesocarp trace; surface not veined; 1-layered; without balsamic vesicles; solid; chartaceous. Endocarp dull to glossy; mottled; yellow; with mottling above and below seed chambers; with brown overlay; smooth; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 3–8; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; ca. 2.5 mm long; of 1 length only; flattened; straight. Aril dry; rim-aril or hippocrepiform rim-aril; entire; cream or brown.

Seed $10\text{--}15 \times 6.5\text{--}9 \times 2\text{--}3$ mm; not overgrown; not angular; asymmetrical; irregular; compressed to flattened; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; glossy; not modified by a bloom; colored; monochrome or mottled; with infrequent mottles; yellowish green to

brown; with brown overlay; glabrous; not smooth; with elevated features; slightly rugose; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe visible or not visible; from hilum through lens to base of seed and bifurcating; bifurcating at base of seed with each arm going up antiraphe side, turning (U-shaped) down, and approaching bifurcation; color of testa; raised. Hilum partially concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 0.7–1 mm long; with curved outline; circular; apical according to radicle tip but marginal according to seed length; recessed; within rim. Hilum rim color of testa. Lens discernible; equal to or greater than 0.5 mm in length; 0.5–1 mm long; with margins straight; wedge-shaped; not in groove of raphe; adjacent to hilum; 0.5 mm from hilum; flush; similar color as testa; darker than testa; brown or green (tannish); not within corona, halo, or rim. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; yellowish green; inner face flat; glabrous around base of radicle. Embryonic axis oblique; perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip curved; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Northwestern and western Madagascar.

Neoharmsia: *N. baroni* (E. Drake del Castillo) R. Viguier ex G. Bentham (*C–E*), *N. spp.* (*A–B*). *A*, Fruits ($\times 0.9$); *B*, seeds ($\times 3.2$); *C–D*, testa ($\times 50$, $\times 1000$); *E*, embryos ($\times 4$).



Genus: *Sakoanala* R. Viguier

Phylogenetic Number: 2.35.

Tribe: Sophoreae.

Group: Sophora.

Species Studied—Species in Genus: 2 spp.—2 or 3 spp.

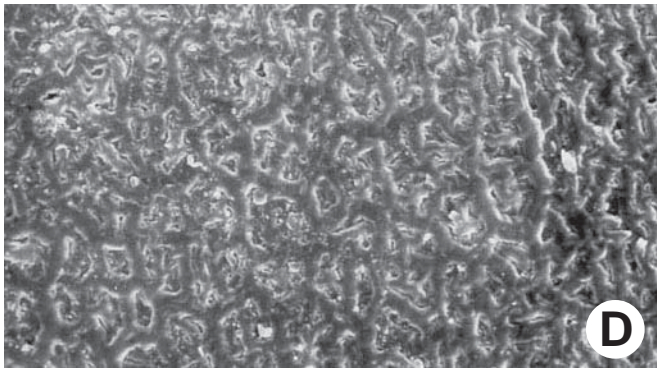
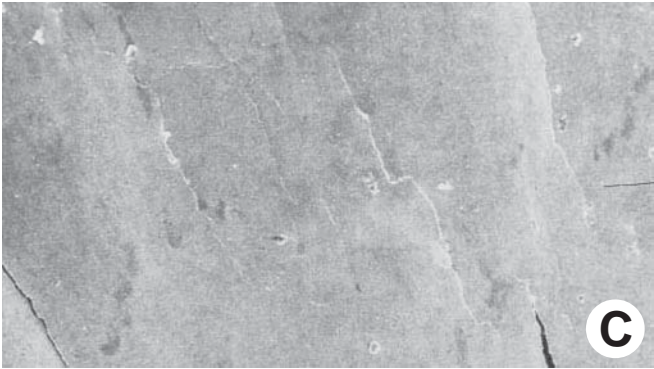
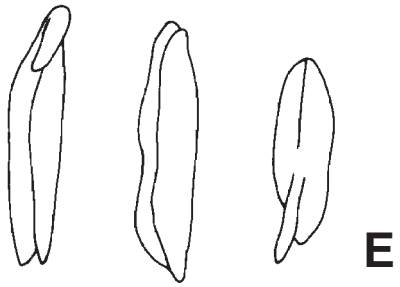
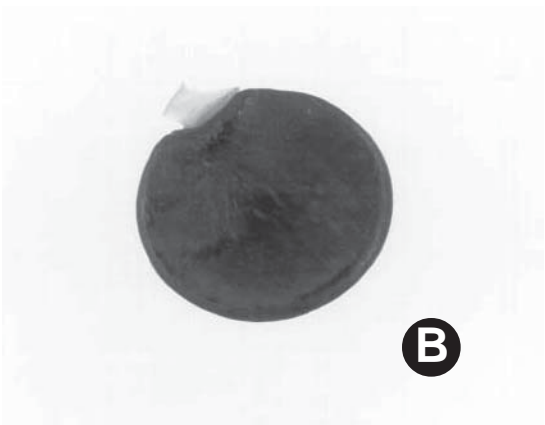
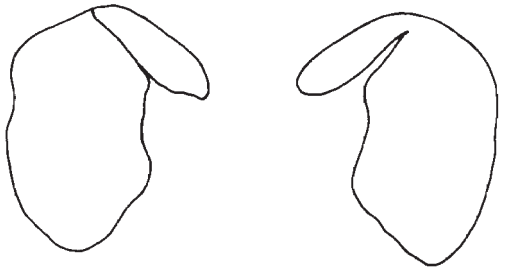
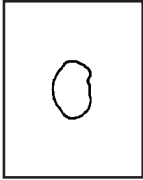
Fruit a legume; unilocular; $5-15 \times 1.3-2.6 \times 0.1-0.2$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical or asymmetrical (slightly); fusiform, falcate, or linear (or nearly so); when asymmetrical with both sutures parallelly curved; not inflated; flattened; without or with beak; straight or hooked; with solid beak the same color and texture as fruit; rounded or tapered at apex; apex aligned or oblique with longitudinal axis of fruit; tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous; seed chambers externally slightly visible; with the raised seed chambers not torulose. Fruit margin not constricted or constricted; slightly constricted along both margins; without sulcus; embellished or plain; with wing. Fruit wing 1; 1–2 mm wide; sutural; on 1 suture. Fruit nonstipitate. Fruit apparently indehiscent. Epicarp dull; monochrome or multicolored; bichrome (darker over seed chambers); brown; with brown (darker) overlay; with surface texture uniform; pubescent and indurate; with hairs erect; with 1 type of pubescence; sparsely pilose; with pubescence golden; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; glandular; with glandular dots; without spines; not smooth; with elevated features; reticulately veined; not tuberculate; sometimes glandular dotted; not exfoliating or exfoliating in part; without cracks. Mesocarp absent. Endocarp dull; opaque; monochrome; tan; smooth; without adhering pieces of testa; nonseptate; chartaceous; not exfoliating; remaining fused to or separating from epicarp; entire. Seeds 3–7; length parallel with (observed) or transverse to fruit length (in literature); neither overlapping nor touching; in 1 series. Funiculus measured; 1–2.5 mm long; of 1 length only; filiform; straight. Aril dry; rim-aril; tan.

Seed $10-11 \times 6-7 \times 2-3$ mm; not overgrown; not angular; symmetrical; reniform; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces;

without medial ridge on each face. Cuticle not exfoliating; not inflated; not wrinkled. Testa without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; glossy; not modified by a bloom; colored; monochrome; tan to brown; glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible; with faboid split; with the lips of the faboid split lighter colored than the rest of the hilum and therefore conspicuous; larger than punctiform; 1.2–1.8 mm long; with curved outline; elliptic to circular; apical according to radicle tip but marginal according to seed length; recessed; within rim. Hilum rim color darker than testa. Lens discernible; equal to or greater than 0.5 mm in length; 1.2 mm long; with margins curved; 2 oblong mounds separated by groove; not in groove of raphe; confluent with hilum; mounded; same color as testa; brown; not within corona, halo, or rim. Endosperm absent. Cotyledons smooth; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; completely or partially concealing radicle; entire over or notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; tan; inner face flat; glabrous around base of radicle. Embryonic axis oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip straight; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Eastern and northeastern Madagascar.

Sakoanala: *S. madagascariensis* R. Viguier (*C–E*), *S. villosa* R. Viguier (*B*), *S. spp.* (*A*). *A*, Fruits ($\times 0.6$); *B*, seed ($\times 4.3$); *C–D*, testa ($\times 50$, $\times 1000$); *E*, embryos ($\times 5$).



Genus: *Cadia* P. Forsskål

Phylogenetic Number: 2.36.

Tribe: Sophoreae.

Group: Sophora.

Species Studied—Species in Genus: 2 spp.—6 spp.

Fruit a legume; unilocular; 7–15 × 1–1.5 cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; slightly curved to curved; not plicate; not twisted; asymmetrical or symmetrical; linear, oblong (elliptic), or falcate; when asymmetrical with both sutures parallelly curved; not inflated; compressed; with beak; straight; with solid beak the same color and texture as fruit; tapered at apex; apex oblique with longitudinal axis of fruit; long tapered or tapered at base; base oblique with longitudinal axis of fruit; with the apex and base uniform in texture; subcoriaceous; seed chambers externally visible (slightly). Fruit margin not constricted or constricted; slightly constricted along both margins; without sulcus; plain or embellished; with thickened sutural areas. Fruit wings absent. Fruit stipitate; with the stipe 5–16 mm long. Fruit with all layers dehiscent; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull or glossy; monochrome or multicolored; mottled; brown to tan; with brown overlay; glabrous; eglandular; without spines; not smooth; with elevated features; reticulately veined; not tuberculate; sometimes papillose; not exfoliating; with or without cracks; fine cracking oblique to fruit length. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; solid; chartaceous. Endocarp glossy; monochrome; tan; smooth; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 2–14; length oblique or transverse to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 1–2.5 mm long; of 1 length only; flattened; straight to triangular. Aril dry; rim-aril and tongue-aril; entire; cream or tan.

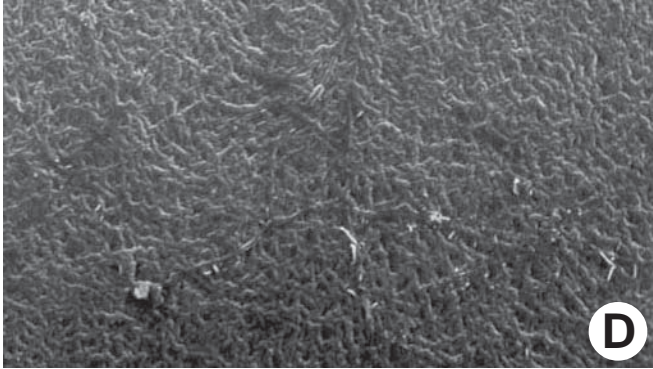
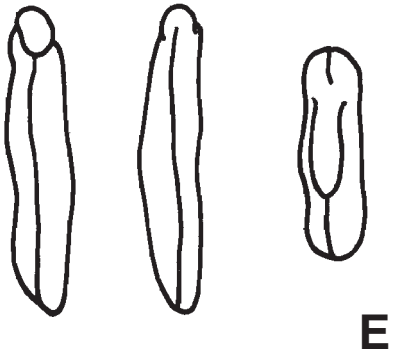
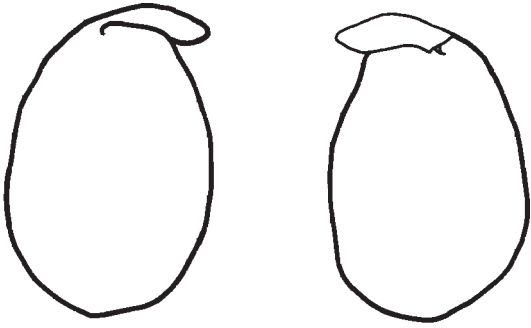
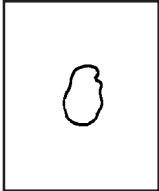
Seed 5–9.5 × 3–7 × 2–4 mm; not overgrown; not angular; symmetrical; elliptic to ovate to circular (sub) or D-shaped; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; glossy to dull; not modified by a bloom; colored; monochrome; red to brown (also to reddish

brown); glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum partially concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 0.6–1.5 mm long; with curved outline; elliptic; subapical to radicle tip; recessed; within rim. Hilum rim color darker than testa. Lens discernible; equal to or greater than 0.5 mm in length; 1.2–1.5 mm long; with margins straight; linear; not in groove of raphe; adjacent to hilum; 0.5 mm from hilum; flush; similar color as testa; darker than testa; brown or red (dark); not within corona, halo, or rim. Endosperm thin; covering at least 1/2 of embryo, but not entire embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; split over radicle; with lobes; with lobes touching (auriculate); without basal groin formed by lobes; with the interface division terminating at base of radicle; without margins recessed; pale tan; inner face flat or with central ridge on 1 and central groove on other; glabrous around base of radicle. Embryonic axis oblique; perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip curved; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Arabia to Kenya (1 sp.) and Madagascar (5 spp.).

Notes: Van der Maesen (1970) revised *Cadia*, and considered it to belong in an unnamed tribe of subfamily Caesalpinioideae.

Cadia: *C. purpurea* (G. Piccioli) W. Aiton (A–E). A, Fruits (× 0.9); B, seeds (× 4); C–D, testa (× 50, × 1000); E, embryos (× 5).



Genus: *Bolusanthus* H.A.T. Harms

Phylogenetic Number: 2.37.

Tribe: Sophoreae.

Group: Sophora.

Species Studied—Species in Genus: 1 sp.—1 sp.

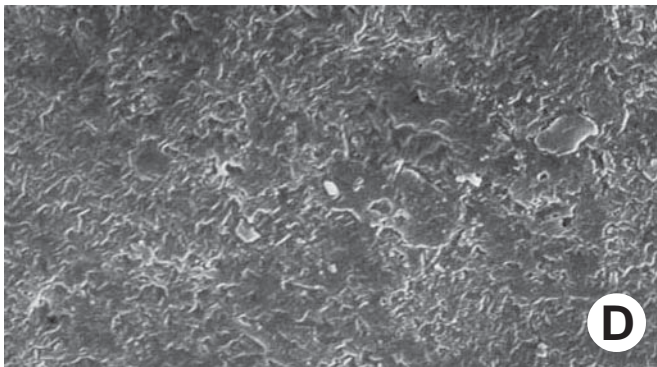
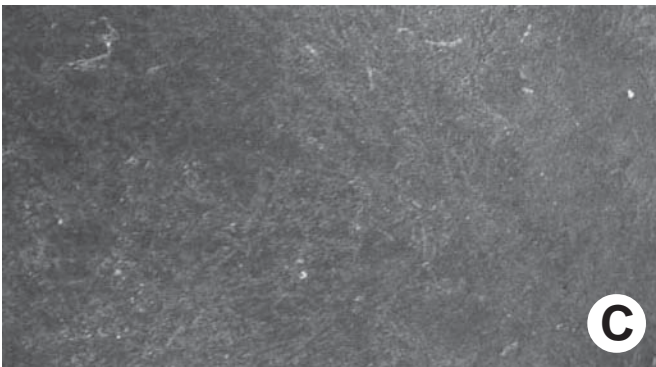
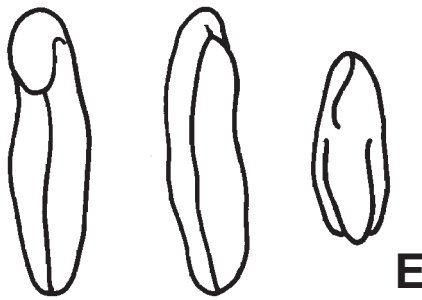
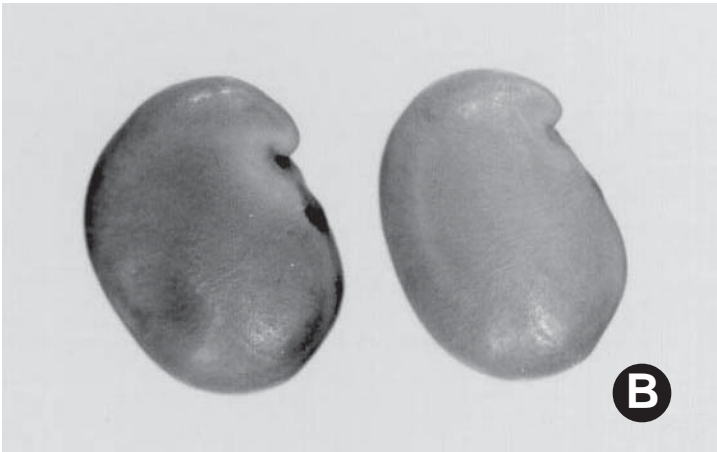
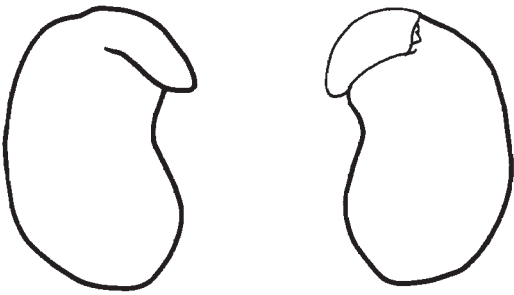
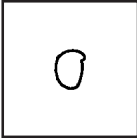
Fruit a legume; unilocular; $4.6\text{--}7.3 \times 0.8\text{--}1.3 \times 0.2\text{--}0.4$ cm; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical to nearly symmetrical; linear to fusiform or moniliform (slightly); not inflated; flattened; without beak; tapered or rounded at apex; apex aligned or oblique with longitudinal axis of fruit; tapered or rounded at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally visible; with the raised seed chambers not torulose. Fruit margin constricted or not constricted; slightly constricted along both margins; without sulcus; plain. Fruit wings absent. Fruit substipitate; with the stipe 2–4 mm long. Fruit with all layers dehiscent (tardily according to literature, not seen). Replum invisible. Epicarp dull; multicolored; mottled; brown or tan; with brown or gray overlay; pubescent and indurate or pubescent but soon deciduous; with 1 type of pubescence; sericeous; with pubescence golden to white; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; reticulately veined; not tuberculate; sometimes papillose; not exfoliating; without cracks. Mesocarp trace; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; chartaceous. Endocarp dull; mottled; tan; with mottling (dark); with brown overlay; smooth and floury-filamentous; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 2–5; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 0.3–0.5 mm long; of 1 length only; thick; straight. Aril dry; rim-aril; entire; tan or yellow.

Seed $5\text{--}9 \times 4\text{--}6.8 \times 2.5\text{--}3.5$ mm; not overgrown; not angular; symmetrical or asymmetrical (slightly); elliptic or oblong; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; glossy to dull; not modified by a bloom;

colored; monochrome to mottled; yellowish green to brown (greenish); with brown overlay; glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe visible or not visible; from hilum through lens to base of seed and terminating; not bifurcating; darker than testa; flush. Hilum partially concealed; concealed by aril or wing; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 0.3–0.7 mm long; with curved outline; circular; apical according to radicle tip but marginal according to seed length; recessed; within halo or not within corona, halo, or rim. Hilum halo color lighter than testa. Lens discernible; equal to or greater than 0.5 mm in length; 0.6–0.9 mm long; with margins straight; diamond-shaped; not in groove of raphe; adjacent to hilum; ca. 0.4 mm from hilum; mounded; similar color as testa; darker than testa; brown; not within corona, halo, or rim. Endosperm thick to thin; covering entire embryo; adnate to embryo. Cotyledons not smooth; sulcate; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin not entire 180 degrees from base of radicle; similar at apex; not concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; creamy white to white or pink; inner face flat; glabrous around base of radicle. Embryonic axis oblique; perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; slightly bulbous; lobe tip curved; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Malawi to Natal.

Bolusanthus: *B. speciosus* (H. Bolus) H.A.T. Harms (A–E). A, Fruits ($\times 1.6$); B, seeds ($\times 7.3$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 5$).



Genus: *Platycelyphium* H.A.T. Harms

Phylogenetic Number: 2.38.

Tribe: Sophoreae.

Group: Sophora.

Species Studied—Species in Genus: 1 sp.—1 sp.

Fruit a legume; unilocular; 4.5–6 × 2.5–3 × 4.5–5 cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; elliptic to ovate; when asymmetrical with both sutures parallelly curved; not inflated; compressed; with beak; straight; with papery fragile beak up to 1 cm long; emarginate or rounded at apex; apex aligned with longitudinal axis of fruit; tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally visible. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit substipitate; with the stipe up to 3 mm long. Fruit indehiscent. Epicarp dull; multicolored; bichrome; tan; with brown (over seed chamber) overlay; with surface texture uniform; pubescent and indurate; with hairs appressed; with 1 type of pubescence; sparsely strigose; with pubescence golden; with pubescence uniformly distributed; with simple hairs; stiff; with hair bases plain; eglandular; without spines; not smooth; with elevated features; reticulately veined; not tuberculate; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; chartaceous. Endocarp dull; opaque; mottled; tan; smooth; without adhering pieces of testa; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seed 1; length parallel with fruit length. Funiculus measured; ca. 0.5 mm long; thick; straight. Aril dry; thin rim-aril; cream.

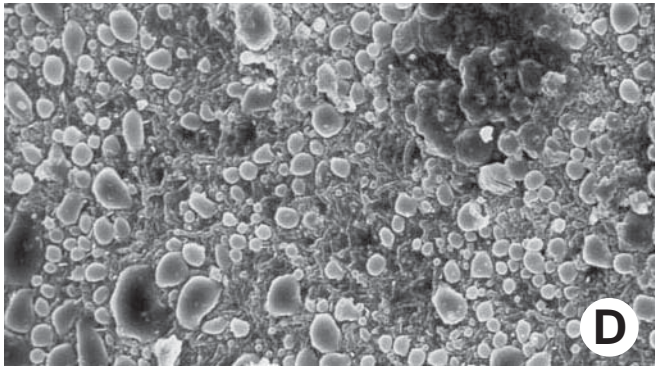
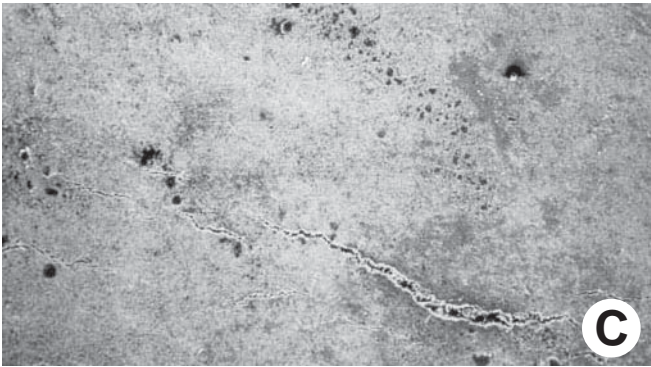
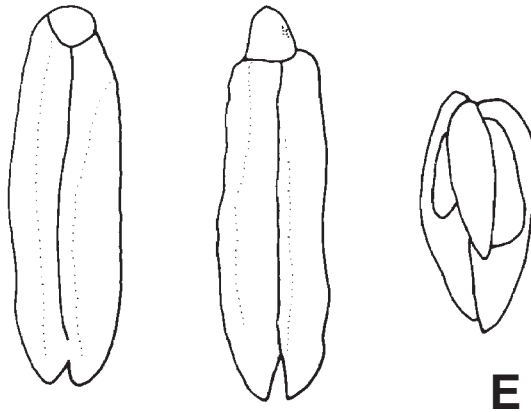
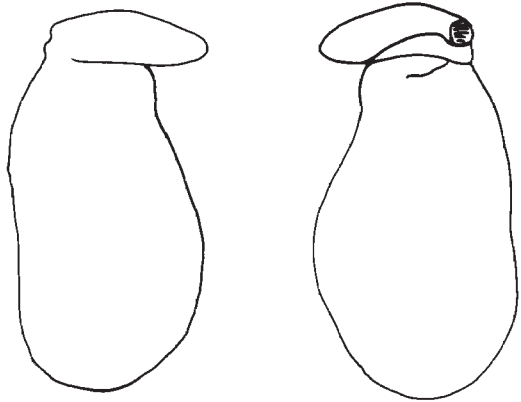
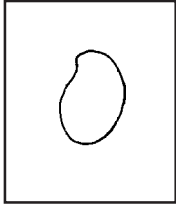
Seed 12–18 × 8–10.5 × 4–6.5 mm; not overgrown; not angular; asymmetrical; irregularly ovate; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; with umbo on both faces of seed; without medial ridge on each face. Cuticle not exfoliating; not inflated; not wrinkled. Testa without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; dull; not modified by a bloom; colored; mottled; with infrequent mottles; tan; with brown overlay; glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe

from hilum through lens to base of seed and bifurcating; bifurcating at base of seed with each arm going up antiraphe side, turning (U-shaped) down, and approaching bifurcation; color of testa and darker than testa; brown; flush. Hilum visible; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 1–1.2 mm long; with curved outline; elliptic; apical according to radicle tip but marginal according to seed length; recessed; not within corona, halo, or rim. Lens discernible; equal to or greater than 0.5 mm in length; 2–2.5 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; flush; similar color as testa; darker than testa; not within corona, halo, or rim. Endosperm thin; covering entire embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; pale yellow; inner face flat; glabrous around base of radicle. Embryonic axis right angled; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip slightly curved; with 90-degree turn; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Eastern and northeastern Africa.

Notes: Van der Maesen (1970) treated *Platycelyphium*.

Platycelyphium: *P. voense* (H.G.A. Engler) H. Wild (A–E). A, Fruits (× 1.7); B, seeds (× 3.5); C–D, testa (× 50, × 1000); E, embryos (× 4).



Genus: *Camoensia* F.M.J. Welwitsch ex G. Bentham

Phylogenetic Number: 2.39.

Tribe: Sophoreae.

Group: Sophora.

Species Studied—Species in Genus: 2 spp.—2 spp.

Fruit a legume; unilocular; 14–22 × 3.5–4 cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight or curved (slightly); not plicate; not twisted; asymmetrical; nearly linear; when asymmetrical with both sutures parallelly curved; not inflated; compressed; with beak; hooked; with solid beak the same color and texture as fruit; tapered or rounded at apex; apex right-angled with or almost reaching longitudinal axis of fruit; rounded at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally invisible. Fruit margin constricted or not constricted; slightly constricted along both margins; without sulcus; plain. Fruit wings absent. Fruit stipitate; with the stipe 60–65 mm long. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull (obscured by pubescence); monochrome; brown; pubescent and indurate; with 1 type of pubescence; densely velutinous; with pubescence brown; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not tuberculate. Mesocarp thick; surface sparsely, uniformly veined; 2-layered; without balsamic vesicles; without fibers; with solid layer over solid layer; coriaceous. Endocarp dull; mottled; tan; with mottling over seed chambers and mottling above and below seed chambers; with brown overlay; smooth; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 3–5; in 1 series. Aril fleshy; 2-lipped rim-aril; entire; covering less than 1/2 of seed; with tongues (or flap-like) on lips of 2-lipped rim-aril; with 1 tongue or flap on 1 lip of 2-lipped rim-aril; brown to tan.

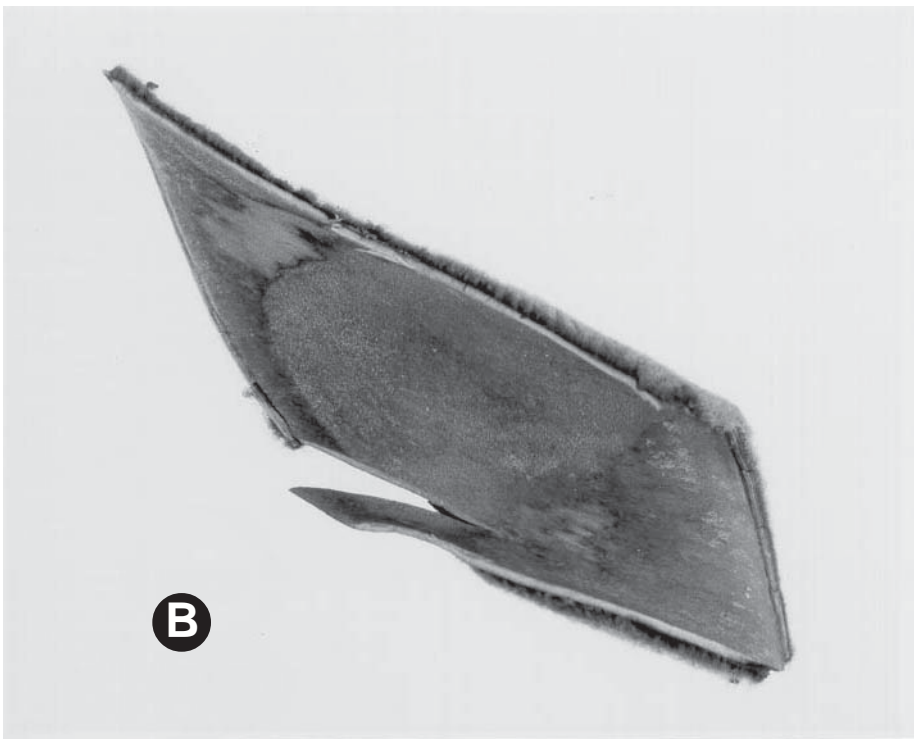
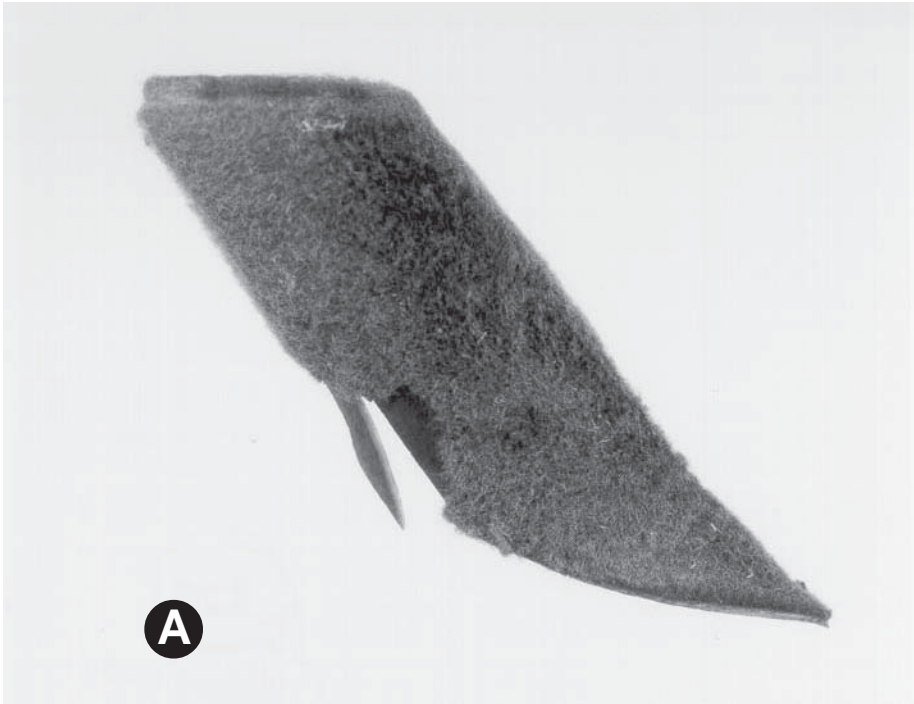
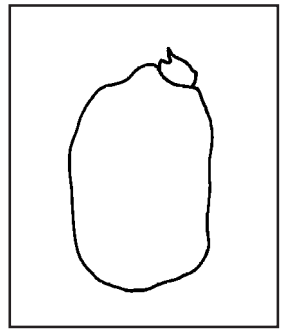
Seed 20–37 × 14–24 × 8–10.5 mm; not overgrown; angular or not angular; symmetrical or asymmetrical; irregular, oblong, or ovate; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; glossy to dull; not modified

by a bloom; colored; monochrome or mottled; with frequent mottles; black to brown; with brown overlay; glabrous; not smooth; with elevated and recessed features; wrinkled; striate; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 4.2–6 mm long; with curved outline; oval or heart-shaped; apical at apex of radicle tip to subapical to radicle tip; recessed; within rim and corona. Hilum corona color lighter than testa. Hilum rim color of testa. Lens discernible; equal to or greater than 0.5 mm in length; 1–2.5 mm long; with margins straight or curved; triangular or elliptic; not in groove of raphe; adjacent to or confluent with hilum; 0.5 mm from hilum; mounded or recessed; same or similar color as testa; lighter than testa; brown; within rim or corona or not within corona, halo, or rim. Lens corona color lighter than testa. Lens rim color of testa. Endosperm absent. Cotyledons not smooth; 5–7-branched grooves (from veins of testa) on each face; both outer faces convex; both the same thickness; 1 longer (slightly) than other; not folded; margin entire 180 degrees from base of radicle; similar at apex; completely concealing radicle; split over radicle; with lobes; with lobes overlapping; without basal groin formed by lobes; with the interface division terminating at base of radicle; without margins recessed; creamy white or tan; inner face flat; glabrous around base of radicle. Embryonic axis straight; parallel to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous or triangular; lobe tip straight; straight with embryonic axis; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

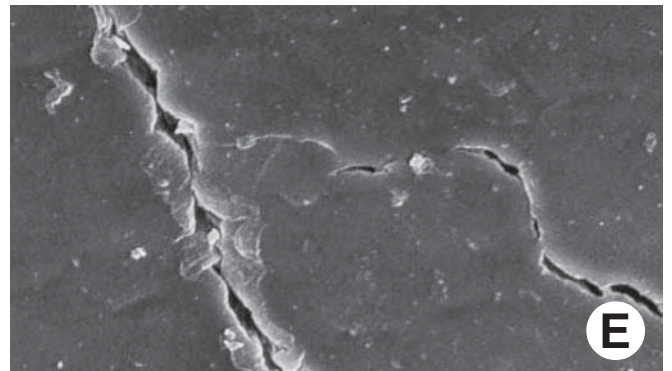
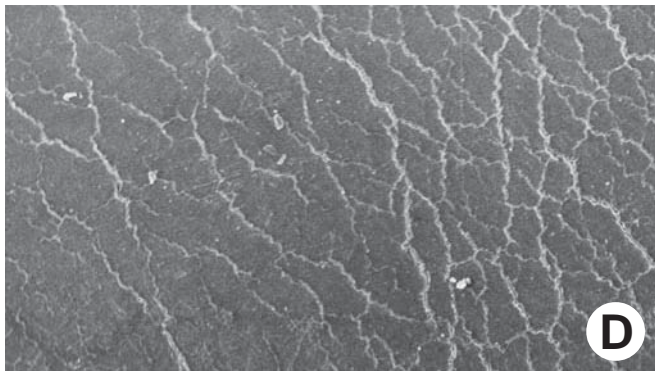
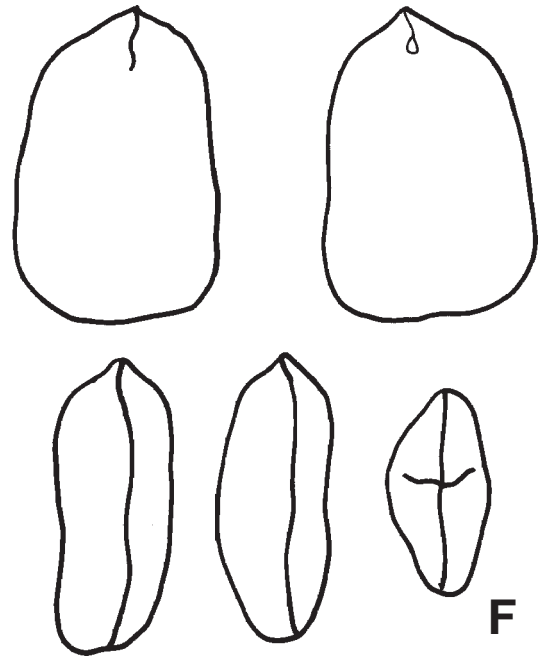
Distribution: Gulf of Guinea (Nigeria to Angola).

Notes: Only one small piece of a fruit was available for study.

Camoensia: *C. maxima* G. Bentham (*A–B*). *A–B*, piece of a fruit, external and internal views (× 1.9).



Camoensia (con.): *C. maxima* G. Bentham (*D–F*), *C. spp.*
(*C*). *C*, seeds ($\times 1.7$); *D–E*, testa ($\times 50$, $\times 1000$); *F*,
embryos ($\times 1.5$).



Genus: *Maackia* F.J. Ruprecht & C.J. Maximowicz

Phylogenetic Number: 2.40.

Tribe: Sophoreae.

Group: Sophora.

Species Studied—Species in Genus: 6 spp.—ca. 8 spp.

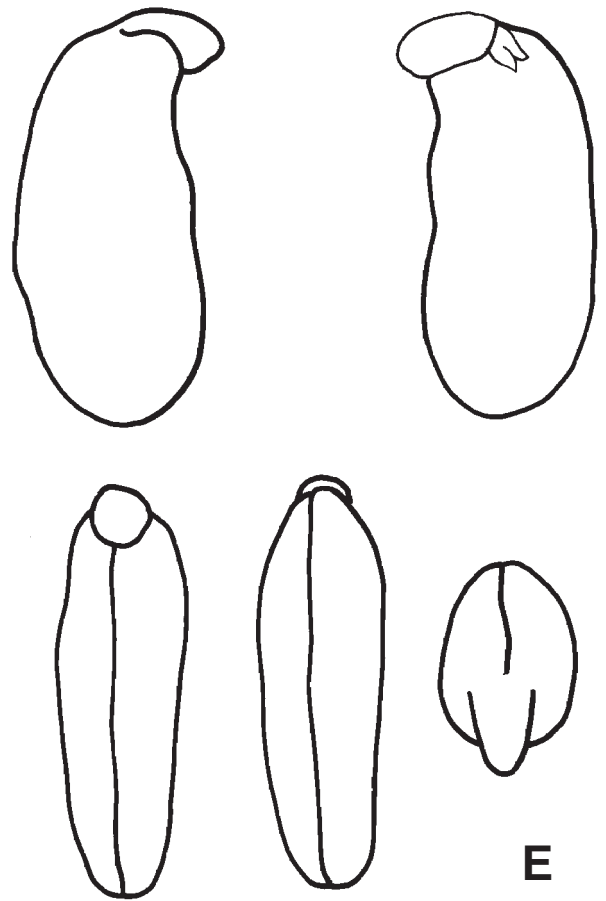
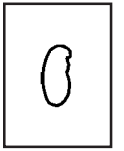
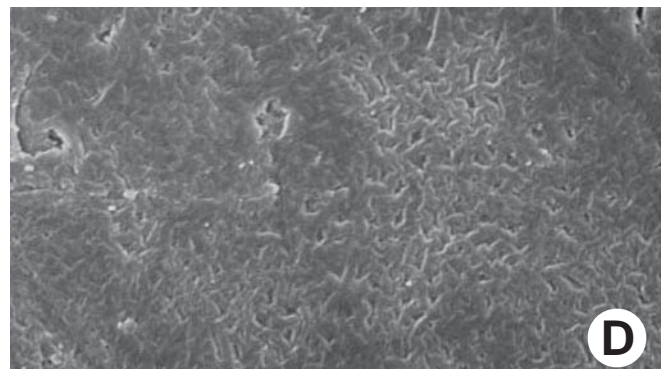
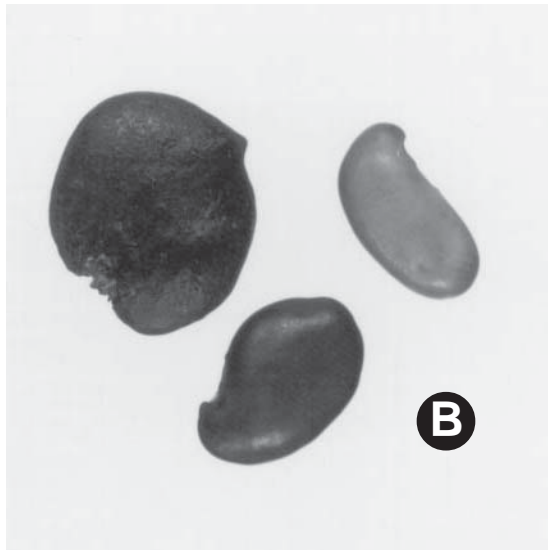
Fruit a legume; unilocular; $2.3-8 \times 1-1.7 \times 0.1-0.3$ cm; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical; elliptic, fusiform, or ovate (narrowly); not inflated; compressed or flattened; without or with beak (short); straight; with solid beak the same color and texture as fruit; rounded at apex; apex aligned or oblique with longitudinal axis of fruit; rounded or tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; embellished or plain; with ridges. Fruit wings absent. Fruit substipitate or nonstipitate; with the stipe up to 2 mm long. Fruit with all layers dehiscent or indehiscent; splitting along sutures. Dehiscence of valves along both sutures; apical and down. Replum invisible. Epicarp dull; monochrome or multicolored; mottled; brown; with brown (darker) overlay; with surface texture uniform; pubescent and indurate or pubescent but soon deciduous; with hairs appressed; with 1 type of pubescence; puberulent or strigose; with pubescence golden or white; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; transversely veined relative to fruit length or reticulately veined; not tuberculate; not exfoliating; without cracks. Mesocarp absent. Endocarp glossy; monochrome; tan to brown (light); smooth; without adhering pieces of testa; nonseptate; chartaceous (thin); not exfoliating; remaining fused to epicarp; entire. Seeds 1–5; length parallel with or oblique to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 1–2.2 mm long; of 1 length only; flattened; curved or straight. Aril dry; very slight rim-aril; without tongue (or flap-like) on lips of 2-lipped rim-aril; white.

Seed $7.2-12.5 \times 4-7 \times 3-4.5$ mm; not overgrown; not angular; asymmetrical; reniform; terete to compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on

seed faces; without medial ridge on each face. Cuticle not exfoliating; not inflated; not wrinkled. Testa without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; dull; not modified by a bloom; colored; monochrome; tan; glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe from hilum through lens to base of seed and terminating; not bifurcating; darker than testa; flush. Hilum visible; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 1–2 mm long; with curved outline; circular to elliptic; apical according to radicle tip but marginal according to seed length; recessed; within rim. Hilum rim color darker than testa. Lens discernible; equal to or greater than 0.5 mm in length; 2–3.5 mm long; with margins straight; narrowly diamond-shaped; not in groove of raphe; confluent with hilum; flush; dissimilar color from testa; brown; within corona. Lens corona color lighter than testa. Endosperm present or absent; thin; covering entire embryo; adnate to embryo. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; creamy white; inner face flat; glabrous around base of radicle. Embryonic axis oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear or triangular; lobe tip curved; oblique to cotyledons or with 90-degree turn; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Eastern Asia and cultivated elsewhere.

Maackia: *M. amurensis* F.J. Ruprecht (C–E), *M. spp.* (A–B). A, Fruits ($\times 1.3$); B, seeds ($\times 3.3$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 5$).



Genus: *Cladrastis* C.S. Rafinesque-Schmaltz

Phylogenetic Number: 2.41.

Tribe: Sophoreae.

Group: Sophora.

Species Studied—Species in Genus: 5 spp.—5 or 6 spp.

Fruit a legume; unilocular; $3.8\text{--}9.5 \times 0.8\text{--}1.3 \times 1.8\text{--}2.7$ cm; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical; fusiform to linear; not inflated; flattened; with beak; straight or hooked; with solid beak the same color and texture as fruit; long tapered or tapered at apex; apex aligned with longitudinal axis of fruit; tapered or rounded at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous; seed chambers externally invisible. Fruit margin constricted or not constricted; slightly constricted along both margins; without sulcus; plain or embellished; with thickened sutural areas. Fruit wings present or absent; 2; 1–2 mm wide; sutural; on both sutures. Fruit substipitate or nonstipitate; with the stipe 2–8 mm long. Fruit with all layers dehiscent (in literature) or indehiscent. Replum invisible. Epicarp dull; monochrome or multicolored; mottled; yellow to brown; with brown overlay; glabrous or pubescent and indurate; with 1 type of pubescence; sparsely strigose; with pubescence golden; with pubescence uniformly distributed; with simple hairs; stiff; with hair bases plain; eglandular; without spines; not smooth; with elevated features; veined or not veined; reticulately veined; not tuberculate; slightly wrinkled; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; solid; chartaceous. Endocarp dull; monochrome; brown to yellow; smooth or smooth and floury-filamentous; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1–7; length oblique to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; ca. 2 mm long; of 1 length only; partially filiform and partially thick; convoluted. Aril dry; rim-aril; fimbriate; cream.

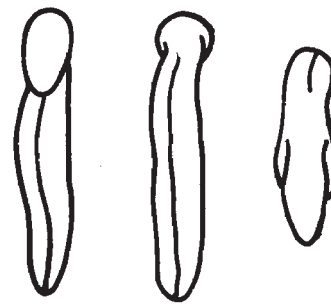
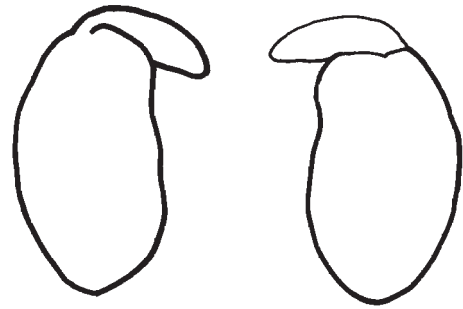
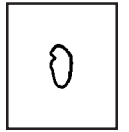
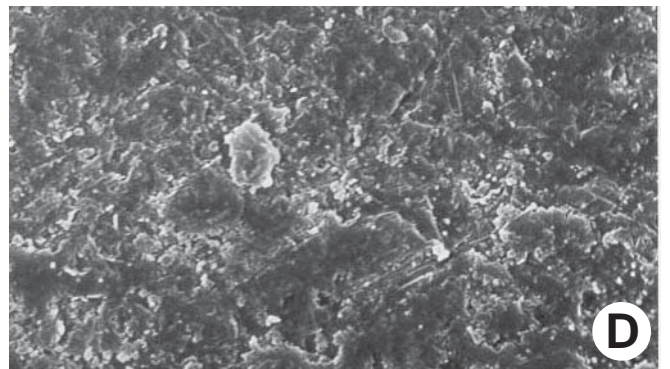
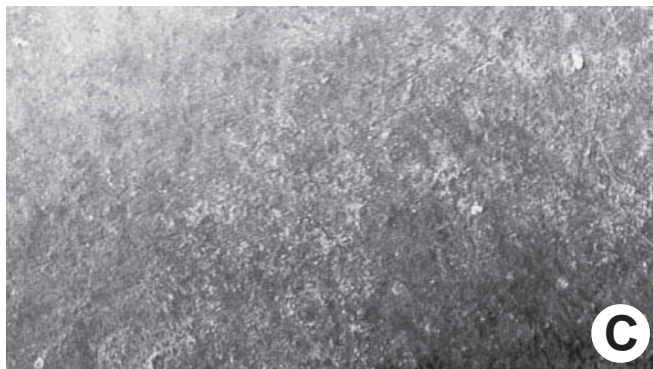
Seed $5\text{--}10 \times 3\text{--}5 \times 1.8\text{--}3$ mm; not overgrown; not angular; asymmetrical; elliptic to irregular; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a

bloom; colored; monochrome; brown to reddish brown; glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe from hilum through lens to base of seed and terminating; not bifurcating; darker than testa; brown; flush. Hilum visible; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 1–1.5 mm long; with curved outline; circular or elliptic; apical according to radicle tip but marginal according to seed length; recessed; within corona. Hilum corona color darker than testa. Lens discernible; equal to or greater than 0.5 mm in length; 1–1.5 mm long; with margins straight; diamond-shaped; not in groove of raphe; adjacent to hilum; 1–2 mm from hilum; mounded; similar color as testa; darker than testa; brown; not within corona, halo, or rim. Endosperm thick; covering entire embryo; adnate to testa or embryo. Cotyledons not smooth; sulcate; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle or not concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; tan; inner face flat; glabrous around base of radicle. Embryonic axis oblique; parallel to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip straight or curved; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: North America (1 sp.) and eastern Asia (4 or 5 spp.).

Notes: Robertson (1977) discussed the cultivation and morphology of *Cladrastis*.

Cladrastis: *C. lutea* (F.A. Michaux) K.H.E.L. Koch (*C–E*), *C. spp.* (*A–B*). *A*, Fruits ($\times 1.1$); *B*, seeds ($\times 5.6$); *C–D*, testa ($\times 50$, $\times 1000$); *E*, embryos ($\times 5$).



E

Genus: *Salweenia* E.G. Baker

Phylogenetic Number: 2.42.

Tribe: Sophoreae.

Group: Sophora.

Species Studied—Species in Genus: 1 sp.—1 sp.

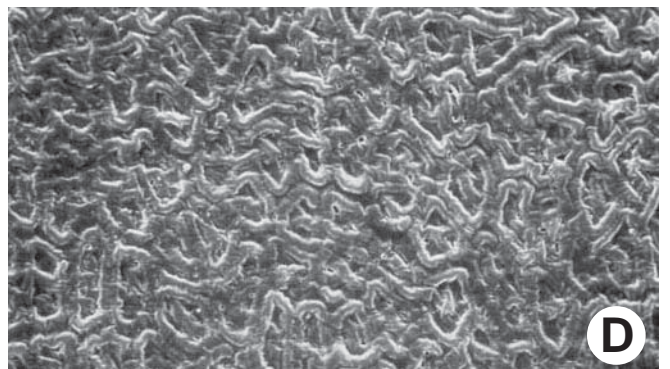
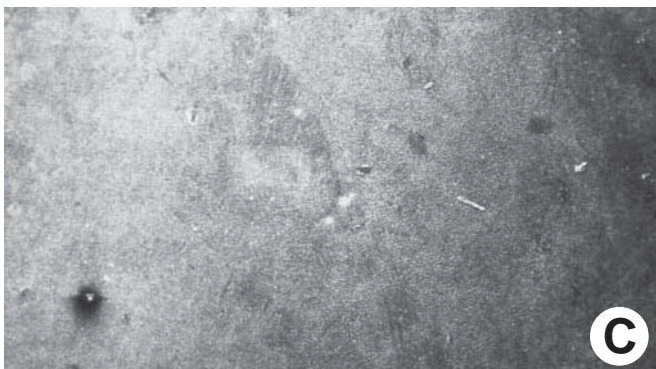
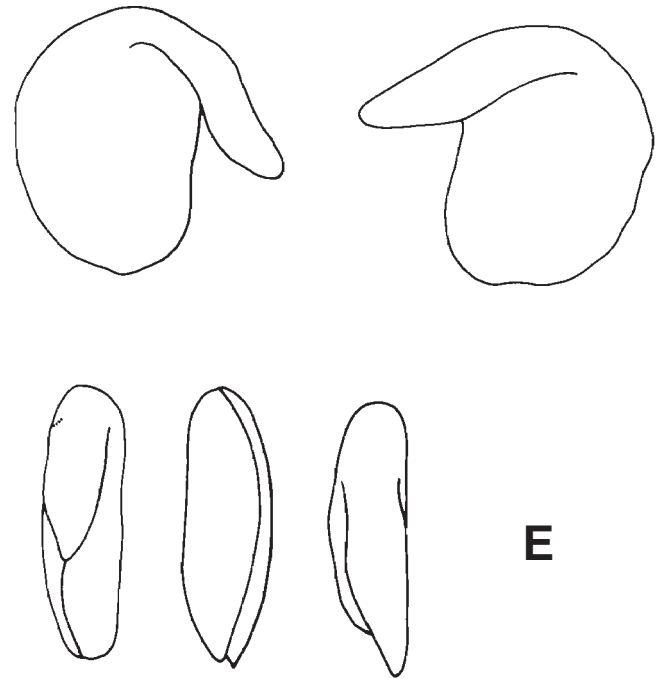
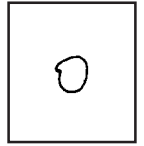
Fruit a legume; unilocular; $6-9 \times 0.8-1.2 \times$ ca. 0.4 cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical; linear to moniliform (slightly); not inflated; compressed; with beak; straight; with solid beak the same color and texture as fruit; tapered at apex; apex aligned or oblique (slightly) with longitudinal axis of fruit; rounded and tapered at base; base aligned to oblique (slightly) with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous; seed chambers externally visible; with the raised seed chambers not torulose. Fruit margin very slightly constricted along both margins; without sulcus; plain. Fruit wings absent. Fruit substipitate. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; multicolored; mottled; tan; with brown overlay; with surface texture uniform; pubescent and indurate; with hairs appressed; with 2 types of pubescence; long and short sericeous; with pubescence white; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; reticulately veined; not tuberculate; not exfoliating; without cracks. Mesocarp absent. Endocarp dull; opaque; monochrome; tan; smooth; without adhering pieces of testa; nonseptate; chartaceous; not exfoliating; remaining fused to epicarp; entire. Seeds 5–8; length oblique to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 1.8–2.2 mm long; of 1 length only; filiform; straight. Aril dry; rim-aril; cream.

Seed $6.3-7 \times 5-6.5 \times 1.7-2.2$ mm; not overgrown; not angular; asymmetrical; irregular; compressed; with surface smooth; with visible radicle and cotyledon lobes; without external groove between radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle not exfoliating; not inflated; not wrinkled. Testa without pieces of adhering epicarp; not adhering to

endocarp; free from endocarp; dull; not modified by a bloom; colored; monochrome; brown; glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum partially concealed; concealed by radicle lobe; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; ca. 0.5 mm long; with curved outline; circular; apical according to radicle tip but marginal according to seed length; recessed; not within corona, halo, or rim. Lens discernible; equal to or greater than 0.5 mm in length; ca. 1.5 mm long; with margins straight; narrowly diamond-shaped; not in groove of raphe; adjacent to hilum; 0.3 mm from hilum; slightly mounded; similar color as testa; darker than testa; not within corona, halo, or rim. Endosperm trace; restricted to region of embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; greenish tan to white (creamy); inner face flat; glabrous around base of radicle. Embryonic axis oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip straight or curved; oblique to cotyledons; centered between cotyledons; less than 1/2 or 1/2 to nearly length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Tibet.

Salweenia: *S. wardii* E.G. Baker (A–E). A, Fruits ($\times 1.3$); B, seeds ($\times 5.5$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 7$).



Genus: *Styphnolobium* H.W. Schott

Phylogenetic Number: 2.44.

Tribe: Sophoreae.

Species Studied—Species in Genus: 2 spp.—9 spp.

Fruit a legume; unilocular; $3-16 \times 0.7-4 \times 0.5-1$ (at least) cm; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical; moniliform; not inflated; compressed or terete; with beak; straight; with solid beak the same color and texture as fruit; short tapered at apex; apex aligned with longitudinal axis of fruit; short tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous or fleshy (in literature); seed chambers externally visible; with the raised seed chambers torulose or not torulose. Fruit margin constricted along both margins; without sulcus; plain. Fruit wings absent. Fruit stipitate or nonstipitate; with the stipe 1.5–2.5 mm long. Fruit indehiscent. Replum invisible. Epicarp dull; monochrome or multicolored; mottled; brown; with brown or green overlay; with surface texture uniform; glabrous or pubescent and indurate; with hairs erect or appressed; with 1 type of pubescence; pilose, puberulent, sericeous, or velutinous; with pubescence white; with pubescence uniformly distributed or apical pubescence different from basal pubescence; with stipe (only) sericeous (in literature); with simple hairs; stiff; with hair bases plain; eglandular; without spines; smooth or not smooth; with elevated features; not veined; not tuberculate; finely rugose and wrinkled; not exfoliating; without cracks. Mesocarp thick; surface not veined; 2-layered; with balsamic vesicles; without fibers; with solid layer over solid layer; coriaceous or fleshy. Endocarp dull; opaque; monochrome; black or tan; smooth; without adhering pieces of testa; septate; with septa thicker than paper, firm; with septa eglandular; chartaceous; exfoliating in part or not exfoliating; separating from mesocarp; entire. Seeds 1–8; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; about 2 mm long; of 1 length only; thick; straight. Aril absent.

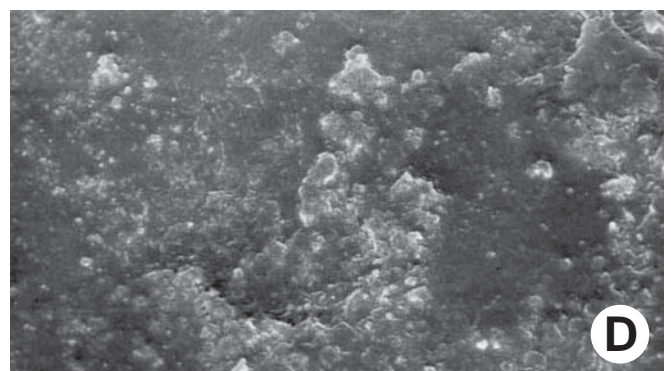
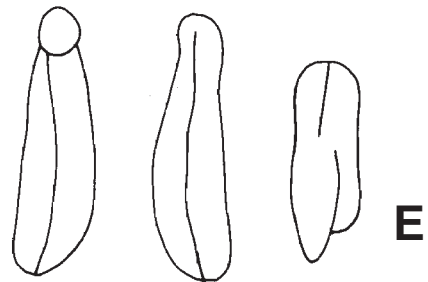
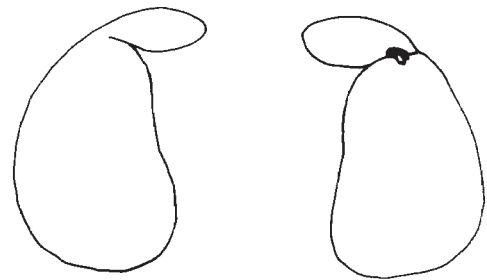
Seed $6-25 \times 4-15 \times 3-4$ (at least) mm; not overgrown; not angular; symmetrical or asymmetrical; ovate or reniform; compressed; with surface smooth; with visible radicle and cotyledon lobes; without external groove between radicle and cotyledon lobes; with

shallow hilar sinus or without hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle not exfoliating; not inflated; not wrinkled. Testa with or without pieces of adhering epicarp; partially or not adhering to endocarp; free from endocarp; dull or glossy; not modified by a bloom; colored; monochrome; dark brown; glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 1.5–2 mm long; with curved outline; elliptic or oval; apical according to radicle tip but marginal according to seed length; recessed; within rim. Hilum rim color of or lighter than testa. Lens discernible; equal to or greater than 0.5 mm in length; 0.5–1 mm long; with margins straight or curved; oblong or ovate; not in groove of raphe; adjacent to hilum; 1–2 mm from hilum; mounded; similar color as testa; darker than testa; darker brown; within halo or not within corona, halo, or rim. Lens halo color darker than testa. Endosperm thick; not pluglike and not resembling tip of radicle; covering entire embryo; adnate to embryo. Cotyledons smooth; both outer faces flat; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; green; inner face flat; glabrous around base of radicle. Embryonic axis oblique; parallel to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip curved; with 90-degree turn; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately developed; glabrous.

Distribution: China, southeastern United States, Mexico, and Central America.

Notes: *Styphnolobium* was revised by Sousa and Rudd (1993). We placed it in the generic sequence in agreement with Rudd (personal communication, 1998).

Styphnolobium: *S. affine* (J. Torrey & A. Gray) W.G. Walpers (C–E), *S. spp.* (A–B). A, Fruits ($\times 1.9$); B, seeds ($\times 4$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 5$).



Genus: *Sophora* C. Linnaeus

Phylogenetic Number: 2.45.

Tribe: Sophoreae.

Group: *Sophora*.

Species Studied—Species in Genus: 16 spp.—45(–50) spp.

Fruit a legume; unilocular; 3–12 × 0.4–1.8 × 0.3–1.8 cm; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight, curved, or 1.5- or 1-coiled; not plicate; not twisted or twisted; symmetrical or asymmetrical; coiled or moniliform; when asymmetrical with both sutures parallelly curved; not inflated; compressed or terete; with or without beak; straight or declined; with solid beak the same color and texture as fruit; blunt, rounded, or tapered at apex; apex aligned, oblique, right-angled with, or almost reaching longitudinal axis of fruit; long tapered at base; base aligned, oblique, or right angled with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous, coriaceous, or ligneous; seed chambers externally visible; with the raised seed chambers not torulose. Fruit margin constricted or not constricted; constricted along both margins; without sulcus; embellished or plain. Fruit wings present or absent; 4; 2–3 mm wide; sutural; on both sutures. Fruit stipitate (usually by abortion of ovules); with the stipe up to 30 mm long. Fruit with all layers dehiscing, indehiscent, or with epicarp and mesocarp breaking near center of valve and endocarp dehiscing along suture; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull to semiglossy; monochrome or multicolored; bichrome or mottled; black, brown, green, or tan; with brown overlay; with surface texture uniform; glabrous or pubescent and indurate; with hairs erect or appressed; with 1 type of pubescence; sericeous or villous; with pubescence gray, golden, or white; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; smooth or not smooth; with elevated features; not veined; not tuberculate; papillose, raised reticulate, or wrinkled; exfoliating in part or not exfoliating; without cracks. Mesocarp thick or thin; surface not veined; 1-, 2-, or 3-layered; with or without balsamic vesicles; without fibers; solid, with solid layer over spongy layer, or with solid layer over spongy layer over solid layer or solid layer over 2 distinct spongy layers;

coriaceous or chartaceous. Endocarp dull; opaque or translucent; monochrome; brown or tan; smooth; without adhering pieces of testa; septate or nonseptate; with septa thicker than paper, firm; with septa eglandular; chartaceous; exfoliating in part or not exfoliating; remaining fused to mesocarp and epicarp or separating from mesocarp; entire. Seeds 1–12; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured or less than 0.5 mm long; up to 0.5 mm long; of 1 length only; thick; straight. Aril present or absent; dry; thin rim-aril; tan to white.

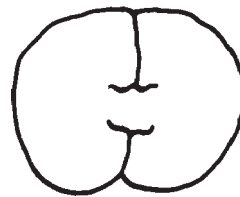
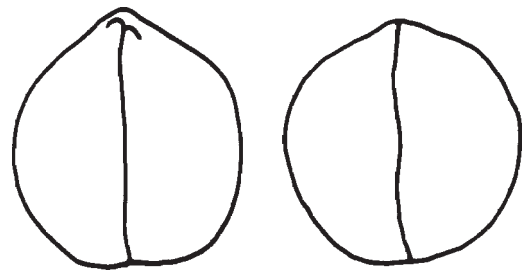
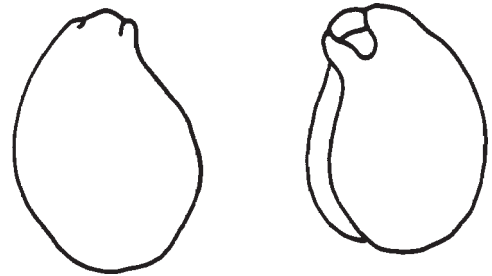
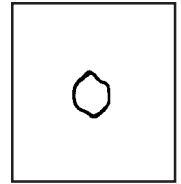
Seed 3–17 × 2–14 × 2–14 mm; not overgrown; not angular or angular; symmetrical; ovate, elliptic to circular (nearly), or rhombic; terete to compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle not exfoliating; not inflated; not wrinkled. Testa with or without pieces of adhering epicarp; partially adhering or not adhering to endocarp; free from endocarp; dull; not modified by a bloom; colored; monochrome; brown, red, or tan; glabrous; smooth or not smooth; with elevated features; bearing endocarp remnants; coriaceous to chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe from hilum through lens to base of seed and terminating or hilum to near base of seed and terminating; not bifurcating; color of or darker than testa; flush or raised. Hilum visible or partially concealed; concealed by funicular remnant; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 0.7–3 mm long; with curved outline; elliptic; apical according to radicle tip but marginal according to seed length; recessed; within halo or within rim. Hilum halo color lighter or darker than testa. Hilum rim color of, lighter, or darker than testa. Lens discernible or not discernible; less than 0.5 mm or equal to or greater than 0.5 mm in length; up to 2 mm long; with margins straight; linear or triangular; in groove or not in groove of raphe; confluent with hilum; flush; similar color as testa; darker than testa; not within corona, halo, or rim. Endosperm present or absent; thick or thin; covering entire embryo; adnate to testa. Cotyledons smooth or not smooth; sulcate; both outer faces convex; both the same thickness; both more or less of equal length; with both folded or not folded; sufficiently folded for inner face to touch itself; portions of inner folded face unequal; margin entire or not entire (rarely) 180 degrees from base of radicle; notched; similar at apex; completely concealing, partially concealing, or not conceal-

ing radicle; entire over, notched at, or split over radicle; with lobes; with lobes overlapping, touching (auriculate), or not touching; with basal groin formed by lobes; with the interface division terminating at base of radicle; with 1 or both margins recessed; recessed on same side as radicle; yellow, green, tan, or yellow and brown; inner face flat; glabrous around base of radicle. Embryonic axis oblique or right angled; oblique or perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous or linear; lobe tip straight; oblique to cotyledons or with 90-degree turn; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary or moderately developed; glabrous.

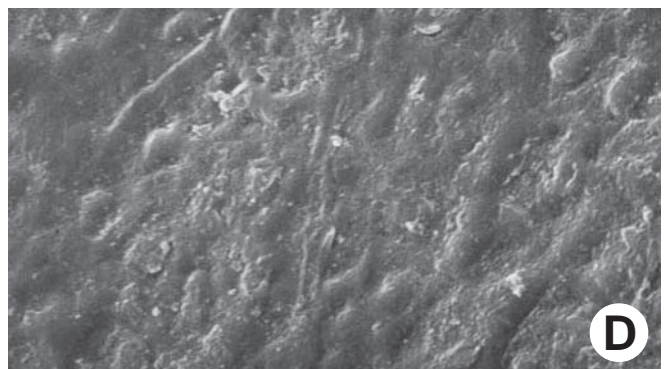
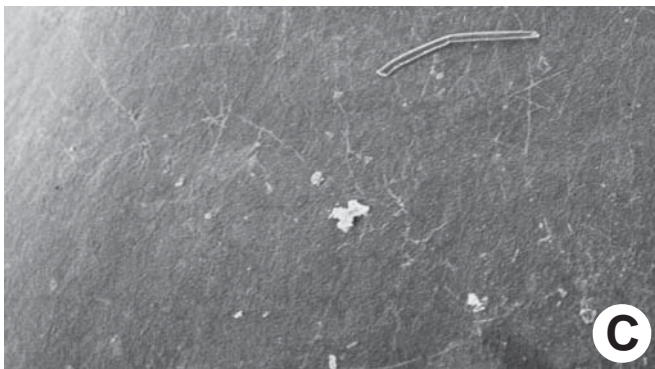
Distribution: North America and Eurasia.

Notes: Tsoong Pu-Chiu and Ma Chi-Yon revised *Sophora* in 1981. Polhill (1994b) and Sousa and Rudd (1993) maintained *Calia* J.L. Berlandier (2.43) as a genus, but Tsoong and Ma kept it as a synonym of *Sophora*. We have chosen to follow them, and included *Calia* in *Sophora*. Seeds of *Sophora* are rather variable. Cotyledons and endosperm of some *Sophora* species, along with those of *Calpurnia* (25.04) and *Cladrastis* (2.41), are similar to those of some Phaseoleae, such as *Diphyllarium* (10.37) and *Neonotonia* (10.40) of Glycininae and *Kennedia* (10.47), *Hardenbergia* (10.48), and *Vandasina* (10.49) of Kennedinae.

Sophora: *S. tomentosa* C. Linnaeus (*C–E*), *S. spp.* (*A–B*). *A*,
Fruits ($\times 1$); *B*, seeds ($\times 3$); *C–D*, testa ($\times 50$, \times
1000); *E*, embryos ($\times 5$).



E



Genus: *Ammodendron* F.E.L. von Fischer ex A.-P. de Candolle

Phylogenetic Number: 2.46.

Tribe: Sophoreae.

Group: Sophora.

Species Studied—Species in Genus: 6 spp.—ca. 6 spp.

Fruit a legume; unilocular; $1.6-4.2 \times 0.4-1 \times 0.2-0.3$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight or curved (slightly); not plicate; twisted; symmetrical; fusiform to ovate (narrowly); not inflated; flattened to compressed; without or with beak (short); straight; with papery fragile beak up to 1 cm long; tapered or rounded at apex; apex aligned with longitudinal axis of fruit; tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous to coriaceous; seed chambers externally visible; with the raised seed chambers not torulose. Fruit margin not constricted; without sulcus; plain or embellished. Fruit wings 4; $0.2-0.5$ mm wide; valvular; on both valves (2 on each valve, $0.5-2$ mm from sutures). Fruit nonstipitate. Fruit indehiscent. Replum invisible. Epicarp dull; monochrome; tan, yellow, or orange; glabrous, glabrate, or pubescent and indurate; with 1 type of pubescence; puberulent; with pubescence white; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; not veined; not tuberculate; wrinkled; not exfoliating; with or without cracks; cracking irregular. Mesocarp present or absent; trace; surface not veined; 1-layered; without balsamic vesicles; solid; chartaceous. Endocarp dull; monochrome; yellow to orange; smooth; nonseptate; chartaceous; not exfoliating; separating from epicarp; entire. Seeds 1-2; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only; flattened; straight. Aril present or absent; dry; very thin rim-aril; entire; ivory.

Seed $3.5-8.2 \times 2-4.5 \times 1.8-4.5$ mm; not overgrown; not angular; symmetrical; oblong or ovate; terete or compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored;

monochrome; brown to orange; glabrous; not smooth; with elevated features; wrinkled; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible; with faboid split; with the lips of the faboid split lighter colored than the rest of the hilum and therefore conspicuous; larger than punctiform; $0.3-1.2$ mm long; with curved outline; circular to elliptic; subapical to radicle tip; recessed; within rim. Hilum rim color lighter than testa. Lens discernible; equal to or greater than 0.5 mm in length; $0.5-2$ mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; flush; same color as testa; brown; not within corona, halo, or rim. Endosperm thin or trace; covering entire embryo; adnate to embryo. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; split over radicle; with lobes; with lobes touching (auriculate); without basal groin formed by lobes; with the interface division terminating at base of radicle; without margins recessed; yellow or green; inner face flat; glabrous around base of radicle. Embryonic axis oblique; perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip curved; oblique to cotyledons; centered between cotyledons; less than $1/2$ length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Central Asia.

Ammodendron: *A. karelinii* F.E.L. von Fischer & C.A. von Meyer var. *conollyi* (A.A. von Bunge) G.P. Yakovlev (*C-E*), *S.* spp. (*A-B*). *A*, Fruits ($\times 2.2$); *B*, seeds ($\times 8.1$); *C-D*, testa ($\times 50$, $\times 1000$); *E*, embryos ($\times 5$).

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