

## Loteae (13.01–13.17)

Genus: *Cytisopsis* H.F. Jaubert & É. Spach

Phylogenetic Number: 13.01.

Tribe: Loteae.

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

Fruit a legume; unilocular;  $1\text{--}2.2 \times 0.4\text{--}0.5 \times 0.4\text{--}0.5$  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; oblong; not inflated; terete; without beak; 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; ligneous; seed chambers externally visible or invisible; with the raised seed chambers not torulose. Fruit margin not constricted or constricted; constricted along both margins; without sulcus; plain. Fruit wings absent. Fruit substipitate. Fruit with all layers dehiscing (to tardily so); splitting along sutures. Dehiscence of valves along both sutures; apical and down; passive or active; with valves twisting. Replum invisible. Epicarp dull; monochrome; reddish brown; pubescent and indurate; with hairs appressed; with 1 type of pubescence; with pubescence gray; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; somewhat reticulately veined; not tuberculate; wrinkled; not exfoliating; without cracks. Mesocarp thick; 1-layered; without balsamic vesicles; without fibers; solid; ligneous. Endocarp dull; monochrome or mottled; tan; with mottling above and below seed chambers; with brown (reddish) overlay; smooth; subseptate; with septa thin (tissue paper-like), flexible; with septa eglandular; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 2–6; length transverse 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.

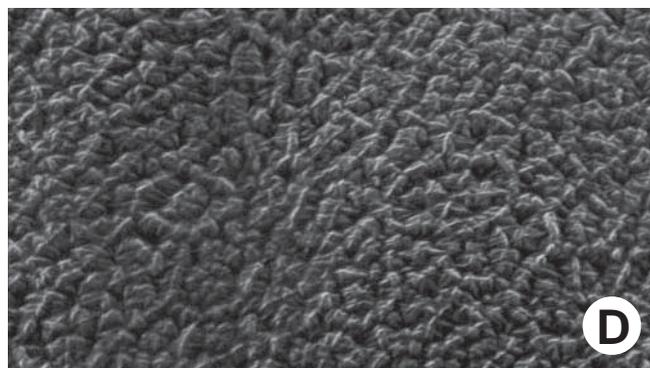
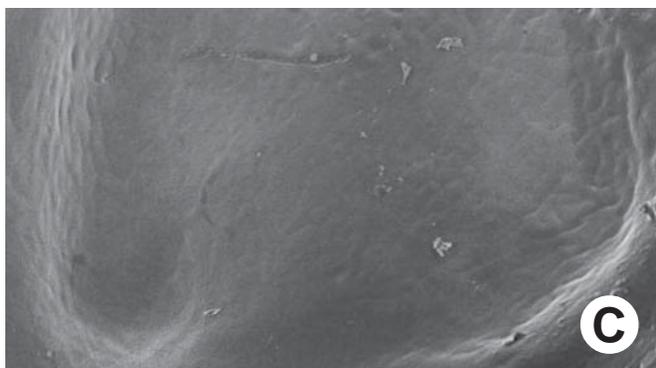
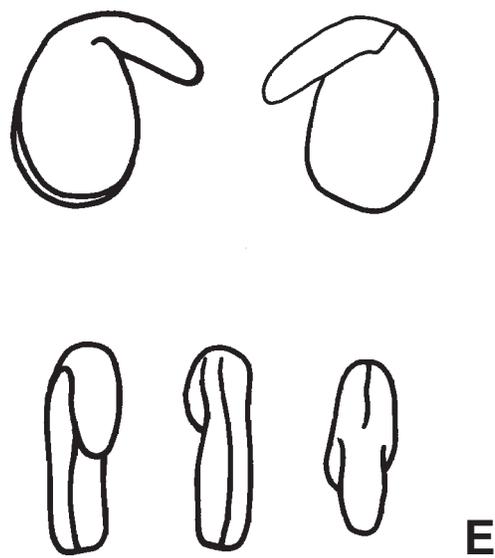
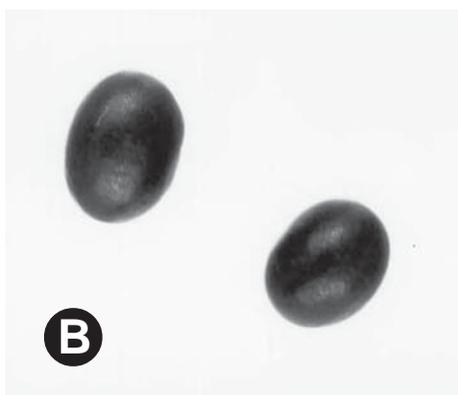
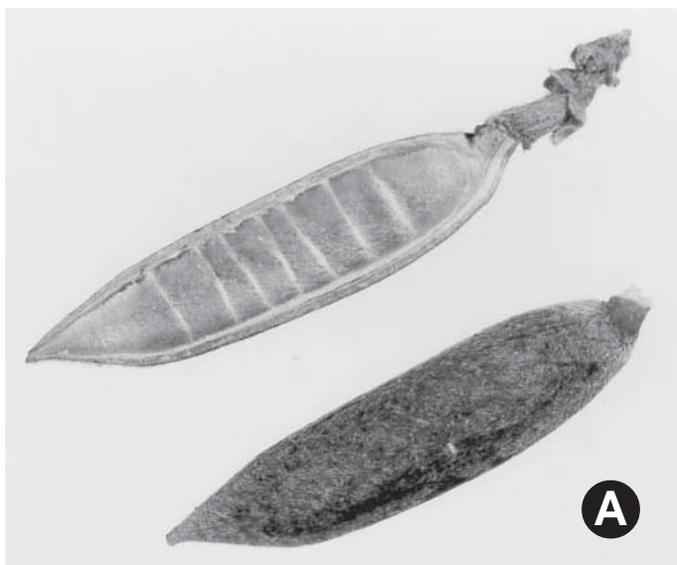
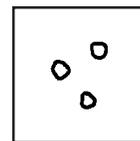
Seed  $2.2\text{--}2.8 \times 2 \times 2$  mm; not overgrown; not angular or angular; asymmetrical; circular, oblong, or irregular; terete; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; clear; monochrome; dark reddish

brown; glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum fully concealed; concealed by funicular remnant; with faboid split; the same color as the rest of the hilum; punctiform; apical at apex of radicle tip; flush; not within corona, halo, or rim. Lens discernible or not discernible; equal to or greater than or less than 0.5 mm in length; 0.5 mm long; with margins curved; elliptic; not in groove of raphe; adjacent to hilum; 0.3 mm from hilum; mounded; dissimilar color from testa; darker than testa; black; not within corona, halo, or rim. Endosperm thin; not pluglike and resembling tip of radicle; covering entire embryo; adnate to embryo and 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; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; tan or green; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed; with a joint evident between the radicle and the cotyledons. Radicle linear; lobe tip straight; deflexed and parallel to cotyledon length; centered between cotyledons;  $1/2$  to nearly length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Eastern Mediterranean (1 sp.) and perhaps in north Africa (1 sp.).

Notes: In 1981, Polhill (1981*k*) accepted much broader generic circumscriptions in tribe Loteae and only accepted four genera in the tribe: *Cytisopsis*, *Anthyllis* (13.02), *Hymenocarpus* (13.04), and *Lotus* (13.07). In his most recent classification of Fabaceae (Polhill 1994*a,b*), he combined the tribes Loteae and Coronilleae and accepted six segregate genera in Loteae, s.s.: *Tripodion* (13.03), *Dorycnopsis* (13.05), *Dorycnium* (13.06), *Podolotus* J.F. Royle (13.08), *Pseudolotus* K.H. Rechinger (13.09), and *Vermifruix* (13.10). Polhill (1981*k*) noted that the status of the North African species of *Cytisopsis*, which also has been placed in the segregate genus *Lyauteya* R.C.J.E. Maire, is not certain and that perhaps both species of *Cytisopsis* are better placed in *Anthyllis* (13.02). We studied only the eastern Mediterranean species *C. pseudocytisus*.

*Cytisopsis*: *C. pseudocytisus* (P.E. Boissier) Fertig (A–E). A, Fruit and valve ( $\times 4$ ); B, seeds ( $\times 7$ ); C–D, testa ( $\times 50$ ,  $\times 1000$ ); E, embryos ( $\times 10$ ).



Genus: *Anthyllis* C. Linnaeus

Phylogenetic Number: 13.02.

Tribe: Loteae.

Species Studied—Species in Genus: 19 spp.—20–25 spp.

Fruit a legume; unilocular;  $0.4\text{--}1.3 \times 0.2\text{--}0.5 \times 0.1\text{--}0.2$  cm; with deciduous or persistent calyx; with calyx longer than fruit; without or with orifice formed by curving of fruit or fruit segments; straight or 1-coiled; not plicate; not twisted; symmetrical or asymmetrical; linear or coiled; when asymmetrical with both sutures parallelly curved or 1 straight and 1 curved suture; widest near middle or D-shaped; inflated; compressed or terete; without or with beak; with solid beak the same color and texture as fruit; short tapered or rounded at apex; apex oblique with longitudinal axis of fruit; tapered or rounded at base; base right angled with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous or fragile, thinner than chartaceous like *Trifolium* (21.06) (area of “dehiscences”); seed chambers externally visible; with the raised seed chambers not torulose. Fruit margin not constricted or constricted; slightly constricted along both margins; without sulcus; plain or embellished. Fruit wing absent or present; 1; 0.5 mm wide; sutural; on 1 suture. Fruit nonstipitate or stipitate. Fruit indehiscent or with all layers dehiscent (tardily); opening by deterioration of delicate strip of tissue along inner suture or both sutures. Dehiscence of valves along 1 suture; medial and up and down; passive. Replum invisible. Epicarp dull or semiglossy; monochrome; brown or tan; with surface texture uniform or not uniform, with patches of different texture not restricted to the base and apex; 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; coriaceous. Endocarp dull; monochrome; tan; smooth; nonseptate or septate; with septa thin (tissue paper-like), flexible; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1–3; 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 absent.

Seed  $1.7\text{--}3.5 \times 1\text{--}3 \times 1\text{--}2$  mm; not overgrown; not angular or angular; asymmetrical or symmetrical (except

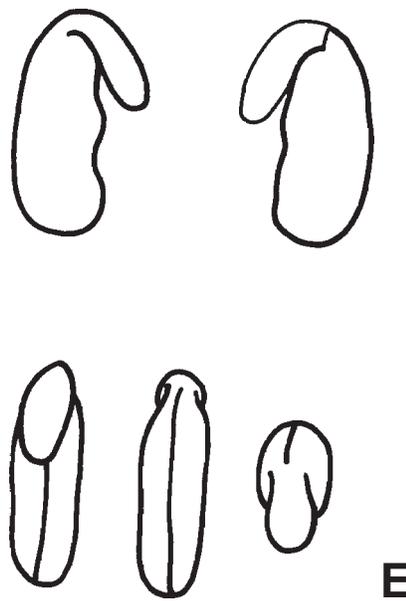
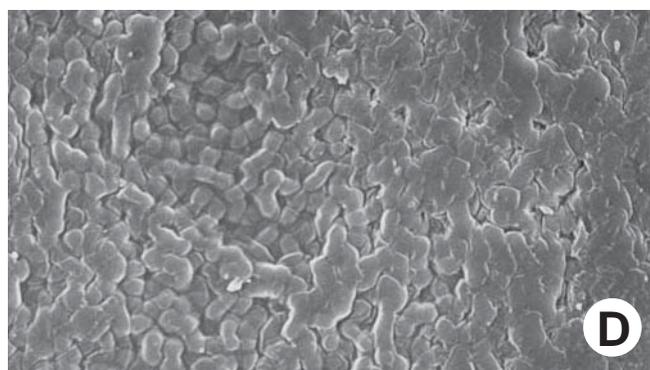
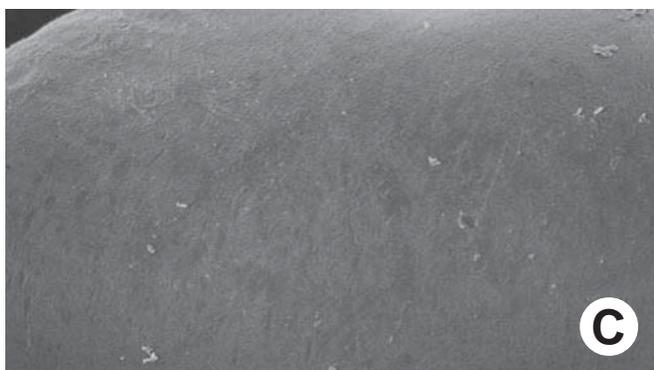
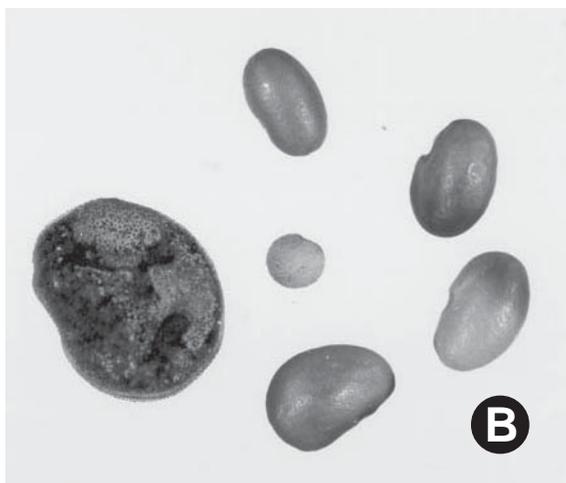
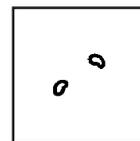
hilum); oblong, mitaform, or triangular; compressed or terete; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome or mottled and streaked; with frequent mottles; with frequent streaks; brown, tan, or green; with purple overlay; glabrous; smooth or not smooth; with elevated features; shagreen, wrinkled, or tuberculate; 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; punctiform; between cotyledon and radicle lobe; flush; within rim. Hilum rim color slightly darker than testa. Lens discernible; less than 0.5 mm in length; with margins straight or curved; wedge-shaped; elliptic, or hourglass or dumbbell-shaped; not in groove of raphe; confluent with hilum; mounded; dissimilar color from testa; darker than testa; reddish brown; 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; 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 deflexed; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle linear; lobe tip straight; deflexed and parallel to cotyledon length; centered between cotyledons; less than 1/2 length or 1/2 to nearly length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Mediterranean region, extending into Europe, Atlantic islands, and North Africa.

Notes: Polhill (1981k) noted that *Anthyllis* and *Lotus* (13.07) seem to be closely related to *Hammatolobium* (13.17). Polhill also noted that *Cytisopsis* (13.01) may be combined with *Anthyllis*. *Tripodion* (13.03), previously *A. tetraphylla* C. Linnaeus, was not discussed by Polhill. *Anthyllis vulneraria* C. Linnaeus is a variable species with many subspecies and some economic value. Some species, but not *A. vulneraria*, possess fruits with unusual dehiscences. Either the lower or both sutural areas have much thinner fruit tissue, and this tissue easily ruptures gradually exposing the seeds in situ. Eventually the seeds fall free from one or both valves.



*Anthyllis*: *A. hermanniae* C. Linnaeus (*C-E*), *A. spp.* (*A-B*).  
A, Fruits ( $\times 3$ ); B, seeds ( $\times 7$ ); C-D, testa ( $\times 50$ ,  
 $\times 1000$ ); E, embryos ( $\times 10$ ).



Genus: *Tripodion* F.C. Medikus

Phylogenetic Number: 13.03.

Tribe: Loteae.

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

Fruit a legume; unilocular;  $0.9-1 \times 0.3-0.4 \times 0.2$  cm; with persistent calyx; with calyx longer than fruit (and inflated); without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; oblong; when asymmetrical with both sutures unequally or parallelly curved; not inflated (but calyx inflated); terete; with beak (1 mm long); with solid beak the same color and texture as fruit; short tapered 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; chartaceous or fragile, thinner than chartaceous like *Trifolium* (21.06); seed chambers externally visible; with the raised seed chambers torulose. Fruit margin constricted along both margins; without sulcus; plain. Fruit wings absent. Fruit substipitate. Fruit indehiscent (but fragile enough to open easily). Replum invisible. Epicarp dull; multicolored; streaked (because streaked endocarp is seen through epicarp); tan; with brown (reddish) overlay; with mottling over seed chambers; pubescent and indurate; with 1 type of pubescence; puberulent; with pubescence golden or gray; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; straight; eglandular; without spines; smooth or not smooth; veined or not veined; reticulately veined (some best seen from endocarp view); not tuberculate; not exfoliating; without cracks. Mesocarp absent. Endocarp dull; streaked; tan; with streaking above and below seed chambers; with brown (reddish) overlay; smooth; septate; with septa thin (tissue paper-like), flexible; with septa eglandular; chartaceous; not exfoliating; remaining fused to 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 absent.

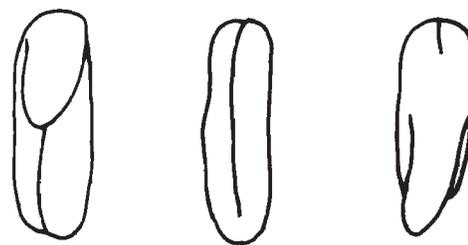
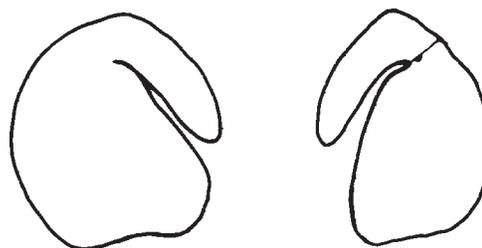
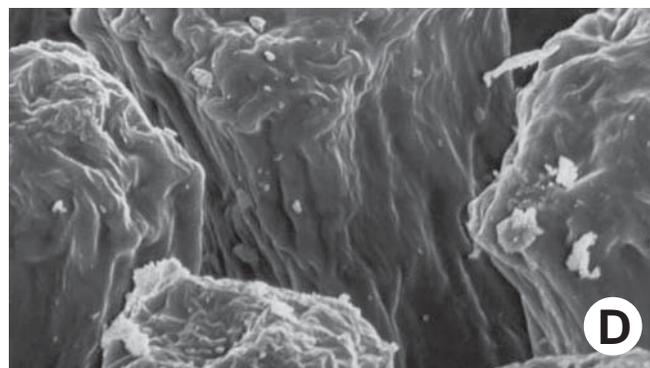
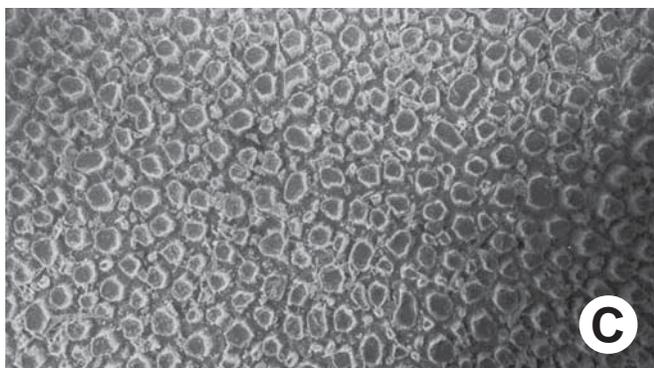
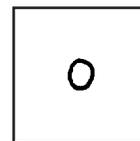
Seed  $3-3.5 \times 2.8-3.2 \times 1.5-2.5$  mm; not overgrown; not angular or angular (to somewhat); asymmetrical; oblong or reniform; compressed; with surface smooth; without hilar sinus; without umbo on seed faces. Testa without or with pieces of adhering epicarp (occasionally); not adhering to endocarp; dull; not modified by a

bloom; colored; monochrome or streaked and mottled; with frequent mottles; with frequent streaks; reddish brown or tan; with black overlay; glabrous; not smooth (and distinctly grooved between cotyledons especially opposite from hilum); with elevated features; tuberculate; coriaceous. 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; punctiform; marginal according to radicle tip or between cotyledon and radicle lobe; recessed; not within corona, halo, or rim. Lens obviously or faintly discernible or not discernible; less than 0.5 mm in length; with margins curved; circular or elliptic; not in groove of raphe; adjacent to hilum; 0.5 mm from hilum; mounded; same color as, similar color as, or dissimilar color from testa; lighter than or darker than testa; reddish brown, tan (reddish), or black; not within corona, halo, or rim. Endosperm thick; 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; 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 deflexed; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle linear; deflexed and parallel to cotyledon length; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Mediterranean region, southern Portugal.

Notes: This genus was part of *Anthyllis* (13.02) in the report of Polhill (1981k), but *Tripodion* is now recognized as a separate genus (Polhill 1994a,b). Previously, *Tripodion* was also known as *Physanthyllis* P.E. Boissier. The testa fragments during imbibition as does that of *Cyamopsis* (9.06).

*Tripodion*: *T. teraphyllum* (C. Linnaeus) J.P. Fourreau (A–E). A, Fruits and fruiting calyx ( $\times 1.25$ ); B, seeds ( $\times 4$ ); C–D, testa ( $\times 50$ ,  $\times 1000$ ); E, embryos ( $\times 15$ ).



E

Genus: *Hymenocarpus* C.G. Savi

Phylogenetic Number: 13.04.

Tribe: Loteae.

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

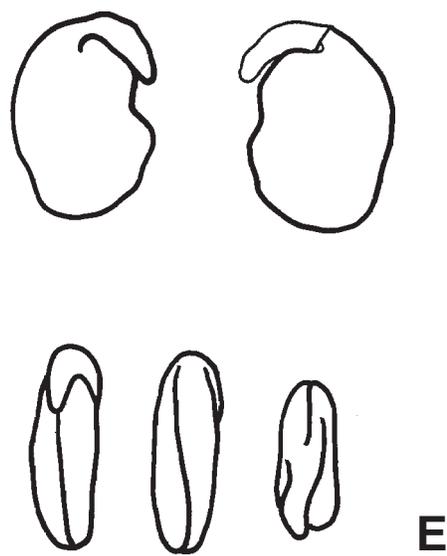
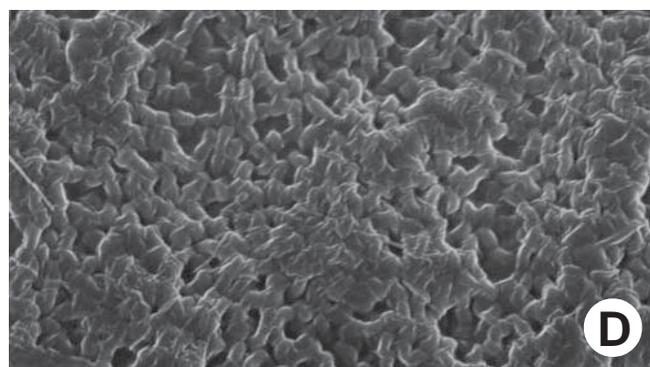
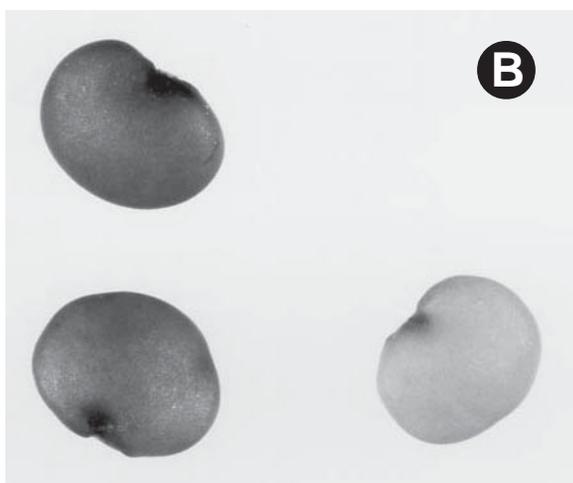
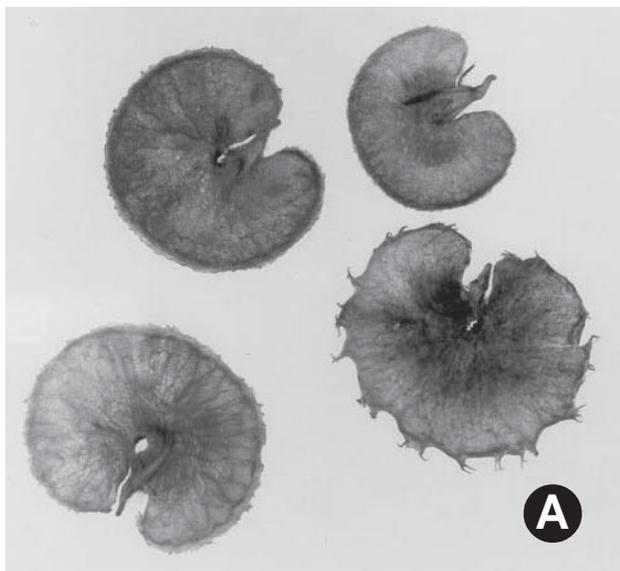
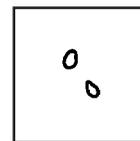
Fruit a legume; unilocular;  $2-2.5 \times 0.6-0.8 \times 0.25$  cm; with persistent calyx; with calyx shorter than fruit; with orifice formed by curving of fruit or fruit segments; 1-coiled; not plicate; not twisted; asymmetrical; coiled; when asymmetrical with both sutures parallelly curved; not inflated; flattened; without beak; truncate at apex; apex right-angled with longitudinal axis of fruit; truncate at base; base right angled with longitudinal axis of fruit; with the apex and base uniform in texture; membranous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; embellished; with wing (margins either entire, dentate, or aculeate). Fruit wing 1; 3 mm wide; sutural; on 1 suture. Fruit nonstipitate. Fruit indehiscent. Replum invisible. Epicarp dull; monochrome (to irregularly brown tinged with purple); brown, tan, or gray and purple; glabrous, pubescent and indurate, or pubescent but soon deciduous; with hairs appressed; with 1 type of pubescence; with pubescence golden; 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 present (restricted only to seed chamber); thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous. Endocarp glossy; monochrome; tan; smooth; septate; with septa thicker than paper, firm; with septa eglandular; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 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 absent.

Seed  $1-3 \times 2-2.5 \times 1$  mm; not overgrown; not angular; asymmetrical; reniform; compressed; with surface smooth; without visible radicle and cotyledon lobes; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; reddish brown, tan, cream, or yellow; glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum fully concealed; concealed by funicular remnant; without faboid split; punctiform; between cotyledon

and radicle lobe; somewhat recessed; not within corona, halo, or rim (if testa light colored) or within halo (if testa dark colored). Hilum halo color darker than testa. Lens discernible; less than 0.5 mm in length; with margins curved; elliptic; not in groove of raphe; confluent with hilum; mounded; dissimilar color from testa; darker than testa; black; 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; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; light tan; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed; with a joint evident between the radicle and the cotyledons. Radicle linear; deflexed and parallel to cotyledon length; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Mediterranean region and western Asia.

*Hymenocarpus*: *H. circinnatus* (C. Linnaeus) C.G. Savi (A-E). A, Fruits ( $\times 2$ ); B, seeds ( $\times 6$ ); C-D, testa ( $\times 50$ ,  $\times 1000$ ); E, embryos ( $\times 10$ ).



Genus: *Dorycnopsis* P.E. Boissier

Phylogenetic Number: 13.05.

Tribe: Loteae.

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

Fruit a legume; unilocular;  $0.2\text{--}0.23 \times 0.15 \times 0.1$  cm; with deciduous calyx (if fruits in a head then longer than calyx); without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; elliptic; when asymmetrical with both sutures 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; coriaceous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; embellished. Fruit wing 1; 0.3 mm wide; sutural; on 1 suture. Fruit nonstipitate. Fruit indehiscent (difficult to remove seed from fruit even though fruit coat thin). Replum invisible. Epicarp dull; monochrome; brown; 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; coriaceous. Endocarp glossy; monochrome; reddish brown; smooth; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1(–2) (though 2-seeded fruits not seen); 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 absent.

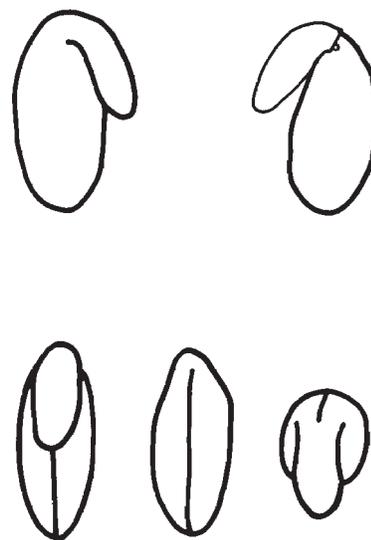
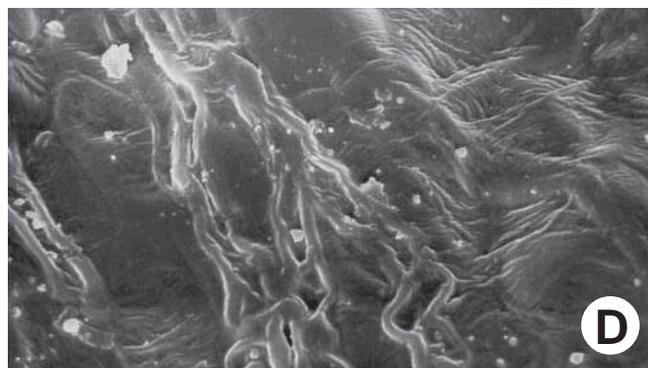
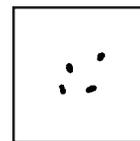
Seed  $1.5 \times 1 \times 0.8$  mm; not overgrown; not angular; symmetrical (except hilum); elliptic; terete; with surface smooth; without visible radicle and cotyledon lobes; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; brown; glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum fully concealed; concealed by funicular remnant; with faboid split; the same color as the rest of the hilum; punctiform; marginal according to radicle tip; flush; within rim. Hilum rim color darker than testa. Lens discernible; less than 0.5 mm in length; with margins straight or curved; oblong; not in groove of raphe; adjacent to hilum; 0.1 mm from hilum; mounded; dissimilar color from testa; darker than testa;

reddish brown; 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; not concealing radicle; entire over 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 deflexed; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle linear; deflexed and parallel to cotyledon length; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Spain and southwestern Europe.

Notes: This genus was part of *Anthyllis* (13.02) in the report of Polhill (1981*k*), but *Dorycnopsis* is now recognized as a separate genus (Polhill 1994*a,b*). Tikhomirov and Sokoloff (1997) examined the taxonomic status of *Vermifrux* (13.10) *abyssinica* (A. Richard) J.B. Gillett and concluded that *Vermifrux* and *Dorycnopsis* are synonymous. Therefore they made the new combination *D. abyssinica* (A. Richard) V.N. Tikhomirov & D.D. Sokoloff for the only species of *Vermifrux*. Pending further evaluation, we are accepting *Vermifrux*.

*Dorycnopsis*: *D. gerardii* (C. Linnaeus) P.E. Boissier (A–E). A, Fruits ( $\times 1.25$ ); B, seeds ( $\times 4$ ); C–D, testa ( $\times 50$ ,  $\times 1000$ ); E, embryos ( $\times 15$ ).



Genus: *Dorycnium* P. Miller

Phylogenetic Number: 13.06.

Tribe: Loteae.

Species Studied—Species in Genus: 7 spp.—ca. 12 spp.

Fruit a legume; unilocular;  $0.3\text{--}2 \times 0.2\text{--}1 \times 0.2\text{--}0.32$  cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical or symmetrical; oblong, obovate, ovate, or circular; when asymmetrical with both sutures nearly straight or parallelly curved; not inflated; terete; without or with 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 at base; base aligned or oblique with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous or ligneous; 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 or passive; with valves twisting or enrolling. Replum invisible. Epicarp dull; monochrome; light to dark reddish brown; glabrous or pubescent and indurate; pilose; with simple hairs; eglandular; without spines; not smooth; with elevated features; not veined; not tuberculate; wrinkled; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; subligneous. Endocarp glossy; monochrome or mottled; reddish brown or tan (greenish); with mottling (dark); with brown (reddish) overlay; smooth; septate or nonseptate; with septa thin (tissue paper-like), flexible; with septa eglandular; chartaceous; exfoliating in part to exfoliating; separating from mesocarp; entire. Seeds 1–8; 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 absent.

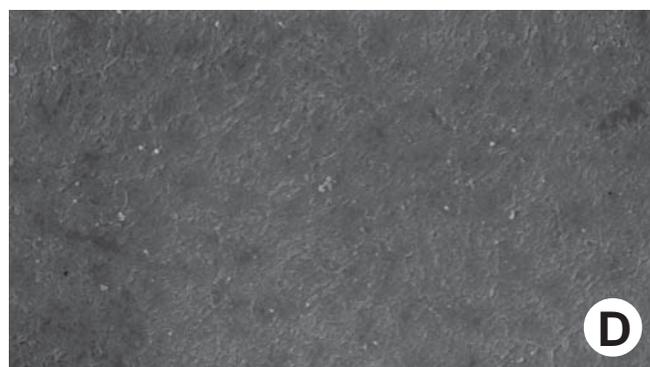
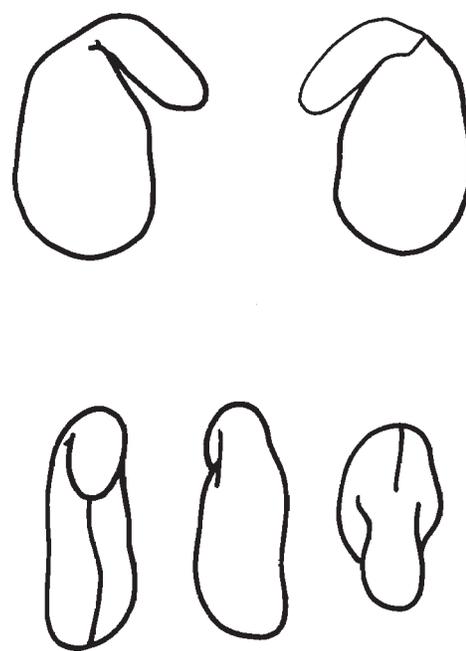
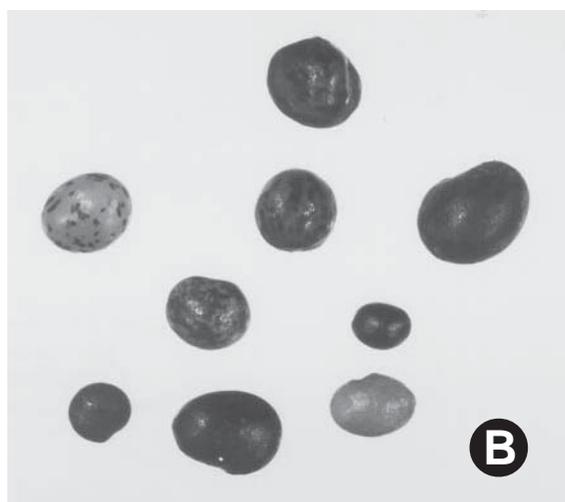
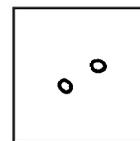
Seed  $1.3\text{--}2 \times 1\text{--}1.6 \times 1\text{--}1.4$  mm; not overgrown; not angular; symmetrical or asymmetrical; elliptic, mitaform, or circular; terete; with surface smooth; without visible radicle and cotyledon lobes; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome or mottled; with frequent mottles; brown to yellowish or reddish brown or green (to tannish); with black overlay;

glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Raphe not visible. Hilum visible or fully concealed; concealed by funicular remnant; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; punctiform; marginal according to radicle tip or between cotyledon and radicle lobe; flush; not within corona, halo, or rim or within halo. Hilum halo color darker than or lighter than testa. Lens discernible or not discernible; equal to or greater than or less than 0.5 mm in length; 0.5 mm long; with margins curved; key-hole shaped; not in groove of raphe; adjacent to hilum; 0.1 mm from hilum; mounded; dissimilar color from testa; darker than testa; black; not within corona, halo, or rim. Endosperm thick; 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; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; tan or white; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed; with a joint evident between the radicle and the cotyledons. Radicle linear or bulbous (somewhat); deflexed and parallel to cotyledon length; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Central and southern Europe and Mediterranean region.

Notes: This genus was part of *Lotus* (13.07) in the report of Polhill (1981k), but *Dorycnium* has often been recognized as a separate genus with two sections: *Bonjeania* (H.G.L.R. Reichenbach) P.E. Boissier with 2–8-seeded legumes and *Dorycnium* with 1-seeded legumes.

*Dorycnium*: *D. hirsutum* (C. Linnaeus) N.C. Seringe (C–E), *D.* spp. (A–B). A, Fruits (dehiscent and closed) ( $\times 1.25$ ); B, seeds ( $\times 4$ ); C–D, testa ( $\times 50$ ,  $\times 1000$ ); E, embryos ( $\times 15$ ).



Genus: *Lotus* C. Linnaeus

Phylogenetic Number: 13.07.

Tribe: Loteae.

Species Studied—Species in Genus: 62 spp.—ca. 100 spp.

Fruit a legume; unilocular;  $2.5\text{--}9 \times 0.2\text{--}0.8 \times 0.2\text{--}0.3$  cm; with deciduous or persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight or curved (or slightly curved); not plicate; not twisted; symmetrical or asymmetrical; linear, oblong, or falcate; when asymmetrical with both sutures parallelly curved or nearly straight; not inflated; terete or compressed; without beak; short tapered or 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; coriaceous; seed chambers externally visible or invisible; with the raised seed chambers not torulose or torulose. Fruit margin not constricted or constricted; slightly constricted along both margins; without sulcus; plain or embellished. Fruit wings absent or present (section *Tetragonolobus*); 2 or 4 (with 2 wings on long upper suture and none below or 2 wings along both sutures); 1–2 mm wide; sutural; on both sutures or 1 suture. Fruit nonstipitate. Fruit with all layers dehiscent or indehiscent (rarely); splitting along sutures. Dehiscence of valves along both sutures; apical and down; passive or active; with valves twisting or enrolling. Replum invisible. Epicarp dull; monochrome; reddish brown; glabrous or pubescent and indurate; with hairs appressed; with 1 type of pubescence; with pubescence golden; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth or smooth; with elevated features; veined or not veined; reticulately veined; not tuberculate; not exfoliating or checking (of cuticle); without or with cracks (of cuticle); cracking oblique to fruit length. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous. Endocarp dull; monochrome; tan; smooth; septate; with septa thin (tissue paper-like), flexible; with septa eglandular; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1–18; length parallel with fruit length; neither overlapping nor touching; in 1 or 2 or more series (section *Tetragonolobus*). Funiculus less than 0.5 mm long; of 1 length only; triangular or thick; straight. Aril absent.

Seed  $0.8\text{--}5 \times 0.7\text{--}5 \times 0.3\text{--}5$  mm; not overgrown; not angular or angular; symmetrical or asymmetrical; circular, mitaform, irregular, quadrangular, or triangular; terete, compressed, or quadrangular; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; glossy or dull; not modified by a bloom; colored; monochrome or mottled and streaked; with frequent mottles; with frequent streaks; dark brown, tan (to reddish), green, yellow, or purple; with black or purple overlay; glabrous; smooth or not smooth; with elevated features; tuberculate; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum partially or fully concealed; concealed by funicular remnant; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; punctiform; marginal according to radicle tip or between cotyledon and radicle lobe; flush; within rim or halo. Hilum halo color darker than testa. Hilum rim color darker than testa. Lens discernible; less than 0.5 mm in length; with margins straight or curved; linear; circular or elliptic; not in groove of raphe; adjacent to or confluent with hilum; 0.2–0.4 mm from hilum; mounded; dissimilar color from or similar color as testa; darker than testa; black; not within corona, halo, or rim. Endosperm thin or thick; covering entire embryo; adnate to embryo or 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; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; green, tan, or yellow; 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 linear; deflexed and parallel to cotyledon length; centered between cotyledons; 1/2 to nearly length of cotyledons. Plumule rudimentary; glabrous.

Distribution: North America and extratropical South America, Europe, Russia, extending into Africa and Australia.

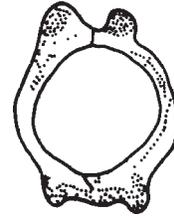
Notes: Polhill (1981k) noted that *Lotus* and *Anthyllis* (13.02) seem to be closely related to *Hammatolobium* (13.17). In our treatment, *Tetragonolobus* G.A. Scopoli is included in *Lotus* even though the species of section *Tetragonolobus* have winged fruits and generally larger seeds than species in other sections of *Lotus*. Lassen (1986) transferred *L. roudairei* E. Bonnet of North

Africa to *Acmispon* (13.07A) because of its glandular stipules and 5–6 leaflets per leaf. Kramina and Sokoloff (1997) reexamined *L. roudairei* and concluded that it is not related to New World taxa and should remain in *Lotus*. They recognized its unique features among Old World *Lotus* by placing it in the new section *Lotus* sect. *Pseudosimpetaria* T.E. Kramina & D.D. Sokoloff. We left it in *Lotus* pending further study.

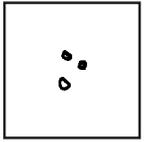
*Lotus*: *L. corniculatus* C. Linnaeus (*D–F*), *L. maritimus* C. Linnaeus (*B*), *L. spp.* (*A, C*). *A*, Fruits ( $\times 1.25$ ); *B*, fruit cross section with four wings ( $\times 10$ ); *C*, seeds ( $\times 4$ ); *D–E*, testa ( $\times 50, \times 1000$ ); *F*, embryos ( $\times 15$ ).



**A**



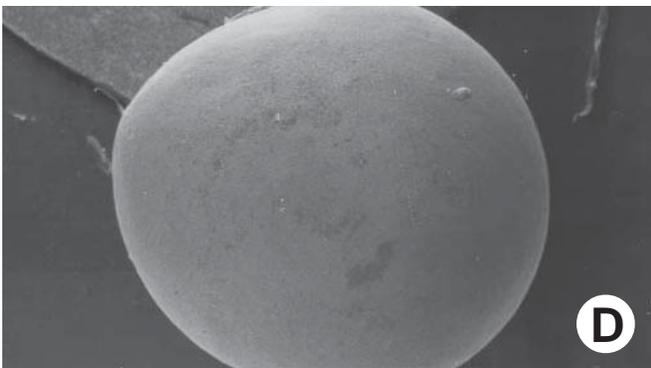
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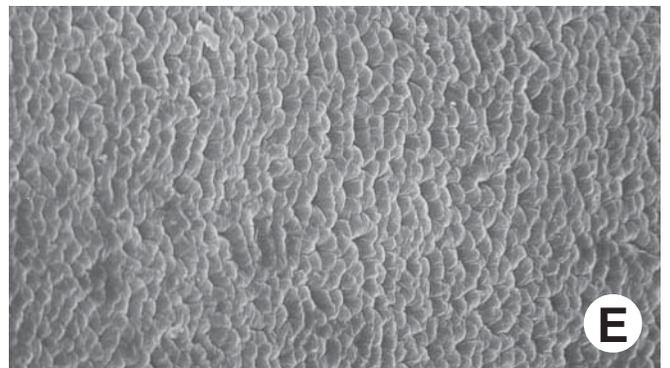
**C**



**F**



**D**



**E**

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

Phylogenetic Number: 13.07A.

Tribe: Loteae.

Species Studied—Species in Genus: 5 spp.—ca. 10 spp.

Fruit a legume; unilocular;  $0.8\text{--}3 \times 0.1\text{--}0.3 \times 0.1$  cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight or curved (or slightly curved); not plicate; not twisted; symmetrical; linear; not inflated; compressed or terete; without or with beak; hooked; 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. Fruit margin not constricted; without sulcus; plain. 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 or semiglossy; monochrome; reddish brown; glabrous or pubescent and indurate; with 1 type of pubescence; pilose or villous; with pubescence gray or golden; with pubescence uniformly distributed; pliable; with hair bases plain; eglandular or glandular; with glandular dots (in herringbone pattern on valve); without spines; not smooth; with elevated features; reticulately veined; not tuberculate; dotted or wrinkled; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous. Endocarp dull; monochrome; tan; smooth (below and around seed and cobweb between “seed chambers” or smooth throughout); septate; with septa thin (tissue paper-like), flexible (each seed in individual “seed chamber” with 2 septa between seeds or with 1 thin septum between each seed); with septa eglandular; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 5–10; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only; filiform; curved. Aril absent.

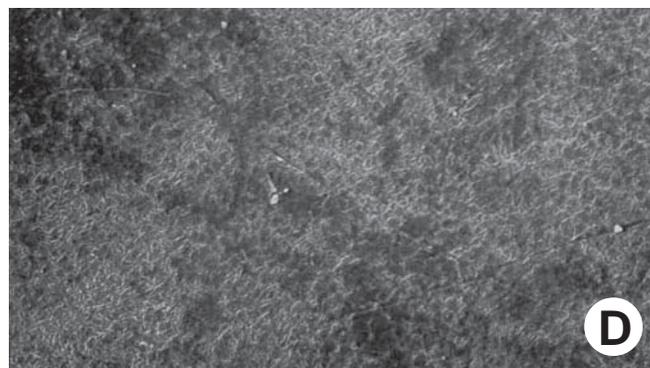
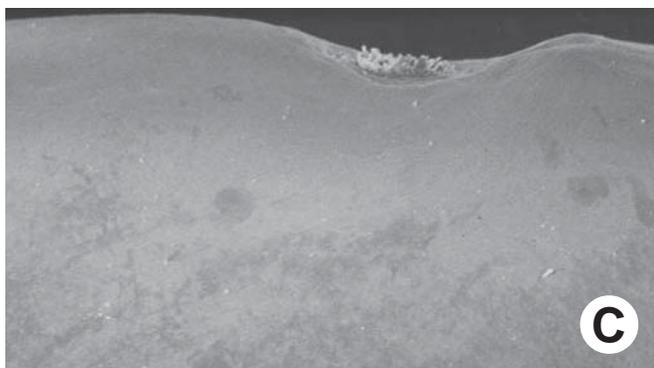
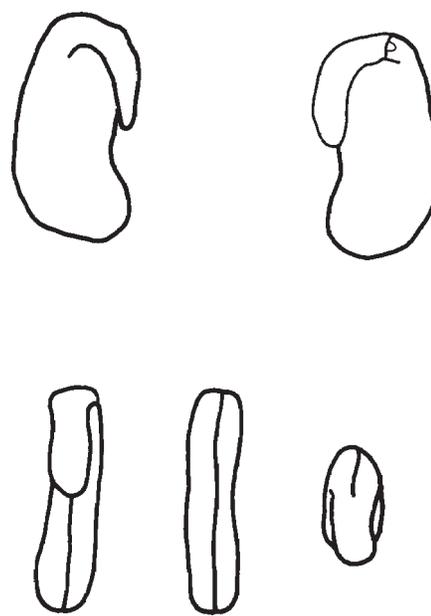
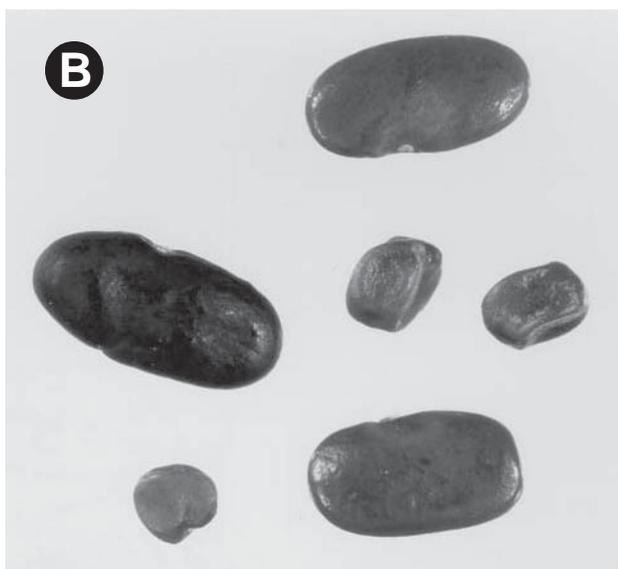
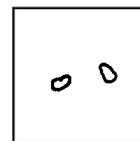
Seed  $1\text{--}2.7 \times 1\text{--}1.5 \times 0.6\text{--}0.8$  mm; not overgrown; not angular or angular; asymmetrical; circular, oblong, or mitaform; compressed; with surface smooth; with or without visible radicle and cotyledon lobes; without external groove between radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa

not adhering to endocarp; dull; not modified by a bloom; colored; monochrome or mottled and streaked (both faintly); with frequent mottles; with frequent streaks; reddish brown or tan (greenish); with brown (darker reddish) overlay; glabrous; smooth; 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; punctiform; between cotyledon and radicle lobe; barely recessed; within halo. Hilum halo color darker than testa. Lens discernible; equal to or greater than or less than 0.5 mm in length; 0.5 mm long; with margins curved; elliptic or 2 circular mounds separated by groove; not in groove of raphe; adjacent to hilum; 0.2 mm from hilum; mounded; dissimilar color from testa; darker than testa; dark reddish brown; not within corona, halo, or rim. Endosperm thin or thick; covering entire embryo; adnate to embryo or 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; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; tan, yellow, or green; 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 linear; lobe tip straight; deflexed and parallel to cotyledon length; centered or not centered between cotyledons (radicle outside 1 cotyledon and inside other, therefore junctions for each cotyledon different); less than 1/2 length or 1/2 to nearly length of cotyledon. Plumule rudimentary; glabrous.

Distribution: North America, Mexico, South America.

Notes: Lassen (1986) transferred *Lotus roudairei* E. Bonnet of North Africa to *Acmispon* because of its glandular stipules and 5–6 leaflets per leaf. Kramina and Sokoloff (1997) reexamined *L. roudairei* and concluded that it is not related to New World taxa and should remain in *Lotus*.

*Acmispon*: *A. americanus* (T. Nuttall) P.A. Rydberg (C–E); A. spp. (A–B). A, Fruits (dehiscent and closed) ( $\times 1.5$ ); B, seeds ( $\times 4$ ); C–D, testa ( $\times 50$ ,  $\times 1000$ ); E, embryos ( $\times 15$ ).



Genus: *Vermifrux* J.B. Gillett

Phylogenetic Number: 13.10.

Tribe: Loteae.

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

Fruit a legume; unilocular;  $0.4\text{--}0.6 \times 0.15\text{--}0.17 \times 0.15\text{--}0.2$  cm; with deciduous or persistent calyx (rarely); with calyx shorter than fruit; with or without orifice formed by curving of fruit or fruit segments; 1-coiled, 0.5-coiled, or curved; not plicate; not twisted; asymmetrical; coiled or C-shaped; when asymmetrical with both sutures parallelly curved; not inflated; terete; without beak; short tapered at apex; apex oblique with longitudinal axis of fruit; short tapered at base; base oblique with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally invisible or visible (faintly). Fruit margin not constricted; without sulcus; embellished. Fruit wing (very narrow) 1; 0.3 mm wide; sutural; on 1 suture. Fruit nonstipitate. Fruit indehiscent. Replum invisible. Epicarp glossy; monochrome; reddish brown or tan; 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; coriaceous. Endocarp glossy; monochrome; reddish brown; smooth; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 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 absent.

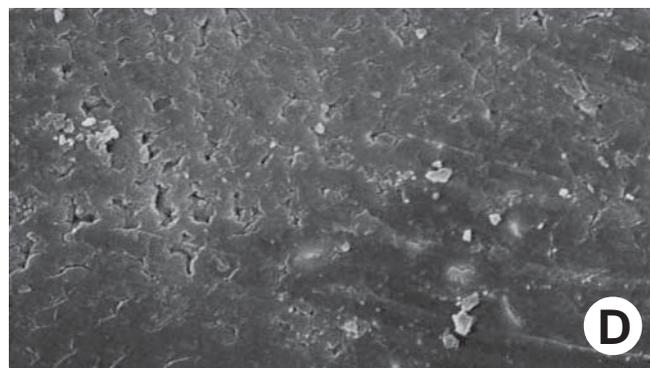
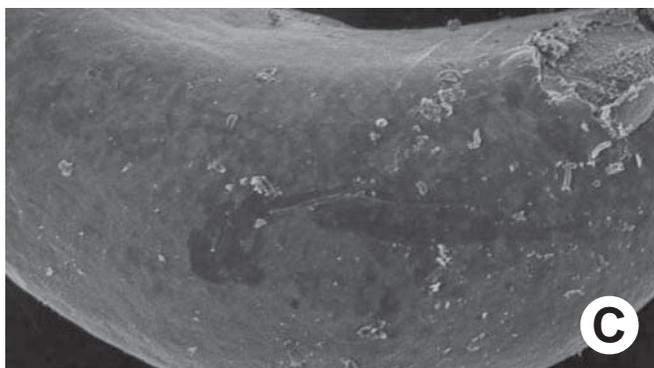
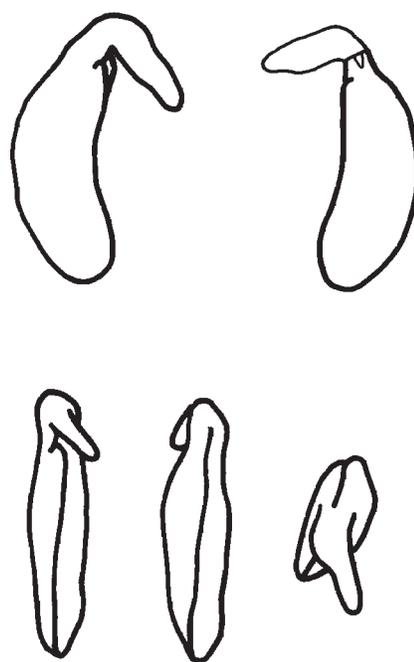
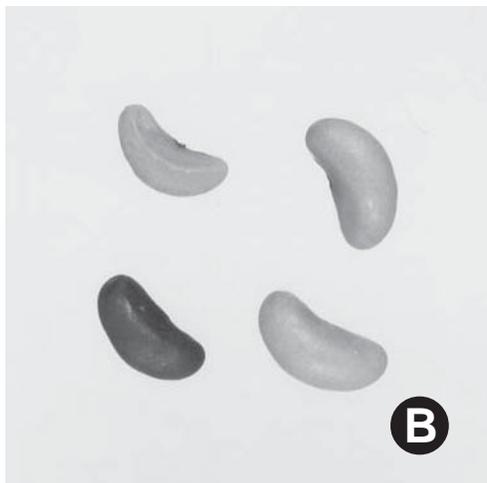
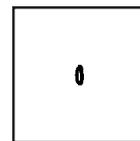
Seed  $1.8\text{--}2 \times 0.9\text{--}1 \times 0.7\text{--}0.8$  mm; not overgrown; not angular; asymmetrical; C-shaped; terete; with surface smooth; without visible radicle and cotyledon lobes; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; dark reddish brown; glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum fully concealed; concealed by funicular remnant; without faboid split; punctiform; marginal according to radicle tip; flush; within rim. Hilum rim color slightly darker than testa. Lens discernible; less than 0.5 mm in length; with margins curved; elliptic; not in groove of raphe; adjacent to hilum; 0.1 mm from hilum; mounded; dissimilar color from testa; darker than testa; black; 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; not concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; brown; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed; with a joint evident between the radicle and the cotyledons. Radicle somewhat bulbous or linear; deflexed and parallel to cotyledon length; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Africa (Yemen, Sudan, Eritrea, Ethiopia).

Notes: This genus was part of *Lotus* (13.07) in the report of Polhill (1981k), but *Vermifrux* often has been recognized as a separate genus. Tikhomirov and Sokoloff (1997) examined the taxonomic status of *Vermifrux abyssinica* and concluded that *Vermifrux* and *Dorycnopsis* (13.05) are synonymous. Therefore they made the new combination *D. abyssinica* (A. Richard) V.N. Tikhomirov & D.D. Sokoloff for the only species of *Vermifrux*. Pending further evaluation, we are accepting *Vermifrux*.

*Vermifrux*: *V. abyssinicum* (A. Richard) J.B. Gillett (A–E). A, Fruits ( $\times 1.25$ ); B, seeds ( $\times 4$ ); C–D, testa ( $\times 50$ ,  $\times 1000$ ); E, embryos ( $\times 15$ ).



Genus: *Coronilla* C. Linnaeus

Phylogenetic Number: 13.11.

Tribe: Loteae.

Species Studied—Species in Genus: 7 spp.—9 spp.

Fruit a loment (or a loment segment);  $1-5 \times 0.1-0.3 \times 0.1-0.25$  cm; with deciduous corolla; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight to curved; not plicate; not twisted; symmetrical; linear or 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 or differing in texture; upper  $3/4$  barely inflated, reticulate, and pubescent and lower  $1/4$  not inflated, reticulate, or pubescent; coriaceous; seed chambers externally visible or invisible; with the raised seed chambers not torulose. Fruit margin constricted or not constricted; constricted along both margins; without sulcus; plain. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscent. Replum invisible. Loment indehiscent. Loment segments (articles) inconspicuous; 4.5–5.5 mm long; widest across each end or widest across seed area; with upper or lower 1 different shape than middle ones; oblong or quadrangular. Epicarp dull or glaucous; monochrome; brown or tan; glabrous; glandular or eglandular; with glandular dots; limited to a portion of fruit; upper  $3/4$  glandular and lower  $1/4$  eglandular; without spines; not smooth; with elevated features; longitudinally veined relative to fruit length; not tuberculate; not exfoliating; without cracks. Mesocarp absent. Endocarp glossy; monochrome or bichrome (with central reddish-brown band); tan; smooth; nonseptate; chartaceous; not exfoliating; remaining fused to epicarp; entire. Seeds 1–7; length parallel with fruit length; neither overlapping nor touching; in 2 or more series. Funiculus less than 0.5 mm long; of 1 length only; thick; straight. Aril absent.

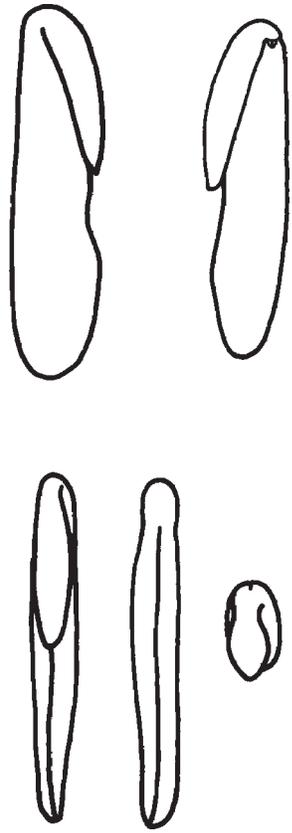
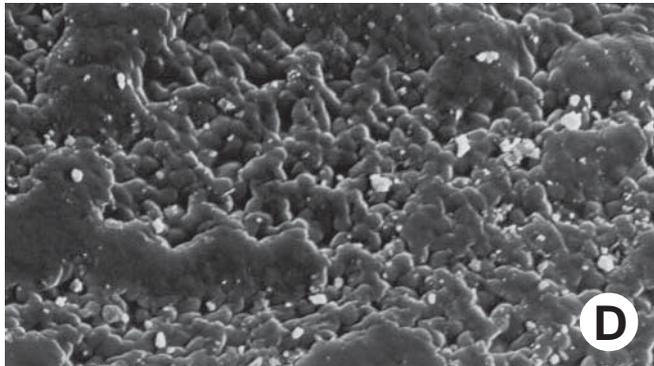
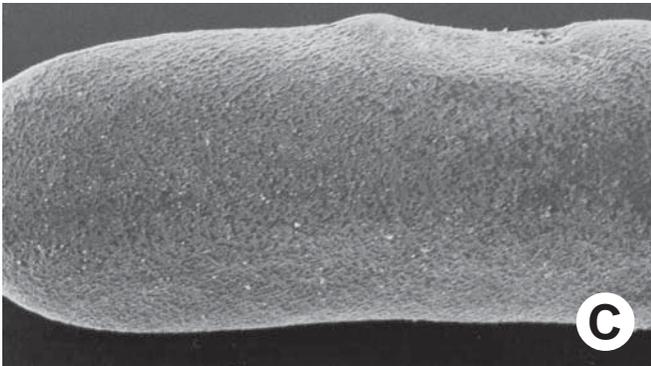
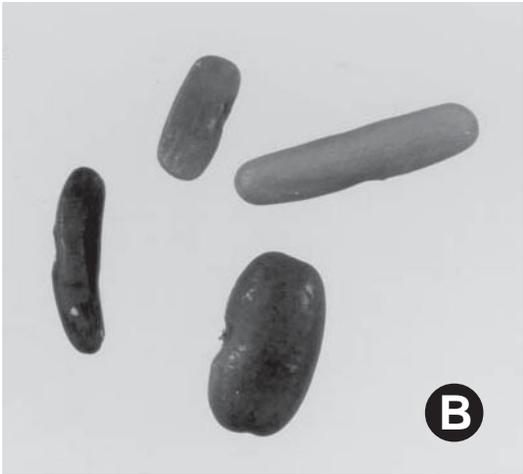
Seed  $3-5 \times 1-2 \times 1-1.5$  mm; not overgrown; not angular; symmetrical or asymmetrical; rhombic; compressed; without visible radicle and cotyledon lobes; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; dark reddish brown or tan; glabrous; smooth (except for 1 longitudinal ridge on each face) or not smooth; with

or without (Schmidt 1979a) elevated features; with 1 longitudinal ridge on each face; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible or fully concealed; concealed by funicular remnant; with or without faboid split; with the lips of the faboid split the same color as the rest of the hilum; punctiform; marginal according to radicle tip; flush or recessed (within depression or not); not within corona, halo, or rim. Lens discernible (or barely discolored or darker than testa); less than 0.5 mm in length; with margins straight; wedge-shaped; not in groove of raphe; adjacent to hilum; mounded; dissimilar color from testa; darker than testa; black or brown; not within corona, halo, or rim. Endosperm thick; covering entire embryo; adnate to testa or 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; entire over 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 deflexed; parallel to length of seed. Radicle linear; deflexed and parallel to cotyledon length; centered between cotyledons; less than  $1/2$  or  $1/2$  to nearly length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Europe, Mediterranean region, Atlantic islands, West Asia, northeastern Africa.

Notes: Schmidt (1979b) monographed *Coronilla* and documented (Schmidt 1979a) the reduction of *Securigera*. We accept *Securigera* (13.12) as a separate genus based on Lassen (1989) and use it as the basis of our species count. Schmidt (1979a) illustrated the seeds of 31 species, showing which ones bear a longitudinal line on each face.

*Coronilla*: *C. scorpioides* (C. Linnaeus) W.D.J. Koch (C–E), *C. spp.* (A–B). A, Fruits and articles ( $\times 2.3$ ); B, seeds ( $\times 6.6$ ); C–D, testa ( $\times 50$ ,  $\times 1000$ ); E, embryos ( $\times 10$ ).



Genus: *Securigera* A.P. de Candolle

Phylogenetic Number: 13.12.

Tribe: Loteae.

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

Fruit a legume or loment (or a loment segment); unilocular; 8.5–9.5 × 0.15–0.6 × 0.1–1.6 cm; with deciduous corolla; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight to curved (slightly); not plicate; not twisted; symmetrical; linear; not inflated; flattened or terete; with beak; declined or hooked; with solid beak the same color and texture as fruit; long 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; seed chambers externally visible; with the raised seed chambers not torulose. Fruit margin not constricted; with sulcus; plain or embellished; with thickened sutural areas. Fruit wings absent. Fruit substipitate or nonstipitate. Fruit indehiscent (the chartaceous valve surface between thickened sutures open transversely and irregularly in *S. securidaca*). Replum invisible. Loment indehiscent. Loment segments (articles) inconspicuous; 5–10 mm long; widest across seed area; with upper 1 different shape than middle ones; linear. Epicarp dull; monochrome or multicolored; bichrome (sutures thickened and a lighter or darker shade); brown (including dirty-brown), tan (and greenish-tan), or green; glabrous or pubescent and indurate; with 1 type of pubescence; pilose (but not on thickened sutures); with pubescence golden; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated or recessed features; veined or not veined; longitudinally veined relative to fruit length (1 medial on each valve) or reticulately veined (faint); not tuberculate; wrinkled (faintly); grooved (faintly); not exfoliating; without cracks. Mesocarp absent. Endocarp dull; monochrome; tan; smooth; septate or subseptate; with septa thicker than paper, firm; with the septa eglandular; chartaceous; not exfoliating; remaining fused to epicarp; entire. Seeds 7–9; 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 absent.

Seed 3.5–4 × 1.5–4 × 1–1.5 mm; not overgrown; angular or not angular (some are square in outline); symmetri-

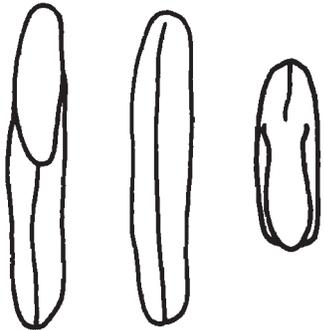
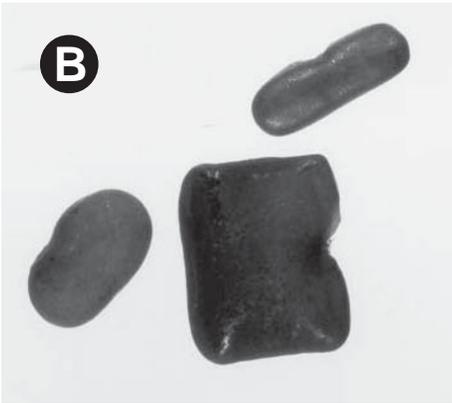
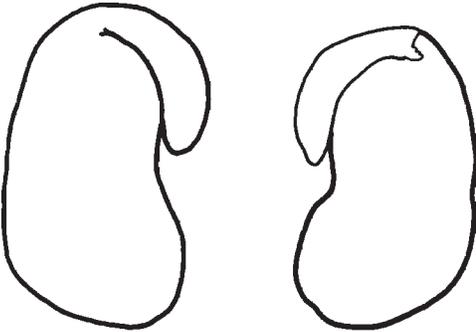
cal; linear, rectangular, or quadrangular; compressed or flattened; without visible radicle and cotyledon lobes; without umbo on seed faces. Testa not adhering to endocarp; glossy or dull; not modified by a bloom; colored; monochrome; light to dark reddish brown or tan (reddish near hilum); glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum fully concealed; concealed by funicular remnant; without faboid split; punctiform; marginal according to radicle tip; flush; not within corona, halo, or rim or within halo. Hilum halo color darker than testa. Lens discernible or not discernible; less than 0.5 mm in length; with margins curved; circular; not in groove of raphe; adjacent to hilum; 0.3 mm from hilum; mounded; same color as testa; within halo. Lens halo color darker than testa. Endosperm thick; 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; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; yellow or tan; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed. Radicle bulbous or linear; deflexed and parallel to cotyledon length; centered between cotyledons; less than 1/2 or 1/2 to nearly length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Southern Europe.

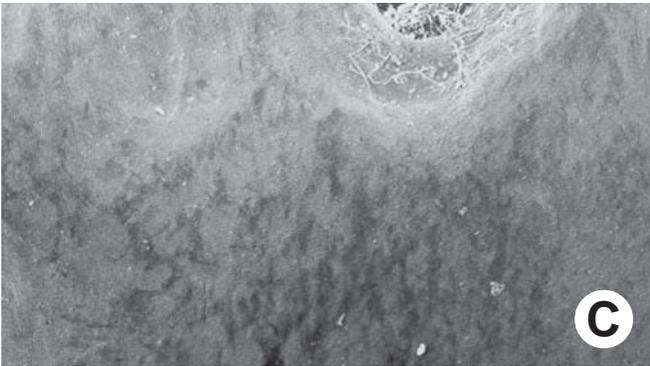
Notes: *Securigera* has been maintained separate from *Coronilla* (13.11) because of its fruits being heavy, flattened, and apparently not divided and thus not breaking into articles at maturity. It was united with *Coronilla* (13.11) for diverse reasons by Schmidt (1979a). Lassen (1989) realigned *Coronilla* (13.11), *Hippocrepis* (13.13), and *Securigera* and in so doing recognized 12 species of *Securigera*, the species count that we are using. When doing this, Lassen devaluated the loment versus legume character.

*Securigera*: *S. securidaca* (C. Linnaeus) A. von Degen & I. Doerfler (C–E), *S. spp.* (A–B). A, Fruits and articles (× 1.2); B, seeds (× 6.5); C–D, testa (× 50, × 1000); E, embryos (× 11.4).

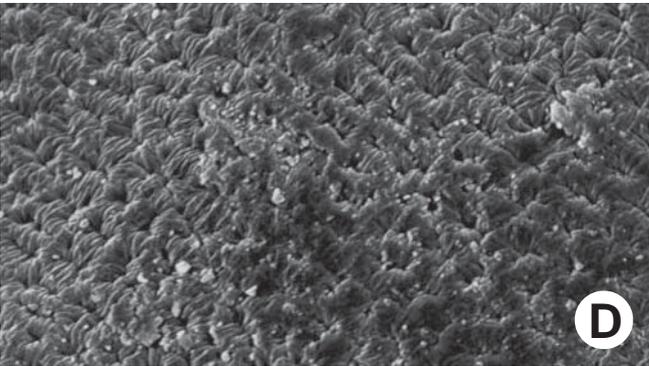
B



E



C



D

Genus: *Hippocrepis* C. Linnaeus

Phylogenetic Number: 13.13.

Tribe: Loteae.

Species Studied—Species in Genus: 10 spp.—30 spp.

Fruit a loment (or a loment segment);  $1.2-4 \times 0.1-0.6 \times 0.07-0.16$  cm; with deciduous corolla; with persistent calyx; with calyx shorter than fruit; with orifice formed by curving of fruit or fruit segments (more than 1 per fruit) or without orifice formed by curving of fruit or fruit segments (*H. emerus*); straight to curved (to slightly curved) or 0.5-coiled to 1-coiled to 1.5-coiled; not plicate; not twisted; asymmetrical or symmetrical; linear or quadrangular; when asymmetrical with both sutures parallelly or unequally curved; not inflated; flattened or compressed; without beak; long tapered to tapered at apex; apex aligned to oblique with longitudinal axis of fruit; long tapered at base; base aligned to oblique 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; constricted along both margins; without sulcus; plain or embellished; with wing. Fruit wing present or absent; 1; 2 mm wide; sutural; on both sutures. Fruit substipitate. Fruit indehiscent. Replum invisible. Loment indehiscent. Loment segments (articles) inconspicuous; 5–25 mm long; widest across seed area; with all essentially similar in shape; hippocrepiform. Epicarp semiglossy; monochrome; reddish brown; pubescent and indurate; with 1 type of pubescence; puberulent; with pubescence gray; with pubescence uniformly distributed; with glandular hairs (restricted to top of arch between winged margins); stiff; with hair bases plain; glandular; with glandular hairs; without spines; smooth or not smooth; with elevated features; longitudinally veined relative to fruit length; not tuberculate; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous. Endocarp glossy; monochrome; tan; smooth; septate; with septa thicker than paper, firm; with the septa eglandular; chartaceous; not exfoliating; remaining fused to epicarp; entire. Seeds 3–12; length transverse 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  $2-4.5 \times 0.7-0.8 \times 0.7-0.8$  mm; not overgrown; not angular; asymmetrical; hippocrepiform or linear; terete;

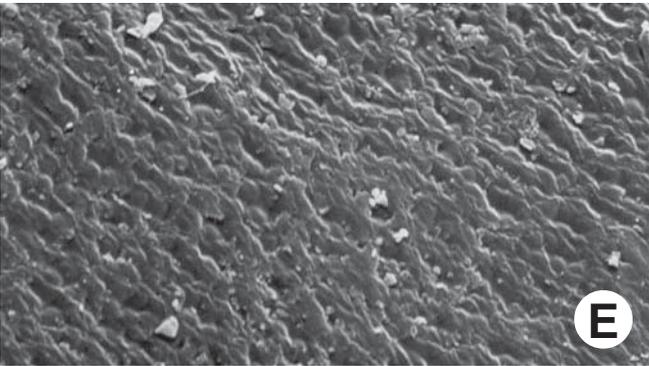
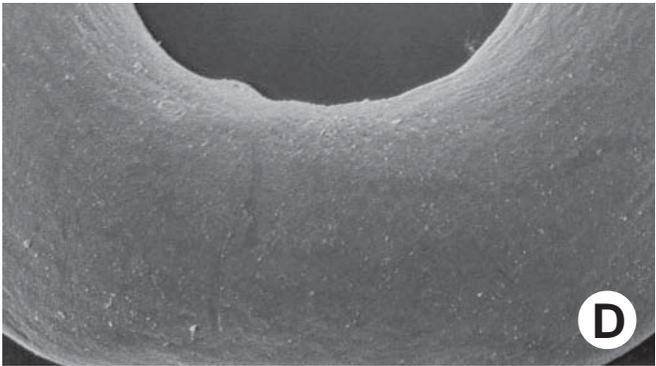
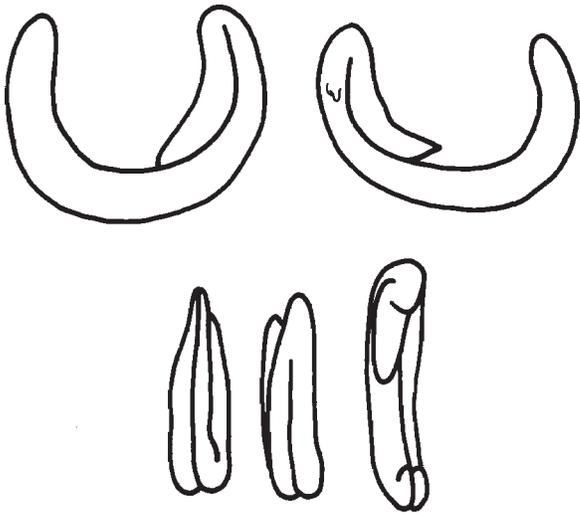
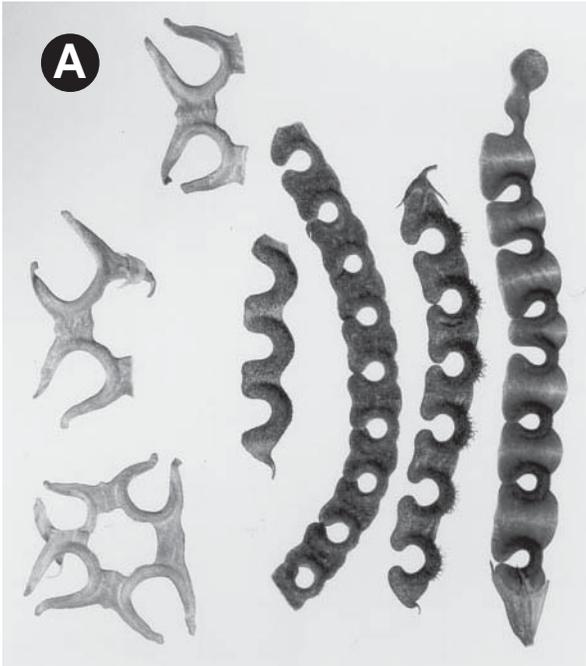
without visible radicle and cotyledon lobes; without umbo on seed faces. Testa not adhering to endocarp; glossy; not modified by a bloom; colored; monochrome; brown (brown to reddish), green (yellowish), tan, or blue (reddish); glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible; without faboid split; punctiform; between cotyledon and radicle lobe; slightly recessed; within corona (*H. ciliata* C.L. von Willdenow) or not within corona, halo, or rim. Hilum corona color darker than testa (black). Lens discernible; less than 0.5 mm in length; with margins curved; circular; not in groove of raphe; adjacent to hilum; mounded or flush; same color as testa or dissimilar color from testa; darker than testa; red; not within corona, halo, or rim. Endosperm 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; not concealing radicle; entire over 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 deflexed; parallel to length of seed. Radicle linear; with 180-degree turn; not centered between cotyledons (radicle outside 1 cotyledon and inside other, therefore junctions for each cotyledon different); less than 1/2 length of cotyledons. Plumule moderately developed; glabrous.

Distribution: Mediterranean region into Europe and western Asia.

Notes: Domínguez (1976) monographed the annual species of *Hippocrepis* and illustrated their fruits. Our species count is based on Lassen (1989), who gave the genus a traditional treatment except for the transfer of *Coronilla emerus* C. Linnaeus into *Hippocrepis*. This transfer is particularly disturbing to us because the fruit characters and to some degree the seed characters are unlike those of the other species in *Hippocrepis* (compare figs. A and B).

*Hippocrepis*: *H. emerus* (C. Linnaeus) P. Lassen (B), *H. unisiliquosa* C. Linnaeus (D–F), *H. spp.* (A, C). A–B, Fruits and fruit segments ( $\times 2$ ,  $\times 2.3$ ); C, seeds ( $\times 6$ ); D–E, testa ( $\times 50$ ,  $\times 1000$ ); F, embryos ( $\times 10$ ).

C



Genus: *Scorpiurus* C. Linnaeus

Phylogenetic Number: 13.14.

Tribe: Loteae.

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

Fruit a loment (or a loment segment);  $8 \times 0.3 \times 0.3$  cm; with deciduous corolla; with deciduous calyx; with or without orifice formed by curving of fruit or fruit segments; 4-coiled; not plicate to plicate (at most loosely plicate); loosely to tightly twisted or not twisted; asymmetrical or symmetrical; linear; when asymmetrical with both sutures nearly straight; not inflated; terete; without beak; long tapered or short tapered at apex; apex exceeding (crossing) longitudinal axis of fruit; long to 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 constricted or not constricted; slightly constricted along both margins; without sulcus; plain. Fruit wings absent. Fruit nonstipitate. Fruit indehiscent. Replum invisible. Loment indehiscent. Loment segments (articles) inconspicuous; 5–10 mm long; with all essentially similar in shape; curved. Epicarp dull; monochrome or multicolored; bichrome (spines may be darker colored than surface and ribs below spines may be darker colored); brown or tan; glabrous; eglandular; with spines (aligned in longitudinal ribs) or without spines (longitudinal ribs present); with spines persistent; with spines same color or spines (or their basal remnant) a different color from the rest of the fruit; not smooth; with elevated features; not veined; tuberculate or not tuberculate; tuberculate (blunt spines in longitudinal rows); not exfoliating; without cracks. Mesocarp absent. Endocarp dull; monochrome; tan; smooth; subseptate; with septa thicker than paper, firm; with the septa eglandular; chartaceous; not exfoliating; remaining fused to epicarp; entire. Seed 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 absent.

Seed  $2.3\text{--}5 \times 1.5\text{--}3 \times 1.5\text{--}3$  mm; not overgrown; not angular; asymmetrical; C-shaped, circular (subcircular), or reniform; terete; without visible radicle and cotyledon lobes; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; orangish red to orange; gla-

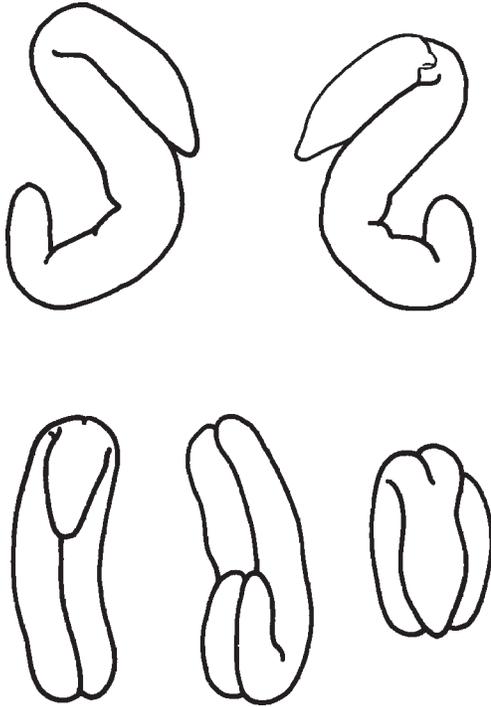
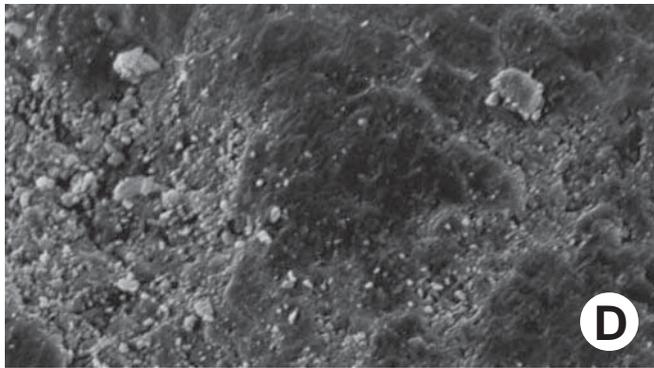
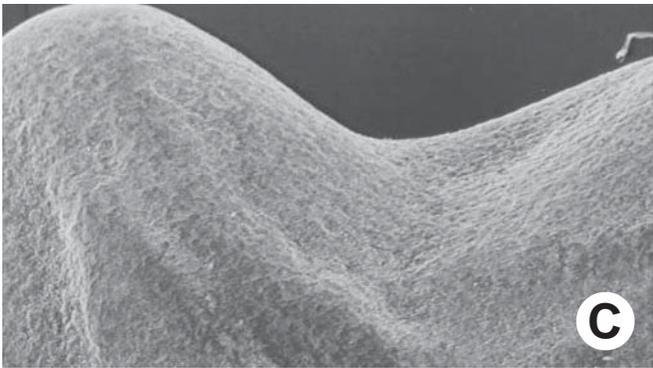
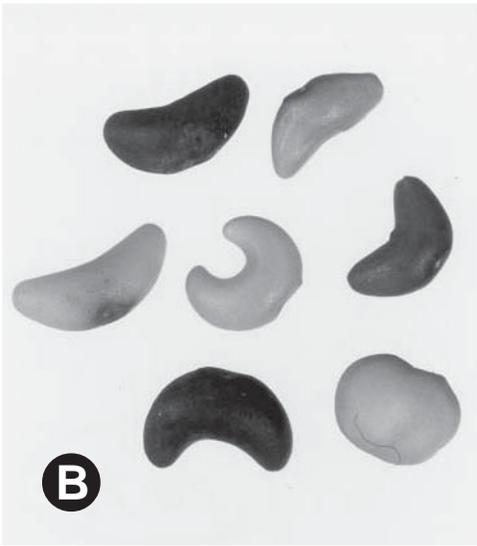
brous; smooth or not smooth; with elevated and recessed (present or absent) features; shagreen; striate (faintly and when present caused by ribs on fruit); coriaceous. Fracture lines absent. Rim absent. Raphe not visible. Hilum fully concealed; concealed by funicular remnant; without faboid split; punctiform; marginal according to radicle tip (but on side opposite lobes); flush; not within corona, halo, or rim or within halo. Hilum halo color darker than testa (blackish-brown). Lens discernible; less than 0.5 mm in length; with margins curved; elliptic; not in groove of raphe; adjacent to hilum; 0.4 mm from hilum; mounded; dissimilar color from testa; darker than testa; dark brown; not within corona, halo, or rim. Endosperm thick; covering entire embryo; adnate to embryo. Cotyledons smooth or not smooth; both outer faces convex; both the same thickness; both more or less of equal length; with both folded; 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; not concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; white; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed. Radicle bulbous; deflexed and parallel to cotyledon length; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Europe, Mediterranean region, western Asia, northeastern Africa.

Notes: Domínguez and Galiano (1974) monographed the genus and recognized four species; however, Heyn and Raviv (1966) recognized only two of the four species: *S. vermiculatus* C. Linnaeus and *S. muricatus*. Heyn and Raviv reorganized the *S. muricatus* complex with two varieties: var. *muricatus* (*S. muricatus*, s.s., and *S. sulcatus*, p.p.) and var. *subvillosus* (C. Linnaeus) J.B.A.P.M. de Lamarck (*S. subvillosus* and *S. sulcatus* C. Linnaeus, p.p.). Kaniewski and Miszkiel (1980) studied the histogenesis of the pericarp of *Scorpiurus* and noted that *S. muricatus* var. *muricatus* had “pods with smooth or tubercled ribs, usually coiled in one plane,” while *S. muricatus* var. *subvillosus* had “pods spiny, usually twisted.” Heyn and Raviv noted that the two seed shapes (straight with truncate margin and reniform with apiculate margin) faithfully reflect the degree of coiling of the loment segment, or article in which it developed. Upon soaking the seeds, the endosperm greatly expands (up to twice the diameter of the seed) and ruptures the testa, as it does in *Antopetita* (13.16).



*Scorpiurus*: *S. muricatus* C. Linnaeus (C–E), *S. spp.* (A–B).  
A, Fruits and one article ( $\times 2.2$ ); B, seeds ( $\times 4.8$ );  
C–D, testa ( $\times 50$ ,  $\times 1000$ ); E, embryos ( $\times 10$ ).



E

Genus: *Ornithopus* C. Linnaeus

Phylogenetic Number: 13.15.

Tribe: Loteae.

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

Fruit a loment (or a loment segment);  $1.5-5 \times 0.1-0.23 \times 0.08-0.13$  cm; with deciduous corolla; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; curved to 0.5-coiled; not plicate; not twisted; asymmetrical or symmetrical; linear or falcate; when asymmetrical with both sutures parallelly curved; not inflated; compressed; with beak; hooked; with solid beak the same color and texture as fruit; long tapered at apex; apex oblique 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; 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 nonstipitate. Replum invisible. Loment indehiscent. Loment segments (articles) inconspicuous or conspicuous; 4–11 mm long; widest across seed area; with upper or lower 1 different shape than middle ones; circular, oblong, or rectangular. Epicarp dull; monochrome; brown or tan; glabrous or pubescent and indurate; with 1 type of pubescence; puberulent; with pubescence brown; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; smooth or 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; coriaceous. Endocarp glossy; monochrome; tan; smooth; septate; with septa thicker than paper, firm; with the septa eglandular; chartaceous; not exfoliating; remaining fused to epicarp; entire. Seeds 4–12; 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.

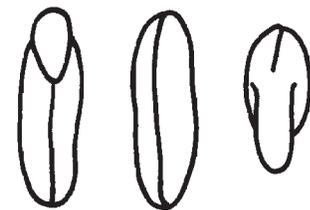
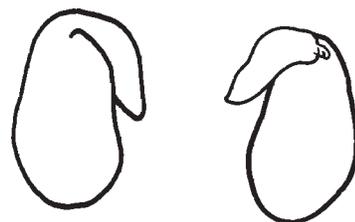
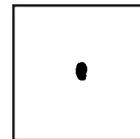
Seed  $1.5-3 \times 1-2 \times 0.7-1.1$  mm; not overgrown; not angular (except hilum); symmetrical (except hilum); circular, oblong, ovate, or reniform; compressed; without visible radicle and cotyledon lobes; without umbo on seed faces. Testa dull; not modified by a

bloom; colored; monochrome; orange (reddish), red (dish), or yellow (pale); glabrous; smooth; 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; punctiform; marginal according to radicle tip; flush; within halo. Hilum halo color darker than testa. Lens discernible or not discernible; less than 0.5 mm in length; with margins curved; circular (sub); not in groove of raphe; adjacent to hilum; mounded; dissimilar color from testa; darker than testa; black; not within corona, halo, or rim. Endosperm thick or 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; not concealing radicle; entire over 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 deflexed; parallel to length of seed. Radicle bulbous; deflexed and parallel to cotyledon length; centered between cotyledons; less than 1/2 or 1/2 to nearly length of cotyledons. Plumule rudimentary or moderately developed; glabrous.

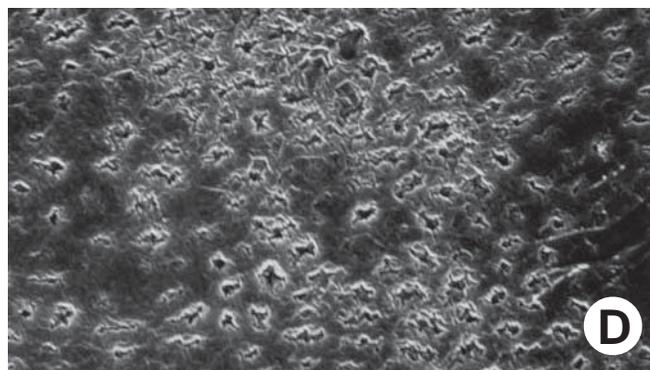
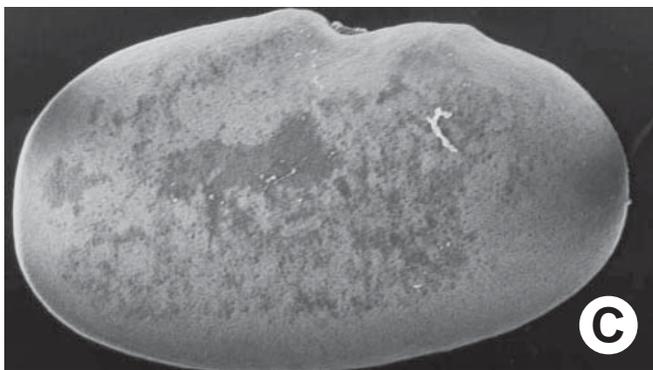
Distribution: Five species in Europe, Mediterranean region, western Asia, and Atlantic islands; *O. micranthus* (G. Benth) J. Arechaveleta y Bolpardo in southern South America.

Notes: Alsina (1988) described the morphology and anatomy of seeds of four species and illustrated their testa with micrographs at  $\times 320$ . The monotypic genus *Antopetitia* (13.16) differs by having dehiscent fruit segments and a persistent dorsal suture (Verdcourt 1974).

*Ornithopus*: *O. sativus* F.d'A. Brotero (C–E), *O. spp.* (A–B). A, Fruits and articles ( $\times 2.2$ ); B, seeds ( $\times 5.6$ ); C–D, testa ( $\times 50$ ,  $\times 1000$ ); E, embryos ( $\times 10$ ).



**E**



Genus: *Antopetitia* A. Richard

Phylogenetic Number: 13.16.

Tribe: Loteae.

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

Fruit a legume or a loment (not a true loment); unilocular; 0.7–1.2 × 0.2–0.25 × 0.23 cm; with deciduous corolla; 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; falcate or moniliform; when asymmetrical with both sutures parallelly curved; not inflated; terete; with beak (small); straight; with solid beak the same color and texture as fruit; rounded at apex; apex aligned with longitudinal axis of fruit; short tapered at base; base oblique 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; plain. Fruit wings absent. Fruit substipitate (may be longer than 2–3 mm if lowest locule aborted). Fruit with all layers dehiscing; fenestrating, opening by a coiling strip of tissue. Dehiscence of valves along 1 suture; passive. Replum invisible. Loment dehiscing along 1 suture. Loment segments (articles) inconspicuous; 2–2.5 mm long; widest across seed area; with upper or lower 1 different shape than middle ones; circular. Epicarp glossy; monochrome; light brown to tan; 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 fibers; solid; coriaceous. Endocarp glossy; monochrome; tan or white; smooth; nonseptate; chartaceous; not exfoliating; remaining fused to epicarp; entire. Seeds 2–4; length parallel with fruit length; neither overlapping nor touching; in 2 or more series. Funiculus less than 0.5 mm long; of 1 length only; thick; straight. Aril absent.

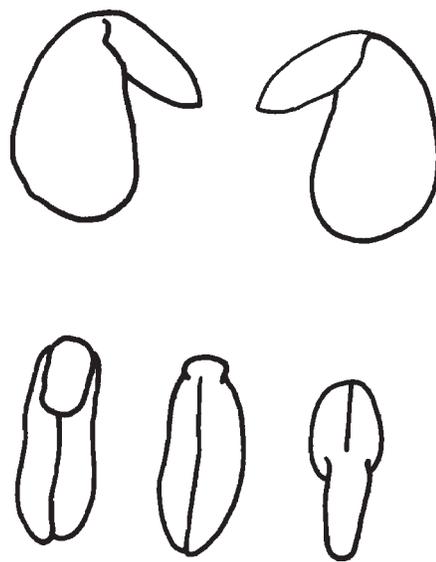
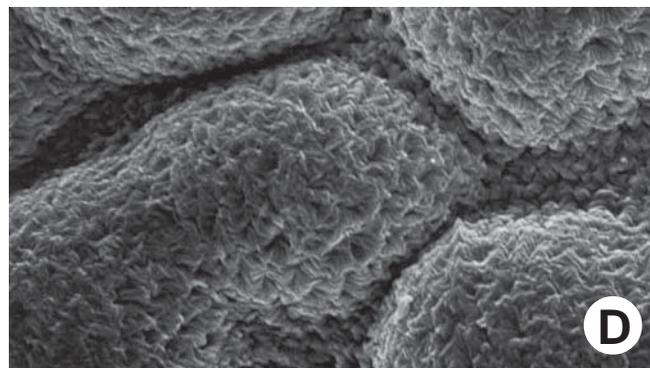
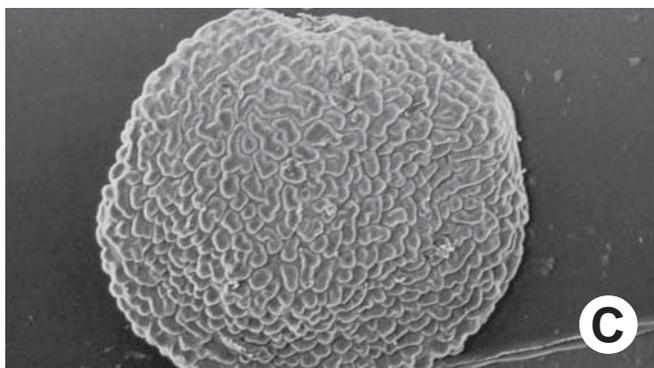
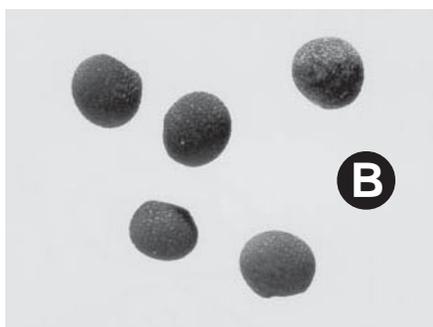
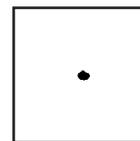
Seed 1.5–2 × 1.2–1.7 × 0.5–1.3 mm; not overgrown; angular to not angular; asymmetrical; circular to irregular; compressed; without visible radicle and cotyledon lobes; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; dark to reddish brown to tan (reddish); glabrous; not smooth; with elevated features; rugose or tuberculate; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum

visible; without faboid split (hilum too small); punctiform; between cotyledon and radicle lobe; flush; not within corona, halo, or rim. Lens not discernible. Endosperm thick; 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; not concealing radicle; entire over 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 deflexed; oblique to length of seed. Radicle bulbous; oblique to cotyledons; centered between cotyledons; 1/2 to nearly length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Tropical Africa.

Notes: Polhill (1981) noted that this genus is closely related to *Ornithopus* (13.15) and that the genera of the Coronilleae only differ from those of the Loteae (13) by the presence of jointed fruits in the former. Verdcourt (1974) noted that *Antopetitia* is “a monotypic genus closely allied to *Ornithopus* L., but differing in the pod segments being dehiscent and in the persistent dorsal suture.” Both authors alluded to an anomaly in fruit of *Antopetitia*. These fruits are unique in the Fabaceae. At first glance they appear to be loment, but they are not. At most they are loment-like or lomentaceous because the fruits dehisce, albeit by a unique mechanism. In addition, Léonard (1954, fig. 10) clearly illustrated that the fruit dehisces on the plant, the seeds falling free of the fruiting cluster. By definition a loment separates at maturity into 1-seeded indehiscent articles. The unique dehiscence mechanism is the opening of the valves by the rolling up of the vertical suture. During the process, the individual fruit segments become fenestrated and then the seed may fall out or one valve may fall off (Léonard 1954, fig. 10). Upon soaking the testa fractures as the endosperm rapidly expands (as in *Scorpiurus* (13.14)). Both the seed and fruit dehiscences are related to edaphic factors in the habitat of the species.

*Antopetitia*: *A. abyssinica* A. Richard (A–E). A, Fruits and fruit segments (× 4.5); B, seeds (× 6.3); C–D, testa (× 50, × 1000); E, embryos (× 20).



Genus: *Hammatolobium* E. Fenzl

Phylogenetic Number: 13.17.

Tribe: Loteae.

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

Fruit a loment (or a loment segment);  $2-6 \times 0.15-0.4 \times 0.2$  cm; with deciduous corolla; 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 and moniliform; not inflated; compressed; 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 visible; with the raised seed chambers not torulose. Fruit margin constricted along both margins; without sulcus; plain. Fruit wings absent. Fruit substipitate. Fruit indehiscent. Replum invisible. Loment indehiscent. Loment segments (articles) inconspicuous; 3–6 mm long; widest across seed area; with upper or lower 1 different shape than middle ones; oblong. Epicarp dull; monochrome; dark brown; pubescent and indurate; with 1 type of pubescence; pilose or villous; with pubescence golden; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; smooth or 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; coriaceous. Endocarp glossy; monochrome; white; smooth; septate; with septa thicker than paper, firm; with the septa eglandular; coriaceous; not exfoliating; remaining fused to epicarp; entire. Seeds up to 11; 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  $2.5 \times 2.3 \times 1$  mm; not overgrown; not angular; asymmetrical; nearly circular; compressed; without visible radicle and cotyledon lobes; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; reddish brown; glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum fully concealed; concealed by funicular remnant; without faboid split; punctiform; between cotyledon

and radicle lobe; recessed; not within corona, halo, or rim. Lens discernible; less than 0.5 mm in length; with margins curved; elliptic; not in groove of raphe; adjacent to hilum; mounded; dissimilar color from testa; darker than testa; black; 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; not concealing radicle; entire over 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 deflexed; oblique to length of seed. Radicle linear; oblique to cotyledons; centered between cotyledons;  $1/2$  to nearly length of cotyledons. Plumule rudimentary; glabrous.

Distribution: One species at either end of the Mediterranean region.

Notes: Polhill (1981) noted that this genus seems to be more closely related to *Anthyllis* (13.02) and *Lotus* (13.07) in the Loteae than to *Coronilla* (13.11).

*Hammatolobium*: *H. kremerianum* (E.St.-C. Cosson) C.H. Muller (C–E), *H. spp.* (A–B). A, Fruits with calyx and 1 article ( $\times 1.8$ ); B, seeds ( $\times 7$ ); C–D, testa ( $\times 50$ ,  $\times 1000$ ); E, embryos ( $\times 10$ ).

