

Carmichaelieae (17.01–17.05)

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

Phylogenetic Number: 17.01.

Tribe: Carmichaelieae.

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

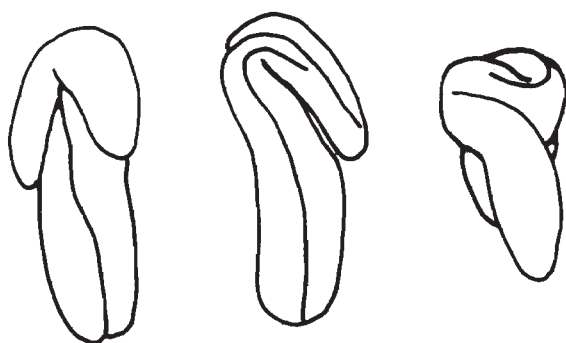
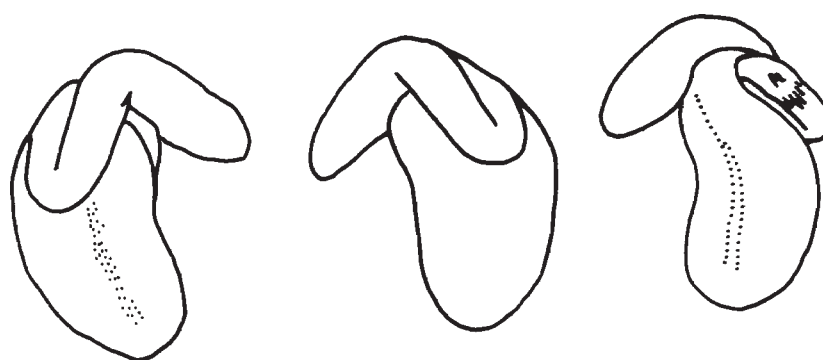
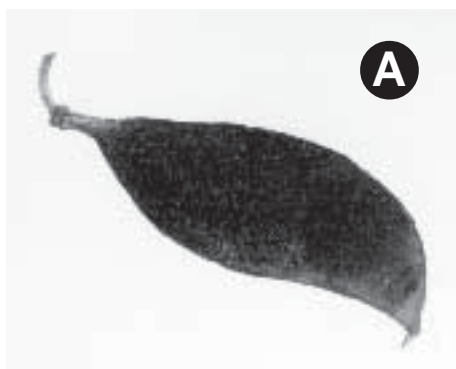
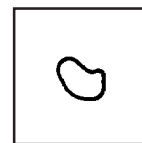
Fruit a legume; unilocular; $4.5 \times 1.8 \times 0.3$ cm; with deciduous corolla; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical or symmetrical; oblong or falcate (obliquely subfalcate); when asymmetrical with both sutures parallelly to unequally curved; not inflated; compressed; without beak; tapered at apex; apex right-angled 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 (barely). Fruit margin not constricted; without sulcus; plain. Fruit stipitate; with the stipe 6 mm long. Replum invisible. Epicarp dull; monochrome; dark brown; pubescent but soon deciduous to glabrous (with age); with 1 type of pubescence; 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; not exfoliating; without cracks. Seeds length parallel with fruit length; neither overlapping nor touching; in 1 series. Aril absent.

Seed $6 \times 4.5 \times 3$ mm; not overgrown; not angular; asymmetrical; reniform; compressed; with visible radicle and cotyledon lobes; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; brown (dark reddish); glabrous; smooth; coriaceous (assumed). Fracture lines absent. Rim absent. Raphe from hilum to lens; not bifurcating; color of testa; recessed. Hilum fully concealed or partially concealed; concealed by radicle lobe or wing; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 1 mm long; with curved outline; elliptic; marginal according to radicle tip; recessed; not within corona, halo, or rim. Lens discernible; less than 0.5 mm in length; with margins curved; circular; in groove of raphe; adjacent to hilum; 1.5 mm from hilum; recessed; dissimilar color from testa; darker than testa; black; not within corona, halo, or rim. Radicle lobe tip curved.

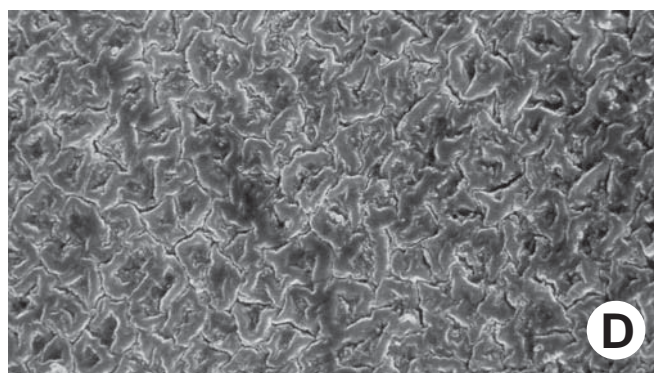
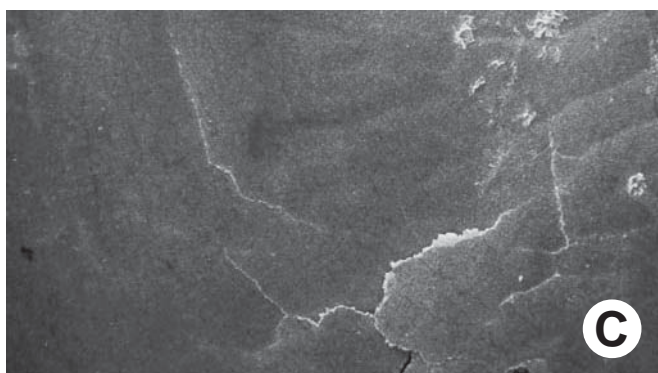
Distribution: Philip Island.

Notes: Hutchinson (1964) established the tribe Carmichaelieae, and Polhill (1981i, 1994a,b) accepted it. Heenan (1995, 1998c), using unpublished nuclear ribosomal DNA ITS data, concluded that “*Carmichaelia* (17.05) is nested within [the] ‘Astragalean clade’ of Galegeae” and is the sister group of *Clianthus* (16.01). He therefore supported the proposal of Sanderson and Wojciechowski (1996) that Carmichaelieae should not be recognized at tribal level but rather should be included in Galegeae (16). Heenan (1998c) also carried out cladistic analyses of *Carmichaelia* (17.05), *Chordospartium* (17.03), *Corollospartium* (17.04), and *Notospartium* (17.02) using morphological and anatomical characters. Heenan (1998a,c) concluded that “*Carmichaelia* is paraphyletic with *Chordospartium*, *Corollospartium*, and *Notospartium* excluded,” and reunited them with *Carmichaelia*. Polhill (1981i) noted that *Streblorrhiza* is extinct. Hutchinson (1964) stated that the “embryonic axis is twice folded.” We were able to study only one mature pod and one mature seed.

Streblorrhiza: *S. speciosa* S.F.L. Endlicher (A–E). A, Fruit ($\times 1.2$); B, seed ($\times 3.3$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 4.7$).



E



Genus: *Notospartium* J.D. Hooker

Phylogenetic Number: 17.02.

Tribe: Carmichaelieae.

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

Fruit a legume; unilocular; $2.5\text{--}2.8 \times 0.5\text{--}0.6 \times 0.17\text{--}0.3$ cm; with deciduous corolla; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight or curved (slightly); not plicate; not twisted; asymmetrical; linear (nearly); when asymmetrical with both sutures parallelly curved to 1 straight and 1 curved suture; not inflated; compressed; without beak; 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; with the raised seed chambers not torulose. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit substipitate. Fruit indehiscent. Replum invisible. Epicarp dull; monochrome; tan; glabrous; eglandular; without spines; not smooth; with elevated features; transversely 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 dull; monochrome; tan; cobwebby; subseptate; with septa thin (tissue paper-like), flexible; with the septa eglandular; chartaceous; not exfoliating; remaining fused to epicarp; entire. Seeds 3–5; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 1 mm long; of 1 length only; filiform; straight. Aril absent.

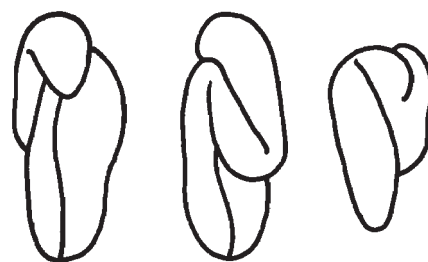
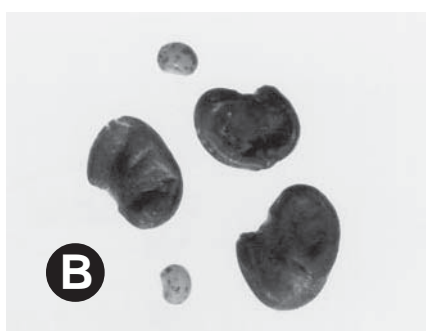
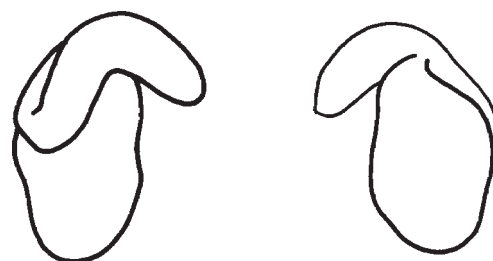
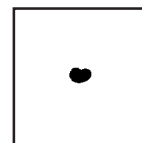
Seed $2.5\text{--}3.5 \times 2\text{--}2.8 \times 1.2\text{--}1.3$ mm; not overgrown; angular or not angular; asymmetrical; mitaform; compressed; with visible radicle and cotyledon lobes; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome or mottled and streaked; with frequent mottles; with frequent streaks; brownish red; with black overlay; glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe from hilum to lens; not bifurcating; darker than testa; raised. 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; recessed; not within corona, halo, or rim. Lens discernible; less than 0.5 mm in length; with margins curved; punctiform; not in groove of raphe; adjacent to hilum; 1 mm from hilum;

mounded; similar color as testa; darker than testa; brownish red; not within corona, halo, or rim. 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; tan; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed. Radicle linear; lobe tip straight; with 360-degree turn; not centered between cotyledons (radicle outside 1 cotyledon and inside other, therefore junctions for each cotyledon different); exceeding length of cotyledons. Plumule rudimentary; glabrous.

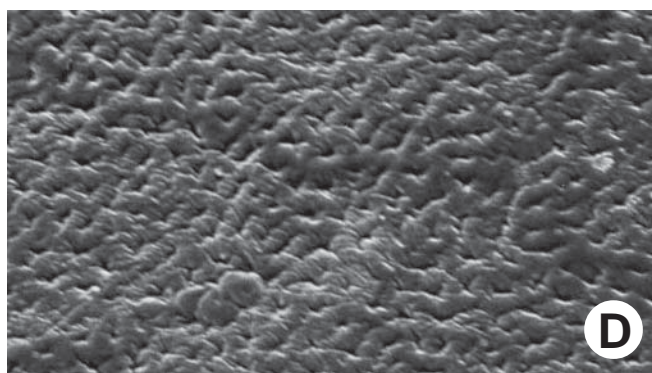
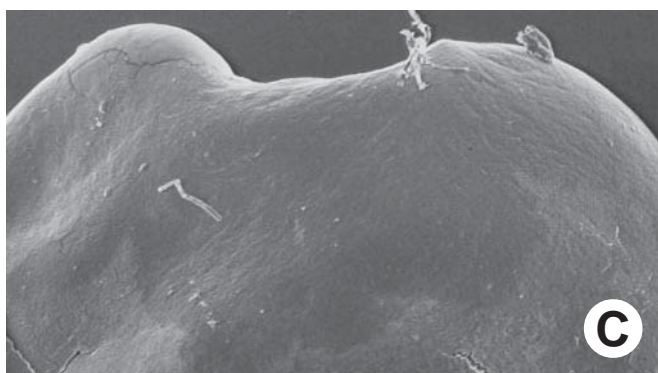
Distribution: New Zealand (South Island).

Notes: Heenan (1998a,c) carried out cladistic analyses of *Carmichaelia* (17.05), *Chordospartium* (17.03), *Corollospartium* (17.04), and *Notospartium* using morphological and anatomical characters and concluded that this genus should be merged with *Carmichaelia*.

Notospartium: *N. carmichaeliae* J.D. Hooker (C–E), *N.* spp. (A–B). A, Fruits and valve ($\times 2$); B, seeds ($\times 5.3$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 10$).



E



Genus: *Chordospartium* T.F. Cheeseman

Phylogenetic Number: 17.03.

Tribe: Carmichaelieae.

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

Fruit a legume; bilocular; $0.4\text{--}0.5 \times 0.2\text{--}0.26 \times 0.13\text{--}0.18$ cm; with deciduous corolla; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; when asymmetrical with 1 straight and 1 curved suture; widest near middle or D-shaped; not inflated; compressed; without beak; short tapered at apex; apex aligned with longitudinal axis of fruit or right-angled 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. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit substipitate. Fruit indehiscent. Replum invisible. Epicarp dull; multicolored; mottled; brown; with brown overlay; pubescent and indurate; with 1 type of pubescence; pilose (crinkled); with pubescence gray; 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; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous. Endocarp glossy; monochrome; tan; smooth; nonseptate; chartaceous; not exfoliating; remaining fused to epicarp. Seed 1; length parallel with fruit length. Funiculus measured; to 1 mm long; filiform; straight. Aril absent.

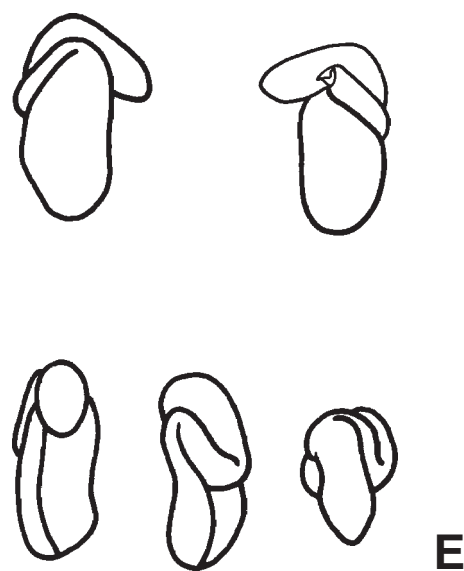
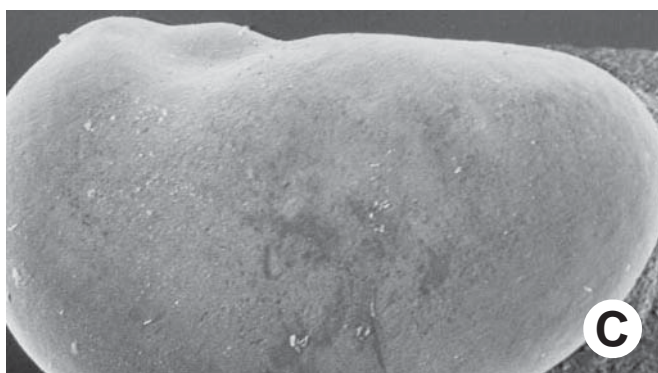
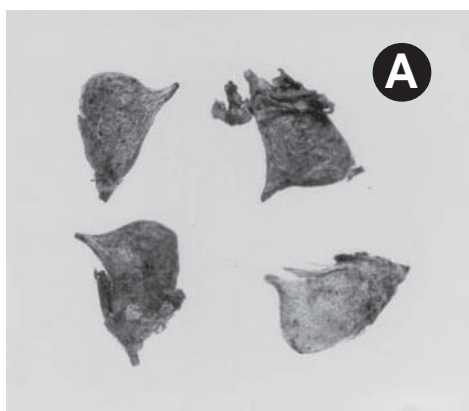
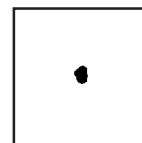
Seed $2.5\text{--}3 \times 1.8\text{--}2 \times 1\text{--}1.2$ mm; not overgrown; not angular; asymmetrical; reniform; compressed; with visible radicle and cotyledon lobes; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; red; glabrous; not smooth; with recessed features; pitted with small separate pits; coriaceous. Fracture lines absent. Rim absent. Raphe from hilum to lens; darker than testa (slightly); flush. Hilum visible; without faboid split; punctiform; marginal according to radicle tip; recessed; not within corona, halo, or rim. Lens discernible; less than 0.5 mm in length; with margins curved; punctiform; not in groove of raphe; adjacent to hilum; 0.7 mm from hilum; mounded; same color as testa or dissimilar color from testa; darker than testa;

red; not within corona, halo, or rim. 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; differing at apex (1 concealed by overarched radicle and other auriculate and concealing radicle); not concealing radicle; 1 cotyledon scooped out to accommodate plicate radicle and other cotyledon entire; without lobes; with the interface division terminating at base of radicle; brownish red; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; plicate to length of seed. Radicle linear; lobe tip curved; with 360 degree turn; centered between cotyledons; exceeding length of cotyledons. Plumule rudimentary; glabrous.

Distribution: New Zealand (South Island).

Notes: Heenan (1998a,c) carried out cladistic analyses of *Carmichaelia* (17.05), *Chordospartium*, *Corallospartium* (17.04), and *Notospartium* (17.02) using morphological and anatomical characters and concluded that this genus should be merged with *Carmichaelia*.

Chordospartium: *C. stevensonii* T.F. Cheeseman (A–E). A, Fruits ($\times 3.9$); B, seeds ($\times 4$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 8$).



Genus: *Corallospartium* J.B. Armstrong

Phylogenetic Number: 17.04.

Tribe: Carmichaelieae.

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

Fruit a legume; unilocular; $0.5\text{--}0.6 \times 0.25\text{--}0.3 \times 0.2\text{--}0.22$ cm; with deciduous corolla; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; when asymmetrical with 1 straight and 1 curved suture; widest near middle or D-shaped; not inflated; compressed; without beak; 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; coriaceous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down (assumed); passive. Replum invisible. Epicarp dull; monochrome; gray; pubescent and indurate; with 1 type of pubescence; velutinous; with pubescence gray; 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; not exfoliating; without cracks. Mesocarp absent or present (if present, very thin). Endocarp dull; monochrome; tan; smooth; nonseptate; chartaceous; not exfoliating; remaining fused to epicarp; entire. Seeds 1(–2); length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; less than 1 mm long; of 1 length only; filiform; straight. Aril absent.

Seed $1.9\text{--}2.1 \times 1.4\text{--}1.6 \times 1.4\text{--}1.6$ mm; overgrown, 1 seed filling entire fruit cavity; not angular; symmetrical; circular; terete; with visible radicle and cotyledon lobes (barely); without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; mottled and streaked; with frequent mottles; with frequent streaks; brown or green; with green or black (bluish) overlay; glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible; without faboid split; punctiform; marginal according to radicle tip; recessed. Lens discernible; less than 0.5 mm in length; with margins curved; punctiform; not in groove of raphe; adjacent to hilum; 0.5 mm from hilum; flush; dissimilar color from

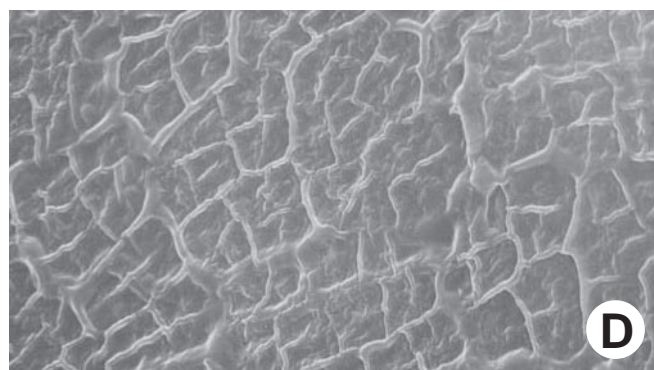
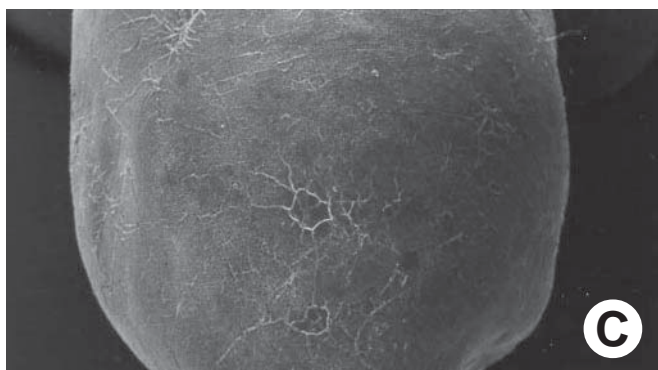
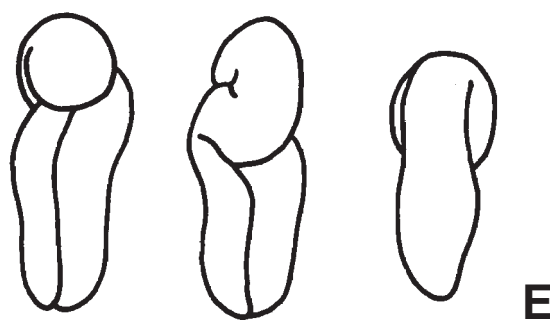
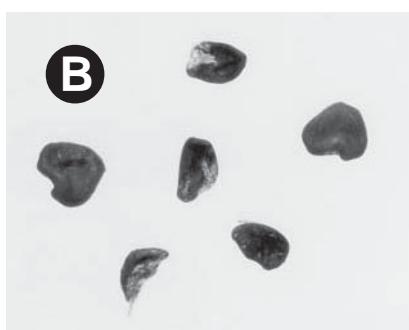
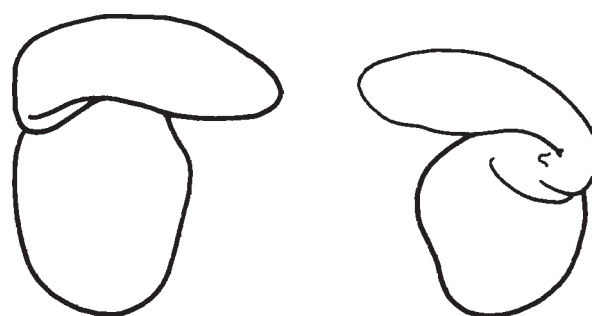
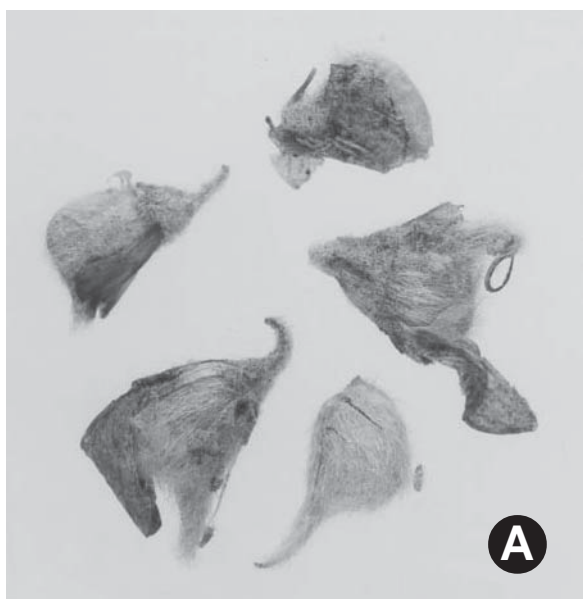
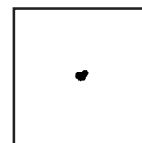
testa; darker than testa; brown; not within corona, halo, or rim. Endosperm thin; covering entire embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; reddish tan; inner face flat; glabrous around base of radicle. Embryonic axis oblique; perpendicular to length of seed. Radicle linear; lobe tip curved; with 180 degree turn; not centered between cotyledons (radicle outside 1 cotyledon and inside other, therefore junctions for each cotyledon different); exceeding length of cotyledons. Plumule rudimentary; glabrous.

Distribution: New Zealand (South Island).

Notes: Heenan (1998a,c) carried out cladistic analyses of *Carmichaelia* (17.05), *Chordospartium* (17.03), *Corallospartium*, and *Notospartium* (17.02) using morphological and anatomical characters and concluded that *Corallospartium* should be merged with *Carmichaelia*. Cheeseman (1906) noted that *Corallospartium* “is technically separated from *Carmichaelia* by the 2-valved pod without a persistent replum.”

Corallospartium: *C. crassicaule* (J.D. Hooker) J.B.

Armstrong (A–E). A, Fruits (with calyx and floral parts) ($\times 4.1$); B, seeds ($\times 7.3$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 20$).



Genus: *Carmichaelia* R. Brown

Phylogenetic Number: 17.05.

Tribe: Carmichaelieae.

Species Studied—Species in Genus: 7 spp.—18 spp.

Fruit a legume; unilocular; $0.5\text{--}5 \times 0.15\text{--}0.8 \times 0.1\text{--}0.15$ cm; with deciduous corolla; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical or symmetrical; subcircular, oblong, ovate, elliptic, linear, or falcate; when asymmetrical with both sutures parallelly curved; not inflated; compressed to terete; with beak; straight; with solid beak the same color and texture as fruit; abruptly long acuminate 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; ligneous; seed chambers externally visible; with the raised seed chambers not torulose. Fruit margin not constricted; without sulcus; embellished; with thickened sutural areas. Fruit wings absent. Fruit substipitate. Fruit with all layers dehiscent or indehiscent; splitting along suture. Dehiscence of valves along 1 suture; basal and up; active; with valves twisting. Replum visible or invisible. Epicarp dull; monochrome; black, brown, or tan; glabrous; without spines; not smooth; with elevated features; transversely veined relative to fruit length; not tuberculate; wrinkled; not exfoliating; without cracks. Mesocarp thin; 1-layered; without balsamic vesicles; without fibers; solid; ligneous. Endocarp dull; monochrome; brown; fibrous; subseptate or nonseptate; with septa thin (tissue paper-like), flexible; with the septa eglandular; chartaceous; not exfoliating; remaining fused to epicarp. Seeds 1–12; length parallel with fruit length; overlapping or neither overlapping nor touching; in 1 series. Funiculus measured; $0.3\text{--}2.5$ mm long; of 1 length only; filiform or thick; straight, S-curved, hooked, or plicate. Aril dry; rim-aril; brown.

Seed $2\text{--}4.5 \times 2\text{--}3 \times 1.5\text{--}3$ mm; not overgrown; angular (because of pressure of adjacent seeds in fruit) or not angular; symmetrical or asymmetrical; irregular, mitaform, oblong, or reniform; terete or compressed; with or without visible radicle and cotyledon lobes; without umbo on seed faces. Testa present or absent; not adhering to endocarp; glossy; not modified by a bloom; colored; monochrome or mottled and streaked; with frequent or infrequent mottles; with frequent or

infrequent streaks; black (to bluish-black), brown, green (pale), orange (reddish), red, tan, white (to bluish-white), yellow, or blue; with black overlay (to bluish-black); 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; larger than punctiform; up to 7 mm long; with straight outline; oblong; marginal according to radicle tip or between cotyledon and radicle lobe; recessed; not within corona, halo, or rim. Lens discernible or not discernible; less than 0.5 mm in length; with margins curved; punctiform; not in groove of raphe; adjacent to hilum; 0.5 mm from hilum; mounded or flush; same color as testa; darker than testa; black or red (dish); 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; differing at apex (1 concealed by overarched radicle and other auriculate and concealing radicle); not concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; white or red; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; perpendicular to length of seed. Radicle bulbous; lobe tip curved; with 180-degree or 90-degree turn; centered between cotyledons; $1/2$ to nearly length of or equaling length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Seventeen species in New Zealand and one (*C. exsul* H.F. Mueller) on Lord Howe Island.

Notes: Simpson (1945) revised the genus recognizing eight subgenera and 41 species based on whether pods dehisce or not and their dehiscence mechanisms and presented a key to the subgenera essentially using pod characters. Allan (1961) used pod characters as primary divisions in his New Zealand species key. Heenan (1995, 1996, 1998a,c) revised the genus for New Zealand and carried out cladistic analyses of *Carmichaelia* and related genera. He concluded that “*Carmichaelia* is paraphyletic if *Chordospartium* (17.03), *Corallospartium* (17.04), and *Notospartium* (17.02) are excluded.” Therefore Heenan (1998a) merged the four genera and created new combinations in *Carmichaelia* for the species of *Chordospartium*, *Corallospartium*, and *Notospartium*. We have chosen to use Polhill’s (1981i, 1994b) generic delimitations pending the expression of a general consensus of opinion concerning Heenan’s work by taxonomic

botanists. Although we studied seeds and fruits of 7 species, the literature cited above provided brief descriptions of seeds and fruits for all species. Heenan's (1995, 1996, 1998a) species count was used.

Carmichaelia: *C. uniflora* T. Kirk (C–E), *C. spp.* (A–B). A, Fruits (× 4.4); B, seeds (× 4.9); C–D, testa (× 50, × 1000); E, embryos (× 10).

